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Phenotypic Diversity Assessment and Related Indigenous Knowledge of Yam (*Dioscorea* spp) in Ebonyi State, Nigeria

JOSHUA FRIDAY AJA
EBSU/PG/M.Sc./2014/06679
EBONYI STATE UNIVERSITY, ABAKALIKI

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APPROVAL

This is to certify that this research titled "phenotypic diversity assessment and related indigenous knowledge of yam (*Dioscorea* spp) in Ebonyi State, Nigeria was carried out by (Joshua Friday Aja with registration number EBSU/PG/M.Sc./2014/06679) under my/our supervison in the Department of Crop Production and Landscape Management Ebonyi State University, Abakaliki" and approved for recommendation to graduate council.

……. ……...
Professor (Mrs.) H. O. Oselebe D. E. B. Utobo
Supervisor Head of Department
Date……15/10/2021…… Date……15/10/2021…..

…….. ……..
Professor F. C. Ekwu Professor C. Njoku
Dean, FARM Internal examiner & committee member
Date…15/10/2021……

…… ……
Professor C. Ogbu professor B.C. Ogbonna
Vice chancellor External Examiner UNN
Date: 15/10/2021

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Authors institutions:
Author
1 and 2' institution: Ebonyi State University, Abakaliki.
3. Department of Business Administration, Wesleyan University Mabini, Extension Cabanatuan City Nueva, Ecija 3100 Philippines.
4. BAAUCCO Business HUB INT'L, LTD. NO 1 Mgbabor Achara Road, Abakaliki, Ebonyi & Bertoua, Republic of Cameroon.
5. POGGIL College of Health Technology (POCHTECH), Ijebu-ode, Ogun state, Nigeria.
6. International institute of Tropical Agriculture, Ibadan, Nigeria.
7. Federal College of Agriculture, Ibadan.
8th authors 'company name: Chukwuma and Sons Industrial company LTD, no 23, Enitan Street Aguda Surulere, Lagos, Nigeria.

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ABSTRACT

This project was conducted to collect accessions of farmers' grown yams, phenotypically characterize and identify accessions with superior traits that can be used as composite parent in future yam breeding. A total of 856 yam accessions were collected, grouped at community level to give rise to 202 accessions and temporarily stored in the yam barn of EBSU/IITA African Yam project for two months before planting in 2019 and 2020. Data collected were grouped into quantitative and qualitative, subjected to multivariate analysis using mean, coefficient of variation, correlation and cluster analysis. Result of socio-economic data indicated 91.7% males and few female experienced farmers and through indigenous knowledge, name and classify accessions based on yield, maturity time and other phenotypic performance across the communities. Five out of 856 were identified with three species *D.alata, D.rotundata,* and *D.cayenensis* ranking highest in diversity. Cluster analysis based on qualitative traits showed five distinct groups with difference in size and presence of variability ranging from two to nine traits in cluster 1 amounting to 56.2%. Correlation result showed that all the quantitative traits measured except leaf width and maturity time correlated significantly to the yield component. Estimate of mean showed that the weightiest and widest tubers (6.8 kg/Plant and 13.9 cm) were recorded for *D. alata* and longest tubers for *D.rotundata* (21.7cm). The overall result showed that Ebonyi North recorded the highest yam diversity, followed by Ebonyi South mostly Ishiagu community that recorded yam accessions with enormous traits variation that can be selected for further research.

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CHAPTER ONE
INTRODUCTION

Yam is a multi-species and staple crop of great economic value that belongs to the genus *Dioscorea* and family *Dioscoreaceae* (Tewodros and Getachew, 2013). It is widely cultivated but peak cultivation were mostly in many parts of sub-Saharan Africa and Nigeria account for about 70 per cent of the world production, contributing globally to 17 million tons from land area of 2,837,000 hectares under yam cultivation (World Bank, 2011). Cultivation in Africa was revealed to have started at least 7,000 years ago where new introduction are barely seen but domestication of its wild types continues today (Lebot, 2009). Presently, yam is widely grown and found in Africa, India, Southeast Asia, and Australia with about 600 described species (Wilkin *et al*., 2005; Tewodros and Getachew, 2013). Some of the species are widely adapted to vagaries of weather such as drought, flood and tolerant to some pest and diseases, having a higher multiplication ratio, high tuber yields as well as better storability against prevalent environmental and biological problems (Udensi *et al*., 2008, Fukuda *et al*., 2010, Dansi *et al*., 2013). Howerver, of all the 600 known existing species, *Dioscorea alata* L., *Dioscorea cayensis* and the *Discorea rotundata* complex are the most widely cultivated and this is because they have more real economic siginificance (Norman *et al*., 2012).

Yam is a monocotyledons crop with both dioecious and monoecious flowers born seperately and which make it an outcrossing crop often multiplied through natural hybridization and human selection, incidentally leading to diversity of the crop (IITA, 2011). This unique phenotypic traits are found in some species like *D. alata*, *D. bulbifera*, *D. cayenesis* and *D.rotundata* (IITA, 2011). IITA (2011) noted that the monoecious occurrences of flowers were pronounced in male flowers than in female flowers and were mostly seen in the species of *D. alata*. Some species having growth parameters that are closely related to each other, while some are known to differ significantly. Yam vines are often cordate leaf that may be alternate, opposite or whorled with pink vein resulting to pink tuber surface or meat. The skin vary in colour from dark brown to light pink, while some tuber have a softer substance called meat with colour ranges from white to yellow to purple or pink at maturity (Norman, 2011, Wikipedia, 2011). The veins also are dominant green, purplish green, pink to dark brown and brownish green with short or long internodes for species of *Dioscorea alata*, *Dioscorea rotundata*, *Dioscorea cayenensis* and all these morphological trais are the bases for plant identification (Tewodros and Gatechew, 2013). Tewodros (2013) revealed that morphological traits such as vine length, leaf length and width correlated to bulbs or tuber yield (length and width) and are selection bases for increasing the genetic improvement of the crop. These characters are efficient in maximizing the yield of tubers and bulbils of *Dioscorea Spp*. Nevertheless, high vegetative yield could lead to negative yield component and this was reported by Khayatnedzhad *et al*., (2010) who asserted negative correlation between harvest of grain yield of wheat and plant height. The composition of yam tubers is the function of the yam vegetative parts, as light green veined yams or purplish veins might result to variation in tuber colourations ranging from green to purple or pupplish white at maturity (Norman, 2011).

Yam traits or characters defining the economic importance and food wise are often evaluated based on indigenous knowledge. The farmers being long in yam production, had knowledge that can aid collection and phenotypic characterization of existing landraces within an area. This indigenous knowledge in other hand can be described as knowledge which has been accumulated by a people over generations by observation, experimentation, and gaining from old people's experience and wisdom in any particular area for over a period of time (Atte, 1992). Indigenous knowledge including local names of yam accessions and cultivars usually differ from one village or community to another within the same ethnic zone (Adjatin *et al*., 2012, Loko *et al*., 2013). In the same vein, farmers use their personal experience and valuable traditional knowledge gained, including agromorphological traits, plant growth, quality and end-use characteristics to classify the varieties that they grow, and there is no consistency on how one variety is classified within and between different communities (Rubenstein and Heisey, 2003; Tewodros *et al*., 2011, Soleri *et al*., 2013, Agre *et al*., 2015). This also amounting to either having the same variety with different names or different varieties with same name. Similarly, Agre *et al* (2016) revealed ethnobiological study of varietal classification of cassava using farmers' knowledge that not all the available varieties are unique and there is presence of duplicates and mislabeling (synonyms and homonym). Studying yam, indigenous knowledge is one aspect of crop conservation practices and diversity management. Loko (2013) noted that maintaining improved species in yam cultivation, consistent yam collection is required for introduction, morphological characterization and selections for improved yam diversity assessment.

The indigenous farmers who have the phenotypic traits configuration of species can predict yield by mere observation of the traits. In this, selection of superior genotypes is based most times on outward appearance (phenotype) which varies due to unstable environmental conditions changing some phenotypic traits of yam under the influence of environmental factors (Fukuda *et al*., 2010, Dansi *et al*., 2013). Phenotype in this regard is defined as the physical observable features (vine colour, number of vines, leaf composition, vine length etc.) and other traits that can be found in a particular yam accession. For instance, Mulunel *et al.,* (2006) reported morphological variability of tubers both in sizes, shapes and colour of yam grown in Ethopia. Morphological traits including vine length, tuber yield (length and width), leaf length and width are selection bases for efficient yield actualization of tubers and bulbils of *Dioscorea Spp* (Tewodros and Getchaw, 2013). However, these phenotypic traits can be significantly influenced by some factors like pests and disease organisms, poor soil, drought, flooding resulting to severe yield losses and genetic erosion of a particular crop (Adegbite *et al*., 2006; Dansi *et al*., 2013).

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In Ebonyi State of southeastern Nigeria, yam production is faced with many constraints (pests and diseases, poor soil necessitated by continuous cultivation, drought, flood, and poor aged farmers with crude implements, lack of improved varieties etc). To address these constraints, genetic control through the use of improved yam cultivars which have been phenotypically characterized is paramount. Phenotypic characterization is a veritable tool for selecting superior genotype used in breeding of potential crops, such phenotypic trait a prerequisite for genotypes identification may be found within the existing yam diversity in the State and may serve as parents in future breeding programs.

- Problem Statement: Yam is one of the staple food in this region of West Africa and Ebonyi State in particular, but have no or few documentated indigenous knowledge arising from wide age long cultivation which makes the understanding of phenotype that will aid conservation and management of its diversity difficult, hence the need for the survey and field trials.

The broad objective of the study is to collect yam accessions, characterize and evaluate them as well as document the indigenous knowledge involved in their cultivation in Ebonyi State.

➢ *Specific Objectives*

- Conscious expedition to collect farmer-grown yam accessions and related indigenous knowledge in Ebonyi State.
- To phenotypically characterize accessions using quantitative and qualitative traits.
- To identify superior accessions or groups that can be used as composite parents in future yam breeding.

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CHAPTER TWO
LITERATURE REVIEW

A. Origin and Distribution

The origin of yam (*Dioscorea spp)* is not traced on one particular region as different species have different records and places of origin across the globe. For instance, *Diosocrea spp* has been stipulated to originate from southern Asia as indicated by Muluonel (2006), but recent studies have identified Melanesia as its centre of origin and the region remains the centre of diversity (Lebot, 1999 and 2009). Similarly, Sesay (2013) noted that aeriel yam (*D.bulbifera)* and Chinese yam (*D.esculenta)* came from Asia, while water yam (*D. alata)* was found in South East Asia, inavaribly in Burma, and from there distributed to the main land of East of Africa (Muluneh, 2006; Lebot, 2009). The cultivars of both yellow and white yam (*D. cayenesis and D. rotundata*), respectively are believed to originate from Africa, they are said to have arisen from cultivation of wild Parent including: *D. abyssinica* Hochest, *D. prachensilis* Benda and *D. burkilliana*, with little genetic exchange occurring naturally among members of other groups (Chair *et al.*, 2005). They are now the most widely cultivated both in Asia, America and have real economic significant in Africa (Norman *et al*., 2012). Other species like *D. oppista* and *D. japonica* were revealed to have originated from Japan while *D.roundata*, *D.cayenesis*, *D. dumetorum* complex started its wide cultivation from Africa, *the cush cush (D.trifida* L.) was from America origin and the most important cultivated new world yam, *D.pentaphylla*, *D.oppsitifolia*, and *D. nummularia* came from both Asia and Oceania (Dumout *et al*., 2005, Girmas *et al*., 2012, Norman *et al.*, 2012).

B. Domestication/Cultivation

There are about 600 species of *Dioscorea* that have been identified, among which 12 species are edible and have been domesticated and cultivated across some regions of yam belt (Coursey, 1967, Sesay, 2013,). These are: water yam *(Dioscorea alata*), white yam (*D. rotundata*), and aerial yam *(D. bulbifera*), and yellow yam (*D. cayenesis*), and other species include: intoxicating yam (*D. hispida*), Cush Cush yam (*D. trifida*), bitter yam or trifoliate yam (*D.dumetorum*), Chinese yam (*D.esculentus)*, cinnamon yam *(Dioscorea oppista)*, like-cinnamon yam *(Dioscorea japonica*), *D. pentaphylla* and *D. floribunda*. The domestication of 12 species of *Dioscorea* did not start from African but evidence exists of its domestication in New Guinea at least 10,000 years ago. It is believed to have been among the several Asian crops introduced to Madagascar by Austronesia (Australian Voyage), some 2,000 years ago, and from there distributed to main land east Africa (Lebot, 2009). The cultivation of these species in Africa is also known to have started at 7000 years ago, domestication and distribution of wild continues today (Lebot, 2009). On the contrary, Sesay (2013) noted that the genus *Dioscorea* comprises 600 species but only ten of them were cultivated. These are: *Dioscorea alata* L., *D.esculenta* Lour, *D.batatas* Decne or *D.oppsita* Thumb traced from Asia, *D. bulbifera, D. cayenesis-rotundata* complex and *D.domentorum* Kenth came from Africa, while *D.trifida* was from America, *D.nummularia* Lam and *D.pentaphylla* were indigenous to both Asia and Oceania (Girma *et al*., 2012). Maalapa (2005) also noted that *D.alata* is indigenous to Asia and most of the varieties cultivated in West Africa were introduced in the 16th century.

Yam is grown almost all over the countries of Africa, and cultivar diversity can now be evaluated based on its economic significance. For instance, in West Africa, guinea yam (*D. cayenesis* and *D. comslese*) is more than 95% total production with considerable varietal and genetic diversity due to continuous cultivation and domestication from related wild species such as *D. abyssinica* and *D. prachensilis* (Dumount *et al*., 2005, Sesay *et al.*, 2013). Of all these species, *Dioscorea alata* L., *Dioscorea cayensis* and the *Discorea rotundata* complex are the most widely cultivated and distributed due to them having real economic significances (Norman *et al*., 2012). IITA (2010) also reported that yams are now farmed/cultivated on about 5 million hectares in over 47 countries in the tropical and sub-tropical regions of the world. It was observed that Nigeria alone accounted for about 70 per cent of the world production resulting to 17 million tons from land area of 2,837,000 hectares under yam cultivation annually (World Bank, 2011). In the same vein, FAO (2009) reported that yams were among the first plants to be cultivated intentionally by humans but are consistently influenced by the process of domestication. Some species of yam are more cultivated than the others in a particular area owing to its economic roles and purposes they serve for the farmers. For instance, guinea yam (*D. cayenesis* and *D. comslese*) is more than 95% total production with considerable varietal and genetic diversity due to continuous process of domestication from related wild species (Dumount *et al*., 2005, Sesay *et al.*, 2013). The availability of wild relatives plays significant role in cultivation and domestication of yam cultivars. For instance, the most important edible yam species and widely cultivated, *D. rotundata*, *D. alata*, *D. cayenesis* and the minor species, *D. oppsita* and *D. japonica* belong to the section enantiophyllum. The major characteristics of *Dioscorea* species are: Species twine to the right, examples are *D. alata*, *D. rotundata*, *D. opposita, and D. japonica,* while some species twine to the left and typical examples are *D. cayenensis, D. bulbifera, D. esculenta, D. dumentorum, D. trifida, D. hispida etc.* In the light of this, Tarqul (2011) noted that germplasm or accession of *D. alata* had anticlockwise twining direction while *D.bulbifera* had clockwise twining directions. However, yams are heterogeneous perennials with many shared morphological attributes, and assessing yam diversity using its taxonomical complex genus is difficult due to high traits variability of the crop (Mignouna, 2003).

C. Uses of Yam

The vines and leaves are used as vegetables. Vines can grow to great heights if provided with a rigid support or may grow vertically on other herbaceous species (Okonkwo, 1985). It is advisable to stake when the main use is for vegetable. Sweet yam is consumed as boiled yam, as cooked vegetable, fufu, yam flour, chips, flake and starch; yam may be fried or baked. It is often prepared into thick paste called pounded yam after boiling, served and consumed with soup (FAO, 2010, USDA, 2011; Lawal,

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2012). Edible yams are nutritionally rich in carbohydrate, protein, mineral salts and vitamins like B6, B9, potassium, magnesium etc. and these facilitate global production and consumption of yams (USDA, 2011; Lawal, 2012). It is also prepared into intermediate end product such as yam flour (elubo), which are used either for direct consumption by man, animals or used as basic ingredients for snacks and making instant puree (Adejumo *et al*., 2013).

In Nigeria also, yam is used for different purposes ranging from consumption to social-economic and cultural values. This led to growing one species more than the other. Apart from this, yam is grown because of its nutritional components, which is also the function of its genotype. Yam grown from any genotype, sweet in flavor is consumed as boiled yam, as cooked vegetable, fufu, yam flour, chips, flake and starch. Yam may be fried or baked. Food delicacies made of yams are serve for special ceremonies like burial, blessing grave, festivals and rituals (the village chiefs and the traditional title holders who grow yam make it a religions practice by not consuming yam untill it is offered to the gods) in southeastern Nigeria (FAOSTAT, 2011; USDA, 2011). The tubers of yam (*Dioscorea spp*) serve a dual agricultural role of usage as a source of food for millions of people as well as planting material for yam farmers (Crawford *et al*., 2006). Yam is also used for rituals festivity, taboos or restriction of uses and abuses are common mostly in the area where the crop is the considered staple food like in southeastern Nigeria (FAOSTAT, 2011). A yam festival is held every year to mark the beginning of harvesting of the crop and it is a taboo to harvest yam without the new yam festival celebrations in southeastern Nigeria. Hence, Nigeria is the largest producer of valued edible yams, accounting for 70% to 76% of total world production, with 35.07 million meteric tones, having wider uses of yam including been the largest consumers of yams (Ezulke and Nwosu, 2006, World Bank, 2011).

Ebonyi State is one of the southeastern states where yam is valued economically, culturally and nutritionally. Yam is second among cultivated crops in Ebonyi State in terms of land area after rice and the average annual production surpasses rice. It is the first among root and tuber crops contributing to main agricultural practices and activities in Ebonyi state of the West Africa region, its contribution aid Nigeria to produce between 90% and 95 % of world production of yam (FAO, 2010). It is one of the most economically valued root crops in Ebonyi State, adding to the dynamic value chains that generate income for local population while continuing to play a leading role of supporting food security and diversification when improved agricultural programs is adopted in its cultivation in Ebonyi State (Aja and Igboji, 2017).

D. Land Preparation and Tillage

Yam requires a raised good fertile soil and the land must be ridged or heaps/mound made which add to high labour demand but must be done for best yield (Agbede, 2006; Oyetunji *et al*., 2008). Tillage reduces density of the soils, and generally increase aeration encouraging friendly microbial activities leading to high yield (Agbede, 2005). In the forest zone, or in southeastern Guinea savanna which Ebonyi state belong, land clearing starts January/February and continues till March and planting mid-March or early April and four types of land preparation is available for ware yam production. They include mound, holes, ridges and flats and this is done to protect the roots as well as the tuber which is the most important part (Orkwor, 1992; Melteras *et al.*, 2008).

E. Planting

For planting of yam, there are presently no conventional planting methods. Planting is dependent on the species and the sizes of yam setts. Seed yam or setts can be planted 4cm or 6cm deep as most of plant roots tend to grow horizontally on the soil surface (Onwueme and Charles, 1994). Sprouting may be promoted and synchronized by incubation at constant warm temperatures, between 25^{o}C and 30^{o}C. In this, Lebot (2009) noted that dormancy is prolonged by temperatures below 15^{o}C. In Tonga, a common practice is to place prepared planting setts in a pit covered with banana leaves and soil, so that their respiration raises the temperature. The yam setts were reported to be incubated for 3-4 weeks before planting to accelerate sprouting (Lebot, 2009).

Yams have vines like stems and are staked to ensure easy farm operations like weeding, fertigation and to increase light interception of the leaf canopy which help in tuber reserved build up (Agbake and Adegbite *et al*., 2006). Staking aids other farm operations such as weeding and harvesting which is done 180 days after planting for some species (IIe *et al.*, 2006). In contrast, Ernest and Sullivan (2004) successfully revealed the use of gliricidia as a live staking material to stake and facilitate the yield of *D. rotundata*, which its yield increased significantly compared to unstake.

F. Morphological Characterization

Morphological characterization has been carried out using international standard Descriptors for yams and on many valuable crops in different parts of West Africa. For instance, Agre *et al*., (2015) evaluated agromorphological diversity of Elite Cassava (*Manihot esculenta* Crantz) cultivars collected in Benin. Morphological diversity of sweet potato have been reported separetly by Tairo *et al.*, (2008) and Norman *et al*., (2014). Morphological diversities have been reported by many researchers on taro (Quero-Garcia *et al*., 2014, Mukherjee *et al*., 2016). Agromorphological or phenotypic characterization is a veritable tool for selecting superior genotype use in breeding of potential crops. Morphological characteristics such as leaf and flower have been attributed to follow segregation of genes and hybrids, but most agronomic traits are not associated with easily observable phenotypic markers (Rabbi *et al*., 2014). Norman (2011) revealed also that 43 genotypes of *D. alata* exhibited different of traits ranging from saggitate long green leaf to chordate long dark leaf. Conversely, most morphological traits are not completely associated with easily observable phenotypic traits, but is needed to underscore genetic diversity (Rabbi *et al.*, 2014). Similarly, Norman (2014) reported factor and cluster analyses on agromorphological characterization of sweet potato (*Ipomoea batatas* L.) genotypes and noted that

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the yield of potato is correlated with phenotypic traits such as plant height, root diameter and number of leaves. On the contrary, Khayatnezhad *et al*., (2010) reported negative correlation between harvest index and plant height of grain wheat varieties. For effective scientific work and classical breeding, phenotypic or morphological traits (vein colour, leaf shapes, leaf colour, tuber size, shapes and colours) of plants growing in the field are the basis for identification (Fukuda *et al.,* 2010; Robooni *et al*., 2014). In contrast, Kambaska (2009) reported high variability of morphological traits in quantifying the relative agronomic performance of twelve *Dioscorea species* collected in different parts of Orissa, and noted that plant height was significantly superior in *D. hispida* (3.21 m) followed by the shortest height noticed in *D. oppositifolia* (1.98 m), while at final stage of the crop, the highest number of leaves was obtained in *D. oppositifolia* (179) and *D. wallichii* (156). Conversely, on the general yiled of species kg/plant, significantly highest in *D. bulbifera* (1.646 kg) tuber yield and lowest yield were obtained with *D. belophyllla* (0.654 kg) followed by *D. Pubera* (0.678 kg) (Kambaska, 2009). The conclusion derived from Kambaska (2009) result indicated that each species has their own identical morphological trait with certain similarities and dissimilarities. However, it was revealed that phenotypic traits are altered by environment factors and may not provide actual assessment of genetic diversity of the studied crop (Asare *et al*. 2011; Noerwijati *et al.* 2013). So that good yield could be attributed to cultivar, crop environment and farmers' management practices.

G. Yam Diversity Studies

The amount of phenotypic variation among individual of a genotype, species or population, which provides adaptability traits to stable environment and the potential conditions to develop new genotypes is related to phenotypic diversity (Brown, 2008). The phenotypic and genetic diversity cannot be understood without a record of assessment of morphological traits of plants growing in the field which are the basis for identification (Fukuda *et al*., 2010; Robooni *et al*., 2014). Species diversity studies is a heavy task and requires a wide knowledge of cultivar morphological diversities or variation within a particular region. Norman (2011) revealed diversity of the morphological traits of 52 yam genotypes in Sierra Leone in 2007 with two checks of *D. rotundata* from (IITA), and noted that 43 genotypes of *D. alata* were characterized by saggitate long green leaf, chordate long dark leaf, 17 had round tubers, 11 oval, seven oblong with two irregular and one cylindrical tuber shape; while the flesh colour of central section of tuber of 40 genotypes was white, three exhibited light purple. Genotypes of *D. bulbifera* showed chordate light green leaf and cudspidate leaf apex shape. The tuber shape of both genotypes was round, while the members of *D. rotundata* exhibited mainly saggitate green leaf, chordate green purple leaf and saggitate long leaf. The tuber shape of all genotypes was cylindrical possessing white flesh colour of central section of tuber (Norman *et al.,* 2011).

Girma (2012) noted that *D. alata* come from Asia and possess a higher multiplication tuber yield ratio as well as better storability than the preferred indigenous species *D.rotundata, D.cayenesisn* and *D.esculentus* and is also popular and prevalent in interior part of West Africa like in Abakaliki agricultural zone of Ebonyi State, Nigeria where it is called 'Mbala or Nvula/ mbana/nwawafu' (Udensi *et al*., 2008). The name of cultivars are identified in vernacular or local dialect for crop varieties identification generally, and particularly in yam, local names often vary from one village to another within the same ethnic zone (Adjatin *et al.*, 2012, Loko *et al.*, 2013). Chair (2010) and Loko (2013), all reported the diversity of yams through the use of three varieties of yam *Dioscorea rotundata*, to *Dioscorea cayenesis* and *Dioscorea alata* in several villages in Benin in 2013, and concluded that there were more wide diversity of yam in Centrale with 21 villages, Kara, 14 villages than in Maritime regions with 5 villages.

H. Farming Experience and Related Indigenous Knowledge

Yam farming is a business that requires a certain skill and experience to ensure efficient and profitable ventures. Age and experience of farmers are synonymous to working ability and proficiency of farmers. Okoye *et al.,* (2009) stated that the more experience the farmer is, the more efficient in managing factors that affect farming business including decision making process and associated risks in both adoption and rejection of any innovative in farming business. It is easier for an old experienced farmer to manage general agricultural problems including pest, cultivation cost etc. than young farmer. Ada *et al*., (2007) asserted that the greater the years of farming experience, the greater the farmers' ability to handle major factors distressing the farm business. Traditionally and scientifically, farmers' decision in diversity assessment of some crop has been overlooked. This is seen as rudimentary and hence neglected. It is on note that most of diversity of crops yam inclusive appeared to be on detect of farmers preference. For instance, farmers' decisions and management activities play a central role in determining the availability, composition, distribution and availability of crop species or cultivars in a given agro-ecosystem i.e farmers have strong influence in biological agriculture organization (Thrall *et al*., 2011) . This event, referred to as "planned diversity" (Matson *et al*., 1997, Adah *et al*., 2007), is important both in terms of crop production and in shaping the total biodiversity of an area. It is, therefore, imperative that attempts to study crop diversity in traditional agriculture take into account the role traditional farmers play in creating and managing diversity. Farmers used their experiences over the years of farming in classifying the yam they grow within a geographical locations, thereby identifying grown varieties morphologically and this might introduce large variation among a cultivated varieties within communities (Sadiki *et al*., 2006; Soleri *et al*., 2013). Yam production in Africa generally is stemmed on indigenous knowledge which in most cases are not documented and understanding indigenous knowledge is a prerequisite in understanding the morphology of yams. This was evidently supported by Sesay *et al*., (2013) on assessment of farmers' indigenous knowledge and selection criteria of yam in Sirerra Leone. In other hand, indigenous knowledge according to Atte (1992) is a knowledge that indigenous communities accumulated over a generation for living in a particular environment. Detailed studies and descriptions of species based on agronomic characters have tremendous impact on the conservation, diversity analysis and genetic improvement of the crop and this can be obtained easily through indigenous knowledge. Witcombe *et al*., (1996) asserted that assessment of yam

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accessions and degree of acceptance of local names and associated traits of yam collected within the study area is dependent on indigenous knowledge.

It is imperative to underscore and study indigenous knowledge use by the farmer in growing a particular accessions in an area considering their role as the major user of any agriculture improvement program. It will be counter productive to embark on evaluation program without involving farmers. The essence of farmers classifying the cultivars with their traditional knowledge and experience invalidated such program. Farmers' participation in evaluation programs helps the researchers to secure endangered yam using available traditional knowledge of accessions or clones for securing livelihood through yam conservation and production (Ikeorgu *et al*., 2007). Conversely, farmers use their personal experience and valuable traditional knowledge gained, including agromorphological traits, plant growth, quality and end-use characteristics to classify the varieties that they grow, and there is no consistency on how one variety is classified within and between different communities (Rubenstein and Heisey, 2003; Soleri *et al*., 2013, Agre *et al*., 2015).

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CHAPTER THREE
MATERIALS AND METHODS

A. Experimental Site

The field experiment was conducted in the teaching and research farm of the Department of Crop Production and Landscape Management, Ebonyi State University Abakaliki in the cropping season of 2019 and 2020. Ebonyi State is derived savanna zone of Nigeria and is located between latitude $06^{o}4^{1}$N and longitude $08^{o}65^{1}$E at an altitude of 448.1 meters above sea level. The area usually experiences bimodal pattern of rainfall (April-July) and (September – November) with a break in August. The average rainfall pattern range from 119.40 to 513.80mm in 2019, while in 2020 117.90 mm to 520.41mm with temperature ranges of 23.30^{0}_{C} to 33.80^{0}_{C} and 22.90^{0}_{C} to 33.70^{0}_{C} in 2019 and 2020 (Ebonyis University weather data, 2019 and 2020). The soil of the study area is a sandy loam soil having 85.2% of sand, 8.8% silt and 6.0 of clay with soil pH of 6.80, and moderate organic matter content and low total nitrogen as described by (Haney *et al*., 2008, Kyrodin, 2014).

B. Germplasm Collection of Farmer-Grown Yam Accessions and Related Indigenous Knowledge in Ebonyi State using Multistage Purposive and Stratified Sampling Techniques

➢ *Rapid Rural Appraisal*

Rapid rural appraisal (RRA) involving multistage purposive and stratified sampling technique was adopted for farmers' selection based on sampling frame of contact farmers of the Agricultural Development Programme (ADP) in Ebonyi State. Accessions collection were concentrated in areas identified as the major yam producing areas in the three senatorial zones of the State based on State Department of Agriculture annual production figures 2013-2014.

➢ *Sampling Techniques and Sampling Size*

Multistage purposive and stratified sampling techniques were adopted. In the first stage, 3 Local Government Areas each were selected from the 3 Senatorial zones in Ebonyi State. In the second stage, 2 autonomous communities were selected from each of the 3 LGAs, to give a total of 18 communities. From each community, 3 stratified villages were selected and 4 farmers stratified according to gender per village was randomly involved. In all, a total of 216 stratified and randomly selected respondents participated in the study.

Rapid Rural Appraisal (RRA) was used to establish information regarding diversity of yam accessions within the area, as well as farmers' indigenous knowledge about yam production. Actual survey was done using questionnaires structured in line with the specific objectives of the study (see attached appendix). These were administered in form of oral interview schedule in order to ensure that responses to the questions were correctly filled. Yam accessions and varieties were collected from each farmer that was interviewed. These were synthesized at the end to identify the total number of accessions and the degree of agreement of the local names of accessions collected within the study area (Witcombe *et al*., 1996).

Focal group discussion (FGD) was conducted at ADP level, using representative contact farmers from all the Local Government Areas implicated in the study, to elicit clearer information on the status of the yam accessions as well as indigenous knowledge/information related to them.

➢ *Accession Collection and Storage*

Germplasm collection was made during the 2017 harvest season (December to February). Two to four tubers or seed yams of each farmers grown accessions were collected and documented based on the location. A total of 856 accessions were collected and stored temporarily in the yam barn of Africa Yam Project, Ebonyi State University (EBSU) located at Faculty of Agriculture and Natural Resources Management CAS campus, Abakaliki.

The collected accessions were bulked based on Community to reduce the size of collection as most of the farmers presented similar accessions. After bulking, a total of 202 accessions were obtained. The accessions were later planted in experimental ridges.

C. Phenotypic Characterization of Collected Accessions Using Quantitative and Qualitative Traits

➢ *Experimental Design*

The collected 856 accessions were bulked according to eighteen communities to give rise to 202 accessions and planted accessions per ridge fashion (design). The communities represent the number of blocks (replicates) and the size of block is equal to the number of accessions collected in a community. Accesions were prepared into a minisett weighing 100 gram each and planted with planting distance of 0.5m x 1.0 m within and between accessions.

➢ *Field Layout and Evaluation*

Field evaluation of the accessions were carried out at the experimental field at the Faculty of Agriculture and Natural Resource Management, CAS campus, Ebonyi State University, Abakaliki. The field was ploughed and harrowed with plant debris worked out into the soil, prior to ridging. Each of the accessions was cut into minisett weighing 100 g each.These were planted out in

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accessions-to-ridge fashions (accessions per ridge) and planting distance of 0.5m x 1.0 m within and between accessions, respectively, was maintained. Each ridge was made up of 10 plant stands, planted with 100 g weight seedlings/setts. The total weight of setts per plot was taken prior to planting. Eight plants out of ten plants were tagged and data collected from them.

D. Cultural Practices

- **Preplanting setts treatments**: All seedlings/setts were treated with a cocktail of (fungicides, insecticides and nematicides - Basudin, 1.5gram /L and mancozeb 2.5gram) before planting.
- **Premergence weed treatment**: Pre-emergence herbicide (Butaforce) was applied one week after planting.
- **Staking or Sticking:** Staking of the yam was done between 6th and 8th week after planting in the two seasons.
- **Weeding**: Manual weeding was carried out throughout the life cycle of the plant. Weeding was carried out four times prior to maturity.
- **Reheaping:** Reheaping (earthening up) of the ridges was done manually immediately after the second weeding.

E. Data Collection

Agro-morphological data were collected from sampled plants based on International Board for Plant Genetic Resources (IBPGR/IITA, 1997) recommended descriptor procedures for yam. The following agronomic characters were measured, recorded and grouped into quantitative and qualitative data:

➢ *Quantitative Data:*

- Number of sprout per plant (NSP): The number of sprouts per plant was counted and recorded starting from the second week after planting or as soon as the sprout (plant) emerged and emergence date indicated.
- Sprout Length (Sle-cm): The sprout length was measured at two intervals and the average taken from twenty days after plant emergence as recommended by IBPGR/IITA (1997).
- Sprout girth or sprout diameter (Sdia-cm): The sprout diameter was taken by winding thread on the vine girth of the plants. Thereafter the thread length was transferred to the meter rule, read and recorded at twenty days after sprouts emergence.
- Number of internode before first branching (NIBB): This was obtained by counting the number of internodes before the first branching taken from 15cm above the ground. This was taken at 5 and 6 months after planting (on or before flowering).
- Internode length (Ile-cm): This was obtained by measuring the distance between one node to the other, starting from 15cm above ground of the sprouts or emerged plants. This was taken at 5 and 6 months after planting (on or before flowering).
- Internode diameter (Idia): This was taken at point where the internode length was measured on the eight tagged plants at the widest point using measuring tape and recorded in centimeter (cm). This was taken at 5 and 6 months after planting (on or before flowering).
- Number of vines or branches per plant (NVP): This was obtained by counting the number of vines at senescence. It was counted per plant and average of 8 tagged plants recorded. This was taken at 5 and 6 months after planting.
- Number of leaves (NLv): The number of leaf was counted and average of the 8 plants was recorded at 5th month after planting.
- Leaf length (Llv): This was obtained by measuring the longest part of the leaves using a thread, from the leaf tip to node of the base (point of attachment to the vine). The thread was then transferred to a meter rule, read and recorded.
- Leaf width (Lvwi): The leaf width was obtained by measuring the broadest or widest part of the two edges of the leaves using thread and thereafter obtained the reading using meter rule.
- Days to 50% leaf senescence or Maturity rate (MR): this was obtained by counting the number of days after leaf emergence to days of 50% leaf senescence per ridge. It was counted and recorded per ridge at 6th and 8th month after planting.
- Number of tubers harvested per plant and ridge: The number of tuber harvested per plant was obtained by counting the harvested tubers per ridge and recorded.
- Total tuber weight (TBW): The total tuber weight of the harvested tubers was obtained by weighing the total harvested number of tubers of the tagged plants per ridge using weighing balance and recorded in (kg/ridge).
- Number of seed yam (NSY): The total number of seed yam per plot of average 8 tagged plants were counted and recorded per ridge.
- Weight of seed yam (WSY) (kg): The weight of seed yam per ridge was weighed and recorded in kilogram.
- Number of ware yam (NWY): The total number of ware yam per plot for 8 tagged plants were counted and recorded per ridge.
- Weight of ware yam (WWY) (kg): The ware yam per ridge was counted, weighed and recorded in kilogram.
- Tuber length (Tle) (cm): The tuber length of average 5 plant or tubers from the 8 tagged plants were selected among the total tuber harvested per ridge. This was measured using meter rule after harvesting.
- Tuber width (Tbwi): The tuber width of average five plants or tubers from the 8 tagged plants were selected among the total tuber harvested per ridge and was measured with meter rule and recorded.

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➢ *Qualitative Data*

- Stem or vine colour per ridge (Sc): 1- green; 2 - purplish green; 3 - brownish green; 4 – dark brown, 5 – purple, 6 – pink and 7 –light green at on-set of flowering.
- Hairiness of the stem of accession per plant at sprouting (Hoss): The hairiness for individual accession per ridge was scored based (IPGRI/IITA, 1997) recorded descriptor procedures for yam as 1-hairness, 0- no hairiness.
- Spines on stem per ridge (SOS): This was determined using yam descriptors (IPGRI/IITA, 1997) as follows: 0 – absent, 1 – few, 2 – many.
- Twining habit (scale) (THS): This was determined on mature vine or stem plant stand per ridge as 0 – anticlockwise, 1 – clockwise.
- Leaf colour per ridge at senescence (Lc): This was determined using yam descriptors (IPGRI/IITA, 1997) as follows: 1 – yellowish, 2 - pale green,3 – dark green, 4 – purplish green, 5 – purple, 7 – light green at on-set of flowering (5 months after planting).
- Leaf shape per plot (Ls): The shape of the leaves was recorded using yam descriptors (IPGRI/IITA, 1997) as follow: 1- ovate; 2-cordate; 3-cordate long, 4-cordate broad; 5-saggitate; 6-saggitate broad; 7-hastate.
- Leaf Apex shape (LAS): This was determined using yam descriptors (IBPGRI/IITA, 1997) as follows: 1 – obtuse, 2 – acute, 3 – emarginated, 4 – acuminate, 5 – aristate, 6 – caudate, 7 – cudspidate.
- Tuber shape (TS): The shape of the tuber was scored and recorded using yam descriptors (IPGRI/IITA, 1997) as follows: 1-spherical/round, 2-oval, 3-cylindrical, 4-oval oblong, 5-ireregular.
- Tuber surface texture (TST): The tuber surface texture of the tubers (average 5 tubers) was scored according to IPGRI/IITA (1997) descriptors for yam scoring as 1=smooth, 2=rough.
- Tendency of tuber to branch (TTB): The tuber tendency to branch was scored according to IBPGRI/IITA (1997) recorded descriptors for yam as 0-No branch, 3 - slightly branched, 5- branched, 7-highly branched.
- Position of branching (PoB): This was determined using yam descriptors (IBPGRI/IITA, 1997) as follows: 1 - upper middle, 2 - tail, 3 - middle, 4 - upper middle/head & tail regions, 5 - lower third.
- Cracks on the tuber surface (COTS): This was obtained using direct measurement according to IBPGRI/IITA (1997) descriptors for yam with cracks as 0 – absent, 1 – few, 3 – many.
- Thorniness of tuber (TOT): This was obtained using direct measurement according to IBPGRI/IITA (1997) descriptors for yam with thorns as 0 – absent, 1 – present.
- Intensity of thorns or spines on Tuber surface (ITTS): This was recorded as in relation to thorns as 0 – No, 3 – Few, 7 – many.
- Wrinkles on the surface of tuber (WTS): This was obtained by using IBPGRI/IITA (1997) recorded descriptors for yam tubers with wrinkles on the surface of tubers as 0 – No, 1 – Few, 2 – Many.
- Root on the surface of tuber (RST): This was recoreded based on IBPGRI/IITA (1997) descriptors for yam tubers as 0 - no roots, 2 – few, 3 – many.
- Position of roots at harvest (PST): This was determined using yam descriptor based on IBPGRI/IITA (1997) with roots as 0 – no roots, 1- tuber head, 2 - entire tuber, 3 - lower, 5 - lower & head region, 7- middle,
- Corm size and Type (Coty): This was determined based on IBPGRI/IITA (1997) descriptors for yam tubers with corms as corm size (0= No corm size, 1-small, 2-intermediate, 3-large) and corm type as 0 - No corm type, 1 - regular, 2-transversally elongated, 3 – branched.
- Tuber colour at harvest upper part (TCHup): 1 – white, 2 – creamy white, 3 – yellow, 4 – purplish, 5 - purplish white, 6 - creamy, 7 - Brownish white, 8 - Deep purple, 9 - orange.
- Tuber colour at harvest middle part (TCHmi): as 1 – white, 2 – creamy white, 3 – yellow, 4 – purplish, 5 – purplish white, 6 – creamy, 7 - Brownish white, 8 – Deep purple, 9 – orange.
- Tuber colour at harvest lower part (TCHlo): 1 – white, 2 - creamy white, 3 – yellow, 4 – purplish, 5 – purplish white, 6 – creamy, 7 – Brownish white, 8 - Deep purple, 9 – orange.

F. Statistical Data Analysis

Descriptive statistics such as frequency counts and percentages were used to analyzed the collected data for the physical and socio-economical characteristics of the respondents, while mean or average, percentage rate of diversity loss and diversity ranking were also performed on the data collected to understand the degree of variation within and among accessions as well as the distributions within three senatorial zones in accordance to drawing on the extant validation tests of wealth ranking methods (Chambers, 1994a), and diversity rate loss (Rl) of yam species is obtained by RL = $n_i \; x \; \frac{100}{N}$. Number identified (n_i) multiplied by 100 and divided by the total population (N) and as outlined by (Kombo *et al.,* 2012) using SPSS (2016).

Tables, mean, range, frequency counts and percentage and multiple responses tables were also used to elicit the indigenous knowledge of the farmers regarding cultivated accession, performed using Genstat 12.1 (Payne *et al.,* 2009).

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Five-Points Likert scale was used to evaluate questionnaire number 27:5+4+3+2+1 = 3. 1-very poor, 2 – poor 3 – fair, 4 – good, 5 – very good. These points were summed up to get a total point of (5+4+3+2+1 = 15). The total point was divided by 5 to have an average of 3 points. In essence, a mean score above 3 was categorized as very good traits and any one below 3 was grouped as very poor. This description was in accordance to (Anyanwu *et al*., 2002).

Field data collected was also analyzed using descriptive statistics (mean, and mean percentage coefficient of variation) to identify and document phenotypic diversity and degree of variability among the accession on 19 quantitative and 21 qualitative traits across the seasons using SARS (2008)**.**

Correlation analysis was run to understand the contributory relationship among traits and to identify those traits significantly useful in characterizing the accessions, as well as those necessary for selecting parents to be used in crosses in future studies. Correlation analysis was done using a statistical software package tools for multivariate data analysis as described by Dray and Dufu (2007) for quantitative traits, while cluster analysis was performed using SARS (2008) to identify relationships among accessions since similar accessions would cluster together and a dendogram tree was constructed to show the cluster relationship of all accessions as decribed by (Akoroda, 1982, Martins *et al*., 1999-2000) for qualitative traits.

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CHAPTER FOUR
RESULTS

A. Germplasm Collection of Farmer-Grown Yam Accessions and Related Indigenous Knowledge in Ebonyi State

➢ *Physical and Socio-Economic Characteristics of Farmers*

The physical and socio-economic characteristics of yam farmers in the three senatorial zones in Ebonyi State covering gender differences among the farmers interviewed, age, years of experience, educational qualifications; sources of income and size of their farms are shown in Table 1. The result indicated that a greater percentage (91.7%) of yam farmers from the three senatorial zones (Ebonyi North, Central and South) were male. Ebonyi North had the highest number of male farmers (70), compared to Ebonyi Central (65). The least number of male farmers was observed for Ebonyi South (63), while very few yam farmers were females (Table 1). The highest number of female yam farmers (9) was found in Ebonyi South, seven (7) female farmers were found in Ebonyi Central, while two (2) female yam farmers were found in Ebonyi North. Cumulatively, 91.7 % of yam farmers irrespective of their Local Government Area and senatorial zones were male, while 8.3 % were females. This implies that very few women engage in yam cultivation in Ebonyi state.

➢ *Age of Yam Farmers from Ebonyi State*

The results (Table 1) indicated that most of the yam farmers in Ebonyi State, approximately 66.2 % of the total number of farmers sampled were above 50 years. Ebonyi South and Ebonyi North had the highest number of aged yam farmers (58 and 45 farmers), respectively, while the least was recorded for Ebonyi Central (40 farmers – 54 %). The youngest yam farmers were found in Ebonyi Central and Ebonyi North having only 4 and 3 farmers below 30 years, 5 and 10 farmers between 31- 40 years, respectively.

Table 1: Frequency and Percentage Distribution of Smallholder Yam Farmers in Ebonyi State based on Biodata, Physical and Socioeconomic Characteristics

Variables	**Ebonyi North**		**Ebonyi Central**		**Ebonyi South**		**Total**	
Gender	**Freq. (N = 72)**	**Perc. (%)**	**Freq. (N = 72)**	**Perc. (%)**	**Freq. (N = 72)**	**Perc. (%)**	**Freq. (N= 216)**	**Perc. (%)**
Male	70	97.2	65	90.3	63	87.5	198	91.7
Female	2	2.8	7	9.7	9	12.5	18	8.3
Total	**72**	**100**	**72**	**100**	**72**	**100**	**216**	**100**
Age (years)								
<30	3	4.2	4	5.6	-	-	7	3.2
31-40	10	13.9	5	6.9	1	1.4	16	7.4
41-50	14	19.4	23	31.9	13	18.1	50	23.2
51-60	19	26.4	17	23.6	19	26.4	55	25.5
>60	26	36.1	23	31.9	39	54.2	88	40.7
Total	**72**	**100**	**72**	**100**	**72**	**100**	**216**	**100**
Storage site								
Field	23	31.9	25	16.7	16	22.2	71	32.9
Garden	8	11.1	-	-	6	8.3	14	6.5
Barn/home	41	31.9	48	66.7	48	38.9	137	45.8
Total:	**72**	**100**	**72**	**100**	**72**	**100**	**216**	**100**
Role in yam cultivation								
Decision maker	15	20.8	17	23.6	21	29.2	53	24.5
None decision	57	79.2	55	76.4	51	70.8	163	75.5
maker. Total:	**72**	**100**	**72**	**100**	**72**	**100**	**216**	**100**
Years of experien.								
<5	3	4.2	2	2.8	-	-	5	2.3
5 – 19	30	41.7	19	26.4	15	20.8	64	29.6
20 – 30	14	19.4	28	38.9	22	30.6	64	29.6
30 – 50	25	34.7	23	31.9	35	48.6	83	38.4
Total:	**72**	**100**	**72**	**100**	**72**	**100**	**216**	**100**
Educational qualification								
None	32	44.4	30	41.7	25	34.7	87	40.3
Primary	18	25.0	11	15.3	13	18.1	42	19.4
Secondary	12	16.7	18	25.0	13	18.1	43	19.9

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Tertiary **Total:** Source of income	10 **72**	13.9 **100**	13 **72**	18.1 **100**	21 **72**	29.2 **100**	44 **216**	20.4 **100**
Farming	47	65.3	37	51.4	55	76.4	139	64.4
Business	2	2.8	3	4.2	2	2.8	7	3.2
Formal employment	1	1.4	-	-	1	1.4	2	0.9
Informal employment	1	1.4	2	2.8	1	1.4	4	1.6
Formal emp. & farming	7	9.3	8	11.1	3	4.2	18	8.3
F. &business: **Total:** Farm size:	14 **72**	19.4 **100**	22 **72**	30.6 **100**	10 **72**	13.9 **100**	46 **216**	21.3 **100**
< 0.50	-	-	4	5.6	-	-	4	1.9
1	4	5.6	8	11.1	12	16.7	24	11.1
1 – 2½	57	79.2	42	58.3	16	22.2	115	53.2
5 – 10	11	15.3	18	25.0	44	61.1	73	33.8
Total	**72**	**100**	**72**	**100**	**72**	**100**	**216**	**100**

Source: Field survey 2019. Freq. = frequency, perc.-percentage, emp.-employment, gen. - general and N – total number of household interviewed, cult. -Cultivation

➢ *Age of Yam Farmers from Ebonyi State Continued*

Ebonyi South senatorial zone comprising Ivo, Ohaozara and Afikpo South LGAs, respectively, was found to have the highest number of aged farmers with 39 (54.2%) above 60 years, 19 farmers between 51- 60 years (Table 1).

➢ *Site or Place of storage of yam (Storage Unit) by Yam Farmers in Ebonyi State*

A greater number of yam farmers from Ebonyi North comprising Ohaukwu, 1zzi and Abakaliki LGAs store their yams at area of cultivation for a reasonable length of time after harvesting. In this, 23 yam farmers had field as their storage site. Eight farmers store their yams in the gardens, 23 farmers store in Barn/home and 18 farmers, had field and barn/home as their storage site. A different result-information was obtained from Ebonyi Central where most of the farmers store their yams in the barn and very few farmers store yam at the field. Unlike Ebonyi Central, most farmers in Ebonyi South store their yams in the barn followed by field and garden, respectively.

➢ *Role of Yam Farmers in Yam Cultivation*

Results revealed that most yam farmers in Ebonyi, approximately 75.5 % of the total number of farmers sampled are household members without decision making role in selection of yam species to be planted (Table 1). This implies that the species of yam cultivated by yam farmers might be dependent on the financial strength, available species, government policies and other factors confronting yam farmers. A total of 21 yam farmers were decision makers in yam cultivation from Ebonyi South, followed by Ebonyi Central and the least was recorded in Ebonyi North.

➢ *Years of Experience of Yam Farmers in Yam Cultivation*

The result revealed that yam farmers from Ebonyi South had the highest number (30-50) of years of experience in yam cultivation, followed by Ebonyi North senatorial zone, while the least experienced yam farmers were from Ebonyi Central (Table 1). Generally, the more years a farmer engages in yam production the more skilled and experienced the farmer is. Hence, the aged yam farmers were more likely to have more experience than the young yam farmers. Cumulatively, majority (68.5%) of the respondents had a farming experience ranging between 20 - 50 years while 29.6% of yam farmers had 5 - 19 years farming experience and below 5 years of experience in yam cultivation was low (2.3 %).

➢ *Educational Qualification of Yam Farmers in Ebonyi State*

The result shows that a greater number and percentage of yam farmers were educated, while less than half of yam population were not educated (Table 1). The highest number of educated yam farmers that attended tertiary institution was found in Ebonyi South (21), followed by Ebonyi Central (13) and the least was from Ebonyi North (10).

➢ *Main Sources of Income for Yam Farmers in Ebonyi State*

The result revealed that a greater number of yam farmers earned their income from the proceeds of yam sales of previous seasons or years (Table 1). Cumulatively, 65% of yam farmers depended solely on farming as their main source of income, while some depended on farming and other businesses (21.3 %) as source of income. Some of the farmers depended on farming and formal employment (8.3 %), 3.2 % yam farmers engages in other businesses, while 1.9 % depended on formal employment and very few on informal employment (0.9 %).

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➢ *Sizes of Farm Managed by Yam Farmers in Ebonyi State*

The results revealed that most of the yam farmers in Ebonyi State, approximately 64.3 % of the total number of farmers sampled cultivate (1 – 2 ½ hectares), while only 33.8 % cultivate between 5 to 10 hectares.

➢ *Yam Species and Accessions Currently Cultivated by Yam Farmers and their Distribution Across the Three Senatorial Zones of Ebonyi State*

Table 2 summarizes the yam accessions collected from the three senatorial zones of Ebonyi State, comprising nine out of thirteen Local Government Areas (LGAs) of the State. A total of 856 yam accessions were collected from the areas surveyed. Out of this number, 467 accessions were white yam **(***Dioscorea rotundata***).** Names of accessions are listed based on dialect (Table 2).The highest number of cultivated white yam (183 accessions) was from Ebonyi North, followed by Ebonyi South (152 accessions) and the least was collected from Ebonyi Central (132 accessions). Ebonyi North, comprising Ohaukwu, Izzi and Abakaliki L.G.As cultivate accessions of white yam including 34 Okpebe accession, 24 Usuekpe accession, 39 Igum/Okeji accession, 21 Ewada accession, 28 Jimaka accession, 45 Obia, 25 Nnebiji accession, 16 Obella accession, and 107 Abi accession and few others (Table 2). Ebonyi Central had the highest number of Abi which is also called Amage or Iboki and Ibada (45 accessions) and ranked the second highest diversity among all the accessions from the five species of yam identified across the three zones.This includes Igum (24 accessions), and Nnebiji (22 accessions) in cultivation with second highest diversity, while the least number of accessions in cultivation included Ayaregu or Ayalegu, Onaka, Orunte, Orumeh, etc (Table 2). Ebonyi South had the highest number of Obiaturugo accession and 24 Akiri accession diversity (7.6) in cultivation which also ranked 4th in the highest diversity or distribution of accessions.

The result indicated 91 farmer-named accessions of water yam (*Dioscorea alata*) with local names 'Nvula or mbala or Mbana' having the highest number of accessions per zone surveyed and ranking the highest diversity with 46 accessions collected from Ebonyi North, while 29 and 16 accessions of Nvula or Mbana were collected from Ebonyi Central and Ebonyi South, respectively. The higher the percentage value the lower the risk of losing the accession. In the same vein, the lower the percentage the higher the risk of losing the accession in the next few years. Ebonyi North cultivate more of Mbala and other cultivars. Accessions of Egboru, Nvula mbube, Nvula Odawhehi, and Nneonwuka are peculiar in that zone compared to Ebonyi Central that cultivates more of Nvula Nwawafu, Caret yam, Urainum, Nvula mme and Onyeoma and Ebonyi South that cultivates Ishitu nvula, Igum Mbana/mbula and Awoke nvula.

Yellow yam accessions have just three identified cultivars including Oko or Nka or Enegbe, Ogomodu and Nkpenyi or Nkwenyi or Nkwanyi or Oluoku. It ranked 3rd highest diverse accessions with relative lower rate of diversity loss (9.4%). Ebonyi Central had the highest number of Oko accession and ranked the third highest in diversity among five species of yam cultivated in the three geopolitical zones. Ebonyi South had the second highest number of Oko accession in cultivation with local names as Nka (Afikpo South and Ishiagu) and Enegbe (Ohaozara). Both Ebonyi South and North cultivate the three accessions, while Ebonyi Central cultivate less of Ogomodu and Nkpenyi (Table 2).

Aerial yam is locally called 'Edu' (*Dioscorea bulbifera***)** and was not regarded as yam within the study area, and hence, cultivation was limited to one zone. Ikwo and Ezza South LGAs cultivate 'Edu' with exception of Ezza North in the same zone. Within the households assessed, only the female yam farmers cultivate 'Edu' within the zone.

Three-leaf yam or bitter yam (*Dioscorea domentorum*) accessions locally called 'Una' is cultivated in the three zones having Ebonyi South as producing the highest number of accessions (6), followed by Ebonyi Central and the least was recorded in Ebonyi North. The overall result indicated that each village and community produced more of one accession than the other, Ebonyi North produced 325, 280 and 251 accesssions for Ebonyi Central and Ebonyi South senatorial zones respectively. So that a yam zone is characterized by the total number of yam produced (water yam - *D. alata*, white yam-*D.rotundata*, yellow yam - *D. cayenesis*, bitter yam - *D. domentorum* and aerial yam - *D. bulbifera*) this determines cultivar diversity**.**

Table 2: List of Yam Accessions Currently Cultivated by the Farmers in the Three Senatorial Zones of Ebonyi State

Species	Accession local name	1Z	2Z	3Z	Cum.f	Min	Max	Aver.	%Rdl	Dr.
		Ebn	Ebc	Ebs						
TDr	Jioke	1	0	0	1	0	1	1.0	0.1	25
TDr	Nwopoke	1	0	0	1	0	1	1.0	0.1	25
TDr	Obela	16	0	0	16	0	16	16.0	1.9	13
TDr	Okpebe or okpembe	31	3	0	34	3	31	17.0	4.0	8
TDr	Opoke	3	0	0	3	0	3	3.0	0.4	23
TDr	Ozibo	10	1	0	11	1	11	5.5	1.3	18
TDr	Ozibo wire	3	0	0	3	0	3	3.0	0.4	23
TDr	Usuekpe	22	1	1	24	1	24	8.0	2.8	11
TDr	Abi/Amage/Iboki/Ibada	18	45	44	107	18	45	35.7	12.5	2
TDr	Igum/okeji	14	14	11	39	11	14	19.7	6.9	7
TDr	Jimanu/Jimaka	20	4	4	28	4	20	9.3	3.3	9

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TDr	Akamunze	1	3	0	4	1	3	2.0	0.5	22
TDr	Ayaregu	2	0	0	2	0	2	2.0	0.2	24
TDr	Agba/Agabro	13	0	12	25	12	13	12.5	2.9	10
TDr	Akiri	2	0	13	15	2	13	7.5	1.8	14
TDr	Ewada	21	1	1	24	1	21	7.7	2.8	11
TDr	Ekowji	0	0	1	1	0	1	1.0	0.1	25
TDr	Ipe	4	0	1	5	1	4	2.50	0.7	21
TDr	Obiaoturugo	7	11	27	45	7	47	21.7	7.6	4
TDr	Onaka	1	0	0	1	0	1	1.0	0.1	25
TDr	Nwiba	0	1	0	1	0	1	1.0	0.1	25
TDr	Ojeoso	0	14	0	14	0	14	14.0	1.6	15
TDr	Nnebiji	0	22	3	25	3	22	12.5	2.9	10
TDr	Ogbodo	0	1	0	1	0	1	1.0	0.1	25
TDr	Agboji/jioji/igum oji	2	0	0	2	0	2	2.0	0.2	24
TDr	Ogbaruogbuya	1	0	0	1	0	1	1.0	0.1	25
TDr	Nwagbam	0	1	0	1	0	1	1.0	0.1	25
TDr	Awoke	0	0	12	12	0	12	12.0	1.4	17
TDr	Orunte	0	0	12	12	0	12	12.0	1.4	17
TDr	Orumeh	0	0	7	7	0	7	7.0	0.8	20
TDr	Ishiutu	0	0	2	2	0	2	2.0	0.2	24
TDr	Ogbeka	0	0	2	2	0	2	2.0	0.2	24
TDr	Otutu	0	0	2	2	0	2	2.0	0.2	24
TDr	Paper	0	0	1	1	0	1	1.0	0.1	25
TDr	Egbeogba	0	0	1	1	0	1	1.0	0.1	25
TDa	Egboru (mbala)	1	0	0	1	0	1	1.0	0.1	25
TDa	mbula/mbala/Mbana/Nvula	46	39	25	110	15	46	36.7	12.9	1
TDa	Nvula Mamanu	0	13	0	13	0	13	13.0	1.5	16
TDa	Nwawafu/Makwuruoba	12	11	13	36	7	13	10.6	3.7	5
TDa	Nneonwuka	3	0	1	4	1	3	2.0	0.5	22
TDa	Nvula (odawhehi)	1	0	0	1	0	1	1.0	0.1	25
TDa	Mkpumeke	0	1	0	1	0	1	1.0	0.1	25
TDa	Nvula ajingworo	0	4	0	4	0	4	2.0	0.5	22
TDa	Nvula agbirigba	0	3	1	4	1	3	2.0	0.5	22
TDa	Okwalenkata/opanawanka	33	16	12	61	12	33	26.7	3.6	6
TDa	Nvula mme	0	3	0	3	0	3	3.0	0.4	23
TDa	jinvula/Nvula abi	0	0	3	3	0	3	3.0	0.4	23
TDa	Igum mbula	1	0	2	3	1	2	1.5	0.4	23
TDa	Igum elumelu	0	0	1	1	0	1	1.0	0.1	25
TDa	Mbula Paul	1	0	3	4	1	3	2.0	0.5	22
TDa	MbulaOhaukwu/obiaraohiu	0	0	3	3	0	3	3.0	0.4	23
TDa	Mbula America	1	0	8	9	1	8	4.5	1.1	19
TDa	Ogboja	18	0	7	25	7	18	12.5	2.9	10
TDa	Gborogborogidi	9	9	19	11	1	9	3.7	1.3	18
TDa	Nvula Mbube	1	0	0	1	0	1	1.0	0.1	25
TDa	Uranium	0	1	0	1	0	1	1.0	0.1	25
TDa	Onyeoma	0	1	0	1	0	1	1.0	0.1	25
TDa	Caret yam	0	1	0	1	0	1	1.0	0.1	25
TDa	Akpuruakputu	2	0	0	2	0	2	2.0	0.2	24
TDa	Awoke nvula	0	0	1	1	0	1	1.0	0.1	25
TDa	Ishitu nvula	0	0	1	1	0	1	1.0	0.1	25
TDc	Oko/Nka/Enegbe	23	45	35	103	23	45	34.3	12.0	3
TDc	Nkpenyi/Nkwanyi	1	0	2	3	1	3	1.5	0.4	23
TDc	Ogomodo	16	3	0	19	3	16	9.5	2.8	11
TDd	Una	1	2	6	9	1	6	3.0	1.1	19
TDb	Edu	0	4	0	4	0	4	4.0	0.5	22

TDa (Tropical *Dioscorea alata*), TDr (Tropical*Dioscorea rotundata*) TDc(Tropical *Dioscorea cayenesis*) TDb (Tropical *Dioscorea bulbifera*), TDd (Tropical *Dioscorea dumetorum*), 1z-zone one - Ebonyi North, 2z-zone two- Ebonyi Central, 3z-Ebonyi South, Cum.F.-Cumulative frequency, min-minimum, max-maximum, Aver- Average, %RDL-percentage rate of diversity loss and Dr - diversity ranking

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➢ *Documentation of Variety Information Based on the Language of Naming, English Translation, Other Names and why the Names*

The result in (Table 3) indicates the common white yam accessions Abi, Obia, Igum, Opoke, Okpebe, Agba, Nnebiji and Ozibo grown across the three senatorial zones of Ebonyi State. A total of 32 accessions were collected from the different local government areas in Ebonyi North, 28 accessions from Ebonyi Central and 28 accessions from Ebonyi South senatorial zone. Sometimes, there is an overlap in the name of accessions from the different senatorial zones and different Local Government Areas within the senatorial zones. For instance, there is Obela, Ozibo, Okpebe, and Nwopoke in Ohaukwu LGA and in Izzi LGA. Genotyping data will indicate whether these accessions are the same or different.

A good number of the yam accessions (42- 46.8%) have diverse other names within the same or different localities, and the names were duplicated in some cases. In Izzi and Abakaliki LGAs, different names were given to Okpebe (Ojoeso and Okpokitoro) and Opoke (as Nwopoke), respectively. Nevertheless, there were other varieties that were identified with two names within the study area, example, Ibada (also known as Abi or Amage) in Ezza South LGA (Table 3). In Ebonyi Central senatorial zone, Obiaoturugu, Igum, Nnebiji, and Abi accessions were white yam accessions collected and grown in all the LGAs within this zone. Other names that the accessions were called based on different dialects were Obiaturugo (Nkpuruji in Ezza language and Njimanu in Ikwo dialect) and others (Table 3). However, there were other white yam accessions identified with more than one name within the study area (Table 3). Obiaoturugo, Abi, Agba and Igum were common accessions grown within Ebonyi South senatorial zone. Accession 'Agba' retained the same name within the zone, while the rest had one or two other names that they were identified with within the zone.

Summarily, each zone had more than one accession grown within the zones that were not identified in other zones. However, Abi, Obia, Igum, Opoke, Okpebe, Agba, Nnebiji and Ozibo were the common accessions grown across the three senatorial zones of Ebonyi State. Ebonyi North had two languages of naming (Ngbo and Izzi), Ebonyi Central (Ezza and Ikwo languages), Ebonyi South (Uburu, Ishiagu and Edda languages). This was what led to duplications of names, i.e. one accession having different names.

Some of the accessions names were called based on vegetative and yield characters. Accessions of white yam Abi or Omengwagwa and Ojoeso were called because of their fast growth and early maturity. Majority of the yam accessions corned their names based on tuber coloration, such as white section of the tubers and hence Agbocha and Agboji, tuber appearance e.g. python head-like white yam (Ishinworoke) and source of the accessions (Agba is known to have come from Agba while Ozibo is known to had come from Ozibo in Izzi). Other accessions were called based on the role they served like Okeji and Jioke are ceremonial yam and are sometimes regarded as male white yam while the female known for multiple tubers production is called Nyeji. Therefore, about 53.9% of white yam accessions had no reasons they are called such names, while about 46.1% were identified with reasons for they names they are called.

Table 3: Variety information based on Language of Naming, English Translation and Other Names of White Yam Species Across the Three Senatorial Zones of Ebonyi State

Senatorial zone	LGA	Accession names	Language of naming	English translation	Other names of accession	Why this name?
Ebonyi North	Ohaukwu	Jioke	Ngbo	White yam		Ceremonial yam
		Nwopoke	Ngbo	White yam	Opoke	
		Obela	Ngbo	White yam		
		Okpebe	Ngbo	White yam	Okpambe	
		Ozibo	Ngbo	White yam		
		Utsuekpe	Ngbo	White yam	Akpa	
	Abakaliki	Amage	Izzi	White yam	Ugele	
		Igum	Izzi	White yam	Jimmanu	Main white yam
		jimanu	Izzi	White yam	Ogbarugbia	Faster growth white yam
		Nwopoke	Izzi	White yam	Opoke	
		Okpebe	Izzi	White yam	Ojioeso	Fast growing yam
		Ozibo	Izzi	White yam		
	Izzi	Akamunze	Izzi	White yam	Okpebe	Titled white yam
		Amage	Izzi	White yam	Ugele	
		Ayalegu	Izzi	White yam	Ayaragu	Field recognized white yam
		Igum	Izzi	White yam	Agbocha	White section of tuber
		Igum oji	Izzi	White yam	Opoke	
		Jioji	Izzi	White yam	Agbaoji	White yam with black tuber section
		Ogbaruogbiya	Izzi	White yam	Ojioeso	Faster growth white yam
		Okpebe	Izzi	White yam	Okpokitoro	

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		Ozibo	Izzi	White yam		From Ozibo in Izzi
		Ozibo wire	Izzi	White yam		Coiled and long tuber Ozibo yam
		Obela	Izzi	White yam		
Ebonyi Central	Ezza North	Akamunze	Ezza	White yam	Ishinworoke	Python head-like white yam
		Igum	Ezza	White yam	Okeji	Male white yam
		Nnebiji	Ezza	White yam	Jimmanu	Main white yam
		Nyeji	Ezza	White yam	Jimmaka	Female white yam
		Iboki	Ezza	White yam	Abi	
		Obia	Ezza	White yam		
		Ojioeso	Ezza	White yam		
		Okpebe	Ezza	White yam		
		Ozibo	Ezza	White yam		
		Usuekpe	Ezza	White yam	Utekpe	
	Ezza South	Abi/amage	Ezza	White yam	Omengwagw	
		Ibada	Ezza	White yam	Abi, amage	
		Igum	Ezza	White yam	Okeji	Male white yam
		Jimmanu	Ezza	White yam	Nyeji	Female white yam
		Nnebiji	Ezza	White yam	Jimmaka	Main white yam
		Nyeji	Ezza	White yam	Nnebiji	Female white yam
		Okeji	Ezza	White yam	Igum	Male white yam
		Obia	Ezza	White yam	Nkpuruji	Small multiple tuber yam
	Ikwo	Agbabro	Ikwo	White yam	Agba	White yam from Agba people
		Amage	Ikwo	White yam	Ibada	
		Ewada	Ikwo	White yam		Survived from planted tuber
		Ibada	Ikwo	White yam	Amage	New yam announcer
		Igum	Ikwo	White yam	Okeji	Main white yam
		Nnebiji	Ikwo	White yam		
		Obia	Ikwo	White yam	Njimanu	Ordinary white yam
		Nwagbam	Ikwo	White yam		
		Ogbodo	Ikwo	White yam		Brought by a man called ogbodo
		Agba	Uburu	White yam		
Ebonyi South	Ohaozara	Abi	Uburu	White yam	Amage	
		Agba	Uburu	White yam		
		Ekowiji	Uburu	White yam		Starting yam of new yam farmer
		Egbeogba	Uburu	White yam		
		Nnebiji	Uburu	White yam	Igum	The main white yam
		Obiaoturugo	Uburu	White yam	Jimmaka	Ordaianry white yam
		Usuekpe	Uburu	White yam		
	Ivo	Abi	Ishiagu	White yam	Amage	It grows faster than any other yam
		Agba	Ishiagu	White yam		
		Agboji	Ishiagu	White yam		
		Awoke	Ishiagu	White yam	Jimmaka	
		Ekwere	Ishiagu	White yam		
		Igum	Ishiagu	White yam		
		Ishiutu	Ishiagu	White yam		
		Jimmaka	Ishiagu	White yam		Ordinary white yam
		Obiaoturugo	Ishiagu	White yam	Jinkporo	Multiple tuber white yam
		Ogbaeka	Ishiagu	White yam		Single tuber white yam
		Orumeh	Ishiagu	White yam		
		Orunte	Ishiagu	White yam		

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		Paper	Ishiagu	White yam		Light tuber white yam
	Afikpo South	Abi	Edda	White yam	Amage	
		Agba	Edda	White yam		
		Akiri	Edda	White yam		
		Ewada	Edda	White yam		
		Igum	Edda	White yam		
		Ipe	Edda	White yam		
		Obia	Edda	White yam		

Source: Field Survey 2017. 53.2% - No Other Names, 46.8% - Identified with Other Names, 53.9% - No Reasons They Are Called Such Names, 46.1%-Identified with Reasons

The result in (Table 4) revealed water yam accessions (*Dioscorea alata*) with Mbala or Nvula and Nwawafu or Okwalenwankata (Okwalenkata) among the two common accessions of water yam in Ebonyi North senatorial zone. However, there were other names given to these accessions. Accessions of Nvula and Okwalenwankata had other names (Nvula mmanu and Nwiteogbaga) in Izzi dialect, while they are called Mbala and Nwawafu in Ngbo languages, respectively. Other varieties Nvula Nneonwuka (Ngbo), Nvula Akpuruakputu and Akpuruakputu (Izzi) were identified with one or two names within the study area (Table 4). In Ebonyi Central senatorial zones, Nvula and Okwalenwankata accessions were the common accessions of water yam grown in all the LGAs within this zone. Other names in which accessions were called based on different dialects were Nvula (Njimini in Ikwo dialect), while the common name was retained in Ezza dialect. The accession named Okwalenwankata was also called Akowafu or Nwawafu in the two dialects. However, there were other water yam accessions that were identified with more than one name within the study area (Table 4). Water yam (Nvula) is grown within the three LGAs in Ebonyi South senatorial zones with different common accession names given; in Uburu dialect, it was called 'Mbana or 'Nvula', Ishiagu (Mbala), while in Edda language it was called 'Mbula'. Summarily, each zone had more than one accession grown within the zone that were not identified in other zones and having other names that they were called (Table 4). However, Nvula and Nwawafu were the only accessions that were commonly grown across the three senatorial zones of Ebonyi State. Over 64.4 % of the water yam accessions were identified with other names, while few accessions (35.2%) were identified without other names (Table 4).

Majority of the water yam accessions coined their names based on nature of the tubers or tuber characteristics. Examples are high water content tubers (Njimini) as called in Ikwo dialect, tuber coloration such as Nvula mme (blood looking-like water yam), Makwuruoba (water yam that produces multiple tubers that causes expansion of the barn). Others include Nwawafu (water yam accessions that can survive anywhere) and Okwalenwankata or Opananwankata (water yam accessions that yield so much that it breaks the local basket called (Nkata)). Others include tuber appearance e.g. Ekwokuoku (roundish egg-like tuber) and source of the accessions (Mbula Ohaukwu, Mbula America and Mbula Paul). Cumulatively, 94.4% of water yam accessions were identified with meaning of the others names or the reasons they are called such names while 5.6 % were identified without reasons for the names they are called.

Yellow yam (*Dioscorea cayenensis*) accessions identified were three and one accession (Oko) is grown across the three senatorial zones of Ebonyi State (Table 5). Yellow yam accessions (Oko) is household name or common name was known as such across the three senatorial zones. However, in Ebonyi South the name varied from one LGA to the other. It is called Enegbe in Uburu language, Nka (Ishiagu) and Oko (in Edda languages). Similarly, the accession called Ogomodu was grown only in Ohaukwu and Ezza North, and were called other names such as Oko and Abalenji, respectively. Another type of yellow yam accession grown in Ohaukwu and Afikpo South only is called Nkpenyi and Nkwanyi in Ngbo and Edda languages, respectively. Summarily, 75% of yellow yam accessions were identified with a meaning for other names or reasons behind such names they are called while 25% of yellow yam accessions were not. Unlike yellow yam accessions, accessions Three-leaf yam (*Dioscorea dumentorum*) had only identified in Ohukwu, Ezza South and Ezza North and Afikpo South in Ebonyi North, Central and South senatorial zones. In Ebonyi North senatorial zones, it retained the common local name Una, while in other zones the names varied (Table 5).

Unlike three leaf yam, aerial yam accessions (*Dioscorea bulbifera*) locally called 'edu' and cultivated only by Ikwo and Ezza language speaking farmers had other names (Egbe-edu and Obajigboro) as were called by Ezza North and Ezza South farmers respectively. The reason behind the other names were that the yam spread widely and can be seen growing where not actually planted, hence wild yam. In conclusion, all the yam accessions irrespective of species were identified with seven languages or local dialects in the study area.

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Table 4: Variety Information based on Language of Naming, English Translation and Other Names Local Names of Water Yam Species Across the Three Senatorial Zones of Ebonyi State

Senatorial zone	LGA	Accession names	Language of naming	English translation	Other names of accession	Why this name?
Ebonyi North	Ohaukwu	Egboru mbala	Ngbo	Water yam	mbala	Hairy tuber with high water content
		Mbala	Ngbo	Water yam	Mbala	High water content of tuber
		Nneonwuka	Ngbo	Water yam	Mbala	Large tuber that rotten easily
		Nwawafu	Ngbo	Water yam	Okwalenwankata	
	Abakaliki	Nvula	Izzi	Water yam		Multiple high water tuber yam
		Okwalenwata	Izzi	Water yam	Nvula	Small tubers carried in local basket
		Nvula mmanu	Izzi	Water yam		Ordinary water yam
	Izzi	Nvula	Izzi	Water yam	Nvula mmanu	Ordinary water yam
		Akpuruakputu	Izzi	Water yam		Small multiple tuber yam
		Nvulaodawehi	Izzi	Water yam	Odawhei	Long neck water yam tuber
		Nvula mbube	Izzi	Water yam	Mbube	Roundish water yam tuber
		Nwopoke offu	Izzi	Water yam	Nwopoke	Water yam that looks like obela
		Okwalenwakata	Izzi	Water yam	Nwitegba	Brought by man called Nwitegba
Ebonyi Central	Ezza North	Nvula	Ezza	Water yam		High water content of the tuber
		Nwawafu	Ezza	Water yam	Opalenwnkata	Survive everywhere
		Nvula mmanu	Ezza	Water yam		High water tuber yam
	Ezza South	Akoawafu	Ezza	Water yam	Nwawafu	Plant and survive
		Nvula mmanu	Ezza	Water yam		Oil water yam
		Nvula uranium	Ezza	Water yam	Uranium	Water yam that grows near river
		Okwalenwakata	Ezza	Water yam		Yam carried only in local basket
		Nvula	Ezza	Water yam		High water in the tuber
	Ikwo	Nvula	Ikwo	Water yam	Njimini	Yam with high water content tuber
		Okwalewankata	Ikwo	Water yam	Nwawfu	Multiple yam carried with Nkata
		Nvula mmanu	Ikwo	Water yam		Only high water tuber yam
		Nvulamme	Ikwo	Water yam		Blood tuber water yam
		Nvulagbirigba	Ikwo	Water yam	Egburike	Irregular and hair tuber yam
		Ajingworo	Ikwo	Water yam	Nvula-eke	Coiled like snake water yam
		Mkpumeke	Ikwo	Water yam	Ekwoku	Roundish like egg tuber
		Onyeoma	Ikwo	Water yam		Goodwill water yam
		Uranum	Ikwo	Water yam	Urainyim	Only water yam plant near river
		Caret yam	Ikwo	Water yam	Chinese yam	Have like-caret tuber
		Nwiba	Ikwo	Water yam		Water yam brought by man nwiba
Ebonyi South	Ohaozara	Mbana/nvula	Uburu	Water yam	Jinvula	All other man lands
		Opanankata	Uburu	Water yam		Carried only in local basket nkata
		NvulAmerica	Uburu	Water yam		Water yam from America

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		Nvula abi	Uburu	Water yam		Long tuber water yam
		Jinvula	Uburu	Water yam	Mbana	Long tuber water yam
		Igborogidi	Uburu	Water yam	Ogborogidi	Large tuber and profuse vining yam
	Ivo	Awokenvula	Ishiagu	Water yam		Look like awoke tuber
		Ishiutu	Ishiagu	Water yam		Start rotten from tuber head
		Makwuroba	Ishiagu	Water yam	Kpokwuruoba	Yam that causes barn expansion
		Mbala	Ishiagu	Water yam		
		Otutu	Ishiagu	Water yam	Mbala	Multiple small tubers water yam
	Afikpo South	Igumeluenyim	Edda	Water yam		Yam on riverbank like igum
		Igumbula	Edda	Water yam	Mbula	Water yam like white yam igum
		Mbula Paul	Edda	Water yam	Mbula	Water brought by man called Paul
		Ogboja	Edda	Water yam	Mbula	
		Gborogidi	Edda	Water yam	Mbula	Wild growth habit
		Mbula	Edda	Water yam	Mbula	High water content yam
		Mbula America	Edda	Water yam	Mbula	Water yam from America
		Mbula obirohu	Edda	Water yam	Mbula	New water yam
		Nneonwuka	Edda	Water yam	Mbula	Big tuber that rotten easily
		Mbula ohaukwu	Edda	Water yam	Mbula	Water yam from Ohaukwu LGA

Source: Field survey 2017. 68.8%- identified with other names, 35.2%- identified without other names, 94.4% - identified with other names, 5.6% - no reasons they are called such names

Table 5: Documentation of Information based on the Language of Naming, English translation and other local names of yellow yam, three-leaf yam and aerial yam species across the three agricultural zones of Ebonyi State

Senatorial zone	**LGA**	**Accession names**	**Language of naming**	**English translation**	**Other names of accession**	**Why this name?**
Ebonyi North Agric Zone	**Ohaukwu**	Nkpenyi	Ngbo	Yellow yam	Oluoku	Thin long tuber
		Ogomodo	Ngbo	Yellow yam	Oko	Yellow tuber
		Una	Ngbo	Three-leaf yam	Jilu	Bitter tuber
	Abakaliki	Oko	Izzi	Yellow yam	Ishiangbu	Big irregular head tuber
	Izzi	Oko	Izzi	Yellow yam		Yellow tuber
Ebonyi Central Agric Zone	**Ezza North**	Ogomodu	Ezza	Yellow yam	Abalenji	Yam from Aba
		Oko	Ezza	Yellow yam	Jiughi	Yellow inner tuber
		Edu	Ezza	Aerial yam	Egbe-edu	Spread like a kite
	Ezza South	Oko	Ezza	Yellow yam	Jiughi	Yellow inner tuber
		Una	Ezza	Bitter yam	Ji-ilu	Bitter tuber
		Edu	Ezza	Aerial yam	Obajigbororo	Grows wildly
	Ikwo	Oko	Ikwo	Yellow yam	Jiodo	Yellow inner tuber
		Edu	Ikwo	Aerial yam	Ukoji	Famine yam
Ebonyi South Agric Zone	**Ohaozara**	Enegbe	Uburu	Yellow yam	Oko	Yellow inner tuber
	Ivo	Nka	Ishiiagu	Yellow yam	Jiuko	famine yam
	Afikpo South	Nkwanyi	Edda	Yellow yam	Oko	Supportive yam
		Oko	Edda	Yellow yam	Oko	Yellow inner tuber

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		Una	Edda	Three leaf yam	Nwuneke	Brought by Nwuneke

Source: Field Survey 2017. 75%- Identified with Reasons and 25% - Identified Without Reasons they are Such Names for Yellow yam

- *Variety Information based on Morphological Traits for White Yam Aaccessions across the Three Senatorial Zones of Ebonyi State*

Direct observations made by yam farmers on the growth condition of cultivated accessions in the last five years indicated increased planting in comparison to other years. However, some areas witnessed decreased production within the last five years. This include Abakalik, Izzi and all the surveyed three LGAs in Ebonyi South attributing it to flooding, pest and disease (Table 6). Cumulatively, 66.6 % of white yam accessions had increased production in the last five years, 32.4% accessions had decreased production, while very few had no change in the production condition within the last five years (Table 6). Farmers noted that all the white yam accessions twined anticlockwise and indicated high tendancy to sprouting with variable sprout colours ranging from dominant purplish green, green to pink, purple, and dark green and light green. They also observed that some accessions had few to many spines and hairs and twined anticlockwise.

Assessment on farmers'knowledge on maturity condtions indicated that white yams had high variable maturation times. There was overlap of farmers' views on maturity rate of white yam accessions. Farmers identified some white yam accessions to be early maturing in one village and within the same community another farmer identifies the same accession as either medium maturing or late maturing. However, the result shows that white yam accessions locally called (Abi) matures early than any other group of white yam accessions and all other yam species. Other early maturing accessions include Ojioeso, Okpbebe, Usuekpe, while late maturing ones include Igum, Obiaoturugo, Agba, Obela and others (Table 6).

Cummulatively, 50% accessions had intermediate maturity time or were perceived by the farmers to be medium or matures moderately, 24.1% had early maturity and are predominantly found in accessions of Abi or Amage/Ibada/Iboki, Ojeoso, Ogbaruogbia and others (Table 6). About 17.6% had late maturity time, while few 8.3% had variable or double maturity times ranging from intermediate to late maturity time, and were identified on the accessions of Obia, Agba, Orumeh, Ayaragu, Usuekpe, Okpebe and Igum.

Assessment of the farmers on leaf colouration of white yam revealed that yam farmers from Ebonyi South identified white yam accessions with the highest number of variable leaf colours ranging from dominant purplish green to green, dark green, light green, brownish green and yellowish leaf colourations at senescence. This may be as result of Ebonyi South having a greater percentage of educated yam farmers than other senatorial zones.

Table 6: Variety Information based on the Record of Planting White Yam Species Across the Three Senatorial Zones of Ebonyi State

Senatorial Zon.	LGA	Accession N.	Planting last 5 yrs	Sprout condition	Sprout colour	Hairs	Spines	Twining habit	Maturity rate	Leaf colour
Ebonyi North	**Ohaukwu**	Jioke	1	1	2,1	0	1	0	1	4,3,4
		Nwopoke	2	1	2	0	2	0	1	1,4,5
		Obela	2	1	2,6	1	0	0	2	1
		Okpebe	2	1	4,6,2	0	0	0	2	2
		Ozibo	2	1	2,3,7	1	0	0	3	1
		Utsuekpe	2	1	2	0	1	0	1	2
		Obela	2	1	2,7	0	0	0	2	2
		Okpebe	2	1	2,7	0	1	0	2	4
		Ozibo	2	1	2,5	0	0	0	2	2
		Usuekpe	2	1	2,5	0	1	0	2	1
	Abakaliki	Amage	1	1	1	0	0	0	1	6
		Igum	1	1	2,6	0	0	0	2	2
		jimanu	2	1	2,6	0	0	0	1	1
		Nwopoke	1	1	4,3	0	0	0	2	7
		Okpebe	1	1	4,3,1	1	1	0	1	7
		Ozibo	2	1	4,2	0	0	0	2	2,1,5
	Izzi	Akamunze	2	1	4,3	0	0	0	1	7
		Amage	1	1	1,2	0	0	0	1	1
		Ayalegu	1	1	1,3,4	0	0	0	1	4
		Igum	2	1	6	1	0	0	2	4

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		Igum oji	2	1	4,3	0	1	0	2	1
		Jioji	1	1	3	0	1	0	3	1
		Ogbaruogbiya	1	1	4,3	0	0	0	1	4
		Okpebe	1	1	2	1	1	0	1	1
		Amage	1	1	2	0	0	0	2	2
		Igum	2	1	6	6	1	0	2	2
		Okpebe	2	1	2	1	1	0	2	2
		Ozibo	2	1	2	0	0	0	1	2
		Ozibo wire	2	1	1	0	0	0	2	2
		Obela	1	1	2	0	0	0	3	2
Ebonyi Central	**Ezza North**	Akamunze	1	1	4,3	1	0	0	2	2
		Igum	1	1	6	1	1	0	2	7
		Nnebiji	2	1	5	1	0	0	1	3
		Nyeji	1	1	1	0	0	0	2	1
		Iboki	1	1	1	0	0	0	2	1
		Obia	2	1	1,5	0	0	0	1	4
		Ojioeso	1	1	1	0	0	0	1	4
		Okpmbe	1	1	4	1	1	0	2	1
		Usuekpe	2	1	4	1	1	0	2,3	1
		Ozibo	1	1	4,3,2	0	0	0	2	2
		Usuekpe	2	1	4,3	0	1	0	2	3
Ebonyi central	**Ezza S.**	Abi/amage	2	1	1,2	0	0	0	1	1
		Ibada	2	1	1,2,1	0	0	0	1	1
		Igum	2	1	5,6	1	1	0	3	4
		Jimmanu	2	1	2,6	0	1	0	2	7,4
		Nnebiji	2	1	6,2	1	1	0	3	2
	Ezza S.	Abi	1	1	2	0	0	0	1	1,7
		Igum	2	1	2	0	0	0	3	1
		Nyeji	2	1	2	0	0	0	3	1
		Okeji	2	1	6,2,1	0	0	0	3	3
Ebonyi central	**Ezza S.**	Obia	2	1	1,5,6	0	0	0	2	3
		Nnebiji	2	1	2,6	1	0	0	3	2
Ebonyi Central	**Ikwo**	Nnebiji	2	1	2,5,6	0	0	0	2	2
		Obioturugo	1	1	2	0	0	0	2	6
		Ojioso	2	1	2	0	0	0	2	2
		Ewada	1	1	2	1	0	0	2	2
		Ibada	2	1	2		1	0	1	2
		Amage	2	1	1	0	0	0	1	1
		Ewada	2	1	2	0	0	0	3	4
		Agbabro	2	1	1	0	1	0	3	1
		Ibada	2	1	1	0	0	0	1	2
		Igum	2	1	6,5	1	0	0	3	4
		Nnebiji	2	1	5	1	0	0	3	4
		Obia	2	1	5	0	0	0	1	2
		Nwagbam	2	1	2,5	0	0	0	3	2
		Ogbodo	2	1	2,1	0	0	0	3	2
		Ojioso	2	1	5,7	0	0	0	1	2
Ebonyi South	**Ohaozara**	Abi	1	1	1	0	0	0	1	4,1,7
		Agba	1	1	2	1	1	0	3	1
		Ekowiji	1	1	2,5	1	0	0	2	1
		Egbeogba	2	1	2	1	1	0	3	1
		Nnebiji	2	1	2,5	0	0	0	2	1
		Obiaoturugo	2	1	2,1,5	0	0	0	3	2
		Usuekpe	2	1	1.2	0	0	0	2	2
		Abi	1	1	1,2,5	0	0	0	2	7,1,2

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		Agba	1,2	1	2,5	0	0	0	2,3	2,4,3
		Obiaoturugo	2	1	2,5,1	0	0	0	3,2	2,4,7
		Okpebe	2	1	2,5	0	0	0	3,2	3,4,2
	Ivo	Otutu	2	1	5	0	1	0	2	1
		Ishiutu	1	1	2,5	0	0	0	2	4,5
		Ayaragu	2	1	2,5,3	1	1	0	2,3	2
		Abi	2	1	1	0	0	0	1	1,3
		Agba	2	1	5,6	0	0	0	2	1,3
		Igum	1,2	1	6,5	1	1	0	2,3	4,2,1
		Obiaoturugo	2	1	4,2	0	0	0	2	2,1
		Agboji	2	1	2	1	1	0	2	1,4
		Orumeh	1,2	1	3,2	0	0	0	2,3	4
	Ivo	Orunte	2,2	1	2,5	0	0	0	2	4,1
		Paper	1	1	1	0	0	0	2	2
		Awoke	1	1	2,5	0	0	0	2	1,7
		Ekwere	1	1	2	0	0	0	2	1
		Igum	2	1	6,5	0	0	0	2	1
		Jimmaka	2	1	6	0	0	0	2	1,3,4
Ebonyi South	**Ivo**	Obiaoturugo	2	1	1,2	0	0	0	2	7
		Ogbaeka	1	1	4,3	0	0	0	2	2
		Orumeh	2	1	3,2	0	0	0	2	4
		Orunte	2	1	2	0	0	0	2	4
	Afikpo S.	Abi	2	1	1	0	0	0	1	7
		Agba	2	1	2,5	0	0	0	2,3	7
		Akiri	2	1	2	1	0	0	2	7,1
		Ewada	2	1	2	0	0	0	2	2
		Igum	2	1	6,5	0	0	0	2	2
		Ipe	2	1	5	1	0	0	2	1
		Obia	2	1	2,1	0	0	0	2	2
Ebonyi South	**Afikpo S.**	Obiaoturugo	1	1	1,2	1	0	0	2	1,4,2
		Agba	1	1	1,2,7	0	0	0	2,3	7,1
		Akiri	2	1	1,4	0	0	0	2	2
		Igum	1	1	1,4,2	1	1	0	3	4,2,1

Source: Field Survey 2017. Production within the last five: 2- increased –66.6%, 1-decrease – 32.4%, don't know 1%. Hairs: Absent – 74.5%, present – 25.5%, spines: presence – 74.5%, absent – 25.5%. Maturity rate: 1 – early 24.1%, 2 – medium or intermediate 17.6%, double days of maturation with dominant medium or late maturing 8.3%. Leaf colour: sprout condition - purplish green 27.3%, green-25.5%, 2 variables colours – 13.6%, dark green – 11.8%, 3 variable leaf colours - 11.8%, light green - 6.4%, pink leaf – 3.6 % .

➢ *Variety Information Based on other Morphological Traits for White Yam Accessions Continued*

The result indicated that farmers were able to identify variable leaf shapes. Cumulatively, 43.4% was cordate long leaf shape of white yam which was the most dominant followed by cordate 36.4%, ovate 8.2%, cordate broad 5.4%, saggitate broad 3.4% and hastate 3.2%. The respondents were able to identify variable leaf apex shapes among the acceessions of the white yam grown in the study area. The majority of the respondents (63.5% and 25%) interviewed agreed that white yam had caudate and acute leaf apex shapes as most dominant with few obtuse (3.6%), emarginated (2.8%), aristate (2.7%) and cudispate (2.4%).

Farmers also held variable views on yield traits of white yam including tuber shapes, tuber surface texture, tendancy to branch, branching position, presence of cracks, thorns, wrinkles on tubers, presence of roots and root positions, presence or absence of corms in an accession and tuber colourations in all white yam accessions as recorded in (Table 7 and 8). Almost all the white yam accessions had few roots at tuber head regions and cylindrical tubers with few oval and oval oblong shapes mostly in accessions of Obiaoturugo, orumeh, Ozibo and Igum. Accessions of Agba, Nyeji and Abi or Amage and others also were identified with irrgular tuber shapes. There was no particular accessions identified with known uniform tuber shapes as one accession can produce different tuber shapes. However, accessions with spines presented light and thick thorns on the tuber and were identified among accessions of Igum, Jimanu, Jioji, Agba, Akiri and Okpebe.

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Furthermore, almost all the accessions have tendancy to produce multiple tubers (corms) but majority were identified without corms (multiple tubers) while few had a detacheable regular, slightly branched or branched corms at the middle and tail regions. Accessions of white yam tubers were identified by farmers to have range of tuber colours at variable tuber regions while few maintained their uniform colouration in all the tuber regions (Table 7). Howerver, the most noticeable tuber colours range from creamy to creamy white, deep purple to purplish and purplish white. This amounting to tuber colours at upper regions having creamy colour 80%, creamy white 2.7%, purplish 7.3%, purplish white 1.8%,and deep purple 8.2% and varied the similarly in other tuber regions (Table 7).

Table 7: Variety Information based on the Morphological Record of Planting White Yam Species Across the Three Senatorial Zones of Ebonyi State

Senatorial Zon.	LGA	Accession N.	Leaf shape	Leaf apex	Tuber shape	Tuber texture	Tuber Ttb	Branch position	Cracks present	Thorns preence
Ebonyi North	**Ohaukwu**	Jioke	2	6	3,5	1	3	4,2,3	0	0
		Nwopoke	2	6	3,5	1	3	4,2,3	0	0
		Obela	2	6	3,5	1	3	4,2,3	0	0
		Okpebe	2	6	3,5	1	3	4,2,3	0	0
		Ozibo	1	6	3,5	1	3	4,2,3	0	0
		Utsuekpe	2	6	4,5	1,2	3	4,2,3	0	0
		Obela	2	3	3,2	1	3	4,2,3	0	0
		Okpebe	2	2	3,5	1	3	4,2,3	0	0
		Ozibo	1	2	3,5	1	3	4,2,3	0	0
		Usuekpe	2	6	3,5	1,2	3	4,2,3	0	0
	Abakaliki	Amage	2	2	3,5	1	3,5	4,2,3	0	0
		Igum	2	6	3,2	1	3	4,2,3	0	1
		jimanu	2	6	3,2,5	1	3,5	4,3,2	0	1
		Nwopoke	2	3	3,5	1	3	4,2,3	0	0
		Okpebe	2	2	3,5	1	3	4,2,3	0	0
		Ozibo	2	2	2,3,4	1	3	4,2,3	0	0
	Izzi	Akamunze	1	2	3,5	1	3	4,2,3	0	1
		Amage	1	2	3,5	1	3,5	4,2,3	0	0
		Ayalegu	2	3	3,5	1	3,5	4,2,3	0	0
		Igum	2	6	3,2,4	1	3	4,2,3	0	0
		Igum oji	2	6	2,4,3	1	3	4,2,3	0	0
		Jioji	2	6	3	1	3	4,2,3	0	1
		Ogbaruogbiya	2	6	3	1	3	4,2,3	0	0
		Okpebe	2	6	3	1	3	4,2,3	0	0
		Amage	1	2	3,5	1	3,5	4,2,3	0	0
		Igum	2	6	3,2	1	3	4,2,3	0	0
		Okpebe	2	5	3,2	1	3,5	4,2,3	0	0
		Ozibo	2	6	3,2	1	3	4,2,3	0	0
		Ozibo wire	2	6	2,3	1	3,5	4,2,3	0	0
		Obela	2	6	3,2,5	1	3	4,2,3	0	0
Ebonyi Central	**Ezza North**	Akamunze	2	6	3,5	1	3	4,2,3	0	0
		Igum	1	2	2,3	1	3	4,2,3	0	1
		Nnebiji	2	6	3,4	1	3	4,2,3	0	0
		Nyeji	2	3	3,5	1	3,5	4,2,3	0	0
		Iboki	1	2	3,5	1	3	4,2,3	0	0
		Obia	1	2	3,5	1	3	4,2,3	0	0
		Ojioeso	2	6	3,5	1	3	4,2,3	0	0
		Okpmbe	2	6	3,4	1	3	4,2,3	0	1
		Usuekpe	2	6	3,5	1	3	4,2,3	0	0
		Ozibo	2	6	3,2,4	1	3	4,2,3	0	0
		Usuekpe	2	6	3,5	1	3	4,2,3	0	0
	Ezza South	Abi/amage	1	6	3,5	1	3,5	4,2,3	0	0
		Ibada	3	2	3,5	1	3	4,2,3	0	0
		Igum	3	6	3,4,2,5	1	3	4,2,3	0	0
		Jimmanu	2	6	3,5	1	3	4,2,3	0	0
		Nnebiji	3	6	3,5	1	3	4,2,3	0	0
		Jimaka	2	6	3,5	1	3,5	4,2,3	0	0

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		Nyeji	2	6	3,5	1	3,5	4,2,3	0	0
	Ezza South	Abi	1	6	3	1,2	5	4,2	0	0
		Igum	3	5	3	1	3	3,2	0	0
		Nyeji	3	6	3	1	3	3,4	0	0
		Okeji	2	6	3	1	3	2,4,3	0	0
		Obia	1	6	3	1	3	4,2	0	0
		Nnebiji	2	6	3,4	1	3	2,4	0	0
Ebonyi Central	**Ikwo**	Nnebiji	5	6	3,4	1	3	1,4	1	0
		Obioturugo	2	6	3	1	3	3,2	0	0
		Ojioso	2	6	3	1	3	3	0	0
		Ewada	2	6	3	1	3	3	0	0
		Ibada	2	5	3	1	3	4,1,2	0	0
		Amage	2	5	3,5	1	3	1,3	0	0
		Ewada	2	6	3	1	3	4,2	0	0
		Agbabro	3	6	3	1	3	4,2,3	0	0
		Ibada	1	5	3	1,2	3	3,4	1	0
		Igum	6	6	3,4	1	3	4,2	0	0
		Nnebiji	5	1	3	1	3	2,3	0	0
		Obia	3	6	3,4,5	1	3	4,1	0	0
		Nwagbam	2	6	3	1	3	4,3	0	0
		Ogbodo	4,2	6	3	1	3	4,3,1	0	0
		Ojioso	3	6	3	1	3	4,2	0	0
Ebonyi South	**Ohaozara**	Abi	3	6	3	1,2	3	1,3	1	0
		Agba	3	6	3,5	1	3	4,2	0	0,1
		Ekowiji	5,2	6	3,5	1	3	3,2,1	0	0,1
		Egbeogba	3	2	3	1	3	2,4,1	0	0
		Nnebiji	3	1	3	1	3	2,3	0	0
		Obiaoturugo	3	2	3	1	3	4,2	1	0
		Usuekpe	2	1	3	1	3	3,4	1	0
		Abi	1,2	6	3,5	1	3	3,4	0	0
		Agba	2	6	3	1	3	1,2	0	0,1
		Obiaoturugo	3	6	3	1	3	3,4	0	0
		Okpebe	3	6	3	1,2	3	4,1,3,2	1	0,1
	Ivo	Otutu	3	6	3,5	1	3	3	0	0
		Ishiutu	2,6	6	3,4,2	1	3	3	0	0
		Ayaragu	4,2	2	3,5	1	3	4,1,2	0	0
		Abi	2,1	6	3,5	1,2	3	3,1	0	0
		Agba	5,4	6	3,5	1	3	4,2	0	0
		Igum	7,2	6	3,4	1	3	2,4	1	0
		Obiaoturugo	3	6	3	1	3	4,2	0	0
		Agboji	3	6	3	1,2	3	4,2	0	0
		Orumeh	3	6	4	1	3	2	0	0
	Ivo	Orunte	3	5,6	1,2	1,2	5,3	3,2	0	0
		Paper	3	5,6	1,2	1,2	3	2,3	0	0
		Awoke	2	5,6	2,2	2,1	5,3	2,3	0	0
		Ekwere	,3	5	2,1	2,1	3	2,4	0	0
		Igum	1,2	5,6	1,2	1,2	3	3,2	0	1
		Jimmaka	2	6	1,2	1,2	3	3,2,4	0	0
Ebonyi South	**Ivo**	Obiaoturugo	3	6	1,2	1,2	3	2,3	0	0
		Ogbaeka	3	6	1,2	1,2	3	2,3	0	0
		Orumeh	3,2	6,5	1,2	1,2	3	2	0	0
		Orunte	2,3	6	1,2	1,2	5,3	2	0	0
	Afikpo S.	Abi	2,3	6,2	1,2	1,2	5,3	4,2	0	0
		Agba	4	6	2,1	1,2	3	2	0	0
		Akiri	4,3	6	2,1	1,2	5,3	3,2	0	1
		Ewada	3	6	1,2	2,1	3	2	0	0
		Igum	2,1	6	1,2	1,2	3	2	0	0
		Ipe	1,2	6	1,2	1,2	5,3	2	0	1
		Obia	3	6	1,2	1,2	3	2	0	0

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Ebonyi South	**Afikpo S.**	Obiaoturugo	3	6,2	1,2	1,2	3	2	0	1
		Agba	3	6	1,2	1,2	5,3	2	0	0
		Akiri	3	6	1,2	2,1	5,3	3,2	0	1
		Igum	2	6	1,2	1,2	3	2	0	0

Source: Field Survey 2017. Leaf Shapes – Cordate Long- 43.4%, Cordate- 36.4%, Ovate - 8.2%, Cordate Broad 5.4%, Saggitate Broad 3.4% And Hastate – 3.2%. Tuber Shapes Cylindrical 74.5%, Spherical/Oval Tuber – 15.5%, Irregular - 7.5%, Oval Oblong 2.5%. Tuber Surface Texture: Smooth – 73.6 %, Smooth And Rough – 22.8%, Rough – 3.6%. Tuber Ttb- Tuber Tendancy To Branch: Slightly Branched 81.8%, Branched – 11%, Highly Branched 7.2 %. Cracks: Absent – 93.7%, Presence Of Cracks – 6.3%. Thorns: No Thorns – 89.1%, Presences Of Thorns – 10.9%

Table 7: Continued

Senatorial Zon.	**LGA**	**Accession N.**	**Thorns intensity**	**Wrinkles**	**Roots present**	**Roots position**	**Corm size**	**Corm type**	**Tuber cl.up**	**Tuber cl.mid**	**T.colour lower R**
Ebonyi North	Ohaukwu	Jioke	0	0	2,3	1	0,1	3	4	5	5
		Nwopoke	0	0	2	1	0	0	8	8	8
		Obela	0	0	2	1	0	0	5	8	8
		Okpebe	0	0	2	1	0	0	4	4	4
		Ozibo	0	0	2	1	0	0	8	8	5
		Utsuekpe	0	0,1	2	1	0	0	2	5	5
		Obela	0	0	2,3	1	3,0	1,3,0	4	5	5
		Okpebe	0	0	3,2	1	3,0	1,0	4	5	5
		Ozibo	0	0	2	1	1,0	1,0	8	8	5
		Usuekpe	0	0	2	1	0	0	8	8	8
	Abakaliki	Amage	0	0	3,2	1	3,1,0	2,1,0	2	2	2
		Igum	7,0	0	2	1	0	0	6	6	6
		jimanu	3,0	0	2	1	0	0	6	6	2
		Nwopoke	0	0	2	1	0	0	6	6	6
		Okpebe	0	0	2	1	0	0	4	4	4
		Ozibo	0	0	2	1	0	0	5	5	5
	Izzi	Akamunze	7,0	0	3,2	1	0	0	6	6	6
		Amage	0	0	2	1	0,2	0,2	6	6	6
		Ayalegu	0	0,1	2,3	1	0	0	6	6	6
		Igum	0	0	2	1	0	0	6	6	6
		Igum oji	0	0,1	3,2	1	0,2	0,2	8	8	4
		Jioji	7,0	1,0	2	1	0,3	0,3	8	8	8
		Ogbaruogbiya	0	0	2	1	0	0	6	6	2
		Okpebe	0	0	2,3	1	0	0	4	8	8
		Amage	0	0	2	1	1,2,0	1,3,0	6	6	2
		Igum	0	0	2	1	3,2,0	2,1,0	6	6	6
		Okpebe	0	0,1	2	1	0	0	4	4	4
		Ozibo	0	0	2	1	1,0	1,0	8	8	8
		Ozibo wire	0	0,1	2	1	1,2,0	1,3,0	8	8	8
		Obela	0	0	2	1	0,3	0,3	6	6	6
Ebonyi Central	Ezza North	Akamunze	3,0	0	3,2	1	0	0	6	6	6
		Igum	0	0	2	1	0	0	6	6	6
		Nnebiji	0	0,1	2	1	2,3,0	1,3,0	6	6	6
		Nyeji	0	0	2	1	1,2,0	1,3,0	6	6	2
		Iboki	0	0	2	1	3,1,0	2,1,0	6	6	6
		Obia	0	0	2	1	0	0	6	6	6
		Ojioeso	0	0	3,2	1	0	0	6	6	6
		Okpmbe	3,0	0,1	2	1	0	0	8	8	8
		Usuekpe	0	0,1	2	1	0	0	6	6	6
		Ozibo	0	0	2	1	0	0	6	6	6
		Usuekpe	3,0	0	2	1	2,3,0	0	6	6	6
Ebonyi central	Ezza South	Abi/amage	0	0	2	1	0	0	6	6	6
		Ibada	0	0	2	1	0	0	6	6	6

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		Igum	0	0,1	3,2	1	0	0	6	6	6
		Jimmanu	0	0	3,2	1	0	0	6	6	6
		Nnebiji	0	0	2	1	0	0	6	6	6
		Jimaka	0	0,1	2	1	0	0	6	6	6
		Nyeji	0	0	3,2	1	2,3,1	1,3,1	6	6	6
	Ezza South	Abi	0	0	2	1	0	1	6	6	6
		Igum	0	0	2,3	1	2	1	6	2	2
		Nyeji	0	0	2,0	1,0	2	1	6	6	6
		Okeji	0	0	2	1	2	3	6	6	6
		Obia	0	0	2,3	1	2	3	6	6	6
		Nnebiji	0	0	2,0	1,0	2	1	6	6	6
Ebonyi Central	Ikwo	Nnebiji	0	0	2,0	1,0	2	1	6	6	6
		Obioturugo	0	0	2	1	2	3	6	2	2
		Ojioso	0	0	2,0	1,0	1	1	6	2	2
		Ewada	0	0	2	1	1	1	6	2	2
Ebonyi Central	**Ikwo**	Ibada	0	0	2	1	1	1	6	6	6
		Amage	0	0	2	1	3	2	6	6	6
		Ewada	0	0	2	1	0	0	6	6	6
		Agbabro	0	0	2,3	1	0	0	6	6	2
		Ibada	0	0	2	1	2	0	6	6	2
		Igum	0	0	2,0	1,0	2,0	1,0	6	6	6
		Nnebiji	0	0	2	1	0	0	6	6	6
		Obia	0	0	2,3,0	1,0	0	0	6	6	6
		Nwagbam	0	0	2,3,0	1,0	0	0	6	6	6
		Ogbodo	0	0	2	1	0	0	6	2	6
		Ojioso	0	0	2,0	1,0	0	0	6	6	6
Ebonyi South	**Ohaozara**	Abi	0	0	2	1	0	0	6	6	6
		Agba	0	0,1	2	1	0	0	6	6	6
		Ekowiji	0	0,1	2,0	1,0	1	1	6	2	6
		Egbeogba	0	0	2,3	1	1	1	6	2	6
		Nnebiji	0	0	2	1	2	2	6	6	6
		Obiaoturugo	0	0	2	1	1	1	6	6	6
		Usuekpe	0	0	2,0	1,0	2	3	6	6	6
		Abi	0	0	2	1	0	0	6	6	6
		Agba	0	0,1	2,3,0	1,0	2	3	6	6	6
		Obiaoturugo	0	0	2	1	1	1	6	6	6
		Okpebe	0	0	2,3,0	1,0	3	3	6	6	6
	Ivo	Otutu	0	0	0	1	3,0	3,0	6	6	6
		Ishiutu	0	0,1	2,0	1,0	2,0	1,0	6	6	6
		Ayaragu	0	0	2,0	1,0	0	0	6	6	6
		Abi	0	0	2,0	1,0	0	0	6	6	6
		Agba	0	0	2,0,3	1,0	2,0	1,0	6	6	6
		Igum	0	0	2,3,0	1,0	0	0	6	6	6
		Obiaoturugo	0	0,1	2	1	2,1	1	6	6	6
		Agboji	0	0,1	2,3	1	0	0	6	6	2
		Orumeh	0	0	2	1	0	0	6	6	2
	Ivo	Orunte	0	0	2,0	1	2,1,0	1,0	6	6	6
		Paper	0	0	2,3	1	0	0	6	2	6
		Awoke	0	0	2	1	3,2,0	1,0	6	6	2
		Ekwere	0	1	2	1,5	0	0	4	4	4
		Igum	3	0	2	1	0	0	6	6	2
		Jimmaka	0	0	2	1	3,2,0	1,3,0	6	6	2
Ebonyi South	**Ivo**	Obiaoturugo	0	0	2	1,3	2,1,0	1,0	6	6	2
		Ogbaeka	0	0	2	1	0	0	6	6	6
		Orumeh	0	0	2,3	1	0	0	6	6	6
		Orunte	0	0	2	1	3,2,0	1,2	6	6	2
	Afikpo South	Abi	0	0	2	1	0	1	6	6	6
		Agba	0	1	2,3	1	3,2,0	1,2,0	6	6	6
		Akiri	3	0	2	1,5	0	0	2	2	6
		Ewada	0	0	2	1	1,0	1,0	6	6	2
		Igum	0	0	2	1	0	0	6	6	6
		Ipe	7	0	2	1,3	0	0	6	6	6

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		Obia	0	0	2	1	0	0	6	6	6
Ebonyi South	**Afikpo S.**	Obiaoturugo	3	0	2	1	2,1,0	1,0	6	6	6
		Agba	0	0	2	1	0	1	6	2	6
		Akiri	3	0	2	1,5	3,2,0	1	6	2	2
		Igum	0	0	2	1	2,1,0	1,3,0	6	6	6

Source: Field Survey 2017.Thorns Thorns intensity absent – 89.1%, few thorns or no thorns – 7.3%, many thorns or no thorns – 3.6 %. Wrinkles: absent 82.7%, tubers with no wrinkles and wrinkled 15.5%, all wrinkled – 1.8%. Presence of few roots – 75.4%, many and few roots – 16.4% and no roots – 8.2%. Position of roots: tuber head – 80%, 5- tuber head and lower third – 14.3%, middle – 3.9%, entire tuber 1.8%. Corm size: No corm – 56.4%, 1-small corm – 11.8%, 2- intermediate corm – 21.8% and 3-large corm 10%. No corms 0 – 56.4%, 1- regular corm type 33.6%, 3-branched – 6.6%, 2 – transvessally elongated 3.4%. Tuber colours: Tuber cl.up r- tuber colour at upper regions: 2 – creamy white 2.7%, 4 – purplish 7.3%, 5– purplish white 1.8%, 6– creamy colour 80 %, 8–deep purple 8.2%. Tuber cl.up r- tuber colour at middle regions: 2 – creamy white 10.9%, 4 – purplish 3.4%, 5– purplish white 4.6%, 6– creamy colour 70.9 %, 8–deep purple 10%. Tuber cl.up r- tuber colour lower upper regions: 2 – creamy white 20.9%, 4 – purplish 5.5%, 5– purplish white 6.4%, 6– creamy colour 60 %, 8–deep purple 7.3%.

- *Variety Information based on Morphological Traits for Water Yam Accessions Across the Three Senatorial Zones of Ebonyi State*

Farmers across the three senatorial zones noted 83.3 % increase in production of all water yam accessions within the last five years, while very few farmers accounted for decreased (16.7%) production of water yam. Decreased yam production within the last five years in the affected areas was attributed to pest attack, flooding and other factors. The decreased yields recorded were more in Ebonyi North mostly in Abakaliki LGA and Izzi LGA, followed by Ebonyi South. There was generally increased production of water yam accessions within the last five years in Ebonyi Central senatorial zone (Table 8).

All the water yam accessions idenitified by the respondent indicated high tendancy to sprouting with variable sprout and leaf colour ranging from purplish green most dominant to dark green, brownish green, purple and light green. Farmers noted that they were absence of hairs and spines on the stem but twines anticlockwise. Moreso, farmers also noted that water yam accessions mature early mostly the accessions of (Nwawafu, Okwalenwankata, Uranium, and Nvulammanu and Nwopoke offu). The early maturation enhanced wide cultivation. However, greater percentage of water yam accessions (67.3%) had medium, while 17.3% and 15.4% had late maturity and early maturity respectively, with variable leaf colourations on or before senescence. The most dominant leaf colours include purplish green, light green, dark green to green, purple and turned pale green at senescene (Table 8).

Table 8: Variety information based on the Record of Planting Water Yam Species Across the Three Senatorial Zones of Ebonyi State

Senatorial Zon.	**LGA**	**Accession N.**	**Planting last 5 yrs**	**Sprout condit.**	**Sprout colour**	**Hairs**	**Spines**	**Twining habit**	**Maturity rate**	**Leaf colour**
Ebonyi North	**Ohaukwu**	Egborumbula	1	1	2,4	0	0	0	1,2	3,7
		Mbala	2	1	1,2,4	0	0	0	1	4,5,2
		Nneonwuka	2	1	2	0	0	0	3	4,5,2
		Nwawafu	2	1	2	0	0	0	1	4,5,2
		Nneonwuka	2	1	2	0	0	0	1	7,2
	Abakaliki	Nvula	2	1	2	0	0	0	3,2	7,2,1
		Okwalenkata	2	1	2	0	0	0	2,3	3,7
		Nvulammanu	2	1	2	0	0	0	2,3	3,2,7
		Nvulammanu	2	1	2	0	0	0	1	4,2
		Okwalenkata	2	1	1	0	0	0	1	4,7
		Nvula	2	1	2	0	0	0	2	4,7,2
	Izzi	Nvula	2	1	2	0	0	0	2	4,7,2
		Akpuruakputu	1	1	2,5	0	0	0	3	7,2
		Nvuladawhi	1	1	2,5	0	0	0	3	7,2,1
		Nvulambube	2	1	3	0	0	0	2	7,1
		Nwopokeofu	2	0	2	0	0	0	1	7,1
		Okwalenkata	1	1	1	0	0	0	2	4,7,2
	Ndieze Izzi	Nvulamme	2	0	2	0	0	0	2	7,4,1
		Akpuruakputu	2	1	2	0	0	0	2	7
		Nwawafu	2	1	2	0	0	0	1	4,2,
		Opokeoffu	2	0	2	0	0	0	1	7,4,2
Ebonyi central	**Ezza North**	Nvula	2	1	2	0	0	0	2	5,4,2
		nwawafu	2	1	2	0	0	0	1	4,5,2
		Okwalenkata	2	1	1	0	0	0	2,1	4,3
		Nvulammanu	2	1	2	0	0	0	2	5,2

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Ebonyi Central	**Ezza South**	Akoawafu	2	1	2	0	0	0	2	4,2
		Nvula	2	1	2	0	0	0	3	7,2
		Nvulammanu	2	1	2	0	0	0	2,3	7,3,1
		Nvuluranium	2	1	2	0	0	0	2	3,2
		Okwalenkata	2	1	2	0	0	0	2	7,2
		Nvulamme	2	1	2	0	0	0	2	7,2
	Ikwo	Nvula	2	1	2	0	0	0	2	7,2
		Okwalenkata	2	1	2	0	0	0	3,2	3,1
		Nvulammanu	5	1	2	0	0	0	2	7,2
		Nvulamme	2	1	2	0	0	0	2	4,2
		Agbirigba	2	1	7	0	0	0	2	4,2
		Ajingworo	2	1	7	0	0	0	2	7,1
		Mkpumeke	2	1	2	0	0	0	2	7,1
		Onyeoma	2	1	4	0	0	0	2	7,4
		Uranium	2	1	2	0	0	0	1,2	4,7
		Caret yam	2	1	2	0	0	0	2	4,7
		Nwiba	2	1	2	0	0	0	2	4,2
Ebonyi South	**Ohaozara**	Opanankata	2	1	2	0	0	0	2	3,7,2
		Ogboja	2	1	2	0	0	0	3	4,7,2
		NvulAmerica	2	1	2,4	0	0	0	2	3,7,2
		Nvulabi	1	1	7,5	0	0	0	2	4
		Jinvula	1	1	1	0	0	0	2	4,7,2
		Igborogidi	2	1	2,5	0	0	0	2	3
		Mbana/nvula	2	1	2,5	0	0	0	2	4,7,2
Ebonyi South	**Ivo**	Awokenvula	1	1	2	0	0	0	2	7,4,2
		Orumenvula	1	1	7,2	0	0	0	2	5,4,1
		Isihutunvula	2	1	1	0	0	0	2	3,7
		Makwuruoba	2	1	2,1	0	0	0	2	3,4,2
		Mbala	2	1	2	0	0	0	2	5,1
		Otutunvula	2	1	2,1	0	0	0	2	5,1
		Orumenvula	1	1	1	0	0	0	2	2
	Afikpo S.	Igumeluenyim	2	1	2	0	0	0	2	7,4
		Igumbula	2	1	7	0	0	0	2	4,2
		MbalsPaul	2	1	2	0	0	0	2	4,2,7
		Ogboja	2	1	2	0	0	0	3	5,1
		Igborogidi	2	1	2,7	0	0	0	3	7,2,1
		Mbula	1	1	2,4	0	0	0	2	7,4,2
		MbulAmerica	2	1	2,3	0	0	0	2	7,4,2
		mbulobiraohu	2	1	2,3,7	0	0	0	2	7,2
		Nneonwuka	2	1	3,2,5	0	0	0	2	7,2
		Mbulohaukwu	2	1	5,2	0	0	0	2	7,4,2

Farmers also identified variations in the leaf shapes, leaf apex, tuber shapes, tuber texture, tuber tendancy to branch, presences of cracks and thorns of water yam accessions (Table 9). Cumulatively, 43% was cordate long leaf, 20% each for cordate broad and saggitate long with few other colourations. Majority of the respondents (83.5%) interviewed agreed that water yam accessions had caudate leaf apex shapes as most dominant with few emarginated (9.2%), acute (6.2%) and cudispate (1.5%). Variable tuber colours, shapes with dorminant cylindrical smooth tubers with or without cracks and thorns in some accessions with few roots at tuber head and body (Table 9). Hairs and roots in entire tuber body are common among accessions of Carat yam, Nvula Agbirigba and Nvula Ajingworo. Colourations of tubers at different regions varied and had one colour that was dominant in each regions. Accessions of water yam had 53.8% and 52.3% amounting to deep purple and purplish tuber at both upper and middle regions, while lower regions had more of purplish tubers 73.9% than other regions (Table 9). However, there were some accessions of water yam that maintained uniform tuber colours (29.2%) across the regions. There were founded among accessions of Okwalenwankata, Nvulamme, Makwuroba, Igborogidi and others with either dominant purplish or deep purple tubers.

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Table 9: Variety Information based on the Record of Planting Water Yam Species Across the Three Senatorial Zones of Ebonyi State

Senatorial Zon.	LGA	Accession N.	Leaf shape	Leaf apex	Tuber shape	Tuber texture	Tuber Tb	Branch position	Cracks present	Thorns presence
Ebonyi North	**Ohaukwu**	Egborumbula	4,3	6	5,3	2	3	2,3,4	1	0
		Mbala	3	2	3	1	3	3	0	0
		Nneonwuka	3	3	3	2	3	2	1	0
		Nwawafu	3	2	3,2	1	3	2	0	0
		Mbala	2	6	2	2	3	3	0	0
		Nwawafu	3	2	3	1	3	3	0	0
		Nneonwuka	3	2	3	1	3	2	0,1	0,1
	Abakaliki	Nvula	3	6	3	1	3	3	0	0
		Okwalenkata	3	6	3	1	5	2	0	0
		Nvulammanu	3	6	3	1	5	3	0	0
		Nvulamme	4	6	5	1	3	2	0	0
		Okwalenkata	3	6	3	1	5	3	0	0
		Nvula	3	6	2	1	3	3	0	0
	Izzi	Nvula	3	6	1	1	3	2	0	0
		Akpuruakputu	5	6	3	2,1	3	2	0	0
		Nvuladawhi	3	3	2	1,2	3	3	0,1	0
		Nvulambube	3	3	2	1	3	2	0	0
		Nwopokeofu	3	6	3	1	3	2	0	0
		Okwalenkata	3	6	2	1	3	3	0	0
	Ndieze Izzi	Nvulamme	4,3	3,6	3	1	3	2	0	0
		Akpuruakputu	5	6	3	1	5	2,3,4	0	0
		Nwawafu	3	6	4	1	3	3	0	0
		Opokeoffu	4	3	3	1	3	3	0	0
Ebonyi central	**Ezza North**	Nvula	3	6	3	1	3	2	0	0
		Nwawafu	3	6	4	1	3	3	0	0
		Okwalenkata	5	6	2	1	3	3	0	0
		Nvulammanu	4	6	3	2	3,5	2,3,4	0	0
	Ezza South	Akoawafu	3	6	2	1	3	3	0	0
		Nvula	4	6	4	1	3	3	0	0
		Nvulammanu	5	6	3	1	5	2	0	0
		Okwalenkata	5	6	2	1	3	2	0	0
		Nvulamme	7	3	3	1	5	2	0	0
	Ikwo	Nvula	7	6	7	1	5	3	0	0
		Okwalenkata	5	6	2	1	3	2	1,0	0
		Nvulammanu	4	6	3	1	5	1	1,0	0
		Nvulamme	4	6	3	1	5	3,2,4	0	0
		Agbirigba	5	6	5	2	5	3,2,4	0	0
		Ajingworo	2	6	5	2	5	3,2,4	0	0
		Mkpumeke	2	6	4	1	3	2,3,4	0	0
		Onyeoma	5	6	3	1	3	1	0	0
		Uranium	3	6	2	2	3	1	0	0
		Caret yam	2	6	2	2	3	2,3,4	0	0
		Nwiba	1	6	2	1	3	2	0,1	0
Ebonyi South	**Ohaozara**	Mbana/nvula	7	6	2	2,1	3	3	0	0
		Opanankata	4	6	1	1,2	3	3	0	0
		NvulAmerica	4,3	6	2	1	3	3	0	0
		Nvulabi	5	6	3	1	3	3	0	0
		Jinvula	5	6	3	2,1	5	3	0	0
		Igborogidi	3	6	3	2	3	2	1	0
	Ivo	Awokenvula	5	6	3	2	5	2	0	0
		Isihutunvula	3	6	3	2	5	2	0	0
		Makwuruoba	5	6	2	1,2	3	2	0	0
		Mbula	3,5	6	4	1	3	3	0	0
		Otutunvula	3	6	2	1	3	3	0	0
		Orumenvula	7	7	3	1	5	3	0	0

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	Afikpo S.	Igumeluenyim	4	6	3	2,1	3	2	0	0
		Igumbula	3	6	2	3	5	3	0	0
		MbalsPaul	2	6	2	1,2	3	2	0	0
		Ogboja	4	6	3	1	5	2	1	0
		Igborogidi	4	6	3	1	5	2	1	0
		Mbula	3	6	3	1	3	3	0	0
		MbulAmerica	1,3	6	2	1	3	2	0	0
		Makwuroba	5	6	2	1	3	3	0	0
		Nneonwuka	3	6	4	1	3	2	1	1
		Mbulohaukwu	3	6	4	1	3	1	0	0

Source: Field survey 2017. Leaf shapes – cordate long- 43%, cordate broad- 20%, saggitate long 20, acute 7.7%, and hastate 6.2% and obtuse – 3.1%. Leaf apex – caudate 83.1%, emarginated 9.2%, acute 6.2% and cudispate 1.5%. Tuber shapes Cylindrical 74.5%, spherical/oval tuber – 15.5%, irregular - 7.5%, oval oblong 2.5%. Tuber surface texture: smooth – 75.4 %, rough – 23.1%, smooth and rough – 3.6%. Tuber Ttb- tuber tendancy to branch: slightly branched 80.8%, branched – 12%, highly branched 7.2 %. Cracks: absent – 95.7%, presence of cracks – 4.3%. Thorns: no thorns – 98.1%, presences of thorns – 1.9%.

Table 9: Continued

Senatorial Zon.	**LGA**	**Accession N.**	**Thorns intensity**	**Wrinkles**	**Roots present**	**Roots position**	**Corm size**	**Corm type**	**Tuber cl.up. r**	**Tuber cl.mid r.**	**T.colour lower R**
Ebonyi North	**Ohaukwu**	Egborumbula	0	0	2	1	1	1	4	4	4
		Mbala	0	0	2	1	0	0	4	4	4
		Nneonwuka	0	0	2	1	2	1	8	4	4
		Nwawafu	0	0	2	1	2	1	4	5	5
		Nwawafu	0	0	2	1	1	1	4	4	4
		Nneonwuka	3	0	2	1	3	2	8	8	8
	Abakaliki	Nvula	0	0	2	1	0	0	8	8	4
		Okwalenkata	0	0	2	1	0	0	8	8	4
		Nvulammanu	0	0	2	1	2	1	4	5	4
		Nvulammanu	0	0	2	1	0	0	4	8	4
		Okwalenkata	0	0	2	1	2	1	8	8	4
		Nvula	0	0	2	1	0	0	4	8	4
	Izzi	Nvula	0	0	2	1	0	0	8	8	4
		Akpuruakputu	0	0	2	1	3	3	4	8	4
		Nvuladawhi	0	0	2	1	2	1	8	8	4
		Nvulambube	0	0	2	1	0	0	8	8	4
		Nwopokeofu	0	0	2	1	2	1	8	8	4
		Okwalenkata	0	0	2	1	2	1	8	8	4
	Ndieze Izzi	Nvulamme	0	0	2	1	2	1	4	8	4
		Akpuruakputu	0	0	2	1	2	1	4	4	4
		Nwawafu	0	0	2	1	0	0	4	4	4
		Opokeoffu	0	0	2	1	0	0	5	4	4
Ebonyi central	**Ezza North**	Nvula	0	0	2	1	2	1	5	4	4
		Nwawafu	0	0	2	1	3	2	4	4	4
		Okwalenkata	0	0	2	1	0	0	4	4	4
		Nvulammanu	0	0	2	1	2	1	8	4	4
Ebonyi Central	**Ezza South**	Akoawafu	0	0	2	1	0	0	8	4	4
		Nvula	0	0	2	1	2	1	4	4	4
		Nvulammanu	0	0	2	1	2	1	4	4	4
		Nvuluranium	0	0	2	1	2,3	2	4	4	4

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		Okwalenkata	0	0	2	1	2	1	4	4	4
		Nvulamme	0	0	2	1	2	1	4	4	4
	Ikwo	Nvula	0	0	2	1	2	3	4	4	4
		Okwalenkata	0	0	2	1	2	3	4	4	4
		Nvulamman u	0	0	2	1	2	2	4	4	4
		Nvulamme	0	0	2	1	0	0	4	4	4
		Agbirigba	0	0	2	2	3	1	6	2	5
		Ajingworo	0	0	2	2	3	1	6	8	4
		Mkpueke	0	0	2	1	1	1	8	4	4
		Onyeoma	0	0	2	1	1	1	8	4	4
		Uranium	0	0	2	1	1	1	8	4	4
		Caret yam	0	0	2	2	3	3	8	4	4
		Nwiba	0	0	2	1	1	1	8	4	4
Ebonyi South	Ohaozara	Mbana/nvula	0	0	2	1	3	2	8	8	4
		Opanankata	0	0	2	1	2	1	8	8	8
		NvulAmeric a	0	0	2	1	2	1	4	4	4
		Nvulabi	0	0	2	1	2	1	8	4	4
		Jinvula	0	0	2	1	2	1	8	5	5
		Igborogidi	0	0	3	2	3	3	8	8	8
	Ivo	Awokenvula	0	0	2	1	2	1	8	4	4
		Isihutunvula	0	2	2	1	2	1	8	8	8
		Makwuruoba	0	2	2	1	2	1	8	8	8
		Mbala	0	0	2	1	1	1	4	4	4
		Otutunvula	0	0	2	1	1	1	8	5	5
	Afikpo South	Igumeluenyi m	0	0	2	1	1	1	8	5	5
		Igumbula	0	0	2	1	3	2	8	4	4
		MbalaPaul	0	0	2	1	2	1	4	4	4
		Ogboja	0	0	3	2	3	3	8	5	5
		Igborogidi	0	2	2	2	3	1	8	5	5
		Mbula	0	0	2	1	1	1	8	5	5
		MbulAmeric a	0	0	2	1	1	1	4	5	5
		mbulobiraoh u	0	0	2	1	2	1	8	4	4
		Nneonwuka	0	2	2	1	2	1	8	5	5
		Mbulohaukw u	0	0	2	1	1	1	8	5	5

Field survey 2017.Tuber colours: few roots – 96.9%, many roots – 3.1%. Position of roots on the tuber: At tuber head 89.2% and roots on entire body 10.7%. Tuber cl.up r- tuber colour at upper regions: 8 – deep purple 53.8%, 4 – purplish 40%, 5– purplish white 3.1%, 6– creamy colour 3.1 %. Tuber cl.up r- tuber colour at middle regions: 4 – purplish 52.3%, 8– deep purplish 27.7%, 5–deep purple 16.9%. Tuber cl.up r- tuber colour lower upper regions: 4 – purplish 73.9%, 5– purplish white 16.9%, 8–deep purple 9.2%.

➢ *Variety Information Based on Morphological Traits for Other Yam Accessions*

Yellow yam, Three-leaf yam and aerial yam accessions were cultivated by very few households and about 72.2 % witnessed increased production within the last five years. Among other yam accessions, yellow yam accessions had the highest increased production followed by three-leaf yam and the least was obtained in aerial yam accession. About 27.8 % of other yam accession farmers recorded decreased production within the last five years. Accessions of yellow yam and three-leaf yams were poorly affected and cuts across the zones, while aerial yam witnessed high decrease in production for the last five years, i.e. cultivation of the yam species by few households. Similarly, aerial yam is also known to mature early than other species of both yellow yam and three leaf yam accessions, whereas three leaf yam and yellow yam accessions are generally identified by farmers to attain late maturity (Table 10). This perhaps may be the reasons why very few farmers cultivate them. Accessions of the three species had 100% tendency to sprouting with brownish green colouration as the most dominant colours for yellow yam accessions, purple and purplish for three leaf yam and green colourations for aerial yam accessions and both twined clockwise.

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Table 10: Variety Information Based on the Record of Planting Other Yam Species Across the Three Senatorial Zones of Ebonyi State

Senatorial Zon.	LGA/ community	Accession N.	Planting last 5 yrs	Tendency to sprout	Sprout colour	Hairs	Spines	Twining habit	Maturity rate	Leaf colour
Ebonyi North	**Ohaukwu**	Ogomodu	2	1	2	0	1	1	3	1
	Umuezaka	Nkpenyi	2	1	4	0	1	1	3	2
		Ogomodu	2	1	4	0	1	1	3	1
	Abakaliki	Oko	2	1	3	0	2	1	3	2
	Ndiegu-okpu.	Oko	2	1	3	0	2	1	3	4
	Izzi- Igbegu	Oko	1	1	2	0	2	1	3	4
	Ndieze	Oko	1	1	3	0	2	1	3	1
Ebonyi Central	**Ezza North**	Ogomodu	2	1	3	0	1	1	3	1
	Umuoghara	Oko	2	1	4	0	2	1	3	1
	Okoposi-um.	Ogomodu	2	1	4	0	2	1	3	1
	Ezza South-Id	Oko	2	1	3	0	1	1	3	1
	Amagu	Oko	2	1	2	0	2	1	3	1
	Ikwo	Oko	2	1	2	0	2	1	3	1
	Ekpelu	Oko	2	1	3	0	2	1	3	1
Ebonyi South	**Ohaozara-Ub**	Enegbe	2	1	3	0	2	1	3	2
	Eweze-Ihenu	Enegbe	2	1	3	0	2	1	3	1
	Ivo –Ishiagu	Nka	2	1	3	0	2	1	3	1
	Okue	Nka	2	1	3	0	2	1	3	1
	Afikpo South	Nkwanyi	1	1	3	0	1	1	2	1
	Owotu	Oko	2	1	2	0	1	1	3	1
	Oso Edda	Nkwanyi	1	1	3	0	2	1	2	4
		Oko	2	1	3	0	1	1	3	1
Three leaf yam or bitter yam (*Dioscorea dumetorum*)										
Ebonyi North	Ohaukwu Um.	Una	2	1	5	1	2	1	3	2
Ebonyi Central	Ezza south Id.	Una	2	1	2	1	2	1	3	1
Ebonyi South	Owutu Edda	Una	2	1	5	1	2	1	3	4
	Oso Edda	Una	2	1	2	1	2	1	3	4
Ariel yam accessions or air potato (*Dioscorea bulbifera*)										
Ebonyi central	Ezza South	Edu	1	1	1	0	0	1	1	1
	Ikwo	Edu	1	1	1	0	0	1	1	2
Ebonyi South	Afikpo South	Edu	1	1	1	0	0	1	1	7

Field survey 2017. Production within the last five: yellow yam: 2- increased –81.8%, 1-decrease – 18.2%. Three leaf yam: 2 – increased 100%. Aerial yam 100% decreased. Hairs: yellow yam absent – 100%. Three leaf yam 100% present. Aerial yam 100% absent. Spines: 1-few 31.8%, many – 68.2% for yellow yam, 100% present for three leaf yam and 100% absent for aerial yam. Sprout colour: sprout colour for yellow yam: 3 - brownish green 59.1%, 2- purplish green-22.7%, 4-dark brown colours – 18.2%. Three leaf yam: 5- purple – 50%, 2 –purplish 50%. Aerial yam: 1 green-100%. Leaf colour for yellow yam: 1- yellowish 72.8%, 2-purplish green 13.6% and 4-Dark green 13.6%. Three leaf yam: Leaf colouration – 4 – purplish green 50%, 1- yellowish 25% and 2 – pale green 25%. Aerial yam 1 – yellowish 33.3%, 2 – pale green 33.3% and 7-light green 33.3%.

- *Variety Information based on the Morphological Traits for Other Yam Accessions Across the Three Senatorial Zones of Ebony State.*

Farmers also noted that yellow yam accessions leaf orientation include 72.8% yellowish and 13.6% each for purplish green and dark green colours with leaf shapes and apex shapes dominated by cordate long and hastate leaf shapes respectively. Accessions of three leaf yam were majorly purplish green and turned yellowish and pale green at senescence. They were also identified with hastate and saggitate long leaves and cudspidate leaf apex shapes unlike aerial yam accessions characterized by light green leaf that turns either pale green or yellowish with cordate broad leaves and obtuse leaf apex shapes. Tubers are distinguished from each other with accessions of yellow yam having dominantly cylindrical, irregular and oval oblong tubers with smooth tuber surface texture. Accessions of yellow yam tubers were highly branched to slightly and transverally enlongated tubers that had roots positioned at tuber head. There were presence of few to many cracks and thorns with large, medium and small corms which were either branched or regular and transervally enlongated. Colouration of tubers varied at different regions but dominant orange colours at upper regions, brownish white at middle and lower regions were identified with either uniform orange, deep purple, purplish or brownish white on both tuber regions. On the other hand, accessions of three leaf yams were identified with spherical/roundish and oval shaped tubers with regular or branched non-detacheable corms. Tuber colours range from purplish to deep purple and creamy white and varied in all the tuber regions, while roots were either few or many at tuber head regions. Unlike accessions of three leaf yam, aerial yam accessions had irregular tubers with hairs or roots on the entire tuber body, branched slightly at middle with variable tuber colours at different regions (Table 11).

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Table 11: Variety Information on the other Yam Species Across the Three Senatorial Zones of Ebonyi State

Senatorial Zon.	LGA/ community	Accession N.	Leaf shape	Leaf apex	Tuber shape	Tuber texture	Tuber Tb	Branch position	Cracks present	Thorns presence
Ebonyi North	**Ohaukwu**	Ogomodu	2	2	5,4	1	5	1	3	1
	Umuezaka	Nkpenyi	4	5	3,5	1	3	4	2	1
		Ogomodu	3	7	3,5	1	7	4	0	0
	Abakaliki	Oko	2	2	3,5	1	7	4	0	0
	Ndiegu-okpu.	Oko	3	7	3,5	1	5	4	0	0
	Izzi- Igbegu	Oko	2	4	3,5	1	7	3	0	0
	Ndieze	Oko	2	4	3,5	1	5	1	0	0
Ebonyi Central	**Ezza North**	Ogomodu	3	7	3,5	1	5	4	0	0
	Umuoghara	Oko	4	7	3,5	1	7	1	0	0
	Okoposi-um.	Ogomodu	3	7	3,5	1	7	4	3	1
	Ezza South-Id	Oko	4	6	3,5	1	3	4	0	0
	Amagu	Oko	3	7	3,5	1	7	4	0	0
	Ikwo	Oko	3	7	3,5	1	7	4	2	1
	Ekpelu	Oko	3	7	3,5	1	5	3	0	0
Ebonyi South	**Ohaozara-Ub**	Enegbe	4	6	3,4	1	7	4	0	0
	Eweze-Ihenu	Enegbe	3	7	3,4	1	7	4	0	1
	Ivo –Ishiagu	Nka	3	5	3,5	1	7	4	0	0
	Okue	Nka	3	7	5,4	1	5	1	3	1
	Afikpo South	Nkwanyi	4	7	5,4	1	7	3	2	1
	Owotu	Oko	3	5	3,5	1	7	4	0	0
	Oso Edda	Nkwanyi	4	7	3,4	1	3	4	3	1
		Oko	3	6	3,5	1	3	1	2	0
Three leaf yam or bitter yam (*Dioscorea dumetorum*)										
Ebonyi North	Ohaukwu Um.	Una	7	7	1	1	5	1	0	0
Ebonyi Central	Ezza south Id.	Una	7	7	2	1	5	1	0	0
Ebonyi South	Owutu Edda	Una	7	7	1	1	5	1	0	0
	Oso Edda	Una	5	5	1	1	5	1	0	0
Ariel yam accessions or air potato (*Dioscorea bulbifera*)										
Ebonyi central	Ezza South	Edu	4	1	5	1	3	3	0	0
	Ikwo	Edu	4	1	5	1	3	3	0	0
Ebonyi South	Afikpo South	Edu	4,3	1	5	1	3	3	0	0
Ebonyi North	**Ohaukwu**	Ogomodu	3	1	2	1	3	2	9	9	9
	Umuezaka	Nkpenyi	7	1	3	1	1	1	9	9	9
		Ogomodu	0	0	2	1	0	0	9	9	9
	Abakaliki	Oko	0	0	2	1	2	3	9	9	9
	Ndiegu-okpu.	Oko	0	0	2	1	0	0	8	8	8
	Izzi- Igbegu	Oko	0	0	2	1	0	0	8	8	8
	Ndieze	Oko	0	0	2	1	0	0	7	7	7
Ebonyi Central	**Ezza North**	Ogomodu	0	0	2	1	3	3	7	7	7
	Umuoghara	Oko	0	0	2	1	3	2	9	9	9
	Okoposi-um.	Ogomodu	7	2	2	1	0	0	9	9	9
	Ezza South-Id	Oko	0	0	2	1	0	0	9	9	7
	Amagu	Oko	0	0	2	1	2	1	9	9	9
	Ikwo	Oko	7	1	2	1	0	0	9	9	9
	Ekpelu	Oko	0	0	2	1	0	0	9	9	9
Ebonyi South	**Ohaozara-Ub**	Enegbe	0	0	2	1	3	2	8	8	4
	Eweze-Ihenu	Enegbe	7	1	3	1	3	3	8	8	8
	Ivo –Ishiagu	Nka	0	0	2	1	3	3	9	9	9
	Okue	Nka	3	1	2	1	2	1	9	9	7
	Afikpo South	Nkwanyi	7	2	3	1	0	0	9	9	9

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	Owotu	Oko	0	0	2	1	3	2	9	9	9
	Oso Edda	Nkwanyi	7	2	3	1	2	1	9	9	7
		Oko	0	0	2	1	0	0	7	7	7
Three leaf yam or bitter yam (*Dioscorea dumetorum*)											
Ebonyi North	Ohaukwu Um.	Una	0	1	2	1	2	3	8	8	4
Ebonyi Central	Ezza south Id.	Una	0	1	2	1	2	3	4	4	4
Ebonyi South	Owutu Edda	Una	0	0	2	1	1	3	4	4	4
	Oso Edda	Una	0	0	2	1	1	3	6	2	2
Ariel yam accessions or air potato (*Dioscorea bulbifera*)											
Ebonyi central	Ezza South	Edu	0	0	3	2	0	0	2	2	7
	Ikwo	Edu	0	0	3	2	0	0	6	2	2
Ebonyi South	Afikpo South	Edu	0	0	3	2	0	0	8	4	4

Field survey 2017. Ndiegu-okputuimo. Okposi um- Umoghara. Ezza South Id- Umunwagu Idembia, Ohaozara- Ub- Uburu. Tuber cl.up r- tuber colour at upper regions: Tuber cl.up r- tuber colour at middle regions, Tuber cl.up r- tuber colour lower upper regions.

- *Knowledge of Farmers on the Accessions Yield Performance of White Yam Accessions Using A 5 Likert Scale Points.*

Farmers knowledge on the yield of white yam accessions showed that mean range 3.0 - 5.9 of the variation in the yield of white yam was determined by the explanatory variables of rated farmers' perception using 5 Likert point scale. The mean value of (5.9) which is the highest among all yam accessions indicated good yield performance as it is above Likert rating value (Table 12). Good to excellent rating of white yam accessions yield are the obvious reasons they are grown across the three senatorial zones of the State.

Table 12: Mean Distribution of the Knowledge of Farmers Based on the Accessions Yield Performance of White Yam Accessions using a 5 Likert Scale Points

Senatorial zone	**LGA**	**Accession name**	**Yield**	**Mean score**	**Decision rule**
Variables		Dialect	Farmers' Pd		
Ebonyi North	Ohaukwu	Jioke	Excellent	4.5	Accepted
		Nwopoke	Very good	3.8	Accepted
		Obela	Excellent	3.8	Rejected
		Okpebe	Excellent	3.5	Rejected
		Ozibo	Very good	3.4	Rejected
		Utsuekpe	Very good	5.3	Accepted
		Obela	Very good	3.5	Accepted
		Okpebe	Good	3.4	Accepted
		Ozibo	Very good	3.4	Rejected
		Usuekpe	Very good	5.0	Accepted
	Abakaliki	Amage	Very good	3.3	Rejected
		Igum	Very good	3.9	Accepted
		jimmanu	Excellent	4.5	Accepted
		Nwopoke	Excellent	2.5	Rejected
		Ogbaruogbiya	Very good	2.0	Rejected
		Okpebe	Excellent	4.5	Accepted
		Ozibo	Very good	3.5	Accepted
	Izzi	Akamunze	Very good	3.6	Accepted
		Amage	Excellent	3.4	Rejected
		Ayalegu	Excellent	5.0	Accepted
		Igum	Excellent	5.7	Accepted
		Igum oji	Excellent	3.9	Rejected
		Jioji	Excellent	4.0	Rejected
		Ogbaruogbiya	Excellent	5.0	Accepted
		Okpebe	Excellent	2.5	Rejected
		Ozibo	Very good	3.6	Accepted
		Ozibo wire	Excellent	4.0	Rejected
		Obela	Excellent	5.1	Accepted
Ebonyi Central	Ezza North	Akamunze	Excellent	4.5	Accepted
		Igum	Excellent	4.6	Accepted
		Nnebiji	Excellent	4.5	Accepted

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		Nyeji	Excellent	5.0	Accepted
		Iboki	Very good	3.4	Rejected
		Obia	Excellent	4.8	Accepted
		Ojioeso	Very good	2.9	Rejected
		Okpembe	Very good	3.3	Rejected
		Usuekpe	Good	3.5	Accepted
		Ozibo	Excellent	3.6	Rejected
		Usuekpe	Excellent	5.2	Accepted
	Ezza South	Abi/amage	Very good	3.4	Rejected
		Ibada	Excellent	5.1	Accepted
		Igum	Excellent	5.9	Accepted
		Jimmanu	Excellent	4.5	Accepted
		Nnebiji	Excellent	4.6	Accepted
		Jimaka	Very good	4.5	Accepted
		Nyeji	Excellent	5.0	Accepted
		Abi	Excellent	5.5	Accepted
		Igum	Excellent	5.7	Accepted
		Nyeji	Excellent.	4.8	Accepted
		Okeji	Very good	3.6	Accepted
		Obia	Good	3.0	Accepted
		Nnebiji	Excellent	4.0	Rejected
Variables		Dialect	Farmers' Pd		
Ebonyi Central	Ikwo	Nnebiji	Excellent	4.5	Accepted
		Obiaoturgu	Very good	3.8	Accepted
		Ojioso	Very good	4.0	Accepted
		Ewada	Good	3.0	Accepted
		Ibada	Good	4.0	Accepted
		Amage	Very good	3.3	Rejected
		Ewada	Good	3.5	Accepted
		Agbabro	Excellent	4.0	Rejected
		Ibada	Excellent	4.5	Accepted
		Igum	Excellent	4.5	Accepted
		Nnebiji	Excellent	3.5	Rejected
		Obia	Excellent	5.0	Accepted
		Nwagbam	Excellent	5.0	Accepted
		Ogbodo	Very good	3.0	Rejected
		Ojioeso	Very good	3.9	Accepted
Ebonyi South	Ohaozara	Abi	Very good	3.5	Accepted
		Agba	Excellent	5.0	Accepted
		Ekowiji	Very good	2.0	Rejected
		Egbeogba	Very good	3.9	Accepted
		Nnebiji	Very good	4.0	Accepted
		Obiaoturugo	Excellent	4.5	Accepted
		Usuekpe	Excellent	2.9	Rejected
		Abi	Excellent	3.5	Rejected
		Agba	Excellent	4.9	Accepted
		Obiaoturugo	Excellent	5.5	Accepted
		Okpebe	Very good	2.9	Rejected
	Ivo	Otutu	Excellent	3.5	Rejected
		Ishitutu	Very good	4.0	Accepted
		Ayaragu	Good	2.8	Rejected
		Abi	Very good	3.5	Accepted
		Agba	Excellent	4.4	Rejected
		Obiaoturugo	Excellent	4.0	Rejected
		Agboji	Very good	2.6	Rejected
		Orumeh	Excellent	5.5	Accepted
		Orunte	Excellent	4.9	Accepted
		Paper	Excellent	5.0	Accepted
		Awoke	Very good	2.5	Rejected

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		Ekwere	Very good	3.0	Rejected
		Ayaragu	Very good	4.0	Accepted
		Igum	Very good	3.9	Accepted
		Ishiutu	Very good	3.0	Accepted
		Jimmaka	Very good	4.0	Accepted
		Obiaoturugo	Very good	5.0	Accepted
		Ogbaeka	Very good	3.0	Rejected
		Orumeh	Very good	4.0	Accepted
		Orunte	Very good	4.5	Accepted
	Afikpo S.	Abi	Very good	3.5	Accepted
		Agba	Excellent	5.0	Accepted
		Akiri	Very good	4.9	Accepted
		Ewada	Excellent	4.0	Rejected
		Igum	Very good	3.9	Accepted
		Ipe	Very good	3.4	Rejected
		Obiaoturugo	Very good	3.1	Rejected
		Agba	Excellent	3.5	Rejected
		Akiri	Excellent	4.8	Accepted
		Igum	Excellent	4.5	Accepted

Source: Field survey 2017. pd- perceptions decision,acpt-accepted,rejected, Dec.R.- decision rule 5 points Likert scale = $\frac{5+4+3+2+1}{5}$ = 3 for yield – 1-very poor, 2-poor, 3-good, 4- very good, 5-excellent.

➢ *Knowledge of Farmers on the Accessions Yield Performance of Water Yam Accessions Using a 5 Likert Scale Points.*

Accessions of water yam either yield very good or excellent, having the second highest mean 5.9 among the yam species. Accessions of water yam Okwalenkata and few others yield above 5.0 mean value (Table 13). This authenticated the fact that they yield high and can survive in any kind of soil without compromising their yield. Water yam accession Okwalenwankta collected from Abakaliki Local Governemnt Area yield higher than any other accessions across the three senatorial zone of Ebonyi State. This was closely followed by Okwalenwankata collected from Izzi LGA and Okwalenwankata collected from Ezza South with mean value of 5.8 and 5.6 respectively. They are known for multiple tuber yields. Hence, the farmers had acceptable view of yield water yam accessions.

Table 13: Mean Distribution of the Knowledge of Farmers based on the Accessions Yield Performance of Water Yam Accessions using a 5 Likert Scale Point

Senatorial Zone	**LGA**	**Accession Names (Dialect)**	**Yield Farmers' Pd**	**Mean Score**	**Decision Rule**
Ebonyi North	Ohaukwu	Egborumbala	Very good	4.5	Accepted
		Mbala	Very good	4.8	Accepted
		Nneonwuka	Excellent	3.8	Rejected
		Nwawafu	Excellent	5.5	Accepted
	Abakaliki	Nvula	Very good	3.3	Rejected
		Okwalenkata	Excellent	5.9	Accepted
		Nvula manu	Excellent	4.5	Accepted
	Izzi	Nvula	Very good	3.6	Accepted
		Akpuruakputu	Very good	3.4	Rejected
		Nvulaodawehi	Very good	4.0	Accepted
		Nvula mbube	Good	5.0	Accepted
		Nwopokeoffu	Very good	3.9	Rejected
		Okwalenkata	Excellent	5.8	Rejected
Ebonyi Central	Ezza North	Nvula	Very good	4.5	Accepted
		Nwawafu	Excellent	4.6	Accepted
		Nvulamanu	Excellent	5.5	Accepted
	Ezza South	Akoawafu	Excellent	3.4	Rejected
		Nvulammanu	Excellent	5.1	Accepted
		Nvula	Very good	5.4	Accepted
		Okwalenkata	Excellent	5.6	Accepted
	Ikwo	Nvula	Very good	4.0	Rejected
		Okwalenwa.	Excellent	4.1	Rejected
		Nvulammanu	Excellent	3.9	Rejected

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		Nvulamme	Excellent	3.5	Rejected
		Nvulagbirigba	Excellent	4.5	Accepted
		Ajingworo	Excellent	3.5	Rejected
		Mkpumeke	Excellent	5.0	Accepted
		Onyeoma	Excellent	5.0	Accepted
		Uranum	Very good	3.0	Rejected
		Caret yam	Excellent	3.9	Rejected
Ebonyi South	Ohaozara	Nwiba	Very good	3.5	Accepted
		Ogboja	Very good	5.0	Accepted
		NvulaAmerica	Very good	2.0	Rejected
		Nvulaabi	Very good	3.9	Accepted
		Jinvula	Very good	4.0	Accepted
		Igborogidi	Excellent	4.5	Accepted
	Ivo	Awokenvula	Excellent	3.5	Accepted
		Ishiutu nvula	Excellent	4.4	Rejected
		Makwuroba	Excellent	2.6	Rejected
		Mbala	Very good	2.5	Rejected
		Otutu	Very good	3.0	Rejected
		Igumelunyim	Very good	3.5	Accepted
		Igummbula	Good	5.0	Accepted
		Mbula Paul	Excellent	4.9	Accepted
		Ogboja	Very good	4.0	Rejected
		Mbula	Very good	3.4	Rejected
		Gborogidi	Very good	3.9	Accepted
		MbulaAmerica	Very good	3.1	Rejected
		Mbulaobirohu	Very good	4.2	Accepted
		Nneonwuka	Very good	3.8	Accepted
		mbla ohaukwu	Excellent	5.0	Accepted

Source: Field survey 2017. pd- perceptions decision,acpt-accepted,rejected, De.R-decision rule
5 points Likert scale = $\frac{5+4+3+2+1}{5}$ = 3 for yield – 1-very poor, 2-poor, 3-good, 4- very good, 5-excellent.

➢ *Knowledge of Farmers on the Accessions Yield Performance of other Yam Accessions Using a 5 Likert Scale Points.*

Accessions of yellow yam Oko or Nka or Engebe as they are locally called by Ezza, Ikwo, Edda, Ivo and Ohaozara people, produced well to excellent yield among all the yam species with the highest mean value of 5.5. The second group of yellow yam accessions was either selective to soil as known to grow well in Ohaukwu LGA and compromise yield in the slightest change in environment. Hence, the respondents reported that the yield were very poor and were not widely cultivated across the State (Table 14). The yield of three leaf yam accessions had acceptable decision and rated excellent because they tend to yield many non-detachable medicinal tubers, unlike the aerial yam accesssions that was rated poor due to yield performance of tubers but yielding aerial wild bulbs believed to have some medicinal values by the farmers and were consistently grown for that. However, all the yam accessions identified, collected and assessed in the study area had inherent potential of high yield as the decision rule ranged from good to excellent yield.

Table 14: Mean Distribution of the Knowledge of Farmers Based on the Accessions Yield Performance of Other Yam Accessions using a 5 Likert Scale Points

Senatorial zone	LGA	Accession names	Yield	Mean score	Decision rule
Ebonyi North	Ohaukwu Amoffia community	Ogomodu	Very good	4.5	Accepted
	Amoffia	Nkpenyi	Good	3.5	Accepted
	Umuezaka community	Ogomodo	Good	2.8	Accepted
	Abakaliki – Ndiabor Okpuitumo	Oko	Good	5.5	Accepted
	Ndiegu Okpuitumo community	Oko	Very good	4.6	Accepted
	Izzi Igbiagu community	Oko	Very good	3.5	Rejected
	Ndieze community	Oko	Very good	4.3	Accepted
Ebonyi Central	Ezza North Umuoghara	Oko	Very good	3.2	Rejected
	Okposi – umuoghara	Ogomodu	Very good	4.5	Accepted
	Ezza South Amagu community	Oko	Very good	3.4	Rejected
	Umunwagu Idembia	Oko	Excellent	5.2	Accepted
	Ikwo Ndufu-Alike community	Oko	Very good	3.9	Rejected

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	Ekpelu community	Oko	Excellent	4.0	Rejected
Ebonyi South	Ohaozara Uburu community	Enegbe	Excellent	5.0	Accepted
	Eweze-Ihenu community	Enegbe	Excellent	4.5	Accepted
	Ivo Ishiagu community	Nka	Very good	4.6	Accepted
	Okue community	Nka	Good	3.7	Accepted
	Afikpo South Owutu Edda	Nkwanyi	Very good	2.5	Rejected
	Oso Edda community	Oko	Very good	3.4	Rejected
	Oso Edda community	Nkwanyi	Very good	4.4	Accepted
Three leaf yam or bitter yam accessions (*Dioscorea dumentorum*)					
Ebonyi North	Ohaukwu	Una	Very good	5.8	Accepted
Ebonyi Central	Ezza South	Una	Very good	5.0	Accepted
Ebonyi South	Owurtu Edda	Una	Very good	5.5	Accepted
	Oso Edda	Una	Good	4.0	Accepted
Aerial yam accessions or air potato (*Dioscorea bulbifera*)					
Ebonyi Central	Ezza North	Edu	Excellent	3.6	Rejected
	Ezza south	Edu	Excellent	2.9	Rejected
	Ikwo	Edu	Very good	3.4	Rejected

Source: Field survey 2017. Pd- perceptions decision

5 points Likert scale = $\frac{5+4+3+2+1}{5}$ = 3 for yield – 1-very poor, 2-poor, 3-good, 4- very good, 5-excellent.

LGA – Local Government Area (bolded)

B. Phenotypic Characterization of Yam Accessions Using Quantitative and Qualitative Traits.

➢ *Agro-Morphological Characterization of Grown Accessions*

- Coefficient of variation of agromorphological results indicated 11 out of 19 quantitative traits among the accessions manifested high (CV >50%) coefficients of variation for the traits examined. Howerver, phenotypic variance less than 25% (CV < 25%) were recorded for sprout length, sprout diameter, internode diameter and leaf length and days to maturity for both seasons Appendix two (Table 15 - 18). The low percentage coefficent differences observed among the species for these traits revealed that the contributions of these traits for the phenotypic diversity examined were very low. The mean values of phenotypic diversity for different characters of yam accessions and species assessed also differed from each other. Selection of accession for further research work ranged from 1.6 and 1.7 (5% and 9%) for internode diameter, 1.6 and 1.9 (79% and 69%) for number of internode before the first branching to 103.3 and 93.8 (74% and 75.6%) for number of leaf and 10.3 and 9.8 for number of vine per plant (61% and 62%) (Table 18). Those accessions that performed above the mean value and with high percentage coefficient of variation can be selected for further research.
- Number of sprout per plant (NSp): The result showed that *Dioscorea alata* accessions Nwawafu and Nneonwuka collected from Umunwagu Idembia in Ezza South and Oso Edda in Afikpo South LGAs, produced the highest average number of sprouts per plant among accessions 13.3 and 12.2 and among the species, which was higher than the mean values (3.6 and 3.7) within the two seasons. This was closely followed by *Dioscorea rotundata* accessions Ozibo and Utsuekpe (13.2 and 9.5) collected from Amoffia community of Ohaukwu LGA. The lowest number (1.3) of sprouts were produced by *Dioscorea dumentorum* accessions Una collected from Umunwagu Idembia especially in 2017 planting season (Table 18). The estimation of coefficient of variation ranged from 26% to 28% for number of sprouts among the species in both seasons. This implied that the variation that occurred among the accessions and species examined were inherent and might not be due to environmental factors.
- Number of internode before the first branching (NIBB): The result of the phenotypic characterization for number of internode before the first branch indicated high coefficient of variation (78.8% and 69%) among the accessions in both seasons examined. Accessions of white yam Okpembe collected from Ndieze produced the highest number of internode before the first branching (7.0), followed by Okpebe collected from Umuezaka and Ndufu Alike with mean value of 6.2 and 5.0 (Table 15). At species level, in 2016 planting season, *Dioscorea cayenensis and Dioscorea rotundata* accessions produced the highest number of internodes (2.5, 2.4) before first branching, while the *Dioscorea bulbifera* accessions produced the lowest internodes before first branching. Intra-accessions differences existed in number of internodes in the two seasons evaluated with greater mean values but lower mean percentage coefficient of variation obtained in 2016 than 2017 planting seasons (Table 18).
- Internode length (Ile-cm): The result showed that *Dioscorea rotundata* accessions produced the longest internodes (10.1 cm) per plant among species, which was higher than mean length of internode recorded for *D. cayenensis* accessions and the least mean values recorded for *D. alata* accessions (Table 19). Accessions of *Dioscorea alata* produced the shortest internodes (4.7cm) in both years which was lower than other yam species (Table 18). Thus, internode length for coefficient of variation ranged from 24% in 2017 to 30% in 2016 among species. This implied that internode length contributed immensely to the major variations that occurred in the characters examined, and may be influenced by environmental factors.

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Table 15: Mean Distribution on Quantitative Morphological Traits of White Yam Accessions

Senatorial Zone	LGA/Community	Access.name	Plot Id	NSP	Sprout len. (cm)	Sprout d (cm)	NIN	ILE (cm)	India (cm)	NVP/plant	NLv	Lvle (cm)	Lvwi (cm)	Maturity rate (days) Min	Max.
Ebonyi North	Ohaukwu	Jioke	101	5.8	5.0	1.6	1.6	12.4	1.5	7.4	101.0	9.2	6.4	119.0	145.0
	Amaoffia	Nwopoke	102	3.5	3.7	1.4	1.8	8.8	2.0	18.0	111.0	7.1	5.0	139.0	159.0
		Obela	103	6.8	5.2	1.7	1.0	6.6	1.8	17.4	59.0	6.2	4.7	140.0	159.0
		Ozibo	105	**13.2h**	5.0	2.0	1.5	8.6	1.6	21.2	70.0	7.9	5.6	128.0	154.0
		Utsuekpe	106	9.5n	5.0	1.8	1.0	8.6	1.9	20.0	39.0	7.5	5.6	141.0	161.0
	Umuezeaka	Obela	116	2.0	4.8	1.6	1.7	8.6	1.4	17.7	121.0	7.3	6.2	140.0	160.0
		Okpebe	118	3.0	2.0	1.7	**6.3n**	7.0	**6.4h**	16.7	98.0	9.1	8.2	141.0	167.0
		Ozibo	119	2.3	3.8	2.0	2.3	1.6	1.8	26.5	**201.0r**	9.1	7.0	111.0	141.0
		Usuekpe	120	1.8	4.9	1.5	2.3	8.9	1.7	23.5	84.0	8.8	5.6	112.0	154.0
	Abakaliki	Amage	121	2.9	5.2	1.8	1.4	9.7	1.8	15.1	46.0	8.7	7.2	98.0	121.0
	Ndiegu-Okpuitum	Igum	122	2.8	4.9	1.5	2.8	9.3	1.5	16.3	51.0	7.5	5.9	154.0	179.0
		jimmanu	123	2.4	4.6	1.7	2.4	9.3	1.8	9.2	29.0	7.6	6.0	142.0	169.0
		Okpebe	124	1.9	4.3	1.8	1.7	9.4	1.6	19.4	123.0	6.6	5.8	149.0	161.0
		Ozibo	125	1.0	4.8	2.0	1.0	10.7	1.6	19.7	36.0	8.1	5.3	129.0	139.0
	Ndiabor-Okpu.	Amage	133	1.1	5.0	1.4	2.4	10.6	1.8	16.8	55.0	8.5	6.6	95.0	117.0
		Igum	134	1.6	4.7	1.8	2.4	5.7	1.6	17.4	112.0	10.6	5.3	151.0	179.0
		Jimmanu	135	1.5	3.8	2.1	2.7	8.7	1.8	26.2	44.0	11.2	7.5	149.0	159.0
		Nwopoke	136	1.8	3.8	1.9	1.0	9.0	1.6	4.5	98.0	10.0	9.6	139.0	155.0
		Ogbaruogbiya	137	1.0	5.6	1.9	3.6	11.1	1.7	18.8	33.0	5.8	7.8	100.0	129.0
		Okpebe	139	2.3	4.0	1.7	1.0	**16.4t**	1.7	10.1	64.0	8.1	4.4	141.0	159.0
	Izzi	Akamunze	140	1.3	5.7	1.7	2.5	12.1	1.5	8.8	57.0	7.6	5.8	149.0	179.0
	Igbeagu	Amage	141	1.4	4.9	1.8	2.8	12.1	1.6	16.4	107.0	6.6	5.7	102.0	117.0
	Igbeagu	Igum	142	1.4	4.3	1.7	4.9	9.0	1.8	8.1	58.0	9.4	4.4	141.0	164.0
Ebonyi North	Igbeagu	Okpebe	143	2.3	5.5	2.0	2.5	11.40	1.5	17.4	34.0	6.8	7.3	139.0	161.0
	Igbeagu	Ozibo	144	1.5	4.8	2.1	4.0	**29.0h**	1.8	3.5	64.0	7.8	5.6	121.0	145.0
	Ndieze	Amage	156	1.3	4.7	1.7	2.9	8.9	1.4	13.0	45.0	8.1	5.8	145.0	169.0
		Ayaragu	157	2.0	4.1	2.0	3.5	13.9	1.8	9.5	79.0	8.6	6.0	95.0	112.0
		Igum	158	1.1	5.0	1.8	**5.6r**	10.4	1.8	22.9	69.0	9.0	6.9	151.0	164.0
		Jioji	159	1.0	4.2	2.0	2.5	5.9	1.7	17.5	103.0	10.0	5.7	149.0	179.0
		Obela	160	2.5	4.5	1.6	5.0	7.3	1.6	9.5	113.0	9.3	7.4	139.0	151.0
		Ogbagharuogbia	161	1.8	4.2	1.6	4.2	12.9	1.5	13.6	98.0	8.4	6.3	110.0	139.0
		Okpembe	162	1.6	4.6	1.8	**7.0h**	7.9	1.7	18.5	58.0	8.8	6.0	145.0	179.0
		Ozibo	163	2.1	4.8	2.3	3.9	11.7	1.6	18.8	137.0	8.0	6.3	119.0	151.0
		Ozibo wire	164	3.5	3.9	1.9	3.0	14.0	1.7	19.3	25.0	7.7	5.0	121.0	159.0
Ebonyi Central	**Ezza South**	Abi	166	3.0	4.7	**2.4r**	3.3	10.8	1.7	25.5	109.0	8.5	5.3	149.0	164.0
	Umu. Idembia	Igum	167	2.6	5.3	1.8	4.3	13.2	1.9	18.9	56.0	8.8	5.1	154.0	185.0
		Jimaka	168	2.0	5.6	1.6	3.8	10.5	1.7	18.8	133.0	9.2	6.1	151.0	185.0
		Jimanu	169	2.3	4.9	1.6	1.8	**16.3t**	**2.2r**	**29.3t**	111.0	8.4	6.5	149.0	164.0
		Nyeji	170	3.3	5.0	1.7	1.0	9.7	1.4	20.4	89.0	8.0	7.2	151.0	179.0
		Obiaoturugo	171	1.9	5.1	2.0	3.7	10.9	1.7	24.6	76.0	7.7	6.8	149.0	164.0

Source: Field survey 2016 and 2017. Plot Id-identity of the plot. NSp-Number of sprout, sprout len.–length, sprout d.-diameter, NIN – number internode before the first branching, ILE (cm) – internode length measured in centimeter, India – internode diameter, NVP – number of vine per plant, NLv – number of leaf. Lvle – leaf length. Lvwi – leaf width cm/plant. Min – minimum, max – maximum.

Table 15: Continued

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Senatorial Zone	LGA/Community	Access.name	Plot Id	NSP	Sprout len. (cm)	Sprout d (cm)	NIN	ILE (cm)	India (cm)	NVP /plant	NLv	Lvle (cm)	Lvwi (cm)	Maturity rate (days) Min	Max.
Ebonyi central	Amagu	Abi	181	2.2	4.0	1.4	1.8	10.7	1.7	21.5	50.0	9.7	6.2	101.0	121.0
		Igum	182	1.5	4.8	1.6	1.9	9.6	1.7	24.8	87.0	8.3	6.2	155.0	183.0
		Nnebiji	183	2.0	3.6	1.9	2.5	12.3	1.6	25.0	69.0	9.4	8.0	161.0	183.0
		Nyeji	184	3.1	3.7	1.7	2.1	10.0	1.5	17.0	73.0	8.7	5.4	154.0	183.0
	Ezza North	Akamunze	186	3.0	5.8	1.9	3.3	11.9	1.4	18.0	89.0	8.0	8.1	141.0	169.0
	Umuogharu	Iboki	187	3.0	4.5	1.7	1.8	11.5	1.6	19.2	94.0	7.7	6.4	101.0	119.0
		Igum	188	1.6	4.6	1.7	3.5	10.9	1.8	19.3	123.0	8.1	6.4	169.0	183.0
		Nyeji	189	3.1	3.8	1.5	1.8	11.8	1.5	27.3	38.0	8.1	6.0	154.0	179.0
Ebonyi Central	Umuogharu	Okpembe	192	3.8	3.8	1.6	2.8	11.3	1.6	19.0	106.0	8.1	6.3	139.0	154.0
	Umogharu	Usuekpe	193	3.0	4.5	1.7	4.0	11.5	1.9	21.0	152.0	8.1	6.6	139.0	151.0
		Ojioso	194	2.5	3.6	1.8	2.5	10.6	1.9	15.5	108.0	9.1	7.6	105.0	141.0
		Obiaoturuo	195	2.8	3.8	1.8	4.4	10.9	1.8	24.4	67.0	9.2	5.8	145.0	161.0
	Okposi Umuogh.	Akamunze	201	3.2	4.7	1.6	2.4	8.7	1.7	16.4	56.0	9.3	8.6	139.0	164.0
		Iboki	202	3.0	**6.4h**	1.5	2.0	9.1	1.6	24.5	32.0	7.0	5.4	95.0	117.0
		Igum	203	2.0	3.8	2.2	1.4	10.8	1.4	26.0	**209.0n**	8.7	7.1	164.0	179.0
		Nyeji	204	4.8	5.2	2.4	1.3	7.6	1.8	17.3	193.0	7.6	6.4	151.0	169.0
		Okpebe	207	3.3	**6.8h**	1.9	3.0	9.2	1.6	12.7	77.0	9.1	7.4	142.0	159.0
		Ozibo	208	7.3r	2.8	1.6	2.0	9.3	1.4	26.0	28.0	8.3	6.6	131.0	145.0
		Usuekpe	209	3.8	4.2	1.6	1.0	11.6	1.9	29.8	19.0	8.5	6.8	142.0	159.0
	Ikwo	Amage	210	3.5	5.2	2.1	**5.0r**	9.4	1.5	12.0	89.0	9.1	7.5	111.0	121.0
	Ndufu-Alike	Nebinji	213	3.2	3.7	1.6	2.6	11.0	**2.2n**	21.0	41.0	8.7	6.3	159.0	189.0
		obiaoturugo	214	2.6	5.4	1.4	1.8	8.1	1.5	25.0	22.0	7.1	5.5	151.0	169.0
		Ojioso	215	2.6	5.3	1.5	3.0	6.7	1.6	17.0	29.0	8.5	6.5	101.0	129.0
		Ewada	218	2.5	6.5h	1.7	2.5	10.0	1.3	**34.5h**	19.0	10.3	7.7	154.0	179.0
		Ibada	219	2.0	4.0	1.7	1.8	7.4	1.1	24.2	59.0	8.4	6.0	101.0	121.0
	Ekpelu-Amak	Agbabro	227	2.5	4.3	1.6	1.5	9.5	1.4	17.0	89.0	10.0	7.7	154.0	179.0
		Ibada	228	3.1	3.9	1.8	1.8	10.6	1.6	20.3	41.0	7.0	5.4	98.0	117.0
		Igum	229	2.5	**6.5h**	1.7	2.0	10.3	1.5	**31.0r**	50.0	8.1	6.0	161.0	179.0
		Nnebinji	230	3.0	5.9	2.1	4.0	17.3	1.2	**29.0t**	191.0	8.9	6.2	169.0	189.0
		Nwagbam	231	3.0	5.6	1.2	2.5	8.7	1.8	**30.5r**	38.0	8.2	6.1	161.0	185.0
		Obia	232	2.1	4.6	1.8	2.7	9.9	1.8	23.0	44.0	8.7	6.8	151.0	179.0
		Ojeoso	233	2.0	4.58	1.6	2.7	10.4	1.7	22.8	113.0	7.4	7.0	121.0	139.0
Ebonyi South	Orobo Uburu	Abi	236	2.0	4.2	1.6	1.6	10.1	1.4	20.4	36.0	8.2	6.4	108.0	119.0
		Agba	237	2.1	4.4	1.7	3.4	8.6	1.3	15.5	49.0	8.9	6.4	139.0	171.0
		Ekowenyi	238	3.1	4.8	1.7	1.5	10.8	1.9	11.1	87.0	9.1	7.6	169.0	189.0
		Nnebiji	241	2.0	5.0	1.6	2.3	11.1	1.6	19.6	24.0	7.3	5.7	169.0	184.0
		Obiaoturugo	242	4.0	4.2	1.6	2.0	9.8	1.8	13.0	181.0	9.7	8.5	161.0	184.0
	Eweze-Ihenu	Abi	245	3.0	4.8	1.5	1.8	11.3	1.5	18.1	**221.0h**	8.9	6.9	98.0	117.0
		Agba	246	3.0	4.4	1.6	1.7	8.6	1.6	14.2	12.0	6.6	5.1	149.0	169.0
		Obiaoturugo	249	3.0	4.1	1.6	1.7	11.1	1.5	23.9	102.0	8.5	6.7	151.0	179.0
		Okpebe	250	3.6	5.3	1.3	2.5	6.8	1.6	12.4	22.0	8.2	6.0	141.0	159.0

Source: Field Survey 2016 and 2017: H -Highest Scored Value, N- Second, R – Third And T – Fourth Highest Recorded Value

Table 15: Continued

Senatorial Zone	LGA/ Community	Access.name	Plot Id	NSP	Sprout len. (cm)	Sprout d (cm)	NIN	ILE (cm)	India (cm)	NVP /plant	NLv	Lvle (cm)	Lvwi (cm)	Maturity rate (days) Min	Max.
Ebonyi South	**Ivo**	Otutu	255	2.0	4.4	1.7	1.3	5.2	1.3	3.33	128	8.3	7.3	171.0	200.0
	Ishiagu	Ishitu	256	3.3	4.7	1.8	1.3	3.5	1.5	4.33	103	11.8	9.9	110.0	119.0
		Ayaragu	258	3.3	4.7	1.6	1.3	13.7	1.4	13.7	19.0	8.8	6.4	105.0	121.0
	Ishagu-Amag.	Agba	259	2.7	4.5	1.7	4.2	10.9	1.7	17.8	26.0	8.3	5.7	141.0	159.0
		Igum	260	3.5	4.6	1.7	2.5	11.5	1.7	25.3	44.0	8.1	5.6	169.0	189.0
		Obiaoturugo	261	2.1	4.7	1.9	3.3	11.4	1.9	22.9	37.0	8.6	6.7	161.0	179.0
		Orumeh	262	2.5	4.2	2.0	2.3	10.5	**2.1r**	18.3	33.0	7.8	5.9	169.0	183.0
		Orunte	263	1.0	4.0	1.7	1.8	8.7	1.6	20.2	120.0	8.4	5.5	154.0	169.0
		Paper	264	2.0	3.6	2.3	2.0	12.3	1.9	22.0	115.0	9.1	5.6	139.0	151.0
	Okue	Ogbeka	266	1.0	5.6	1.8	2.3	10.6	1.6	21.0	47.0	8.2	6.1	151.0	165.0
		Agboji	267	2.3	5.8	2.1	1.8	10.3	1.5	**30.5r**	25.0	7.5	5.7	141.0	179.0
		Igum	268	2.6	5.3	2.0	2.0	11.8	1.7	**28.2t**	78.0	9.3	7.1	154.0	179.0

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		Obiaturugo	269	2.5	5.0	2.0	2.0	10.9	1.6	19.5	23.0	9.0	6.4	161.0	161.0
		Orumeh	270	1.0	5.2	1.8	1.2	9.0	**2.2n**	15.4	86.0	9.0	5.5	151.0	179.0
		Orunte	271	1.8	4.8	1.8	1.8	3.9	1.9	21.5	91.0	8.5	5.8	149.0	176.0
Ebonyi South	Afikpo South	Abi	278	3.0	**5.6r**	1.8	2.0	12.7	1.2	20.8	103.0	9.1	6.2	95.0	119.0
	Owutu Edda	Agba	279	2.6	5.3	1.7	1.5	11.5	1.7	19.4	28.0	7.8	5.6	141.0	169.0
		Akiri	280	2.4	5.0	1.4	1.7	9.9	1.5	22.6	48.0	8.5	6.6	154.0	169.0
		Ewada	281	1.8	5.0	1.8	1.5	4.7	1.1	3.5	32.0	8.8	6.3	149.0	171.0
		Ipe	283	2.5	4.9	1.4	1.8	5.0	1.5	16.8	24.0	9.2	7.3	149.0	195.0
		Obiaoturugo	285	3.5	4.7	1.4	2.6	**18.0n**	1.5	22.6	67.0	8.6	6.6	149.0	169.0
	Oso Edda	Obiaoturugo	291	3.1	4.6	1.5	1.8	11.7	1.6	22.3	49.0	8.6	6.8	139.0	164.0
		Agba	293	2.4	4.5	1.5	1.6	9.7	1.6	17.3	30.0	8.4	6.4	142.0	161.0
		Akiri	294	2.8	5.3	1.5	1.9	4.6	1.7	22.9	23.0	8.4	6.5	154.0	171.0
		Igum	295	3.0	5.6	1.5	1.5	15.2	1.4	23.9	18.0	8.1	6.1	171.0	195.0
Mean				**2.7**	**4.7**	**1.7**	**2.5**	**10.3**	**1.7**	**19.4**	**56.7**	**8.4**	**6.3**	**138.9**	**160.7**
SE				**2.3**	**2.12**	**0.49**	**1.44**	**3.72**	**1.08**	**8.03**	**105.6**	**2.40**	**2.35**	**33.12**	**143.2**
CV (%)				**77.1**	**48.1**	**28.4**	**78.8**	**46.59**	**28.4**	**61.3**	**74.8**	**24.4**	**30.8**	**23.4**	**24.2**

Source: Field Survey 2016 And 2017. Plot Id-Identity Of The Plot. Nsp-Number Of Sprout, Sprout Len.–Length, Sprout D.-Diameter, NIN – Number Internode Before The First Branching, ILE (Cm) – Internode Length Measured In Centimeter, India – Internode Diameter, NVP – Number Of Vine Per Plant, Nlv – Number Of Leaf. Lvle – Leaf Length. Lvwi – Leaf Width Cm/Plant. Min – Minimum, Max – Maximum. H -Highest Scored Value, N- Second, R – Third And T – Fourth Highest Recorded Value

- **Internode diameter (Idia-cm):** The result showed minimal differences in internode diameter among the accessions studied with the widest internodes recorded for accessions of *D. rotundata* in 2017 compared to 2016 season. Accessions of *Dioscorea bulbifera* had the lowest plant diameter (0.98cm), which was recorded in 2017 planting season. However, it was observed that the longer the internode length the lower the diameter in the different seasons. The low coefficient variation value (5% and 9%) indicated low contribution of this trait to phenotypic diversity among yam accessions on the traits examined (Table 18).
- **Number of vine per plant or number of branch per plant (Nvp):** Inter-species variation was observed for this trait. The highest number of vines or stems per plant was produced by *D. rotundata* accessions Ewada, Igum, Nnebiji and others, followed by *D. cayenensis, D. dumetorum, D. alata* and *D. bulbifera*, respectively. Within the species, there were mean differences with high percentage coefficient of variation (62% and 61%) in the number of vines per plant produced by the accessions in both seasons (Table 18). This implies that some accessions and species of yam examined showed inherent quality for producing more stems than the others within and between species. This also implied that the phenotypic diversity observed on the traits or characters evaluated could be genetic.
- **Number of leaf per plant (Nlv):** Accessions of *Dioscorea bulbifera* produced the highest number of leaves per plant in 2017 (approx. 141 leaves) than in 2016 planting season, followed by *Dioscorea dumentorum* (approx. 133 leaves*)* and *Discorea alata* (approx. 115 leaves) in 2016 planting season (Table 18). The least number of the leaves among species was found among *Dioscorea rotundata* accessions (57 leaves), while there was high CV 74% and 75.6% in comparison to the high mean value. Phenotypic diversity in characters examined might occur mainly only on the accessions and not on the species. Hence, the variation occurred could be due to accessions performance influenced by different soil nutrient at different portion of the plot since the different yam species can produce either higher or lower leaves in both seasons.

Table 16: Mean And Coefficient Variation for Quantitative Morphological Traits of Water Yam Accessions

Senatorial Zone	LGA/ Community	Access.name	Plot Id	NSP	Sprout len. (cm)	Sprout d (cm)	NIN	ILE (cm)	India (cm)	NVP /plant	NLv	Lvle (cm)	Lvwi (cm)	Maturity rate (days) Min	Max.
Ebonyi North	Ohaukwu	Mbala	107	7.1r	4.4	1.7	1.5	3.1	1.6	3.8	100.0	10.8	8.8	151.0	169.0
	Amaoffia	Nwawafu	109	3.3	4.6	1.6	1.0	4.2	1.8	4.5	180.0	10.5	8.4	110.0	141.0
	Umuezeaka	Egboru	111	4.5	4.6	1.8	1.6	3.6	1.8	3.5	175.0	11.7	9.0	141.0	174.0
		Mbala	112	4.0	3.9	1.7	2.1	3.9	1.8	3.7	200.0	12.0	9.7	139.0	171.0
		Nwawafu	113	4.5	3.3	1.9	1.8	3.9	1.7	5.0	135.0	11.4	9.7	101.0	139.0
	Umuezeaka	Nneonwuka	114	4.0	3.9	1.8	1.3	7.1	1.6	2.8	150.0	11.2	9.5	169.0	191.0
	Abakaliki	Nvula	127	2.8	4.8	1.6	2.6	7.7	1.6	3.8	100.0	11.3	10.7	161.0	189.0
	Ndiabor-Okpu.	Okwalenkata	128	5.0	5.2	1.7	2.0	4.5	1.9	5.0	100.0	12.0	10.2	90.0	131.0
		nvulamanu	129	4.9	4.1	1.7	3.1	4.3	1.6	3.9	105.0	10.9	7.7	171.0	201.0
	Ndiegu-Okpu.	Nvulamanu	130	2.3	4.7	1.5	1.0	3.9	1.8	2.9	129.0	10.4	8.5	169.0	195.0
		Okwalenkata	131	2.6	4.2	1.5	1.0	2.8	1.9	3.6	130.0	11.7	8.5	101.0	119.0
		Nvula	132	3.8	4.8	1.7	1.5	3.4	1.7	3.7	200.0	7.8	6.2	171.0	200.0
	Izzi	Nvula	146	3.0	3.1	1.7	1.1	3.4	1.3	4.5	156.0	**12.7r**	11.7	169.0	195.0
	Igbiegu	Okwalenktata	147	2.8	3.3	2.0	3.8	3.6	1.7	4.4	78.0	**13.0r**	10.5	121.0	151.0
		Nvulambube	148	2.0	2.5	**2.5h**	5.0	5.1	1.7	3.0	180.0	10.7	7.6	171.0	200.0
		Opokenvula	149	2.5	5.4	1.5	4.0	4.0	1.5	13.0	133.0	10.5	8.0	171.0	200.0
		Nwopokeofu	150	3.9	4.4	1.7	1.8	4.8	1.8	4.0	111.0	11.4	8.8	180.0	195.0

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		Nvula mme	151	3.0	4.5	2.0	1.0	10.7	1.6	5.3	100.0	11.1	9.4	114.0	139.0
	Ndieze	Akpuruakputu	152	2.5	3.5	1.6	1.0	12.3	1.5	8.5	100.0	11.9	10.7	169.0	190.0
		Nwawafu	153	3.8	4.6	1.7	2.9	2.7	1.8	3.5	100.0	11.6	10.1	143.0	159.0
		Opokeffu	154	1.5	2.8	1.6	1.0	10.3	1.6	3.5	200.0	**12.4**	10.4	110.0	139.0
Ebonyi Central	**Ezza South**	Nwawafu	173	**13.3h**	3.6	1.7	1.0	3.8	2.0	4.3	100.0	**12.5r**	10.5	121.0	139.0
	Umu. Idembia	Nvula	174	3.3	3.1	1.7	1.0	2.7	**2.2r**	3.8	60.0	12.1	10.6	171.0	191.0
		Nvulamanu	175	4.0	4.0	1.6	1.0	4.2	2.0	3.4	155.0	11.1	8.8	169.0	190.0
Ebonyi Central	**Ezza south**	Nvula	178	3.9	3.9	1.5	1.0	4.2	1.8	3.1	125.0	12.3	10.4	171.0	190.0
	Amagu	Nvula mme	179	3.4	4.2	1.7	1.0	4.7	1.8	3.6	100.0	11.6	9.9	105.0	131.0
		Opalenkata	180	4.9	3.3	1.6	1.6	2.2	**2.1r**	3.3	200.0	11.6	10.4	110.0	139.0
	Ezza North	Nwawafu	196	3.9	4.0	1.6	1.0	3.2	1.8	3.4	140.0	11.4	9.7	108.0	139.0
	Umuogharu	Okwalenkata	197	3.1	3.7	1.7	1.0	2.9	2.0	3.6	56.0	12.0	10.2	110.0	131.0
	Okposi Umu.	Okwulenkata	198	4.3	3.8	1.9	1.0	2.4	2.0	2.8	100.0	11.8	10.5	121.0	139.0
		Nvula	199	3.5	3.5	1.6	1.0	5.2	1.5	3.2	100.0	**13.2n**	11.1	174.0	200.0
		Nwawafu	200	4.2	4.1	1.8	2.0	6.9	1.5	3.8	130.0	11.9	9.9	110.0	139.0
	Ikwo	Caret yam	211	3.3	5.5	1.8	1.0	6.9	1.7	3.0	133.0	10.1	7.2	151.0	169.0
	Ndufu-Alike	Mkpueke	212	6.3	4.7	1.7	1.3	9.2	1.6	3.5	183.0	9.8	8.2	141.0	161.0
		Onyeoma	217	4.3	4.6	1.5	1.0	4.4	1.8	3.8	175.0	10.5	7.5	139.0	155.0
		Nvula	220	1.3	3.8	2.2	1.0	4.6	1.8	4.3	133.0	9.9	6.7	169.0	191.0
		Nvulamme	221	2.0	3.3	1.8	1.0	4.8	**2.2r**	4.5	109.0	12.7	11.2	171.0	199.0
	Ekpelu-Amak.	Opalenkata	222	2.7	3.7	2.0	1.0	4.0	1.5	6.5	138.0	10.5	9.3	108.0	131.0
		Uranium	225	2.3	3.9	1.8	1.8	3.5	1.7	3.0	110.0	**12.8r**	10.8	155.0	179.0
		Agbirigba	226	3.8	4.4	1.8	1.4	3.8	1.8	5.1	150.0	10.1	9.3	90.0	131.0
		Ajingworo	228	3.0	4.5	**2.7h**	1.0	6.5	1.4	5.00	140	**13.1n**	10.8	169.0	190.0
		Nwiba	235	5.0	3.0	1.9	1.0	5.8	1.6	5.5	133.0	10.6	9.3	169.0	195.0

Table 16: Continued

Senatorial Zone	**LGA/ Community**	**Access.name**	**Plot Id**	**NSP**	**Sprout len. (cm)**	**Sprout d (cm)**	**NIN**	**ILE (cm)**	**India (cm)**	**NVP /plant**	**NLv**	**Lvle (cm)**	**Lvwi (cm)**	**Maturity rate (days) Min**	**Max.**
Ebonyi South	**Ohaozara**	Igborogidi	240	2.5	4.9	1.8	1.0	6.3	1.3	15.0	165.0	**13.8h**	**12.2n**	142.0	159.0
	Urobo	Nvula America	243	2.6	4.3	1.6	1.0	7.4	1.7	4.2	70.0	11.2	9.8	90.0	117.0
		Opananwankata	244	3.6	4.3	1.9	1.0	2.9	1.7	5.0	155.0	**13.4n**	10.4	111.0	121.0
		Igborogidi	248	2.6	4.5	1.7	1.0	4.3	1.7	3.1	200.0	11.1	9.4	142.0	159.0
		Opananwakata	251	4.1	4.4	1.4	1.0	4.0	1.6	3.4	100.0	11.3	10.8	101.0	131.0
	Ohaozara	Mbala	252	2.9	4.3	1.3	1.0	3.9	1.5	4.4	125.0	12.4	11.0	154.0	179.0
	Ivo	Awokenvula	253	3.3	4.2	1.8	1.2	4.6	1.4	4.5	117.0	10.6	9.2	141.0	159.0
	Ishiagu	Orumehnvula	254	2.3	4.2	1.8	1.7	4.5	1.6	6.2	117.0	10.2	8.4	171.0	200.0
Ebonyi South	Ishiagu-Okue	Awokenvula	257	3.5	4.3	1.5	1.1	4.3	1.6	5.0	118	12.2	9.9	110.0	119.0
	Okue	Makwuruba	272	3.2	5.7	2.0	2.2	7.8	1.6	22.4	104	8.9	6.2	105.0	121.0
	Afikpo South	Mbula	273	2.8	4.9	1.8	4.5	4.8	1.5	5.6	153	10.2	9.0	110.0	131.0
	Owutu-Edda	MbulaAmerica	275	3.8	4.8	1.9	1.0	3.0	1.7	4.8	170	11.3	10.0	171.0	195.0
		MbulaPaul	276	2.0	5.4	1.6	1.3	5.0	1.4	3.0	150	11.5	10.2	110.0	131.0
		Igborogidi	277	2.6	4.6	1.6	1.3	7.1	1.6	3.8	156	12.2	10.2	100.0	121.0
		Mbulahaukwu	282	4.5	4.2	1.4	1.0	4.7	1.9	4.8	125	11.5	9.8	139.0	171.0
		Agbirigba	288	2.5	5.1	1.7	1.0	10.2	1.4	4.0	153	**14.2h**	**12.5n**	169.0	190.0
	Oso-Edda	Ogboja	289	1.8	4.1	1.7	1.0	8.8	1.6	11.4	164	12.4	10.9	171.0	201.0
		Igum eluenyim	292	4.7	4.2	1.6	1.0	4.1	1.8	2.6	161	13.1	11.1	149.0	179.0
		Igum mbula	296	3.0	5.6	1.6	2.0	5.3	1.3	8.0	130	10.2	7.2	171.0	191.0
		Mbula	297	3.8	4.8	1.4	1.6	5.2	1.7	3.8	100	12.1	9.3	169.0	189.0
		Mbula	298	3.0	4.5	**2.7h**	1.0	6.5	1.4	5.0	140	**13.1n**	10.8	169.0	190.0
		MbulaAmerica	299	3.0	4.9	1.6	1.0	4.8	1.8	6.0	148	**13.2n**	12.1	111.0	139.0
		Nneonwuka	300	**12.4n**	4.4	1.4	1.6	2.7	1.6	4.2	102	12.1	10.6	154.0	169.0
		Mbula paul	301	4.0	4.4	1.7	1.3	4.6	1.6	5.3	125	**13.4n**	11.4	108.0	131.0
Mean				**3.5**	**4.2**	**1.7**	**1.5**	**5.0**	**1.7**	**4.9**	**112.6**	**11.5**	**9.6**	**139.3**	**163.3**
SE				**2.3**	**2.1**	**0.5**	**1.4**	**3.7**	**1.1**	**8.0**	**105.6**	**2.4**	**2.4**	**133.1**	**141.6**
CV (%)				**77.4**	**8.1**	**2.4**	**78.8**	**46.6**	**62.3**	**61.3**	**74.8**	**24.4**	**30.8**	**23.2**	**27.0**

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Table 17: Mean and Coefficient of Variation for Quantitative Morphological Traits for Other Yam Accessions

Senatorial Zone	LGA/ Community	Access.name	Plot Id	NSP	Sprout len. (cm)	Sprout d (cm)	NIN	ILE (cm)	India (cm)	NVP /plant	NLv	Lvle (cm)	Lvwi (cm)	Maturity rate (days) Min	Max.
Ebonyi North	Amoffia	Ogomodu	104	1.0	5.2	1.7	3.0	6.6	2.0	10.0	70.0	8.8	6.2	141.0	179.0
	Umuezaka	Nkpenyi	115	3.0	4.9	1.8	2.8	8.9	1.7	9.3	80.0	9.2	6.4	171.0	**208.0t**
	Umuezeaka	Ogomodu	117	4.0	4.8	1.6	2.3	10.7	1.6	14.0	85.0	11.0	7.9	169.0	183.0
	Abakaliki	Oko	126	2.0	4.8	2.0	2.4	7.5	1.6	6.6	107.0	9.6	8.2	**189.0r**	**212.0n**
	Ndiegu Okpu.	Oko	138	5.4	5.6	1.9	1.8	10.0	1.6	3.8	116.0	9.9	7.4	**190.0n**	**210.0r**
	Izzi – igbiegu	Oko	145	1.9	4.8	2.1	3.0	15.1	1.5	19.0	70.0	10.7	8.7	181.0	199.0
	Ndieze	Oko	155	1.7	2.8	1.6	**7.0h**	12.0	1.7	3.3	30.0	10.7	8.7	179.0	208.0
Ebonyi Central	**Ezza South –**	Oko	172	1.5	5.1	2.0	2.5	4.6	1.7	16.0	76.0	8.7	7.0	179.0	193.0
	Amagu	Oko	185	1.7	3.7	1.7	2.2	12.4	1.5	19.0	21.0	11.8	11.0	180.0	202.0
	Ezza North	Ogomodu	190	3.0	3.8	1.5	2.7	9.0	1.7	23.0	86.0	9.7	7.7	139.0	169.0
	Umogharu	Oko	191	1.3	3.4	1.6	2.0	11.4	1.6	20.0	69.0	10.6	8.7	**191.0h**	**221.0h**
	Okposi-Umuogh.	Ogomodu	205	2.7	5.2	2.4	2.0	2.1	1.8	19.0	90.0	10.7	8.7	139.0	155.0
		Oko	206	2.4	**6.4n**	1.0	1.6	8.0	1.5	20.0	53.0	9.7	7.0	154.0	179.0
	Ikwo	Oko	216	3.6	5.3	1.5	4.0	9.7	1.7	19.0	71.0	10.6	8.7	169.0	191.0
	Ekpelu	Oko	234	2.5	4.6	1.6	2.4	7.1	1.5	20.0	66.0	9.1	8.0	149.0	174.0
Ebonyi South	**Ohaozara-** Uburu	Engbe	239	4.5	5.0	1.6	1.0	7.7	1.3	8.5	87.0	10.5	9.5	149.0	174.0
	Eweze-Ihenu	Enegbe	247	2.6	4.1	1.6	1.9	10.0	1.6	16.0	65.0	10.4	8.3	149.0	174.0
	Ivo- Ishiagu	Nka	265	3.0	**6.3n**	1.9	2.4	9.2	1.7	26.0	40.0	9.3	7.1	154.0	179.0
	Okue	Nka	274	3.0	4.9	1.8	2.0	7.5	2.0	28.0	89.0	9.6	7.8	169.0	183.0
	Afikpo South	Nkwenyi	284	3.0	4.9	1.4	1.3	**17.1r**	1.8	17.0	79.0	9.0	7.7	139.0	165.0
	Owutu	Oko	286	4.3	5.1	2.3	2.7	13.4	1.7	22.1	45.0	**13.4n**	9.1	174.0	195.0
	Oso Edda	Nkwenyi	302	1.0	4.4	1.6	3.0	3.8	1.5	19.0	35.0	10.8	9.0	142.0	169.0
		Oko	303	3.1	5.3	1.7	1.9	5.2	1.6	12.0	90.0	9.0	7.4	183.0	199.0
Mean				**2.6**	**4.8**	**1.7**	**2.5**	**8.9**	**1.7**	**15.8**	**72.7**	**10.5**	**8.1**	**164.3**	**187.9**
Three leaf yam or bitter yam (*Dioscorea dumetorum*)															
Ebonyi North	Ohaukwu	Una	110	2.2	4.6	1.60	1.7	4.7	1.8	5.3	206.0	10.8	8.0	131.0	155.0
Ebonyi Central	Ezza South Um	Una	176	1.3	4.0	1.64	2.8	11.1	1.5	7.6	**212.0n**	12.6	9.2	139.0	169.0
Ebonyi South	Owutu Edda	Una	287	4.0	4.6	1.43	2.3	14.3	**2.2r**	8.3	140.0	**14.3h**	**13.0h**	141.0	151.0
Ebonyi South	Oso Edda	Una	304	2.4	5.0	1.40	1.0	11.1	1.5	4.3	100.0	12.5	11.0	141.0	169.0
Mean				**2.5**	**4.5**	**1.52**	**1.9**	**10.3**	**1.7**	**6.4**	**114.5**	**12.6**	**10.3**	**138.0**	**161.0**
Ariel yam accessions or air potato (*Dioscorea bulbifera*)															
Ebonyi Central	**Ezza S.UM.I.**	Edu	177	4.0	4.1	1.73	1.0	10.4	1.8	6.6	**231.0h**	12.0	12.0	85.0	115.0
	Ikwo NdufuAl	Edu	223	1.5	3.7	1.98	1.0	9.0	1.4	2.3	115.0	11.9	11.0	90.0	121.0
Ebonyi South	Afikpo S.Owut	Edu	290	1.9	4.1	1.68	1.0	3.1	1.3	4.6	63.8	11.4	11.0	109.0	129.0
Mean				**2.5**	**4.0**	**1.79**	**1.0**	**7.5**	**1.5**	**4.9**	**136.6**	**11.8**	**10.1**	**94.7**	**121.7**
SE				**2.3**	**2.1**	**0.5**	**1.4**	**3.7**	**1.1**	**8.0**	**105.6**	**2.4**	**2.4**	**78.1**	**98.2**
CV.%				**77.4**	**8.1**	**2.4**	**78.8**	**46.6**	**62.3**	**61.3**	**74.8**	**44.4**	**30.8**	**24.0**	**27.0**

Source: Field Survey 2016 And 2017. Plot Id-Identity Of The Plot. Nsp-Number Of Sprout, Sprout Len.–Length, Sprout D.-Diameter, NIN – Number Internode Before The First Branching, ILE (Cm) – Internode Length Measured In Centimeter, India – Internode Diameter, NVP – Number Of Vine Per Plant, Nlv – Number Of Leaf. Lvle – Leaf Length. Lvwi – Leaf Width Cm/Plant. Min – Minimum, Max – Maximum. H -Highest Scored Value, N- Second, R – Third And T – Fourth Highest Recorded Value

- **Leaf length (Lvle cm):** Accessions of *Dioscorea dumentorum* produced the longest leaves (12.6cm) in 2016 compared to 2017 (11.5cm) (Table 15 – 18). Statistical similarity was observed for length of leaves in both seasons for *Dioscorea bulbifera* and *Dioscorea alata accessions* at species level, respectively. The smallest leaf length which was almost similar in both seasons was observed for *Dioscorea rotundata* (8.4 and 8.8cm) among other species. This suggested that variations occurring at leaf length were mainly species. Leaf length can be used as a discriminant factor among the *Dioscorea species*.
- **Leaf width (Lvwi-cm):** A similar trend as in leaf length was repeated for leaf width. The result showed that *Dioscorea bulbifera* produced the widest leaves in both seasons and higher than all the other species. Widest leaves range from 11.3cm to 11.9 cm produced by *Dioscorea bulbifera* accessions in 2016, while other species had increase for leaf width in 2017 planting season. The narrowest leaves were found in *Dioscorea rotundata* (6.1cm - 6.4cm) reduced in comparison to other species (Table 18).

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Howerver, some accessions of both white yam (Ishitu 9.9cm, Nwopoke 9.6cm, Okpebe 8.2, Akamunze 8.1-8.6 and Obiaoturugo 5.5-8.5), water yam

- (Nvula 6.7 – 11.7cm, Okwalenwankata 10.5 – Igborogidi 9. 4 – 12.2cm and Nvula Agbirigba 12. 5cm), yellow yam (Oko 6.2 – 11.0cm), three leaf yam (Una 8.0 – 13.0cm) and aerial yam Edu (11.0 – 12.0cm), produced far higher than their group mean values.

Table 18: Mean and Coefficient of Variation Distribution for Quantitative Phenotypic Traits for Different *Disoscorea Species* Across the Two Seasons

Species	Number of sprout 2016 2107		Sprout length (cm) 2016 2017		Sp. diameter (cm) 2016 2017		Number of internode bb 2016 2017		Internode length (cm) 2016 2017		Internode diameter (cm) 2016 2017		Number of vine per plant 2016 2017		Number of leaf per plant 2016 2017		Leaf length (cm) 2016 2017		Leaf width (cm) 2016 2017		Maturity time (days) 2016 2017	
D. rotundata	2.7	2.5	4.7	4.4	1.7	1.7	2.4	1.8	10.1	9.0	1.6	2.0	18.4	17.3	57.1	54.4	8.4	8.8	6.4	6.1	124.5	139.5
D. alata	3.6	3.7	4.2	4.1	1.7	1.8	1.5	1.1	4.7	5.5	1.7	1.7	5.0	4.5	115.3	109.8	11.5	11.6	9.4	9.3	141.0	137.5
D. cayenensis	2.6	2.3	4.5	4.4	1.7	1.8	2.5	1.7	9.5	9.3	1.6	1.9	15.5	14.9	79.4	67.1	10.0	10.2	8.0	6.9	155.5	149.5
D.dumentorum	2.2	1.8	4.2	4.8	1.6	1.7	1.9	2.2	10.0	6.1	1.6	1.8	8.0	6.8	132.8	96.7	12.3	11.5	10.0	8.2	141.4	147.5
D.bulbifera	2.4	2.7	4.5	4.2	1.6	1.7	1.0	1.4	6.7	9.2	1.5	1.0	4.4	5.2	132.0	141.1	11.7	11.6	11.3	11.9	104	110.0
Mean	**2.7**	**2.6**	**4.4**	**4.4**	**1.7**	**1.7**	**1.9**	**1.6**	**8.2**	**7.9**	**1.6**	**1.7**	**10.3**	**9.8**	**103.3**	**93.8**	**10.8**	**10.7**	**9.1**	**8.5**	**133.3**	**136.8**
CV %	**26**	**28**	**5**	**6**	**4**	**26**	**69**	**79**	**47**	**44**	**5**	**9**	**62**	**61**	**74**	**75.6**	**12**	**27**	**31**	**31**	**15**	**12**

Field Data 2016 And 2017: NTB/NBH-Number Of Tuber Harvested/Number Bulbs Harvested, TBW/BW (Kg)- Total Tuber Weight/Bulbs Weight Measured In Kilogram,NSY-Number Of Seed Yam, WSY- Weight Of Seed Yam, NWY-Number Of Ware Yam Per Plot,WWY- Weight Of Ware Yam Per Plant, Tuber Length And Tuber Width Per Plant

- **Days to 50% leaf senescence or maturity time (days):** Result indicated that accessions of *D. cayenensis* took longer days to 50% leaf senescence (149.5-155.5 days) in both seasons, compared to other species. The maximum days to leaf senescene or maturity was recorded among accessions of Oko collected from Ezza North (190 - 221 days) and Oko accessions collected from Abakaliki (189 – 212 days) (Table 17). This was closely followed by accessions of *D. dumentorum* (147.5 and 141.4 days) and *D. alata* (141 and 137 days), respectively in 2016 and 2017 planting seasons at species level. The lowest number of days to senescence was recorded for accessions of *D.bulbifera* in both seasons (Table 18). The mean with high coefficient variation value indicated high phenotypic diversity among the species for the trait examined. The senescence of leaf is a mark of maturity, hence result agreed with farmers' assertion that some yam accessions and species were either early, intermediate or late maturing. In this work, late maturity could be assigned to yellow yam as indicated by the mean, evidently revealing the indigenous knowledge of farmers. Accessions of *D. bulbifera* were implicated to be early maturing followed by some accessions of *D. alata* (Nwopoke offu nvula and Okwalenwanta) and *D. rotundata* (Abi or Amage or Ibada/Iboki, Ojoeso and Usuekpe). These accessions mature as early as from 90 days to 119 days. However, *D.rotundata*, *D. alata* and *D. dumentorum* were indicated to have either intermediate or late maturity among the accessions and species (Table 15 –18).

➢ *Yield and Yield Components Characterization of Grown Accessions*

Mean values and percentage coefficient of variation were used to evaluate total number of tuber harvested, number of seed yam, weight of seed yam, number of ware yam and weight of ware yam,tuber length and width all recoreded per plant. Percentage coefficient of variation of agromorphological yield data results indicated that 11 out of 19 yield quantitative traits among the accessions manifested high (CV> 50%) coefficients of variation for the traits examined. Howerver, phenotypic variance less than 25% (CV< 25%) were observed for tuber width in 2016 planting season (Table 19 – 22).

- Number of tubers harvested per plant: Tables 19 – 22 results revealed that different accessions and species produed range of tubers (1–1.5 and 2 –28 tubers/plant). Accessions of *D. rodunata* (Nyeji – 24.5, Akiri – 20.5 and Agba 18 tubers) from Okposi Umogharu in Ezza North,Umunwagu Idembia in Ezza South and Oso and Owutu Edda in Afikpo South LGAs produced the second to the highest number of tubers among accessions and 13.0 tubers per plant among the species in both seasons (Table 20 and 24). Accessions of *D.alata* (Mbula Paul, Nneonwuka and Nvula, and Opanwankata) from Oso Edda, Urobo and Ndiegu Okpuitumo in Afikpo South, Ohaozara and Abakaliki LGAs respectively, produced the highest number of tubers per plant (28.0, 25.5 and 26.0 tubers) among the accessions and species (19.5 and 25.6 tubers) in the two seasons. This was attributed to multiple sprouting as the highest number of sprout per plant was observed among the accessions. However, highest number of tubers with high percentage coefficient of variation 83% and 73% were produced in 2017 planting season with lesser bulbs in comparison to 2016 (Table 23 and 24).

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Table 19: Combined mean and Coefficient of Variation for Quantitative Yield Data for White Yam Accessions

Senatorial Zone	LGA/Community	Access.name	Plot Id	Number of tuber harvest.	Tuber weight kg/plant	Number of seed yam	Weight of seed yam Kg/plant	Number of ware yam/p	Weight of ware yam Kg/plant	Tuber length (cm)	Tuber width (cm)
Ebonyi North	Community	Jioke	101	6.0	2.1	6.0	2.1	0.0	0.0	20.2	11.5
	Amaoffia	Nwopoke	102	4.0	2.0	3.0	0.6	1.0	1.4	15.3	10.2
		Obela	103	7.0	4.6	5.0	1.4	2.0	3.2	18.2	10.9
		Ozibo	105	10.0	8.1	7.0	2.4	3.0	**5.7t**	22.3	13.3
		Utsuekpe	106	5.5	3.5	4.0	1.7	1.5	1.9	27.2	13.7
	Umuezeaka	Obela	116	10.5	7.7	9.0	4.7	1.5	3.0	21.1	12.7
		Okpebe	118	5.0	3.6	3.5	1.1	1.5	2.5	20.6	11.4
		Ozibo	119	2.5	2.5	1.0	0.7	1.5	1.9	16.7	12.0
		Usuekpe	120	6.0	3.3	5.0	2.1	1.0	1.2	**29.1t**	10.4
	Abakaliki	Amage	121	3.5	2.3	3.0	1.4	0.5	0.9	26.1	10.7
	Ndiegu-Okpu.	Igum	122	3.5	2.3	3.5	2.3	0.0	0.0	18.9	11.2
		Jimmanu	123	13.0	7.4	11.0	5.1	2.0	2.3	20.8	14.6
		Okpebe	124	11.0	6.4	9.0	2.5	3.0	3.7	26.9	12.5
		Ozibo	125	4.0	2.5	3.0	0.7	1.0	1.8	18.6	11.0
	Ndiabor-Okpu.	Amage	133	6.5	7.1	3.0	1.2	**3.5t**	**5.9t**	**29.0t**	13.7
		Igum	134	17.0	6.5	16.0	5.2	1.0	1.3	20.4	10.7
		Jimmanu	135	6.5	6.7	5.0	2.7	1.5	4.0	18.3	10.3
		Nwopoke	136	11.5	5.8	10.5	2.7	1.0	3.1	18.9	12.4
		Ogbaruogbiya	137	5.0	3.1	4.0	2.0	1.0	1.1	18.9	12.4
		Okpebe	139	5.5	4.7	4.0	1.6	1.5	3.1	25.6	10.9
	Izzi	Akamunze	140	9.0	2.3	9.0	2.3	0.0	0.0	23.8	8.6
	Igbeagu	Amage	141	7.5	8.0	3.0	2.1	**4.5r**	**5.9t**	27.2	12.7
		Igum	142	10.0	1.8	10.0	1.8	0.0	0.0	14.2	8.3
Ebonyi North	Igbeagu	Okpebe	143	15.0	4.5	14.5	3.8	0.5	0.9	22.2	8.5
	Igbeagu	Ozibo	144	5.5	1.8	5.0	0.9	0.5	0.9	14.6	8.2
	Ndieze	Amage	156	8.5	7.0	5.0	2.5	3.5	4.5	27.8	10.5
		Ayaragu	157	3.0	1.1	2.5	0.5	0.5	0.6	19.0	7.7
		Igum	158	8.5	4.7	7.5	3.2	1.0	1.6	19.5	10.5
		Jioji	159	5.0	2.2	4.5	1.4	0.5	0.8	24.7	9.5
		Obela	160	1.5	0.5	1.5	0.5	0.0	0.0	14.6	8.9
		Ogbagharuogbia	161	10.5	3.3	10.0	2.6	0.5	0.9	17.0	11.3
		Okpembe	162	10.5	4.1	10.0	3.4	0.5	0.7	24.1	10.0
		Ozibo	163	7.0	5.0	5.0	3.0	2.0	2.1	21.2	12.8
		Ozibo wire	164	4.5	3.4	3.0	1.3	1.5	2.1	24.5	14.8
Ebonyi Central	**Ezza North**	Abi	166	4.5	3.4	3.5	2.1	1.0	1.3	**30.0r**	11.2
	Umu. Idembia	Igum	167	8.5	3.7	7.5	2.4	1.0	1.2	19.3	12.3
		Jimaka	168	4.0	2.8	3.0	1.7	1.0	1.1	22.7	10.5
		Jimanu	169	9.0	4.5	8.0	3.4	1.0	1.1	24.3	10.6
		Nyeji	170	**24.5r**	5.8	**24.0r**	5.2	0.5	0.7	23.5	8.1
		Obiaoturugo	171	8.0	4.5	6.5	2.1	1.5	2.4	17.7	14.1
	Amagu	Abi	181	6.5	2.7	6.5	2.7	0.0	0.0	28.2	7.9
Ebonyi Central		Igum	182	7.0	3.5	6.0	2.4	1.0	1.0	15.7	11.5
		Nnebiji	183	7.5	3.6	7.0	2.3	0.5	1.3	17.9	9.5
		Nyeji	184	22.5	6.0	**22.5t**	**6.0t**	0.0	0.0	22.6	8.4
	Ezza North	Akamunze	186	6.5	2.4	5.5	1.2	1.0	1.2	21.1	9.8
	Umogharu	Iboki	187	4.5	2.7	4.0	1.1	0.5	1.6	21.1	9.6
		Igum	188	11.0	4.9	9.0	2.8	2.0	2.1	19.1	10.8
		Nyeji	189	20.0	8.9	18.5	**6.2t**	1.5	2.6	25.0	9.7

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Ebonyi Central	Community	Okpembe	192	14.5	2.9	14.0	2.1	0.5	0.8	18.2	7.1
	Umogharu	Usuekpe	193	3.0	0.4	3.0	0.4	0.0	0.0	16.6	6.1
		Ojioso	194	3.0	2.8	2.5	0.9	0.5	2.0	25.2	10.9
		Obiaoturuo	195	5.0	1.5	5.0	1.5	0.0	0.0	16.4	7.2
	Okposi UM.	Akamunze	201	6.5	1.9	6.5	1.9	0.0	0.0	22.9	11.8
		Iboki	202	2.0	2.3	1.0	0.5	1.0	1.9	23.5	11.8
		Igum	203	13.5	7.9	12.0	4.1	1.5	3.8	**37.8h**	10.6
		Nyeji	204	**24.5r**	4.3	24.0	3.5	0.5	0.8	26.3	8.5
		Okpebe	207	3.5	2.2	3.0	1.6	0.5	0.7	24.9	9.6
		Ozibo	208	5.5	1.8	5.0	1.3	0.5	0.5	16.3	8.4
		Usuekpe	209	3.0	1.8	1.0	0.3	2.0	1.5	18.6	8.9
	Ikwo	Amage	210	12.5	8.0	10.0	4.4	2.5	3.6	22.8	11.7
	Ndufu-Alike	Nebinji	213	8.5	6.1	6.5	3.2	2.0	2.8	21.5	9.3
		Obiaoturugo	214	8.0	7.8	5.0	3.1	3.0	4.7	25.8	11.8
		Ojioso	215	10.0	6.0	8.0	3.6	2.0	2.4	**28.9t**	9.0
		Ewada	218	2.5	2.7	1.0	0.8	1.5	1.9	19.3	**15.8t**
		Ibada	219	4.5	2.7	4.0	1.9	0.5	0.8	25.3	8.5
	Ekpelu-Amak	Agbabro	227	7.5	4.3	6.0	1.9	1.5	2.4	19.9	7.3
		Ibada	228	4.0	3.8	2.5	1.1	1.5	2.8	25.1	10.4
		Igum	229	5.5	3.0	5.0	1.9	0.5	1.1	20.6	11.0
		Nnebinji	230	4.5	3.5	3.0	1.3	1.5	2.2	17.8	9.2
		Nwagbam	231	5.0	1.6	5.0	1.6	0.0	0.0	**29.7r**	12.6
		Obia	232	6.0	2.3	5.5	1.7	0.5	0.6	19.9	10.0
		Ojeoso	233	6.5	6.1	6.0	4.9	0.5	1.2	18.0	6.7
Ebonyi South	Orobo Uburu	Abi	236	10.5	8.7	6.0	4.2	**4.5r**	4.4	30.1	10.9
		Agba	237	11.0	3.8	10.5	3.3	0.5	0.6	16.5	9.2
		Ekowenyi	238	5.5	2.3	5.5	2.3	0.0	0.0	18.9	11.4
		Nnebiji	241	8.5	5.1	7.5	2.9	1.0	2.3	15.0	12.2
		Obiaoturugo	242	15.5	9.0	13.0	**6.0t**	2.5	3.1	22.7	10.9
	Eweze-Ihenu	Abi	245	4.5	2.7	4.0	2.0	0.5	0.7	26.5	7.6
		Agba	246	5.5	2.3	5.5	2.3	0.0	0.0	15.2	9.2
		Obiaoturugo	249	17.5	7.8	15.5	4.3	2.0	3.5	14.6	11.4
		Okpebe	250	8.5	2.6	6.5	0.6	2.0	2.0	23.9	8.0
Ebonyi South	**Ivo**	Ayaragu	258	9.5	5.6	9.0	4.8	0.5	0.9	**30.5r**	10.2
	Ishagu-Amag.	Agba	259	7.0	5.4	5.0	1.5	2.0	4.0	20.5	11.4
		Igum	260	6.0	2.8	5.5	2.2	0.5	0.6	24.0	11.5
		Obiaoturugo	261	7.5	4.0	7.0	3.2	0.5	0.8	20.6	9.7
		Orumeh	262	10.5	7.5	6.5	3.5	**4.0t**	4.0	27.9	10.1
		Orunte	263	5.5	4.9	3.0	1.3	2.5	3.7	15.8	10.2
		Paper	264	3.5	2.3	3.0	0.5	0.5	1.8	23.0	11.3
	Okue	Ogbeka	266	4.0	2.9	2.5	0.9	1.5	2.0	24.2	9.3
		Agboji	267	4.0	1.7	3.5	0.9	0.5	0.8	22.2	10.9
		Igum	268	4.0	2.2	4.0	2.2	0.0	0.0	**35.9n**	12.9
		Obiaturugo	269	6.5	3.6	5.5	1.9	1.0	1.7	19.5	10.5
		Orumeh	270	6.5	4.1	5.5	2.8	1.0	1.3	25.8	11.4
		Orunte	271	7.5	3.3	6.5	1.9	1.0	1.0	19.0	10.7
Ebonyi South	Owutu Edda	Abi	278	4.0	2.7	3.0	1.2	1.0	1.5	17.6	8.2
		Agba	279	5.0	2.0	4.5	1.5	0.5	0.5	14.9	9.0
		Akiri	280	**20.5**	3.2	18.5	1.1	2.0	2.1	24.6	9.6
		Ewada	281	4.5	5.5	3.0	1.3	1.5	4.2	19.5	16.4
		Ipe	283	7.5	3.1	7.5	3.1	0.0	0.0	23.4	10.1
		Obiaoturugo	285	9.0	4.6	7.0	2.6	2.0	2.0	24.5	10.6
	Oso Edda	Obiaoturugo	291	13.0	3.4	13.0	3.4	0.0	0.0	21.7	11.6
		Agba	293	18.0	6.5	16.0	4.3	2.0	2.2	18.7	10.7

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		Akiri	294	17.0	6.6	16.0	5.0	1.0	1.6	19.4	11.1
		Igum	295	13.5	6.3	10.0	2.8	**3.5t**	3.5	21.7	12.3
Mean				**13.0**	**4.1**	**11.8**	**2.4**	**1.2**	**1.8**	**22.4**	**10.6**
SE				**1.65**	**1.9**	**5.2**	**0.8**	**0.4**	**0.5**	**6.7**	**3.7**
CV				**51.0**	**87.9**	**70.0**	**54.7**	**50.0**	**59.0**	**37.0**	**32.4**

Source: Field Survey 2016 and 2017. SE – Standard Error of the Mean. C.V. Percentage Coefficient of Variation

- **Total tuber weight (TBW (kg)/plot):** Results revealed that *D. alata* produced the weightiest tubers (6.0kg and 6.8kg) per plant, within accessions and between species across the seasons. The greatest variability for this traits was found within *D. alata* (6.0 kg and 6.8 kg/plant), followed by *Dioscorea rotundata* (3.6 kg and 4.5kg/plant) and *Dioscorea cayenensis* (3.9 kg and 4.0 kg) and *Dioscorea domentorum* (2.6 kg and 3.5kg per plant) (Fig.1). In this, *D. rotundata* produced a total number of (26) and weighed 28.1 kg per plant, while 25.5 and 28.0 tubers for *D. alata* weighed 12.9 kg and 9.8 kg respectively for accessions of Nneonwuka and Mbula Paul all from Afikpo South LGA in Ebonyi South Senatorial Zone of Ebonyi State. Accessions *D.bulbifera* from Ezza North and South in Ebonyi Central produced bulbs of 179.0 weighing 7.8 kg, while 232.0 weighed 6.8 kg per plant (Table 22). Although a wide range of variability exist among the accessions within the accessions and species, the weightiest tubers obtained for *D. alata* accessions could be attributed to high water content of the tuber as also noted by farmers that *D. alata* derived its name due to high water content and this shown in (Fig.1).
- **Number of seed yam (NSY):** Accessions of *D. alata* produced the highest mean number of seed yams per plantt (19.5 and 23.6) among the species across seasons. Accessions of *D. rotundata* and *D. dumetorum* witnessed increased number of seed yam in 2016 planting seasons, while *D.alata, D. cayenensis* and *D.bulbifera* produced more seed yams/bulbs in 2017 than in 2016 planting seasons, respectively.

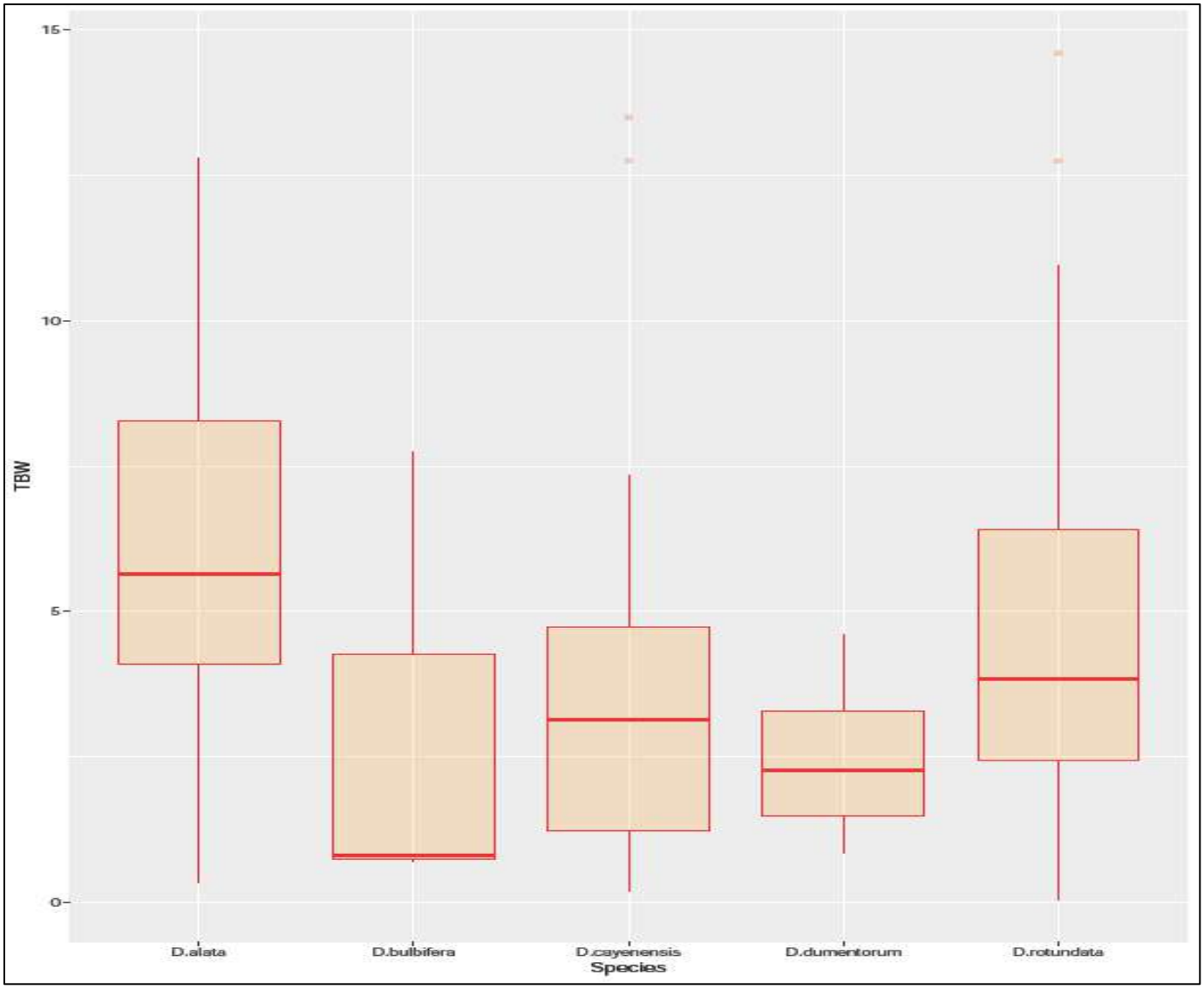

Fig 1: Moustache Box Plot of Total Tuber Weight (Kg)/Plot among Five Species of Yam

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Table 20: Combined Mean and Coefficient of Variation for Quantitative Yield Data for Water Yam Accessions

Senatorial Zone	LGA/ Community	Access.name	Plot Id	Number of tuber harvest.	Tuber weight kg/plant	Number of seed yam	Weight of seed yam Kg/plant	Number of ware yam/p	Weight of ware yam Kg/plant	Tuber length (cm)	Tuber width (cm)
Ebonyi North	Ohaukwu	Mbala	107	13.0	7.0	9.5	2.8	3.5	4.2	17.9	14.6
	Amaoffia	Nwawafu	109	23.5t	8.3	22.0t	5.1	1.5	3.2	19.3	15.1t
	Umuezeaka	Egboru	111	18.0	9.4	15.5	6.7r	2.5	2.7	17.7	13.9
		Mbala	112	14.5	9.8	9.5	2.0	5.0n	7.5n	19.7	14.4
		Nwawafu	113	10.5	6.6	8.0	3.6	2.5	3.0	19.0	14.7
	Umuezeaka	Nneonwuka	114	3.5	2.0	3.5	1.9	0.0	0.0	25.4	17.0r
	Abakaliki	Nvula	127	15.0	8.3	12.5	4.7	2.5	3.6	19.9	16.5r
	Ndiabor-Okpu.	Okwalenkata	128	19.5	12.0r	17.0	8.1n	2.5	3.9	20.8	13.3
		nvulamanu	129	24.0t	13.5h	19.5	8.0n	4.5r	5.5t	21.0	13.2
	Ndiegu-Okpu.	Nvulamanu	130	10.5	3.3	9.5	2.0	1.0	1.3	17.7	11.3
		Okwalenkata	131	9.5	3.6	8.5	2.5	1.0	1.1	14.7	10.6
		Nvula	132	11.0	8.7	3.0	0.6	8.0h	8.1h	18.3	10.3
	Izzi	Nvula	146	25.5n	6.0	25.5n	5.9	0.0	0.0	18.2	12.7
	Igbiegu	Okwalenktata	147	19.5	9.5	16.5	5.3	3.0	4.2	20.0	14.9
		Nvulambube	148	8.5	2.7	8.5	2.7	0.0	0.0	17.1	9.5
		Opokenvula	149	5.0	1.7	5.0	1.7	0.0	0.0	12.1	6.5
		Nwopokeofu	150	17.0	5.6	16.0	4.0	1.0	1.6	16.7	12.1
		Nvula mme	151	9.0	7.7	5.0	2.2	4.0t	5.5t	20.6	11.9
	Ndieze	Akpuruakputu	152	4.0	2.2	3.0	1.2	1.0	1.0	18.4	12.5
		Nwawafu	153	14.0	7.9	11.0	3.6	3.0	4.3	17.6	13.3
		Opokeffu	154	9.0	4.5	7.0	2.0	2.0	2.5	17.5	14.7
Ebonyi Central	Ezza South	Nwawafu	173	18.5	8.7	17.5	6.7r	1.0	2.0	20.4	14.3
	Umu. Idembia	Nvula	174	9.5	5.8	7.5	3.1	2.0	2.7	22.3	13.6
		Nvulamanu	175	12.0	7.2	10.5	4.0	1.5	3.2	19.3	11.6
Ebonyi Central	Amagu	Nvula	178	18.0	8.8	14.5	5.0	3.5	3.8	26.5	11.6
		Nvula mme	179	14.5	8.9	12.5	5.9	2.0	3.0	19.9	13.6
		Opalenkata	180	15.0	7.9	13.5	4.6	1.5	3.3	17.6	13.5
	Ezza North	Nwawafu	196	18.5	6.9	17.0	5.5	1.5	1.4	16.0	12.3
	Umuogharu	Okwalenkata	197	22.0	8.8	21.5	8.1n	0.5	0.7	18.5	12.8
	Okposi Umu.	Okwulenkata	198	9.0	5.3	8.0	3.6	1.0	1.7	18.2	15.6
		Nvula	199	15.5	7.7	13.0	5.5	2.5	2.2	19.3	12.8
		Nwawafu	200	15.0	6.9	13.5	4.4	1.5	2.5	15.6	13.3
	Ikwo	Caret yam	211	13.0	8.4	10.5	3.3	2.5	5.1t	21.6	13.0
	Ndufu-Alike	Mkpueke	212	12.0	2.8	12.0	2.8	0.0	0.0	9.9	10.2
		Onyeoma	217	6.0	2.7	4.5	1.3	1.5	1.4	15.5	9.7
		Nvula	220	14.0	6.2	13.0	4.6	1.0	1.6	19.0	12.6
		Nvulamme	221	12.5	5.9	12.0	4.5	0.5	1.4	21.8	11.4
	Ekpelu-Amak.	Opalenkata	222	14.0	4.7	13.5	3.6	0.5	1.1	16.5	11.5
		Uranium	225	5.5	3.0	4.0	1.2	1.5	1.8	19.4	13.6
		Agbirigba	226	20.0	11.9	12.0	4.0	6.0	7.9h	18.3	14.6
		Ajingworo	229	6.0	6.7	3.5	1.9	2.5	5.1t	36.7n	19.3h
		Nwiba	235	9.0	3.7	7.5	2.1	1.5	1.6	28.3	12.9
Ebonyi South	Ohaozara	Igborogidi	240	3.0	0.7	3.0	0.7	0.0	0.0	17.1	10.7
	Urobo	Nvula America	243	25.0r	7.5	21.0	3.2	4.0t	4.3	18.1	14.9
		opananwankata	244	26.0n	11.0t	23.0r	6.2t	3.0	4.8	20.8	14.0
		Igborogidi	248	7.0	4.1	6.0	2.5	1.0	1.6	28.2	12.0
		Opananwakata	251	11.0	6.2	9.5	2.9	1.5	3.3	17.2	13.1
	Ishiagu	Mbala	252	17.0	6.6	15.0	4.1	2.0	2.5	15.5	12.7
		Awokenvula	253	21.0	5.7	21.0	5.7	0.0	0.0	20.2	9.7
		Orumehnvula	254	10.0	5.2	6.0	1.4	4.0t	3.8	25.8	10.7
Ebonyi South	Ivo – Okue	Awokenvula	257	19.0	11.1	14.0	5.9	5.0n	5.2t	16.2	11.6
		Makwuruba	272	7.5	2.5	7.5	2.5	0.0	0.0	24.9	12.8
	Owutu-Edda	Mbula	273	15.0	4.2	15.0	4.2	0.0	0.0	12.7	10.2
		MbulaAmerica	275	10.5	7.2	7.0	2.1	3.5	5.1t	11.2	8.6
		MbulaPaul	276	10.0	6.0	6.0	1.5	4.0t	4.5	15.4	12.6
		Igborogidi	277	9.0	4.9	7.5	2.3	1.5	2.6	15.8	12.5
		Ogboja	282	10.0	5.1	9.5	4.1	0.5	1.0	28.5	11.2
		Agbirigba	288	6.0	6.7	3.5	1.6	2.5	5.1t	35.7n	18.5h
	Oso-Edda	Ogboja	289	12.0	8.3	7.5	1.9	4.5r	6.4r	21.5	15.3t
		Igum eluenyim	292	17.0	7.8	15.0	5.0	2.0	2.8	15.6	14.7
		Igum mbula	296	11.5	6.0	8.5	2.6	3.0	3.4	22.1	10.8
		Mbula	297	12.0	4.9	12.0	4.9	0.0	0.0	31.3r	14.8
		Mbula	298	11.0	10.8t	7.0	2.4	4.0t	8.4h	15.4	13.5

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		MbulaAmerica	299	6.0	4.0	6.0	6.0t	0.0	0.0	19.9	18.8h
		Nneonwuka	300	25.5n	12.9n	21.0	6.2t	4.5r	6.7n	16.1	17.9n
		Mbula paul	301	28.0h	9.8	27.5h	9.2h	0.5	0.6	20.0	15.6t
Mean				25.6	12.6	22.0	7.5	3.7	5.2	19.4	12.9
SE				11.7	4.9	10.2	2.6	1.4	2.5	8.9	3.7
CV%				81	85	55	52	88	95	37	25

Source: Field Survey 2016 And 2017. SE – Standard Error of the Mean. C.V. Percentage Coefficient of Variation

- **Weight of seed yam (WSY) (kg):** Accessions of *D. alata* produced the highest mean weight for this trait in 2017 seasons followed by *D. dumentorum* and *D. cayenensis* in both seasons (Table 24), while the least weight of seed yam was obtained for *D. bulbifera* tubers (0.5 kg and 1.3 kg) for bulbils in 2016 and 2017 respectively.
- **Number of ware yam (NWY):** The highest mean number of ware yams was recorded for *D. alata* only in 2016, while 2.1 and 2.5 was recorded for *D. rotundata* in both seasons. This revealed the high yield attributes of the accession. Accessions of *D.alata* and *D. rotundata* in 2016 planting season produced the second highest number of ware yams. The least number of ware yam was obtained for *D. cayenensis* (1.5), while ware yam was not produced in *D. dumentorum* and *bulbifera* in both seasons.
- **Weight of ware yam (WWY) (kg/plantt): t**he highest mean weight (4.5 kg) of ware yam was obtained for *D. alata* in 2016 planting season, closely followed by *D. rotundata* (3.2 kg) in 2016 respectively. However, *D. rotundata* obtained higher mean weight for this trait in 2017 in comparison to other species.

Table 21: Combined Mean and Coefficient of Variation for Quantitative Yield Data for Other Yam Accessions

Senatorial Zone	LGA/Community	Access.name	Plot Id	Number of tuber harvest.	Tuber weight kg/plant	Number of seed yam	Weight of seed yam Kg/plant	Number of ware yam/p	Weight of ware yam Kg/plant	Tuber length (cm)	Tuber width (cm)
Ebonyi North	Amoffia	Ogomodu	104	3.5	2.3	3.0	0.7	0.5	1.6	17.6	11.3
	Umuezaka	Nkpenyi	115	4.0	1.5	4.0	1.5	0.0	0.0	14.7	7.3
	Umuezeaka	Ogomodu	117	3.0	3.4	1.5	0.7	1.5	2.7	18.9	10.8
	Abakaliki	Oko	126	6.5	4.1	5.5	2.7	1.0	1.4	24.5	12.0
	Ndiegu Okpu.	Oko	138	5.5	4.9	3.5	2.0	2.0	2.9	25.4	12.9
	Izzi – igbiegu	Oko	145	2.0	0.8	2.0	0.8	0.0	0.0	18.2	8.2
	Ndieze	Oko	155	3.5	1.4	3.5	1.40	0.0	0.0	19.9	8.8
Ebonyi Central	**Ezza South – Id**	Oko	172	6.0	5.1	4.5	2.9	1.5	2.2	27.0	9.6
	Amagu	Oko	185	6.0	3.9	4.5	1.8	1.5	2.1	**29.6t**	10.2
	Ezza North	Ogomodu	190	5.0	1.8	5.0	1.8	0.0	0.0	20.7	8.2
	Umogharu	Oko	191	7.0	7.2	5.0	2.7	2.0	4.5	21.9	11.0
	Okposi-Umuogh.	Ogomodu	205	3.5	2.5	3.0	1.3	0.5	1.2	25.8	10.4
		Oko	206	6.0	6.2	4.0	2.7	2.0	3.5	23.9	12.2
	Ikwo	Oko	216	9.0	5.5	6.0	2.4	3.0	3.1	24.1	9.8
	Ekpelu	Oko	234	3.0	1.4	3.0	1.4	0.0	0.0	14.8	6.2
Ebonyi South	**Ohaozara-** Uburu	Engbe	239	4.0	2.6	3.5	1.5	0.5	1.1	15.5	8.5
	Eweze-Ihenu	Enegbe	247	4.5	2.5	3.5	0.7	1.0	1.8	20.3	10.0
	Ivo- Ishiagu	Nka	265	6.0	7.4	2.5	1.2	3.5	**6.2**	25.0	11.6
	Okue	Nka	274	6.5	2.5	5.5	1.5	1.0	1.0	21.5	10.6
	Afikpo South	Nkwenyi	284	4.5	2.0	4.5	1.9	0.0	0.0	18.9	7.5
	Owutu	Oko	286	15.5	6.7	14.0	4.6	1.5	2.1	22.5	10.8
	Oso Edda	Nkwenyi	302	11.5	4.2	10.5	2.7	1.0	1.5	13.7	7.2
		Oko	303	9.5	2.6	8.5	1.9	1.0	0.7	18.9	7.6
Mean				**5.9**	**3.6**	**4.8**	**1.8**	**1.1**	**1.7**	**21.0**	**9.7**
Ariel yam accessions or air potato (*Dioscorea bulbifera*) tubers											
Ebonyi North	Ohaukwu	Una	110	11.0	5.8	11.0	5.8	0.0	0.0	10.9	13.3
Ebonyi Central	Ezza South UM.I.	Una	176	4.5	2.4	4.5	2.4	0.0	0.0	10.4	10.1
Ebonyi South	Owutu Edda	Una	287	2.0	1.0	2.0	1.0	0.0	0.0	10.8	11.8
Ebonyi South	Oso Edda	Una	304	10.0	2.7	10.0	2.7	0.0	0.0	11.4	11.1
Mean				**6.9**	**3.0**	**6.9**	**3.0**	**0.0**	**0.0**	**10.8**	**11.6**
Ariel yam accessions or air potato (*Dioscorea bulbifera*) tubers											
Ebonyi Central	**Ezza south UM.I.**	Edu	177	7.0	0.8	7.0	0.8	0.0	0.0	6.9	6.0
	Ikwo Ndufu Ali.	Edu	223	5.0	0.5	5.0	0.5	0.0	0.00	7.0	5.6
Ebonyi South	**Afikpo South Ow.**	Edu	290	8.0	1.3	8.0	1.3	0.0	0.00	8.1	7.5
Mean				**6.7**	**0.9**	**6.7**	**0.9**	**0.0**	**0.0**	**7.3**	**6.4**
Ariel yam accessions or air potato (*Dioscorea bulbifera*) bulbs											
Ebonyi Central	**Ezza south UM.I.**	Edu	177	179.0	7.8	179.0	7.8	0.0	0.0	6.6	4.5

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	Ikwo Ndufu Ali.	Edu	223	232.0	6.8	232.0	6.8	0.0	0.0	5.4	5.2
Ebonyi South	**Afikpo South Ow.**	Edu	290	126.0	3.5	126.0	3.5	0.0	0.0	7.2	6.0
Mean				**179.0**	**6.0**	**179.0**	**6.0**	**0.0**	**0.0**	**6.4**	**5.2**
SE				**3.4**	**3.9**	**3.2**	**2.6**	**1.0**	**2.5**	**2.1**	**4.8**
CV %				81.0	85.0	50.5	88.0	94.5	95.0	37.0	25.0

Source: Field Survey 2016 And 2017. SE – Standard Error of the Mean. C.V. Percentage Coefficient of Variation. Um I. – Umunwagu Idembia, Ow. – Owutu Edda Afikpo South LGA

- **Tuber length per plant (Tuble-cm):** Accessions of *Dioscorea rotundata* (21.3 cm and 21.7 cm), *Dioscorea cayenensis* (21.4 cm and 21.3 cm) and *Dioscorea alata* (18.6 cm and 20.6 cm) produced longest tubers in the two seasons that were different from each other (Table 22). This suggested that variation occurring at tuber length per plant were mainly within accessions and not between species. Hence, tuber length may be subject to environmental factors like soil nutrient and other photosynthates.
- **Tuber width per plant (Tbwi-cm):** Species of *Dioscorea alata* produced the largest tuber in 2017 planting season which was slightly different from width of tuber in 2016, but differed from tubers produced by *Dioscorea dumentorum* and *Dioscorea rotundata* in 2017 (Table 22). As expected, the width was lowest for accessions of *D. bulbifera*. This implies that some of the accessions and species of yam examined have inherent quality of producing wider tubers than the others within and between species (Table 19 – 22). This also implied that the variation occurring for the traits or characters evaluated are more of generic than phenotypic.

Table 22: Mean and Coefficient Variation Distribution of Yield Quantitative Phenotypic Traits for *Disoscorea species* Across Two Seasons

Species	**Total tuber harvested/plant**		**Tbw kg/plant**		**Nsy/plant**		**Wsy kg/plant**		**Nwy/plant**		**Wwy kg /plant**		**TbLe (cm)/plant**		**Tuber width cm plant**	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
D. rotundata	13.0	13.0	3.6	4.5	10.9	10.5	0.4	1.8	2.1	2.5	3.2	2.7	21.3	21.7	11.0	10.5
D. alata	19.5	25.6	6.0	6.8	15.5	23.6	1.5	4.5	4.0	2.0	4.5	2.3	18.6	20.6	12.4	13.9
D. cayenensis	8.0	12.5	3.9	4.0	4.5	5.1	1.7	2.0	1.5	1.7	2.2	2.0	21.4	21.3	10.2	9.4
D.dumentorum	8.0	8.0	2.6	3.5	7.2	5.3	2.6	2.0	0	0	0	0	9.8	11.8	12.3	11.0
D.bulbifera	5.0	8.0	0.5	1.3	5.0	8.0	0.5	1.3	0	0	0	0	8.8	7.4	6.7	6.1
Mean	**11.3**	**12.6**	**3.3**	**4.0**	**8.6**	**10.1**	**1.3**	**2.2**	**2.8**	**2.3**	**3.3**	**2.3**	**16.0**	**16.6**	**10.5**	**10.2**
CV %	**78**	**83**	**84**	**86**	**30**	**81**	**48**	**53**	**84**	**92**	**93**	**96**	**39**	**35**	**22**	**28**
D. bulbifera bulbs																
	179.0	**223.0**	**7.3**	**7.7**	**179.0**	**223.0**	**7.3**	**7.7**	**0.0**	**0.0**	**0.0**	**0.0**	**6.4**	**5.8**	**5.2**	**4.6**

Legend: TBW/BW (kg)- total tuber weight/bulbs weight measured in kilogram,NSY-number of seed yam, WSY- weight of seed yam, NWY-number of ware yam per plot,WWY- weight of ware yam per plot, tuber length and tuber width per plot

➢ *Phenotypic (Agro-Morphological) Characterization of Yam Accessions Using Qualitative Traits for the Grown Accessions*

Among the 202 accessions planted in two seasons in field experiment, 110 accessions were identified as *D. rotundata*, 63 as *D. alata*, 22 as *D. cayenensis*, 4 as *D. dumentorum* and three as *D. bulbifera* (Table 23 – 29).

- Vine Colour: White yam (*Dioscorea rotundata*): 110 Accessions of *D. rotundtata* exhibited high variability for vine colours (1.8% to 27.7%) ranging from purplish green to green, purple, pink, dark brown, brownish green and light green colourations. However, green and purplish green colours predominated within the two seasons with percentage range of 24.6% to 27.7%, respectively. Accessions of *Dioscorea alata* had the highest purplish vine (75.7%) and less other colourations with exception of pink colours among the yam species. The vines of *D. cayenensis* were brownish coloured with few others of purplish green, dark brown and green colouration. The accessions of *D. dumentorum* were observed to be either purplish green, purple and brownish green whereas *D. bulbifera* accessions had 75% and 25 % for green and brownish green vine colourations respectively. In general, there were high variability of colours among the accessions and species evaluated (Table 23 to 28) and (Appendix II to VI).
- Hairiness (Hos): over 80 % of the accessions had no hairs irrespective of species. However, few accessions (Igum, Obela, Ozibo, Akamunze and Okpebe) of *D. rotundata* (32.7%) were presented with hairiness, while the most dominant in hairiness (100%) among all the specie was *D. dumentorum* (Una) in both seasons, but hairiness were absent in *D. alata*, *D. bulbifera* and *D. cayenensis*, respectively.

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Table 23: Phenotypic Characterization using Qualitative Morphological Traits for White Yam Accessions

Senatorial Zone	LGA/ Community	Access.name	Plot Id	Vine colour	Hairs	Spines on stem	Twine habit	Leaf colour	Leaf shape	Leaf apex sh	Tuber shape	Tuber surf. T.	Tuber Tb.	Position of bran.	Presence of cracks
Ebonyi North	Ohaukwu	Jioke	101	1,2,1	0,1	1,2,	0	3,7,	1,2	6,3	3,4	1,2	5,3	4,3,1	0
	Amaoffia	Nwopoke	102	3, 2,1	0,1	2,1	0	5, 2	1, 2	6,2	3,5	1,2	3,0	2, 4, 5	0
		Obela	103	3,2,1	1,0	0	0	4,2	1,2	2,6	3,4,5	1,2	3,5,0	3,1	0
		Ozibo	105	4	1	0	0	2	1	6	3,2,4	1,2	3	1,2,3	1,3,0
		Utsuekpe	106	2,1	0,1	1,2,0	0	2,7	6,2	6,2	3,4	1,2	3,5	3,4	0,1
	Umuezeaka	Obela	116	6,1,3	1,0	0	0	2,4,7	1,2	2,6	3,5,2	1	5,3,7	4,1	0
		Okpebe	118	6,5	1,0	0	0	7,1	2,1	1,2	3.5	1, 2	3,0	1, 4	0
		Ozibo	119	3,1	0	0	0	2,1	1, 4	6,2,1	3,4	1, 2	3,5	4, 1	0
		Usuekpe	120	5,2	0,1	1,2	0	4,3	2	1,2	3,4	1,2	5, 3	4,1	0
	Abakaliki	Amage	121	2,1	0,1	1,0	0	7,1	1,2	5,6,2	3, 5,4	1, 2	3,5,7	3, 1,4	0
	Ndiegu-Okpuitum	Igum	122	6	1,0	1	0	1	1,2	6,2	3,4	1	3	1,3	0
		Jimmanu	123	2	0,1	0	0	1	1	2,6	2,3	1	3	1, 4	0
		Okpebe	124	3,2,1	0,1	0	0	7,2,4	1	2,6	5,3	1	3,7,5	1	0
		Ozibo	125	3	0	0	0	2	1	2	3,4	1	5,3	2,5	1,0
	Ndiabor-Okpu.	Amage	133	2,1	0	0	0	1,2,7	2,1	5, 6,1	3, 5	1	3, 5	2,3,4	0
		Igum	134	6,5,7	1,0	0	0	1,2	1	6	4,3,2	2,1	3	2,3	0,1
		Jimmanu	135	7,2, 1	0	0	0	1	1,2	6	3,4	1,2	3	3, 1	0,1
		Nwopoke	136	4,3	0	0	0	7,3,1	1,2	2,6	2,3,4	2,1	3	1,4	0,1
		Ogbaruogbiya	137	3	0	0	0	3,1	1,2, 3	6,2	3,4	2,1	3,5	3,1	0,1
		Okpebe	139	7,1,2	0,1	0	0	2,1	2,1	1,2,6	3,4,5	2,1	3	3,2,4	1,0
	Izzi	Akamunze	140	3.4,2	0,1	1,0	0	1,3	1	2, 6	3	2,1	0	1,4	1,0
	Igbeagu	Amage	141	1,2,3	0,1	0	0	3,2,7, 4	1, 2	5,2,6	3, 5	2,1	0,1	2,4	1,0
	Igbeagu	Igum	142	4,6,2,5	1,0	1,2,0	0	4,5,7	6,2	6,2	3,4,2	1,2	3	2,4	1,0
Ebonyi North	Igbeagu	Okpebe	143	2,1,7	0	0	0	3,7	1,2	6,1,2	3,5	2,1	3	3,4	1,0
	Igbeagu	Ozibo	144	2	0	0	0	2,1	1	6,2	2,3,4	2,1	3,5	3,2,1	1,0
	Ndieze	Amage	156	1,2	0	0	0	3,7	5,3	6	2	1,2	3	1,3	0
		Ayaragu	157	2,1	0	0	0	7,2,4	2,1	6,5,2	3,5,2	1,2	3,5	3, 1	0,1
		Igum	158	1	1	1	0	1	6	6	3	1	3	3	0
		Jioji	159	6,3,1	1,0	0,1	0	2,1	6,2	6,2	3,4	1,2	3,5	3, 4	0
		Obela	160	3,2	0	0	0	1	2	6	3	2,1	7,5	2,4	0
		Ogbagharuogbia	161	2,1	0	0	0	4	5	6,2	3	1	3	1	1
		Okpembe	162	6,3,2	0	0	0	2,7,1	3	6,2	3,5,4	1,2	3,5	3	0,1
		Ozibo	163	4,3,1	0	0	0	1,3,4	1,2	2,6	3,5	1	3	1	1,0
		Ozibo wire	164	2,3,7,1	0	0	0	1,2,3	4,3, 2	6	3,5	1,2	3	1	0,1
Ebonyi Central	Ezza South	Abi	166	1	0	0	0	2,1	1,2	2,1	3,5	1	3,5	2,4,1	0,1
	Umu. Idembia	Igum	167	2,1	0	0	0	4,2	2,1	6	3	1	3,0	2,1	1,0
		Jimaka	168	2,1	1,0	0	0	1,2	2,1	5,2	4,3,5	1	3	2,4	1,0
		Jimanu	169	2,6,7	1,0	0	0	7,4,3	2,1	6	3,2,4	1	3,5	2,3	1,0
		Nyeji	170	2,6,1	1,0	0	0	2	2,1	6, 2	3,5	1, 2	3	3,2	1,0
		Obiaoturugo	171	1,2,6	1,0	0	0	2,3,5	2	6,2	3,5	1,2	3,5	3,4,2	1,0
Ebonyi Central	Ezza South	Abi	181	2,1,3	0,1	0	0	5,3	3,2	5,6	3,5	1	3,5	2,3	0,1
	Amagu	Igum	182	3,6,2	1,2	1,2	0	5,6,1	2,1	6,2	4,2,3	1,2	3,5,7	2,3	0,1
		Nnebiji	183	5,2,3	1	2,1	0	2,7	2,1	1,2	3,5	1	3	1,3,4	0,1
		Nyeji	184	2,5	0,1	0	0	5,4	3,2	6	3,5	1,2	5,7,3	2,3	0
	Ezza North	Akamunze	186	4	1	1,2	0	2,1	1	2	3	2,1	3	2,4	0
	Umogharu	Iboki	187	1,2	0	0	0	7,3	2,5	5,2	3,5	2,1	3	3,1,4	0
		Igum	188	4,3,2	1,0	0,1,2	0	1,2	2,1	6,2	3,2,4	1,2	3	3	0
		Nyeji	189	2,1,7	1,0	0	0	4,3,5	2	6	3,5	2,1	3,5	3	0,1
Ebonyi Central	Ezza North	Okpembe	192	4,3,2	0	0	0	7,2	1	2,6	3,5	1	3,5	3	0,1
	Umogharu	Usuekpe	193	1	0	0,1	0	4	2	2,1	3	2,1	3,5,7	3	0,1
		Ojioso	194	6,5	0	0	0	1,2	3	6	3	2,1	5,7,3	3,2,1	0,1
		Obiaoturuo	195	1,3,2	0	0	0	3,7	2,1	6	3,5,2	1,2	3,0,5	3,1,4	0,1

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	Okposi UM.	Akamunze	201	6,1	1,0	1,0	0	1,3	1,2	2,1	3,	1,2	3,5	2,4,1	0
		Iboki	202	1,2	0,1	0,1	0	2,1	2,3	5,3	3,5	1,2	7,5,3	3,2	0
		Igum	203	6,5	1,0	1,0	0	1,4	1,2	6	3,4	1,2	3,5,0	1,3,2	0,1
		Nyeji	204	2	1,0	0	0	7,3	2	6,2	3,5	2,1	3,5	3,1	0
		Okpebe	207	3,2	0	0	0	3	1	2	3	1	5,7	3,4	0,3
		Ozibo	208	2,1	0	0	0	2,3	4,2	6	2,4,3	1	5,3	1,4	0
		Usuekpe	209	1,2	1	1,2,0	0	3,7	2	1	3,5	1,2	5,7	3	0
	Ikwo	Amage	210	2	0	0	0	1	2	5	3	1	5,7	3,1	0
	Ndufu-Alike	Nebinji	213	6,5	1,0	1,0	0	1,2	2,1	1,2	2,4	1,2	1,2	2,4,3	0,1
		obiaoturugo	214	1,2	0	0	0	3	2,1	6,2	3,5	1	1	1,2	0
		Ojioso	215	6,2,3	0,1	0	0	1,4	2,3,1	6,2	3,5	1,2	1,2	1,3	0,1
		Ewada	218	5	0	0	0	7	2	6	4	1	1	2	0
		Ibada	219	1,2	0	0	0	4,5	1,2	6,5	3,5	1,2	7,3,5	3,4	0,1
	Ekpelu-Amak	Agbabro	227	6	0	0	0	1	4	5	3	1	3,5	3,4	0
		Ibada	228	1,2,3	0	0	0	7,2	4,2,1	6,5	3,5	1	3,5	3,1,4	0
		Igum	229	6	1	0	0	1	2	6	3	1	3	3	0
		Nnebinji	230	6	1	1	0	1	2	1	4	1	3	1,3	0
		Nwagbam	231	2	0	0	0	2,1	2	6,2	5	1,2	3,7	3	0
		Obia	232	2,1,5	0,1	0,2	0	4,5	2,1	6,2	4,5	1,2	3,5,7	3,4,1	0,1
		Ojeoso	233	2,1	0,1	0	0	4,5	3,2	6	4,5	1,2	3,5	1,3,4	0,1
Ebonyi South	Ohaozara	Abi	236	1,2	0	0	0	2	2,1	6,5	3,5	1	3,5	3,4,1	0,1
	Orobo Uburu	Agba	237	2,3,7	0,1	0,2	0	1,3	1,2	6,5,2	4,3	1,2	7,3,5	3,1	0,1
		Ekowenyi	238	4,3	1,0	0,1	0	1	2	6	3	1	3	3,4	1,0
		Nnebiji	241	6,2,7,5	1,0	1,2,0	0	1,7	2,1	1,2	4,5,2	1,2	5,3,7	3,1	1,0
		Obiaoturugo	242	2,1	0	0	0	2	2	6,2	3,4,2	1,2	3,5,0	2,1	1,0

Table 23: Continued

Senatorial Zone	**LGA/Community**	**Access.name**	**Plot Id**	**Vine colour**	**Hairs**	**Spines on stem**	**Twine habit**	**Leaf colour**	**Leaf shape**	**Leaf apex sh**	**Tuber shape**	**Tuber surf. T.**	**Tuber Tb.**	**Position of bran.**	**Presence of cracks**
Ebonyi South	Eweze-Ihenu	Abi	245	1,7	0	0	0	4,7	2,1	6,5	3,4,5	1,2	3,7	3,2,1	1,0
		Agba	246	2,5	0	0	0	1,2	4,2,1	5	3,2,5	1,2	5,3,7	1,3,4	0,1
		Obiaoturugo	249	5,2	0	1,0	0	1,2	2,1	5,2,1	2,3,1	1,2	7,3,0	2,1,3	0,1
		Okpebe	250	1,2,7	0	0	0	2	2,1	2,6	3,5	1,2	3,7,5	4,2	0,1
	Ivo	Otutu	255	2	0	0	0	1	6	5	3	2	3	2	1,0
	Ishagu-Amgu	Ishitu	256	5	0	0	0	1	3	6	3	2	3	2	0
		Ayaragu	258	1	0	0	0	1	1,2	5	3,4	1	3	3	0
		Agba	259	2,5	1,0	0	0	1,2	6,1	5,6	4,2,5	1	3,7,5	1,3	0
		Igum	260	6,7	1	0	0	1,2	2	6,2	4,2,3	1,2	3	1,2,3	0,1
		Obiaoturugo	261	5,2	0	0	0	1,2	2,1	6,2	4,2,5	1	3,5	3,1	0,1
		Orumeh	262	1,7,2	1,0	0	0	1,2	2,3	6,5	3,5,4	1,2	3,5,7	3,4,1	0
		Orunte	263	4,6,2,1	0	0	0	1,2	2	6	4,2	1,2	3,5	2,4	0
		Paper	264	6	0	0	0	1	2	6	3	1	3	3	0
	Okue	Ogbeka	266	3	1,0	0	0	1	2	5	3,5	1	3,5	3	0
		Agboji	267	6	1	0	0	2,1	2	**6**	2,3,4	1,2	3	4,2	0,1
		Igum	268	5,6	1,0	0	0	1,2	1,2	**6**	3,4	1,1	3	3,4	0,1
		Obiaturugo	269	5,2	0	0	0	1,3,7	2,1	6,2	3,2,4	1,2	3,5,0	3,2,4,1	1,0
		Orumeh	270	2,1,6	1,0	0	0	1,3,7	**2**	6	3,5	1	3,7	3,2,1	0
		Orunte	271	4,3	0	0	0	7,2	6	6,2	3,5	1	3	3	0
Ebonyi South	**Ivo**	Awoke	272	6,5,2	0	0	0	2	4,2,1	6	2,3,4	1,2	3	3,1	1,0
Ebonyi South	**Afikpo South**	Abi	278	1,7	0	0	0	1	2,1	6,5	3,5	1	3,5,7	2,4	1,0
	Owutu Edda	Agba	279	5,2	0	0	0	1,7,4	4,2	5,6	3,4,2	1,2	3,5	3,1,4	0
		Akiri	280	1,2	1,0	0,1	0	2,3	2,1	6,5	3,5,4	1,2	3	3,4	1,0
		Ewada	281	2,5	1	0	0	2	2	6,5	3,4	1	7,5	3,1	1,0
		Ipe	283	2,5	0	0	0	1,2	2,1	6	3,2	1,2	5,7	3,4	0

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		Obiaoturugo	285	1,7,2	0	0	0	3,4,1	2	6,2	3,5,4	1	3,5,7,0	3,4,1	1,0
	Oso Edda	Obiaoturugo	291	5,2,7,1	0,1	0	0	1,2	2,1	6,2	3,2	1,2	3,5,0	3,1	1,0
		Agba	293	5,2	0,1	0	0	1,2,7	2,1	6	3,5	1,2	3	3,4,1	1,0
		Akiri	294	1,2	1,0	0	0	1,2	2,1,3	6	3,5,4	1,2	3,5,7	3,1	1,0
		Igum	295	5,6,2	1,0	0	0	1,3,4	2,1	6,2	3,4	1	5,3,7	3,1	1,0

Source: Field Experiment 2016 And 2017. IPGR/IITA,(1997 Descriptors For Yam;Vc-Vine Colour For *D. Rotundata* : 1 – Green 24.6%,2 – Purplish Green 27.7%,3 – Brownish Green 9.1%,4 – Dark Brown 5 – Purple13.6%, 6 – Pink And 7 – Light Green 1.8%. 2. Hairiness On Stem (Hos): 1 – Present Of Hairs 32.7%, 0 – No Hairs 67.3%. 3. Spines On The Stem: 0 – Absent 78.6%, 1 – Few Hairs, 2 – Many Hairs 2.7 Twht – Twining Habit : Anticlockwise 100%

- **Spines on the stem (Sop):** The result indicated that 70.9 % of the total accessions had no spines, 23.6 % had few spines on their stems or sprouts, while 5.6 % had many spines. Few spines occurred among *D. rotundata* accessions (Igum, Agba, Jimanu, Usekpe, Awoke, Abi and Orumeh) and *D. cayenensis* (Ogomodu and Nkpenyi), while many spines occurred among *D. cayenensis* accessions (Oko, Nkwenyi and Ogomodu), *D. dumetorum and D. rotundata* (Nwopoke) (Table 28) and (Appendix II Table 23 – 28).
- **Twining habit (Twht):** Accessions of *D. rotundata and D. alata* exhibited anticlockwise twining directions (climbing to the right on the bamboo stick), while accessions of *D. dumetorum, D. bulbifera* and *D. cayenensis* climbed the bamboo stick to the left (clockwise). Twining habit could be genetically determined and might not be influenced by the environment. Hence, there was specific twining habit common among the 5 cultivated species of yam. However, some accessions of *D. Cayenensis* (Nkpenyi and Nkwanyi) were observed to twining anticlockwise. This could be wrong identification and mislabelling as these characters were known to be peculiar to *D. rotundtata* and *D. alata* (Table 23 – 24)**.**

Table 24: Phenotypic Characterization using Qualitative Morphological Traits for White Yam Accessions

Senatorial Zone	**LGA/Community**	**Access.name**	**Plot Id**	**Thorns on tubers**	**Intensity of thorns**	**Wrinkles on tuber**	**Roots on tuber**	**Position of roots**	**Corms size**	**Corm type**	**Tuber col. upper Reg.**	**Tuber col. middle Reg**	**Tuber col. lower Reg.**
Ebonyi North	Ohaukwu	Jioke	101	0	0	0	2,3,	1	0,1	0,1,3	8,4	5	5
	Amaoffia	Nwopoke	102	0	0	0	2,3	1	0,1	0,1	5,4	2	2
		Obela	103	0	0	0	2,3,0	1	0,1	0, 1,3	8,2,4	8,	5
		Ozibo	105	0,1	0,3	0	3,2	1	0,1	0,1	8	8	4
		Utsuekpe	106	0	0	1,0	2, 3	1	2,1,0	1,3,0	3,4	3, 2	3, 2
	Umuezeaka	Obela	116	0	0	0	3,0	1	0	0	8,4	2	2
		Okpebe	118	0	0	**0**	3,2,0	**1**	0	0	8,4	5	5
		Ozibo	119	0	0	0	2,0	1	0	**0**	4,8	8	5
		Usuekpe	120	0	0	0	0,2	1	3	2, 1, 3	8	8	5
	Abakaliki	Amage	121	0	0	0	2,3,0	1	0,1	0,1,	8	4	5
	Ndiegu-Okpuitum	Igum	122	0	0	0	3,0	1,0	3,2	1,3	4,6,8	4	4
		jimmanu	123	0	0	0	2	5,1	2	1	6	2	6
		Okpebe	124	0	0	0	2	1	0,1	0,1	4,8	4	5
		Ozibo	125	0	0	0	2	1	1	1	2	2	6
	Ndiabor-Okpu.	Amage	133	0	0	0	2	1	1	1,2,3	6,2	2	6
		Igum	134	1,0	3,0	0	2	1	1,2,3	1,2,3	6,2	2	2
		Jimmanu	135	1,0	3,0	0	2	1	3,2,1	2,3,1	6	2	2
		Nwopoke	136	0,1	0,3	0	2	1	1,3,0	1,0	4,4	5	5
		Ogbaruogbiya	137	1,0	3,0	0	2	1,2	2,1,3	1,0	6,2,9	6	6
		Okpebe	139	0	0	0	2	2	1,0	0,1	7,8	6, 5,7	5
	Izzi	Akamunze	140	0	0	0	2	1	0,1	0,1	6	6	6
	Igbeagu	Amage	141	0,1	0	0	2	1	0,2,3	0, 2,3	4	8	4
	Igbeagu	Igum	142	1,0	0	0	2	1	0,1,2,3	1,0,2,3	6	2	2
Ebonyi North	Igbeagu	Okpebe	143	0,1	0,1	0	2	1	2,0,3	1,30	2	2	2
	Izzi-Igbeagu	Okpebe	144	0	1,0	0	**2**	1	1,2,3	3,1,2	2	6	2
	Igbeagu	Ozibo	149	0	0	0	**2**	1,3	0	0	6	6	2
		Opoke	156	0,1	0,1	0	2	1	1,3,0	1,0,3	6	2	2
	Ndieze	Amage	157	0	0	0	2	1	0	0	4	4	5
		Ayaragu	158	1,0	0	0	2	1	0,1,3	0, 1	4	4	6

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		Igum	159	0,1	0	1	2	1	1	0	4	4	5
		Jioji	160	0,1	0	0	2	1	3,1	1	6	6	2
		Obela	161	0	0	0	2	1	0,3	0,3	6	2	2
		Ogbagharuogbia	162	0,1	0	**0**	2	1	3,2,1	3,2,1	4	4	5
		Okpembe	163	0,1	0,1	0	2	1	1,2	1	2	6	2
		Ozibo	164	0,1	0,1	0	2	1	1,0	1,0	9	9	7
		Ozibo wire	166	1,0	1,3,0	0	2	1	0,1	0,1	8	4	4
Ebonyi Central	**Ezza South**	Abi	167	0,1	0,1	0	2	1	1,0,2,3	0,2,3	6	2	2
	Umu. Idembia	Igum	168	0,1	0,3	0	2	1	0,2,3	0,1,2	2	2	6
		Jimaka	169	1,0	3,0	1	**2**	**1**	**2,3**	1,3	6	2	2
		Nyeji	170	0,1	0,3	0	2	1	2,3	1,3	6	2	6
		Obiaoturugo	171	0,1	0,1	1,0	2	1	2,1,3	1	4	4	5

Table 24: Continued

Senatorial Zone	**LGA/ Community**	**Access. name**	**Plot Id**	**Thorns on tubers**	**Intensity of thorns**	**Wrinkles on tuber**	**Roots on tuber**	**Position of roots**	**Corms size**	**Corm type**	**Tuber col. upper Reg.**	**Tuber col. middle Reg**	**Tuber col. lower Reg.**
Ebonyi Central	Amagu	Abi	181	0,1	0,1	0	2	1	0,3,2	0,1	6	6	2
		Igum	182	0,1	0,1	0,1	2	1	2,0,3	1,0,3	8	4	5
		Nnebiji	183	0,1	0,1	0	2	1	3,2,1	1,3	6	2	2
		Nyeji	184	0	0	0	2	1	3,1,0	1,3,0	2	2	6
	Ezza North	Akamunze	186	0	0	0	2	1	0	0	6	2	2
	Umogharu	Iboki	187	0	0	0	2	1	0,2	0,1	2	6	2
		Igum	188	0	0	0	2	1	2,3,0	1,0,3	8	4	4
		Nyeji	189	0,1	0	0	2	1	1,2,3	1	8	4	5
Ebonyi Central	**Ezza North**	Okpembe	192	0	0	0	2	1	0,2	0,1	6	2	2
	Umogharu	Usuekpe	193	0	0	0	2	1	0,3	0,3	6	2	2
		Ojioso	194	0,1	0,7	0	2	1	0,2	0,2	6	2	2
		Obiaoturuo	195	0,1	0,1	0	2	1	0,1,2	0,1	2	2	6
	Okposi UM.	Akamunze	201	0	0	0	2	2	0	0	6	2	2
		Iboki	202	0	0	0	2	2	0,3	0,1	7	2	2
		Igum	203	0,1	0	0	2	2	0,3,2	0,1	6	2	2
		Nyeji	204	0	0	0	2	1	3,2,1	1,3	6	2	6
		Okpebe	207	0,1	0,7	0	2	1	1,0	1,0	2	6	2
		Ozibo	208	0	0	0	2	1	0,1	0,1	6	6	2
		Usuekpe	209	0,1	0,7	0	2	1	0,1	0,1	6	2	2
	Ikwo	Amage	210	0	0	0	2	1	0,2	0,2,3	6	6	2
	Ndufu-Alike	Nebinji	213	0,1	0	0	2	**1**	2,0,3	1,0	6	2	2
		obiaoturugo	214	0	0	0	2	1	2,0,3	0,3	2	2	2
		Ojioso	215	0,1	0	0	2	1	0,2,1	0,1,3	6	2	2
		Ewada	218	0	0	0	2	1	0	0	8	2	5
		Ibada	219	0	0	0	2	1	2,0,3	0,3	2	2	6
	Ekpelu-Amak	Agbabro	227	0	0	0	2	1	2,1	1	8	4	8
		Ibada	228	0	0	0	2	1	1,3	1	6	6	2
		Igum	229	0	0	0	2	1	3	1	6	2	2
		Nnebinji	230	0	0	0	2	1	3,2	3,1	4	4	5
		Nwagbam	231	0,1	0,1	0	2	0,1	1	0,1	6	6	2
		Obia	232	0	0	0	0,2	1	0,1,2	0,1	6	2	2
		Ojeoso	233	0,1	0,7	0	2	1	1	0,1	8	5	5
Ebonyi South	**Ohaozara**	Abi	236	0	0	0	2	1	3,1,0	3,1,0	8	4	4
	Orobo Uburu	Agba	237	0,1	0,3	0	2	1	3,2,1,0	3,2,1,0	7	7	7
		Ekowenyi	238	0,1	0,3	0	2	1	0,1	0,1	9	9	9

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		Nnebiji	241	0,1	0,3	0	2	1	2,3,1, 0	1,3,0	6	2	2
		Obiaoturu go	242	0,1	0,3	0	2	1	0,1	0,1	6	2	6
	Eweze-Ihenu	Abi	245	0,1	0,3	0	2	1	2,3,1, 0	2,1,0	6	6	6
		Agba	246	0,1	0,3	0	2	1	3,2,0	3,0	6	6	6
		Obiaoturu go	249	0	0	0	2,0	1,0	3,1,2	1,2	9	7	7

- **Leaf colour per plant (Lc):** Phenotypic diversity was observed among the accessions and yam species for leaf colour at senescence. A great number of accessions *D. rotundata* (36.8%) and *D. cayenensis* (75%) turned yellowish at senescence, some dark green, pale green, purplish green, purple and light green colour in descending order. There was no specific leaf colour to a particular accession. This indicated high phenotypic diversity on leaf colour. While *D. rotundata* accessions were either yellowish or pale green and dark green at senescence, *D. alata* had leaf colours ranging from pale green, dark green, light green and purplish green to purple on or before flowering and turned pale green light pale green and yellowish at senescence. Unlike *D. alata*, accessions of *D. cayennsis* had leaf colourations ranging from dark brown (77.3%), 9.1% each for brownish green and purplish green and yellow (4.5%) that turned yellowish at senescence. Accessions of *D. dumentorum* and *D. bulbifera* exhibited high phenotypic diversity of leaf colouration at senescence amounting to 75% to 25% and 66.7% to 33.3% for purplish green, pale green and light green colours in both seasons.
- **Leaf shape per plant (Lsh**): Over 54% of the leaves of white yam accessions studied were cordate leaf shaped. However, other leaf shape diversities include ovate, cordate long, cordate broad, saggitate broad and hardly exhibited hastate leaf shapes. Unlike *D. rotundata* that was cordate shaped, *D. alata* exhibited high phenotypic diversity for leaf shapes, having cordate long, saggitiate long leaf and hastate leaves to a very few cordate broad, saggitate broad, cordate and ovate leaves (Table 25). On the other hand, *D. cayenensis* accessions had variations in the leaf orientation ranging from cordate long the most dominant to very few saggitiate long, cordate broad, cordate, ovate and hastate leaf shapes (Table 23 to 28) (Appendix II-VI). Accessions of *D. dumentorum* were characterized by saggitate long leaf shapes about (50%) and few cordate long and hastate, while the accessions of *D. bulbifera* exhibited ovate leaf 75% and cordate broad leaf shapes (Table 28).

Table 25: Phenotypic Characterization using other Qualitative Morphological Traits for Water Yam Accessions

Senatorial Zone	LGA/ Community	Access. name	Plot Id	Vine colour	Hairs	Spines on stem	Twine habit	Leaf colour	Leaf shape	Leaf apex sh	Tuber shape	Tuber surf. T.	Tuber Tb.	Position of bran.	Presence of cracks
Ebonyi North	Ohaukwu	Mbala	107	2,5	0	0	0	2	3,7	6	2,1	1	3	2,3	1,0
	Amaoffia	Nwawafu	109	2	0	0	0	1	4,6	2	1,2	1	0	5	0
	Umuezeaka	Egboru	111	3,2	0	0	0	3	3,6	3	1,2,3	2,1	3	1	1,0
		Mbala	112	2	0	0	0	2	7,3,6	6	1,2	1,2	3	4	1,0
		Nwawafu	113	4,7,2	0	0	0	4	4,6,7	2	2	1,2	3	5	0
	Umuezeaka	Nneonwuka	114	5,2	0	0	0	4	6,3,4	4	3	1,2	3	2	0
	Abakaliki	Nvula	127	2,4,7	0	0	0	4	7,6	6	3	1,2	3	2	0
	Ndiabor-Okpu.	Okwalenkata	128	2,4	0	0	0	4	3,6,7	3	2	1	3	3	0
		nvulamanu	129	3,7	0	0	0	5	4,6	6	5	2,1	3	1	0
	Ndiegu-Okpu.	Nvulamanu	130	2	0	0	0	2	3,7	3,6	3,1,2	1,2	3,5,7	2,3,1	0
		Okwalenkata	131	2	0	0	0	3	4,3	6,7	2,3,1	1	5,3	2,3,1	0
		Nvula	132	3,2	0	0	0	1	7,4	7,6, 3	4,2,3	1,2	3,5	2,3,1	0
	Izzi	Nvula	146	2,7,3	0	0	0	4,3	7,3,4	6	2,4	1,2	3,5.7	2,3,1	0
	Igbiegu	Okwalenkta ta	147	2,7,3	0	0	0	3,4,2	3,4	6	2,4	1,2	3,5	2,3,1	1,0
		Nvulambube	148	2,7	0	0	0	2,3	3,4	6	2,4	2,1	3,5	2,3,1	0
		Nwopokeofu	150	2,7,1, 5	0	0	0	2,3,7	3,4,7	6,3	2,4,3	1,2	3,0	3,1,2	0,1
		Nvula mme	151	1,2	0	0	0	2,3,7	3,4,6	6	4,2,3	1,2	3,0	2,3,1	0,1
	Ndieze	Akpuruakputu	152	7,1	0	0	0	2,3,7	3,4	6,3	3,2,4	1,2	3,0	2,1,3	0,1
		Nwawafu	153	7,2,5	0	0	0	2,3,7	3,4	6,3	3,4,2	1,2	3,0	2,1,3	0,1
		Opokeffu	154	2	0	0	0	2	5	6	3	1	3,7	2	0
Ebonyi Central	Ezza South	Nwawafu	173	2	0	0	0	2	3	6	2	1,2	3	3	1,0
	Umu. Idembia	Nvula	174	2	0	0	0	1	7	6	4	2,1	7,3	3,2	1,0

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		Nvulamanu	175	2	0	0	0	5	4	6	3	2,1	3,2	3,2	0,1
	Amagu	Nvula	178	2,1,7	0	0	0	2,4	7,3,4	6	3,2	1	5,3,7	3	1,0
		Nvula mme	179	2,1,7	0	0	0	2,4	3,5,4	6	2,3	1	3,5	3	0
		Opalenkata	180	2,1,7	0	0	0	2,4	5,7,4	6	2,3	1	3,5	3	1,0
	Ezza North	Nwawafu	196	2,5,7	0	0	0	2	4,5,7	6,4,3	2,3,4	1,2	3	2	1,0
	Umuoghar u	Okwalenkat a	197	1,4,2,7	0	0	0	2	5,4,7	6,4,3	2,1,4	1,2	3	2	1,0
	Okposi Umu.	Okwulenkat a	198	1,2,7	0	0	0	2	7,5,4	6,4,7	2,1,4	1,2	3	2	1,0
		Nvula	199	2,5,7	0	0	0	2,3,7	3,5,1	6,4,3	2,1,5	1,2	3,0	1,3,0	0
		Nwawafu	200	7,2,5	0	0	0	2,3,7	5,3,1	6,4,3	2,4	1,2	3,0	1,3	0
	Ikwo	Caret yam	211	7,2,5	0	0	0	2,3,7	5,1,3	6,4,3	5,3,5	2,1	5,3	3,1	0
	Ndufu-Alike	Mkpueke	212	2,5,7	0	0	0	2,3	1,3,5	6,3,4	5,3,2	2,1	3,5	1,3	0
		Onyeoma	217	2,7	0	0	0	2,4	5	6	3,4	1	5,3	3,2,1	1,0
		Nvula	220	2,4,7	0	0	0	2,4	7	6	4,3	1	3,5	1,3,2	1,0
		Nvulamme	221	2,5,7	0	0	0	2,7	3	6	3,4	1	5,3	2,1,3	0
	Ekpelu-Amak.	Opalenkata	222	1,2,7	0	0	0	2,4,7	3	6	3,4	1	3,5	2,1,3	1,0
		Agbirigba	225	1,7,2	0	0	0	2,4,7	7	6,4	4,2,3	1,2	3,5	2	1,0
		Ajingworo	226	2,1,7	0	0	0	2,7,4	5	6	2,4,3	1,2	3,5	2	1,0
		Nwiba	235	1,2,7	0	0	0	2,4,7	3	6	3,2,4	2,1	5,3	2	0

Table 25: Continued.

Senatorial Zone	LGA/Community	Access. name	Plot Id	Vine colour	Hairs	Spines on stem	Twine habit	**Leaf colour**	Leaf shape	Leaf apex sh	Tuber shape	Tuber surf. T.	**Tuber Tb.**	Position of bran.	Presence of cracks
Ebonyi South	**Ohaozara**	Igborogidi	240	2,5,7,4	0	0	0	3,7,2	5	6	3,4	**2**	**5,3,7**	3,1,2,4	0,1
	Urobo	Nvula America	243	2,5	0	0	0	1,4,7	1	6	2,3	1,2	3	2	0
		opananwankata	244	2,7,5	0	0	0	2,3,7	5	6	4,3,1	**1,2**	3	2	1
		Igborogidi	248	2,5,4,7	0	0	0	3,7,2	3	6	3,4	2	3,5,7	3,2,4,1	1,0
		Opananwakata	251	2,7,5	0	0	0	7,2,3	4,7,5	5,6	2,1,4	1	3	2	0
		Mbana/Nvula	252	2,5,7	0	0	0	2,7,3	7,4	6,5	3,4	1	3	2	0
Ivo	Ishiagu	Awokenvula	253	2,7,5	0	0	0	2,3,7	5,7	7,6	3,4	2,1	3	3	0
		Orumehnvula	254	2,5,7	0	0	0	2,4,7	5,2,4	6,5	3,4	2,1	3	3	0
		Makwuruoba	257	2	0	0	0	7	6	6	2	1	3,5	3,2,1	1,0
	Owutu-Edda	Mbula	273	2	0	0	0	4	5	6	2	1	5,3	2,1,3	1,0
		MbulaAmerica	275	2	0	0	0	7	7	6	2	1	3,5	3,2,1	0,1
		MbulaPaul	276	2	0	0	0	4	5	6	2	1	5,3	3,2,1	0,1
		Igborogidi	277	2	0	0	0	7	5	6	2	1	3,5	1,2,3	0,1
		Ogboja	282	2	0	0	0	2	4	6	2	1	3,5	3,2,1	1,0
		Agbirigba	288	2	0	0	0	2	3	6	2	**2,1**	**5,3**	2,1,3	1,0
	Oso-Edda	Ogboja	289	2	0	0	0	7	2	6	2	2,1	7,3,5	3,2,1	1,0
		Igumeluenyim	292	2	0	0	0	4	3	6	2	2,1	3,5,7	3,2,1	1,0

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		Igum mbula	296	2	0	0	0	2	2	6	2	1	3,5	3,1,2	1,0
		Mbula	297	2	0	0	0	2	5	6	2	2,1	3,5,7	3,2,1	0,1
		Mbula	298	2	0	0	0	7	6	6	2	**1,2**	3,5	3,2,1	1,0
		MbulaAmerica	299	1	0	0	0	7	7	6	2	**1,2**	3,5,7	2,3,1	1,0
		Nneonwuka	300	**2**	0	0	0	3	7	6	2	2,1	3,5,7	2,1,3	**1**
		Mbula paul	301	2	0	0	0	7	5	6	2	**1,2**	5,7	2,1,3	1,0

- **Leaf Apex Shape (Lash):** Over 59% of accessions of *D. rotundata* and *D. alata* exhibited caudate leaf apex shapes, respectively. However, other phenotypic diversity of leaf apex shapes include aristate, acute and obtuse for accessions of white yam, while emarginated,obtuse,acute cudspidate and acuminate leaf apex shapes were recorded for water yam accessions (Table 23 – 28) and appendix II. Accessions of *D. cayenensis* were characterized by leaf apex shapes were acute, caudate, emarginated, obtuse and very few aristate and cudispate leaf apex shapes. The accessions of *D. dumentorum* were phenotypically characterized predominantly by aristate leaf apex shape with few acute and cudspidate leaf apex shapes, while *D. bulbifera* accessions were characterized by obtuse and aristate leaf apex shapes (Table 26).

Table 26: Phenotypic Characterization Using Qualitative Some Yield Traits for Other Yam Accessions

Senatorial Zone	**LGA/ Community**	**Access.name**	**Plot Id**	**Thorns on tubers**	**Intensity of thorns**	**Wrinkles on tuber**	**Roots on tuber**	**Position of roots**	**Corms size**	**Corm type**	**Tuber col. upper Reg.**	**Tuber col. middle Reg**	**Tuber col. lower Reg.**
Ebonyi North	**Ohaukwu**	Mbala	107	0	0	0	0	0	0	0	2	2	4
	Com, Amaoffia	Nwawafu	109	0	0	0	2,0	3,0	0	0	4	5	5
	Umuezeaka	Egboru	111	0	0	0	0	0	0	0	8	8	5
		Mbala	112	0	0	0	2	1	3	1	2	6	2
		Nwawafu	113	0	0	0	2	1	3	1	8	4	4
	Umuezeaka	Nneonwuka	114	1,0	3,0	0	2	2	0	0	2	5	5
	Abakaliki	Nvula	127	0	0	0	0	0	2	3	2	2	6
	Ndiabor-Okpu.	Okwalenkata	128	0	0	0	2	1	2	2	8	4	5
		nvulamanu	129	0	0	0	0	0	2	2	8	4	4
	Ndiegu-Okpu.	Nvulamanu	130	0	0	0	0	0	3,2,1	3,1	8,4	8	5
		Okwalenkata	131	0	0	0	2,0	1	1,3,2	1,3	4	4	5
		Nvula	132	0	0	0	2,0	1	2,3,0	1,2	8	4	5
	Izzi	Nvula	146	0	0	0	2	1	0	0	**4**	4	5
	Igbiegu	Okwalenktata	147	0	0	0	0	0	2	1	**8**	4	4
		Nvulambube	148	0	**0**	0	3,0,2	1,0	2,3	2,3	4,8	8,5	8,5
		Nwopokeofu	150	0	0	0	0,2	1	2,3,1	2	8	5	5
		Nvula mme	151	0	0	0	2	1	0	0	8	4	4
	Ndieze	Akpuruakputu	152	0	0	0	2,3	2,1	0	0	8	4	4
		Nwawafu	153	0	0	0	2	1	0	0	8	4	4
		Opokeffu	154	0	0	0	2	1	2	3	**8**	4	5
Ebonyi Central	**Ezza South**	Nwawafu	173	0	0	0	2	1	0	0	**8**	8	4
	Umu. Idembia	Nvula	174	0	0	0	2	**1**	2,3	2,3	7	2	2
		Nvulamanu	175	0	0	0	2	1	1	3	5	5	5
	Amagu	Nvula	178	0	0	1	2	1	2	3,2	5	5	5
		Nvula mme	179	0	0	0	2	1	0	0	8	4	4
		Opalenkata	180	0	0	1	2	**1**	0	0	4	4	5
	Ezza North	Nwawafu	196	0	0	0	2	1	0	0	8	8	5
	Umuogharu	Okwalenkata	197	0	0	0	2	1	2	1	8	8	8
	Okposi Umu.	Okwulenkata	198	0	0	0	2	1	3	1	8	4	4
		Nvula	199	0	0	0	2	1	0	0	**8**	4	5
		Nwawafu	200	0	0	0	2	1	0	0	4	8	4
	Ikwo	Caret yam	211	1,0	7	0	2	1	2	3	8	4	4
	Ndufu-Alike	Mkpueke	212	1,0	7	0	2	2	2	1	8	8	5
		Onyeoma	217	0	0	0	2	1	1	1	8	5	5
		Nvula	220	0	0	0	2	1	2	1	4	5	5
		Nvulamme	221	0	0	0	2	**1**	0	0	4	4	4
Ekpelu-Amak.	Opalenkata	222	0	0	0	2	2	0	0	8	5	5	
	Agbirigba	225	0	0	0	2	2	2	1	**6**	2	2	
	Ajingworo	226	0	0	0	2	1	2	1	8	8	4	

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	Nwiba	235	0	0	0	3	1	0	0	6	6	2	
Ohaozara	Igborogidi	240	0	0	2	3	2	3	3	**8**	**4**	4	
Urobo	Nvula America	243	0	0	0	3	1	3	3	8	4	5	
	opananwankata	244	0	0	0	2	1	1,3	1	**2**	2	6	
	Igborogidi	248	0	0	2,0	3	2	0,3	0,3	8	5	5	
	Opananwakata	251	0	0	0	2	1	0	0	8	8	4	
	Mbana/Nvula	252	0	0	0	2	1	0	0	8	8	8	
Ishiagu	Awokenvula	253	0	0	0	2	1	0	0	8	5	5	
	Orumehnvula	254	0	0	0	2	1	0	0	4	4	5	
	Makwuruoba	257	0	0	0	2	1	0	0	8	8	8	
Owutu-Edda	Mbula	273	0	0	0	2	1	1	1	8	4	4	
	MbulaAmerica	275	0	0	0	2	1	0	0	8	8	4	
	MbulaPaul	276	0	0	0	2	1	0	0	8	4	5	
	Igborogidi	277	0	0	0	2	1	0	0	8	8	8	
	Ogboja	282	1	7	1	2,3,1	1,3,4	1	3	8	5	5	
	Agbirigba	288	0	0	0	2	1,2	3	1	**8**	**4**	5	
Oso-Edda	Ogboja	289	1	7	0	2,3	1,2	3	2	8	4	4	
	Igum eluenyim	292	0	0	1,0	2	1	3	3	4	8	5	
	Igum mbula	296	0	0	0	2	1	3	2	8	4	5	
	Mbula	297	0	0	0	2	1	3	2,1	2	6	2	
	Mbula	298	0	0	0	2	1	1,3	2,1	**8**	5	5	
	MbulaAmerica	299	0	0	0	2	1	1,3,0	1	**5**	8	8	
	Nneonwuka	300	1	3	0	3,2	1	0	0	4	4	4	
	Mbula paul	301	0	0	0	2	1	1	1	**6**	2	2	

Source: 2016 and 2017 Field Experiment. Cots- Cracks On Tubers: 1 – Present, 0 –Absent. Tht – Thorniness- 1–Present, 0–Absent. Inth–Intensity Of Thorniness. Wrt –Wrinkles On Tubers. Rsut –Roots On Tuber Body. Por–Position Of Roots. Cms – Corm Size, Cmty– Corm Type, Tcup- Tuber Colour At Upper Region,Tcmr– Tuber Colour At Middle And Tclr–Tuber Colour At Lower Regions.

Table 27: Phenotypic Characterization Using Qualitative Some Yield Traits for Water Yam Accessions

Senatorial Zone	**LG A/Community**	**Access.name**	**Plot Id**	**Vine colour**	**Hairs**	**Spines on stem**	**Twine habit**	**Leaf colour**	**Leaf shape**	**Leaf apex sh**	**Tuber shape**	**Tuber surf. T.**	**Tuber Tb.**	**Position of bran.**	**Presence of cracks**
Ebonyi North	Amoffia	Ogomodu	104	2	0	1	1	2	4	6	5	2	3	4	3
	Umuezaka	Nkpenyi	115	1,2	0	1	1	2	5	1	3	1	3	3	0
	Umuezeaka	Ogomodu	117	4,3	0	2,1	1	2,4	4,3	6	3,5	1	5,3	3,4	1
	Abakaliki	Oko	126	4	0	2	1	3	3	2	2	2		4	1
	Ndiegu Okpu.	Oko	138	4,3	0	2,1	1	1,4	2,3	2	5,3	1	3,5	2,5	1
	Izzi – igbiegu	Oko	145	4	0	2	1	2	7	7	2	2	5	3	0
	Ndieze	Oko	155	4	0	2	**1**	1	5,3	3	5	1	5	4	1
Ebonyi Central	**Ezza South** –	Oko	172	4	0	2	1	1	3	2	3	1	3	3	0
	Amagu	Oko	185	4	0	1	1	1	5	6	3	1	5	4	0
	Ezza North	Ogomodu	190	4	0	2	1	1	1	2	3	1	3	3	0
	Umogharu	Oko	191	4	0	2	1	1	3	2	3	1	3	4	1
	Okposi-Umuogh.	Ogomodu	205	4,3	0	2	1	1	3	2	3	2	3	3	0
		Oko	206	4	**0**	2	1	1	3	2	3	1	3	3	0
	Ikwo	Oko	216	4,3	0	2	1	1	3	2	3	2	5	3	0
	Ekpelu	Oko	234	4	0	2	1	1	3	3	3	2	5	3	1
Ebonyi South	**Ohaozara**-Uburu	Engbe	239	4	0	2	1	1	6	5	3	1	3	3	1
	Eweze-Ihenu	Enegbe	247	4	0	2	1	1	3	2	3	1	3	3	0
	Ivo- Ishiagu	Nka	265	3	0	2	1	1	3	2	3	1	3	3	1
	Okue	Nka	274	4,3	0	2	1	1	3	2	3	1	3	3	0
	Afikpo South	Nkwenyi	284	2	0	1	2	**1**	2	1	5	2	5	5	1
	Owutu	Oko	286	4,3	0	2	1	1	5	5	1,3	**1**	5	3	0
	Oso Edda	Nkwenyi	302	3	0	2	1	1	3	6	3	1	3	4	0
		Oko	303	4	0	2	1	2	3	2	3	1	7	3	0
Three leaf yam or bitter yam (*Dioscorea dumetorum*)															
Ebonyi North	Ohaukwu	Una	110	2	1	2	1	4	5	5	1,2	1	3	4	0

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Ebonyi Central	Ezza South Um	Una	176	5	1	2	1	4	7	7	2,4	1	3	4	1
Ebonyi South	Owutu Edda	Una	287	3	1	2	1	2	**3**	2	3,2	**1**	**3**	3	1
Ebonyi South	Oso Edda	Una	304	2	1	2	1	4	5	5	2,3	2	5	3	0
Ariel yam accessions or air potato (*Dioscorea bulbifera*)															
Ebonyi Central	**Ezza S.UM.I.**	Edu	177	1	0	0	1	2	4	1	5	2	3	3	0
	Ikwo NdufuAl	Edu	223	1	0	0	1	7	1	1	5	2	3	2	0
Ebonyi South	Afikpo S.Owut	Edu	290	3	0	0	1	2	1	5	5	2	5	3	0

Source: Field Survey 2016 and 2017. Note that the First Figure in Each Row of a Trait

Table 27: Continued

Senatorial Zone	**LG A/Community**	**Access.name**	**Plot Id**	**Thorns on tubers**	**Intensity of thorns**	**Wrinkles on tuber**	**Roots on tuber**	**Position of roots**	**Corms size**	**Corm type**	**Tuber col. upper Reg.**	**Tuber col. middle Reg**	**Tuber col. lower Reg.**
Ebonyi North	Amoffia	Ogomodu	104	1	7	1	2	2	1	1	8	3	3
	Umuezaka	Nkpenyi	115	0	0	0	2	1	1	1,2	5	5	5
	Umuezeaka	Ogomodu	117	0	0	0	2	1	2	1	7	7	7
	Abakaliki	Oko	126	0	0	1	2	0	0	0	8	4	4
	Ndiegu Okpu.	Oko	138	0	0	0	3	1	3,2	2,1	4	4	7
	Izzi – igbiegu	Oko	145	0	0	1	2	0	0	0	9	9	9
	Ndieze	Oko	155	1	3	**0**	2	1	0	0	9	9	9
Ebonyi Central	**Ezza South –**	Oko	172	1	3	0	2	1	0	0	3	3	3
	Amagu	Oko	185	0	0	0	2	1	0	0	9	9	9
	Ezza North	Ogomodu	190	0	0	0	2	1	0	0	9	9	9
	Umogharu	Oko	191	1	3	0	2	1	0	0	9	9	9
	Okposi-Umuogh.	Ogomodu	205	0	0	0	2	1	0	0	9	9	9
		Oko	206	**1**	3	0	2	1	3	5	3	3	3
	Ikwo	Oko	216	0	0	0	3	1	1	1	3	2	2
	Ekpelu	Oko	234	1	3	0	2	1	0	0	3	3	3
Ebonyi South	**Ohaozara-** Uburu	Engbe	239	1	3	0	2	1	0	0	3	3	3
	Eweze-Ihenu	Enegbe	247	0	0	0	2	1	0	0	8	4	4
	Ivo- Ishiagu	Nka	265	**0**	0	0	3	1	3	1	3	3	3
	Okue	Nka	274	0	0	0	3	1	0	0	3	3	3
	Afikpo South	Nkwenyi	284	1	7	0	**2**	2	2	2	3	6	6
	Owutu	Oko	286	0	0	0	2	1	0	0	**9**	9	9
	Oso Edda	Nkwenyi	302	0	0	0	2	1	2	1	3	3	3
		Oko	303	1	3	0	2	1	2	2	9	9	9
Three leaf yam or bitter yam (*Dioscorea dumetorum*)													
Ebonyi North	Ohaukwu	Una	110	0	0	0	2	1	3	3	6	6	6
Ebonyi Central	Ezza South Um	Una	176	0	0	0	2	1	2	1	5	5	5
Ebonyi South	Owutu Edda	Una	287	0	0	0	2	**1**	3	3	**6**	**6**	6
Ebonyi South	Oso Edda	Una	304	1	2	0	1	1	3	3	6	6	6
Ariel yam accessions or air potato (*Dioscorea bulbifera*)													
Ebonyi Central	**Ezza S.UM.I.**	Edu	177	1	7	0	3	2	0	0	3	3	3
	Ikwo NdufuAl	Edu	223	1	7	0	3	2	0	0	9	9	9
Ebonyi South	Afikpo S.Owut	Edu	290	1	7	0	3	2	0	0	9	9	9

Source: Field Survey 2016 and 2017. Note that the first figure in each row of a trait

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Table 28. Frequency Distribution of 21 Qualitative Traits According IPGR/IITA (1997) Descriptors for Yam among Dioscorea spp Across the Two Seasons

S/N	Qualitative Characters	[(IPGR/IITA,(1997)] Descriptors adopted	*D. rotund.* Freq. (%)	*D. alata* Freq. (%)	*D. cayen.* Freq. (%)	*D. dumen.* Freq. (%)	*D. bulbife.* Freq. (%)
1.	Vine colour (Vc)	1.Green	24.6	12.3	6.8	0.0	66.7
		2.Purplish green	27.7	75.7	11.4	50.0	0.0
		3.Brownish green	9.1	4.8	70.5	25.0	33.3
		4.Dark brown	11.4	1.6	11.4	0.0	0.0
		5.Purple	13.6	0.8	0.0	25.0	0.0
		6.Pink	11.8	0.0	0.0	0.0	0.0
		7.Light green	1.8	4.8	0.0	0.0	0.0
2.	Hairiness on stem (Hos)	0.No hairiness	67.3	100	100	0.0	100.0
		1. Hairiness	32.7	0.0	0.0	100.0	0.0
3.	Spines on stem (Sop)	0.Absent	78.6	100	0.0	0.0	100.0
		1.Few	18.6	0.0	22.7	0.0	0.00
		2.Many	2.7	0.0	77.3	100.0	0.00
4.	Twining habit (Twht)	0.Anticlockwise	100.0	100	25.0	0.0	0.00
		1.Clockwise)	0.0	0.0	75.0	100.0	100.0
5.	Leaf colour at senescence (Lc)	1.Yellowish	36.8	5.6	75.0	0.0	0.0
		2.Pale green	17.3	45.2	15.9	25.0	66.7
		3.Dark green	24.1	21.4	2.3	0.0	0.0
		4.Purplish green	10.5	11.9	6.8	75.0	0.0
		5.purple	1.4	3.2	0.0	0.0	0.0
		6.Light green	10.0	12.7	0.0	0.0	33.3
6.	Leaf shape (Lsh)	1.Ovate	26.8	3.2	4.6	0.0	66.7
		2.Cordate	54.6	2.4	13.6	0.0	0.0
		3.Cordate long	6.4	29.4	70.5	25.0	0.0
		4.Cordate broad	7.3	12.7	11.4	0.0	33.3
		5.Saggitate long	2.7	24.6	0.0	50.0	0.0
		6.Saggitaiate broad	0.9	3.9	0.0	0.0	0.0
		7.Hastate	0.0	23.8	0.0	25.0	0.0
7.	Leaf apex shape (Lash)	1.Obtuse	8.2	3.9	4.6	0.0	83.3
		2.acute	14.1	3.2	75.0	25.0	0.0
		3.Emarginated	0.0	7.1	4.6	0.0	0.0
		4.Acuminate	0.0	1.6	0.0	0.0	0.0
		5.Aristate	18.6	2.4	2.3	50.0	0.0
		6.Caudate	59.1	78.6	9.1	0.0	0.0
		7.Cudspidate	0.0	3.2	1.6	25.0	16.7

Freq. frequency, % - percentage, D. rotund. – *Dioscorea rotndata*, D. alata, *Dioscorea alata*, D.cayen. – *Dioscorea cayenensis*, D. dume. – *Dioscorea dumentorum*, D. bulbif. – *Dioscorea bulbifera*

➢ *Yield and Yield Components Characterization of Grown Accessions Using Qualitative Traits*

- **Tuber shape (TSH)**: Over 76 % of the accessions of *D. rotundata* showed wide variability for tuber shape. Some were cylindrically shaped, followed by over oblong, oval and few spherical/ round and irregular tubers. The highest number for tuber shapes (37.3% and 34.1%) observed in the accessions of *D. alata* indicated that accessions of this species were oval and cylindrically shaped (Table 29) (Appendix 11). Some accessions produced more shapes in one season than the other. Accessions of *D. cayenensis* produced more of cylindrically shaped tubers in 2016 than in 2017 and produced more irregular tubers in 2017 than 2016 planting seasons. Similarly, most of *D. dumentorum* tubers in both seasons were oval shaped, with spherical/round and cylindrical tubers produced more in 2016 than 2017. Accession of *D. bulbifera* maintained uniform tuber shapes (irregular) across seasons (Appendix 11). Cylindrical shapes are common and can be seen in the five species of yam assessed except in *D.bulbifera* (Table 29).
- **Tuber Surface Texture** (TsT): Over 80.1 % of accessions examined accounted for tuber surface texture that was smooth across all the species and seasons, respectively, while very few species were found to have rough tuber texture. Accessions of *D. alata* had the highest number of rough tuber surface (25.4%) and was common among Nvula-ajingworo, Igborogborogidi, Agbirigba and Nvula-egboru. This was closely followed by *D. rotundata* (13.2%) accessions, manifested but was minimal in other yam accessions,while smooth tuber texture were obtained in *D. dumetorum* and *D. bulbifera*, *D. cayenensis* had the least rough surface tuber texture. This suggested that tuber surface textures were phenotypic variation that can be influenced by the environment and other factors.

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Table 29: Frequency Distribution of 21 Qualitative Yield Traits According IPGR/IITA (1997) Descriptors for Yam among *Dioscorea spp*

S/N	Qualitative characters	[(IPGR/IITA,(1997)] Descriptors adopted	*D. rotund.* Freq. (%)	*D. alata* Freq. (%)	*D. cayen.* Freq. (%)	*D. dumen.* Freq. (%)	*D. bulbife.* Freq. (%)
8.	Tuber shape (Tsh)	1.Spherical/round	2.3	11.9	2.3	25.0	0.0
		2.Oval	8.6	37.3	2.3	50.0	0.0
		3.Cylindrical	76.4	34.1	79.6	25.0	0.0
		4.Oval oblong	10.5	8.7	4.6	0.0	0.0
		5.Irregular	2.3	7.9	11.4	0.0	100.0
9.	Tuber surface texture (TsT)	1.Smoot	86.8	74.6	50.0	75.0	100.0
		2.Rough	13.2	25.4	50.0	25.0	0.0
10.	Tendency of tuber to branch (Ttb)	0.No branch	0.0	1.6	0.0	0.0	0.00
		3.slightly branched	77.3	77.8	54.6	50.0	66.7
		5. branched	15.5	17.5	31.8	50.0	33.3
		6.Highly branched	7.3	3.2	13.6	0.0	0.0
11.	Position of branching (Pob)	1.upper middle -um	12.3	12.7	18.2	75.0	0.0
		2.tail	17.7	38.1	11.4	0.0	0.0
		3.middle	60.0	38.1	59.1	25.0	66.7
		4. Um/head & tail	10.0	8.7	9.1	0.0	33.3
		5.lower third	0.0	2.4	2.3	0.0	0.0
12.	Cracks on tuber surface (CoTs)	0.Absent	64.6	45.2	65.9	50.0	100.0
		1.Few	33.2	54.8	31.8	50.0	0.0
		3.many	2.3	0.0	2.3	0.0	0.0
13.	Thorniess of tuber (ThT)	0.Absent	90.5	91.3	59.1	75.0	33.3
		1.Present	9.6	8.7	40.9	25.0	66.7
14.	Intensity of thorniess (IthT)	0.No	90.5	92.1	59.1	50.0	33.3
		3. Few	6.4	3.9	31.8	25.0	0.00
		7. Many	3.2	3.9	9.1	0.0	66.7
15.	Wrinkles on surface tuber (WrT)	0.No wrinkles	92.7	92.1	90.9	100.0	100.0
		1.Few	7.3	6.4	9.1	0.0	0.0
		2.Many	0.0	1.6	0.0	0.0	0.0
16.	Roots on surface of tuber (Rsut)	0.No roots	1.4	7.1	2.3	0.0	0.0
		2.Few	93.6	84.9	72.7	50.0	0.0
		3.Many	5.0	7.9	25.0	25.0	100.0
17.	Position of roots (PoR)	0.No roots	1.4	6.4	0.0	0.0	0.0
		1.tuber head	93.6	76.2	86.4	100.0	0.0
		2-entire tuber	3.6	15.9	13.6	0.0	100.0
		3.lower (L)	0.5	0.8	0.0	0.0	0.0
		5.L. & head region	0.9	0.0	0.0	0.0	0.0
		7.middle	0.5	0.8	0.0	0.0	0.0
18.	Corm size and type (Cms)	0.None	52.3	46.8	38.6	0.0	100.0
		1.Regular	10.5	7.9	6.8	25.0	0.0
		2. Transversally elong.	23.2	23.8	22.7	25.0	0.0
		3.Branched	14.1	20.6	31.2	50.0	0.0

Table 29: Continued

S/N	Qualitative characters	[(IPGR/IITA,(1997)] Descriptors adopted	*D. rotund.* Freq. (%)	*D. alata* Freq. (%)	*D. cayen.* Freq. (%)	*D. dumen.* Freq. (%)	*D. bulbife.* Freq. (%)
19.	Tuber colour at Upper region of the tuber (Tcup)	1.White	0.0	0.0	0.0	0.0	0.0
		2.Creamy white	8.2	5.6	4.5	25.0	0.0
		3.Yellow	0.5	18.3	40.9	0.0	0.0
		4.Purplish	15.0	1.6	0.0	0.0	0.0
		5.Purplish white	1.8	3.2	4.5	0.0	0.0
		6.Creamy	51.4	6.4	4.5	75.0	0.0
		7.Brownish white	1.2	1.6	4.5	0.0	33.3
		8.Deep purple	19.1	63.5	18.2	0.0	0.0
		9.Orange	2.3	0.0	36.4	0.0	66.7

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20.	Tuber colour at Middle region (Tcm)	1. White	0.0	0.0	2.3	0.0	0.0
		2. Creamy white	23.6	4.8	4.3	25.0	0.0
		3. Yellow	0.5	0.0	6.8	0.0	0.0
		4. Purplish	15.0	29.4	6.8	0.0	0.0
		5. Purplish white	4.6	11.1	9.1	0.0	0.0
		6. Creamy	38.6	7.8	4.6	75.0	0.0
		7. Brownish white	1.4	0.8	11.4	0.0	33.3
		8. Deep purple	14.1	46.0	9.1	0.0	0.0
		9. orange	2.3	0.0	45.5	0.0	66.7
21.	Tuber colour Lower region (Tclr)	1. White	0.0	0.0	2.3	0.0	0.0
		2. Creamy white	26.4	3.2	6.8	25.0	0.0
		3. Yellow	0.5	0.0	4.6	0.0	0.0
		4. Purplish	7.7	28.6	4.6	0.0	0.0
		5. Purplish White	14.1	24.6	11.4	0.0	0.0
		6. Creamy	37.7	7.1	9.1	75.0	0.0
		7. Brownish white	1.8	0.8	13.6	0.0	33.3
		8. Deep purple	8.6	33.3	6.8	0.0	0.0
		9. orange	2.3	0.0	40.9	0.0	66.7

Freq. frequency, % - percentage, D. rotund. – *Dioscorea rotndata*, D. alata, *Dioscorea alata*, D.cayen. – *Dioscorea cayenensis*, D. dume. – *Dioscorea dumentorum*, D. bulbif. – *Dioscorea bulbifera*

- **Tendency of tuber branching (Ttb):** A great majority of accessions of *D. rotundata* and *D. alata*, accounted for over 77% of tubers that were slightly branched among the accessions and species assessed. Highly branched tubers were common among the three species including *D. cayenensis* (Ogomodu, Oko, Nka and Enegbe), *D.rotundata* (Nyeji and Abi) and *D. alata* (Nvula, Nvula-mme, Nvula-ajingworo and Igborogborogidi) (Table 29).
- **Position of branching (Pob):** High phenotypic diversity for position of branching was recorded for *D. alata* accessions (76.1%) and *D. rotundata* accessions (60%) accounting for tail and middle regions of tuber positions. Few accessions of *D. cayenensis* and *D. alata* produced tubers that branched at the lower third region. The accessions of *D. dumetorum* and *D. bulbifera* also had over 50% branched tubers at the middle (Table 29).
- **Cracks on the harvested tubers**: High phenotypic diversity was observed among *D. rotundata* accessions. Few had cracked tubers, while more number of tubers were without cracks than *D. alata* (Table 29). Over 54% of *D. alata* accessions tubers were cracked in both seasons but had only one tuber in 2017 that manifested many cracks on the tuber. Accessions of *D. cayenensis*, produced tubers with few cracks obtained in each season and some tubers with many cracks were produced in 2016. Accessions of *D. dumetorum* showed cracked tubers and tubers without cracks in each season, while *D. bulbifera* had no cracks.
- **Thorniness of the tubers:** The accessions of *D.rotundata* (Igum, Ipe, and Ogbaruogbia) presented thorns at harvest and had the highest in both seasons followed by *D. cayenensis.* Some of the species that had thorns are among species that possessed hairiness and spines on stems. This is evident in *D. cayenensis* accessions (Oko, Enegbe, Nka and Ogomodu), while some species did not present thorns mostly *D. alata* accessions (except Nvula mbube, Agbirigba and Nneonwuka). Cumulatively, 87.6 % accounted for tubers without thorns while 12.4% presented thorns at harvest among the species.
- **Intensity of thorniness (IthT):** Accessions of *D. cayenesis* had more intensity of thorns than any other species as it recorded 31.8 % followed by *D. rotundata* accessions having (6.4%) 8.9% recorded few intensity of thorniness and 4.9% had many intensity of thorniness (Table 30). Accessions of *D. dumetorum* rarely produced thorns on the tuber surface, *D. bulbifera* produced tubers characterized by many thorns on the tuber surface (75%).
- **Wrinkles on the harvested tubers (WohT):** Accessions of *D. rotundata* produced tubers with wrinkles (7.3%), *D. alata* (6.3 %), *D. cayenensis* (2.4%) and other yam species had no wrinkle tubers. Cumulatively, 16% tubers harvested had wrinkles that made the surface texture rough while greater number of the tubers harvested had no wrinkles (84 %) on the surface of tubers.
- **Roots on the surface of tubers (RosT)**: The frequency distributions of tubers among the species across the seasons indicated that *D. rotundata* produced (93.6%) few roots on tuber surface. This made it highest among the species. This was closely followed by *D.alata* (84.9%), 72.7 % by *D. cayenensis*, and 62.5 % by *D. dumetorum*. The least value for this trait 50% was produced by *D. bulbifera*. All the accessions among the species produced tubers with few roots on the tuber surfaces. Cumulatively, 72.7 % of the accessions produced few roots on their tuber surfaces irrespective of the species, while 16.7% were tubers with many roots on the tuber surfaces, observed more on *D. bulbifera* and the least 10.6% founded more in *D. alata* (Table 29).
- **Position of roots (PoR):** The result revealed that 202 accessions of Dioscorea species across the seasons produced tubers with roots positioned at tuber heads. This accounted for 93.6 % of the total white yam accessions. One tuber each was identified to have roots on the entire body, lower and head region, middle and two tubers accessions without roots on the tuber surfaces irrespective of positions. 76.2% tubers of *D. alata* accessions were founded to have roots on tuber heads, 15.9% tubers had roots on the entire body including Nvula agbirigba, Caret yam, Ajingworo and Nvula egboru. Accessions of *D. cayenensis* produced 86.4% tubers with roots at head regions and 13.6% with roots on the entire. Accessions of *D. dumenntorum* produced tubers with few roots at head region and accounted for 100%, while 100% of *D. bulbifera* tubers across the seasons indicated tubers with roots on the entire body surfaces (Table 29).

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- **Corm size and type (Cmst):** High phenotypic diversity was observed for corm size and type in all the species. Over half of white yam accessions 51.4% were tubers without corm. However, corms for *D. rotundata* and *D. cayenensis* were large, transversally elongated or branched and regular detachable corms. *D. alata* corms were differentiated by having intermediate corm type either fused or detachable. Accessions of *D. dumentorum* produced corm tubers that are between small tubers to intermediate with fused corm types and transversally elongated or branched, while corms were not common with *D. bulbifera* but can produce small tubers with no corms. Cumulatively, 55.5 % accounted for accessions without corms among all the species, 21.3 % accounted for corms with transversally elongated corms, 12.32% were branched corms and 10.9% regular type of corm tubers (Table 29).
- **Tuber colour upper surface region (Tcup):** The same accessions within species exhibited different colour changes in each season. No accession of any species was characterized by white tuber colour across the two seasons. Accessions of *D. rotundata* revealed that most of the tubers were creamy coloured at upper regions across the seasons. This was followed by deep purple and purplish colour, while the least were obtained in yellow and purplish white tubers (Table 29). Accessions of *D. alata* produced deep purple tubers, followed by purplish coloured tubers, creamy, creamy white, purplish white and no or less of orange, brownish white and yellowish tubers at upper regions. Tubers of *D. cayenensis* exhibited high diversity of tuber colours at upper regions but produced yellow to orange coloured tubers more than any other colour. Accessions of *D. dumentorum* and *D. bulbifera* exhibited high colour diversity at upper region having creamy, orange and brownish green as the most dominant colours among the species. The colours of each species suggested that most of the colour of vines and leaves affected the colour of the tubers.
- **Tuber colour at Middle region (Tcm):** Most of the accessions retained to an extent the colour from the head regions to middle regions, *D. rotundata* produced more creamy coloured tubers in the first season and creamier colours in the second seasons. However, *D.rotundata* maintained creamy to creamy white (38.6% and 23.6%) tubers. The deep purple of *D. alata* accessions were reduced to purplish tubers and other colours mostly in the first season. Similarly, *D.dumentorum* maintained creamy white to creamy and *D. bulbifera* recorded other variable colours of orange to brownish white tubers.
- **Tuber colour Lower region (Tclr):** Tuber colour at lower region indicated nine colour variabilities. Creamy colour and creamy white were the most dominant colour on *D. rotundata*, suggesting that some of the tubers maintained uniform colour from head regions to lower regions. This observations were the same among the accessions and species across the seasons. However, the tubers of *D. alata* was mostly affected as the deep purple colour of the upper regions changed to purplish and purplish white at the lower regions. This implied that as the tubers grows deeper in the soil, the soil presses the tuber resulting to change of colour and shapes of the tubers. Probably for this reasons, accessions of yam species exhibited different shapes, sizes and colours across the seasons. This also suggested that tuber colours were more of environmental factor governed, unlike vine colour, leaf shape, hairiness, spines and twining habits of the species.

C. Identification of Superior Accessions or Groups that can be used as Composite Parents for Future Yam Breeding.

The correlation matrix (Table 30) explained relationship and associated traits that can enhance characters responsible for high and significant yield of yam tubers. The extent of relationship among the examined traits, either strongly positively correlated, moderately and slightly or weak correlations at different significant levels were shown in correlation matrix (Table 30). Correlation analysis among tuber yield associated with other trait of accessions and species showed that number of leaf, leaf width per plant, internode length, and internode diameter, number of vine per plant and leaf length per plant had the highest significant positive correlation at 1% level of probability. These traits correlated with the accessions yield and yield component including number of tuber harvest, number of seed yam harvested per plant, total tuber weight, weight of seed yam, number of ware yam and weight of ware yam per plant. These traits also had significantly positive correlation at 5% level of probability with weight of seed yam and tuber length per plant. Internode length significantly correlated to the weight of seed yam at 5% level of probability. This implies that the longer the internode length the larger the surface area that can attract photosynthates that build up the food reserve of the tuber resulting to increase in the weight of tubers at harvest. However, the correlation between number of internode before the first branching and number of vine per plant to the number of tuber harvested and total tuber weight per plant were higher than other trait assessed in this study. This implies that the role played by these traits were higher than other traits among the accessions and species. Significant and positive correlation between morphological traits and yield component of the accessions, indicated that the morphological traits were converted to yield traits. In other word, the higher the number of sprouts, the high the tendency of multiple tubers production of the accessions. The longer the internode length the larger the surface area that can attract photosynthates (photosynthetic materials) that build up the food reserve of the tuber resulting to increase in the tuber length and width, and incidentally increase in the weight of tubers at harvest. This also implies that the wider the internode diameter and leaf width, the larger the surface area to attract photosynthates that build food reserve in the tuber. Number of tuber harvested also significantly and positively correlated to number of ware yam and weight of ware yam per plant as well as the tuber length is moderately correlated with the number of ware yam and weight of ware yam per plant.

Total tuber weight (TBW) is more positively correlated to the weight of ware yam (wwy) than number of seed yam (NSY) and weight of seed yam (WSY) but slightly positive correlated with the tuber length (Tle) and tuber width (Tbwi). Some traits were negatively correlated, for instant, number of leaf negatively correlated to leaf length. This implies that the more the number of leaf, the shorter the leaf length. However, the highest negative correlations were recorded in number of leaf, leaf length and internode length (Ile). This implies the lesser the number of the traits the lower the yield and other yield component. Nonetheless, the mainly correlated characters of accessions are found in sprout diameter, number of internode before branching, internode length, and

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internode diameter, number of leaf, number of vine per plant, and leaf length and width indicating the most diversified traits recorded in the study (Table 30). Consequently, selection based on these traits is efficient to improve tuber fresh yield and weight for further breeding.

Table 30: Correlation Matrix for 19 Quantitative Traits

Variables	Sdiacm	NIN	Ilecm	Idacm	NVP	NLV	Lvlecm	LVwicm	Mt (day)	NTBPlnt	TBwplot	Tblecm	Tbwicm	NSYplot	WSYkg	NWYplot	WWYkg
Sdiacm	1																
NIN	0.23	1															
Ilecm	0.06	0.72**	1														
Idiacm	0.11	0.98**	0.45*	1													
NVP	-0.02	0.66**	0.11	0.66**	1												
NLV	0.69**	0.19	-0.48	0.11	0.10	1											
Lvlecm	0.28	-0.05	-0.50	0.00	.66**	0.32	1										
LVwicm	0.89**	-0.48	-0.28	0.10	-0.28	-0.84	-0.48	1									
Mtday	0.09	-0.17	0.41	-0.22	-0.60	-0.11	0.79**	-0.01	1								
NTBPlot	-0.19	-0.42	0.13	-0.07	-0.10	.80**	0.08	0.24	0.13	1							
TBwplot	0.04	-0.40	-0.06	-0.03	.92**	-0.05	-0.48	0.20	0.05	0.98**	1						
Tblecm	-0.04	-0.11	0.35	-0.09	0.17	0.10	-0.15	-0.04	-0.11	-0.08	-0.03	1					
Tbwicm	0.03	-0.19	0.06	-0.22	.72**	0.06	0.26	0.19	-0.09	-0.11	0.02	0.92**	1				
NSYplot	0.21	.80**	0.24	0.06	-0.01	0.04	-0.08	-0.00	-0.06	0.98**	-0.15	0.00	0.09	1			
WSYkg	0.00	-0.36	0.36*	0.24	-0.13	-0.01	-0.07	-0.05	-0.01	-0.15	0.93**	0.30	0.03	0.17	1		
NWYplot	-0.09	0.13	-0.09	0.18	-0.07	0.01	0.02	0.02	0.03	0.70**	0.74**	0.47*	0.00	-0.07	0.05	1	
WWYkg	0.65**	0.27	0.06	-0.27	-0.03	0.00	-0.11	-0.06	0.01	0.69**	0.75**	0.49*	0.10	0.08	0.98**	0.94**	1

Legend: residual-3.5, ** and *Correlation significant at 1% and 5% level of probability. NSP - Number of sprout per plant (count),Sle -Sprout length of (cm),Sdia Sprout diameter (cm), NIbb - Number internode before the first branching (count), Ile- Internode length of (cm), Idia - Internode diameter (cm), NVP- Number of vines or branches of plant (count), NLv - Number of leaf (ranked),Lvle- Leave length (cm),Lvwi - Leave width (cm),NTH Number of tuber harvested (count),TBW- Total tuber weight (kg), Tle - Tuber length (cm), Tbwi - Total tuber width (cm), NWY - Number of ware yam (count), WWY - weight of ware yam (kg), NSY-number of seed yam (count), WSY- weight of seed yam (kg).

D. Cluster Analysis of 21 Qualitative Characters used to Explained 202 Accessions

Dendrogram tree (Fig.2) showing hierarchical clustering of 202 *Dioscorea* accessions was constructed based on 21 qualitative traits using UPGMA method (Fig. 2). The 21 qualitative traits used in constructing UPGMA dendogram tree include :vine colour, hairiness on stem, spines on stem,twining habit, leaf colour, leaf shape, leaf apex shape, tuber shape, tuber surface texture, tuber tendency to branch, position of branching, cracks on tuber surface, thorniness on tubers,intensity of thorniness of tubers, wrinkles on tubers, roots on surface of tubers, position of roots on tubers, corm size and type, tuber colour upper region, tuber colour middle region and tuber colour lower regions (Table 22 – 31 and appendix I-IV).

- Cluster I: The dendogram indicated the classification of 202 accessions into 5 clusters (Fig.2). Table 31 shows the cluster number, frequency, percentage as well as traits that distinguish members of each cluster. Cluster 1, the largest in number comprised 114 accessions (56.4 %) with majorly three species of yam, *D. rotundata* (58- 28.7%), *D. alata* (53 - 26.2%) and *D. cayenensis* (3 -1.5%) (Table 32). They were mainly two cluster groups commonly characterized by anticlockwise twine habit for *D. rotundata* and *D. alata*, while *D. cayenensis* showed clockwise twine habit. Cluster 1 also had about 21 sub-classes or sub-groups or clusters. Accessions in this cluster mostly the two major sub-classes of cluster 1 were 26 accessions of *Dioscorea rotundata*, 18 *Dioscorea alata* groups and two *Dioscorea cayenensis.* This sub-group revealed highest phenotypic diversity with variation in each trait ranging from 2 to 6. This group is characterized by six colourations of vines (purplish green, brownish green, dark brown, green, light green and pink), six leaf shapes (cordate, cordate broad, cordate long, ovate, hastate and saggitiate long), and five leaf apex shapes (caudate, acute, aristate, obtuse and emarginated). The dominance of vine colour of this sub-group ranged from purplish green, dark green to few green and light green, no hairiness and absence of spines on the stems except few spines observed from Jioke, Usuekpe and Nkpenyi collected from Amofia community in Ohaukwu LGA (Appendix I-IV). Variations in the leaf orientation of this sub-group ranged from dominant cordate leaf to a very few cordate long, cordate broad and hastate, while leaf apex shape were predominately caudate, acute, aristate, obtuse and few emarginated with variables leaf colours ranging from purplish green, dark green to green on or before flowering and turned light green to pale green and

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yellowish at senescence. Tubers were characterized mostly by cylindrical, irregular, oval shape to few oval oblong and spherical/round tubers, having smooth tuber surface texture except tubers of Ajingworo, Amage, Oko and Ozibo with rough tuber surface, slightly branched at middle, tail, upper middle/head and tail regions, few to many roots on the surface of tuber at head region (tuber head) and very few tubers with roots on the entire body. Other distinguishing phenotypic traits from the second sub-group include absence of cracks, thorns and wrinkles on the tuber surface, small to intermediate and large corm size with branched corm type to transversally elongated and regular corm type. Tuber colour is characterized by six colours ranging from dominant deep purple at upper region of the tubers to purple, creamy, creamy white, brownish white, purplish and purplish white and very few orange coloured tubers for both middle and lower regions of the tubers. However, some tubers maintained uniform colouration from the upper regions to the lower regions.

The second sub-major groups of cluster 1, 35 accessions were *Dioscorea rotundata* and 32 accessions (*Dioscorea. alata*.), while one accession *D. cayenensis*. Accessions of this sub-groups were characterized by variable vine colours as in sub-group 1 with additional purple colours of some vines of accessions but differentiated by presence of hairiness and spines on the stem of some of the accessions, had anticlockwise twine habit except *D.cayenensis* (Ogomodu accession) that showed clockwise twine habit. The leaf colouration include 30 pale green,12 dark green,9 yellowish leaves, 7 light green, 6 purplish green and 4 purple leaves. Leaf orientations were the same with sub-group one having cordate and caudate as the most predominant leaf shape and leaf apex shapes respectively. They are also characterized by variables leaf colours ranging from dominant pale green to purple and light green on or before flowering and turned mostly yellowish and few light green at senescence. The tubers were long cylindrical shaped tubers, oval to oval oblong and spherical/round tubers with no irregular tubers. The oval and oval oblong shaped tubers were mostly from *D. alata* groups and few *D. roundata*, mostly Obiaoturugo, Abi and Agba. Tuber surface texture were majorly smooth surface texture with few rough surface tuber texture. Tubers were dominantly slightly branched to few branched tubers at middle, tail, upper middle, upper middle/head and tail regions with few cracks and very few accessions without cracks. Tubers were also characterized by absence of thorns and intensity and wrinkles, while dominant few to very few many roots on the surface of tuber at head region and entire body were observed. Many tubers were without corms to very few with both small and intermediate long regular detachable corm types, and hairiness had no influence on the tubers since there were no thorns and rough surfaces. The tuber colours were the same as in sub-group one but were differentiated by having more purplish white and creamy white on the middle and lower regions respectively.

- Cluster II showed 32 accessions (15.8 %) dominated only by *D. rotundata* having two sub-classes with 9 sub-groups. The cluster result revealed anticlockwise twining, high variability of vine colours, and presence of few hairs to no hairiness on the stem. Cumulatively, the group was made up of 9 purplish green, 8 green, 6 brownish green, 5 light green and 4 dark brown. There was high variability of leaf shapes in this cluster group. It included 20 cordate, 11 ovate, 1 saggitiate long and one obtuse shapes (Table 31) and Appendix I – IV. The leaf apex shapes exhibited majorly caudate with few acute and obtuse leaf apex shapes. There was no distinguishing colour traits among the sub-groups. However, the leaf of the sub-group 1 had more of purplish green to dark brown, while the sub-group 2 had more pink and green on or before flowering and turned light green and yellowish at senescence.

The two major sub-classes having 19 and 13 accessions, respectively, all from *Dioscorea rotundata* and were characterized majorly by cylindrical shaped tubers with few oval oblong shaped tubers, smooth with few rough tuber surface texture, majorly slightly branched with few highly branched tubers at middle, tail regions and upper middle and head and tail regions with few to many cracks on the tubers. Accessions were characterized by absence of thorns, no intensity of thorns, no wrinkles at tuber surface but had uniform few roots at the tuber head only. A very few of the accessions had small, intermediate and large corms with regular detachable corm type. Tuber colours ranged from dominant creamy to deep purple and very few orange and purplish white tubers at the upper regions of the tuber, while creamy white to creamy colours and few purplish, purplish white and orange dominate both the middle and lower part of the tubers. In other hand, the second sub-major groups of cluster II are distinguished from the first by cylindrical and oval oblong shaped tubers, smooth and rough surface tubers that branched at upper middle, middle, tail regions and upper middle and head and tail regions., absence of cracks, thorns and wrinkles, creamy as dominant colour of tuber head, creamy, creamy white to purplish white on both middle and lower regions (Appendix V-VI).

- Cluster III includes 23 accessions (11.4 %) from three *Dioscorea spp*, eighteen accessions from *Dioscorea cayenensis*, and four from *D. dumentorum* and one from *Dioscorea rotundata*. It had two major sub-groups with about six sub-classes. Cluster III generally revealed variations in vine colours ranging from dark brown to purplish green with few brownish green and purple. Twined majorly clockwise by *D. cayenensis and D. dumentorum*, while one *D. rotundata* (Otutu accession) twined clockwise. Having some of the accessions that presented many spines and very few with few spines and hairs on the stems. Leaves were predominately cordate long, cordate broad, saggaitate long with few ovate and hastate, while the leaf apex were predominately acute, aristae and few cudspidate. Wide variability of leaf colour at senescence include 17 yellowish, 4 purplish green and 2 pale green. Cylindrical shaped tubers were found except for *D. dumentorum* accessions with smooth and rough tubers, slightly branched to branched tubers at middle. Some accessions presented few cracks on the tuber surface, while some had no cracks. They were few presence of thorns among accessions with very few intensity but absence of wrinkles on the tuber. Few roots to a very few many roots were on the surface of tuber at head region (tuber head), while intermediate and large with very few small corms with regular corm type fused, either transversally elongated and branched corms were exhibited by *D. dumentorum*

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accessions. Variable tuber colours were obtained ranging from creamy colours with few purplish white were observed for both (upper, middle and lower regions) of the tubers (appendix V-VI).

- Cluster IV consisted of 17 number of accessions, accounting for about 8.4 % of the total accessions (Table 31). Cluster IV accessions were sub-grouped into two. Seventeen accessions were three *Dioscorea spp,* 11 accessions from *Dioscorea rotundata,* 4 accessions from *D. alata* and two from *Dioscorea bulbifera*. The first sub-groups were characterized predominantly by purplish green vines with few green mostly the *D. bulbifera* group, purple and brownish green. Absences of hairs except Jimanu collected from Umunwagu Idembia in Ezza South presented with few hairs and only two accessions presented spines on the stem. Accessions of *D.bulbifera* indicated no hairs of the bulbs but tuber had hairs with leaf turning pale green at maturity. Leaf shapes were ovate, while leaf apex shapes were obtuse with smooth and rough bulbs and tubers, irregular shape tubers branching at the middle. Accessions of *D. bulbifera* tubers presented with thorns with high intensity of thorns as well many roots on the entire tuber body. It has no corms and corm type and showed uniform creamy colour at both upper, middle and lower regions of the tubers. Spines and thorns were common among *D.rotundata* and *D. bulbifera* in the group, while the *D.alata* in the group presented no hairiness, spines, variation of leaf shapes (cordate long, cordate broad and saggitiate broad, uniform leaf apex caudate, dark green leaf to light green and pale green). Accession of *D.alata* was observed having tubers predominated by oval shaped, smooth tuber surface with many roots at tuber head, detachable transversally elongated corm type with uniform tuber colour like other species in the group. The accessions of *D. rotundata* twined anticlockwise. Few hairiness, many spines on the stems, leaf shapes varied from cordate, ovate to few saggitiate long to cordate broad and cordate long. High variability was observed on the leaf apex shape and colour at senescence (caudate, obtuse, few acuminate, hastate and cudspidate) and (purple, purplish green, pale green and yellow leaves). Cylindrical to irregular and few spherical/round shaped tubers with smooth to rough tuber surface texture that had slightly branched to few branched tubers at the middle, upper middle, tail and upper middle/head and tail regions. There were few cracks on some tubers, while cracks were absent in many of the tubers. Majority of the accessions have thorns with many roots on the tuber head and tail, few had large and intermediate corms to few and many corms slightly fused, branched and transversally elongated, colours ranged from creamy to creamy white, purplish to purplish white for both middle and lower regions, while the upper region is dominated by creamy colouration.

- Cluster V consisted of 16 accessions, accounting for about 7.9 % of the total accessions (Table 31). Cluster V accessions were sub-grouped into two. Sixteen accessions were four *Dioscorea spp,* 9 accessions from *Dioscorea rotundata,* 5 accessions from *D. alata* and one each from *Dioscorea bulbifera* and *Dioscorea cayenensis.* The first sub-groups were characterized predominantly by pale green and purplish green vines with few green, mostly the *D. bulbifera* group, purple and brownish green for *D.cayenensis* accession. Cluster V accession characterized by green vine that turned pale green at maturity. Clockwise twining habit obtained for *D. bulbifera* and *D.cayenensis*, while *D.rotundata* and *D.alata* accessions exhibited anticlockwise twining habit. There was absence of hairs and spines but ovate leaf shape and obtuse leaf apex shape. Tubers and bulbs having irregular tuber shapes with smooth to rough tuber surface texture and slightly branched tubers at upper middle/head regions. Accession had many roots at middle. Absence of cracks and thorns but had few wrinkles. The tuber colours is creamy white and brownish white. Accounting for 7.9 % of the total population while the bulbils were brownish white, creamy white, purplish to purplish white with irregular and oval oblong bulbils (Table 31 and Appendix V-VI). Summarily, *Dioscorea bulbifera* results according to IPGR/IITA (1997) cluster analysis performed were predominantly green to purplish green to yellow vines, absence of hairs and spines on the stem, characterized by pale green to yellow leaf at senescence, cordate to cordate broad leaves and twining in clockwise directions. Tubers were oval oblong, cylindrical to irregular shapes of the bulbils and tubers and slightly branched at middle with tuber dominant variable colours of creamy white to brownish white.

Table 31: Cluster Number or Cluster Groups, Frequency, Percentage Distributions and Characters or Traits Associated with each Group

Parameters examined					**Traits or characters identified in each cluster group**		
Clusters	**Freq.**	**Perc. (%)**	**No *spp***	**Location/no of Accessions**	**Twine habit**	**Vegetative**	**Yield**
C1 red Sub-group 1	114 58 53 3 26 18 2	56.4 28.7 26.2 1.5 12.9 8.9 1.0	**3** 58 Dr 53 Da 3 Dc 26 Dr 18 Da 2 Dc	17 communities Amagu - 3, Amofia - 4, Ekpelu-9, Eweze - 6, Igbeagu-9, Ishiagu - 11, Ndiabor Okpuitmo - 6 Ndiegu Okpuitmo - 6, Ndieze -7 NdufuAlike -9,	Anticlockwise Anticlockwise =111 Clockwise = 3 Anticlockwise = 44 Clockwise = 2	27 Purplish green, 12 green, 4 brownish green, 3 dark brown, 1 light green & 1 pink vine with 1 hair vined and 3 few spines, 11 green, 9 purplish green, 9 pale green, 9 dark green, 3 Light green and 5 yellowish leaves, 15 cordate leaf shapes, 9 cordate broad, 9 cordate long, 8 ovate, 3 hastate, 1 saggitate long and 1	29 cylindrical, 6 irregular,6 oval,3 spherical/ round,2 oval tuber shapes, 41 smooth & 5 rough, 35 slightly branched, 5 highly b,5 branched, 1 no branch, 26 middle, 8 upper middle, 5 upper middle/head & tail regions,5 tail and 2 lower third, 29 absence

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				Okposi Umuogharu -5, Okue-4, Oso Edda - 5, Owutu-8, Uburu-5 Umuezeaka-7, Umunwagu Idembia -5 Umuogharu -5		saggitate broad leaf shapes, 28 caudate, 8 aristate, 6 acute, 2 emarginated and 2 obtuse leaf apex shapes.	and 17 few cracks, no thorns, wrinkles & intensity, 38 few,5 many & 3 no roots, 36 tuber head, 5 entire body,1 middle, 1 lower third & 3 no roots,16 intermediate,14 large,5 small & 11 no corm,16 regular, 11 branched, 8 transversally el. & 11 no corm type, 15 deep purple,12 creamy, 7 purplish, 5 creamy white, 3 purplish wh. & 1 brownish wh. colours upper & middle with 1 orange colour, 12 deep purp, 11 creamy,8 purplish, 8 pp wh, 2 brownish wh. & 1 orange tuber colour lower regions.
Subgr2	35 32 1	17.3 15.8 0.5	35 Da 32 Dr 1 Dc		Anticlockwise = 67 Clockwise = 1	35 ppg, 12 g, 10 db, 5 pink, 3 purple, 2 lg & 1 brownish green, 67 no hairs & 1 hair, 4 many spines & 1 few, 31 pg, 13 dark green,8 yellowish, 6 ppg, 6 light green, and 4 purple leaf colours, 15 cl, 14 cordate broad, 12 saggitate long, 11 cordate, 9 hastate, 6 ovate & 1 saggitate broad, 52 caudate, 10 aristate, 3 acute, 1 obtuse, 1 hastate & 1 emarginated leaf apex shapes	37 cylindrical, 20 oval, 9 oval oblong & 2 spherical/round tubers, 53 smooth & 15 rough tubers, 62 sli. b & 6 branched, 29 middle, 24 tail, 11 upper middle & 4 upp.m/h, 37 absence & 31 few cracks, no thorns, intensity & wrinkles, 65 few & 3 many roots at 61 tuber h & 6 entire tub. 42 no corm,15 intermediate, 8 small & 3 large corm, 23 regular, 2 branched & 1 T. elongated, 29 dp,22 creamy,6 c. white, 6 pp wh. & 5 pp. 23 dp,17 creamy, 10 pp, 10 pp wh. & 8

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							creamy wh.16 dp, 14 pp white,13 pp, 12 creamy & 11 C. white for middle & lower tuber regions

Table 31: Continued

Parameters examined					**Traits or characters identified in each cluster group**		
Clusters	**Freq.**	**Perc. (%)**	**No *spp***	**Location/no of Accessions**	**Twine habit**	**Vegetative**	**Yield**
C2 blue	32 19	15.8 9.4	**1** 19 Dr	17 Communities. 2 OhAm, 2 OhUmu, 1 AbNda, 2 IzGb,4 EznOk,1 AbNdg, 1 EzsAM, 2 Ubu, 1 IkwNduf, 3 EznOK	Anticlockwise	10 pink,6 ppg, 6 db, 4 g, 3pp, 2 bg, 5 Lt, 4 db, 30 hairs & 2 no hairs, 22 no spines,6 many & 4 few, 14 yell, 7 pg, 5 Lt, 4 ppg & 2 dg of leaf colours, 19 cordate, 12 ovate and one saggitate long,	27 cy & 5 oval ob., 26 smooth & 6 rough, 27 sb, 4 b & one highly b. tubers at middle (20), 5 tail, 5 upper m. & 2 upper m./head & tail regions, 19 no cracks, 12 few & one many cracks, no thorns & spines, 31 few & one many roots at 30 T. head, 1 L. third & one entire body, 22 no corm,
Subgr2	13	6.4	13 Dr	3 Okue, 2 Oso, 2 Owu, 2 EzsUm., 2 IzNdz, 1 Ekp, 1 Ishiagu	Anticlockwise	20 caudate, 6 acute & 6 obtuse for both leaf shapes & leaf apex shapes, respectively.	4 sm, 3 large & 3 interm. with regular corm type, 17 crm, 6 dp, 4 pp, 3 ppw, 1 bw, 1 orange, 13 cw, 10 pp, 4 dp, 3 ppw, 1 crm, 1 or, 16 cw, 5 crm, 5 pp, 5 ppw & 1 or for both tuber regions
C3 black	23 14	11.4 6.9	**3** 9 Dc, 4Dd, 1Dr	1 IkwNduf, 2 Ishiagu, 1 okue, 1 OhAm, 3 Oso, 2 EzsUm, 2 owu, 2 EznUm	Clockwise Clockwise Anticlockwise	15 db, 4 ppg, 3 bg & one purple vine colours, 19 no hairs & 4 hairs, 17 yellow, 4 ppg & 2 pale green leaf colours, 13 Cordate broad, 5 saggitate long	17 cy, 3 oval, 2 spherical/round & one irregular, 17 smooth & 6 rough, 14 sb, 8 b & one slightly branched at middle (16), 5 Upp. middle, 1 tail & one upp.middle/head & tail region, 9 few cracks, thorns, 18 few & 3 many roots at tuber head
Subgroup 2	9	4.5	9 Dc	1 Ekp, 1 Ubu, 1 IzGb, 1 EzsAM, 1 IzNdz, 1 Ewe, 1 AbNda, 2 Eznokp,	Clockwise	2 sag.broad, 2 hastate & one ovate, 14 acute, 7 aristate & 2 cudspidate for leaf apex shapes.	5 large, 4 inter.& one small, 5 regular, 4 b & one T. elongated, 11 orange, 4 cw, 3 to 5 cream, 1 to 2 yel, one for dp. bw. bg, pp for both regions
C4 yellow	17 11	8.4 5.4	**3** 11 Dr	2 IkwNduf, 3 owu, 1 EznUm, 1 Eznokp, 3 AbNdg	Anticlockwise	10 ppg, 2 g, 2 bg, 2 purple, 1 db, 16 no hairs, 3 spine. 5 dg, 4 yell	11 cy,5 irr, 1 sph/r, 12 sm & 6 rough, 10 sl, 6 b & 1 hb, 8 mid,5 upp.m/h, 2 tail, 1 lt & 1 upp.m
Subgroup2	4 2	2.0 1.0	4 Da, 2 Db	1 EzsUm, 2 IzNdz, 2 Oso, OhUmu, 1 Owo	Anticlockwise Clockwise	3pg, 3 lg, 2 ppg, 7 ovate, 6c, 1 cl,1 sl, 1 sb, & 1 hastate, 8 cau,4 obt, 2 cu,1 acum & 1 emarginated	5 cracks, 14 thorns, 8 many & 6 few, 12 few & 5 many roots, 4 large,2 inter.,3 t.el,2 reg & 1 b, 11 creamy,3 c. wh & 3 dp for both regions
C5 orange	16 9	7.9 4.5	**4** 9 Dr	1 ohAm,1 AbNda, 1	Anticlockwise	6 ppg, 4 bg,5 g, & 1 pp, 3 spines, 4	9 cy, 2 irr, 2 oval oblong, 2 oval, 1 sph/r, 10 smooth

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	1	0.5	1 Dc	EznOkP, 1 Ubu, 1 EzsAM, 2 Oso, 1 IkwNduf,1 EzsUm	Clockwise	few hairs, 7 pg, 4 dg, 2 pp, 1 g, 1 yell & 1 lg, 7 c, 3 ov, 2 hast,	& 6 rough, 11 sl, 4 b & one highly b at 11 mid,3 tail & 2 upp. m/h, 1 p, 5 few & 4 many,
Subgroup 2	5 1	2.5 0.5	5 Da 1 db	2 IzNdz, 2 EzsAM, 1 OhAm, 1 EzsUm , Eweze	Anticlockwise Clockwise	1 cl, 1 cb & 1 sl, 7 ov, 6 cordate, 1 cl, 1 sb, 1 sl & 1 hast,11 cau,2 acute, 1obtuse & one cuspidate	15 few & 1 many at 12 tub.h & 4 entire body, 4 l,4 interm & 2 3 corm, 8 reg & 3b, 7 dp,4 c, 2 bw, 5ppw, 1 or, 5 dp,5ppw,3 bw & 3 c for both

Source: Field experiment 2016 and 2017. freq. – frequency, per.-percentage, Dr – *Dioscorea rotundata*, Da – *Dioscorea alata*, Dc – *Dioscorea cayenensis*, Dd- *Dioscorea dumentorum*, Db- *Dioscorea bulbifera*, OhAm- Ohaukwu Amofia, OhUm- Ohaukwu Umezeaka, AbNda- Abakaliki Ndiabor Okpoitumo, AbNdg- Abakaliki Ndiegu Okpoitumo, IzIgb – Izzi Igbeagu, EzsAm- Ezza South Amagu, EzsUm-Ezza South Umunwagu Idembia, Uburu, IkwNduf – Ndufu Alike Ikwo, Ekp – Ekpelu, IzNdz – Izzi Ndieze, EznU – Ezza North Umogharu, EznOkp – Ezza North Okposi Umunwagu

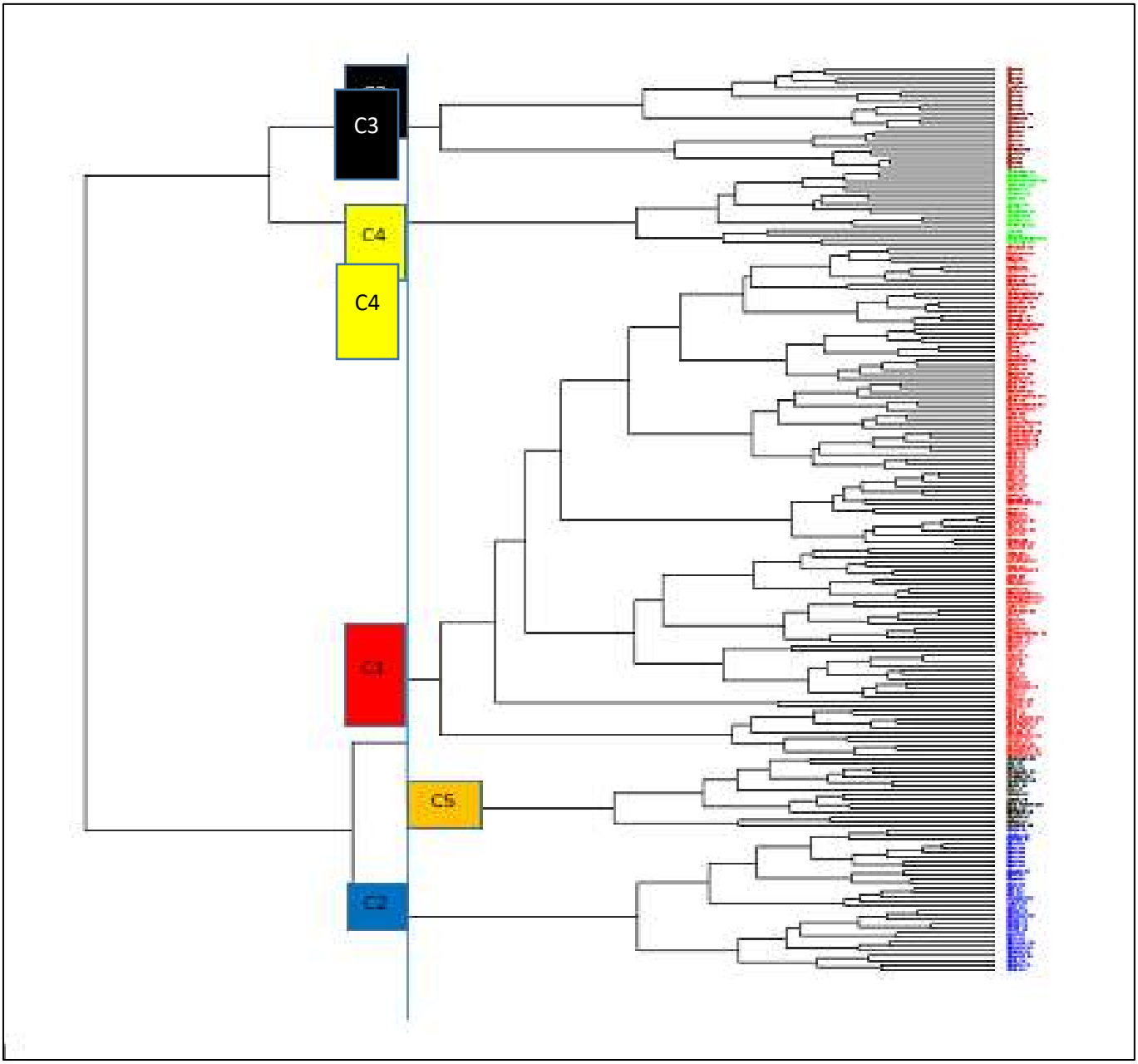

Fig 2: Dendogram Showing Relationship of 202 Accessions of Five Species of Yam based on Cluster Distance 2cm and UPGMA Clustering using 21 Qualitative Traits

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CHAPTER FIVE
DISCUSSION

A. Conscious Expedition to Collect Farmer-Grown Yam Accessions and Related Indigenous Knowledge in Ebonyi State

The physical and socio-economic characteristics of yam farmers in the three senatorial zones in Ebonyi State covering gender differences among the farmers interviewed, age, years of experience, educational qualifications; sources of income and size of farms were studied. A greater percentage (91.7%) of yam farmers in Ebonyi State were males and very few female with about 66.2% of farmers above 50 years of age. This suggested that most of the farmers in the study area have been in yam cultivation for a very long time, adding to their years of experience in farming. On the other hand, the farming population is predominantely older persons. This has some implications as the farmers may not produce enough yams in all the seasons, due to age despite the age-longed experience. However, 68.5% of farmers were identified having farming experience ranging between 20-30 years. This is an indication of high age-long level of experience of farming and this is expected to have positive influence on the availability of the crop in the state and nation at large. This is true as the more experienced the farmer is, the more productive and efficient the farmer will be. This observations corroborated with findings of Okoye *et al*.,(2009) that the more experienced the farmer is, the more efficient in managing factors that affect farming business including adoption and rejection of any innovation in farming business. This observation is also synonymous with Ada *et al*., (2007) who revealed that the greater the years of farming experience, the greater the farmers' ability to manage generally specific factors that affect the farm business.

These experienced farmers produced yams they store in the barn/home, field and garden. A greater number of them store their yam in the barn and home and less than 40% of yam farmers in the study area store yam in the field and garden. This has implication as no new or modern storage facilities have been developed or introduced in Ebonyi State, leading to farmers losing some yam accessions due to poor storage. This could be premised on poor involvement of farmers on decision making as the result indicated that very few yam farmers were decision makers in yam cultivation in the study area, while greater percentage of farmers 75.5 % had no specific role in decision making process in yam farming. This also implies that the farmers had no central role to play in selection of yam to plant within a season, or after planting where to store. It is imperative to involve farmers as the key decision markers in farming business since they are the end users of agricultural policy decisions. This observation is in agreement with Thurston *et al.*, (1998) and Jain (2000) who asserted that studying crop diversity in traditional agriculture takes into account the role traditional farmers play in creating and managing diversity. This observation is also in consonance with Rubenstein and Heisey (2003) who noted that farmers are the ultimate users of crop improvement programs with valuable traditional knowledge and should be given due consideration in evaluation programs.

Another social economic characteristic factor affecting the farmers in the surveyed area is educational qualification. The result revealed that less than half of yam farmers' population (40.8%) are not educated, while others had either primary, secondary or tertiary education (59.2%). Ebonyi South was observed to have higher number of educated farmers yet it was not transmitted to having more yam in cultivation, as Ebonyi North and Central had more yam accessions in production than Ebonyi South but had a community (Ishiagu) that produced the highest number of diversed yam accessions as observed in cluster one of this evaluation. Education helped farmers in the study area in identification of grown accessions totalling 856 yam accessions and from five species, having accessions of water yam (*Dioscorea alata*) with local names 'Nvula or Mbala or Mbana' as the most diverse, followed by white yam **(***Dioscorea rotundata*) accessions and yellow yam accessions (*Dioscorea cayenensis*) with local names of yam vary from one community and senatorial zone to another. This result is synonymous with Loko (2013) who revealed diversity of three varieties of *Dioscorea rotundata*, to *Dioscorea cayenesis* and *Dioscorea alata* in several villages in Benin in 2013. This observation is in tandem with the findings of Adjatin *et al*., (2012) and Loko *et al*., (2013) who revealed that local names of yam vary from one ethnic group to another.

Yam diversity was founded more in Ebonyi North (325 accessions) followed by Ebonyi Central (280 accessions) and the least from Ebonyi South (251 accessions) with widest diversity recorded in *D. alata*, *D.rotundata* and *D.cayenensis* and the least *D. dumentorum* and *D. bulbifera*. The more diverse the species are the more number of farmers that engaged in cultivation. Of all the five species identified and collected, *Dioscorea alata, Dioscorea rotundata* and *Dioscorea cayenensis* in descending order were the most diverse and widely cultivated species in the study area.This result corroborated with the observations of Chair (2010) and Loko (2013) who reported separately the diversity of three varieties *Dioscorea rotundata*, to *Dioscorea cayenesis* and *Dioscorea alata* in several villages in Benin in 2013 noting the highest diversity in of the ethnic zones called Centrale that had over 21 villages.

There are accessions not grown in one zone that are prevalent in another zone. However, out of the known 600 *Dioscorea* species only five species are grown and domesticated by yam farmers in Ebonyi State with *D.alata* ranking first of the most diversified species followed by *D.rotundata* and *D. cayenensis.* Obiaoturugo, Igum, Nnebiji, and Abi or Amage were the only white yam accessions that are grown across the three zones, while in water yam Nvula or Mbala and Okwalenkata or Nwawafu accessions were grown across as well as Oko or Nka or Enegbe accessions of *D. cayenensis* were grown across the three senatorial zones. This findings is in agreement with Sesay *et al.*, (2013) who reported wide domestication of the few *Dioscorea species* including *D. alata, D.rotundata* and *D. cayenensis*. The widely cultivated accessions and species in the study area were considered most economic important. So that yam accessions associated with high economic significance were identified to include early maturity/fast growth, uses in festival, and high yielding/multiple tuber ratio which can generate money to the farmer. This observation is in consonance

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with Norman *et al*., (2012) who asserted that of all these species, *Dioscorea alata* L., *Dioscorea cayensis* and the *Discorea rotundata* complex are the most widely cultivated, having real economic significances. This result is also synonymous with the findings of Chair (2010) and Loko (2013) who reported the diversity of yams through the use of three varieties of yam *D. rotundata*, *D cayenensis* and *D. alata* in several villages in Benin in 2013.

Farmers also name these accessions using the relative diverse morphological and functional roles of each accession and this led to duplication of names as one accession was called different names from one village of a community to another. In respect to this**,** accessions of water yam Okwalenwakata or Nwawafu had other local names (Opananwankata, Makwuruoba, Mbula America or Mbula Paul) across the three senatorial zones. Accession of yellow yam 'Oko' was also called Nka (Afikpo South and Ivo LGA) and Enegbe (Ohaozara LGA) all in Ebonyi South. Accessions collected had different names from seven local dialects thereby widening their diversity**.** Local names of yam accessions and cultivars irrespective of the species often vary from one LGA to another within the same senatorial zone. Farmers name accessions based on the phenotypic performance and hence has no consistency in naming accessions as they could be different performance of accessions on different environment resulting to one having diferent names within or across the communities. This observation is similar with findings of Soleri *et al*. (2013) who reported that classification using farmers knowledge showed no consistency on how one variety is classified within and between different communities. The observation is also synonymous with findings of Adjatin *et al*., (2012) and Loko *et al*., (2013) who jointly noted that local names of yam accessions and cultivar often vary from one village to another within the same ethnic zone. Furthmore, phenotypic performance of yam accessions are the bases for naming, for examples accessions of *D. rotundata* Abi or Amage and Ojeoso were called these names because they grew fast and mature earlier than other accessions. Accessions of Okwalenwantata or Makwuruoba were called their names because they yield high with multiple tubers and can break a local basket called Nkata when carried on it and that the yield causes expansion of yam barn. This is misleading as several villages can call one accession different names using the dominant phenotypic traits of the accessions. The farmers' knowledge on naming and classification are often based on their experience and knowledge including traits, adaptation, quality and characteristics which they use to classify the varieties they grow. There is no consistency therefore since one variety can be classified into many group within and between different communities. This result is similar with the findings of Soleri *et al*., (2013) who reported yam classification using farmers' knowledge that there is no consistency on how one variety is classified within and between different communities. This observations is also consistent with the findings of Agre *et al*. (2016) who revealed that using farmers' knowledge in varietal classification of cassava, not all the available varieties are unique and there is presence of duplicates and mislabeling.

Prior to indigenous knowledge evaluated, farmers also named and grew accessions based on growth habit, examples are accessions of *D. alata* (Okwalenwankata and Nvula) were grown for high survival rate and yield and farmers identified most of the accessions to have high sprouting tendencies with incresead yield in comparison to white *D. rotundata* (Igum, Nnebiji, Abi, Jimanu, Agba and Obioturugo) grown also for high yield, early maturity, ceremonial use and other economic roles. The observations were similar to Norman *et al*., (2012) who noted that yam species most widely cultivated have real economic significances. This also was the reason Mignouna *et al.,* (2005), Gbessovi *et al*. (2016) and Adejumo (2013) all noted that yam ranked the world's fourth most important tuber crops in many villages and communities of West Africa in economic terms after potatoes (*Solanum tuberosum*), cassava (*Manihot spp*) and sweet potatoes (*Ipomea batatas* L). Furthermore, over 80% of the accessions identified were inherited or product of previous planting in the three Senatorial zones. This implies that traditional yam varieties have been in cultivation for long and were locally improved using farmers knowledge and experience as no introduction of new varieties was recorded, except for water yam. The water yam accession called Okwalenwankata is believed by many yam farmers to have arrived to Igbeagu in Izzi LGA around 2003, Mbula America around 2002 and white yam accession called Paper found at Amagu in Ivo LGA which was brought by one of the yam farmers around 2014. This findings is in agreement with Dumont *et al* (2005) and ITRA (2010) who observed that all African yam cultivars are locally bred and none imported from elsewhere meaning that there has not been any cross breeding with foreign cultivars.

B. Phenotypic Characterization of Collected and Cultivated Accessions using Quantitative and Qualitative Traits

The result revealed that there were intra-species variations (variation within accessions of the same species) and inter-species variation (variation between accessions of different species). These occurred in vein colours, sprouting tendencies, number of internode before the first branching, internode length, number of leaf, leaf colours, roots on tubers, position of roots, tuber size and shapes, cracks and wrinkles on tuber and tuber colours, while inter-species variation was recorded in twining habit, number of sprouts, number of veins, spines on the stem, tuber width and leaf sizes. The mean values and percentage coefficient of variation for the phenotypic diversity for the yam accessions and species traits assessed also differed from each other. This is also an indication of high variability among the accessions assessed. Hence, to understand the genetic diversity of these accessions, understanding the variations in the morphological traits are the bases for proper identification of the accessions. Similar result was reported by Kambaska (2009) on the high variability of morphological traits in quantifying the relative agronomic performance of twelve *Dioscorea species* collected in different parts of Orissa. This result is also corroborated with findings of Rabbi *et al.,* (2014) who asserted that morphological traits are not completely associated with easily observable phenotypic traits, but is needed to underscore genetic diversity. The result is also synonymous to Fukuda *et al.,* (2010), and Dansi *et al.,* (2013) who noted that some of the previous diversity studies using ethnobotanical survey and agro-morphological evaluation showed the existence of high diversity of yam.

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On the estimation of coefficient of variation ranged from 26% to 28% for number of sprouts among the accessions in both seasons, accessions of water yam (*Dioscorea alata)* had higher tendency to sprouting than other accessions for the species examined across the two seasons. Highest number of vines or stems per plant was produced by *D. rotundata* accessions, followed by *D. cayenensis, D. dumetorum, D. alata* and *D. bulbifera*, respectively. The narrowest leaves were found in *Dioscorea rotundata* reduced in comparison to other species, while ovate widest leaf shape was produced by *D. bulibfera* and longest leaf was produced by *D. alata* (11.5cm) and *D.dumentorum* (12.3cm) respectively. Concurrently, *D. alata* accessions produced the highest number of tuber harvested per plant as well as the weightiest tubers (6.0kg and 6.8kg) within accessions and between species across the seasons, while *D.rotundata* produced the highest number of ware yam (6.7 and 7.0) within and between accessions across the species and seasons. This could be attributed to the performance of morphological traits (leaf length, internode diameter, number sprout and number vine per plant) which correlated to yield component (number of tuber harvested per plant, number of ware and seed yam, weight of seed and ware yam). This also implied that the vegetative growth yield was converted to yield component. Accessions of both species identified with multiple sprouting produced more number of tubers than none sprouting type, while other traits like number of leaf, leaf length, and leaf width, number of vines which significantly tuber length and width among yam accessions were the quantitative traits that selection would be based. This observation corroborated with findings of Fukuda *et al*., (2010) and Robooni *et al*., (2014) who jointly revealed that agromorphological traits of plants are the bases for identification. The result is also synonymous with the findings of Tewodros (2013) who revealed that morphological traits such as vine length, leaf length and width correlated to bulbs or tuber yield (length and width) and are selection bases for increasing the genetic improvement of the crop.

The highest number of tuber produced by accessions of *D. alata* with widest and weightiest tubers indicated high tuber yield ratio and this was noted to have high multiplication yield ratio in comparison to other accessions of *Dioscorea species* and the sole reason is the most diversified species in Ebonyi State. This observation is similar to findings of Girma *et al*., 2012 and Udensi *et al.,* (2008) who jointly noted that *D. alata* have high multiplication ratio and tuber yields as well as better storability than the preferred indigenous species such as *D.rotundata, D.cayenesisn* and *D.esculentus* and sole reason they are popular and prevlant in interior part of West Africa such as in Abakaliki agricultural zone area where they are called different local names of Nvula or Mbala or Mbana etc.

Phenotypic characterization of the grown accessions using qualitative traits showed high phenotypic diversity among the 21 qualitative traits examined both at accessions and species levels. Morphological qualitative traits result descriptively estimated, indicated that twining habit are the only traits that had 100% phenotypically unique performance assigned to a particular species. Accessions of *D. rotundata and D. alata* exhibited anticlockwise twining directions, while accessions of *D. dumetorum, D. bulbifera* and *D. cayenensis* climbed the bamboo stick to the left (Clockwise). These observations were in lines with the finding of Tariqul *et al.,* (2011) who noted that germplasm or accession of *D. alata* had anticlockwise twining direction while *D. bulbifera* had clockwise twining directions. Other qualitative traits assessed shows high variability as roots on the head of tubers recorded 93.6%, smooth and cylindrical tubers for white yam, 86.8% of water yam and 79.5% for either *D. cayenenis, D. dumentorum* or *D. bulbifera*. This makes morphological characterization a difficult task due to high morphological variability existing among the yam accessions. This result also shared similar views with Tamiru *et al.,* (2007) who observed that attempts to characterize yam by morphological characters and molecular markers have not yielded conclusive results, because of the high variability of this crop. Nevertherless, selection of those accessions with good and high vegetative performance is a creteria for selecting for a good genotype or for genetic gain or improvement. This observations were in agreement with Tewodros (2013) who revealed that morphological traits including vine length, tuber yield (length and width), leaf length and width are selection bases for increasing the genetic improvement of the crop and these characters are efficient in maximizing yield of tubers and bulbils yield of *Dioscorea Spp*. This observations is also line with findings of Fukuda *et al.,* (2010) and Robooni *et al.,* (2014) who noted that classical breeding uses morphological traits of plants growing in the field as basis for identification. Farmers identified wide variability in yam veins, leaf colour, shapes and sizes of tuber with tubers of *D. alata* accessions having more purplish tubers than other species with corresponding purplish veins and leaf colours, while *D. cayenensis* presented yellowish and orange tubers with corresponding darkbrown, brownish green and yellowish leaf than *D. rotundata* that had creamier and creamy white tubers with corresponding pink, greenish and purplish veins veins. This showed wide phenotypic traits on the skin or tubers of assessed accessions. This result is in agreement with findings of Norman (2011) and Wikipedia (2011) who asserted separately on the skin colourations of *Dioscorea alata, Dioscorea rotundata* and *Dioscorea cayenensis* to vary in colour from dark brown to light pink, while some tuber have a softer substance called meat with colour ranges from white to yellow to purple or pink at maturity. Wide variability of yam species traits including leaf colourations, leaf shapes and tuber sizes have been reported also by Kambaska (2009).

C. Identification of Superior Accessions or Groups that can be used as Composite Parents for Future Yam Breeding

- *Identification of Superior Accessions or Groups using Correlation and Cluster Analysis*

The correlation analysis result explained relationship and associated traits that can enhance characters responsible for high and significant yield of yam tubers. Correlation analysis among tuber yield associated with other trait of accessions and species showed that number of leaf, leaf width per plant, internode length, and internode diameter, number of vine per plant and leaf length per plant had the highest significant positive correlation at 1% level of probability, while internode length and tuber length per plant alone had a significant positive correlation at 5% with the weight of seed yam and internode length. However, the correlation between number of internode before the first branching and number of vine per plant to the number of tuber harvested and total tuber weight

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per plant were higher than other trait assessed. These morphological traits togther contributed positively to total tuber yield per plant and are important in distinguishing the various accessions and species of yam grown in Ebonyi State. This can be used as minimum descriptors for characterization and selection. In other words, selecting those accessions with good and high phenotypic or morphological performance is a criteria for selecting for a good genotype for genetic gain or improvement of the crop. Nevertheless, reduction in some morphological traits internode diameter, internode length, and number of internode before the first branching increased positively the total tuber harvested per plant, tuber width per plant, weight of seed yam, number of a ware yam and weight of ware yam. This implies that reduction in the vegetative growth of those morphological traits enhances positively the yield of the crop. The result is in agreement with Khayatnezhad *et al*., (2010) who reported negative correlation on harvest index and plant height of barley crop. This observations is line with findings of Fukuda *et al.,* (2010) and Robooni *et al.,* (2014) who noted that classical breeding uses morphological traits of plants growing in the field as basis for identification. This result is also synonymous with findings of Tewodros (2013) and (Norman, 2014).

Conversely, increase in sprout diameter increases the number of leaf and leaf width and were positively correlated to the weight of ware yam per plant in kilogram, whereas increase in number of internode before the first branching increases significantly at 1% up to 66% to 98% increase in number of vine per plant, internode length and internode diameter which both accounted to increased yield of number of seed yam per plant. This implies that accessions with highest number of tubers intercepted more light leading to photosynthesis affecting the food production reserve of the tubers. Similar result was obtained by Mukherege *et al*., (2016) and Agre *et al.,* (2016).

The phenotypic diversity of yam specices based on qualitative data using cluster analysis indicated that the number of accessions belonging to each clusters varied from sixteen and seventeen in clusters V and IV to 114 in cluster I. Cluster analysis (CA) result grouped the yam accessions into five distinct. The largest group cluster 1 consisted of 114 accessions (56.4%), with that greater number of *D. alata* and *D. rotundata* and few *D. cayenensis* as the most predominant and excellent economic important species in terms of agro-morphological diversity of accessions by having 2 to 9 variability of assessed traits. This observations is synonymous with the findings of Norman *et al*., (2012) who noted that of all the species studied, *Dioscorea alata* L., *Dioscorea cayensis* and the *Discorea rotundata* complex are the most widely cultivated, having real economic siginificance. Howerver, similar accessions occurred more than twice in each of the cluster group indicating the same accession having different names. This implied that there was duplication of names among the yam accessions as one accession was called different names across the communities in the same senatorial zones, and not all characterized yam accessions are unique. Examples are Abi or Amage identified with other names as Ibada, Iboki, Ugele and Omengwagwa. This makes morphological characterization using farmers' indigenous knowledge a difficult task as there is no consistency in the classification. Similar result was obtained by Agre *et al.,*(2016) who noted that characterizing collected elite cassava using farmers' knowledge in varietal classification of cassava not all the available varieties are unique and there is presence of duplicates. This result is also in conformity with the findings of Soleri *et al*., (2013) who reported that classification using farmers knowledge showed no consistency on how one variety is classified within and between different communities.

Accessions of *D. rotundata* were majorly characterized by six colourations of vines (purplish green, brownish green, dark brown, green, light green and pink), six leaf shapes (cordate, cordate broad, cordate long, ovate, hastate and saggitiate long), and five leaf apex shapes (caudate, acute, aristate, obtuse and emarginated). The dominance of vine colour of this sub-group ranged from purplish green, dark green to few green and light green, no hairiness and absence of spines on the stems except few spines observed from Jioke, Usuekpe and Nkpenyi collected from Amofia community in Ohaukwu LGA, while *D. alata* in the group are characterized mainly by leaf colours ranging from dominant pale green to purple and light green on or before flowering and turned mostly yellowish and few light green at senescence. Accessions of *D. alata* produced the highest number of leaf that were cordate long to saggitate long purplish green to green, dark green leaf with few cordate leaf and caudate leaf apex shapes than others accessions among the five species. This result corroborated with the findings of Kambaska (2009) on his studies to quantify relative agronomic characteristics of 12 *Dioscorea species* collected from Orisia. The result is also similar to the findings of Norman (2011) who revealed that 43 genotypes of *D. alata* exhibited different traits ranging from saggitate long green leaf to chordate long dark leaf. Cluster analysis also indicated wide variability of the tubers and also identified underlying differences among yam accessions groups. The tubers of the accessions all have greater number of cylindrical shaped tubers than any other tuber shapes indicated by the descriptors. This observation is synonymous with Norman *et al.,* (2011) who reported variability of tuber shapes and sizes.

- *Identification of Superior Accessions or Groups that can be used as Composite Parents for Future Yam Breeding using Cluster Analysis.*

Cluster result indicated that accessions collected in closer location or the same location were grouped under different clusters. Accessions of Obiaoturugo collected from Ndufu Alike Ikwo Ebonyi Central, Ozibo collected from Ndieze in Izzi Ebonyi North, Agba from Ishiagu in Ivo and Agba from Eweze Uburu in Ebonyi South senatorial zones were grouped under sub-group of cluster 1, while accessions of Nwawafu from Umuezaka in Ohaukwu, Okwalenwankata from Ndiabor Okpuitumo, all in Ebonyi North senatorial zones and Okpebe from Eweze Ebonyi South were grouped together in another sub-group of cluster 1. This suggest that location or geographical origin does not bear any relationship with the morphological characterization. The observation is conformity with morphological analysis done on other root and tuber crops by (Lebot *et al*., 2009, Vinutha *et al*., 2015). Cluster analysis indicated wide morphological traits differences among the assessed accessions irrespective of the species. Water yam

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accessions, white yam accessions and yellow yam accessions were either in the same cluster or together in another sub-group of cluster. This implies that the variation that occurred are not as a result of belonging to a particular species but due to the nature of the plant. Wide variability of some traits both in shapes and colours in cluster 1 and 2 exhibited the highest phenotypic variance in terms of the accessed traits except those traits that had minimum descriptor range from 1 to 3, examples are twining habit, tuber body surface texture, corms and corm size, wrinkles and thorns on the tuber and also identified underlying differences among yam accessions groups. For instance, accessions with spines presented light and thick thorns on the tuber and were identified among accessions of Igum, Jimanu, Jioji, Agba, Akiri and Okpebe and these distinguished them from other accessions. Cluster and correlations analyses fresh tuber yield of the assessed accessions correlated with phenotypic traits like number of internode before the first branching, number of vines, sprout diameter and number of leaf. This findings corroborated with Lebot *et al*., (2009) who reported that taro morphological diversity is due to large number of chromosome structure and number leading to morphological difference among cultivars. This observation is synonymous with Norman *et al.*, (2011) who reported variability of tuber shapes and sizes of yam cultivars. This result is also synonymous with Dansi *et al.*, (2013) who noted that some of the previous diversity studies using ethnobotanical survey and agro-morphological evaluation showed the existence of high phenotypic diversity of yam. The result also corroborated with Norman (2014) reported factor and cluster analyses on agromorphological characterization of sweet potato (*Ipomoea batatas* L.) genotypes and noted that the yield of potato is correlated with phenotypic traits such as plant height, root diameter and number of leave.

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CHAPTER SIX
SUMMARY, CONCLUSION AND RECOMMENDATION

A. Summary

The social economic factors indicated that farmers are mostly elderly men with about 30-50 years farming experience and who mostly cultivate 1 to 2 ½ hectares with indigenous yam species inherited or bought from local market. Indigenous knowledge wise, farmers can predict yield of cultivated yam by looking at the morplogical traits of a growing yam in the field as well as the earlier maturing cultivars and the high yielding accessions. Farmers' method of naming yam accessions across the senatorial zones introduced more variability to the assessed traits and high education qualification of Ebonyi South farmers helped in identification of variable traits. High variability were recorded on field trial using descriptive statistics, estimation of coefficient of variation, correlation and cluster analysis. All the quantitative morphological traits recorded high (CV> 25%) coefficient of variation except for sprout length, sprout girth, internode diameter and leaf length, while agronomic yield data recorded higher (CV> 50%) coefficient of variation except for maturity time and tuber width with phenotypic variance less than 25%. Selection for accessions of *D. alata* increases the chance for the highest number of harvested tubers (19.5 and 25.5), tuber weight (6.0 kg and 6.8kg) as well as selecting for longest tubers (21.4cm, 21.3cm and 18.6cm and 20.6 cm) of *D. rotundata* and *D. alata* respectively. Significant tuber width (12.4cm and 13.9cm) were also recorded in *D. alata*, followed by *D. dumetorum* (12.3 cm and 11.0 cm) and *D. rotundata* accessions (11.0 cm and 10.5 cm). Inter-species variation were recorded on traits including, hairiness,spines on the stem, number of vine per plant, leaf apex shape, number of sprout and twining habit, while intra-species variations occurred in leaf colours, vein colours, roots on tubers, position of roots, tuber shapes, cracks and wrinkles on tuber and tuber colours. Estimate of phenotypic traits coefficient of variation showed 74%, 62%, 75% and 46% for morplogical variability for number of internode before the first branching, number of vine, number of leaf and internode length and correlated to the yield of weight of ware yam, number of ware yam, tuber weight, number of tuber harvested and tuber length (95%, 85%, 81%, 88% and 37%). The accessions of *D.alata* and *D. rotundata* had anticlockwise twining habit while *D. cayenensis, D. dumentorum* and *D. bulbifera* twined clockwise at 100%. Correlation result showed that all the quantitative traits measured except internode length,leaf width and maturity rate correlated significantly to the yield component including total number of harvested, tuber,tuber length and width at ($p<0.001$ and $p<0.05$). Significant negatively or reduction of sprout diameter, number of leaf, internode diameter, internode and number of vines per plant increases or decreases the yield of tubers. Cluster analysis based on qualitative traits showed creation of five distinct groups with presence of variability, both agromorphological and yield traits of the crop assessed. Cluster 1 and 2 had the highest percentage variation of 56.4% and 15.8% with three most important species *D. alata* (anticlowise twining, deep to purplish vine*)*, *D.rotundata* (pink, purplish to light green vine) and *D.cayenensis* (clockwise twining habit, darkbrown to brownish vein), respectively. Cluster one accessions with 2 to 9 traits variabilities include Okwalenwankata, Nwawafu, Nvulamme, Nvula, Igborogidi, Makwuruoba, Akamunze, Nvula mmanu, Nyeji, Nvula Ajingworo, Igum, Abi, Agba, Obia, Jimanu, Nwagbam, Ojioeso, Ibada and Okpebe etc. Accessions grown in the zone are mostly the ones available and most likely to survive within the zones. Consequently, selection based on these traits of the accessions is efficient to fresh tuber yield and genetic improvement of the crop.

B. Conclusion

All the tools employed to examine the phenotypic diversity of cultivated yam accessions in Ebonyi State and related indigenous knowledge indicated that farmers are veritable tool for understanding indigenous knowledge and yam diversity particularly in Ebonyi State. The result elucidated the benefit of understanding phenotypic diversity of yam in Ebonyi State using farmers' indigenous knowledge and agro-phenotypic traits characterization. Result of social economic factors indicated older male farmers with few female having age-long experienced but constrained by few educated farmers involving in yam cultivation, few hectares in cultivation and stores mostly the grown yam accessions in the barn/home. Documentation of indigenous knowledge of yam farmers also showed that three species (*D. alata, D. rotundata,* and *D. cayenensis*) were more diverse and because of economic significance which were identified to include wide variability in vegetative and yield traits. Indigenous knowledge is needful in understanding the phenotypic diversity of yam. The mean acceptable views using likert scale and high percentage acceptability of the perceptions ranged from 3.0 to 5.9 and 50.1% to 100% to both quantiative and qualitative traits. Farmers' indigenous knowledge also revealed that *D. bulbifera* and some accessions of *D. alata* (Okwulenwakata) and *D. rotundata* (Abi and Ojeoso) showed early maturity, while *D. cayenensis* and *D. dumetorum* are known to be medium and late maturing. All the quantitative agronomic traits recorded high (CV> 25%) coefficient of variation except for sprout length, sprout girth, internode diameter and leaf length, while agronomic yield data recorded higher (CV> 50%) coefficient of variation except for maturity time and tuber width with phenotypic variance less than 25% and were positively correlated to yield traits. There were wide variability as implicated by correlation and cluster analysis, where accessions in cluster 1 and 2 were considered to be the superior accessions by having highest variability of all the traits assessed ranging from 2 to 9. Selection based on these traits of the accessions with high coefficeient of variation, siginificant correlation, and high percentage value for all the traits and cluster analysis helped in improvement of the crop, hence the following recommendation proffered.

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C. Recommendation

The observations made on this research are paramount and following recommendations are suggested:

- Farmers should be involved in decision making process as they are the chief manager of farm businesses as well as play pivotal role in selection program.
- Collaboration of research institute and yam farmers for new species exploitation as greater number of species are not in cultivation in Ebonyi State.
- Government should make available improved yam species as farmers only grow 5 out of 600 known species in the study area.
- There is need for molecular techinques to augment morphological classification to resolve issues of overlap, one accession with multiple names and confirm morphological association of the assessed accessions.
- More research work is needed to assess and register the phentopyic and genetic improvement of the assessed accessions in Ebonyi State.
- A designed preliminary breeding research work can now be designated to yam accessions based on yield, maturity time as early maturing accessions include Abi, Edu, Okwalenwankata, Ojioso, Ogbaruogbia; medium (Akiri, Nyeji, Opoke, Akiri, Ewada, Mbula Paul, Mbula America etc) and late maturing (Igum, Agba, Obia, Obela, Orumeh, Nvula mme, Ajingworo, Igborogidi, Oko, Ogomodu and Una).

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APPENDIX I. QUESTIONNAIRE FOR FARMER'S KNOWLEDGE OF YAM DIVERSITY

Questionnaire No.

Instruction: For each question or sub-question, please fill or tick appropriately.

BIODATA OF FARMERS

BIODATA OF FARMERS

1. Name of the Farmer/Information----------
2. Gender: Male ☐ Female ☐
3. Age: ----------
4. Senatorial Zone: ----------
5. Local Government Area.....
6. Community: ----------
7. Village: ----------
8. Storage Method: Field ☐ Garden ☐ Barn/Home ☐

Physical and Socio-economic Factors

9. What is your role in yam cultivation?
   (a) Principal caretaker/decision marker?
   (b) Member of household without decision making role in selection of species of yam
10. How long have you been growing yam? Farming experience
    5 years ☐ 1-19 years ☐ 20-30 years ☐ 30-50 years ☐
11. Educational level: None ☐ Primary ☐ Secondary ☐ Tertiary ☐
12. Main source of income: Farming ☐ Business ☐ Formal employment ☐
    Informal Employment ☐
13. Size of farm: ½ha ☐ 1ha ☐ 1- 2½h ☐ 5-10ha ☐

VALIDITY

14. Please list all the yam species, varieties and cultivars or accessions you currently cultivate (yam diversity)

S/NO		Planting Location		Name of Farmer	Collection No
i.					
ii.					
iii.					
iv.					
v.					

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VARIETY INFORMATION

S/N	Variety	(15) Language (dialect) of naming	(16) Other names of variety & reasons for the names	(17) Has the panting of variety increased or decreased in the last five years? (1.Decreased; 2. Increased; 3. No change Don't know)	(18)Tendency to sprout 0 – absent, 1 – present	(19) sprout colour 1=green;2 purplish green, 3=brownish green;4=dark brown; 5=purple; 99=others (specify)
1						
2						
3						
4						
5						

S/N	(20) Does the sprouts have hairs? 1 – hairs present; 0 – no hairs	(21) Does the stems have spines? 0 – absent; 1 – few; 2 – many.	(22) How is the twining habit of yam accessions? 0 – anticlockwise; 1 – clockwise,	(23) Is accession early; medium or late maturing? Maturity rate 1, 2, and 3 ☐ Early ☐ Medium ☐ Late
1				
2				
3				
4				
5				

Rate the following qualities of {variety} from 1 to 5.0

S/N	Variety	(24) Identify leaf colours at the on-set of flowering? 1 – yellowish, 2 - pale green,3 - pale purple, 4 - dark green, 5 - purplish green, 6 – purple	(25) Can you identify the shape of the leaf? 1-ovate; 2-cordate; 3-cordate long, 4-cordate broad; 5-saggitate; 6-saggitate broad; 7-hastate	(26) Can you identify the leaf apex shape? 1 – obtuse, 2 – acute, 3 – emarginated, 4 – acuminate, 5 – aristae, 6 – caudate, 7 – cuspidate	(27) Identify yield conditions:1 = Very poor; 2 = poor; 3 = fair 4 = good 5 = very good
1					
2					
3					
4					
5					

S/N	Variety	(28) How is the shape of the tubers? 1-spherical/round; 2 – oval; 3 – cylindrical; 4 – oval oblong, 5 – irregular	(29) Identify tuber surface texture: 1 – smooth; 2 – rough	(30) Does the accession tuber branch? 0 – No branch;3 – slightly branch; 5 – branched; 7 – highly branched	(31) Can you identify the position of tuber branching? 1- upper middle;2 – tail; 3 – middle, 4 – upper middle/head & tail region; 5 – lower third
1					
2					
3					
4					
5					

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S/N	Variety	(32) Does tuber present cracks? 0 – absent; 1 – few; 3 – many	(33) Is accession identified with thorns? 0 – absent ; 1 – present	(34) How intense are the thorns on the tubers? 0 – No thorns; 3 – few; 7 – many	(35) wrinkles on tuber 0 – No; 1 – few; 2 – many
1					
2					
3					
4					
5					

S/N	Variety	(36) Roots on the surface of tubers? 0 – roots; 2 – few; 3 – many	(37) Identify the position of roots on the tubers:1 – tuber head; 2 – entire tuber; 3 – lower; 5 – lower & head region; 7 - middle	(38) Is the corms 1 – small; 2 – intermediate; 3 – large?	(39) Identify corm type 1 – regular; 2 – transversally elongated; 3 – elongated
1					
2					
3					
4					
5					

S/N	Variety	(40) What is the usual colour of the tubers at harvest at upper region? 1 – white; 2 – creamy white; 3 – yellow; 4 – purplish; purplish white; 6 – creamy; brownish white, 8 – deep purple; 9 – orange	(41) What is the usual colour of the tubers at harvest at middle region? 1 – white; 2 – creamy white; 3 – yellow; 4 – purplish; purplish white; 6 – creamy; brownish white, 8 – deep purple; 9 – orange	(42) What is the usual colour of the tubers at harvest at lower region? 1 – white; 2 – creamy white; 3 – yellow; 4 – purplish; purplish white; 6 – creamy; brownish white, 8 – deep purple; 9 – orange
1				
2				
3				
4				
5				

APPENDIX II. DENDROGRAM GROUPING OF 21 QUALITATIVE TRAITS OF YAM ACCESSIONS GROWN IN THE THREE SENATORIAL ZONE OF EBONYI STATE

Cluster	Zone	Community	Access.name	Plot Id	Traits - VC	hairs	spines	Twining	Leaf colour	Leaf shape	Leaf apexs.	Tuber shape	TsT	Ttb	Pob	CoTs
C1 red	Ebonyi N.	Ndiabor Okp	Nvulame	129	Purplish g.	absent	absent	Anticlock	Purplish g	C. broad	Caudate	irregular	Smooth	Slightly b.	tail	Absent
		Igbeagu	Nwopoke	150	Purplish g	absent	absent	Anticlock	Pale green	Cordate	Caudate	cylindrical	Smooth	Slightly b.	middle	Absent
	Ebonyi C.	Ekpelu	Obiaoturugo	232	Purplish g	absent	absent	Anticlock	Purplish g	C. broad	cauda te	Oval oblong	Smooth	Slightly b.	middle	Absent
	Ebonyi N.	Umueze aka	Usuekpe	120	Darkbrown	absent	few	Anticlock	darkgreen	C. long	Obtuse	cylindrical	Smooth	Slightly b.	Up m/h	Few
		Ndiegu Okp	Nvulame	130	Purplish g	absent	absent	Anticlock	lightgreen	hastate	Emarg.	cylindrical	Smooth	Branched	middle	Absent
		Amofia	Mbala	109	Purplish g	absent	absent	Anticlock	darkgreen	C. long	Acute	spherical/round	Smooth	No branch	LT	Absent
	Ebonyi S	Owutu edda	MbulaPaul	277	Purplish g	absent	absent	Anticlock	palergreen	Cordate	cauda te	Oval	Smooth	Slightly b.	middle	Few
	Ebonyi N.	Igbeagu	Okwalen kata	147	Purplish g	absent	absent	Anticlock	darkgreen	C. long	cauda te	cylindrical	Smooth	Slightly b.	middle	Absent

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	Ebonyi S	Owutu edda	mubAmerica	276	Purplish g	absent	absent	Anticlock	purplish g	C. broad	caudate	Oval	Smooth	Slightly b.	Upp .m	Few
	Ebonyi N.	Amofia	Mbala	107	Purplish g	absent	absent	Anticlock	palegreen	cordate	caudate	Oval	Smooth	Slightly b.	middle	Few
		Ndiabor Okp	Nvula	127	Purplish g	absent	absent	Anticlock	darkgreen	C. long	caudate	spherical/round	Smooth	Slightly b.	middle	Absent
		Ndiabor Okp	Jimmanu	123	Purplish g	absent	absent	Anticlock	darkgreen	C. long	Acute	irregular	Smooth	Slightly b.	Upp . m	Few
	Ebonyi S	Owutu edda	Ajingworo	288	Purplish g	absent	absent	Anticlock	palegreen	Cordate	caudate	irregular	Rough	Slightly b.	middle	Absent
	Ebonyi C	Amagu	Nyeji	184	Green	absent	absent	Anticlock	purplish g	C. broad	caudate	cylindrical	Rough	Branched	middle	Absent
		Ndufu Alike	Ibada	219	Green	absent	absent	Anticlock	purplish g	C. broad	caudate	cylindrical	Smooth	Highly b.	middle	Few
	Ebonyi N.	Ndiegu Okp	Okwalenkata	131	Green	absent	absent	Anticlock	purplish g	C. broad	caudate	Oval	Smooth	Branched	middle	Absent
	Ebonyi S	Ishiagu	Ogbeka	266	Brownish g	absent	absent	Anticlock	yellowish	Ovate	caudate	cylindrical	Smooth	Branched	middle	Absent
		Uburu	Agba	237	Green	absent	absent	Anticlock	darkgreen	C. long	aristate	cylindrical	Smooth	Highly b.	middle	Absent
	Ebonyi C	U. Idembia	Nyeji	170	Green	absent	absent	Anticlock	yellowish	Ovate	caudate	cylindrical	Smooth	Highly b.	middle	Few
	Ebonyi S	Uburu	Abi	236	Green	absent	absent	Anticlock	palegreen	Cordate	caudate	cylindrical	Smooth	Highly b.	middle	Absent
	Ebonyi N.	Amofia	Jioke	101	Green	absent	few	Anticlock	darkgreen	Cordate	caudate	cylindrical	Smooth	Highly b.	Upm/h	Absent
	Ebonyi C	Okposi Um.	Iboki	202	Green	absent	absent	Anticlock	palegreen	Ovate	aristate	cylindrical	Smooth	Slightly b.	Tail	Absent
		Ndufu Alike	Amage	210	Pink	absent	absent	Anticlock	green	Cordate	aristate	cylindrical	Rough	Slightly b.	Tail	Absent
	Ebonyi N.	Ndiegu Okp	Oko	138	Darkbrown	absent	many	clockwise	green	Cordate	Acute	irregular	Rough	Slightly b.	Tail	Few
	Ebonyi C	U. Idembia	Nvula	174	Purplish g	absent	absent	Anticlock	green	C. long	caudate	irregular	Smooth	Slightly b.	Upm/h	Few
	Ebonyi N.	Umueza ka	Nkpenyi	115	Green	absent	few	Clockwise	green	Hastate	Obtuse	cylindrical	Smooth	Slightly b.	Middle	Absent
		Umueza ka	Nwawafu	113	Brownish g	absent	absent	Anticlock	purplish g	Cordate	ermargin	cylindrical	Smooth	Slightly b.	LT	Absent
		Ndiabor Okp	Okwalenkata	128	Purplish g	absent	absent	Anticlock	purplish g	C. broad	acute	Spherical/round	Smooth	Slightly b.	Middle	Absent
	Ebonyi S	Eweze	Okpebe	250	Purplish g	absent	absent	Anticlock	palegreen	C. long	aristate	cylindrical	Smooth	Slightly b.	Middle	Absent
	Ebonyi C	Ekpelu	Ibada	228	Green	absent	absent	Anticlock	green	Cordate	caudate	cylindrical	Smooth	Slightly b.	Middle	Absent
	Ebonyi S	Oso edda	Igum	296	Purplish g	absent	absent	Anticlock	green	Cordate	aristate	cylindrical	Smooth	Slightly b.	Middle	Few
		Eweze	Abi	245	Green	absent	absent	Anticlock	green	Cordate	aristate	cylindrical	Smooth	Slightly b.	Upm/h	Few
		Owutu	Obiaoturugo	285	Green	absent	absent	Anticlock	darkgreen	Cordate	caudate	cylindrical	Smooth	Slightly b.	Middle	Few
	Ebonyi N	Igbeagu	Nvulambube	148	Purplish g	absent	absent	Anticlock	lightgreen	C. long	caudate	cylindrical	Smooth	Slightly b.	Middle	Absent
	Ebonyi S	Uburu	NvuAmerica	243	Purplish g	absent	absent	Anticlock	green	Ovate	caudate	Oval	Smooth	Slightly b.	Middle	Absent

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	Ebonyi N	Ndieze	Nwopoke	154	Light green	absent	absent	Anticlock	palegreen	S. long	caudate	cylindrical	Smooth	Slightly b.	upm/h	Absent
	Ebonyi S	Eweze	Agba	246	Purplish g	absent	absent	Anticlock	green	C. broad	aristate	cylindrical	Smooth	Branched	Upp. m	Absent
	Ebonyi C	Ekpelu	Nwagbam	231	Purplish g	absent	absent	Anticlock	palegreen	Cordate	caudate	irregular	Smooth	Slightly b.	Upp. m	Absent
	Ebonyi S	Ishiagu	Agba	259	Purplish g	present	absent	Anticlock	green	S. broad	aristate	Oval oblong	Smooth	Slightly b.	Upp. m	Absent
	Ebonyi N	Ndieze	Ozibo	163	Purplish g	absent	absent	Anticlock	green	C.broad	caudate	cylindrical	Smooth	Slightly b.	Upp. m	Absent
	Ebonyi C	Ndufu Alike	Obiaoturugo	214	Purplish g	absent	absent	Anticlock	darkgreen	Cordate	caudate	Cylindrical	Smooth	Slightly b.	Upp. m	Absent

Appendix ii. Continued

Cluster	Zone	Community	Access.name	Plot Id	Thorns	Int.	Wrinkle	Rsut	PoR	Corm S.	Corm type	TubC	Tcm	Tclr
C1 red	Ebonyi N.	Ndiabor Okp	Nvulamme	129	Absent	No	No	Few	Tuber head	Large	T. elongated	Deep purple	Deep purple	Deep purple
		Igbeagu	Nwopoke	150	Absent	No	No	Few	Tuber head	Large	T. elongated	Deep purple	Deep purple	Creamy
	Ebonyi C.	Ekpelu	Obiaoturugo	232	Absent	No	No	No root	No root	No corm	Regular	Creamy	Creamy wh.	Creamy wh.
	Ebonyi N.	Umuezeaka	Usuekpe	120	Absent	No	No	Few	Tuber head	Intermediate	Regular	Deep purple	Deep purple	Deep purple
		Ndiegu Okp	Nvulamme	130	Absent	No	No	Few	Tuber head	Large	Branched	Purplish	Purplish	Purplish
		Amofia	Mbala	109	Absent	No	No	Few	Tuber head	No corm	None	Purplish	Purplish	Purplish
	Ebonyi S	Owutuedda	MbulaPaul	277	Absent	No	No	Few	Tuber head	No corm	None	Deep purple	Deep purple	Deep purple
	Ebonyi N.	Igbeagu	Okwalenkata	147	Absent	No	No	Few	Tuber head	Intermediate	Regular	Deep purple	Deep purple	Deep purple
	Ebonyi S	Owutuedda	mubAmerica	276	Absent	No	No	No root	No root	No corm	None	Deep purple	Purplish	Purplish wh.
	Ebonyi N.	Amofia	Mbala	107	Absent	No	No	No root	No root	No corm	None	Deep purple	Purplish wh.	Purplish wh.
		Ndiabor Okp	Nvula	127	Absent	No	No	Few	Tuber head	Intermediate	Branched	Deep purple	Deep purple	Creamy
		Ndiabor Okp	Jimmanu	123	Absent	No	No	Few	L/T region	Large	Regular	Creamy	Creamy	Creamy
	Ebonyi S	Owutuedda	Ajingworo	288	Absent	No	No	Many	Middle	Large	Regular	Deep purple	Purplish	Purplish wh.
	Ebonyi C	Amagu	Nyeji	184	Absent	No	No	Few	Tuber head	Large	Branched	Creamy white	Creamy wh.	Creamy
		Ndufu Alike	Ibada	219	Absent	No	No	Few	Tuber head	No corm	None	Creamy white	Creamy wh.	Creamy
	Ebonyi N.	Ndiegu Okp	Okwalenkata	131	Absent	No	No	Few	Tuber head	Small	Regular	Purplish	Purplish	Purplish
	Ebonyi S	Ishiagu	Ogbeka	266	Absent	No	No	Many	Tuber head	Intermediate	Regular	Creamy	Deep purple	Deep purple
		Uburu	Agba	237	Absent	No	No	Few	Tuber head	Large	T. elongated	Creamy	Orange	Orange
	Ebonyi C	U. Idembia	Nyeji	170	Absent	No	No	Few	Tuber head	Large	Branched	Creamy	Creamy	Creamy
	Ebonyi S	Uburu	Abi	236	Absent	No	No	Few	Tuber head	No corm	None	Deep purple	Purplish	Purplish
	Ebonyi N.	Amofia	Jioke	101	Absent	No	No	Few	Tuber head	No corm	None	Deep purple	Purplish	Purplish
	Ebonyi C	Okposi Um.	Iboki	202	Absent	No	No	Few	Tuber head	No corm	None	Deep purple	Purplish	Purplish
		Ndufu Alike	Amage	210	Absent	No	No	Few	Tuber head	Intermediate	T. elongated	Creamy	Creamy wh.	Creamy

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	Ebonyi N.	Ndiegu Okp	Oko	138	Absent	No	No	Many	Tuber head	Large	T. elongated	Purplish	Purplish	Brownish wh
	Ebonyi C	U. Idembia	Nvula	174	Absent	No	No	Many	Entire tuber	No corm	None	Brownish white	Brownish wh	Brownish wh
	Ebonyi N.	Umuezaka	Nkpenyi	115	Absent	No	No	Few	Tuber head	Small	T. elongated	Purplish white	Purplish wh.	Purplish wh.
		Umuezaka	Nwawafu	113	Absent	No	No	Few	Tuber head	Large	Regular	Purplish	Purplish	Purplish
		Ndiabor Okp	Okwalenkata	128	Absent	No	No	Few	Tuber head	Large	Regular	Deep purple	Deep purple	Deep purple
	Ebonyi S	Eweze	Okpebe	250	Absent	No	No	Few	Tuber head	Intermediate	Regular	Purplish	Purplish	Purplish
	Ebonyi C	Ekpelu	Ibada	228	Absent	No	No	Few	Tuber head	Intermediate	T. elongated	Purplish	Creamy	Creamy
	Ebonyi S	Oso edda	Igum	296	Absent	No	No	Few	Tuber head	Small	T. elongated	Deep purple	Deep purple	Deep purple
		Eweze	Abi	245	Absent	No	No	Few	Entire body	Intermediate	Regular	Creamy	Creamy	Creamy
		Owutu	Obiaoturugo	285	Absent	No	No	Many	Tuber head	Intermediate	Regular	Deep purple	Deep purple	Purplish wh.
	Ebonyi N	Igbeagu	Nvulambube	148	Absent	No	No	Few	Entire tuber	No corm	None	Deep purple	Deep purple	Purplish wh.
	Ebonyi S	Uburu	NvuAmerica	243	Absent	No	No	Few	Tuber head	Small	Branched	Deep purple	Deep purple	Deep purple
	Ebonyi N	Ndieze	Nwopoke	154	Absent	No	No	Few	Entire tuber	Large	Regular	Deep purple	Deep purple	Deep purple
	Ebonyi S	Eweze	Agba	246	Absent	No	No	Few	Tuber head	Large	Branched	Creamy	Creamy	Creamy
	Ebonyi C	Ekpelu	Nwagbam	231	Absent	No	No	Few	Tuber head	Intermediate	Branched	Creamy	Creamy	Creamy wh.
	Ebonyi S	Ishiagu	Agba	259	Absent	No	No	Few	Tuber head	Intermediate	regular	Creamy	Creamy	Creamy wh.
	Ebonyi N	Ndieze	Ozibo	163	Absent	No	No	Few	Tuber head	Small	Regular	Creamy white	Creamy	Creamy wh.
	Ebonyi C	Ndufu Alike	Obiaoturugo	214	Absent	No	No	Few	Tuber head	Intermediate	Branched	Creamy	Creamy	Creamy

Source: Field survey 2016. Ebonyi N.,C., and S= Ebonyi North, Central & South, Ndiegu O=Ndiegu Okpuitmo, Okposi Um=Okposi Umuogharu,Owutu edda= Owutu Edda,U.Idembia=Umunwagu Idembia. leaf colour-purplish g-purplish green, leaf apex shape-saggataiate, TST-tuber surface texture, Ttb-tuber tendency to branch: slightly b - slightly branched, highly b- highly branched, POb - position of branching,4-upper middle/head & tail region,1 - upper middle.

Appendix iii. Continued

Cluster	**Zone**	**Community**	**Access.name**	**PlotId**	**Traits – VC**	**hairsness**	**spines**	**Twining**	**LC**	**LS**	**LAS**	**Tuber shape**	**TsT**	**Ttb**	**Pob**	**CoTs**
C1 red	Ebonyi N.	Igbeagu	Ozibo	144	Purplish g	Absent	Absent	Anticlock	Yellowish	Ovate	Caudate	Cylindrical	Smooth	Slightly b	Middle	Few
	Ebonyi S	Oso	Igumbula	297	Purplish g	Absent	Absent	Anticlock	light green	Hastate	Caudate	Oval	Smooth	Slightly b	Middle	Few
	Ebonyi N.	Igbeagu	Okepbe	143	Brownish g	Absent	Absent	Anticlock	Yellowish	Ovate	Caudate	Cylindrical	Smooth	Slightly b	Middle	Few
		Ndiabor okp	Ozibo	125	Brownish g	Absent	Absent	Anticlock	Yellowish	Ovate	Acute	Cylindrical	Rough	Branched	Tail	Few
		Ndieze	**Okpembe**	**162**	Dark brown	Absent	Absent	Anticlock	Yellowish	Ovate	Acute	Cylindrical	Smooth	Slightly b	Upp. m	Few

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	Ebony i S	Ishiagu	obiaoturugo	261	Purple	Absent	Absent	Anticlock	pale green	Cordate	Caudate	Oval oblong	Smooth	Slightly b	Middle	Absent
		Ishiagu	Orunte	263	Dark brown	Absent	Absent	Anticlock	Purplish g	ovate	Caudate	Cylindrical	Smooth	Slightly b	Middle	Absent
	Ebony i C	Ekpelu	Igum	229	Pink	Absent	Many	Anticlock	dark green	cordate	Caudate	Cylindrical	Smooth	Slightly b	Middle	Absent
	Ebony i S	Okue	Obiaoturugo	269	Pink	Absent	Absent	Anticlock	pale green	cordate	Caudate	Cylindrical	Smooth	Slightly b	Middle	Absent
	Ebony i	Ishiagu	Paper	264	Pink	Absent	Absent	Anticlock	yellowish	cordate	Caudate	Cylindrical	Smooth	Slightly b	Middle	Few
	Ebony i S	Okue	Ogbagharu	161	Pink	Absent	Absent	Anticlock	yellowish	C. long	Caudate	Cylindrical	Smooth	Slightly b	Middle	Absent
	Ebony i C	Ndufu Alike	Ojeoso	215	Pink	Absent	Absent	Anticlock	pale green	C. long	Caudate	Cylindrical	Smooth	Slightly b	Middle	Absent
	Ebony i N	Ndiegu	Nvula	132	Purplish g	Absent	Absent	Anticlock	pale green	Hastate	Caudate	Cylindrical	Smooth	Slightly b	Middle	Absent
	Ebony i S	Okue	Orunte	271	Dark brown	Absent	Absent	Anticlock	yellowish	Ovate	Acute	Oval oblong	Smooth	Slightly b	Middle	Absent
	Ebony i N	Ndieze	akpuruakput	152	Light green	Absent	Absent	Anticlock	pale green	S. long	Caudate	Cylindrical	Smooth	Slightly b	Middle	Absent
	Ebony i C	Okposi um.	Nwawafu	200	Light green	Absent	Absent	Anticlock	pale green	S. long	Caudate	Cylindrical	Smooth	Slightly b	Upm/h	Absent
	Ebony i S	Okue	Awoke	272	darkbrown	Absent	Absent	Anticlock	Purple	C. broad	Caudate	Oval	Smooth	Slightly b	Up p. m	Few
		Oso	Agba	293	Purple	Absent	Absent	Anticlock	pale green	C. broad	Aristate	Oval	Rough	Slightly b	Middle	Few
	Ebony i C	Ekpelu	Agbabro	227	Dark brown	Absent	Absent	Anticlock	yellowish	C. broad	Aristate	Cylindrical	Smooth	Slightly b	Middle	Absent
	Ebony i S	Ishiagu	Ishitu	256	Purplish g	Absent	Absent	Anticlock	pale green	C. long	Caudate	Cylindrical	Rough	Slightly b	Middle	Absent
	Ebony i C.	Umogharu	Ojioso	194	Dark brown	Absent	Absent	Anticlock	dark green	C. long	Caudate	Cylindrical	Smooth	Slightly b	Middle	Absent
	Ebony i S	Owutu	Agba	279	Purple	Absent	Many	Anticlock	yellowish	C. broad	Aristate	Cylindrical	Rough	Slightly b	Middle	Absent
	Ebony i C	Ekpelu	Nvula	225	Purplish g	Absent	Absent	Anticlock	dark green	Hastate	Caudate	Cylindrical	Smooth	Slightly b	Middle	Few
	Ebony i N.	Ndieze	Obela	160	Purplish g	Absent	Absent	Anticlock	purplish g	S. long	Caudate	Cylindrical	Smooth	Slightly b	Up p. m	Few
	Ebony i C	Ndufu Alike	Nvula	220	Purplish g	Absent	Absent	Anticlock	pale green	Hastate	Caudate	Oval oblong	Smooth	Slightly b	Up p. m	Few

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	Ebonyi N.	Umuezaka	Mbala	112	Purplish g	Absent	Absent	Anticlock	dark green	Hastate	Caudate	Oval oblong	Smooth	Slightly b	Upm/h	Few
	Ebonyi C	Ndufu Alike	Onyeoma	217	Purplish g	Absent	Absent	Anticlock	pale green	S. long	Caudate	Cylindrical	Smooth	Slightly b	Middle	Few
	Ebonyi S	Okue	Makuuoba	273	Purplish g	Absent	Absent	Anticlock	purplish g	S. long	Caudate	Oval	Smooth	Slightly b	Tail	Few
	Ebonyi C	Okposi um.	Okwulenkata	198	Purplish g	Absent	Absent	Anticlock	pale green	Hastate	Caudate	Oval	Smooth	Slightly b	Tail	Few
	Ebonyi	Umogharu	okwulenkata	197	Purplish g	Absent	Absent	Anticlock	pale green	S. long	Caudate	Oval	Smooth	Slightly b	Tail	Few
	Ebonyi	Ekpelu	opalenkata	226	Purplish g	Absent	Absent	Anticlock	pale green	S. long	Caudate	Spherical/round	Smooth	Slightly b	Tail	Few
	Ebonyi N	Umuezaka	Ogomodu	117	darkbrown	Absent	Many	Clockwise	pale green	C. broad	Caudate	Cylindrical	Smooth	Branched	Middle	Few
	Ebonyi S	Ishiagu	Orumeh-nvul	254	Green	Absent	Absent	Anticlock	pale green	Hastate	Hastate	Cylindrical	Smooth	Branched	Middle	Few
	Ebonyi N	Igbeagu	Nvula	146	Purplish g	Absent	Absent	Anticlock	light green	C. broad	Caudate	Oval	Smooth	Branched	Tail	Absent
	Ebonyi C	Okposi um.	Ozibo	208	Purplish g	Absent	Absent	Anticlock	dark green	C. broad	Caudate	Oval	Smooth	Branched	Tail	Absent
	Ebonyi S	Ishiagu	Makwuroba	257	Purplish g	Absent	Absent	Anticlock	pale green	S. broad	Caudate	Oval	Smooth	Slightly b	Tail	Few
		Eweze	Opanankata	251	Purplish g	Absent	Absent	Anticlock	light green	C. broad	Aristate	Oval	Smooth	Slightly b	Up p. m	Absent
		Owutu	Mbula	275	Purplish g	Absent	Absent	Anticlock	light green	Hastate	Caudate	Oval	Smooth	Branched	Tail	Absent
		Uburu	Opanankata	244	Purplish g	Absent	Absent	Anticlock	light green	S. long	Caudate	Oval	Smooth	Slightly b	Tail	Few
	Ebonyi N	Ndieguu	Nwopoke	136	Dark brown	Absent	Absent	Anticlock	light green	S. long	Caudate	Oval	Rough	Slightly b	Up p. m	Few
	Ebonyi S	Oso	Mbula	298	Purplish g	Absent	Absent	Anticlock	dark green	hastate	Caudate	Oval oblong	Smooth	Slightly b	Tail	Few

Appendix iii. Continued

Cluster	Zone	Community	Access.name	Plot Id	Thorns	Intense	Wrinkle	Rsut	PoR	Corm S.	Cormty.	TubC	Tcm	Tclr
C1 red	Ebonyi N.	Igbeagu	Ozibo	144	Absent	Absent	Absent	Few	Tuberhead	Intermediate	Regular	Creamy	Creamy	Creamy
	Ebonyi S	Oso	igummbula	297	Absent	Absent	Absent	Few	Tuber	No corm	No corm	Deep purple	Deep purple	Deep purple

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									head					
	Ebonyi N.	Igbeagu	Okepbe	143	Absent	Absent	Absent	Few	Entire body	Intermediat	Branched	Deep purple	Deep purple	Deep purple
		Ndiabor okp	Ozibo	125	Absent	Absent	Absent	Few	Tuber head	Intermediat	Regular	Creamy wh.	Creamy wh.	Creamy
		Ndieze	**Okpembe**	162	Absent	Absent	Absent	Few	Tuber head	Intermediat	Branched	Purplish white	Purplish white	Purplish white
	Ebonyi S	Ishiagu	obiaoturugo	261	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Creamy	Creamy	Creamy wh.
		Ishiagu	Orunte	263	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Creamy	Creamy	Creamy
	Ebonyi C	Ekpelu	Igum	229	Absent	Absent	Absent	Few	Tuber head	Large	Branched	Creamy	Creamy	Creamy
	Ebonyi S	Okue	Obiaoturugo	269	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Creamy	Creamy wh.	Creamy wh.
	Ebonyi	Ishiagu	Paper	264	Absent	Absent	Absent	Few	Tuber head	Small	Regular	Creamy	Creamy wh.	Creamy wh.
	Ebonyi S	Okue	Ogbagharu	161	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Creamy	Creamy wh.	Creamy wh.
	Ebonyi C	Ndufu Alike	Ojeoso	215	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Creamy	Creamy wh.	Creamy wh.
	Ebonyi N	Ndiegu	Nvula	132	Absent	Absent	Absent	Few	Tuber head	intermediat	Regular	Creamy	Purplish	Purplish wh.
	Ebonyi S	Okue	Orunte	271	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Creamy	Creamy	Creamy
	Ebonyi N	Ndieze	akpuruakput	152	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Deep purple	Deep purple	Deep purple
	Ebonyi C	Okposium.	Nwawafu	200	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Purplish	Deep purple	Purplish
	Ebonyi S	Okue	Awoke	272	Absent	Absent	Absent	Few	Tuber	intermediat	Regular	Purplish	Purplish	Purplish

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									head					
		Oso	Agba	293	Absent	Absent	Absent	Few	Tuber head	Small	Regular	Deep purple	Deep purple	Purplish
	Ebonyi C	Ekpelu	Agbabro	227	Absent	Absent	Absent	Few	Tuber head	Small	Regular	Deep purple	Purplish	Deep purple
	Ebonyi S	Ishiagu	Ishitu	256	Absent	Absent	Absent	Few	Entire body	No corm	No corm	Creamy	Creamy	Creamy
	Ebonyi C.	Umogharu	Ojioso	194	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Deep purple	Deep purple	Purplish wh.
	Ebonyi S	Owutu	Agba	279	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Purplish	Purplish	Deep purple
	Ebonyi C	Ekpelu	Nvula	225	Absent	Absent	Absent	Few	Tuber head	intermediat	Regular	Creamy	Purplish	Purplish
	Ebonyi N.	Ndieze	Obela	160	Absent	Absent	Absent	Few	Tuber head	intermediat	Regular	Creamy	Creamy	Creamy wh.
	Ebonyi C	Ndufu Alike	Nvula	220	Absent	Absent	Absent	Few	Tuber head	Small	Regular	Deep purple	Purplish wh.	Purplish wh.
	Ebonyi N.	Umueza ka	Mbala	112	Absent	Absent	Absent	Few	Tuber head	Small	Regular	Purplish	Creamy	Purplish
	Ebonyi C	Ndufu Alike	Onyeoma	217	Absent	Absent	Absent	Few	Tuber head	Large	Regular	Deep purple	Purplish wh.	Purplish wh.
	Ebonyi S	Okue	Makuruoba	273	Absent	Absent	Absent	Few	Tuber head	Intermediat	Regular	Deep purple	Purplish	Purplish
	Ebonyi C	Okposium.	Okwulenkata	198	Absent	Absent	Absent	Few	Tuber head	Intermediat	Regular	Deep purple	Purplish	Purplish
	Ebonyi	Umogharu	okwulenkata	197	Absent	Absent	Absent	Few	Tuber head	intermeidat	Regular	Deep purple	Deep purple	Deep purple
	Ebonyi	Ekpelu	Opalenkata	226	Absent	Absent	Absent	Few	Tuber head	intermediat	Regular	Purplish	Deep purple	Deep purple
	Ebonyi N	Umueza ka	Ogomodu	117	Absent	Absent	Absent	Few	Tuber	intermediat	Regular	Deep purple	Purplish wh.	Purplish wh.

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									head					
	Ebonyi S	Ishiagu	Orumeh-nvul	254	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Deep purple	Deep purple	Deep purple
	Ebonyi N	Igbeagu	Nvula	146	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Purplish	Deep purple	Deep purple
	Ebonyi C	Okposium.	Ozibo	208	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Creamy	Creamy	Creamy wh.
	Ebonyi S	Ishiagu	Makwuroba	257	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Deep purple	Deep purple	Deep purple
		Eweze	Opanankata	251	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Deep purple	Deep purple	Purplish
		Owutu	Mbula	275	Absent	Absent	Absent	Few	Tuber head	No corm	No corm	Deep purple	Deep purple	Purplish
		Uburu	Opanankata	244	Absent	Absent	Absent	Few	Tuber head	Small	Regular	Creamy wh.	Creamy wh.	Creamy
	Ebonyi N	Ndiegu	Nwopoke	136	Absent	Absent	Absent	Few	Tuber head	Small	Regular	Purplish	Purplish wh.	Purplish wh.
	Ebonyi S	Oso	Mbula	298	Absent	Absent	Absent	Few	Entire body	Large	T.elongated	Deep purple	Deep purple	Deep purple

Source: Field survey 2016. Ebonyi N.,C., and S= Ebonyi North, Central & South, Ndiegu O=Ndiegu Okpuitmo, Okposi Um=Okposi Umuogharu,Owutu edda= Owutu Edda,U.Idembia=Umunwagu Idembia. leaf colour-purplish g-purplish green, leaf apex shape-saggataiate, TST-tuber surface texture, Ttb-tuber tendency to branch: slightly b - slightly branched, highly b- highly branched, POb - position of branching,4-upper middle/head & tail region,1 - upper middle.

Appendix iv. Continued

Cluster	Zone	Community	Access.name	Plot	Traits - VC	Hairs	spines	Twining	Leaf col	Leaf sh	LAS	Tuber shape	TsT	Ttb	Pob	CoTs
C1 red	Ebonyi S	Oso	Mbula Paul	301	Purplish g	Absent	Absent	Anticlock	Pale green	Hastate	Caudate	Oval oblong	Rough	Slightly b	Upp. m	Few
	Ebonyi N	Ndiabor Okp	Okpebe	124	darkbrown	Absent	Absent	Anticlock	Yellowish	Ovate	Acute	Cylindrical	Smooth	Slightly b	Middle	Absent
		Amofia	Nwopoke	102	Purplish g	Absent	Many	Anticlock	darkgreen	Ovate	Caudate	Oval	Smooth	Slightly b	Upp. m	Absent
		Igbeagu	Opoke	149	Purplish g	Absent	Absent	Anticlock	Purple	S. long	Caudate	Cylindrical	Smooth	Slightly b	Tail	Absent
	Ebonyi C	Amagu	Amage	181	Purplish g	Absent	Absent	Anticlock	Purple	Cordate	Aristate	Cylindrical	Smooth	Slightly b	Tail	Absent
		Ndufu Alike	Nvulame	221	Purplish g	Absent	Absent	Anticlock	Purplish g	C. long	Caudate	Cylindrical	Smooth	Branched	Tail	Absent
	Ebonyi S	Ishiagu	Orumeh	262	Green	Present	Absent	Anticlock	Pale green	Cordate	Caudate	Oval oblong	Smooth	Slightly b	Middle	Absent

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	Ebonyi C	U. Idembia	Abi	166	Green	Absent	Absent	Anticlock	Yellowish	Cordate	Aristate	Oval oblong	Smooth	Slightly b	Upm/h	Few
	Ebonyi S	Ishiagu	Abi	258	Green	Absent	Absent	Anticlock	darkgreen	Cordate	Aristate	Oval	Smooth	Slightly b	Middle	Absent
		Uburu	Obiaoturugo	242	darkbrown	Present	Few	Anticlock	Purplish g	Ovate	Caudate	Oval oblong	Smooth	Slightly b	Upm/h	Few
		Owutu	Abi	278	Green	Absent	Absent	Anticlock	Yellowish	Cordate	Caudate	Cylindrical	Smooth	Slightly b	Tail	Few
		Ndiegu Okp	Amage	133	Purplish g	Absent	Absent	Anticlock	darkgreen	Cordate	Aristate	Cylindrical	Smooth	Slightly b	Tail	Absent
	Ebonyi C	Umuogharu	Obiaoturugo	195	Green	Absent	Absent	Anticlock	darkgreen	Cordate	Caudate	Cylindrical	Smooth	Slightly b	Middle	Few
	Ebonyi S	Owutu	Gborogidi	282	Purplish g	Absent	Absent	Anticlock	Pale green	C. broad	Caudate	Cylindrical	Smooth	Slightly b	Middle	Few
	Ebonyi C	U. Idembia	Nwawafu	173	Purplish g	Absent	Absent	Anticlock	Pale green	C. long	Caudate	Oval	Smooth	Slightly b	Middle	Few
		Umuogharu	Nwawafu	196	Purplish g	Absent	Absent	Anticlock	Pale green	C. broad	Caudate	Oval	Smooth	Slightly b	Tail	Few
		Okposi Um	Nvula	199	Purplish g	Absent	Absent	Anticlock	Pale green	C. long	Caudate	Oval	Smooth	Slightly b	Upp. m	Absent
	Ebonyi N	Igbeagu	Nvulame	151	Green	Absent	Absent	Anticlock	Pale green	C. long	Caudate	Cylindrical	Smooth	Slightly b	Tail	Absent
	Ebonyi C	Amagu	Akoawafu	179	Purplish g	Absent	Absent	Anticlock	Pale green	C. long	Caudate	Oval	Smooth	Slightly b	Middle	Absent
	Ebonyi N	Ndieze	Okwalenkata	153	Purplish g	Absent	Absent	Anticlock	Pale green	S. long	Caudate	Oval	Smooth	Slightly b	Tail	Absent
	Ebonyi C	Ndufu Alike	Opanankata	222	Purplish g	Absent	Absent	Anticlock	Pale green	C. long	Caudate	Oval	Smooth	Slightly b	Tail	Few
	Ebonyi N	Umuezaka	Egboru	111	Brownish g	Absent	Absent	Anticlock	darkgreen	C. long	Emargin.	Spherical/R	Rough	Slightly b	Upp. m	Few
	Ebonyi C	Ndufu Alike	Mkpumeke	212	Purplish g	Absent	Absent	Anticlock	Pale green	Ovate	Obtuse	Cylindrical	Smooth	Slightly b	Upp. m	Absent
	Ebonyi S	Eweze	Mbala	252	Purplish g	Absent	Absent	Anticlock	Pale green	Hastate	Caudate	Cylindrical	Rough	Slightly b	Middle	Absent
	Ebonyi C	U. Idembia	Nvulamanu	175	Purplish g	Absent	Absent	Anticlock	Purple	C. broad	Caudate	Cylindrical	Rough	Slightly b	Tail	Absent
		Ekpelu	Ojeoso	233	Green	Absent	Absent	Anticlock	Purplish g	C. long	Caudate	Cylindrical	Rough	Slightly b	Middle	Absent
	Ebonyi S	Ishiagu	Awoke	253	Purplish g	Absent	Absent	Anticlock	Pale green	S. long	Caudate	Cylindrical	Rough	Slightly b	Middle	Absent
	Ebonyi N	Igbeagu	Amage	141	Green	Absent	Absent	Anticlock	darkgreen	C. long	Aristate	Cylindrical	Rough	Slightly b	Tail	Few
	Ebonyi C	Umuogharu	Iboki	187	Green	Absent	Absent	Anticlock	lightgreen	C. long	Aristate	Cylindrical	Rough	Slightly b	Middle	Absent
		Ekpelu	Nvulame	235	Green	Absent	Absent	Anticlock	Pale green	C. broad	Caudate	Cylindrical	Rough	Branched	Tail	Absent
	Ebonyi S	Eweze	Igborogidi	248	Green	Absent	Absent	Anticlock	darkgreen	C. broad	Caudate	Cylindrical	Rough	Slightly b	Tail	Few
C2 blue	Ebonyi N.	Amoffia	Obela	103	Brownish g	Present	Absent	Anticlock	Purplish g	Ovate	Acute	cylindrical	Smooth	Slightly b.	Middle	Absent
		Umuezaka	Okpambe	118	Pink	Absent	Absent	anticlock	palegreen	ovate	Acute	cylindrical	smooth	Branched	Upm/h	Absent
		Umuezaka	Obela	116	Pink	Present	Absent	anticlock	lightgreen	cordate	Obtuse	cylindrical	smooth	Slightly b.	Upp. m	Absent

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	Ebonyi C.	Umuogharu	okpambe	192	Darkbrown	Absent	Absent	Anticlock	lightgreen	Ovate	Acute	cylindrical	smooth	branched	Middle	Absent
	Ebonyi N	Ndiegu O.	Okpabe	139	lightgreen	Present	Absent	Anticlock	palegreen	cordate	obtuse	cylindrical	Rough	Slightly b.	Upp. m	Few
		Igbeagu	Akamunze	140	Brownish g	Present	Few	anticlock	yellowish	ovate	Acute	cylindrical	Rough	Slightly b.	Middle	Few
	Ebonyi C.	Umuogharu	Igum	186	Darkbrown	Present	Few	anticlock	yellowish	ovate	Acute	cylindrical	Rough	Slightly b.	Tail	Absent
	Ebonyi N	Ndiabor O.	Igum	122	Pink	Present	few	anticlock	yellowish	ovate	caudate	cylindrical	smooth	Slightly b.	Upp. m	Absent
	Ebonyi S	Ishiagu	Igum	260	Pink	Present	Absent	anticlock	yellowish	cordate	caudate	Oval oblong	smooth	Slightly b.	Upp. m	Absent
	Ebonyi C.	Amagu	Nnebiji	183	Purple	Present	few	anticlock	palegreen	cordate	obtuse	cylindrical	smooth	Slightly b.	Upp. m	Absent
		Ndufualike	Nnebiji	213	Pink	Present	many	anticlock	yellowish	cordate	obtuse	Oval oblong	smooth	Slightly b.	Tail	Absent
	Ebonyi S.	Uburu	Nnebiji	241	Pink	Present	many	anticlock	yellowish	cordate	obtuse	Oval oblong	smooth	branched	Middle	Few

Appendix iv.Continued

Cluster	**Zone**	**Community**	**Access.name**	**Plot Id**	**Thorns**	**Intensity**	**Wrinkle**	**Rsut**	**Po R**	**Corm S.**	**Corm ty.**	**TubC**	**Tcm**	**Tclr**
C1 red	Ebonyi S	Oso	Mbula Paul	301	Absent	Absent	Absent	Few	Tuberhead	Intermediate	Regular	Creamy	Creamy	Creamy
	Ebonyi N	Ndiabor Okp	Okpebe	124	Absent	Absent	Absent	Few	Tuberhead	No corm	None	Deep purple	Deep purple	Purplish white
		Amofia	Nwopoke	102	Absent	Absent	Absent	Few	Tuberhead	No corm	None	Purplish white	Deep purple	Deep purple
		Igbeagu	Opoke	149	Absent	Absent	Absent	Few	Tuberhead	No corm	None	Creamy	Creamy	Creamy
	Ebonyi C	Amagu	Amage	181	Absent	Absent	Absent	Few	Tuberhead	No corm	None	Creamy	Creamy	Creamy white
		Ndufu Alike	Nvulame	221	Absent	Absent	Absent	Few	Tuberhead	No corm	None	Purplish	Purplish	Purplish
	Ebonyi S	Ishiagu	Orumeh	262	Absent	Absent	Absent	Few	Tuberhead	No corm	None	Creamy	Creamy	Creamy
	Ebonyi C	U. Idembia	Abi	166	Absent	Absent	Absent	Few	Tuberhead	No corm	None	Creamy	Creamy	Creamy
	Ebonyi S	Ishiagu	Abi	258	Absent	Absent	Absent	Few	Tuber	No corm	None	Creamy	Creamy	Creamy

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									head					
		Uburu	Obiaoturugo	242	Absent	Absent	Absent	Few	Tuber head	No corm	None	Creamy	Creamy white	Creamy white
		Owutu	Abi	278	Absent	Absent	Absent	Few	Tuber head	Intermediate	Regular	Creamy	Creamy	Creamy
		Ndiegu Okp	Amage	133	Absent	Absent	Absent	Few	Tuber head	Small	Regular	Creamy white	Creamy white	Creamy white
	Ebonyi C	Umuogharu	Obiaoturugo	195	Absent	Absent	Absent	Few	Tuber head	Intermediate	Regular	Creamy white	Creamy white	Creamy
	Ebonyi S	Owutu	Gborogidi	282	Absent	Absent	Absent	Few	Tuber head	No corm	None	Deep purple	Deep purple	Deep purple
	Ebonyi C	U. Idembia	Nwawafu	173	Absent	Absent	Absent	Few	Tuber head	No corm	None	Deep purple	Deep purple	Deep purple
		Umuogharu	Nwawafu	196	Absent	Absent	Absent	Few	Tuber head	No corm	None	Deep purple	Deep purple	Deep purple
		Okposi Um	Nvula	199	Absent	Absent	Absent	Few	Tuber head	No corm	None	Deep purple	Purplish	Purplish white
	Ebonyi N	Igbeagu	Nvulame	151	Absent	Absent	Absent	Few	Tuber head	No corm	None	Deep purple	Purplish	Purplish
	Ebonyi C	Amagu	Akoawafu	179	Absent	Absent	Absent	Few	Tuber head	No corm	None	Deep purple	Deep purple	Purplish
	Ebonyi N	Ndieze	Okwalenkata	153	Absent	Absent	Absent	Few	Entire body	No corm	None	Deep purple	Deep purple	Deep purple
	Ebonyi C	Ndufu Alike	Opanankata	222	Absent	Absent	Absent	Few	Entire body	No corm	None	Deep purple	Purplish white	Purplish white
	Ebonyi N	Umuezaka	Egboru	111	Absent	Absent	Absent	many	Entire body	No corm	None	Deep purple	Deep purple	Deep purple
	Ebonyi C	Ndufu Alike	Mkpumeke	212	absent	Absent	Absent	Few	Entire body	Intermediate	Regular	Deep purple	Deep purple	Deep purple
	Ebonyi S	Eweze	Mbala	252	Absent	Absent	Absent	Few	Tuber	No corm	None	Deep purple	Deep purple	Deep purple

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									head					
	Ebonyi C	U. Idembia	Nvulamanu	175	Absent	Absent	Absent	Few	Tuber head	No corm	None	Purplish white	Purplish white	Purplish white
		Ekpelu	Ojeoso	233	Absent	Absent	Absent	Few	Tuber head	No corm	None	Deep purple	Purplish white	Purplish white
	Ebonyi S	Ishiagu	Awoke	253	Absent	Absent	Absent	Few	Tuber head	No corm	None	Deep purple	Purplish white	Purplish white
	Ebonyi N	Igbeagu	Amage	141	Absent	Absent	Absent	Few	Tuber head	No corm	None	Purplish	Deep purple	Purplish
	Ebonyi C	Umuogharu	Iboki	187	Absent	Absent	Absent	Few	Tuber head	No corm	None	Creamy white	Creamy	Creamy white
		Ekpelu	Nvulamme	235	Absent	Absent	Absent	Many	Tuber head	No corm	None	Creamy	Creamy	Creamy white
	Ebonyi S	Eweze	Igborogidi	248	Absent	Absent	Absent	Many	Entire body	No corm	None	Deep purple	Purplish white	Purplish white
C2 blue	Ebonyi N.	Amoffia	Obela	103	Absent	Absent	Absent	Few	Lower T	No corm	None	Deep purple	deep purple	Purple wh.
	Ebonyi N	Umuezaka	Okpambe	118	Absent	Absent	Absent	Few	Tuber h.	No corm	None	Creamy	Purplish	Creamy white
	Ebonyi N	Umuezaka	Obela	116	Absent	Absent	Absent	Few	Tuber h.	No corm	None	Creamy	Purplish	Creamy white
	Ebonyi C.	Umuogharu	okpambe	192	Absent	Absent	Absent	Few	Tuber h.	No corm	None	Creamy	deep purple	Creamy white
	Ebonyi N	Ndiegu O.	Okpabe	139	Absent	Absent	Absent	Few	Entire b.	No corm	None	Brownish white	Purplish w.	Purplish white
	Ebonyi N	Igbeagu	Akamunze	140	Absent	Absent	Absent	Few	Tuber h.	No corm	None	Creamy	Creamy	Creamy
	Ebonyi C.	Umuogharu	Igum	186	Absent	Absent	Absent	Few	Tuber h.	small	Regular	Creamy	Creamy white	Creamy white
	Ebonyi N	Ndiabor O.	Igum	122	Absent	Absent	Absent	Many	Tuber h.	Large	Regular	Purplish	Purplish white	Purplish
	Ebonyi S	Ishiagu	Igum	260	Absent	Absent	Absent	Few	Tuber h.	small	Regular	Purplish	Purplish	Purplish white
	Ebonyi C.	Amagu	Nnebiji	183	Absent	Absent	Absent	Few	Tuber h.	Large	Regular	Creamy	Creamy white	Creamy white

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	Ebonyi C.	Ndufualike	Nnebiji	213	Absent	Absent	Absent	Few	Tuber h.	Intermediate	Regular	Creamy	Creamy white	Creamy white
	Ebonyi S.	Uburu	Nnebiji	241	Absent	Absent	Absent	Few	Tuber h.	No corm	None	Creamy	Creamy white	Creamy white

Appendix V

Cluster	**Zone**	**Community**	**Access.name**	**Plotid**	**Traits - VC**	**hairs**	**spines**	**Twining**	**LC**	**LSH**	**LAS**	**Tuber sh**	**TsT**	**Ttb**	**Pob**	**CoTs**
C2 blue	Ebonyi C	Okposi Um	Akamunze	201	Pink	Present	many	anticlock	yellowish	Ovate	Acute	cylindrical	smooth	Slightly b.	Middle	Absent
Subg1		**Ekpelu**	**Nnebiji**	**230**	**Pink**	Present	many	anticlock	yellowish	cordate	obtuse	Oval oblong	smooth	Slightly b.	middle	Absent
	Ebonyi N.	Amofia	Ozibo	105	darkbrown	Present	Absent	anticlock	palegreen	Ovate	Caudate	Cylindrical	smooth	Slightly b.	middle	many
	Ebonyi S.	Owutuedd.	Ewada	281	Purplish g.	Present	Absent	anticlock	dark green	Ovate	caudate	Oval oblong	smooth	Highly b.	middle	absent
		Uburu	Ekoweji	238	darkbrown	Present	Absent	anticlock	yellowish	cordate	caudate	cylindrical	smooth	Slightly b	middle	few
		Owutuedd.	Akiri	280	Green	Present	Absent	anticlock	yellowish	cordate	caudate	cylindrical	smooth	Slightly b	middle	few
		Osoedda	Akiri	294	Green	Present	Absent	anticlock	yellowish	cordate	caudate	cylindrical	smooth	Slightly b	middle	few
	Ebonyi C.	Umuogharu	Nyeji	189	Purplish g.	Present	Absent	anticlock	Purplish g	cordate	caudate	cylindrical	rough	Slightly b	middle	absent
		Okkposi U.	Nyeji	204	Purplish g.	Present	Absent	anticlock	light green	cordate	caudate	cylindrical	rough	Slightly b	tail	few
	Ebonyi C.	U. idembia	Igum	167	Purplish g.	Present	Absent	anticlock	light green	cordate	caudate	cylindrical	smooth	Slightly b	tail	few
	Ebonyi S.	Okue	Orumeh	270	Purplish g.	Present	Absent	anticlock	light green	cordate	caudate	cylindrical	smooth	Slightly b	tail	absent
	Ebonyi N.	Igbeagu	Igum	142	darkbrown	Present	Absent	anticlock	Purplish g	cordate	caudate	cylindrical	smooth	Slightly b	Up/h	few
	Ebonyi S	Oso	Igum	295	Green	Present	Absent	anticlock	Purplish g	cordate	caudate	cylindrical	smooth	Slightly b	middle	few
	Ebonyi C	Umuogharu	Igum	188	Dark brown	Present	Absent	anticlock	yellowish	cordate	caudate	cylindrical	smooth	Slightly b	middle	absent
	Ebonyi S	Okue	Igum	268	Purple	Present	Absent	anticlock	yellowish	cordate	caudate	cylindrical	smooth	Slightly b	middle	few
	Ebonyi N.	Ndiezee	Igum	158	Pink	Present	Absent	anticlock	palegreen	cordate	caudate	cylindrical	smooth	Slightly b	middle	absent

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	Ebonyi C	Okposi um	Igum	203	Pink	Present	many	anticlock	palegreen	Ovate	caudate	cylindrical	smooth	Slightlyb	Middle	Absent
	Ebonyi N	Ndieze	ayaragu	157	Green	Present	many	anticlock	dark green	Sag. l	caudate	cylindrical	smooth	Slightlyb	middle	Absent
	Ebonyi C	U. Idembia	Jimaka	168	Purplish g.	Present	Absent	anticlock	palegreen	Ovate	caudate	cylindrical	smooth	Slightlyb	middle	absent
	Ebonyi S	Okue	Agboji	267	purple	Present	Absent	anticlock	Purplish g	cordate	caudate	cylindrical	smooth	Slightlyb	middle	Few
Cluster3	Ebonyi C.	Ndufu Alike	Oko	216	Dark brown	Absent	Many	clockwise	Yellowish	Cordatel	Acute	cylindrical	Rough	branched	middle	Absent
	Ebonyi S.	Ishiagu	Nka	265	Brownish g	Absent	Many	clockwis	Yellowish	Cordatel	Acute	cylindrical	Smooth	Slightlyb	middle	Few
		Okue	Nka	274	Dark brwon	Absent	Many	clockwis	Yellowish	Cordatel	Acute	cylindrical	Smooth	Slightlyb	middle	Absent
		Ishiagu	Otutu	255	Purplish g.	Absent	Many	Anticlock	Yellowish	Sag. bro.	Aritate	cylindrical	Rough	Slightlyb	Tail	Few
		Oso	nkwenii yi	302	Brownish g	Absent	Many	clockwis	Yellowish	Cordatel	Aristate	cylindrical	Smooth	Slightlyb	Upp.m	Absent
	Ebonyi C.	U.Idembia	Una	176	Purple	Present	Many	clockwis	Purplish g	hastate	cudspida	Oval	Smooth	Slightlyb	Upp.m	Few
	Ebonyi S.	Oso	Una	304	Purplish g.	Present	Many	clockwis	Purplish g	S.long	aristate	cylindrical	Smooth	branched	Middle	Absent
	Ebonyi N.	Amofia	Una	110	Purplish g.	Present	Many	clockwis	Purplish g	S.long	aristate	Spherical/R	Smooth	Slightlyb	Upp.m	Absent
	Ebonyi S.	Owutu	Una	287	Brownish g	Present	Many	clockwis	Purplish g	Cordatel	Aristate	cylindrical	Rough	branched	Middle	Few
	Ebonyi C.	**Umogharu**	**Ogomodu**	190	Dark brwon	Absent	Many	clockwis	Yellowish	Ovate	Acute	cylindrical	Smooth	Slightlyb	Middle	Absent
		Ekpelu	Oko	234	Dark brwon	Absent	Many	clockwis	Yellowish	Cordatel	Acute	cylindrical	Rough	branched	Middle	Few
	Ebonyi S.	Uburu	Enegbe	239	Dark brwon	Absent	Many	clockwis	Yellowish	Sag. bro.	Aristate	cylindrical	Smooth	Slightlyb	Middle	Few
	Ebonyi C	Okposi um	Ogomodu	205	Dark brwon	Absent	Many	clockwis	Yellowish	Cordatel	Acute	cylindrical	Smooth	Slightlyb	Middle	Absent
	Ebonyi N	Igbeagu	Oko	145	Dark brwon	Absent	Many	clockwis	Pale green	Hastate	cudspida	Oval	Rough	Slightlyb	Middle	Absent
	Ebonyi S	Owutu	Oko	286	Dark brwon	Absent	Many	clockwis	Yellowish	S. long	Aristate	Spherical/R	Smooth	branched	Middle	Absent
	Ebonyi C	Amagu	Oko	185	Dark brwon	Absent	Few	clockwis	Yellowish	S. long	Aristate	cylindrical	Smooth	branched	Up/h	Absent

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	Ebonyi N	Ndieze	Oko	155	Purplish g	Absent	Many	clockwis	Yellowish	S. long	Aristate	Irregular	Smooth	branched	Middle	Few
	Ebonyi C	Umogharu	Oko	191	Dark brwon	Absent	Many	clockwis	Yellowish	Cordatel	Acute	cylindrical	Smooth	Slightly b	Up.m	Few
	Ebonyi S	Eweze	Enegbe	247	Dark brwon	Absent	Many	clockwis	Yellowish	Cordatel	Acute	cylindrical	Smooth	Slightly b	Middle	Absent
	Ebonyi N	Ndiabor	Oko	126	Dark brwon	Absent	Many	clockwis	Yellowish	Cordatel	Acute	Oval	Rough	Branched	Up.m	Few
	Ebonyi S	Oso	Oko	303	Dark brwon	Absent	Many	clockwis	Pale green	Cordatel	Acute	cylindrical	Smooth	Highly b	Middle	Absent

Source: Field survey 2016. Ebonyi N.,C., and S= Ebonyi North, Central & South, Ndiegu O=Ndiegu Okpuitmo, Okposi Um=Okposi Umuogharu,Owutu edda= Owutu Edda,U.Idembia=Umunwagu Idembia. leaf colour-purplish g-purplish green, leaf apex shape-saggataiate, TST-tuber surface texture, Ttb-tuber tendency to branch: slightly b - slightly branched, highly b- highly branched, POb - position of branching,4-upper middle/head & tail region,1 - upper middle.

Appendix v. Continued

Cluster	**Zone**	**Community**	**Access. name**	**Plot Id**	**Thorn**	**Interns.**	**Wrinkles**	**Rsut**	**PoR**	**Corm S.**	**Cormty.**	**TubC**	**Tcm**	**Tclr**
C2 blue	Ebonyi C	Okposi Um	Akamunze	201	Absent	No	No	Few	Tuberhead	No corm	None	Creamy	C. white	C. white
	Ebonyi C	Ekpelu	Nnebiji	230	Absent	No	No	Few	Tuberhead	No corm	None	Purplish	Purplish	Purplish wh.
Subg 2	Ebonyi N.	Amofia	Ozibo	105	Absent	No	No	few	Tuberhead	No corm	None	orange	purplish	purplish
	Ebonyi S.	Owutu edd.	Ewada	281	Absent	No	No	Few	Tuberhead	No corm	None	Deep purple	deeppurple	C. white
		Uburu	Ekoweji	238	Absent	No	No	Few	Tuberhead	No corm	None	orange	Orange	Orange
		Owutu edd.	Akiri	280	Absent	No	No	Few	Tuberhead	No corm	None	Creamy	Creamy	Creamy
		Oso edda	Akiri	294	Absent	No	No	Few	Tuberhead	Intermediate	Regular	Deep purple	deep purple	C. white
	Ebonyi C.	Umuogharu	Nyeji	189	Absent	No	No	Few	Tuberhead	Small	Regular	Deep purple	Purplish	Purplish whi.
		Okposi um	nyeji	204	Absent	No	No	few	Tuberhead	Large	Regular	Deep purple	C. white	Creamy

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	Ebonyi N.	Igbeagu	Igum	142	Absent	No	No	Few	Tuberhead	No corm	None	Creamy	C. white	C. white
	Ebonyi S.	Okue	Orumeh	270	Absent	No	No	Few	Tuberhead	No corm	None	Creamy	C. white	Creamy
	Ebonyi C.	U. idembia	Igum	167	Absent	No	No	Few	Tuberhead	Small	Regular	Creamy	C. white	C. white
	Ebonyi S	Oso	Igum	295	Absent	No	No	Few	Tuberhead	Intermediate	Regular	Creamy	C. white	C. white
	Ebonyi C	Umuogharu	Igum	188	Absent	No	No	Few	Tuberhead	No corm	None	Deep purple	Purplish	purplish
	Ebonyi S	Okue	Igum	268	Absent	No	No	Few	Tuberhead	No corm	None	Creamy	C. white	C. white
	Ebonyi N.	Ndieze	Igum	158	Absent	No	No	Few	Tuberhead	No corm	None	cream y	C. white	C. white
	Ebonyi C	Okposium	Igum	203	Absent	No	No	Few	Tuberhead	No corm	None	Purplish white	Purplish	Purplish
	Ebonyi N	Ndieze	ayaragu	157	Absent	No	No	Few	Tuberhead	No corm	None	Purplish white	Purplish	Purplish
	Ebonyi C	U. Idembia	Jimaka	168	Absent	No	No	Few	Tuberhead	No corm	None	cream y	C. white	Creamy
	Ebonyi S	Okue	Agboji	267	Absent	No	No	Few	Tuberhead	No corm	None	purplish	Purplish	purplish
Cluster3	Ebonyi C.	NdufuAlike	Oko	216	Absent	No	No	Many	Tuberhead	Small	Regular	Yellow	Yellow	Yellow
	Ebonyi S.	Ishiagu	Nka	265	Absent	No	No	Many	Tuberhead	Large	Regular	Yellow	Yellow	Yellow
		Okue	Nka	274	Absent	No	No	Many	Tuberhead	No corm	None	Yellow	Yellow	Yellow
		Ishiagu	Otutu	255	Absent	No	No	Few	Tuberhead	intermediate	Regular	Creamy	Creamy white	Creamy whit

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		Oso	nkweniyi	302	Absent	No	No	Few	Tuberhead	intermediate	Regular	Yellow	Yellow	Yellow
	Ebonyi C.	U.Idembia	Una	176	Absent	No	No	Few	Tuberhead	intermediate	Regular	Purplish white	Purplish white	Purplish wh.
	Ebonyi S.	Oso	Una	304	Present	Few	No	Few	Tuberhead	Large	Branched	Creamy	Creamy	Creamy
	Ebonyi N.	Amofia	Una	110	Absent	No	No	Few	Tuberhead	Large	Branched	Creamy	Creamy	Creamy
	Ebonyi S.	Owutu	Una	287	Absent	No	No	Few	Tuberhead	Large	Branched	Creamy	Creamy	Creamy
	Ebonyi C.	Umogharu	Ogomodu	190	Absent	No	No	Few	Tuberhead	No corm	None	orange	Orange	Orange
		Ekpelu	Oko	234	Present	Few	No	Few	Tuberhead	No corm	None	Orange	Yellow	Yellow
	Ebonyi S.	Uburu	Enegbe	239	Present	Few	No	Few	Tuberhead	No corm	None	Orange	Yellow	Yellow
	Ebonyi C	Okposium	Ogomodu	205	Absent	No	No	Few	Tuberhead	No corm	None	Orange	Orange	Orange
	Ebonyi N	Igbeagu	Oko	145	Absent	No	No	Few	Tuberhead	No corm	None	Orange	Orange	Orange
	Ebonyi S	Owutu	Oko	286	Absent	No	No	Few	Tuberhead	No corm	None	Orange	Orange	Orange
	Ebonyi C	Amagu	Oko	185	Absent	No	No	Few	Tuberhead	No corm	None	Orange	Orange	Orange
	Ebonyi N	Ndieze	Oko	155	Present	Few	No	Few	Tuberhead	No corm	None	Orange	Orange	Orange
	Ebonyi C	Umogharu	Oko	191	Present	Few	No	Few	Tuberhead	No corm	None	Orange	Orange	Orange
	Ebonyi S	Eweze	Enegbe	247	Absent	No	No	Few	Tuberhead	No corm	None	Deep purple	Purplish	Purplish

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	Ebonyi N	Ndiabor	Oko	126	Absent	No	No	Few	Tuber head	No corm	None	Brownish wh.	Brownish g	Brownish g
	Ebonyi S	Oso	Oko	303	Present	Few	No	Few	Tuber head	intermediate	T.elongated	Orange	Orange	Orange

Source: Field survey 2016. Ebonyi N.,C., and S= Ebonyi North, Central & South, Ndiegu O=Ndiegu Okpuitmo, Okposi Um=Okposi Umuogharu,Owutu edda= Owutu Edda,U.Idembia=Umunwagu Idembia, Rsut-roots on the surface of the tubers, PoR-position of the roots on the tuber- lowerT= lower third, tuber h=tuber head, corm S.-corm size: intermediat-intermediate, TubC-tuber colour upper region: brownish w-brownish white, purplish w.-purplish white, TCM-tuber colour middle region-C.white –creamy white and Tclr-tuber colour at lower region:purplish whi.-purplish white

Appendix vi

Cluster	**Zone**	**Community**	**Access.name**	**Plotid**	**Traits - VC**	**hairsness**	**spines**	**Twining**	**LC**	**LSH**	**LAS**	**Tuber sh**	**TsT**	**Ttb**	**Pob**	**CoTs**
C3	Ebonyi C	U. Idembia	Oko	172	darkbrwon	Absent	Many	clockwis	Yellowish	Cordatel	Acute	cylindrical	Smooth	Slightlyb	Middle	Absent
		Okposi um	Oko	206	darkbrwon	Absent	Many	clockwis	Yellowish	Cordatel	Acute	cylindrical	Smooth	Slightlyb	middle	Absent
C4	Ebonyi C	Ndufu Alike	Caret yam	211	Purple	Absent	No	anticlock	Purplish g	S. long	Emargin.	Irregular	Rough	branched	middle	Absent
	Ebonyi S	Owutu	Mbagbirigba	289	Purplish g	Absent	No	anticlock	Light gre.	Cordatel	Caudate	Irregular	Rough	Highlyb.	middle	Few
	Ebonyi C	Ndufu Alike	Edu	223	Green	Absent	No	clockwise	paleg reen	Ovate	Obtuse	Irregular	Smooth	Slightlyb	middle	**Absent**
	Ebonyi S	Owutu	Edu	290	Brownish g	Absent	No	clockwise	paleg reen	Ovate	Obtuse	Irregular	Rough	branched	Middle	**Absent**
	Ebonyi S	Owutu	Nkweinyi	284	Purplish g	Absent	Few	anticlock	Yellowish	Cordate	Obtuse	cylindrical	Rough	branched	Lowert	Absent
	Ebonyi C	Umogharu	Usuekpe	193	Purplish g	Absent	Few	anticlock	dark green	Cordate	cudspida	cylindrical	Smooth	branched	Upp/h	Absent
	Ebonyi C	Okposi Um	Usuekpe	209	Purplish g	Absent	Few	anticlock	dark green	Cordate	Obtuse	cylindrical	Rough	branched	Upp/h	Absent
	Ebonyi N	Ndiegu Okp	Ogbagharu	137	Dark brown	Absent	No	anticlock	dark green	Ovate	Caudate	cylindrical	Smooth	Slightlyb	Middle	Absent
	Ebonyi S	**Owutu**	**Ipe**	**283**	Purplish g	Absent	No	anticlock	dark green	Ovate	Caudate	cylindrical	Smooth	branched	Tail	Absent
	Ebonyi C	U. Idembia	Jimanu	169	Purplish g	Present	No	anticlock	Light gre.	Cordate	Caudate	cylindrical	Smooth	Slightlyb	middle	Absent
	Ebonyi N	Ndiegu Okp	Igum	134	Purplish g	Absent	No	anticlock	Yellowish	Ovate	Caudate	cylindrical	Smooth	Slightlyb	middle	Absent
	Ebonyi N	Ndiegu Okp	Jimanu	135	Purplish g	Absent	No	anticlock	paleg reen	Ovate	Caudate	cylindrical	Smooth	Slightlyb	middle	Absent

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	Ebonyi N	Ndieze	Amage	156	Brownish g	Absent	No	anticlock	Yellowish	Cordate	Cudspid.	cylindrical	Smooth	Slightly b	middle	Absent
	Ebonyi N	Ndieze	Ozibowire	164	Green	Absent	No	anticlock	Yellowish	Ovate	Caudate	cylindrical	Smooth	Slightly b	Up/h	Few
	Ebonyi S	Oso	Nneonwuka	300	Purplish g	Absent	No	anticlock	dark green	Hastate	Hastate	Spherical/R	Smooth	Slightly b	upp.m	Few
	Ebonyi N	Umuezeaka	Nneonwuka	114	Purplish g	Absent	No	anticlock	Purplish g	S. broad	acumina	cylindrical	Smooth	Slightly b	upp/h	few
	Ebonyi S	Oso	Obiaoturgo	291	Purple	Absent	No	anticlock	Light gre.	Cordate	caudate	Irregular	rough	Slightly b	upp/h	Few
Cluster 5	Ebonyi N.	Amofia	Ogomodu	104	Purplish g	Absent	Few	clockwise	Pale green	C. broad	caudate	irregular	rough	slightly b	upp/h	many
	Ebonyi N.	Ndiabor O.	Amage	121	Purplish g	Absent	Few	anticlock	purple	Cordate	aristate	Cylindrical	rough	branched	middle	many
	Ebonyi C.	Okposi Um.	Okpebe	207	Brownish g	Absent	Absent	anticlock	Yellowish	Ovate	Acute	Cylindrical	rough	branched	middle	many
	Ebonyi S.	Uburu	Igborogidi	240	Purplish g	Absent	Absent	anticlock	dark green	Sag. long	obtuse	Cylindrical	rough	branched	middle	many
	Ebonyi C	Amagu	Nvula	178	Green	Absent	Absent	anticlock	Pale green	Hastate	caudate	oval oblong	smooth	branched	middle	absent
	Ebonyi S	Oso Edda	MbuAmerica	299	Brownish g	Absent	Absent	anticlock	light green	Hastate	cudspida	oval	smooth	slightly b	middle	few
	Ebonyi C	Ndufu Alike	Ewada	218	Purplish g	Absent	Absent	anticlock	Pale green	Cordate	caudate	Cylindrical	smooth	slightly b	middle	few
	Ebonyi S	Oso Edda	Ogboja	292	Purplish g	Absent	Absent	anticlock	dark green	C. long	caudate	Spherical/R	smooth	slightly b	middle	absent
	Ebonyi C	U. Idembia	Edu	177	Green	Absent	Absent	clockwise	Pale green	C.broad	Aristate	irregular	smooth	slightly b	middle	absent
	Ebonyi N	Ndieze	Opoke	165	Green	Absent	Absent	anticlock	Pale green	Cordate	caudate	Cylindrical	rough	slightly b	upp/h	few
	Ebonyi C	Amagu	Opalenkata	180	Purplish g	Absent	Absent	clockwise	Pale green	Sag. long	caudate	oval	smooth	slightly b	tail	few
	Ebonyi N	Amofia	Usuekpe	106	Brownish g	Absent	Few	anticlock	dark green	Ovate	caudate	Cylindrical	smooth	slighty b	middle	absent
	Ebonyi C	U. Idembia	Obiaoturugo	171	Green	Present	Absent	anticlock	Pale green	Cordate	caudate	Cylindrical	smooth	slightly b	middle	few
	Ebonyi	Amagu	Igum	182	Purple	Present	Few	anticlock	purple	Cordate	caudate	Oval oblong	smooth	Slightly b	tail	absent
	Ebonyi N	Ndieze	Jioji	159	Brownish g	Present	Absent	anticlock	Green	Cordate	caudate	Cylindrical	smooth	highly b	middle	absent

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	Ebonyi S	Eweze	Obiaoturugo	249	Green	Absent	Absent	anticlock	darkgreen	Cordate	caudate	Cylindrical	rough	slightly b	tail	absent

Source: Field survey 2016. Ebonyi N.,C., and S= Ebonyi North, Central & South, Ndiegu O=Ndiegu Okpuitmo, Okposi Um=Okposi Umuogharu,Owutu edda= Owutu Edda,U.Idembia=Umunwagu Idembia, Rsut-roots on the surface of the tubers, PoR-position of the roots on the tuber- lowerT= lower third, tuber h=tuber head, corm S.-corm size: intermediat-intermediate, POR- position of branching – 1- upper tuber, 4- upper middle, head and tail region, TubC-tuber colour upper region: brownish w-brownish white, purplish w.-purplish white, TCM-tuber colour middle region-C.white –creamy white and Tclr-tuber colour at lower region:purplish whi.-purplish white

Appendix vi. Continued

Cluster	**Zone**	**Community**	**Access.name**	**Plot Id**	**Thorns**	**Int.**	**Wrinkles**	**Rsut**	**PoR**	**Corm S.**	**Corm type**	**TubC**	**Tcm**	**Tclr**
	EbonyiC	U. Idembia	Oko	172	Present	Few	No	Few	Tuberhead	No corm	None	Yellow	Yellow	Yellow
		Okposium	Oko	206	Present	Few	No	Few	Tuberhead	large	Branched	Yellow	Yellow	Yellow
C4	EbonyiC	Ndufu Alike	Caretyam	211	Present	many	No	Few	Tuberhead	intermediate	branched	deep purple	deep purple	deep purple
	EbonyiS	Owutu	Mbagbirigba	289	Present	many	No	Many	Tail	large	T.elongated	Orange	Orange	Orange
	Ebony C	Ndufu Alike	Edu	223	Present	many	No	Many	Entirebody	No corm	None	Orange	Orange	Orange
	EbonyiS	Owutu	Edu	290	Present	many	No	Many	Entirebody	No corm	None	Creamy white	Brownish w	Brownish w
	EbonyiS	Owutu	Nkweinyi	284	Present	many	No	few	Tail	intermediate	T.elongated	creamy	creamy	Creamy
	EbonyiC	Umogharu	Usuekpe	193	Present	many	No	few	Tuberhead	No corm	None	creamy	creamy	Creamy
	EbonyiC	Okposi Um	Usuekpe	209	Present	many	No	few	Tuberhead	No corm	None	creamy	creamy	creamy
	EbonyiN	Ndiegu Okp	Ogbagharu	137	absent	No	No	few	Tuberhead	Large	Regular	creamy	creamy	creamy
	EbonyiS	Owutu	Ipe	283	Present	many	No	many	Tuberhead	large	T.elongated	creamy white	creamy wh.	creamy wh.
	EbonyiC	U. Idembia	Jimanu	169	Present	Few	Few	few	Tuberhead	No corm	None	creamy	creamy	creamy

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	Ebonyi N	Ndiegu Okp	Igum	134	absent	No	No	few	Tuber head	No corm	None	cream y	cream y	cream y
	Ebonyi N	Ndiegu Okp	Jimanu	135	Present	Few	No	few	Tuber head	No corm	None	cream y	cream y	cream y
	Ebonyi N	Ndieze	Amage	156	absent	No	No	few	Tuber head	No corm	None	cream y	cream y	cream y
	Ebonyi N	Ndieze	Ozibo wire	164	Present	Few	No	few	Tuber head	No corm	None	orang e	orang e	orang e
	Ebonyi S	Oso	Nneonw uka	300	Present	Few	No	few	Tuber head	No corm	None	deep purple	deep purple	deep purple
	Ebonyi N	Umueze aka	Nneonw uka	114	Present	Few	No	many	Tail	No corm	None	cream y white	purpli sh	purpli sh
	Ebonyi S	Oso	Obiaotur go	291	Present	Few	No	few	Tail	No corm	None	deep purple	deep purple	deep purple
Cluster5	Ebonyi N.	Amofia	Ogomod u	104	present	many	few	few	Entire body	small	regular	orang e	Yellow	Yellow
	Ebonyi N.	Ndiabor O.	Amage	121	absent	No	No	few	Tuber head	no corm	none	cream y	purpli sh	Purpli sh wh.
	Ebonyi C.	Okposi Um.	Okpebe	207	absent	No	No	many	Tuber head	small	regular	cream y	cream y	cream y
	Ebonyi S.	Uburu	Igborogi di	240	absent	No	many	few	Tuber head	interme diate	branch ed	Deep purple	cream y	cream y
	Ebonyi C	Amagu	Nvula	178	absent	No	few	few	Tuber head	large	branch ed	Purpli sh white	Purpli sh wh.	Purpli sh wh.
	Ebonyi S	Oso Edda	MbuAm erica	299	absent	No	few	few	Entire body	large	regular	Deep purple	Deep purple	Deep purple
	Ebonyi C	Ndufu Alike	Ewada	218	absent	No	few	few	Tuber head	no corm	none	Deep purple	Deep purple	Deep purple
	Ebonyi S	Oso Edda	Ogboja	292	absent	No	few	few	Entire body	large	branch ed	Deep purple	Deep purple	Deep purple
	Ebonyi C	U. Idembia	Edu	177	absent	No	few	few	Entire	No corm	none	Brownish white	Brownish wh	Brownish wh

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									body					
	Ebonyi N	Ndieze	Opoke	165	absent	No	few	few	Tuber head	No corm	none	Deep purple	Purplish wh.	Purplish wh.
	Ebonyi C	Amagu	Opalenkata	180	absent	No	few	few	Tuber head	No corm	None	Deep purple	Deep purple	Deep purple
	Ebonyi N	Amofia	Usuekpe	106	absent	No	few	few	Tuber head	intermediate	regular	Creamy	creamy	creamy
	Ebonyi C	U. Idembia	Obiaoturugo	171	absent	No	few	few	Tuber head	intermediate	regular	Creamy	creamy	Brownish wh
	Ebonyi	Amagu	Igum	182	absent	No	few	few	Tuber head	intermediate	regular	Deep purple	creamy	Purplish wh.
	Ebonyi N	Ndieze	Jioji	159	absent	No	few	few	Tuber head	No corm	none	purplish	purplish	Purplish wh.
	Ebonyi S	Eweze	Obiaoturugo	249	absent	No	few	few	Tuber head	large	regular	Brownish white	Brownish wh	Brownish wh

Source: Field survey 2016. Ebonyi N.,C., and S= Ebonyi North, Central & South, Ndiegu O=Ndiegu Okpuitmo, Okposi Um=Okposi Umuogharu,Owutu edda= Owutu Edda,U.Idembia=Umunwagu Idembia. leaf colour-purplish g-purplish green, leaf apex shape-saggataiate, TST-tuber surface texture, Ttb-tuber tendency to branch: slightly b - slightly branched, highly b- highly branched, POb - position of branching,4-upper middle/head & tail region,1 -