CONSTRAINTS AND PROSPECTS OF YAM PRODUCTION IN NIGERIA

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ABSTRACT

Yam is the most important food crop in West Africa, except for cereals. Nigeria is the largest world producer of yam with more than 45.004 million metric tonnes annually. Yam contributes more than 200 dietary calories per day for over 60 million people in Nigeria. It is the only crop which is usually celebrated during and after harvest. The production of yam is besets by many problems which include weed pressure, decline in soil fertility, soil borne pests and diseases, storage pests, high labour cost of land preparation and maintenance, staking and barn making among others. Effort so far made to improve yam production include breeding varieties for distribution to farmers, development of` minisett technology for rapid seed yam production, development of alternative propagation materials through vine cutting, research into non-stake yam varieties, development of soil management packages and inputs distribution by the State and Federal Governments of Nigeria.

Keywords: *Dioscorea spp,* yam distribution, Production Trend, Constraints, Prospects.

INTRODUCTION

Yam *(Dioscorea spp) are generally classified under the genus Dioscorea*[2]*, family* Dioscoreaceae, and order Dioscoreales. They are the most important food crops in West Africa, except for cereals (Okonkwo, 1985). Yams are the second most important tuber crop in the whole world after cassava, in terms of production (11TA, 2013).They also form an important food source in other tropical countries including East Africa, the Caribbean, South America, India and South East Asia(Okonkwo,1985). Average yam consumption per capita per day is highest in Benin (364 kcal), followed by Cote d'lvoire (342 kcal), Ghana (296 kcal) and Nigeria (258 kcal) (11TA, 2009). Yam may be barbecued, roasted, fried in oil, grilled, boiled, baked, smoke, pounded into paste (fufu) or grated and made into a dessert. It may be cooked or fried with rice, beans, plantain, sweet potato, lamb, chicken and butter nut as squash soup (Umar *et al.*, 2016). It can be boiled, roasted and eaten with oil, vegetable or sauce (11TA, 2004; Timothy and Bassey, 2009). The tubers may be peeled and sliced into tiny pieces and dried to very low moisture contents and milled into yam flour and flakes (Udoh *et al.*, 2005). The tubers may be peeled and prepared into porridge and cooked with traditional spices and served for the sick and aged as appetizer. Yam prices have been increasing in recent years due to strong demand for the crop in Africa and even in Europe and the United State of America where rapidly growing West African migrants' communities still have big appetite for their traditional preferred staple. Nigeria exported US S27.7 million worth of yam to the United States of America in 2011 (Babatunde, 2012) and it is expected that much foreign exchange through yam trade would be realized in future.

Nigeria is the highest world producer of yam with more than 45.004 million metric tonnes (mmt) annually with Ghana (7.119 mmt), Cote d'lvoire (5.808 mmt), Benin republic

(3.220mmt), Ethopia (1.448mmt), Togo (0.786mmt) and Cameroon (0.579mmt) (FAO, 2014), following that order. Yam contributes more than 200 dietary calories per day for over 60 million people in Nigeria (Nweke *et al*., 1991). In many yam producing areas in Nigeria "yam is food and food is yam". It is the only crop which is usually celebrated during and after harvest, called yam festival (Ugwu, 1996). Yams are also important as sources of pharmaceutical compounds like saponins and sapogenins, which are precursors of cortisone and steroidal hormones (Okonkwo, 1985).The most important species of *Dioscorea* include *Dioscorea rotundata, D. cayenensis, D. dumetorum, D. esculenta, D. Bulbifera, D.* trifida, *D. opposita, D. japonica,* and *D. hispida*. The genus is further divided into 5 sections within which the species are grouped. The section Enantiophyllum comprises the most economically useful species (D. *rotundata, D. alata, D. cayenensis, D, opposite* and *D. Japonica*) and are distinguished by the fact that their vines twine in a clockwise direction. The section, Lasiophyton consists of D. *dumetorum and D. hispida: Opsophyton,* of *D. bulbifera; Combilium,* of *D. esculenta,* and *Macrogynodium, of D. trifida*. All the species in these latter four sections have vines twine anti-clockwise. *Dioscorea rotundata* Poir (common names: white yame; guinea yam) is the most widely grown and eaten yam species in Nigeria and indeed, West Africa, and it is the most important in the whole world. Germplasm collection and breeding work on yams, especially on the all- important *D. rotundata* is going on at the National Root Crops Research Institute, Umudike, and the International Institute of Tropical Agriculture (11TA), Ibadan both in Nigeria and the United States Department of Agriculture (USDA) in Puerto Rico and Universities in Nigeria and throughout West Africa (Okonkwo, 1985).

CHEMICAL COMPOSITION OF YAM

Yam tubers are high in moisture contents between 60 and 85% and dry matter content ranges between 7 and 40%. The observed high moisture content influences the keeping quality of tubers adversely. In terms of protein and fat, yam tubers may not be considered as a very rich food sources. Yam tubers are good energy sources and the energy is derived mainly from carbohydrate since the tubers are low in fats.

Most of the yam species may be considered rich in three minerals, namely: calcium, phosphorus and iron. (Eka, 1985). The vitamin contents of some yam tubers include carotene (pro-vitamin A), thiamine, riboflavin, niacin (nicotinic acid) and ascorbic acid. Whole yam proteins are low in histidine, methionine, leucine, isoleucine, and valine. The limiting amino acids in the yam tubers are the sulphur containing amino acids. Some toxicants of yam tubers include phytic acid, tannins, oxalic acid, hydrocyanic acid, dioscorine, dihydrodioscorine, saponins and sapogenins acid. These toxicants which are present in low amount precipitate upon cooking and are rendered harmless and nutritionally available when yam is cooked with proteinous food substances (Eka, 1985). Fresh tubers, yam tuber have about 70% water, 25% starch, 2% protein and 3% of vitamins and traces of sugar (Showemimo, 2006).

DISTRIBUTION OF YAM IN NIGERIA

Yam is Nigeria's leading root crop, both in terms of land under cultivation and in the volume and value of production (Agboola, 1979). The production of the crop in Nigeria is undertaken in the forest, derived savanna and southern guinea savanna environments. This is explained by its ability to thrive under a variety of environmental conditions owing to differences in the ecological requirements of the various species. Generally, its natural habit is considered to be secondary bush or forest where the canopy has not been disturbed. The branches of trees in

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the forest zone provide the support required by the climbing vine, thereby reducing the cost of procuring stakes. Yam species are well adapted to the savanna conditions and in such cases the yam vines use the stems of taller and bigger grasses as climbing supports (katung *et al., 2006*).

Some of the most important yam producing areas are located in the savanna environment which supports the speculation that the cultivation of yam probably originated there (Agboola, 1979). Yam production is therefore concentrated in the forest and savanna (the derived and southern guinea savanna) environments. The most important area for yam production with over 50% of cultivated land under the crop covers Ikom, Obubra and Ogoja of the Cross River State and Abakaliki in Ebonyi State. The predominance of yams in the yam producing area is due to absence of export tree crops capable of limiting arable crops production, the high proportion of farmers who grow the crop, its position in crop combinations and the social status attached to the crop. There are four other areas where yam production is also important and 30-49% of cultivated land is under the crop. There are Akwa Ibom , Imo and Anambra States and a more limited extent Delta and Edo, more extensive area stretching from Borgu,Oyo,Illorin, Ekiti, Ondo and Kwara; and Benue, and Plateau States covering parts of Igala, Idoma, Tiv,Nasarawa and Lafia. The first two of these are located in areas of high population densities; the remaining two are located in the derived and southern guinea savanna environments and with the exception of part of Tivs (Agboola, 1979).

TREND IN YAM PRODUCTION

Yam presents a greater problem with uncertain data. Estimates of yam production differ by a factor of three among published sources. Prior to the oil boom in the early 1970s agriculture was the backbone of the Nigeria's economy and the country was self sufficient in food. This is illustrated by the performance of yam. According to Degras (2000), yam production increased by about 70 percent from 1960 to 1970 due to an increase in surface area (+44 per cent) and yield (+18 percent). It was observed that the annual output of yam had fluctuated since then reflecting changes in area cultivated and yield. However, output was much higher between 1986 and 1995 while the lowest performance occurred between 1970 and 1983 when the agricultural indices were generally low. In 1997, the estimated world production was about 30 million tonnes (FAO, 1997), in which approximately 90% was produced in the so-called yam belt of west and central Africa. The production trends indicated that world yam production grew at 2.5% per year between 1965 and 1974 and 1.9% per year from 1975 to 1985 (Gebresmeskel and Oyewole 1987).The growth rate of FAO statistics jumped to 10% per year between 1985 and 1990. This was as a result of the combined effort of increases in yield at the rate of 4% per year and increases in area by 6% per year. In West Africa, the corresponding annual growth rate were 5% for the yield and 7% for the area harvested (Manyong *et al.*, 2001). In West Africa, the leading yam producing country Nigeria (75% of world production in 1997) experienced an annual growth rate as high as 6% for the yield and 10% for the area planted for the same period. More than 70% of yam growing areas were found in the savanna (Manyong, 1996). The savanna area are better suited to yam production than the forest zone based on climate, soil, pest and disease considerations (Ugwu et al., 1996). Nigeria produced about 23.3 million tonnes which was 70.7% of the world population in 1997 (FAO, 1997).

Yield in farmers' plots is relatively low compared with other West African countries. The high production of yam in Nigeria is related to area under cultivation; average yield of 9.

55t/ha is obtained in Nigeria, 10.83t/ha in Cote d' Ivoire, 10.94t/ha in Benin and 12.74t/ha in Ghana, Yam growth rate for 2011 stood at 5.4, but reduced to 4.9 in 2012 (CBN, 2012), higher yields however continued, Nigeria produced over 45.004 million metric tonnes in 2014 (FAO, 2014), which is attributed to the combined effort of the National Root Crops Research Institute and IITA, Ibadan

CONSTRAINTS TO YAM PRODUCTION

The major challenges in yam production can be categorized into ten groups: weed pressure, decline in soil fertility, soil borne pests and diseases, leaf disease, storage pests and diseases, labour cost for land (heap) preparation, and barn making and lack of staking materials, use of traditional technology for production of seed yam, scarcity of planting materials (Manyong *et al*., 2011; Nweke *et al*., 1991) as well as consumer preference (Katung *et al*., 2006).

Many farmers retain and use about 25% of the yam harvested as planting material for next crop. Where the number of seed yams required is large, especially when there is expansion in farm size, the proportion as planting materials may be consistently higher (Katung *et al.,* 2006). The cost of planting materials has been shown to represent about 50% of the cost of yam production (Nweke *et al*., 1991). The traditional methods of yam production include double harvesting and cutting large tubers into setts of 150-1000g. The minsett technique using 25-50g setts to produce seed yam has been introduced to farmers but the rate of adoption is generally low (11TA, 1985). Using the vine cutting for seed yam production (Cabanillas and Martins, 1987) may not be practicable at the farmers' level because of rooting problems and extended growing period (Aighewi *et al.,* 2001).

Pests and diseases in both field and storage constitute the most important constraint in yam production; pests especially yam beetles create holes in the tubers and reduced the quality of the tubers and also facilitate fungal infection leading to tuber rots. Attack by nematodes affects the quality of tubers too. Infestations by nematodes in yam producing areas increases due to the shortening of fallow (Manyong and Oyewole, 1997).

It is also estimated that staking could double cost of yam production especially in areas where live stakes or crop stakes are not present in the farm for trailing of the vines. Stakes also deteriorate in value within a year demanding for fresh stakes in subsequent cropping year(s) and this poses a serious stress on the farmer who desires for high yield of the crop (Manyong *et al*., 2001). It is worrisome that this particular farm input is not considered within the confine of government input support. However, this problem could be tackled when the research results on non-stake yam is available which would be released to farmers in Nigeria.

Weeding is also considered as a major challenge to yam in the tropics. This is because weeds easily developed under stake condition because of low canopy cover (Manyong and Oyewole, 2001). The yam varieties in famers' field are no longer the heavy foliage type yet high yielding compared with older varieties and local types and this situation creates favorable condition and open spaces for rapid weed growth. As a result, farmers carry out three weddings before final harvest and this increases the overhead cost of production and reduces profit margins of yam farmers (Manyong and Oyewole, 1997). However, Katung *et al*. (2006) recommends the use of pre- emergence herbicides such as primextra at 3kg ai per hectare or fluometuron +metolachor at 2-3+2-3kg ai per hectare for effective weed control in addition to occasional weeding.

PROSPECTS OF YAM PRODUCTION

There are many strategies of solving the major constraints to yam production and sufficiency in Nigeria. It involves a complex interaction of agronomic, genetic, technology consumer preferences in the choice of species/cultivars and socio-economic considerations (Manyong *et al.,* 2001). The National Root Crop Research Institute (NRCRI), Umudike, Nigeria has the genetic mandate on yam. Collaborative evaluation of 11TA derived breeding lines with the National Root Crops Research Institute, Umudike and the Crops Research Institute Ghana has resulted in the release of ten varieties of *Dioscorea rotundata* during the 2001-2009 research project in Nigeria, and one in 2007 in Ghana. More lines have been released for multi-locational evaluation by Root Crop Research Institutes in Nigeria, Ghana, Benin republic, Cote d'lvoire, Sierria Leone, Togo and Liberia, with multiple pest and disease resistance, wide adaptability and good organoleptic attributes (NACGRAB, 2004). Attention has also been given to improved management practices, soil fertility management and development of improved production packages and development of simple and effective storage techniques (Katung *et al.,* 2006). In the year 2008, four more new hybrid yam varieties were released in Nigeria. These were made up of three water yam (*Dioscorea alata)* varieties and one white yam (*Dioscorea rotundata*) variety (Nwachukwu, 2009). The National Root Crops Research Institute, Umudike employs a cyclic selection system which involves several stages of selection and re-selection vis-à-vis national and local checks. These stages spanning over nine years include hybrid botanic seed production (crossing), seeding evaluation, cloned evaluation, preliminary yield trial uniform yield trial and the pre-release trial. Similarly, the trail of 24 top yielding hybrid yam lines in Umudike and Utobi, resulted in the nomination of five yam lines (99/AMO/110, AMO/189,99/AMO/115, 99/SMO/MAX and OO/ AMO/191 for National Coordinated Research Project (NCRP) multi-locational trials based on their total fresh tuber yield rank sums (Nwachukwu., 2009).The National Root Crops Research Institute, Umudike has not lost focus in the pursuit of its official mandate. Aggressive efforts towards the realization of the highest yield possible have been intensified.Some of the measures for improvement in yam production include:

Yam Minisett Technology

The yam minisett technologies were developed by the National Root Crops Research Institute, Umudike several decades ago to address the problem of high cost and scarcity of seed yam (Okolie *et al.,* 1982). Yam minisett is a section from a clean, healthy yam tuber weighing approximately 25g or less, about 15 to 25 setts can be obtained from an average seed yam (Enwezor et al., 1989). A tuber of 20cm long can give about 5-6 disc, which gives 20 to 24 minisetts (Otoo et al., 2001). The minisett technique could increase yam production due to ready availability of planting materials at affordable cost and high multiplication ratio (Ezulike et al., 2006) and this technique could encourage many farmers to go back to yam production (Ekpe *et al.,* 2005), thereby increasing total yam output. Minisett technique using 25 to 50 setts to produce seed yams has been introduced to farmers (11TA, 1985) and the result is good.

Reports by Ogbodu (1995) and Anuebunwa et al. (1998) showed that adoption rate of the technology was still below 40% and that farmers showed only partial adoption. Among the reasons advanced by farmers for the poor adoption is that the size of the minisetts (25g) is too small and that the technology was developed under monoculture, while most farmers in the humid tropics practice inter cropping (Ikeogu and Ogbonna, 2009). The yam minisett technique has been modified and recommendations makes more elastic such that farmers who wish to produce seed yams of 500g and above could use minisett of 35g-45g (Ikeogu *et al*., 2000).Now, farmers are provided mini tubers (Ikeogu and Ogboma,2009) for planting according to their production objectives, thereby eliminating the fears that the minisett would delay the production cycle.

Propagation by Vine Cutting

Progress has been recorded with vine cutting technique (Mazza *et al*., 2009). Sett production through yam vine cuttings increases the multiplication of clones beyond levels possible through conventional use of tuber sett (Wilson, 1978), and a lot of tubers need not be reserved for planting purposes (Akoroda and Okonmah., 1982). However, when the this trial is fully established would result in the production of mini tubers for farmers thereby reducing the problems of scarcity and high cost of both planting materials and yam tubers; Nyoku (1963) drew attention to the possibility of raising plant of *D.alata, D. rotundata and D. dumetorum* through vine cutting, as an alternative to propagation by tuber. It was demonstrated that cuttings of the vine excluding a node never rooted, even after being treated with rooting substances. A cutting normally involves a node made in such a way that about 2.5cm of vine tissue is left attached below and above the node, with the leaf intact. Okonkwo *et al.* (1973) showed that nodal cuttings from old plants (10 weeks and above) of *D.bulbifera* regenerated and formed tubers and roots only, but no shoots, whereas cuttings from younger plant (5 weeks or less) produced roots, tubers and shoot). Increase in number of nodes leads to increase in the growth of the resulting root, tuber and shoot. Using single-node cuttings, procedure has been developed for the propagation of virus-free tested clones of yam. A two step propagation developed for yam involves, placing single-node cuttings in a liquid culture medium for 1 month to induce multiple shoot formation, followed by sub culturing the node cuttings in solid media for distribution. Virus-tested clonal materials are micro propagated and distributed on request to national programmes as plantlets and microtubers of yam (Ng, 1992).

Development of non-Stake Yam Genotypes

Recently, the National Root Crops Research Institute, Umudke in collaboration with other research institutes has directed attention and research to the development of non-stake yam. Staking has been considered to increase cost of yam production. Vegetation is now constantly removed which may result in lack of staking materials (Manyong *et al.*, 2001) or insufficiency and high cost of staking materials. It also requires transportation of stakes from far distances or locations to the farm and this too reduces the profit margins of farmers engaged in yam production. Staking is also time consuming and labour intensive (Tomothy and Bassey, 2009) which in turn impinges on the profit which the farmers would have realized. For these reasons, Manyong *et l,*.(2001) and Nweke *et al* (1991) consider yam production as a non-profitable business. Therefore, yams have been considered mainly as "man crop". Breeding and selection of yam for non-staking potentials by the NRCRI, Umudike would be another milestone in the development of farmers friendly technology and could encourage more farmers to go back to yam production (Timothy and Bassey, 2009), thereby increasing total tuber yield.

Advances in Soil Management

Several programmes of soil management for yam production have been developed and introduced to farmer. Soil fertility is probably the most crucial factor in the cultivation of yams in Nigeria. Attention has already been drawn to the relationship between soil fertility and the duration of bush and grass fallow (Agboola,1979).Awareness has been created on the role of organic manure on yield of yam (Eze *et al.*, 20016) and the adoption of this practice is high for homestead farms. Due to loss of agricultural land to national disaster and contemporary man's infrastructural advancement, there is no enough fertile land for producing the amount of yam that would be sufficient to feed the ever growing human population relying on bush fallow practices to restore soil fertility, loss of site productivity on account of bush burning, intense cropping often without nutrient supplementation, over grazing and soil erosion are important factors that affect yam productivity in Nigeria. Integrated plant nutrition, integrated nutrient supply or integrated nutrient management system is a recent development advocated by the Food and Agriculture organization (FOA). It is the combination of organic and inorganic fertilizer, coupled with soil conservation farming system in the supply of nutrients to crops. Researches conducted on effectiveness of organic mineral fertilizer result in higher crop yield compared with recommended NPK fertilizer alone (Eya, 2016), efforts in this direction will build up soil productivity and quality on long term basis (Adeniyam and Ojeniyi, 2005). Compared with chemical fertilizers integrated plant nutrition ensures longer residual effect and overall development of soil physical, chemical and biological qualities (Ayeni *et al.*, 2009) (Nyoku *et al*., 2016).

Agricultural Policy and Institutional Support

The Federal Government of Nigeria has continued with the implementation of the Agricultural transformation Action Plan (ATAP). Under the Growth Enhancement Support Scheme (GESS) designed to give farmers timely access to agricultural inputs, 17 major fertilizer suppliers were selected to supply the commodity to about 2,500 agro-dealers across the country. In addition, a national farmers' census was carried out in 2012 to create a reliable database for effective input distribution under the scheme (CBN, 2012). It is expected that yam farmers in Nigeria through the All Farmers Association of Nigeria (AFAN) will key into this noble plan of the Federal Government of Nigeria by demanding for seed yams for farmers as it is the case for maize, cotton, rice cassava, cocoa and palm nuts.

CONCLUSION

Many problems beset yam production in Nigeria, ranging from weed pressure, decline in soil fertility, soil borne pests and diseases, leaf and shoot diseases, storage pests, high labour cost for land preparation and maintenance, staking, harvesting, barn construction and tuber quality deterioration. The contributions of the National Root Crops Research Institute, Umudike to yam improvement is highly commendable. However, the tasks before it and collaborating crop research institutes, and crop breeders are the development of alternative planting materials which do not compete with human food, non-stake yam varieties, weed tolerant, pest and disease resistant and highly adaptable yam genotypes/varieties for Nigerian farmers. The need for the adoption of molecular techniques in addition to the conventional breeding techniques cannot be over emphasized. The Federal and State governments should consider yam under the growth enhancement support scheme by providing highly subsidized seed yams to farmers. There is a dire need for proper funding of the National Root Crops Research Institute, Umudike to enable it deliver on its mandate before the year 2025.

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