Yam Germplasm In Ghana – A Survey On Storage And Varietal Properties Of Dioscorea Rotundata–Alata In Northern Region Of Ghana

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Abstract:- As part of research towards building a data base for the study of yam germplasm in Ghana, a baseline study was carried out to ascertain the storage properties and challenges faced in the protection of yam biodiversity. The survey was conducted in six districts of the Northern region of Ghana which are the major yam production areas. Questionnaires were administered to yam farmers and sellers in each of these districts to elucidate information on harvesting, and storability of available yam varieties. Forty-six (46) varieties were encountered. The yams were largely characterised as short storage and long storage types. Short storage varieties were early sprouting, early maturing, and prone to yam rot. They include *lariboko*, *kpuna*, *yiri*, *kulunku*, *sangaguo* and *gunguma*. Long shelf life varieties were late sprouting, late in maturing, and more resistant to rot. They include *olondo*, *mpuano*, *akaaba*, *kparinjo*, *limo*, *fugura* and *kparinsi*. Varieties noted to be nearing extinction were *kinima*, *nimo*, *kunkuma*, *pupu*, *chamba* and *sung*. Some of the factors contributing to their nearing extinction or being limited in cultivation included unavailability of setts, poor yield, and low market value.

Index Terms:- Dioscorea, germplasm, storage, variety, yam

1 INTRODUCTION

Yam (*Dioscorea* spp. L) is a vegetatively propagated tuber food crop. It is a polyploidy that belongs to the family *Dioscoreaceae* and is classified among monocotyledonous herbaceous annual or perennial climbing or trilling crop plants. The crop produces underground tubers and or aerial tubers, bulbils and rhizomes which act as a source of food, feed and drugs or medicines. Yam is cultivated in Africa, Asia, Australia, the Caribbean, India, and in South Pacific (IITA, 2010). Out of the over 600 species of the genus *Dioscorea,* six (6) are cultivated for food in the tropics (Hahn *et al*, 1987). The six (6) edible yam species are *Dioscorea alata* (water yam), *Dioscorea rotundata* (white guinea yam), *Dioscorea esculanta* (Chinese or lesser yam), *Dioscorea cayenensis* (yellow guinea yam), *Dioscorea bulbifera* (aerial or bulbils yam)and *Dioscorea dumetorum* (trifoliate or bitter yam) (Purseglove, 1972; Degras L. 1993). In Ghana, majority of the cultivated yams are cultivars of *D. rotundata* and *D. alata*. Even though yam is cultivated all over the country, a larger proportion is produced in Northern and Brong-Ahafo regions. The Northern region alone produced 1,337,701 metric tonnes of yam for the 2009 season (SRID, MOFA Dec 2009), which is the highest field crop followed by groundnuts and maize. Other areas of production include Upper West, Volta, Eastern (Afram plains) and Ashanti regions. From these production areas, yam is exported all over the country and abroad (Tetteh and Saakwa, 1991). Biodiversity loss of some potentially important yam species and varieties has been a general problem among farmers as a result of commercial cultivation of a few varieties in response to market demands. Breeding and selection of yam varieties with novel characteristics under the current circumstances suffers from the fact that traditional cultivars have not been adequately characterized. This makes reference to varieties ambiguous, unreliable and impossible to determine the true variation in yams. This seriously affects reliable identification of cultivars for germplasm improvement and subsequent preservation. It is against this background that the research was conducted in different locations of northern Ghana to identify the storability of yam varieties, and to determine reasons for the loss of biodiversity.

2.0 MATERIALS AND METHODS

2.1 Study Area

The study covered six (6) districts in the Northern Region of Ghana namely; East Gonja, West Gonja, Central Gonja, Nanumba North, Gushegu and Kpandai districts. The region is located at an altitude 183 m above sea level and has mean monthly minimum temperature of 23.4^0C and mean monthly maximum temperature of 35.5^0C. It is characterised by a unimodal rainfall occurring between May – September with mean annual rainfall being 1050 mm. The minimum and maximum relative humidity are 46.6% and 76.8% respectively.

2.2 Data Collection

Purposive sampling technique was adopted for selecting the districts based on the Ministry of Food and Agriculture annual production figures from 2003-2009 (SRID, MOFA December, 2009), which indicated that these were the major yam producing areas in Ghana. Data was collected through personal interviews of yam farmers, yam sellers and farm field visits using structured and semi-structured questionnaires. The semi-structured questionnaires were included to enable full consideration of the open-ended questions such as how farmers evaluate and identify the different cultivars. The number of varieties in each farm was recorded on-farm, where each farmer was asked to distinguish, name and describe the different varieties he/she was growing or selling. This was then accompanied by recording of the selected morphological characters. The methods that were used in measuring genetic variability were farmer's perceptions and folk (ethno-botany) classification, and morphological characterisation (Hoogendijk & Williams, 2001). Farmers and sellers were interviewed randomly following their selection from communities and district capital markets. In all, a total of one hundred and twenty (120) respondents comprising of ninety (90) yam farmers and thirty (30) yam sellers were interviewed at their farms, homes, and markets.

2. 3 Data Analysis
The data generated was subjected to descriptive analysis using Statistical Package for Social Sciences (SPSS) version 16 and Microsoft Office Excel 2007.

3.0 RESULTS
3.1 Gender and Age Distribution, Occupation, and Ethnicity of Respondents
The results showed 78.3 % of the respondents were males and 21.7 % females. Age wise, 72.5 % of the respondents were between the ages 31-50 years. The research indicated that 76.7 % engaged in both farming and selling of their own yams. The remaining 13.3 % either farmed or were involved in only selling the yams. It was realised that to some extent some yam varieties and their naming are characteristic of some localities and groups of people. The ethnic groups encountered in this survey were Bimobas, Chechosis, Chumburus, Dagarbas, Dagombas, Gonjas, Grunshis and Konkombas.

3.2 Reasons for Choice of Yam Variety Cultivated
The reasons and frequency for which the choice for yam varieties cultivated are shown in Figure 1. The highest reason for choice was high income (43 %).

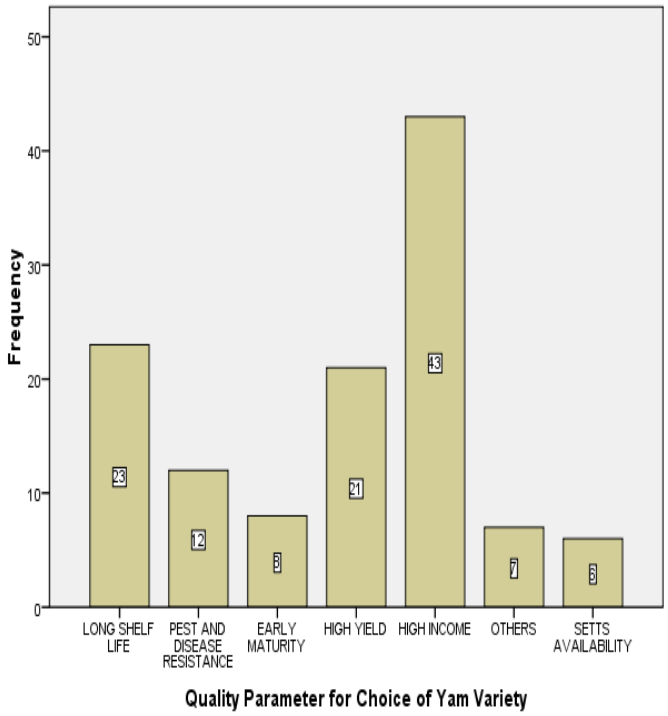

Figure 1: Reasons for Choice of Yam Variety Cultivated

3.3 Challenges to Cultivation/Sale of Yam Varieties
The respondents indicated that they faced challenges in the cultivation and sales of some yam varieties as shown in Table 1. Among the challenges, yam rot (30%), poor soil fertility (29.2%) and high manual labour demand (13.3%) recorded the high frequencies/percentages.

Table 1: Challenges to choice of variety cultivated

Challenge mentioned	*Frequency*	*Percent (%)*	*Cumulative Percent*
Tuber Size	8	6.7	6.7
Prone to Rot	36	30.0	36.7
Labour intensive	16	13.3	50.0
Poor Soil Fertility	35	29.2	79.2
Pest and Insects	11	9.2	88.3
Climate	4	3.3	91.7
Others	10	8.3	100.0
Total	**120**	**100.0**	

3.4 Time of Harvest
The varietal type served as a main determining factor as to whether it is early or late maturing. As to the early maturing varieties, 62% of respondents affirmed to harvesting in August, after which the late maturing follows from October to as late as February.

3.5 Milkable Varieties
The study realised that some varieties can be harvested twice while others can only be harvested once. The second harvest was for seed-sets. This depended on the time of maturity, duration of rainfall and the variety of yam involved. Yam varieties that can be milked are shown in Figure 2. *Lariboko* and *kpuna* recorded 36% and 35% respectively as the most milkable varieties though some farmers maintained their view that all yam varieties could be milked.

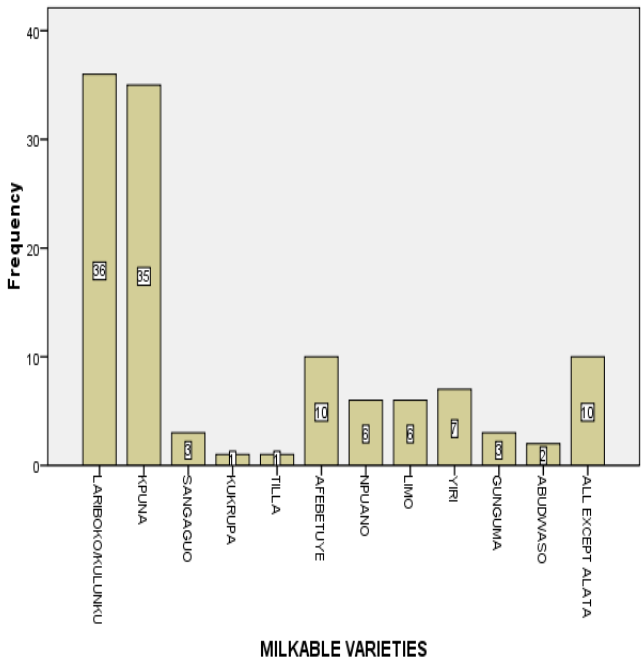

Figure 2: Yam Varieties that are milked.

3.6 Milking Time

Sixty percent (60%) of respondents indicated that yam milking is usually done in August of the growing season with 27.5% affirming to a milking time of July.

3.7 Yam Varieties and Shelf-Life

Forty-six percent (46%) of respondents indicated *afebetuye* as the variety with the longest shelf life, followed by *kparinjo*, *akaaba* and *limo* (Figure 3). A few farmers (11%) indicated that all yam varieties are capable of being stored for as long as a year depending on the efficiency of the storage method.

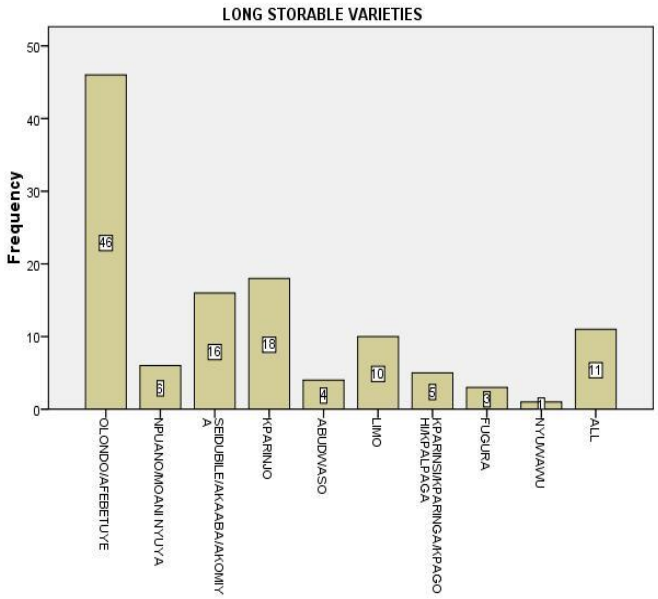

Figure 3: Yam varieties with long shelf-life

In terms of yams that stored poorly, respondents mentioned varieties such as *lariboko*, *kpuna* and *yiri*as being the main. In addition, *kulunku*, *sangaguo* and *shanti* were also mentioned for their inability to store for long (Table 2). Some respondents (10%) did not indicate any yam variety as having a short shelf-life.

Table 2: Yam Varieties that store poorly

Variety	*Frequency*	*Percent*	*Cumulative Percent*
Lariboko	46	38.3	38.3
Kpuna/Puna	39	32.5	70.8
Yiri	16	13.3	84.1
Shanti	2	1.7	85.8
Kulunku/Okulunku	3	2.5	88.3
Sangaguo	2	1.7	90.0
None	12	10.0	100.0
Total	**120**	**100**	

3.8 Sprouting of Yam Varieties

Under storage, both farmers and sellers listed *lariboko,kpuna* and *kparinjo* as the most easily sprouted varieties at a frequency of 28.3%, 25.0% and 10.0% respectively (Table 3). About 21.7% of the respondents also indicated all varieties could sprout easily when harvested early, stored with heads facing the ground and with good ventilation.

Table 3: Easy to Sprout Varieties under storage

Variety	*Frequency*	*Percent*	*Cumulative Percent*
Lariboko	34	28.3	28.3
Kpuna/Puna	30	25.0	53.3
Kparinjo	12	10.0	63.3
Kulunku	2	1.7	65.0
Nawawu/Fugura	8	6.7	71.7
Sangaguo/Kukrupa	4	3.3	75.0
Yiri	4	3.3	78.3
All	26	21.7	100.0
Total	**120**	**100.0**	

On the other hand, under the same storage conditions, respondents indicated that*olodo/olando/afebetuye* variety is the slowest to sprout. Indeed, its local name '*afebetuye*' implying it will survive a year is indicative with its sprouting and storage abilities. In addition, *akaaba*, *kparinjo*, *fugura*, *kpalpaga*, *kparinsi*, *kparinjo* and *limo* are equally late sprouting (Table 4).

Table 4: Late sprouting varieties under storage

Variety	*Frequency*	*Percent*	*Cumulative Percent*
Olodo/Olando	49	40.8	40.8
Bayere	3	2.5	43.3
Npuano	5	4.2	47.5
Akaaba/Seidubile	23	19.2	66.7
Kparinjo	17	14.2	80.8
Limo	6	5.0	85.8
Fugura/Kpalpaga/ Kparinsi/Kparinga	11	9.2	95.0
All Varieties Have Same Time	6	5.0	100.0
Total	**120**	**100**	

3.9 Easily Sproutable Varieties after Planting

The emergence of shoots after planting is not dependent on whether a species is early or late maturing. It was realised that though l*ariboko* and *kpuna* are the most easily sprouted varieties in storage, *matches/seidubile, kparinga, yiri* and others sometimes over takes them in shoot emergence after planting.

3.10 Disease Prone Varieties

In terms of disease and pest prone varieties *lariboko*, *kpuna* and *yiri* are highly affected at frequencies of 41%, 36% and 14% respectively (Figure 4).

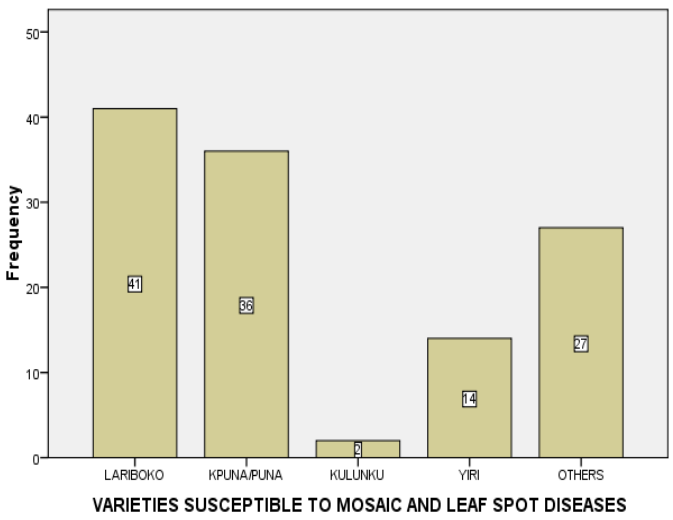

Figure 4: Varieties Prone to Mosaic and Leaf spot

3.11 Varieties Resistant to Mosaic and leaf spot

The resistance of yam varieties to pest and diseases as in Table 5, 30.8 % the respondents mentioned that *afebetuye* is the yam variety with highest resistance to pest and diseases by followed by *nawawu*, *akaaba* and *kparinjo* while 24.2% of respondents chose others following their little knowledge on pest and disease resistance by yam types on their fields.

Table 5 Resistance of Varieties Mosaic and Leaf spot

Variety	*Frequency*	*Percent*	*Cumulative Percent*
Olodo/Afebetuye	37	30.8	30.8
Kparinjo	11	9.2	40.0
Mpuano/Moani	8	6.7	46.7
Matches/Akaaba	13	10.8	57.5
Nawawu/Kparinsi	16	13.3	70.8
Abudwaso/Kukrupa	6	5.0	75.8
Others	29	24.2	100
Total	**120**	**100**	

3.12 Yam Tuber Rot

People engaged in yam business are mostly challenged by yam tuber rot especcially in storage. Results recorded showed *kpuna* and *lariboko* to have 46% and 43% rottage respectively indicating a high degree of susceptiblity to yam rot. *Yiri*, *sangaguo* and *gunguma* also easily got rotten.

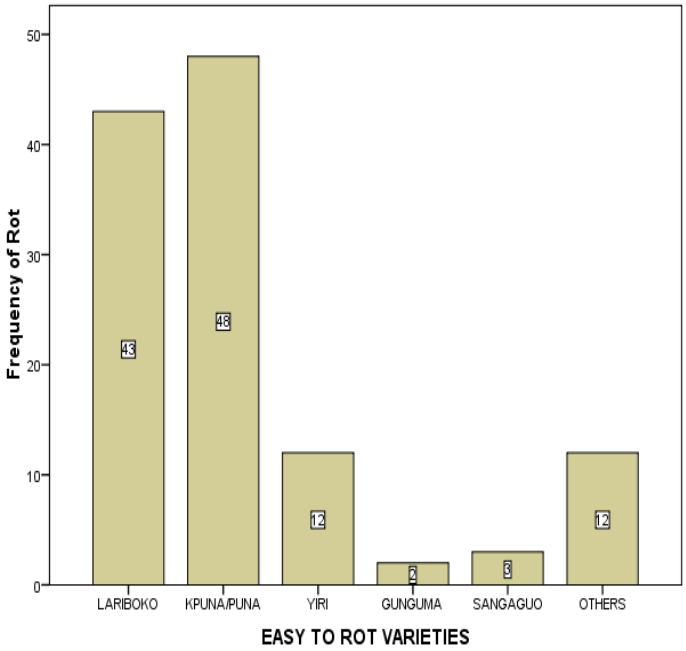

Figure 5: Varieties Susceptible to Yam Rot Fungus

4.0 DISCUSSION

Several yam varieties of *Dioscorea rotundata* and *Dioscorea alata* were encountered which belongs to the genus Dioscorea. This affirms the findings of Tetteh and Sackwa (1991) who stated that, majority of yams cultivated in Ghana are cultivars of *D. rotundata* (white yam) and *D. alata* (water yam). They include *lariboko, kpuna, olando, akaaba, mpuano, kparinjo, akomiya, matches, tilla, yiri, baafou, abudwaso, bayere, kulunku, nyuwawu* and *dagba* among others. Out of these *akaaba, akomiya*, and *matches* are *D. alata* varieties. The commonest varieties grown in the area are *lariboko*, *kpuna*, *nigeria*, *akaaba* and *mpuano*. The choice of variety by farmers and sellers were based on factors such as higher income earning, long shelf life, high yielding, pest and disease resistance, early maturing and yam setts availability among others. Though farmers claimed *laribokohas* a small tuber size, low yielding and stores poorly, they still prefer to grow *lariboko* because of its high marketability and early maturity. Early maturing varieties like *lariboko*, *kpuna*, *yiri* and *kulunku* help to fill the hunger gap when other yams are not in season. However, *nigeria*, *kparinjo* and *mpuano* stores long, for this reason more of them were found in storage during the time of the study as compared to the early maturing varieties. Yam tuber rot was considered by both farmers and sellers as the most encountered challenge in yam storage which reduces the market value of yams. Other challenges include pest and diseases, high manual labour demand, small tuberization and unavailability of setts. This confirms the findings of Gbedole, (1980) who reported pest and diseases among others as problems confronting farmers in West Africa. Inadequate yam planting materials is a serious constraint to yam production across the districts. Also, the cultural practice that was mentioned by farmers is staking with a 43.7%. Most especially *lariboko*, *kpuna*, *yiri* and *kulunku* would give good yield when staked. Farmers considered unavailability of setts, poor yield and low market value as the factors accounting for the

unavailability of these varieties. Varietal diversity is influenced by each farmer's decision, which in turn is dependent on the varied use of each variety.

CONCLUSION

The results indicated that, varieties that could store for a short period were easy to rot, easy to milk and were the early maturing varieties. Some of them include *lariboko*, *kpuna*, *yiri*, *gunguma*, *kulunku* and *sangaguo*. While long store varieties were difficult to rot, difficult to milk and are late maturing in nature. These include *olondo*, *mpuano*, *akaaba*, *kparinjo*, *limo*, *fugura* and *kparinsi*.

RECOMMENDATION

It is recommended that, further research should be conducted on varietal characterisation using biochemical and molecular characterisation. There is a need to conserve varieties in gene banks to avoid loss of certain varieties. Research should be conducted on increasing the tuber yield and size of *lariboko* and increasing varietal resistance to yam rot. Information and research on yam identification should be made readily available to farmers, sellers and consumers to ease the compounding problem of varietal identification.

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