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Yield and Nutritive Attributes Are Not Considered by Farmers in Choice of Sweet Potato Varieties Grown in East Kamagak Location – Homabay County-Kenya

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Abstract:

Sweet potato is one of the most important crops for food security and income generation in Kenya. The crop is increasing in importance as adverse climate changes limit crop production in many areas. Understanding the genetic diversity of germplasm of crop species is of importance for its rational management and use. Identification of the sweet potato landraces is paramount in addressing food security not only in the study region but elsewhere in the country. Morphological characterization of the accessions facilitates the identification of duplicates and unique traits which is important in the future improvement of the crop having the desired characteristics. The study aimed at identifying the factors that farmers consider in selecting the sweet potato variety to plant in East Kamagak location of Rachuonyo District, Homabay County. The experiment started with survey and germplasm collection aided by use of questionnaire. The accessions were used for morphological characterization, The results showed that 30% Of the farmers selected sweet potato to plant based on taste compared to 24% farmers who preferred high yielding varieties. Rachar, Nyathi odiewo and Nyakowino which are local landraces showed high yield. Similarly Nyakowino which is a landrace is rich in beta carotene besides being high yielding. Thus, it is recommended to be grown in large quantities since it is important in controlling malnutrition in children.

Keywords: Survey, Yield, characterization

1. Introduction

Sweet potato, *Ipomea batatas* (L) Lam is the world's seventh most important food crop after wheat, rice, maize, potato, barley and cassava (FAO,1992). More than 95% of the production is in the developing countries, with approximately an important subsistence food crop as well as cash crop in East Kamagak location and is also very popular in the major cities in the country such as Nairobi. Sweet potato also does well with little agronomical management practices and provide's household food security because it stores well in the soil as a famine reserve crop (Mukasa, et al. 2003).

Persistent drought occasioned by climate change has reduced maize, sorghum and cassava production in recent years, posing a serious threat to food security in the region. To effectively confront this challenge strategies have been proposed based on enterprise diversification to include production of crops that tolerate drought better. (Gakonyo 1993). Similarly, nutritionists in several developing countries have assembled compelling evidence that many children (especially young ones) and adults lack adequate essential vitamins and minerals in their diets (United Nations, 1997). Deficiency in vitamin A is one of the most prevalent problems, particularly in Sub-Saharan Africa and South Asia. The functional consequences of vitamin A deficiency are dramatic: "Severe Vitamin A deficiency has very high fatality rates (60%) but even sub-clinical deficiency is associated with a 23% increase in preschooler mortality in areas with endemic vitamin A deficiency" (McGuire, 1993). Sweet potato is an important food crop as well as a cash crop in East Kamagak location

2. Literature Review

Besides simple starches, sweet potatoes are rich in complex carbohydrates, dietary fiber, beta-carotene (a provitamin A carotenoid), vitamin C, vitamin B₆, manganese and potassium. Pink, yellow and green varieties are also high in beta-carotene (Hagenimana and Low, 2000). In 1992, the Center for Science in the Public Interest compared the nutritional value of sweet potatoes to other vegetables. Considering fiber content, complex carbohydrates, protein, vitamins A and C, iron, and calcium, the sweet potato ranked highest in nutritional value. According to these criteria, sweet potatoes earned 184 points, 100 points over the next on the list, the common potato. Sweet potato varieties with dark orange flesh have more beta carotene than those with light-colored flesh, and their increased cultivation is being encouraged in Africa, where vitamin A deficiency is a serious health problem. A 2012 study of 10,000 households in Uganda found that 50% of children who ate normal sweet potatoes suffered from vitamin A deficiency compared with only 10% of those on the high beta carotene variety (FAO 1992). Many land races in Kenya may be distinguished using those characteristics. The crop grows well in poor soils with little fertilizer and the rapidly growing vines suppresses weeds such as gallant soldier. Thus little weeding is required, which reduces costs and contributes to soil conservation and fertility. In Kenya the crop is stored in the ground, harvested piecemeal and boiled or sometimes roasted. Sweet potato especially the pink and yellow flesh varieties are rich in vitamin A and are a good source of potassium, vitamin C, B₆, riboflavin, copper, pantothenic acid and folic acid (Hagenimana and Low, 2000). Sweet potato recipes are numerous and include pies, cakes, fries, baked and boiled sweet potato and their sweetness makes them versatile.

Sweet potato is an important food crop for many Kenyans whose staple diet is based on cereals particularly maize (Gakonyo, 1993). Mutuura (1992) established that sweet potato is an important food crop in years of drought. In 1996, area under sweet potato in Kenya was 65,000 hectares with yield of 10 tons per hectare, which was less than the global average of 15 tons per hectare. It yields more calories and proteins per area compared to maize and cassava. Average per capita consumption is 24 kg per year. Gakonyo (1993) identified bulkiness, perishability, high cost per unit sold as well as low consumer acceptability as constraints to the exploitation of sweet potato for food security and income in Kenya. To lower the price of sweet potato there is need to train on better production technologies and supply planting material of high yielding varieties and to improve consumer acceptability there is need for increasing the available recipes since ordinarily boiled sweet potato is the most widespread recipe in Kenya.

3. Materials and Methods

3.1. Study Site

The study was conducted in Rachuonyo District of Homabay County Kenya. The district has a population of 300,000 persons and an area of 507km². The district lies at Latitude 0° 26' 24" (0.44°) south and longitude 34° 44' 20.4" (34.739°) east with average elevation of 1,378 meters (4,521 feet) above sea level (Rachuonyo district-Kenya mapcarta). The temperatures ranges between 14°C and 25°C. The district has two main rainy seasons; the long rains which start from late february and runs through June with rainfall ranging between 500mm and 1000mm and the short rain season which occurs between the months of August and November with rainfall ranging between 250mm and 700mm (Rachuonyo district-Kenya mapcarta).

The main trading center is Oyugis and the study site that is Sino Sub-Location lies 5 km and Kachieng' Sub-Location 6 km southeast. Others are Kajiei Sub-Location 6 km north, Kasipul Location 7 km south and Karabondi Sub-Location 9 km north. The soil from Sino is of medium acidic at a pH of 5.8 while soil from Kachieng is extremely acidic at a pH of 4.5. Sino soil is rich in organic matter at 2.26% while Kachieng is 1.97%. Soil from both sites is adequate in phosphorus concentration at 88 and 98mg/kg, respectively (Soil test results from KARI Njoro, 2011)

3.2. Survey and Germplasm Collection.

Rachuonyo District which comprises two divisions and seven locations was purposively selected for reasons of being the major sweet potato growing divisions yet they exhibit variations in some agroecological conditions for sweet potato production. The district has a total population of 3000,000 persons (Kenya population census 2009). The other population details are summarized in the table below:-

Location	Male	Female	Total population	Total Households
Sino	32%	68%	7235	520
Kachieng	34%	66%	5071	482

Table 1: Population distribution in per location, Source MOPHS (2010)

3.2.1. Sampling Strategy

Multistage sampling procedure was used to select the 100 households who participated in the study. In the first stage, Rachuonyo district was purposively selected and secondly, the two locations were selected by simple random sampling.

3.2.2. Research Instrument for Primary Data- Questionnaires

Questionnaires were used as instruments of data collection. A questionnaire was used because according Kothari (2004), it is free from bias of the interviewer, is appropriate in obtaining in-depth responses, is economical in terms of time and money and appropriate in analyzing the feelings, interests and motivations of the respondents.

The respondents to the questionnaires were members of selected households in the two locations of Rachuonyo district, Homabay county. The questionnaire had structured (closed ended) questions and unstructured (open ended) questions. According to Babbie (1995) the closed ended questionnaires design, seem to be the best method available for collecting original data, to describe a population too large to be observed directly. This is because structured questions are easier to analyze since they are in an immediate usable form. They are also easier to administer because each item is followed by alternative answer. They are economical to use in terms of time and money. In addition, it promotes detailed responses where the respondents are able to give reliable information. The questionnaire was divided into two sections. The first section consisted of background information which included gender, age, education status and employment status for demographic analysis.

This study also utilized open-ended (unstructured) questionnaires. The open ended questions were prompt spontaneity. As explained by Babbie (1995) an open ended or unstructured questionnaire is utilized when the researcher wants the responded to freely discuss issues without limiting the scope.

The germplasm collected is used for; morphological characterization; molecular characterization and yield trials. Land races were identified using the morphological descriptors as per CIP (1999).

4. Results and Discussion

4.1. Survey and Germplasm Collection

The survey conducted in East Kamagak location aided by the use a questionnaire yielded the following results;

Out of the 100 farmers interviewed 90 responded which translate to 90% reported to be planting local landraces namely; Nyakowino, Abiro Nenywol, Rachar, Nyathi odiewo, Kuny kibujonjo and Amina. This formed the basis of putting the said varieties under yield trials along side commercial varieties released by KARI namely; KSP20, KSP004, KSP013, Zapallo, Mugande and Nyawo. Among other variables put forward in the questionnaire 90% of the respondents indicated that they obtained planting material from their own farms while 10% of the responded indicated that they obtained their planting material from neighbor's farm. None of the farmers obtain their planting materials from research stations. This result is similar to finding from Abidin (2004) which pointed out that by the time of the official release, the two cultivars were spreading quickly through farmer-to-farmer exchange or purchase of planting materials and promotions. Tairo et al. (2008) also found out that the cultivation is largely depended on locally available materials that are reserved in home gardens as source of planting materials for the next season. Thus farmers are keeping or sharing landraces that are similar but under different names due to poor record keeping.

The number of women growing sweet potato and other food crops for home consumption was 71%, and again sweet potato is mostly grown for subsistence and not for commercial purposes.

This finding is consistent with findings of Tairo et al. (2008) that cultivation of sweet potato is mostly for subsistence. Also the findings of GOK (2004) indicate that more women than men in Rachuonyo are involved in farming activities.

Majority of farmers at 40% prefer sweet potato variety that matures early, 24% prefer those that give high yields and 30% prefer the sweet tasting varieties. Most farmers do not consider keeping quality of the sweet potato in the soil before harvesting to be an important factor (Table 4). This finding is consistent with findings from (Tairo et al., 2008). This finding was unexpected since most farmers would prefer high yielding varieties. The results can be attributed to the fact that sweet tasting sweet potato variety could easily be used for breakfast as an accompaniet of porridge without necessarily using sugar.

Eighty six point six percent of the farmers interviewed do not use agricultural inputs such as fertilizer, pesticides in their farms. This results is similar to the result found by (GOK, 2004) who carried out a survey in Homabay and Rachuonyo districts.

The sale of sweet potato stands at 80% for local market whereas a paltry 20% of the farmers sell their sweet potato in major cities. This results to poor returns for farmers who toil for several months to grow sweet potato, and as such sweet potato has not been fully been considered a crop which can be grown for commercial purpose but only subsistence. This result is contrary to findings by (FAO, 1997) carried out in the neighbouring Kisii district whose major market is the cities in Kenya like Nairobi and Mombasa. Lack of proper knowledge on the existing sweet potato market in East Kamagak location can be attributed to low levels of education in the area. From the findings 60% of the farmers had primary school education while only 9% had college education. A major factor contributing to apathy in planting of orange fleshed sweet potato as only 6% of the farmers consider colour as an important attribute while selecting sweet potato to plant or consume (Table 2 and Table 4).

Attribute	Gender		Age years			Education level		
	Male	Female	18-25	25-30	> 35	1 ⁰	2 ⁰	3 ⁰
% of farmers	29	71	20	27	53	60	31	9
Total	100		100			100		

Table 2: Information on farmers' education level, age and gender

1⁰, 2⁰ and 3⁰ represent primary, secondary and tertiary levels respectively

Attribute	Source of Planting Material			Pests		Diseases	
	Own farm	Neighbours farm	Research station	Weevil	Other pests	SPFMV	Other diseases
% of farmers	90	10	None	75	25	72	28
Total	100			100		100	

Table 3: Source of planting material, pests and diseases of sweet potato

Character	Taste	Colour	Yield	Early maturity
% preference	30	6	24	40

Table 4: Preferred sweet potato characters by respondents

Varieties	Vine Internode Diameter	Leaf Size Diameter	Petiole Length	Average Vine Length	Vine Weight	Small Size Storage Root	Marketable Size Storage Root	Total Yield
Ksp20	1.00 ^a	7.33 ^b	9.85 ^d	2.73 ^c	23.83 ^e	12.50 ^{abc}	36.50 ^d	49.00 ^c
Rachar	0.58 ^b	7.03 ^{bc}	10.03 ^{cd}	2.15 ^{de}	38.50 ^d	9.67 ^{abcd}	44.83 ^d	54.50 ^c
Mugande	0.51 ^c	6.70 ^c	10.85 ^b	1.90 ^f	39.00 ^{cd}	16.33 ^a	62.17 ^{abc}	78.50 ^a
Zapallo	0.50 ^{cd}	1.48 ^e	4.92 ^g	0.95 ^g	9.17 ^f	1.17 ^e	11.17 ^e	12.33 ^d
Spk013	0.50 ^{cd}	9.08 ^a	10.83 ^b	2.32 ^d	47.00 ^{abcd}	2.67 ^e	64.50 ^{ab}	67.17 ^{abc}
Nyathi Odiewo	0.50 ^{cd}	7.20 ^{bc}	11.43 ^a	4.05 ^a	55.17 ^a	8.83 ^{bcd}	73.50 ^a	82.33 ^a
Kuny Kibuonjo	0.48 ^{cd}	4.63 ^d	9.78 ^d	2.03 ^{ef}	43.67 ^{bcd}	14.33 ^{ab}	44.17 ^d	58.67 ^{abc}
Nyakowino	0.46 ^d	1.53 ^e	9.35 ^e	3.10 ^b	48.33 ^{abc}	15.83 ^{ab}	52.17 ^{bcd}	68.00 ^{ab}
Spk004	0.40 ^e	0.15 ^f	8.53 ^f	2.08 ^{ef}	46.50 ^{abcd}	11.17 ^{abc}	47.83 ^{cd}	59.00 ^{bc}
Amina	0.38 ^e	7.02 ^{bc}	10.02 ^{cd}	3.22 ^b	45.00 ^{bcd}	6.83 ^{cde}	43.00 ^d	49.33 ^{bc}
Nyawo	0.30 ^f	4.82 ^d	10.25 ^c	2.02 ^{ef}	39.50 ^{cd}	11.83 ^{abc}	52.67 ^{bcd}	64.50 ^{abc}
Abiro Nenywol	0.23 ^g	1.55 ^e	10.03 ^{cd}	3.27 ^b	51.50 ^{ab}	6.83 ^{cde}	50.50 ^{bcd}	57.33 ^{bc}

Table 5: Vine internode diameter, leaf size diameter, average vine length, vine weight, small size storage root, marketable size storage root and total yield for varieties put on yield trials a cross site

Means with the same letter(s) within the column are not significantly different at $p < 0.05$

The a cross site results reveals that there was a significant difference for morphological characters vine internode diameter at $P < 0.05$ for genotypes ksp20, Rachar, Nyawo and Abiro nenywol. However, there was no significant difference between Mugande and Kuny kibuonjo at $p < 0.05$ (Table 5). In terms of leaf size diameter Spk013 and Spk004 were significantly different from the other genotypes at $p < 0.05$. There was a significant difference in petiole length in Nyathi, Nyako, Spk004 and Zapallo at $p < 0.05$, the other genotypes were not significantly different. In all the morphological traits scored Zapallo was significantly different from all other genotypes. Nyathi Odiewo was significantly different at $p < 0.05$ for yield. Mugande was the second highest in yield after Nyathi Odiewo. There was significant variation and positive correlation between leaf area, petiole length, vine weight, average vine length and yield for the genotypes and this could explain why Nyathi Odiewo performed better than all the other genotypes. This could also be explained by the fact that petiole is an important parameter in determining the orientation of leaves. This result is similar to that of (Fongod, et al., 2012) that petiole is an important parameter in determining the orientation of leaves. Proper leaf orientation is needed for efficient trapping of solar needed for photosynthesis.

This result is also similar to that of (Boote et al. 1988) who confirmed that leaf area is important for crop light interception and therefore has a large influence on growth and thus yield.

5.1. Conclusion

The study showed that most farmers in East Kamagak choose the sweet potato to plant based on factors such as taste, yield, keeping quality in the soil, texture after cooking.

There was a significant difference in performance of the varieties with Nyathi Odiewo, Mugande and Nyakowino having the highest yield. The local varieties Nyathi Odiewo and Nyakowino were also very sweet.

5.2. Recommendation

Nyakowino which is landrace grown in East Kamagak location, should be promoted to be grown by farmers in large acreage since it is rich in beta carotene and is also high yielding compared to zapallo and spk004 which are also orange fleshed from KARI Njoro. Nyakowino is also very adaptable to the existing environmental conditions.

There is a need for proper documentation and follow up of the newly released variety from research stations to ensure that there is no variety mixing and misnaming which hinders future improvement of sweet potato.

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