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Research Paper

Evaluation of some Rossele (*Hibiscus sabdariffa* L.) germplasm in Nigeria

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Abstract. Six accessions of Roselle collected from different parts of Niger state, Nigeria, were evaluated for their morphological and yield attributes during the cropping season of 2012 at the Department of Biological Sciences experimental field, Federal University of Technology, Minna, Nigeria, using a randomized complete block design (RCBD) with four replications. The objectives of the experiment were to investigate the morphological and yield characteristics and performance of these Roselle entries. Data collected included plant height, number of branches colour of calyx, number of fruit per plant (NF), width of fruit (WDF), length of fruit (LF), and weight of 1000 seeds. The six entries displayed four different colour of calyx (red, light red, deep red and green) which could be used to delimit them. Significant differences ($P < 0.05$) were observed for morphological parameters in all the accessions collected. This is an indication that there is a store of genetic variability that can be exploited for the improvement of Roselle in Niger state. There was also pronounced variation in yield and other morphological parameters, suggesting the possibility of evolving higher yield variants of Roselle through proper selection. Specific accessions; NG001, NG002, NG003 and NG004 which were identified with the highest weight (26.04 g) per 1000 seeds, the highest length of fruit (9.16 cm), the highest width of fruit (6.33 cm) and the highest number of fruits per plant (58.16) respectively, could be passed on to breeders for utilization in the Roselle improvement programme in Nigeria.

Keywords: Accessions, Roselle entries, morphological parameters, improvement.

INTRODUCTION

Hibiscus sabdariffa L. also known as Roselle is one of the most important species of Hibiscus in Nigeria. It belongs to Division Spermatophyta, Subdivision Angiospermae, Class Dicotyledonae, Order Malvales, Family Malvaceae and Genus *Hibiscus* (Hutchinson and Dalziel, 1958; Heywood, 1978; Olubukola and Illoh, 1996). The genus consists of about 300 species, some of which are widely distributed as tropical herbs and shrubs (Heywood, 1978). Some of these are *H. sabdariffa, H. cannabinus, H. tiliaceus, H. surattensis, H. acetosella*, *H. physaloides H. lunarifolius* and *H. scotellii*. More than half of these species originate in the warmer parts of central and eastern Africa, while the remainder came from tropical America, Asia and Australia (Schippers, 2000). The most popular among them in Nigeria is Roselle *(H. sabdariffa*). This species was domesticated in the heat waters of the River Niger and Western Sudan some 6500 years ago (Murdock, 1995). It is an herbaceous upright plant growing up to two metres or more. The flowers are usually yellow sometimes with dark red centres. The fruits are up to 2-5 cm in length and the seeds usually contain a high percentage of oil (Rice et al., 1993). According to Udom et al. (2001), there are three common varieties grown in Nigeria, two of which are red and the

Figure 1. Grouped accessions types based on the colours of calyx and epicalyx.

other green. The green variety is more predominant in the Southern parts of the country. The two red varieties on the other hand are predominant in the Northern parts of Nigeria, which are remarkably different in appearance. One variety has dark red, almost black calyces while the other had bright red calyces. The crop is used for many different purposes, the most common of which are as a fibre crop, a refreshing beverage and a leafy vegetable (Schippers, 2000). As a vegetable crop it is mainly known from the savannah and semi-arid areas in Africa, while its use as a fibre crop is mostly in Southern Asia. The colour extract from the dry calyces has potential as a natural colourant to replace red synthetic colouring agents in foods, drinks and pharmaceutical preparations. This extract is rich in anthocyanin and is therefore also a potential source of natural colourant for the manufacture of jams, juices, wines, carbonated soft drinks and other acidic foods (Walford, 1984; Henry, 1990). The recent increased preference for food colouring materials of natural origin has led to substantial increases in its production (Schippers, 2000). In Nigeria, the crop is extensively cultivated in many parts as a leafy vegetable. It is very popular in the northern parts where the dried calyx is used for making a popular “sobo” drinks and the seeds are used for local delicacy called ‘daddawa’ (Falusi, 2007).

This paper seeks to show some morphological and yield characteristics of some Roselle landraces grown in the various regions of Niger state, Nigeria; then to identify and assess accession(s) with superior agronomic performance suitable for adoption by Roselle farmers; more so, accessions with unique features useful for the Roselle breeding programme in Nigeria.

MATERIALS AND METHODS

Twenty-six accessions of Roselle were collected from different parts of Niger state, Nigeria in November, 2011 when farmers were expected to be harvesting the crop. However, many of these accessions were replicated throughout the local governments, consequently, they were grouped into six different genotypes based on the calyx and epicalyx colours. They include NG001 (Deep red calyx and epicalyx), NG002 (Red calyx and epicalyx), NG003 (Light Red calyx and epicalyx), NG004 (Green calyx and epicalyx), NG005 (Green calyx and epicalyx) and NG006 (Light Red calyx but green epicalyx) (Figure 1). These genotypes were planted in 15 L pots in the experimental garden of the Department of Biological Sciences, Federal University of Technology, Minna during the raining season of 2012. The experimental design used was randomized complete block design (RCBD) with 4 replications. There were four seedlings in each pot which were later thinned to 2 per pot to reduce competition. These plants were monitored for morphological variables at budding, flowering and fruiting stages of development. The morphological parameters investigated were accessed using standard procedure after the technique of Akinyele and Osekita (2006). The height of the shoot of the plant (HP) was measured every two weeks using a meter rule. Number of branches per plant was counted visually along with measurement of shoot. Calyx colours and stem colours were observed visually. Yield parameters from different accessions of *H. sabdariffa* were determined as function of number of fruit per plant (NF), width of fruit (WDF), length of fruit (LF), and weight of 1000 seeds. NF was determined by counting the total number of fruit on a plant at harvest. WDF was measured as the diameter of the fruit at the widest portion around the epicalyxes using a venial calliper, while LF was determined as the length of the fruits from tip to the point of attachment of the petiole using meter rule. Weight of seed (WS) was determined as the weight of 1000 seeds weighed from each accession using a chemical balance. Data which were

Table 1. Plant heights (cm) of the Roselle accessions at 4, 8 12 and 16 weeks after sowing.

Accession	Weeks			
	4	8	12	16
NG001	22.11 ± 4.52^{bc}	60.39 ± 6.29^{b}	92.71 ± 1.46^{b}	141.83 ± 21.36^{c}
NG002	23.33 ± 087^{c}	61.11 ± 7.41^{b}	93.85 ± 6.12^{b}	154.00 ± 40.02^{c}
NG003	23.44 ± 3.08^{c}	55.00 ± 5.51^{b}	89.77 ± 6.03^{b}	118.00 ± 17.42^{bc}
NG004	17.27 ± 1.84^{ab}	40.16 ± 9.70^{a}	59.16 ± 19.5^{a}	74.16 ± 25.00^{a}
NG005	15.83 ± 0.87^{a}	38.11 ± 1.07^{a}	61.44 ± 3.34^{a}	80.16 ± 4.97^{ab}
NG006	21.94 ± 3.56^{bc}	53.39 ± 2.83^{b}	64.55 ± 8.59^{a}	75.91 ± 2.47^{ab}

Values are mean ± SD. Values followed by the same letter(s) within the same column do not statistically differ at the 5% level tested by DMRT.

Table 2. Mean of branches of the Roselle accessions at 4, 8 12 and 16 weeks after sowing.

Accession	4	8	12	16
NG001	6.113 ± 1.71^{bc}	12.94 ± 1.99^{c}	13.22 ± 0.84^{c}	22.22 ± 3.67^{b}
NG002	5.83 ± 1.09^{abc}	13.66 ± 1.73^{c}	15.72 ± 1.39^{c}	24.50 ± 1.01^{b}
NG003	6.61 ± 0.54^{c}	13.50 ± 0.92^{c}	15.16 ± 1.15^{c}	23.77 ± 4.01^{b}
NG004	5.33 ± 0.76^{abc}	9.11 ± 1.14^{b}	10.05 ± 3.18^{b}	19.77 ± 3.81^{b}
NG005	4.11 ± 0.35^{ab}	8.99 ± 0.44^{b}	13.33 ± 1.50^{c}	19.89 ± 3.25^{b}
NG006	3.69 ± 1.77^{a}	5.38 ± 0.89^{a}	5.98 ± 0.14^{a}	6.08 ± 0.58^{a}

Values are mean ± SD. Values followed by the same letter(s) within the same column do not statistically differ at the 5% level tested by DMRT.

collected were analyzed using analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) was used to separate the means while significant differences detected at $P = 0.05$.

RESULTS

The results obtained for the entire yield parameters showed an interesting variation between the accessions studied in term of the yield as well as the morphological parameters.

Plant height

There is variation in the plant height among the accessions for all the period of data collection (Table 1). For example at week 16, the shortest height (74.16 cm) was recorded for NG004, this value was significantly different from all the other accessions; the highest value (154.00 cm) was recorded for NG002 and the value is significantly different from all the other accessions but the same with NG001 (141.83 cm) (Table 1).

Number of branches/plant

The results obtained for number of branches per plant in all the accessions showed some variations within the weeks (Table 2). At week 16, the accession with the lowest number of branches/plant was recorded for NG006 (6.08), this value is statistically different from all the other accessions. However, the highest number of branches/plant is recorded for NG002 (24.50); this value is significantly the same with all other accessions apart from the NG006 (Table 2).

Yield parameters

The shortest day for the bud emergence (77.83 days) was recorded for NG005, this value is significantly different from all the other accessions; NG004 took a longer time before the bud emergence (147.17 days), this value is significantly different from all the other accessions. There is no significant different between NG001 and NG002 (115.50 and 117.17 respectively) as well as NG003 and NG006 (125.33 and 125.67 respectively) (Table 3).

Weight of 1000 seeds per accession also showed some variations, the smallest weight (20.75 g) is found in NG006, this value is significantly different from all the other accessions. NG001 has the highest value (26.04 g), this value is statistically the same with NG004 (25.21 g). However, NG002 and NG005 showed statistically the same values (22.01 and 21.61 g, respectively).

In term of number of fruit per plant, NG004 has the highest value (58.16); this value is significantly different from all the other accessions. The smallest (32.66) is recorded for NG005 and it is significantly the same with NG001 (33.50) but significantly different from all other

Table 3. Mean value of the yield parameters of the Roselle accessions.

Accession	Weight of seed (g)	Width of fruit (cm)	length of fruit (cm)	Number of fruit per plant	Bud Emergence (in days)
NG001	26.04 ± 1.62^{c}	6.16 ± 1.16^{c}	7.00 ± 1.78^{a}	33.50 ± 10.20^{a}	115.50 ± 20.74^{b}
NG002	22.01 ± 1.73^{bc}	5.33 ± 0.81^{bc}	9.16 ± 1.83^{ab}	44.66 ± 10.76^{ab}	117.17 ± 21.36^{b}
NG003	22.82 ± 1.54^{b}	6.33 ± 1.36^{c}	10.33 ± 2.94^{b}	49.66 ± 7.11^{bc}	125.33 ± 24.22^{c}
NG004	25.21 ± 1.03^{c}	6.00 ± 1.26^{c}	6.66 ± 1.50^{a}	58.16 ± 7.52^{c}	147.17 ± 39.70^{d}
NG005	21.61 ± 2.26^{bc}	3.50 ± 1.05^{a}	6.83 ± 2.22^{a}	32.66 ± 12.72^{a}	77.83 ± 7.47^{a}
NG006	20.75 ± 1.03^{a}	4.00 ± 1.41^{ab}	6.66 ± 0.81^{a}	39.16 ± 9.50^{ab}	125.67 ± 32.65^{c}

Values are mean ± SD. Values followed by the same letter(s) within the same column do not statistically differ at the 5% level tested by DMRT.

accessions. NG003 has the longest length of fruit (10.33 cm), this value is significantly different from all the other accessions; the shortest length (6.66 cm) is recorded for NG004 and NG006, the value is statistically different from all the other accessions. For the width of fruit, the highest value (6.33 cm) was recorded for NG003, this value is significantly different from NG002, NG005 and NG006 but statistically the same with NG001 (6.16) and NG004 (6.00) (Table 3).

DISCUSSION

The differences observed between accessions of roselle collected in morphological and yield parameters are indications of significant difference in their genetic bases and high genetic variability of the plant in Niger State of Nigeria. The ranges of plant height were between 118 and 141 cm for red accessions and 74 to 80 cm for the green accessions (Table 1). This is similar to the ranges (116 to 169 cm) observed by Sanoussi et al. (2011) in *H. sabdariffa* on different roselle accessions obtained in Niger republic. Although Amir et al. (2008) and Mahadevan et al. (2009) said that roselle plant is about 3.5 m tall. Although, Anonymous (2000) also opined that the plant can reach heights between 1 and 3 m depending on cultivation conditions at the site.

The differences between ranges of number of branches for the red accessions (22.22 to 24.50) and 6.08 to 9.89 for the green accession showed that the accessions are not likely to be the same genetically (Table 2). Mohammed et al. (2011) stated that Terengganu and Arab (two common RED accessions in Malaysia) have number of branches 6.4 and 6.1 respectively; this value is close to the number of branches observed for NG006 (a green variety). Mostofa et al. (2002) also observed variation in number of branches of plant in different growing season; however the variations were sometimes significant and sometimes non-significant. The range of value obtained in the present study is also similar to the work of Sanoussi et al. (2011).

Generally, the results from the morphological parameters among the accessions are similar to these reported by Mahaptra et al. (2009) on *H. cannabinus*. The differences could be attributed to the conditions of plant growth. The differences in yield parameters might be recorded for environmental influences as reported by Falusi et al. (2012) in okra while non-significant differences indicate that genetic components of the accessions are still intact as reported by Akinyele and Osekita (2006) also in okra. The results obtained for the weight of seed from all the accessions (Table 3) were similar to that of Sanoussi et al. (2011) and similar pattern of variability in germplasm evaluation have been reported also by Ibrahim and Hussein (2006) and can support the selection programs for better seed yield.

A great diversity among the accessions was also recorded in number of fruit per plant indicating the possibility to increase calyx fruit production through selection. The green type with the highest number of fruit is the one that is most preferred by most vegetable farmers. The results of the morphological groups according to stem, leaf shapes and calyx colours agree with the work of Yandong et al. (2012) and (Futuless et al., 2010) on Roselle. The diversities observed in all the accessions used in this study can be exploited and used in the improvement of Roselle in Niger State, Nigeria. Methods such as hybridization can be used to bring out a variety that could share the valuable characters like the number of fruit per plant, number of branches and plant height.

The finding in this work has brought to light some important and unique morphological features as well as superior yield characters of some selected Roselle accessions. It is believed that this information, as thoroughly researched, would be of great value to agronomists and breeders alike in their improvement programmes in Nigeria and beyond, which would go a long way to help the vegetable crop industry and subsequently improve the per capita income of Nigeria.

REFERENCES

Akinyele BO, Osekita OS (2006). Correlation and Path Coefficient Analysis of seed yield attributes in Okra *(Abelmoschus esculentus)*. Afr. J. Biotechnol. 5(14):1330-1336.

Amir I, Emmy H, Khairu I, Halimatul S, Mohamed N (2008). Roselle (*Hibiscus sabdariffa* L.) Seeds-Nutritional Composition, Protien Quality and Health Benefits. Global science books. Bailiere Tinall Ltd.,

London.

Anonymous (2000). Organic Farming in the tropic and subtropics exemplary description of 20 crops: *Hibiscus. Naturland. 1st edition*, http://www.emeraldinsight.com, assessed 20th January 2013.

Falusi OA, Dangana MC, Daudu OY, Teixeira da Silva JA (2012). Studies on morphological and yield parameters of three varieties of Nigeria Okra (*Abelmuscus esculentus*).J. Hortic. For. 4(7):126-128.

Falusi OA (2007). Cultivation and Use of Roselle (Hibiscus sabdariffa L) in Nigeria. PAT. 3(2):129-134.

Futuless KN, Kwaga YM, Clement T (2010). Effect of sowing date on Calyx yield and yield components of Roselle (*Hibiscus sabdariffa* L.) in Northern Guinea Heywood, V. H. (1978)**.** *Flowering Plants of the World.* Oxford University Press, Oxford, London. pp. 94-95.

Heywood VH (1978). *Flowering Plants of the World.* Oxford University Press, Oxford, London. pp. 94-95.

Henry BS (1990). Introduction to the World of Natural Colours. UNIDO, UK.

Hutchinson J, Dalzeil JM (1958). *Flora of West Tropical Africa*. White friars press, London. Revised by Crown Agents, London. 1(2):343-348

Ibrahim MM, Hussein RM (2006). Variability, heritability and genetic advance in some genotypes of Roselle *Hibiscus sabdariffa* L. World J. Agric. Sci. (2):340-345.

Mahaptra BS, Sabyasachi M, Sinha MK, Ghoral AK (2009). Research and Development in Jute Corchorus sp and allied fibres in India. A review. *Indian Journal of Agriculture*, 54, 361-373.

Mohammed O, Faruq G, Shabnam S, Nazia A, Noor HN, Mohammed Z (2011). Morpho-agronomic analysis of three roselle (*Hibiscus sabdariffa* L.) mutants in tropical Malaysia. Austr. J. Crop Sci. 5(10):1150-1156.

Mostofa MG, Islam MR, Alam, ATM, Mahbub SM, Molla MAF (2002). Genetic variability, heritability and correlation studies in kenaf. Online J. Biol. Sci. 2:422-424.

Murdock GP (1995). Africa, its peoples and their culture history. New York Toronto, London. McGraw-Hill Book Company, Inc.

Mahadevan N, Shivali, OE, Pradeep K (2009). *Hibiscus sabdariffa* L. An overview. Nat. Prod. Rad. 8(1):77-83.

Olubukola A, Illoh HC (1996). Pollen grain Morphology of some species of Hibiscus. Niger. J. Bot. 9:9- 14.

Rice RP, Rice LW, Tindall HD (1993). Fruit and Vegetable production in warm climates, Hong Kong, p. 231.

Sanoussi A, Hadiara HS, Yacoubou B, Benoît S, Issaka L, Mahamane S (2011). Yield character variability in Roselle (Hibiscus sabdariffa L.). Afr. J. Agric. Res. 6(6):1371-1377.

Schippers RR (2000). *African Indigenous Vegetable, An overview of the cultivated species,* Chatham, UK. Natural Resources Institute/ACP-EU Technical Centre for Agricultural and Rural Cooperation pp. 122-133.

Udom O, Igwe CC, Osinowo FAO (2001). Comparison of the anthocyanin content of two varieties of red Roselle (*Hibiscus sabdariffa)* from Nigeria. Niger Food J. 19:101-105.

Walford JE (1984). Developments in Food Colours. Applied Science Publishers, London. Vol.1.

Yandong QI, Kitl C, Fatemah M, Mila B, Janet G (2012). Biological characteristics, Nutritional and Medicinal value of Rosele, *Hibiscus sabdariffa*. Urban for. Natl. Resour. Environ. p. 604.