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Collection and evaluation of Roselle (*Hibiscus sabdariffa* L.) germplasm in Nigeria

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In order to assess the genetic diversity of Roselle (*Hibiscus sabdariffa* L.) in Nigeria, a survey was undertaken to collect the germplasm of the crop. The survey cut across 56 towns and 20 villages in 17 states including the Federal Capital Territory (FCT). Sixty three (63) farmers were interviewed and 60 accessions of Roselle were collected from them. Results showed that 41.7% of these accessions were having green calyx, while 31.7% were with red calyx. On the other hand, 20.0% of the accessions possessed deep red calyx while only 6.7% have light red and pink calyx. Collections from the North Central, North Eastern, North Western and South Western parts were replicated over states, towns and villages. The highest number of Roselle accessions was collected from Kaduna State (8 accessions) followed by Niger State (6 accessions); Jigawa State (6 accessions) while FCT and Bauchi State have 4 accessions each. This is an indication that these areas have the greatest diversity of the crop genetic resources in Nigeria and the states might be secondary centre of origin of the crop. However, morphological as well as molecular characterizations are required to arrange the Roselle accessions collected into a suitable group; this will eventually provide the raw materials needed for the Roselle improvement programme in Nigeria.

Key words: Genetic diversity, germplasm, Roselle accessions, improvement programme.

INTRODUCTION

Roselle (*Hibiscus sabdariffa* Linn.) is a shrub belonging to the Family Malvaceae (Mahadevan et al., 2009; Anjah et al., 2012). It is thought to have originated from Asia (India to Malaysia) or Tropical Africa. The plant is widely grown in the Tropics including Caribbean, Central America, India, Africa, Brazil, Australia, Hawaii, Florida and Philippines, as a home garden crop (Mahadevan et al., 2009). In Sudan, it is a major crop of export, especially, in the western part where it ranks after pearl millet, and followed by *Sesamum* (Leung and Foster, 1996; Gautam, 2004). The genus consists of about 300 species some of which are widely distributed as tropical herbs and shrubs (Heywood, 1978) or as annual erect, bushy, herbaceous sub-shrub (Amin, 2008). Some of the species include: *Hibiscus canabinus* L., *Hibiscus asper* (Hook.) F., *Hibiscus tiliaceus* L., *Hibiscus acetosella* Weiw ex Hiern and *Hibiscus scotelli* Bak. F.

The plant is about 3.5 m tall and has a deep penetrating taproot system. It has a smooth or nearly smooth, cylindrical, typically dark-green to red stems (Amin, 2008;

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Mahadevan, et al., 2009). The leaves are alternate, 7.5-12.5 cm long, green with reddish veins and long or short petioles. Leaves of young seedlings and upper leaves are deeply 3 to 5 or even 7-lobed and the margins are toothed. Flowers are borne singly in the leaf axils and are up to 12.5 cm wide, yellow or buff with a rose or maroon eye, that turn pink as they wither at the end of the day. The typically red calyx, consist of 5 large sepals with a collar (epicalyx) of 8-12 slim, pointed bracts (or bractioles) around the base. The fruit is a velvety capsule, 2-5 cm long, which is green when immature, 5-valved, with each valve containing 3-4 seeds which usually contain high percentage of oil (Rice et al., 1993). The capsule turns brown and splits open when mature and dry. Seeds are kidney-shaped, light-brown, 3-5 mm long and covered with minute, stout and stellate hairs (Julia, 1987).

The importance of this crop cannot be over emphasized; it is used for many different purposes, the most common of which are as a fibre crop, the young leaves are eaten as cooked vegetables especially with soup (Fasoyiro et al., 2005). The seeds are pounded into meal which is used as oily soup or sauce after roasting. Oil extracted from the seed is a substitute for castor oil while the residue is used in a fermented form as soup or cake (Aliyu, 2000).

The crop is used fresh for making wine, juice, jam, jelly, syrup, gelatin, pudding, cakes, ice cream and also dried and brewed into tea as well as flavours and carbonated soft drinks, other acidic foods, spice and used for butter, pies, sauces, tarts and other desserts (Walford, 1984; Qi et al., 2005). The grinded leaves and seeds are added to curries as seasoning. Roselle contains an acid, rhubarb-like flavour. The red calyces contain anti-oxidants including flavonoids, gossypetine, hibiscetine and sabdaretine (Qi et al., 2005). The fresh calyces are also rich in riboflavin, ascorbic acid, niacin, carotene, calcium, and iron that are nutritionally important (Mahadevan et al., 2009), as well as, amino acids and mineral salts (Cisse et al., 2009).They are also known for their unique flavour, characteristics that make them appealing to taste. Roselle drink had been improved nutritionally by producing fruit-flavoured Roselle drinks, which are richer in vitamins and minerals by addition of different fruits with higher consumption acceptability (Fasoyiro et al., 2004).

The crop is mainly grown as a vegetable from the savannah and semi-arid areas in Africa, while its use as a fibre crop is mostly in southern Asia. Formerly, it was traditionally cultivated in Nigeria for its leaves, seeds and stems; but is now being grown commercially for its calyces (Babatunde, 2003). Roselle is widely grown in northern parts of Nigeria, where the dried calyx is used for making a popular ‘zobo’ drinks (Falusi, 2007). Udom et al. (2001) reported that there are three common varieties of Roselle grown in Nigeria. Two of these varieties have red calyces while one has green calyces.

The green variety is more predominant in the Southern arts of Nigeria but the green variety is scarce while the other two red varieties are predominant in the Northern parts of this country; however, the green variety is also common in the Northern part of the country. The calyces from these varieties have a number of uses and promising prospects for industrial purposes (Alegbejo, 2000). These popular uses to which Roselle have been assigned had fuelled increasing demand for the crop thus, necessitating corresponding increased supply of the products. Though attempts have been made to achieve this increased supply through increased cultivation of the different varieties; the successes of such attempts have been limited by challenges ranging from unfavourable environmental conditions, as well as dwindling man-power and inadequate farming conditions. As the crop continues to play important horticultural roles in Nigeria, its improvement will surely enhance agricultural productivity, alleviate poverty and facilitate food security. But unfortunately, very little research attention has been given to the improvement of the crop. This background has made it necessary to collect and evaluate the germplasm of the crop, as a basis for research into its development and promotion as a major crop in Nigeria.

MATERIALS AND METHODS

Exploration and collection of Roselle germplasm in Nigeria

A survey of *H. sabdariffa* (Roselle) growers was conducted in south-western, north-central, north-western and north-eastern parts of Nigeria, representing the major Roselle producing areas of the country. The survey was conducted between October 2012 and January 2013, when the farmers were expected to be harvesting the crops. The states visited were Niger, Kogi, Nasarawa, Kwara, Ekiti, Ondo, Osun, FCT, Benue, Taraba, Plateau, Kebbi, Gombe, Bauchi, Kaduna, Katsina, Jigawa, and Sokoto. Questionnaires were administered through an interpreter in some cases and samples of available Roselle accessions under husbandry were collected. The questions asked included local name of accessions, source of seed supply, yield, Roselle seed preferences, constraints to cultivation and economic importance (Table 1).

The seeds were collected packed and sealed in thick paper envelopes each of which was given an accession code, local name and locality before they were finally stored in dry containers.

Measurement of the seed diameter

Ten seeds at random were selected from each of the accessions for the seed diameter. The seed diameters were measured using meter rule and the mean value was recorded as the average diameter.

RESULTS AND DISCUSSION

The survey covered 56 towns and 20 villages in 17 states including the Federal Capital Territory (FCT), Nigeria. Sixty three (63) farmers were interviewed and 60 accessions of Roselle were collected (Table 1). It was observed that most of the accessions were duplicated in most of the

Table 1. Sources and description of Roselle germplasm in Nigeria.

S/N	Accession number	Local name	Local Government	State	Calyx colour	*seed Diameter (mm)
1.	NGR-OD-001	Ishapa Otatupe	Ikare	Ondo	Green	3.55
2.	NGR-OD-002	Ishapa	Ogbese/ Akure	Ondo	Green	3.55
3.	NGR-OD-003	Ishapa Oloho	Ondo/Irele	Ondo	Green	3.65
4.	NGR-EK-004	Ishapa	Ijero	Ekiti	Green	3.30
5.	NGR-EK-005	Ishapa Toromoyan	Ado/ Ijan	Ekiti	Green	3.65
6.	NGR-EK-006	Ishapa Toromoyan	Omuo/ Ilasha	Ekiti	Green	3.55
7.	NGR-OS-007	Sapa	Iwo/ Ibode Osi	Osun	Green	3.35
8.	NGR-OS.008	Isapa	Ikoyi/ Ikire	Osun	Green	3.35
9.	NGR-OS-009	Isapa	Ilaorangun	Osun	Green	3.50
10.	NGR-KW-010	Ishapa	Oro	Kwara	Green	3.10
11.	NGR-KW-011	Ishapa	Offa	Kwara	Green	3.35
12.	NGR-NG-012	Emagi	Bida	Niger	Deep red	3.60
13.	NGR-NG-013	Emagi	Dabban/ Lavun	Niger	Red	3.35
14.	NGR-NG-O14	Emagi	Mokwa	Niger	Light red	3.30
15.	NGR-NG-015	Ama	Beji/ Bosso	Niger	Green L.V	3.50
16.	NGR-NG-016	Ama	Paiko/Paikoro	Niger	Green	3.45
17.	NGR-NG-017	Yakuwa	Kontagora	Niger	Pinkish G.L	3.20
18.	NGR-KD-018	Yakuwa	Kubau	Kaduna	Red	3.33
19.	NGR-KD-019	Barkatata	Sanga	Kaduna	Red	3.25
20.	NGR-KD-020	Yakuwa	Jema'a	Kaduna	Green	3.32
21.	NGR-KD-021	Zoborodo	Zaria	Kaduna	Red	3.27
22.	NGR-KD-022	Zobo	Chukun	Kaduna	Red	3.48
23.	NGR-KD-023	Zobo	Kachia	Kaduna	Red	3.29
24.	NGR-KD-024	Tseng	Jaba	Kaduna	Green	3.36
25.	NGR-KD-025	Zobo	Kagarko	Kaduna	Red	3.31
26.	NGR-JG-026	Bakin zobo	Kazaure	Jigawa	Deep red	3.24
27.	NGR-JG-027	Jan zoborodo	Gumel	Jigawa	Red	3.21
28.	NGR-JG-028	Jan zobo	Kaugama	Jigawa	Red	3.29
29.	NGR-JG-029	Farin zobo	Kazaure	Jigawa	Green	3.16
30.	NGR-JG-030	Farin zoborodo	Hadejia	Jigawa	Green	3.48
31.	NGR-JG-031	Bakin zobo	Kaugama	Jigawa	Red	3.34
32.	NGR-GB-032	Bakin zobo	Yamaltu-Deba	Gombe	Deep red	3.31
33.	NGR-GB-033	Barkata/ Gwaten	Dadin Kowa	Gombe	Green	3.28
34.	NGR-GB-034	Jan zobo	Kwani	Gombe	Red	3.41
35.	NGR-FCT-035	Emagi zuru	Yaba	FCT	Deep red	3.80
36.	NGR-FCT-036	Megi	Kuchi Goro (Amac)	FCT	Red	4.20
37.	NGR-FCT-037	Ama	Dakwa (Bwari)	FCT	Green	2.90
38.	NGR-FCT-038	Echi	Zuba	FCT	Deep red	3.70
39.	NGR-NS-039	Ogbomwa zobo	Eddo (Doma)	Nasarawa	Red	4.00
40.	NGR-NS-040	Echi zobo	Kiyi (Akwanga)	Nasarawa	Red	3.00
41.	NGR-NS-041	Yakwan Miya	Keffi	Nasarawa	Green	3.00
42.	NGR-PL-042	Yakuwa	Jos	Plateau	Red	3.90
43.	NGR-PL-043	Yakuwa	Jos	Plateau	Green	3.10
44.	NGR-BA-044	Farin Zobo	Toro	Bauchi	Green	3.00
45.	NGR-BA-045	Yakuwa/Bakin Zobo	Bauchi	Bauchi	Deep red	3.48
46.	NGR-BA-046	Yakuwa/Janzobo	Toro	Bauchi	Red	3.34
47.	NGR-BA-047	Farin Zobo	Gamawa/Katagun	Bauchi	Green	3.31
48.	NGR-BE-048	ASHWE	Gboko	Benue	Deep red	3.28
49.	NGR-BE-049	ASHWE	Gboko	Benue	Red	4.00
50.	NGR-BE-050	ASHWE	Yandev	Benue	Green	4.00
51.	NGR-TR-051	Farin zobo	Ardo Kola	Jalingo	Green	3.00

Table 1 Contd.

52.	NGR-TR-052	Jan Zobo	Karim Lamido	Jalingo	Deep red	3.41
53.	NGR-TR-053	Yakwa/Bakin zobo	Ardo Kola	Jalingo	Deep red	3.46
54.	NGR-KG-054	AGOLO	Ankpa	Kogi	Light red	4.00
55.	NGR-KG-055	AGOLO	Ankpa	Kogi	Red	4.00
56.	NGR-SK-056	YAKUWA	Sokoto	Sokoto	Deep red	3.29
57.	NGR-SK-057	JAN ZOBO	Sokoto	Sokoto	Red	3.16
58.	NGR-KT-058	YAKUWA	Katsina	Katsina	Deep red	3.48
59.	NGR-KT-059	YAKUWA	Katsina	Katsina	Green	3.34
60.	NGR-KB-060	YAKUWA	Birnin Kebbi	Kebbi	Deep red	3.31

* Values are means of the seeds measured in millimetre. Green L.V: Green. FCT: Federal Capital Territory. GREEN (L.V): late variety Pinkish (G.L): Pinkish calyces with green leaves.

Table 2. Predominant calyx colours among the accessions collected.

	Calyx colours				Total
	Green	Red	Deep Red	Others	
No. of accession	25	19	12	4	60
Calyx colour (%)	41.7	31.7	20.0	6.7	100.1

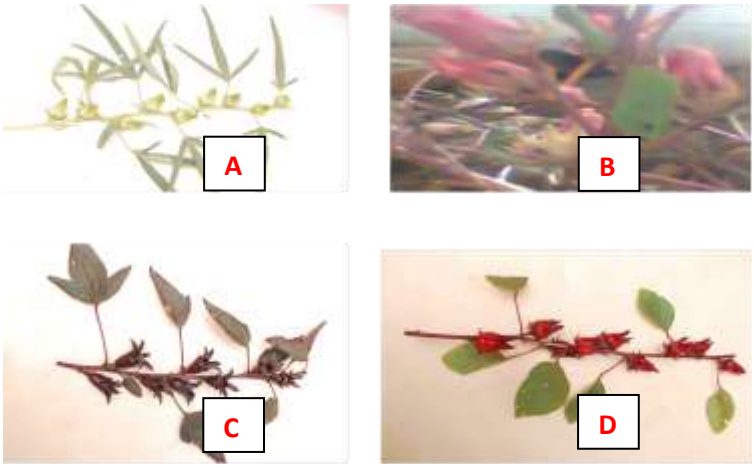

Plate 1. Roselle accessions with different calyx colour. A: Accession with green calyx; B: Accession with light red or pink calyx; C: Accession with deep red calyx; D: Roselle accession with red calyx.

towns and villages. The various calyx colours encountered were green, red, deep red, pink and light red (Plate 1). Results showed that 41.7% of these accessions were having green calyx, while 31.7% were with red calyx. On the other hand, 20.0% of the accessions possessed deep red calyx while only 6.7% had light red and pink calyx. Collections from the North Central, North Eastern, North Western and South Western parts were replicated over states, towns and villages in Nigeria (Table 2). The highest number of Roselle accessions was collected from Kaduna state (8 accessions) followed by Niger and Jigawa States (6 accession each); FCT and Bauchi State on the other hand have 4 accessions each (Table 1). This is an indication that these states had the greatest diversity of the crop genetic resource; it also showed that these regions might be the primary or secondary centre of origin of Roselle. This is in line with the report of Mohamed et al. (2012) that the genus *Hibiscus* has its centre of origin in Africa.

About 81.8% of the farmers preferred Roselle variety with dark red or red calyx because apart from having medicinal value, it is widely used in the preparations of

foods and drinks. This variety is grown in commercial quantities in Jigawa, Kaduna, Bauchi, Niger States and FCT. According to Stevels (1990), Roselle plants with anthocyanin pigmentation are able to withstand the harsh environment and more tolerant than the green variety. Hence, they are common in the dry zones of the areas of the production in Nigeria.

The farmers in the south-western part of Nigeria gave more priority to their starchy stable crops. 100% of them responded that they normally grow the green varieties of Roselle for vegetable. They also attend to this vegetable only when their main food crop has been established. The Roselle variety with green calyces is predominant in the south-western part of Nigeria. In view of the popularity of Roselle as a crop of considerable economic importance in Nigeria, there is a need to retain the diversity of the indigenous germplasm. A scientific morphological and molecular characterization of the materials collected is therefore necessary to ascertain the genetic diversity existing within the species in Nigeria.

Conflict of interest

The authors did not declare any conflict of interest.

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