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Mrenda (Jew's Mallow) Germplasm Characterization by Morphological Traits

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ABSTRACT

Jew's mallow or Mrenda is widely grown in Africa with its species being highly variable in their morphological traits. In Kenya there are many local varieties widely grown across the counties as indigenous vegetable for its important contribution to diet by supplying high nutrients and medicinal value. The rich genetic variation in the many land races found locally has so far hardly been exploited nor characterized, leaving ample room for development of improved varieties or accessions. The objective was to do characterization of Mrenda morphotypes. Mrenda seed Germplasm was collected using stratified random sampling technique from various counties and planted in pots at green house and morphological traits taken, grouped and analyzed. Characterization results showed presence of two morphotypes based on color and two based on height named: Morphotypes 1(Green Short), Morphotypes 2 (Green Tall), Morphotypes 3 (Brown Short) and Morphotypes 4 (Brown Tall). Plant height showed early maturing variety being short with Morphotypes 1 (28.3 cm) and Morphotypes 3 (29.0 cm) and differentiated by stem color. The shortest variety was from West Pokot, Morphotypes 1 and Morphotypes 3 at height of 26 cm, while tall accession was from Nandi, Morphotypes 1 (31 cm) and Morphotypes 3 (33 cm). The highest pod count per plant was Morphotypes 1 at 14 pods from Simlaw seed selection while lowest was 5 pods (West Pokot, Keiyo and Trans Nzoia). On late maturing variety, West Pokot had both the shortest, Morphotypes 2 (79 cm) and Morphotypes 4 (77 cm), while Nandi had the tallest (93 cm) from Morphotypes 2 and 84 cm from Morphotypes 4. Generally the Green types were taller than Brown types. Highest Pod count per plant was from Nandi on both Morphotypes 2 and 4 at (19 pods) and lowest was from West Pokot (16 pods). It is concluded that there was variation in traits of Mrenda Germplasm thereby needing purification of accessions to separate them into various morphotypes for farmer's crop production purposes.

Keywords: Characterization, Morphological, Mrenda, Traits.

I. INTRODUCTION

Corchorus species also called Jew's mallow are cultivated leafy vegetables though in different areas e.g. South East Asia it is used as fibre crop [1][2[. In Africa, it is well adapted to a wide range of environmental conditions in both warm and dry regions. *C. olitorius* also called Mrenda is widely grown in Kenya [3] as an indigenous African vegetable due to its important contribution to diet by supplying nutrients and rendering food more palatable [4]. It is reported to be demulcent, deobstruent, diuretic, lactagogue, purgative, and tonic [5]. It can meet major protein-calorific nutritional needs especially in children, sick, elderly and both expectant and lactating mothers in rural areas [6]. Cooked leaves form a mucilaginous substance that has a character that is highly appreciated especially in areas where people depend on rather coarse food such as millets. Mrenda leaves are normally mixed with cowpeas to reduce their coarseness or to neutralize the bitter taste in *Crotalaria brevidens*. In characterization, the process consists of recording those parameters that are highly and less highly heritable [7]. They include plant height, leaf number and number of branches, number of flowering plants per plot, leaf yield and seed yield [8]. Generally, growers, farmers and breeders would like to know the variation in plant traits to assist when grouping or selecting cultivars for planting or breeding [9].

Most of the germplasm of indigenous vegetables in most parts of the world, including Mrenda, has not been systematically characterized and their plant trait variation not established [10][11]. This has caused a major knowledge gap. Apart from the local land races, there are little known described improved varieties of Mrenda in Kenya [12]. This is because there is no official breeding in place for these indigenous vegetables [13] in many areas. For instance farmers in many areas in Kenya grow landraces which differ in their morphological traits or characteristics leading to production challenges like variation in growth periods, poor quality seeds and low yields. In order for Mrenda to be increased in production to meet current high demand of these vegetables, purification, selection and breeding need be enhanced necessitating for characterization to provide current field accessions traits information for use in future breeding work or conservation strategies.

A. Characterization of Mrenda (Jew's mallow)

Characterization and evaluation approaches are generally varied and depends on what is being worked on [14]. At present most Germplasm breeders and conservationist believe that the larger the collection, the higher the degree of getting desirable characters to use in crop improvement [15. When doing characterization it's important to note that morphological traits such as stem, color, leaf size, petiole, flower color, fruit size, seed yield, plant height, branching pattern, days to flowering and tolerance to pests and diseases often have a high variability [16], and are helpful as descriptors [17].

Generally, accurate characterization through phenotypic and genotypic methods is of interest both for the description, enhancement and protection of landrace materials and for the initiation of breeding programs [11]. Also further knowledge of Germplasm diversity through genetic variation assessment has significant impact on the improvement of crop plant like Jute mallow [18]. In Kenya, the cultivated morphotypes types are highly variable. The rich genetic variation found in the many plant land races has so far hardly been exploited nor characterized, leaving ample room for development of improved varieties [19].

When selections are made, characters considered useful include; better yields, rapid revenue earnings and high nutrition value [20]. The most commonly selected characters are large leaf size, deep green and glossy leaf colors, late flowering, rapid early growth and profuse branching [21]. In some cases certain leaf types are associated with the nutritionally desirable 'draw' property of the leaves and plants with specific leaf shapes are selected [22]. The common practice, however, is to plant unselected and generally quite heterogeneous local variety and do selection or characterization process leading to morphotypes [23]. Such will assist breeders in collection and conservation of local Germplasm and create a large enough base to be used for future crop improvement programs [24].

Despite increased importance of characterization in plant resources; there is scarce information about analysis of this type of data [25]. To fill such a gap of information, research like this being done on Jute mallow needs to be done. This will bring out the rationale behind relationship among accessions [26] whether morphologically or genetically (within and between groups) and to identify morphotypes or accession [27], and also discuss the parameters for specific plant [18].

II. METHODS AND MATERIALS

B. Experimental site

The research was carried out in a green house at Chepkoilel farm, University of Eldoret, Kenya which is situated at longitude 0'30''N and latitude 35'15''E and altitude of about 2140 m above sea level, and is 9 km North of Eldoret in Uasin Gishu county. Seed Germplasm was collected from five counties of Keiyo, Uasin Gishu, Nandi, Trans Nzoia and West Pokot in Kenya.

C. Morphological trait data collection

Collected seed sample was planted in pots at green house and data scoring done. Five plants were selected per pot and tagged and thereafter their heights measured using a ruler from the soil surface to the apical bud. Number of emerged leaves, its average length and width, color, leaf lamina shape, leaf serration presence and leaf tip noted and number of branches per plant counted. Leaf petiole length was measured and average length

determined. Flower shape, color, number of sepals and its length and width noted and determined. The number of pods per plant was counted in each pot and average determined. Fruits' shape was noted and its average length and width per fruit determined. Seeds were harvested when mature but before drying up and shattering, and dried, threshed, winnowed and seed traits determined.

III. RESULTS AND DISCUSSIONS

A total of two morphotypes emerged based on stem color and two based on plant height and named as Green short - Morphotypes 1, Green tall - Morphotypes 2, Brown short - Morphotypes 3 and Brown tall - Morphotypes 4.

D. Characterization results of Morphotypes 1 and Morphotypes 3

The plant height (Table 1) of early maturing variety showed no significant difference ($p<0.001$) for seed sources and county as were averagely dwarf (less than 50cm) as indicated by [28]. The Morphotypes 1 (28.3 cm) and Morphotypes 3 (29.0 cm) were same in height and only differentiated by color. The shortest variety was from West Pokot; Morphotypes 1 and 3 at (26 cm), while tall accession was from Nandi; Morphotypes 1 (31 cm) and Morphotypes 3 (33 cm).

Table 1. Plant parameters results in centimeters of Morphotypes 1 and morphotypes 3 of Mrenda varietals at harvesting

Source of seed	Plant height (cm)		Pod count (numbers)		Leaf Petiole length (cm)	
	Morphotypes 1	Morphotypes 3	Morphotypes 1	Morphotypes 3	Morpho types 1	Morpho types 3
West Pokot	26±0.6	26±1.5	5±0.5	5±1	1.2±0.1	1.2±0.1
Simlaw seed	27±1.5	*0	14±2.1	*0	1.2±0.1	*0
Keiyo	27±2.5	27±0.6	5±0.6	5±0.5	1.3±0.1	1.2±0.1
Trans Nzoia	29±1.5	28±1	5±0.5	6±0.5	1.4±0.6	1.3±0.1
Uasin Gishu	30±2.5	31±2.9	6±0.5	6±0.5	1.3±0.1	1.2±0.1
Nandi	31±1	33±3.2	7±1	6±0.5	1.3±0.1	1.3±0.1
Mean	28.3	29.0	7	6	1.3	1.2

Nb. 0* indicate absence of morphotypes 3 in Simlaw seed accessions collected Mrenda pod count per plant showed significant difference ($p<0.001$) for seed source and county. The highest pod count per plant (Table 1) was Morphotypes 1 at 14 pods from Simlaw seed selection while lowest was 5 pods (West Pokot, Keiyo and Trans Nzoia). On Morphotypes 3 pod count per plant, the highest was 6 pods (Most seed sources), except sources with 5 pods were West Pokot and Keiyo. On average, Morphotypes 1 had 7 pods per plant while Morphotypes 3 had 6 pods per plant.

The leaf petiole length analysis showed no significant difference ($p<0.001$) on average (Table 1) was Morphotypes 1 (1.3 cm) and Morphotypes 3 (1.2 cm).

The leaf lamina shape for Morphotypes 1 and 3 were lanceolate. Analysis showed no significant difference ($p<0.001$) in leaf measurement measuring 6.5 cm length by 2.5cm width (Table 2) in alternate positions. Leaf margin showed serration as present and facing leaf apex in both Morphotypes 1 and 3 varietals. Leaf tip shape was acute in both Morphotypes 1 and 3. Morphotypes 1 leaf was green in color, while Morphotypes 3 was brown.

Flower measurements showed no significant difference ($p<0.001$) for varieties. Both Morphotypes 1and 3 flowers were 1.2 cm in length and 1.0 cm width (Table 2), yellow in color, solitary in shape, positioned in opposite to leaves and 5 small narrow sepals. The fruit width and length results showed no significant difference ($p<0.001$) for varieties, where length for Morphotypes 1 and 3 were 3.6 cm and 3.8 cm respectively and width were 1.2 cm and 1.3 cm respectively. The fruit was cylindrical, 10 ridged; dehiscing by 5 with traverse septa between seeds averagely 100 seeds per capsule. All seeds of Morphotypes 1and 3 were pyramidal in shape, dark grey – blue in color and measurement of 1mm in length.

Table 2. Width and length measurement results in centimeters of morphotypes 1 and morphotypes 3 of Mrenda parameters

Variety	Measurement	Leaf Lamina	flower	Fruit
Morphotypes 1	Width (cm)	2.5±0.1	1.2±0.2	1.2±0.1
	Length (cm)	6.5±0.4	1±0.1	3.6±0.5
Morphotypes 3	Width (cm)	2.5±0.1	1.2±0.1	1.3±0.2
	Length (cm)	6.5±0.4	1±0.1	3.8±0.6

E. Characterization results of Morphotypes 2 and Morphotypes 4

Plant height results of late maturing Mrenda showed no significant difference ($p<0.001$) for seed sources and county with West Pokot having both shortest plants in Morphotypes 2 (79 cm) and Morphotypes 4 (77 cm), while Nandi had the tallest plants (93 cm) Morphotypes 2 and 84 cm Morphotypes 4 (Table 3). The above results show that generally, Green types were taller than the Brown types of Mrenda in the counties as also observed by [12].

Pod count per plant results (Table 3) on Morphotypes 2 and 4, showed significant difference ($p<0.001$) for seed sources and county with Nandi having the highest (19 pods) and the lowest being 16 pods from West Pokot. On average both Morphotypes 2 and 4 had same pods per plant at 17 pods and only colors could differentiate them.

Table 3. Plant parameters results in centimeters of Morphotypes 2 and morphotypes 4 of Mrenda varietals at harvesting

Source of seed	Plant height (cm)		Pods count (numbers)		Leaf petiole length (cm)	
	Morpho types 2	Morpho types 4	Morpho types 2	Morpho types 4	Morpho types 2	Morpho types 4
Simlaw seed	0*	0*	0*	0*	0*	0*
West Pokot	79±3.2	77±3	16±0.6	16±1	1.7±0.1	1.8±0.1
Uasin Gishu	82±3.1	84±3.2	17±1	18±1.7	1.8±0.1	1.7±0.2
Keiyo	84±3.5	81±4.2	17±1.2	17±1.5	1.7±0.1	1.7±0.1
Trans Nzoia	85±4.1	84±5.1	18±1.8	17±1.2	1.8±0.2	1.7±0.1
Nandi	93±5.2	84±3.2	19±1.5	19±2	1.7±0.1	1.7±0.1
Mean	85	82	17	17	1.7	1.7

Nb. 0* indicate absence of morphotypes in seed accessions from Simlaw Seed Company

The leaf petiole length analysis showed no significant difference in leaf measurements with Morphotypes 2 and 4 were of 1.7 cm and 1.8 cm in length respectively across the seed sources, and could only be differentiated by their colors. Both Morphotypes 2 and 4 leaf lamina shape was lanceolate and analysis showing no significant difference ($p<0.001$) in width measurement at 8.5 cm length by 2.8 cm (Table 4) respectively and in alternate positions.

Table 4. Width and length measurements of Morphotypes 2 and 4 of Mrenda parameters

Variety	Measurement	Leaf lamina	Flower	Fruit size
Morpho types 2	Width (cm)	2.8±0.1	1.2±0.1	1.4±0.3
	Length (cm)	8.5±1.1	1.0±0.1	3.9±0.5
Morpho types 4	Width (cm)	2.8±0.1	1.2±0.1	1. 4±0.4
	Length (cm)	8.5±0.2	1.0±0.1	3.9±0.6

Both Morphotypes 2 and 4 leaf had serration present, facing leaf apex and of acute shape. The Morphotypes 2 leaves were green in color while Morphotypes 4 was brown.

The flower measurement showed no significant difference ($p<0.001$) for varieties for both Morphotypes 2 and 4 were 1.2 cm length by 1.0 cm in width respectively, yellow in color, solitary in shape, positioned in opposite to leaves and having 5 small narrow sepals as supporting [29]. The fruit length and width measurements showed no significant difference ($p<0.001$) for varieties of Morphotypes 2 and 4 were the same of 3.9 cm by 1.4 cm. respectively, were cylindrical, 10 ridged, dehiscing by 5 with traverse septa between the seeds. All seeds of Morphotypes 2 and 4 were of pyramidal in shape, dark grey–blue in color and 1mm in length.

IV. CONCLUSIONS

It is concluded that collected Mrenda Germplasm varied in morphological traits with two morphotypes outcome based on stem color and two morphotypes on plant height. This shows that there was traits variation or differences in characterized Mrenda accession from the five seed sources.

V. RECOMMENDATIONS

It is recommended that in order to avail varietals of Mrenda to farmers, it is envisaged further work be done by breeders especially on breeding or purification to produce or come-up with improved varietal from the local identified available landraces.

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