A KEY FOR IDENTIFICATION OF MANGO (*Mangifera indica* L.) CULTIVARS IN SHENDI AREA

Tagelsir Hassan Mohamed Ahmed and Zenab Mohamed Ahmed Mohamed
Faculty of Science and Technology- Shendi University -Sudan.

Abstract

The study has been made to develop a quhck and easy way to identify Mango cultivars (*Mangiffera indica* L.) in Shendi - Sudan. Leaf characters viz: leaf length, leaf width, leaf petiol length, leaf blade shape, leaf apex shape and leaf texture were used as a key parameters to identify the cultivars. Each character was divided to ranges according to the leaf measurements or according to the shape of leaf blade and leaf apex or leaf texture. The cultivars were identified first by leaf length then leaf width, petiol length, leaf blade shape, leaf apex shape and leaf texture respectively. The key was found to be a useful tool for mango cultivare identification in Shendi area.

1. INTRODUCTION

The mango (*Mangifera indica L.*) is one of the most important horticultural crops worldwide. Mangoes are a member of the *Anacardiaceae* family that comprises 73 genera, fitted in the order Sapindales. This order belongs to the sub-class Rosidae from the class Magnoliopside and division Magnoliophyta (Anonymous, 2008).The genus mangifera to which mangoes belong consists of 69 species and is classified into tow Sub-genera with several sections based on morphological characters. Among the species,*M. indica* is the most important,

There are three main groups of mango cultivars: a) Most improved tropical cultivars with fibreless fruit and no turpentine flavor; b) Improved subtropical cultivars, with attractive, good quality fruit, but with unsatisfactory yield and less resistance to disease and c) Unimproved cultivars with high fiber content, external green color, turpentine flavor and poor shelf life, e.g. "Peach" and "Sabre" (Human, 2008).

In Sudan there are more than 30 traditional mango cultivars in addition of hundred seedling cultivars. Most mangoes grown in Sudan are monoembryonic cultivars such as Alphonso, Mulgoba, Mubroka, Desha, Shendi, Zebda, Jolik, Abu samaka and Nailum. Seedling cultivars grown in Sudan are Kitchener, Betbady, Sinaria, Shreefia, Hindi Abusinara, and Iwis. The new introduced cultivars cultivated in Sudan were imported from South Africa such as Tommy Atkins, Keitt, Kent, Sensation and Heidi.

There are great variation in leaf length, width and petiole length between different cultivars, and even within the same cultivar according to the season of growth and position of the leaf on the flush. Usually lower leaves of the flush are longer than the upper ones, the middle leaves, have the longest petioles. Mango leaves are evergreen, alternate, borne mainly in rosettes as the tips of branches and numerous twigs from, which they droop like ribbons on slender petioles (Morton, 1987).

Characteristic leaf shapes include entire, leathery, short, pointed and oblong to lanceolate leaves. The length is about 450mm. Differences are due to varietal variation, climate, cultural practices and growth stages. Young leaves from different varieties can present different colors. This can vary from copper- red to purplish in color. At maturity the leaf color changes to dark green and usually smells like turpentine (Fivaz, 2008).

The leaves of atypical mango tree may be about 4 to 12 inches in length and ¾ to 2 inches in width. Leaves are borne mainly in rosettes at the tips of the branches and numerous twigs from which they drop like ribbons on slender petioles 2.5 – 10 cm long (Morton,1987). The new leaves, appearing periodically and irregularly on a few branches at a time, are yellowish , pink , deep rose or wine red, becoming dark green and glossy above , lighter beneath. The midrib is pale and conspicuous with many horizontal and distinct veins.

2. MATERIALS AND METHODS

2.1 Sampling area

Shendi is located on the east bank of the river Nile, river Nile state it is north-east of hartoum about 170 Km, between latitudes (16 -42) north and longitude (33-26) east, it is the main area of mango cultivation in Sudan. Many cultivars have been grown in this area.

2.2 Sampling materials

Thirty mango (Mangifera indica L) trees were used in this study. Sixteen of which were grafted genotypes of Indian or Egyptian origin of known varieties .V.Z: Abu samaka ,Shendi, Nailum, Mitlaky, Mabroka, Zibda, alphonse, Galbeltowr, Malgoba, Julik, Timor, Dibsha, Mahmoudi, Walibasha, Bet Abusamaka, Segrest (1 – 16).These varieties were well known in Sudan and cultivated for many years by formers.

Recently three cultivars were introduced from South Africa these were, Elkent, Elkeitt, and Tommy atkinz(17 – 19). Eleven varieties were grown directly from seeds (Balady). Which in clude :Kutchineer, Betbady , Wadsrear, Sinaria, Shabala , Shreefia, Yageen, Bizrtshendi, Rasmaktoul, Taiba, Higazia (20 – 30) These cultivars showed high production with high quality fruits.

2.3 Morphological characterization

Morphological characterization of the selected cultivars was carried-out for leaves, inflorescences, fruits and seeds using Diversity International Descriptor (IBPGR; Rome, 2006).

2.3.1 Samples collection

From each variety three trees were used for collecting the leaves and inflorescences, and from each tree three leaves or inflorescences were taken for study randomly.

2.3.2 Leaf characterization

Leaves were cut by apex from the base of the leaves and were taken to the laboratory for measurement.

2.3.2.1 Leaf length

The length of each leave was measurement from the apex to the base in cm.

2.3.2.2 Leaf width

The width of the leaves was measurement of the widest area of the leaf in cm.

2.3.2.3 Petiole length

The length of the petiole was measurement from the base leaf to stick branch in cm.

2.3.2.4 Leaf shape

Blade shape, apex shape, base shape, texture and margin were tested and compared

 to the known leaves samples.

2.3.3 Inflorescences characterization

Inflorescences were cut by apex from the base of the inflorescences and were taken to the laboratory for measurement.

2.3.3.1 Inflorescences length

The length of the inflorescences measured the length was measured from the apex to the base in cm.

2.3.3.2 Inflorescences shape

Blade shape, density, color, and floral leaves were tested and compared to

3. Results and Discussion

The characterization and identification of mango genotypes in this study were based on leaf morphology.

The parameters used were, leaf length, leaf width, petiol length ,leaf blade shape, leaf apex shape and leaf texture.

There are great variations in leaf length, width and petiole among the cultivars. These findings coincide with previous findings by (Elgozuli, 2011)who reported leaf length of 15- 35cm, width ranged from 4.0- 10.0cm, and petiole length of 1.1- 7.0cm. Budwar (2002) reported similar ranges of length, width and petiole depending on cultivar, climate and cultural practices. Variations within the same cultivar were observed as a result of the area where the cultivar was grown, season of growth and position of the leaf on the flush (Abdelrahman, 2009). Fivaz,(2008). reported variations between all cultivars he tested among leaf blade, apex and base shape. The study revealed that mango leaves are variable in shape and size and even color, a fact reported by Bally et al., (2009).

Variations in leaf margin and texture was reported by Bally et al.,(2009) who found that these variations were due to climate, cultural practices and growth stage.

Leaf length showed significant differences ranging from <15cm up to > 26 cm. It was grouped into 7 categories. Segrest genotype leaf length of < 15cm. the other genotypes were grouped in the other categories, L_2, L_3, L_4, L_6 and L_7.

Leaf width ranging from 3.5 to 7.5 cm. it was grouped into 4 categories w_1, w_2, w3 and w4. Each group of the leaf length matched with the groups of the leaf width.

From the second group of leaf length (L_2: 16- <18cm) which contains 5 genotypes, 3 of them have the same leaf width where as Nailum and Bizrtshendi with leaf width range of 4.5 - < 5.5 and 6.5 -7.5 cm respectivly were separated.

The third category of leaf length L_3 (18- < 20 cm) separated in to 3 groups according to leaf width. Wad srear was separated alone.

Ln categony t4 (20 – c22cm) leaf length Malgoba was separated with leaf width of 3.5 -< 4.5 cm, where as other genotypes with L_4 were grouped into two categories. Only 3 genotypes were grouped in category 6 of leaf length. Leaf width of 6.5 - < 7.5 cm. The other 2 have a leaf width of 4-5 -<5-5 cm

L7 the last category of leaf length > 26 cm Taiba has a leaf width of 4.5 -<5.5cm and Rasmakloul has 6.5 -< 7.5 cm leaf width.

The third parameter to identify mango genotypes was petiol length.

The genotypes which were not identified according to leaf length, leaf length and width were further identified with leaf petiol length.

According the leaf length and matching leaf width the genotypes that were not identified were grouped into 7 categories viz L_1W_1, L_3W_2 ,L_3W_3 ,L_4W_2, L_4W_3, L_6W_2 and L_7W_3 Petiol length was grouped into 6 categories ranging from 2cm up to < 4.5 cm.

From the first group of leaf length-Width ($L_2 W_1$) Shendi I have 3- < 3.5 cm petiol length. Group3($L_3 w_3$) Bit abusamaka and Mahmoudi have petiol length of 2-< 2.5 and 3- < 3.5 cm respectively. Group 4($L_4 W_2$) separated by petiol length, Mitlaky with petiol length of 2.5 -<3 and Alphonso of petiol length of 3.5 - < 4. Julik and Yogeun both have petiol length of > 4.5 cm. Group 5 ($L_4 W_3$) was separated into Walibasha and Timor with petiol length of 3- < 3.5 and 4 - < 4.5 cm respectivly.

With petiol length of 3-< 3.5 cm Shareefia in the 6th group($L_6 W_2$)and Cutchineer in the 7th group ($L_7 w_3$) were separated. In the same group Dibasha and Bet bady with petiol length of 3.5 –<4cm were separated.

The genotupes which were not identified by leaf length, leaf width, petiol length were further undergo identification by leaf blade shape. Leaf blade shape is either Lanceolate or Elliptic. According to leaf length, leaf width and petiol length unidentified genotypes were grouped into 3 categories, $L_2W_1P_1$, $L_2w_2P_1$ and $L_4W_2 P_6$. The first group include Higazia and Shabala with Lanceolate blade shape. The second one $L_3 W_2 P_1$ include Abusamaka and Galbelower with Lanceolate leaf blade shape, and Mabroka and Zibda with Elliptic leaf blade shape. The last group $L_4 W_2 P_6$ was separated into Yageen with Lanceolat leaf blade shape and Julik with Elliptic blade shape.

Leaf apex shape, either Acute or Acumintc, was also used to Identify the unidentified genotype by the previous parameters. The group of $L_2 W_1 P_1 B_1$ was separated into Shsbala and Higazia with Acute and Acuminate leaf apex shape respectively.

The last group of leaf length, width, petiol length and blade shape ($L_3 W_2 P_1 B_2$) cantains two genotypes Mabroka and Zibda with acuminate leat apex shape.

They were separated by leaf texture with Mabroka of membranous leaf texture and Zibda with chartaceus one.

Many research workers used the leaf characteristics to identify trees. A key for identification of trees based on leaf's edge was developed by Blandy Experimental Farm Education Departmentin 2014, WWW.virginia.edu/blandy 540=837-1758. Nix, S. (2015) established a quick and easy way to identify 50 common North American Trees.

Leaf length:-

L1	L2	L3	L4	L5	L6	L7
> 15	16 - < 18	18 - < 20	20 - < 22	22 - < 24	24 - < 26	> 26
Segrest	Nailum	Abu samaka	Mitlaky		Dibsha	Kutchineer
	Shendi 1	Mabroka	Alphonso		Sinaria	Bet bady
	Shabala	Zibda	Malgoba		Shreefia	Taiba
	Higazia	Galbeltowr	Julik			Ras maktoul
	Bizrt shendi	Mahmoudi	Timor			
		Bet abusamaka	Walibasha			
		Wad srear	Yageen			

*L: length

Leaf width :-

Length	W1	W2	W3	W4	W5
	3.5 - < 4.5	4.5 - < 5.5	5.5 - < 6.5	6.5 - < 7.5	> 7.5
L2 **16 - < 18**	Shendi 1 Higazia Shabala	**Nailum**		**Bizrt shendi**	
L3 **18 - < 20**	**Wad srear**	Abu samaka Mabroka Zibda Galbeltowr	Mahmoudi Bet abu samaka		
L4 **20 - < 22**	**Malgoba**	Alphonso Julik Yageen Mitlaki	Timor Wali basha		
L6 **24 - < 26**		Dibsha Shreefia		**Sinaria**	
L7 **> 26**		**Taiba**	Kutchineer Bet bady	**Ras maktoul**	

 * W: width

Petiole length : -

Length - Width	P1	P2	P3	P4	P5	P6
	2 - < 2.5	2.5 - < 3	3 - < 3.5	3.5 - < 4	4 - < 4.5	> 4.5
L2 W1 **L2 : 16 - <18** **W1 : 3.5 - < 4.5**	Higazia Shabala		**Shendi 1**			
L3 W2 **L3 : 18 - < 20** **W2 : 4.5 - < 5.5**	Abu samaka Mabroka Zibda Galbeltowr					
L3 W3 **L3 : 18 - < 20** **W3 : 5.5 - < 6.5**	**Bet abusamaka**		**Mahmoudi**			
L4 W2 **L4 : 20 - < 22** **W2 : 4.5 - < 5.5**		**Mitlaky**		**Alphonso**		Julik Yageen
L4 W3 **L4 : 20 - < 22** **W3 : 5.5 - < 6.5**			**Walibasha**		**Timor**	
L6 W2 **L6 : 24 - < 26** **W2 : 4.5 - < 5.5**			**Shreefia**	**Dibsha**		
L7 W3 **L7 : > 26** **W3 : 5.5 - < 6.5**			**Kutchineer**	**Bet bady**		

*P: petiole

Leaf blade shape :-

Length - Width –Petiole	B1 Lanceolate	B2 Elliptic
L2 W1 P1 **L2 : 16 - < 18** **W1 : 3.5 - < 4.5** **P1 : 2 - < 2.5**	Higazia Shabala	
L3 W2 P1 **L3 : 18 - < 20** **W2 : 4.5 - < 5.5** **P1 : 2 - < 2.5**	Abu samaka Galbeltowr	Mabroka Zibda
L4 W2 P6 **L4 : 20 - < 22** **W2 : 4.5 - < 5.5** **P6 : > 4.5**	Yageen	Julik

*B: blade shape

Leaf apex shape : -

Length - Width - Petiole Blade shape	**A1** Acute	**A2** Acuminate
L2 W1 P1 B1 **L2 : 16 - < 18** **W1 : 3.5 - < 4.5** **P1 : 2 - < 2.5** **B1 : Lanceolate**	**Shabala**	**Higazia**
L3 W2 P1 B1 **L3 : 18 - < 20** **W2 : 4.5 - < 5.5** **P1 : 2 - < 2.5** **B1 : Lanceolate**	**Abu samaka**	**Galbeltowr**
L3 W2 P1 B2 **L3 : 18 - < 20** **W2 : 4.5 - < 5.5** **P1 : 2 - < 2.5** **B2 : Elliptic**		Mabroka Zibda

*A: apex shape

Leaf texture : -

Length- Width - Petiole	T1	T2
Blade and Apex shape	**Membranous**	**Chartaceus**
L3 W2 P1 B2 A2 **L3 : 18 - < 20** **W2 : 4.5 - < 5.5** **P1 : 2 - < 2.5** **B2 : Elliptic** **A2 : Acuminate**	**Mabroka**	**Zibda**

*T: texture

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