

# Differentiation of autochthonous figs from northwestern Morocco with morphological criteria

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**Abstract**— The importance varietal diversity of fig tree in the traditional agro ecosystems of the Riffian Mountains remains ignored. To evaluate it, a prospection and characterization were carried out in North West of Morocco. Seventy-five morphological parameter traits were used to characterize the fig accessions. In the first way of hierarchical clustering, the fig accessions were distributed into three main groups. The groups were very heterogeneous and include many clusters separate under tow or more clusters. Thus, it could be concluded that there are a wide range of variability within the cultivated fig accessions under current study. This diversification could enrich the genetic base of this genus and required more studies to achieve the maximum usefulness from this diversification.

**Keywords**— Fig, morphology, diversity, cluster analysis, Morocco.

## I. INTRODUCTION

*Ficus carica* L. is a diploid species ( $2n = 26$ ) [1] that belongs to the Moraceae family. It is characterized by the presence of latex in all parts of the plant. The fig is probably the oldest cultivated crop [2], being widely used as a fruit tree in the eastern Mediterranean regions of Europe and Africa and in southwestern Asia [3]. It is the only species of this family cultivated for its edible fruits [1], [4]. In Morocco, the cultivation of the fig tree is ancestral, the villagers of some production areas (Taounate, Chaouen, Ouezane) claim that its culture is very old and that the dried fruit traded with cereals, from the Gharb. Its cultivation, which once covered a number of flat lands, is currently limited to hills, sloping land and housing. Indeed, this fruit tree is considered secondary and sometimes grown on the edges of orchards to protect them. The fruits are mainly destined for the local market and eaten fresh or dried. This Mediterranean fruit has been linked and has been classified as a minor species despite the role it can play in the development of many areas, especially with the drought and the reduction in the cold availability necessary for fruiting. Intensive fruit species such as apple, peach, pear, etc. The marginalization of the *F. carica* culture exposes the species to severe genetic erosion. It is therefore imperative to put in place a safeguarding strategy aimed at preserving and protecting this heritage.

The varietal heritage of the fig tree (*Ficus carica* L) on the Mediterranean scale consists of a few hundred varieties

whose genetic diversity has been characterized essentially morphologically [4], [5]. Several studies have reported the use of morphometric and pomological parameters as well as isozyme markers to discriminate fig cultivars [6], [7], [8]. In Morocco, the first work concerning the pomological description of fig tree varieties was made by [9] but from surveys limited to the Chefchaouen region. In order to analyze the constraints affecting the production and marketing of figs, important factors for the development of this sector, particularly the knowledge and characterization of local varieties, must be taken into account. In this context, a study identifying the differentiation of local varieties using morphological parameters was carried out in the northwestern region of Morocco.

## II. MATERIAL AND METHODS

### Plant material

The study looked at 96 ecotypes of fig trees prospected in northern Morocco. It is about 49 indigenous figs, well spread in the orchards of northern Morocco (Table.1). The work was based mainly on surveys carried out in 14 stations in four large areas in the north - west of the country. These stations were chosen according to the importance of fig orchards in agrosystems (Fig. 1).

- Beni Ahmed area: characterized by its richness in fig and caprifiquier as well as a good knowledge of cultivation techniques in particular caprification.

- Areas of Moukrisset, Zoumi and Oued Laou: areas rich in figs with very diversified varieties, but with a lack of knowledge of caprification techniques.

- Khmiss anjra area: is a new and much diversified variety of resources especially in Douar Tafza, this area is also characterized by a neglect of caprification.

Table.1: List of varieties studied

The main varieties		
Rhoudane	Saadi	Jouhri
Gaouizi	Lemti	Ournakssi
Ferzaoui	Sinani	Kharar
Baghi assal	Achir	Hafer elbrel
Harchi el khal	Hafri	Sbaa ou rhgoud
Meltoufa	Chitoui	Kohli
Kharaza	Bakour	Zerki
Tahadakte	Larchan	Tbantou
Tabli	Mouslikh	Sibti
Hazouta	aroui	Kourti
Lmdar	L'khoubiz	Silfaf
L'hmar	Lndbar	Smouni
Fassi	L'beidi	Khoumsi
El messari	harchi lbeid	Ounk Hmam
Makoutia	L'mdar eL khal	Ozilane
Qouti	Maalmouss	
Lassoune	Zenfoukh	

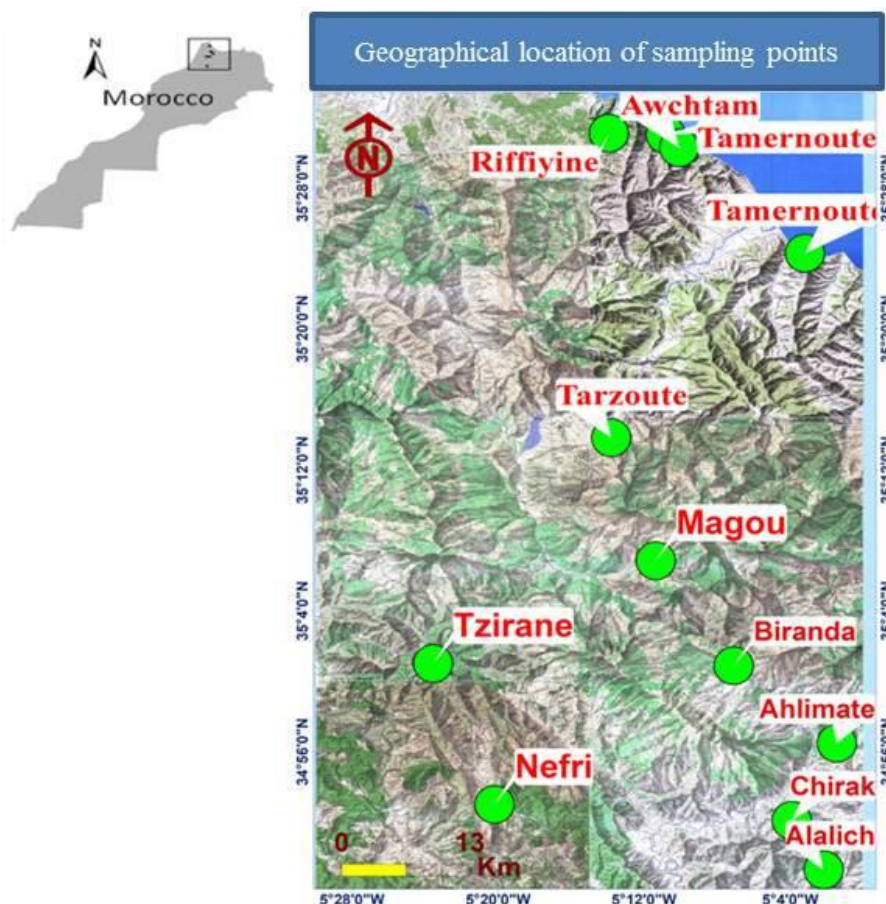


Fig. 1: Localization of the sites prospected

**Morphological character**

The characteristics studied concerned the vegetative development of the tree and, in particular, the measurement of certain parameters characterizing the growth of leaves and shoots developed during the years 2015 and 2016. For each ecotype, the measurements were carried out on two trees and, for each tree, six shoots selected on the south, north-east and north-west sides, at the rate of two shoots per exposure.

We took into account 3 characters: tree habit, leaf type and lobes. For each character, the different modalities are considered (Table 2).

Harbor of the tree:

It corresponds to the general appearance of the tree, there are 5 cases:

Erected: The outer shape of the set of leaves on the tree forms an angle of 60 °,

Semi-erect: The outer shape of all leaves on the tree forms an angle of 80 °,

Compact: The outer shape of all leaves on the tree forms an angle of 90 °,

Spread: The outer shape of the set of leaves on the tree forms an angle of 100 °,

Falling: The outer shape of all leaves on the tree forms an angle of 120 °.

Type of leaves:

This character corresponds to the number of leaves divided by 5 cases: leaves of a single division, leaves little divided, leaves moderately divided, leaves divided, leaves very divided:

Lobe :

The lobes of fig leaves differ in their depth, so we can distinguish leaves with lobes: very shallow, shallow, medium, deep, very deep.

Table. 2: Morphological characters studied

Character	Modality
Tree port	Erected
	Semi erected
	Compact
	Spread
	drooping
Sheet type	1 piece
	Little divided
	Middle divided
	divided
	Very divided
Lobe	Very little deep
	Shallow
	Middle Deep
	Very deep

*Fruit general appearance*

For the general appearance of fruits,

a set of qualitative and quantitative characteristics has been studied, several modalities have been taken according to each parameter (Table 3).

Table. 3: Fruits General Appearance

Character	Modality
Average height	Very small
	small
	Average
	Big
	Very big
Average weight	Very light
	Lightweight
	Way
	Heavy
	Very heavy
Skin	Very delicate
	Little Delicate
	hairy
Mountain peak	No Pubescente
	Round
	Dish
	flattened
	Spherical
Form	egg-shaped
	pyriform
	Turbiniforme
	Squash

**External and internal characteristics of the fruit**

For the general appearance of the fruit, 10 quantitative and 12 qualitative characters were studied. For the external characters of the fruit (Table.4): 35 qualitative and 3 quantitative characters, while for the internal characters of the fruit, 32 qualitative characters (Table.5).

Table. 4: The external characters of the fruit

Character	Modality
Epidermis color	Light green
	Yellow
	Green yellow
	Grey
	Brown
	Purple
	Dark purple almost black
	Violet tied dark wine
	Greenish
	Golden yellow
	Red-brown

Eye	Black purple
	Violet - red
	Brown gray
	Purple
	Uniformly dark
	Closed
	Open
	Half open
	small
	Big
Peduncle shape	Providing duplication
	Variable
	Long and thin
Col	Short and thick
	strong
	Long
	Well distinct
	Contrasted to the body
	Very affected
	+/- marked
cracks	Thick
	Low Importance
	absent
Average size of the ostiole	Longitudinal
	small
	Average
	big

Character	Modality
Placenta	Yellowish-white
	Greenish white
Pulpe	Salmon pink
	Black violet
	Red
	purplish
	Pink yellow
	Amber
	Amber rose
	Pale yellow
	Red brunette

Abundance seeds	Hot pink
	Dark purplish red
	Low
Seed size	Average important
	Low
	Average important
Perfume of the fig	Low perfume
	fragrant
	Very fragrant
vesicles	finest
	Pretty fine
	Grosses
Quality	Poor
	Fair
	Pretty good
	good
State of the fig	excellent
	Fresh fig
	Dried fig

### Statistical analyzes

In order to facilitate the acquisition and processing of data, each modality has been assigned a code. The data processing is carried out using the NTSYSpc software for the UPGMA analyzes of similarities and algorithm for the construction of the clusters.

## III. RESULT AND DISCUSSION

Port of tree :

According to surveys conducted in the region, most of the trees have a semi-erect habit (48.98%, effective 24), and 34.70% have a spreading habit (number 17), the others have a falling port 10 , 20% (effective 5) and 6.12% of the trees have a compact habit, while erect varieties have not been observed. [10] have shown that the variability of the vigor and the habit of the fig tree is due to a strong reiteration of the growth which is accompanied by a significant collapse of the branches. The carrying of the tree is also heritable and this heritability can change according to genotypic diversity and ecological conditions [11].

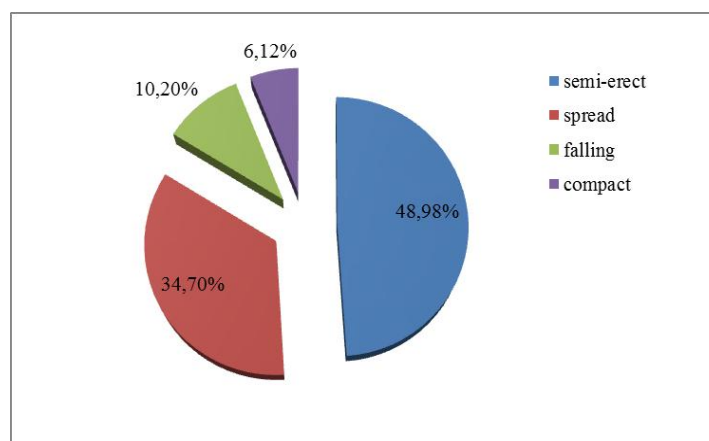


Fig .2 : port of tree

**Type of sheet:**

The importance of the morphological characteristics of the leaves (Fig. 4) for the varietal differentiation of the fig tree has been the subject of much research [12] and [13]. These traits are very important for the selection of genotypes by arborists and breeders [14].

For this trait, it was noted that the varieties' maturity is divided (63.27%, effective 31), 22.45% have medium

division leaves, 12.24% have very divided leaves and 2.04 % have poorly divided leaves, whereas no variety has leaves with a single division. These values are different (14 to 21) from those recorded by [15] but close (6 to 13) to those of [16]. Nevertheless, the differentiation of fig varieties with their leaves, especially in the number of lobes [17] and the thickness of the petiole is difficult because they are polymorphic within the same individual.

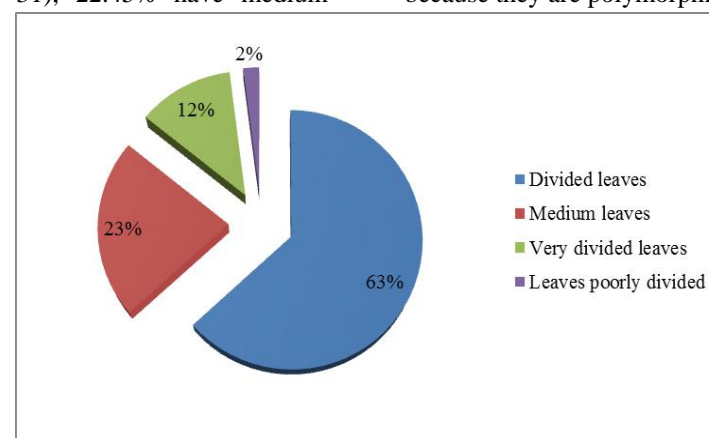


Fig.3: types of leaves

**Lobe:**

The study of the morphology of the leaves of the varieties showed that 53.06% of the varieties have a deep lobe (effective size 26), 28.58% of the varieties have an average lobe (effective size 14), while 10.20% have a shallow lobe and 8.16% have a very deep lobe (effective 4). [18] consider that the length of the petiole, the number of lobes per leaf, the length, the width and the leaf area are

important parameters for the phenotypic analysis of the fig tree, whereas for [19] they are the form of the base of the leaf, the position of the small side lobes, the degree of approval, and the number and shape of the lobes that are important. In Turkey, [16] found that the color of the petiole is a character that can also change according to the type of fig tree, the cultivar and the conditions of the environment.

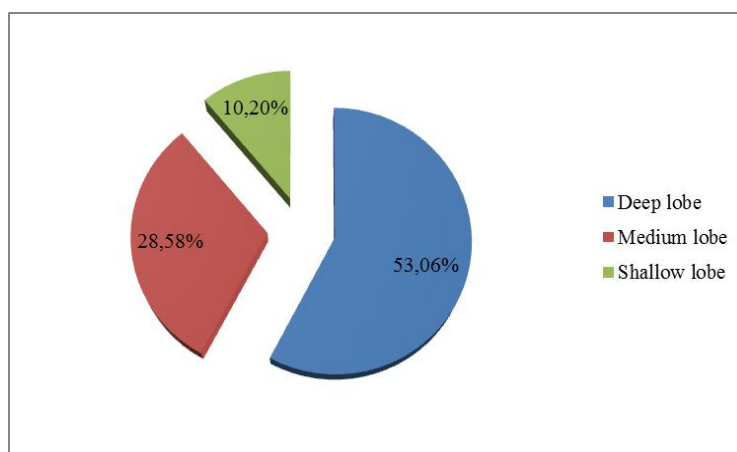


Fig.4: The different types of lobes

#### *Hierarchical classification*

In the first way of hierarchical clustering, the fig accesses were distributed into three main groups. The first group includes four clusters separate under two clusters. The first cluster included Rhouddane accessions, Baghi assal and Harchi lkhal, the second cluster included accessions, Lfassi, Lhmar. The third group was heterogenous (Fig.5). The analysis of the data shows that these types have a great variability as well as the variety. The varieties which bear the same name, with the same morphological

characters, but it is a general case. We think that they may be in certain cases different varieties but bearing the same name (homonymy) or on the contrary (synonymy). As they can be in other cases polymorphic varieties, polyclonal nature of the varieties is shown in the evaluation of the national collection [20]. It is thus necessary to record the importance of the problems of denomination of the species listed in the prospected area. These problems are due to local names which vary from one locality to another and the absence of the syntheses and varietal characterization.



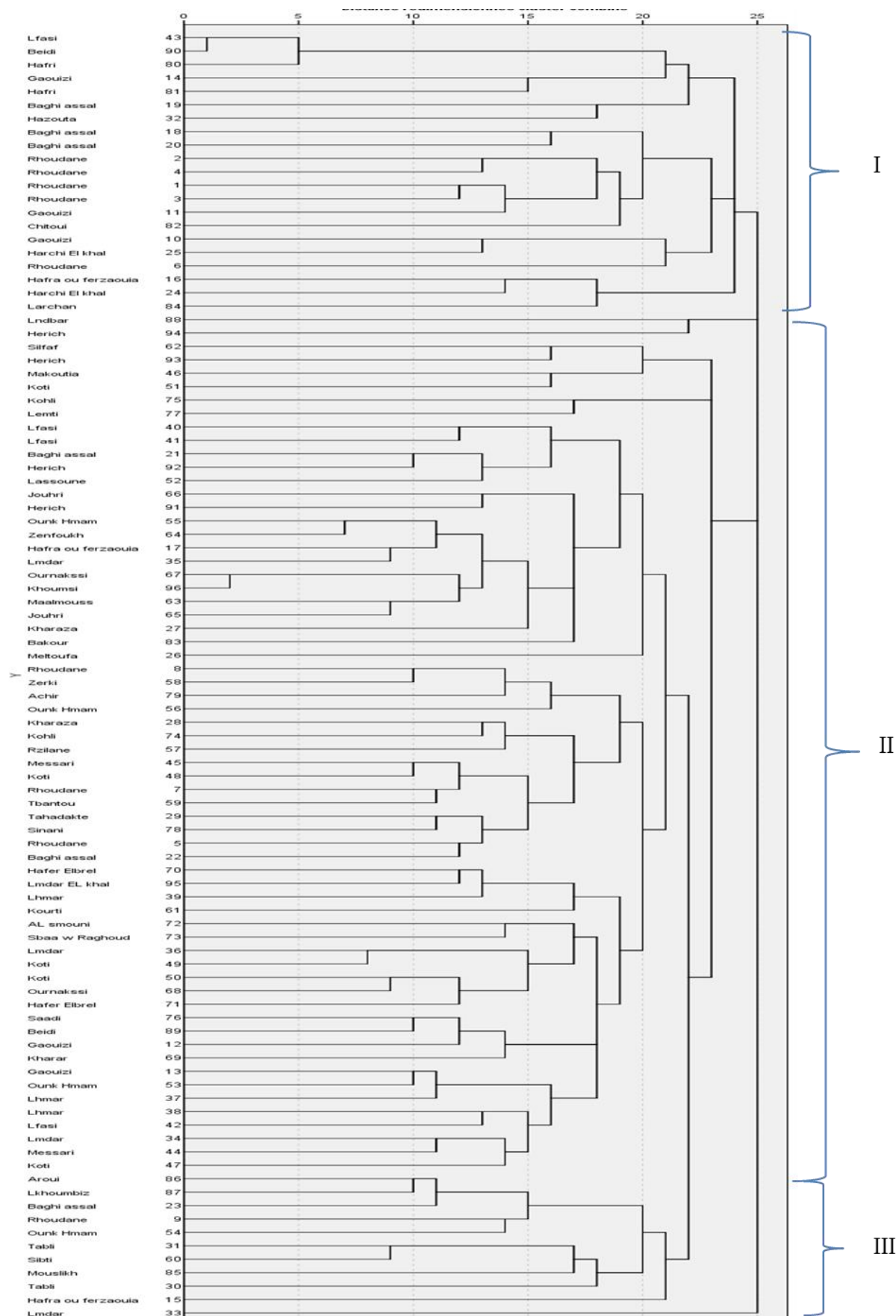


Fig. 5. Representation in cluster of individuals of the north region of Morocco.

#### IV. CONCLUSION

It could be concluded that there are a wide range of variability within the cultivated fig accessions under current study. This diversification could enrich the genetic base of this genus and required more studies to achieve the maximum usefulness from this diversification. Morphological results will be useful in characterizing and to create the first reference and catalogue of the fig accessions.

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