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Pomological Characterization of the Mulberry Tree (*Morus* spp.) in the South of Tunisia

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Abstract: In Tunisia, the mulberry tree is limited to certain orchards in the coastal zones and the oases. In spite of its various uses, this species is threatened by the extension of the urbanization. It is in order to contribute to a better knowledge of the variability of mulberry tree in the Tunisian South than one makes a pomological characterization of the sheet and fruit. This study shows the existence of the differences on the level of the form, the size and the color of the sheets and the fruits. The leaf area varies from 44 cm^2 for the cultivar Elmay I to 254.68 cm^2 for that of Jara. The fruit weight varies 1.091 g for Midoune I with 6.245 g for Gafsa III. The studied cultivars belong to the species *Morus alba*, *M. nigra* or *M. rubra*.

Keywords: Morphological characters, Mulberry variability, South of Tunisia

1. Introduction

Mulberry (*Morus* spp.) are trees of the family Moraceae. There are 24 species of Morus and one subspecies, with 100 known varieties (Ercisli & Orhan, 2007). The various methods used in classification of *Morus* were mainly based on the conventional systematic studies (Seringe, 1855; Burgess and Husband, 2006) and agronomic characters (Katsumata, 1972). The difficulty of fruit conservation and the reduction in the use of its foliage for silkworm food (*Bombyx mori*) menace the existence of mulberry and support its extinction. This work aims to contribute to better knowledge of the present cultivars of mulberry tree in Tunisia by studying their morphological variability.

2. Materials and Methods

2.1. Morphological analysis

Following a prospection in the southern Tunisian zones of Gabès, Gafsa, Djerba and Zarzis, 23 cultivars were the subject of this study (**Table 1**). Ten leaves and ten fruits were collected by cultivar in full maturation, in order to determine their descriptors (**Table 2**).

2.2. Statistical analyses

A variance analysis (ANOVA) was done for the quantitative morphological characters. Results were significant when $p < 0.05$. Whereas the qualitative morphological characters variations were evaluated using the contingence tables of the chi-square test with a confidence level of 95 %.

Table 1. Localization and main ecological traits for the 23 *Morus* spp. collected cultivars (Cointepas and Gaddar, 1973; INRF, 1976).

Locality	Code	Edaphic substrate	Bioclimatic stage	Rainfull (mm/year)
Djerba	1, 2, 3, 4, 5, 6, 7, 8, 9	Isohumic ground, subtropical	lower arid with hot winter	244 - 209
Zarzis	10, 11, 12, 13	Isohumic ground	lower arid with Moderate winter	125.3 - 218
Gabès	14, 15	Calcomagnes imorphes, gypseous ground	lower arid with Moderate winter	90 - 230
Gafsa	16, 17, 18, 19, 20, 21, 22, 23	Partially gypseous, halomorphic ground	lower arid with fresh winter	207.2

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Table 2. Examined morphological characters.

Qualitative characters	Abbreviation	Quantitative characters	Abbreviation
Limb contour serration	L Cn	Petiole length	PL (cm)
Apex form	AF	Leaf surface	LS (cm^2)
Leaf form	LF	Fruit weight	FW (g)
Leaf color	LC	Fruit length	FL (cm)
Leaf rugosity	LR	Fruit dispatcher length	FD (cm)
Petiole color	PC	Stalk length	SL (cm)
Lobes presence	LP		
Fruit color	FC		
Hair presence on fruits in the maturation stage	HP		
Stalk color	SC		

3. Results and Discussion

3.1. Leaves morphological characterization

The variation of the leaves qualitative morphological characters is represented in **Figure 1**. The majority of the cultivars had an oval leaf form (78%). A percentage of 44% of the studied cultivars had green leaves, 43% dark green leaves and only 13% clear green leaves. 39% of the cultivars presented fair teeth leaves, 35% were lightly cogged and 26% deeply cogged. For the apex form, 52% were characterized by a triangular apex, 35% acute, 9% round and 4% blunt. For the leaves rugosity character and the presence of lobes, the majority of the cultivars were respectively smooth (61%) and without lobes (84%). Variations of the qualitative leaves parameters (LC, LCn, LF, LR, PC AF and LP) were independent from cultivars variations ($p = 1 > 0.05$). The quantitative variation of leaf characters were presented in **Figure 2**. The character leaf surface varied from 44 cm^2 for the cultivar 1 to 254.68 cm^2 for the cultivar 14 ($p < 0.05$). The petiole length varied from 1.93 cm to 6.56 cm ($p < 0.05$).

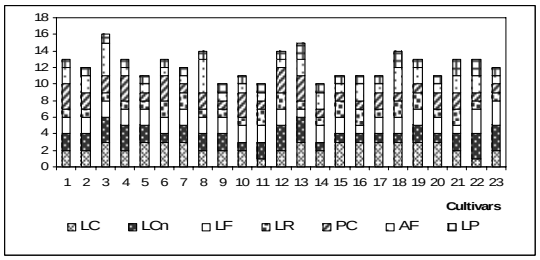

Fig. 1. Qualitative leaves variations descriptors of the studied cultivars.

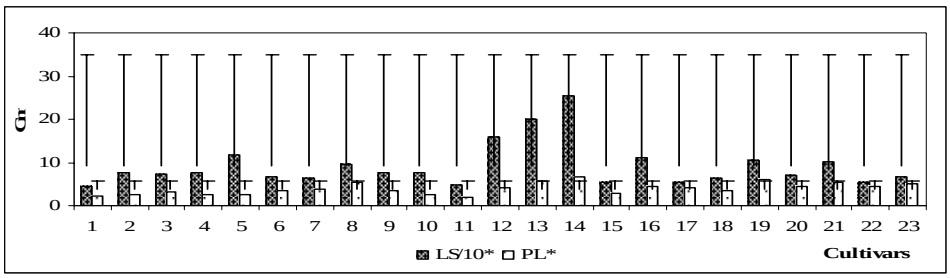

Fig. 2. Quantitative leaves variations descriptors of the studied cultivars. * Significant variation (ANOVA). The bar of error corresponds to the standard deviation between ten repetitions.

3.2. Fruits morphological characterization

For the fruit color, 56 % of the cultivars had purplish brown fruits, 22% had white fruits, 13% dark red and 9% black fruits ($p < 0.01$). For the stalk color, 61% of the cultivars presented clearly green stalks, 30% green stalks and 9% dark green stalks ($p < 0.01$). The abundance of hairs in maturation was noticed in 74% (**Fig. 3**). Variations of the qualitative fruits characters (HP, FC and SC) were independent from cultivars variations ($p = 1 > 0.05$). The cultivars showed significant differences in the fruit weight, FW varied from 1.091 g for the cultivar 3 to 6.245 g for the cultivar 19. For the fruit length and dispatcher

and stalk length characters, the measurements varied respectively from 1.461 cm (cultivar 14) to 3.196 cm (cultivar 20), 0.808 cm (cultivar 3) to 1.741 cm (cultivar 21) and 0.641 cm (cultivar 1) to 2.313 cm (cultivar 5) (**Fig. 4**). Variations of the quantitative characters were significant ($p < 0.05$) except for the character SL ($p = 0.439$).

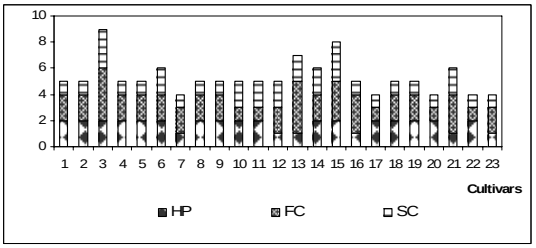

Fig. 3. Qualitative fruits variations descriptors of the studied cultivars.

The morphological analysis constitutes a first approach of the genetic diversity assessment. Prospections, leaves morphological characterizations and classification of the various mulberry tree species according to several criteria were carried out in many countries of the world. The characterized species were *Morus alba*, *M. alba pendula*, *M. will nigra*, *M. celtidifolia*, *M. multicaulis*. (Guillaud, 1899; Seringe, 1855).

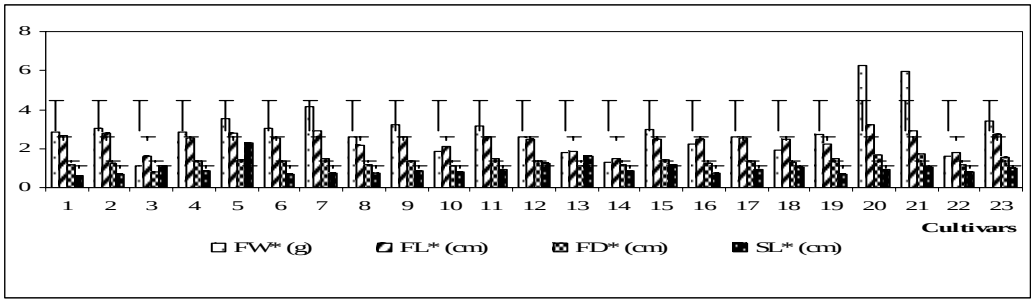

Fig. 4. Quantitative fruits variations characters of the studied cultivars. * Significant variation (ANOVA). The bar of error corresponds to the standard deviation between ten repetitions.

4. Conclusion

The morphological studies showed the existence of significant variability between the 23 cultivars of our collection, concerning the size, the weight and the color of the leaves and fruits.

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