

Study of the Morphological Variability of the Fruits of Some Coastal Date Palm (*Phoenix dactylifera* L.) Cultivars in Tunisian Oases

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Abstract: This work consists in studying the variability of the fruits of sixteen coastal date cultivars at the stage “Tamar”, the last stage of maturity of the fruit, collected from the coastal oases of Gabes and from the island of Djerba. Thus, thirteen parameters (qualitative and quantitative) concerning the pulp and the seed of the fruit were the subject of this study. Results show an important variability between the studied cultivars. The Principal Component Analysis (PCA) makes possible to distinguish differences between cultivars. Fruits of the cultivars Ammari, Korkobi 2, Mermella and Rotbi are smaller than others of which values of Lth f, Wd f, Wg f and T p are lower than those of others. The PCA analysis shows a big variability for all morphological parameters.

Key words: Coastal cultivars, Date palm (*Phoenix dactylifera* L.), Morphological variability, PCA analysis

1. Introduction:

The date palm (*Phoenix dactylifera* L.) forms the principal framework of the oasien ecosystem. In Tunisia, we distinguish three types of oasis of which the coastal oases that contain only common varieties as predicted by GID (2004) and Rhouma *et al.* (1996) of less commercial importance compared to the variety Deglet Nour. The aim of this work is the recovery of these dates by studying the morphological variability of the fruits of sixteen coastal date cultivars at the stage “Tamar”. Thus, thirteen parameters (qualitative and quantitative) concerning the pulp and the seed of the fruit were the subject of this study.

2. Materials and methods

2.1. Plant material

Sixteen coastal date cultivars (coastal oases of Gabes and the island of Djerba), collected at the stage “Tamar”, were the subject of this study (Table 1).

Table 1. Designation of different studied varieties of Tunisian dates and their origins.

Number of cultivar	Cultivar	Code	Place of collection
1	Ammari	Amm.	Djerba
2	Baht	Baht	Zarat
3	Bekrari	Bek.	Elhamma
4	Bou Hattem	B. H.	Chenenni
5	Eguiwa	Egw.	Dkhilt Toujène
6	Garn Gzel	G. G.	Elhamma
7	Halway	Hal.	Zarat
8	Kenta	Kent.	Elhamma
9	Korkobi 1	Kork.1	Djerba
10	Korkobi 2	Kork.2	Zarat
11	Lemsi	Lem.	Djerba
12	Mermella	Mer.	Elhamma
13	Nefzawi	Nef.	Zarat
14	Smitti 1	Smit.1	Elhamma
15	Smitti 2	Smit.2	Zarat
16	Rotbi	Rot.	Chenenni

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2.2. Morphological parameters

The morphological characterization of the fruit is carried out thanks to the thirteen parameters which relate to the pulp and the seed of fruit (**Table 2**).

Table 2. Morphological parameters studied and their designations.

Morphological parameter	code	Unit
Colour of the fruit	Cl	scale of notation
Texture fruit	Txt	scale of notation
Consistency of the fruit	Cst	scale of notation
Weight of the fruit	Wg f	gr
Weight of the seed	Wg s	gr
Length of the fruit	Lth f	mm
Length of the seed	Lth s	mm
width of the fruit	Wd f	mm
width of the seed	Wd s	mm
Thickness of the pulp	T p	mm
Weight of the seed/Weight of the fruit	R1	-
Length of the seed/Length of the fruit	R2	-
width of the seed/ width of the fruit	R3	-

With: gr: gram; mm: millimetre.

3. Results and Discussion

3.1. Characterization of dates on the basis of morphological descriptors

The quantitative and qualitative parameters are different from a cultivar to another.

The weight of fruit varies from 11.28 mm for the cultivar Nef. to 4.34 mm for the cultivar Mer. The cultivar Nef. has a fruit whose size is the most important, the average length of this fruit is 48.41 mm, it is a fruit of a elongated shape. The length of this date is similar to the variety Deglet Nour whose average Lth f is of 45 mm as predicted by Rhouma *et al.* (1987).

The parameters R1 (weight of the seed / weight of the fruit), R2 (length of the seed/ length of the fruit) and R3 (width of the seed / width of the fruit) show significant variability between different cultivars. The parameter R1 varies from 28.27 for the cultivar Mer. to 11.94 for the cultivar Hal. These differences may be due to the characteristics of cultivars or the effect of pollination. Indeed, the absence or the poor pollination gives a fruit of poor quality. The qualitative parameters (Txt, Cl and Cst) vary from a cultivar to another.

Thus, even Kork.1 and Kork.2, which belong to the same variety they show differences, they have different textures and consistencies: Kok.1 (from Djerba) is soft and honeyed while Kork.2 (from Zarate) is dry and fibrous. Smit.1 and Smit.2 belonging to the same variety but different origin are also different: Smit.1 is soft while Smit.2 is half-soft. This can be explained by the effect of cropping site of cultivars. They may be close or far from shore with hot or humid or rainy or not climate as predicted by Rasoazanakolona (2001).

3.2. Group and study of correlations between cultivars: Principal Component Analysis

The ACP, that describes and classifies all samples in smaller spaces dimensions, was applied to the matrix of morphological data. The first two axes of the ACP (1 and 2) express 71% of the total variability estimated from the morphological characteristics.

In the plan 1-2, the correlation circle (**Fig. 1a**) shows the distribution of varying 2 groups of compounds highly representative according to axis F1:

- Group1: the parameters R1, R2, R3 and Lth s;
- Group2: contains settings T p, W f, Lth f and Lr f.

Groups 1 and 2 are negatively correlated in the plan 1-2. Thus, the representation of samples in this landmark shows that: cultivars Amm., Mer. and Kork.2 reporting R1, R2 and R3 lower and low values of Lth f and Lth s and W f. These cultivars have smaller size and weight compared to others.

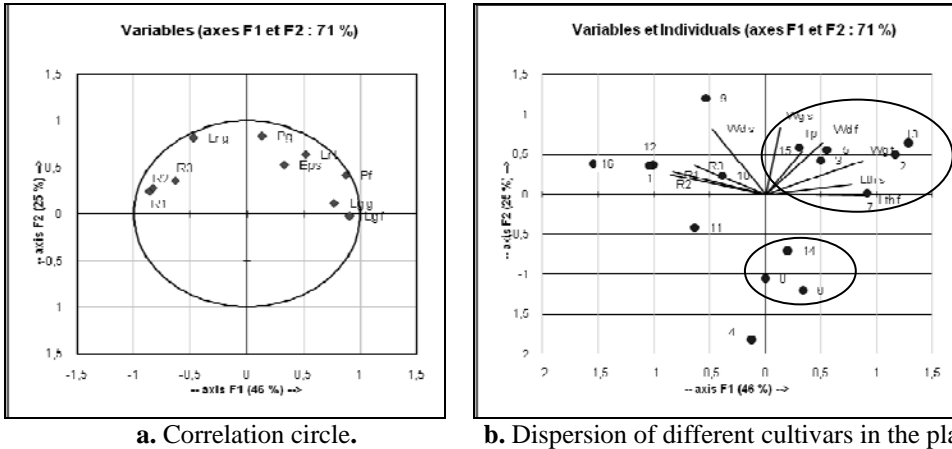


Fig. 1. Dispersion of individuals and variables made through the ACP analysis from morphological characteristics.

In general, we observe a big variability for all morphological parameters as shown by the correlation circle; they are distributed far from the centre of the circle.

The analysis of the matrix (Table 3) confirms the results given by the circle of correlation. It shows that parameter correlations have more or less importance. A positive correlation exists between Lth s and R1 and R2 and a strong negative correlation between the parameter Lth f and R2 and R3. Thus, a study of a parameter can give an idea on the other according to the synergy or the antagonism of parameters.

According to the distribution of the individuals in the plan 1-2 (Fig. 1b), we can notice that cultivars were distributed into groups according to axes 1 and 2. We distinguish:

- Group 1: formed of the cultivars collected from Zarat such as: Nef., Baht, Halw., Smit.1 (numbered on the plan 1-2: 13,1,7 and 15 respectively). These cultivars are, for the majority, soft.
- Group 2: contain cultivars collected from Elhamma such as: G. G., Kent. and Smit.2. (numbered on the plan 1-2: 6, 8 and 14 respectively). These cultivars are, for the majority, dry to half-soft.

Concerning the cultivars resulting from Djerba and Cheninni, they are set far from the other groups. The cultivar Rot., which is collected from Cheninni, differs significantly from all others cultivars; it has a strong negative correlation with axis F1 and a positive correlation with the axis F2. As for the cultivar B. H. whose negative correlation is very high with the axis F2.

In fact, some cultivars of the same varieties are distributed differently, the cultivar smit.1 and smit.2 of the variety Smitti belong to different groups from different origins (Zarat and Elhamma) in the plan 1-2 of PCA analyze.

These results can reinforce the assumption of geographical sites effect on the morphological characterization of date palm fruits, knowing that Zarat is close to the sea compared to Elhamma.

Table 3. Correlation matrix of morphological parameters of Tunisian coastal dates studied.

	W f	W s	T p	Lth f	Lth s	Lr f	Lr g	R1	R2	R3
W f	1									
W s	0.51	1								
T p	0.44	0.14	1							
Lth f	0.79	0.28	0.09	1						
Lth s	0.74	0.47	0.06	0.93	1					
Lr f	0.66	0.43	0.65	0.26	0.19	1				
Lr g	-0.07	0.53	0.30	-0.50	-0.39	0.35	1			
R1	-0.67	0.27	-0.32	-0.64	-0.44	-0.39	0.52	1		
R2	-0.61	0.21	-0.18	-0.74	-0.45	-0.30	0.56	0.81	1	
R3	-0.35	0.29	-0.09	-0.43	-0.29	-0.34	0.55	0.63	0.48	1

In bold, significant values (excluding diagonal) threshold alpha = 0.05 (bilateral test).

But these results should not be taken as assertion, they must be reinforced by chemical and molecular analyzes.

4. Conclusions

The morphological characterization of coastal dates revealed a significant variability. The differences were revealed between all cultivars for all morphological parameters (qualitative and quantitative ones) as shown by the PCA analyse. The parameters have different correlations between them, some ones are correlated positively, others negatively.

Thus, the PCA analyze distinguish the differences between cultivars: Amm., Kork.2, Mer. and Rot. These varieties have smaller sizes with values of Lth f, Lth s, Wg f and T p lower than those of other coastal cultivars studied.

These differences appear between dates of the different varieties, but also within same varieties of which the geographic origin are different. This can be explained by the effect of sites of cropping. The cultivars can be near or far from coast, the climate can be heat or wet or rainy or not.

In fact, this morphological characterisation of date palm fruits is a preliminary study which can be reinforced by others markers with more specificity as chemical and molecular markers.

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