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Research paper

Morphological characteristics denomination of date palm studied cultivars

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Absract

Sixteen cultivars of Algerian date palms have been characterized to estimate the degree of polymorphism and the level of similarity possible. Twenty-seven morphological traits were exploited and subjected to analysis of the principal components of the PCA, ascending hierarchical classification AHC and correlation. The results showed significant differences in morphological characters of all date palm cultivars. PCA indicated that all the characters of the date and seed are divergent with the width of the right and left spine, the characters of the date are divergent with the thickness of petiole between spines and leaflets. And all characters of the leaflets are divergent with the right leaflets angle. Similarly, the AHC also revealed a morphological variability of cultivars and a certain relationship and heterogeneity was also observed for cultivars of the same date consistency.

Keywords: Date palm, cultivar, correlation, morphologicalcharacters, polymorphism.

Résumé

Seize cultivars de dattiers algériens ont été caractérisés pour estimer le degré de polymorphisme et le niveau de similitude possible. Vingt-sept traits morphologiques ont été exploités et soumis à l'analyse des principales composantes PCA, à la classification hiérarchique ascendante CAH et à la corrélation. Les résultats ont montré des différences significatives pour les caractères morphologiques de tous les cultivars de palmiers dattiers. L'ACP a montré que tous les caractères de la date et de la graine sont divergents avec la largeur des épines droite et gauche, tandis que les caractères de la date sont divergents avec l'épaisseur du pétiole entre les épines et les folioles. Et tous les caractères des pennes sont divergents avec l'angle droit des pennes. De même, la CAH a également révélé une variabilité morphologique des cultivars et une certaine relation et une hétérogénéité ont également été observées pour les cultivars de même consistance de date.

Mots clés: Palmier dattier, cultivar, corrélation, caractères morphologiques, polymorphisme.

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1. Introduction

The date palm (*Phoenix dactylifera* L.), 2n = 36 is a monocotyledon perennial plant of the genus *Phoenix*, this genus includes 14 species distributed in the tropical and subtropical regions of the Old World (Barrow, 1998;Govaerts&Dransfield, 2005; Henderson, 2009), from the family *Arecaceae* (*Palmae*). The date palm is a thermophilous species and is cultivated as a fruit tree in the arid and semi-arid regions of the hot globe (Munier, 1973). Is the mainstay of the oasis ecosystem (Bouguedouraandal., 2010). Indeed, this species constitutes the framework of the ecophytocenosis of the oases, creating a mesoclimatefavorable to the life of the man, his crops and his livestock, allowing him to stay in a difficult desert environment (Skouri, 1990).

The traditional or potential historic crop area is found in the arid and semi-arid hot areas of the Old World at a latitude between 15 ° N and 35 ° N (Zoharyandal., 2012) Northern and southern Spain, the Middle East, Pakistan, and northwestern India (Munier, 1973; Barrow, 1998). Its origin in Mesopotamia (Wrigley, 1995). In Australia, it was first introduced by seed in the 19th century and later via releases imported from the United States, Iraq and Algeria, which allowed the development of large palm groves for ecotourism (Ouennoughi&Dubost, 2005).

Worldwide, 800 000 ha are dedicated to date tree cultivation (Elhoumaiziandal., 2002) and the number of date palms in the world is estimated at about 100 million (Zaid, 2002), which is increasing every year (FAOSTAT, 2017).

The mature date tree produces 100-120 numbers of green leaves (3-5 m). Each leaf contains varying numbers (120-150) of leaflets, fleshy leaflets with sharp spikes on both sides; while the petiole contains a number (20-40) of spine which later changes in the basal laminae. Both pamphlets and spines vary in length depending on leaf position, cultivar type and climatic conditions (Summarand*al*., 2015).Studies on the characterization of date palm cultivars are rare (Baker and*al*., 1999).

The signature of the Convention of Biological Diversity (CBD) in 1992 and the adoption of national regulatory frameworks for access to genetic resources.In the world the date palm cultivated on an area of 1353159 hectares with nearly 100 million palm trees and a production of 8460443 tons (FAOSTAT, 2017). The date palm cultivation in Algeria occupies an area of 167,269 hectares with 18.5 million palm trees and a production of nearly 1 million and 29,596 tonnes (MADRP, 2017). The variety inventory has identified more than 1100 cultivars (Hannachi, 2015) but only a few are commercially important.Elhoumaizi (1993), he worked on the search for discriminating morphological criteria for the vegetative reproductive system of date. Harrak et al. (2003) worked on characterization using dates. Studies on the characterization of date palm cultivars are rare (Baker et al., 1999).

This study focuses on the quantitative morphological characterization of some date palm cultivars in the Ziban region of Algeria.

2. Materials and methods

2.1. Plant material

We took palms and dates and these cores for sixteen cultivars in the Ziban region (figure1) for morphological characterization. Details of cultivars with their coordinates are shown in (Table 1).

Figure 1.Biskra area in Algeria.

Table1.Date palm studied cultivars.

Number	Cultivar ID	Cultivar	Longitude	Latitude	Altitude
1	C1	Degletnour	E 5°.01.110	N 34°.23.058	204
2	C2	Ghars	E 5°01.268	N 34°23.103	195
3	C3	Mechdegla	E 5°01.099	N 34°.23.084	189
4	C4	Deglabeida	E 5°.01.125	N 34°.23.085	202
5	C5	Litima	E 5°.01.124	N 34°.23.061	201
6	C6	Heloua	E 5°.01.093	N 34°.23.056	200
7	C7	Tantbouchet	E 5°01.264	N 34°23.105	192
8	C9	Hamraya	E 5°01.234	N 34°23.077	194
9	C40	Thouri	E 5°01.108	N 34°.23.077	192
10	C47	Elhorra	E 5°01.150	N 34°23,060	190
11	C51	Bouhlas	E 5°01.190	N 34°23.083	189
12	C52	Eche el oued	E 5°01.105	N 34°.23.087	201
13	C53	Degletlehsir	E 5°01.240	N 34°23.065	194
14	C54	Moukentichi	E 5°.01.070	N 34°.23.073	198
15	C55	Degla 01	E 5°01.140	N 34°23.093	188
16	C56	Degla 02	E 5°01.248	N 34°23,102	195

2.2. Method

Twenty-seven quantitative traits were measured (Table 2) on 320 dates and seeds and 48 palm date palms representing 16 date cultivars, 20 dates and seeds and 3 palms cultivars. Morphometric characters were measured by meter for dimensions, balance for weights and circle for angles using standard date palm descriptors (IPGRI, 2005).

Table2.Morphological characteristics denomination of date palm studied cultivars.

Characters	Dénomination	Unit
Length of the date	LD	(cm)
Width of the date	ED	(cm)
Weight of the date	PD	(g)
Seedlength	LN	(cm)
Seedwidth	EN	(cm)
Seedweight	PN	(g)
Right leafletlength	PLD	(cm)
Right leafletwidth	PED	(cm)
Right leaflet angle	PAD	(°)
Leftleafletlength	PLG	(cm)
Leftleafletwidth	PEG	(cm)
Leftleaflet angle	PAG	(°)
Right spinelength	ELD	(cm)
Right spinewidth	EED	(cm)
Right spine angle	EAD	(°C)
Leftspinelength	ELG	(cm)
Leftspinewidth	EEG	(cm)
Leftspine angle	EAG	(°C)
Leaflength	LP	(cm)
Thickness of petiole between spines and leaflets	EPP	(cm)
Width in the middle of the leaf	EP	(cm)
Length of the pinnate part	LPP	(cm)
Length of the spineate part	LPE	(cm)
Right leafletsnumber	NPD	
Leftleafletsnumber	NPG	
Right spinenumber	NED	
Leftspinenumber	NEG	

2.3. Statistical analysis

Multivariate analysis was performed using XLSTAT 2017. PCA and CAH were run for correlation measurement and plot projections of variables and cultivars (Snedecor and Cochran, 1968).

3. Results and discussion

The main analysis of distributed components 27 morphological variables of palm, date and seed in two components accounted for 46.928 % cumulative diversity (Table 3). The first factor accounted for 25.123% of the variability including seed length, date length and left and right spine number, length of the spine, width of the date and seed, the length of the leaf, the length of the left leaflet, the weight of the date, and the length of the right leaflet. For factor 2, the variability was 21.804% was observed on the left spine angle, the number of right and left leaflets, the right spine angle, the right and left leaflets width, the length of the spine. Right and left leaflets, the right and left spine width and the weight of the seed.

Tableau 3.Cosinus squares variables.

	F1	F2	F1+F2
LD	0,659	0,008	0,667
ED	0,440	0,001	0,441
PD	0,202	0,075	0,277
LN	0,680	0,020	**0,700**
EN	0,308	0,009	0,317
PN	0,002	0,213	0,215
NPD	0,006	0,580	0,586
NPG	0,009	0,541	0,550
PLD	0,187	0,447	0,634
PLG	0,233	0,398	0,631
PED	0,382	0,505	**0,886**
PEG	0,428	0,464	**0,892**
PAD	0,050	0,278	0,328
PAG	0,032	0,130	0,163
NED	0,553	0,002	0,556
NEG	0,587	0,012	0,599
ELD	0,068	0,154	0,223
ELG	0,080	0,049	0,129
EED	0,360	0,341	**0,701**
EEG	0,376	0,338	**0,714**
EAD	0,008	0,538	0,546
EAG	0,047	0,634	0,680
LP	0,353	0,077	0,429
EPP	0,008	0,015	0,023
EP	0,053	0,031	0,084
LPP	0,118	0,026	0,144
LPE	0,555	0,000	0,555
Eigen value	6,783	5,887	
Variability (%)	25,123	21,804	
Cumulative %	25,123	46,928	

Genetic variability among cultivars could be assessed by the two factors (F1, F2) of the Principal Component Analysis (PCA). In (Figure 2) the cultivars are dispersed in the four quartiles of the F1, F2 plane. Cultivars close to the centre of the axes presented the low variability but the cultivars farthest from the centre of the axes shows the greatest variability as Bouhlas (C51), Elhorra (C47), Thouri (C40), Tantbouchet (C7), (C1), (C5), (C53).

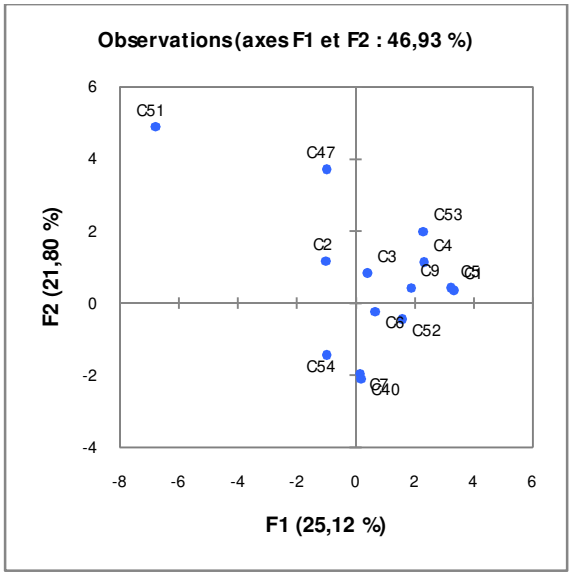

Figure 2.Analysis plot of the main components representing of cultivars.

Correlation between morphological variables, NPD and NPG, PLD and PLG, PED and PEG, NED and NEG, ELD and ELG, EED and EEG are highly significant and positively highly correlated with symmetry between them, EED and PEG, EEG and PEG are highly significant and positively highly correlated. The variables EPP and EP, PED and PAD, ELD and EP are highly significant and negatively highly correlated (Table 3).

Table4.Coefficient of correlation between quantitative morphological characters of 16 cultivars of Algerian date palm.

Variables	LD	ED	PD	LN	EN	PN	NPD	NPG	PLD	PLG	PED	PEG	PAD	PAG	NED	NEG	ELD	ELG	EED	EEG	EAD	EAG	LP	EPP	EP	LPP	LPE
LD	**1,000**																										
ED	**0,688**	**1,000**																									
PD	**0,645**	**0,597**	**1,000**																								
LN	**0,782**	**0,609**	0,281	**1,000**																							
EN	0,219	0,309	-0,040	**0,624**	**1,000**																						
PN	-0,066	0,020	0,369	0,042	0,223	**1,000**																					
NPD	0,152	-0,134	0,234	-0,020	-0,009	0,112	**1,000**																				
NPG	0,207	-0,105	0,270	-0,008	-0,016	0,089	**0,992**	**1,000**																			
PLD	0,279	0,103	0,188	**0,560**	**0,533**	**0,634**	0,436	0,415	**1,000**																		
PLG	0,264	0,127	0,172	**0,572**	**0,596**	**0,631**	0,396	0,372	**0,991**	**1,000**																	
PED	-0,366	-0,302	0,131	-0,431	-0,375	0,430	0,417	0,386	0,138	0,074	**1,000**																
PEG	-0,365	-0,290	0,046	-0,403	-0,375	0,276	0,390	0,360	0,073	0,003	**0,979**	**1,000**															
PAD	0,168	0,119	-0,194	0,236	0,146	-0,281	-0,482	-0,462	-0,142	-0,139	**-0,529**	-0,459	**1,000**														
PAG	0,239	0,186	0,175	0,186	-0,067	0,071	-0,440	-0,436	-0,059	-0,086	-0,231	-0,222	**0,838**	**1,000**													
NED	0,492	**0,524**	0,227	**0,531**	0,462	-0,088	0,206	0,177	0,214	0,273	-0,435	-0,452	-0,182	-0,250	**1,000**												
NEG	**0,566**	**0,539**	0,337	**0,580**	0,462	-0,089	0,305	0,288	0,303	0,345	-0,425	-0,433	-0,139	-0,186	**0,928**	**1,000**											
ELD	0,020	-0,223	-0,026	0,261	0,262	0,108	0,363	0,330	**0,508**	**0,531**	-0,047	-0,073	-0,062	-0,141	0,137	0,250	**1,000**										
ELG	0,036	-0,208	-0,144	0,239	0,181	-0,139	0,285	0,258	0,310	0,341	-0,202	-0,202	0,086	-0,079	0,166	0,235	**0,941**	**1,000**									
EED	-0,281	-0,200	-0,092	-0,274	-0,303	-0,023	0,315	0,293	-0,025	-0,092	**0,827**	**0,920**	-0,252	-0,174	-0,430	-0,411	-0,098	-0,164	**1,000**								
EEG	-0,293	-0,218	-0,098	-0,291	-0,323	-0,026	0,319	0,295	-0,038	-0,105	**0,836**	**0,928**	-0,273	-0,184	-0,415	-0,395	-0,099	-0,165	**0,998**	**1,000**							
EAD	0,100	0,213	0,031	0,343	0,210	0,246	0,296	0,270	**0,536**	**0,527**	0,461	**0,503**	-0,093	-0,066	0,056	0,048	0,229	0,190	**0,564**	**0,551**	**1,000**						
EAG	0,376	0,327	0,416	0,417	0,112	0,443	0,365	0,362	**0,598**	**0,566**	**0,533**	**0,527**	-0,133	0,078	0,032	0,071	0,160	0,052	**0,511**	**0,498**	**0,879**	**1,000**					
LP	**0,566**	0,294	0,386	0,342	0,026	0,046	0,303	0,318	0,225	0,261	-0,114	-0,163	0,060	0,077	0,374	0,282	0,149	0,217	-0,130	-0,147	0,292	0,457	**1,000**				
EPP	-0,209	**-0,566**	-0,125	-0,240	0,075	-0,130	0,473	0,468	0,018	0,029	-0,025	-0,060	-0,279	-0,405	0,067	0,131	**0,600**	**0,582**	-0,143	-0,126	-0,336	-0,372	-0,102	**1,000**			
EP	0,439	**0,568**	0,265	0,206	-0,330	-0,149	-0,242	-0,220	-0,184	-0,204	-0,108	-0,076	0,305	0,412	0,024	-0,032	**-0,544**	-0,431	0,040	0,023	0,150	0,274	0,430	**-0,828**	**1,000**		
LPP	0,363	0,106	0,188	0,168	-0,140	0,118	0,211	0,204	0,137	0,140	-0,004	-0,067	0,065	0,180	0,171	0,011	-0,153	-0,047	-0,104	-0,116	0,187	0,330	**0,799**	-0,253	**0,552**	**1,000**	
LPE	**0,705**	**0,525**	**0,557**	0,476	0,240	-0,199	0,143	0,163	-0,004	0,048	-0,395	-0,403	0,172	0,148	**0,577**	**0,563**	0,170	0,235	-0,296	-0,309	-0,016	0,166	**0,747**	0,072	0,247	0,393	**1,0**

Date palmcultivars were grouped into seven different classes according to phylogenetic distance (Figure 3). All cultivars were placed between the similarity levels of 0.99745554 to 0.9574554. Main class (3) was a large group consisting of eight cultivars and class (4) groups three cultivars while the other classes (1, 2, 5, 6 and 7) are unique cultivars C1, C2, C51, C53, and C56 respectively. Previously, many authors have considered different parts of date palm as suitable variables for the estimation of morphological diversity the works of El Houmaizi (1993) and Sedraandal. (1996) that are based on fruit characteristics. The work of Hammadiandal. (2009); Ahmed andal. (2011).Summarandal.(2015) used seeds as a tool for estimating diversity. Earlier, Elshibli and Korpelainen (2009) and Ahmed andal. (2011) worked only on some quantitative traits of seeds, and Belguedj(2002).

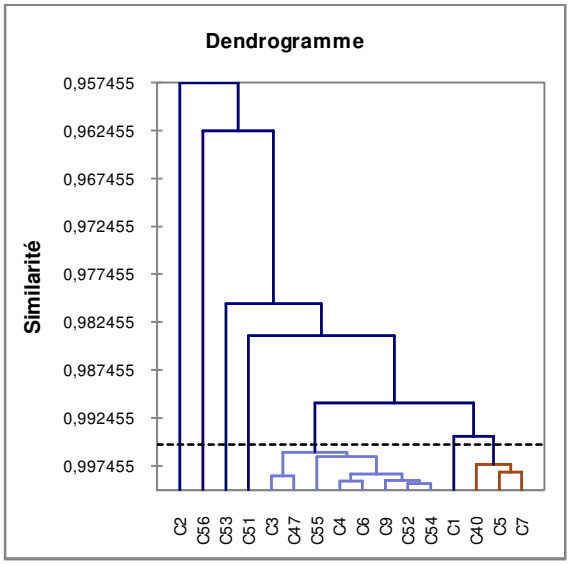

Figure 3.Dendrogram of date palms cultivars studied.

Among the sixteen genotypes collected, there is an arrangement according to the consistency of the date. The cultivars C3, C4, C6, C9, C47, C52, C54 and C55 are dry date cultivars and the cultivars C5, C7 and C40 are soft date cultivars.

The two components of the ACP analysis of 27 quantitative morphological characters in size cultivars of Algerian date palms show great variability.Elhoumaiziandal. (2002) and Ahmed andal. (2011) reported a wide range of morphological diversity within genotypes. The dendrogram topography of the 16 cultivars of Algerian date palms discriminate cultivars in their group mentioned above.

4. Conclusion

Concluded with there is great variability among the cultivars of date palms studied and can be the basis for classifying cultivars in Algeria into groups based on morphological traits.

Principalcomponent analysis PCA indicated that all the characters of the date and seed are divergent with the width of the right and left spine, the characters of the date are divergent with the thickness of petiole between spines and leaflets. And all characters of the leaflets are divergent with the right leaflets angle. Similarly, the ascending hierarchical classification AHC also revealed a morphological variability of date palm cultivars and a certain relationship and heterogeneity was also observed for cultivars of the same date consistency.

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