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Product Quality and Safety

# Interrelationships between some vegetative components and fruit quality of Algerian date palm

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***Abstract.*** *The date palm is a monocotyledon thermophilic desert plant, in Algeria grown more than 18 million trees. To have a better quality of dates for the most answered cultivars in Algeria, we can act with fertilization on the palm and these components of the leaflets and spines that affect dates quality. The three cultivars of date palms (Deglet nour-C1, Ghars-C2 and Mechdegla-C3) have been studied to estimate the relationship between leaflet and spine number and date quality. Five phenotypic traits were exploited and subjected to analysis of the principal components in ascending hierarchical classification. The results revealed that the cultivar Deglet nour scored the highest value for the parameters spine number (25) and weight of the date (8.63g), the cultivar Ghars also recorded the highest value for the parameters: number of leaflets (80) and length (4.35cm) and thickness (2.25cm) of the date. In all studied cultivars positive correlations between the length and width of the leaf – on the one side, and weight of the date - on the other, and between the width of leaf and width of the date were found.*

**Keywords***:* date, cultivar, leaf, leaflets number, spines number, correlations

## Introduction

In Algeria, the date palm (*Phoenix dactylifera* L.) is the mainstay of oasis agriculture and constitutes the main economic source for the local population. It 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 and 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). It is the mainstay of the oasis ecosystem (Bouguedoura et al., 2010). Indeed, this species constitutes the framework of the ecophytocenosis of the oases, creating a mesoclimate favorable to the life of 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 (Zohary et al., 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 19$^{th}$ century and later via releases imported from the USA, Iraq and Algeria, which allowed the development of large palm groves for ecotourism (Ouennoughi and Dubost, 2005). The mature date tree produces 100-120 numbers of green leaves (3 to 5m). 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 spines which later change in the basal laminae. Both pamphlets and spines vary in length depending on leaf position, cultivar type and climatic conditions (Summar et al., 2015). Studies on the characterization of date palm cultivars are rare (Baker et al., 1999). The leaves are responsible for the vital functions, respiration, perspiration and photosynthesis producing organic compounds forming the sap that feeds the plant and is preserved in fruits. In the world the date palm is cultivated on an area of 1353159 hectares with nearly 100 million palm trees and a production of 8460443t of dates (FAOSTAT, 2017). The date palm cultivation in Algeria occupies an area of 167269 hectares with 18.5 million palm trees and a production of nearly 1029596t of dates (MADRP, 2017). The variety inventory has identified more than 1100 cultivars (Hannachi, 2015) but only a few are commercially important

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because of monoculture. Harrak et al. (2003) worked on characterization using dates. Djerouni et al. (2015) studied the morphological variability of the elite males cultivated in the Oued rich collection where Simozrag et al. (2016) evaluated the phenotypic diversity of date palms in Ziban region, Algeria and this work was followed by Bedjaoui and Benbouza (2018) on 26 date palm cultivars grown in the same region. The objective of this study was to answer the question if there are any interrelationships between the palm leaflets and spines number on the one side, and the quality of dates on the other.

## Material and methods

Plant material used in this study consisted of three date palm cultivars - Deglet nour (C1), Ghars (C2) and Mechdegla (C3) planted in Ziban (Biskra) region in Algeria (Figure 1). For the purpose of the study leaves and dates from the three palm cultivars were collected (Table 1).


**Figure 1.** Biskra area in Algeria

**Table 1.** Characteristics and denomination of the date palms cultivars studied

| Characters | Denomination | Unit |
|---|---|---|
| Length of the date | LD | cm |
| Width of the date | ED | cm |
| Weight of the date | PD | g |
| Leaf length | LP | cm |
| Width in the middle of the leaf | EP | cm |
| Right leaflets number | NPD | |
| Left leaflets number | NPG | |
| Right spine number | NED | |
| Left spine number | NEG | |

According to IPGRI (2005) nine quantitative morphological features were controlled and measured - three for dates and six for leaves (Figures 2 and 3). The statistical analysis was based on the principal component analysis (PCA) and ascending hierarchical classification (CAH), (Snedecor and Cochran, 1968). The correlation matrix, the coefficients of correlations between the variables and the two axes F1 and F2 and the projection of the variables in the space of the axes F1 and F2 were obtained with a Software XLSTAT 2017 (trial version), during the period of the study, 9 variables for 3 cultivars were measured.

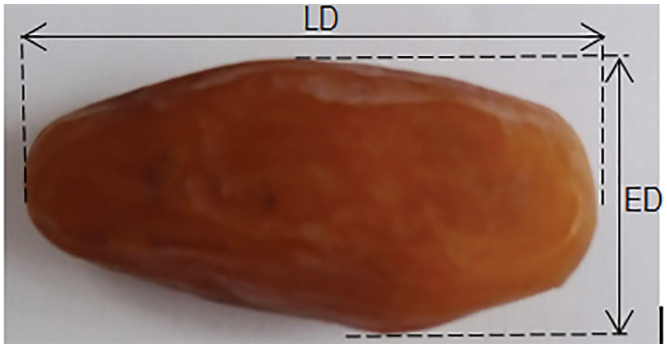


**Figure 2.** Date dimensions, cm
(ED- Width of the date, LD- Length of the date)

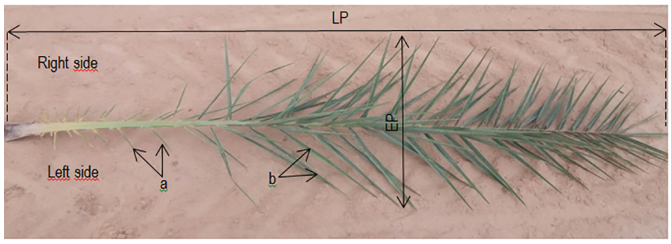


**Figure 3.** Palm date leaf composition
(a- spines, b- leaflets, EP- Width in the middle of the leaf, LP- Leaf length)

## Results

The results of the measurements of the parameters studied show that the largest number of leaflets is 80 for Ghars on the right and left side, 71 for Degletnour and 61 for Mechdegla. For spines was recorded the highest number of 25 for Degletnour, 14 and 15 on the right and left side for Ghars and 6 for Mechdegla (Table 2).

**Table 2.** Characteristics of date palm fronds of Algerian cultivars studied

| Cultivars | LD | ED | PD | NPD | NPG | NED | NEG | LP | EP |
|---|---|---|---|---|---|---|---|---|---|
| C1 | 3.64 | 1.79 | 8.63 | 71 | 71 | 25 | 25 | 353.69 | 61.19 |
| C2 | 4.35 | 2.25 | 7.04 | 80 | 80 | 14 | 15 | 340.83 | 65.12 |
| C3 | 3.17 | 1.73 | 5.26 | 61 | 61 | 6 | 6 | 293.17 | 37.00 |

*C1- Degletnour, C2- Ghars, C3- Mechdegla, LD= length of the date, ED= width of the date, PD= weight of the date, LP= leaf length, EP= width in the middle of the leaf, NPD= right leaflets number, NPG= left leaflets number, NED= right spine number, NEG= left spine number, LP= leaf length, EP= width in the middle of the leaf.

The main results for the components distributed by quantitative morphological variables of leaf and date are presented in Table 3. Two components of PCA accounted for 100% cumulative variability. The first axis accounting for 74.595% was observed on leaf length (LP), width in the middle of the leaf (EP), right leaflets number (NPD) and left leaflets number (NPG). For the second axis, the variability was 25.405% observed on the width of the date (ED).

**Table 3.** Square cosines of parameters for the first 2 axes of the PCA analysis

| Parameters | F1 | F2 |
|---|---|---|
| LD | **0.724** | 0.276 |
| ED | 0.431 | **0.569** |
| PD | **0.701** | 0.299 |
| NPD | **0.858** | 0.142 |
| NPG | **0.839** | 0.161 |
| NED | **0.612** | 0.388 |
| NEG | **0.632** | 0.368 |
| LP | **0.918** | 0.082 |
| EP | **0.998** | 0.002 |
| Eigen value | 6.714 | 2.286 |
| Variability, % | 74.595 | 25.405 |
| Cumulative, % | 74.595 | 100.000 |

*LD= length of the date, ED= width of the date, PD= weight of the date, LP= leaf length, EP= width in the middle of the leaf, NPD= right leaflets number, NPG= left leaflets number, NED= right spine number, NEG= left spine number, LP= leaf length, EP= width in the middle of the leaf.

Presentation of cultivars and traits of characters is dispersed in the four quartiles of the F1, F2 plane. Cultivars and characters close to the centre of the axes presented the low variability but the cultivars or characters farthest from the centre of the axes show the greatest variability (Figure 4).

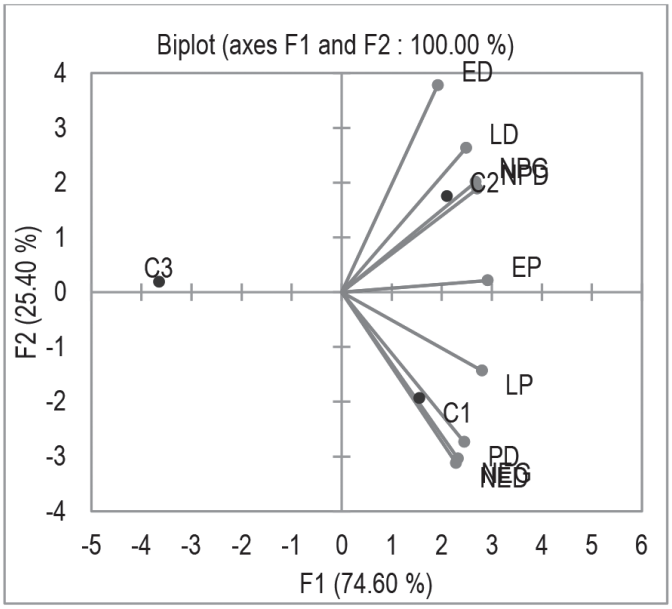


**Figure 4.** Presentation of characters and cultivars according to F1 and F2 plan
(C1- Degletnour, C2- Ghars, C3- Mechdegla, LD= length of the date, ED= width of the date, PD= weight of the date, LP= leaf length, EP= width in the middle of the leaf, NPD= right leaflets number, NPG= left leaflets number, NED= right spine number, NEG= left spine number, LP= leaf length, EP= width in the middle of the leaf)

For the ascending hierarchical classification (CAH) treatment, the similarity dendrogram shows that all the cultivars have been placed between the similarity levels from 0.9972735 to 0.9997735, they are homogeneous and grouped within the same class (Figure 5).

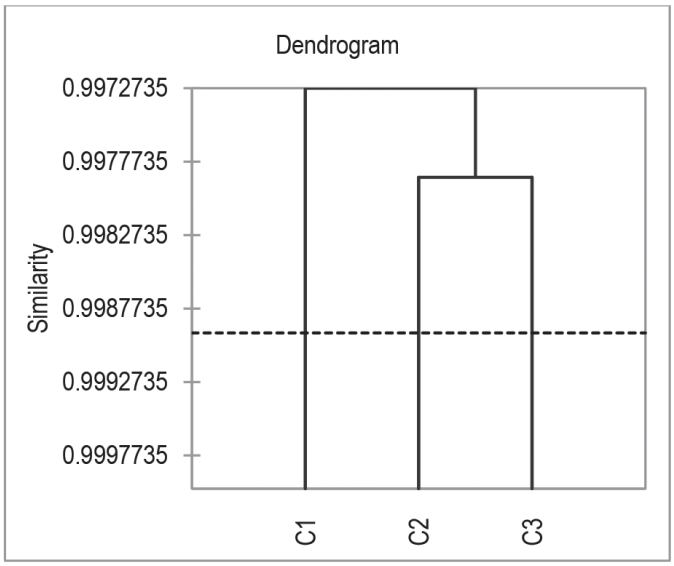


**Figure 5.** Dendrogram of studied date palm cultivars (C1- Degletnour, C2- Ghars, C3- Mechdegla)

Correlations between morphological variables are presented in Table 4. Very high values of positive correlations were found: between the Length of the date (LD) and the Width of the date (ED), the right leaflets number (NPD), the left leaflets number (NPG) and the width in the middle of the leaf (EP) (r= 0.872-0.990), the length of the dates increases as the number of spines increases and the width of the date increases; between the Width of the date (ED) and the right leaflets number (NPD) and left leaflets number (NPG) (r= 0.892-0,904), the width of the date increases with the increase in the number of spines; between the weight of the date (PD) and the right spine number (NED), the left spine number (NEG), the Length of the date (LP) and the width in the middle of the leaf (EP) (r= 0.814-0.997), the weight of the date increases with the increase in the number of spines and the length and width of the leaf; between the right leaflets number (NPD) and the left leaflets number (NPG) and the Length of the date (LP) (r= 0.941-1.000), the length of the leaf increases with the increase in the number of leaflets; between the left leaflets number (NPG) and the Length of the date (LP) and the width in the middle of the leaf (EP) (r= 0.763-0.932), the number of leaflets increases with the length and width of the leaf; between the left spine number (NEG) and the Length of the date (LP) (r= 0.935); between the Length of the date (LP) and the width in the middle of the leaf (EP) (r= 0.945), the higher the length of the leaf, the greater its width.

**Table 4.** Coefficients of correlations between quantitative morphological characters of cultivars of Algerian date palm

| Variables | LD | ED | PD | NPD | NPG | NED | NEG | LP | EP |
|---|---|---|---|---|---|---|---|---|---|
| LD | 1.000 | | | | | | | | |
| ED | **0.955** | 1.000 | | | | | | | |
| PD | 0.425 | 0.138 | 1.000 | | | | | | |
| NPD | **0.986** | **0.892** | 0.570 | 1.000 | | | | | |
| NPG | **0.990** | **0.904** | 0.548 | **1.000** | 1.000 | | | | |
| NED | 0.338 | 0.044 | **0.996** | 0.490 | 0.466 | 1.000 | | | |
| NEG | 0.358 | 0.064 | **0.997** | 0.508 | 0.485 | 1.000 | 1.000 | | |
| LP | 0.665 | 0.413 | **0.959** | 0.780 | **0.763** | 0.928 | **0.935** | 1.000 | |
| EP | **0.872** | 0.688 | **0.814** | **0.941** | **0.932** | 0.755 | 0.769 | **0.945** | 1.000 |

*LD= length of the date, ED= width of the date, PD= weight of the date, LP= leaf length, EP= width in the middle of the leaf, NPD= right leaflets number, NPG= left leaflets number, NED= right spine number, NEG= left spine number, LP= leaf length, EP= width in the middle of the leaf.

## Discussion

The morphological studies of date palm have always been considered difficult to undertake because they require a large set of phenotypic data and because they are varied due to the environment effect (Munier, 1973). The leaves have a very important role for the nutrition of the plant and the place of photosynthesis which allows the production of carbohydrates. This carbohydrate is transported to the fruit to be preserved, the quantity of carbohydrate conserved will assess the quality of the fruit. In palm date, the leaves are composed and formed of leaflets and spines, therefore these components have an effect on the weight and volume of dates. The results revealed that the cultivar Deglet nour (C1) scored the highest value for the parameters spine number (25) and weight of the date (8.63g), the cultivar Ghars (C2) also recorded the highest value for the parameters: number of leaflets (80) and length (4.35cm) and thickness (2.25cm) of the date. Al-Wusaibai et al. (2014) reported the highest mean value of number of spines/frond (26.60) in Saudi Arabian palm cultivars. Acourene and Tama (1997) recorded for the weight of the date (3.83-15.38g) and a length of the date (2.73-4.56cm) in the Ziban region in Algeria.

For the three cultivars studied we found that the right leaflets number (NPD) and left leaflets number (NPG) are closely correlated positively with the length of the date (LD) and the width of the date (ED), length and width of the date increases with the increase in the number of leaflets. The weight of the date (PD) was closely correlated positively with the left spine number (NEG) and right spine number (NED), the weight of the date increases with the increase in the number of spines.

## Conclusion

Based on the results obtained it was found that high positive correlations and direct relationships exist between the length and the width of the leaves with the weight of the dates and there are similar correlation between the width of the leaves and the width of the dates. We can act on the vegetative part especially the palms by reasoned fertilization to increase the length and the width of the leaf and the number of leaflets and spines which allows the increase of the size and the weight of the date.


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