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# Using Morphological and Anatomical Features as Taxonomical Evidences to Differentiate Between Some Soft and Semi-Dry Egyptian Cultivars of Date Palm

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**Abstract:** The experimental work of this study was carried out at the Central Lab. of Research and Development of Date Palm, Agricultural Research Center, Giza, Egypt during two successive seasons of 2010 and 2011. Leaflets of ten date palm cultivars were used in this study. The soft date cultivars were Zaghloul, Samany, Amhat, Hiany and Aoshik Engabel and the semidry dates were Sewy, Aglany, Amry, Barhee and Suaedy. Results obtained from analyzing the morphological and anatomical characters,by numerical analysis technique represent the taxonomic similarity between cultivars, proved that the cultivars which grow under similar environmental conditions and had the same needs like temperature, humidity and soil types were more close taxonomically to each other than to the other cultivars with different needs. For example, cultivars as Amhat, Zaghloul and Hiany were very close taxonomically to each other as they grow at the same area of the same climate. The same had been observed with cvs. Suaedy and Aglany and also cvs. Barhee and Sewy.

**Key words:** *Phoenix dactylifera* · Soft and semidry fruits · Taxonomic similarity · Leaflet anatomy

## INTRODUCTION

Palm tree belongs to the *Arecaceae* or *Palmaceae* family which contains roughly 202 genera with about 2600 species most of which are restricted to tropical, subtropical and warm temperate climates. *Phoenix dactylifera* L. is the widely cultivated palm tree for fruit crop products, in addition to numerous known important byproducts such as fiber, fuel and furniture. Date palm is the most important fruit crop used as an ornamental plant in the Middle East and Arabian lands [1, 2]. It is a monocot and dioeciously fruit tree that traditionally propagated through offshoots. However, there are many problems associated with this system [3]. In Egypt, there are over 200 recorded local cultivars that are significantly differed in their vegetative growth and yield characteristics. Most of these cultivars are landraces that spread geographically within certain areas all over the Nile valley and the Eastern Desert Oasis. Dates are classified according to their fleshiness tone. This is an arbitrary classification, but is the most common and convenient. Some of the semidry cultivars are Sewy, Aglany, Amry, Barhee and Suaedy and some of the soft cultivars are; Zaghloul, Samany, Amhat, Hiany and Aoshik Engabel.

For satisfying the increased demand on palm trees in the international markets, several attempts have been made to establish micro propagation protocols based on either somatic embryogenesis or organogenesis [4, 5]. According to these protocols, the production of date palm through organogenesis process should be clonally and less risk of genetic variation than callus derived plantlets [6]. This study aimed to distinguish the taxonomic similarities between ten date palm cultivars; five belongs to soft dates and five as semidry dates, trying to overcome the problems resulted from occasionally mixing soft and semidry cultivars produced through *in vitro* micro propagation. To achieve this aim the morphological and anatomical characters of leaflet are used.

## MATERIALS AND METHODS

The experimental work of this study was carried out at the Central Laboratory of Research and Development of Date Palm, Agricultural Research Center, Giza, Egypt in two successive seasons 2010 and 2011. Soft cultivars are Zaghloul, Samany, Amhat, Hiany and Aoshik Engabel and the semidry cultivars are Sewy, Aglany, Amry, Barhee and Suaedy.

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Table 1: Morphological characters of some soft and semidry cultivars date palm (ex vitro)

| | Soft Cultivars | | | | Semidry Cultivars | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Character | Samany | Aoshikengabel | Amhat | Zaghlol | Hiany | Barhee | Saedy | Aglany | Sewy | Amry |
| Leaf length cm | 510 | 460 | 395 | 389 | 420 | 375 | 430 | 490 | 350 | 470 |
| Leaf width cm | 85 | 80 | 45 | 68 | 47 | 85 | 80 | 100 | 50 | 97 |
| Leaflet region length cm | 326 | 313.5 | 255 | 271.5 | 286 | 271 | 305 | 352 | 242 | 345 |
| Petiole length cm | 110 | 90 | 77 | 75 | 95 | 49 | 75 | 74 | 50 | 65 |
| Spin area length cm | 62 | 50 | 55 | 35 | 32 | 47 | 40 | 55 | 50 | 54 |
| No. of spine/leaf | 30 | 24 | 25 | 22 | 23 | 25 | 24 | 22 | 27 | 23 |
| Petiole base width cm | 12 | 6.5 | 8 | 7.5 | 7 | 8 | 10 | 9 | 8 | 6 |
| Leaflet length cm | 45 | 30 | 38 | 40 | 35 | 32 | 31 | 37 | 33 | 41 |
| No. of leaflet/Leaf | 210 | 190 | 199 | 198 | 200 | 203 | 200 | 207 | 205 | 206 |

Table 2: Anatomical measurements and counts of five soft date palm cultivars as shown in transverse sections of leaflet blade.

| Cultivars | Samany | Aoshikengabel | Amhat | Zaghloul | Hiany |
|---|---|---|---|---|---|
| Upper epidermis thickness (µ) | 31 | 23 | 38 | 28 | 28 |
| Lower epidermis thickness (µ) | 29 | 20 | 35 | 26 | 27 |
| Leaflet thickness (µ) | 2878 | 1794 | 2559 | 2176 | 1985 |
| Mesophyll thickness (µ) | 2818 | 1751 | 2486 | 2122 | 1930 |
| Main vascular bundle length (µ) | 610 | 398 | 541 | 444 | 410 |
| Main vascular bundle width (µ) | 692 | 408 | 630 | 501 | 465 |
| Lateral bundle length (µ) | 378 | 247 | 335 | 275 | 254 |
| Lateral bundle width (µ) | 429 | 253 | 391 | 311 | 288 |
| Xylem vessel diameter (µ) | 118.9 | 82.0 | 143.5 | 106.6 | 110.7 |
| Phloem thickness (µ) | 96.3 | 66.4 | 116.2 | 86.3 | 89.7 |
| Main bundle fibrous sheath thick (µ) | 114.1 | 78.7 | 137.8 | 102.3 | 106.3 |
| Lateral bundle fibrous sheath thick (µ) | 73.0 | 50.4 | 88.2 | 65.5 | 68.0 |
| Presence of tannin cells | +++ | -- | + | -- | ++ |

Table 3: Anatomical measurements and counts of five semidry date palm cultivars as shown in transverse sections in leaflet blade

| Cultevars | Barhee | Saedy | Aglany | Sewy | Amry |
|---|---|---|---|---|---|
| Upper epidermis thickness (µ) | 37.5 | 33.9 | 46.0 | 27.8 | 33.9 |
| Lower epidermis thickness (µ) | 3501 | 31.5 | 42.4 | 24.2 | 32.7 |
| Leaflet thickness (µ) | 3482.4 | 2633 | 3096.5 | 2170.7 | 2401.9 |
| Thickness of mesophyll (µ) | 3409.8 | 2567.6 | 3008.1 | 2118.7 | 2335.3 |
| Main vascular bundle length (µ) | 738.1 | 537.2 | 654.6 | 481.6 | 496.1 |
| Main vascular bundle width (µ) | 837.3 | 606.2 | 762.3 | 493.7 | 562.7 |
| Lateral bundle length (µ) | 457.4 | 332.8 | 405.4 | 298.9 | 307.3 |
| Lateral bundle width (µ) | 519.1 | 376.3 | 473.1 | 306.1 | 348.5 |
| Xylem vessel diameter (µ) | 143.9 | 129.0 | 173.6 | 99.2 | 133.9 |
| Phloem thickness (µ) | 116.5 | 104.4 | 140.6 | 80.3 | 108.5 |
| Main bundle fibrous sheath thick (µ) | 138.1 | 123.8 | 166.7 | 95.2 | 128.6 |
| Lateral bundle fibrous sheath thick (µ) | 88.3 | 79.3 | 106.7 | 61.0 | 82.3 |
| Presence of tannin cells | +++ | +++ | ++ | ++ | ++ |

Ninety plantlets aged six months (nine plantlets representing each cultivar) throughout hardening stage were secured from the micro propagation lab. Plantlets were arranged in the green house randomly in three replicates. Sampling was done individually upon all plantlets. Data were scored on nine morphological characters (Table 1) and thirteen anatomical features (Tables 2 and 3) on the leaflets at hardening stage. Single linkage Cluster analysis technique was carried out on all recorded date as described by Sneath and Sokal [7].

## RESULTS AND DISCUSSION

### Numerical Analysis

**Taxonomic Similarity Relationship Between the Studied Cultivars:** Concerning the morphological and anatomical characters (Tables 1-3) of the ten date palm cultivars, data in the dendrogram (Fig. 1) proved that these cultivars split into three clusters. The first cluster includes cv. Samany which linked at the end of similarity level (4.50) with the rest of the other clusters. The second cluster includes cv. Aoshik Engabel where it liked with the third cluster at 4.25 similarity level.

The third cluster split into four subgroups. One includes cvs. Amhat, Zaghloul and Hiany, they joined together firstly at 2.50 similarity level and then joined with others at 4.75 similarity level. The second subgroup includes cvs. Sueady and Aglany, they joined together at 1.75 similarity level and linked with the third subgroup of cvs. Barhee and Sewy at 3.50 similarity level. The second and third subgroups linked with the first at 3.80 similarity level before they linked with the last subgroup which includes cv. Amry at 4.00 similarity level. Cluster of cv. Aoshik Engabel linked firstly with all subgroups at 4.25 similarity level and finally all clusters and subgroups linked with the cluster of cv. Samany at 4.50 similarity level as all cultivars belong to the same species date palm.

From the dendrogram (Fig.1), it could be concluded that the cvs. Amhat, Zaghloul and Hiany were taxonomically more close to each other than to the cluster of the other two soft cultivars. The same had been observed with the semidry cultivars Suaedy and Aglany, where these cultivars linked together first before they link with any of other cultivars. Barhee and Sewy cultivars were also more close to each other. Army cultivar was the last semidry one joined the rest of its group. The cv. Engabel was the next soft cultivar linked the cluster of all semidry and the three soft cultivars. Finally cv. Sammany was the last cultivar joined all the others at the highly similarity level 4.50. These results revealed that the cultivars which are very close to each other and joined together firstly was due to they had the same needs for growth habitat and environmental conditions. This was clear with cvs. Amhat, Zaghloul and Hiany from one side and (Sueady and Aglany) as well as (Barhee and Sewy) from the other side.

### Anatomical Study

**Leaflet Blade of Soft Cultivars:** Data in Table 2 show the anatomical features of the five soft date palm cultivars as shown in leaflet transverse sections. It is evident that both Amhat and Samany scored the highest anatomical measurements as compared with the other cultivars. The average blade thickness was comparatively high in these cultivars as all the shared internal tissues showed comparatively highest measurements. Reversely, cv. Aoshik Engabel exhibited the thinnest leaflet blades, while cvs. Zaghloul and Hiany represented the intermediate values. The lessening in leaflet thickening was reflected on all shared internal tissues.

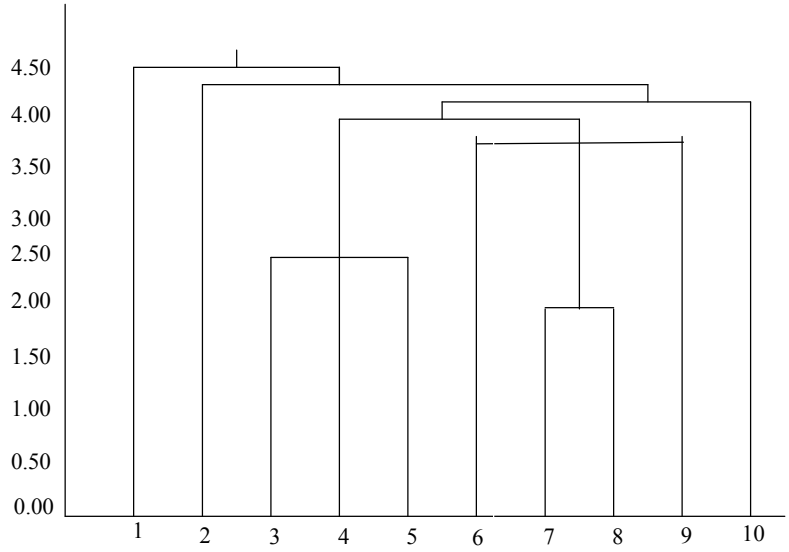


Fig. 1: Dendrogram represent the taxonomic relationship between the studied cultivars
Key: Soft cultivars: 1) Sammany, 2) Aoshik Engabel,3) Amhat, 4) Zagloul,5) Hiany. Semidry cultivars: 6) Barhee, 7) Suaedy,8) Aglany, 9) Sewy, 10) Amry

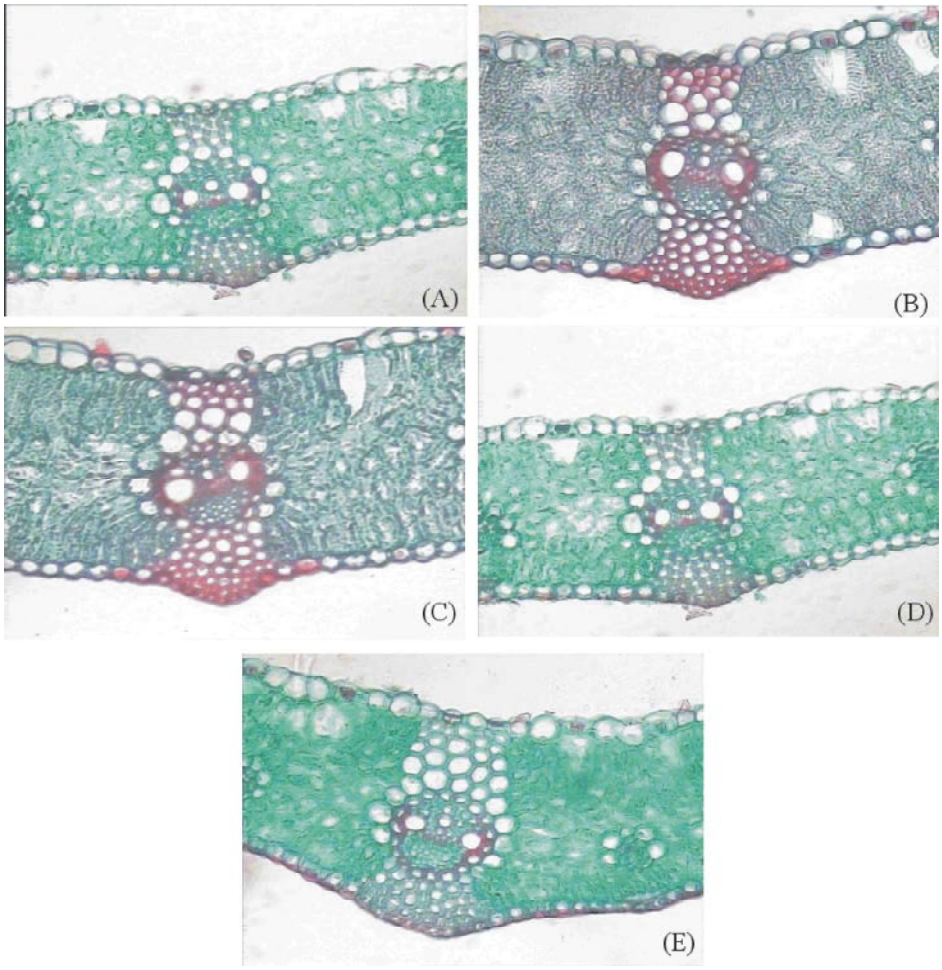


Fig. 2: Transverse sections of five soft palm cultivars A) Samany, B) Aoshik Engabel, C) Amhat, D) Zagloul, E) Hiany in leaflet blade (80 X)

The superior leaflet thickness of cv. Samany followed by cv. Amhat indicated their highly efficient in metabolism and photosynthesis processing than cv. Zaghloul and other cultivars. The upper and lower epidermis thickening show similar trend, as cvs. Amhat and Samany displayed the thickest upper and lower epidermis. It is also evident that the other three cultivars showed a comparable thin epidermis. The existed thickest epidermis and leaf blade elucidated the more tolerant for cvs. Samany and Amhat to drought conditions compared with the other three cultivars (Fig. 2).

Both cvs. Amhat and Samany had the widest average diameter of xylem vessel, while cv. Aoshik Engabel had the thinnest vessel diameter compared wit cvs. Hiany and Zaghloul, which had the intermediate values. Similar trend was found with phloem thickness. The transverse sectin showed that the thickness of mesophyll parenchyma cells of cv. Samany showed considerable highest value compared with the other cultivars. Samany cultivar had also the highest amount of tannin cells as compared with cvs. Hiany and Aoshik Engabel, while the mesophyll cells of Zaghloul was free of tannin cells.

It could be concluded that, the two famous soft Egyptian palm cultivars Amhat and Samany were more superior in their leaflet anatomical features compared to the other cultivars. So, under this study, the soft palm cultivars Samany and Amhat could be recognized by their leaflet anatomical features and the external leaf morphological characters.

**Leaflet Blade of Semidry Cultivars:** The anatomical measurements and counts of the five semidry cultivars as shown in leaflet transverse sections are presented in Table 3. It is clear that cv. Barhee scored the highest anatomical measurements of some characters compared with the other cultivars, while cv. Aglany exceeded all cultivars in some leaflet characters.

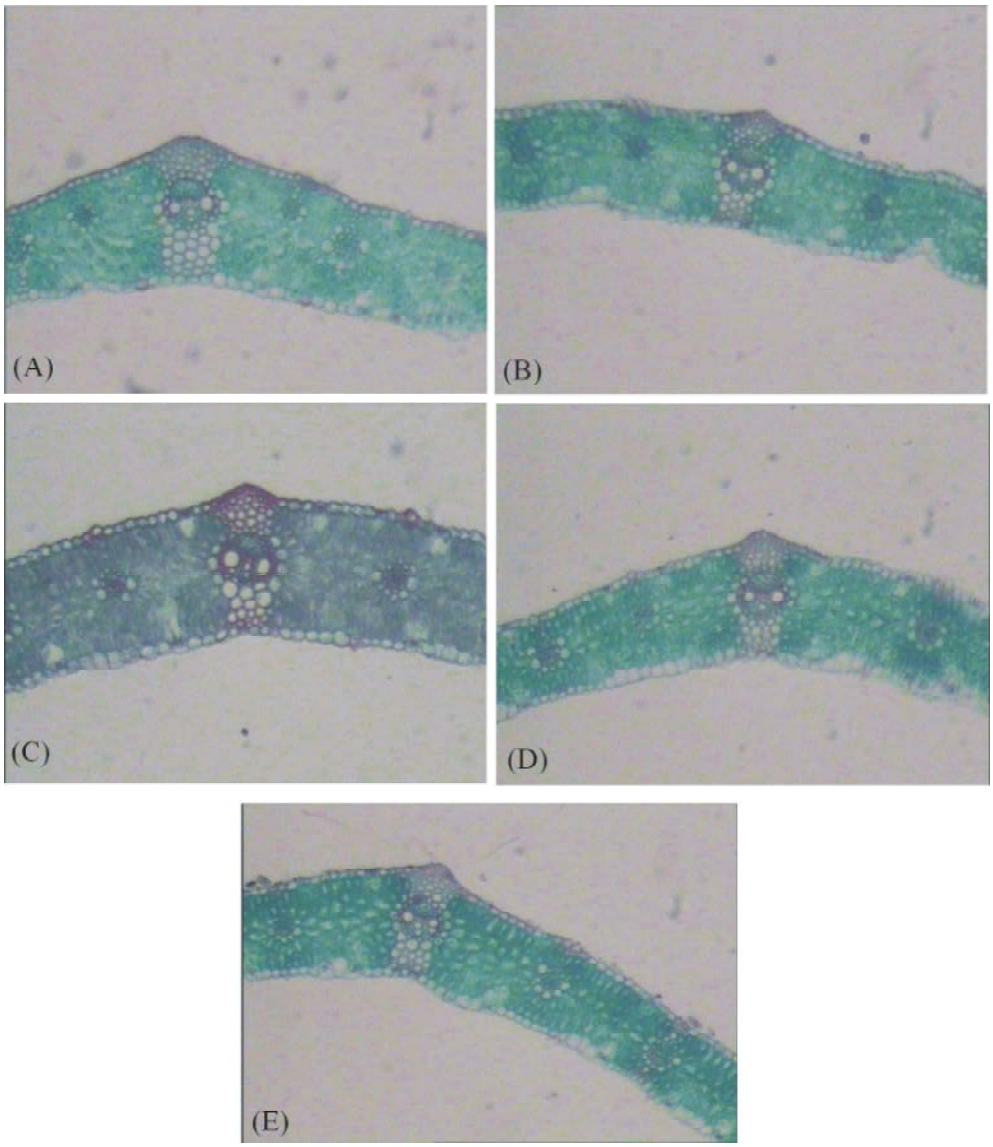


Fig. 3: Transverse sections of five semidry palm cultivars A) Barhee, B) Suaedy, C) Aglany, D) Sewy, E) Amry as shown in transverse sections in leaflet blade (80 X)

The average blade thickness of cv. Barhee was comparatively the highest (3500.5µ) some of the shared internal tissues showed comparatively high measurements. Reversely, cv. Sewy exhibited the thinnest leaflet blade (2196.2µ) while, cvs. Suaedy and Amry scored intermediate measurements (2639.0 and 2410.3µ), respectively. The superior thickness of leaflet of cv. Barhee followed by cv. Aglany indicated their highly efficient in metabolism and photosynthesis processes than cv. Amry and undeniably than the cv. Sewy. The upper and lower epidermis thickness showed relatively similar values with some minute differences, as cvs. Aglany and Barhee displayed more flatten cells with considerable thick cuticle covered both epidermal layers as shown from the transverse section.

It is also evident from the transvers section that the cvs. Suaedy, Amry and Sewy showed a comparable thin barrel shape epidermal cells with thin cuticle. The existed thickest epidermis and leaf blade elucidated the more tolerant for cvs. Barhee and Aglany to drought conditions compared with the other three cultivars (Fig. 3). Parenchymatus mesophyll tissue is apparently thicker in both cvs. Barhee and Aglany (3409.8-3008.1 µ) compared with the cvs. Amry, Suaedy and Sewy. The corresponded scored thickness are 2335.3, 2567.6 and 2118.7µ, respectively.

The anatomical study revealed that the main vascular bundle dimension of the studied leaflet blades, it was relatively wider in cv. Barhee than cv. Aglany compared to the other cultivars. Barhee surpassed cv. Sewy in this parameter by 53.3% in length and 69.6% in width. The average diameter of xylem vessel of cvs. Barhee and Aglany exhibited a further enlargement, while cv. Sewy showed the thinnest vessel diameter value compared with that of cvs. Suaedy and Amry which had intermediate values. Similar trend was found with phloem thickness. In addition, the mesophyll parenchyma cells of cvs. Barhee and Suaedy showed considerable highest amount of tannin cells as compared with cvs. Aglany and Sewy that showed medium amounts, while cv.Amry the mesophyll cells contained a minute amounts of tannin cells.

It was clear from the obtained anatomical study that all the studied cultivars showed considerable variation in their anatomical features. The author is aware that there were no available literatures on the anatomical structure of date palm leaflets at early hardening stage except that presented by Abd El-Baky *et al*. [8] whom emphasized the wide variations in the leaflet anatomical measurements. A matter means that there were no specific anatomical features could be used as criterion to differentiate between the studied cultivars at early hardening stage through the commercial micro propagation production.

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