NEW APPROACH TO IDENTIFY AND CHARACTERIZE TEN COMMERCIAL CULTIV ARS OF DATE PALM

Karim M. Farag[l] and Hassan A. Al-Masri[2]

[1] United Arab Emirates Univ., Faculty of Agricultural Sciences, Plant Production Dept., P.O. Box 17555, Al-Ain, UAE.
[2] Agricultural Research Center, Horticultural Research Institute, Giza, Egypt.

ABSTRACT

Fully mature leaves of ten commercial date palm cultivars were used in an attempt to find a new approach for identification and characterization of cultivars. The leaves were taken from trees of similar age and under the same cultural practices during 1999 season. These cultivars were: Barhi, Khneizi, Neghal, Helali, Khlas, Khesab, Rziz, Lulu, Khadrawi, and Fardh. Traditional parameters for each pinnae were taken such as leaf length, pinnae zone length, blade width, pinnae zone to the total leaf length ratio, valley angle, and apical divergence angle. Other parameters were taken, but not reported before, such as pinnae density, pinnae surface area, exposed leaf area, in addition to the repeated pattern of pinnae distribution and orientation in the three dimensions in the middle 40 cm of the leaf. From all these parameters, a new approach has been suggested to identify and characterize these cultivars. This study provided evidences that there is a fixed and repeated pattern for pinnae distribution and orientation in the three dimensions on each side of the rachis especially in the middle part. In case of similar pattern between two cultivars or more, some traditional parameters that have been taken were employed to clear the differences. It could be concluded from this study that there is a fixed-repeated pattern for pinnae distribution not only in one dimension as used to be reported but in the three dimensions. This pattern in addition to some traditional parameters could be used to identify and characterize date palm cultivars.

Additional Index words: date palm, morphology, cultivars, identification, characterization.

INTRODUCTION

There are hundreds of date palm clones that have the potential to be commercial cultivars. Furthermore, many cultivars were transferred from

one country to another with new names. Even in the same area or country, there could be two names for the same cultivars. Many attempts have been made to identify and characterize cultivars (Nixon, 1945, 1951 and Mason 1915, 1928). Recently, molecular markers have been used but they vary in their sensitivity, technical complexity, ease of use, and stage at which they can be applied (Kunert et al., 2000). Since establishing a date palm plantation is a costly investment for growers (Kunert et al., 2000) and certain cultivars are more demanded than others, there is a great need for new approaches to identify and characterize commercial cultivars. Date palm growers need a true -to -type plants.

Molecular techniques can not fully substitute morphological approaches since the later are the easiest, least complex techniques, and can be adopted by growers, date palm extensionists and buyers. Thus, the objectives of this study were to find new approaches and parameters that could be used to identify and characteize ten commercial cultivars especially in the Gulf region and to utilize traditional parameters in such a way that assist in morphological screening of these cultivars.

MATERIALS AND METHODS

Fully mature leaves of ten commercial cultivars were collected from Al Oha Research station at Al-Ain during 1999 season. These cultivars were namely Barhi, Khneizi, Neghal, Helali, Khlas, Khesab, Rziz, Lulu, Khadrawi and Fardh. All leaves were taken from trees at the same age and under standard cultural practices. The middle 40 cm of each rachis was cut for taking measurements. The following parameters were taken for each cultivar: leaf length (cm), leaf blade length (cm), pinnae density expressed as the number of pinnae at the middle 40 cm, pinnae surface area (cm2) by using a surface area. meter, blade width (cm), pinnae zone as a ratio of the total leaf length, exposed leaf area (cm2) of the excised middle section of the leaf, valley angle (degrees), apical divergence angle (degrees) and pinnae distribution in the three dimensions. Rating the variations in leaf length, pinnae zone length and pinnae width were according to Al-Jabouri (1993). A cross section was also taken at the end of leaf petiole .to show the variations among studied cultivars. Five replicates were used with each cultivar in a completely randomized design. Each leaf represented one replicate. The analysis of variance and the least significant difference at 0.05 level were obtained by using the Mstat computer software.

RESULTS AND DISCUSSION

The data in Table 1 indicated that leaf length of Neghal, Fardh and Khlas was medium (as the set standard by Al-Jabouri, 1993) while that of other studied cultivars from 325-425 cm was considered short (less than 325 cm). Furthermore, Neghal and Fardh leaves were significantly longer than Barhi, Khneizi, Khesab, Rziz, Lulu , Khadrawi and Khlas. Leaf length, however, was not significantly different from that of Neghal, Helali, Khesab, Lulu and Fardh.

In terms of the zone occupied by the pinnae on the rachis, it was considered, according to the standards, that pinnae zone was medium in Khneizi, Neghal, Helali, Khlas, Lulu, Khadrawi and Fardh while it was small in Barhi, Khesab and Rziz. However, within the medium cultivars Neghal, Fardh and Khlas pinnae zone was significantly longer than that of Khneizi (Table 1).

When we look at the pinnae density of the ten cultivars, (expressed as the number of pinnae per the middle 40 cm of the leaf on one side of the rachis) it was found that almost all studied cultivars had similar pinnae density except with Khadrawi that had significantly lower density than that of Barhi, Helali, Rziz and Lulu. However, the surface area of ten pinnae in Khadrawi was significantly greater than that of all other studied cultivars except Khlas and Khneizi. The lowest absolute values for pinnae surface area were obtained with the cultivars Helali, Rziz and Lulu which were not significantly different from each other. Although Fardh had a long leaf relative to most studied cultivars, but its pinnae surface area was rated as low as the cultivars with short leaves such as Rziz and Lulu. (Table 1).

According to the standards, blade width at the middle of the rachis was considered wide for all the ten cultivars. (greater than 44 cm). However there were noticeable variations between studied cultivars (Table 1).

Khadrawi blade width was significantly greater than the of all studied cultivars except Khneizi, Neghayand Khlas. The width of Rziz blade was significantly smaller than that of Khneizi, Neghal, Khlas and Khadrawi.

In spite of all these variations between studied cultivars, it was found that all of them had similar ratios between the zone occupied by pinnae to the total leaf length. In terms of the variations in exposed leaf

area, which indicates to the area intercepting light, it was found that. Khneizi and Khlas had the highest values and significantly greater than that area of, Helali, Rziz, Lulu, Khadrawi and Fardh.

Exposed leaf area ot Barhi, Neghay and Khesab was not significantly different from that of Khneizi and Khlas (Table 1).

The date in Table 1 also showed that the valley angle differed among studied cultivars. It was found that Fardh, Neghay and Rziz had significantly greater angle than that of Khlay and Lulu. The later two cultivars had markedly lower valley angle than most studied cultivars. However, the apical divergence angle was not consistent with the trend observed in the valley angle. The apical divergence of Lulu was as high as that of Khadrawi, Barhi, Khneizi, Khlas and Neghal.

The data in Table 2 indicated to the new approach taken by this study to identify and characterize these commercial cultivars. We found that there was a repeated and consistent pattern of pinnae orientation on each side of the rachis especially in the middle part (Figs 1-10 a, b,c). This pattern considers the angle between the pinnae and the rachis and also the orientation of the pinnae in the three dimensions. Based on these information, the system provided in Table 2 describes the new method suggested to use for identifying and characterizing these ten commercial cultivars.

As shown in Fig. II and Table 2, S, M, and L letters means small, medium/and large angle respectively between the pinnae and the rachis in one repeated unit. Moreover, "up", "I", and "down" means the orientation of the pinnae in the three dimensions where "up" means an angle larger than 45° between the pinnae and the herizontal plane. The letter "I" means an intermediate position or orientation for the pinnae in the three dimension (less than 45° degrees between the pinnae and the horizontal plane). Furthermore, the word "down" means that the orientation of the pinnae is low and its angle with the horizontal plane in zero or subzero, provided that the pinnae in all cases is directed towards the tip end of the leaf (Figs 1-10 a,b,c). From such provided system in Table 2, it was found that the pinnae orientation was similar in the next cases: Barhi was similar to Khlas, Lulu with Khesab, Neghal with Khadrawi and Rziz with Helali. However, the tradional studied parameters (as in Table I) could be utilized in this situation to differentiate between the similar cultivars in pinnae, orientation. Based on this, Venn diagram was used (Fig 12) to show the similarities and variations that could be used to take the decision when identifying cultivars by morphological screening. For example both

Barhi and Khlas had the pinnae orientation: up (s) down (M) but leaf length, pinnae zone and pinnae surface area were greater in Khlas than Barhi. In a similar way, the pinnae. orientation of Lulu and khesab was: up (s) I (M) down (L). However the pinnae surface area and the valley angle of Khesab were greater than those of Lulu.

Similarly, Venn diagrams (Fig. 12) show the way we could differentiate between Neghal and Khadrawi and between Helali and Rziz.

Differences in the cross sections of rachis bases could be observed in Figs (1-10 d). They all take the convex shape. However, the level of convexity varies among the ten cultivars. The upper and lower portion of the rachis base was more convex in Neghal and Fardh as compared with the other cultivars. Furthermore, the lower portion of the rachis base was more convex in Barhi, Khas, Khadrawi and Fardh. The shape of this cross section of the rachis base could affect its tolerance to bunch bending. Fox example, Khneizi and Khesab cross sections were more stream -lined shape than other cultivars and may not tolerate the heavy load of date bunches.

The data in this study provided a new approach to identify and characterize ten commercial date palm cultivars especially in the Gulf region. This approach depends on the repeated pattern of pinnae distribution and orientation in the three dimensions. Researchers such as Elhoumaizi et al (2000) were aware of the importance of pinnae distribution in identifying cultivars but our approach has not been indicated by others who were concerned with identifying and characterizing cultivars since the time of Mason (1915) until recently (Ibrahim and Haggag, 1998, Elhoumaizi, et al., 2000).

Additional efforts need to be exerted in this area of morphological screening of date palm cultivars and more attention must be paid to this area in order to find new important keys for identifying and characterizing cultivars.

LITERATURE CITED

Al-Jabouri, H. J. 1993. Date palm United Arab Emirates University Press. Plant Production Dept. pp. 369.

Elhoumaizi, M.A.; Zirari, A.; Dolle, V.; Dauzat, J.; Jaeger, M.; Lecoustre, R. and Oihabi, A. 2000. Modeling of the architecture of the date' palm (*Phoenix dactylifera* L.) methodology and applications.

Proceedings of the date palm International Symposium, Windhock, Namibia. 1666-1672.

Ibrahim, A. M. and Haggag, M. N. 1998. Date Palm cultivation, Nursing and Production. Monshaat Al-Maaref Press. Alexandria, Egypt. PP. 756.

Kunert, K.J., Vorster, 7.; Bey, E, and Cullis, C. A. 2000. Representational difference analysis as a DNA -based quality assurance procedure for date palm micropropagation. Proceedings of the date palm International Symposium, Windhock, Namibia. 72-80.

Mason, S.C. 1915. Botanical characters of the leaves of the date palms used in distinguishing cultivated varieties. USDA, Washington, D.C. Bull. 223.28 pp.

Mason, S.C. 1928. Date varieties at all growth stages shown by vegetative characters. USDA Separate from year book of Agr. No. 1067:1-2.

Nixon, R.W. 1945. The need for a manograph of the date varieties of the world. Chron. Bot. (Calender). 9 (2/3): 153-154.

Nixon, R. W. 1951. Leaf characters of the Deglet Nour date palm in relation to age and environment. Amer. Soc. Hort. Sci. Proc. 57: 179-185.

Table 1. Leaf Morphological characteristics of ten commercial date palm cultivars

Cultivars	Leaf Length (cm)	Pinnae zone (cm)	Pinnae Density (# of pinnae / 40 cm)	Pinnae surface area (cm^2)	Blade width (cm)	Pinnae zone / total leaf length (Ratio)	Exposed Leaf Area (cm^2)	Valley Angle (Degree)	Apical Divergence (Degree)
Barhi	282.6 DE	223.6 DE	30.6 A	93.73 BC	65.10 BCD	79.36 A	2604.0 ABC	84.00 BC	92.00 AB
Khneizi	290.8 DE	225.0 DE	29.6 AB	105.80 AB	76.70 AB	77.43 A	3068.0 A	83.00 BC	82.00 BC
Neghal	349.2 A	270.6 A	30.4 AB	93.56 BC	73.90 ABC	78.02 A	2956.0 AB	95.00 AB	86.0 ABC
Helali	315.2 BCD	234.9 BCD	31.0 A	71.64 E	58.10 D	75.18 A	2334.0 C	85.00 AC	71.0 C
Khlas	328.4 ABC	257.6 ABC	28.4 AB	112.80 A	76.60 AB	78.50 A	3064.0 A	70.00 CD	94.0 AB
Khesab	298.8 CD	218.4 DE	286 AB	90.69 BCD	66.50 BCD	73.53 A	2660.0 ABC	81.00 BC	76.0 BC
Rziz	264.4 E	203.2 E	32.0 A	74.68 DE	55.00 D	77.23 A	2200.0 C	94.00 AB	77.0 BC
Lulu	296.0 CDE	231.2 BCDE	30.8 A	73.94 E	62.90 CD	78.16 A	2516.0 BC	63.00 D	93.0 AB
Khadrawi	287.8 DE	227.3 DCE	25.6 B	113.60 A	81.30 A	80.02 A	2532.0 BC	89.00 AB	103.0 A
Fardh	335.2 AB	261.0 AB	29.0 AB	81.43 CDE	63.10 CD	78.06 A	2524.0 BC	104.0 A	71.0 C

Table 2: Pinnae distribution and three – dimension orientation of ten commercial cultivars of date palm

Cultivars	Repeated pattern of pinnae distribution and orientation on each side of the rachis
Barhi	Up (S) down (M)
Khneizi	Up (S) down (L)
Neghal	Up (M) down (L)
Helali	Up (M) down (M)
Khlas	Up (S) down (M)
Khesab	Up (S) Intermediate (M) down (L)
Rziz	Up (M) down (M)
Lulu	Up (S) Intermediate (M) down (L)
Khadrawi	Up (M) down (L)
Fardh	Up (M) Intermediate (M)

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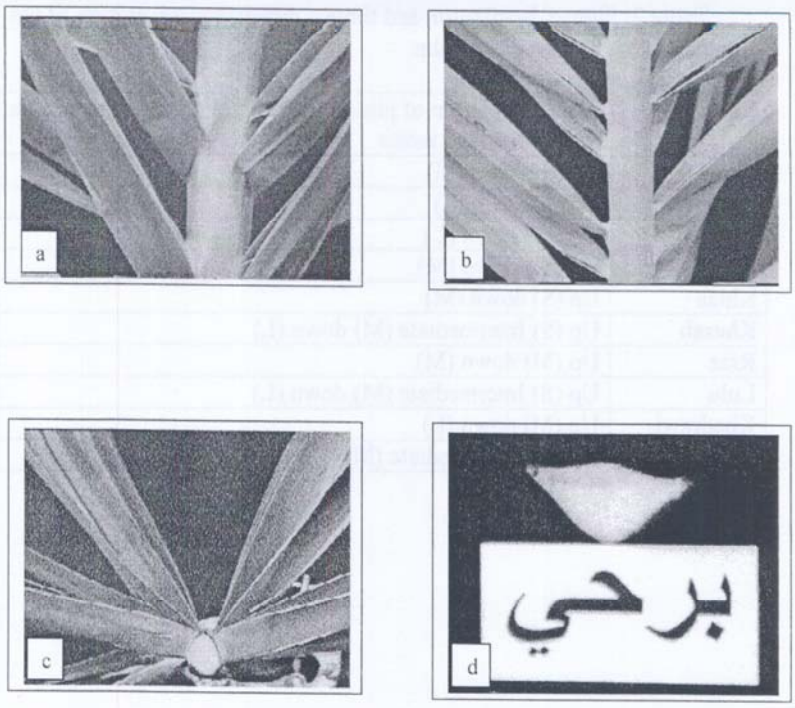

Fig. 1. Morphological features of 'Barhi' date palm fully mature leaves. Pattern of pinnae distribution as shown in ventral view (a) and dorsal view (b). cross sections in the middle part of the rachis (c) and the basal part of the leaf petiole (d).

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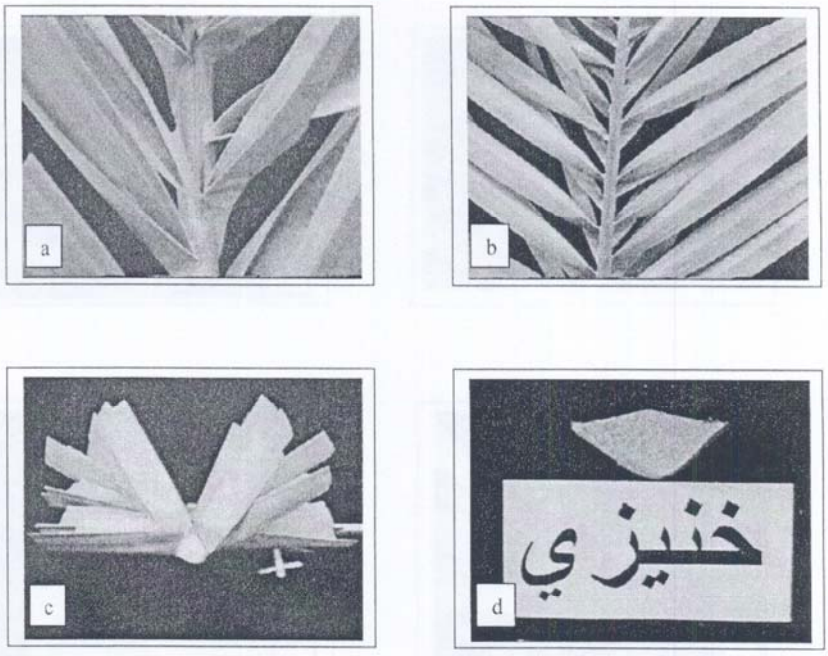

Fig. 2. Morphological features of 'Khneizi' date palm fully mature leaves. Pattern of pinnae distribution as shown in ventral view (a) and dorsal view (b). Cross sections in the middle part of the rachis (c) and the basal part of the leaf petiole (d).

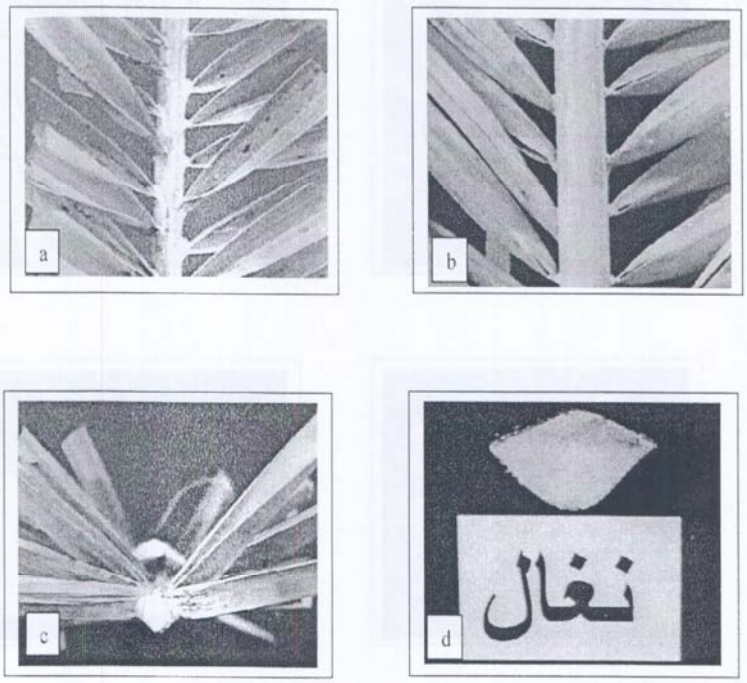

Fig. 3. Morphological features of 'Neghal' date palm fully mature leaves. Pattern of pinnae distribution as shown in ventral view (a) and dorsal view (b). Cross sections in the middle part of the rachis (c) and the basal part of the leaf petiole (d).

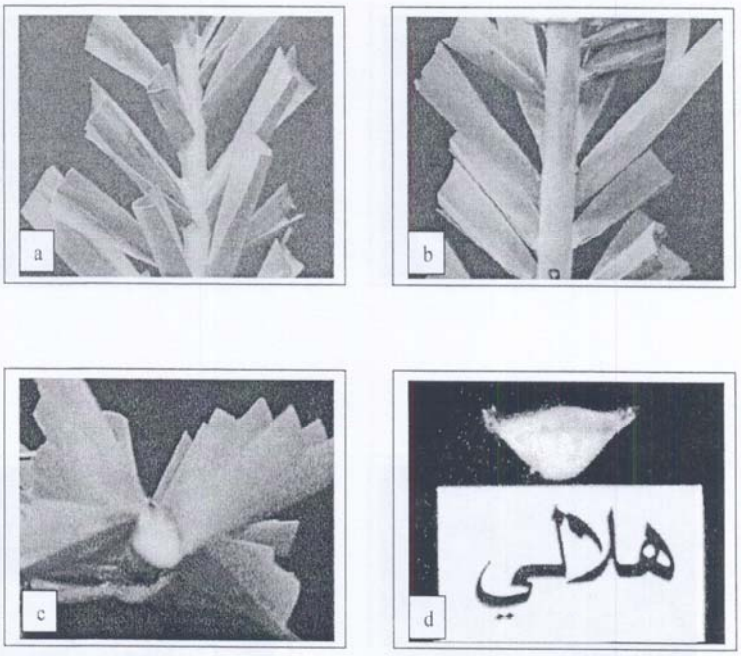

Fig. 4. Morphological features of 'Helali' date palm fully mature leaves. Pattern of pinnae distribution as shown in ventral view (a) and dorsal view (b). Cross sections in the middle part of the rachis (c) and the basal part of the leaf petiole (d).

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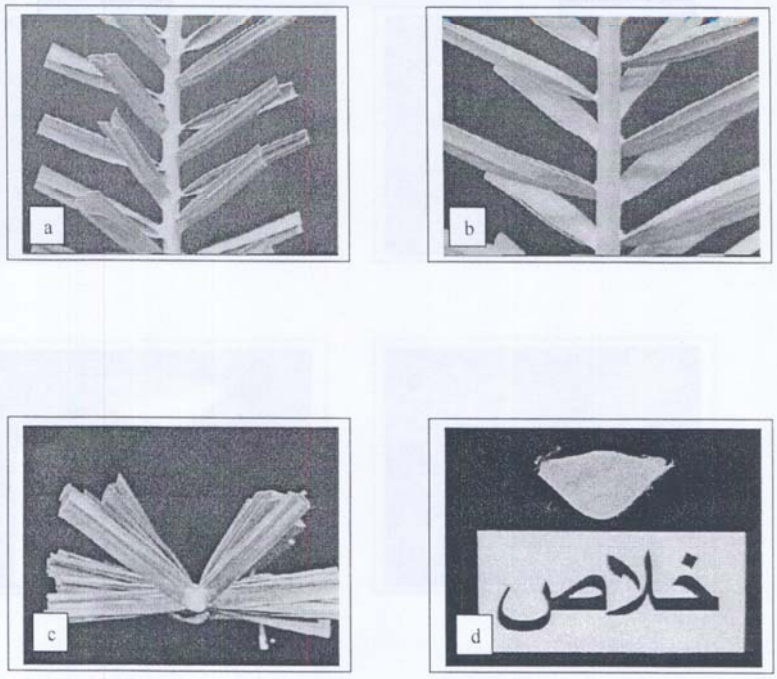


Fig. 5. Morphological features of 'Khlas' date palm fully mature leaves. Pattern of pinnae distribution as shown in ventral view (a) and dorsal view (b). Cross sections in the middle part of the rachis (c) and the basal part of the leaf petiole (d).

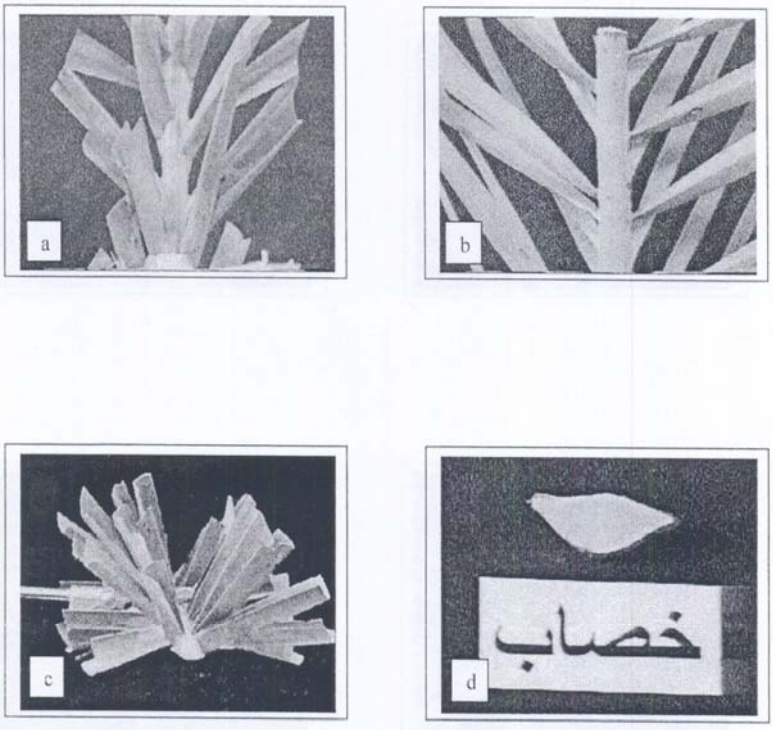


Fig. 6. Morphological features of 'Khesab' date palm fully mature leaves. Pattern of pinnae distribution as shown in ventral view (a) and dorsal view (b). Cross sections in the middle part of the rachis (c) and the basal part of the leaf petiole (d).

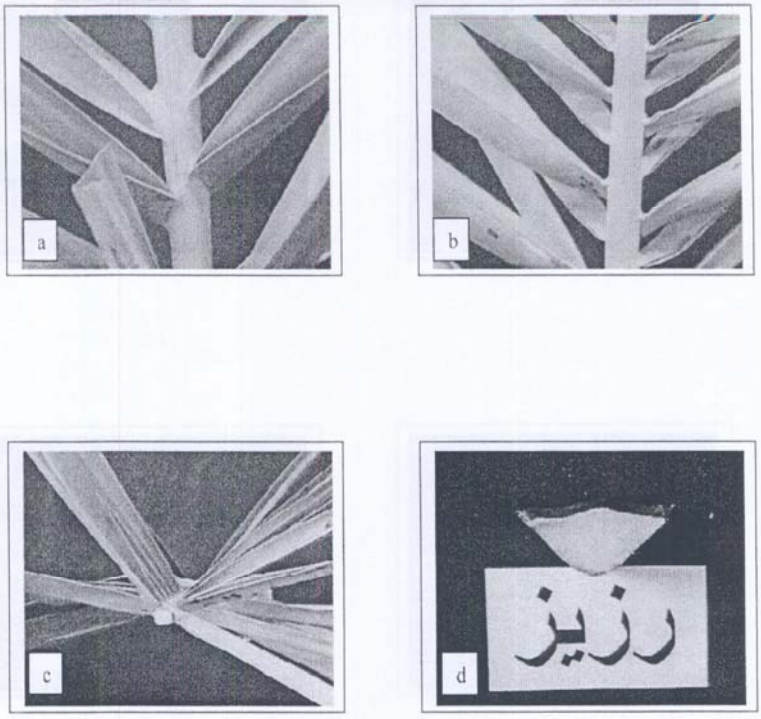


Fig. 7. Morphological features of 'Rziz' date palm fully mature leaves. Pattern of pinnae distribution as shown in ventral view (a) and dorsal view (b). Cross sections in the middle part of the rachis (c) and the basal part of the leaf petiole (d).

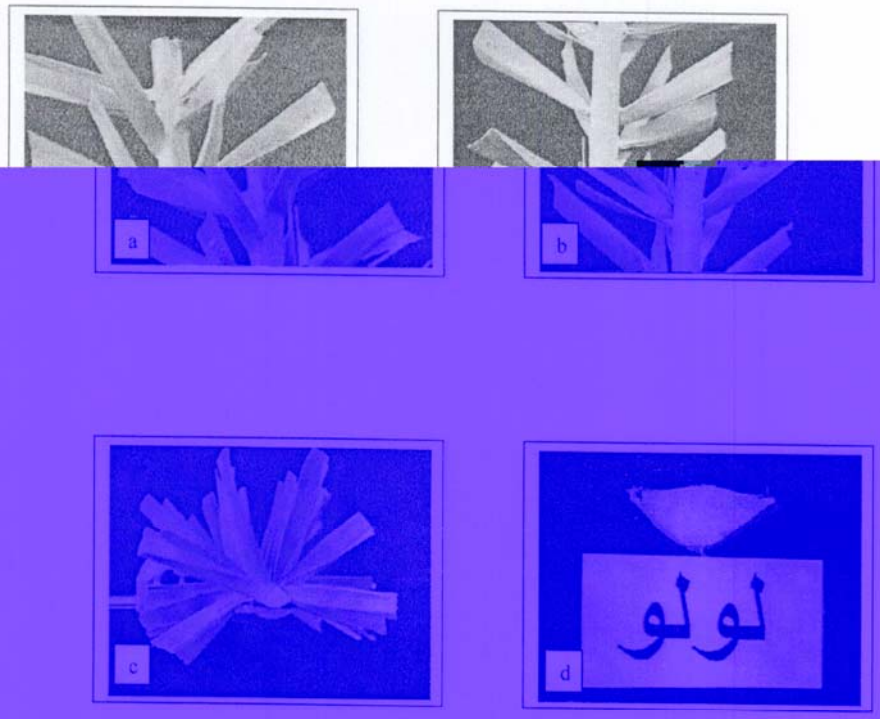
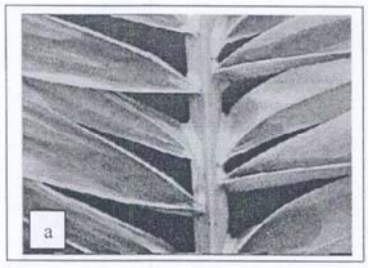


Fig. 8. Morphological features of 'Lulu' date palm fully mature leaves. Pattern of pinnae distribution as shown in ventral view (a) and dorsal view (b). Cross sections in the middle part of the rachis (c) and the basal part of the leaf petiole (d).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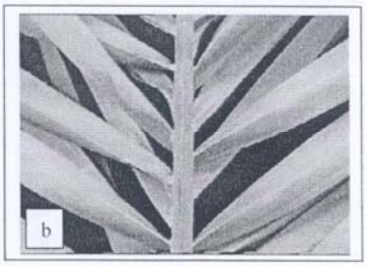
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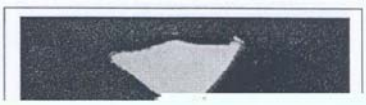

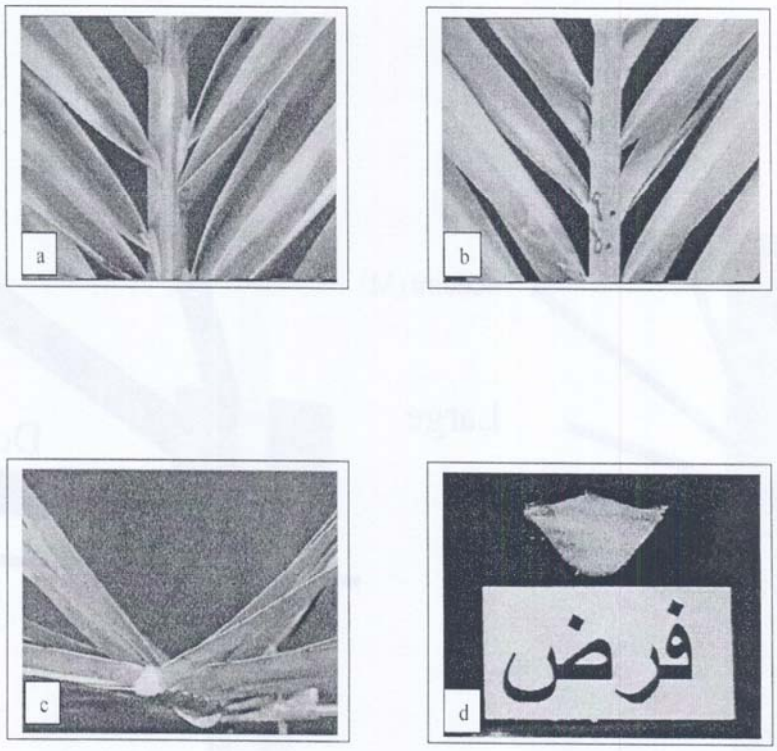

Fig. 10. Morphological features of 'Fardh' date palm fully mature leaves. Pattern of pinnae distribution as shown in ventral view (a) and dorsal view (b). Cross sections in the middle part of the rachis (c) and the basal part of the leaf petiole (d).

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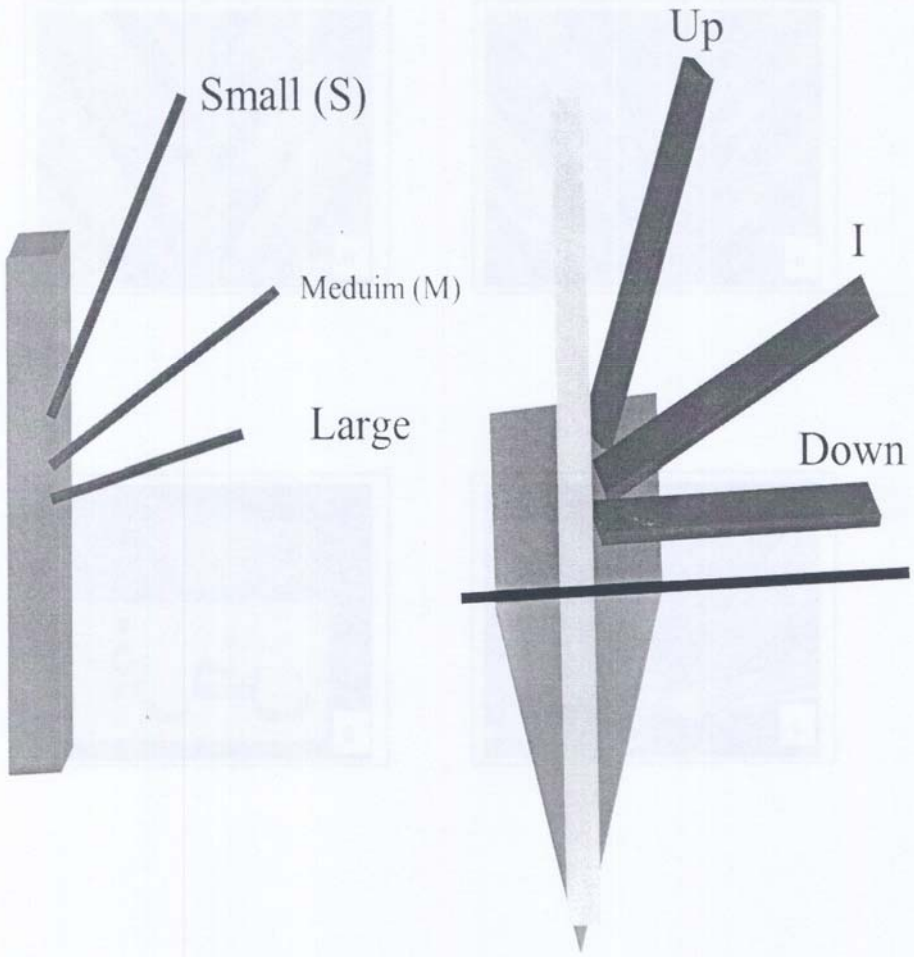

Fig 11. A Diagram showing the system used to describe the distribution and orientation of Pinnae in one and three dimensions.