Foliage Classification Study of Phoenix Dactylifera

by

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Master of Science.

In the College of Agriculture of the

University of Arizona

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ACKNOWLEDGMENT

This opportunity is taken to thank those who have assisted in any way to carry on this study, especially D. W. Albert, Professor of Horticulture of the College of Agriculture of the University of Arizona, for advice and encouragement; also M. F. Wharton, Assistant Horticulturist of the College of Agriculture of the University of Arizona, for reading and suggesting improvements in the manuscript; W. E. Bryan, Professor of Plant Breeding of the College of Agriculture of the University of Arizona, for suggestions in statistical methods; Dr. E. B. Streets, Assistant Professor of Plant Pathology of the College of Agriculture of the University of Arizona, for photographs; J. J. Thornber, Dean of the College of Agriculture of the University of Arizona, for counsel and advice; and T. L. Stapley, Foreman of the University of Arizona Date Orchard at Tempe, Arizona; and A. G. Shamblin, Foreman of the United States Department of Agriculture Experiment Station at Indio, California, for so readily placing information and facilities at the disposal of the writer.
TABLE OF CONTENTS

INTRODUCTION ...................................................... 1

METHOD OF PROCEDURE ............................................. 3

DATA OBTAINED ..................................................... 7

Table I--Measurement of Tree Trunks ......................... 7
Table II--Leaf Measurements .................................... 8
Table III--Degrees of Antrorse Axillary Angle ............. 11
Table IV--Degrees of Introrse Axillary Angle ............... 13
Table V--Degrees of Retrorse Axillary Angle ............... 16
Table VI--Degrees of Antrorse Plane Angle ................. 19
Table VII--Degrees of Introrse Plane Angle ................. 22
Table VIII--Degrees of Retrorse Plane Angle ............... 24
Table IX--Measurements of Pinnae Length ..................... 27
Table X--Measurements of Pinnae Breadth ..................... 30
Table XI--Measurements of Pinnae Thickness ................. 33
Table XII--Number of Pinnae .................................... 36
Table XIII--Pinnae Classes and Groups ....................... 39

DESCRIPTION OF VARIETIES ........................................ 41

Deglet Nor. .................................................... 41
Rachis Outlines .................................................. 42
Photograph of Palm ............................................... 42a
Halawi .......................................................... 44
Rachis Outlines .................................................. 45
Photograph of Palm ............................................... 45a
Hayany ......................................................... 47
<table>
<thead>
<tr>
<th>Section</th>
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</thead>
<tbody>
<tr>
<td>Rachis Outlines</td>
<td>48</td>
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<td>Photograph of Palm</td>
<td>48a</td>
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<tr>
<td>SUMMARY OF MEASUREMENTS</td>
<td>71</td>
</tr>
<tr>
<td>CONSIDERATION OF DATA</td>
<td>73</td>
</tr>
</tbody>
</table>
CONCLUSIONS. ........................................ 76
BIBLIOGRAPHY ....................................... 77
INTRODUCTION

The results herein set down were obtained from a study of the leaves and trunk of the date palm Phoenix dactylifera. The work itself is merely an amplification of that done by Silas C. Mason as set forth in U.S.D.A. Bulletin No. 223. In the original work only four leading varieties were used whereas the writer has increased the number to include ten of the main commercial varieties.

In order to properly study varieties within a species it is well to have in mind the general characters of the Genus and species. The date palm belongs to the order Palmeae, to the genus Phoenix, Linnaeus, and to the species Dactylifera, Linnaeus. Professor Gammie (2) thus describes the genus:

"A moderately tall palm. Stem stout, rough with the persistent bases of spiny petioles. Leaves pinnate, pinnae scattered, rigid, lanceolate. Spadices several, interfoliar, erect, afterwards drooping, branched. Spathe basilar. Flowers small, dioecious. Male flowers: sepals of perianth cupular, three-toothed, petals three, oblately ovate, valvate, stamens six. Female flowers: sepals three, globose, scorescent, petals three, rounded, imbricate, staminodes six, free or connate, carpels three, free, stigmas sessile, hooked. Fruit oblong, terete, one-seeded, perianth (misprint for 'pericarp'? ) fleshy, endocarp membranous. Seed oblong, ventrally grooved, albumen
equable or subruminate."

Professor Willis (2) describes the species as follows:

"P. dactylifera, Linnaeus (date palm). It has a columnar stem covered with old leaf-bases; the leaves are pinnate. Flowers dioecious; the Arabs fertilize the female spadix by hanging a male over it. Berry; seeds with hard, cellulose endosperm."

The importance of the study, according to Masen (1), "is to enable the observer to make such foliage comparisons in a precise and systematic manner, capable of tabulation for future reference." It will obviously be of benefit to the date industry to have a system, by which date palms may be identified without it being necessary to depend upon the fruit characters for identification. Those who work with dates are able to identify the important varieties by the tree and foliage characters, even by the outline of the tree head.

Since these variations in characters are prominent enough to be visible to the eye they should be measureable. In this study as many characteristics as possible were measured and recorded. An effort has been made to include enough individual palms as well as a sufficient number of varieties to establish the value of the characteristics used as a basis for identification of varieties.

Because of the growing importance of
the date industry, in Arizona, it is hoped that this study will aid in the identification of the cultivated varieties of dates grown in Arizona.

METHOD OF PROCEDURE

Most of the data was obtained from trees in the Cooperative Date Orchard, located at Tempe, Arizona. Measurements were also taken at the Government stations at Indio and Mecca, California. This was done to serve as a comparison or check on the work done at Tempe. Mature trees were used in the study at Tempe, and as near as possible the same size trees were used in the studies at Indio and Mecca.

After selecting the trees of a variety to be studied, the first step was to measure the circumference of the trees. The leaf bases were trimmed off with an axe to a height of five and one half feet above the surface of the ground. This was a convenient height to chop and it was above the area commonly affected by roots. A tape was drawn around the trunk to get the measurement.

The next step was to measure from the tree trunk to the leaf apex and was done by using two pine strips which would slide over each other. A tack was placed in the end of the top strip, and a tape was hooked over it. The strips could be pushed back and forth, and with a level on the strips to keep them in a horizontal
position an accurate measurement could be taken of what will be known as the "distance out" of the leaf apex. The "droop" was obtained by measuring the distance from the point on the trunk, where the strip touched in measuring the "distance out", upward to the base of the leaf.

The leaf was cut from the tree at the base. It was then placed over a board about three feet above the ground, and the base against or under some suitable object so that the leaf would retain much the same position it did while on the tree.

The leaf length was measured by placing a tack in the base of the leaf and hooking the ring of the tape over the tack and then drawing the tape over the rachis to the end of the rachis. The tape was left in this position until the remainder of the measurements were made so that the various measurements could be recorded a foot at a time, according to the foot in which they were located.

The area toward the base of the leaf which is occupied by spines was measured by reading the tape at the point where the pinnæ begin. This is called the spine area. The area occupied by the pinnæ was then measured and represents the blade area. A micrometer, reading to 0.001 of an inch, was used in measuring the thickness of
the pinnae to determine the comparative thickness in the different varieties. Four to six measurements were taken per foot throughout the length of the leaf, two or three on each side.

To measure the axillary angle formed by the pinnae with the rachis, a two-foot rule, hinged in the center, and a protractor head graduated to one degree, was used. By closing or opening the rule to the correct angle formed by the pinnae with the rachis the protractor reading would be taken. Separate readings were made for each of the three classes of pinnae. The three classes of pinnae are; antrorse, meaning that the channel of the pinnae is "directed upward or higher"; introrse, meaning that the channel of the pinnae is "directed inward" toward the inner or ventral surface of the rachis; and the third class is retrorose, meaning that the channel of the pinnae has been "directed back or downward". This nomenclature was devised by Mason (1).

Measurement of the angle formed by the pinnae with the plane was made by using the protractor rule to measure the divergence of the pinnae from a plane which would run along the rachis if it were perfectly straight. Two to three readings were taken per foot. The combined divergence of both pinnae was measured at one time. Separate sets of measurements were taken for each class of pinnae.
The two-foot rule was used to measure the length of the pinnae. Four to six readings were taken per foot, one half of the measurements were taken on each side. The widest point on the pinnae was used in measuring the width of the pinnae. Four to six measurements were taken per foot.

The terminal pinnae at the end of the leaf were measured as a separate unit. These terminal pinnae were measured for length, thickness, and breadth.

A full record of all pinnae on the leaves studied was made. They were recorded as to classes and groups following the system of Mason (1); "the pinnae along the respective sides of the rachis are arranged in groups of two, three, four, or, rarely five, a group of two being the most common. These groups fall into regular and irregular classes. The regular groups, which constitute the normal or regular form of arrangement, consist of a lower or proximal antroso pinna and an upper or distal retrorso pinna, between which may occur one, two, or rarely, three introrso pinnae". For example (a, i, i, i, r).

The rachis of one leaf from each variety was cut in foot lengths with a saw, and the ends traced on drawing paper to give actual measurements. Six leaves from four trees each of the following varieties were studied: Deglet Noor, Hayany, Itema, Tadala, Halawi, Khadrawi, Maktum, Zaheedy, Rhars and Saidy.
DATA OBTAINED

Table I.
Measurements of Tree Trunks.

Where less than four trees were measured it was because no more trees of the proper age were available.

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<th>Var: Halawi</th>
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<td>20</td>
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Degrees of Antrorse Axillary Angle

The measurements listed in this table are the degrees of divergence of the antrorse pinnae forming the axillary angle.

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**Degrees of Introrse Axillary Angle**

The measurements listed in this table are the degrees of divergence of the introrse pinnae forming the axillary angle.

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### Table V.

#### Degrees of Retrorse Axillary Angle

The measurements listed in this table are the degrees of divergence of the retrorse pinnae forming the axillary angle.

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**Variety: Hayany**

| Row | 17  | 17  | 17  | 17  | 17  | 1  |
| Leaf | 1  | 2  | 1  | 2  | 1  | Calif. |
| 3-4' | 18  | 14  | 29  | 25  | 34  | 34  | 34  |
| 4-5' | 17  | 17  | 37  | 23  | 37  | 37  | 37  |
| 5-6' | 30  | 19  | 36  | 33  | 41  | 35  | 35  |
| 6-7' | 28  | 28  | 38  | 35  | 48  | 49  | 49  |
| 7-8' | 31  | 23  | 29  | 36  | 48  | 42  | 42  |
| 8-9' | 29  | 28  | 39  | 48  | 55  | 38  | 36  |
| 9-10' | 44  | 34  | 38  | 48  | 43  | 38  | 35  |
| 10-11' | 35  | 35  | 13  | 13  | 18  | 39  | 29  |

**Variety: Rhaps**

| Row | 15  | 15  | 15  | 16  | 10  | 10  |
| Leaf | 1  | 2  | 1  | Calif. | 1  | 2  |
| 3-4' | 23  | 40  | 29  | 34  | 35  | 33  | 32  |
| 4-5' | 28  | 36  | 32  | 35  | 44  | 34  | 34  |
| 5-6' | 28  | 44  | 46  | 39  | 44  | 44  | 44  |
| 6-7' | 39  | 47  | 44  | 35  | 40  | 46  | 44  |
| 7-8' | 40  | 42  | 48  | 35  | 52  | 52  | 45  |
| 8-9' | 39  | 33  | 51  | 44  | 51  | 45  | 42  |
| 9-10' | 42  | 37  | 45  | 47  | 43  | 37  | 42  |
| 10-11' | 32  | 34  | 38  | 28  | 36  | 31  | 31  |
| 11-12' | 29  | 22  | 32  | 30  | 36  | 31  |

**Variety: Ziaheedy**

| Row | 18  | 18  | 18  | 6  | 18  | 18  |
| Leaf | 1  | 1  | 1  | Calif. | 1  | 2  |
| 3-4' | 45  | 47  | 43  | 43  | 41  | 57  | 44  |
| 4-5' | 62  | 58  | 45  | 33  | 53  | 50  | 51  |
| 5-6' | 57  | 59  | 53  | 40  | 58  | 46  | 52  |
| 6-7' | 49  | 51  | 66  | 64  | 55  | 59  | 58  |
| 7-8' | 52  | 53  | 62  | 62  | 42  | 58  | 55  |
| 8-9' | 42  | 44  | 58  | 57  | 43  | 46  | 48  |
| 9-10' | 35  | 47  | 51  | 46  | 38  | 34  | 40  |

**Variety: Saidy**

<p>| Row | 17  | 17  | 16  | 3  | 17  | 17  |
| Leaf | 1  | 2  | 1  | Calif. | 1  | 2  |
| 4-5' | 50  | 50  | 46  | 48  | 49  | 50  | 49  |
| 5-6' | 55  | 52  | 59  | 47  | 42  | 49  | 51  |
| 6-7' | 59  | 54  | 73  | 40  | 51  | 35  | 52  |</p>
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Table VI.

Degrees of Antorose Plane Angle

The measurements listed in this table are the combined divergences of the antorose pinnae from the vertical plane formed by the rachis.

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Table VII.

Degrees of Introrse Plane Angle

The measurements listed in this table are the combined divergences of the introrse pinnae from the vertical plane formed by the rachis.

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### Table VIII.

**Degrees of Retrorse Plane Angle**

The measurements listed in this table are the combined divergences of the retronse pinnae from the vertical plane formed by the rachis.
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Table IX.

Measurements of Pinnae Length.

The measurements listed in this table are the averages of pinnae length for each foot of each leaf blade, expressed in inches.

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### Table I.

**Measurements of Pinnae Breadth.**

The measurements listed in this table are the averages of pinnae breadth for each foot of each leaf blade, expressed in sixteenth inches.

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### Table XI.

**Measurements of Pinnae Thickness.**

The measurements in this table are the averages of pinnae thickness for each foot of each leaf blade, expressed in thousandths of an inch.

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</tr>
<tr>
<td>11-12'</td>
<td>16 3/4</td>
</tr>
</tbody>
</table>

Variety; Zaheedy
Row | 18 | 18 | 18 | 6 | 18 | 18 | Average | 18
Tree | 11 | 11 | 1 | 7 | 9 | 2 |
Leaf | 1 | 2 | 1 Calif | 1 | 2 |
3-4' | 20 | 20 3/4 | 19 | 22 3/4 | 21 3/4 | 21 | 21 |
4-5' | 19 | 19 | 18 | 20 | 20 | 20 | 19 1/2 | 19 |
5-6' | 18 3/4 | 18 | 19 1/2 | 18 3/4 | 18 | 18 | 18 1/2 | 18 |
6-7' | 18 | 18 | 18 | 19 | 18 | 17 1/2 | 19 | 19 |
7-8' | 18 3/4 | 17 | 18 1/2 | 18 1/2 | 17 | 18 | 18 1/2 | 18 |
8-9' | 18 | 16 3/4 | 17 1/2 | 17 | 16 1/2 | 16 | 16 1/2 | 17 |
9-10' | 19 | 17 | 17 1/2 | 19 3/4 | 16 3/4 | 15 |

Variety; Saidy
Row | 17 | 17 | 16 | 6 | 17 | 17 | Average | 17
Tree | 8 | 8 | 1 | 7 | 4 | 4 |
Leaf | 1 | 2 | 1 Calif | 1 | 2 |
3-4' | 20 | 20 | 17 1/2 | 24 | 24 | 24 | 24 1/2 | 22 |
4-5' | 18 | 19 1/2 | 16 3/4 | 20 3/4 | 21 1/2 | 22 | 22 1/2 | 19 |
5-6' | 17 | 18 1/2 | 18 3/4 | 16 | 19 1/2 | 19 | 22 1/2 | 19 |
6-7' | 17 | 19 1/2 | 16 1/2 | 18 3/4 | 20 | 19 | 19 1/2 | 18 |
7-8' | 17 1/2 | 18 1/2 | 17 | 17 1/2 | 18 | 17 | 17 1/2 | 18 |
8-9' | 17 | 18 1/2 | 17 | 17 1/2 | 18 | 17 | 17 1/2 | 18 |
9-10' | 16 3/4 | 15 | 16 | 16 1/2 | 16 | 16 1/2 | 17 |
10-11' | 16 | 18 | 17 1/2 | 18 3/4 | 16 3/4 | 16 |

Variety; Tadala
Row | 23 | 23 | 23 | 15 | 15 | Average | 17
Tree | 10a | 10b | 10c | 9 | 9 |
Leaf | 1 | 2 | 1 | 1 | 2 |
3-4' | 21 1/2 | 19 | 19 | 19 | 21 1/2 | 20 |
4-5' | 17 | 17 | 17 1/2 | 18 1/2 | 17 | 17 |
5-6' | 17 | 18 1/2 | 17 1/2 | 19 | 18 | 18 |
6-7' | 16 1/2 | 18 1/2 | 17 1/2 | 19 | 17 1/2 | 18 |
7-8' | 16 1/2 | 18 1/2 | 17 1/2 | 18 | 17 1/2 | 17 |
8-9' | 16 1/2 | 18 1/2 | 18 1/2 | 18 | 17 1/2 | 17 |
9-10' | 16 | 17 | 19 1/2 | 18 | 18 | 17 |

---0 0---
Table XII.

Number of Pinnae

The total number of pinnae is listed in this table for each foot of each leaf blade. The average of the total number of pinnae is given for each variety.

<table>
<thead>
<tr>
<th>Variety: Deglat Noor</th>
<th>Average</th>
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</thead>
<tbody>
<tr>
<td>Row</td>
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</tr>
<tr>
<td>Tree</td>
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</tr>
<tr>
<td>Leaf</td>
<td></td>
</tr>
<tr>
<td>3-4'</td>
<td></td>
</tr>
<tr>
<td>4-5'</td>
<td></td>
</tr>
<tr>
<td>5-6'</td>
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</tr>
<tr>
<td>6-7'</td>
<td></td>
</tr>
<tr>
<td>7-8'</td>
<td></td>
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<td>9-10'</td>
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<td>10-11'</td>
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</tr>
<tr>
<td>Total</td>
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<tr>
<td>pinnae</td>
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<table>
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<tr>
<td>Tree</td>
<td></td>
</tr>
<tr>
<td>Leaf</td>
<td></td>
</tr>
<tr>
<td>3-4'</td>
<td></td>
</tr>
<tr>
<td>4-5'</td>
<td></td>
</tr>
<tr>
<td>5-6'</td>
<td></td>
</tr>
<tr>
<td>6-7'</td>
<td></td>
</tr>
<tr>
<td>7-8'</td>
<td></td>
</tr>
<tr>
<td>9-10'</td>
<td></td>
</tr>
<tr>
<td>10-11'</td>
<td></td>
</tr>
<tr>
<td>Total</td>
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</tr>
<tr>
<td>pinnae</td>
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</tbody>
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<table>
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<tr>
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<th>Average</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>Tree</td>
<td></td>
</tr>
<tr>
<td>Leaf</td>
<td></td>
</tr>
<tr>
<td>3-4'</td>
<td></td>
</tr>
<tr>
<td>4-5'</td>
<td></td>
</tr>
<tr>
<td>5-6'</td>
<td></td>
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<tr>
<td>6-7'</td>
<td></td>
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<tr>
<td>7-8'</td>
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<td>8-9'</td>
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<td>Total</td>
<td></td>
</tr>
<tr>
<td>pinnae</td>
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</tr>
<tr>
<td>Variety: Tadala</td>
<td>Average.</td>
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<tr>
<td>----------------</td>
<td>----------</td>
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<td></td>
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</tr>
<tr>
<td>Variety: Maktum</td>
<td>Average.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Variety: Khadrawi</td>
<td>Average.</td>
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<tr>
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</table>
### Variety: Halawi

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<th>Leaf 1</th>
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<th>Leaf 2</th>
<th>Average 19</th>
<th>Calif. 8</th>
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</thead>
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<td>18</td>
<td>20</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>5-6'</td>
<td>21</td>
<td>18</td>
<td>21</td>
<td>19</td>
<td>22</td>
</tr>
<tr>
<td>6-7'</td>
<td>21</td>
<td>20</td>
<td>20</td>
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<td>21</td>
<td>26</td>
<td>21</td>
</tr>
<tr>
<td>11-12'</td>
<td>18</td>
<td>21</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-13'</td>
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<td>Total</td>
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### Variety: Zitaed

<table>
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<tr>
<th>Row</th>
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<th>Leaf 6</th>
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<th>Calif. 5</th>
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<tr>
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<td>23</td>
<td>23</td>
<td>1</td>
<td>2</td>
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<tr>
<td>4-5'</td>
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<td>18</td>
<td>21</td>
<td>27</td>
<td>23</td>
</tr>
<tr>
<td>5-6'</td>
<td>20</td>
<td>18</td>
<td>29</td>
<td>27</td>
<td>29</td>
</tr>
<tr>
<td>6-7'</td>
<td>24</td>
<td>29</td>
<td>25</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>7-8'</td>
<td>25</td>
<td>18</td>
<td>23</td>
<td>26</td>
<td>25</td>
</tr>
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<td>22</td>
<td>27</td>
<td>25</td>
</tr>
<tr>
<td>11-12'</td>
<td>33</td>
<td>30</td>
<td>2</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>12-13'</td>
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<tr>
<td>Total</td>
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<td>208</td>
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<td>203</td>
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### Variety: Zaheed

<table>
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<tr>
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<th>Leaf 9</th>
<th>Average 18</th>
<th>Calif. 6</th>
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<td>26</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>4-5'</td>
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<td>30</td>
<td>25</td>
<td>25</td>
<td>29</td>
</tr>
<tr>
<td>5-6'</td>
<td>20</td>
<td>28</td>
<td>27</td>
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<td>30</td>
</tr>
<tr>
<td>6-7'</td>
<td>29</td>
<td>29</td>
<td>30</td>
<td>26</td>
<td>28</td>
</tr>
<tr>
<td>7-8'</td>
<td>32</td>
<td>28</td>
<td>32</td>
<td>27</td>
<td>30</td>
</tr>
<tr>
<td>8-9'</td>
<td>28</td>
<td>33</td>
<td>25</td>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td>9-10'</td>
<td>23</td>
<td>29</td>
<td>27</td>
<td>25</td>
<td>30</td>
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<tr>
<td>10-11'</td>
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<td>11</td>
<td>8</td>
<td>22</td>
<td>12</td>
</tr>
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<td>11-12'</td>
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<td></td>
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</tr>
<tr>
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<td>pinnae 219</td>
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<td>201</td>
<td>208</td>
<td>209</td>
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</table>
### Table XIII.

#### Pinnae Classes and Groups

Only the number averages of these classes and groups of pinnae are listed.

<table>
<thead>
<tr>
<th>Variety:</th>
<th>Antrorse</th>
<th>Introrse</th>
<th>Retrorse</th>
<th>Two Group</th>
<th>Three Group</th>
<th>Four Group</th>
</tr>
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<tbody>
<tr>
<td>Deglet Noor</td>
<td>60</td>
<td>36</td>
<td>63</td>
<td>30</td>
<td>24</td>
<td>2(\frac{1}{2})</td>
</tr>
<tr>
<td>Hayany</td>
<td>52</td>
<td>25</td>
<td>54</td>
<td>40</td>
<td>14</td>
<td>4(\frac{1}{2})</td>
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<tr>
<td>Itema</td>
<td>68</td>
<td>33</td>
<td>75</td>
<td>44</td>
<td>19</td>
<td>4(\frac{1}{2})</td>
</tr>
<tr>
<td>Halawi</td>
<td>71</td>
<td>16</td>
<td>65</td>
<td>52</td>
<td>13</td>
<td>3(\frac{1}{3})</td>
</tr>
<tr>
<td>Rhars</td>
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<td>79</td>
<td>32</td>
<td>31</td>
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<td>58</td>
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</tr>
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<td>56</td>
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<td>79</td>
<td>49</td>
<td>18</td>
<td>1(\frac{1}{2})</td>
</tr>
<tr>
<td>Maktum</td>
<td>63</td>
<td>32</td>
<td>76</td>
<td>46</td>
<td>18</td>
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</tr>
<tr>
<td>Khadrawi</td>
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<td>31</td>
<td>74</td>
<td>59</td>
<td>9</td>
<td>1(\frac{1}{2})</td>
</tr>
<tr>
<td>Saidy</td>
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<td>62</td>
<td>42</td>
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</table>
Table XLV.

Terminal Pinnae Measurements.

The measurements of terminal pinnae listed below are the averages with the two extremes.

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<th>Small</th>
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<th>Average</th>
<th>Small</th>
<th>Large</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
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<td>13</td>
<td>11½</td>
<td>7½</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Breadth</td>
<td>8</td>
<td>14</td>
<td>12</td>
<td>12</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Thickness</td>
<td>19</td>
<td>22</td>
<td>20½</td>
<td>17</td>
<td>24</td>
<td>19</td>
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<table>
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<tr>
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<th>Small</th>
<th>Large</th>
<th>Average</th>
<th>Small</th>
<th>Large</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
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<td>13½</td>
<td>11½</td>
<td>4½</td>
<td>6½</td>
<td>5½</td>
</tr>
<tr>
<td>Breadth</td>
<td>14</td>
<td>17</td>
<td>15</td>
<td>5</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Thickness</td>
<td>19</td>
<td>26</td>
<td>23</td>
<td>16</td>
<td>22</td>
<td>19½</td>
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</table>

<table>
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<th>Variety</th>
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<th>Large</th>
<th>Average</th>
<th>Small</th>
<th>Large</th>
<th>Average</th>
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<tbody>
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<td>7</td>
<td>6½</td>
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<td>10½</td>
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<tr>
<td>Breadth</td>
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<td>9</td>
<td>8</td>
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<table>
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<th>Large</th>
<th>Average</th>
<th>Small</th>
<th>Large</th>
<th>Average</th>
</tr>
</thead>
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<td>6</td>
<td>5½</td>
<td>7</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Breadth</td>
<td>8</td>
<td>10</td>
<td>9</td>
<td>11</td>
<td>17</td>
<td>15</td>
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<tr>
<td>Thickness</td>
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<td>21</td>
<td>18½</td>
<td>16</td>
<td>20</td>
<td>18½</td>
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</table>

<table>
<thead>
<tr>
<th>Variety</th>
<th>Small</th>
<th>Large</th>
<th>Average</th>
<th>Small</th>
<th>Large</th>
<th>Average</th>
</tr>
</thead>
<tbody>
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<td>Length</td>
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<td>12½</td>
<td>11½</td>
<td>6½</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Breadth</td>
<td>8</td>
<td>11</td>
<td>9½</td>
<td>6</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Thickness</td>
<td>17</td>
<td>22</td>
<td>19</td>
<td>16</td>
<td>22</td>
<td>19</td>
</tr>
</tbody>
</table>

Note: Lengths are expressed in inches; breadths are expressed in sixteenth inches; and thicknesses are expressed in thousandths of an inch.
DESCRIPTION OF VARIETIES

The descriptions which follow are based almost entirely upon the measurements taken in this study.

Deglet Noor
(Syn. Deglet Nur, Deglet en-Hour)

The Deglet Noor trees have a slender trunk. The tree trunks of this variety measure from 4 feet 7 inches to 5 feet 4 inches in circumference, with an average of 4 feet 10 inches. The leaves of this variety are long, ranging from 10 feet 4 inches to 12 feet 9 inches, with an average of 11 feet in length. The leaf base is small. The older leaves have a short droop, ranging from 2 feet 6 inches to 4 feet 2 inches, with an average droop of 3 feet 8 inches. The trees of this variety have a wide head, as the "distance cut" of the apex of the leaves from the trunk of the tree ranges between 10 feet 10 inches and 8 feet 2 inches, with an average of 9 feet 6 inches. The spine area is of medium length, with a range between 2 feet 8 inches and 4 feet 7 inches and an average of 3 feet 2 inches, which is 29 per cent of its total leaf length. The blade area ranges from 7 feet 2 inches to 5 feet 6 inches, with an average of 7 feet 8 inches, which is 71 per cent of the leaf length.

The divergences of the axillary entrorse rachis angle is of medium size ranging from 19 to 58 degrees with common angles of 40 to 50 degrees. The axillary intr-
Deglet Noor Rochis Sections 120"
The axillary retrorse angles are small in size, ranging from 19 to 57 degrees, with common angles from 35 to 45 degrees. The combined angular divergence of the antrorse pinnæ from the rachis plane is of medium size, ranging from 41 to 143 degrees, with common angles from 90 to 95 degrees. The combined angular divergences of the introrse pinnæ is of medium size, ranging from 115 to 180 degrees, with common angles from 135 to 145 degrees. The combined angular divergences of the retrorse pinnæ is of large size, ranging from 180 to 220 degrees, with common angles from 190 to 200 degrees.

The number of pinnæ on a leaf of this variety ranges from 136 to 217, with an average of 162, classed as follows: antorose 60, introrose 36, retrorse 63; and grouped as follows: groups of two 30, groups of three 24, groups of four 24.

The common lengths of pinnæ are from 16 to 17 inches. The pinnæ of this variety are narrow, ranging from 11\text{\textfrac{1}{2}} to 21\text{\textfrac{1}{2}} sixteenths of an inch, the common breadths are from 18 to 19 sixteenths inches. The pinnæ thicknesses range from 15\text{\textfrac{1}{2}} to 20\text{\textfrac{1}{2}} thousandths of an inch. The terminal pinnæ are long, ranging from 6\text{\textfrac{1}{2}} to 15 inches, with an average length of 11\text{\textfrac{1}{2}} inches. They are thick ranging from 19 to 23 thousandths of an inch. Their breadth is medium ranging from 3 to 14 sixteenths of an inch.
Halawi
(Syn. Mallawi)

The Halawi trees have a large trunk. The tree trunks of this variety measure from 5 feet 9 inches in circumference, with an average of 5 feet 11 inches. The leaves of this variety are long, ranging from 10 feet 3 inches to 12 feet 4 inches, with an average of 11 feet 4 inches. The leaf base is of medium size. The older leaves have a long droop, ranging from 2 feet to 6 feet 10 inches, with an average droop of 5 feet 2 inches. The trees of this variety have a medium sized head, as the "distance out" of the apex of the leaves from the trunk of the tree ranges between 7 feet 5 inches and 9 feet 3 inches, with an average of 8 feet 3 inches. The spine area is long, with a range of between 3 feet 6 inches and 4 feet, with an average of 3 feet 8 inches which is 30 per cent of the total leaf length. The blade area ranges from 6 feet 3 inches to 8 feet 6 inches, with an average of 7 feet 5 inches, which is 70 per cent of the leaf length.

The combined angular divergences of the antorse pinnæ from the rachis plane is of large size, ranging from 55 to 117 degrees. The combined angular divergences of the introrse pinnæ is of large size, ranging from 100 to 135 degrees. The combined angular divergences of the retrorse pinnæ is of small size, ranging from 120 to 180 degrees. The divergences of the axillary antorse rachis angle is of medium size, ranging from 34½ to 59 degrees, with common angles of 40 to 50 degrees. The axillary introrse angles are of
Halawi Rachis Sections
medium size, ranging from 35 to 73 degrees, with common angles from 40 to 50 degrees. The axillary angles are of medium size, ranging from 33 to 64 degrees, with common angles from 40 to 55 degrees.

The number of pinnae on a leaf of this variety from 144 to 189, with an average of 150, classed as follows: antorse 71, introrse 16, retrorse 65; and grouped as follows: groups of two 52, groups of three 13.

The common lengths of pinnae are from \( \frac{7}{5} \) to 14 \( \frac{1}{2} \) inches. The pinnae of this variety are narrow, ranging from 15 to 25 sixteenths inches, with common breadths of 20 to 22 sixteenths inches. The pinnae thicknesses range from sixteen to 35 thousandths of an inch, which is thick.

The terminal pinnae are of medium length, ranging from 7 \( \frac{1}{2} \) to 10 \( \frac{1}{2} \) inches, with an average of 8 inches. They are of medium breadth, ranging from 12 to 24 sixteenths inches, with an average of 15 sixteenth inches. They are of medium thickness, ranging from 17 to 23 thousandths of an inch, with an average of 19 thousandths of an inch.
Hayany
(Syn. Hayani, Birket al Hajji, Birket el Haggi, Birket el Hadji)

The Hayany trees have a small trunk. The tree trunks of this variety measure from 3 feet 7 inches to 4 feet 4 inches in circumference, with an average of 4 feet 2 inches. The leaves of this variety are medium in length, with a variation from 10 feet 4 inches to 12 feet 9 inches, with an average length of 11 feet. The older leaves have a sharp droop, ranging from 2 feet 6 inches to 4 feet 2 inches, with an average of 3 feet 8 inches. The trees of this variety have a narrow head, as the "distance out" of the apex of the leaves from the trunk ranges between 7 feet 1 inch and 9 feet 6 inches, with an average of 8 feet 3 inches. The spine area is of medium length, ranging between 2 feet 7 inches and 4 feet 5 inches, with an average of 3 feet, which is 28 per cent of the leaf length. The blade area is of medium length, ranging from 6 feet to 9 feet, with an average of 7 feet 6 inches, which is 72 per cent of the leaf length.

The divergences of the retrorse pinnax to form the axillary angle with the rachis are small in this variety, ranging from 16 to 54 degrees, with a common divergence of 30 to 40 degrees. The introrse axillary angles are of small size, ranging from 22 to 60 degrees, with a common divergence of 35 to 40 degrees. The retrorse axillary angles are of small size, ranging from 14 to 55 degrees.
Hayany Rachis Sections
with a common divergence of 30 to 40 degrees. The combined angular divergences of the antorse pinnae from the rachis plane is of large size, ranging from 55 to 167 degrees, with a common divergence of 130 to 135 degrees. The combined angular divergences of the introrse pinnae is of medium size, ranging from 150 to 175 degrees, with a common divergence of 130 to 135 degrees. The combined angular divergences of the retrorse pinnae is of medium size, ranging from 155 to 190 degrees, with a common divergence of 180 to 190 degrees.

The number of pinnae on a leaf ranges from 10 to 164, with an average of 118, classed as follows: antorse 52, introrse 25, and retrorse pinnae 54 in the average leaf; and grouped as follows: groups of two 40, groups of three 14, groups of four 2.

The pinnae of this variety are long, ranging from 9 1/2 to 22 1/2 inches, with a common lengths of 17 to 22 inches. The pinnae are of medium breadth, ranging from 7 1/2 to 23 sixteenth inches, with common breadths of 19 to 21 sixteenth inches. The pinnae are thick, ranging from 16 to 28 thousandth of an inch, with common thicknesses of 1 5/16 to 21 thousandths of an inch.

The terminal pinnae of this variety are long, ranging from 9 1/2 to 13 1/2 inches, with an average of 11 1/2 inches. The terminal pinnae are wide, ranging from 14 to 17 sixteenths inches, with an average of 15 sixteenth inches. They are thick, with a range of 19 to 26 thousandths of an inch.
Itama
(Syn. Itesma, Itima)

The Itama trees have a medium sized trunk. The tree trunks of this variety measure from 5 feet 5 inches to 6 feet 6 inches in circumference, with an average of 5 feet 7½ inches. The leaves of this variety are short, with a range of 8 feet 10 inches to 10 feet 7 inches, with an average of 9 feet 11 inches in length. The older leaves have a short droop, ranging from 3 feet 10 inches to 6 feet, with an average of 2 feet 10 inches. The trees have a narrow head, as the "distance out" of the apex of the leaf from the trunk ranges between 6 feet 9 inches and 8 feet 2 inches, with an average of 7 feet 2 inches. The leaf base is of medium width. The spine area is of short length, with a range of 2 feet 4 inches and 2 feet 10 inches, with an average of 2 feet 7 inches, which is 26 per cent of the leaf length. The blade area is large, ranging from 6 feet 5 inches to 8 feet, with an average of 7 feet 4 inches, which is 74 per cent of the leaf length.

The divergences of the anttorse pinnae to form the axillary angle with the rachis is small in this variety, ranging from 20 to 48 degrees, with a common divergence of 30 to 40 degrees. The introrse axillary angles are of small size, ranging from 21 to 68 degrees, with a common divergence of 40 to 50 degrees. The retrorse axillary angles
Base

12"

24"

24"

48"

48"

72"

72"

96"

96"

84"

84"

60"

60"

36"

36"

108"

Itema Rachis Sections
are of medium size, ranging from 13 to 55 degrees, with a common divergence of 35 to 40 degrees.

The combined angular divergence of the antorose pinnae from the rachis plane is of large size, ranging from 67 to 125 degrees, with a common divergence of 106 to 110 degrees. The combined angular divergences of the introrse pinnae is of medium size, ranging from 61 to 65 degrees, with a common divergence of 135 to 145 degrees. The combined angular divergences of the retrorse pinnae is of medium size, ranging between 148 and 233 degrees, with a common divergence of 180 to 190 degrees. The number of pinnae on a leaf of this variety ranges from 167 to 221, with an average of 196, classed as follows: antorose 68, introrse 33, and 75 retrorse pinnae in the average leaf; and grouped as follows: groups of two 44, groups of three 19, groups of four 4.

The pinnae of this variety are of medium length, ranging from $7\frac{1}{2}$ to $25\frac{3}{4}$ inches, with common lengths from 17 to 18 inches. The pinnae are narrow, ranging from 9 to 21 sixteenth inches, with common breadths of $12\frac{3}{4}$ to 18 sixteenth inches. The pinnae are thick, ranging from 17 to 22 thousandths of an inch. The terminal pinnae are short, ranging from $4\frac{1}{2}$ to $6\frac{3}{4}$ inches long, with an average of $5\frac{1}{2}$ inches. They are narrow, ranging from 5 to 8 sixteenth inches in breadth. The terminal pinnae are of medium thickness, ranging from 16 to 22 thousandths of an inch.
Zhadrawi

(Syn. Khadvawi, Zhadrawi, Khudrawee)

The Zhadrawi trees have a small trunk.

The tree trunks of this variety measure from 4 feet 10 inches to 5 feet in circumference, with an average of 4 feet 11 inches. The leaves of this variety are of medium length, with a variation from 9 feet 8 inches to 11 feet 1 inch, with an average length of 10 feet 2 inches. The older leaves have a medium droop, ranging from three feet 5 inches to 5 feet 2 inches, with an average of 4 feet 1 inch. The trees have a narrow head, as the "distance out" of the apex of the leaf ranges between 6 feet 5 inches and 8 feet 7 inches, with an average of 7 feet 5 inches. The leaf base is wide. The spine area is short in length, with a range between 2 feet 5 inches and 3 feet, with an average of 2 feet 8 inches, which is 33 per cent of the leaf length. The blade area is of medium length, ranging from 7 feet to 8 feet 5 inches, with an average of 7 feet 7 inches, which is 67 per cent of the leaf length.

The divergences of the antorse pinnae to form the axillary angle with the rachis is of medium size in this variety, ranging from 34 to 74 degrees, with a common divergence of 35 to 45 degrees. The introrse axillary angles are of large size, ranging from 32 to 81 degrees, with a common divergence of 60 to 70 degrees. The retrorse axillary angles are of small size, ranging from 34 to 61 degrees, with a common divergence of 35 to 45 degrees.
Khadrawi Rachis Sections

Base

24"  48"  72"  96"  12"

36"  60"  84"  108"
The combined angular divergences of the antroserse pinnae from the rachis plane is of large size, ranging from $149$ to $87$ degrees, with a common divergence of $122$ to $135$ degrees.

The combined angular divergences is of large size, ranging from $116$ to $165$ degrees, with a common divergence of $145$ to $160$ degrees. The combined angular divergences are the retrose are of medium size, ranging between $100$ and $65$ and $235$ degrees, with a common divergence of $160$ to $190$ degrees.

The number of pinnae on a leaf of this variety ranges from $126$ to $172$, with an average of $156$; classed as follows: antroserse $52$, introrse $31$, and $74$ retrose pinnae; and grouped as follows: groups of two $59$, groups of three $9$, groups of four $1$.

The pinnae of this variety are short in length, ranging from $5$ to $15$ inches, with common lengths of $10$ to $14$ inches. The pinnae are of medium breadth, ranging from $12$ to $24$ sixteenth inches, with common breadths of $20$ to $21$ sixteenth inches. The pinnae are of medium thickness, ranging from $16$ to $24$ thousandths of an inch, common thicknesses are $17$ to $19$ thousandths of an inch. The terminal pinnae are small, ranging from $5\frac{1}{2}$ to $7$ inches in length, with an average of $6\frac{1}{4}$ inches. The terminal pinnae are of medium breadth, ranging from $7$ to $10$ sixteenth inches, with an average breadth of $9$ sixteenth inches. The terminal pinnae are thick, ranging in thickness from $19$ to $22$ thousandths of an inch.
The Maktum trees have a medium sized trunk. The tree trunks of this variety measure from 5 feet 6 inches to 5 feet 7½ inches in circumference, with an average of 5 feet 6½ inches. The leaves of this variety are long, with a variation from 10 feet to 12 feet, and an average length of 11 feet 3 inches. The older leaves have a short droop, ranging from 10 inches to 6 feet, with an average of 3 feet 7 inches. The trees of this variety have a wide head, as the "distance out" of the apex of the leaf ranges between 8 feet 6 inches and 10 feet, with an average of 9 feet 6 inches. The leaf base is of medium width. The spine area is medium in length, with a range between 2 feet 9 inches and 3 feet 5 inches, with an average of 3 feet, which is 20 per cent of the leaf length. The blade area is large, ranging from 7 feet 6 inches to 8 feet 11 inches, with an average of 8 feet 2½ inches, which is 74 per cent of the leaf length.

The divergences of the anteror pinnae to form the axillary angle with the rachis is large in this variety, ranging from 37 to 87 degrees, with a common divergence of 50 to 60 degrees. The introrose axillary angles are of large size, ranging from 51 to 81 degrees, with a common divergence of 65 to 75 degrees. The retrorose angles are of medium size, ranging from 30 to 80 degrees, with a common divergence of 44 to 53 degrees.
The combined angular divergences of the antrorse pinnae from the rachis plane is of medium size, ranging from 57 to 152 degrees, with a common divergence of 97 to 108 degrees. The combined angular divergences of the antrorse pinnae is of large size, ranging from 107 to 167 degrees, with a common divergence of 140 to 155 degrees. The combined angular divergence of the retrorse pinnae is of medium size, ranging from 145 to 237 degrees, with a common divergence of 180 to 190 degrees. The number of pinnae on a leaf ranges from 167 to 179, with an average of 173, classed as follows: antrorse 63, introrse 32 and retrorse 76, pinnae in the average leaf; and grouped as follows: groups of two 45, groups of three 18, and groups of four 1.

The pinnae of this variety are of medium length ranging from 13½ to 23 inches, with common length of 17 to 18 inches. The pinnae are of medium breadth, ranging from 8 to 23 sixteenth inches, with common breadths of 20 to 24 sixteenths inches. The pinnae are thin, ranging from 17 to 24 thousandths of an inch in thickness, with common thicknesses of 17 to 18 thousandths of an inch. The terminal pinnae are long ranging from 8 to 12 inches, with an average of 10 inches. The terminal pinnae are medium of breadth ranging from 8 to 10 sixteenth inches, with an average of 9 sixteenth inches. The terminal pinnae are thin ranging in thickness from 17 to 20 thousandths of an inch, and with an average of 18 thousandths of an inch.
Rhars.

The Rhars trees have exceptionally large trunks, ranging from 6 feet 1 inch to 6 feet 3 inches in circumference, with an average of 6 feet 2 inches. The leaves of this variety are long, with a variation from 10 feet to 12 feet 2 inches, and an average length of 11 feet 7 inches. The older leaves have a long droop, ranging from 3 feet 9 inches to 7 feet 11 inches, with an average of 6 feet 2 inches. The trees of this variety have a narrow head, as the "distance cut" of the apex of the leaves ranges between 6 feet 5 inches and 9 feet 3 inches, with an average of 7 feet 4 inches. The leaf bases are narrow. The spine area is of medium length, with a range of 2 feet 10 inches, to 4 feet, with an average of 3 feet 1 inch, which is 26 per cent of the leaf length. The blade area is small, ranging from 7 feet 8 inches to 9 feet 1 inch, with an average of 8 feet 3 inches, which is 74 per cent of the leaf length.

The divergences of the antrorse pinnae to form the axillary angle with the rachis is of medium size in this variety, ranging from 24 to 48 degrees, with a common divergence of 35 to 45 degrees. The introrse axillary angles are of medium size, ranging from 27 to 70 degrees, with a common divergence of 35 to 45 degrees. The retrorse axillary angles are of medium size, ranging from 22 to 52 degrees, with a common divergence of 40 to 49 degrees.
Rhars-Rachis Section
The combined angular divergences of the antorse pinnae from the rachis plane was of small size, ranging from 22 to 131 degrees, with a common divergence of 70 to 80 degrees. The combined angular divergence of the introrse pinnae was of medium size, ranging from 107 to 165 degrees, with a common divergence of 140 to 150 degrees. The combined angular divergence of the retrorse pinnae was of large size, ranging from 180 to 250 degrees, with a common divergence of 195 to 217 degrees. The number of pinnae on the leaf ranges from 188 to 224, with an average of 209, classed as follows: antorse 92, introrse 32, and retrorse 79, pinnae in the leaf average. The pinnae groups are as follows: groups of two 32, groups of three 31, groups of four 8.

The pinnae of this variety are of medium length, ranging from 6½ to 22 inches, with common lengths of 15 to 16 inches. The pinnae are wide, ranging from 13 to 31 sixteenths inches, with common widths of 25 to 27 sixteenths inches. The pinnae are of medium thickness, ranging from 14 to 21 thousandths of an inch, with common thicknesses of 17 to 18 thousandths of an inch. The terminal pinnae are short, ranging from 4½ to 6 inches in length, with an average of 5½ inches. The terminal pinnae are narrow, ranging from 8 to 10 sixteenths inches in breadth, with an average of 9 sixteenths inches. They are medium in thickness, ranging from 15 to 21 thousandths of an inch.
The tree trunks of this variety are small in girth, ranging from 4 feet 4 inches to 5 feet 5 inches in circumference, with an average of 4 feet 8½ inches. The leaves of this variety are of medium length ranging from 9-feet 4 inches to 12 feet 9 inches, with an average of 11 feet. The leaf base is large and wide. The older leaves have a long droop, ranging from 3 feet 8 inches to 5 feet 10 inches, with an average of 5 feet 10 inches. The trees of this variety have a head of medium width, as the "distance cut" of the apex of the leaves ranges from 6 feet 7 inches to 11 feet 10 inches, with an average of 8 feet 4 inches. The spine area is long, ranging from 2 feet 7 inches to 5 feet 2 inches, with an average 3 feet 7 inches, which is 32 per cent of the leaf length. The blade area is short, ranging from 6 feet to 8 feet 6 inches, averaging 7 feet 1 inch, which amounts to 68 per cent of the leaf length.

The divergences of the antororce pinnae to form the axillary angle with the rachis is of medium size, ranging from 23 to 74 degrees, with common angles from 40 to 50 degrees. The axillary introrose angles are of medium size, ranging from 27 to 88 degrees, with common angles of 55 to 65 degrees. The axillary retrocorse angles are of medium size, ranging from 25 to 62 degrees, with common angles
of 40 to 50 degrees.

The combined angular divergence of the antorse pinnae from the rachis plane is of small size, ranging from 25 to 130 degrees, with common angles of 85 to 96 degrees. The combined angular divergence of the introrse pinnae is of small size, ranging from 95 to 195 degrees, with common angles of 130 to 140 degrees. The combined angular divergence of the retrorse pinnae is of large size, ranging from 178 to 242 degrees, with common angles of 200 to 225 degrees. The number of pinnae on a leaf of this variety ranges from 134 to 164, with an average of 151, classed as follows: antorse 56, introrse 30, retrorse 62; grouped as follows: groups of two 42, groups of three 13, groups of four 4.

The pinnae of this variety are of medium length ranging from 7½ to 18 inches, with common lengths of 15 to 16 inches. These pinnae are also wide, ranging from 14 to 30 sixteenths inches, with common widths of 25 to 26 sixteenths inches. These pinnae are classed as thick, ranging from 15 to 24 thousandths of an inch in thickness with a common thicknesses of 17 to 18 thousandths of an inch. The terminal pinnae are of medium length, ranging from 7 to 10 inches, averaging 9 inches. They are thin, ranging from 16 to 20 thousandths of an inch in thickness. These pinnae are wide, ranging from 11 to 17 sixteenths inches in breadth, with an average of 15 sixteenths inches.
The Tadala trees are of medium trunk circumference with a range of 5 feet 7 inches to 5 feet 9 inches, with an average circumference of 5 feet 8 inches. The leaf lengths of this variety are short, ranging from 9 feet 8 inches to 11 feet 1 inch, and averaging 10 feet 2 inches. The leaf base is narrow and small. The older leaves have a medium droop, ranging from 3 feet 5 inches to 5 feet 2 inches, with an average of 4 feet 1 inch. The head of this variety is of medium size as the "distance out" to the apex of the leaves ranges from 7 feet 7 inches to 8 feet 8 inches with an average of 8 feet 1 inch. The spine area is short ranging between 2 feet 5 inches and 3 feet and having an average of 2 feet 8 inches, which is 24 per cent of the total leaf length. The blade area is of medium length, ranging from 7 feet 6 inches to 8 feet 5 inches, averaging 7 feet 7 inches which is 76 per cent of the leaf length.

The divergence of the axillary antrorse rachis angle is of large size, ranging from 40 to 69 degrees with common angles of 62 to 67 degrees. The axillary retrorse angles are large, ranging from 34 to 66 degrees, with common angles of 52 to 65 degrees. The axillary introrse angles of large size, ranging from 32 to 75 degrees with common angles of 62 to 70 degrees. The combined angular divergence of the antrorse pinnae from the
rachis plane is of large size ranging from 54 to 130 degrees with common angles of 100 to 110 degrees. The combined angular divergence of the introrse pinnae is of small size, ranging from 124 to 162 degrees, with common angles of 130 to 140 degrees. The combined angular divergence of the retrorse pinnae is of medium size, ranging from 152 to 215 degrees. The number of pinnae for each leaf ranges from 169 to 184 with an average of 178, classed as follows: antorse 55, introrse 50, retrorse 79; and grouped as follows: groups of two 49, groups of three 18, groups of four 1½.

The pinnae of this variety are long with a range of 12½ to 24½ inches in length, with common length of 17 to 22 inches. This variety has narrow pinnae, ranging from 11 to 25 sixteenths inches, with common breadths of 17 to 19 sixteenths inches. The pinnae thicknesses range from 15 to 21 thousandths of an inch, with common thicknesses of 17 to 18 thousandths of an inch. They are classed as thin. The terminal pinnae are long ranging in length from 10 to 12 inches with an 11½ inch average. They are of medium thickness ranging from 17 to 22 thousandths of an inch with an average thickness of 19 thousandths of an inch. The terminal pinnae of this variety are medium in breadth, ranging from 8 to 11 sixteenths inches, with an average of 9½ sixteenth inches.
The trees of this variety have a medium sized trunk with a range of 5 feet 3 inches to 5 feet 6 inches in circumference with an average of 5 feet 5 inches. They also have short leaves, ranging from 9 feet 8 inches to 11 feet 3 inches, with an average of 10 feet 2 inches. The leaf base is small and slender. The older leaves have a medium droop ranging from 5 feet 3 inches to 6 feet, with an average of 3 feet 4 1/2 inches. The leaves have a medium width head, as the "distance out" of the apex of the leaf ranges from 8 feet to 9 feet 7 inches with an average of 8 feet 9 inches. The spine area is short in length, with a range of 2 feet 5 inches to 3 feet 4 inches, with an average of 2 feet 9 1/2 inches, which is 25 per cent of the total leaf length. The blade area is of medium length, ranging from 6 feet 4 inches to 8 feet 7 inches, with an average of 7 feet 6 inches, which is 75 per cent of the leaf length.

The divergence of the axillary antrose rachis angles are of large size, ranging from 33 to 71 degrees with common angles of 50 to 60 degrees. The axillary introrse angles are of large size, ranging from 28 to 78 1/2 degrees with common angles of 60 to 70 degrees. The axillary retrose angles are of large size also with a range of 33 to 66 degrees with a common divergence of 50 to
Zaheedy Rachis Sections
60 degrees. The combined angular divergence of the antrorse pinnae from the rachis plane is of medium size, ranging from 46 to 138 degrees, with common angles of 80 to 90 degrees. The combined introrse angular divergence is of small size, ranging from 122 to 198 degrees, with common angles of 130 to 140 degrees. The combined angular divergence of the retrose pinnae is of medium size, ranging from 218 to 160 degrees. The number of pinnae on a leaf of this variety ranges from 187 to 219, with an average of 205, classed as follows: antrorse 72, introrse 39, retrose 92; and with the following grouping; groups of two 32, groups of three 31, groups of four 8.

The pinnae of the Zahedy are short, ranging from 7 to 15\(\frac{1}{2}\) inches, with common lengths of 13 to 14 inches. These pinnae are of medium breadth, ranging from 12 to 23 sixteenths inches, with common breadths of 19 to 20 sixteenths inches. The thickness of these pinnae is medium, ranging from 16 to 22 thousandths of an inch, with common thicknesses of 19 and 19 thousandths of an inch. The terminal pinnae are of medium length, ranging from 6\(\frac{3}{4}\) to 9 inches, with an average of 8 inches. They are medium of thickness, ranging from 16 to 22 thousandths of an inch, with an average thickness of 19 thousandths of an inch. The terminal pinnae are narrow, ranging from 6 to 8 sixteenths inches, with an average of 7 sixteenths inches.
SUMMARY OF MEASUREMENTS

The date varieties considered in the table which follows are grouped according to size, which is expressed as small, medium, and large, for every measurement taken. The first letter of the name is used to indicate the variety in every case, except for the Hayany and Malawi varieties, which are Hay. and Hal. respectively.

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<th>Measure</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
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<td>Trunk</td>
<td>S. D. Hay.</td>
<td>M. T. Z. I.</td>
<td>Hal. R.</td>
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<td>Droop</td>
<td>D. Hay. I. M.</td>
<td>T. Z. K.</td>
<td>Hal. R. S.</td>
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<td>Z. T. D. K.</td>
<td>R. M.</td>
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<td>D. Hal. K. S. M. Z. T.</td>
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<tr>
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<td>Plane angles:</td>
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<td>Hal. S. T. Z.</td>
<td>Hay. I. D. R. M. K.</td>
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<td>S.D. M. T.</td>
<td>I. Z. R.</td>
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Groups of four

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<th>S. I. D.</th>
<th>R. Z.</th>
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Pinnae
- **Length**: Z. K. Hal.
- **Breadth**: I. T.
- **Thickness**: S. T. R. M.

*Note: The Khadrawi, Halawi, and Hayany have no groups of four.*
CONSIDERATION OF DATA

The measurements taken at Indio and Mecca, California, with but few exceptions compared closely with the same type of measurements taken at Tempe, Arizona. One exception was the much greater length of the leaves of the Deglet Noor variety in California. The writer is inclined to believe that this is due to a more favorable environment. Other characters of the leaves corresponded favorably with trees from other localities.

Comparison of results obtained by this study, with those given by Mason (1), reveals a marked similarity. For example: Mason gives the range in pinnae of the Deglet Noor variety, from 12 to 25 inches in length, while this study gives almost identical results, 11 to 24 inches long. Other characters studied gave a similar comparison.

The table of trunk measurements shows a tendency for trees of certain varieties to have trunks of uniform size. There are some rather large variations in trunk sizes, as in the Isma variety with a variation of 12 inches, which amounts to a range of 25 per cent.

The leaf measurements are all of value in indicating variety differentiations. This was found true, within certain limits, with the varieties studied. The leaf lengths are reliable enough to be of some value.
in recognizing the variety. The pinnae lengths have considerable value as a means of identification of date palm varieties. Some varieties consistently have short pinnae, as in the Zaheedy, which serve as fairly reliable indications of identification. In the comparison of pinnae lengths one must take into consideration the location of the pinnae on the blade as they decrease in length from the base to the leaf apex. The breadth of the pinnae is an outstanding character in some varieties, the Khars being a good example with pinnae frequently over two inches wide. The pinnae thickness is of relatively little value as there is a very narrow range of variation between the leaves of the different varieties. Nearly all of the varieties studied had pinnae thicknesses of around 18 to 19 thousandths of an inch with the single exception of the Malawi which has an average thickness of approximately 21 thousandths of an inch.

Such characters as the droop and the "distance out" are shown by the tables to be too variable to be depended upon as a means of identification of date varieties. This variation is often so great in a single variety as to be valueless, for example, the Itema variety shows a range of 7 feet between the minimum and the maximum droop which is practically a hundred per cent range.

The blade area and the spine area are
of some value, as a means of identification, if taken into consideration with other characters, but cannot be relied on to any great extent if used alone. These areas vary with the length of the leaf, but the percentage of variation is shown to be reasonably constant.

The antorse, intorse and retrorse axillary angles; and the antorse, intorse and retrorse plane angles, are extremely variable within individual varieties. There is such an overlapping of these measurements between varieties that their use in identification is practically valueless.

The study of the terminal pinnae in this investigation show that this character has merit in the identification of certain varieties. The length and breadth of these pinnae are relatively constant within a variety and to that end are of considerable value in identification. For example, there is a constant difference of an average of one inch between the Itama and Khadrawi varieties. Another outstanding feature of this character is the accessibility of the terminal pinnae for measurement.
CONCLUSIONS

1. Trunk circumference is of little value as a means of identifying varieties, except for varieties having large and small trunks.

2. Leaf length has value as a means of identifying varieties with long leaves, and varieties with short leaves.

3. The droop and "distance out" are of some value in distinguishing certain varieties.

4. The spine area and blade area are of value in identifying certain varieties, especially when considered with other characters.

5. The width and thickness of the leaf base are of value in identifying varieties.

6. The pinnae angles are too variable within the varieties to be of importance in identifying varieties.

7. There is a sufficient difference in the length and breadth of the pinnae to be of considerable value in identification of varieties, and this is particularly true of the terminal pinnae of the leaves of the different varieties. The thickness of the pinnae shows so little variation that it is practically valueless as a means of identifying varieties.
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