Taxonomical Studies on Some Ornamental Plants

II. Micro-morphological descriptions of leaves of *Ipomoea*, *Merremia* and *Argyreia* (family Convolvulaceae)

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Received: 12 Mar. 2018 / Accepted: 30 April 2018 / Publication date: 10 May 2018

ABSTRACT

This study was carried out on three genera; namely genus *Ipomoea* (8 species, some wild and others cultivated); genus *Merremia* (represented by one species) and genus *Argyreia* (one species) to determine the taxonomic relationships between the three genera and to find out an answer for the confusion raised from the taxonomic situation of genus *Merremia* or *Argyreia*. Are they belong to genus *Ipomoea*, or considered as separate genera?. The study was concentrated on the micro-morphological survey on leaf surfaces characteristics of each species by using Scanning Electron Microscope (SEM). Using the posterior characters to design an artificial key to identify these species.

Key words: Taxonomy, Convolvulaceae, leaf morphology, SEM, botanical key.

Introduction

Family Convolvulaceae is one of the biggest family among the ornamental plants. The family distributed around the world in the tropical and subtropical regions and extending into north and south temperate regions. The family includes more than 1500 species (Baily and Bailey, 1976). The family have been divided into three or four subfamilies and/or 3-10 tribes. The relationships between these groups have been generally agreed (Wilson, 1960). The family has actinomorphic, funnel-form to salver-form corolla. This family including annual and perennial herbaceous plants, or mostly woody shrubs. Rich, bushy vegetation or open shrubs (Baily and Bailey, 1976).

The plants of this family are usually climbing with long trailing or twining stems. The most common anatomical features are articulated latex canals or latex cells (Huxely, 1992). Leaves simple, entire, lobed, or pinnately divided to pectinate, alternate, exstipulate. Inflorescence determinate, cymose, or flowers solitary, axillary, with jointed peduncles. Flowers actinomorphic, perfect, hypogynous, often large and showy, ephemeral, usually with intrastaminal disc. Fruit usually 4-valved septifragal capsule . The family comprises many genera, the most common ones is *Ipomoea* with 500 species. The genus *Ipomoea* is the common genus due to its uses as ornamentals, food crops, food additives and vulcanization of its latex to rubber and laxatives (Austin, 2004).

There was a confusion in the taxonomic position of genera *Merremia* and *Argyreia* with genus *Ipomoea*. Where some taxonomists mentioned that both genera split from genus *Ipomoea* (Lineaus, 1753; Jacq, 1788 and Peter, 1891), while others considered both as separate genera (Hall.,1893). So, this study including 8 species of genus *Ipomoea* (wild and cultivated); one species of genus *Merremia* and one species of genus *Argyreia* to determine the taxonomic relationships between the three genera and to identify if *Merremia* or *Argyreia* is belong to genus *Ipomoea*, or considered as separate genera. This study focused on the micro-morphological survey on leaf surfaces characters of each species by using Scanning Electron Microscope (SEM). From the posterior characters, an artificial key to determine and identify the species will design.

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Material and Methods

Plant materials

This study was carried out to determine the relationships between the species of three genera; *Ipomoea*, *Merremia* and *Argyreia* through the micro morphological characteristics of leaves. Fresh plants and leaves of each species were collected from different wild and vegetation areas. The accepted scientific and Arabic names, habit and the collection sites of the studied species represented in Table (1). Using the posterior characters an artificial keys were designed.


The leaf upper and lower surfaces of each species were examined using (SEM). The leaf samples were prepared before examination as follows:

a. The Fixation: carried out according to (Birbick and Mercar, 1960).

<table>
<thead>
<tr>
<th>Accepted Scientific name</th>
<th>Arabic name</th>
<th>Habit</th>
<th>Collection sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- <em>Ipomoea caurica</em> (L.) Sweet.</td>
<td>Set elhossn</td>
<td>Cultivated</td>
<td>El-Marsafa El kaliubia</td>
</tr>
<tr>
<td>2- <em>Ipomoea carnea</em> Jacq.</td>
<td>---</td>
<td>Cultivated</td>
<td>Ismailia lake, Ismailia</td>
</tr>
<tr>
<td>3- <em>Ipomoea eriocarpa</em> R.Br.</td>
<td>---</td>
<td>Wild</td>
<td>A.R.C., Giza</td>
</tr>
<tr>
<td>4- <em>Ipomoea hederacea</em> Jacq.</td>
<td>---</td>
<td>Wild</td>
<td>Shebin El – Kanater, Kalubia</td>
</tr>
<tr>
<td>5- <em>Ipomoea pes-caprae</em> (L.) R. Br.</td>
<td>Khouf elCamel</td>
<td>Cultivated</td>
<td>Alexandria – Cairo runway</td>
</tr>
<tr>
<td>6- <em>Ipomoea stolonifera</em> (Cyr.) J.F.Gmel</td>
<td>---</td>
<td>Wild</td>
<td>Baltim- Delta coast</td>
</tr>
<tr>
<td>7- <em>Ipomoea batatas</em> (L.) Lam.</td>
<td>Batata</td>
<td>Cultivated</td>
<td>Ismailia lake, Ismailia</td>
</tr>
<tr>
<td>8- <em>Ipomoea tricolor</em> Cav.</td>
<td>Magd alsabah</td>
<td>Cultivated</td>
<td>Kaha farme, Kalubia</td>
</tr>
<tr>
<td>9- <em>Merremia dissecta</em> (Jacq.) Hallier f.</td>
<td>Meremia</td>
<td>Cultivated</td>
<td>Fac. of Agri., Giza</td>
</tr>
<tr>
<td>10- <em>Argyreia nervosa</em> (Burm.f.) Bojer</td>
<td>Fedia</td>
<td>Cultivated</td>
<td>Orman Botanic Garden, Giza</td>
</tr>
</tbody>
</table>

b. The Dehydration:

1- Samples dehydration was carried out through a graded series of ethanol; 50% (10 min); 70% (10 min); 80% (10 min); 90% (10 min) and absolute (3x10 min).

2- Up to this stage of preparation the temperature was at 0-4 °C, the next steps were carried out at room temperature.

3- Finally the samples were completely dried through the Critical Point Dryer with CO$_2$ liquid.

4- The samples were mounted on copper stubs with double-sides adhesive tape and coated with gold using Sputter Coater S 150 A Edwards-England.

5- The samples were examined under JXA- 840A Electron Probe Microanalyzer- JEOL-JAPAN.
Results

Micro-morphological descriptions of leaf surfaces by SEM

1. *Ipomoea cairica* (L.) Sweet.

Synonyms: *Convolvulus caircus* L. and *Ipomoea palmate* Forsk.

Upper epidermis has anomocytic stomatal type with semi-raised level. Rugose sculpture pattern. Lower epidermis has actinocytic stomatal type with superficial and semi-depressed level. Pusticulate sculpture pattern (Table 2 and Fig.1).

2. *Ipomoea carnea* Jacq.

Synonyms: *Batatas pareirifolia* (Berthel. ex Spreng.) Choisy

Upper epidermis has diacytic and anisocytic stomata with semi-depressed and superficial level. Favulariate sculpture pattern. Trichomes glandular and non-glandular, smooth ornamentation. Lower epidermis has anomocytic stomatal type with superficial level. Alveolate sculpture pattern. Trichomes glandular and non-glandular, striate and smooth ornamentation (Table 2 and Fig.1).

Table 2: Micro-morphological descriptions of the leaf of studied species.

<table>
<thead>
<tr>
<th>Species Characters</th>
<th>Ipomoea cairica</th>
<th>I. carnea</th>
<th>I. eriocarpa</th>
<th>I. hederacea</th>
<th>Ip&lt;sub&gt;e&lt;/sub&gt;-carpae</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upper epidermis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of stomata</td>
<td>Anomocytic</td>
<td>Diacytic and anisocytic</td>
<td>Anomocytic</td>
<td>Actinocytic</td>
<td>Anomocytic</td>
</tr>
<tr>
<td>Stomatal leveling</td>
<td>Semi-raised</td>
<td>Semi-depressed and superficial</td>
<td>Raised and superficial</td>
<td>Depressed</td>
<td>Semi-raised and superficial</td>
</tr>
<tr>
<td>Type of trichome</td>
<td>..........</td>
<td>Glandular and non-glandular</td>
<td>Glandular and non-glandular</td>
<td>Glandular</td>
<td>Glandular</td>
</tr>
<tr>
<td>Trichome ornamentation</td>
<td>..........</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Smooth</td>
</tr>
<tr>
<td>Sculpture</td>
<td>Rugose</td>
<td>Favulariate</td>
<td>Reticulate</td>
<td>Rugose-Reticulate</td>
<td>Reticulate-areolate</td>
</tr>
<tr>
<td><strong>Lower epidermis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stomatal leveling</td>
<td>Superficial and semi-depressed</td>
<td>Superficial</td>
<td>Semi-depressed</td>
<td>Superficial and semi-raised</td>
<td>Superficial</td>
</tr>
<tr>
<td>Type of trichome</td>
<td>..........</td>
<td>Glandular and non-glandular</td>
<td>Glandular and non-glandular</td>
<td>..........</td>
<td>Glandular</td>
</tr>
<tr>
<td>Trichome ornamentation</td>
<td>..........</td>
<td>Striate and smooth</td>
<td>Smooth and warty</td>
<td>..........</td>
<td>Smooth</td>
</tr>
<tr>
<td>Sculpture</td>
<td>Pusticulate</td>
<td>Alveolate</td>
<td>Weak-reticulate</td>
<td>Reticulate</td>
<td>Weak-reticulate</td>
</tr>
</tbody>
</table>

3. *Ipomoea eriocarpa* R. Br.

Synonyms: *Ipomoea hispida* (Vahl) Roem. & Schult., *Convolvulus hispidus* Vahl, Symb. and *Ipomoea sessiliflora* Roth ex Roem. & Schult

Upper epidermis has anomocytic stomatal type with raised and superficial level. Reticulate sculpture pattern with unicellular hairs with acute apex. Trichomes glandular and non-glandular, watery and smooth ornamentation. Lower epidermis has anomocytic stomatal type with semi-depressed level. Weak Reticulate sculpture pattern of lower epidermis. Trichomes glandular and non-glandular, smooth and warty ornamentation (Table 2 and Fig.1).
Fig. 1. SEM of the upper (A) and lower (B) surfaces of leaf.
1- Ipomoea cairica  2 - Ipomoea. carnea  3 - Ipomoea eriocarpa

4. *Ipomoea hederacea* Jacq.

Synonyms: *Ipomoea barbigera* Sweet and *Pharbitis hederacea* (Jacq.) Choisy

Upper epidermis has actinocytic stomata with depressed level. Rugose- Reticulate sculpture. Trichomes glandular, smooth ornamentation. Lower epidermis has two stomatal type; paracytic and anomocytic with superficial and semi-raised level. Reticulate sculpture pattern (Table 2 and Fig.2).
4. *Ipomoea hederacea*  
5. *Ipomoea pes-carpa*

8. *Ipomoea tricolor* Cav.


Upper epidermis has anomocytic stomatal type with superficial levels. Rugose sculpture pattern. Trichomes non-glandular, smooth ornamentation. Lower epidermis has anomocytic stomatal type with semi depressed level. Ruminate sculpture pattern. Trichomes glandular and non-glandular, smooth ornamentation (Table 3 and Fig.3).

Table 3: Micro-morphological descriptions of the leaf of studied species.

<table>
<thead>
<tr>
<th>Characters</th>
<th><em>I. stolonifera</em></th>
<th><em>I. batatas</em></th>
<th><em>I. tricolor</em></th>
<th><em>Argyria nervosa</em></th>
<th><em>Merremia dissecta</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upper epidermis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of stomata</td>
<td>Undistinct</td>
<td>Actinocytic</td>
<td>Anomocytic</td>
<td>Anomocytic</td>
<td>Undistinct</td>
</tr>
<tr>
<td>Stomatal leveling</td>
<td>Superficial</td>
<td>Superficial</td>
<td>Superficial</td>
<td>Depressed</td>
<td>Undistinct</td>
</tr>
<tr>
<td>Type of trichome</td>
<td>............</td>
<td>Glandular</td>
<td>Non-glandular</td>
<td>Non-glandular &amp;glandular</td>
<td>Non glandular</td>
</tr>
<tr>
<td>Trichome ornamentation</td>
<td>............</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Smooth and warty</td>
</tr>
<tr>
<td>Sculpture</td>
<td>Pusticulate-weak reticulate</td>
<td>Rugose</td>
<td>Rugose</td>
<td>Sulcate</td>
<td>Undistinct</td>
</tr>
<tr>
<td><strong>Lower epidermis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of stomata</td>
<td>Anomocytic</td>
<td>Anomocytic</td>
<td>Anomocytic</td>
<td>Anisocytic</td>
<td>Anomocytic</td>
</tr>
<tr>
<td>Stomatal leveling</td>
<td>Superficial and Semiraised</td>
<td>Depressed</td>
<td>Semi depressed</td>
<td>Superficial</td>
<td>Superficial</td>
</tr>
<tr>
<td>Type of trichome</td>
<td>Non-glandular</td>
<td>Glandular</td>
<td>Non-glandular &amp; glandular</td>
<td>Glandular</td>
<td>Glandular</td>
</tr>
<tr>
<td>Trichome ornamentation</td>
<td>Steiate and smooth</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Smooth</td>
</tr>
<tr>
<td>Sculpture</td>
<td>Weak pusticulate</td>
<td>Rugose</td>
<td>Ruminate</td>
<td>Favulariate</td>
<td>Weak scalariform</td>
</tr>
</tbody>
</table>

Fig. 2. SEM of the upper (A) and lower (B) surfaces of leaf.

4- *Ipomoea hederacea*  
5 - *Ipomoea pes-carpa*
9. *Argyreia nervosa* (Burm.f.) Bojer

Synonyms: *Argyreia speciosa* (L.f.) Sweet
Upper epidermis has actinocytic stomatal type with superficial level. Sulcate sculpture pattern. Trichomes glandular and non-glandular, warty and smooth ornamentation. Lower epidermis has actinocytic stomatal type with superficial level. Favulariate sculpture pattern. Trichomes glandular, smooth ornamentation (Table 3 and Fig.4).

10. *Merremia dissecta* (Jacq.) Hallier f.

Synonyms: *Convolvulus dissectus* Jacq. and *Ipomoea dissecta* (Jacq.) Pursh.
Upper epidermis has undistinct stomatal type. Undistinct sculpture pattern. Trichomes non glandular, smooth and warty ornamentation. Lower epidermis has anomocytic stomatal type with superficial levels. Weak scalariform sculpture pattern. Trichomes glandular, smooth ornamentation (Table 3 and Fig.4).

![Fig.3: SEM of the upper (A) and lower (B) surfaces of leaf.](image)

6) *I. stolonifera*  
7) *I. batatas*  
8) *I. tricolo*
**Fig. 4:** SEM of the upper (A) and lower (B) surfaces of leaf.

9) *Argyreia speciosa* 10) *Merremia dissecta*

**Keys**

**Key based on macro and micro morphological characters of leaf.**

A. Leaf palmate shape in outline.
   a. Upper epidermis has anomocytic stomatal type with semi-raised level, rugose sculpture pattern. Lower epidermis has actinocytic stomatal type with superficial and semi-depressed level, pusticulate sculpture pattern. 
   aa. Upper epidermis has undistinct stomatal type. Undistinct sculpture pattern. Trichomes non-glandular, smooth and warty ornamentation, Lower epidermis has anomocytic stomatal type with superficial levels. Weak scalariform sculpture pattern. Trichomes glandular, smooth ornamentation. 
   Ipomoea cairica

AA. Leaf vary in shape and epidermis surfaces.
   b. Leaf narrowly ovate shape.
      c. Leaf 10-20 x 4-10 cm, aristate apex, base shallowly cordate. Petiole 2-6 cm. Upper epidermis has diacytic and anisocytic stomata with semi-depressed and superficial level. Favulariate sculpture pattern. Trichomes ornamentation smooth. Lower epidermis has anomocytic stomatal type with superficial level. Alveolate sculpture pattern. Trichomes glandular and non-glandular, striate and smooth ornamentation. 
      Ipomoea carnea

cc. Leaf 8-11 x 3.5-5.5 cm, acuminate apex, base obtuse. Upper epidermis has actinocytic stomatal type with superficial level. Sulcate sculpture pattern. Trichomes
ornamentation warty and smooth ornamentation. Lower epidermis has actinocytic stomatal types with superficial level. Favulariate sculpture pattern. Trichomes glandular, smooth ornamentation..............................Argyreia nervosa

bb. Leaf broadly or broadly ovate to hastate or hastate shape (in outline), entire margin, base cordate.

d. Upper epidermis has anomocytic stomatal type with superficial levels. Rugose sculpture pattern. Trichomes non-glandular. Lower epidermis has anomocytic stomatal type with semi depressed level. Ruminate sculpture pattern. Trichomes glandular and non-glandular, smooth ornamentation..................... Ipomoea tricolor
dd. Upper epidermis has actinocytic stomatal type with depressed level. Rugose reticulate sculpture pattern. Trichomes glandular. Lower epidermis has two stomatal types; paracytic and anomocytic with superficial and semi-raised level. Reticulate sculpture pattern..............................................Ipomoea hederacea

ddd. Upper epidermis has anomocytic stomatal type with depressed level. Ruminante-rugose sculpture pattern. Trichomes glandular and hairy, smooth ornamentation. Lower epidermis has anomocytic stomatal type with superficial levels. Rugose sculpture pattern. Trichomes glandular, smooth ornamentation..... Ipomoea batatas

bbb. Leaf ovate shape (in outline) entire margin and acute apex, base cordate. Upper epidermis has anomocytic stomatal type with raised and superficial level. Reticulate sculpture pattern with unicellular hairs along the veins with acute apex. Lower epidermis has anomocytic stomatal type with semi-depressed level. Weak reticulate sculpture pattern. Trichomes of both surfaces; glandular and non-glandular, smooth and warty ornamentation..............................................Ipomoea eriocarpa

bbbb. Leaf oblong to suborbicular or broadly oblong to lobed, coriaceous, entire margin. Upper epidermis has anomocytic stomatal type.

e. Upper epidermis with reticulate-areolate sculpture pattern. Trichomes glandular, smooth ornamentation. Lower epidermis has anisocytic and diacytic stomatal types with superficial levels. Weak reticulate sculpture pattern. Trichomes glandular, smooth ornamentation.............................................Ipomoea pes-carpeae

ee. Upper epidermis has pusticulate-weak reticulate sculpture pattern. Lower epidermis has anomocytic stomatal type with superficial and semiraised levels. Weak pusticulate sculpture pattern. Trichomes non-glandular, steiate and smooth ornamentation..........................................................Ipomoea stolonifera
References

Jacq, N. J., 1788. Icones Plantarum Rariorum, vol.2