BOTANICAL STUDIES ON SOME ORNAMENTAL PLANTS

By

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B.Sc., Agric. Sci. (Genetics), Fac. Agric., Ain Shams Univ., Egypt, 1996
M.Sc., Agric. Sci. (Agricultural Botany), Fac. Agric., Cairo Univ., Egypt, 2004

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Abstract

This study was carried out on 8 species of genus *Ipomoea* (wild and cultivated), in addition to one species of genus *Merremia* and one species of genus *Argyreia*. The aims of this study are to determine the taxonomic relationships between the three genera and to identify the taxonomic situation of genus *Merremia* or *Argyreia,* are they belonging to genus *Ipomoea*, or considered as separate genera?. The study focused on the macro-morphological survey of each species belongs to each genus and the micro-morphological survey on leaf and seed surfaces of each species by using Scanning Electron Microscopy. Using these data and analyzed by numerical analyses technique to represent the taxonomic relationships between the studied taxa in a form of dendrogram. As a result of their sharing in many characters, genus *Argyreia* is linked earlier with a species of genus *Ipomoea* at low similarity level before genus *Merremia.* This indicate that both former genera are belonging to each other. Finally, the posterior characters were used to design an artificial key to these Taxa.

Key words: Taxonomy, Convolvulaceae, *Ipomoea*, *Merremia*, *Argyreia*, macro and micro-morphological characters, numerical analyses.

DEDICATION

I dedicate this work to my parents and all my family for all the support they offered during the course of studies. Also to my colleagues for their encouragement and help.

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CONTENTS

Page

INTRODUCTION

Family convolvulaceae is one of the common and biggest family among the ornamental plants. The family distributed widely throughout the tropical and subtropical regions of the world, with representatives having ranges extending into north and south temperate regions; particularly abundant in tropical America and Asia. The family includes more than 1500 species. Most of these species are called "morning glories or moonflowers"**(Baiely and Bailey, 1976)**.

The family have been divided into three or four subfamilies (sometimes segregated as distinct families) and/or 3-10 tribes. Although the relationships between these groups have been generally agreed upon, the taxonomic rank (family, subfamily, or tribe) is a matter of controversy **(Wilson, 1960)**. A notable segregate group, the Cuscutoideae or Cuscutaceae (a monotypic taxon) has been separated from the rest of the Convolvulaceae by some botanists on the basis of the parasitic habit with related specializations of the corolla and embryo **(Momin, 1977). Sengupta (1972)** disagree on the delimitation of the various genera within the family.

The family is characterized by; showy, actinomorphic, funnelform to salverform, plicate corolla with induplicate-valvate and/or convolute aestivation; 5 epipetalous stamens; 2-carpellate ovary with axile placentation; septifragal capsule; and large embryo with folded, often bifid cotyledons. Various alkaloids and cyanogenic glycosides are present. Tissues commonly have calcium oxalate crystals. The most common anatomical features are intraxylary phloem in the petiole (bicollateral bundles) and stem; unitegmic, generally tenuinucellate ovules **(Huxely, 1992)**.

This family includs annual and perennial herbaceous plants, or mostly woody shrubs. Rich, bushy vegetation or open shrubs **(Bailey and Bailey, 1976)**. The plants are usually climbing or twining stems. They are weeds, *e.g.* Hedge Bindweed (*Calystegia sepium*) or Field Bindweed (*Convolvulus arvensis*) and sometimes parasitic, *e.g.* Common Dodder (*Cuscuta epithymum*). Leaves simple, entire, lobed, or pinnately divided to pectinate, alternate, ex-stipulate. Inflorescence determinate, cymose, or flowers solitary, axillary, with jointed peduncles. Flowers actinomorphic, perfect, hypogynous, often large and showy, ephemeral, usually with intrastaminal disc, generally subtended by a pair of bracts (sometimes enlarged and forming an involucre). Calyx 5 sepals, distinct or sometimes basally connate, sometimes unequal, imbricate, persistent. Corolla sympetalous, entire to slightly 5-lobed, funnel form or salver form, plicate, brightly colored (commonly red, violet,

blue, or white), induplicate-valvate and/or convolute (twisted) in bud. Androecium 5 stamens, epipetalous at corolla base; filaments distinct, often unequal; anthers dorsifixed, dehiscing longitudinally, usually introrse. Gynoecium 1 pistil, 2-carpellate; ovary superior, 2-locular or sometimes appearing 4-locular due to false septa, sometimes with dense covering of hairs; ovules 2 in each locule, anatropous, sessile, placentation basal or basalaxile; style simple and filiform or forked; stigma(s) 1 or 2, linear, lobed or capitates. Fruit usually 4-valved septifragal capsule; seeds smooth or hairy; endosperm scanty, hard, cartilaginous; embryo large, straight or curved, with folded or coiled, emarginate to bifid cotyledons, surrounded by endosperm **(Huxely, 1992)**.

The family comprises many genera, the major ones are *Ipomoea* with 500 species, *Convolvulus* with 250 species, *Cuscuta* with 145 - 170 species and *Jacquemontia* with 120 species.The genus *Ipomoea* is the common useful genus due to its uses as ornamentals, food crops, food additives and vulcanization of its latex to rubber and laxatives **(Austin, 2004)**. Most species widely used for spectacular and colorful flowers and are often grown as ornamental plants; includes food crops (*i.e.* Sweet Potato, leaves of Water Spinach and Moon Vine sap) and used as powerful drugs because the alkaloid and another chemical components such as jalap, lysergic acid and a hallucinogen **(Bailey and Bailey, 1976)**

There was a confusion in the taxonomic position of genera; *Merremia and Argyreia* from one side and genus *Ipomoea* from the other. Where some taxonomists mentioned that *Merremia* split from genus *Ipomoea* **(Lineaus, 1753; Jacq., 1788** and **Peter, 1891)**, while others considered both as a separate genera **(Hall, 1893)**. So, to find an answer for this taxonomic confusion, the study including 8 species of genus *Ipomoea* (some wild and the other cultivated); one species of genus *Merremia* and one species of genus *Argyreia* to justify, firstly the taxonomic relationships between the three genera and secondly to identify if *Merremia and Argyreia* are belong to genus *Ipomoea*, or stay as separate genera.

The study comprised two main parts each dealing with particular taxonomic evidences as follows:

1- The macro-morphological descriptions of each species.
2- The micro-morphological survey on leaf and seed surfaces of each species by using Scanning Electron Microscope (SEM).

Using numerical analyses technique to analyze the data obtained from the previous two parts to represent the taxonomic relationships between the studied taxa. Finally designing an artificial key to determine and identify the studied species.

REVIEW OF LITERATURE

The following survey will be focused on the descriptions of families Convolvulaceae and the three genera (*Ipomoea*, *Merremia* and *Argyreia*), the geographical distribution and the economic uses of each species.

Family convolvulaceae

convolvulaceae (morning glory family) distributed widely throughout the tropical, subtropical and extending into north and south temperate regions; particularly abundant in tropical America and Asia. The family includes more than 1500 species. A great deal of research on members of the family has been published, including plants under investigation. Convolvulaceae are family of herbaceous, twining, or woody, climbing or trailing vines shrubs or trees. It is almost cosmopolitan in distribution, but primarily tropical, with many genera endemic to individual continents **(Austin, 1998). Takhtajan (1980)** placed this family in its own order; Convolvulales, due to numbers of characteristics, *i.e.* presence of articulate latex canals, latex cells, intraxylary phloem position and seed and pollen morphology. Based on molecular phylogenetic studies for the Convolvulaceae suggested that the family is closely related to the Solanaceae and Montiniaceae **(Olmstead & Palmer, 1992; Olmstead, *et al.* (1992 and 1999); Soltis, *et al.*, 2000 and Stefanovic, *et al.*(2002 and 2003)).**

Abdel Khalik and **Osman (2007)** investigated the seed morphology of 31 taxa belong to six genera of Convolvulaceae from Egypt and described three types of basic anticlinal cell wall boundaries and four different shapes of the outer periclinal cell wall. **Ooststroom (1953)** placed *Convolvulus* with *Calystegia, Jacquemontia* and *Merremia* in tribe Convolvuleae. **Austin (1998)** confirmed that by sited *Convolvulus, Calystegia* and *Jacquemontia* under tribe Convolvuleae based on the morphological and the cytological characters.

Genus *Ipomoea* L. nom. Conserve**.**

Annual, perennials or shrubs. Stems prostrate, twining or erect **(Bolous, 2000)**. Leaves usually petiolate, entire to lobed. The inflorescence axillary. Flowers solitary or in dichasial cymes **(Huxely, 1992)**. Fruit 4-6 valved, capsule divided **(Bailey and Bailey, 1976)**. **Wilkin (1999)** presented cladistic analysis of the tribe *Ipomoea* based on 45 morphological and palynological characters, and suggested that the *Ipomoea* is a monophyletic tribe. **Stefanovic*, et al.* (2002 and 2003)** demonstrated a close relationship between the tribes *Merremia* and *Ipomoea*. **Sampathkumar (1970)** investigated the chromosome morphology in the family Convolvulaceae and concluded that the chromosomes of the genus *Ipomoea* much resemble to those of *Merremia.* A survey of records of chromosome numbers indicated that *Ipomoea* has 2*n* =30 (occasionally 2*n* =28) and *Merremia* has 2*n* =28 (or 30).

While **Sampathkumar (1970)** and **Manos** and **Miller (2001)** show that the tribe *Ipomoea* is separated from *Merremia* on the base of leaf venation, echinate pollen surface, pantoporate, exine sculpture semitectate, four seeded fruit and undulate anticlinal boundaries of the seed. Also, characterized by compound leaves, small petals, globose stigma, pollen grain with smooth to micro-granulate, tricolpate, exine punctuate and folded curvature of outer periclinal cell wall. Meanwhile, **Stefanovic *et al.* (2002)** distinguished tribe *Ipomoea* by large, pantoporate pollen with spinous supratectal processes.

Hamed (2005) investigated the seed characters of *Ipomoea* by SEM; seed texture, hilum topography, anticlinal wall leveling and the concave outer periclinal walls of the epidermal cells. **Sharma*, et al.* (2012)** studied the species *Ipomoea purpurea* (L.) Roth. They found that the fruit is sub globose to ovoid capsule. It is six valvate and contain 3-6 seeds. The seeds are dull brown to black in colour and wedge shaped with horse shoe shaped scar and with maximum length and width of 4.0 x 5.8 mm.

Abdel Khalik and **Osman (2007)** stated that the surface of seeds varies from glabrous to hairy. It can separate almost species of *Ipomoea* from the rest of the genera. In the genus *Ipomoea*, surface varies from glabrous in *I. eriocarpa* and *I. purpurea*

to hairy in the rest of the species. Between species of *Merremia*; it is hairy in *M. semisagitta* and glabrous in *M. aegyptia.*

Genus *Merremia* Dennst. ex Endl., nom. Conserv.

Twining or prostrate herbs or low shrubs. Leaves palmtely compound, lobed or entire **(Bolous, 2000).** Inflorescence; 1-4 flowers, broadly funnel shaped, with white-purple tube. Fruit globose **(Bolous, 2000). Sampathkumar (1970)** investigated chromosome morphology in the family Convolvulaceae and concluded that the chromosomes of the genus *Merremia* much resemble those of *Ipomoea.* A survey of records of chromosome numbers yields a fairly consistent number in several genera (*Ipomoea* and *Merremia*). *Ipomoea* has 2*n* =30, occasionally 2*n* =28. *Merremia* has 2*n* =28 or 30.

Genus *Argyreia* Lour.

Leaves petiolate, entire, alternate, simple, orbicular (**Bailey, and Bailey, 1976**), lower surface with silver hairs. Inflorescence one to many flowers. Flowers axillary, cymose, lax to capitate (***Staples, et al. 2000), a*** new species of *Argyreia albiflora* from Thailand is described and illustrated. Micromorphological evidence is presented using scanning electron microscopy (SEM) and light microscopy (LM) demonstrating that microscopic features of the upper leaf surface are useful in separating species that are similar on a macromorphological level. **Tayade and Patil (2003)** studied the foliar epidermal features and their taxonomic significance in the genus *Argyreia* Lour. (Convolvulaceae).

Genus *Ipomoea*

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

Geographical distribution

Nile, Mideterranean and all deserts; canal banks, edges of cultivation cultivated and naturalized in many warm temprate regions. Its native geographical range is uncertain, though it is believed to originate from a rather wide area, ranging from Cape Verde to the Arabian Peninsula, including northern Africa. Because of human dispersal, it occurs today on most continents as an introduced species and is sometimes a noxious weed. It is a major problem along the coast of New South Wales. In the United States it occurs in Hawaii, California, all the gulf coast states, as well as Arkansas and Missouri.

Economic importance

Used as ornamental plants in the gardens.

2. ***Ipomoea carnea*** Jacq.

Geographical distribution

In Egypt , Nile ; canal banks , moist waste ground **(Bolous 2000).** It is mainly distributed and native in temperate North America, Costa Rica, Ecuador, Mexico and Brazil.

Economic importance

Use as ornamental and hedge plant along the banks of irrigation and drainage canals. Reproduction by seeds often lead to increase the plant dissemination into new regions **(Chaudhuri, *et al.* 1994)**. The medicinal uses of leaves as purgative. Leaves paste is applied on 'Haja' kind of sore between toes and fingers due to fungal infection) **(Pankaj** and **Sharmistha, 2014).** Hollow stems were used to make tubes for tobacco pipes.

3. ***Ipomoea eriocarpa*** R. Br.

Geographical distribution

In Egypt, N; weed of cultivation. Madgascar, tropical Africa and Asia , North Australia **(Bolous, 2000)**.

Economic importance

The leaves of *Ipomoea eriocarpa* are eaten in Africa and India as a cooked vegetable, in soups or mixed with other food. In Uganda a root decoction is used to speed up fermentation in the preparation of a local drink called 'kwete'; the roots can be found on local markets. In India the seeds are eaten. It is cultivated in India as good fodder. It is also an effective soil binder and cover plant, which smothers weeds. In Uganda a root decoction is drunk by women to relieve menstrual pain. In India an oil extract of the plant is used externally against headache, rheumatism, leprosy, epilepsy, ulcers and fever. In veterinary medicine the oil extract is used to cure wounds of cattle **(Burkil, 1985–2004)**.

4. ***Ipomoea hederacea*** Jacq.

Geographical distribution

In Egypt N. ,weed of sumer crops especialy in maize fields **(Bolous, 2000)**. USA, Bahamas, Cuba, Lebenon and Palastine

Economic importance

Seeds are used as anti-inflammatory, carminative, depurative, purgative, vermifuge, inflammations, constipation, dyspepsia, bronchitis, fever, skin diseases, scabies and splenopathy (**Pankaj** and **Sharmistha, 2014**).

5. ***Ipomoea pes-caprae*** (L.) R.Br.

Geographical distribution

In Egypt desert of Nile east (Suez canal), Sinai ; sandy seashores, saline maritime soils **(Bolous, 2000).** China, Taiwan, Indonesia, Cambodia and Queensland.

Economic importance

Mangrove associate has been studied for its pollination ecology due to its important role in stabilizing the estuarine banks and shorelines. Further, the plant is also used for the treatment of swelling in different parts of the body caused by wind abrasions, skin diseases, and inflammation caused by jellyfish allergy. Seed is used for the treatment of fatigue **(Ravindran, *et al*., 2005)**.

6. ***Ipomoea imperati*** (Cyr.) J.F.Gmel.

Geographical distribution

In Egypt, Mediterranean region , Sinai, sandy littoral zone **(Bolous, 2000).** Libya, Morocco, Algeria, Palastine, Lebanon, Indonesia, Thailand, USA, Australia and Colombia

Economic importance

Leaves used as tea, and animal food.