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Morphological variation of four *Ipomoea* species from Sudan

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Abstract:

Ipomoea is the largest and most diverse genus of the family Convolvulaceae comprising 500 to 700 species which is commonly distributed in tropical areas. In Sudan Ipomoea species were reported to be an important food and fodder plants. The aim of the present taxonomic study was to determine the affinities and variations in morphological, characters between four species belonging to the genus Ipomoea namely Ipomoea aquatica Forssk, I. verticillata Forssk., I. eriocarpa R. Br., and I. carnea Jacq. The morphology of the leaves, flowers, and stems of the four species were described. The morphological characters include quantitative measurements of different parts of the leaves, flowers, length and width of leaf, length of petiole, stigma, style, anther, calyx, and corolla. A key based on important taxonomic characters such as plant habit, shapes of leaves and stems, colour of flowers, and seeds was provided to identify each of the four species. The study revealed that I. carnea is closely related to I. cairica when their floral parts measurements are considered whereas I. verticillata resembles I. triloba when both floral and foliar parts measurements are compared. The affinities between these pairs of species were confirmed by comparing their polygonal diagrams of the studied characters.

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Key words: *Ipomoea,* Convolvulaceae, morphology, variations, Sudan

INTRODUCTION:

Morphology has been the major criterion for plant classification over a long period of time. During the last century, with the help of light and electron microscopes, internal morphological features played an increasingly important role in elucidating phylogenetic relationship (Carlquist, 1996). *Ipomoea* is the largest and most diverse genus of the family Convolvulaceae comprising 500 to 700 species of mostly shrubs and vines distributed throughout the world particularly in tropical regions (Verdcourt 1963; Mabberly, 1987; Austin and Huaman, 1996; Manos et al., 2001). Andrews (1956) in his Anglo-Egyptian Flora of Sudan reported twenty two species belonging to the genus *Ipomoea*. He adopted classic classification utilizing morphological characters. Updated nomenclature of the *Ipomoea* species has been recently reported by Darbyshire et al. (2015). Earlier, Govil (1971) studied the organogensis of the flowers of *Ipomoea batatus, I. purpurea* and *Tacguemontia poniculata*. He studied the morphology of the floral parts with special reference to their early development. Rabei and Abdel khalik (2012) in their study of the family Convolvulaceae in the flora of Egypt, constructed conventional keys to differentiate between 44 species including the *Ipomoea*. Their keys were based on different morphological characters such as pollen, seeds, and fruits morphology. Adeniyi et al. (2012) used the style length and bracts shape characters to aid the identification and classification of commonly encountered *Ipomoea* species in south west Nigeria. Kadry (2013) used both macro- and micromorphological characters, including seed shape, colour, size, seed surface, epidermal cell shape, anticlinal boundaries, and periclinal cell wall to distinguish between 15 *Ipomoea* species. He emphasized the taxonomic

importance of seed coat micromorphology. The aim of this study is to determine the nature and sources of variations in the morphology of four species of *Ipomoea* and to construct taxonomic key to differentiate between them

MATERIALS AND METHODS:

Ipomoea aquatica Forssk, I. verticillata Forssk., I. eriocarpa R. Br., and *I. carnea Jacq.* were selected for this study. They were taxonomically identified and authenticated by comparing the collection with the available specimens deposited in the herbarium of the Botany Department of Khartoum University and the herbarium of Medicinal and Aromatic Plants Research Institute. Species names were updated and revised for their synonyms consulting relevant publications (Derbyshire et al. 2015; Missouri Botanical Garden online data.www.tropicos.org.). The morphological features of the four species of *Ipomoea* were studied. Attention was paid to certain morphological characters which show similarities between the species. Other characters such as leaf blade, plant habit, colour of flower and colour of seed were used to construct a simple taxonomic key for the identification of each of the studied species. Variations of morphological characters in seeds, flowers and leaves of the studied species were photographed for comparison. Important morphological characters such as stamen length, style length, calyx length, corolla length, leaf length, leaf width, petiole length and peduncle length were measured. Polygonal representations of the floral and foliar characters were constructed and possible relationships were reported. Herbarium samples for the identified species were deposited in the Herbarium of Botany Department of Khartoum University.

RESULTS AND DISCUSSION:

Botanical descriptions with reference to taxonomically important characters are given below:

***Ipomoea carnea* Jacq.**

Shrub up to 6 m. Stem, erect, woody, hairy, slendrical. Leaves, alternate, cordate with symmetric base, petiolate. Flowers on long pedicels, axillary, solitary or arranged in monochasium scropioid, cymose, pinkish white. Fruit capsule, 4-seeded. Seeds dark brown, densely covered with hairs (Plate 1).

Synonyms: *I. carnea* subsp. *Carnea*

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

Twinning annual herb**.** Stems slendrical, hirsute. Leaves alternate, ovate-cordate to linear-oblong. Flowers almost sessile or on short pedicels, funnelform, white, mauve or pink. Fruits ovoid-spherical, hairy capsule. Seeds grey, 3-angled, ornamented. The grey ornamented seeds is a characteristic feature of this species as compared to the other species (Plate 2).

Synonyms: *Convolvulus eriocarpus* (R. Br.) Spreng., *C. hispidus* Vahl, *C. sessiliflorus* (Roth) Spreng, *Ipomoea horsefieldiana* Miq., *I. ligulata* Bojer, *I. sessiliflora* Roth, *I. sindica* Stapf, *Jacquemontia thomensis* Henriq.

***Ipomoea aquatica* Forssk.**

Creeping annual or perennial, on mud or floating on water, up to 3 m long. Stems terete, branched, hollow. Leaves alternate, sagittate, glabrous, petiolate. Flowers funnelform, glabrous, pink, in axillary cymes. Fruits globose to ovoid, 4-seeded capsules. Seeds brown or black, 3-angled, pubescent (Plate 3).

Synonyms: *Ipomoea natans* Dinter & Suess, *I. repens* Roth, *I. reptans* Poir., *I. sagittifolia* Hochr.*, I. subdentata* Miq.

Ipomoea verticillata Forssk.

Twinning annual, up to 4 m long. Stems slenderical, branched, hirsute, leaves alternate, cordate, petiolate. Flowers funnelform, glabrous, white, solitary. Fruits ovoid, glabrous, 4-seeded capsules. Seeds brown, 3-angled, pubescent. White flower is the characteristic feature of this species compared to the other species (Plate 4).

Morphological key:

A simple identification key based on plant habit, stem shape, colour of the flower, and colour and texture of the seed is presented below.

A. Plant erect shrub	*I. carnea*
AA. Plant prostrate herb	
B. Stem hollow, terete, leaves sagittate	*I. aquatica*
B.B. Stem not hollow, slenderical, leaves cordate	
D. Flowers white, seeds grey, hairy	*I. verticillata*
D.D. Flowers pink-pale pink, seeds grey, ornamented	*I. eriocarpa*

Comparing their morphology, the studied species were initially separated on the basis of their growth habit. *I. carnea* is the only erect shrub while the other three species are prostrate herbs. *I. aquatica* is the only species that possesses terete hollow stem and sagittate leaves. Cordate leaves and grey ornamented seeds characterize *I. eriocarpa*; hairy seeds characterize both *I. carnea* and *I. verticillata* while smooth seeds characterize *I. aquatica.*

The present findings are in agreement with many authors who considered the morphological characters of leaves and seeds of *Ipomoea* species as of taxonomic importance (Rodella and Schlitter, 1982; Rabei and Abdel khalik, 2012; Kadry 2013).

Another source of morphological variation within the studied species is the flowers trichomes. The presence of trichomes in both calyx and corolla were observed in *I. eriocarpa.* In the case of *I. verticillata*, trichomes were only

observed in the calyx while in *I. carnea* and *I. aquatica* the trichomes were observed only in the corolla.

Variation in floral and foliar measurements:

Measurements of morphologically important characters showed that the studied species varied when both floral and foliar parts are considered. These variations were confirmed by thedifferent polygonal representation of the floral parts measurements as shown in Fig. 1 and foliar parts measurements as shown in Fig. 2

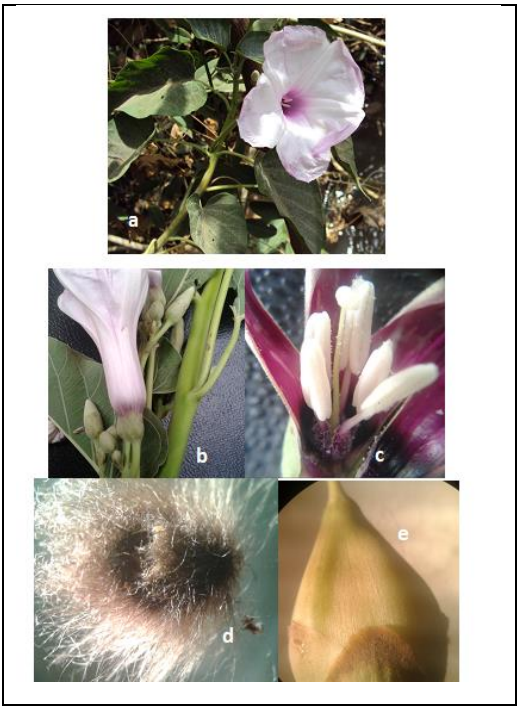

Plate 1: Ipomoea carnea: (a) Growth habit, (b) Inflorescence, (c) Style and stamens, (d) Seed, (e) Fruit.

Plate 2: *Ipomoea eriocarpa*: (a) Growth habit, (b) Hairy calyx and corolla, (c) Hairy fruit, (d) Ornamented seed

Plate 3: *Ipomoea aquatic*a: (a) Growth habit, (b) Dry fruit, (c) Seed

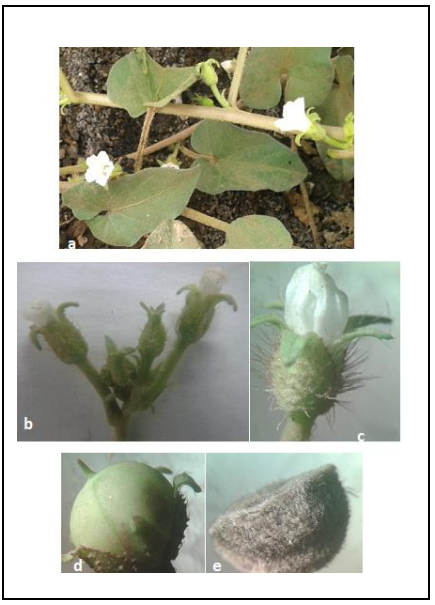

Plate 4: *Ipomoea verticillata*.(a) growth habit, (b) Inflorescence, (c) hairy calyx, (d) fruit, (e) seed.

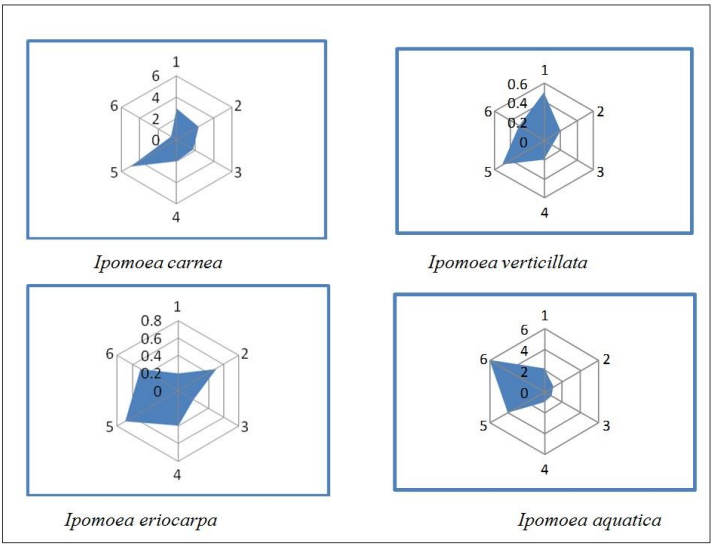

Fig. 1: polygonal representation of the floral parts measurements of the studied species

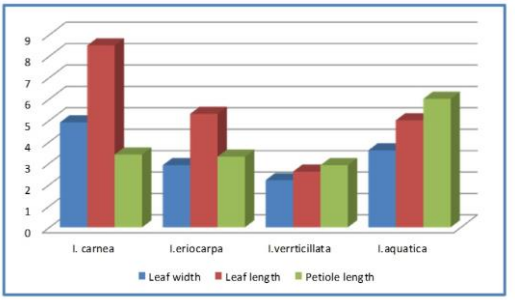

Fig. 2: Foliar parts measurements of the studied species

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