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Important Anatomical Features In The Taxonomy Of Selected Plant Species From The Genus *Ipomoea (Convolvulaceae)* In Sudan

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Abstract

This paper investigated transverse sections of stems and leaves of seven species belonging to the genus *Ipomoea* of the family Convolvulaceae collected from Khartoum state, Sudan. They are *Ipomoea cairica* (L.) Sweet, *Ipomoea aquatica* Forssk, *Ipomoea pes-caprae* (L.) R. Br., *Ipomoae verticillata* Forssk., *Ipomoea eriocarpa* R. Br., *Ipomoea triloba* L., and *Ipomoea carnea* Jacq. The study revealed that certain features were of significant importance in separation of these taxa. The vertically arranged rows of secretory canals separated *I. pes-caprae* from the other species in which they are solitary arranged. Also presence of striated stem cuticle separated *I. carnea* from the other species which show thin entire cuticle. Hollow pith characterizes *I. aquatica* while the presence of crystals in the pith characterizes *I. triloba*. Two species: *I. cairica* and *I. eriocarpa* are characterized by the presence of sunken glandular hairs on their leaves. *I. cairica* and *I. eriocarpa* were differentiated according to their cambium activity, which was equally active in *I. cairica* but not in *I. eriocarpa*. Laterocytic type of stomata is the common feature among all the studied species.

Keywords: Anatomy, Stem, Leaf, Taxonomy, *Ipomoea*, Sudan

1. Introduction

Morphology has been the major criterion for classification over a long period of time. With the help of light and electron microscopes during the last century, anatomical features which are the microscopic characters of morphology have played an increasingly important role in elucidation of phylogenetic relationship (Carlquist, 1996) Many authors studied the taxonomy of *Ipomoea* utilizing different characters. Concerning microscopic characters, Hallier (1893) recognized the usefulness of pollen characters as being palynologically and taxonomically important and divided the family into subfamily 'Echinoconiae' on the basis of distinct spiny pollen and put *Ipomoea* as echinate pollen (Echinoconiae). Metcalfe and Chalk (1950) described the general anatomical

features that characterize the family Convolvulaceae. Inamdar (1971) recorded stomatal variations on the foliar and floral organs of the two species of *Ipomoea*. Karatela and Gill (1985) studied epidermal morphology and stomatogenes in ten species belonging to genera *Ipomoea* and *Merremia*. Shanmukha Rao and Leela (1990) studied the leaf anatomical features of 14 species of *Ipomoea* in relation to taxonomy and based on the studied characters, they prepared a key for the identification of the species investigated. Ugborogho *et al*. (1992) investigated stomatal morphology and distribution in six species of *Ipomoea*. Taxonomic significance of foliar epidermis in some members of the family Convolvulaceae has also been reported by Jayeola *et al* (2001) and Adedeji and Illoh (2004). Teresa *et al* (2011) studied the development of successive combia and cambium activity in *Ipomoea arborescens* seedlings. They considered the occurrence of more than one active cambium is a key character. Adeniyi et al (2012) differentiated between seven species of the genus *Ipomoea* using the pollen shape and size. Abayomi (2013) studied the taxonomic evolution of floral micromorphology of 15 species of *Ipomoea*, he reported that cell shape, anticlinal wall pattern, stomata shape , trichome , circular striation and other characters, are of taxonomic interest.

2. Material and methods

Seven species of the genus *Ipomoae* were collected from Khartoum state. They were taxonomically identified and authenticated by comparing the collection with the available specimens deposited in the herbarium of Botany Department of Khartoum University and the herbarium of Medicinal and Aromatic Plants Research Institute. Species names were updated and revised for their synonyms. Selected species are *Ipomoea cairica* (L.) Sweet, *Ipomoea aquatica* Forssk, *Ipomoea pes-caprae* (L.) R. Br., *Ipomoae verticillata* Forssk., *Ipomoea eriocarpa* R. Br., *Ipomoea triloba* L., and *Ipomoea carnea* Jacq. Transverse sections through the stems and leaves of the studied species were done using the following standard technique steps as recommended by Johansen, 1940:

1) Fixation: carried out using formalin : acetic acid :alcohol solution which is prepared as 5% formaldehyde, 5% glacial acetic acid and 90% ethyl alcohol. The materials were kept in the fixative until the chlorophyll is completely leached out.

2) Dehydration: carried out after stretching each plant between two slides before putting then in staining jars. Plants were subjected to series of concentrations of ethyl alcohol (50%, 70% and 90%). Then the slides were removed and the plants were transferred to wide-mouth bottles and subjected to 95-98% absolute alcohol. The last step was repeated to ensure complete dehydration . Each dehydration step was left overnight.

3) Cleaning: The materials were cleaned by transferring them into a mixture of 1:1, xylene and cedar oil for overnight and pure xylene for half an hour only. The last step was also repeated to ensure clearing.

3) Sectioning: carried out using rotatory microtome (Leitz 1512 West Germany), adjusted at 6.8 microns. Using a brush, the ribbons of section were collected on glass slides which had been wetted with egg albumin to keep the section attached to the slides. The slides were left overnight on a hot plate to give maximum expansion of tissues. After that, dewaxing was done by immersing the slides in pure xylene for one minutes.

4) Staining : Done by immersing the slides in series of solution as follows : xylene 1 for five minutes xylene 2 for three minutes, 95% alcohol for two minutes, 90% alcohol for two minutes, 70% alcohol for one and a half minutes, Haematoxilin mier´s stain which was prepared according to Mahony, (1973) for seven minutes, running water for ten minutes and ammonified water for one minute. Then a back dehydration was carried out and the slides were washed by xylene for two minutes. This last step was repeated twice.

5) Mounting: Done using D.P.X mountant. The slides were placed into a warm plate for five minutes and were left at room temperature overnight. After that the slides were transferred to an oven adjusted at 60o C for one hour .Slides were examined microscopically for the taxonomically valued characters. The characters were then tabulated and used later for both describing the studied species and constructing identification key. Also, fully-labeled photographs of different parts for each individual plant were done under magnification powers x40 and x60.

3. Results and Discussion

Transverse sections through the stems and leaves of the studied species show that many features are common to different species. Anatomical features which characterize the species are:

1. **Hairs :** especially those consisting of long terminal and one to several short stalk cells , somewhat characteristic of the genus . Hairs include glandular and non-glandular types . The simple type with a long terminal cell is widely distributed. They occur in *I. triloba, I verticillata, I eriocarpa, and I carnea*. Glandular hairs, varying in the length of the stalks and in the shape and number of cells in the heads in different species such as *I. pes-caprae, I. verticillata* and *I. carnea*
2. **Internal phloem**. All studied species show patches of internal phloem in their vascular bundles. The first-formed vessels are thin-walled and those formed later on are larger in diameter.
3. **Secretory cells,** either in vertical rows as shown in *I. pes-caprae*, or solitary and

widespread in both leaves and stems of the other species.

4. **Cuticle** usually thin , sometimes striated as shown in *I. carnea*
5. **Stomata** laterocytic stomata is commonly present . In this type of stomata, three or more distinct subsidiary cells partially (not at the apex or base) surrounding the guard cells.
6. **Crystals or druses** in large clustered form as shown in *I. carnea , I. triloba, and I. aquatica* .

Plates 1-7 represent the taxonomically important anatomical features which are illustrated in details for each species

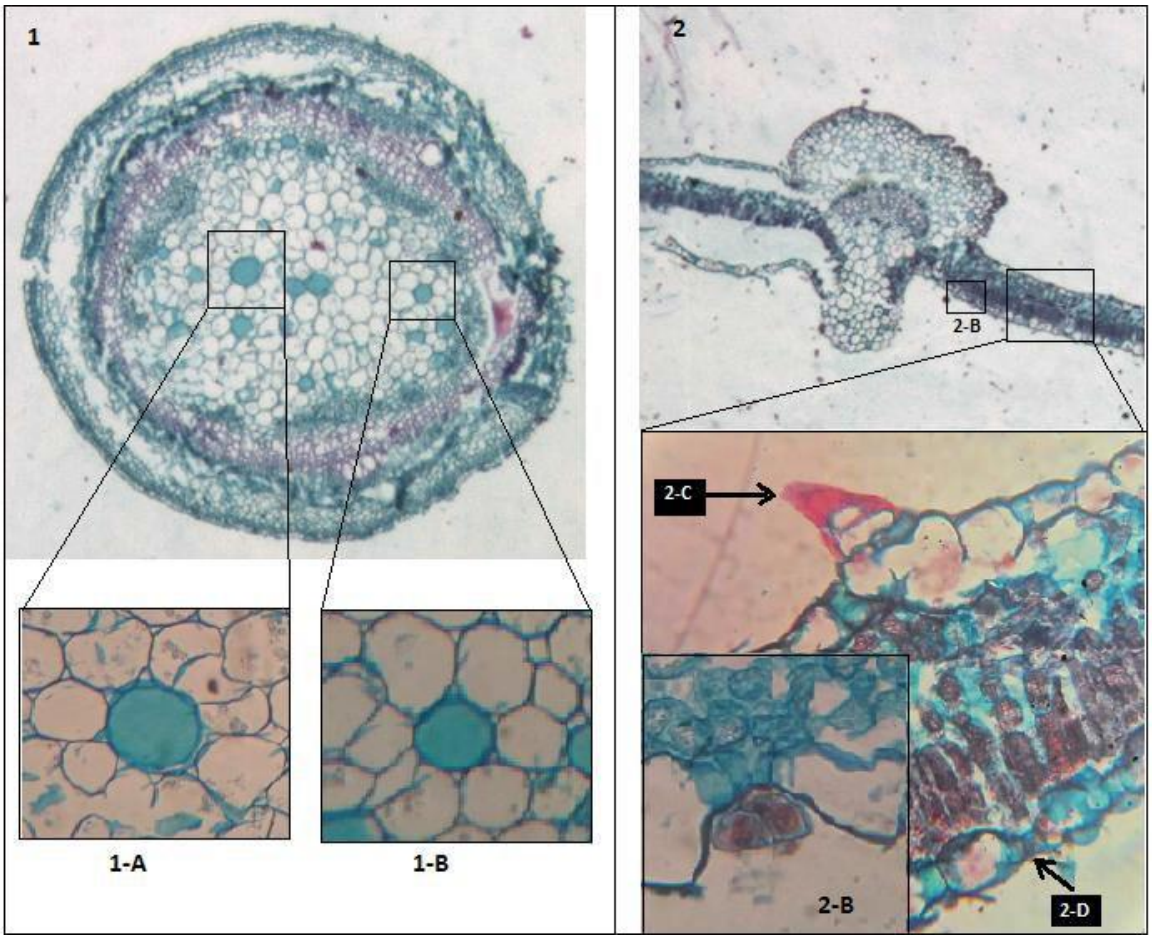

Plate1: Cross-sections in the stem and leaf of *Ipomoae verticillata* showing characteristic anatomical features; 1-A and 1-B: secretory cells in the stem, 2-B: sunken glandular hair on the leaf, 2-C: nonglandular hair with long terminal cell, 2-D: laterocytic stomata.

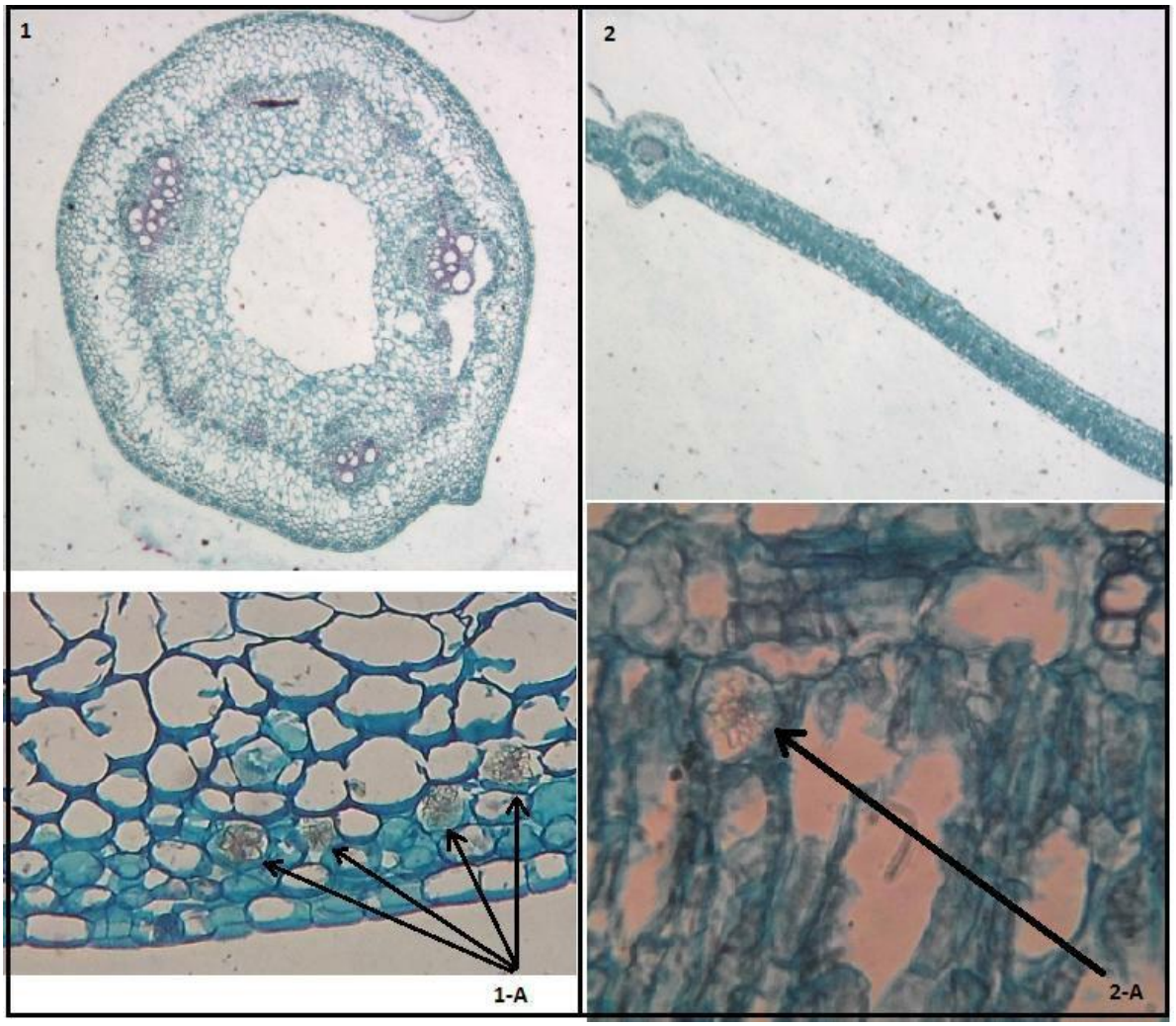

Plate 2 : Cross-sections in the leaf and stem of *Ipomoae aquatica* showing large druses: 1-A and 2-A : stem and leaf druses

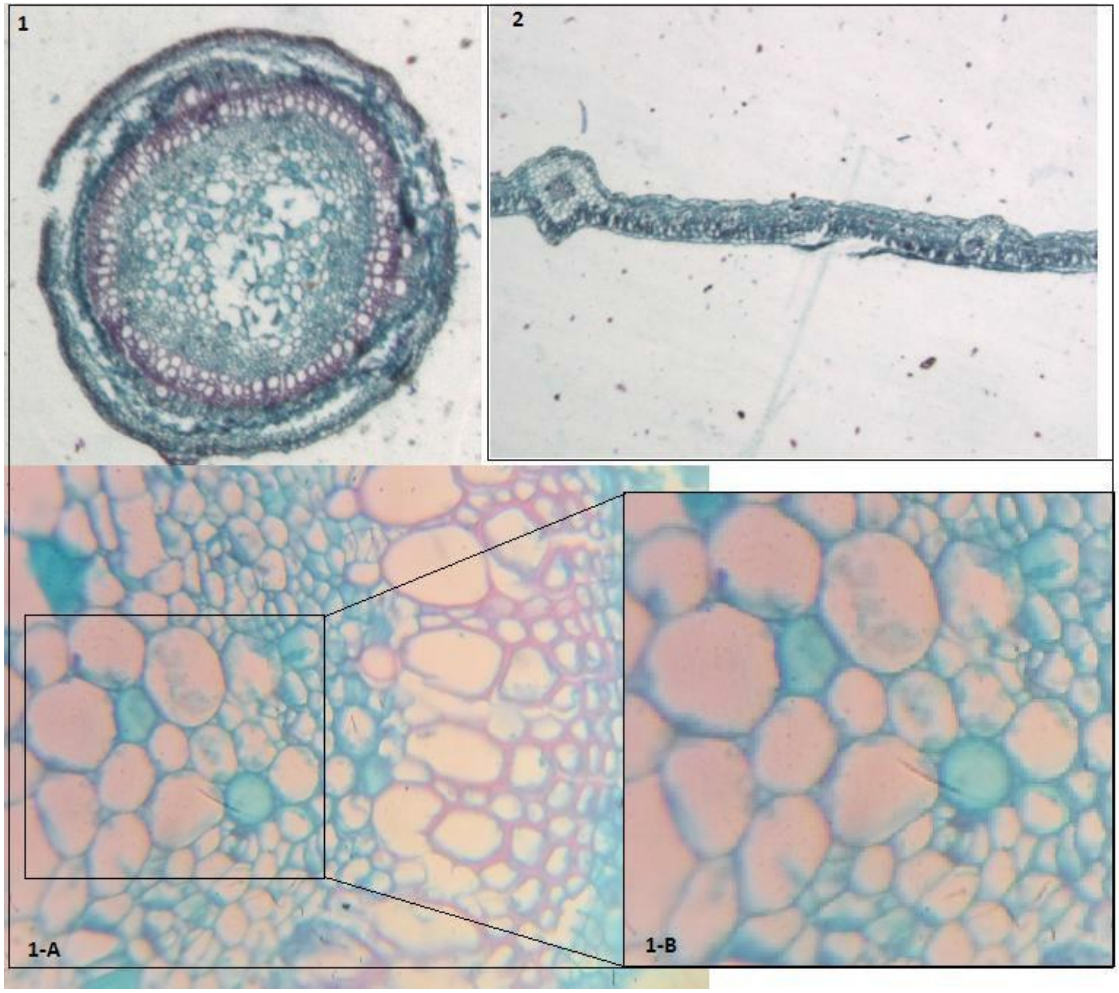

Plate 3*:* Anatomical features of *Ipomoae cairica*: 1-A and 1-B secretory cells in stem cross- section

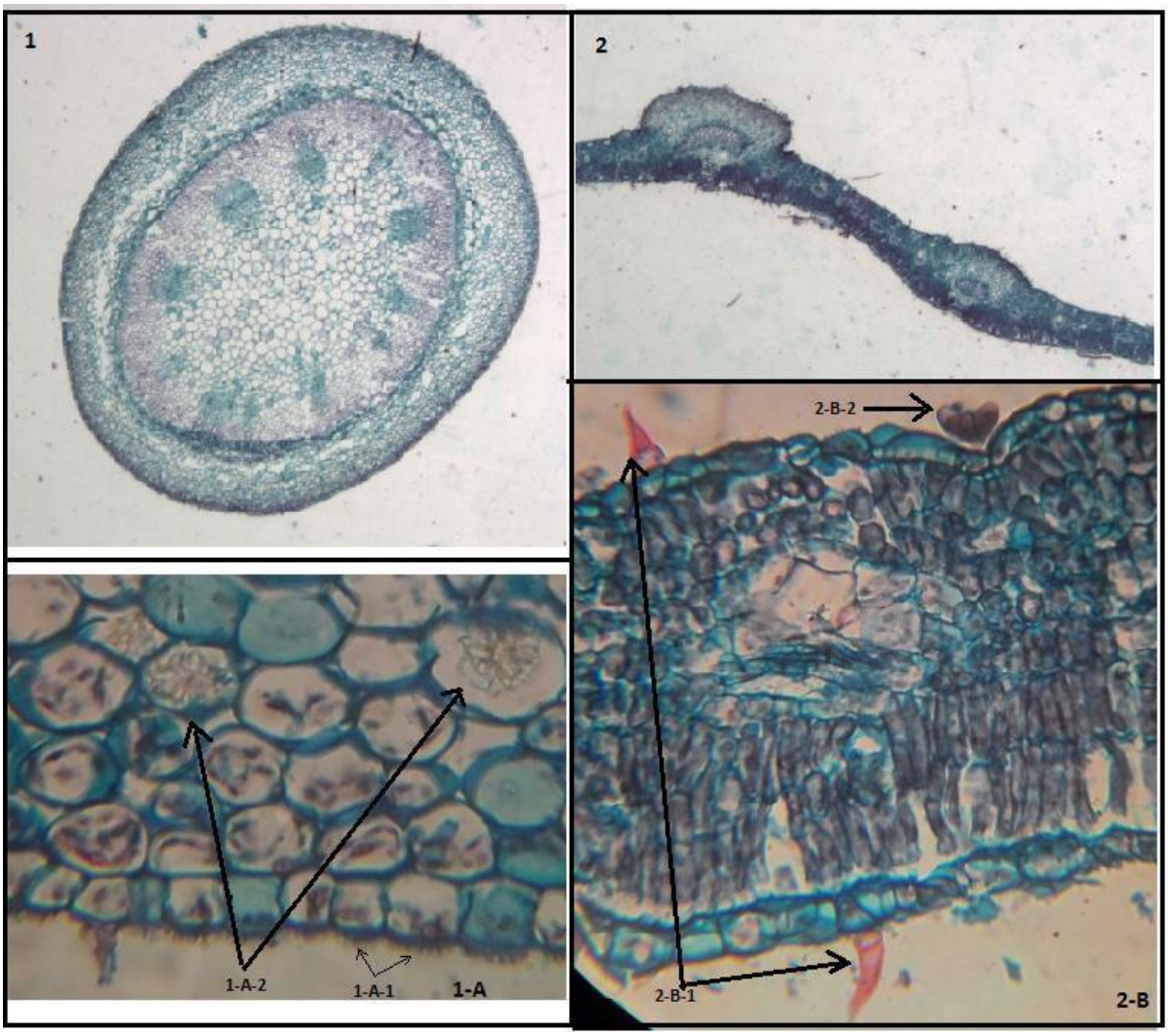

Plate 4: Anatomical features of *Ipomoae carnea*; 1-A stem collenchymas, 1-A1: striated cuticle, 1-A-2: druses, 2-B1: nonglandular hair with long terminal cell , 2- B-2: sunken glandular hair

Plate 5: Anatomical features of *Ipomoae eriocarpa*;2-A: laterocytic stomata, 2-B:nonglandular hair with long terminal cell

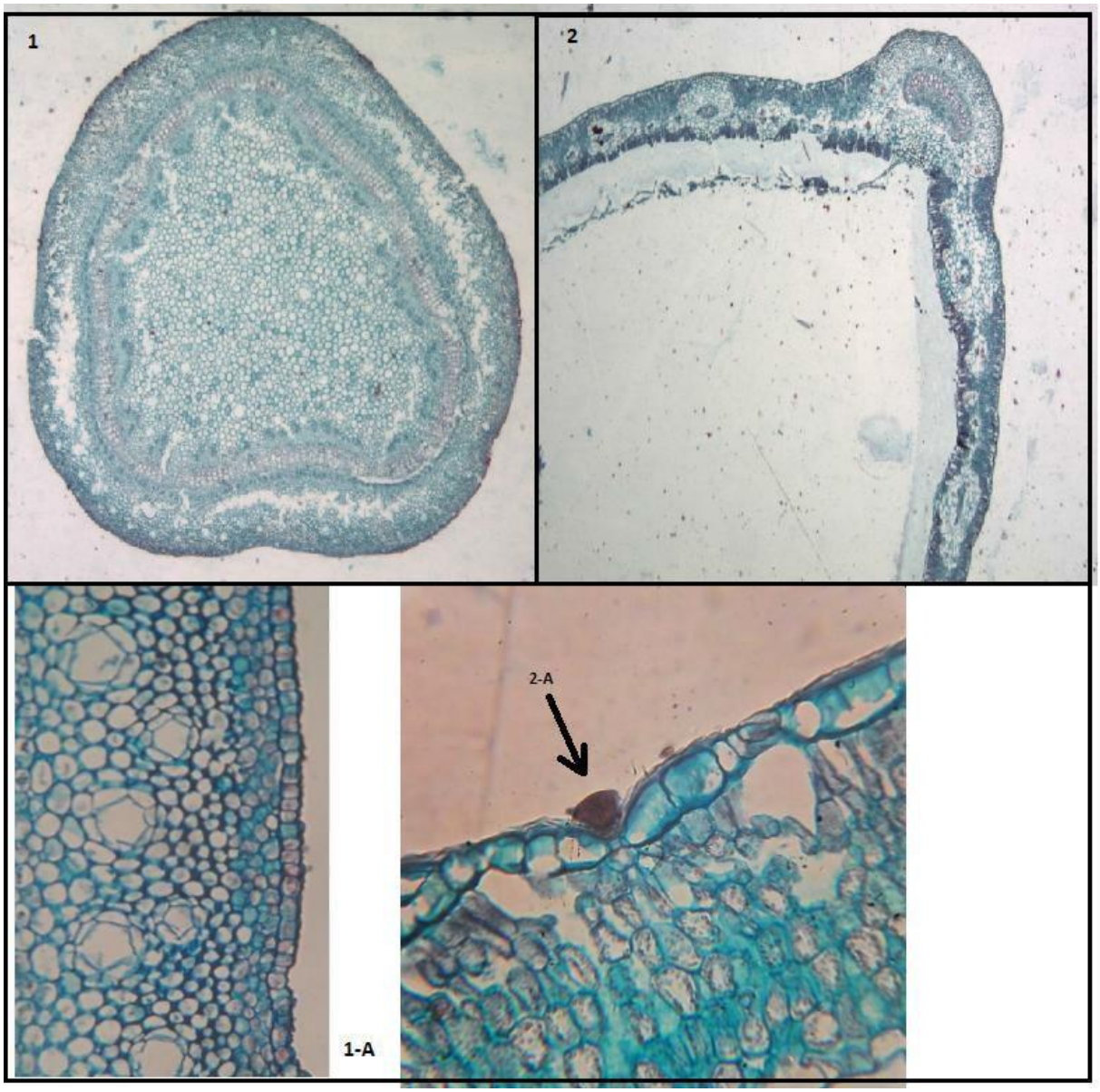

Plate 6: Anatomical features of *Ipomoae pes-caprae*; 1-A: stem vertical rows of secretory cells, 2-A: sunken glandular hair

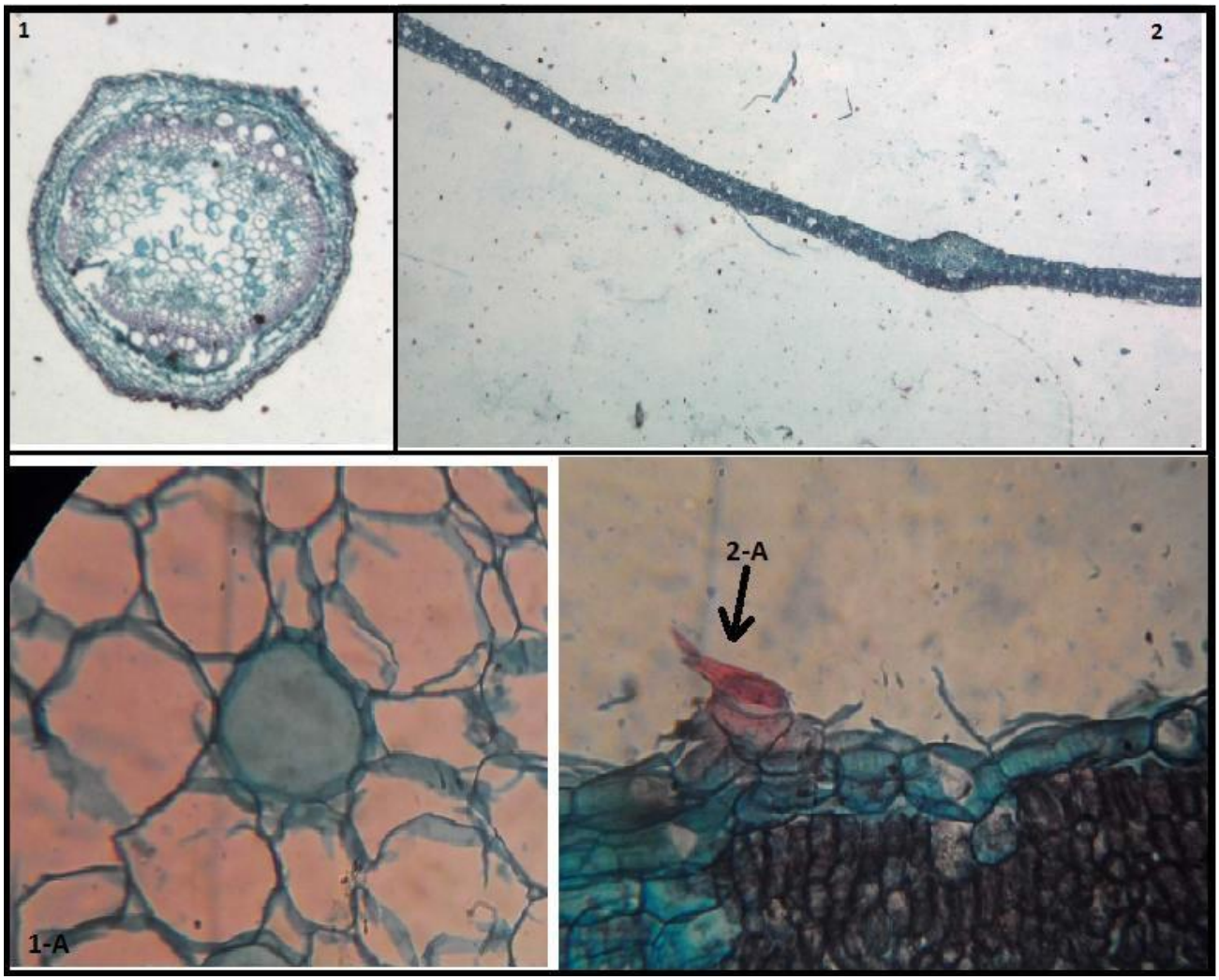

Plate 7: Anatomical features of *Ipomoae triloba*;1-A a secretory cell in stem collenchyma, 2- A: nonglandular hair with long terminal cell

An identification key based on anatomical key characters such as secretory canals, presence of crystals, thick striated cuticle, and hollow pith is constructed as follows:

A. Secretory canals in vertical rows…….….. *I. pes-caprae*

AA. Secretory canals solitary

B. Thick striated cuticle……. *I.carnea*

BB. Thin entire cuticle

C. Pith Hollow ……..…… *I. aquatica*

CC. Pith not hollow

D. Presence of crystals in pith……. *I.triloba*

DD. Absence of crystals in pith

E. Presence of sunken glandular hairs on leaves…. *I.verticillata*

EE .Absence of sunken glandular hairs on leaves

I. Cambium not equally active……..….*I. eriocarpa*

II. Cambium equally active…….……..*I. cairica*

In this key, the vertically arranged rows of secretory canals separated *I. pes-caprae* from the other species which are solitary arranged. Also presence of striated stem cuticle separated *I. carnea* from the other species which show thin entire cuticle. Hollow pith characterizes *I. aquatica* while the presence of crystals in the pith characterizes *I. triloba.* Two species: *I. cairica* and *I. eriocarpa* are characterized by the presence of sunken glandular hairs on their leaves. Many researchers have found the presence or absence and types of trichomes on the epidermal surface as classificatory tools (Metcalfe and Chalk, 1950; Adedeji *et al*, 2007). They reported that the types of epidermal trichomes can frequently delimit species, genera or families in plant. *I. cairica* and *I. eriocarpa* were differentiated according to their cambium activity, which was equally active in *I. cairica* but not in *I. eriocarpa*. Laterocytic type of stomata is the common feature among all the studied species. This was also observed by Leela and Shanmukha-Roa (1994). Concerning the taxonomic significance of the anatomy of foliar epidermis of *Ipomoea* species our results are in agreement with those of many authors such as Inamdar (1971), Karatela and Gill (1985), and Ugborogho et al (1992) and Essiett et al (2011) who stated that the anatomical features are widely used in systematics for identification, facilitation of taxanomic classification and for indicating pattern

of relationship that may have been observed by superficial convergence in morphological features.

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