

Taxonomical study of the genus *Koelpinia* Pallas (Asteraceae) in Iraq

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Abstract

The present research deals with the unique species in genus of *Koelpinia* Pallas which is *Koelpinia linearis* Pall In Iraq. The morphological characters of stems, leaves, flowers and bracts were found to be important value to separate this species from other genera of Asteraceae. The anatomy of stem and leaves characters were found to be of diagnostic value for the genus. *Koelpinia linearis* has Tricolporate and without distinct lacunae pollen grains, and distributing in central and southern Iraq , and growing in sandy loam soil

1- Introduction

Koelpinia Pallas (1776) is a genus within the Compositae (Syn: Asteraceae) [Subfamily Cichorioideae](#), [Tribe Lactuceae](#) Cass.(1819), Subtribe *Scorzonerinae* Dumort.(1827), (Bremer, 1994; Kubitzki, 2007). But other authors treated the genus under different subtribe such as Boisser (1875) treated the genus under subtribe *Lapsanae*; Post (1933) treated it in subtribe *Rhagadiolinae* and Davies (1975) in subtribe *Cichoriinae*. The subtribe *Scorzonerinae* forms a well-supported clade in all phylogenetic analyses of the *Cichorieae* based on morphological and molecular data (Bremer, 1994; Mavrodiev *et al.*, 2004). The molecular analyses with high statistical support of the monophyly confirm its recognition as subtribe *Scorzonerinae* in its traditional morphological characterization and circumscription (Stebbins 1953, but lacking *Koelpinia*; Blackmore 1981; Bremer 1994; Lack 2006).

There are five species in this genus like *Koelpinia linearis* Pall; *Koelpinia macrantha* C.Winkl., *Koelpinia tenuissima* Pavlov & Lipsch. distributed in Southeast Russia, Spain, North Africa, southwest Asia to Afghanistan, India, Central Asia.

The genus under study is a mono-species in Iraq which has Synonym names [Koelpinia latifolia C.Winkl.](#), [Koelpinia linearis var. linearis](#) , [Lapsana koelpinia L.f.](#) and [Rhagadiolus koelpinia Willd.](#) And Common names Dhalooq , Taalooq, Lahiat Al- Tais and goat's beard (Norton *et al.*,2009).

Koelpinia linearis is a subalpine plant grows wild and The life form is an annual herb, has a long lanceolate leaves. It flowers during March- April (Post, 1933; Norton *et al.*,2009). It is a rich source of triterpenoids and steroids, Although it used as an antiseptic for cattle, not much medicinal importance is known (Razdan *et al.*, 1990).

In Razdan *et al.* (1990) reported that the plant is a rich source of triterpenoids and coumarins. Though they did not isolate any coumarin, they reported the presence of some lupeol esters. Since triterpenoids are associated with a long range of biological activities, particularly anti-inflammatory, antiarthritic and cytotoxic activity.

2- Materials and Methods

2.1 - Morphological and Ecology studies:

The material of the current study are based on mainly dried specimens were kept in Babylon university herbarium. Morphological characters for all plant part were studied in the laboratory under dissecting microscope (Meiji). All information including habitat, identification, localities flowering period were obtain from the label of the specimens.

2.2- Palynological Study:

Pollen material of the plant were examined by a light compound microscope. The pollen samples were removed from the anthers of flowers of selected specimens, and put on the slide after that the pollen grains were mounted in glycerine jelly stained with safranin, and the equatorial and polar view were measured for 25 grains

2.3- Anatomical study:

The epidermal study was collected on the middle part of the lamina was made by peeling and Stripping off method were used to prepare adaxial and abaxial surfaces view of leaf epidermis by using Forceps and Needle, then transferred the epidermis into clean slide contain safranin (1%) prepared in ethyl alcohol (70%) for a period of 2-5 minutes and then wash the epidermis in ethyl alcohol (70%) and a few times to diminish of excess dye then placed under a drop of glycerin and covered with a cover slide and kept in the refrigerator until the examination .

The species samples were examined by a compound microscope and measurements of stomata and epidermal cells using the ocular micrometer and drawn the epidermis with the Camera Lucida installed on the microscope.

Leaf and stem transverse section were prepared by hand cutting. The species samples were fixed in alcohol-glycerin (60:40), then Foliar cross sections were prepared from the central leaf . Transverse sections were stained by safranin. The observations were carried out by light microscope and photographed with camera. Stomatal index was calculated as mentioned by (Ditcher, 1974).. Anatomical terms used are cited from (Ditcher, 1974; Radford *et al.*, 1974; Esau, 1977).

3- Results and Discussions

3.1- Morphological Descriptions:

Herb, annual, (12-30) cm high, sparsely pubescent. stems ribbed, erect or decumbent, simple or branched already from base, more or less pubescent or glabrous. Cauline leaves linear, (3.5-13.0) cm long, (0.1-0.5) cm wide, entire, acute, amplexicaul, greyish green on both surfaces, glabrous or subglabrous. Synflorescence diffusely racemiform to paniculiform, with (1-3) capitula or capitulum solitary. Peduncle up to (7.0) mm long, (0.8) mm in diameter. Capitula with (5-9) florets. Involucre at anthesis cylindric, (5.0-7.0) mm. Phyllaries glabrous or sparsely hairy, apex acute; 2- seriate, outer phyllaries 2 or 3, narrowly triangular, (2.0-3.8) × (0.7-1.2) mm; inner phyllaries 7-8, linear-lanceolate, (6.1-11.1) × (1.0-1.8) mm. Receptacle naked. Sepals modified to form a scaly, (0.16-0.30) mm. Corolla ligulate, pale yellow, glabrous; ligule (3.5-5.0) mm long, (0.8-1.7) mm wide, teeth of each ligule not equal approximately (0.53-0.87) × (0.36-0.61) mm. The androecium consists of five stamens that are united by their anthers , (1.14-1.38) mm in length, Fertile, Distal appendage of anther

rounded with two lobes, Sterial tail of anther Sagittate, Basifixed, length of collar (0.34-0.41)mm, (6-7) number of rows in collar, (9-13) cell in each row of collar, (0.36-0.85) mm length of filaments. The gynoecium: Bicarpellary, syncarpous, unilocular, one ovule, the locule, basal placentation, style narrow, total length (2.45-2.67) mm, stigma branched, (0.32-0.85) mm in length; ovary inferior, (1.12-1.46)mm long, (0.44-0.68)mm wide. Achenes cylindrical in outline, curved inwards like birds' claws, much longer than the bracts., (9.3-14.7) ×(1.0-1.5) mm, usually with 5 ribs, finely pubescent or glabrous, light brown or blackish, with longitudinal ribs. Abaxially with antrorse and apically with retrorse rigid hooked needlelike spines, (Plate 1)

Das and Mukherjee (2006) explained that the sculpturing of the achene surface shows similar variation and includes striking hooks for epizoochorous dissemination in *Koelpinia* species (Scorzonerinae). In general the achene surface features are taxonomically valuable, mainly at species level, and more rarely concur with supraspecific delimitation.

3.2- Palynological Study:

The result showed that, the pollen grains are trizonocolporate, sometimes tetracolporate, isopolar, echinate, length of polar axis is (30.0-40.0) μm , and the length of equatorial axis is (30.0-42.5) μm , oblate-spheroidal (P/E = 0.98). The grains are ovate-shaped in equatorial outline and triangular, obtuse-hexagonal in polar outline (quadrangular in 4-colporate pollen). The pollen has distinct equatorial depressions between the apertures and without distinct lacunae. The exine is (5.0-7.5) μm thick (spines included). diameter of the poles in polar axis is (5.0-7.5) μm (Plate 3, 1).

Palynology, although a relatively recent branch of plant sciences has already provided useful information for phylogenetic considerations. Pollen grains are usually categorized largely on the basis of their shape, size, apertural types, symmetry, polarity and exine sculpturing. In connection with the palynology of the genus *Koelpinia*, there are two works which are noteworthy; they are by (Mavrodiev *et al.* 2004, 2005) and (Osman, 2006). The last mentioned work has very good pollen descriptions to various taxa, obtained by light microscopy and the scanning electron microscope. Although, Blackmore (1981) was denoted the distinct types of echinolophate pollen (with equatorial ridges replaced by a lacuna, the aperture being divided into two lacunae, and with a characteristic exine stratification). If the pappus is absent as in *Koelpinia*, the characteristic pollen type of this alliance still allows unequivocal placement, therefore *Koelpinia*, which on palynological evidence is correctly placed in Scorzonerinae.

3.3- Anatomical study:

The result showed the anticlinal walls of epidermal cells in Cauline leaves exhibit a little difference between the adaxial and abaxial surfaces; they are normally straight- curved sometimes and rarely sinuate (Plate 2). The length of epidermal cells in the adaxial surface of leaves ranged between (50.0-207.5) × (37.5-45.0) μm with average (111.5 ×41.25) μm . and in the abaxial surface the length ranged between (27.5-92.5) × (22.5-62.5) μm with average (61.04 ×39.18) μm .

Stomata are rounded or elliptic shaped present on either sides (Amphistomatic leaves) then often more numerous on the abaxial epidermis. Measurements of stomata are approximately (40.0-50.0) × (20.0-35.0) μm with average (44.0 ×29.5) μm in the adaxial surface of leaves and (22.0-37.5) × (20.0-27.5) μm with average

(29.58 × 23.75) μm in the abaxial surface of leaves, therefore the stomatal index are 13.21 and 23.76 in the adaxial and abaxial surfaces respectively.

Guard cells are kidney shaped and anomocytic that the stomatal apparatus lacked accessory (subsidiary) cells. Metcalf and Chalk (1950) supported this truth when they pointed that stomata in Asteraceae are usually ranunculaceous except in a few species found nearly similar types, and the density of stomata in the upper epidermis are less than the lower epidermis

On the other side, the epidermal study for bracts are showed uniform result with surface view of leaf such as anticlinal walls of epidermal cells in external and internal surface of bracts are straight- curved, So Guard cells are anomocytic and amphistomaty, but it differs in dimensions. The length of epidermal cells in the external surface of bract ranged between (37.5-87.5) × (15.0-30.0) μm with average (55.25×22.5) μm and in the internal surface the length ranged between (37.5-87.5) × (20.0-42.5) μm with average (62.5×26.75) μm . While the dimensions of stomata in the external surface of bract approximately (25.0-32.5) × (17.5-27.5) μm with average (28.75×22.5) μm which has a stomatal index equaling 16.89, whereas the internal surface of bract approximately (27.5-37.5) × (20.0-25.0) μm with average (32.0×22.5) μm which has a stomatal index equaling 19.38 (Plate 2). In addition the surface view of stem also has the anomocytic stomata and a straight wall of epidermal cells (Plate 2). These result confirmed the characters which have proven to be of systematic value are: cuticular characters, epidermis, stomata, and trichomes (Radford *et al.*, 1974)

The results of the study show Non-glandular trichomes in the genus *Koelpinia* parts growing in Iraq were differed in terms of the density on the surfaces of upper and lower, and the difference in lengths trichomes as well as the differences in the number depending on the type of environment in which the live plant (Plate 1, 9). Furthermore presence of papillate stigmata which is important for effective wind pollination by expansion of the stigma surface area (Plate 1, 8). Although the previous studied demonstrated the genus *Koelpinia* has trichomes with elongated apical cells. Stalk composed of two or three cells, apical cell always one, several times longer in comparison with the stalk cells, triangular in shape, with thick cell walls (Krak and Mráz, 2008).

Anatomical characters in transverse sections of stems are represented in Outline is semi-circular to ribbed (Plate 3, 2). Epidermis uniseriate of square – rectangular compact cells, (10.0-20.0) μm in thickness, covered with a thick layer of cuticle approximately (5.0-12.5) μm with average (7.64) μm , followed by multilayered differentiated into hypodermis and inner cortex. Hypodermis is found below the epidermis, and is constituted with angular collenchyma which is 3-5 layered concentrated at the ribs. The inner part of cortex is constituted with parenchyma cell with a large numbers of intercellular spaces are present between these cells. So, Vascular tissue represented by many vascular bundles arranged regularly in the form of broken ring. The vascular bundles are conjoint, collateral, endarch, open, wedge shaped and lack the bundle cup fiber. Pith presenting the centre of stem composed of parenchymatous storage cells of isodimetric to polyhedral thin layered cells with more or less large intercellular spaces. Cell dimensions increases towards the center of stem.

Transverse sections of lamina showed two surfaces are bounded by their respective epidermal layers. The epidermal cells are square – rectangular shaped, compactly arranged; upper epidermis is covered with thick cuticle and lower epidermis is covered with thin cuticle and is interrupted by stomata. Mesophyll is the ground tissue but It isn't differentiated because samples did not dehydrated at the early stages of preparation, (Plate 3, 3). Vascular bundles approximately equaling in size via the parallel venation; each bundle is conjoint, collateral and

closed. The vascular bundle is covered by a bundle sheath of parenchyma cells. An extension of bundle sheath is seen above and below the vascular bundle, reaching the epidermal layers. Phloem is towards lower epidermis; xylem is towards upper epidermis, with metaxylem facing phloem. The xylem and phloem elements are conspicuous only in large vascular bundles, thus Al-Hadeethy *et al.* (2014) Confirmed the anatomical examinations showed the stomata and epidermal growth are of particular importance to the anatomical in some plant species, were it was found that for epidermis growth intrinsic value of classification at all levels of the functions

4- Ecology Study:

The species under study found as separated individuals within the area or as a population, in sandy loam soil, sandy with gravel (gravelly desert); altitude: 400-1000 m; Täckholm (1974) and Davis (1975) revealed the genus *Koelpinia* is growing on sandy and calcareous soils, desert wadis, alt. 300-1400 m

From the information was obtained from the notes are written on the label in the specimens of species was collected, The flowering period extended from the beginning of March to the beginning of May, and the species was annuals distributed in different districts such as Persain Foothills District (FPF) in Sudor –Diala, Central Aluvial Plain District (LCA) in Deir az-zor to Babylon. Western Desert District (DWD) in 10 km North of Najaf, 50 km from Najaf toward Rutba, Al-Adhaim, and, 10 km west of Razaza lake, Southern Desert District (DSD) in 90-95Km SW As-Salman. Thus the species under study was distributing in central and southern Iraq although Bornmüller (1911) collected the species in Hamrin mountain in Kirkuk at the date 24/IV/1893 that has No.1193 and other specimens at 28/IV/1893 No. 1771. These results came as a result of the distribution of species in Iran, Egypt (Täckholm, 1974), Also recorded in Qatar, Bahrain, Kuwait, UAE. (Norton *et al.*,2009).

At the end, our results so far indicate plant morphology; pollen morphology and anatomy studies conducted from Iraq provide evidence for identification on one hand as well as a contribution towards the publication of family Asteraceae.

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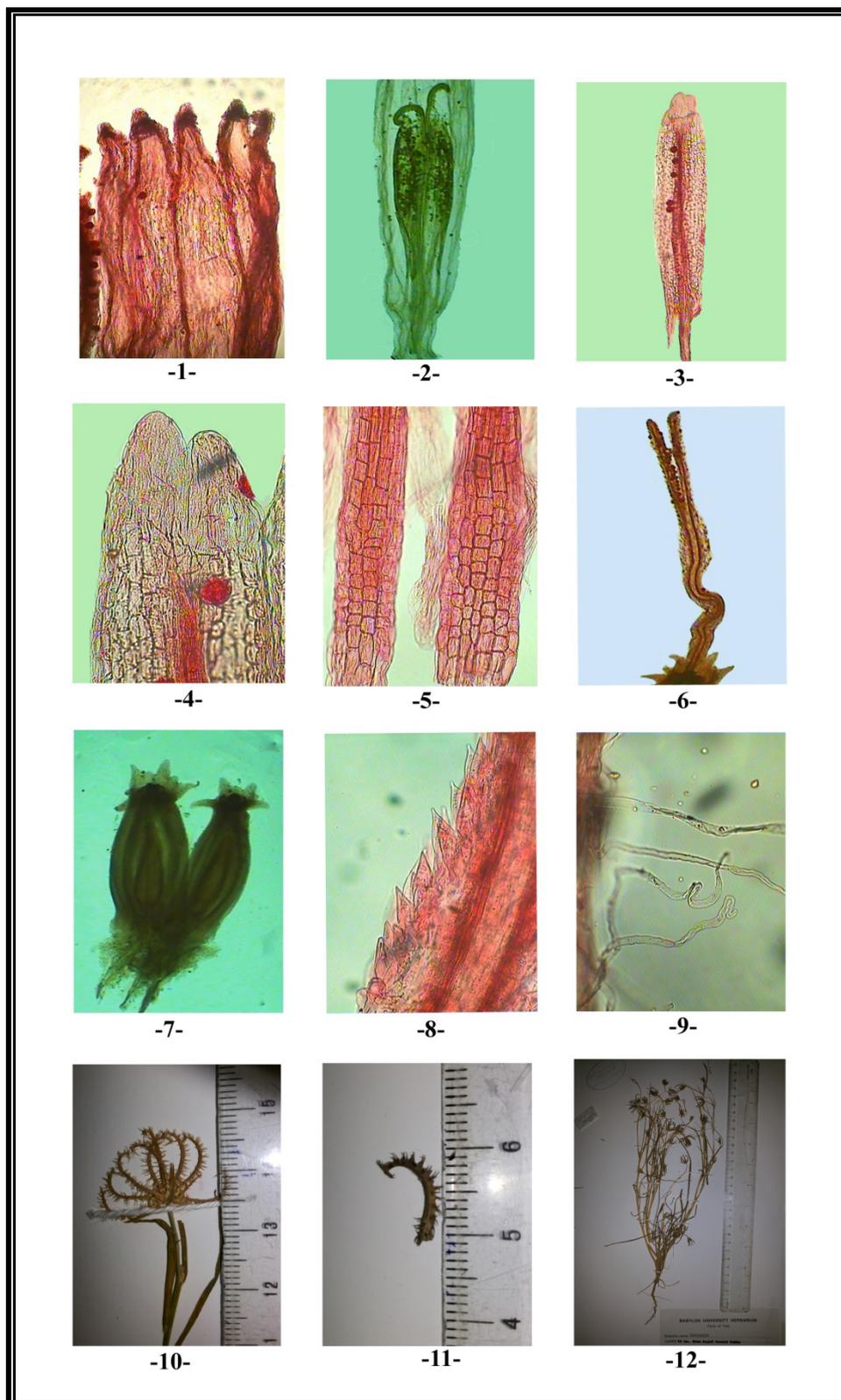


Plate (1) Morphological characters in the species *K. linearis*

- 1-Teeth of corolla 2- Syngenious phenomena in Asteraceae. 3- Androecium
 4- Distal appendage of anther 5- Serial tail of anther 6- Gynoecium 7- Ovary
 8- papillae in stigma surface 9- Trichomes in inner phyllary 10- Fruiting head
 11- fruit 12- Herbarium dry specimen.

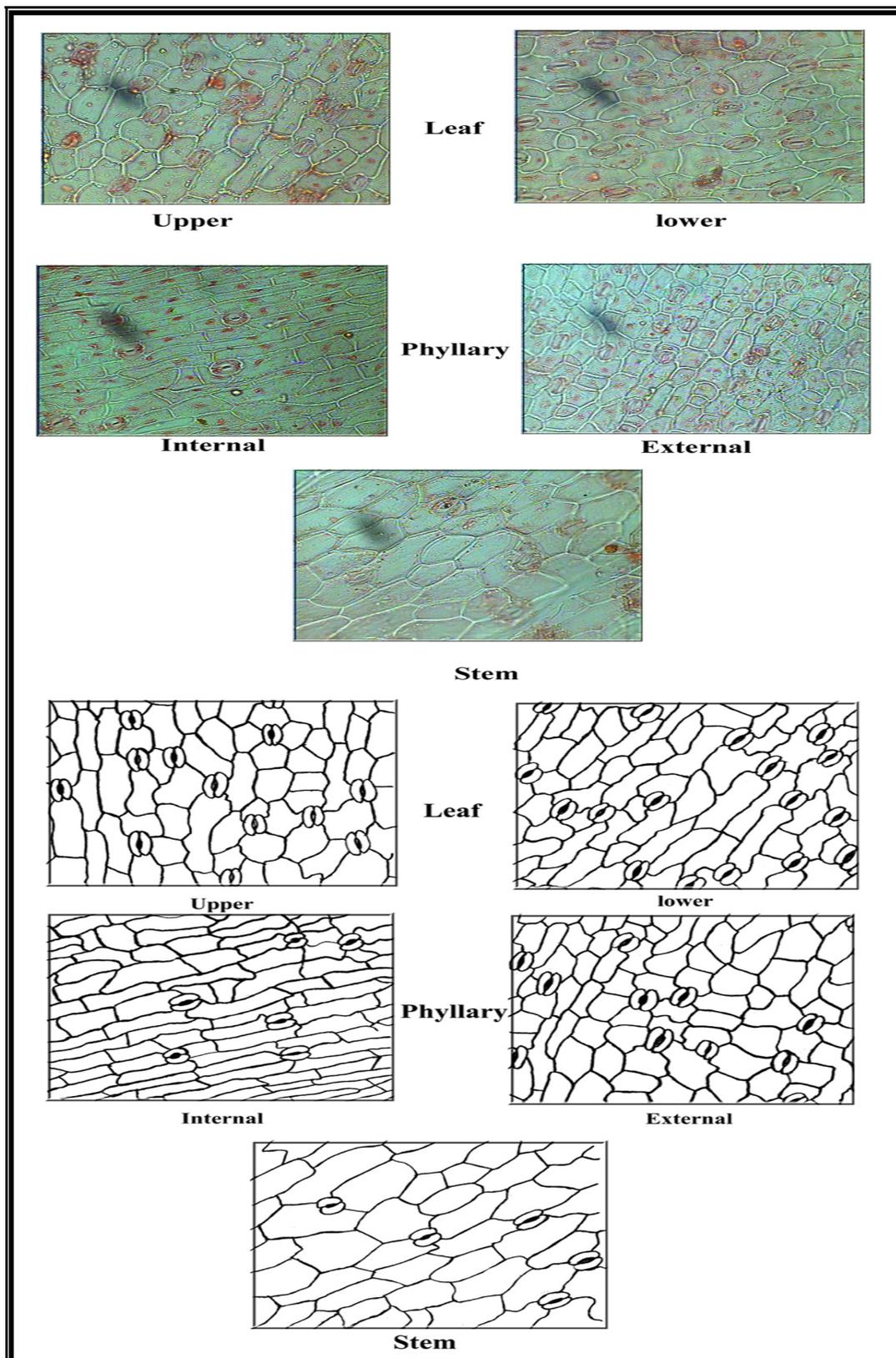


Plate (2) Anatomical epidermal surface in leaf, phyllary and stem in the species *K. linearis*

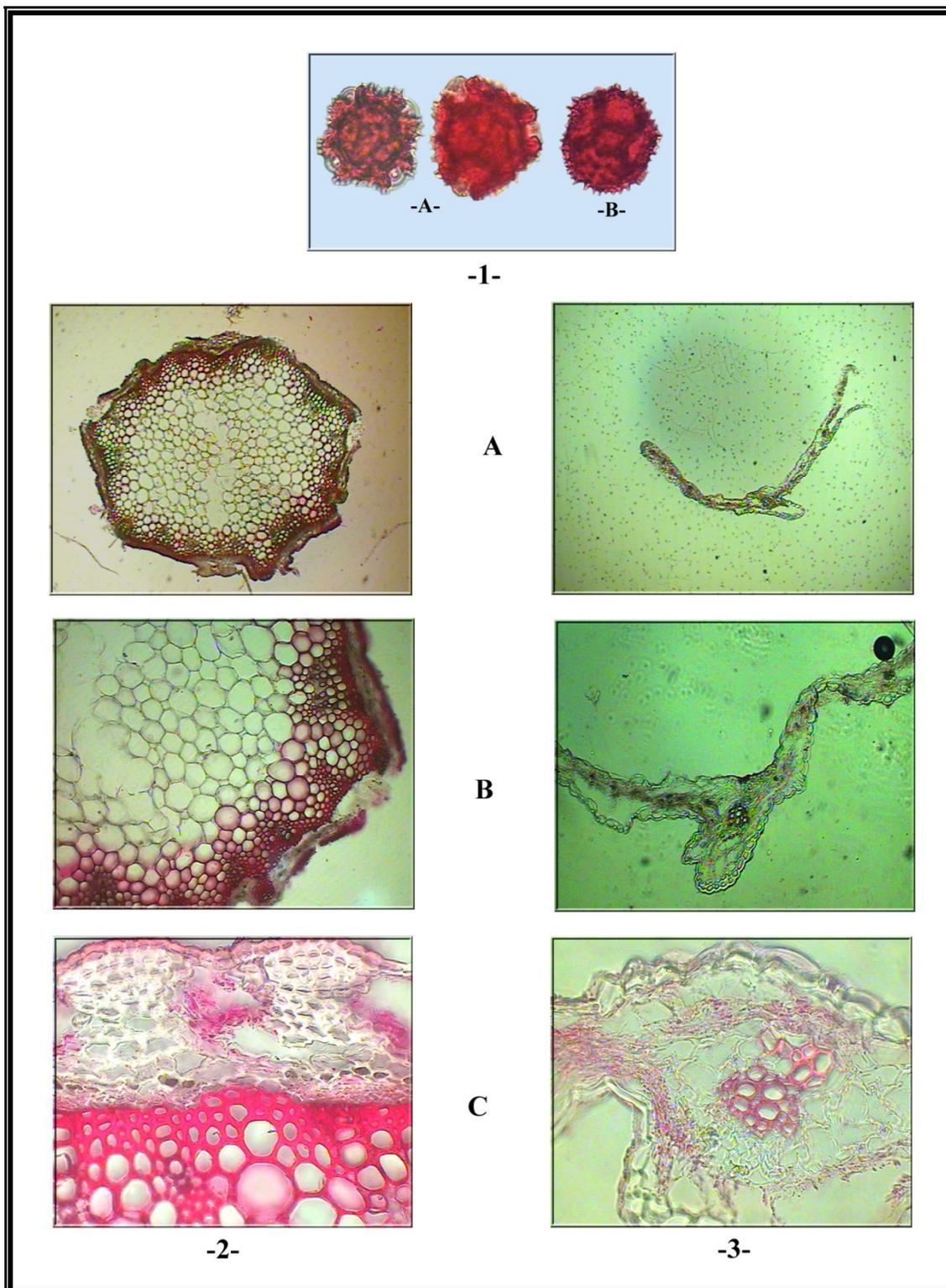


Plate (3) Pollen grain and Cross section of stem and leaf in the species *K. linearis*

1-Pollen grain (A- polar view, B- equatorial view) 2- Cross section of stem (A- Magnification power 40x, B- Magnification power 400x, C- Magnification power 4000x) 3- Cross section of leaf (A- Magnification power 40x, B- Magnification power 400x, C- Magnification power 4000x)

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