

***Alcea acaulis* and *A. fasciculiflora*, two new records for the flora of Iran**

Received: 02.11.2019 / Accepted: 31.12.2019

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Abstract

During several field trips to the western parts of Iran and after comparing the collected plants with other species of *Alcea*, we came across to following two specimens belonging to *Malvaceae* family which were found new to the flora of Iran from Ilam province. *Alcea acaulis* is distinguished from the other species in the genus by its very short stem. The second species, *A. fasciculiflora*, is morphologically similar to *A. iranshahrii* and *A. ghahremanii* which is distinguished by its leaf shape, flower color and indumentum features. Both *Alcea acaulis* and *A. fasciculiflora* are sparsely to densely covered by two types of glandular and non-glandular trichomes. The glandular trichomes are of clavate type and the non-glandular trichomes are divided into three types: simple, stellate and fascicled. The present paper, therefore, deals with taxonomic descriptions and relationships of the species, important diagnostic traits, micromorphological features of the trichomes, illustrations and the distribution maps of the species in Iran.

Keywords: Ilam, *Malvaceae*, morphology, taxonomy, trichome micromorphology

Alcea acaulis* و *A. fasciculiflora*, دو گزارش جدید برای فلور ایران

دریافت: ۱۳۹۸/۰۸/۱۱ / پذیرش: ۱۳۹۸/۱۰/۱۰

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خلاصه

طی مسافرت‌های متعدد میدانی به نقاط مختلف غربی ایران به منظور مطالعه فلور گیاهی منطقه، پس از تطبیق گیاهان جمع‌آوری شده با سایر گونه‌های متعلق به جنس *Alcea* L. به دو گونه جدید از تیره پنیرکیان برای فلور ایران از استان ایلام برخورد گردید. گونه نخست *A. acaulis* که در منطقه صالح‌آباد از توابع شهرستان مهران در استان ایلام جمع‌آوری گردید، با داشتن ساقه بسیار کوتاه از سایر گونه‌های جنس ختمی متمایز می‌شود. گونه دوم *A. fasciculiflora* که در روستای گلزار از توابع شهرستان ایوان در همان استان پراکنش داشت، به لحاظ ویژگی‌های ریخت‌شناختی مشابه با گونه‌های *A. iranshahrii* و *A. ghahremanii* است که در شکل برگ، رنگ گل و ویژگی‌های کرک‌پوش از آن‌ها متمایز می‌شود. *Alcea acaulis* و *A. fasciculiflora* به طور پراکنده تا مترکم با دو نوع کرک غده‌ای و غیرغده‌ای پوشیده شده‌اند. کرک‌های غده‌ای از نوع گزری شکل و کرک‌های غیرغده‌ای به سه نوع ساده، ستاره‌ای و دسته‌ای تقسیم می‌شوند. در این مقاله، شرح جزئیات و ارتباطات تاکسونومیک گونه‌ها، صفات تشخیصی مهم، ویژگی‌های ریزریخت‌شناسی کرک، تصاویر و نقشه پراکندگی گونه‌ها در ایران ارائه شده است.

واژه‌های کلیدی: ایلام، تاکسونومی، تیره پنیرک، ریخت‌شناسی، ریزریخت‌شناسی کرک

* مستخرج از رساله دکتری نگارنده نخست به راهنمایی دکتر حامد خدایاری ارائه شده به دانشگاه لرستان

Introduction

Alcea L. is one of the largest genera of *Malvaceae* family with nearly 70 species worldwide mainly distributed in SW Asia (Zohary 1963a, b, Hutchinson 1973, Riedl 1976, Heywood *et al.* 1978). Highlands of Turkish Armenia and Kurdistan have been considered as the centers of speciation for the genus *Alcea* (Zohary 1963b).

Delimitation of *Alcea* and *Althaea* genera has been a challenging task in taxonomic history of *Malvaceae*. *Alcea* has been traditionally included in *Althaea* based on epicalyx characteristics (Bentham & Hooker 1862, Baker 1890, Candolle 1837, Edlin 1935, Willdenow 1800). However, characteristics of staminal column and fruit features led to consider *Alcea* and *Althaea* as two separate taxa (Alefeld 1862, Boissier 1867, Iljin 1949).

Molecular-phylogenetic data also support the monophyly and distinctness (as suggested by morphological data) of *Alcea* but they are of limited use in determining relationships between species and species delimitations (Escobar Garcia *et al.* 2012). *Alcea* exhibits a considerable taxonomic complexity (Zohary 1963a,b, Riedl 1976, Townsend 1980). So far, two infrageneric classifications have been proposed in *Alcea*, each classified into some informal groups. Despite its relatively large number of species, no formal subgeneric classification is yet accepted.

Due to uniformity and pronounced plasticity in morphological characters of this genus (especially in flower and fruit characters), some traits such as leaf sequence, mericarp shape, relative length of calyx versus epicalyx, and indumentum morphology are more applicable in taxonomy of *Alcea* (Escobar Garcia *et al.* 2012). In recent years, several novelties in *Alcea* have been presented for the flora of Iran (Ghahreman *et al.* 2001, Pakravan & Ghahreman 2006, Pakravan 2006, 2008a). According to the latest revision of the family, it

is represented by 34 species in the Flora of Iran, among them, 15 species are endemic (Pakravan 2008b).

Alcea species are mainly annual, biennial or perennial, mostly tall-growing hemicyptophytes. The stem is erect and rarely branched from the base or acaulescent in a few cases. The leaves are variable in shape from simple to lobed, palmatipartite or palmatisect. Epicalyx segments are 4–10 connate at base. The sepals are 5 and connate at base. Petals are pentamerous and variable in color (white, pink-violet or yellow, sometimes greenish at the base). Mericarps are numerous, each sub-bilocular (due to an internal expansion of the carpel wall) with a sterile upper chamber and a single-seeded lower one.

Alcea acaulis (Cav.) Alef. is distributed in Turkey, Palestine, Egypt, Iraq, Jordan, and Syria. It is distinguishable from other species by its significant characteristic feature, acaulescent habit and very short stem. It grows in steppes, fields and roadsides (Boissier 1875, Post 1896, Guest & Townsend 1966, Zohary 1972, Uzunhisarcikli & Vural 2012). Cavanilles originally described *Althaea acaulis* Cav. in “*Monadelphiae Classis Dissertationes Decem*” in 1786. The figure in his dissertation is the lectotype (Fig. 1). Later, Alefeld transferred this species to the genus *Alcea* in 1862 forming the combination *Alcea acaulis* (Cavanilles) Alefeld *Oesterr. Bot. Z.* 12: 251, 1862 which was followed by the other authors (Boissier 1875, Post 1896, Townsend *et al.* 1966, Zohary 1972, Uzunhisarcikli & Vural 2012).

Alcea fasciculiflora Zohary is also an Irano-Turanian element, reported for first time from Southeastern Turkey (Siirt province) and then from Diyala in eastern Iraq (Zohary 1963 b, Uzunhisarcikli & Vural 2012). It grows in steppes and roadsides. It is easily distinguishable from the other species of *Alcea* by its thyrsoid inflorescence and long peduncles (Uzunhisarcikli & Vural 2012).



Fig. 1. Lectotype of *Alcea acaulis* [illustrated by Cavanilles in 1786 (tab. 27, fig. 3)].

Materials and Methods

During several field excursions to the west of Iran (Ilam province) as well as survey to the several herbaria [virtual Herbarium of Natural History Museum Vienna (W), virtual Herbarium of Royal Botanical Garden Edinburgh (RBGE), Geneva Herbarium (G), Herbarium of Iranian Research Institute of Plant Protection (IRAN), Herbarium of Tehran University (TUH), Herbarium of Shahid Beheshti University (SBUH), and some Herbaria of Natural Resources Research Centers in most provinces of Iran such as: Ilam, Kermanshah, Kordrstan, Kerman, Shiraz, and East and West Azerbaijan], some new information were obtained. The specimens were identified using the identification keys and descriptions of the *Alcea* species in the relevant floras [viz. Flora of Syria (Post 1896), Flora of USSR (Iljin 1949), Taxonomical Studies in *Alcea* of South-western Asia (Zohary 1963a, b), Flora Orientalis (Boissier 1967), Flora Palestina (Zohary 1972), Flora Iranica (Riedl 1976), Flora of Iraq (Townsend *et al.* 1980), and The Taxonomic Revision of *Alcea* and *Althaea* in Turkey (Uzunhisarcikli & Vural 2012)].

The characteristic features of the species were investigated using Light (LM) and Scanning Electron

Microscopy (SEM). SEM micrographs were taken with a KyKy-EM3200 Scanning Electron Microscope (Zhongguancun Beijing, China) located in the Central Laboratory of the University of Lorestan (Khorramabad, Iran) at 25 kV. The terminology of trichome types follows Hardin (1976), Inamdar & Rao (1981), and Hardin & Stone (1984). The distribution map was drawn using Arc GIS software Ver. 10.3. (Fig. 4).

Results and Discussion

- Taxonomy

Alcea acaulis (Cav.) Alef. Oesterr. Bot. Z. 12: 251 (1862)

Syn.: *Althaea acaulis* Cav. Diss. 2, Secunda Diss. Bot. 93 (tab. 27, fig. 3) (1786) (Fig. 1)

Alcea acaulis var. *albiflora* Dinsm. In: Post Fl. Syria ed. 2, 1: 240 (1932)

Lectotype: illustrated by A.J. Cavanilles (1786)

Plants perennial with a woody base, acaulescent or shortly caulescent with condensed internodes. Stems erect, slender, 2–20 cm tall, branches few or many. Leaves small (basal and middle leaves 2.5–5 × 2.5–6 cm); lower leaves almost undivided; upper leaves very shallowly 2–5 lobed, orbicular-reniform, cuneate or cordate at the

base, margin crenate, apex obtuse or acute, covered with (3)5–8(11)-rayed stellate trichomes. Petioles in basal leaves 4–10 cm and 1.5–3.5 times as long as the blade, cauline leaves 2–5 cm and 1–2 times as long as the blade, inflorescence leaves 0.5–3.5 cm and equal to or shorter than the blade. Stipule simple or dissected into two narrowly lanceolate segments, 1.5–5 mm long, margin entire, apex acuminate, stellate-pilose hairy. Flowers axillary solitary, 3.5–6 cm long, arranged at the base or along the branches on 9–30 mm long Pedicels, densely to sparsely stellate hairy. Epicalyx 6–10 mm, parted into 5–7 segments, connate at the base, one-third to nearly half of the calyx. Calyx 17–22 mm long, divided almost to two-third of its length. Sepals 5, 10–20 × 2–5 mm, connate at the base, slightly striate, lanceolate, margin entire, apex acuminate, densely stellate hairy. Corolla white or pink, when dry white or purple and yellowish to slightly green at the base. Petals in apex entire or emarginated, white pilose at the connate part. Mericarps 4–5 × 4–5 mm, glabrous, reniform-orbicular, brown, prominently wrinkled and slightly canaliculate at the back, conspicuously rugose. Seeds 2–2.5 × 2.5–3 mm, reniform, brown, tuberculate, sparsely white pilose around the hilum.

- Characteristic features

Alcea acaulis is distinguishable from the other species of the genus by its acaulescent habit or having a very short stem (Figs 1 & 2). Ecologically this species grows in unique habitats such as semi-deserts.

Specimen examined: Iran: Ilam province, Mehran, 5 km to Saleh-Abad, 15 May 2018, M. Arabameri, Sh. Bahadori & E. Roudi (IRAN 77129).

Alcea fasciculiflora Zohary, Israel J. Bot. 12: 20 (1963)

Type: Turkey, prov. Siirt: Silvan-Kurtalan, 24.06.1954, P.H. Davis & O. Polunin, No. 22177 (BM, holo., C, K, W, iso.).

Plants perennial, erect, branched at the base. Stem cylindrical. Cauline leaves palmatipartite-palmatisect, 5–7 lobed, 70–150 cm, orbicular, cordate at the base, margins serrate-crenate; floral leaves palmatifid-palmatipartite, 3–5-lobed, 2.2–6.5 cm, orbicular, cordate at the base, margin serrate-crenate. Petioles 2–8.5 cm, stellate-pilose hairy. Stipule trifid, 3–8 mm, lanceolate, margins entire, apex acuminate, pilose. Inflorescence with fascicled flowers in the middle and the upper parts. Pedicels 2.2–5 cm, glabrous, sparsely to densely stellate-pilose. Epicalyx 6–8 mm, less than half as long as calyx, connate at the base; lobes 7–13 mm lanceolate, stellate-pilose hairy. Sepals 5, connate at the base, striate, 18–25 mm, lanceolate, margin entire, apex obtuse, acuminate, stellate-pilose hairy. Petals pink, 40–60 mm long. Mericarps 4–5 mm, reniform, clearly winged, pilose hairy, sparsely hairy on the lateral side. Seeds reniform, brown.

- Characteristic features

Alcea fasciculiflora is known by its thyrsoid inflorescence, long pedicles (up to 8 cm), and pink flowers (Fig. 3). Based on inflorescence type and pedicel length, it resembles *A. iranshahrii* Pakravan, Ghahr. & Assadi and *A. ghahremanii* Pakravan & Assadi, two endemic species with limited distribution in Dena mountains and East Azerbaijan (Mianeh), respectively (Table 1).

Specimen examined: Iran: Ilam province: Chavar to Ivan, Golzar village, 16 May 2018, M. Arabameri, Sh. Bahadori & E. Roudi (IRAN 77128).

- Results of Light Microscopy and Scanning Electron Microscopy (Indumentum features)

Alcea acaulis and *A. fasciculiflora* are sparsely to densely covered by a combination of trichome types. The density of indumentum differs among different parts of the plant. It is relatively dense in calyx, epicalyx, moderately dense in leaves and subglabrous in the stem. Two basic types of trichomes

can be distinguished in these two species: i.e. glandular and eglandular trichomes. The capitate glandular trichomes are relatively common in most species of *Alcea* (Arabameri, unpublished data) which are also present in these two species (Fig. 5 L, P). The eglandular trichomes can be subdivided into three subtypes: simple (Fig. 5 E), fascicled (derived from a basal cell and radiate into two to many erect and solid arms, Fig. 5 B, C, I), and stellate (more or less appressed to the epiderm and possessed flat or solid arms, Fig. 5 F–H, M–N). The stellate trichomes [0.3–0.9 mm, (3)5–7(9)-rayed] were the most common trichome types in all parts, somewhat along with simple and fascicled hairs especially in stem (Fig. 5 B–E).

The indumentum features have been known to provide valuable characters in species delimitation and also in characterizing natural groups of species (Iljin 1949, Zohary 1963a, b, Riedl 1976). *Alcea aucheri* (Boiss.) and *A. ilamica* Pakravan have a kind of hairs that do not occur in other species of *Alcea* (Pakravan 2003).

Despite of the uniformity in flower and fruit traits, indumentum features along with some other characters

such as mericarp and leaf shape have been considered as more diverse and informative characters with higher taxonomic usability in *Alcea* (Escobar Garcia *et al.* 2012).

Stellate trichomes are the most common trichome types in *Alcea* species (Arabameri, unpublished data). *Alcea fasciculiflora* is distinguishable from its close species *A. iranshahrii* and *A. ghahremanii* by having fascicled hairs in combination with stellate hairs on most parts of plant such as stem and calyx (Fig. 5 B, I).

In most species of *Alcea* a regular indumentum with a layer of uniform and relatively equal trichomes (as seen in *A. fasciculiflora*, Fig. 5 A) is observed but a few species such as *A. acaulis* exhibit a kind of indumentum (especially in stem) characterized by two layers of trichomes: a dense or sparse coverage of small stellate trichomes, interspersed with long-rayed fascicled hairs (Fig. 5 E). This feature along with other more prominent characters (e.g. acaulescent habit), distinguishes *A. acaulis* from some relatively similar species such as *A. kurdica* (Schltdl.) Alef.

Table 1. Morphological comparison of *Alcea fasciculiflora* and its close relatives

Character	<i>A. fasciculiflora</i>	<i>A. iranshahrii</i>	<i>A. ghahremanii</i>
Leaf shape	Basal leaves: palmatifid-palmatipartite Cauline leaves: palmatipartite-palmatisect	Deeply divided into acute lobes	Palmatisect
Flower color	Pink	White to bright yellow	Yellow
Indumentum	Glabrous, sometimes with sparsely simple, stellate or fascicled hairs	Rather densely covered with stellate hairs	Sparse stellate hairs or almost glabrous

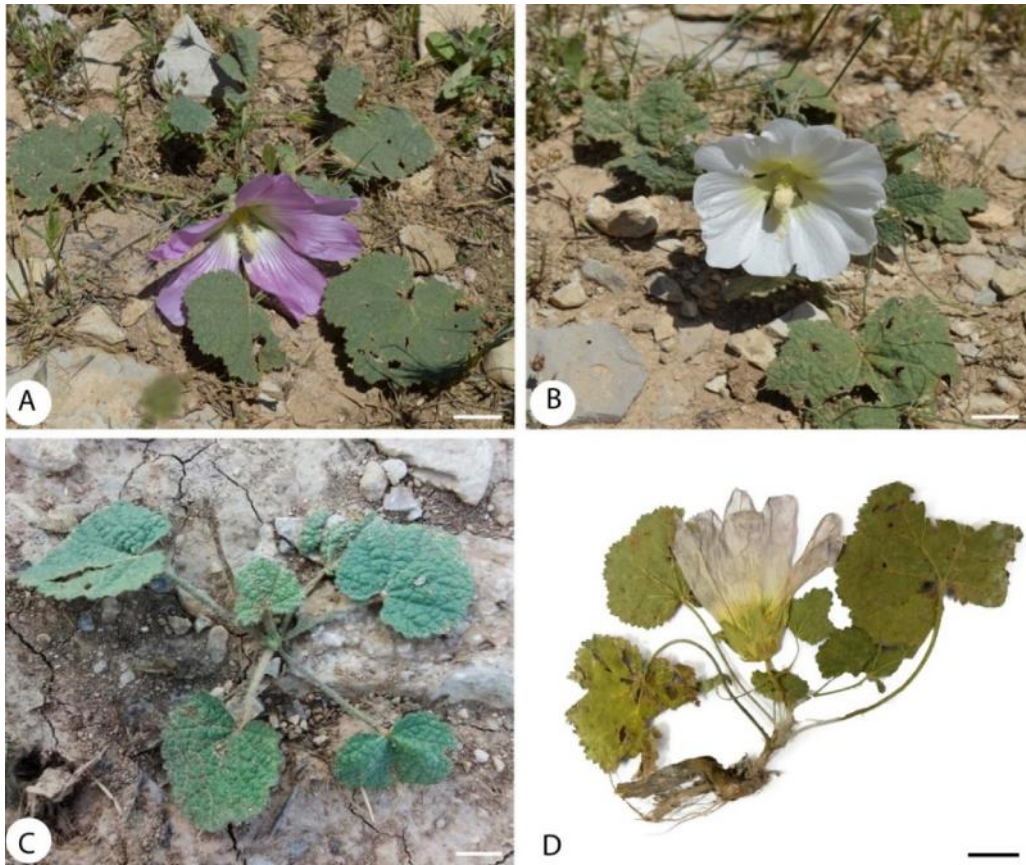


Fig. 2. *Alcea acaulis*: A-B. Habit, C. Basal leaves, D. Herbarium specimen (IRAN 77129) (Bar = 1 cm).

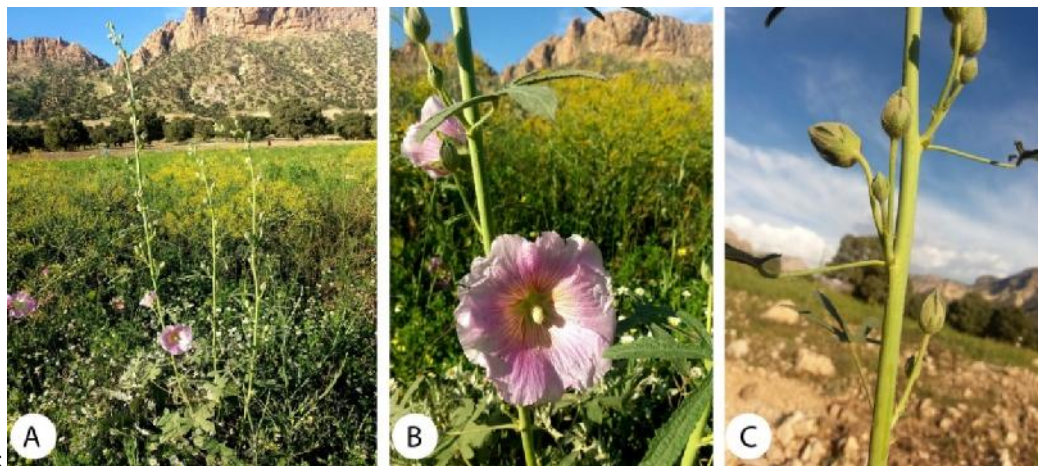


Fig. 3. *Alcea fasciculiflora*: A. Habit, B. Flower, C. Thyrsoid inflorescence.

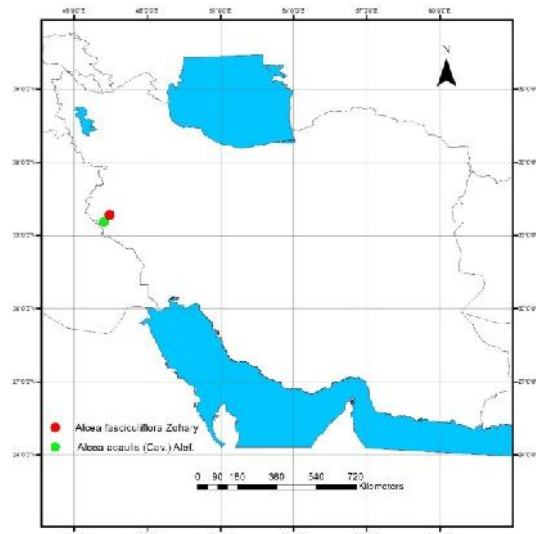


Fig. 4. Distribution map of *Alcea acaulis* and *A. fasciculiflora* in Iran.

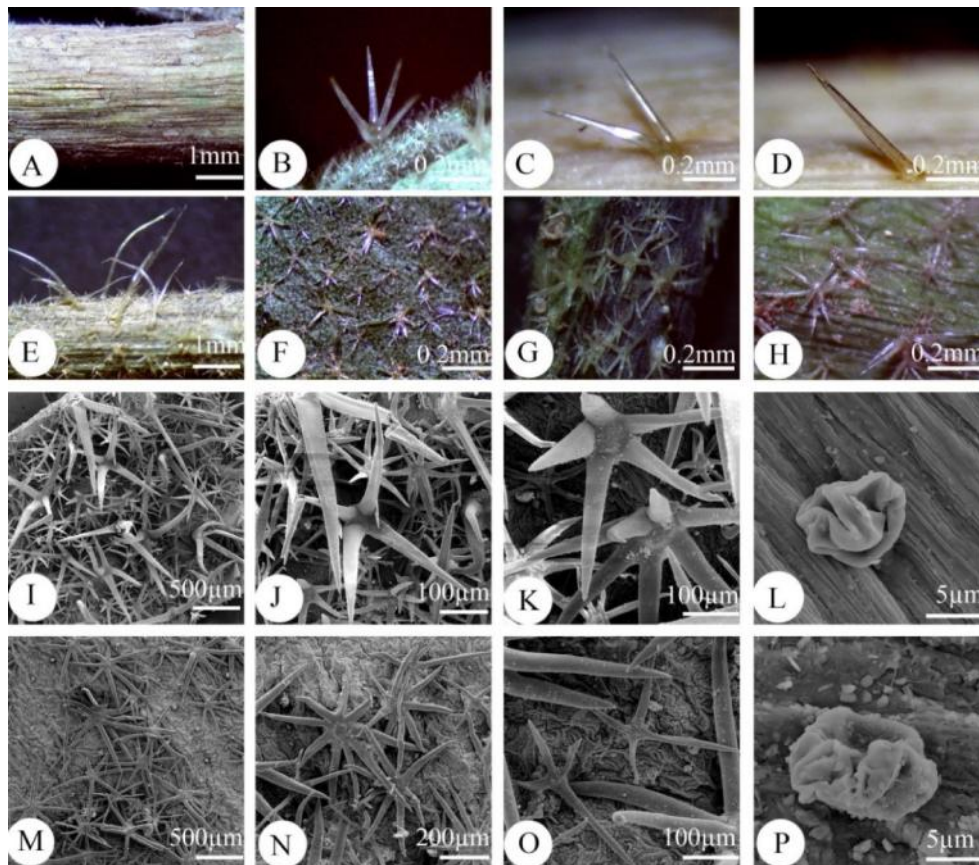


Fig. 5. Selected LM and SEM micrographs of *Alcea fasciculiflora* (A–D and I–L) and *A. acaulis* (E–H and M–P): A. Stem covered by relatively glabrescent indumentum, B & C. Fascicled hairs, D. Simple hair, E. Stem covered by two layers of trichomes, small stellate hairs interspersed with long-rayed fascicled hairs, F. Stellate hairs on leaf, G & H. Stellate hairs on stem, I & J. Combination of stellate and fascicled hairs on calyx, K. Fascicled hairs on calyx, L. Glandular capitate hair on stem, M–O. Stellate hairs on leaves, P. Glandular capitate hair on stem.

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