IHJPAS. 36 (4) 2023

Ibn Al-Haitham Journal for Pure and Applied Sciences
Journal homepage: jih.uobaghdad.edu.iq

A Morphological Study of Some *Silene* L. Species of Caryophyllaceae Family in Iraq

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Article history: Received 28 January 2023, Accepted 26 March2023, Published in October 2023.

doi.org/10.30526/36.4.3249

Abstract

The current works included morphological features studies (vegetative and floral parts) for five species of the genus *Silene* L., *S. ampullata*, *S. chlorifolia*, *S. colorata*, *S. conoidea*, and *S. longipetala*, which belong to the family Caryophyllaceae. Samples were collected from various areas of northern Iraq. The confirmation in the description was on the most critical parts of the plant, including the shape of the leaves, length, and shape of the calyx tube and venation, the modification shapes of coronal scales, petals, and appendages, anther ornamentation, and structures of pistils. Images enhanced the morphological characteristics under study. Information on the locations and dates of the collection was also confirmed.

Keywords: Caryophyllaceae, *Silene*, Species, Taxonomy.

1. Introduction

The family Caryophyllaceae is one of the largest flowering plant families in the world, as well as one of the most important dicotyledonous families and the main one of Angiosperms, It is represented globally by 86 genera and about 2,630 species of herbs and small shrubs. The family is known globally as the Pink family or the Carnation family. Its members are distributed all over the world, especially in the northern hemisphere, except in most of the humid tropics, but it is

concentrated mainly in the Mediterranean region and shows a great diversity in habitats and phenotypic growth. [1, 2, 3].

The genus *Silene* L. is one of the largest genera of flowering plants in this family in the world, with more than 700 species belonging to the subfamily Silenoideae of the family Caryophyllaceae. [4, 5, 6, 7]. It is distributed mainly in the northern hemisphere, but some species appear in Africa and South America [7], and it is distributed in Turkey, Russia, Italy, Iraq, Iran, eastern Mediterranean countries, Japan, Spain, and England [8]. The most important diagnostic characteristics in isolating species and sections of the genus *Silene* are the shape and venation types of the sepals, the length and pubescence of the stamens, the shape and size of the leaves and coronal scales, and the style of the capsule and seeds [9]. Outwardly, it contains a gamosepalous cup; the number of carpels ranges from 3-5; and the shape of the calyx tube differs in the species from campanulate, clube-clavate, and Ovate [10].

There are 24 genera and 135 species of the family Caryophyllaceae in Iraq, of which 37 species are members of the genus Silene [11; 12]. The species *Silene papillose* Boiss was added as a new record of the flora Iraqi by [13], which is described morphologically and anatomically. These species are distributed as wild plants in the high mountain regions, the western desert regions, and the southern desert [14]. This study aims to identify the most critical characteristics for diagnosing species and appearance variations, especially the style of the calyx tube veins, the variation in petals appendages, types of anthers sculpture, and pistil structure.

2. Materials and methods:

28 samples were collected from different locations of the mountains in northern Iraq: Balkan Mountain, Sulaimaniyah, Penguin between latitude 35˚62.38725’ N and longitude 45˚94. 91482’ E; Goby-Qara Dagh), Sulaimaniyah between latitude 35˚16.5740’ N and longitude 45˚21.2920’ E, (Azmer Mountain, Sulaimaniyah between latitude 35˚37.6490’ N and longitude 45˚28. 0780’ E, (Gweija Dagh), Sulaimaniyah between latitude 35˚37.1830’ N and longitude 45˚28. 0160’ E, and (Haj-Omran) Erbil between latitude 36˚40.9830’ N and longitude 45˚0. 2030’ E. during the period from March to May 2022 (**Figure 1**).

The studied species were identified using the important morphological characteristics in determining the species, which were included in the Iraqi flora by Ghazanfer and Edmondson (2016). Some of the plant parts are photographed using a Dissecting Stereomicroscope camera type (Taida TD-HU708A), while the other parts (calyx and petal with stamen) are photographed using a digital camera type (SAMSUNG SM-S908E/DS). The steps mentioned before were followed [15].

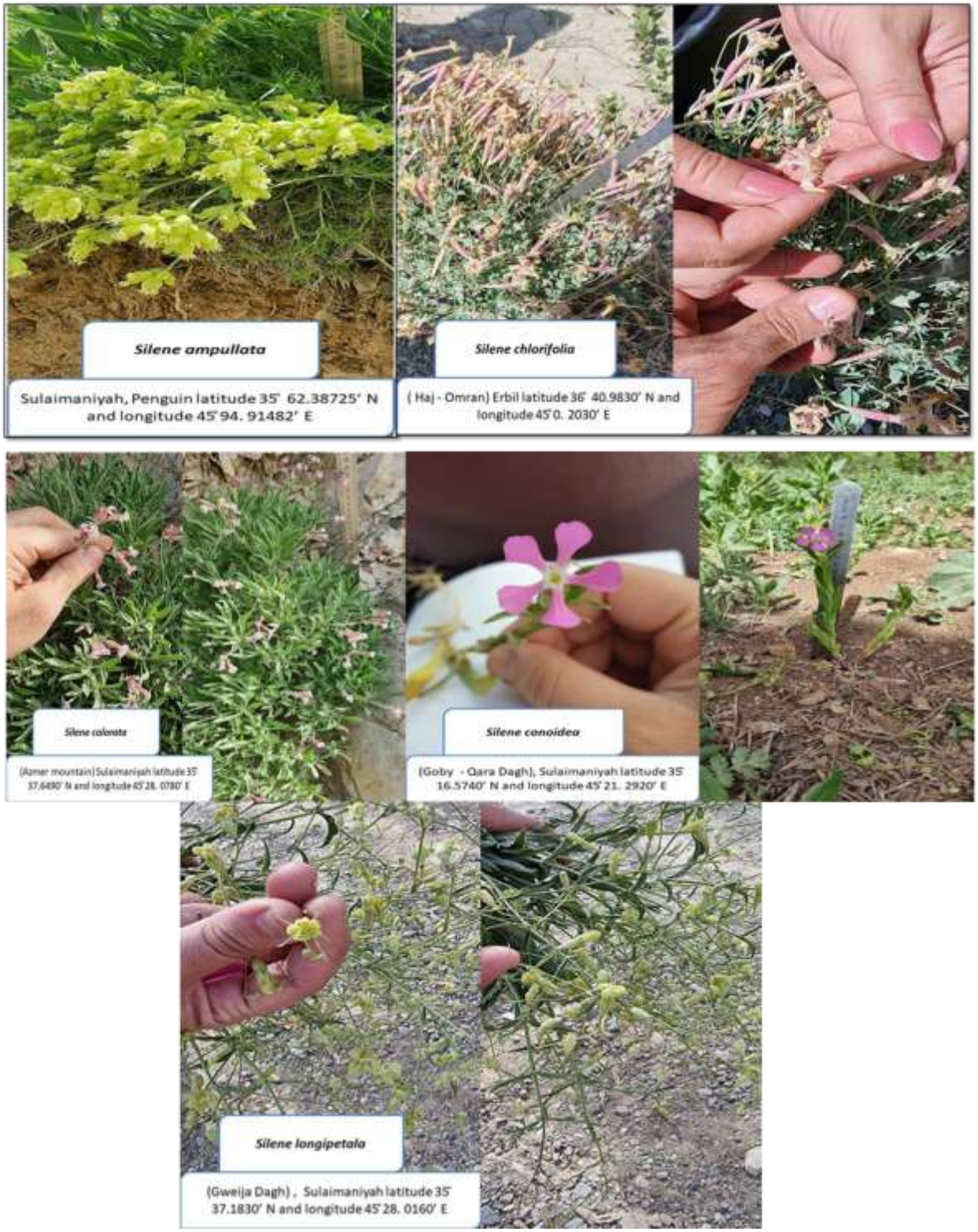

Figure 1. Locations of samples collection

3.Results:

3.1.*Silene ampullata Boiss.*

Root: It's 8.5–15.5 cm long with the densest, thickest branches and subbranches (**Figure 2/A**).

Stem: erect to ascending, shortly pubescent, cylindrical, and brown (**Figure3/A**).

Leaf: sessile slightly (15-30 × 0.5-1mm), base sessile, apex acute, glandular–pubescent. (**Figure 3/A**).

Calyx tube: slightly inflated, bladder-like shape in fresh samples, greenish-yellow, length about 1–1.2 cm, 5 veins extending from a base to the end of each of the sepal teeth, teeth triangular, and pubescence (**Figure4/A**).

Petal with Stamens: petals yellowish-green consist of a medium limb 7mm in size, appendages absent, and an elongated auriculated claw 5–6 mm, coronal scales oblong, stamens 4, two in each ring, the filaments one longer than another, and an anthphore (2.5–3 mm) (**Figures 2 and 5/A**).

Pistil: compound stipitate about (0.7–0.9 cm) in length; the ovary is flask-shaped with 3 short styles; the stigma is cuspid slightly (**Figure 6/A**).

Anther ornamentation: granulated shape in all margins (**Figure7/A**).

3.2.*Silene chlorifolia Boiss*.

Root: It's 5.5–9 cm long, with less dense, thick branches and subbranches (**Figure 2/B**).

Stem: erect, glabrous, viscid above, basal leaves few, cylindrical (**Figure3/B**).

Leaf: blade shape ovate-ovate-lanceolate, cauline leaves (15–3612–35mm), reducing in size above, apex sharply acute to mucronate, base attenuate. (Figure 3/B).

Calyx tube: cylindric tapering below, yellow-pinkish, the length about (2.8–3 cm), with 10 veins extending from a base; five veins terminate in each end sepal tooth, while the others are toward the margin of teeth; teeth are triangular, ciliated (**Figures 2 and 4/B**).

Petal with Stamens: white or greenish to yellowish, consisting of a limb and claw, limb 10–11 mm in size, appendages divided into two parts, finger to triangular-shaped, entire margin, petal claw 22–23 mm auriculate, coronal scales oblong to caudal or paddle-like shape, two stamens in each of one whorl, filaments one longer than another, anthphore (14–15 mm) (**Figures 2 and 5/B**).

Pistil: the length of about (2.3- 2.5 cm), all parts of the pistil carried by gynophore, the ovary flask shaped slightly, swollen, 3 long styles pinkish in fresh samples, stigma cuspid slightly. **(Figures 2 and 6/B).**

Anther ornamentation: lobed shape. **(Figure7/B).**

3.3. *Silene colorata Poiret.*

Pistil: the length of about 2.3–2.5 cm; all parts of the pistil carried by the gynophore; the ovary flask shaped slightly, swollen; 3 long styles pinkish in fresh samples; stigma cuspid slightly. **(Figures 2 and 6/B).**

Anther ornamentation: lobed shape **(Figure 7/B).**

3.4. *Silene colorata Poiret.*

Root: *It's annual (4.5–6 cm), with the densest, thickest branches and subbranches* **(Figure 2/C).**

Stem: leafy, dense, erect, branched or unbranched, cylindric. **(Figure3/C).**

Leaf: blade shape lanceolate or sub-spatulate, basal leaves narrowly obovate (25×0.3 -1.2 cm), apex acute slightly, adnate. **(Figure3/C).**

Calyx tube: cylindrical, goblet-like shape, reddish-green, length about 1.1–1.5 cm; it has 10 veins extending from a base, five of which end each of the tooth sepals, while five others are toward the margin of the teeth; all veins cover pubescence; teeth are triangular and ciliated **(Figure 4/C).**

Petal with Stamen: petals pink consist of limb and claw, consisting of a medium limb 6–9 mm in size, appendages divided into two small parts circular-shaped, entire margin, petal claw elongated auriculate, coronal scales oblong involute, two stamens short, filaments one longer than the other, anthphore (5.5–8 mm). **(Figure 2 and 5/C).**

Pistil: compound stipitate about 0.5–0.8 cm in length; the ovary is conically shaped slightly, swollen, and has three short styles. **(Figure 6/C).**

Anther ornamentation: granulated shape **(Figure 7/C).**

3.5. *Silene conoidea Boiss.*

Root: It's 5-8 cm long, with less dense, thin branches and subbranches **(Figure 2/D).**

Stem: erect, branched at the apex or at the base; cylindrical, slightly thick. **(Figures 2 and 3/D).**

Leaf: blade shape spatulate to lanceolate slightly, basal leaves lanceolate (15–42 42 × 2.5 -10 mm), apex acute **(Figure 3/D).**

Calyx tube: tubular-conical, green, with short glandular hairs, the length about 2.5–3 cm; it has 30 veins green, which extend from a base, five of which expand to the end of each tooth sepal, while others parallel toward the margin of teeth; bracts long-attenuate from the ovate base; teeth finger-like elongated **(Figures 2 and 4/D).**

Petal with Stamens: petal pink, reddish, or lilac, consisting of limb and claw, limb 12–16 mm median in size, bilobed to about ¼, or emarginated, undulate margin, appendages divided into two long parts, serrate-shaped, petal claw tapering, coronal scales ovate, two stamens short, filaments one longer than another, anthphore (0-3 - 4 mm) **(Figure2 and 5/D).**

Pistil: the length of about 2–2.8 cm; the ovary is conical-shaped, tapering at the apex; there are 3 long styles; the stigma is cuspid slightly **(Figure 6/D).**

Anther ornamentation: pitted **(Figure 7/D).**

3.6. *Silene longipetala Vent.*

Root: It's 6–11.5 cm long, with the densest, thickest branches and subbranches **(Figure 2/E).**

Stem: erect, with short retrorse hairs, glabrous and often viscid above, cylindrical. **(Figure2 and 3/E).**

Leaf: lanceolate to ovate-lanceolate, leaves rosette (30–55×11-15mm), apex acute, base attenuate in the lower leaves, sessile in the cauline leaves. **(Figures 2 and 3/E).**

Calyx tube: campanulate and tapering below, green; the length is about 1.1–1.2 cm; it has 10 green veins that extend from a base; five of them end in each sepal tooth, while the others are parallel toward the margin of teeth, bracts, and bracteoles similar to cauline leaves, but reduced in size upwards; teeth are triangular with a ciliate margin **(Figure 4/E).**

Petal with Stamens: petals white-greenish or lurid, consisting of a median limb 13–14 mm in size, deeply bilobed to 2/3 into linear lobes, entire margin, appendages divided into two short finger-like parts, petal claw 7-8 mm, hairy, auriculate, coronal scales oblong, two stamens short, filaments hairy, one longer than another, anthphore (2 -4mm). **(Figure2 and 5/E).**

Pistil: the length is about (0.8- 1 cm), the ovary is conical-shaped, tapering at the base, with three short styles oblique, hairy styles, and the stigma is slightly cuspid. **(Figure 6/E).**

Anther ornamentation: granulated more than other species. **(Figure 7/E).**

Table 1. The comparison of morphological features for species of Silene between our study and Flora of Iraq.

Morphological features	*S. ampullata*	*S. chlorifolia*	*S. colorata*	*S. conoidea*	*S. longipetala*	Flora of Iraq
Leaves shape and dimension	linear to acicular slightly 15-30 × 0.5-1mm	orbicular, ovate - cordate to ovate – lanceolate15 - 36×12 - 35mm	lanceolate or sub-spatulate 2 -5 × 0.3 - 1.2cm	spatulate to lanceolate slightly 15 -42 × 2.5 -10mm	lanceolate to ovate-lanceolate 30 -55 × 11 - 15mm	similar with them
Leaves apex	acute	sharply acute to mucronate	acute slightly	acute	acute	similar with them
Calyx tube length	1-1.2 cm	2.8 - 3 cm	1.1 – 1.5 cm	2.5 – 3 cm	1.1 – 1.2 cm	non record
Calyx shape	slightly inflated	cylindric tapering below	cylindrical goblet like shape	tubular-conical	campanulate like and tapering below	some similar with them
Calyx veins number	5	10	10	30	10	some similar with them
Coronal scales	oblong	oblong to caudal or paddle like	oblong involuted	ovate	oblong	some similar with them
Appendages petal shape	absent	finger to triangular	circular	serrate	finger-like	non record
Pistil length	0.7- 0.9 cm	2.3- 2.5 cm	0.5- 0.8 cm	2- 2.8 cm	0.8- 1 cm	non record
Ovary shape	flask-like	flask-like slightly	conical-like slightly	conical-tapering at apex	conical-tapering at base	non record
Anther ornamentation	lobed	lobed	lobed	pitted	lobed bigger them	non record

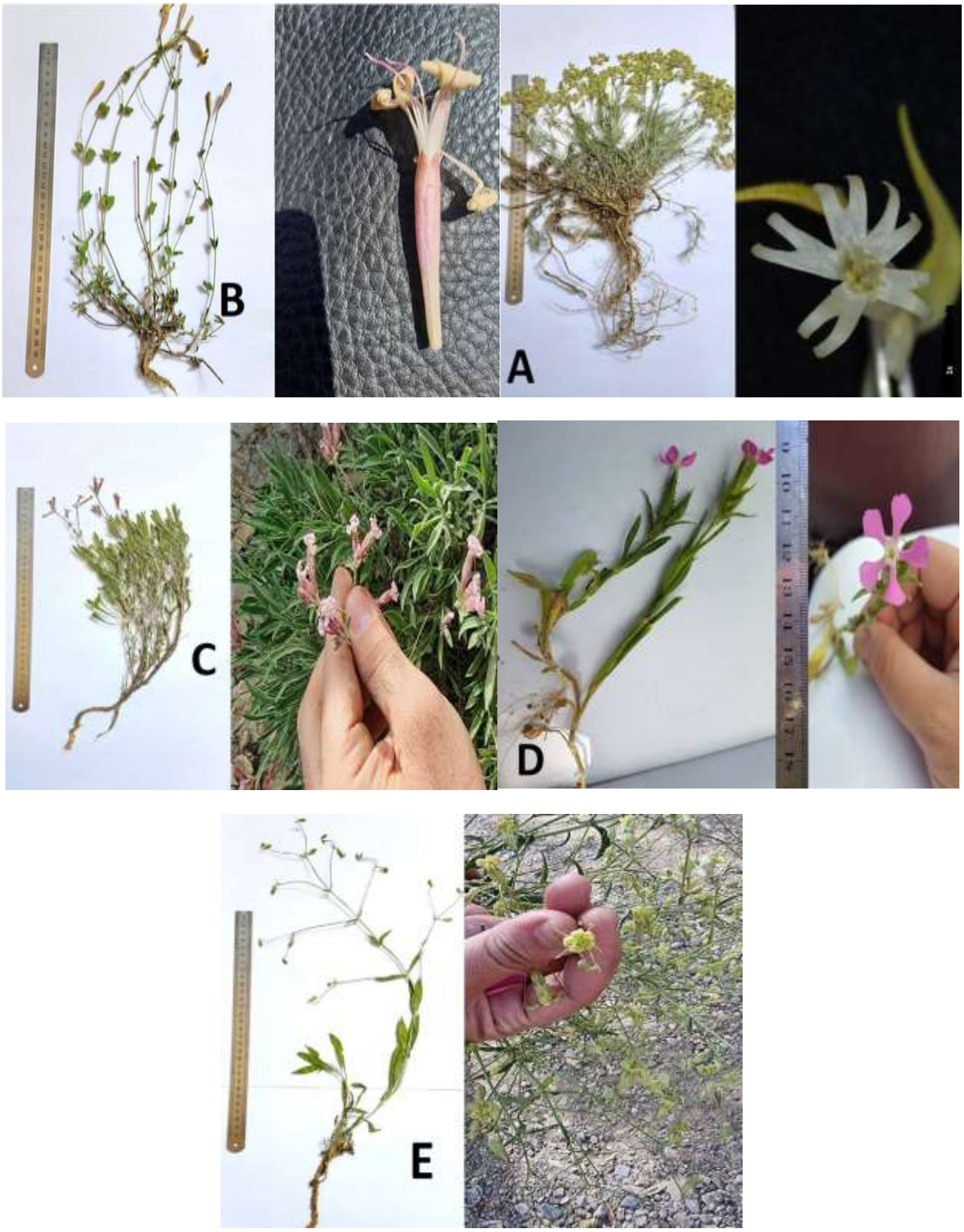

Figure 2. Shape of plants in the fiel, **A-** *S. ampullata*, **B-** *S.chlorifolia*, **C-** *S. colorata*, **D-** *S. conoidea*.

Figure 3. Stem and Leaves, **A-** *S. ampullata*, **B-** *S.chlorifolia*, **C-***S. colorata*, **D-** *S. conoidea*, **E-** *S. longipetala*.

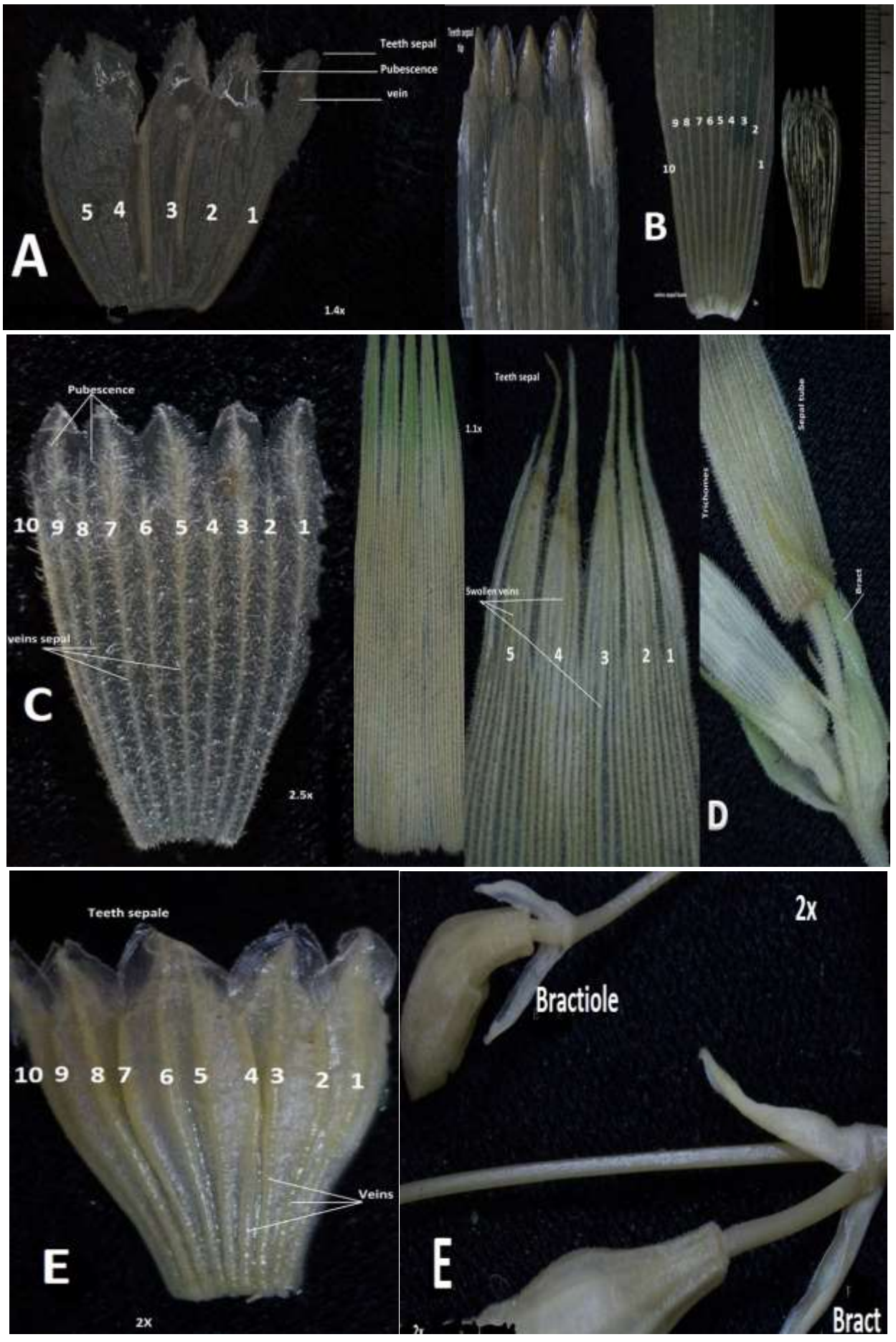

Figure.4. Calyx tube venation, **A-** *S. ampullata*, **B-** *S.chlorifolia*, **C-** *S. colorata*, **D-** *S. conoidea*, **E-** *S. longipetala*.

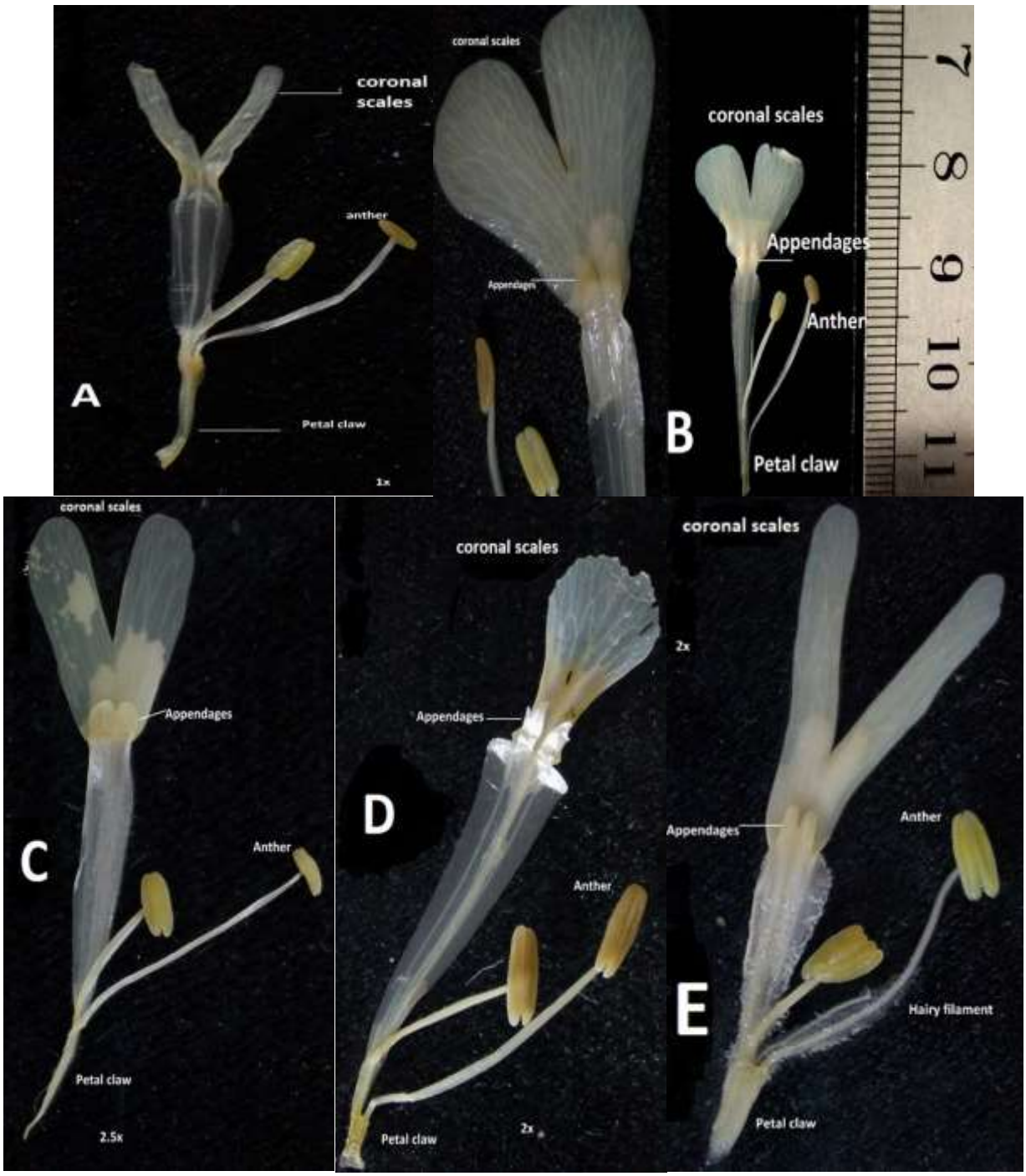

Figure 5. Petal with stamen, **A-** *S. ampullata*, **B-** *S.chlorifolia*, **C-** *S. colorata*, **D-** *S. conoidea*, **E-** *S. longipetala*.

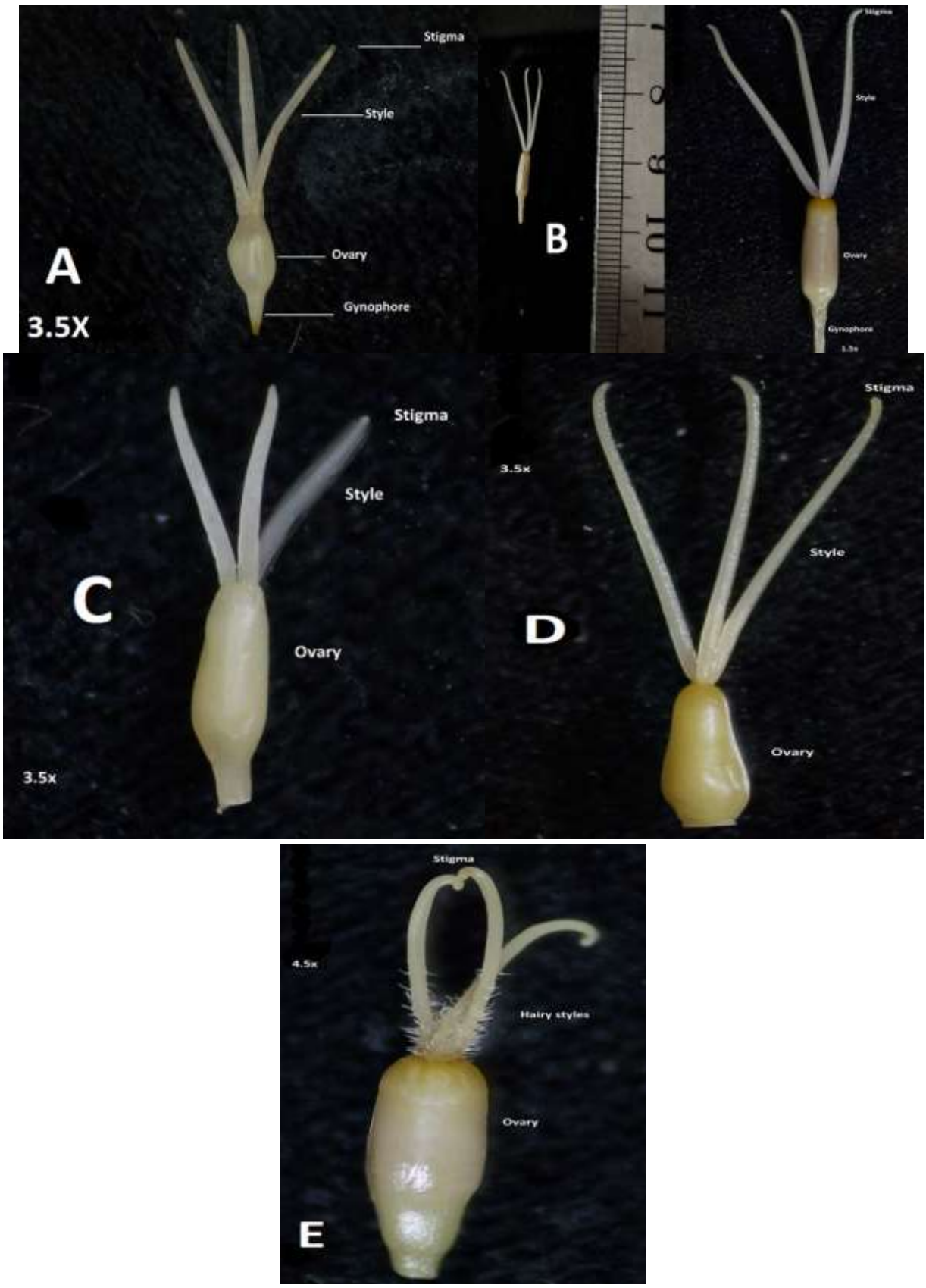

Figure 6. Pistil, **A-** *S. ampullata*, **B-***S.chlorifolia*, **C-** *S. colorata*, **D-** *S. conoidea*, **E-** *S. longipetala*.

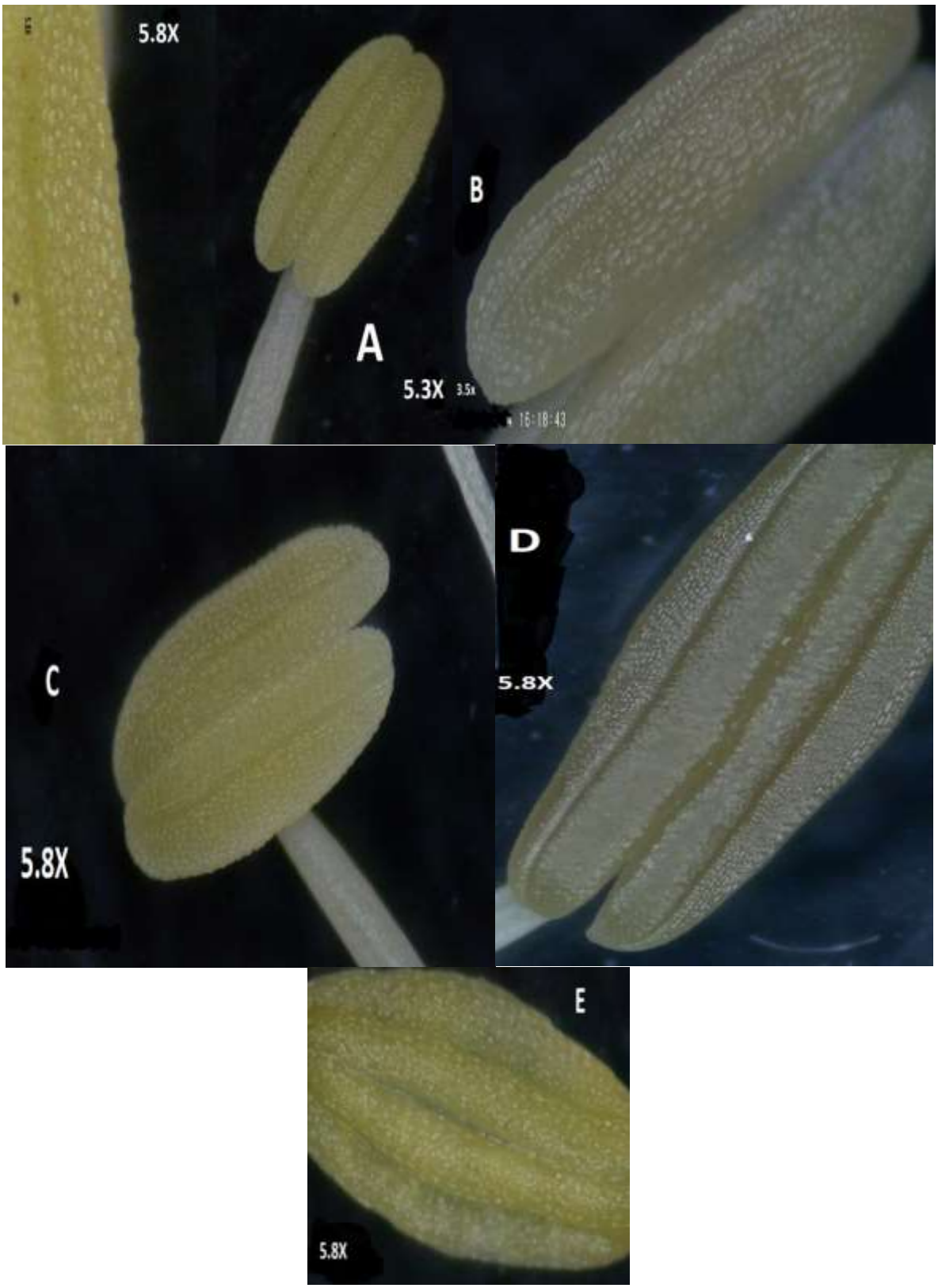

Figure 7. Anther orenamenation**, A-** *S. ampullata***, B-***S.chlorifolia***, C-***S. colorata***, D-** *S. conoidea***, E-** *S. longipetala*.

4. Discussions:

In this investigation, the morphological features between species under study in the genus *Silene* L. were observed. We compared the findings of this study with the Flora of Iraq. There is a similarity in leaves and some floral parts, but a difference in the measurement of other parts of the plant. These are given in **Table 1**.

All the characteristics that have been studied are considered important and diagnostic to differentiate among the studied species, such as leaf shapes and apexes and the presence or absence of hairs and their shapes. This is agreed with [16; 17; 18].

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