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# TRICHOMES MORPHOLOGY AS A TAXONOMIC MARKER IN THE SUBFAMILY HELIOTROPIOIDEAE (BORAGINACEAE) FROM PAKISTAN AND KASHMIR

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## ABSTRACT

Trichomes morphology of the subfamily Heliotropioideae (Boraginaceae) representing by 18 species has been examined by light and scanning microscope. Within the subfamily Heliotropoideae trichomes are generally eglandular rarely glandular as in *Heliotropium ophioglossum* Boiss. Within the subfamily Heliotropoideae 1-celled unicellular and two celled uniseriate trichomes are observed. Shape of the trichomes usually conical with pointed tips and distinct trichomes base. However, few species have indistinct trichome base. The data is significantly useful at specific and generic level within the subfamily Heliotropioideae

**Key words:** *Boraginaceae, Heliotropioideae, Heliotropium Trichomes,*Kashmir, Pakistan

## INTRODUCTION

Boraginaceae is a large cosmopolitan family of about 54 genera and 2500 species, distributed in temperature regions especially Mediterranean and tropical regions (Willis, 1973; Mabberley, 1978). The family has been divided into various groups since it shows considerable variation in their floral and fruit characters. Benthem and Hooker (1876) divided the family in two subfamilies viz., Boraginoideae and Heliotropioideae. In Pakistan subfamily Heliotropioideae is represented by a single genera i.e., *Heliotropium* representing 23 species (Nasir, 1989).

Epidermal attachments of various shape, structure and function are called trichomes, they many be glandular eglandular, unicellular or multicellular. Parbhakar & Leelavathi (1989) examined trichomes morphology of 209 species of plant from India. Carlquist (1991) examined the trichomes in the family Bruniaceae. Rejdali (1991) reported glandular and eglandular trichomes in the North African species of *Sideritis* (Lamiaceae). Dickison (1993) studied the introversion trichomes of family Styracaceae. Falciani *et al*., (1995) studied the morphology and distribution of trichomes in some Italian species of the genus *Stachys* (Labiatae). Pascal *et al.,* (2006) reported glandular trichomes in the Caesalpinieae and Mimosoideae (Leguminosae. Renobales *et al*., (2001) studied the secretary hairs in *Gentiana* and allied genera (Gentianaceae) from Iberian Peninsula. In the Mint family (Lamiaceae) two types of trichomes are found on leaves and stem such as peltate and capitate (Sanz *et al*., 2000; Pierce *et al*., 2001). In the family Boraginaceae all types of hairs are present which may be of these trichomes will be helpful in the taxonomy of the family. There are no reports on trichomes morphology of Boraginaceae: Heliotropioideae from Pakistan. Present study is probably the first attempt of this kind on Boraginaceae: subfamily (Heliotroprioideae).

## MATERIALS AND METHODS

Plant materials were obtained from the field or collected from the Karachi University Herbarium. For this studies different plant parts appx. 1 cm in size were used. For scanning microscopic studies materials were mounted on metallic stubs, using double sided cellotape and coated with gold in sputtering chambers (Ion-sputter JFC-1100). The coating was restricted to 15A. The SEM examination was carried out on a Jeol T20 scanning electron microscope.

## RESULTS AND OBSERVATIONS

### General Morphology of trichomes of subfamily

### Helitrropioideae: Boraginaceae

Generally trichomes of subfamily Heliotropioideae are unicellular (one-celled) . Uniseriate trichomes are 2-3 celled. Uniseriate hairs may be slender or broad-based, and the slender ones may be straight or curly. Some genera have ribbon like trichomes long trichomes with blunt apex this trichomes are mostly unicellular and with out trichomes base. In the few species both types of trichomes are found. Like in *Heliotropium subulatum* (DC.) Vatke. trichomes are quite variable

**Key to the species and the genera**

**1+** Trichomes generally glandular…….2

- Trichomes eglandular…….*H. ophophioglossum*

**2** Trichomes unicellular …….5

- Trichomes uniseriate…….……3

**3. +** Trichomes short……...*H. bacciferum*

- Trichomes long ……..……..4

**4. +** Trichomes with distinct base……*H.subulatum* -

- Trichomes with indistinct base…… *H.crispum, H. dasycarpum*

**5. +** Trichomes short…… *6*

- Trichomes long……7

**6. +** Trichomes with distinct base……..*H.cabulicum*

- Trichomes with indistinct base……*H.calcreum*

**7. +** Trichomes with distinct base……*H.rariflorum,*
*H.burichus*
*H. strigossum,*
*H. ulophyllum*

- Trichomes with indistinct base…… *H. alii, H.biannulatum,*
- *H. europaeum,*
*H.mariflolium,*
*H.ovalifolium, ,*
*H. supium,*
*H. zeylanicum*

***Heliotropium alii*** Y.Nasir
Eglandular, unicellular , long hair, with pointed tips, base more or less swollen. Widely distributed.
***Heliotropium bacciferum*** Frossk. (Fig.1A).
Eglandular, uniseriate, shorthair, with pointed tips, slightly curved, rough surface, base more or less cushion like. Densely distributed on leaf base.
***Helotropium biannulatum*** (Fig.1B).
Eglandular, uniseriate, long hair, with pointed tips, , rough surface, base more or less cushion like. Densely distributed on leaf
***Heliotropium cabulicum*** Bunge (Fig.1 C & D).
Eglandular, unicellular, thin or cylindrical, straight, short hair, with pointed tips, with distinct cushion like base. Bent at the base.
***Heliotropium calcareum*** Stocks (Fig.1E).
Eglandular, unicellular, thin or cylindrical, straight, short hair, with pointed tips, with indistinct base. More at the calyx and at the mid rib.
***Heliotropium crispum*** Desf. (Fig.1F).
Eglandular, uniseriate, thin or cylindrical, straight, long hair, with pointed tips, with distinct cushion like base, few bent at the base.

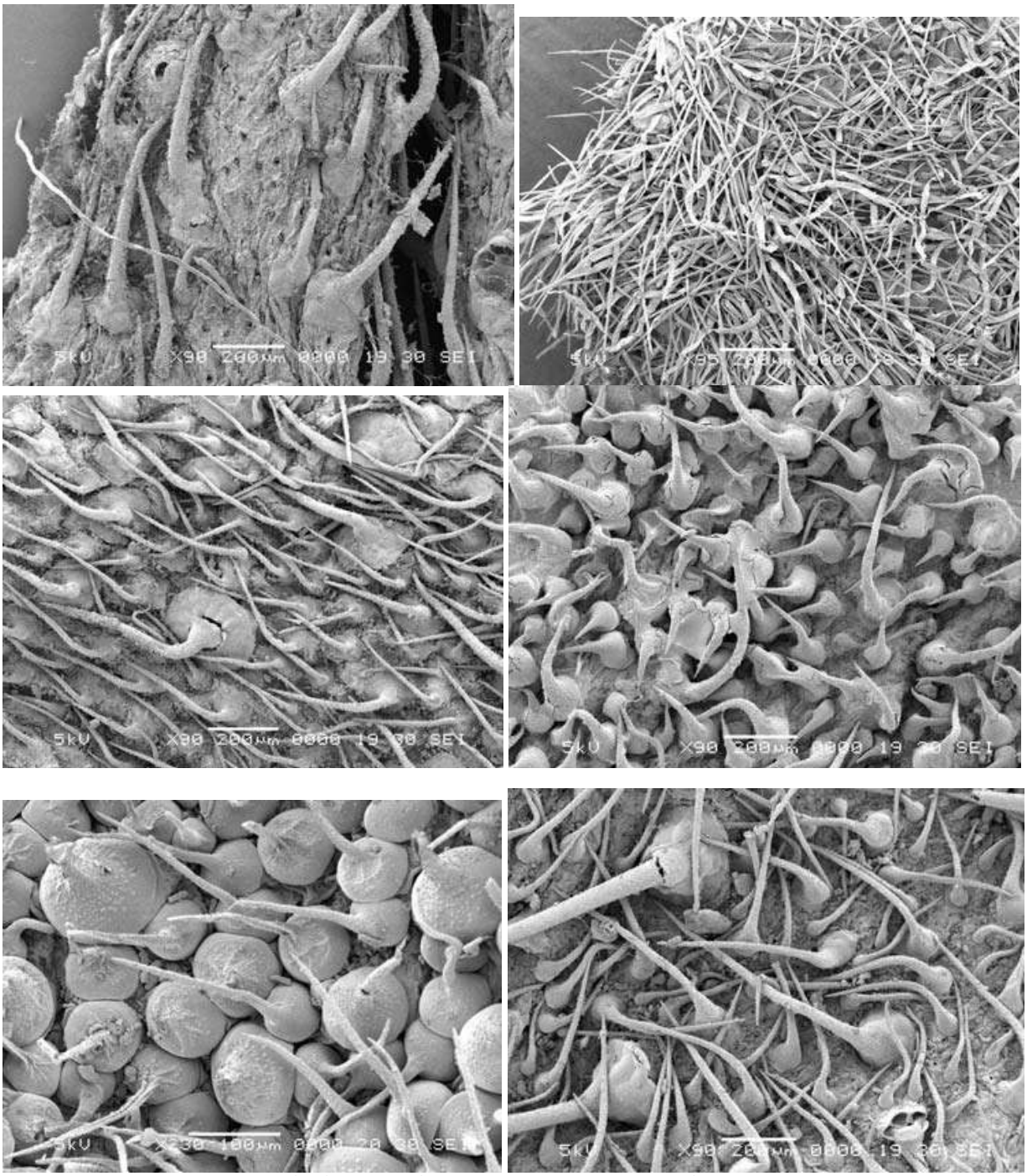

Fig.1. Scanning Electron Microscope. Of leaf trichomes of the genus *Heliotropium.* A, *H. bacciferum*; B, *H.biannulatum;C* & D, *H.cabulicum;* E, *H.calcreum;* F, *H.crispum.*
Scale bar=A-D & F=200 um; E=100um

***Heliotropium dasycarpum*** Ledeb. (Fig.2A).

Eglandular, uniseriate, long hair, with pointed tips, with indistinct base. Surface scabrate, slightly bent at the base.

***Heliotropium europaeum*** L. (Fig.2B).

Eglandular, unicellular, thin or cylindrical, straight, long hair, with pointed tips, with indistinct base. Densely distriubuted.

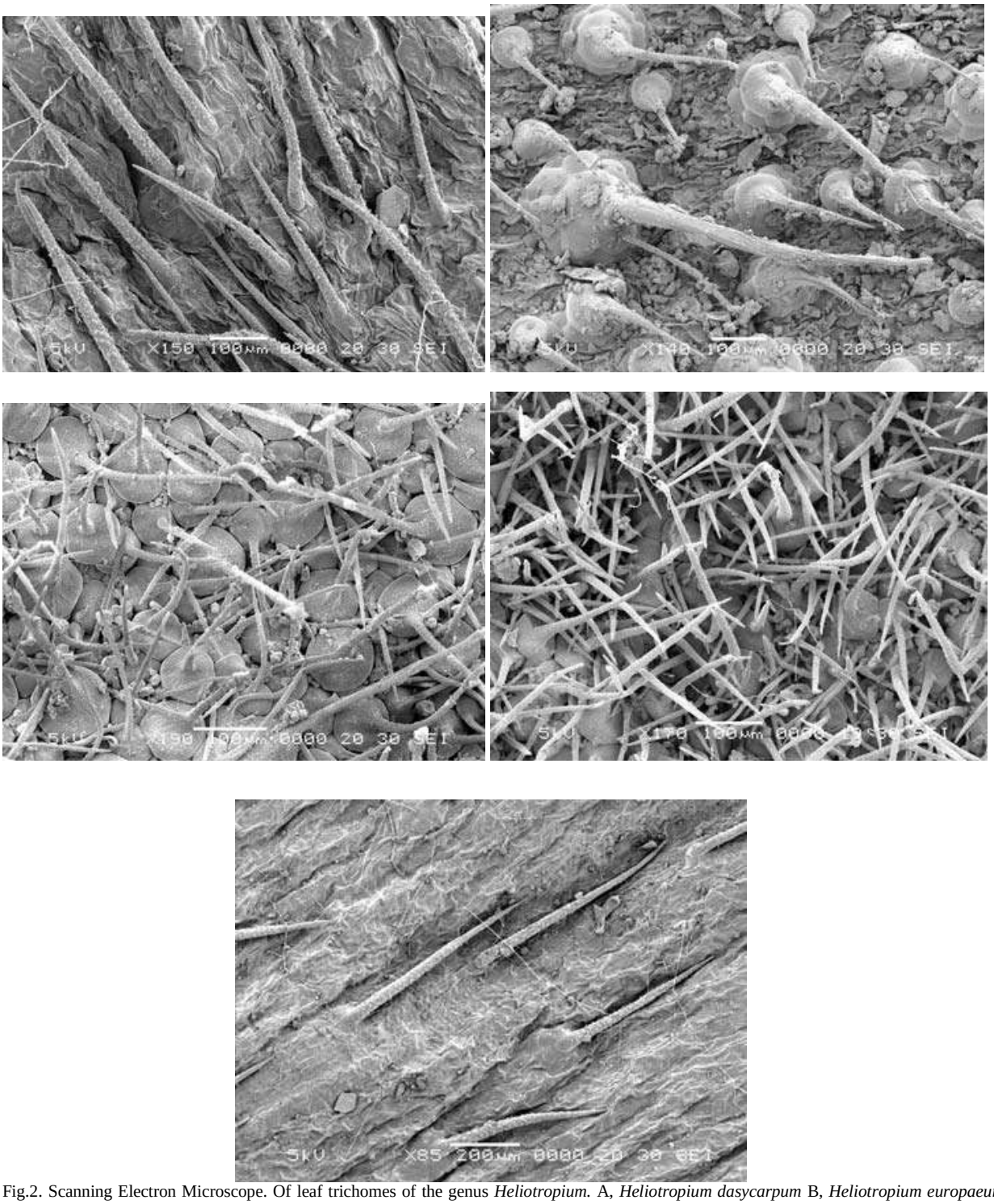

Fig.2. Scanning Electron Microscope. Of leaf trichomes of the genus *Heliotropium.* A, *Heliotropium dasycarpum* B, *Heliotropium europaeum;* **C,** *Heliotropium marifolium* **;** D, *Heliotropium ophioglossum* **;**E, *H. ovalifolium.*
Scale bar=A & B=200 um; D & E=100um; C= 50 um.

***Heliotropium marifolium*** Retz. (Fig.2C).

Eglandular, unicellular, thin or cylindrical, straight, long hair, with pointed tips, with indistinct base. Densely distributed.

***Heliotropium ophioglossum*** Boiss. (Fig.2D).

Eglandular, few glandular uniseriate, thin or cylindrical, straight, long hair, or short, with pointed tips, with indistinct base. Densely distributed.

***Heliotropium ovalifolium*** Forssk. (Fig.2E).

Eglandular, unicellular, thin or cylindrical, straight, long hair, with pointed tips, with distinct base. Surface scabrate. Densely distributed.

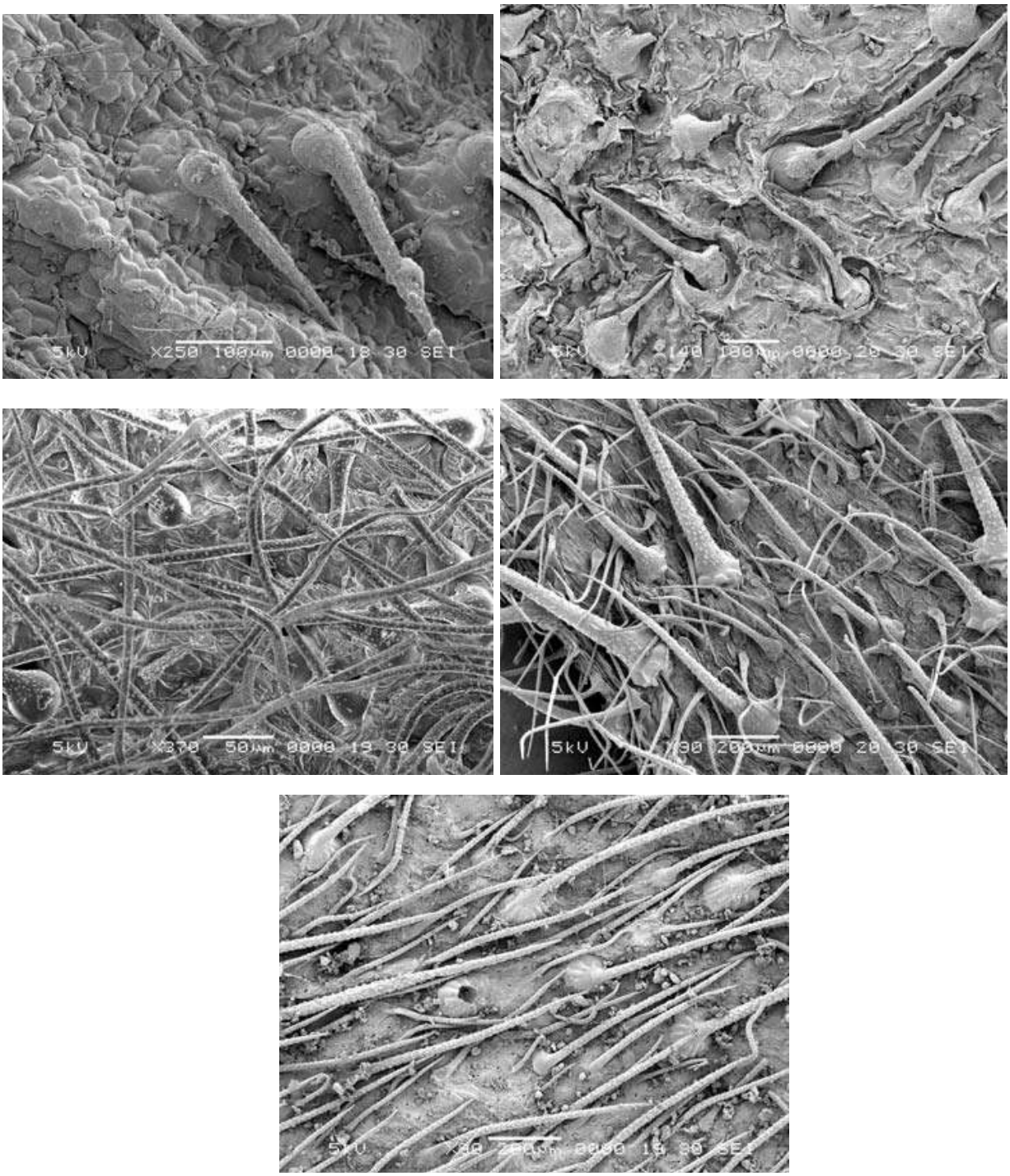

Fig.3. Scanning Electron Microscope. Of leaf trichomes of Genus *Heliotropium.* A, *H.stigossum*; B, *H. subulatum;* C, *H.supium* D, , *H.ulophyllum;* E, *H. .zeylanicum.*
Scale bar=A, B & D =100 um; C & E= 200um

***Heliotropium rariflorum*** Stocks

Eglandular, unicellular, thin or cylindrical, straight, long hair, with pointed tips, with distinct base. Surface scabrate. Densely distributed.

***Heliotropium strigossum*** Willd. (Fig.3 A).

Eglandular, unicellular, thin or cylindrical, straight, long hair, with pointed tips, with distinct base. Surface scabrate. Densely distributed.

***Heliotropium subulatum*** (DC.) Vatke (Fig.3B).

Eglandular, uniseriate, variable in length, short and long, thin, cylindrical, straight, long hair, with pointed tips, with distinct base.

***Heliotropium supinum*** L. (Fig.3C).

Eglandular, unicellular, thin or cylindrical, straight, long hair, with pointed tips, with indistinct base. Surface scabrate. Densely distributed.

***Heliotropium ulophyllum*** Rech. F. Reiedl. (Fig.3D).

Eglandular, unicellular, broad at the base, straight, long hair, with pointed tips, with distinct cushion like base base. Surface scabrate. Densely distributed**.**

***Heliotropium zeylanicum*** (Burm.f.) Lam. (Fig.3E).

Eglandular, unicellular, straight, long hair, with pointed tips, with indistinct base base. Surface scabrate. Densely distributed.

## DISCUSSION

Within the subfamily Heliotropoideae generally eglandular, unicellular (1-celled) trichomes are found. However, in the *H. ophioglossum* glandular trichomes are also observed along with eglandular. Dottori and Cosa (1997) reported glandular, eglandular, unicellular or multicellular trichomes in the family Boraginaceae. In the few species uniseriate (2-3 celled) trichomes are found. In the *H. subulatum* trichomes are quite variable in length. However , in the remaining species unicellular trichomes are present. The trichomes morphology is significantly useful at the specific level (see key to the species).

With the subfamily Heliotropoiedeae 17 species representing single genus i.,e *Heliotropium* have been examined by light and scanning microscope. On the basis of unicellular (1-celled) and uniseriate (2-3 celled) types the trichomes are divided in to two groups. **,** In group –1 : uniseriate trichomes are found in this group 4 species are included. Viz., *Heliotropium crispum* Desf., *Heliotropium dasycarpum* Ledeb., *Heliotropium ophioglossum* Boiss and *Heliotropium subulatum* (DC.) Vatke.

Where as majority of the species have unicellular trichomes like, *Heliotropium alii* Y.Nasir , *Heliotropium bacciferum* Frossk. *Heliotropium cabulicum* Bunge**.,** *Heliotropium europaeum* L., *Heliotropium marifolium* Retz., *Heliotropium ovalifolium* Forssk**.,** *Heliotropium rariflorum* Stocks., *Heliotropium strigossum* Willd., *Heliotropium supinum* L., *Heliotropium ulophyllum* Rech. F. Reiedl. and *Heliotropium zeylanicum* (Burm.f.) Lam.

These species are further divided on the basis of trichomes apex and base. However, in the most of the genera trichomes base is swollen few have cushion like distinct base (key to the species).

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