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Research Article

CHARACTERIZATION OF CYPSELAR AND ANATOMICAL PARAMETER OF SOME COMMONLY OCCURRING PLANTS OF COMPOSITAE IN KALYANI, NADIA, WEST BENGAL

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ABSTRACT

The present paper deals with the morphological features of cypselas, trichome structure, nodal and petiolar vascularization and foliar venation of some (*Blumea lacear* (Burm.f.) DC., *Eclipta prostrata* (L.) L., *Enhydra fluctuans* Lour., *Gnaphalium polycaulon* Pers., *Synedrella nodiflora* (L.) Gaerten., *Tridax procumbens* L., *Xanthium indicum* Koenig) commonly occurring plants of Compositae in Kalyani, Nadia. Among the studied cypselas, homomorphic cypselas are present in *Blumea lacera, Enhydra fluctuans, Gnaphalium polycaulon, Tridax procumbens* and *Xanthium indicum,* whereas remaining 2 studied cypselas are strongly heteromorphic. Among the plants studied, the cypselar structure shows little morphological variations. The cypsela of *Xanthium indicum* is compactely enclosed by hooked spiny utricle. Simple filliform trichomes are common in all the species except *Gnaphalium polycaulon*, where the septate flagellate types of trichomes are present. Nodal anatomy shows no variations but the number of petiolar vascular bundles vary from 5-7 though all have 3 bundles in basal regions. In *Xanthium indicum,* complex types of vascular traces are present throughout the petiole. Foliar venation shows simple or branched type of vein-endings. In the vein-endings of *Blumea lacera,* ideoblastic cells and in *Xanthium indicum* barrel-shaped cells are present.

Keywords*: Cypselar Morphology, Some Anatomical Aspects, Compositae*

INTRODUCTION

The family Asteraceae is one of the largest and highly evolved, most successful family among the dicotyledons, consisting of 43 tribes, 1600- 1700 genera and 24000 species (Funk *et al.*, 2009), which are distributed all over the world and in all parts from the tropical to artic zones. The family contains about one tenth of the total number of flowering plants. The greater proportions are herbaceous, although about 2 percent are trees or shrubs. Cassini's (1877-1830) classification of the family adopted by Bentham and Hooker (1862-1883) is generally followed (With various modifications) and accordingly it is composed of 2 primary subdivisions, which are Tubiflorae and Liguliflorae. The tribes of Tubiflorae are Vernonieae, Eupatorieae, Astereae, Inuleae, Heliantheae, Helenieae, Anthemideae, Senecioneae, Calenduleae, Arctotideae, Cardueae and Mutisieae. The subdivision Liguliflorae has a single tribe-Lactuceae. In the present paper, some of the commonly occurring members of the Inuleae and Heliantheae growing in Kalyani, Nadia, W.B., are studied. Special attention have been done to the study of cypselar morphology, structure of trichome, nodal and petiolar anatomy and venation pattern to find out some helpful parameters in the taxonomy of the studied genera.

MATERIAL AND METHODS

The following plants were studied:

1 *Blumea lacera* (Burm.f.) DC.
2 *Eclipta prostrata* (L.) L.
3 *Enhydra fluctuans* Lour.

4 *Gnaphalium polycaulon* Pers.
5 *Synedrella nodiflora* (L.) Gaerten.
6 *Tridax procumbens* L.
7 *Xanthium indicum* Koenig

Among the studied specimens, listed above, only two species e.g. *Blumea lacera* and *Gnaphalium polycaulon* are under the tribe Inuleae and the rest are under the tribe Heliantheae of Cronquist (1955). All these plants are under the tribe Inuloideae by Clarke (1876). The collected plants were identified with the help of local floras (Prain, 1903; Hooker 1881). Only the mature cypsela was selected from the fruiting heads. The morphological features were described in details as these descriptions were limited in the works of Clarke (1876), Hooker (1881) and Prain (1903). Trichomes were studied from the stem as well as leaf surfaces. The terminology used for the trichomes is followed after Ramayya (1962).Simple hand sections were made for the study of nodal and petiolar vascular pattern. Serial sections were staned in aqueous solution of the safranin (1 %). Sections were then mounted with 70% glycerine (Phenol added as preservative).The leaf fragments were taken from the part 1/3 from the apex and 2/3 from the base of the leaves. These leaf fragments were cleared with 2.5% NaOH solution and then in saturated solution of chloral hydrate (Foster, 1953; Arnot, 1959). The fragments were stained with 1% aqueous safranin and mounted in phenol.

RESULTS AND DISCUSSION

Cypselar Morphology

1 *Blumea lacera* (Burm.f.) DC. (Figure 1a-1c)
2 Cypsela homomorphic, small, subterete, 1 mm long, hairy, pappus 3.5 mm long, represented by 10-14, plumose type of pappus bristles, 1-seriate, slender. Carpopodium concave and obliquely attached with cypselar base.
3 *Eclipta prostrata* (L.) L. (Figure 2a-2b)
4 Cypsela heteromorphic, epappose, 3-angled, more or less compressed, slightly winged, blackish brown. Cypsela of ray florets 2 mm long, dorsally compressed and winged. Cypsela of disk florates 5 mm long, narrow compressed or triquetrous, often muricate, narrow at base, broader at the top. Presence of a few black patches on the body.
5 *Enhydra fluctuans* Lour. (Figure 3a-3b)
6 Cypsela homomorphic, black, oblong-ovate, epappose, enclosed in the rigid palea. Carpopodium present, coronate with an apical rim.
7 *Gnaphalium polycaulon* Pers. (Figure 4a-4c)
8 Cypsela homomorphic, black, oblong to ovoid, minutely warty, 1 mm long. Styler base persistent. Pappus 3-5 mm long, connate at the base, uniseriate.
9 *Synedrella nodiflora* (L.) Gaerten (Figure 5a-5d)
10 Cypsela heteromorphic, those of ray florates dorsally compressed, black, 4 mm long, 2 winged, hairy, and wing lacerate. Cypsela of disk florate few, narrow compressed or triquetrous, often muricate, narrow at the base, broader at the top, black. At the basal region of cypsela, carpopodium present. In both the cypselas, pappus represented by 3 spine like structures.
11 *Tridax procumbens* L. (Figure 6a-6c)
12 Cypsela homomorphic, turbinate or oblong, dark brown, silky hairy, 2 mm long. Pappus represented by short or long aristate feathery bristles. At the basal region of cypsela, carpopodium absent.
13 *Xanthium indicum* Koenig (Figure 7a-7b)
14 Utricle ovoid to oblong, thick, beak erect or diverging. Cypsela homomorphic, enclosed in the hardened involucres wall, 1.5 cm x 0.8 cm, covered with 3-4 mm long hooked incurved prickle. Pappus absent.

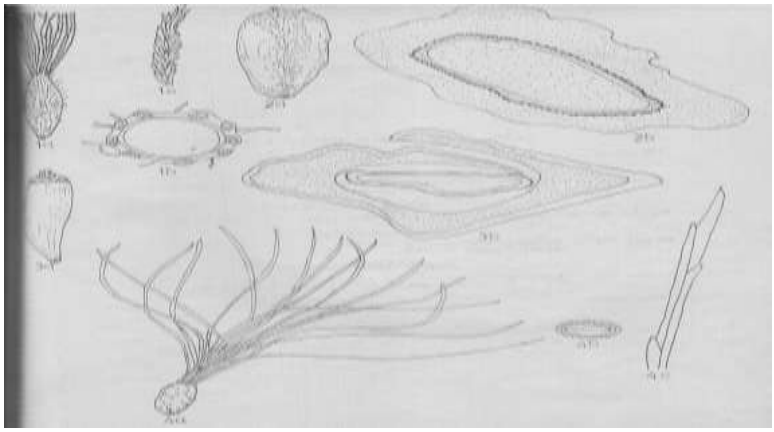

Figure 1a-4a: Cypselar morpho-anatomy of the studied specimens

1a- *Blumea lacera* (Morphology)x100, 1b-T.S. of *Blumea lacera* x 200, 1c-Terminal part of pappus of *Blumea lacera* x300; 2a-*Eclipta prostrate* (Morphology) x 100, 2b-T.S. of *Eclipta prostrate* x 200; 3a-*Enhydra fluctuans* (Morphology) x 100, 3b- T.S. of *Enhydra fluctuans* x 200; 4a- *Gnaphalium polycaulon* (Morphology) x 100, 4b- T.S. of *Gnaphalium polycaulon* x 100, 4c- Terminal part of pappus of *Gnaphalium polycaulon* x 300.

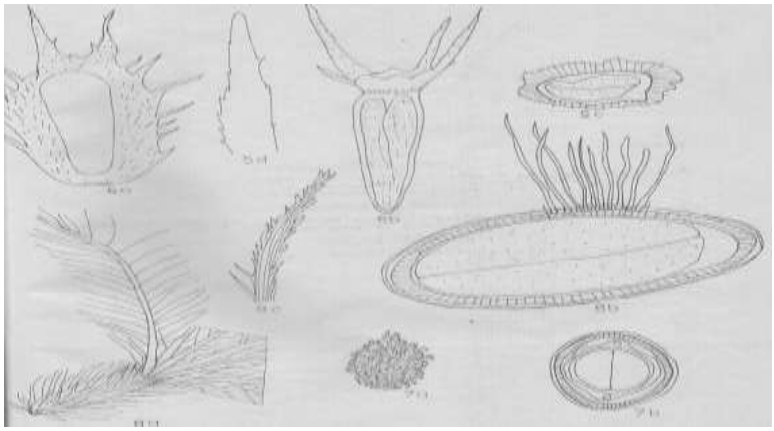

Figure 5a-7a: Cypselar morpho-anatomy of the studied specimens

5a-*Synedrella nodiflora* (Morphology of ray cypsela) x 100, 5b- *Synedrella nodiflora* (Morphology of disk cypsela) x 100, 5c- T.S. of *Synedrella nodiflora* x 100, 5d- Terminal part of pappus of *Synedrella nodiflora* x 150. 6a- *Tridax procumbens* (Morphology of cypsela) x 100, 6b-T.S. of *Tridax procumbens* x 150, 6c- Terminal part of pappus of *Tridax procumbens* x 150.; 7a-*Xanthium indicum* (Morphology) x 2.5, 7b-T.S. of *Xanthium indicum* x 6.

Key to the Studied Cypselas, On The Basis Of Morphological Features

1a. Cypselas without any pappus…….. (2)
2a. Cypsela homomorphic; enclosed by palea or utricle…… (3)
3a. Cypsela solitary, oblong-ovate; enclosed in the rigid smooth palea, coronet, persistant with an apical rim……*Enhydra fluctuans*
3b.Cypselas 2, obovate; enclosed in beaked, utricle covered with hooked spines, non coronet.....*Xanthium indicum*
2b. Cypsela heteromorphic; not enclosed in palea or utricle……*Eclipta prostrate*
1b. Cypsela with pappus…….. (4)
4a. Cypsela homomorphic; without wing…… (5)
5a. Carpopodium present……. (6)

6a. Cypsela warty; stylar base persistent; pappus connate at the base…….*Gnaphalium polycaulon*
6b. Cypsela not warty; styler base deciduous; pappus free…….*Blumea lacera*
5b. Carpopodium absent; cypsela silky; pappus plumose type……*Tridax procumbens*
4b. Cypsela heteromorphic, winged; pappus represented by awns……*Synedrella nodiflora*

Trichome Structure

Blumea lacera **[**Figure 8 (1a-1b)]

There are two types of trichomes, such as- Capitate filiform type and simple filiform type. The former type is present in case of the stem. Foot very simple, uniseriate and filiform type, differentiated into 1 celled stalk and unicellular head. The head is broader than the stalk, swollen to an oblong-ovoid or ovate form, lateral wall is very thin and smooth.

Simple filiform type of trichome is present in case of both the stem and leaf. The foot of the trichome is very simple, body uniseriate, entire, 4-5 celled, filiform, tapering to a pointed tip, slightly constricted at the cross walls; cells of varied length but basal 1 or 2 usually broader;contents translucent or dense, cross walls thin, lateral walls straight, thick or thin and smooth.

Eclipta prostrata [Figure 8(2a-2b)]

The trichome is simple, filiform type, differentiated into two subtypes. In type-1, foot is very simple, found both the stem and leaf. Body uni-seriate, one celled, tapering to a pointed tip, lateral wall straight, thin and smooth. In type-2, foot is compound, found only in the stem. Body uniseriate, entire, 5-6 celled, filiform, tapering above, constricted at the cross walls, pointed at the apex, cells of varied length, cross w alls thick, lateral wall straight, thick and smooth.

Enhydra fluctuans

Trichomes absent.

Gnaphalium polycaulon [Figure 8 (3)]

Septate flagellate type of trichome, found in both stem and leaf, foot compound, body uniseriate, entire, many celled, flagellate, tapering above, pointed at the apex, constricted at cross walls, cross walls thin, lateral walls thick, smooth.

Synedrella nodiflora [Figure 8 (4)]

Simple, filiform type of trichome, found both in stem and leaf. Foot simple, body uniseriate, entire, 3 celled, filiform, tapering above, constricted at the cross walls, cells of varied lengths, cross wall thick; lateral wall straight, thick and smooth, contents translucent.

Tridax procumbens

[Figure 8(5a,5b,5c,5d)]

In case of simple filiform hair, foot may be simple, found in the stem only. Body uniseriate, 1 celled, tapering to a pointed tip; lateral walls straight, thin and smooth. In case of trichome with compound foot, found in both the stem and leaf. Body uniseriate, entire, 3-5 celled filliform, tapering above, constricted at the cross walls, cells of varied length, cross wall thick, lateral wall straight, thick and smooth.

Capitate type of trichome is present in the stem only.Foot compound, body uniseriate, filiform, differentiated into stalk and head; stalk 2 celled, cross walls thin, head unicellular, swollen to an oblong ovoid; contents translucent, lateral walls thin and smooth.

Xanthium indicum [Figure 8 (6a,6b,6c,6d)]

Hair simple filiform type, varies from 1-2 or 3-5 celled. 1-2 celled hairs are present only in the leaf. Foot compound, body uniseriate, entire, when 1 celled pointed at the apex, when 2 celled blunt at the apex, apical cell truncate, slightly constricted at the cross wall, cross wall thick, lateral wall straight, thick, smooth, contents translucent.

3-5 celled trichome also present in both the stem and leaf. Foot compound, body uniseriate, entire, tapering above, constricted at the cross walls, cells of varied length, basal cell broader than the distal cells, contents translucent, cross wall thick, lateral wall straight, thick and smooth.

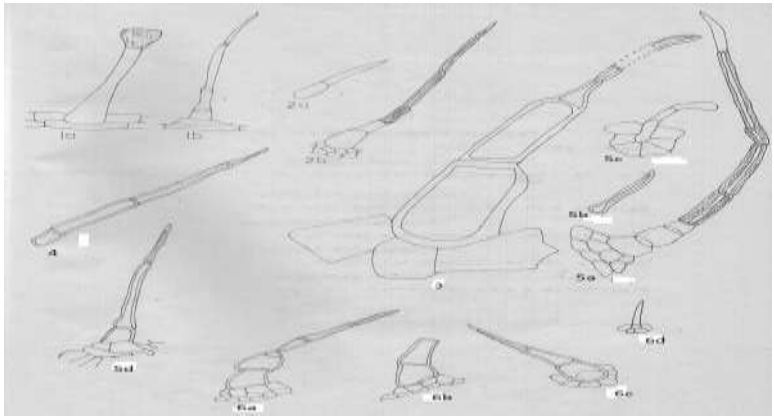

Figure 8- Trichome structure of studied species

1a-1b- *Blumea lacera*: 1a-Capitate filiform hair 1 150, 1b- Simple filiform hair x 150; 2a-2b- Simple filiform hair of *Eclipta prostrate* x 150; 3- Septate flagellate hair (x 600) of *Gnaphalium polycaulon*; 4- Simple filiform hair (x150) of *Synedrella nodiflora*; 5a, 5b, 5d- Simple filiform hair (x150) and 5c- Capitat filiform hair (x150) of *Tridax procumbens*; 6a, 6b, 6c, 6d- Simple filliform hair (x 150) of *Xanthium indicum*

Nodal Anatomy and Petiolar Vascularization [Figure 9(1-7)], [Figure 10 (1a-7a)]

Nodal anatomical study is greatly emphasized by several workers like Sinnott (1914), Decker (1963), Baas (1975) and Ghosh and Banerjee (1981). They have shown that nodal anatomies as well as petiolar vasculature are valuable anatomical characters to show the affinities among the groups. Metcalfe and Chalk (1950) have presented the nodal and petiolar anatomy of the family Compositae.

Nodal anatomical study of these seven species under study shows trilacunar node. Further, these traces are running upward to the petiolar part. In the proximal part all these specimens these three traces immediately increases in number due to division of lateral traces and finally giving rise to smaller laterals along the margin of petioles. This situation is probably due to the sessile and subsessile nature of leaves.

In the middle part of the petiole usually no changes occur in the vasculature. In the distal end of the petioles vascular traces are 5 in number and they are similar in *Blumea lacera, Gnaphalium polycaulon* and *Tridax procumbens*, while these vascular bundles increases in number upto 7 in *Eclipta prostrata* and *Enhydra fluctuans*. In the plant of *Synedrella nodiflora*, several smaller vascular strands appear in the middle part of the petiole and these are usually continued up to the distal part of petiole. In *Xanthium indicum*, complex type of vascular traces are observed throughout the petiolar length. In the basal end small lateral traces are cut off. In the middle part again several smaller lateral traces are formed and finally in the distal end of the petiole medullary bundles are formed instead of other vascular strands.

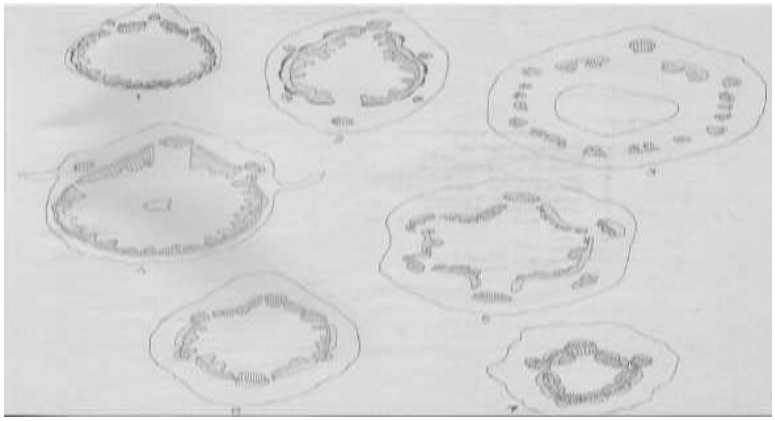

Figure 9-Nodal structure of the studied species

1- *Blumea lacera*, 2- *Eclipta prostrate*, 3-*Enhydra fluctuans*, 4- *Gnaphalium polycaulon*, 5- *Synedrella nodiflora*, 6- *Tridax procumbens*, 7- *Xanthium indicum*

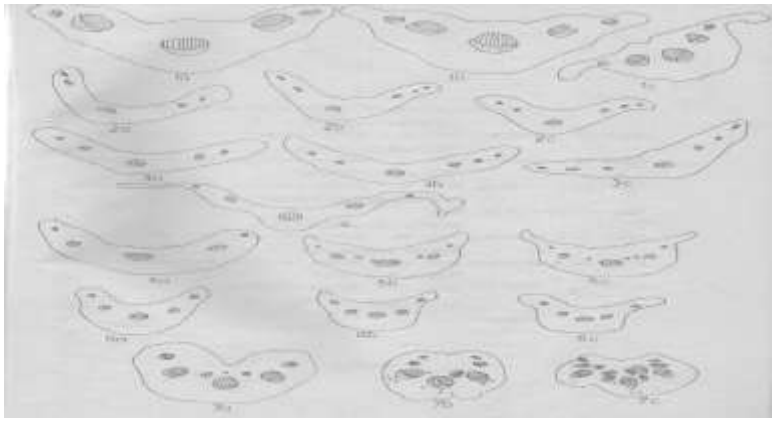

Figure 10- Petiolar vasculature of the studied specimens (All magnified x 100)
1a-1c- *Blumea lacera*: 1a-Proximal part, 1b-Middle part, 1c-Distal part
2a-2c- *Eclipta prostrata*: 2a-Proximal part, 2b-Middle part, 2c- Distal part
3a-3c- *Enhydra fluctuans*: 3a- Proximal part, 3b- Middle part, 3c-Distal part
4- Middle part of *Gnaphalium polycaulon*
5a-5c- *Synedrella nodiflora*: 5a-Proximal part, 5b-Middle part, 5c-Distal part
6a-6c-*Tridax procumbens*: 6a-Proximal part, 6b-Middle part, 6c-Distal part
7a-7c- *Xanthium indicum*: 7a-Proximal part, 7b-Middle part, 7c-Distal part.

Foliar venation [Figure 11,12, 13, 14]
Folier venation pattern is an additional character in taxonomy. General architecture of the leaves, vein-islet areas, vein-islet number and veinlet termination number are greately emphasized by different anatomist like Levin (1929), Hall (1954), Gupta (1961), Hiskey (1973), Banerjee and Ghosh (1984).In the family Compositae venation pattern have been studied only in a few species by Banerjee and Despande (1973) and Ravindranath and Inamder (1985). The foliar venation of the seven species studied show that vein architectural patterns are more or less same. The vein reticulation is upto 5^{th} and 6^{th} order. The reticulation is sparce in all the species except in *Xanthium indicum.*
The sheath cells of the vascular bundles are both parenchymatous in secondary order and then sclerenchymatous upto the last order except the free vein endings in *Blumea lacera.* In this species idioblast cells are present at the tips of free veinlets.Free vein-endings are either simple or branched. In *Eclipta prostrata,* sheath cells are compactely absent. Free vein-endings are branched or simple and naked with 1-2 spirally thickened tracheids. In *Enhydra fluctuans,* parenchymatous sheath cells are compactely absent. Sclerenchymatous sheath cells are present upto the 3 rd order of the reticulation. A few pitted tracheids are present at the junction of 2^{nd} and 3^{rd} order of the vein reticulation. In *Gnaphalium polycaulon,* free vein endings are naked, either simple or branched and the reticulation is more sparce and the reticulation is usually upto the 4^{th} order and very rarely upto the 5^{th} order.Vascular sheath cells are absent. Free vein endings are long, slender, either branched or unbranched, maked consisting of 2-3 spirally thickened tracheids. In *Synedrella nodiflora,* the vein reticulation is upto the 6^{th} order. Sheath cells are both parenchymatous and sclerenchymatous but extends only upto the 3^{rd} order. Free vein-endings are slender, naked, simple and consisting of 2-3 spirally thickened tracheids. Sometimes 4-6 smaller tracheids are present at the very tips of free veinlets. In Tridax procumbens, the reticulation is upto the 6^{th} order. Parenchymatous sheath cells are present upto the 2^{nd} order and sclerenchynmatous upto the 3^{rd} order. Other part of the reticulation is devoid of any sheath cells.Free vein endings are slender, naked, mostly unbranched and consisting of 3-5 spirally thickened tracheids. In Xanthium indicum, vein reticulation is dense and it is upto the 6^{th} order. Throughout the reticulations including the free vein endings parenchymatous sheath cells are present and it is of 1- layer in thickness, consisting of barrel shaped cells. Usually free vein endings are very few but when present these are shorter in size and consisting of 2-4 spirally thickened tracheids. In all the studied species, crystals are present throughout the laminar surface.

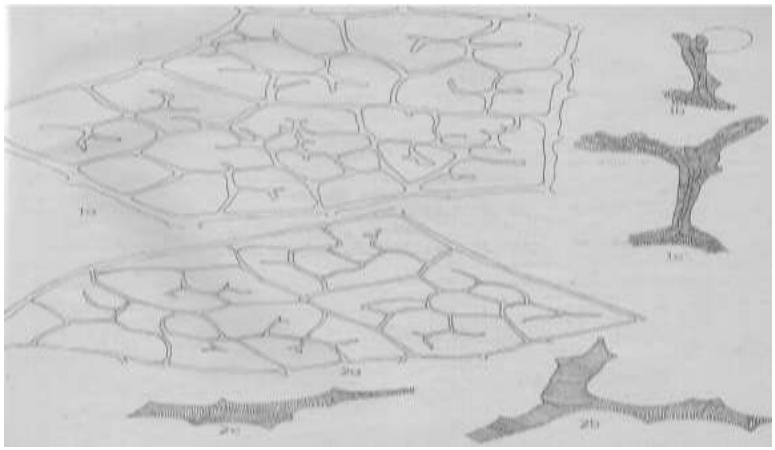

Figure 11: Foliar vasculature of the specimens

1a-1c: *Blumea lacera*: 1a- Vein re ticulation x 150, 1b- Vein ending branched x 300, 1c-Vein ending simple with idioblast x 300

2a-2c: *Eclipta prostrate*: 2a-Vein reticulation x 150, 2b- Vein ending branched x 400, 2c- Vein ending simple x 400

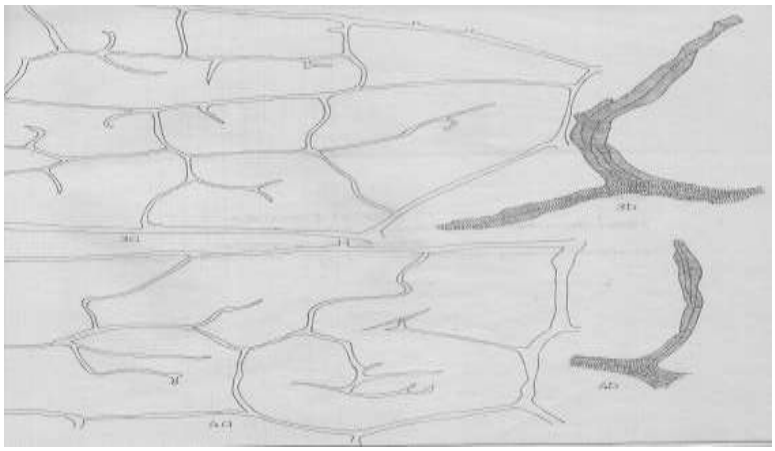

Figure 12: Foliar vasculature of the specimens

3a- Vein reticulation x150 of *Enhydra fluctuans*, 3b- Vein ending x 300 of *Enhydra fluctuans*; 4a- Vein reticulation x 150 of *Gnaphalium polycaulon*, 4b- Vein ending x 300 of *Gnaphalium polycaulon*

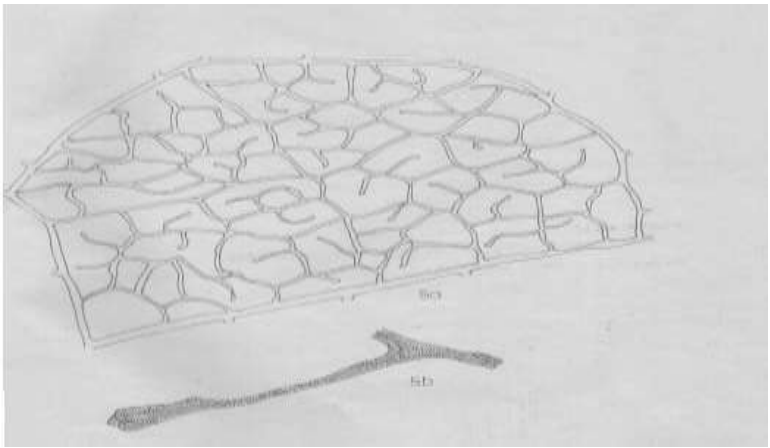

Figure 13: Foliar vasculature of *Synedrella nodiflora*

5a- Vein reticulation x 150; 5b-Vein ending x 300

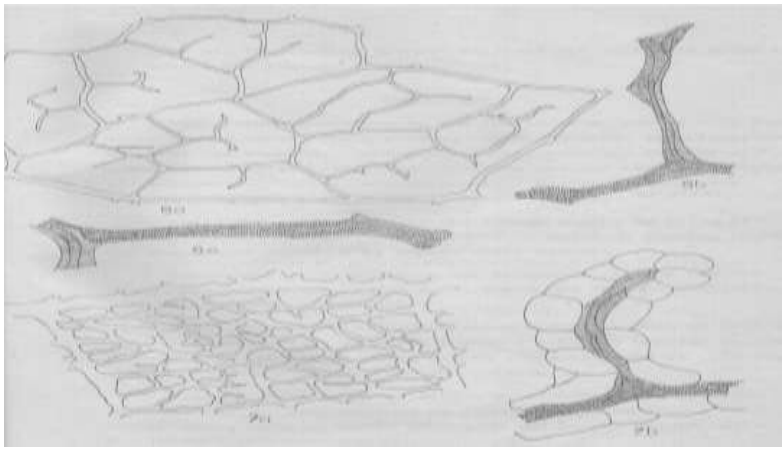

Figure 14: Foliar vasculature of the specimens

6a-6c: *Tridax procumbens*: 6a- Vein reticulation x 150, 6b- vein ending branched x 300, 6c- Vein ending simple x 300.
7a-7b: *Xanthium indicum*: 7a- Vein reticulation x 150, 7b- Vein ending x 300.

DISCUSSION

The present paper is the result of 6th month work and 7 plants of the tribe Inuleae and Heliantheae (Available in Kalyani) are studied. Cypselar morphology, trichome structure, nodal and petiolar anatomy and venation pattern are illustrated and studied in detail. The taxonomical description of the species have been omitted due to want of space.

Among the plants studied, the cypselar structure shows little morphological variations. The cypsela of *Xanthium indicum* is compactely enclosed by hooked spiny utricle.

Simple filliform trichomes are common in all the species except *Gnaphalium polycaulon*, where the septate flagellate type of trichomes are present.

Nodal anatomy shows no variations but the number of petiolar vascular bundles vary from 5-7 though all have 3 bundles in basal regions. In *Xanthium indicum*, a complex type of vascular traces are present throughout the petiole.

Foliar venation shows simple or branched type of vein-endings. In the vein-endings of *Blumea lacera* possess idioblast cells and in *Xanthium indicum* barrel-shaped cells are present.

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