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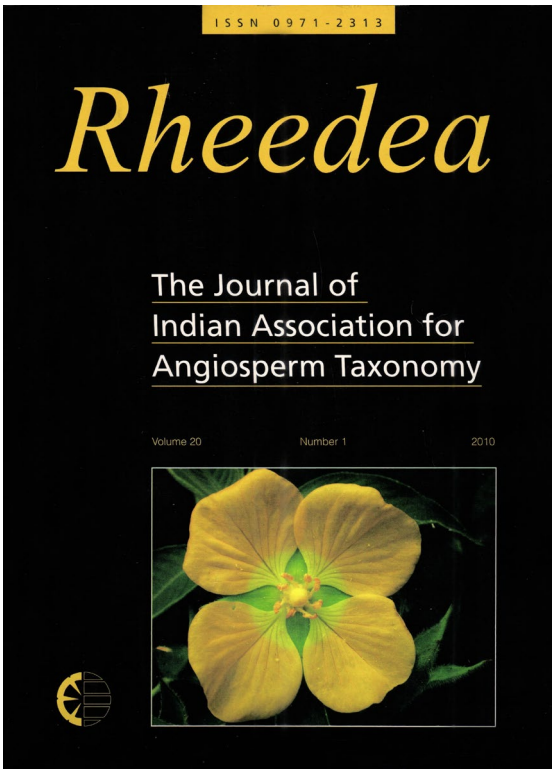

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Cypsela morphology and anatomy in some genera formerly placed in *Inula* (Asteraceae: Inuleae – Inulinae)

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Abstract

The morphology and anatomy of cypsela of 15 species belonging to four genera namely, *Dittrichia, Duhaldea, Inula* and *Iphiona* of the Inuleae – Inulinae are examined. All were formerly placed in the genus *Inula.* Mature cypsela of *Inula, Duhaldea* and *Iphiona* shows prominent ribs whereas in *Dittrichia* ribs are absent. *Inula britannica*, *I. orientalis* and *I. rhizocephala* have distinct cypsela morphology and carpopodium structure. Whereas, remaining six species are placed in three different groups. Cypselae of *Inula* (*s. str.*) and *Duhaldea* are nearly similar in morphology and anatomy. However, they vary in size, surface and number of ribs as well as in shape and size of carpopodium. *Dittrichia* differs from other three genera in having cypsela without ribs, glandular-pubescent surface, size of carpopodium and diameter of foramen. *Iphiona* is distinct in having ellipsoid, pubescent cypsela with apically glandular surface.

Keywords: Anatomy, Asteraceae, Cypsela, Inuleae, Inulinae, Morphology

Introduction

The Asteraceae (Compositae nom. alt.) constitute the largest vascular plant family with *c*. 2,250 genera and *c*. 25,000 species distributed in all continents except Antarctica (Funk *et al*., 2009). The family is represented in India by 167 genera and *c*. 900 species (Hajra *et al*., 1995). The genus *Inula* alone is represented by *c*. 20 species, distributed mainly in Northern Himalayan and Northeastern regions (Kumar & Pant, 1995). In recent years *Inula* has been shown to be polyphyletic and many of its species have been transferred to other genera such as *Duhaldea*, *Iphiona* and *Dittrichia* (Anderberg, 1991, 1994).

The morphology and anatomy of cypsela are often useful in identification of various taxa both at the generic and specific levels within the tribe Inuleae (Pandey *et al*., 1983; Abid & Qaiser, 2002; Abid & Zehra, 2007; Pandey & Kumari, 2007). Pandey *et al*. (2000) investigated the embryology of 18 species belonging to tribe Inuleae (*s.l.*) and discussed variations in embryological features. Abid & Qaiser (2002) studied cypsela morphology of *Dittrichia, Duhaldea, Inula, Iphiona* and *Pentanema* species from Pakistan and Kashmir and concluded that two distinct groups of taxa can be recognized, one comprising *Dittrichia* and *Pentanema* and the other comprising *Duhaldea, Inula* and *Iphiona*.

The phylogeny of the Inuleae – Inulinae was investigated by Anderberg *et al*. (2005) and more recently by Englund *et al*. (2009) who concluded that *Duhaldea* is in a basal clade of the subtribe, together with *Blumea* and *Caesulia*, whereas *Inula* (*s. str*.) is related to *Pentanema, Rhanteriopsis, Varthemia, Telekia, Chrysophthalmum* and *Carpesium*. *Iphiona* is more closely related to *Perralderia* and *Vieria* in another clade. *Dittrichia* found to be much closer to *Chiliadenus* and *Jasonia* within the *Pulicaria* complex, than to *Inula s. str*.

The objectives of the present study are (i) to examine cypsela morphology and anatomy in species formerly placed in *Inula* and (ii) to investigate the taxonomic implications using cypsela characters.

Materials and Methods

Cypsela characters of 15 species belonging to the Inuleae subtribe Inulinae, from four genera, viz., *Dittrichia*, *Duhaldea*, *Inula* and *Iphiona* were studied using fresh and herbarium specimens (Appendix – I).

Cypsela morphology

Shape, size, colour, surface and number of ribs were observed. Series, number, length and colour of the longest pappus were also observed. All these observations were made under light microscope. Shape and position of carpopodium were studied using SEM. Diameter of carpopodium and its foramina were measured using ocular micrometer.

Cypsela anatomy

Anatomical studies on cypsela of the following species were made: *Duhaldea cappa*, *D. rubricaulis*, *Inula obtusifolia*, *I. rhizocephala*, *I. royleana* and *Iphiona grantioides*. Mature fruits were soaked in 10% glycerine. They were dehydrated through tertiary butyl alcohol series and embedded in paraffin wax (melting point 58°C). Microtome sections were taken between 8 and 12μm thickness and stained in safranin-fast green combination and were mounted in DPX.

SEM studies

SEM studies on the following species were done: *Dittrichia graveolens*, *Duhaldea cappa*, *D. cuspidata*, *D. eupatorioides*, *D. rubricaulis*, *Inula acuminata*, *I. britannica*, *I. clarkei*, *I. falconeri*, *I. obtusifolia*, *I. orientalis*, *I. racemosa*, *I. rhizocephala*, *I. royleana* and *Iphiona grantioides*. Mature cypselae were mounted on aluminium stubs using double adhesive tape and coated with gold in sputter coater. The specimens were observed under SEM (LEO 435VP) at All India Institute of Medical Sciences (AIIMS), New Delhi.

Observations

Dittrichia

Cypselae are oblanceolate-ellipsoid, shortly attenuate and glandular towards apex, pubescent. Average size of cypsela is *c*. 2.5 × 0.5 – 1 mm. They are yellowish brown (Table 1). Pappus 22 – 24, uniseriate, bristly, 4 – 5 mm long, basally connate to form a minute cupule, reddish brown (Table 2). Carpopodium is basal, narrow and circular. Carpopodium and foramen are 79μm and 38μm in diameter respectively (Table 3). A large calcium oxalate crystal is present in each epidermal cell.

Duhaldea

Cypselae are narrowly obovate-oblongoid to oblanceolate-ellipsoid. The size ranges from 1 – 1.5 × 0.25 – 0.5 mm (*D. rubricaulis*) to 1.5 – 2 × 0.25 – 0.5 mm (*D. cappa*, *D. cuspidata*, *D. eupatorioides*). Cypselae are brown. However, variation from reddish brown to golden yellow is observed (Table 1). The number of ribs is generally 8 – 10 except in *D. rubricaulis* where it is 10 – 12. Cypselae may be densely sericeous (*D. cappa*), or sparsely white-pubescent (*D. cuspidata*, *D. eupatorioides*, *D. rubricaulis*) (Table 1; Fig. 1a – c). Pappus 22 – 30, uniseriate, bristly and 4 – 5 mm long in *D. cuspidata* and *D. eupatorioides*; 5 – 6 mm in *D. cappa* and 5 – 7 mm in *D. rubricaulis*. Colour of pappus ranges from dull white to golden brown (Table 2). The carpopodium is basal to sub-basal (Fig. 2a – d). It is narrow, circular and without any interruption. Diameter of carpopodium varies from 195μm to 231μm. Carpopodium foramina varies from 98μm (*D. rubricaulis*) to 123μm (*D. cappa*) in diameter (Table 3).

Fruits are circular in transection and show ridges (ribs) and furrows. Pericarp is differentiated into three zones. Outer zone is represented by a single-layered epidermis followed by sub-epidermal zone. Epidermis is followed by fibrous bundles at ridges. These bundles are underlaid by a layer of parenchymatous cells. The zone below the epidermis is composed of thin-walled cells under furrows (Fig. 3a, b). Ridges are more prominent in *D. rubricaulis* as compared to other species. Each epidermal cell contains a large calcium oxalate crystal.

Inula

Cypsela shape varies from narrowly obovate-oblongoid or oblongoid to oblong-oblanceoloid. The size ranges from 1 – 1.5 × *c*. 0.5 mm (*I. acuminata*) to 3 – 4 × 0.75 – 1.0 mm (*I. royleana*). The colour of cypsela is basically brown. However, various brown shades have been observed (Table 1). The number of ribs varies: 3 in *I. acuminata* and *I. falconeri*; 10 – 12 in *I. rhizocephala* and 16 – 24 in *I. racemosa* and *I. royleana* (Table 1). Cypselae are usually hirsute or densely sericeous to sericeous-villous (Table 1; Fig. 1d, e, g). However, it is pubescent in *I. rhizocephala* (Table 1; Fig. 1f). Pappus 20 – 48, bristly, uniseriate, 5 – 9 mm long. However, in *I. rhizocephala* it is 2 or 3-seriate. The colour of pappus varies from golden brown, reddish brown-golden, golden yellow to cream-golden (Table 2; Fig. 2h). The carpopodium is indistinct in *I. britannica* but in other species it is distinct. The carpopodium is narrow, circular in *I. acuminata* and *I. falconeri*, a broad disc-like in *I. clarkei* and *I. obtusifolia*, angular in *I. orientalis*, or a slightly angular – narrow circular ring in *I. racemosa* and *I. royleana*. It is without any interruption in all species and may be basal to subbasal. The diameter of carpopodium varies from 120μm (*I. britannica*) to 465μm (*I. racemosa*). The

Table 1. Cypsela characters of *Inula* complex

Sl. No.	Name of Taxa	Shape	Size (mm)	Colour	Surface	No. of Ribs
1.	*Dittrichia graveolens*	Oblanceolate-ellipsoid	*c.* 2.5 × 0.5 − 1	Yellowish brown	Pubescent-glandular	0
2.	*Duhaldea cappa*	Narrowly obovate-oblongoid	1.5 − 2 × 0.25 − 0.5	Yellowish brown	Densely sericeous	8 – 10
3.	*D. cuspidata*	Narrowly obovate-oblongoid	1.5 − 2 × 0.25 − 0.5	Reddish brown	Sparsely white pubescent	8 – 10
4.	*D. eupatoroides*	Narrowly obovate-oblongoid	1.5 − 2 × 0.25 − 0.5	Yellowish brown	Sparsely white pubescent	8 – 10
5.	*D. rubricaulis*	Oblanceolate-ellipsoid	1 − 1.5 × 0.25 − 0.5	Golden yellow	Pubescent	10 – 12
6.	*Inula acuminata*	Narrowly obovate-oblongoid	1 − 1.5 × *c.* 0.5	Yellowish brown	Sparsely golden brown-hirsute	3
7.	*I. britannica*	Narrowly obovate-oblongoid	1 − 2 × *c.* 0.5	Reddish brown	Sparsely golden brown-hirsute	8 – 10
8.	*I. clarkei*	Oblongoid	2 − 3 × 0.5 − 0.75	Yellowish brown	Densely sericeous	10 – 12
9.	*I. falconeri*	Narrowly obovate-oblongoid	1 − 1.5 × *c.* 0.5	Yellowish brown	Sparsely golden brown-hirsute	3
10.	*I. obtusifolia*	Oblongoid	2 − 3 × 0.5 − 0.75	Dark yellowish brown	Sericeous-villous	10 – 12
11.	*I. orientalis*	Oblong-oblanceoloid	*c.* 1.5 × 0.5	Dark brown	Sparsely golden brown-hirsute	5 – 10
12.	*I. racemosa*	Oblongoid	3 − 4 × 0.5 − 0.75	Dark brown	Glabrous	16 – 24
13.	*I. rhizocephala*	Oblong-oblanceoloid	1.5 – 2 × *c.* 0.5	Golden brown	Glabrous	10 – 12
14.	*I. royleana*	Oblongoid	3 – 4 × 0.75 – 1	Dark brown	Glabrous	16 – 24
15.	*Iphiona grantioides*	Ellipsoid	2 − 3 × 0.5 − 1	Golden brown	Pubescent + apically glandular	10 – 12

foramina of the carpopodium varies from 72μm (*I. orientalis*) to 280μm (*I. racemosa*) in diameter (Table 3; Fig. 2e – g). Mature fruits show ridges (sclerenchymatic ribs) and furrows. In majority of the investigated *Inula* species, the mature pericarp is distinguishable into three zones. The outermost zone is represented by a single-layered epidermis followed by fibre bundles. In *I. royleana* the ridges are more prominent. Adjacent fibre bundles are separated by 2 or 3 layers of parenchymatous cells (Fig. 3d, e, f). The cells of fibre bundles are small and compactly arranged. Each epidermal cell contains a large calcium oxalate crystal.

Iphiona

Cypselae are ellipsoid, 2 – 3 × 0.5 – 1 mm, golden brown and 10 – 12-ribbed (Fig. 1e). Cypselae are

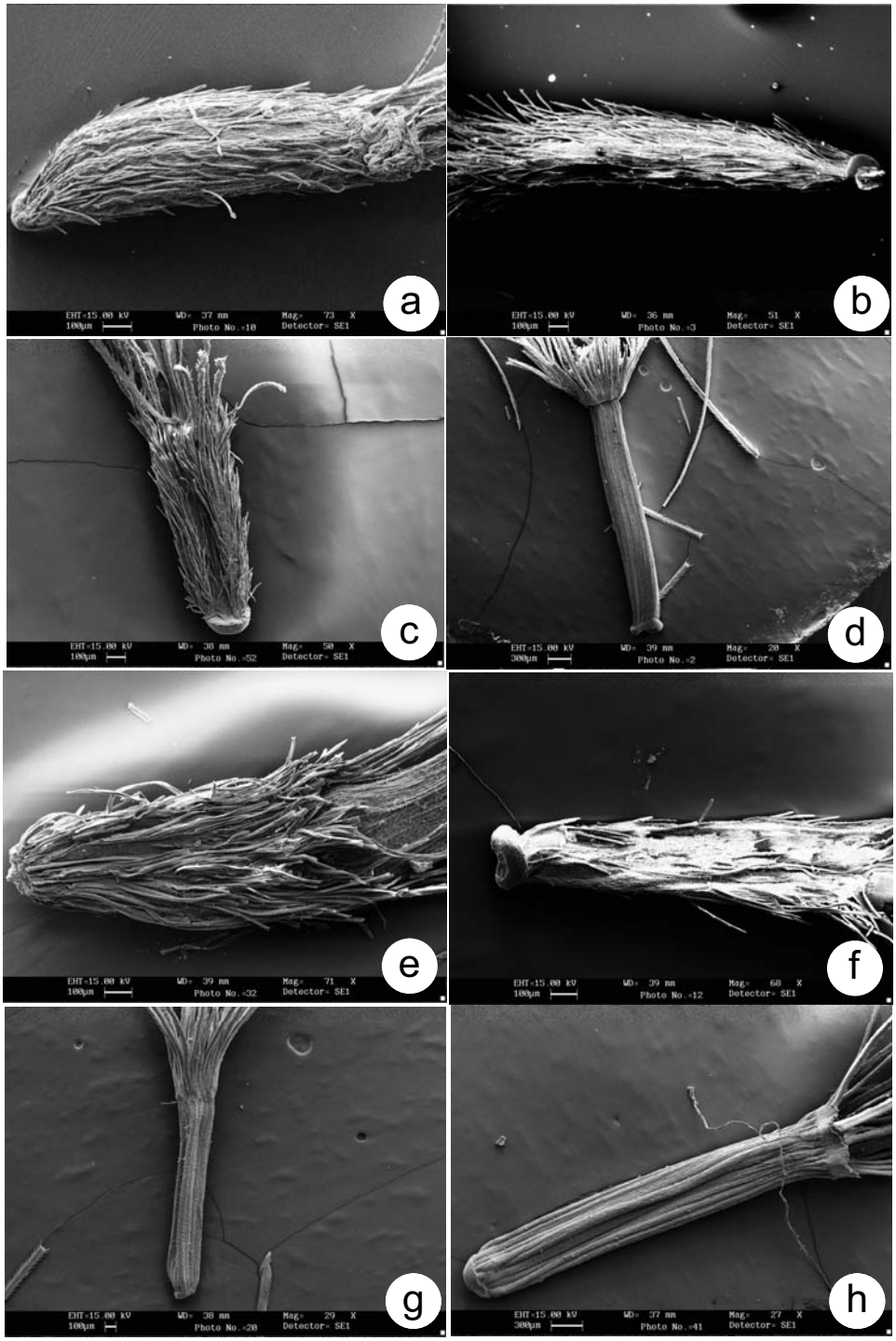

Fig. 1. SEM images of cypsela of *Inula* complex (a – h): a. *Duhaldea cappa*; b. *D. cuspidata*; c. *D. eupatorioides*; d. *Inula racemosa*; e. *I. falconeri*; f. *I. rhizocephala*; g. *I. royleana*; h. *Iphiona grantioides.*

pubescent and apically glandular (Table 1; Fig. 1h). Pappus 22 – 75, bristly, 2 or 3-seriate, 6 – 8 mm long (Table 2). Colour of pappus is golden brown. Carpopodium is U to V-shaped or circular with a little interruption. Carpopodium is basal to sub-basal, 270μm in diameter. Foramen of carpopodium is 141μm in diameter (Table 3). Anatomically, fruits show distinct ridges (ribs) and furrows. Mature pericarp is differentiated into a layer of epidermis followed by sub-epidermal layers composed of parenchymatous cells (Fig. 3c). Epidermis is followed by polygonal parenchymatous cells at ridges. The cells present at the centre of ridges are elongated. Each epidermal cell contains a large oxalate crystal.

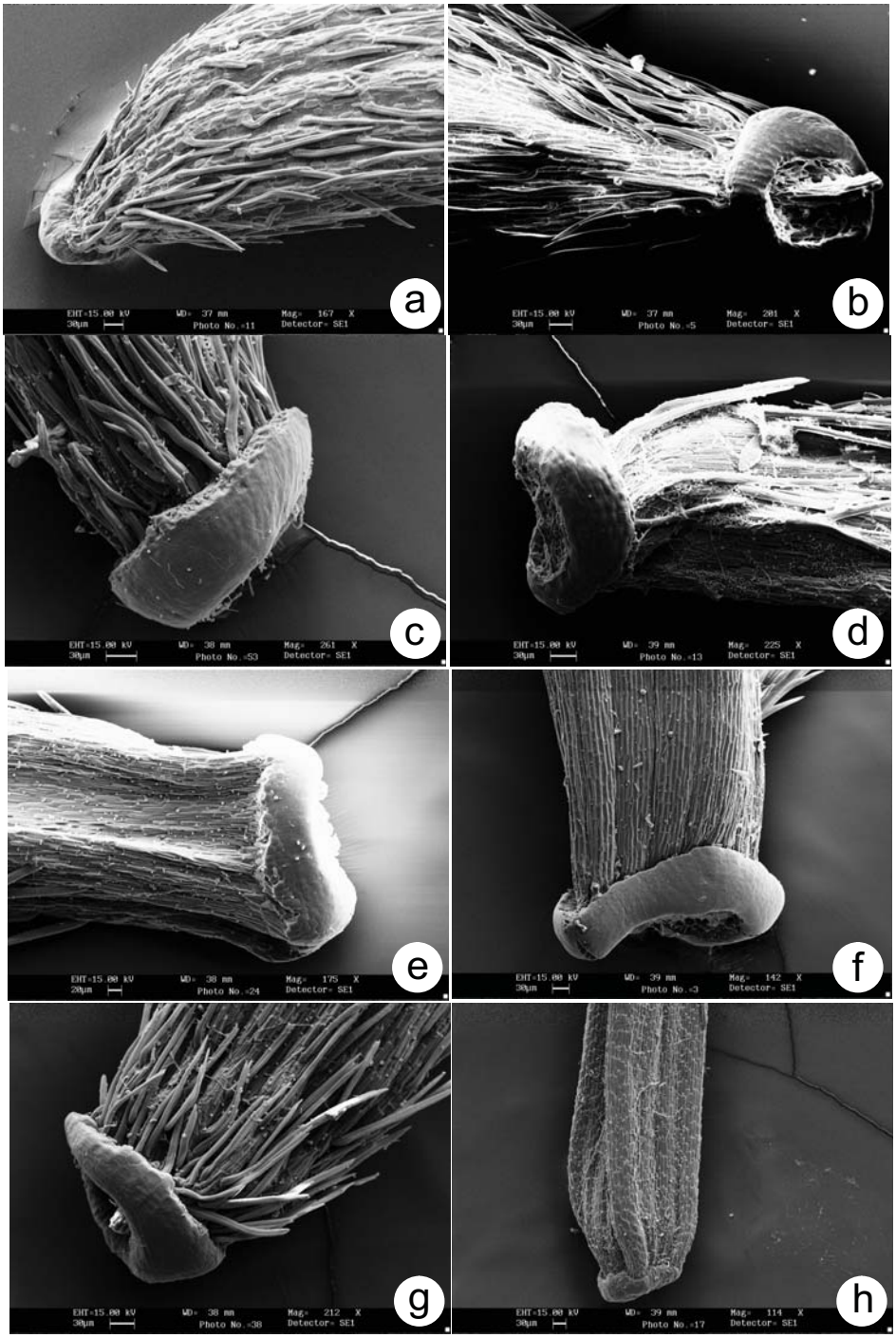

Fig. 2. SEM images of carpopodium of *Inula* complex (a – h): a. *Duhaldea cappa*; b. *D. cuspidata*; c. *D. eupatorioides*; d. *D. rubricaulis*; e. *Inula falconeri*; f. *I. orientalis*; g. *I. racemosa*; h. *I. rhizocephala*.

Discussion and Conclusions

Cypsela shape widely varies in different species of the four genera studied. Hence, delimitation of these genera is difficult. Mature cypselae are ribbed in *Duhaldea, Inula* and *Iphiona* except *Dittrichia*. All taxa studied possess a large elongated calcium oxalate crystal in each epidermal cell as reported by Anderberg (1991).

In the present study nine species of *Inula* have been included. Out of which 3 species i.e., *Inula britannica*, *I. orientalis* and *I. rhizocephala* are easily distinguishable on the basis of cypsela morphology and carpopodium structure whereas remaining six species are placed in three different groups, viz., *I. racemosa* and *I. royleana* (Group I); *Inula acuminata* and *I. falconeri* (Group II) and *I. clarkei* and *I. obtusifolia* (Group III). In the taxa of

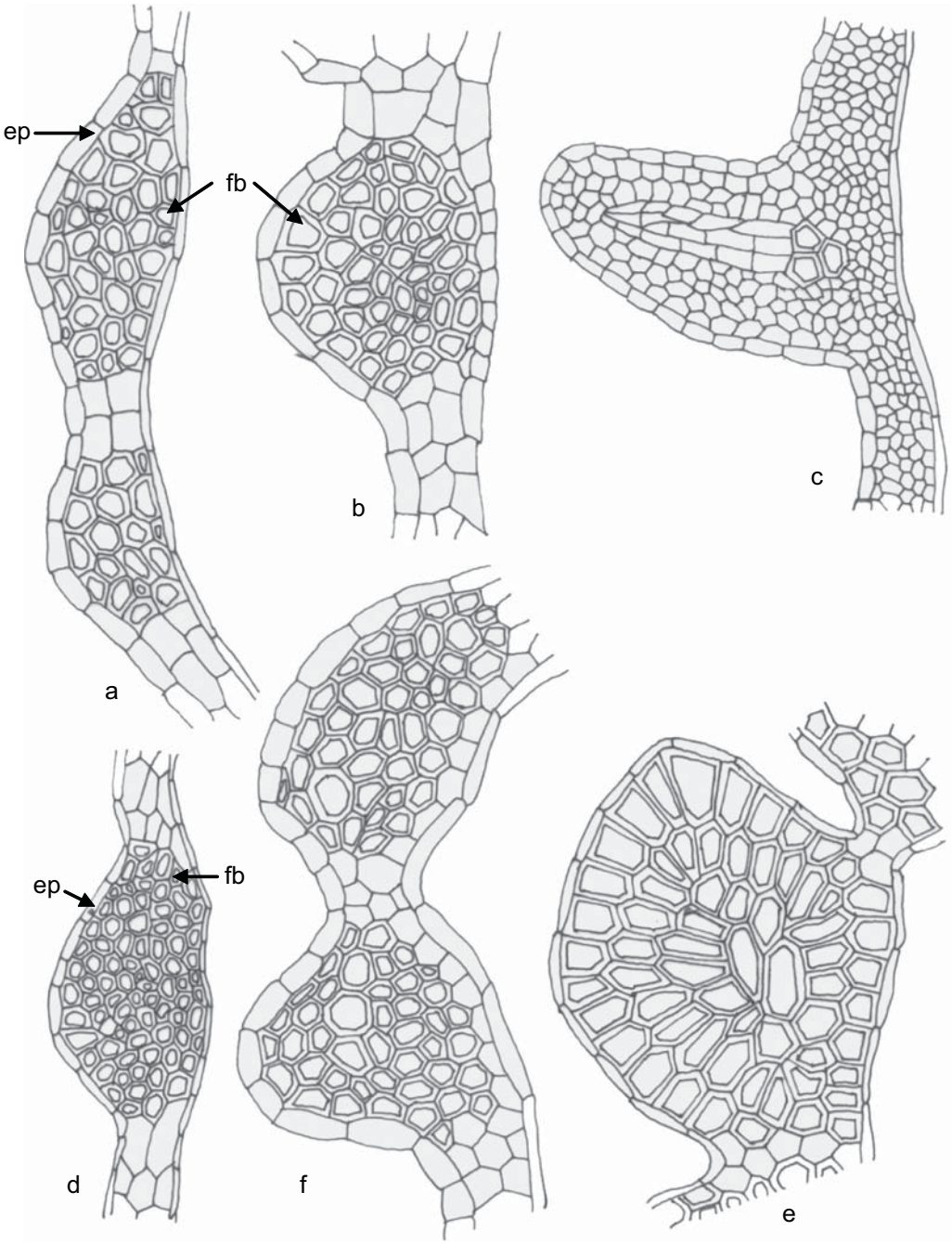

Fig. 3. Cross sections of cypsela of *Inula* complex (a – f): a. *Duhaldea cappa*; b. *D. rubricaulis*; c. *Iphiona grantioides*; d. *Inula obtusifolia*; e. *I. rhizocephala*; f. *I. royleana*; ep – epidermis; fb – fiber bundle (x400).

group I and II the differences lie in the diameter of the carpopodium and its foramen. In group I, the diameter of carpopodium is more than 400μm (*I. racemosa, I. royleana*). The pappus colour is more or less similar in group II and III whereas in group I pappus is reddish brown in *I. racemosa*, and golden brown in *I. royleana*. In group II the diameter of carpopodium ranges from 190μm (*I. falconeri*) to 221μm (*I. acuminata*) whereas in group III it ranges from 300μm (*I. obtusifolia*) to 309μm (*I. clarkei*).

Both *Inula* (*s. str.*) and *Duhaldea* show more or less similar fruit morphology and anatomy. However, they vary in characters like size and surface of cypsela, number of ribs and shape and size of carpopodium.

Table 2. Pappus characters of *Inula* complex

Sl. No.	Name of Taxa	Series of Bristle	Number	Size (mm)	Colour
1.	*Dittrichia graveolens*	1	22 – 24	4 – 5	Reddish brown
2.	*Duhaldea cappa*	1	22 – 24	5 – 6	Dirty white
3.	*D. cuspidata*	1	22 – 26	4 – 5	Cream golden
4.	*D. eupatoroides*	1	22 – 24	4 – 5	Cream golden
5.	*D. rubricaulis*	1	25 – 30	5 – 7	Golden brown
6.	*Inula acuminata*	1	22 – 30	5 – 6	Golden brown
7.	*I. britannica*	1	20 – 24	5 – 6	Reddish brown-golden
8.	*I. clarkei*	1	20 – 24	6 – 7	Golden yellow
9.	*I. falconeri*	1	25 – 28	5 – 6	Golden yellow
10.	*I. obtusifolia*	1	22 – 28	5 – 7	Golden yellow
11.	*I. orientalis*	1	20 – 25	6 – 7	Cream golden
12.	*I. racemosa*	1	30 – 48	8 – 9	Reddish brown
13.	*I. rhizocephala*	2 or 3	20 – 40	7 – 8	Reddish brown-golden
14.	*I. royleana*	1	22 – 40	7 – 8	Golden brown
15.	*Iphiona grantioides*	2 or 3	22 – 75	6 – 8	Golden brown

Genus *Duhaldea* is a monophyletic group distinguished from *Inula* by polarized endothecial tissue, a receptacle with scale-like ridges and truncate or emarginate anther appendices (Anderberg, 1991). Chemically, *Duhaldea* differs from *Inula* in the presence of a unique sesquiterpene lactone, ineupatorolide (Bohlmann & Gupta, 1982; Bohlmann *et al*., 1982a, b). Present study also reveals that *Duhaldea* differs from *Dittrichia* in the absence of ribs.

Dittrichia differs from *Duhaldea, Inula* and *Iphiona* in characters like (i) absence of ribs, (ii) pubescent glandular cypsela surface and (iii) size of carpopodium and diameter of foramen of carpopodium. However, *Dittrichia* species resemble other studied species. They are similar in having uniseriate bristly pappus connate into a cupule at base, as well as in number and length; shape and position of carpopodium are also similar. Interestingly, the diameter of carpopodium is the smallest in *Dittrichia* (79μm) as compared to *Duhaldea* (213μm), *Inula* (269μm) and *Iphiona* (270μm). *Dittrichia* differs from *Inula* in having scale-like ridges on receptacle surface, polarized endothecial tissue, non-ribbed cypsela with short attenuate apex and bristly pappus basally connate into a minute cupule. *Dittrichia* resembles *Duhaldea* in several of the above said features. Anderberg (1991) in his analyses of morphological data found that these two to be closely related, something which is contradicted by the molecular data which places the two in widely separated clades.

Iphiona differs from other genera in having ellipsoid, pubescent cypselae with apically glandular surface. In *I. grantioides* the pappus bristles are of different length and arranged in 2 or 3 series, and their number varies from 22 to 75. Carpopodium is U or V-shaped or circular with interruption. *Iphiona* is distinct from *Dittrichia, Duhaldea* and *Inula* and in cypsela morphology and anatomy. It is closely related to *Inula* (*s. str*.)

Table 3. Carpopodium characters of *Inula* complex

Sl. No.	Name of Taxa	Shape	Position	Diameter of Carpopodium (μm)	Diameter of Foramen of Carpopodium (μm)
1.	*Dittrichia graveolens*	Narrow circular ring without any interruption	Basal	79	38
2.	*Duhaldea cappa*	Narrow circular ring without any interruption	Basal – sub-basal	221	123
3.	*D. cuspidata*	Narrow circular ring without any interruption	Basal – sub-basal	195	102
4.	*D. eupatoroides*	Narrow circular ring without any interruption	Basal – sub-basal	231	110
5.	*D. rubricaulis*	Narrow circular ring without any interruption	Basal – sub-basal	205	98
6.	*Inula acuminata*	Narrow circular ring without any interruption	Basal	221	143
7.	*I. britannica*	Indistinct	Basal	120	85
8.	*I. clarkei*	Broad disc-like ring without any interruption	Basal – sub-basal	309	81
9.	*I. falconeri*	Narrow circular ring without any interruption	Basal	190	125
10.	*I. obtusifolia*	Broad disc-like ring without any interruption	Basal – sub-basal	300	105
11.	*I. orientalis*	Angular without any interruption	Sub-basal	160	72
12.	*I. racemosa*	Slightly angular – narrow circular ring without any interruption	Basal – sub-basal	465	280
13.	*I. rhizocephala*	Slightly angular – narrow circular ring without any interruption	Basal – sub-basal	235	145
14.	*I. royleana*	Slightly angular – narrow circular ring without any interruption	Basal – sub-basal	417	257
15.	*Iphiona grantioides*	U – V-shaped or circular with an interruption	Basal – sub-basal	270	141

but differs in having scale-like ridges on receptacle surface, fleshy leaves and rays neuter when present.

Inula rhizocephala shows unique morphology in being acaulescent with numerous radical, rosulate leaves, and sessile glomerate capitula. *I. rhizocephala* is similar to *Inula* species (present study) in having radiate capitula, naked receptacle without scale-like ridges, anther appendices acute-obtuse, radial endothecial tissues and ribbed cypsela. But it differs from *Inula* species in having (i) rosette of leaves which surround the capitula, (ii) without prominent stem and (iii) pappus bristles (2 or 3-seriate vs 1 or 2-seriate). Its systematic position is yet to be determined by analysis of DNA sequence.

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Appendix – I

Specimens examined

Dittrichia: *D. graveolens* (L.) Greuter: **Himachal Pradesh**, Lahul and Spiti, 15.11.1942, *N.L. Bor* 1881 (DD).
Duhaldea: *D. cappa* (DC.) A. Anderb.: **Meghalaya**, Barapani, 9.7.2009, *A.K. Pandey* 10022; NEHU campus, Shillong, 9.7.2009, *A.K. Pandey* 10032, 10033, 10040 (DUH). **Uttarakhand**, 4 km away from Khirsu, Srinagar-Garhwal, 22.2.2009, *S. Shekhar & A.K. Pandey* 1009 (DUH); Pratap nagar, 23.2.1979, *A.K. Goel* 64797; Tehri, 19.10.1992, *B.P. Uniyal* 78672 (BSD). *D. cuspidata* (DC.) A. Anderb.: **Meghalaya**, Shillong, 7.9.2009, *A.K. Pandey* 10034, 10039 (DUH). **Uttarakhand**, Sahastradhara, 12.12.1964, *C.R. Babu* 34690 (BSD); Pauri, Srinagar-Garhwal, 22.2.2009, *S. Shekhar & A.K. Pandey* 1045; Joshimath, Badrinath, 21.9.2009, *S. Shekhar & A.K. Pandey* 1065 (DUH). *D. eupatorioides* (DC.) A. Anderb.: **Meghalaya**, Khasi Hills, 3.2.1915, *U. Kanjilal* 6169 (DD); Umdingpoh, 31 km from Shillong, 3.3.2009, *A.K. Pandey* 10041, 10043; Shillong peak, 3.3.2009, *A.K. Pandey* 10042 (DUH). *D. rubricaulis* (Wall. ex DC.) A. Anderb.: **Uttarakhand**, Pithoragarh, 23.4.1965, *N.C. Nair* 35564 (BSD).

Inula: *I. acuminata* DC.: **Jammu & Kashmir**, Kishanganga Valley, 9.10.1989, *M.S. Pundhir* 13999 (DD); Bagicha to Olding Industry, 9.10.1992, *B.P. Uniyal* 20859 (BSD). *I. britannica* L.: **Jammu & Kashmir**, Dawar, 1.8.1950, *Stewart* 73 (DD). *I. clarkei* (Hook.f.) R.R. Stewart: **Jammu & Kashmir**, Dras valley, 6.8.1940, *Stewart* 4536 (DD). *I. falconeri* Hook.f.: **Jammu & Kashmir**, Kangi Nullah, 17.8.1942, *R.R. Stewart* 20484 (DD). *I. obtusifolia* Kerner: **Jammu & Kashmir,** Dras-Kargil, 8.7.1976, *B.M. Wadhwa* 58747 (BSD). *I. orientalis* Lam.: **Uttarakhand**, Valley of Flowers, 13.10.1962, *U.C. Bhattacharya* 24448; Kedarnath, 11.9.2006, *C.M. Bist* CMB 6 (BSD); on way to Badrinath, 22.9.2009, *S. Shekhar & A.K. Pandey* 1051; Kedarnath, 23.9.2009, *S. Shekhar & A.K. Pandey* 10097 (DUH). *I. racemosa* Hook.f.: **Himachal Pradesh**, Manali, 8.8.2009, *S. Shekhar & A.K. Pandey* 10078; On way to Manali, 9.8.2009, *S. Shekhar & A.K. Pandey* 1095 (DUH). *I. rhizocephala* Schrenk: **Jammu & Kashmir**, Dras-Kargil, 18.7.1976, *B.M. Wadhwa* 58755; Dras, 27.7.1998, *H.J. Chaudhary & B.P. Uniyal* 85795 (BSD). *I. royleana* DC.: **Jammu & Kashmir**, Kishan Ganga Valley, on the mountain slope, 10.9.1979, *B.M. Wadhwa, S.K. Mathur & P.C. Pant* 84919; Sonmarg, 25.7.1988, *H.J. Chowdhery & B.P. Uniyal* 85756 (BSD).

Iphiona: *I. grantioides* (Boiss.) A. Anderb.: **Punjab**, 17.10.1956, *R.N. Parker* 3438 (DD).

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