

## THE SEED ATLAS OF PAKISTAN-XI. URTICACEAE

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### Abstract

Seed morphology and its numerical analysis of the 9 taxa belonging to the family Urticaceae carried out with the help of scanning electron microscopy. Seed micro and macro morphological characters were significantly helpful to trace the phenetic relationship between the taxa of the family Urticaceae.

**Key words:** Seed morphology, Phenetic relationship, Urticaceae, Pakistan.

### Introduction

The family Urticaceae is commonly known as Nettle family, comprises 1050 species distributed in 48 genera mostly found in tropical regions few species are also reported from temperate zones (Mabberley, 2008). In Pakistan the family Urticaceae is represented by 9 species distributed in 6 genera viz., *Forsskalea* L., *Lecanthus* Wedd., *Parietaria* L., *Pilea* Lindl., *Pouzolzia* Gaudich and *Urtica* L. including 9 taxa (Ghafoor, 1981). There are various reports available where seed morphological data was significantly used to reveal the taxonomic as well as phylogenetic relationship of the taxa (Ather *et al.*, 2010; Rajbhandary & Shrestha, 2010; Kanwal *et al.*, 2012; Abid *et al.*, 2013; Ather *et al.*, 2013). Previously seed morphology of the Nettle family have been studied by few workers (Berggren, 1981; Boufford, 1997; Chen *et al.*, 2003; Kirkbride *et al.*, 2006; Bojnans & Fargasova, 2007) but no detailed report is available on the seed morphology of the family Urticaceae from the area under consideration. The seed morphological characters are analysed numerically to find out the relationship of the taxa within the family Urticaceae from Pakistan.

### Material and Methods

Mature and healthy seeds of 9 taxa of the family Urticaceae were collected from the herbarium specimens. Mostly 10 plants/species and 10 seeds/plant were studied (Appendix-I) and examined under stereomicroscope (Nikon XN Model), compound microscope (Nikon type 102) and scanning electron microscope (JSM-6380A). For scanning electron

microscopy dry seeds were directly mounted on metallic stub using double adhesive tape and coated with gold for a period of 6 minutes in sputtering chamber and observed under SEM. The terminology used is in accordance to Lawrence (1970), Radford *et al.* (1974) and Stearn (1983) with slight modifications. Numerical analysis was carried out to recognize the relationship and dissimilarities of species within the family Urticaceae. Hierarchical clustering was performed by using Euclidean distance index with the computer package (Anon., 2012). Each taxon was treated as operational taxonomic unit (OTU). Macro and micro-morphological characters of seeds viz., size, shape, colour and surface patterns were used. Characters were recorded as presence or absence and coded as 1 or 0 respectively (Tables 2, 3) and the average values of the quantitative characters viz., seed length and breadth were directly used (Tables 2, 3).

### Observations

#### General seed characters of the family Urticaceae

Seeds 0.5-2.5x0.1-1mm, ovate, obovate, oblong, elliptic or broadly elliptic, dark brown, light brown, yellowish, off-white with or without orange patches or black, shiny or unshiny, surface rugose, colliculate, apressedly colliculate, psilate, ruminant, foveate, foveolate, striate or sparsely tuberculate, hilum basal (Table 1. Figs. 1-8).

Represented by 6 genera viz., *Forsskalea* L., *Lecanthus* Wedd., *Parietaria* L., *Pilea* Lindl., *Pouzolzia* Gaudich, *Urtica* L.

### Key to the genera

- 1 + Seeds elliptic, oblong or obovate ..... 2
  - Seeds broadly elliptic or ovate ..... 5
- 2 + Seeds black ..... 3
  - Seeds brown or off-white ..... 4
- 3 + Seeds c. 0.5mm long, surface colliculate ..... *Lecanthus*
  - Seeds c. 1.5mm long, surface psilate ..... *Parietaria*
- 4 + Seeds c. 2.5mm long, dark brown ..... *Forsskalea*
  - Seeds c. 1.2mm long, light brown or off-white ..... *Pouzolzia*
- 5 + Seed surface sparsely tuberculate or foveated ..... *Pilea*
  - Seed surface colliculate or foveolate ..... *Urtica*

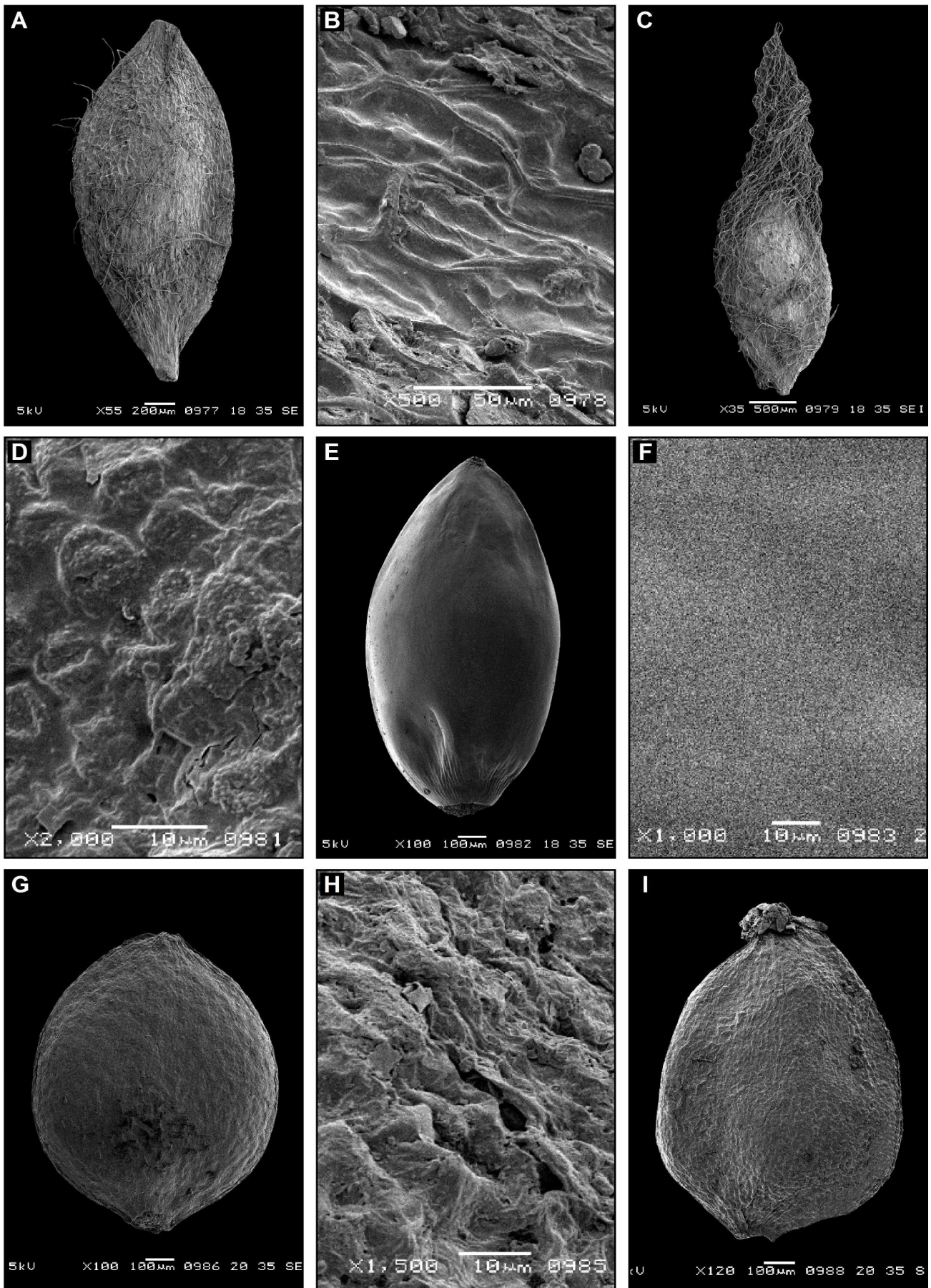


Fig. 1. Scanning electron micrographs. *Forsskalea tenacissima*: A, seed; B, surface. *Lecanthus peduncularis*: C, seed; D, surface. *Parietaria judaica*: E, seed; F, surface. *Pilea scripta*: G, seed; H, surface. *P. umbrosa*: I, seed. (Scale bars: C=500  $\mu\text{m}$ ; A=200  $\mu\text{m}$ ; E, G, I=100  $\mu\text{m}$ ; B=50  $\mu\text{m}$ ; D, F, H=10  $\mu\text{m}$ )

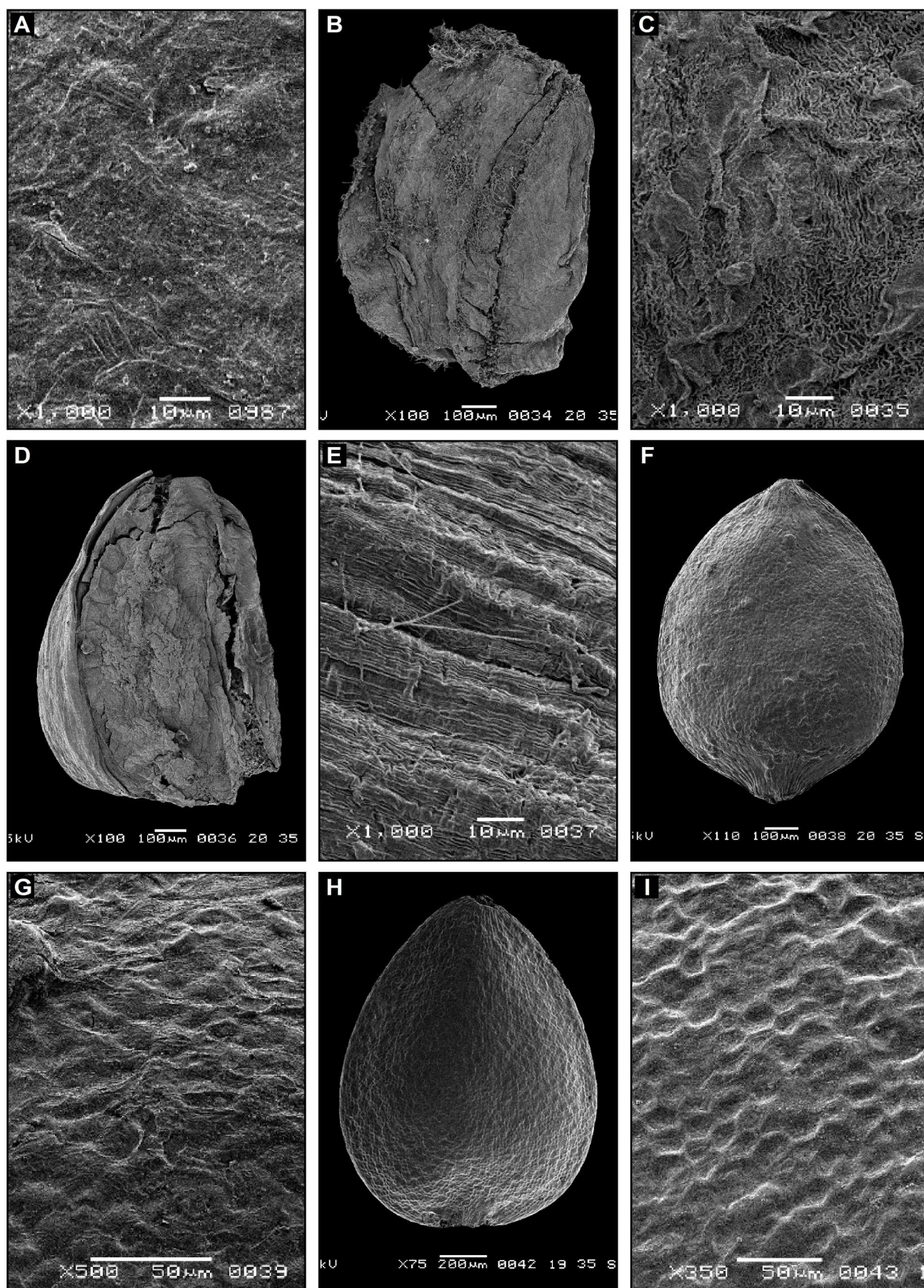


Fig. 2. Scanning electron micrographs. *Pilea umbrosa*: A, surface. *Pouzolzia hirta*: B, seed; C, surface. *P. pentandra*: D, seed; E, surface. *Urtica dioica*: F, seed; G, surface. *U. pilulifera*: H, seed; I, surface. (Scale bars: H=200 μm; B, D, F=100 μm; A, C, E=10 μm; G, I=50 μm)

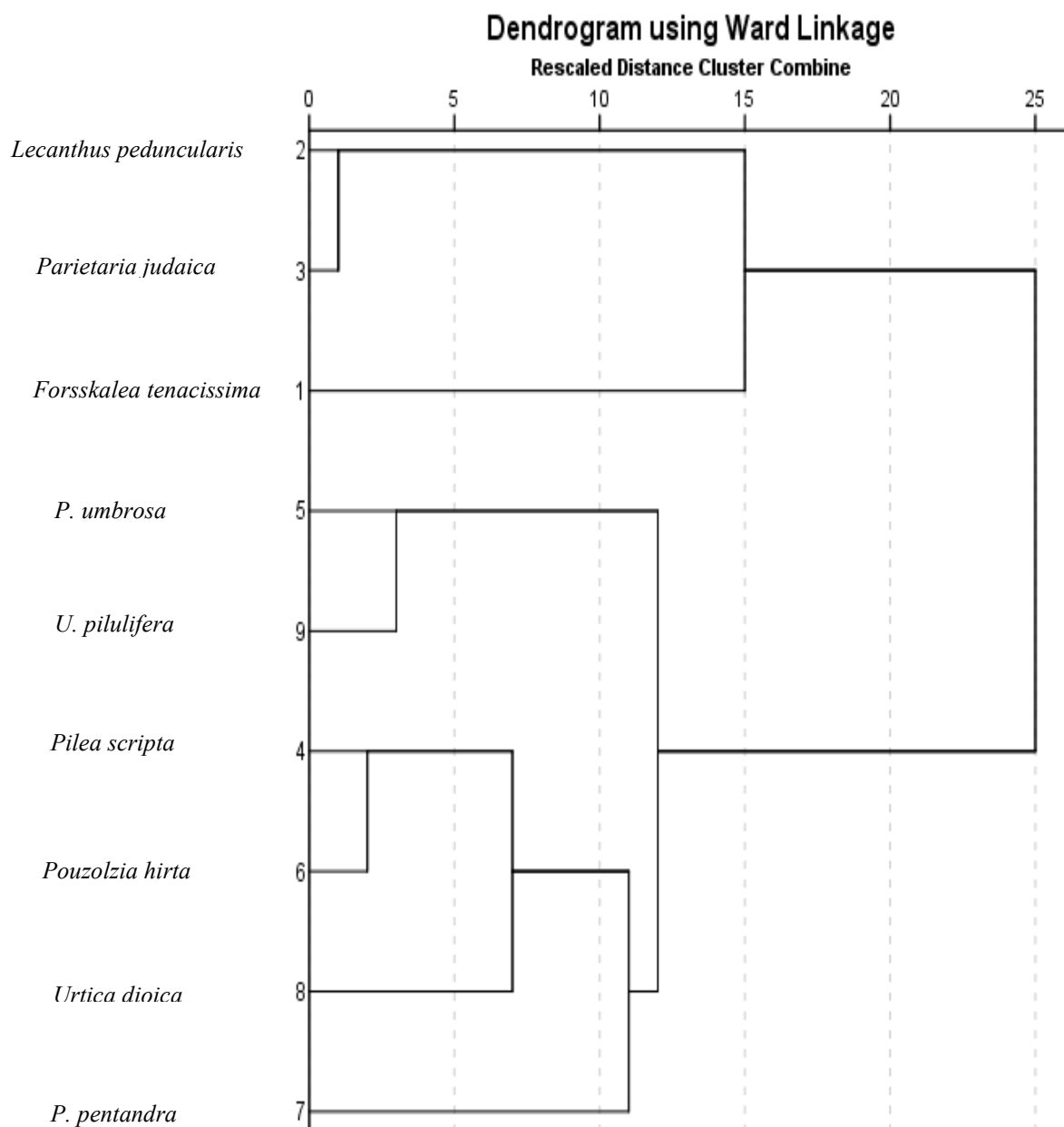


Fig. 3. Dendrogram showing the relationship of the species within the family Urticaceae.

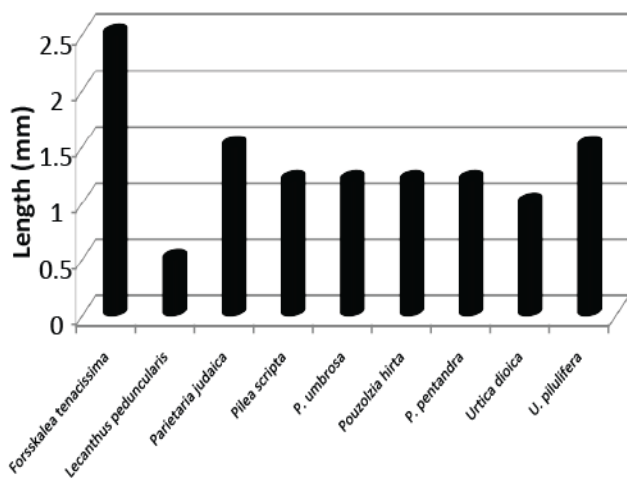


Fig. 4. Bar diagram showing the variation in the length(mm) of the seeds within the family Urticaceae.

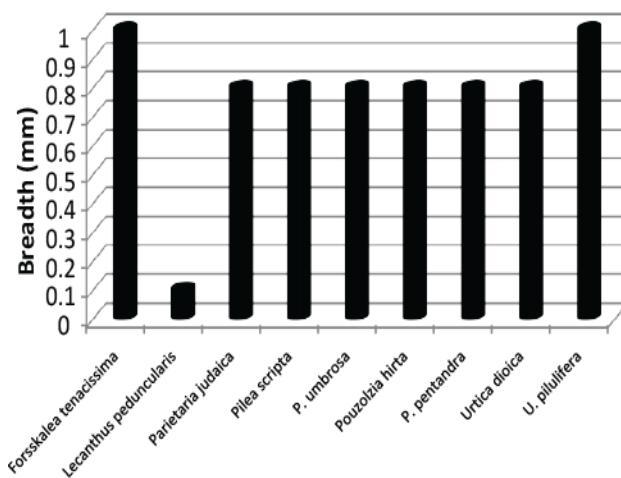


Fig. 5. Bar diagram showing the variation in the breadth (mm) of the seeds within the family Urticaceae.

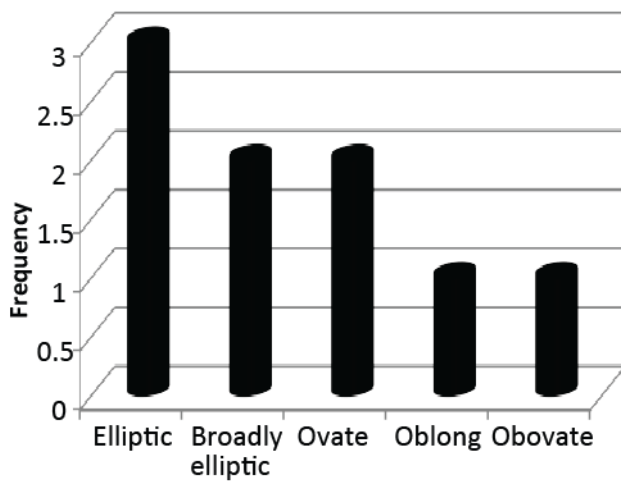


Fig. 6. Bar diagram showing the variation in the seed shapes of the family Urticaceae.

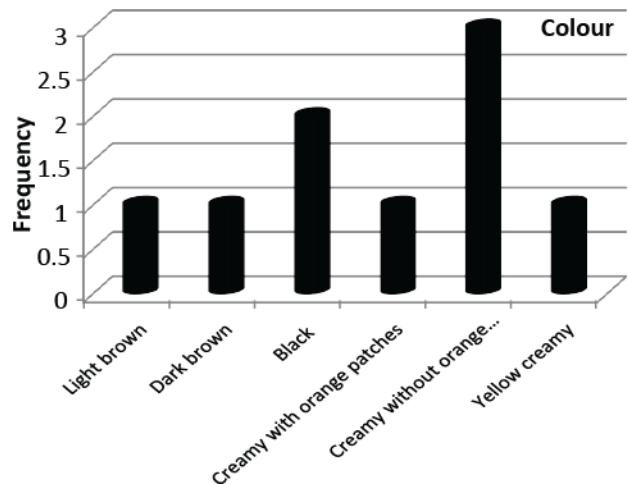


Fig. 7. Bar diagram showing the variation in the seed colours of the family Urticaceae.

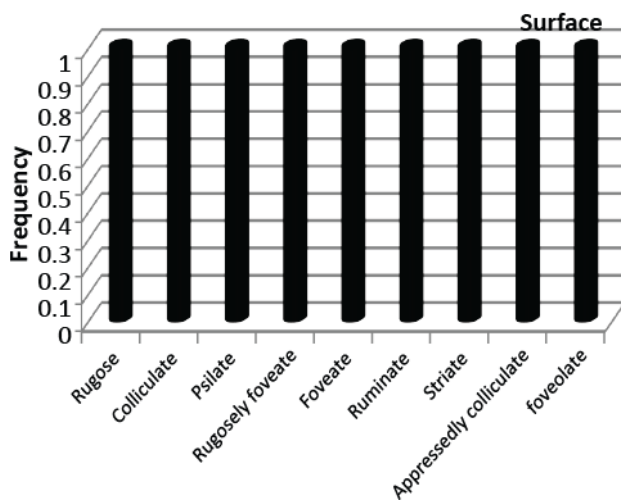


Fig. 8. Bar diagram showing the variation in the seed surfaces of the family Urticaceae.

#### *Forsskalea* L.

Seeds 2.5x1mm, elliptic, dark brown, surface rugose, hilum basal.

Represented by a single species viz., *Forsskalea tenacissima* L.

#### *Lecanthus* Wedd.

Seeds 0.5x0.1mm, elliptic, black, surface colliculate, hilum basal.

Represented by a single species viz., *Lecanthus peduncularis* (Royle) Wedd.

#### *Parietaria* L.

Seeds 1.5x0.8mm, elliptic, black, shiny, surface plicate, hilum basal.

Represented by a single species viz., *Parietaria judaica* L.

#### *Pilea* Lindl.

Seeds 1.2x0.8mm, broadly elliptic or ovate, off-white or yellowish, surface foveate or sparsely tuberculate, hilum basal.

Represented by 2 species viz., *Pilea scripta* Wedd., *P. umbrosa* Blume.

### Appendix-I. List of voucher specimens.

S. No.	Taxa	Collector, number and herbarium
1.	<i>Forsskalea tenacissima</i>	M. Qaiser et al. 7224 (KUH); Nazim et al. 119 (KUH); S.M.H. Jafri 2714 (KUH); Y. Nasir 32 (KUH); A. Ghafoor & Steve M. Goodman 4926 (KUH); T. Ali & G.R. Sarwar 2639 (KUH); T. Ali 952 (KUH); Shams-ul-Islam 26 (KUH).
2.	<i>Lecanthus peduncularis</i>	S. Abedin & M. Qaiser 8731 (KUH).
3.	<i>Parietaria judaica</i>	T. Ali et al. 2229 (KUH); Haider Ali 392, 2464 (KUH); Haider Ali & Jan Alam 1278 (KUH); Jan Alam 124 (KUH); S.W. Khan & Lalmast Khan 386 (KUH).
4.	<i>Pilea scripta</i>	S. Abedin 7665, 8460 (KUH); Saida Qureshi 35, 208 (KUH).
5.	<i>P. umbrosa</i>	Y. Nasir & Khan 1105 (RAW); M. Qaiser & A. Ghafoor 5014, 5071, 5274 (KUH); Saida Qureshi 195 (KUH).
6.	<i>Pouzolzia hirta</i>	M. Qaiser & A. Ghafoor 4924 (KUH).
7.	<i>P. pentandra</i>	M. Qaiser & A. Ghafoor 4611 (KUH); Saida Qureshi 271 (KUH).
8.	<i>Urtica dioica</i>	S. W. Khan 6 (KUH); M. Qaiser & Rizwan Yusuf 7729, 7924 (KUH).
9.	<i>U. pilulifera</i>	Rizwan Yusuf Hashmi 181, 198 (KUH); M. Qaiser & A. Ghafoor 5194 (KUH).

**Table 1. Seed morphological characters of the family Urticaceae.**

Name of taxa	Size (mm)		Shape	Colour	Surface	Hilum
	Length	Breadth				
<i>Forsskalea tenacissima</i>	2.5	1	Elliptic	Dark brown	Rugose	Basal
<i>Lecanthus peduncularis</i>	0.5	0.1	Elliptic	Black	Colliculate	Basal
<i>Parietaria judaica</i>	1.5	0.8	Elliptic	Black, shiny	Psilate	Basal
<i>Pilea scripta</i>	1.2	0.8	Broadly elliptic	Off-white	Sparsely tuberculate	Basal
<i>P. umbrosa</i>	1.2	0.8	Ovate	Yellowish	Foveate	Basal
<i>Pouzolzia hirta</i>	1.2	0.8	Oblong	Off-white	Ruminate	Basal
<i>P. pentandra</i>	1.2	0.8	Obovate	Light brown	Striate	Basal
<i>Urtica dioica</i>	1	0.8	Broadly elliptic	Off-white with orange patches	Appressedly colliculate	Basal
<i>U. pilulifera</i>	1.5	1	Ovate	Off-white	Foveolate	Basal

**Key to the species**

- 1 + Seeds broadly elliptic and sparsely tuberculate ..... *P. scripta*  
 - Seeds ovate and foveated ..... *P. umbrosa*

***Pouzolzia* Gaudich**

Represented by 2 species viz., *Pouzolzia hirta* (Blume) Hassak., *P. pentandra* (Roxb.) Benn.

Seeds 1.2x0.8mm, oblong or obovate, off-white or light brown, surface ruminant or striate, hilum basal.

**Key to the species**

- 1 + Seeds oblong and ruminant ..... *P. hirta*  
 - Seeds obovate and striate ..... *P. pentandra*

***Urtica* L.**

Represented by 2 species viz., *Urtica dioica* L. and *U. pilulifera* L.

Seeds 1-1.5x0.8-1mm, broadly elliptic or ovate, off-white with or without orange patches, surface foveolate or appressedly colliculate, hilum basal.

**Key to the species**

- 1 + Seed surface appressedly colliculate ..... *U. dioica*  
 - Seed surface foveolate ..... *U. pilulifera*

**Results and Discussion**

Seed morphological data is found to be useful to correlate with the gross morphology. The dendrogram based on the seed morphological characters of the taxa belonging to the family Urticaceae clearly revealed the presence of two distinct groups A and B. Group A comprises three genera viz., *Lecanthus*, *Parietaria* and *Forsskalea* with elliptic, black or dark brown seeds and plants with dot like cystoliths (Ghafoor, 1981) While, the genera of group B viz., *Pouzolzia*, *Pilea* and *Urtica* are characterized by the presence of broadly elliptic, oblong, ovate, obovate, off-white, yellowish and light brown seeds and plants with linear cystoliths (Ghafoor, 1981). Moreover within the first group *Lecanthus* and *Parietaria* are coupled together by having black seeds, male flowers with more than one stamen and female flowers with calyx, however *Forsskalea* falls separately and is distinct with dark brown seeds, male flowers with only one stamen and female flowers without calyx.

Within the second group *Pouzolzia pentandra* falls separately by having light brown, obovate seeds. While, the remaining three species of the group B viz., *Pilea scripta*, *Pouzolzia hirta* and *Urtica dioica* share the common cluster by having off-white, yellowish, broadly elliptic and oblong seeds with dioecious plants (Ghafoor, 1981). While, ovate seeds and monoecious or rarely dioecious plants (Ghafoor, 1981) have been observed in *Pilea umbrosa* and *Urtica pilulifera*. Thus it is evident that seed characters are significant enough to correlate the taxonomic delimitation within the family Urticaceae.

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**Table 2. List of characters, scored for cluster analysis for the taxa of Urticaceae listed in Table 1.**

Character description	
1.	Length (mm)
2.	Breadth (mm)
<b>Shapes</b>	
3.	Elliptic: absent (0), present (1)
4.	Broadly elliptic: absent (0), present (1)
5.	Ovate: absent (0), present (1)
6.	Obovate: absent (0), present (1)
7.	Oblong: absent (0), present (1)
<b>Colour</b>	
8.	Light brown: absent (0), present (1)
9.	Dark brown: absent (0), present (1)
10.	Black: absent (0), present (1)
11.	Off-white with orange patches: absent (0), present (1)s
12.	Off-white without orange patches: absent (0), present (1)
13.	Yellowish: absent (0), present (1)
<b>Surface</b>	
14.	Rugose: absent (0), present (1)
15.	Colliculate: absent (0), present (1)
16.	Appressedly colliculate: absent (0), present (1)
17.	Psilate: absent (0), present (1)
18.	Sparsely tuberculate: absent (0), present (1)
19.	Foveate: absent (0), present (1)
20.	Foveolate: absent (0), present (1)
21.	Ruminate: absent (0), present (1)
22.	Striate: absent (0), present (1)
<b>Hilum</b>	
23.	Basal: absent (0), present (1)

Name of species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
<i>Forsskalea tenacissima</i>	2.5	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1
<i>Lecanthus peduncularis</i>	0.5	0.1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1
<i>Parietaria judaica</i>	1.5	0.8	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1
<i>Pilea scripta</i>	1.2	0.8	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1
<i>P. umbrosa</i>	1.2	0.8	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1
<i>Pouzolzia hirta</i>	1.2	0.8	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1
<i>P. pentandra</i>	1.2	0.8	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<i>Urtica dioica</i>	1	0.8	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1
<i>U. pilulifera</i>	1.5	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1

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