

STUDIES ON THE POLLEN MORPHOLOGY OF THE GENUS  
*HELIOTROPIMUM* L. FROM PAKISTAN

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**Abstract**

Pollen grains of 20 species of the genus *Heliotropium* L. from Pakistan were studied. The genus *Heliotropium* is eurypalynous and shows variation in size ranging from 12–39  $\mu\text{m}$  in equatorial diameter and 20–48  $\mu\text{m}$  in polar axis and apertures being 6–10 heterocolpate.

**Introduction**

The genus *Heliotropium* consists of 275 species distributed all over the tropical and temperate zones of both the hemispheres. It is represented by 24 taxa in Pakistan (Kazmi, 1970). There is little palynological information of *Heliotropium* species found in Pakistan. Singh (1930) in his studies of Boraginaceae described very few characters of *Heliotropium marifolium* Retz., and *H. supinum* Linn. Johnston (1959), while describing taxonomy of some American borages, studied pollen characters of *H. ruiz-lealii* Johnston and *H. curassavicum* L. var. *fruticulosum* Johnston. Erdtman (1966) studied only a single species *H. villosum*. Gupta (1971) studied pollen of 8 species of *Heliotropium* from India. Clarke (1977) in Northwest European Boraginaceae observed in detail only *H. europaeum*.

The aim of the present investigation was to provide a detailed account of pollen morphology of the genus *Heliotropium* from Pakistan.

**Material and Method**

The palynological investigations were based on herbarium material obtained from Karachi University Herbarium (KUH), National Herbarium Rawalpindi (RAW) and

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North Regional Laboratories Peshawar (PES). The following is the list of specimens examined and the number given to each specimen is the same as that used in the Table.

1. Sind: Karachi: between paradise point and cape monze, S.I. Ali & S. Abedin 49.
2. Sind: Karachi: Intelligence school, S.I. Ali s.n.
3. Baluchistan: Mir Ali Khel, 1200 m., J.F. Duthie 18922 (PES).
4. Khyber Agency: Jamrud, Bara Fort, Burt 702.
5. Baluchistan: Quetta Dist.: mount chiltan, Rechinger 29115 (PES).
6. Baluchistan: Quetta: Pishin, S. Abedin 3031.
7. Baluchistan: Kalat; Jal Jhao, 400 m., K.H. Rechinger 27667 (PES).
8. Karachi: Wad on way to Bela, S. Abedin & Abrar Hussain 7271.
9. Punjab: 6 miles from Lyallpur on way to Amirpur Bungalow, M. Qaiser 305.
10. Baluchistan: Quetta: 10 miles from Ziarat on way to Loralai at Chuter, M. Qaiser & A. Ghafoor 1450.
11. Swat State: Mingora. R.R. Stewart 24764 (RAW).
12. Baluchistan: Chagi Dist., 100–150 km. E. Nokundi, Rechinger 27273 (PES).
13. Sind: Dadu Dist.: Amri near Sehwan Railway Station, Jafri 2756.
14. Baluchistan: Ab limites austro-orientalis desertis, Lut prope, Nusratabad, inter Bam et Zahedan, Rechinger 3910 (PES).
15. Karachi: Drigh Road, Sandy ground, Jafri 917.
16. Karachi: N. Nazimabad, Manghopir Rd. Jafri 3602.
17. Baluchistan: Makran; Pasni to Kappar, road to Gwader, Jennifer Lamonde 462.
18. D.G. Khan: Lloralai, 6 miles from kingri, M. Qaiser 2532.
19. Sind: Darsano Chano, S. Abedin 28.
20. Sind: Thar Parker: Budhe-sar, M. Qaiser 4080.
21. Baluchistan: Quetta: Loralai to Harnai, below Torkhan pass, 900–1400 m., J. Lamonde 1274 (PES).

The pollen slides were prepared by the method of acetolysis as suggested by Erdtman (1952). All the slides have been deposited in the Pollen Herbarium, Department of Botany, University of Sind. Measurements of about 100 grains for each species were taken and photomicrographs made on Kodak Panatomix-X, 16–DIN rolls under oil immersion. The terminology used for pollen description has been borrowed from Erdtman (1952) and Clarke (1977).

## Results

### POLLEN CHARACTERS OF THE GENUS *HELIOTROPIMUM* L.

- Pollen class: 6–10 Heterocolpate.  
 P/E ratio: Prolate spheroidal to prolate.  
 Size: Small to rather large.  
 Aperture: Ectoapertures – colporate apertures and simple colpi (colpate) of

almost equal length, long, narrow, parallel sided, the colpi sometimes running diagonally across the polar axis.

Endoapertures (Ora) – circular, lolongate and lalongate, faint appearance.

Exine: Sexine as thick as nexine or thicker than nexine, stratification obscure.

Outline: Equatorial view – circular to oval, the long sides slightly to distinctly convex, poles also slightly convex. Polar view – 6 to 10 lobed, colpi separated by convex mesocolpia, sometimes rounded triangular and square with the colporate apertures in the angles.

Measurements: Polar axis = 20–48  $\mu\text{m}$ , equatorial diameter = 12–39  $\mu\text{m}$ , P/E ratio 1.3–1.5  $\mu\text{m}$ ; exine ca. 1.1–4.4  $\mu\text{m}$ ; colporate apertures 16.5–38.5  $\mu\text{m}$ ; mesocolpia 4.4–25.3  $\mu\text{m}$ , apocolpia 1.7–7.7  $\mu\text{m}$ .

Details of the species examined have been summarized in Table 1.

#### KEY TO THE SPECIES BASED ON POLLEN MORPHOLOGY

- |    |  |    |
|----|--|----|
| 1  | + Pollen 6-heterocolpate   | 6  |
|    | – Pollen 8–10 heterocolpate  | 2  |
| 2  | + Grains prolate in shape.   | 5  |
|    | – Grains subprolate in shape.  | 3  |
| 3  | + Pollen 8-lobed, circular and square in polar view  | 4  |
|    | – Pollen 10-lobed and circular in polar view . . . . . 13, <i>H. marifolium</i><br>subsp. <i>wallichii</i> |    |
| 4  | + Grains small to rather small, P=26.7 $\mu\text{m}$ , E=22 $\mu\text{m}$ . . . . . 8, <i>H. crispum</i>   |    |
|    | – Grains medium sized, P=38 $\mu\text{m}$ , E=31 $\mu\text{m}$ . . . . . 18, <i>H. strigosum</i>           |    |
| 5  | + Tectum reticulate . . . . . 16, <i>H. rariflorum</i>   |    |
|    | – Tectum granulated. . . . . 2, <i>H. bacciferum</i> var. <i>tubercullosum</i>                             |    |
| 6  | + Colpi 16.5–22 $\mu\text{m}$ long   | 11 |
|    | – Colpi 23–38.5 $\mu\text{m}$ long   | 7  |
| 7  | + Shape of pollen prolate. . . . . 20, <i>H. supinum</i>   |    |
|    | – Shape of pollen subprolate   | 8  |
| 8  | + Grains in polar view 6-lobed, circular   | 9  |
|    | – Grains in polar view rounded triangular . 1, <i>H. bacciferum</i> subsp. <i>lignosum</i>                 |    |
| 9  | + Exine 1.0–1.7 $\mu\text{m}$ thick  | 10 |
|    | – Exine 1.8–2.2 $\mu\text{m}$ thick . . . . . 11, <i>H. europeum</i> var. <i>lasiocaryum</i>               |    |
| 10 | + Mesocolpia 19.8 $\mu\text{m}$ . . . . . 19, <i>H. subulatum</i>  |    |
|    | – Mesocolpia 9.9 $\mu\text{m}$ . . . . . 6, <i>H. cabulicum</i>  |    |
| 11 | + Mesocolpia 4.4–11 $\mu\text{m}$  | 12 |
|    | – Mesocolpia 14.3–22 $\mu\text{m}$   | 16 |
| 12 | + Pollen subprolate  | 13 |
|    | – Pollen prolate . . . . . 21, <i>H. ulophyllum</i>  |    |

Table 1. Summary of the pollen morphological data in genus *Heliotropium* L.

Species	P ( $\mu\text{m}$ )	E ( $\mu\text{m}$ )	Shape	Size	No. of Apr.	Polar outline	Equatorial outline	Apocolpium ( $\mu\text{m}$ )	Mesocolpium ( $\mu\text{m}$ )	Length of colpi ( $\mu\text{m}$ )	Ora ( $\mu\text{m}$ )	Exine thickness ( $\mu\text{m}$ )
1. <i>Heliotropium bacciferum</i>	27(28)34	22(23)24	SP-Pr	S-RS	6	Rd, Triang	Ovl	3.3	18.7	24.2	3.3x3.3	2.2-3.3
subsp. <i>tigrosium</i>	29(30)32	18(20)23	Pr	S-RS	8	Lbd; Sqr	Ovl	5.5	13.5	22	4.4x7.7	2.2-4.4
2. <i>H. bacciferum</i> var. <i>tuberculosum</i>	24(25)26	22(25)26	Psph-Sph	S-RS	6	Lbd; Cir	Cir	1.7	17.6	16.5	3.3x4.4	2.2
3. <i>H. bahuchistanicum</i>	24(28)32	15(19)23	Pr	S-RS	6	Lbd	Ovl	11	22	19.8	3.3x3.3	2.2
4. <i>H. bianulatum</i>	22(24)25	19(22)24	Sph-SP	S	6	Lbd; Cir	Cir-Ovl	Obs	14.3	18.7	2.2x2.2	1.1
5. <i>H. brahucicum</i>	33(34)36	25(27)29	SP	RS-M	6	Lbd	Ovl	Obs	9.9	27.5	Obs	1.7
6. <i>H. cabulicum</i>	20(21)22	13(17)19	SP-Pr	S	6	Cir	Cir	3.3	5.5	16.5	3.3x3.3	1.1
7. <i>H. calcareum</i>	25(27)28	20(22)23	SP	S-RS	8	Lbd	Ovl	Abst	7.7	19.8	2.2x4.4	2.2
8. <i>H. crispum</i>	22(23)28	15(18)21	SP-Pr	S	6	Cir; Lbd	Ovl	Abst	4.4	18.7	3.3x3.3	1.1
9. <i>H. curassavicum</i>	23(26)29	21(22)24	SP	S	6	Lbd	Ovl	Obs	9.9	20.9	2.2x3.3	2.2
10. <i>H. dasycarpum</i>	29(32)37	22(25)30	SP	RS-M	6	Cir; Lbd	Cir-Ovl	Obs	22	28.6	3.3x2.2	2.2
11. <i>H. europaeum</i> var. <i>Lasiocarpum</i>	28(29)34	20(21)24	Pr	S-RS	6	Lbd	Ovl	Abst	18.7	22	28.6	1.1
12. <i>H. gilliamum</i>	35(42)46	24(32)30	SP-Pr	M-RL	10	Lbd	Ovl	6.6	7.7	27.5	3.3x5.5	2.2x3.3
13. <i>H. marifolium</i>	22(24)26	21(22)23	Psph-Sph	S	6	Lbd	Cir-Ovl	4.4	19.8	18.7	3.3x3.3	1.1
subsp. <i>wallichii</i>	20(23)25	17(18)21	SP	S	6	Lbd; Cir	Cir-Ovl	Abst	7.7	16.5	5.5x3.3	1.1
14. <i>H. oliganthum</i>	26(28)29	18(19)22	Pr	S-RS	8	Cir; Sqr	Ovl	Obs	11	25	4.4x3.3	2.2
15. <i>H. ophioglossum</i>	20(24)26	13(17)20	Pr	S	6	Lbd-Cir	Ovl	3.3	14.3	17.3	3.3x3.3	1.7
16. <i>H. variflorum</i>	35(38)41	29(31)33	SP	M	8	Lbd-Cir	Ovl	5.0	18.7	29.7	2.2x5.5	2.2
17. <i>H. remotiflorum</i>	28(29)31	22(25)26	SP	S-RS	6	Lbd-Cir	Ovl-Cir	Abst	19.8	25.3	2.2x1.1	1.7
18. <i>H. strigosum</i>	40(44)48	22(26)29	Pr	RS-RL	6	6-sided	Ovl	7.7	25.3	38.5	3.3x7.7	2.2
19. <i>H. subulatum</i>	20(22)23	12(14)17	Pr	S	6	Lbd	Ovl	2.2	11.0	16.5	2.2x2.2	1.1
20. <i>H. supinum</i>												
21. <i>H. ulophyllum</i>												

Key to abbreviations: P = polar axis; E = equatorial axis; Pr = prolate; SP = subprolate; Psph = prolate sphaeroidal; Sph = sphaeroidal; S = small; RS = rather small; Sqr = Square; M = medium; RL = rather large; L = large; Cir = circular; Obs = absent; Rd, Triang = Rounded triangular; Lbd = lobed; Ovl = Oval; Apr = Aperture.

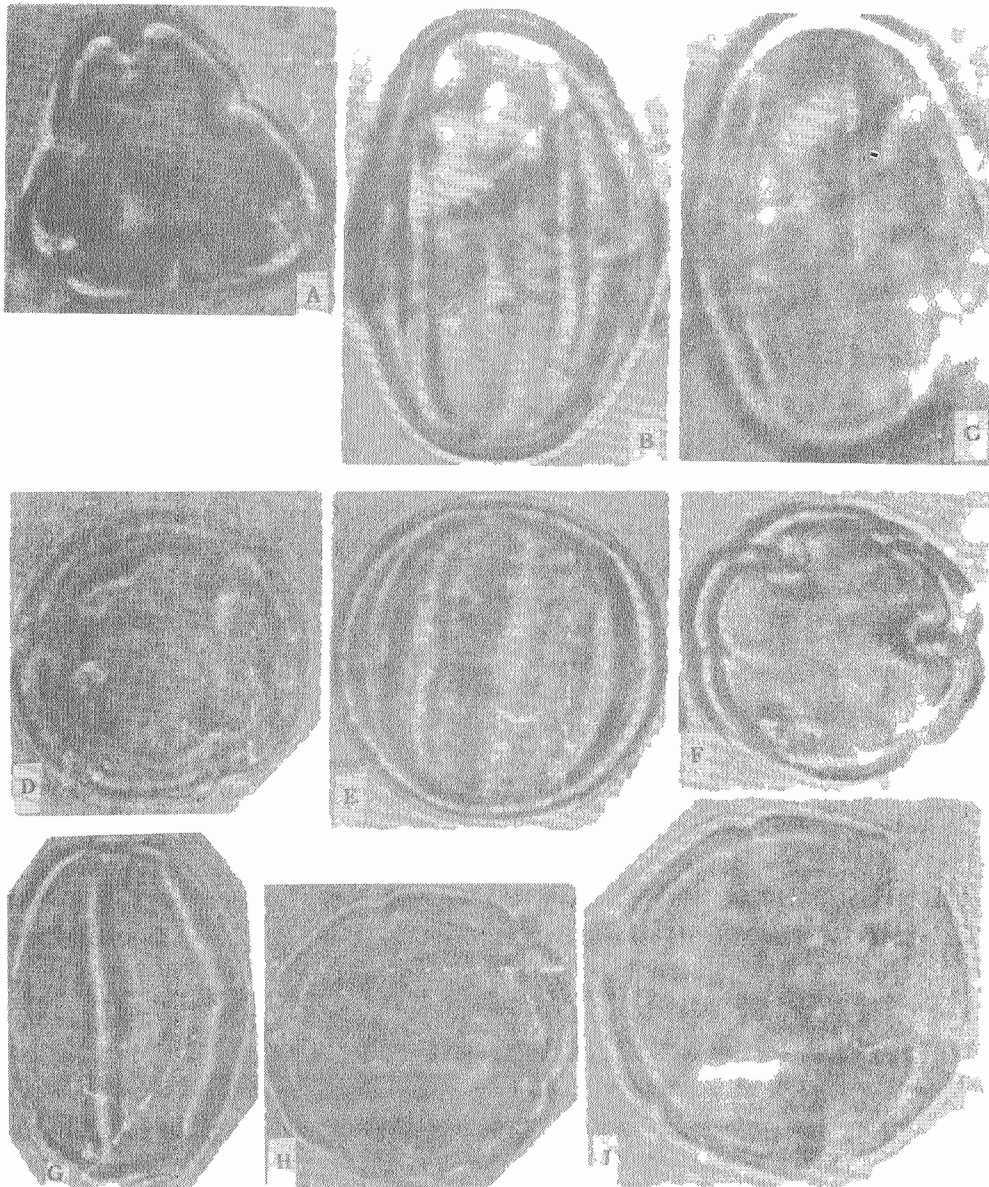


Fig. 1. *Heliotropium bacciferum* subsp. *lignosum*: A. Polar view; B. Equatorial view: simple colpus; C. Equatorial view: colpate and colpiate apertures. *Heliotropium baluchistanicum*: D. Polar view; E. Equatorial view. *Heliotropium biannulatum*: F. Polar view; G. Equatorial view, simple colpus. *Heliotropium brohaicum*: H. Polar view, colpate and colpiate apertures. *Heliotropium cobulicum*: I. Polar view, colpate and colpiate apertures. (Magnification x 2500)

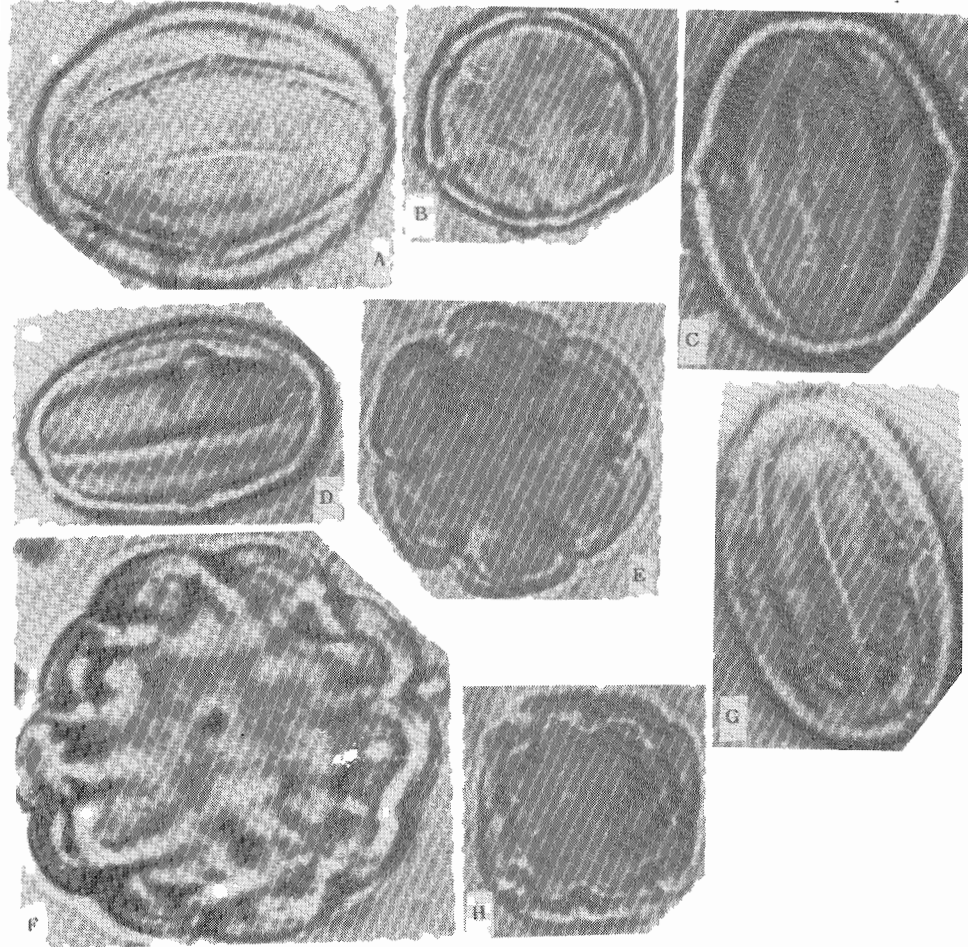


Fig. 2. *Heliotropium cabulicum*. A. Equatorial view; heterocolpate.

*Heliotropium calcareum*: B. Polar view.

*Heliotropium crispum*: C. Equatorial view; colpate and colporate apertures.

*Heliotropium curassavicum*: D. Equatorial view; colpate and colporate apertures.

*Heliotropium dasycarpum* var. *dasycarpum*: E. Polar view.

*Heliotropium marifolium* subsp. *wallichii*: F. Polar view; 10-heterocolpate.

*Heliotropium rariflorum*: G. Equatorial view; colpate and colporate apertures.

*Heliotropium bacciferum* var. *tuberculosum*: H. Polar view; squarish, 8-heterocolpate.

(Magnification x 2500)

13 + Grains oval in equatorial outline	14
– Grains circular in equatorial outline . . . . . 7, <i>H. clacareum</i>	
14 + Mesocolpia 4.4 $\mu\text{m}$ . . . . . 9, <i>H. curassavicum</i>	
– Mesocolpia 7.7–9.9 $\mu\text{m}$	15
15 + Ora lalongate . . . . . 15, <i>H. ophioglossum</i>	
– Ora lolongate . . . . . 10, <i>H. dasycarpum</i> var. <i>dasycarpum</i>	
16 + Exine 1.1–1.7 $\mu\text{m}$	18
– Exine 2.2 $\mu\text{m}$	17
17 + Pollen circular in equatorial view . . . . . 3, <i>H. baluchistanicum</i>	
– Pollen oval in equatorial view. . . . . 4, <i>H. biannulatum</i>	
18 + Grains spheroidal in shape	18
– Grains prolate in shape	19
19 + Apocolpium absent due to long colpi . . . . . 12, <i>H. gillianum</i>	
– Apocolpium 3.3 $\mu\text{m}$ . . . . . 17, <i>H. remotiflorum</i>	
20 + Mesocolpia 19.8 $\mu\text{m}$ . . . . . 14, <i>H. oliganthum</i>	
– Mesocolpia 14.3 $\mu\text{m}$ . . . . . 5, <i>H. brahuicum</i>	

### Discussion

The apertures in the genus *Heliotropium* are heterocolpate i.e., the colpi with ora alternate the colpi without ora (Fig. 1). Erdtman (1966) observed in *H. villosum* the colpate and colporate apertures in the same grain but termed the colpate one's as pseudo-colpi, whereas Gupta (1971) studied eight species of *Heliotropium* and quoted 3–4, zonicolpate, colporate and colporoidate apertures. Clarke (1977) described pollen of *H. europaeum* and termed them as heterocolpate. The grains in *Heliotropium* are usually 6–heterocolpate (Fig. 1). The species *H. crispum*, *H. rariflorum*, *H. strigosum* and *H. bacciferum* var. *tuberculosum* differ for all other species of the genus in having 8-heterocolpate pollen grains. *H. marifolium* subsp. *wallichii* is unique in its 10-heterocolpate grains (Fig. 2). The present observations are not in accordance with that of Gupta (1971) in number and morphology of apertures whereas the other characters are mostly similar.

### Acknowledgement

I am highly indebted to the Directors of Karachi University Herbarium (KUH); National Herbarium Rawalpindi (RAW) and North Regional Laboratories Peshawar (PES) for their generous help and giving all required facilities. I sincerely thank Dr. M. Qaiser, University of Karachi for going through the manuscript and for fruitful discussion.

Thanks are also due to the Pakistan Science Foundation for financing this research work and the University of Sind for providing space and facilities.

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