STUDIES ON THE POLLEN MORPHOLOGY OF THE GENUS

HELIOTROPium 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 euryvalynous and shows variation in size ranging from 12–39 μm in equatorial diameter and 20–48 μm 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. cuassavicium* 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.

9. Punjab: 6 miles from Lyallpur on way to Amirpur Bungalow, M. Qaiser 305.
15. Karachi: Drigh Road, Sandy ground, Jafri 917.
17. Baluchistan: Makran; Pasni to Kapper, road to Gwader, Jennifer Lamonde 462.
18. D.G. Khan: Loralai, 6 miles from kingri, M. Qaiser 2532.

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 HELIOTROPiUM 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, statification 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 μm, equatorial diameter = 12–39 μm, P/E ratio 1.3–1.5 μm; exine ca. 1.1–4.4 μm; colporate apertures 16.5–38.5 μm; mesocolpia 4.4–25.3 μm, apocolpia 1.7–7.7 μm.

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

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

1. + Pollen 6-heterocolpate
   -- Pollen 8–10 heterocolpate

2. + Grains prolate in shape.
   -- Grains subprolate in shape.

3. + Pollen 8-lobed, circular and square in polar view
   -- Pollen 10-lobed and circular in polar view

4. + Grains small to rather small, P=26.7 μm, E=22 μm
   -- Grains medium sized, P=38 μm, E=31 μm

5. + Tectum reticulate
   -- Tectum granulated

6. + Colpi 16.5–22 μm long
   -- Colpi 23–38.5 μm long

7. + Shape of pollen prolate
   -- Shape of pollen subprolate

8. + Grains in polar view 6-lobed, circular
   -- Grains in polar view rounded triangular

9. + Exine 1.0–1.7 μm thick
   -- Exine 1.8–2.2 μm thick

10. + Mesocolpia 19.8 μm
    -- Mesocolpia 9.9 μm

11. + Mesocolpia 4.4–11 μm
    -- Mesocolpia 14.3–22 μm

12. + Pollen subprolate
   -- Pollen prolate
Table 1. Summary of the pollen morphological data in genus *Heliotropium* L.

<table>
<thead>
<tr>
<th>Species</th>
<th>P (µm)</th>
<th>E (µm)</th>
<th>Shape</th>
<th>Size</th>
<th>No. of Apr.</th>
<th>Polar outline</th>
<th>Equatorial outline</th>
<th>Apocolpium (µm)</th>
<th>Mesocolpium (µm)</th>
<th>Length of colpi (µm)</th>
<th>Ora (µm)</th>
<th>Exine thickness (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <em>Heliotropium bacciferum</em> subsp. lignosum</td>
<td>27(28)34</td>
<td>22(23)24</td>
<td>SP-Pr</td>
<td>S-RS</td>
<td>6</td>
<td>Rd. Triang</td>
<td>Ovl</td>
<td>3.3</td>
<td>18.7</td>
<td>24.2</td>
<td>3x3.3</td>
<td>2.2-3.3</td>
</tr>
<tr>
<td>2. <em>H. bacciferum</em> var. tuberculatum</td>
<td>29(30)32</td>
<td>18(20)23</td>
<td>Pr</td>
<td>S-RS</td>
<td>8</td>
<td>Lbd; Sgr</td>
<td>Ovl</td>
<td>5.5</td>
<td>13.5</td>
<td>22</td>
<td>4.4x7.7</td>
<td>2.2-4.4</td>
</tr>
<tr>
<td>3. <em>H. bacciferum</em> var. tuberculatum</td>
<td>24(25)26</td>
<td>21(25)26</td>
<td>Psph-Sph</td>
<td>S-RS</td>
<td>6</td>
<td>Lbd; Cir</td>
<td>Cir</td>
<td>1.7</td>
<td>17.6</td>
<td>16.5</td>
<td>3.3x4.4</td>
<td>2.2</td>
</tr>
<tr>
<td>4. <em>H. bacciferum</em> var. tuberculatum</td>
<td>24(28)32</td>
<td>15(19)23</td>
<td>Pr</td>
<td>S-RS</td>
<td>6</td>
<td>Lbd</td>
<td>Ovl</td>
<td>11</td>
<td>22</td>
<td>19.8</td>
<td>3.3x3.3</td>
<td>2.2</td>
</tr>
<tr>
<td>5. <em>H. bacciferum</em> var. tuberculatum</td>
<td>22(24)24</td>
<td>19(22)24</td>
<td>Sph-SP</td>
<td>S</td>
<td>6</td>
<td>Lbd; Cir</td>
<td>Cir-Ovl</td>
<td>Obs</td>
<td>14.3</td>
<td>18.7</td>
<td>2.2x2.2</td>
<td>1.1</td>
</tr>
<tr>
<td>6. <em>H. bacciferum</em> var. tuberculatum</td>
<td>26(27)29</td>
<td>25(27)29</td>
<td>SP</td>
<td>RS-M</td>
<td>6</td>
<td>Lbd</td>
<td>Ovl</td>
<td>Obs</td>
<td>9.9</td>
<td>27.5</td>
<td>Obs</td>
<td>1.7</td>
</tr>
<tr>
<td>7. <em>H. bacciferum</em> var. tuberculatum</td>
<td>20(21)23</td>
<td>13(17)19</td>
<td>SP-Pr</td>
<td>S</td>
<td>6</td>
<td>Cir</td>
<td>Cir</td>
<td>3.3</td>
<td>5.5</td>
<td>16.5</td>
<td>3.3x3.3</td>
<td>1.1</td>
</tr>
<tr>
<td>8. <em>H. bacciferum</em> var. tuberculatum</td>
<td>25(27)28</td>
<td>20(22)23</td>
<td>SP</td>
<td>S-RS</td>
<td>8</td>
<td>Lbd</td>
<td>Ovl</td>
<td>Abst</td>
<td>7.7</td>
<td>19.8</td>
<td>2.2x4.4</td>
<td>2.2</td>
</tr>
<tr>
<td>9. <em>H. bacciferum</em> var. tuberculatum</td>
<td>22(23)28</td>
<td>15(18)21</td>
<td>SP-Pr</td>
<td>S</td>
<td>6</td>
<td>Cir; Lbd</td>
<td>Ovl</td>
<td>Abst</td>
<td>4.4</td>
<td>18.7</td>
<td>3.3x3.3</td>
<td>1.1</td>
</tr>
<tr>
<td>10. <em>H. dasyarum</em> var. dasyarum</td>
<td>23(26)30</td>
<td>21(22)24</td>
<td>SP</td>
<td>S</td>
<td>6</td>
<td>Lbd</td>
<td>Ovl</td>
<td>Obs</td>
<td>9.9</td>
<td>20.9</td>
<td>2.2x3.3</td>
<td>2.2</td>
</tr>
<tr>
<td>11. <em>H. dasyarum</em> var. dasyarum</td>
<td>29(32)37</td>
<td>22(25)30</td>
<td>SP</td>
<td>RS-M</td>
<td>6</td>
<td>Cir; Lbd</td>
<td>Cir-Ovl</td>
<td>Obs</td>
<td>22</td>
<td>28.6</td>
<td>3.3x2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>12. <em>H. gilliatum</em></td>
<td>28(29)34</td>
<td>20(21)24</td>
<td>Pr</td>
<td>S-RS</td>
<td>6</td>
<td>Lbd</td>
<td>Ovl</td>
<td>Abst</td>
<td>18.7</td>
<td>22</td>
<td>28.6</td>
<td>1.1</td>
</tr>
<tr>
<td>13. <em>H. marforiifolium</em> subsp. wallii</td>
<td>35(42)46</td>
<td>24(32)80</td>
<td>SP-Pr</td>
<td>M-RL</td>
<td>10</td>
<td>Lbd</td>
<td>Ovl</td>
<td>6.6</td>
<td>7.7</td>
<td>27.5</td>
<td>3.3x5.5</td>
<td>2.2x3.3</td>
</tr>
<tr>
<td>14. <em>H. oliganthum</em></td>
<td>22(24)26</td>
<td>21(22)23</td>
<td>Psph-Sph</td>
<td>S</td>
<td>6</td>
<td>Lbd</td>
<td>Cir-Ovl</td>
<td>4.4</td>
<td>19.8</td>
<td>18.7</td>
<td>3.3x3.3</td>
<td>1.1</td>
</tr>
<tr>
<td>15. <em>H. phlogiogossum</em></td>
<td>20(23)25</td>
<td>17(18)21</td>
<td>SP</td>
<td>S</td>
<td>6</td>
<td>Lbd</td>
<td>Cir-Ovl</td>
<td>Abst</td>
<td>7.7</td>
<td>16.5</td>
<td>5.5x3.3</td>
<td>1.1</td>
</tr>
<tr>
<td>16. <em>H. rariflorum</em></td>
<td>26(28)29</td>
<td>18(19)22</td>
<td>Pr</td>
<td>S-RS</td>
<td>8</td>
<td>Cir; Sgr</td>
<td>Ovl</td>
<td>Obs</td>
<td>11</td>
<td>25</td>
<td>4.4x3.3</td>
<td>2.2</td>
</tr>
<tr>
<td>17. <em>H. remotiflorum</em></td>
<td>20(24)26</td>
<td>13(17)20</td>
<td>Pr</td>
<td>S</td>
<td>6</td>
<td>Lbd-Cir</td>
<td>Ovl</td>
<td>3.3</td>
<td>14.3</td>
<td>17.3</td>
<td>3.3x3.3</td>
<td>1.7</td>
</tr>
<tr>
<td>18. <em>H. strigosum</em></td>
<td>33(34)41</td>
<td>29(31)33</td>
<td>SP</td>
<td>M</td>
<td>8</td>
<td>Lbd-Cir</td>
<td>Ovl</td>
<td>5.0</td>
<td>18.7</td>
<td>29.7</td>
<td>2.2x5.5</td>
<td>2.2</td>
</tr>
<tr>
<td>19. <em>H. subulatum</em></td>
<td>28(29)31</td>
<td>22(25)26</td>
<td>SP</td>
<td>S-RS</td>
<td>6</td>
<td>Lbd-Cir</td>
<td>Ovl-Cir</td>
<td>Abst</td>
<td>19.8</td>
<td>25.3</td>
<td>2.2x1.1</td>
<td>1.7</td>
</tr>
<tr>
<td>20. <em>H. supinum</em></td>
<td>40(44)48</td>
<td>22(26)29</td>
<td>Pr</td>
<td>RS-RL</td>
<td>6</td>
<td>6-sided</td>
<td>Ovl</td>
<td>7.7</td>
<td>25.3</td>
<td>38.5</td>
<td>3.3x7.7</td>
<td>2.2</td>
</tr>
<tr>
<td>21. <em>H. ulophyllum</em></td>
<td>20(22)23</td>
<td>12(14)17</td>
<td>Pr</td>
<td>S</td>
<td>6</td>
<td>Lbd</td>
<td>Ovl</td>
<td>2.2</td>
<td>11.0</td>
<td>16.5</td>
<td>2.2x2.2</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Key to abbreviations: P = polar axis; E = equatorial axis; Pr = prolate; SP = subprolate; Psph = prolate sphaeroidal; Sph = sphaeroidal; S = small; RS = rather small; Sgr = Square; M = medium; RL = rather large; L = large; Cir = circular; Obs = obscure; Abst = absent; Rd. Triang = Rounded Triangular; Lbd = lobed; Ovl = Oval; Abr = Aperture.
Fig 1 Heliotropium barbatum var. lignosum A. Polar view B. Equatorial view: simple colpus C. Equatorial view: colporate and colporate apertures
Heliotropium baluchistanicum D. Polar view E. Equatorial view
Heliotropium annuum E. Polar view F. Equatorial view: simple colpus
Heliotropium pardinum G. Polar view: colporate and colporate apertures
Heliotropium tenuifolium H. Polar view: colporate and colporate apertures (Magnification x 2500)
Fig. 2. *Heliotropium cabulicum*. A. Equatorial view; heterocolpate.

*Heliotropium calcareum*: B. Polar view.

*Heliotropium criepum*: 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
   - Grains circular in equatorial outline
     7, *H. clacareum*

14. + Mesocolpia 4.4 μm
   - Mesocolpia 7.7–9.9 μm
     9, *H. curassavicum*

15. + Ora lalongate
   - Ora lalongate
     15, *H. ophioglossum*
     10, *H. dasycarpum* var. *dasycarpum*

16. + Exine 1.1–1.7 μm
   - Exine 2.2 μm
     18

17. + Pollen circular in equatorial view
   - Pollen oval in equatorial view
     3, *H. baluchistanicum*
     4, *H. biannulatum*

18. + Grains spheroidal in shape
   - Grains prolate in shape
     19

19. + Apocolpium absent due to long colpi
   - Apocolpium 3.3 μm
     12, *H. gillianum*
     17, *H. remotiflorum*

20. + Mesocolpia 19.8 μm
   - Mesocolpia 14.3 μm
     14, *H. oliganthum*
     5, *H. brahuicium*

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. *tuberculatum* 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.

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References


