Plant Sci. Arc.
Plant Science Archives
An International Journal of Plant Biology

Original Research Article
ISSN 2518-6965
Journal Homepage: www.plantarc.com

Analysis of Pollen Micro-Morphological Traits in Selected Rubiaceae Species from Iraq

Tahseen A. H. Al-Taie and Afrah A. Sadek*

Al-Karkh III Baghdad Education Directorate, Baghdad, Iraq

Citation: Tahseen A. H. Al-Taie and Afrah A. Sadek (2025). Analysis of Pollen Micro-Morphological Traits in Selected Rubiaceae Species from Iraq. *Plant Science Archives.* **DOI: https://doi.org/10.51470/PSA.2025.10.3.41**

Corresponding Author: **Afrah A. Sadek** | E-Mail: **(7sonialaa@gmail.com)**

Received 13 May 2025 | Revised 15 June 2025 | Accepted 17 July 2025 | Available Online 21 August 2025

ABSTRACT

This study focused on examining the micro-morphological characteristics of pollen grains from various Rubiaceae species found in Iraq. The species analyzed included: Wendlandia ligustroides, Sherardia arvensis, Crucianella parviflora, C. exasperata, C. kurdistanica, C. chlorostachys, C. gilanica, Asperula setosa, A. xylorhiza, A. laxiflora, A. insingis, A. friabilis, A. comosa, A. astrocephala, A. laxiflora. This study of pollen morphology has been carried out under LM with differential analysis by shape, size (polar and equatorial), and number of colpi. It comprised an evaluation based on qualitative and quantitative traits to test their role in the identification of species belonging to this large family and placement within it. Most grains qualified as small, presenting a shape spectrum that extended from oblate-spheroidal, oblate, sub-oblate, up to prolate-spheroidal. Much variation was found in the number of colpi, with three from Wendlandia ligustroides up to eleven from Sherardia arvensis.

Keywords: *Asperula, Crucianella, Sherardia, Wendlandia, pollen morphology.*

Introduction

The Rubiaceae is the fourth largest family of dicotyledonous plants, comprising about 563 to 611 genera and between 10,900 to 13,150 species worldwide [1]. In Iraq, this family has representation by 12 genera [2]. Among these, the genus *Asperula* contains twelve species; *Crucianella* comprises eight species while *Sherardia* and *Wendlandia* are represented by a single species each [2]. Palynology has proved very useful in illustrating diversity as well as providing classification information for angiosperms [3]. Several international studies have described the pollen morphology of Rubiaceae that includes *Asperula*, *Crucianella*, *Sherardia*, and *Wendlandia* [4–12]. Studies on Iraqi members of this family have not been anything to go by, apart from works done mainly on the genus *Galium* [13,14]. Thus, this paper intends to carry out a study on pollen morphology from Iraqi species of *Asperula*, *Crucianella*, *Sherardia*, and *Wendlandia* for any possible contribution toward better taxonomic or phylogenetic elucidation of Rubiaceae in that area.

Materials and Methods

The material of this work comprised herbarium specimens from the National Herbarium of Iraq (BAG) and the University Herbarium, College of Science, University of Baghdad (BUH). Fresh plant material was also collected during field trips between April and June 2019 deposited later at the Herbarium, College of Education, University of Baghdad (BUE). Pollen grains were prepared for light microscopic study using a staining solution of glycerin-safranin. Measurements were taken from 15 to 25 pollen grains for each specimen (figure1,2,3) observed. The following features have been recorded: diameter, polar axis (P), equatorial diameter (E), number and length of colpi, and exine thickness.

Results

General Morphology

All the taxa reviewed exhibited isopolar and radially symmetrical pollen grains in confirmation with findings previously reported [9,15,12].

Size

Pollen grains for the studied taxa were generally small. The diameter in polar view varied from 11.8 µm in Crucianella kurdistanica to 24.8 µm in Asperula setosa. Equatorial diameters ranged from 15.1 µm for Wendlandia ligustroides to 23.1 µm for A. xylorhiza.

Shape

The P/E ratio determined the shape of the pollen. The grains of A. comosa, A. friabilis, and C. exasperata were between oblate and spheroidal. Suboblate Subulate forms were seen in A. astrocephala and C. gilanica, while C. kurdistanica Kurdistanica presented oblate grains. Prolate forms were found in A. setosa as well as Sherardia arvensis and W. ligustroides.

Apertures (Colpi)

Exine thickness. All taxa except the number of colpi exhibited zonocolpate pollen. *W. ligustroides* showed three colpi as also reported earlier [15,11]. Four were observed in *C. kurdistanica*, six in *A. comosa*, *A. friabilis*, and *A. xylorhiza*. Nine were seen in *A. astrocephala*, *C. exasperata*, and *C. gilanica* but the highest number was noted from *S. arvensis* with eleven numbers. Colpi are semi-elliptical, having acute ends.

Exine thickness

Exine thickness recorded shows a great variation among species, from 0.52 µm in *C. exasperata* to 2.8 µm in S. arvensis.

DOI: https://doi.org/10.51470/PSA.2025.10.3.41

Table 1. Morphological characteristics of pollen grains in selected Rubiaceae species from Iraq. Measurements in micrometers (µm); P/E = Polar/Equatorial axis ratio.

Species Name	Diameter (Top View)	Diameter (Side View)	Shape Ratio (P/E)	Number of Furrows	Furrow Length	Exine Thickness
A. astrocephala	13–15.6 µm (avg. 14.17)	13–15.6 µm (avg. 13.9)	0.83	8	13–15.6 µm (avg. 14.8)	1.3 µm
A. comosa	18.2–22.1 µm (avg. 19.5)	16.9–22.1 µm (avg. 20)	0.96	6	16.9–23.4 µm (avg. 19.6)	1.3 µm
A. friabilis	16.9–20.8 µm (avg. 18.3)	15.6–20.8 µm (avg. 18.2)	0.93	6	13–15.6 µm (avg. 14.5)	0.78 µm
A. setosa	23.4–26 µm (avg. 24.8)	23.4–26 µm (avg. 24.4)	1.09	8	20.8–23.4 µm (avg. 22.3)	1.3 µm
A. xylorhiza	14.3–20.8 µm (avg. 17.5)	20.5–25.8 µm (avg. 23.1)	0.77	6	18.2–23.4 µm (avg. 20.8)	1.4 µm
C. exasperata	15.6–20.8 µm (avg. 18.2)	18.2–20.8 µm (avg. 19.3)	0.82	8	15.6–19.5 µm (avg. 17.7)	0.52 µm
C. gilanica	18.2–20.8 µm (avg. 19.1)	15.6–23.4 µm (avg. 19.6)	0.87	9	15.6–19.5 µm (avg. 17.6)	1.4 µm
C. kurdistanica	11.6–12 µm (avg. 11.8)	12.2–13 µm (avg. 12.6)	0.64	4	15.6–18.2 µm (avg. 17)	1.3 µm
S. arvensis	20.8–23.4 µm (avg. 22.3)	20.8–23.4 µm (avg. 21.7)	1.02	11	20.8–23.4 µm (avg. 22.1)	2.8 µm
W. ligustroides	13–15.6 µm (avg. 14.5)	13.4–16.8 µm (avg. 15.1)	0.96	3	13–15.6 µm (avg. 14.8)	1.56 µm

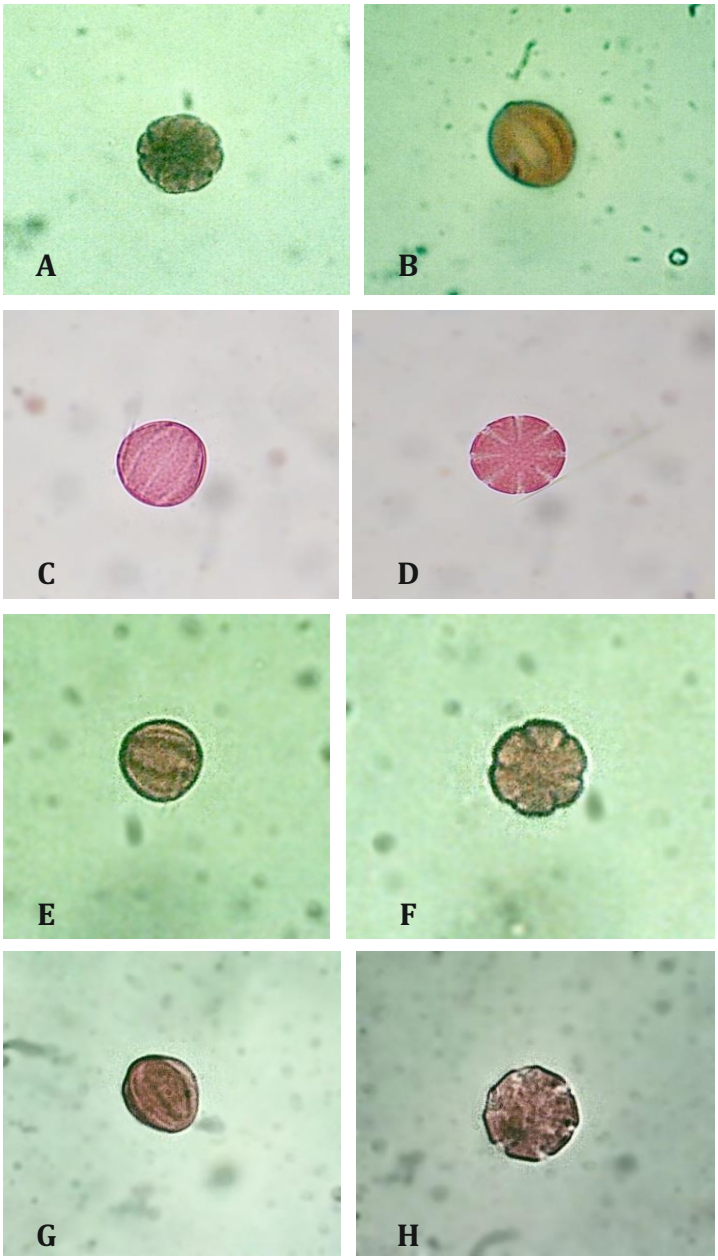

Figure 1 presents microscopic pollen taken at 10 µm from different species of Asperula. A, B- Asperula astrocephala, A. from the top (polar) side which shows colpi arrangement, and B from the side (equatorial view) where furrows (colpi) are seen clearly. C, D- These show the pollen of A. setosa, C from equatorial orientation and D displaying the grain from the polar axis. E, F- This is A. comosa, E gives a lateral view wherein colpi are distinct and F gives a polar aspect presenting symmetry of the grain. G , H- This is A . friabilis , G displays a side view showing surface features while H represents a polar view that emphasizes aperture arrangement.

Figure 2 presents the light microscopic views of pollen taken at the scale bar of 10 µm for Asperula xylorrhiza and two Crucianella species. I represent an equatorial view that shows the distribution of colpi while the J image gives a polar view in which the arrangement of apertures can be seen for A. xylorrhiza. K gives a lateral (equatorial) overview indicating the outline as well as furrows on grains for Crucianella exasperata pollen whereas L provides a polar aspect with clearly visible colpi, M displays surface structure together with colpal pattern in equatorial orientation for Crucianella gilanica and finally, N also presents symmetry besides location of aperture in polar view.

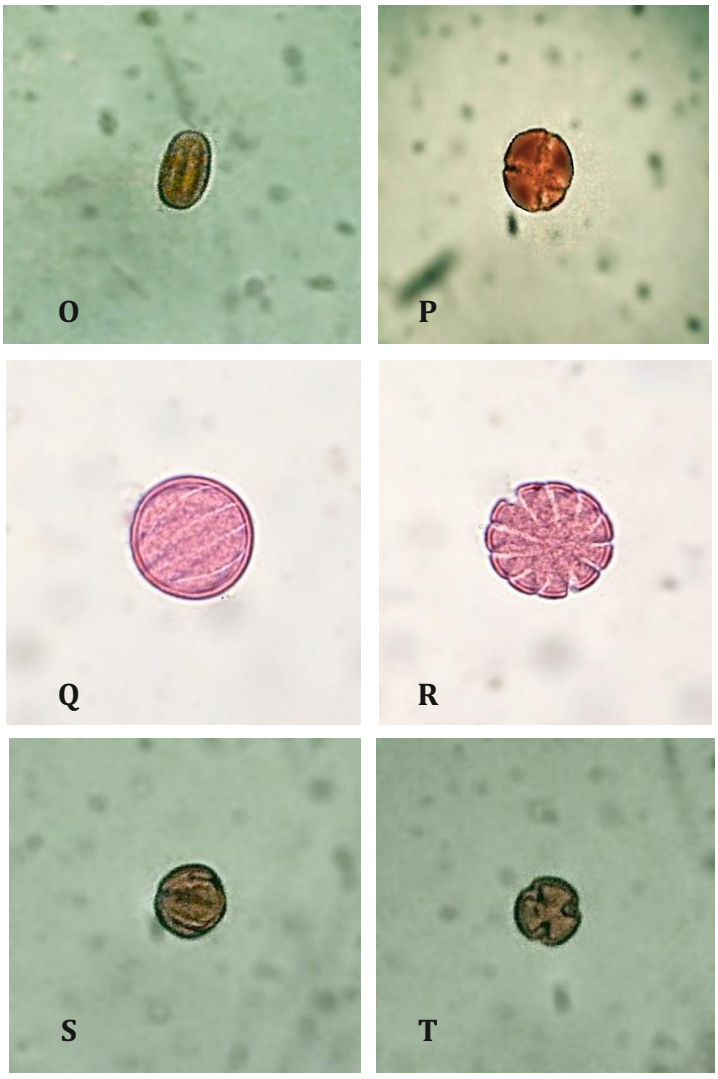

Figure 3 comprises the photomicrographs of pollen grains belonging to Crucianella kurdistanica, Sherardia arvensis, and Wendlandia ligustroides at 10 µm. Pictures O and P show C. kurdistanica, where in O a view from the equatorial side exposing the colpi arrangement along the surface of the grain is given, and in P a polar view indicating the arrangement of colpi is presented. Pictures Q and R show Sherardia arvensis, where in Q an equatorial view with furrows visible is presented, and in R a polar view displaying grain shape with several apertures is indicated. The last pictures S and T belong to W. ligustroides; S presents an equatorial view with very clear colpi, while T gives the polar view with a very regular arrangement of apertures.

Discussion

The palynological features of the Rubiaceae taxa from Iraq prove that pollen grains are, in general, small and agree with previous studies [15,9,12,10]. The aperture forms were mostly of colpate type and the number of colpi ranged between 3 and 11 [15]. Particularly *W. ligustroides* has three colpi, as also reported in studies performed in China and Pakistan [11,15]. *A. comosa* was found to be six-colpate, whereas *A. setosa* had eight colpi, and this finding also supported earlier work [15]. *S. arvensis* has eleven colpi, which is within the range provided [9]. The length of colpi showed variability: *A. friabilis* presented a mean of 14.5 µm, having the shortest value, whereas that for *A. setosa* was highest at a mean value of 22.3 µm. Comparative literature reports a colpus length of 19.6 µm for *A. comosa* [15] and 12.4 µm in a separate study [12].

The shape of pollen grains, inferred from P/E ratios, varied from oblate-spheroidal to prolate-spheroidal. For example, *A. comosa* exhibited oblate-spheroidal shapes [12], while *A. setosa* and *S. arvensis* displayed prolate-spheroidal forms [15,9]. These morphological distinctions—especially in pollen size, shape, colpi number, and exine thickness—are valuable for the taxonomy and phylogenetic interpretation of Rubiaceae species. Further palynological investigations on additional Rubiaceae taxa are recommended to deepen systematic understanding.

References

1. Simpson, M.G. (2010). *Plant systematics*, 2nd ed., Elsevier Acad. Press: 740 pp.

2. Townsend, C.C. & Guest, E. (1980). *Flora of Iraq*, vol. 4, part 1. Agriculture and Agrarian Reform, Baghdad: 627 pp.

3. Blackmore, S. (2007). Pollen and spores: Microscopic keys to understanding the earth's biodiversity. *Plant Syst. Evol.*, 263: 3-12. DOI:10.1007/s00606-606-0464-3.

4. Erdtman, G. (1952). *Pollen morphology and plant taxonomy-angiosperms: An introduction to palynology*, vol. 1, Almqvist & Wiksell, Stockholm: 553 pp.

5. Huysmans, S.; Robbrecht, E. & Smets, E.F. (1994). Are the genera Hallea and Mitragyna (Rubiaceae-Coptosapelteae) pollen morphologically distinct? *Blumea: Biodivers. Evol. Biogeogr. Plants*, 39(1/2): 321-340.

6. Huysmans, S.; Robbrecht, E. & Smets, E. (1998). A collapsed tribe revisited: Pollen morphology of the Isertieae. *Rev. Paleobot. Palynol.*, 104: 85-113. DOI:10.1016/S0034-6667(98)00054-2.

7. Bremer, B. & Manen, J.-F. (2000). Phylogeny and classification of the subfamily Rubioideae (Rubiaceae). *Pl. Syst. Evol.*, 225(1-4): 43-72. DOI:10.1007/ BF00985458.

8. Molina, L.S.; Zequeira, M.F. & Oliver, P.H. (2002). Pollen morphology of some Cuban *Guettarda* species (Rubiaceae: Guettardeae). *Grana*, 41(3): 142-148. DOI:10.1080/001731302321042605.

9. Huysmans, S.; Dessein, S.; Smets, E. & Robbrecht, E. (2003). Pollen morphology of NE European representatives confirms morphology of Rubieae (Rubiaceae). *Rev. Paleobot. Palynol.*, 127(3-4): 219-240. DOI:10.1016/S0034-6667(03)00121-0.

10. Minareci, E.; Yildiz, K. & Cirpici, A. (2010). Comparative morphological and palynological study on poorly known *Asperula serotina* and its closest relative *A. purpurea* subsp. *Apiculate*. *Sci. Res. Essays*, 5(17): 2472-2479.

11. Xie, P. & Zhang, D. (2010). Pollen morphology supports the transfer of *Wendlandia* (Rubiaceae) out of Rondeletieae. *Bot. J. Linn. Soc.*, 164(2): 128-141. DOI:10.1111/j.1095-8339.2010.01080.x.

12. Öztürk, M. (2013). *Asperula anatolica* (Rubiaceae) a new species from south-east Anatolia, Turkey. *Turk. J. Bot.*, 37: 46-54. DOI:10.3906/bot-1207-5.

13. Gharb, L.A. & Al-Musawi, A.H.E. (2013). Vascularization of leaves and stem of the species *Galium aparine* L. *Iraqi J. Sci.*, 54(2): 274-279.

14. Al-Dabagh, Z.M. (2019). A comparative taxonomical study for some species of the genus *Galium* L. (Rubiaceae) in Iraq. M. Sc. Thesis, Coll. Educ. Pure Sci. (Ibn Al-Haitham), Univ. Baghdad: 138 pp. (In Arabic).

15. Perveen, A. & Qaiser, M. (2002). Pollen flora of Pakistan-Liv. Rubiaceae. *Pak. J. Bot.*, 39(4): 999-1015.