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# Micromorphology Pollen Grains of Five Species of the Genus *Salvia* L. (Lamiaceae) in Libya

By Ghalia T. El Rabiai & Khatria K. Elfaidy
*Benghazi University*

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# Micromorphology Pollen Grains of Five Species of the Genus *Salvia* L. (Lamiaceae) in Libya

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*Abstract-* In the present work, the pollen morphological features of five species, belonging to the genus *Salvia* (Lamiaceae: subfamily Nepetoideae: tribe Mentheae) *S. lanigera* Poir, *S. verbenaca* L., *S. fructicosa* Miller., *S. spinosa* L., *S. viridis* L., which were collected throughout Libya, have been intensively studied by using scanning electron microscopy(SEM). The basic shape of the pollen grains in most taxa is suboblate, oblate-spheroidal. oblate-spheroidal in one species(*S. lanigera*) and suboblate in four species others. Hexacolpate pollen is dominant in all studied taxa. All species medium size. The exine ornamentation of these four species is bireticulate-Perforate(the common type) with one exception in the case of (*S. verbenaca*), showing a reticulate-Perforate. The findings show that palynological characters such as pollen shape, aperture numbers, and types, and exine ornamentation exhibit remarkable differences amongst the studied species.

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## I. Introduction

Lamiaceae is one of the largest Angiosperm families, comprising approximately 240 genera and more than 7,000 taxa distributed throughout the world, and is economically important (Myoung & Yuon, 2012). In the flora of Libya, is represented by 22 genera and about 65 species (JAFRI & El-GADI, 1985). The family is known for its fine ornamental or culinary herbs like basil, lavender, mint, oregano, rosemary, sage, and thyme and is a rich source of essential oils for the perfume industry (Kahraman *et al*., 2009 c). The genus *Salvia* L. is one of the largest genera in this family (Cvetkovikj et al., 2015). *Salvia* is a genus with about 1000 species (Walker and Sytsma, 2007; Kahraman et al., 2009 a,c; Özler et al., 2011; Saravia & Pinto, 2018; and Akta et al., 2020). In Libya, is represented by ten species; out of which, three are cultivated (JAFRI 1985). *Salvia* species are used in traditional medicines worldwide, possessing antioxidant, antidiabetic, antibacterial, antitumor, antiplasmodial, and anti-inflammatory features. Many Salvia species are used as herbal tea, and in food, cosmetics, perfumery, and the pharmaceutical industry. In addition, *Salvia* species are also grown in parks and gardens as ornamental plants (Kahraman et al., 2010a). Pollen morphologies for the family Lamiaceae have been investigated by several workers, such as (Harley et al.,1992; Celenk et al., 2008; Moon et al., 2008; and Doaigey et al., 2018). However studies on pollen morphology in *Salvia* have been conducted by many researchers worldwide (Kahraman et al., 2009 a,c,2010a,b; Özler et al., 2011,2013; Doaigey et al., 2018; Akta et al., 2020). In general, the shape of pollen grains is specific to the taxonomic ranks, such as family, genus, and species (Myoung & Yukon; 2012). Therefore, the main objective of the present study is to provide a detailed account of the pollen morphology of five species by using a scanning electron microscope (SEM).

*Author α σ: Department of Botany, Faculty of Science, Benghazi University, Libya. e-mail: Ghalia.Alrabiai@uob.edu.ly*

## II. Materials and Methods

Pollen grains of five species of the genus *Salvia* (*S. lanigera* Poir, *S. verbenaca* L., *S. fruticosa* Mill, *S. spinosa* L., *S. viridis* L.) were studied by SEM. Pollen material was obtained from plant specimens collected from Libya between 2018 and 2020. The voucher specimens are listed in Table 1. Pollen grains were compared in their morphological characters by determining their size, shape, and exine ornamentation. The terminology used is by Punt *et al*. (2007), Özler *et al*. (2011), and AKTA *et al*. (2020). Size measurements for the pollen grains were taken according to Erdtman (1971) (very small < 10 µm in dimensions; small 10-25 µm; medium (25-50) µm; large (50-100) µm; very large (100-200) µm; huge > 200 µm) (Al-Watban *et al*. 2015).

*Table 1:* List of *Salvia* species used in this study and their locations

| No. | Species | Locality | Date |
|---|---|---|---|
| 1 | *Salvia lanigera* Poir. | Busnib | 20/Mar./2019 |
| 2 | *S. verbenaca* L. | Wadi aleagr | 23/Jan./2020 |
| 3 | *S. fruticosa* Mill. | Albayadih | 28/Mar/2018 |
| 4 | *S. spinosa* L. | Garyounis | 15/Mar/2019 |
| 5 | *S. viridis* L. | Talmitha | 13/Feb/2020 |

## III. Results

*a) Salvia lanigera Poir*

The pollen grains are yellow in color, medium size, oblate-spheroidal shaped in outline. Pollen with hexa-colpate, exine ornamentation with bireticulate-perforate. The polar length is 34.64µm, equatorial length is 35.69µm; and polar axis/equatorial axis (P/E) is 0.97µm (Figure A, B and Table 2).

*b) S. verbenaca L.*

The pollen grains are yellow in color, medium size, suboblate shaped in outline. Pollen with hexa-

colpate, exine ornamentation with reticulate-perforate. The polar length is 30.85µm, equatorial length is 35.88µm; and polar axis/equatorial axis (P/E) is 0.86µm (Figure C, D and Table 2).

*c) S. fruticosa Mill.*

The pollen grains are white in color, medium size, suboblate shaped in outline. Pollen with hexa-colpate, exine ornamentation with bireticulate-perforate. The polar length is 34.28 µm, equatorial length is 42.15µm; and polar axis/equatorial axis(P/E) is 0.81µm (Figure E,F and Table 2).

*d) S. spinosa L.*

The pollen grains are white in colour, medium size, suboblate shaped in outline. Pollen with hexa-colpate, exine ornamentation with bireticulate-perforate. The polar length is 36.82µm, equatorial length is 45.28µm; and polar axis/equatorial axis (P/E) is 0.81µm (Figure G,H and Table 2).

*e) S. viridis L.*

The pollen grains are yellow in color, medium size, suboblate shaped in outline. Pollen with hexa-colpate, exine ornamentation with bireticulate-perforate. The polar length is 29.02µm, equatorial length is 34.15 µm, and polar axis/equatorial axis (P/E) is 0.85µm (Figure I, J and Table 2).

*Table 2:* Summary of pollen micromorphology for *Salvia* species examined using SEM

| No. | Taxa name | mean value | | P/E | Shape | Exine ornamentation | Type of aperture | Size |
|---|---|---|---|---|---|---|---|---|
| | | P | E | | | | | |
| 1 | *Salvia lanigera* Poir. | 34.64 | 35.69 | 0.97 | oblate-spheroidal | Bireticulate-perforate | Hexa-colpate | medium |
| 2 | *S. verbenaca* L. | 30.85 | 35.88 | 0.86 | suboblate | Reticulate-perforate | Hexa-colpate | medium |
| 3 | *S. fruticosa* Mill. | 34.28 | 42.15 | 0.81 | suboblate | Bireticulate-perforate | Hexa-colpate | medium |
| 4 | *S. spinosa* L. | 36.82 | 45.28 | 0.81 | suboblate | Bireticulate-perforate | Hexa-colpate | medium |
| 5 | *S. viridis* L. | 29.02 | 34.15 | 0.85 | suboblate | Bireticulate-perforate | Hexa-colpate | medium |

*P/E ratio: oblate = 0.50–0.75; suboblate = 0.75–0.88; oblate-Spheroidal = 0.88–1.00 (Punt et al., 2007). E, equatorial axis; P, polar axis. All measurements in µm.*

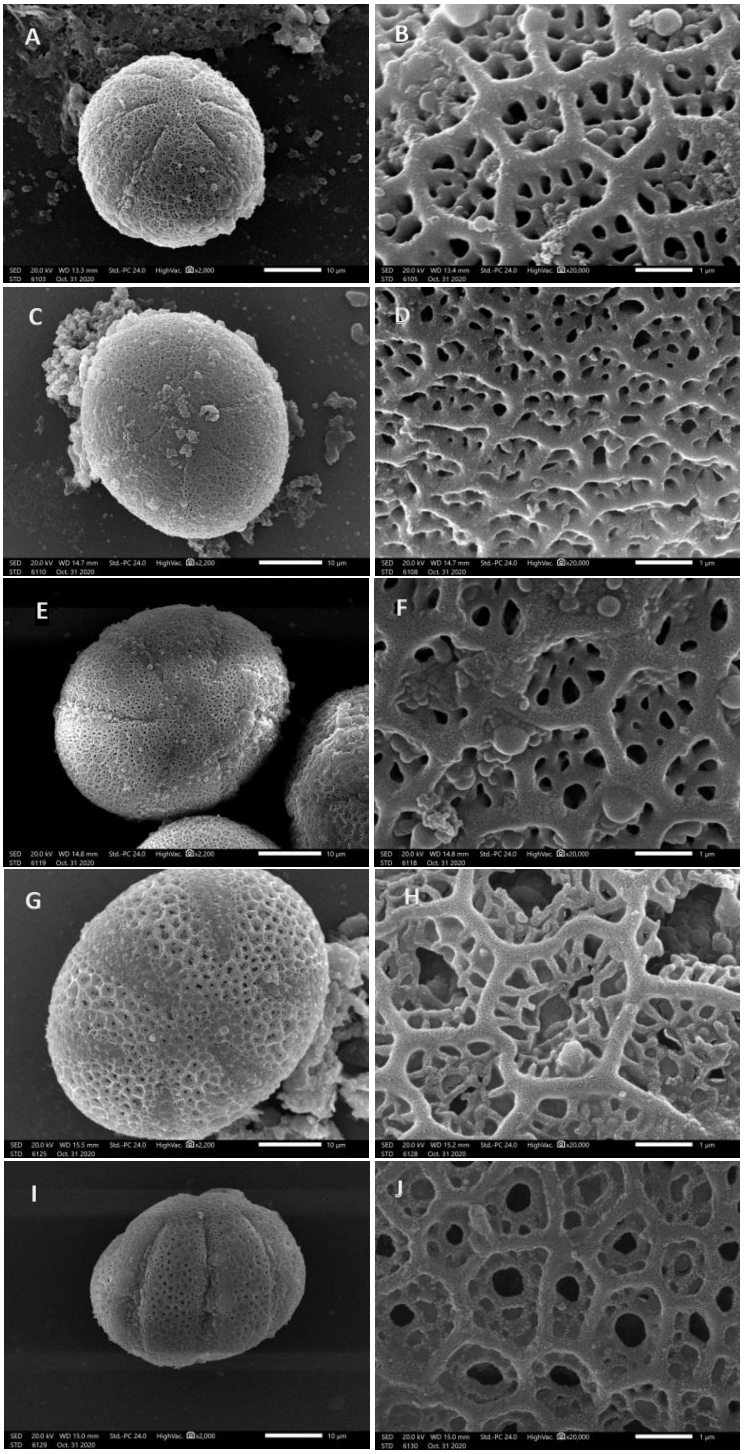


*Figure 1:* SEM photographs of the pollen grains of Salvia species. A-B Salvia lanigera, C-D S. verbenaca, E-F, S. fruticosa, G-H, S. spinosa, I-J, S. viridis.

## IV. Discussion and Conclusion

Previous studies have shown that the pollen grains of Lamiaceae could be prolate-spheroidal, subprolate, prolate; tricolpate or hexacolpate, and exine ornamentation was observed as tuberculate, microreticulate, bireticulate, and polish (Myoung *et al*., 2012). Doaigey *et al*., 2018 reported in their study that 20 species belong to 16 genera of the Lamiaceae that have been investigated using a light microscope (LM), and SEM size of the pollen is variable between the genera but not among the species of the same genus. Characters of pollen grains size, shape, exine

ornamentation, and the number of apertures are important and deciding factors for the systematic study of various genera under the family Lamiaceae. These results in our study pollen grains of five species belonging to genus of *Salvia* of the family Lamiaceae shown genus variation in the shape of the pollen grains varies from suboblate to oblate-spheroidal. The size of the polar axis (P) varies from 29.02 µm, in *S. viridis*, to 36.82 µm, in *S. spinosa*, while size of equatorial axis in same taxa (E) varies from 34.15, in *S. viridis*, to 45.28 µm, in *S. spinosa* (Table 2). (P/E) in (*S. fruticosa and S. spinosa* = 0.81 µm) – and (0.97µm in *S. lanigera*), oblate-spheroidal in one species(*S.lanigera*) and suboblate in four species(*S. verbenaca, S. fruticosa, S. spinosa and S. viridis*). medium size in all the species. The pollen grains are radially symmetric, isopolar, hexacolpate. The exine ornamentation of these four species is Perforate-bireticulate (the common type), with one exception in the case of *S. verbenaca*, showing a Perforate reticulate structure (Figure 1-F). *S. glutinosa* and *S. staminea* (Kahraman *et al*., 2009 a) were observed to be suboblate to prolate-spheroidal shaped pollen grains; While the sculpturing bireticulate-perforate. (Kahraman *et al*., 2009 c). The pollen in *S. indica* is hexacolpate, radially symmetrical and isopolar. Its shape is suboblate. The exine sculpturing is bireticulate-perforate. (Kahraman *et al*., 2010 a) *S. chrysophylla* has hexacolpate, radially symmetrical and isopolar, oblate-spheroidal; bireticulate-perforate. (Kahraman *et al*., 2010 c) examined pollen grains of *S. limbata* and *S. palaestina*, found some differences in their shape and size(oblate-spheroidal, prolate-spheroidal), respectively. Still they look similar in their exine ornamentation bireticulate-perforate. (Özler *et al*., 2011). Pollen grains of 30 taxa of the genus *Salvia*, belonging to sections *Salvia*, *Horminum*, *Drymosphace*, *Plethiosphace*, and *Hemisphace* from Turkey were examined by LM and SEM. Suboblate to subprolate often between oblate–spheroidal to prolate–spheroidal; hexacolpate, sometimes mixed with octacolpate grains, shows three distinct types of surface structures, reticulate–perforate (the common type), reticulate–granulate and bireticulate; (*S. fruticosa*) has the Reticulate–perforate type of exine sculpturing and bireticulate in *S. viridis*. Also (Özler *et al*., 2013) examined of 30 *Salvia* taxa in sections *Hymenosphace* and *Aethiopis* from Turkey using LM and SEM. All taxa examined are hexacolpate and rarely heptacolpate, suboblate to spheroidal in equatorial view, size is small to large. (Al-Watban *et al*., 2015) examined three *Salvia* species (*S. aegyptiaca*, *S. deserti* and *S. spinosa*); Sub-spheroidal, Bireticulate-Perforate, Prolate, Bireticulate-Perforate, and Sub-spheroidal, Bireticulate-perforate respectively; these three species is hexacolpate. (AKTA *et al*., 2020) examined pollen morphologies of twenty-one taxa belonging to the genus *Salvia* (*S. aethiopis* L., *S. argentea* L., *S. aytachii* Vural & Adigüzel, *S. blepharochlaena* Hedge & Hub.-Mor., *S. cadmica* Boiss., *S. ceratophylla* L., *S. cryptantha* Montbret & Aucher, *S. frigida* Boiss., *S. fructicosa* Miller, *S. halophile* Hedge, *S. napifolia* Jacq., *S. microstegia* Boiss. & Bal., *S. recognita* Fisch. & Mey. *S. sclarea* L., *S. smyrnaea* Boiss. *S. suffruticosa* Montbret & Aucher, *S. tchihatcheffii* (Fisch. & Mey.) Boiss., *S. tometosa* Bertol, S. *verbenaca* L., *S. viridis* L., and *S. wiedemanni* Boiss.) in Turkey using LM and SEM. all pollen grains are hexacolpate except *S. viridis* has both hexacolpate and octacolpate. Shows (*S. fructicosa* Mill) Bireticulate-perforate; (*S. verbenaca, S. viridis*) exine shows bireticulate; small size(*S. fructicosa*). To conclude, in agreement with previous investigations with few the differences in their result. The results of the present study show that palynological characters such as pollen shape, aperture numbers and types of exine ornamentation exhibit remarkable differences amongst the studied taxa, as already reported in previous studies, and may be significant in distinguishing the species.

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