

TAXONOMIC STUDY OF THE FAMILY LAMIACEAE BASED ON TRICHOME AND PALYNOLOGICAL CHARACTERS

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ABSTRACT

Trichome morphological and palynological investigations have been conducted in some members of Lamiaceae from West Bengal. Both glandular and non-glandular trichomes have obtained from *Hyptis*. Pollens are clearly grouped into two types- the 3 colpate pollen and the 6- colpate pollen. These characters are used to prepare identification key.

Keywords: *Lamiaceae, Trichome Morphology, Pollen Morphology*

INTRODUCTION

Lamiaceae is a large cosmopolitan family. According to Mabberley (2008) Lamiaceae comprises 6500 species under 238 genera. The family was earlier restricted to herbs or shrubs. Many genera of Verbenaceae and Chloanthaceae have now been included under largely circumscribed Lamiaceae (Cantino *et al.*, 1992; Harley, 2004). Therefore, many large trees are fallen under this family. Deeply four lobed ovary with gynobasic style is unique to this family.

The first palynological study of Lamiaceae was carried out by Erdtman (1945). He divided the pollens this family into two groups based on aperture number and number of nuclei in shed pollen. The number of colpi per pollen was identified as a key character to distinguish the subfamilies (Cantino and Sanders, 1986). Abu-Asab & Cantino (1994) proved that pollen morphology is an essential feature for classification within the family. Dinc and Ozturk (2008) showed that pollen characters play an important role in sectional and inter-specific classification under Lamiaceae.

Trichome morphology is now considered as an important taxonomic character. Many authors (Servettazo *et al.*, 1994; Bini Maleci *et al.*, 1995; Navarro and El Oualidi, 2000 and Dinc and Ozturk, 2008) emphasized the great value of trichomes in Lamiaceae taxonomy.

The present paper deals with the investigation on the pollen morphology and trichome morphology of some members of the family Lamiaceae found in West Bengal. The aim of this study is the production of an identification key based on pollen and trichome morphology.

MATERIALS AND METHOD

The materials for the present study were collected from both wild and home gardens. A total of nine species of Lamiaceae under six genera were collected for this study. The studied specimen were – (a) *Anisomeles ovata* R. Br.; (b) *Hyptis suaveolense* Poit.; (c) *Leonurus sibiricus* Linn.; (d) *Leucas aspera* Spreng.; (e) *Leucas biflora* (Vahl) R.Br.; (f) *Ocimum canum* Sims; (g) *Ocimum gratissimum* Linn.; (h) *Ocimum sanctum* L.; (i) *Salvia plebeja* R. Br. Voucher information of the studied taxa was properly maintained. Identification of species was confirmed by standard literatures.

Study of Trichome Morphology

Epidermal peels were passed through different grades of alcohol, from 50% to absolute alcohol, and stained in 1% safranin solution dissolved in 50% alcohol. Finally peels were mounted in Canada balsam on a clean slide (Dipa & Daniel, 2011). Trichome morphologies were drawn with the help of drawing prism and measurements were taken by stage and ocular micrometers.

Study of Pollen Morphology

Pollens were prepared following Erdtman's acetolysis technique and pictures were captured in a Carl Zeiss Axio. Lab. A1 microscope fitted with photographic attachment. All measurements were taken in Axio Vision software.

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RESULTS AND DISCUSSION

In *Hyptis suaveolense* both glandular and non-glandular trichomes are present. Trichomes in all other species are more or less similar in appearance except some critical measurements. The longest trichome is appeared in *Ocimum gratissimum* and the shortest in *Salvia plebeja*.

Descriptions of Trichome Morphology

- **Anisomeles ovata:** Hispid, non-glandular (Figure 12A), 3-4 celled, base flattened, bent, blunt length- $478.5 \pm 5.58 \mu\text{m}$, breadth- $9.13 \pm 0.08 \mu\text{m}$.
- **Hyptis suaveolens:** Hispid, both glandular and non-glandular (Figure 12B), 3-4 celled, base flattened, bent, blunt length- $770.18 \pm 24.09 \mu\text{m}$, breadth- $28.92 \pm 0.33 \mu\text{m}$.
- **Leonurus sibiricus:** Hispid (Figure 12C) non-glandular, 2-3 celled, base flattened, bent, blunt length- $137.50 \pm 5.83 \mu\text{m}$, breadth- $6.30 \pm 0.25 \mu\text{m}$.
- **Leucas aspera:** Hispid, non-glandular (Figure 12D), 2 celled, base flattened, bent, blunt length- $123.80 \pm 2.37 \mu\text{m}$, breadth- $10.16 \pm 0.20 \mu\text{m}$.
- **Leucas biflora:** Hispid, non-glandular (Figure 12E), 2 celled, base flattened, bent, blunt length- $264.28 \pm 5.49 \mu\text{m}$, breadth- $9.81 \pm 0.12 \mu\text{m}$.
- **Ocimum canum:** Hispid, non-glandular (Figure 12F), 2-3 celled, base flattened, bent, blunt length- $152.90 \pm 6.08 \mu\text{m}$, breadth- $15.04 \pm 0.16 \mu\text{m}$.
- **Ocimum gratissimum:** Hispid, non-glandular (Figure 12G), 4-5 celled, base flattened, bent, blunt length- $176.5 \pm 4.30 \mu\text{m}$, breadth- $10.09 \pm 0.11 \mu\text{m}$.
- **Ocimum sanctum:** Hispid, non-glandular (Figure 12H), 4-5 celled, base flattened, bent, blunt length- $318.70 \pm 8.83 \mu\text{m}$, breadth- $7.42 \pm 0.14 \mu\text{m}$.
- **Salvia plebeja:** Hispid, non-glandular (Figure 12I), 2 celled, base flattened, bent, blunt length $818.32 \pm 48.23 \mu\text{m}$ breadth- $26.03 \pm 0.06 \mu\text{m}$.

Table 1: Summary of Trichome Characters in Lamiaceae

Species	Trichome Type	Trichome Length (μm) [Mean $\pm$ SD]	Trichome Breadth at Base (μm) [Mean $\pm$ SD]	Trichome Cell Number
<i>Anisomeles Ovata</i>	Non-Glandular	$478.5 \pm 5.58^*$	9.13 ± 0.08	3-4
<i>Hyptis Suaveolense</i>	Non-Glandular	770.18 ± 24.09	28.92 ± 0.33	4-6
	Glandular	109.82 ± 1.33	17.86 ± 0.68	2-3
<i>Leonurus Sibiricus</i>	Non-Glandular	137.50 ± 5.83	6.30 ± 0.25	2-3
<i>Leucas Aspera</i>	Non-Glandular	123.80 ± 2.37	10.16 ± 0.20	2
<i>Leucas Biflora</i>	Non-Glandular	264.28 ± 5.49	9.81 ± 0.12	2
<i>Ocimum Canum</i>	Non-Glandular	152.90 ± 6.08	15.04 ± 0.16	2-3
<i>Ocimum Gratissimum</i>	Non-Glandular	176.5 ± 4.30	10.09 ± 0.11	5
<i>Ocimum Sanctum</i>	Non-Glandular	318.70 ± 8.83	7.42 ± 0.14	4-5
<i>Salvia Plebeja</i>	Non-Glandular	818.32 ± 48.23	26.03 ± 0.06	5-6

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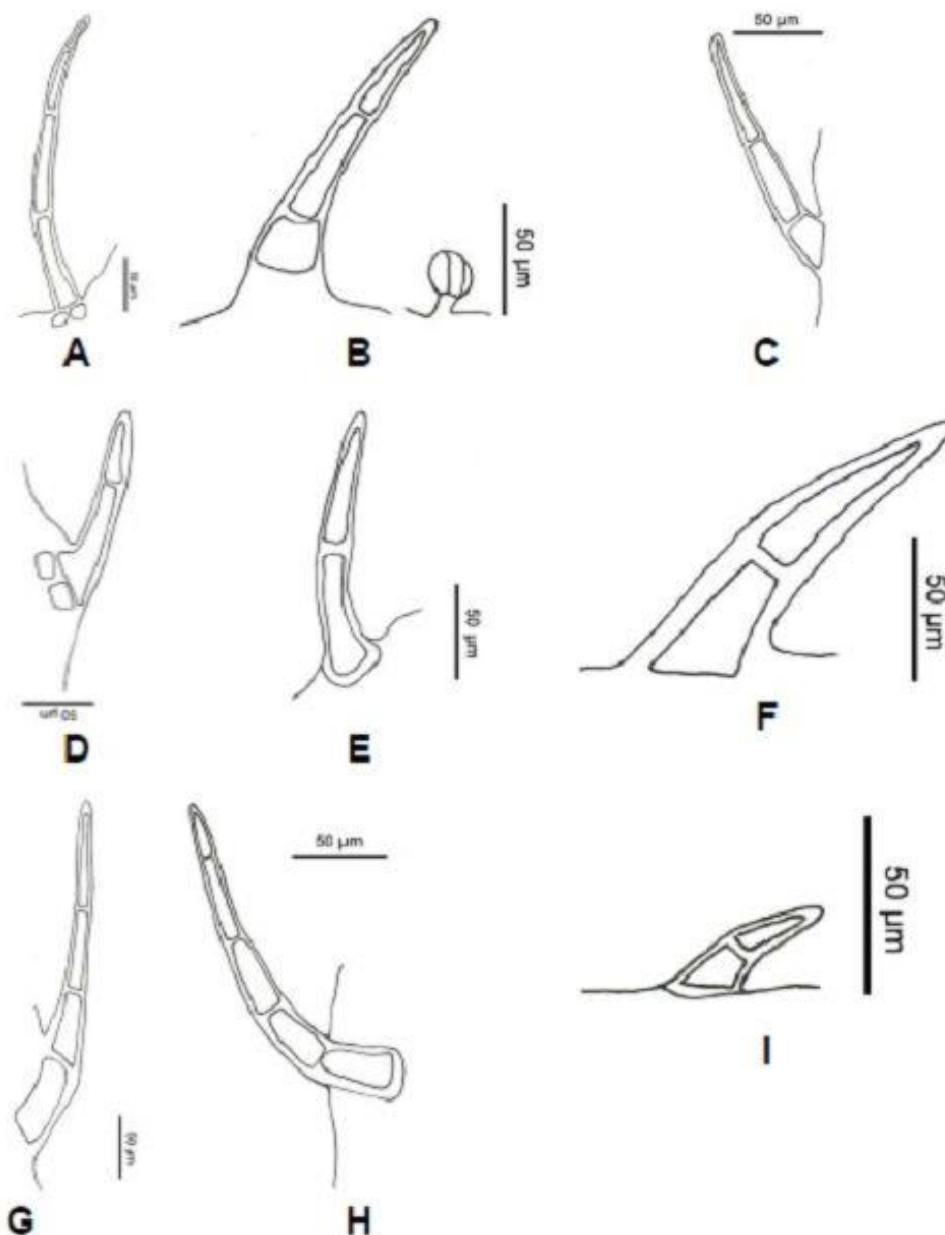


Figure 1: Leaf Trichomes of Studied Taxa. A- *Anisomeles Ovate*; B- *Hyptis Suaveolense*; C- *Leonurus Sibiricus*; D- *Leucas Aspera*; E- *Leucas Biflora*; F- *Ocimum Canum*; G- *Ocimum Gratissimum*; H- *Ocimum Sanctum*; I- *Salvia Plebeja*

Pollens are clearly distinguishable into two groups, the 3-colpate group and the 6-colpate group. *Anisomeles ovata*, *Hyptis suaveolense*, *Leucas* spp. represent the former group and *Salvia plebeja*, *Ocimum* spp. represent the later group. In the 3-colpate group finely reticulate to reticulate exine sculpturing is visible whereas in the 6-colpate group the exine sculpturing is lophoreticulate type.

Descriptions of Pollen Morphology

– ***Anisomeles ovata*:** Colpate, 3 in number (Fig.10 A-B); colpi length- c. 22.32µm, breadth c. 1.7µm. Equatorial shape Oblate-spheroidal, amb- peritreme. Polar axis c. 27.88 µm, equatorial diameter c. 31.45 µm. Sexine c. 1.70 µm and nexine c. 1.70 µm thick. Sexine = Nexine. Pollen surface sculpturing- reticulate. NPC- 343.

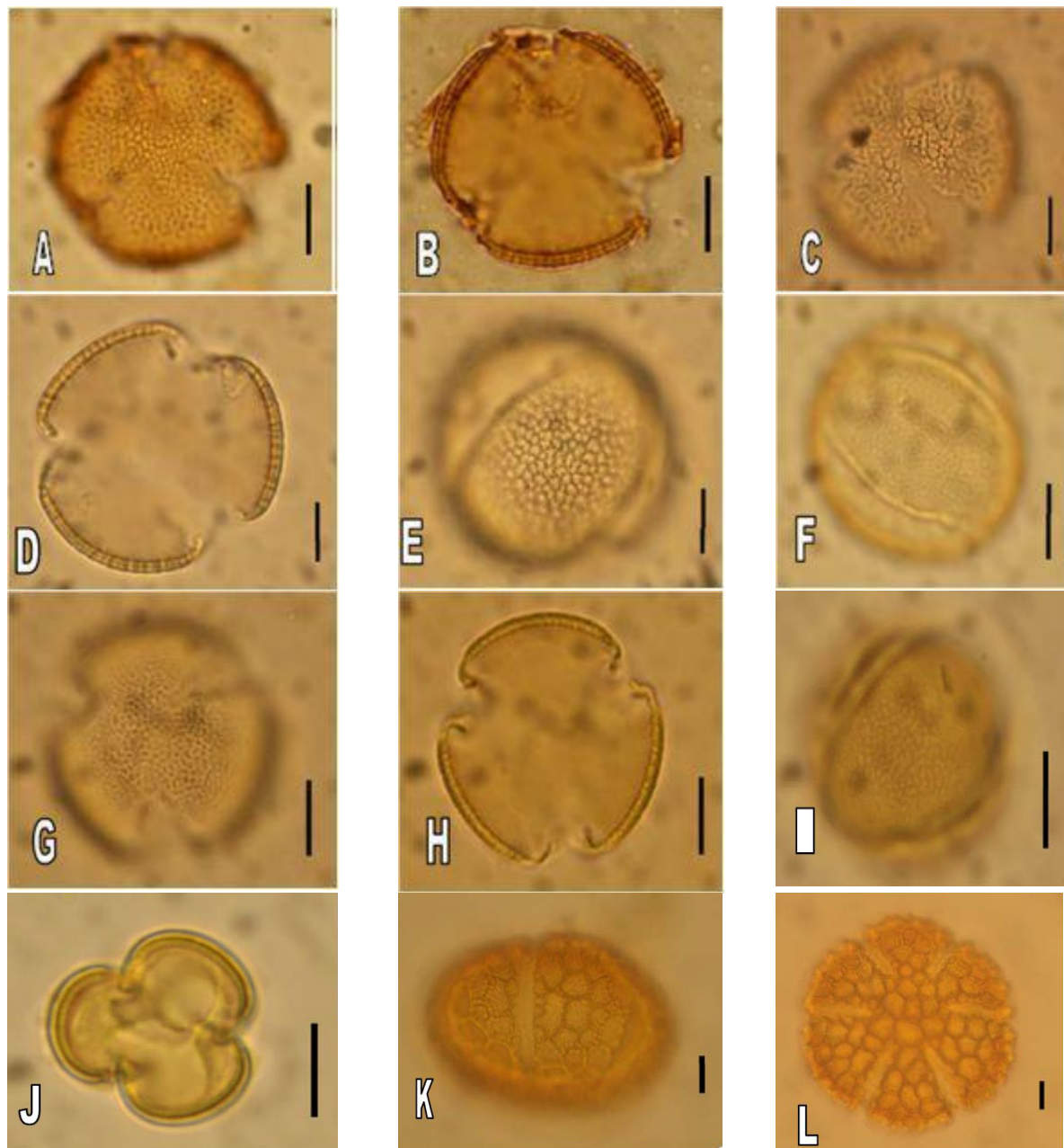


Figure 2: LM Morphographs of Pollen Grains. A- B: *Anisomeles Ovata*; C – E: *Hyptis Suaveolense*; F-H: *Leucas Aspera* ; I-J: *Lucus Biflora*; K-L: *Ocimum Cannam*. Bar- 10 μ m

– ***Hyptis suaveolens***: Colpate, 3 in number (Figure 10C-E); colpi length- c.28.4 μ m, breadth c. 1.7 μ m. Equatorial shape sub-oblate, amb- peritreme. Polar axis c. 36.04 μ m, equatorial diameter c. 41.14 μ m. Sexine c. 1.70 μ m and nexine c. 1.70 μ m thick. Sexine = Nexine. Pollen surface sculpturing- finely lophoreticulate. NPC- 343.

– ***Leonurus sibiricus***: Colpate, 3 in number; colpi length- c. 21.3 μ m, breadth- c. 85 μ m. Equatorial shape spheroidal, amb- peritreme. Polar axis c. 27.57 μ m, equatorial diameter c. 30.22 μ m. Sexine c. 2.55 μ m and nexine c. 1.70 μ m thick. Sexine > Nexine. Pollen surface sculpturing- reticulate. NPC- 343.

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– ***Leucas aspera***: Colpate, 3 in number (Figure 10F-H); colpi length- c. 25.6 μm , breadth- c. 1.7 μm . Equatorial shape prolate-spheroidal, amb- peritreme. Polar axis c. 32.30 μm , equatorial diameter c. 29.58 μm . Sexine c. 2.04 μm and nexine c. 1.70 μm thick. Sexine > Nexine. Pollen surface sculpturing- reticulate. NPC- 343.

– ***Leucas biflora***: Colpate, 3 in number (Figure 10I-J); colpi length- c.16.5 μm , breadth c. 1.7 μm . Equatorial shape oblate-spheroidal, amb- ptychotreme. Polar axis c. 21.9 μm , equatorial diameter c. 23.99 μm . Sexine c. 1.70 μm and nexine c. 0.85 μm thick. Sexine > Nexine. Pollen surface sculpturing- Reticulate. NPC- 343.

– ***Ocimum canum***: Colpate, 6 in number (Figure 10K-L); colpi length- c 27.4 μm , breadth c. 1.7 μm . Equatorial shape oblate, amb- peritreme. Polar axis c. 34.85 μm , equatorial diameter c. 39.44 μm . Sexine c. 3.40 μm and nexine c. 1.70 μm thick. Sexine > Nexine. Pollen surface sculpturing- lophoreticulate. NPC- 643.

– ***Ocimum gratissimum***: Colpate, 6 in number (Figure 11B-D); colpi length- c 29.7 μm , breadth c. 1.7 μm . Equatorial shape oblate, amb- peritreme. Polar axis c. 35.91 μm , equatorial diameter c. 42.28 μm . Sexine c. 3.40 μm and nexine c. 1.70 μm thick. Sexine > Nexine. Pollen surface sculpturing- lophoreticulate. NPC- 643.

– ***Ocimum sanctum***: Colpate, 6 in number (Figure 11 E-F); colpi length- c. 46.8 μm , breadth- c. 1.8 μm . Equatorial shape sub-oblate, amb- peritreme. Polar axis c. 59.33 μm , equatorial diameter c. 66.99 μm . Sexine c. 3.40 μm and nexine c. 1.70 μm thick. Sexine > Nexine. Pollen surface sculpturing- lophoreticulate. NPC- 643.

– ***Salvia plebeja***: Colpate, 6 in number (Figure 11 G-I); colpi length- c. 39.7 μm , breadth- c. 1.7 μm . Equatorial shape oblate, amb- peritreme. Polar axis c. 41.31 μm , equatorial diameter c. 55.42 μm . Sexine c. 1.70 μm and nexine c. 0.85 μm thick. Sexine > Nexine. Pollen surface sculpturing- finely lophoreticulate. NPC- 643.

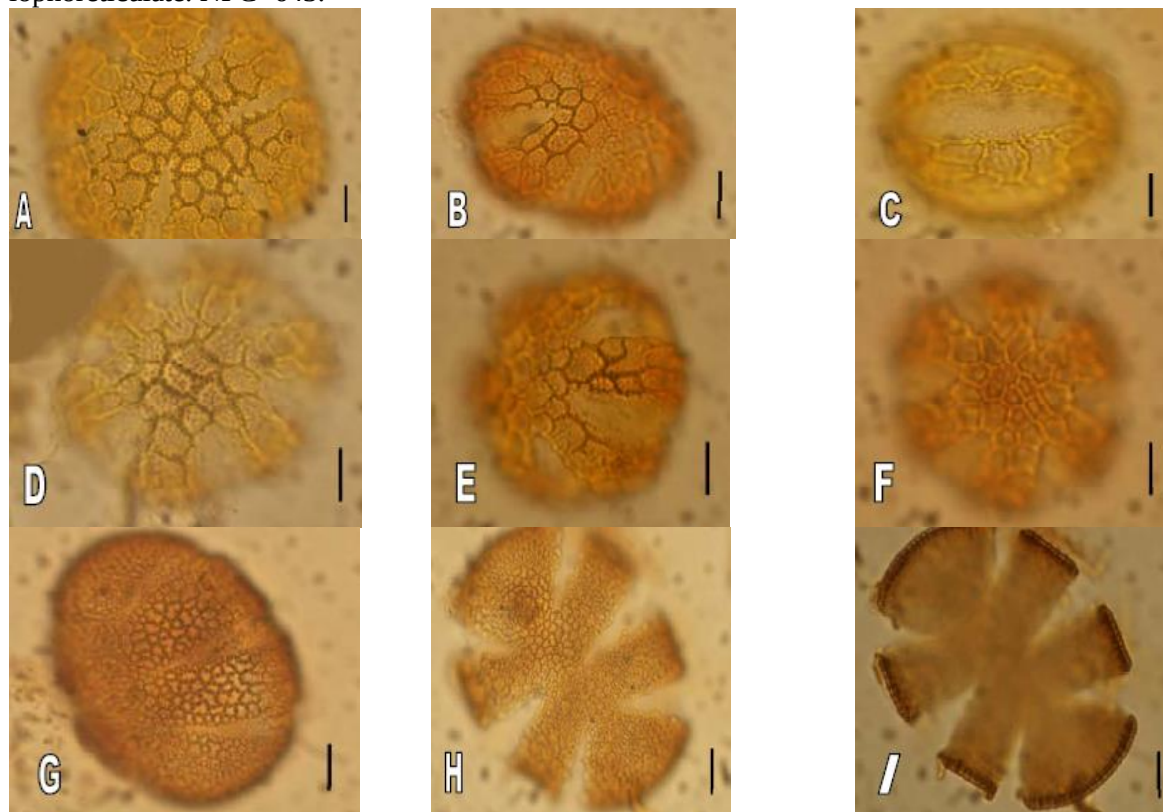


Figure 3: LM Morphographs of Pollen Grains. A: *Ocimum Canum*, B-D: *Ocimum Gratissimum*; E- F: *Ocimum Sanctum*; G-I: *Salvia Plebeja* Bar- 10 μm

Table 2: Summary of Palynological Characters in Lamiaceae

Species	Apertures Type	Aperture Number	Pollen Shape	PA (µm)	ED (µm)	Wall Thickness			Pollen Surface Sculpturing
						Exine (µm)	Sexine (µm)	Nexine (µm)	
<i>Anisomeles Ovata</i>	Colpate	3	Oblate-Spheroidal	25.11 - 27.29	30.22 - 31.33	3.40	1.70	1.70	Reticulate
<i>Hyptis Suaveolense</i>	Colpate	3	Sub-Oblate	36.04 - 37.56	41.14 - 42.42	3.40	1.70	1.70	Finely lophoreticulate
<i>Leonurus Sibiricus</i>	Colpate	3	Prolate	26.41 - 27.57	30.22 - 31.56	2.55	1.70	0.85	Reticulate
<i>Leucas Aspera</i>	Colpate	3	Prolate-Spheroidal	32.30 - 33.45	29.58 - 29.97	3.74	2.04	1.70	Reticulate
<i>Leucas Biflora</i>	Colpate	3	Oblate-Spheroidal	21.90 - 22.45	23.99 - 25.12	2.55	1.70	0.85	Reticulate
<i>Ocimum Canum</i>	Colpate	6	Oblate	34.85 - 36.45	39.44 - 42.58	5.10	3.40	1.70	Lophoreticulate
<i>Ocimum Gratissimum</i>	Colpate	6	Oblate	35.91 - 37.24	40.68 - 42.28	5.10	3.40	1.70	Lophoreticulate
<i>Ocimum Sanctum</i>	Colpate	6	Sub-Oblate	59.33 - 61.12	66.99 - 68.45	5.10	3.40	1.70	Lophoreticulate
<i>Salvia Plebeja</i> R	Colpate	6	Oblate	41.31 - 43.68	55.42 - 57.89	2.55	1.70	0.85	Finely lophoreticulate

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Conclusion

Two artificial keys are prepared based on palynological data and trichome characters for identification.

Key to the Genera of Lamiaceae Based on Trichome Characters-

- | | |
|--|-------------------|
| (1) Trichome glandular & non glandular | <i>Hyptis</i> |
| (1) Trichome non glandular | (2) |
| (2) Basal cell present | (3) |
| (2) Basal cell absent | (4) |
| (3) Trichome 3 – 4 celled | <i>Anisomeles</i> |
| (3) Trichome 2 celled | <i>Leucas</i> |
| (4) Trichome bent | (5) |
| (4) Trichome straight | <i>Leonurus</i> |
| (5) Leaf trichome 2 celled | <i>Salvia</i> |
| (5) Leaf trichome 3-5 celled | <i>Ocimum</i> |

Key to the Species of *Leucas* Based on Trichome Characters-

- | | |
|---------------------------------------|-----------------------|
| (1) Bract trichome basal cell 2 | <i>Leucas aspera</i> |
| (1) Bract trichome Basal cell 3 | <i>Leucas biflora</i> |

Key to the Species of *Ocimum* Based on Trichome Characters-

- | | |
|--|---------------------------|
| (1) Breadth of trichome 13-15 μm | <i>Ocimum canum</i> |
| (1) Breadth of trichome 5-10 μm | (2) |
| (2) Length of trichome 250-350 μm | <i>Ocimum sanctum</i> |
| (2) Length of trichome 150-250 μm | <i>Ocimum gratissimum</i> |

Key to the Genera of Lamiaceae Based on Palynological Data-

- | | |
|---|-------------------|
| (1) Aperture number 3 | (2) |
| (1) Aperture number 6 | (3) |
| (2) Pollen shape prolate or prolate-spheroidal | (4) |
| (2) Pollen shape sub-oblate or oblate-spheroidal | (5) |
| (3) Pollen shape oblate | <i>Salvia</i> |
| (3) Pollen shape sub-oblate | <i>Ocimum</i> |
| (4) Pollen shape prolate | <i>Leonurus</i> |
| (4) Pollen shape prolate-spheroidal | <i>Leucas</i> |
| (5) Pollen shape sub-oblate, finely lophoreticulate ornamentation | <i>Hyptis</i> |
| (5) Pollen shape oblate-spheroidal, reticulate ornamentation | <i>Anisomeles</i> |

Key to the Species of *Ocimum* Based on Palynological Data-

- | | |
|---|---------------------------|
| (1) PA= 59.33 to 61.12 μm , ED= 66.99 to 68.45 μm | <i>Ocimum sanctum</i> |
| (1) PA < 50 μm , ED < 65 | (2) |
| (2) PA= 34.85 to 36.45 μm , ED= 39.44 to 42.58 μm | <i>Ocimum canum</i> |
| (2) PA= 35.91 to 37.24 μm , ED= 40.68 to 42.28 μm | <i>Ocimum gratissimum</i> |

Key to the Species of *Leucas* Based on Palynological Data-

- | | |
|---|-----------------------|
| (1) PA= 32.30 to 33.45 μm , ED= 29.58 to 29.97 μm | <i>Leucas aspera</i> |
| (1) PA= 21.90 to 22.45, ED= 23.99 to 25.12 μm | <i>Leucas biflora</i> |

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