

POLLEN MORPHOLOGY AND TAXONOMY OF THE GENUS *NEPETA* SECT. *PSILONEPETA* (LABIATAE) IN IRAN

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Azizian, D., Jamzad, Z. & Serpooshan, F. 2001 12 15: Pollen morphology and taxonomy of the genus *Nepeta* sect. *Psilonepeta* (Labiatae) in Iran. -*Iran. Journ. Bot.* 9 (1): 19-26. Tehran.

Based on the SEM studies, the pollen morphology of 8 species of the genus *Nepeta* L. Sect. *Psilonepeta* native to Iran is described and compared. Taxonomic value of pollen morphology is discussed.

Differences in size and ornamentation of pollen and other conclusions from morphological and anatomical data, suggest that *N. denudata* should be transferred to Sect. *Denudata* supporting Budanstsev's treatment.

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Key words. Labiatae, *Nepeta*, Pollen, Taxonomy, Iran.

مطالعه دانه گرده در گونه‌هایی از جنس *Nepeta* L. در ایران

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دانه گرده ۸ گونه بومی ایران از جنس *Nepeta* L. بخش *Psilonepeta* Sect. بوسیله میکروسکوپ الکترونی (SEM) مورد بررسی قرار گرفت. تفاوت‌های مشخصی از نظر اندازه و تزئینات سطح دانه گرده بین گونه‌ها بخصوص با گونه *N. denudata* مشاهده شد. نتایج بدست آمده همراه با تفاوت‌های مورفولوژیکی و آناتومیکی این گونه نشان داد که گونه *N. denudata* به بخش دیگر از جنس *Nepeta* بنام بخش *Denudata* Sect. که با نتایج کار Budanstsev مطابقت دارد منتقل شود.

Introduction

Previous studies on pollen of *Labiatae* have mainly involved the use of the light microscope only. Nabli (1976) used both Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) to investigate the surface structure and exine ultra - structure of pollen of various selected genera of the family. Erdtman (1952) summarized pollen morphology of 100 species and 50 genera of the *Labiatae*. He regarded the family as stenopalynous, that is, showing little variation in pollen morphology. Later, Wunderlich (1967) published an extensive survey of *Labiatae* pollen morphology, including many genera whose pollen had not previously been described. Her results strongly support Erdtman's (1945) proposed delimitation of the *Labiatae* into two subfamilies; *Lamioideae*, binucleate with three colpi and *Nepetoideae*, trinucleate with six colpi. Characters from seed structure also support this primary subdivision of the family; the tricolpate group has seeds with a small amount of endosperm and the hexacolpate group has seeds with no endosperm.

Most light microscopic examinations have concentrated on general shape and measurements and numbers of colpi, rather than details of surface ornamentation, which can be seen most clearly with the SEM. However in various works notably by Rudall (1980), Azizian & Moore (1982), Hausain & Heywood (1982) and Trude & Morton (1992), pollen structure in many of genera and species of *Labiatae* is described and illustrated using SEM, but very few groups of genera in *Nepetoideae* are considered by SEM. Recently Harley (1992) studied the pollen morphology of subtribe *Ociminae* (*Nepetoideae*). The results showed the potential value of pollen characters both in taxonomic revision and in the understanding of relationships and

evolution within the *Labiatae*. On the other hand, Jamzad & al. (2000) described exine morphology of the annual species of *Nepeta*, although this study showed some variation in surface ornamentation, but had rather limited taxonomic application in the group.

Since there has been no comprehensive study of pollen morphology in SW Asian taxa of the genus *Nepeta*. The present work considered pollen morphology of 8 Iranian and endemic species of *Nepeta*, belonging to Sect. *Psilonepeta* to evaluate the exine ornamentation as a taxonomic character.

This paper is part of a project undertaken by one of the authors (F.Serpooshan) for a M.Sc degree in Shahid Beheshti University.

Materials and Methods

Pollen material was obtained from the herbarium specimens of the Research Institute of Forests and Rangelands (TARI), Iran. For Scanning Electron Microscopy (SEM) observation, the pollen dusted onto SEM stubs and coated with platinum using the JEOL Cambridge 35 SEM. The measurements are based on SEM data.

A list of materials used in this study, including collection number, origin and the location of voucher specimens is given in table I.

Results

The results of this palynological study are presented in table 2. Pollen grains of all species examined in sect. *Psilonepeta* of the genus *Nepeta* can be characterized as follows: monadic, isopolar, prolate or elliptic (P/E= 1.34-1.79), almost circular in polar view, colpate with six equal sized and equally spaced colpi (Hexacolpate). The average size of pollen grains ranges from 29.18 - 46.93 μm in polar axis and 16.28 - 32.85 μm in equatorial axis, *N.*

Table I. Materials used for pollen morphology of the genus *Nepeta*.

Taxa	Collecting data
<i>Nepeta dschuparensis</i> Bornm.	Kerman: N.W. slope of Kuh-e Khabr, Assadi & Miller 25222.
<i>N. depauperata</i> Benth.	Kerman: S. slope of Kuh-e Khabr, Assadi & Miller 25190.
<i>N. laxiflora</i> Benth.	Fars: Bamu Protected Region, Cheshmeh Fil. Wendelbo & Foroughi 17644.
	Arak: Aladagh Mts. N.E. slope, Mozaffarian 64119.
<i>N. sessilifolia</i> Bunge	Tehran: between Arak and Khomein, Mozaffarian & Maassomi 48058.
<i>N. archibaldii</i> Rech. f.	Bakhtiari: Zardkuh, opposite to Tunel-e Kuhrang, Mozaffarian 57685.
<i>N. scrophularioides</i> Rech. f.	Lorestan: Dorud, Neck Mts. Mozaffarian & Sardabi 42325.
<i>N. oxyodonta</i> Boiss.	Esfahan: Semirum, Gardane-e Bizan, Nowroozi 2881.
<i>N. denudata</i> Benth.	Mazandaran: Chalus road, after Kandavan tunnel, Mozaffarian & Nowroozi 33905.

denudata has the smallest pollen grain and it is distinct from the others in this group. (Table 2, Figs. 1-15). The tectume is perforate, biretulate, consisting of a primary network of coarse tectal ridges (muri), surrounding spaces (lumina) containing few to many perforation (puncta), such as *N. oxyodonta* with few puncta per lumen (3-6) (Figs. 5,6, table 2, or with (12-15) puncta per lumen in *N. sessilifolia* (Fig. 15). Variation in surface sculpturing, the shape of lumina and the number of perforation within each lumen appear to represent a continuous range in which there is no clear distinction between them. The lumina are rounded-polygonal, with (7-11) or (12-15) puncta in most of the species examined, but more or less elongated in *N. depauperata* (Figs. 7-8) and angular polygonal in *N. sessilifolia* (Figs. 14, 15). Most of the species examined are more or less similar in shape and mean size except *N. denudata* which is smaller than other species, Polar axis (18.6-) 29.18 (-37.8) μ m, equatorial axis (11.7-) 16.28 (-23) μ m, the shape of pollen is elliptic to sub spheroidal with fine muri (Figs 10, 11).

Discussion

Bentham (1848). described Section *Psilonepeta* with three following species; *N. depauperata*, *N.*

laxiflora and *N. oxyodonta*. The most important morphological characteristic of the species in this section is erect calyx throat with a ring of hairs inside, subequal teeth and exerted corolla. Boissier (1879) considered two groups in the section; group one includes the species with erect calyx throat and equal teeth which includes the species mentioned by Bentham for the section, and the other with oblique calyx throat and unequal teeth which includes *N. denudata* Benth. It lacks the hairy ring, but is covered with scattered hairs inside the tube and was placed in Sect. *Macronepeta* by Bentham. Rechinger (1982) described two new species considered *N. denudata* with the other previously described species in Sect. *Psilonpepta*. Reviewing the three mentioned works reveals the differences in morphology between *N. denudata* and other considered species of the section in calyx character.

The pollen morphology of the studied species as recorded for the *Lamiaceae* shows minor differences either in size or exine sculpturing but a distinct difference in pollen size is noticed in *N. denudata* which has the smallest pollen grain in the group, it also differs in lumen shape which is elongated. Differences in anatomical structures i.e. petiole and leaf anatomy (Serpooshan 1999) as well as

Table 2. Summary of pollen morphology data of *Nepeta* species (measurements in μm).

Taxa	Polar length (P)			Equatorial width (E)			P/E	Colpus length	Lumen shape	No of perforation
	Min	Mean	Max	Min	Mean	Max		mean		per lumen
<i>N. dschuparensis</i>	(42.9)	46.93	(54.3)	(26.7)	32.85	(38.8)	1.42	39.98	Rounded	7 - 11
<i>N. depauperata</i>	(31.6)	41.11	(46.8)	(16.8)	28.41	(37.5)	1.44	34.26	Elongate	7 - 11
<i>N. laxiflora</i>	(36.3)	44.2	(47.8)	(21.6)	32.78	(43.4)	1.34	39.38	Rounded	12 - 15
<i>N. sessilifolia</i>	(32.1)	39.08	(42.2)	(26.6)	28.91	(30.9)	1.35	34.02	Angular	12 - 15
<i>N. scroptularioides</i>	(39.3)	44.1	(47.8)	(27.7)	31.02	(33)	1.42	40.33	Rounded	7 - 11
<i>N. oxyodonta</i>	(29.3)	39.82	(48.5)	(18.5)	28.5	(34.3)	1.39	34.57	Rounded	3 - 6
<i>N. denudata</i>	(18.6)	29.18	(37.8)	(11.7)	16.28	(23)	1.79	24.92	Elongate	12 - 15

the mentioned morphological differences, agrees the consideration of it in a separate section; Sect. *Denudatae* as was suggested by Budantsev (1993), but the idea of including some of the species of Sect. *Capituliferae* (Benth.) Pojark. (the Iranian species; i.e. *N. cephalotes* Boiss., *N. prostrata* Benth.) in this section is not approved, because of insufficient data.

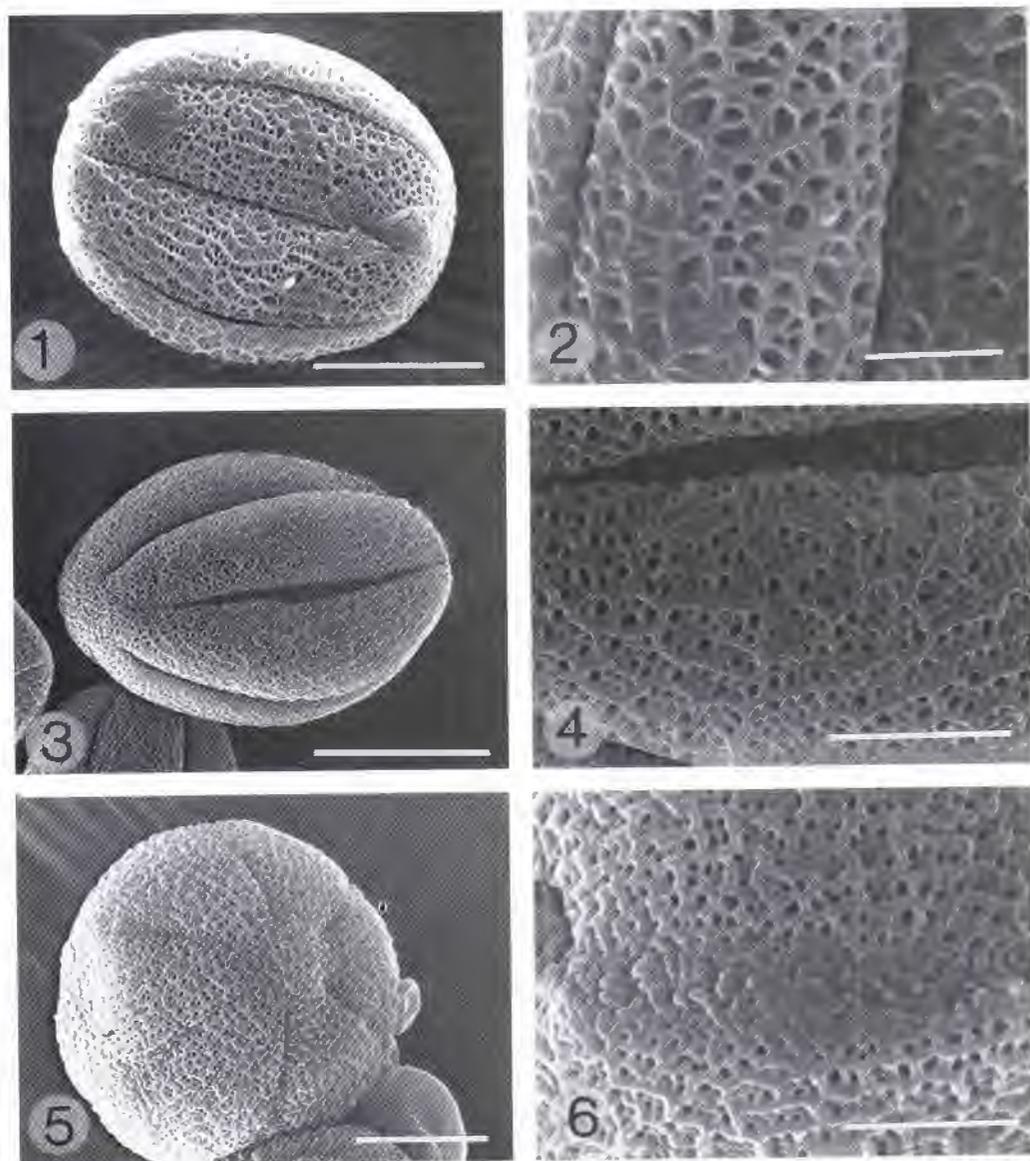
Acknowledgements

We would like to acknowledge the curator of the herbarium of Research Institute of Forests and Rangelands for permission to remove pollen from herbarium specimens, and Ministry of Jahad-e Sazandegi for financial support of the project.

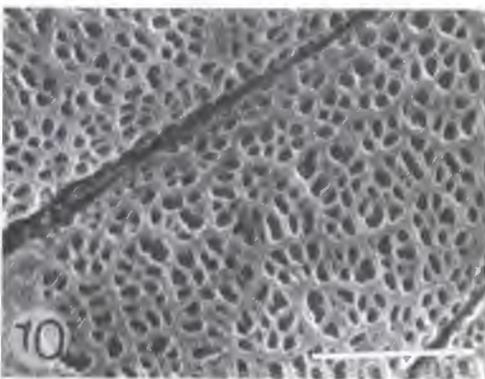
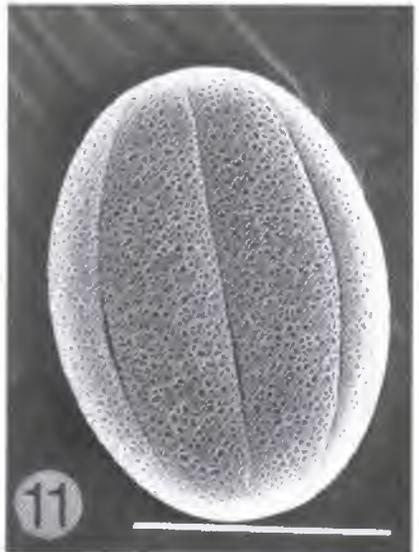
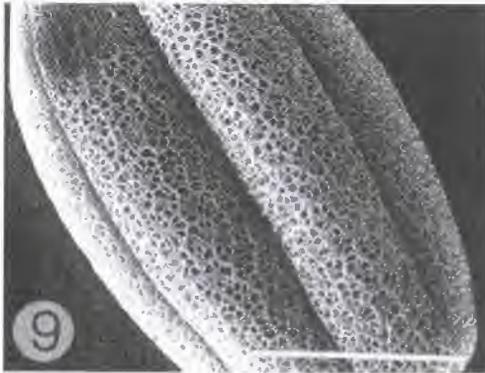
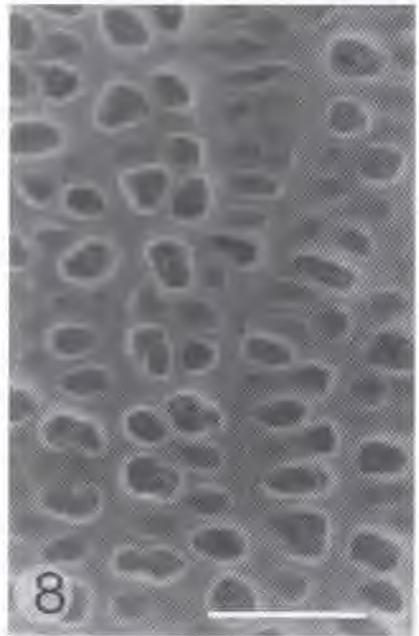
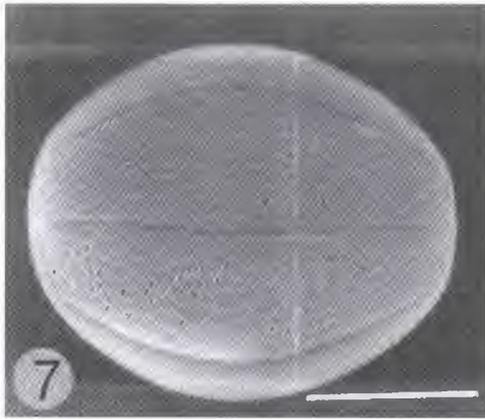
We are also grateful to Dr. David Cutler and his colleagues in Jodrell Laboratory (SEM section) at the Royal Botanic Gardens, Kew for permission to take, the SEM pictures of pollen grains in this paper.

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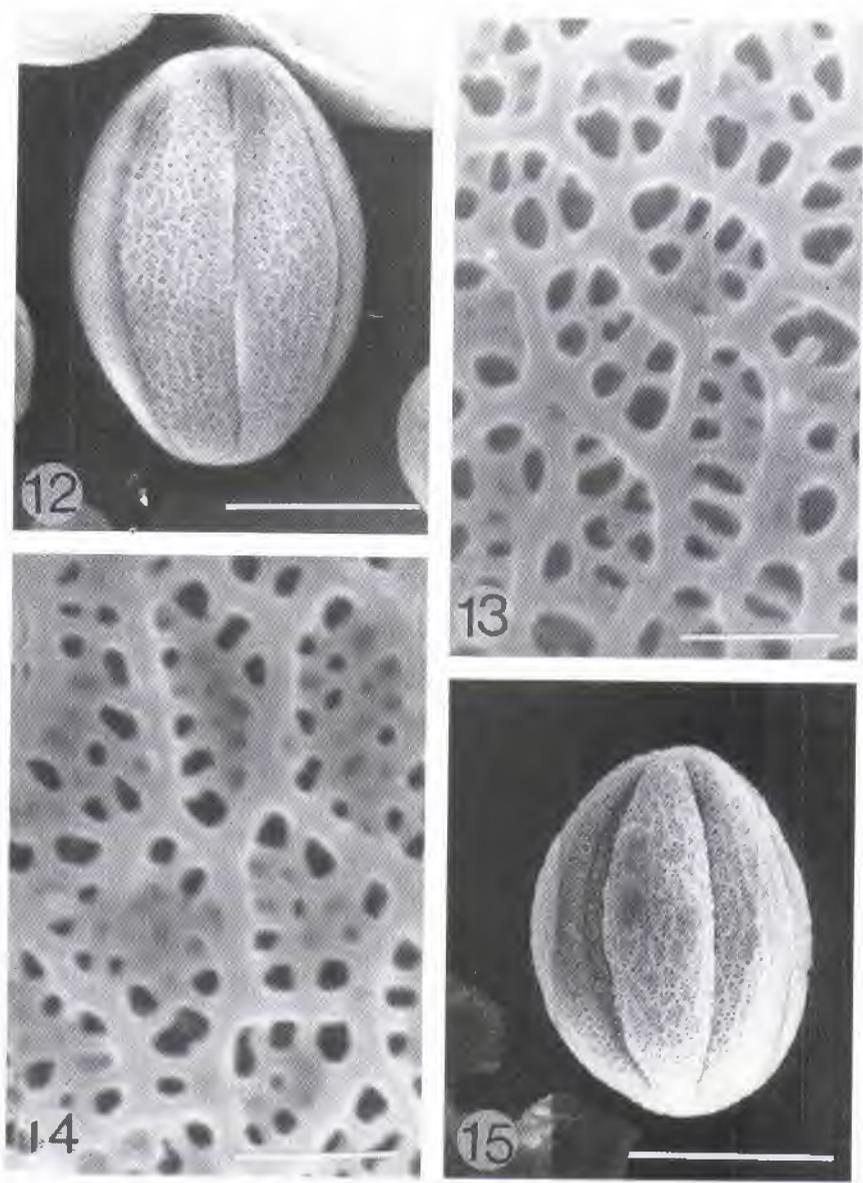
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Figs. 1-6. Pollen grains of the genus *Nepeta* (SEM): Figs. 1,2. *N. laxiflora*. 3,4. *N. dschuparensis*. 5, 6. *N. oxyodonta*. Figs 1,3. Equatorial view, Fig 5. Polar view. Figs. 2,4,6. Ornamentation. Scale bar in 1, 3= 20 μ m, 5 = 10 μ m, 2, 4, 6 = 5 μ m.



Figs. 7-11, Pollen grains of the genus *Nepeta* (SEM): Figs. 7, 8. *N. depauperata*, 9, *N. archibaldii*, 10, 11. *N. denudata* Figs. 7,9,11. Equatorial view (hexacolpate). Figs. 8, 10. Ornamentation. Scale bar in 7, 9, 11=20 μ m, 8 = 2 μ m, 10=5 μ m.



Figs. 12-15, Pollen grains of the genus *Nepeta* (SEM): Figs. 12,13. *N. scrophularioides*, 14,15 *N. sessilifolia*. Figs. 12, 15 = 20 μ m, 13,14. = 2 μ m.

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