

A NEW SPECIES OF NEPETA FROM TAKHT-E-SULAIMAN, PAKISTAN

A. Sultan, N. Khan, T. Khan & Z. Jamzad

Received 2021. 09. 09; accepted for publication 2021.12. 10

Sultan, A., Khan, N., Khan, T. & Jamzad, Z. 2021. 12. 30: A new species of *Nepeta* from Takht-e-Sulaiman, Pakistan. - *Iran. J. Bot.* 27 (2): 84-92. Tehran.

Nepeta is the largest genus in the family Lamiaceae in the flora of Pakistan, represented by 49 species, including 9 endemics. The genus is mainly distributed in Gilgit-Baltistan, Kashmir, Khyber Pakhtunkhwa, Baluchistan, northern and western Punjab. A new species of *Nepeta* from section *Spicatae*, *Nepeta sulaimanica* is described and illustrated from Takht-e-Sulaiman in Sulaiman Mountain Range, Pakistan. The new species is characterized by spike-like inflorescence, 25 mm long blue corolla, with tube long exerted from the calyx and middle lobe of the lower lip dropping, bilobed, with entire lobules; nutlet surface smooth. *Nepeta sulaimanica* is compared with the closely related species, *N. laevigata*, which has a different indumentum, larger leaf size, longer petiole, and shorter corolla.

Amir Sultan (correspondence <amirsultan_2000@yahoo.com>) National Herbarium (Stewart Collection), Bio-Resources Conservation Institute, PARC-National Agricultural Research Centre, Islamabad, Pakistan. - Nazar Khan, Department of Botany, Government Degree College, Zhob, Baluchistan, Pakistan..- Tahir Khan, Department of Botany, Government Girls Degree College, Zhob, Baluchistan, Pakistan. Ziba Jamzad, Research Institute of Forests and Rangelands, PO. Box 13185-116, Tehran, Iran.

Keywords: *Nepeta sulaimanica*; section *Spicatae*; Lamiaceae; Takht-e-Sulaiman; Pakistan

گونه جدیدی از *Nepeta* از تخت سلیمان پاکستان

عامر سلطان: هرباریوم ملی مؤسسه حفاظت از منابع بیولوژیکی مرکز ملی تحقیقات کشاورزی اسلام آباد، پاکستان

نزر خان: بخش گیاهشناسی کالج دولتی، ژوب بلوچستان، پاکستان

طاهر خان: بخش گیاهشناسی کالج دولتی دختران ژوب، بلوچستان، پاکستان

زیبا جمزاد: مؤسسه تحقیقات جنگلها و مراتع کشور، سازمان تحقیقات آموزش و ترویج کشاورزی، تهران، ایران

جنس *Nepeta* بزرگترین جنس خانواده نعنا در پاکستان است که دارای ۴۹ گونه بوده و ۹ گونه از آنها انحصاری هستند. این جنس بیشترین پراکندگی را در مناطق Gilgit-Baltistan, Kashmir, Khyber Pakhtunkhwa, Baluchistan و شمال و غرب پنجاب دارد. گونه *Nepeta sulaimanica* از بخش *Spicatae* از رشته کوههای تخت سلیمان شرح داده می‌شود و تصویر آن ارائه می‌گردد. گونه جدید با داشتن گل‌آذین سنبله مانند به طول ۲/۵ سانتی‌متر، گل‌های آبی رنگ، لوله جام گل بلند و از کاسه گل بیرون آمده و لبه پایینی با لوب میانی دوقسمتی و با حاشیه صاف و هم‌چنین فندقچه با سطح صاف قابل تشخیص است. گونه جدید با گونه *Nepeta laevigata* خویشاوند خویش که دارای پوشش کرکی متفاوت، برگ‌های بزرگتر و دم‌برگ‌های بلندتر و گل‌های کوچکتر است مقایسه می‌گردد.

INTRODUCTION

Lamiaceae (the mint family) has a cosmopolitan distribution comprising 7200 species in 236 genera

(Harley & al. 2004). It is the sixth largest family of flowering plants including many well-known plants, herbs, shrubs, and trees of economic and medicinal

significance (Harley & al. 2004). Subfamily Nepetoideae is the largest of the seven subfamilies within Lamiaceae, comprising about one third (c.105) of the genera (Harley & al., 2004) and about half of the species (Harley & al., 2004). The tribe Mentheae comprises both the largest number of genera and species of any tribe within Nepetoideae and Lamiaceae (Zhao & al., 2021), with nearly half of species in the subfamily Nepetoideae (Moon & al., 2010). Mentheae is divided into three subtribes: Salviinae, Menthinae, Nepetinae, and comprises ca. 65 genera (Harley & al. 2004). The subtribe Nepetinae consists of 12 genera and about 350 species distributed over large parts of Eurasia and North America (Razavi, 2018).

Nepeta comprises approximately 300 species distributed in the southwest and central Asia, Europe, North Africa, and North America. South-West Asia and Western Himalayas are the main centres of diversity of the genus (Acar & al., 2011). *Nepeta* is the largest Labiate genus in the flora of Pakistan represented by 49 species (Hedge, 1990; Jehan, 1996) of which c. nine species are endemics. The genus is mainly distributed in Gilgit-Baltistan, Kashmir, Khyber Pakhtunkhwa, Baluchistan, northern and western Punjab. In this paper, we describe a new species, *Nepeta sulaimanica* from Takht-e-Sulaiman, Pakistan.

Phylogenetic study of the genus conducted by Jamzad & al. (2003) revealed that *Nepeta* is monophyletic and composed of five major monophyletic groups, most of which comprised species belonging to more than one section in previous classifications. These five clades were: (1) sect. *Spartonepeta*; (2) sects. *Macronepeta* + *Spicatae*; (3) sects. *Nepeta* + *Micranthae* p.p. + *Oxynepete* + *Schizocalyx* + *Macrostegiae*; (4) sects. *Capituliferae* + *Denudatae* + *Micranthae* p.p. + *Micronepeta* p.p. and (5) sect. *Psilonepeta*. The phylogenetic relationships among species of these groups were congruent with the distribution of some floral characters, including corolla shape, bract texture, colour, and pollen exine ornamentation (Jamzad & al., 2003).

The genus *Nepeta* is attributed with a number of pharmacological effects and *Nepeta* oils are known for antimicrobial activity (Amirmohammadi & al., 2020). In general, the bioactivities of *Nepeta* essential oils are attributed to the presence of nepetalactones (Amirmohammadi & al., 2020).

MATERIALS AND METHODS

During exploratory field expeditions to Takht-e-Sulaiman by the second author (Nazar Khan), populations of a *Nepeta* species were collected from Dera Ismael Khan district of Khyber Pakhtunkhwa in Sulaiman Mountain Range, a north-south extension of the southern Hindu Kush Mountain system in Afghanistan and Pakistan, at an altitude of c. 3000 m. a.s.l. The specimens were identified using the identification keys in the Flora of Pakistan (Hedge, 1990) and adjacent areas (Rechinger, 1982; Jamzad, 2012). The type specimens of the close relatives were examined in virtual herbaria (www.eFloras.org). For pollen study, mature anthers were detached from the flowers and treated with one to two drops of 45% acetic acid and then crushed with the help of a glass rod. The pollen debris was removed with a brush. Pollen was stained by putting a drop of fresh glycerin jelly mixed with 1% safranin on the area containing pollen. Pollen measures were based on seven samples.

The holotype of the new species has been deposited in the National Herbarium of Pakistan, National Agricultural Research Centre, Islamabad (RAW).

RESULTS & DISCUSSION

Nepeta sulaimanica Amir Sultan, Jamzad & Nazar Khan **sp. nov.** (figs. 1-9).

Type: Pakistan, Khyber Pakhtunkhwa, Dera Ismael Khan district, Sulaiman Mountain Range, Takht-e-Sulaiman, 31°36'20.0"N, 69°58'03"E, c. 3000 m, *Nazar Khan, Kamran Ishaque & Tahir Khan*, 16 July 2020 (RAW 101959).

The new species is characterized by the dense hairy stem, covered with minute and 3-6 cellular white spreading hairs (vs. glabrous to minutely pilose stem with retrorse eglandular hairs in *N. laevigata*); leaves 10-19 x 7-15 mm, petiole 4-5 mm in *N. sulaimanica* (vs. leaves 30-60 mm x 20-30 mm; petiole 40 mm in *N. laevigata*); bracts crenate-dentate in *N. sulaimanica* (vs. entire in *N. laevigata*); calyx 9-11 mm in *N. sulaimanica* (vs. calyx 6-8 mm in *N. laevigata*); corolla 25 mm in *N. sulaimanica* (vs. 12-14 mm in *N. laevigata*); nutlets smooth, cream-light brown in *N. sulaimanica* (vs. minutely granular, brown-black in *N. laevigata*).

Perennial herb, many stemmed, stems ascending-erect, to 40 cm high, densely hairy, covered with

minute and 3-6 cellular white spreading hairs and sessile glands. Cauline leaves petiolate, petiole (2-) 4-5 (-6) mm long, petiole indumentum similar to the stem indumentum; leaf blade 10-19 × 7-15 mm, ovate, cordate to subcordate, acute to obtuse, crenate-dentate, rugose, densely hairy on both surfaces with white flattened multicellular hairs, more so on the abaxial surface especially along veins, with numerous sessile glands, abaxial surface canescent. Bracts 9-10 × 2.8-6 mm, ovate, obovate or spatulate, crenate-dentate, ciliate, purplish, acute-acuminate, bearing minute hair and multicellular hairs on the abaxial surface along the veins, adaxial surface glabrous or sparsely hairy, few sessile glands present on both surfaces. Inflorescence spike-like terminal, c. 2.5 cm long, verticillasters many-flowered, close to each other. Bracteoles 5-8 × 0.1-0.8 mm, subulate to linear, ciliate, purplish. Pedicel c. 1 mm long, pubescent. Calyx 9-11 mm long, 15 nerved, purplish, tube internally pilose along the nerves, 5.5-6 mm long, throat ± oblique, teeth subulate, ciliate, 3.5-5 mm long. Corolla 25 mm long, blue, tube long exerted from calyx, sparsely pubescent, upper lip bilobed, 3-3.5 mm long, adaxially pubescent, middle lobe of the lower lip c. 3 × 4 mm, constricted in the middle, deflexed. Filament 5.5 - 6.5 mm long, anthers exerted, 1 mm long, anther cells divergent, style 20-21 mm long. Nutlets 1.75 × 1 mm, oblong-obovate, cream-pale brown, surface smooth, areole bilobed, short.

Nepeta sulaimanica belongs to section *Spicatae* (Benth.) Pojark and the monophyletic species group II A (Jamzad et. al. 2003), including sections *Macronepeta* Benth. and sect. *Spicatae* (Benth.) Pojark is characterized by spike-like inflorescence, middle

lobe of the lower lip of corolla dropping, bilobed with entire lobules.

The other species of sect. *Spicatae* in Pakistan which is a close relative to the new species is *N. laevigata* (D. Don) Hand.-Mazz., a rather common species in Pakistan, also distributed in Afghanistan, Kashmir, NW India, the Himalayas to Nepal, and SW China (figs. 10-14). *Nepeta laevigata* grows in a variety of habitats, open slopes, in forest areas, wet places from Chitral, Swat, Hazara, Galiat to Kashmir and Kurram (Hedge, 1990).

Flowering/fruiting period: July-September

Distribution: Known from Takht-e-Sulaiman, Pakistan so far.

Habitat: It grows in humus-rich gravelly/rocky soil, in association with grasses, *Geranium collinum*, *Himalaiella heteromalla*, *Impatiens* sp., *Allium roylei*, *Salvia nubicola*, *Astragalus kurrumensis*, and *Potentilla gerardiana* in the forest dominated by Chilgoza pine (*Pinus gerardiana*) and blue pine trees (*Pinus wallichiana*) (fig. 1.c) at elevations of c. 3000 m a. s. l.

Pollen morphology

Pollen grains in both species are hexacolpate, subprolate (P/E= 1.21-1.24). The polar length, equatorial width, and exine thickness are all larger in *N. laevigata*. Palynological characters of the two species are compared in table 1 & figs. 7a, 7b, 12a & 12b.

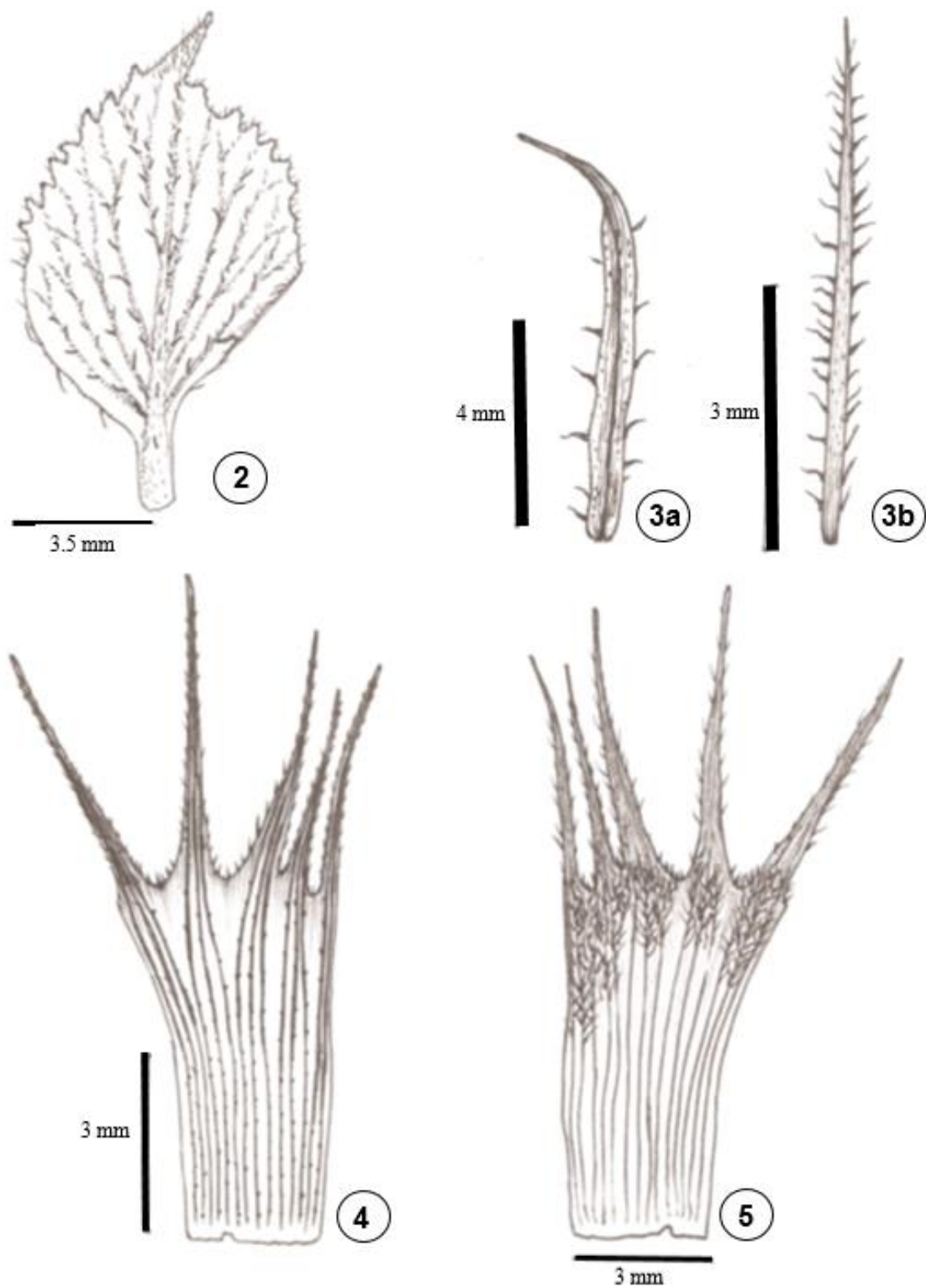
Etymology: The specific epithet is based on the Sulaiman Mountain Range, the area where it has been collected.

Table 1. Quantitative characters of pollen grains in *Nepeta sulaimanica* sp. nov. and *N. laevigata*.

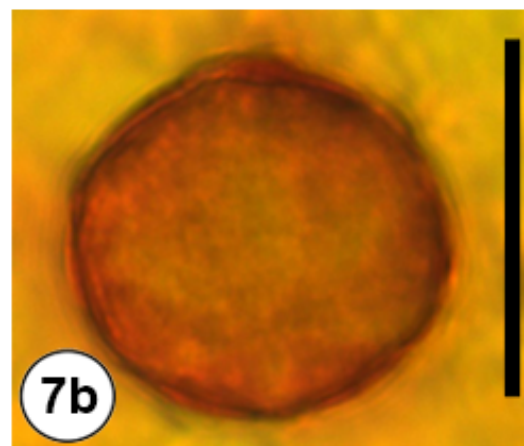
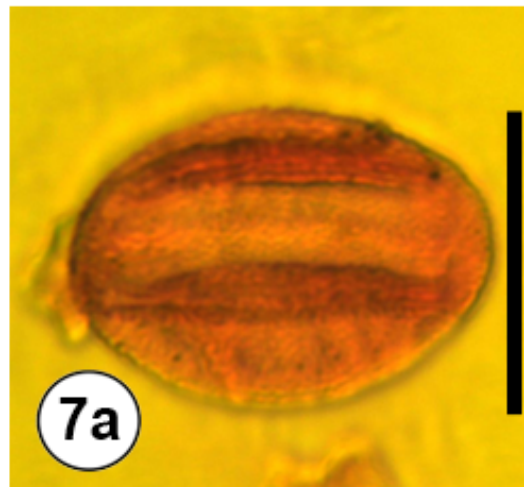
Taxa	Polar length Max-Min= M±SE (µm)	Equatorial width Max-Min=M±SE (µm)	P/E ratio	Length of colpi Max-Min= M±SE (µm)	Width of colpi Max-Min= M±SE (µm)	Mesocolpium Max-Min= M±SE (µm)	Apocolpium Max-Min= M±SE (µm)	Exine thickness M±SE (µm)
<i>N. sulaimanica</i>	32.50-25.00= 29.58±1.19	27.50-20.00= 23.75±1.07	1.24	25.00-20.00= 22.50±0.91	7.50-2.50= 4.16±0.83	12.50-7.50= 9.16±0.83	10.00-7.50= 8.75±0.55	1.25-0.50= 0.95±0.11
<i>N. laevigata</i>	35.00-25.00= 30.41±1.50	27.50-22.50= 25.00±0.91	1.21	27.50-20.00= 23.75±1.07	7.50-2.50= 4.58±0.76	15.00-7.50= 10.41±1.35	12.50-7.50= 10.00±0.64	1.50-0.75= 1.12±0.10



Figs. 1-9. *Nepeta sulaimanica*, 1. a, b, & c, Habit; 2. Bract; 3. a & b. Bracteoles; 4. Calyx abaxial view; 5. Calyx adaxial view; 6. Stem indumentum; 7. a. Pollen grain, equatorial view (scale bar= c. 25 μ m), 7b Pollen grain, polar view (scale bar= c. 25 μ m); 8. Nutlet ventral view; 9. Nutlet dorsal view.



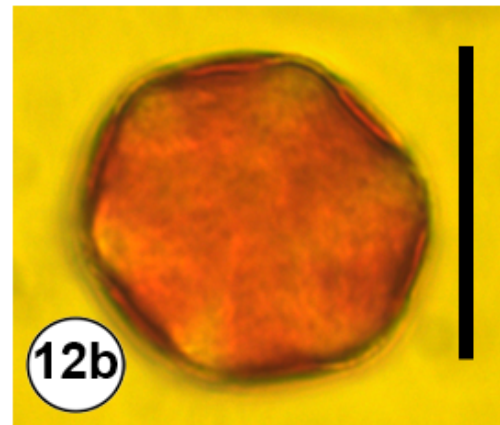
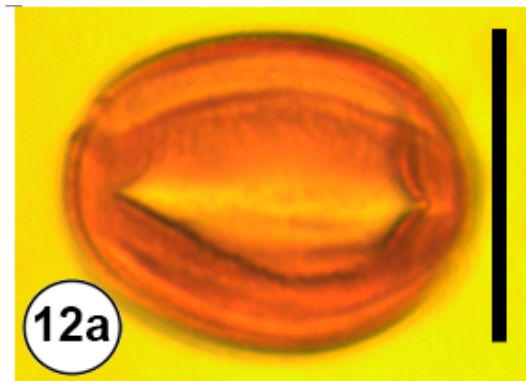
Figs. 1-9. Continued.



Figs. 1-9. Continued.



Figs. 10-14. *Nepeta laevigata*, 10. a & b. Habit; 11. Stem indumentum; 12a. Pollen grain, equatorial view (scale bar= c. 25 μ m); 12b Pollen grain, polar view (scale bar= c. 25 μ m); 13. Nutlet ventral view; 14. Nutlet dorsal view.



Figs. 10-14. Continued.

(Photo credits: *Nepeta sulaimanica*: habit and habitat photos by Nazar Khan; *Nepeta sulaimanica* line drawing by Muhammad Saleem; *Nepeta laevigata*: habit photo by Asif Mehmood; *Nepeta laevigata* line drawing reproduced with permission from Flora of Pakistan; nutlet and stem indumentum photos by Saeeda Naz & Amir Sultan, pollen photos by Amjad Khan)

ACKNOWLEDGEMENTS

Authors are thankful to Mr. Saleem and Ms. Saeeda Naz for illustrating the plant, to Dr. Muhammad Qaiser for permitting the use of *Nepeta laevigata* illustration from Flora of Pakistan, and to Mr. Amjad Khan for preparing pollen slides. The authors are indebted to Mr. Asif Mehmood for allowing the use of *Nepeta laevigata* photograph.

REFERENCES

- Acar, M., Ozcan, T., Satil, F. & Dirmenci, T. 2011: A comparative anatomical study on two endemic *Nepeta* L. species (*N. baytopii* and *N. sorgerae*). - Biological Diversity and Conservation, 4/3:58-70.
- Amirmohammadi, F. Z., Azizi, M., Nemati, S. H., Iriti, M., & Vitalini, S. 2020: Analysis of the essential oil composition of three cultivated *Nepeta* species from Iran. Z. Naturforsch., 75 (7-8) c: 247-254.
- Harley, R. M., Atkins, S., Budantsev, A. L., Cantino, P. D., Conn, B. J., Grayer R., Harley, M. M., de Kok R. P. J., Krestovskaja, T., Morales, R., Paton, A. J., Ryding, O. & Upson, T. 2004: Labiatae. In: Kadereit, J. W., editor. The families and genera of vascular plants, vol. 7. Berlin: Springer Verlag, p. 167-275.
- Hedge, I. C. 1990: Flora of Pakistan (Labiatae). No. 192, in Ali, S. I. & Nasir, Y. J. (eds.). University of Karachi. Karachi.
- Jehan, A. 1996: *Nepeta subcaespitosa* (Labiatae), a New Species from Pakistan. Willdenowia, 25 (2): 647-649.
- Jamzad, Z., Chase, M., Ingrouille, M, Simmonds M, & Jalili, A. 2003: Phylogenetic relationships among *Nepeta* L. (Lamiaceae) species and related genera based on sequence data from internal transcribed spacers (ITS) of nuclear ribosomal DNA. (Taxon 52: 21-32).
- Jamzad, Z. 2012: *Lamiaceae*. In: Assadi, M., Maassoumi, A. & Mozaffarian, V. (eds). Flora of Iran. Vol. 76. Research Institute of Forests & Rangelands, Tehran (in Persian).
- Moon, H-K., Smets, E. & Huysmans, S. 2010: Phylogeny of tribe Mentheae (Lamiaceae): The story of molecules and micromorphological characters. Taxon, 59 (4):1065-1076.
- Razavi, S. M., Ghaffari, A. A. & Bidarlord, M. 2018: Pollen morphology of some *Nepeta* L. species in NW Iran, Botany Letters, 165:2, 286-291.
- Rechinger, K. H., Hedge, I. C., Ietswaart, J. H., Jalas, J., Mennema, J. & Seybold, S. 1982: Labiatae. In: Rechinger, K.H. (ed.) Flora Iranica, 150. Graz, Austria.
- Zhao, F., Chen, Y-P., Salmaki, Y., Drew, B. T., Wilson, T. C., Scheen, A. C., Celep, F., Bräuchler, C., Bendiksby, M., Wang, Q., Min, D-Z., Peng, H., Olmstead, R. G., Li, B. & Xiang, C-L. 2021: An updated tribal classification of Lamiaceae based on plastome phylogenomics. BMC Biology, 19:2.