

Scrophularia longiflora Benth. and S. nana Stiefelh. (Scrophulariaceae), two distinct species from Iran, confused under the name S. farinosa Boiss.

Authors: Ranjbar, Massoud, Rahchamani, Narges, and Gautier, Laurent

Source: Candollea, 71(2) : 195-203

Published By: The Conservatory and Botanical Garden of the City of Geneva (CJBG)

URL: <https://doi.org/10.15553/c2016v712a5>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Scrophularia longiflora Benth. and S. nana Stiefelh. (Scrophulariaceae), two distinct species from Iran, confused under the name S. farinosa Boiss.

Massoud Ranjbar, Narges Rahchamani & Laurent Gautier

Abstract

RANJBAR, M., N. RAHCHAMANI & L. GAUTIER (2016). *Scrophularia longiflora* Benth. and *S. nana* Stiefelh. (Scrophulariaceae), two distinct species from Iran, confused under the name *S. farinosa* Boiss. *Candollea* 71: 195-203. In English, English abstract. DOI: <http://dx.doi.org/10.15553/c2016v712a5>

The authors revise the material associated with *Scrophularia farinosa* Boiss. (Scrophulariaceae) and its synonyms according to “Flora Iranica”. Two distinct taxa emerge, which differ in terms of morphology, anatomy, distribution and ecology and both deserve recognition at species level. *Scrophularia longiflora* Benth. is an earlier synonym of *Scrophularia farinosa*, and is reinstated as the valid name for this species based on priority principle. *Scrophularia nana* Stiefelh. which was synonymized with *Scrophularia farinosa*, is resurrected as a separated species. We provide a key to differentiate between the two species as well as detailed descriptions with illustrations and a distribution map. Additionally, lectotypes are designated for *Scrophularia farinosa* and *Scrophularia nana*.

Keywords

SCROPHULARIACEAE – *Scrophularia* – Iran – Identification key – Lectotypification – Taxonomy

Addresses of the authors:

MR, NR: Department of Biology, Herbarium division, Bu-Ali Sina University, P.O. Box 65175/4161, Hamedan, Iran. E-mail: ranjbar@basu.ac.ir

LG: Conservatoire et Jardin botaniques de la Ville de Genève and Laboratory of Plant Systematics and Biodiversity, University of Geneva, C.P. 60, 1292 Chambésy, Switzerland.

Submitted on January 30, 2016. Accepted on May 31, 2016.

First published online on August 2, 2016.

ISSN: 0373-2967 – Online ISSN: 2235-3658 – *Candollea* 71(2): 195-203 (2016) © CONSERVATOIRE ET JARDIN BOTANIQUES DE GENÈVE 2016

Introduction

The genus *Scrophularia* L. is one of the largest genera of the family *Scrophulariaceae* with nearly 200 (MABBERLEY, 1997) to more than 300 species (WILLIS, 1973). In Iran *Scrophularia* is a widespread and diversified genus with recent accounts listing ca. 60 species (ATTAR, 2011). However, fieldwork often reveals that the taxonomy and nomenclature of these species still need to be revised.

Recent collections from Iran and a complete revision of material available in herbaria reveal the existence of two morphologically distinct taxa of contrasted distribution and ecology, that both key out as *S. farinosa* Boiss. when using the identification key of Flora Iranica (GRAU, 1981), in which *S. longiflora* Benth. as well as *S. nana* Stiefelh. are considered as synonyms. In this contribution, we explore the morphological, anatomical and ecological differences between these two taxa, we review the relevant literature and draw the necessary taxonomical and nomenclatural conclusions.

Material and methods

The present study was based on field observations made in Fars province from 2011 to 2014. In addition, herbarium specimens of *Scrophularia* deposited at BASU, FAR, and G were examined, as well as digital images of type material at BM, JE, K, MO, P and W. We selected a list of characters of importance to the taxonomy of this group including indumentum, leaf shape and variation, shape and size of the corolla tube and position of staminode, and scored their value for the specimens examined.

Anatomical studies were performed on representative specimens of the two taxa deposited at BASU, respectively *Ranjbar* 35993 and 26927. In order to investigate the indumentum, segments of dried plant specimens such as stems and leaves were separated and preserved in a mixture of water-glycerine-ethanol (1:1:1) for 2 weeks and then washed with distilled water. Transversal sections of the stems were prepared by manual cutting. The sections were cleared with dilute sodium hypochlorite and acetic acid and were then stained with methylene blue and carmine solutions. Then, they were inspected using an Olympus BX-51 photomicroscope at different magnifications and photographed using an Olympus camera.

Results and Discussion

Examination of herbarium material and anatomical studies clearly allowed us to separate specimens in two taxonomical entities that we hypothesize as distinct species.

The first one includes the type of *S. longiflora* and all type material of *S. farinosa* and we can already conclude that the synonymy proposed by BOISSIER (1879) and GRAU (1981) is justified, although, as will be explained below, the name that should be used is *S. longiflora*.

The second entity comprises the type material of *S. nana*. In his revision of the genus STIEFELHAGEN (1910) described *S. nana* as new and distinct form *S. farinosa* (= *S. longiflora*) not only at a specific level, but attributed these species to separate subsections: *S. farinosa* in subsect. *Farinosae* Stiefelh., with a urceolate corolla tube and *S. nana* in subsect. *Lucidae* Stiefelh., with a ventricose corolla tube. GRAU (1981), when he sunk *Scrophularia nana* in synonymy, argued that Stiefelhagen had based *S. nana* on observation of young flowers. However, accumulation of recent material and field observations provide evidence that *S. nana* consistently has a shorter and broader corolla and included stamens, as well as a set of other associated distinct character states.

Table 1 provides the comparison of morphological characters between these two species. Differences in flower structure are also illustrated in Fig. 1.

Details of stems anatomy are illustrated in Fig. 2. Anatomical studies showed slight differences between the stems of *S. longiflora* and *S. nana*. In *S. longiflora*, an outline of the stem transversal section is rather regular and hexagonal, whereas in *S. nana* is irregular and wrinkled. Both species are covered with trichomes that have a multi-cell base and a cup-shaped head, responsible of the farinaceous appearance of the plants. Although the trichome type is similar in both species, hairs in *S. nana* are predominantly longer than in *S. longiflora* and this difference is linked with the number of basic cells of these hairs. By contrast, the hair density in *S. longiflora* is clearly higher than in *S. nana*.

On the basis of the results of morphology and anatomy, we conclude that we are in the presence of two clearly distinct taxa, which both deserve specific rank. Distribution and ecology corroborate this conclusion. Both *S. longiflora* and *S. nana* are limited to Fars province, Iran (Fig. 3A). *Scrophularia longiflora* is relatively widely distributed there. Although the collection place of its type [Persia] is too vague for mapping, the type collection of its synonym *S. farinosa* comes from Sabz Pushan Mt. which is located in the south west of Shiraz, with its highest point reaching 3167 m. This area experiences a temperate climate with rainfall in winter and a warm and dry summer. *S. nana* is limited to Marvdasht city, north of Shiraz, and its original material comes from a limestone rock near Persepolis and Kotel Parrou. This region, with an altitude about 1620 m, experiences a temperate climate with an abundance of water and suitable soil.

Scrophularia species are known to display a high potential of hybridization. Several other species occur in Fars province, e.g. *S. schiraziana* Attar & Hatami, *S. denaensis* Attar and *S. xylobasis* Rech. f. It is thus legitimate to ask if *S. longiflora* or *S. nana* could either be hybrids or if they could have evolved through hybridization. Based on their morphology, it seems unlikely that these species could be potential parents of the two taxa treated in this contribution. However, only

Table 1. - Morphological features distinguishing *Scrophularia longiflora* Benth. from *S. nana* Stiefelh.

	<i>S. longiflora</i>	<i>S. nana</i>
Leaf phyllotaxy	Mostly alternate	Mostly opposite
Lower leaf shape, width [mm], dissection	Broadly ovate, 5-10, pinnatifid to pinnatisect	Broadly ovate to deltoid, 10-17, entire with serrate to dentate margins
Lower leaf petiole length [mm]	8-20	5-12
Upper leaf shape, width [mm], dissection	Ovate, 4-7, pinnatifid to pinnatisect	Broadly ovate to circular to triangular or rhombic, 10-14, entire with serrate to dentate margins
Upper petiole length [mm]	4-10	5-8
Inflorescence length [cm]	8-9 in fruit	4-5
Peduncle length [mm]	4-6	5-10
Pedicle length [mm]	1.5-2	1-1.5
Bract shape, length [mm]	lanceolate, entire to pinnatisect, 5-10	lanceolate entire to dentate, 10-15
Calyx lobes shape	Ovate-orbicular, obtuse	Ovate-lanceolate, obtuse to acute
Corolla shape, colour when fresh, length [mm]	Urceolate, yellowish-white, 9-10	Ventricose, purple, 5-7
Anthers position	Exserted	Included
Staminode shape	Orbiculate	Reniform
Style length [mm]	8	4-5

a molecular study which is beyond the scope of this paper, could definitely rule out such hypothesis. A molecular study would nevertheless be of high interest to elucidate speciation processes of *Scrophularia* in this region which appears to be a center of diversity for this genus.

Taxonomy

The two species can be easily separated using the following identification key:

1. Leaves narrowly ovate to broadly ovate, pinnatisect to pinnatipartite; corolla urceolate, 9-10 mm long, yellowish-white when fresh; stamens exserted, staminode shorter than stamens; style 8 mm long..... *S. longiflora*
- 1a. Leaves broadly ovate to circular to triangular or rhombic to deltoid, serrate to dentate; corolla ventricose, 5-7 mm long, purple when fresh; stamens included, staminode the same length as stamens; style 4-5 mm long..... *S. nana*

Scrophularia longiflora Benth. in DC., Prodr. 10: 313. 1846 (Fig. 3B-D).

Typus: IRAN: Persia, *s.d.*, *Anon. s.n.* (holo-: G-DC [G00498883]!).

- = *Scrophularia farinosa* Boiss., Diagn. Pl. Orient. ser. 1, 7: 40. 1846. **Lectotypus** (designated here): IRAN. **Prov. Fars:** in fissuris rupium sept. v. spectantium m. Sabst-Buschom [Sabz Pushan] pr. u. Schiras rarius, [29°26'55"N 52°32'00"E], 25.V.1842, *Kotschy 427* (G-BOIS [G00330405]!); isolecto-: E [E00327361]

image seen, FI [FI009673] image seen, G [G00382756, G00382757, G00382758]!, GOET [GOET011067] image seen, K [K001096210] image seen, MO-97706 image seen, MO-97810 image seen, P [P03412070, P03412071, P03412073 in part., P03412074] images seen, WAG [1835848], W [W0017712] image seen). **Syntypi:** IRAN. **Prov. Fars:** Sabz Pushan [Sabst Buschom], 1842, *Kotschy 843* (G-BOIS [G00330408]!), JE [JE00010888] image seen, P [P03412073] image seen, W [W0017422] image seen).

Perennial herb, 4-16 cm tall, decumbent, stems short, thin, numerous, with long internodes below and shorter above, grey, with a white dense indumentum of farinaceous hairs and with rare dispersed dendroid hairs. *Lower leaves* alternate, grey, densely farinaceous with a few dendroid branched hairs on both surfaces, petioles 8-20 mm long, blade broadly ovate in overall shape, 16-20 × 5-10 mm, venation pinnate, prominent on abaxial surface, pinnatifid to pinnatisect, upper part of leaf dentate, with 3-4 teeth 0.5-1 mm long each side; angle of teeth with reference to midrib 20-30°, subacute to obtuse; lower part of leaf divided, with 2-3 lobes 3-6 mm long each side, angle of lobes with reference to midrib 30-40°, obtuse, each lobe with ca. 2-3 teeth 0.5 mm long each side, angle of teeth ca. 45°, obtuse, apical side of tooth convex and straight, basal side of tooth concave. *Upper leaves* alternate, grey, densely farinaceous and with rare dendroid hairs on both surfaces, petiole 4-10 mm long, blade symmetrical, narrowly ovate, acute, 12-20 × 4-7 mm, venation pinnate, prominent on abaxial surface, blade pinnatifid to pinnatisect, with ca. 2-4 lobes each side;

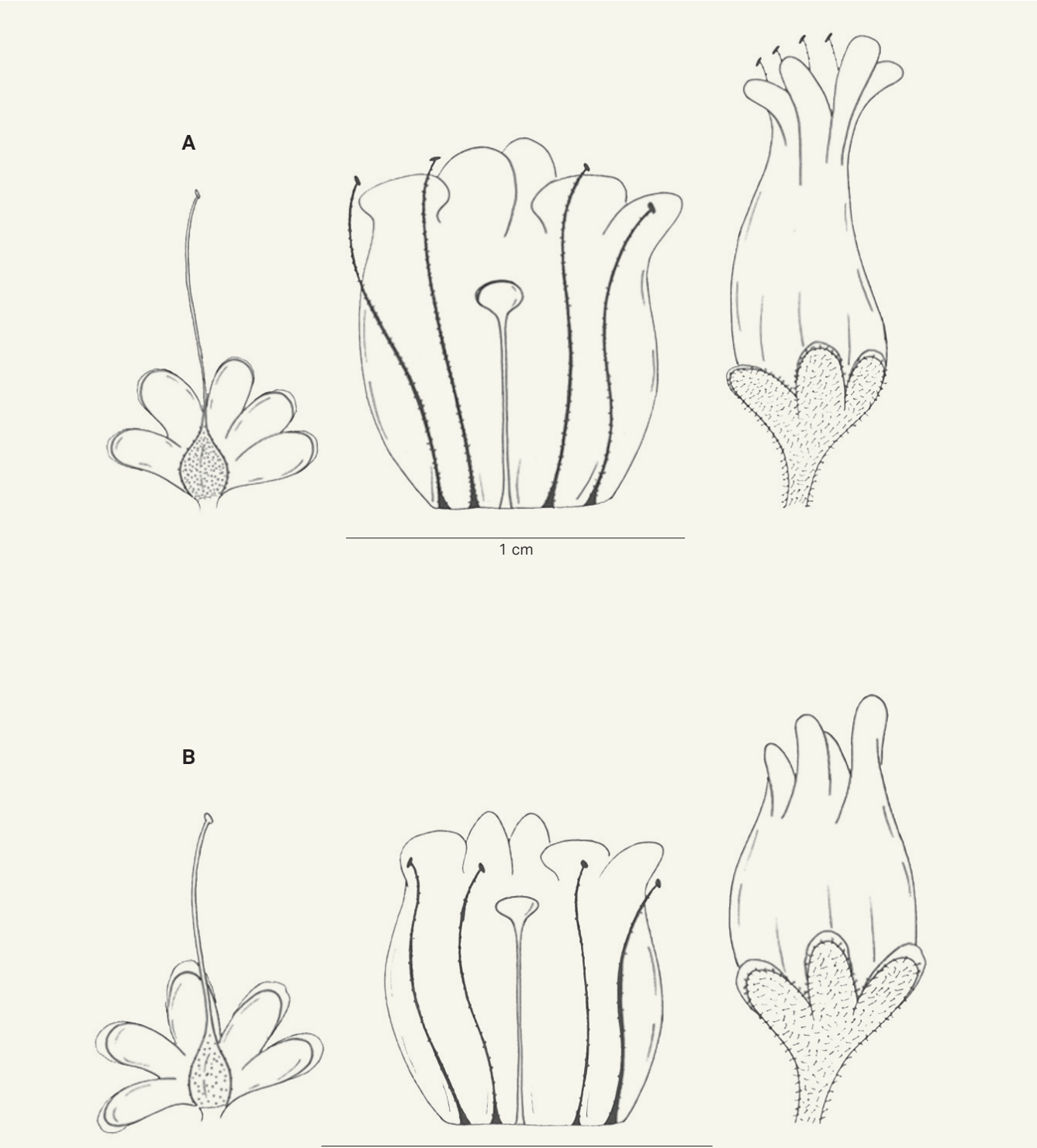


Fig. 1. – Flower structure. **A.** *Scrophularia longiflora* Benth.; **B.** *Scrophularia nana* Stiefelh. [A: Ranjbar 35993, BASU; B: Ranjbar 26927, BASU]

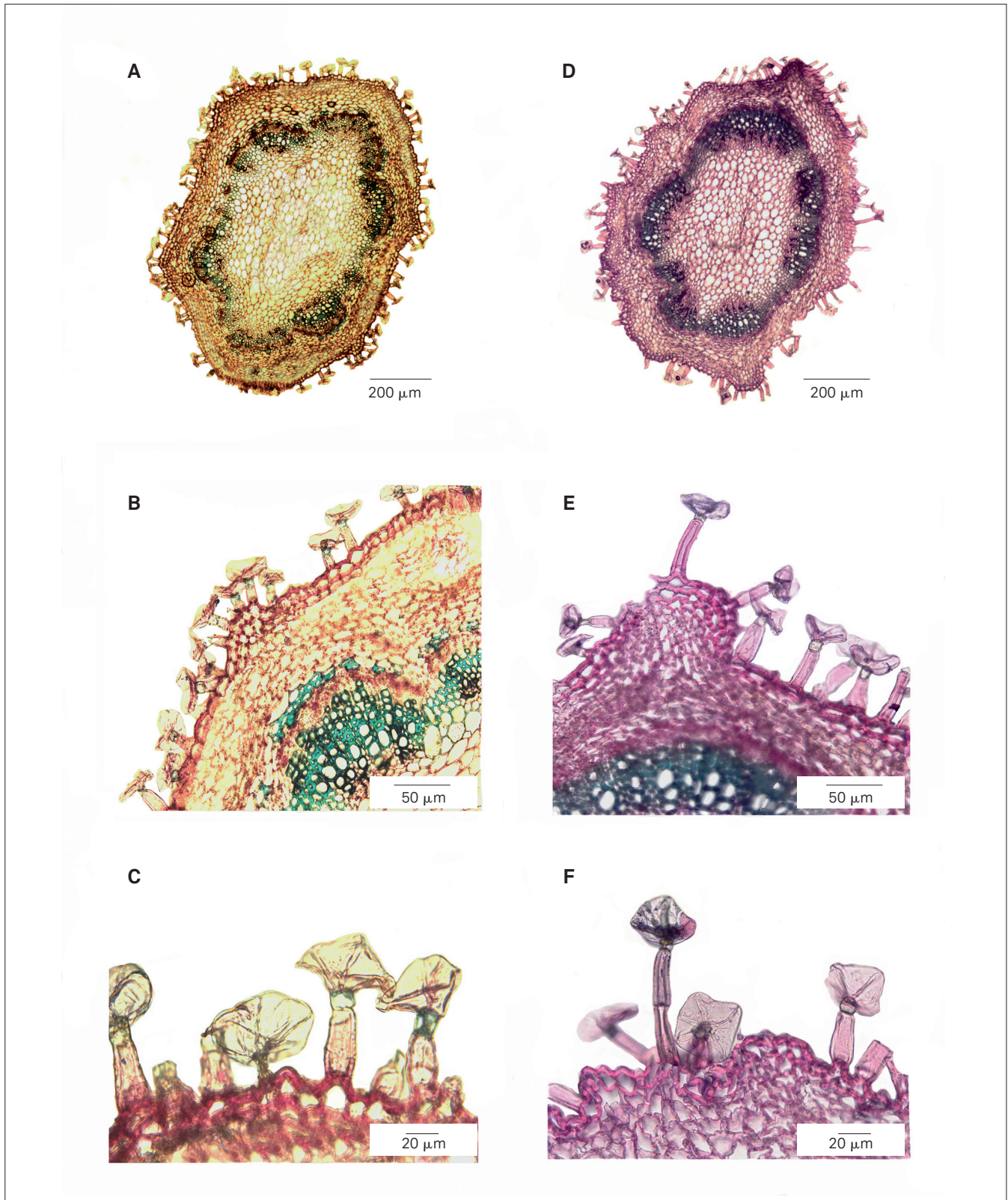


Fig. 2. – Anatomical comparison of stem transversal section of *Scrophularia longiflora* Benth. (A-C) and *S. nana* Stiefelh. (D-F). A, D. Outline of the stem transversal section. B-C, E-F. Focus on farinaceous hairs at two different magnifications. [A-C: Ranjbar 35993, BASU; D-F: Ranjbar 26927, BASU]

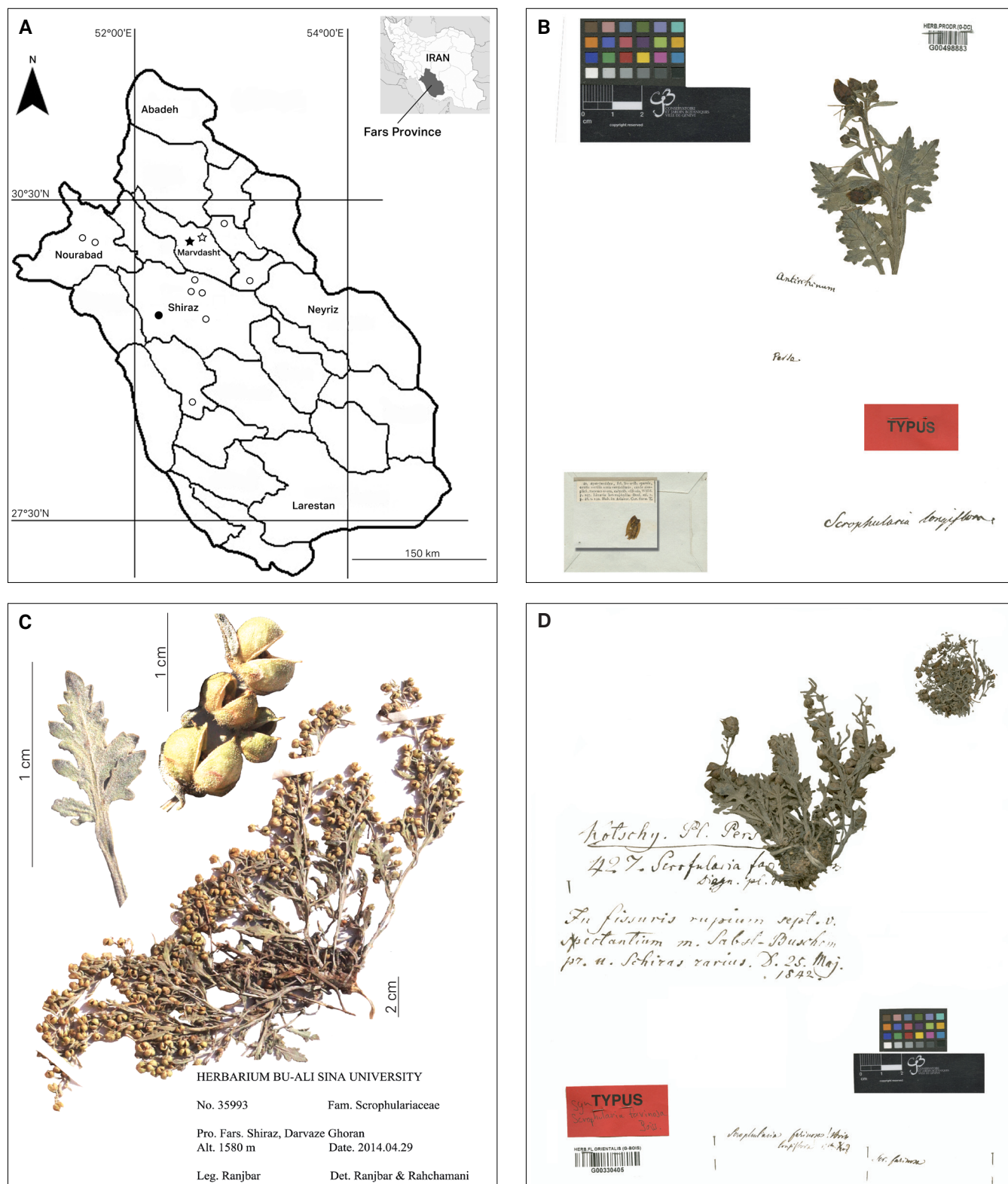


Fig. 3. – Distribution map of *Scrophularia longiflora* Benth. and *S. nana* Stiefelh. in Fars Province in Iran (**A**) and collections of *S. longiflora* (**B-D**). **A.** Examined specimens and data of “Flora Iranica” (white circles: *S. longiflora*; white stars: *S. nana*) and type collections (black circle: *S. farinosa* (= *S. longiflora*); black star: *S. nana*); **B.** Holotype; **C.** Details of Ranjbar 35993 collection at BASU: overview of plant, close-up of leaf, and fruit; **D.** Lectotype of its synonym *S. farinosa* Boiss. [**B:** Ranjbar 35993, BASU; **C:** Anon. s.n., G-DC; **D:** Kotschy 427, G-BOIS]

0.5–1.8 mm long, angle of lobes with reference to midrib ca. 30°, acute, apical side of lobes convex to straight, basal side concave. *Inflorescence* dense, many-flowered, bracteate, paniculate, cymes drepanium, elongate in fruiting status up to 7–8 cm long. *Bracts* lanceolate, entire, acute, 5–10 × 1–3 mm, grey, densely farinaceous, the lower ones leaf-like. *Bracteoles* lanceolate, entire, acute, 3–3.5 × 1 mm, grey, densely farinaceous. *Peduncle* 4–6 mm long, densely farinaceous hairs mixed with sparsely glandular hairs. *Pedicels* 1.5–2 mm long, densely glandular and with a sparsely farinaceous hairs. *Flowers* zygomorphic. *Calyx* 2.5–3 × ca. 2.5 mm, sepals equal, ovate-orbicular, obtuse at apex, grey to greenish, densely covered with glandular hairs, with white often glabrous margins. *Corolla* 9–10 mm long, urceolate, yellow-white when fresh, brown in dried status, glabrous, lobes unequal, obtuse, upper lobes 1.5–2 mm longer than lower lobes. *Stamens* 4, fertile, exerted, 9.5–10 mm long, filaments white, densely glandular-dotted, anthers white. *Staminode* small, orbiculate, ca. 0.5 × 0.5 mm, purple, its filament shorter than the ones of the fertile anthers, and thus included in the corolla tube. *Ovary* spherical to ovoid, 1–1.5 × 1.5 mm, densely gland-dotted. *Style* terminal, filiform, ca. 8 mm long, glabrous. *Capsule* spherical to ovoid, 3.5–5 × 3–4 mm, mucronate at apex, mucron 0.5–1 mm long, grey to green, densely gland-dotted. *Seed* rectangular to elliptic, 0.9–1.1 × 0.4–0.5 mm, dark brown to black, with scattered depressed area, sometimes lighter discontinuous bands.

Notes. – The name *S. longiflora* was published on April 8, 1846 by BENTHAM (1846: 313) (see STAFLEU & COWAN, 1976), where it is clearly stated that the only specimen seen is a specimen of unknown collector coming from Persia, and kept in the de Candolle herbarium. There is only one specimen under this name in the G-DC herbarium, and this is consequently the holotype of that name.

The name *S. farinosa* first appeared in 1845 on the printed labels of Kotschy's specimen distributed and edited by R.F. Hohenacker. However, these labels lack any kind of diagnostic elements and hence the name cannot be considered as validly published until BOISSIER (1846), released in Jul.–Oct. 1846 according to STAFLEU & COWAN (1976). The species is described based on two collections: *Kotschy 427* and *843* collected from Iran, Sabz Pushan (Sabst-Buschom) around Shiraz. Although GRAU (1981) cites “Typus Kotschy 427, 843; holotypus G!, isotypus W!”, the G-BOIS duplicates of these collections should be considered as syntypes and lectotypification is needed. The specimen *Kotschy 427* [G00330405] is designed here as lectotype (Fig. 3D) because it is complete and includes a mature plant with fruit. The other specimen *Kotschy 843* [G00330408] is not complete being without fruit. Besides, *Kotschy 427* is much more widely distributed in other herbaria.

Both BOISSIER (1879) and GRAU (1981) have correctly considered that *S. farinosa* and *S. longiflora* were synonyms. However, they both retained the name *S. farinosa*, whereas *S. longiflora* was effectively published a few months earlier and has priority.

Other specimens examined. – IRAN. **Prov. Fars:** Sabz Pushan [Sabst Buschom], 1842, *Kotschy 427a* (G [G00330574]); *sine loc.*, s.d., *Michaux s.n.* (G [G00382553]); around Shiraz, s.d., *Michaux s.n.* (P [P03412072]); Shiraz, Darvaz-e Qoran, 29°38'03"N 52°33'37"E, 1580 m, 29.IV.2014, *Ranjbar 35993* (BASU); Bamu protected region, Darreh Chap, 1650–1900 m, 30.V.1975, *Wendelbo & Foroughi 17531*, partly (G [G00418106]).

Scrophularia nana Stiefelh., Bot. Jahrb. Syst. 44: 479. 1910. (Fig. 4A, B)

Lectoypus (designated here): IRAN. **Prov. Fars:** around Persepolis and Kotel Parrou, *Hausknecht s.n.* (JE [JE00010886] image seen; probable isolecto-: G [G00330575]!, W [W0017409] image seen).

Perennial herb, 3–15 cm tall, erect, stems short, thin, branched, with long internodes below and shorter above, grey, with a white dense indumentum of farinaceous hairs. *Lower leaves* opposite, grey, densely farinaceous on both surfaces, petioles 5–12 mm long, blade broadly ovate to rhombic to deltoid, 15–20 × 10–17 mm, venation pinnate versus palmate, serrate to dentate, with ca. 6–8 teeth each side; 1–3 mm long, angle of teeth with reference to the midrib ca. 40°, obtuse, apical side of teeth convex and straight, basal side concave. *Upper leaves* opposite to rarely alternate, grey, with densely farinaceous hairs on both surfaces, petiole 5–8 mm long, blade broadly ovate to rhombic, obtuse, 18–20 × 10–14 mm, venation pinnate, serrate to dentate, with ca. 5–7 teeth each side; 0.5–2 mm long, angle of teeth with reference to the midrib ca. 30°–40°, obtuse, apical side of teeth convex to straight, basal side concave. *Inflorescence* 4–5 cm long, dense, many-flowered, bracteate, paniculate, cymes drepanium. *Bracts* lanceolate, entire, acute, 10–15 × 2–5 mm, grey, with a dense indumentum of farinaceous hairs, the lower ones with a few teeth. *Bracteoles* lanceolate, entire, acute, 2–3 × 0.5 mm, grey, with a dense indumentum of farinaceous hairs. *Peduncle* 5–10 mm long, densely glandular mixed with sparsely farinaceous hairs. *Pedicel* 1–1.5 mm long, with densely glandular hairs. *Flowers* zygomorphic. *Calyx* 3–4 × 2.5–3 mm, sepals equal, ovate-elliptic, obtuse, grey, with white often glabrous margins, densely covered with glandular hairs. *Corolla* 5–7 mm long, ventricose, purple when fresh, red to brown in dried status, glabrous, lobes unequal, obtuse, upper lobes 0.5 mm longer than lower lobes. *Stamens* 4, fertile, included, 5–7 mm long, filaments white, loosely gland-dotted, anthers white. *Staminode* small, reniform, ca. 0.5 × 1 mm, red, its filament as long as the ones of the fertile anthers. *Ovary* spherical, ca. 1.5 × 2 mm, loosely gland-dotted. *Style* terminal, filiform, 4–5 mm long, glabrous. *Capsule* spherical to ovoid, ca. 3 × 3.5 mm, mucronate, mucrone 0.5 mm long, green, loosely gland-dotted. *Seed* elliptic, to 1 mm, brown.

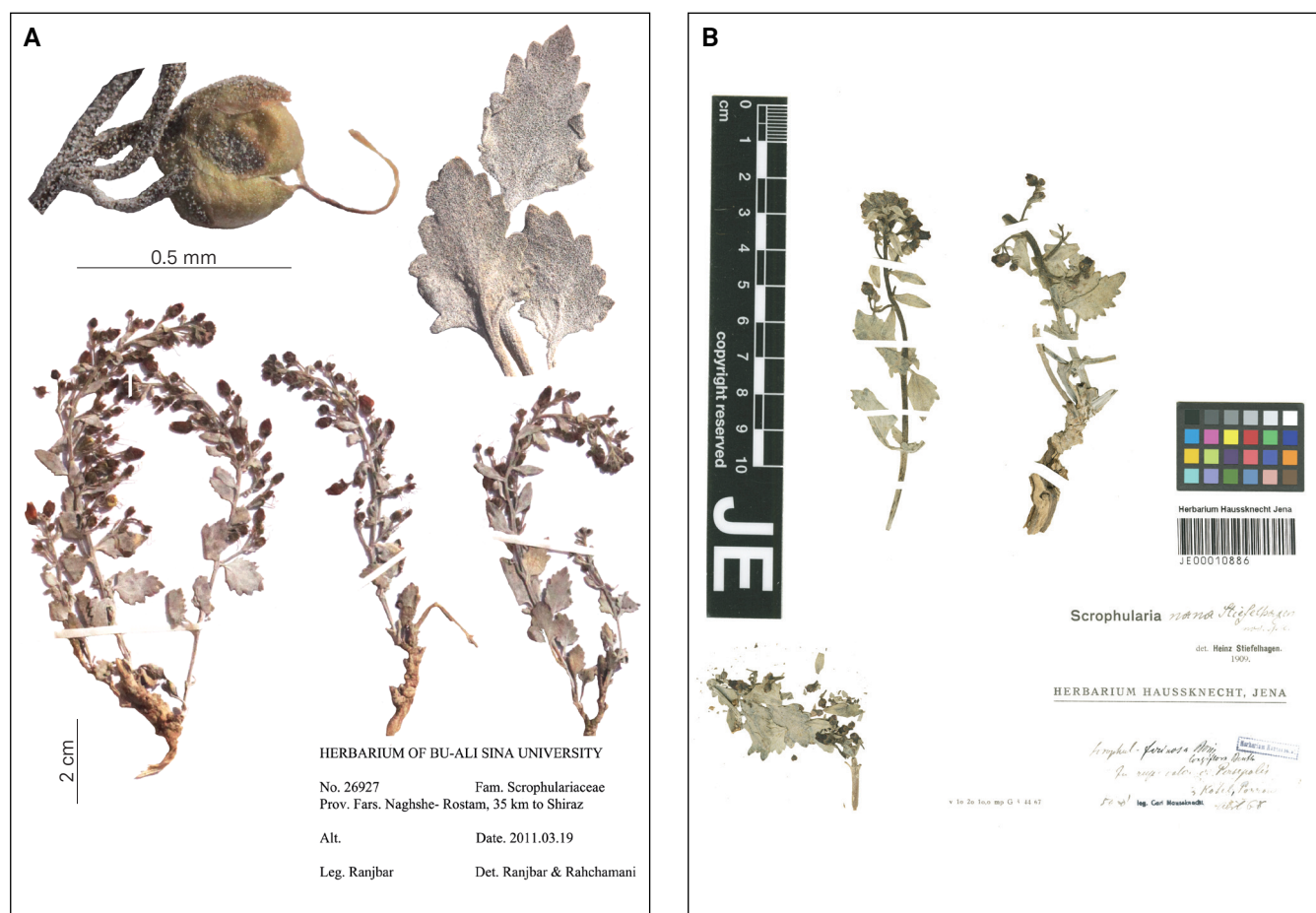


Fig. 4. – *Scrophularia nana* Stiefelh. **A.** Details of Ranjbar 26927 collection at BASU: overview of plant, close-up of leaf, and fruit; **B.** Lectotype.

[A: Ranjbar 26927, BASU; B: Haussknecht s.n., JE]

Note. – The protologue of *S. nana* provides the following indications: “Verbr.: Südwestliches Persien: Kalkfelsen bei Persepolis und Kotel Parrou, 5000’ (leg. Hausskn. April 1868 sub *S. farinosa* Boiss.)”. However, there is no mention of the herbarium of deposition of the type and lectotypification is needed. Among herbaria where corresponding material has been traced, herbarium JE, where the Haussknecht herbarium is now incorporated, has two specimens by Haussknecht that were recently databased as syntypes. Both have an identification label by Stiefelhagen as “*Scrophularia nana* Stiefelhagen nov. spec.; det. Heinz Stiefelhagen. 1909”. However, only one of them [JE00010886] has a locality (“In rup. calc. ca. Persepolis et Kotel Parrou; 5000”) that matches the protologue. Consequently, this specimen has been selected as lectotype. The second specimen, [JE00010885], with locality “In rup. calc. ca. Persepolis et Kotel Kumaredj”, is not cited in the diagnosis and despite its label by Stiefelhagen, it should not be considered as type material. Duplicates of these collections in other herbaria have either a locality with elements of these

two collections [G00330575] or a locality which is too vague to be attributed to one of these collections [W0017409]. Both should be considered as probable isoelectotypes.

In the diagnosis of this species a wide variation of leaf shape is mentioned. Among all observed specimens, margin leaf is irregular crenate, serrate to dentate or incised, but never pinnatipartite. This character is very important and a distinguishing trait between *S. nana* and *S. longiflora*. Another point is that the fruit of this species was not described. Based on examined specimens and digital images, we provide above a description of capsules and seeds.

Other specimen examined. – IRAN. Prov. Fars: Marvdasht, Naqshi Rostam, 29°59'19"N 52°52'29"E, 1644 m, 19.III.2011, Ranjbar 26927 (BASU); Takht-e Jamshid [Persepolis] and Kotel Kumaredj, 1525 m, IV.1868, Haussknecht s.n. (JE [JE00010885]); between Takht-e Jamshid [Persepolis] to Daulatabad [Dolat Abad], 1000-2000 m, 2.V.1956, Schmid 5471 (G [G00382551]); Bamu protected region, Darreh Chap, 1650-1900 m, 30.V.1975, Wendelbo & Foroughi 17531 (G [G00382552] in part).

Acknowledgments

We would like to thank Dr. Attar (Prof. of Plant Systematics – Tehran University) for her suggestions and guidance as the pioneer researcher of the genus *Scrophularia* in Iran. We are indebted to the personnel of the following herbaria: BM, G, JE, K, MO, P, TUH and W for their contribution during the revision of materials and for providing type images. The field work in Iran was supported by grants from Bu-Ali Sina University. We would also like to thank two anonymous reviewers for their helpful comments.

References

- ATTAR, F. (2011). Scrophulariaceae. In: ASSADI, M. (ed.), *Fl. Iran* 68: 206-307. Research Institute of Forests and Rangelands, Tehran.
- BENTHAM, G. (1846). Scrophulariaceae. In: CANDOLLE, A.P. DE & A. DE CANDOLLE (ed.), *Prodr.* 10: 180-586.
- BOISSIER, P.E. (1846). *Diagn. Pl. Orient.* ser. 1, 7.
- BOISSIER, P.E. (1879). *Scrophularia*. *Fl. Orientalis* 4: 387-421.
- GRAU, J. (1981). Scrophulariaceae. In: RECHINGER, K.H. (ed.), *Fl. Iranica* 147: 213-284. Akademische Druck- und Verlagsanstalt.
- MABBERLEY, D.J. (1997). *The plant book*. Cambridge University Press.
- SCHEUNERT, A. & G. HEUBL (2011). Phylogenetic relationships among New World *Scrophularia* L. (Scrophulariaceae): new insights inferred from DNA sequence data. *Plant Syst. Evol.* 291: 69-89.
- STAFLEU, F.A. & R.S. COWAN (1976). *Taxonomic Literature*. Vol. 1. 2nd ed. Scheltema, Bohn & Holkema.
- STIEFELHAGEN, H. (1910). Systematische und pflanzengeographische Studien zur Kenntnis der Gattung *Scrophularia*. *Bot. Jahrb. Syst.* 44: 406-496.
- WILLIS, J.C. (1973). *A dictionary of the flowering plants and ferns*. 8th ed. University Press, Cambridge.