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from flora of Iran

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# A morphological re-evaluation of the taxonomic status of *Satureja* L. (Lamiaceae, Nepetoideae, Mentheae) from flora of Iran

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## ABSTRACT

A new circumscription of *Satureja* L. from the flora of Iran was carried out. The data presented are mainly based on the extensive field observation and herbarium studies of *Satureja*. The genus contains 12 species of which seven species are endemic to Iran. Complete descriptions for each of these taxa, illustrations, remarkable taxonomic notes, and materials examined as well as a key for their identification, geographical distribution, together with updated distribution maps in Iran are given. Some taxa are placed in synonymy for the first time here: *S. kermanshabensis* Jamzad is a synonym of *S. bachtiarica* Bunge, *S. rechingeri* Jamzad is a synonym of *S. khuzistanica* Jamzad, *S. atropatana* Bunge is a synonym of *S. macrantha* C.A.Mey., and *S. spicigera* (C.Koch) Boiss. is synonym of *S. mutica* Fisch. & Mey. Additionally, *S. boissieri* Hausskn. ex Boiss. was excluded from the flora of Iran, and the earlier species name, *S. longiflora*, previously treated as synonym of *S. edmondii*, is resurrected here.

KEY WORDS  
Iran,  
Labiatae,  
Menthinae,  
taxonomic status,  
new synonyms.

## RÉSUMÉ

Réévaluation morphologique du statut taxonomique de *Satureja* L. (Lamiaceae, Nepetoideae, Mentheae) de la flore d'Iran.

Une nouvelle circonscription de *Satureja* à partir de la flore d'Iran a été réalisée. Les données présentées sont principalement basées sur l'observation approfondie sur le terrain et les études d'herbier de *Satureja*. Le genre contient 12 espèces dont sept espèces sont endémiques de l'Iran. Des descriptions complètes pour chacun de ces taxons, des illustrations, la distribution géographique, des remarques taxonomiques sur les matériaux examinés ainsi qu'une clé d'identification, et des cartes de distribution mises à jour pour l'Iran sont données. Certains taxons sont ici mis en synonymie pour la première fois: *S. kermanshabensis* Jamzad est synonyme de *S. bachtiarica* Bunge, *S. rechingeri* Jamzad est synonyme de *S. khuzistanica* Jamzad, *S. atropatana* Bunge est synonyme de *S. macrantha* C.A.Mey. et *S. spicigera* (C.Koch) Boiss. est synonyme de *S. mutica* Fisch. & Mey. De plus, *S. boissieri* Hausskn. ex Boiss. a été exclu de la flore iranienne, et le nom d'espèce antérieur, *S. longiflora*, auparavant traité comme synonyme de *S. edmondii*, est ressuscité ici.

MOTS CLÉS  
Iran,  
Labiatae,  
Menthinae,  
statut taxonomique,  
synonymes nouveaux.

## INTRODUCTION

*Satureja* L. is a member of subtribe Menthinae (Lamiaceae, Nepetoideae, Mentheae) (Harley *et al.* 2004). This genus belongs to a taxonomically complex group of plants in which delimitation of the taxa has been controversial among taxonomists. *Satureja* was described by Linnaeus (1753) with nine species separated from many genera later considered to be *Satureja* s.l. There are two circumscriptions for *Satureja* widely accepted by the next taxonomists: Bentham (1834, 1848) preferred a narrow delimitation while Briquet (1895-1897) recognized a much more broadly circumscription for *Satureja*. In the twentieth century, both these contrary approaches entered in parallel by authors in many floras. In Europe and Asia in particular, a number of botanists began to consider again the genera *Satureja*, *Calamintha*, *Clinopodium*, *Acinos* and *Micromeria* independent, and followed *Satureja* sensu Bentham (1848, 1876). The best-known examples are the *Flora of the USSR* (Borissova 1977), *Flora Europaea* (Ball & Getliffe 1972), *Flora of Turkey* (Davis 1982) and *Flora Iranica* (Rechinger 1982). On the other hand, the others (Thonner 1915; Killick 1961; Greuter *et al.* 1986, etc.) pursued the broad sense of Briquet (1895-1897). Therefore, there was no single opinion accepted by the majority of taxonomists about the delimitation of these genera. In his doctoral thesis, Doroszenko (1986) revised *Satureja* complex worldwide for the first time since Briquet (1895-1897). He preferred a narrow generic term, dispatched *Satureja* s.l. into 17 genera, and modified the description of many taxa. He divided all the genera into four informal groups, and assigned the Satureioid group to *Satureja* s.s., *Gontscharovia* Boriss and *Euhesperida* Brullo & Furnar. In recent decades, the advances in molecular biology and bioinformatics have provided powerful tools for the taxonomist to eliminate long time unresolved problems and greatly improved previous generic concept based on a traditional morphological approach. The first molecular phylogenetic investigation of Nepetoideae was published by Wagstaff *et al.* (1995) using plastic DNA restriction site analysis. The results clearly indicated that *Satureja* s.l. is paraphyletic, and should be divided into several genera. Since then, many species of *Satureja* have moved to the other genera (e.g. Cantino & Wagstaff 1998; Cantino & Doroszenko 1998; Harley & Granda 2000; López & Morales 2004; Ryding 2006a, b; Bräuchler 2018; Bordbar & Mirtadzadini 2019).

There is no exact idea of the number of species of *Satureja* s.s. Doroszenko (1986) has numbered 29 species while according to the latest summary (Harley *et al.* 2004), it is indicated that the genus contains about 38 species distributed in the Mediterranean region, N Africa (Morocco and Libya), Caucasus and W Asia (Iran, Iraq and Saudi Arabia). Harley *et al.* (2004) divided the genus into two sections *Satureja* and *Salzmania* including the monotypic genera *Euhesperida* Brullo & Furnari and *Argantoniella* López & Morales. Recently, molecular

phylogeny investigations of the taxa in Menthinae (Bräuchler *et al.* 2010) reinforced the narrowly circumscription of *Satureja*. In this study, *Satureja* formed a distinct clade (called *Satureja* group including *Satureja* s.s. and *Gontscharovia popovii* (B.Fedtsch. & Gontsch.) Boiss.), and sister to *Clinopodium* L. and *Micromeria* Benth. groups. This work confirmed *Satureja* independence from *Argantoniella*. Moreover, *Satureja linearifolia* (Brullo & Furnari) Greuter (syn. *Euhesperida linearifolia* Brullo & Furnari) and *S. thymbrifolia* were not grouped with the other species of *Satureja* which later entered into *Thymbra* Mill. by Bräuchler (2018).

Seven species of *Satureja* from Iran were mentioned by Boissier (1879) in *Flora Orientalis* (Table 1). This is the first regional Flora including the plants of Iran. Boissier followed Bentham by placing all the Old World *Satureja* s.l. into three genera: *Satureja*, *Micromeria* and *Calamintha* Adans. *Satureja* sensu Boissier is equivalent to *Satureja* s.s. Years later, Parsa (1949) in *Flore de l'Iran* enumerated 11 species of *Satureja* previously recorded from Iran by the other taxonomists (Table 1). An equal number of the species of *Satureja* is represented in *Flora Iranica*, a comprehensive survey on the plants of Iran (Rechinger 1982). However, *S. hortensis* L. and *S. macrosiphonia* Bornm. were not reported from Iran. Instead, *S. laxiflora* C.Koch and a newly reported species by Rechinger (1979), namely *S. isophylla* Rech.f., were included in the list of species (Table 1). Jamzad (2012) provided a valuable taxonomic treatment of Lamiaceae in *Flora of Iran*, and counted 16 species belonging to *Satureja*. She added five species to the species list of *Flora Iranica* which previously described by her as a new record, namely *S. macrosiphonia* (Jamzad 2009) or new species including *S. kallarica* Jamzad (Jamzad 1992), *S. khuzistanica* Jamzad (Jamzad 1994), *S. rechingeri* Jamzad (Jamzad 1996) and *S. kermanshahensis* Jamzad (Jamzad 2010). It was the last revision of the genus from Iran. *S. macrosiphonia* was previously described from Iran by Parsa (1949), and probably missed by Jamzad. *Satureja avromanica* Maroofi was reported from Iran by Maroofi (2010) as a new species, but it was supposed to be an intra-specific variation for *Satureja edmondii* Briquet in *Flora of Iran* (Jamzad 2012), and more studies were suggested to confirm its taxonomic state.

Field and herbarium observations have increased our knowledge of the taxonomy of the genus and questioned the present circumscription of the taxa. Recently, *S. kallarica* was transferred to *Clinopodium* (Bordbar & Mirtadzadini 2019) and *Satureja kermanica* Payandeh, Bordbar & Mirtadz. was described from Iran as a new species (Bordbar *et al.* 2020). But, there are still several taxonomic problems that could not be referred to in the present treatment and need a comprehensive work on *Satureja*. Presented below provides an updated taxonomic context for the genus *Satureja* in Iran, which includes delimitation of taxonomically difficult species, detailed descriptions, distribution of the species, remarkable taxonomic notes, as well as an identification key to the species.

## MATERIAL AND METHODS

The revisionary work was based on extensive field studies from different regions of Iran between 2015 and 2022 by the two authors, and exploring of the specimens in Armenia in 2019 by the second author as well as the examination of herbarium specimens from MIR, IRAN, TUH. TARI herbarium visited exclusively for the type specimens. The digital photographs of the specimens including the types from P, K, W, WU, E, G, JE, SAV, LE, VHLV, and the herbarium of Balıkesir University have either been received or viewed on the online databases (acronyms according to Thiers 2019). In addition, the taxonomic state of the species was undertaken based on the study of the following taxonomic literatures, including description of *Satureja* species: *Flora Iranica* (Rechinger 1982), *Flora of Iran* (Jamzad 2012), *Flora of Turkey* and the East Aegean Islands (Davis 1982), and *Flora of the USSR* (Borissova 1977). A 10-40 × magnification stereomicroscope was used to analyze morphological features of the specimens. The measurements were taken from herbarium samples. Information that could not be clearly observed on dried materials (e.g. flower color) was recorded in the field. We provided a list of selected studied material (indication of the locality, collection date, collectors and voucher number) after the description of each species. This information is indicated in the general distribution

of the taxa through different Provinces of Iran. Finally, we have prepared distribution maps for the species examined.

## HERBARIUM ABBREVIATIONS

E	Royal Botanic Garden, Edinburgh, Living Plant Collections;
FUMH	Ferdowsi University of Mashhad, Iran;
G	Conservatoire et Jardin botaniques de Genève, Switzerland;
G-BOIS	Boissier herbarium in G;
HKS	Kurdistan Agricultural and Natural Resources Research and Education Center, Sanandaj, Iran;
IRAN	Iranian Research Institute of Plant Protection, Iran;
JE	Friedrich Schiller University Jena, Germany;
K	Royal Botanic Gardens, Kew;
LE	Komarov Botanical Institute of RAS, Saint Petersburg, Russian Federation;
MIR	Shahid Bahonar University of Kerman, Iran;
P	Muséum national d'Histoire naturelle, Paris;
TARI	Research Institute of Forests and Rangelands, Iran;
TUH	Tehran University, Iran;
SAV	Slovak Academy of Sciences, Bratislava, Slovakia;
VHLV	Yüzüncü Yıl University Faculty of Education, Van, Turkey;
W	Natural History Museum Vienna, Wien, Austria;
WU	University of Vienna, Wien, Austria.

KEY TO THE SPECIES OF *SATUREJA* L. FROM FLORA OF IRAN

1. Annual ..... *S. hortensis* L.  
— Perennial suffruticose ..... 2
2. Corolla tube exserted from the calyx ..... 3  
— Corolla tube non-exserted from the calyx ..... 8
3. Corolla blade white ..... *S. sabendica* Bornm.  
— Corolla blade not white (violet, purplish-lilac, rarely yellowish) ..... 4
4. Plants covered with pubescent hairs, leaves broad (obovate, ovate or wide elliptic) ..... *S. khuzistanica* Jamzad  
— Indumentum not as above, leaves narrow ..... 5
5. Plants non-aromatic, corolla slender, tube diameter ≤ 1 mm ..... *S. avromanica* Maroofi  
— Plants aromatic, corolla non-slender, tube diameter ≥ 1 mm ..... 6
6. With lemon like fragrance, verticillasters always distant, calyx tubular-campanulate .....  
..... *S. macrosiphonia* Bornm.  
— With *Satureja hortensis* like fragrance, Verticillasters distant or approximate, calyx tubular ..... 7
7. Lower leaves often broad, calyx teeth straight ..... *S. longiflora* Boiss. & Hausskn.  
— Lower leaves not broad, calyx teeth recurved ..... *S. macrantha* C.A.Mey.
8. Plants caespitose ..... *S. isophylla* Rech.f.  
— Plants non-caespitose ..... 9
9. Leaves broad (obovate-oblong or obovate-spathulate) ..... *S. intermedia* C.A.Mey.  
— Leaves not broad (linear-narrow elliptic, linear-oblancoelate) ..... 10
10. Length of calyx > 4 mm, length of corolla > 7 mm ..... *S. mutica* Fisch. & Mey.  
— Length of calyx < 4 mm, length of corolla < 7 mm ..... 11
11. Calyx campanulate, 2.5-3 mm, corolla blade white ..... *S. bachtiarica* Bunge  
— Calyx tubular-campanulate, 3-3.5 mm, corolla blade violet ..... *S. kermanica* Payandeh, Bordbar & Mirtadz.

## TAXONOMIC TREATMENT

Family LAMIACEAE Martynov  
 Subfamily NEPETOIDEAE (Dumort.) Luerss.  
 Tribe MENTHEAE Dumort.  
 Subtribe MENTHINAE (Dumort.) Endl.

### Genus *Satureja* L.

*Species Plantarum* 567 (Linnaeus 1753). — *Satureja* sect. *Tragoriganum* Benth., *Labiatarum genera et species*: 354 (Bentham 1834). — *Satureja* sect. *Annuae* Boiss., *Flora Orientalis* 4: 562 (Boissier 1879). — *Satureja* sect. *Eusatureiae* Boiss., *Flora Orientalis* 4: 563 (Boissier 1879). — *Satureja* sect. *Subbilabiatae* Boiss., *Flora Orientalis* 4: 565 (Boissier 1879). — *Satureja* sect. *Zatarioideae* Boiss., *Flora Orientalis* 4: 567 (Boissier 1879). — *Satureja* sect. *Sabbatia* Briq. in Engler & Prantl, *Die natürlichen Pflanzenfamilien*, 4, 3a: 298 (Briquet 1895-1897).

TYPE SPECIES. — *Satureja montana* L. (designated by Doroszenko 1986).

PERSIAN VERNACULAR NAMES. — This plant is known by local people as (*S. khuzistanica* in Khuzestan), Azbua (*S. longiflora* Boiss. & Hausskn. in Kermanshah), Ezgen and Ezghand (*S. kermanica* in Kerman), Oushan and Ourishan (*S. bachtiarica* Bunge in Bakhtiari), Maraza (*S. bachtiarica* in Kermanshah), Hazbeh (*S. bachtiarica* in Kordestan) and the common name Marzeh for *S. hortensis*.

DISTRIBUTION. — N, NW, W, SW and SE of Iran.

ECOLOGY AND PHYTOGEOGRAPHY. — The distribution pattern of most of *Satureja* species in Iran follows that of the Irano-Turanian floristic region. Exceptionally, *S. isophylla* existed in transitional area between the Irano-Turanian and Euro-Siberian regions, and *S. khuzistanica* distributed on the rocky slopes of mesic areas between the Irano-Turanian and Saharo-Arabian regions. *S. mutica* is distributed in both the Irano-Turanian and Euro-Siberian regions (Floristic regions followed Zohary's classification in 1973).

PHYLOGENETIC RELATIONSHIPS. — *Satureja* is more closely related to the monotypic genus *Gontscharovia* (Doroszenko 1986; Bräuchler *et al.* 2010). The two genera can be distinguished by the acute nutlet apex in *Gontscharovia* opposed to an obtuse (rounded) apex in *Satureja* s.s. (Bräuchler *et al.* 2010).

### DESCRIPTION

Suffruticose, rarely caespitose or fruticose, aromatic or non-aromatic, perennial or annual, sometimes with stout woody stock. stems erect, erect-procumbent or out-spreading, many-branched from base to above, covered with short retrorse or spreading, rarely antrorse hairs and sessile glands on young parts, rarely glabrous. Leaves entire, sessile, attenuate at base rarely with a short petiole, cauline leaves oblanceolate, narrow elliptic, linear, obovate, rarely obovate-spathulate and lanceolate, recurved or out-spreading, conduplicate, rarely flattened, covered with short and/or long hairs and subsessile or rarely capitate glands on both surfaces, floral leaves similar in shape to the cauline leaves and shorter. Verticillasters distant, approximate or in lax cymes, often with up to six flowers, rarely up to 20, flowers mostly sessile, or pedunculate. Calyx green to dark purple, straight, bilabiate, with three superior teeth clearly shorter than the inferior two, tubular, campanulate, or tubular-campanulate, covered with short hairs and sessile

glands on the outside, throat usually with a sparse fringe of hairs, calyx teeth unequal, wide to narrowly triangular, recurved or rarely straight. Corolla two-lipped, white or violet, rarely with yellow lines, violet spots or smears, 4-20 mm long, covered with hirsute or puberulent hairs, tube straight, not annular inside, with few sparse hairs, throat ciliate, upper lip erect, shortly emarginated, lower lip spreading with three subequal lobes. Stamens 4, exserted from the corolla tube, rarely included, the two anterior longer, thecae divergent. Style shortly or longly exserted from the tube, two-branched, branches equal. Nutlets mostly elliptic, rarely obovate or widely obovate, rounded at the apex, ± smooth or sculptured, usually nervate, light to dark brown, 1-2 mm long, 0.5-1.5 mm wide.

### MORPHOLOGICAL CHARACTERS (Figs 1; 2)

#### *Habit and stem*

Among the taxa studied, *S. hortensis* is annual, whereas the majority of species are herbaceous perennials. Perennial herbs sometimes have woody stems at the base or woody stocks and sometimes are recorded as low shrubs or subshrubs. Stems are erect (in *S. hortensis*, *S. khuzistanica*, Fig. 2B), erect-procumbent (in *S. bachtiarica*, *S. kermanica*, *S. intermedia* C.A.Mey., *S. longiflora*, *S. mutica* Fisch. & Mey., *S. sabendica* Bornm., Fig. 1C, I) and erect to out-spreading (in *S. avromanica*, *S. macrantha* C.A.Mey., *S. macrosiphonia*, Fig. 1A). Exceptionally, *S. isophylla* exhibits a caespitose habit with short internodes (Fig. 1L). The height of stem is variable throughout the range of distribution of *S. bachtiarica* (Fig. 1C, E).

#### *Leaves*

Most leaves are entire, usually sessile and attenuate at base. They are rarely with a short petiole up to 2 mm in *S. khuzistanica* and *S. intermedia*. Leaf shape is variable, from linear to lanceolate or oblanceolate, rarely obovate-oblong or obovate-spathulate (*S. intermedia*, Fig. 1K), and obovate, ovate or wide elliptic (*S. khuzistanica*, Fig. 2B). The lower leaves in *S. longiflora* are variable from elongated elliptic or obovate to oblong-oblanceolate (Fig. 1H-J). It seems that the leaves of *Satureja* species in more humidity are larger and wider. The middle and upper leaves are often conduplicate.

#### *Inflorescence*

Inflorescence is formed of terminal verticillasters composed of often 2-6 flowers with reduced or very short peduncles and pedicels, rarely with up to 20 flowers in *S. hortensis* or in lax cymes (*S. avromanica* and *S. macrosiphonia*, Figs 1B; 2G). Verticillasters are distant or approximate. Sometimes both states are observed in one species (e.g. *S. longiflora*, *S. macrantha*, Fig. 1G-H).

#### *Bract and bracteole*

Floral leaves in shape are similar to the cauline leaves but shorter.

#### *Calyx*

Calyx is straight and bilabiate with three superior teeth shorter than the inferior two. It is usually green, but sometimes dark purple in fruiting (e.g. *S. avromanica*, *S. bachtiarica*,

TABLE 1. — Overview of *Satureja* L. species belonging to flora of Iran in literature.

Flora Orientalis, Boissier (1879)	Flore de l'Iran, Parsa (1949)	Flora Iranica, Rechinger (1982)	Flora of Iran, Jamzad (2012)	Present study
<i>S. atropatana</i> Bunge	<i>S. atropatana</i>	<i>S. atropatana</i>	<i>S. atropatana</i>	<i>S. avromanica</i> Maroofi
<i>S. bachtiarica</i> Bunge	<i>S. bachtiarica</i>	<i>S. bachtiarica</i>	<i>S. bachtiarica</i>	<i>S. bachtiarica</i> Bunge
<i>S. hortensis</i> L.	<i>S. boissieri</i> Hausskn. ex Boiss.	<i>S. boissieri</i>	<i>S. boissieri</i>	<i>S. edmondii</i>
<i>S. intermedia</i> C.A.Mey. (syn. of <i>S. subdentata</i> Boiss.)	<i>S. hortensis</i>	<i>S. edmondii</i> Briq. (syn. of <i>S. longiflora</i> )	<i>S. edmondii</i> (syn. of <i>S. longiflora</i> )	(syn. of <i>S. longiflora</i> )
<i>S. longiflora</i> Boiss. & Hausskn.	<i>S. longiflora</i>	<i>S. intermedia</i> (syn. of <i>S. subdentata</i> )	<i>S. intermedia</i> (syn. of <i>S. subdentata</i> )	<i>S. intermedia</i>
<i>S. macrantha</i> C.A.Mey.	<i>S. macrantha</i>	<i>S. isophylla</i> Rech.f.	<i>S. kallarica</i> Jamzad	(syn. of <i>S. subdentata</i> )
<i>S. mutica</i> Fisch. & C.A.Mey.	<i>S. macrosiphonia</i> Bornm.	<i>S. laxiflora</i> K.Koch	<i>S. kermanshahensis</i> Jamzad	<i>S. isophylla</i>
<i>S. mutica</i> Fisch. & C.A.Mey.	<i>S. mutica</i>	<i>S. macrantha</i>	<i>S. khuzistanica</i> Jamzad	<i>S. kermanica</i>
	<i>S. sahendica</i> Bornm.	<i>S. mutica</i>	<i>S. laxiflora</i>	<i>S. macrantha</i>
	<i>S. spicigera</i> (C.Koch)	<i>S. sahendica</i>	<i>S. macrantha</i>	<i>S. macrosiphonia</i>
	<i>S. subdentata</i> Boiss.	<i>S. spicigera</i>	<i>S. macrosiphonia</i>	<i>S. mutica</i>
			<i>S. mutica</i>	<i>S. sahendica</i>
			<i>S. rechingeri</i> Jamzad	
			<i>S. spicigera</i>	
			<i>S. sahendica</i>	

*S. macrantha*). Typically, the calyx is tubular-campanulate however *S. avromanica*, *S. longiflora* and *S. macrantha* are distinct by tubular (Figs 1B, G-H; 2E, F) and *S. bachtiarica* by campanulate calyces (Fig. 1D, F). Calyx teeth vary in shape from wide triangular (e. g. *S. bachtiarica*) to narrow linear (e.g. *S. mutica* and *S. hortensis*). Moreover, several *Satureja* spp. have slightly recurved calyx teeth, while the erect state is observed in *S. longiflora* (Fig. 1H). Calyx length is ranged from 2.5 mm in *S. bachtiarica* up to 9 mm in *S. khuzistanica*.

#### Corolla

The color ranges from white or violet, rarely lilac, yellowish, pink, and cream. The colors can vary within the same species in natural habitats (e.g. *S. hortensis*, *S. khuzistanica* (Fig. 2C, D), and *S. bachtiarica*, *S. mutica*). The corolla is two-lipped (two lobes forming the upper lip, three lobes forming the lower lip) with the posterior lip straight and emarginated and the anterior lip spreading. The tube is straight, covered with hirsute or puberulent hairs, not annular inside, with few sparse hairs, and throat ciliate. Corolla in *S. avromanica* is conspicuous with the slender tube (Fig. 1B). The tube of the corolla is longer than the calyx in *S. avromanica*, *S. longiflora*, *S. khuzistanica*, *S. macrantha*, *S. macrosiphonia* and *S. sahendica*, while it is nearly of the same length as the calyx in *S. bachtiarica*, *S. hortensis*, *S. intermedia*, *S. isophylla*, *S. kermanica* and *S. mutica*.

The stamens, style and stigma have no taxonomic value for the *Satureja* as they have a very constant morphology. The four stamens are didynamous, curved, included in or exerted from corolla, and thecae divergent. The style is bifid with subequal branches.

#### Nutlet

The shape of nutlets are mostly elliptic, rarely obovate (*S. isophylla*) and widely obovate (*S. khuzistanica*). The nutlets are rounded at the apex, usually nervate, and light to dark brown in color.

#### USES AND CHEMICAL PROPERTIES

The species are widely used as flavor in foods, herbal tea, and traditional medicine to treat various ailments, such as cramps, muscle pains, nausea, indigestion, diarrhea, and infectious diseases. Chemical analyses have revealed that *Satureja* species are rich in terpenoids, such as carvacrol,  $\gamma$ -terpinene, thymol, *p*-cymene,  $\beta$ -caryophyllene, linalool, and known to have antimicrobial, antiprotozoal, antioxidant as well as anti-inflammatory and anti-nociceptive properties (Amanlou *et al.* 2005; Sadeghi-Nejad *et al.* 2011; Alizadeh 2015; Mazandarani & Monfaredi 2017).

#### *Satureja avromanica* Maroofi (Figs 1A, B; 3)

*The Iranian Journal of Botany* 16 (1): 76-80 (Maroofi 2010). — Type: Iran • W Iran, Kurdistan, Marivan to Paveh, Bolbar village; 35°14'22.8"N, 46°17'31.2"E; alt. 830 m; 13.X.2004; Maroofi, Mardani & Moradi 7192; holo-, HKS; iso-, TARI.

PHENOLOGY. — Flowering from early October to late November and fruiting from early November to December.

DISTRIBUTION AND ECOLOGY. — An endemic species to W of Iran, Kordestan Province, Auraman valley (Fig. 4B). Rock crevices, dry limestone slopes.

SPECIMENS EXAMINED. — Iran • W Iran, Kordestan Prov., Auraman valley, SW of Bülbar village; 35°14'22.5"N, 46°17'30.7"E; alt. 944 m; 04.X.2017; Mirtadzadini 3028 (MIR) • *Ibid.*; 35°14'08.5"N, 46°17'36.9"E; alt. 1012 m; 05.X.2017; Mirtadzadini 3029 (MIR).

#### DESCRIPTION

Non-aromatic perennial, 35-80 cm high. Stems erect or out-spreading, glabrous, lower internodes 20-30 mm, inflorescence internodes *c.* 5-10 mm. Leaves entire, sessile, conduplicate, linear or linear to lanceolate, attenuate at base, blade tip obtuse or acute, 10-20 long, 1.5-4 mm wide, glabrous with sparsely sessile glands. Verticillasters distant, in lax cymes, mostly 1-2, up to 3 flowered, peduncle up to 3 mm, pedicel *c.* 1 mm.

Calyx green to dark purple, tubular, covered with short scattered white hairs and sessile glands on the outside, 4–6 mm, subulate-triangular, inferior teeth *c.* 1.7 mm., superior teeth *c.* 1 mm long. Corolla slender, purplish-lilac, 15–20 mm long, the tube white at base. Stamens included in the corolla tube. Style longer than or as long as posterior stamens, sometimes shorter and up to two-thirds of the tube length. Nutlets elliptic to elongated elliptic, *c.* 1.5–2 mm long, 0.8–1 mm wide, brown to dark brown.

REMARKS

*Satureja avromanica* was reported from west of Iran, Kordestan Province, Auraman valley by Maroofi (2010), and later from Turkey as well (Firat 2015). However, this species was supposed to be an intra-specific variation for *Satureja edmondii* in *Flora of Iran* (Jamzad 2012). Here, we consider them as separate species. *S. avromanica* is distinct and easy to recognize by its verticillasters in lax cymes and corollas with slender tube. In our knowledge, *S. avromanica* is the only species of *Satureja* that is not aromatic. It seems that the Turkish specimens reported as *Satureja avromanica* are actually *S. macrosiphonia* which also has verticillasters in lax cymes (for more information see remarks under *S. macrosiphonia*).

*Satureja bachtiarica* Bunge  
(Fig. 1C–F)

In *Mémoires de l'Académie impériale des Sciences de Saint Pétersbourg*, ser. 7, 21: 37 (Bunge 1873). — Type: Iran • Persiae australis districtus Bachtariaci montosis supra Abergun; *s.d.*; *Hausknecht s.n.*; lecto-, G, G-BOIS; isolecto-, JE[JE00013739 image!], JE00013740 image!], W[W0031749 image!].

*Satureja kermanshabensis* Jamzad, *The Iranian Journal of Botany* 16 (2): 214 (Jamzad 2010). — Type: Iran • Kermanshah, between Eivan and Sumar, Chehelzari; alt. 1100 m; *Assadi & Nikchehre 76300* (holo-, TARI!), **syn. nov.**

PHENOLOGY. — Flowering September to October and fruiting October to December.

DISTRIBUTION AND ECOLOGY. — Endemic species, widely distributed in western and south-western region of Iran (Fig. 4A). Dry rocky limestone slopes.

SPECIMENS EXAMINED. — Iran • W Iran, Bakhtiari Prov., Tshoghakhor, NE of Mt. Kallar; 31°51'44.9"N, 50°54'27.0"E; alt. 2858 m; 30.IX.2017; *Mirtadzdadini 3025* (MIR) • Bakhtiari, N of Ardal, Darkash canyon; 32°03'08.7"N, 50°39'43.3"E; alt. 2721 m; 27.X.2016; *Mirtadzdadini 1991* (MIR) • SE of Tshelgerd, 2 km SE of Ahmadabad; 32°24'49"N, 50°09'07"E; alt. 2550 m; 25.IX.2022; *Mirtadzdadini & Bordbar 4151* (MIR) • Tshelgerd, Marbore area, E of Mt. Zardkuh; 32°20'06"N, 50°10'37"E; alt. *c.* 2300 m; 25.IX.2022; *Mirtadzdadini & Bordbar 4152* (MIR) • Ilam Prov., 1 km to Sumar from Tshelzar'i village; 34°00'02.2"N, 46°02'55.7"E; alt. 1164 m; 03.X.2017; *Mirtadzdadini 3026* (MIR) • Kordestan Prov., Dezli to Auraman, Kalam defile; 35°20'15.52"N, 46°13'9.54"E; alt. 1690 m; 05.X.2017; *Faruginia 3024* (MIR) • Kermanshah Prov., Kerend, near Asiab-Tanureh village; 34°29'40.14"N, 46°08'39.07"E; alt. 1874 m; 03.XI.2016; *Bordbar 1995* (MIR) • Kermanshah, Kerend; 34°30'07.39"N, 46°07'53.72"E; alt. *c.* 1880 m; 03.XI.2016; *Bordbar 1994* (MIR) • C Iran, Yazd Prov.; 13 km from Mehriz to Tang-e

Tshenar; 31°30'38.0"N, 54°21'30.3"E; alt. 1946 m; *Mirtadzdadini 1987* (MIR) • SW Iran, Fars Prov., east of Niriz; 29°11.633"N, 54°25.747"E; alt. 2539 m; 25.VIII.2016; *Bordbar 1944* (MIR) • South west of Estahban, Kuhbehesht; 29°06'43.16"N, 54°02'03.55"E; alt. 1829 m; 14.X.2016; *Bordbar 1952* (MIR) • Persia australis, Schiraz in montibus calc.; alt. 1700 m; 21.X.1892; *Bormmüller 4264* (P[P02998216, P02998218, P02998219]) • East of Shiraz, 6 km east of Dariun, on stony slopes; 29°34'20.8"N, 52°50'17.5"E; alt. 1606 m; 15.IX.2011; *Mirtadzdadini 2038* (MIR) • NW of Shiraz, Bamu national Park, Dasht-e Ahooh; 29°42'17.4"N, 52°41'51.6"E; alt. 1720 m; 04.X.2010; *Khosravi & Sajjadi 3030* (MIR) • Bamu national park, road of Pasgah to Cheshmeh Fil; 29°42'32.9"N, 52°37'48.3"E; alt. 1770 m; 29.IX.2010; *Khosravi 3031* (MIR) • Sisakht, near Tsheshme-Mishi; 30°51'12.0"N, 51°31'10.0"E; alt. *c.* 2500 m; 26.X.2016; *Mirtadzdadini 1992* (MIR) • Sepidan, east of Margun waterfall; 30°29'24.81"N, 51°53'52.34"E; 07.IX.2014; *Mirtadzdadini 1950* (MIR) • Kogiluyeh Prov., NW of Sisakht, before Dashtak; 18.VII.2000; *Mirtadzdadini 1949* (MIR) • *Ibid.*; 30°53'34.9"N, 51°24'44.6"E; alt. 2343 m; 26.X.2016; *Mirtadzdadini 1988* (MIR) • Yasuj toward Dezhkord; 30.IX.2022; *Mirtadzdadini & Bordbar 4158* (MIR) • Esfahan Prov., south of Isfahan, on stony and rocky slopes near Semirom; 26.IX.2014; *Mirtadzdadini 1967* (MIR) • Semirom, 6 km from Semirom toward Vanak; 31°26'48.34"N, 51°30'07.62"E; 26.IX.2014; *Mirtadzdadini 1993* (MIR).

DESCRIPTION

Aromatic perennial, 10–45 cm high. stems erect- procumbent, covered with white short retrorse or spreading hairs and sessile glands on young parts, length of lower internodes 5–12 mm, length of inflorescence internodes 3–9 mm. Leaves entire, sessile, recurved, conduplicate, cauline leaves mostly linear-narrow elliptic, rarely linear or narrow elliptic or oblanceolate, 6–15 mm long, 1–3.5 mm wide, blade tip obtuse or acute, covered with short hairs and sessile glands on both surfaces, floral leaves similar in shape to the cauline leaves and shorter. Verticillasters distant, sometimes approximate at upper parts of stem, with 2–6 flowers, flowers mostly sessile, peduncle and pedicel 0.7–1.5 mm (if present). Calyx green to dark purple, campanulate, covered with short hairs and sessile glands on the outside, 2.5–3 mm, calyx teeth wide triangular to narrow triangular, inferior teeth 0.7–1.4 mm, superior teeth 0.5–0.8 mm. Corolla white sometimes with violet or yellow lines, spots or smears, 4–6.5 mm long. Stamens exerted from the tube, the anterior pair longer. Style exerted from the tube, 4.5–6.5 mm. Nutlets elliptic, 1.2–1.5 mm long, 0.5–0.7 mm wide, brown to dark brown.

REMARKS

*Satureja kermanshabensis* was described by Jamzad (2010) from a single specimen growing in a single locality in Kermanshah Province, and no other specimens from this species have been reported since then. By the exploring the species in the type locality, we found only *Satureja bachtiarica*. In the first description, the former species is compared with *S. bachtiarica*, and differs in morphological characters, namely: habit (ascending vs erect), verticillasters (two-flowered, approximate vs many-flowered, distant at the lower parts), calyx (2.5–3 mm vs 1.5 mm), and corolla (pink-purple vs white). For the following reasons *S. kermanshabensis* is reported here as a synonym for *S. bachtiarica*: (1) the habit of *S. bachtiarica* is erect-procumbent which may seems ascending. (2) Verti-



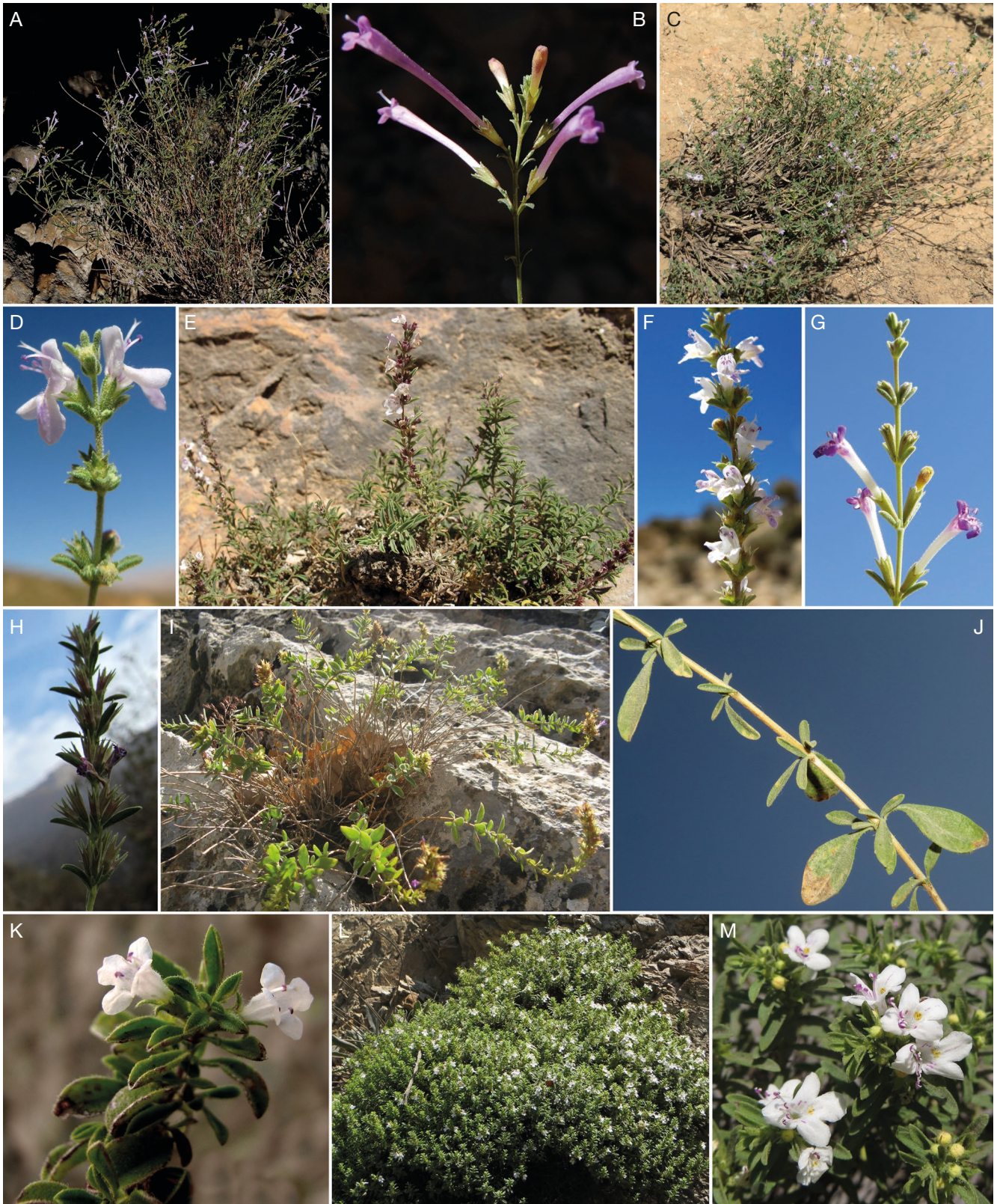


FIG. 1. — Habit and close-up of inflorescence of *Satureja* L. species from flora of Iran: **A, B**, *S. avromanica* Maroofi (Mirtadzadini 3029); **C, D**, *S. bachtiarica* Bunge (Mirtadzadini & Bordbar 4151); **E**, *S. bachtiarica* (Bordbar 1995); **F**, *S. bachtiarica* (Bordbar 1944); **G**, *S. longiflora* Boiss. & Hausskn. (Mirtadzadini 2031); **H**, *S. longiflora* (Bordbar 2032); **I**, *S. longiflora* (Advay 4155); **J**, *S. longiflora* (Mirtadzadini & Bordbar 4153); **K**, *S. intermedia* (Mirtadzadini 1980); **L, M**, *S. isophylla* Rech.f. (Mirtadzadini 1978).

cillasters are 2–6 flowers in *S. bachtiarica*. (3) The length of calyx is 2.5–3 mm in *S. bachtiarica*. (4) Violet smears are seen among the flowers of *S. bachtiarica* especially in the populations from Kermanshah and Kordestan Province. (5) The verticillasters are not all close to each other and are distant in the lower parts of the stems in the type of *S. kermanshahensis* (*Assadi & Nikchehre* 76300) similar to those of *S. bachtiarica*.

Among the studied taxa, *S. bachtiarica* has the widest distribution in Iran, and shows high morphological and genetical diversity (Saidi *et al.* 2013; Khadivi-Khub *et al.* 2014, 2015; Bordbar *et al.* 2020). However, Bordbar *et al.* (2020) do not believe in any infraspecific classification for this species. It can be distinguished by the campanulate calyx 2.5–3 mm long and the whitish corolla 4.3–6 mm long.

*S. bachtiarica* was reported from southern Iran, Bushehr Province, Kuh-e Khormuj in *Flore de l'Iran* (Parsa 1949) and *Flora Iranica* (Rechinger 1982) based on two herbarium specimens *Nábělek* 1622, deposited in the herbarium SAV [SAV0002657, SAV0002658] (<http://www.nabelek.sav.sk>). These specimens were collected in February, and hard to identify as far as their inflorescence has fallen and only few calyces remained. However, in our opinion the remaining parts resemble those of *Gontscharovia popovii* distributed in south of Iran.

### *Satureja hortensis* L.

*Species Plantarum*: 568 (Linnaeus 1753). — Type: described from S France and Italy (Hb. Linn. 723/9)

*Satureja officinarum* Crantz, *Institutiones Rei Herbariae* 1: 526 (Crantz 1766).

*Satureja brachiata* Stokes, *A Botanical Materia Medica* 3: 300 (Stokes 1812).

*Satureja pachyphylla* C.Koch, in *Linnaea* 17: 295 (Koch 1843). — *Clinopodium pachyphyllum* (C.Koch) Kuntze, *Revisio Generum Plantarum* 2: 515 (Kuntze 1891).

*Satureja laxiflora* C.Koch, in *Linnaea* 21: 668 (Koch 1848).

*Satureja hortensis* L. var. *inclusens* Schur, *Enumeratio plantarum Transsilvaniae*: 531 (Schur 1866).

*Satureja hortensis* L. var. *exserens* Schur, *Enumeratio plantarum Transsilvaniae*: 531 (Schur 1866).

*Satureja filicaulis* Schott ex Boiss., *Flora Orientalis* 4: 562 (Boissier 1879).

*Satureja hortensis* L. var. *grandiflora* Boiss., *Flora Orientalis* 4: 562 (Boissier 1879). — *Clinopodium hortense* (L.) Kuntze, *Revisio Generum Plantarum* 2: 515 (Kuntze 1891).

*Satureja litwinowii* Schmalh. ex Lipsky, *Flora Caucasi*: 108 (Lipsky 1899).

*Thymus cunila* E.H.L.Krause, In *Flora von Deutschland* ed. 2, 11: 172 (Krause 1903).

*Calamintha hortensis* hort. ex F.T.Hubb., *The Standard Cyclopaedia of Horticulture* 6: 3082 (Bailey 1917).

*Satureja hortensis* L. var. *speciosa* Náb, *Iter Turcico-Persicum*. 3:44 (Nábělek 1926).

*Satureja hortensis* L. var. *depauperata* Thieb., *Flore libano-syrienne* 3: 49 (Thiébaud 1953).

*Satureja altaica* Boriss., in *Botanicheskie Materialy Gerbariya Botanicheskogo Instituti Imeni V.L. Komarova Akademii Nauk SSSR* 15: 326 (Borissova 1953).

*Satureja densiflora* Zein., in *Izvestiya Akademii Nauk Azerbaidzhana Seriya Biologicheskikh Nauk* 1969 (2):15 (Zeinalova 1969).

PHENOLOGY. — Flowering July to September, fruiting August to October.

DISTRIBUTION AND ECOLOGY. — Widely cultivated over the country or naturally grows on dry or moist soils of NW of Iran (Fig. 4B).

SPECIMENS EXAMINED. — Iran • W Iran, Isfahan Prov., Pol-e Zamankhan; 03.VII.2004; *Mirtadzadini* 3806 (MIR) • Kordestan Prov., Auraman valley, SW of Bólbar village; 35°14'22.5"N, 46°17'30.7"E; alt. 944 m; 04.X.2017; *Mirtadzadini* 3807 (MIR) • SW of Auraman valley, Shiradarra area; 35°13'50.5"N, 46°16'18.5"E; alt. 1645 m; 05.X.2017; *Mirtadzadini* 3833 (MIR) • NW Iran, West Azerbaijan Prov., Khoy to Maku; 28.VIII.2008; *Mirtadzadini* 3808 (MIR) (naturally grows) • Ardabil Prov., Givi; 15.X.2007; *Mirtadzadini* 1958 (MIR) (naturally grows). Armenia • S Armenia, Syunik Province, 4 km to Goris from Sisian; 39°29'16.9"N, 46°17'33.5"E; alt. 1800 m; 06.IX.2019; *Mirtadzadini* 3809 (MIR).

### DESCRIPTION

Aromatic, annual, 10–25(–35) cm high, all parts of the plant covered with short simple appressed hairs and sessile glands. Stems erect, covered with short white spreading glandular and eglandular hairs, length of lower internodes 15–35 mm, length of inflorescence internodes 20–40 mm. Leaves linear or linear-lanceolate, obtuse, conduplicate, cauline leaves 10–30(–40) mm long, 1–4(–5) mm wide, floral leaves similar in shape to the cauline leaves. Verticillasters distant, congested to lax, 2- to 20-flowered, flowers often sessile, peduncle up to 4 mm (if present), pedicel up to 2.5 mm (if present). Calyx green, campanulate, 3–5 mm, teeth narrow linear to subulate, slightly unequal, up to 3 mm. Corolla lilac, pink or white, 5–10 mm, tube included in or somewhat exerted from calyx. Nutlets widely elliptic, brown to dark brown, 1.2–1.3 mm long, c. 1 mm wide.

### REMARKS

This species has a typical form with densely flowered verticillasters which is widely cultivated in Iran as a medicinal as well as pot-herb. The second form with lax-flowered verticillasters described as *Satureja laxiflora* in *Flora Iranica* (Rechinger 1982) and *Flora of Iran* (Jamzad 2012), naturally grows in NW of Iran.

### *Satureja intermedia* C.A.Mey. (Fig. 1K)

*Verzeichniss der Pflanzen*: 91 (Meyer 1831). — *Clinopodium intermedium* (C.A.Mey.) Kuntze, *Revisio Generum Plantarum* 2: 515 (Kuntze 1891). — Type: Iran • Common in the area between Iran and Azerbaijan, Talisch; *s.d.*; C.A. Meyer 775; holo., LE[LE01175436, image!]; iso-, LE[LE01175434, LE01175435, image!], G, G-BOIS[G00786094, image!], P[P02998275], W[W0031747, image!].

*Satureja subdentata* Boiss., *Flora Orientalis* 4: 565 (Boissier 1879).

*S. gunibica* Woronow, *Acta Instituti Botanici Academiae Scientiarum URSS*, sér. 1, 1: 222 (Woronow 1933).

PHENOLOGY. — Flowering August to September, Fruiting October.

DISTRIBUTION AND ECOLOGY. — NW of Iran and S of Azerbaijan (Lenkoran, near the border of Iran) (Fig. 4C). Rocky slopes.

SPECIMENS EXAMINED. — **Iran** • NW Iran, Ardabil Prov., Talesh area, east of Khalkhal, after Kalestan village, Soltan-e Khuni; [37°42'52.74"N, 48°36'13.28"E]; alt. 2695 m; 08.VIII.2012; *Mirtadzadini* 1980 (MIR) • Asalem to Khalkhal, Mt. Kerman; alt. 2100-2300 m; 06.IX.1982; *Terme, Matin & Zargani* 25028 (IRAN).

#### DESCRIPTION

Aromatic perennial, 10-20 cm high. stems erect-procumbent, covered with white hairs and scattered sessile glands. Leaves broad, obovate-oblong or obovate-spathulate, conduplicate, 8-15 mm long, 3-6 mm wide, with sparsely hairs and sessile glands, gradually attenuate at base or with a short petiole, apex rounded or ± acute, floral leaves similar to or slightly smaller than the cauline leaves in shape and size. Verticillasters axillary, distant or approximate especially at upper parts of stem, 2-6 flowers in verticillaster, flowers with a short pedicel up to 2 mm. Calyx green, campanulate-tubular, covered with hairs and sessile glands on the outside, 5-7 mm, teeth subulate or subulate-lanceolate, inferior teeth *c.* 3 mm, superior *c.* 2 mm. Corolla white, 8-12 mm long. Stamens exerted from the tube. Style exerted from the tube. Nutlets elliptic, brown to dark brown, 1.4-1.6 mm long, 0.7-0.8 mm wide.

#### REMARKS

This species is characterized by its obovate-oblong or obovate-spathulate leaves. The color of corolla in *S. intermedia* was mentioned to be “rosea” in *Flora Iranica* (Rechinger 1982), red in *Flora of Iran* (Jamzad 2012), and pink in *Flora of the USSR* (Borissova 1977). However, we found only the specimens with white corollas in nature including the type locality.

Rechinger (1982) in *Flora Iranica*, defined specimen “*Meyer 775*” as the “*typus*” without mentioning the herbarium where the specimen is kept, and G-BOIS and W specimens were defined to be the “*isotypus*”. Later, Doroszenko (1986) was assigned LE specimen as the holotype. Three specimens are deposited in LE collected by Meyer, No. 775 labelled “*typus*”. Accordingly, we considered one of them in LE [LE01175436] as the holotype.

#### *Satureja isophylla* Rech.f. (Fig. 1L-M)

*Plant Systematics and Evolution* 133: 107 (Rechinger 1979). — Type: **Iran**. N Persia, Prov. Mazanderan, Firuzabad in ditone fl. Chalus; alt. 1000-2000 m; 12-16.X.1956; *F. Schmid* 6676; holo-, G[G00435679, image!]; iso-, W[W19590022203, image!].

PHENOLOGY. — Flowering August to October, Fruiting October to November.

DISTRIBUTION AND ECOLOGY. — Endemic species to N of Iran, Mazandaran Province (Fig. 4D). Rocky slopes.

SPECIMENS EXAMINED. — **Iran** • N Iran, Mazandaran Prov., between Tshalus and Karaj, 14 km to Siabishe from Tshalus; 14.VIII.2013; *Mirtadzadini* 1978 • SW of Nur, 5 km from Poul to Largan village; 36°23'07.76"N, 51°32'29.4"E; alt. 1420 m; 27.X.2011; *Mirtadzadini* 1979 (MIR) • Karaj to Tshalus, 15 km to Marzanabad, 3 km before Macarud; 36°19'11"N, 51°15'5"E; alt. 906 m; 05.X.2014; *Mirtadzadini* 1973 (MIR) • 40 km to Tshalus; 15-16.X.1986; *Barkbordari* 25029 (IRAN).

#### DESCRIPTION

Caespitose, aromatic perennial, 8-15 cm high, stems numerous, slender, covered with short scabrous hairs, internodes short, up to 5 mm. Leaves sessile, linear, lanceolate, oblanceolate or narrow obovate, 3-8(-10) mm long, 1-2 mm wide, attenuate at base, apex acute, rarely obtuse, with white scabrous hairs and sessile glands, floral leaves similar to the stem leaves. Verticillasters terminal, 1-3(-5-6) flowers in verticillaster, flowers subsessile, pedicel up to 1 mm. Calyx green, campanulate-tubular, covered with short scabrous hairs on outside, 3-4(-5) mm, triangular-subulate, inferior teeth *c.* 2 mm, superior *c.* 1.5 mm. Corolla white, 5-8(-10) mm long. Stamens exerted from the tube. Nutlets obovate, brown to dark brown, 1-1.2 mm long, 0.3-0.5 wide.

#### REMARKS

This species can be distinguished from the other *Satureja* spp. by its caespitose habit, small leaves and small obovate nutlets. It has also a lemon or *Micromeria* spp. like fragrance, different from those of the majority species of *Satureja*.

#### *Satureja kermanica* Payandeh, Bordbar & Mirtadz. (Fig. 2A)

*Phytotaxa* 441 (2): 190 (2020). — Type: **Iran** • SE Iran, S of Kerman, Mt. Jupar; 29°59'11.3"N, 57°12'10.8"E; alt. 2289 m; 21.X.2016; *Mirtadzadini* 1943; holo-, MIR!; iso-, MIR!

*Satureja bachtiarica* auct. non Bunge, in *Mémoires de l'Académie impériale des Sciences de Saint Pétersbourg*, sér. 7, 21: 37 (Bunge 1873).

PHENOLOGY. — Flowering from September to October and fruiting from October to December.

DISTRIBUTION AND ECOLOGY. — This species is found in several locations of south-east Iran, in Kerman Province and geographically apart from the other *Satureja* species (Fig. 4C). *S. kermanica* is basically found in gravelly sediments of the seasonal streams, only rarely extending to rocky slopes.

SPECIMENS EXAMINED. — **Iran** • SE Iran, Kerman Prov., S of Kerman, N of Mt. Jupar; alt. 2800 m; 18.VIII.1997; *Mirtadzadini* 1960 (MIR) • Mt. Jupar; 29°59'11.3"N, 57°12'10.8"E; alt. 2289 m; 21.X.2016; *Mirtadzadini* 1943 (MIR) • SE of Kerman, Sardu, Mt. Bahraseman, Hanzakuh; alt. 2700 m; 16.X.2015; *Payandeh* 1996 (MIR) • Sardu, Dehvali; 29°12'31.78"N, 57°16'11.37"E; 02.IX.2015; *Bordbar* 1956 (MIR) • SE of Kerman, Bam, Mt. Jebal-e Barez, Nesa river watershed; 19.X.2000; *Mirtadzadini* 1966 (MIR) • Bam, Mt. Jebal-e Barez,

Mij; *Mirtadzadini* 2040 (MIR) • S of Kerman, E of Rabor, Mt. Javarán, *Atashbar* 1989 (MIR) • Kerman to Jiroft, Dehbakri, Marghak; 29°07'18.39"N, 57°52'43.06"E; 05.IX.2015; *Bordbar* 1962 (MIR).

#### DESCRIPTION

Aromatic perennial, 50-100 cm high, stems erect, outspreading, many-branched from base to above, covered with short antrorse hairs and sessile glands on young parts, length of lower internodes 15-35 mm, length of inflorescence internodes 10-25 mm. Leaves sessile, recurved, stem leaves mostly linear-narrow elliptic, rarely linear or narrow elliptic or oblanceolate, conduplicate, 10-25 mm long, 2.5-4 mm wide, blade tip obtuse or acute, covered with short hairs and sessile glands on both surfaces, floral leaves similar in shape to the stem leaves, 1-1.5 mm long, 0.3-0.5 mm wide. Verticillasters approximate, 2-6 flowers in verticillaster, flowers sessile or pedicellate, peduncle up to 1.5-3 mm (if present), pedicel up to 1-2 mm (if present). Calyx green, campanulate-tubular, covered with short hairs and sessile glands on the outside, 3-3.5 mm, calyx teeth triangular, inferior teeth 0.5-1 mm, superior teeth 0.5-0.8 mm. Corolla blade violet sometimes with dark violet spots, tube whitish, 6-7 mm long. Stamens exerted from the tube. Style exerted from the tube. Nutlets elliptic, 1.2-1.5 mm long, 0.5-0.7 mm wide, brown to dark brown.

#### REMARKS

This species is similar to *S. bachtiarica* in the form of inflorescence and small flowers but differs mainly in stem indumentum (antrorse hairs vs retrorse or rarely spreading hairs), color of corolla blade (violet vs whitish), ratio of the length of lower to the length of upper calyx teeth (1.2-1.6 vs 1.5 to 2.4), the shape of calyx (campanulate-tubular vs campanulate), and the length of calyx (3-3.5 mm vs 2.5-3 mm).

### *Satureja khuzistanica* Jamzad (Fig. 2B-D)

*The Iranian Journal of Botany* 6 (2): 216 (Jamzad 1994). — Type: Iran • Khuzistan, 72 km from Andimeshk to Khorramabad, 5 km after pol-e Tang; alt. 520 m; 14.XI.1985; *Mozaffarian* 58416; holo-, TARI!

*Satureja rechingeri* Jamzad, *Annalen des Naturhistorischen Museums in Wien*, 98 B: 75 (Jamzad 1996). — Type: Iran • Ilam Province, Ilam to Mehran, Ban-e Roushan; alt. 900 m; *Jamzad, Mazhari & Ahmadi* 75587; holo-, TARI!; **syn. nov.**

**PHENOLOGY.** — Flowering September to December, fruiting November to January.

**DISTRIBUTION AND ECOLOGY.** — *S. khuzistanica* is an endemic species distributed on the rocky slopes of mesic areas between Irano-Turanian and Saharo-Arabian regions in SW and W of Iran, Ilam, Lorestan and Khuzestan Provinces (Fig. 4D).

**SPECIMENS EXAMINED.** — Iran • SW Iran, Khuzestan Prov., SE of Pol-e Dokhtar, SE of Jelowgir village; 14.III.2011; *Mirtadzadini* 1983 (MIR) • NE of Dezful, Salankuh; 32°42'06.1"N, 48°57'24.4"E; alt. 1518 m; 02.VI.2017; *Mirtadzadini* 3802 (MIR) • W Iran, Ilam

Prov., 16 km to Mehran from Ilam, S of Banroshan; 33°33'17.79"N, 46°13'12.98"E; alt. 900 m; 13.XII.2019; *Mirtadzadini, Bordbar & Doostmohammadi* 3803 (MIR) (type locality of *Satureja rechingeri*) • Lorestan Prov., Pol-e Dokhtar to Andimeshk, road of Emamzadeh Shah Ahmad; 32°48'30.0"N, 47°59'47.5"E; alt. 830 m; 17.IX.2019; *Mirtadzadini* 3805 (MIR) • *Ibid.*, 32°48'03.4"N, 48°00'04.0"E; alt. 1150 m; 17.IX.2019; *Mirtadzadini* 3804 (MIR).

#### DESCRIPTION

Aromatic perennial, fruticose, up to 50 cm high covered with dense extremely long simple hairs, small dense capitate glands and large scattered capitate glands with globular head. Stems erect, branched mostly at the base, length of lower internodes 6-15 mm, length of inflorescence internodes 3-12 mm. Leaves broad, obovate, ovate or wide elliptic, flattened, apex often acute, cuneate or attenuate at the base, petiole up to the 2 mm long, stem leaves 8-20 mm long, 6-12 mm wide, floral leaves similar in shape to the stem leaves. Verticillasters distant, 2-8 flowers in each verticillaster, peduncle up to 2-4 mm, pedicel up to 2 mm. Calyx green, tubular-campanulate, 5-9 mm, triangular-lanceolate, inferior teeth 2-3 mm, superior teeth 1.5-2.5 mm. Corolla blade pale violet, yellowish, cream, the tube cream, white or pink, 12-15 mm long, tubular in the basal part, from the middle gradually broadened toward the mouth. Stamens exerted from the corolla tube. Style slightly shorter than or as long as posterior stamens. Nutlets widely obovate, 1.8-2 mm long, 1.2-1.5 mm wide, brown.

#### REMARKS

*Satureja khuzistanica* was described by Jamzad (1994) based on a specimen collected by Mozaffarian (*TARI* 58416) from south-west of Iran, Andimeshk to Khorramabad (in Khuzestan Province). This species is readily recognized from the other *Satureja* species by its large broad obovate or elliptic leaves covered with pubescent hairs. Later, Jamzad (1996) collected a specimen herself closely related to *S. khuzistanica* and recognized it as a separate species namely *S. rechingeri*. The second species was collected from west of Iran, Ilam Province, Ilam to Mehran. According to Jamzad (1994, 1996, 2012) the two species differ by the indumentum composed of short simple glandular hairs in *S. khuzistanica* vs dense, white villose hairs in *S. rechingeri*. They also separated by the form of inflorescence: shortly pedunculate and remote in former and dense interrupted spike with longer peduncles in latter species. The length and width of leaves, the length of calyx, calyx teeth and corolla in *S. rechingeri* is longer than those of *S. khuzistanica*. Moreover, the two species differ by having different color of corolla: bluish-violet in *S. khuzistanica* and yellow with the lips tinged purple in *S. rechingeri*. Other morphological properties are the same for both species in the mentioned descriptions. Exploring of the species in nature in Ilam, Lorestan and Khuzestan Provinces (including their type localities) as well as the study of deposited herbarium specimens in MIR and TUH does not support the recognition of them as independent taxa for the reasons discussed in the following and consequently, *S. rechingeri* is reduced to synonymy under *S. khuzistanica* by the name priority: 1) the indumentum characteristics can not be regarded as

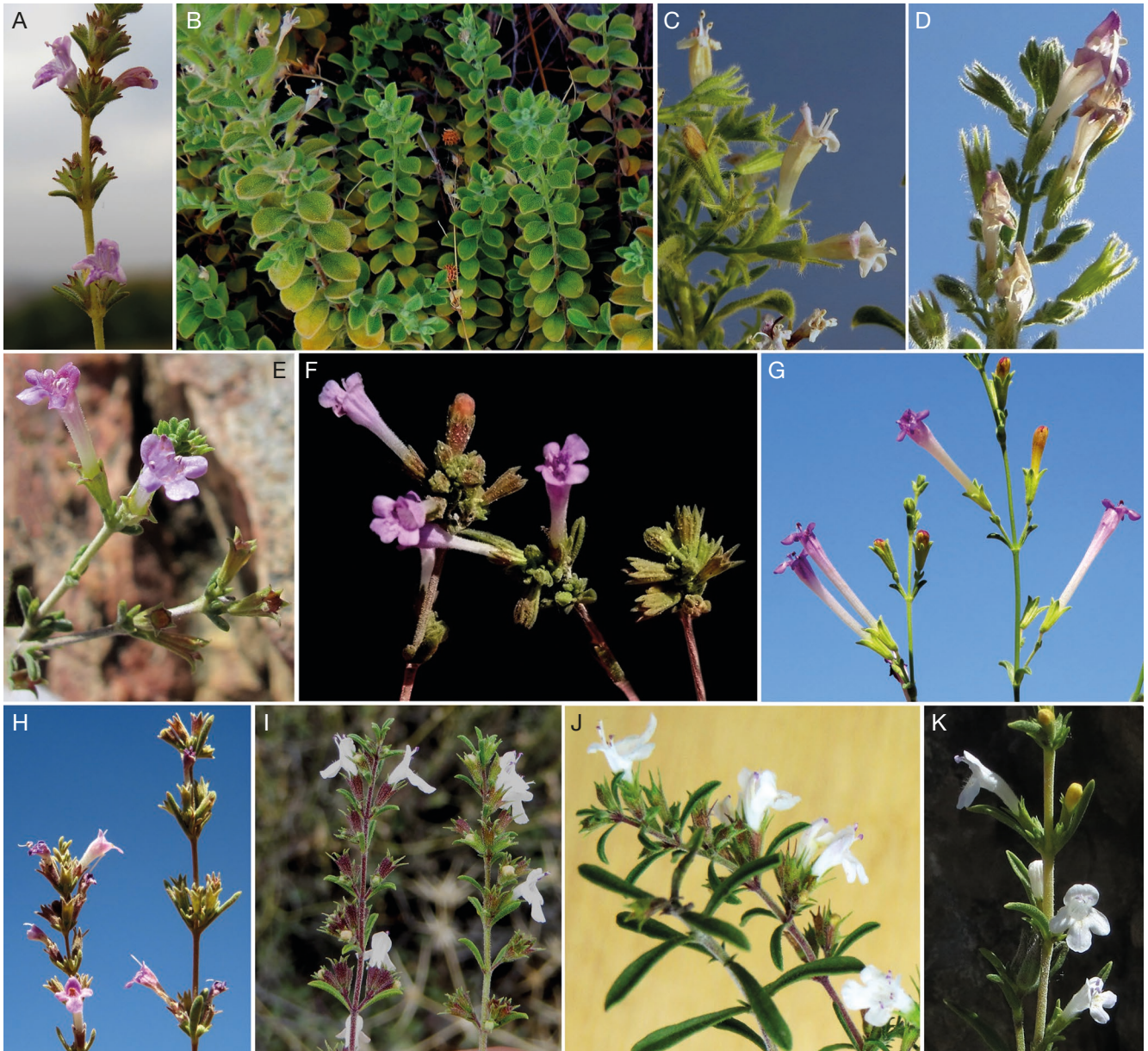


FIG. 2. — Habit and close-up of inflorescence of *Satureja* L. species from flora of Iran: **A**, *S. kermanica* Payandeh, Bordbar & Mirtadz. (Bordbar 1956); **B**, **C**, *S. khuzistanica* Jamzad (Mirtadzadini 3805); **D**, *S. khuzistanica* (Mirtadzadini 3804); **E**, *S. macrantha* C.A.Mey. (Bordbar 1970); **F**, *S. macrantha* (Mirtadzadini 2036); **G**, *S. macrosiphonia* Bomm. (Mirtadzadini & Bordbar 5156); **H**, *S. macrosiphonia* Bomm. (Mirtadzadini & Bordbar 4157); **I**, *S. mutica* Fisch. & C.A.Mey. (Mirtadzadini 3822); **J**, *S. mutica* (Mirtadzadini 3832); **K**, *S. sahendica* Bomm. (Mirtadzadini 1984).

diagnostic characters. Some individuals are more densely hairy but this is only intra-population diversity; 2) there is no clear difference in the form of inflorescence; 3) there is no discontinuity in the length and width of leaves as well the length of corolla. In some individuals the length of calyx and calyx teeth is longer however these characters have no correlation with the other morphological features; and 4) The species cannot be identified by the color of corolla, a variable characteristic among the individuals of a population. The corolla tube is cream, yellowish, white, or pink while the blade is pale violet, yellowish or cream.

*Satureja longiflora* Boiss. & Hausskn.  
(Fig. 1G-J)

In *Flora Orientalis* 4: 566 (Boissier 1879), non Presl (1826). — Type: Iran • In rup. in Parrow supra Kermanschah; alt. 1525 m; 06.IX.1867; *Hausknecht* 760a; holo-, G, G-BOIS; iso-, JE[JE00013735 image!, JE00013736 image!], K[K000193595, image!], W[W0031746, image!] (typified by Rechinger 1982).

*Satureja edmondii* Briq., in *Annuaire du Conservatoire et du Jardin botaniques de Genève* 2: 186 (Briquet 1898).

*Satureja boissieri* Briq., in *Die Natürlichen Pflanzenfamilien* 4, 3a: 298 (Briquet 1895-1897) non Hausskn. ex Boiss. (Boissier 1879).

PHENOLOGY. — Flowering September to October, fruiting November.

DISTRIBUTION AND ECOLOGY. — Endemic species to W of Iran, Kermanshah Prov. (Mt. Parrow) and Kordestan Prov. (Mt. Shahu) (Fig. 5D). Rock crevices, dry limestone slopes.

SPECIMENS EXAMINED. — Iran • W Iran, Kermanshah Prov., 5 km from Bisotun toward Sonqor, Mt. Parow, Nojubaran defile; 34°26'20.4"N, 47°24'14"E; alt. 1376 m; 04.XI.2016; *Bordbar2032* (MIR) • *Ibid.*; 12.XII.2019; *Mirtadzadini, Bordbar & Doostmohammadi 3800* (MIR) • Mt. Paraw, 25 km NW of Kermanshah, E of Mahmoudabad (Maimunabad); 34°35'9.5"N, 46°59'40.8"E; alt. 1660 m; 21.IX.2022; *Mirtadzadini & Bordbar 4153* (MIR) • Bisotun to Sonqor; 20.VIII.2007; *Mirtadzadini 2030* (MIR); *Ibid.*; 34°31'57.3"N, 47°22'28.4"E; alt. 1350 m; 15.X.2019; *Mirtadzadini 2031* (MIR) • 12 km from Bisotun to Sahneh; 34°27'36.7"N, 47°33'3.5"E; alt. 1450 m; 22.IX.2022; *Mirtadzadini & Bordbar 4154* (MIR) • Kordestan Prov., Hawraman (Auroman) region, Speziz village, North slopes of Mt. Shahu; alt. 1300 m; 30.X.2021; *Advay 4155* (MIR).

#### DESCRIPTION

Aromatic perennial, 20-50 cm high. Stems erect-procumbent, covered with short white spreading glandular and eglandular hairs, length of lower internodes 15-20 mm, length of inflorescence internodes 3-10 mm. Leaves sessile, lower leaves elongated elliptic or obovate, sometimes oblong-ob lanceolate, upper leaves oblong, elliptic or elongated obovate, rarely elongated ovate, conduplicate, covered with short white glandular and eglandular hairs and sessile glands, lower leaves 10-25 × 2-7 mm, attenuate at base, apex rotundate, rarely acute. Verticillasters distant or approximate, 1-6 flowers in verticillasters, flowers sessile or with a short pedicel up to 2 mm. Calyx green, tubular, covered with short spreading glandular and eglandular hairs and sessile glands on the outside, 4-7(-8-9) mm, calyx teeth straight, triangular or triangular-lanceolate, inferior teeth 1.5-3 mm, superior teeth 0.7-2.5 mm. Corolla blade violet, tube white, 10-18 mm long. Stamens slightly exerted from the corolla tube. Style slightly shorter than or as long as posterior stamens, rarely longer. Nutlets elliptic, c. 1.5-1.8 mm long, 0.6-0.8 mm wide, brown to dark brown.

#### REMARKS

The new name *Satureja edmondii* was described by Briquet (1898) as substitute name for *Satureja longiflora* Boiss. & Hausskn. ex Boiss., which has an earlier homonym. However, this earlier homonym, *Satureja longiflora* C.Presl. (Presl 1826) had been previously regarded as synonym of *Micromeria graeca* Benth. (Nyman 1878-1881), and probably missed by Briquet and the other taxonomists, e.g., Rechinger (1982) and Jamzad (2012) in revision of the genus. Therefore, in the present treatment, we resurrected the correct name *S. longiflora* Boiss. & Hausskn. ex Boiss. for this species.

*S. longiflora* is morphologically more close to *S. macrantha*. The two species indicate a variation in the state of verticillasters which are distant or approximate. In *S. longiflora* both forms of verticillasters are observed among the individuals of accession *Bordbar2032* (MIR). They have tubular calyces,

corollas with elongated white tube and violet blade. However, they are separated in the shape of lower leaves and the state of calyx teeth. In *S. longiflora*, the lower leaves are often elongated elliptic or obovate while they are linear to oblong or oblanceolate in *S. macrantha*. The calyx teeth are often straight in *S. longiflora* but mostly recurved in *S. macrantha*.

*S. longiflora* has been reported from Lorestan and Bakhtiari Provinces of Iran by Jamzad (2012). By the exploration of the specimens in the reported localities in Lorestan and Bakhtiari Provinces, we found only *S. macrosiphonia* and *S. bachtiarica*, respectively. We conclude that there might be a mistake in their identification.

#### *Satureja macrantha* C.A.Mey.

(Fig. 2E, F)

*Index seminum, quae Hortus Botanicus Imperialis Petropolitanus pro mutua commutatione offert: accedunt Animadversiones botanicae nonnullae* 11: Suppl. 67 (Meyer 1846). — Type: Azerbaijan • In montibus lapidosis calcareis ad Ghierus, Akarschai et Pachlutschinari; 03.IX.1829; *Szovits 587*; lecto-, LE[LE01175439], designed by Dirmenci in Duman *et al.* 2023; isolecto-, LE[LE01175438, LE01175440]).

*Satureja atropatana* Bunge, *Mémoires de l'Académie impériale des Sciences de Saint Pétersbourg*, sér. 7, 21 (1): 36 (Bunge 1873). — Type: Iran • In rupestribus apricis montanis Metschet Dag inter Nehmetabad et Nähend haud procul ab urbe Tabris; *Seidlitz s.n.*; (G[G00786054 image!], LE [LE01064419 image!, LE01064420, image!], P[P02998217]), **syn. nov.**

PHENOLOGY. — Flowering time July-October, fruiting time September-November.

DISTRIBUTION AND ECOLOGY. — This is an Irano-Turanian element distributed in NW and W of Iran (Fig. 5A) as well as Armenia, Azerbaijan, Iraq and Turkey. It prefers to grow on the crevices of the rocky slopes.

SPECIMENS EXAMINED. — Iran • NW Iran, East Azarbaijan Province, NE of Tabriz, Ahar road; 28.VIII.2007; *Mirtadzadini 1981* (MIR) • E of Tabriz, Paktshin; 38°07'23.1"N, 46°25'32.6"E; alt. 1490 m; 09.IX.2019; *Mirtadzadini 2041* (MIR) • NW of Kaleibar, Vinaq village; 39°01'55.6"N, 46°50'30.2"E; alt. 816 m; 12.VII.2016; *Mirtadzadini & student team 1972* (MIR) • Aras valley, near Asheqlu, N of Sultan village; 38°59'54.5"N, 46°44'12.6"E; alt. 630 m; 11.VII.2016; *Mirtadzadini & student team 1974* (MIR) • Aras valley, 22 km from Nurduz to Asheqlu; 38°53'27.3"N, 46°25'48.2"E; alt. 425 m; 11.VII.2016; *Mirtadzadini & student team 1976* (MIR) • Aras valley, E of Siahroud, S of Nurduz; 38°49'55.1"N, 46°12'16.9"E; alt. 810 m; 10.VII.2016; *Bordbar 1970* (MIR) • Aras valley, E of Siahroud, SW of Nurduz; 38°50'05.5"N, 46°11'10.4"E; alt. 996 m; 10.VII.2016; *Mirtadzadini & student team 1971* (MIR) • Arasbaran forest, Sooli-Darreh, Kalale-Sofia village; 25.X.2007; *Attar & Zamani 37841* (TUH) • West Azarbaijan Province, Urumieh to Oshnavieh from Ghasemlu valleys, between Ghasemlu and Sangar; alt. 1560 m; 02.XI.1995; *Ghabreman & Mozaffarian 18184* (TUH). Armenia • S Armenia, Syunik, N of Meghri; 39°00'39.0"N, 46°12'28.0"E; alt. 1290 m; 29.VIII.2019; *Mirtadzadini 1963* (MIR) • N of Meghri; 38°58'37.8"N, 46°12'48.8"E; alt. 1100 m; 29.VIII.2019; *Mirtadzadini 2036* (MIR) • On the pass 9 km from Vorotan to Kajaran; 39°24'35.1"N, 46°23'21.1"E; alt. 1350 m; 30.VIII.2019; *Mirtadzadini 1964* (MIR) • Between Goris & Vorotan; 39°26'24.1"N, 46°23'52.4"E; alt. 825 m; 06.IX.2019; *Mirtadzadini 1965* (MIR).



FIG. 3. — Herbarium specimen of *Satureja avromanica* Maroofti collected from the type locality (Maroofti, Mardani & Moradi 7192).

DESCRIPTION

Aromatic perennial, 20-50 cm high. Stems erect or outspreading, branched mostly at the base, covered with short retrorse hairs, length of lower internodes 10-25 mm, length of inflorescence internodes 5-15 mm. Leaves entire, sessile, linear to oblong or oblanceolate, rarely lanceolate, lower leaves 10-18 mm long, 2-5 mm wide, usually conduplicate, attenuate at base, apex obtuse or ± acute, covered with short scattered scabrous hairs and sessile glands. Verticillasters distant or approximate, 1-6 flowers in each verticillaster, flowers often sessile, peduncle (if present) up to 1-3 mm, pedicel (if present) up to 1-2 mm, bracts and bracteoles 1.5-3 mm long. Calyx green, rarely purple, tubular, covered with short scattered scabrous hairs and scattered sessile glands on the outside, (3.5-)4-6(-7) mm, teeth slightly recurved, superior teeth triangular-subulate or deltoid-triangular, 1-1.5(-2) mm, inferior teeth lanceolate or subulate, 1.5-2.5(-3) mm. Corolla blade violet, the tube white, (11-)12-15(-16) mm long. Stamens slightly exerted from the corolla tube. Style slightly shorter than or as long as posterior stamens. Nutlets elliptic to elongated elliptic, *c.* 1.2-1.5 mm long, 0.5-0.7 mm wide, brown to dark brown.

REMARKS

*Satureja atropatana*, a narrow endemic species, was described by Bunge (1873) based on specimens collected by Seidlitz from a single location in NW of Iran. In the first description, this species was compared with *S. longiflora* (syn. *S. edmondii*) but not with *S. macrantha*. *S. macrantha* formerly was reported by Meyer (1846) from "Karabagh" (Azerbaijan). This species is distributed in a variety of localities in Armenia, Azerbaijan and Turkey as well as NW of Iran. The two species are separated mainly by the shape of calyx teeth. The superior teeth in *S. atropatana* is wide triangular, and the inferior teeth longer, lanceolate and obtuse while the superior teeth in *S. macrantha* is triangular, and the inferior teeth longer and narrower (Rechinger 1982; Jamzad 2012). No other herbarium materials were reported from the type locality of *S. atropatana* since the first record, probably because of human activities and destructions in the area. In *Flora Iranica* this species was described based on the type and in *Flora of Iran* based on two specimens near the type locality. By the exploring of the plant materials from Iran and the locality of *S. macrantha* in Armenia, there is a confusion in the delimitation of *S. macrantha* and *S. atropatana* as separate species. In fact, the shape and length of calyx teeth are variable morphologic characters in *S. macrantha*, even in one individual. No other morphological differences were found. Therefore, *S. atropatana* is placed in synonymy under the name *S. macrantha* as the name has precedence.

The color of corolla for *S. macrantha* was mentioned to be "rosea" in *Flora Iranica* (Rechinger 1982) and red in *Flora of Iran* (Jamzad 2012), while it is mauve (pale purple) in *Flora of Turkey* and the East Aegean Islands (Davis 1982), and pink in *Flora of the USSR* (Borissova 1977). We observed only the corollas with the white tubes, and violet blades in Iran and Armenia.

This species has been reported from Hamadan and Kermanshah Provinces of Iran by Jamzad (2012). By the exploration of the specimens in the reported localities in Hamadan and Kermanshah Provinces, we found only *S. macrosiphonia* and *S. longiflora*, respectively. We supposed to be a mistake in identification of the specimens.

*Satureja macrosiphonia* Bornm.  
(Fig. 2G-H)

In *Feddes Repertorium* 6: 114 (Bornmüller 1908). — Type: Iran, Irak • Common in the area between Iran and Iraq, Assyria, in siccis Mar Jako ditiois urbis Mosul; IX.1879; *Barré de Lancy s.n.*; holo-, JE, JE-Hauskn. [JE00024985 image!].

PHENOLOGY. — Flowering September to October, fruiting October to November.

DISTRIBUTION AND ECOLOGY. — NE of Iraq and W of Iran, Ilam and Lorestan Provinces (Fig. 5B). Crevices of the rocky slopes.

SPECIMENS EXAMINED. — Iran • W Iran, Ilam Prov., 4 km SE of Eivan, near Imamzadeh Abdullah; 33°46'24.2"N, 46°16'22.0"E; alt. 1345 m; 02.XI.2016; *Bordbar 2033* (MIR) • *Ibid.*; 12.XII.2019; *Mirtadzadini, Bordbar & Doostmohammadi 3834* (MIR) • Darreshahr, after Jahangirabad; 33°06'43.5"N, 47°21'29.5"E; alt. 720 m; 16.IX.2019; *Mirtadzadini 3812* (MIR) • Lorestan Province, 36 km from Babazeid to Islamabad; 33°22'55.0"N, 47°26'58.8"E; alt. 1240 m; 16.IX.2019; *Mirtadzadini 3810* (MIR) • 75 km from Khoramabad to Andimeshk; 33°04'56.1"N, 48°13'57.3"E; alt. 1230 m; 18.IX.2019; *Mirtadzadini 3811* (MIR) • 20 km SW of Aleshtar, Bastam dam; 33°41'9.40"N, 48°9'0.61"E; alt. 1540 m; 21.IX.2022; *Mirtadzadini & Bordbar 5156* (MIR) • Hamadan Prov., 6 km N of Nahavand, road of mine; 34°16'57"N, 48°22'24"E; alt. 1995 m; 23.IX.2022; *Mirtadzadini & Bordbar 4157* (MIR) • 6 km NE of Nahavand; 34°15'19.5"N, 48°23'39.6"E; alt. 1900 m; 27.IX.2022; *Mirtadzadini & Bordbar 4159* (MIR).

DESCRIPTION

Aromatic perennial, 30-50(-60) cm high. STEMS erect or outspreading, length of lower internodes *c.* 15 mm, length of inflorescence internodes 5-10 mm, covered with short retrorse hairs. LEAVES sessile, linear-oblanceolate, sometimes linear-elliptic, 10-20 mm long, 1-5 mm wide, usually conduplicate, attenuate at base, apex rounded or mucronate, covered with short scattered scabrous hairs and sessile glands. Verticillasters distant, in lax cymes or congested, 1-6 flowers in verticillasters, sessile or pedicellate, peduncle up to 1.5-10 mm, pedicel up to 1.5-3 mm. Calyx green, tubular-campanulate, covered with short scattered scabrous hairs and scattered sessile glands on the outside, 3-4 mm, superior teeth triangular-subulate or deltoid-triangular, *c.* 1 mm, inferior teeth lanceolate or subulate, 1.2-1.5 mm. Corolla blade violet to lilac, the tube white or yellowish, (12-)14-20 mm long. Stamens slightly exerted from the corolla tube. Style slightly shorter than or as long as posterior stamens. Nutlets elliptic, 1.5-1.8 mm long, 0.8-1 mm wide, brown to dark brown.

REMARKS

This species is morphologically more close to *S. avromanica* by having verticillasters in lax cymes. However, *S. macrosiphonia* is mainly distinguished from *S. avromanica* by the shape of



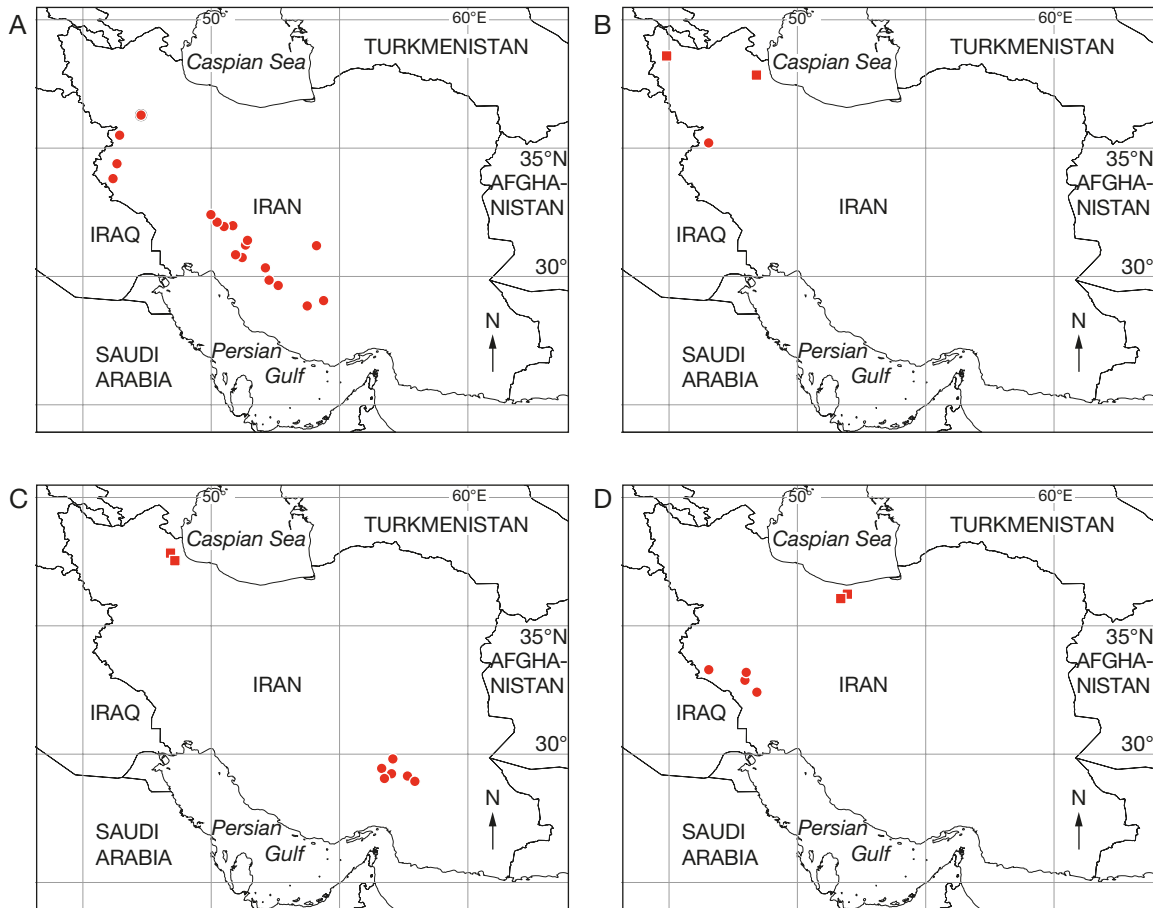


FIG. 4. — Distribution map of *Satureja* L. species in Iran: **A**, *S. bachtiarica* Bunge; **B**, *S. avromanica* Maroofi (circle), *S. hortensis* L. (naturally grows) (square); **C**, *S. kermanica* Payandeh, Bordbar & Mirtadz. (circle), *S. intermedia* C.A.Mey. (square); **D**, *S. khuzistanica* Jamzad (circle), *S. isophylla* Rech.f. (square).

leaves (linear-oblongate, sometimes linear-elliptic vs linear or linear to lanceolate), shape of calyx (tubular-campanulate vs tubular). Additionally, *S. avromanica* has slender corollas different from those of *S. macrosiphonia*. The leaves in *S. avromanica* are glabrous while the leaves in *S. macrosiphonia* are covered with short scattered scabrous hairs. Among the Iranian *Satureja*, *S. macrosiphonia* as well as *S. isophylla* are exceptional by their scent. However, their scent is also different from each other, both of them have a lemon or a *Micromeria* spp. like fragrance. On the other hand, *S. avromanica* is a non-aromatic plant. For the differences mentioned above we believe that the Turkish specimens reported as *S. avromanica* (Firat 2015) are in fact *S. macrosiphonia*. However, for a definite statement, we need to study the herbarium specimens from Turkey.

This species exhibits a variation in density of trichome on the plants, the form of inflorescence and the color of corolla.

*S. macrosiphonia* was placed in synonymy with *S. macrantha* by Doroszenko (1986) however with the difference mainly in the shape and size of calyx and fragrance, we accept *S. macrosiphonia* as a separate species.

### *Satureja mutica* Fisch. & Mey. (Fig. 2I-J)

*Index seminum, quae Hortus Botanicus Imperialis Petropolitanus pro mutua commutatione offert: accedunt Animadversiones botanicae nonnullae* 2: 49 (Meyer 1846). — Type: **Iran, Azerbaijan** • Common in the area between Iran and Azerbaijan, Talisch; C.A.Meyer s.n.; holo-, G-BOIS[G00786050 image!]; iso-, LE[LE01204662 image!], W[W0033023 image!].

*Satureja intermedia* sensu Benth., in *Prodromus Systematis Universalis Regni Vegetabilis* 12: 210 (Bentham 1848).

*Satureja spicigera* (C.Koch) Boiss., *Flora Orientalis* 4 (2): 566 (Boissier 1879). — Type: **Georgia** • Radscha; Ruprecht s.n.; (holo-, G, G-BOIS[G00786074 image!]), **syn. nov.**

**PHENOLOGY.** — Flowering September to October, fruiting October to November.

**DISTRIBUTION AND ECOLOGY.** — N and NE of Iran (Fig. 5D), S of Turkmenistan, E of Georgia, NE of Turkey. Crevices of the rocky slopes of the Irano-Turanian as well as Euro-Siberian regions.

**SPECIMENS EXAMINED.** — **Iran** • NE Iran, N Khorasan Prov., Ashkhana, NW of Darkash; 37°27'18.0"N, 56°42'59.1"E; alt. 982 m; 31.X.2019; Mirtadzadini 3822 (MIR) • SW of Ashkhana, S of

Jauzak; 37°25'16.7"N, 56°40'49.3"E; alt. 1333 m; 30.X.2019; *Mirtadzadini 3829* (MIR) • 26 km from Tangrah to Bojnurd; 37°20'04.5"N, 56°00'12.3"E; alt. 930 m; 29.X.2019; *Mirtadzadini 3832* (MIR) • 17 km from Tangrah to Bojnurd; 37°22'07.5"N, 55°57'38.5"E; alt. 753 m; 29.X.2019; *Mirtadzadini 3831* (MIR) • 5 km from Tangrah to Bojnurd; 37°23'18.2"N, 55°50'13.0"E; alt. 529 m; 29.X.2019; *Mirtadzadini 3830* (MIR) • W of Bojnurd, near to Darkash; alt. 1200 m; 06.VIII.2000; *Joharchi & Zangoeei 33158* (FUMH) • Jangal-e Golestan, Tang-e Gol; alt. 600-700 m; 13-14.X.1976; *Terme & Matin 25027* (IRAN) • N Iran, Gilan Prov., 45 km Punel to Khalkhal; alt. 700 m; 29.IX.2016; *Eskandari & Ghamghami 75703* (IRAN) • Manjil; alt. 900 m; 07.XI.1937; *Gauba 25033* (IRAN) • Near to Astara, Mt. Ashin; 26.VII.1941; *Gauba 25034* (IRAN) • Harzevil, near Manjil; 01.XII.1937; *Gauba 25032* (IRAN) • South of Rasht, Ganja toward Rudbar; 36°51'53.0"N, 49°29'04.2"E; alt. 180 m; 13.IX.2019; *Mirtadzadini 3821* (MIR) • Between Ardabil and Astara; 38°23'44.6"N, 48°36'02.5"E; alt. 976 m; 11.IX.2019; *Mirtadzadini 3819* (MIR).

#### DESCRIPTION

Aromatic perennial, 30-50 cm high, stems erect-procumbent, covered with white short retrorse hairs and sessile glands. Leaves sessile, often conduplicate, linear-oblongate, 8-15(-20) mm long, 2-3 mm wide, attenuate at base, apex rounded or acutiusculate, covered with short scattered scabrous retrorse hairs and sessile glands. Verticillasters distant or approximate, (1-)2-6(-8) flowers in verticillaster, cymes one- or two-sided, peduncle up to 5 mm, flowers sessile or with a short pedicel up to 1-2 mm. Calyx green, manifestly 2-lobed, campanulate-tubular, covered with short hairs and sessile glands on the outside, 4-6(-7) mm, teeth narrow linear to subulate, inferior teeth 2.5-3 mm, superior teeth 1-2 mm. Corolla white, rarely lilac, (7-)8-10 mm long, covered with hirsute indumentum. Stamens exerted from the tube. Style usually as long as posterior stamens. Nutlets elliptic, 1.3-1.5 mm, 0.8-1 mm wide, brown to dark brown.

#### REMARKS

*Satureja mutica* was first described from Talisch, a common area between N of Iran and south of Azerbaijan in first description, and later from NE of Iran and south of Turkmenistan (Rechinger 1982; Borissova 1977). *Satureja spicigera* was reported under the name *Micromeria spicigera* C. Koch (1843) from Radscha, E of Georgia. This species was later transferred to *Satureja* by Boissier (1879). *Satureja spicigera* is distributed in Talisch, N of Iran as well as in NE of Turkey (Davis 1982; Rechinger 1982; Borissova 1977). Therefore, the two species overlap in their distribution range. These species are mainly distinguished by the inflorescence elongated, second, many-flowered and the stamens and style prominently exerted from the corolla in *S. spicigera* vs inflorescence axillary, loosely racemose, few-flowered and the stamens and style not exerted from the corolla in *S. mutica*, but these distinctive characters are of low taxonomic importance. In addition, no morphological differences were found by the study of their types deposited in LE, G and W. There are some minor differences between the individuals of different populations in the number of flowers, length of calyx and corolla. Some individuals have stems more lignified, and some individuals of the same population have second inflorescence (Fig. 2J).

But no morphological discontinuity has been observed among the populations from Iran. *S. spicigera* is distributed in Turkey and Georgia as well. By the observation of some herbarium images belonging to *S. spicigera* from Turkey and Georgia, we can not find any differences with the specimens from Iran. *S. spicigera* is reduced here to synonymy under *S. mutica* by the name priority.

#### *Satureja sabendica* Bornm.

(Fig. 2K)

*Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien* 60: 160 (Bornmüller 1910). — Type: Iran • Persia, Isperchian, in declivibus borealibus montis Sahend; 30.VII.1884; *Knapp s.n.*; holo-, WU[WU0043454 image!].

PHENOLOGY. — Flowering July to November, fruiting October to November.

DISTRIBUTION AND ECOLOGY. — This is an endemic species distributed on the rocky slopes of the Irano-Turanian region of NW of Iran (Fig. 5C).

SPECIMENS EXAMINED. — Iran • NW Iran, East Azerbaijan, south of Qaraghaj, south west of Pir-e Saqqa village; 36°51'48"N, 46°56'35"E; alt. 2459 m; 08.VII.2016; *Mirtadzadini 1984* (MIR) • Osku, Kandovan, Anish, Mt. Nour; alt. 2200-2350 m; 08.VIII.1984; *Terme & Moussavi 25038* (IRAN) • Qazvin Prov., 5 km from Kiseh-Jin to Dashtak; 35°48'39"N, 49°8'47"E; alt. 1716 m; 10.VIII.2012; *Mirtadzadini 1985* (MIR).

#### DESCRIPTION

Aromatic perennial, 20-25 cm high, stems erect-procumbent, covered with white short hairs and sessile glands. Leaves sessile, flattened or conduplicate, linear-oblong to lanceolate, 8-12 mm long, 1-2 mm wide, attenuate at base, apex obtusiusculate or acute, with short simple hairs over sessile glands, floral leaves similar to the cauline leaves in shape. Verticillasters distant or approximate, 1-6 flowers in verticillaster, flowers often sessile or with a short pedicel, *c.* 1 mm. Calyx green, campanulate-tubular, covered with short hairs and sessile glands on the outside, 4-6 mm, superior teeth triangular-subulate, inferior teeth lanceolate-subulate. Corolla white, 8-12 mm long. Stamens exerted from the tube. Style exerted from the tube. Nutlets elliptic, brown to dark brown, 1.2-1.5 mm long, 0.7-0.8 mm wide.

#### REMARKS

*S. sabendica* is morphologically close to *S. mutica* but they are recognized by the corolla tube obviously exerted from the calyx in *S. sabendica*.

#### EXCLUDED SPECIES

##### *Satureja boissieri* Hausskn. ex Boiss.

*Flora Orientalis* 4: 565 (Boissier 1879). — Type: Turkey • Anatolia, in monte Akdagh Cataonia inter Malatya et Adiaman; 13.IX.1865; *Haussknecht s.n.*; holo-, G[G00786097 image!]; iso-, JE[JE00013746 image!].

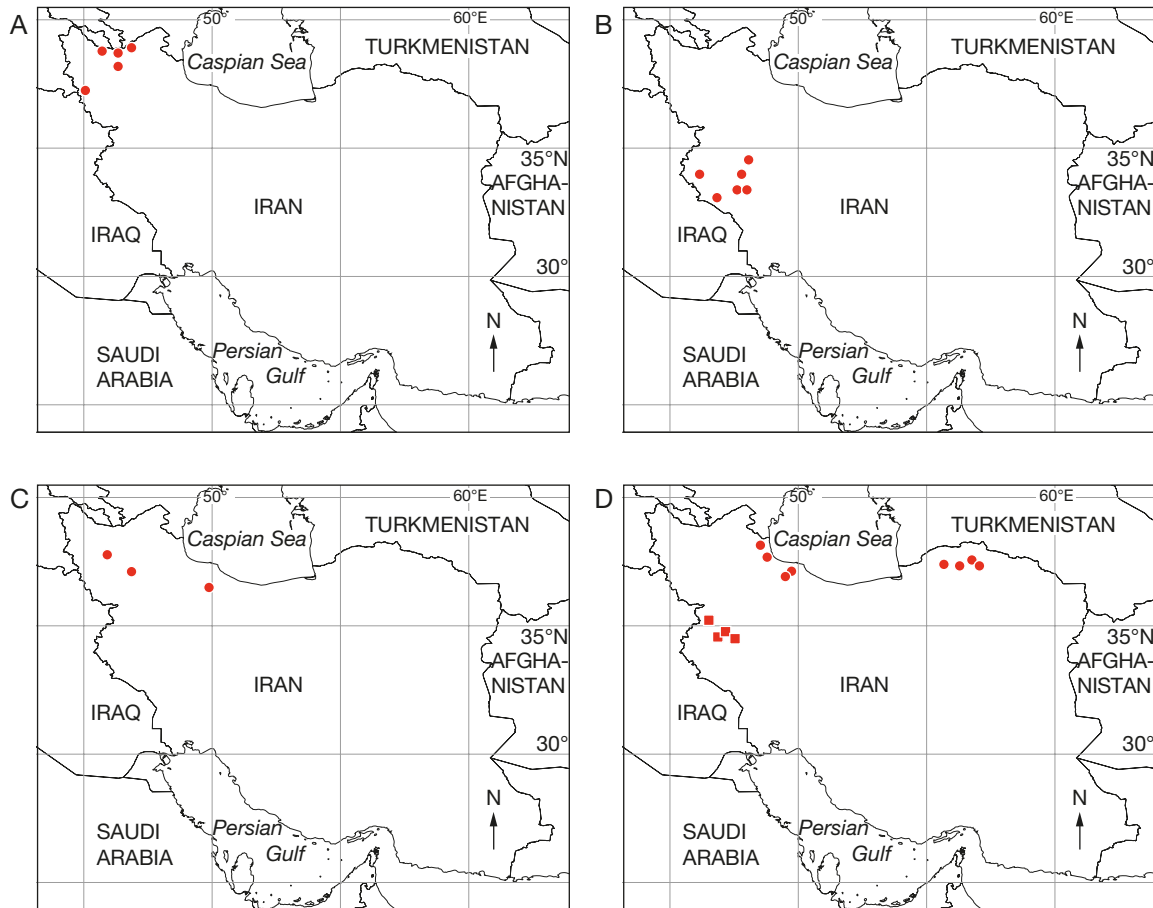


FIG. 5. — Distribution map of *Satureja* L. species in Iran: **A**, *S. macrantha* C.A.Mey.; **B**, *S. macrosiphonoa* (Coss.) Maire; **C**, *S. sahendica* Bornm.; **D**, *S. mutica* Fisch. & C.A.Mey. (circle), *S. longiflora* Boiss. & Hausskn. (square).

SPECIMEN EXAMINED. — Turkey • Adiyaman, Yazıbaşı village; alt. 2000 m; 30.IX.2001; *K. Kietnk F.S. 1027* (Herbarium of Balikesir University) [image!].

NOTES

*Satureja boissieri* was reported from Iran in *Flora Iranica* (Rechinger 1982) from a single locality in North of Iran, Golestan Province, 14 km E Chaman Bid. Later, this species was also reported from Iran in *Flora of Iran* (Jamzad 2012) based on three specimens collected from the same area as well as Golestan Province, Tang-e Rah to Tang-e Gol and Gilan Province, Amlash, Blourdakan, Khasildasht. *Satureja boissieri* is morphologically close to *S. mutica* in the characteristics of the flowers such as the color of corolla and the size of calyx but the former species markedly can be identified by its terminal inflorescence. By the exploring of this species in North and NE of Iran and with the study of herbarium materials deposited in TUH, IRAN, and MIR, we do not confirm the occurrence of *S. boissieri* in Iran, and therefore, it is excluded from the flora of Iran. The specimens from Khasildasht, Tang-e Gol and Chaman Bid are all belong to *Satureja mutica*. We conclude that its report from Iran was a misidentification for *S. mutica*.

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