

A TAXONOMIC STUDY OF ACANTHOPHYLLUM C. A. MEY. (CARYOPHYLLACEAE) IN IRAN

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The genus *Acanthophyllum* in Iran has been revised. According to the results of the present study three species i.e., *A. gracile* Bunge ex Boiss., *A. pachycephalum* Schiman-Czeika & *A. kandaharicum* Gilli are reduced to the rank of variety under *A. bracteatum* Boiss. In addition, following nine synonymies are made: *A. leucostegium* Schiman-Czeika and *A. khuzistanicum* Rech. f. as synonymies of *A. bracteatum* Boiss., *A. kurdicum* Boiss. & Hausskn. is treated as a synonym of *A. crassifolium* Boiss., *A. microcephalum* Boiss. as a synonym of *A. mucronatum* C. A. Mey., *A. crassinodum* Yukhan. & Edmondson and *A. chloroleucum* Rech. f. & Aell. as synonymies of *A. glandulosum* Bunge ex Boiss., *A. borsczowii* Litw. as a synonym of *A. elatius* Bunge ex Boiss., *A. heterophyllum* Rech. f. as a synonym of *A. stocksianum* Boiss. and finally *A. heratense* Schiman-Czeika as a synonym of *A. laxiusculum* Schiman-Czeika. Identification keys, descriptions and geographical distribution of all consisting taxa are included.

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Key words. *Acanthophyllum*, Caryophyllaceae, Taxonomy, revision, Iran.

بررسی آرایه شناسی جنس *Acanthophyllum* از تیره میخک در ایران

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در این پژوهش، جنس *Acanthophyllum* C. A. Mey. در ایران مورد بررسی تاکسونومی قرار گرفته است. سه گونه‌ی زیر به سطح وارسته-هایی از گونه‌ی *A. bracteatum* Boiss. تنزل یافته اند.

A. gracile Bunge ex Boiss., *A. pachycephalum* Schiman-Czeika & *A. kandaharicum* Gilli

همچنین نه مترادف‌سازی به شرح ذیل ایجاد شد: گونه‌های *A. leucostegium* Schiman-Czeika و *A. khuzistanicum* Rech. f.

مترادف گونه *A. bracteatum* Boiss. قرار داده شدند. گونه *A. kurdicum* Boiss. & Hausskn. به عنوان مترادف *A. crassifolium*

Boiss. و *A. microcephalum* Boiss. مترادف *A. mucronatum* C. A. Mey. شناخته شد. گونه‌های *A. crassinodum* Yukhan. &

Edmondson و *A. chloroleucum* Rech. f. & Aell. مترادف گونه *A. glandulosum* Bunge ex Boiss. قرار داده شدند. گونه *A.*

borsczowii Litw. مترادف *A. elatius* Bunge ex Boiss. تشخیص داده شد. گونه *A. heterophyllum* Rech. f. مترادف *A.*

stocksianum Boiss. و گونه *A. heratense* Schiman-Czeika به عنوان مترادف *A. laxiusculum* Schiman-Czeika در نظر گرفته

شدند. کلید شناسایی، شرح و پراکنش جغرافیایی تمام تاکسون‌های موجود تهیه شده است.

INTRODUCTION

The first two authors revised different sections of the genus *Acanthophyllum* C. A. Mey. in Iran as their M. S. dissertations and also the preparation of the draft of

Flora of Iran (Assadi, 1989). The present paper is based on the results of their studies. The genus *Acanthophyllum*. is an alpine and subalpine genus with ca. 50 species in the world, exclusively occurring in the

Irano-Turanian region. However, the number of the species may vary due to poor knowledge of the genus. According to literature the highest number of species has been recorded in east of Iran (Khorasan province) and in the adjacent areas i. e., Turkmenistan and Afghanistan (Ghaffari, 2004). The number of species decrease toward the east of Afghanistan to the China and towards the west to Turkey and Syria, where only a single species occurs in China (*A. punges*) and Syria (*A. verticillatum*).

The delimitation of *Acanthophyllum* species in Iran, has been dealt with in widely differing ways by different authors in different Floras and also variable number of species have been reported for this genus in Iran: Boissier (1810), Parsa (1951), Schiman-Czeika (1988) have mentioned 2 sections and 10 species, 5 sections and 18 species, 4 sections and 32 species respectively. Schiman-Czeika (1988) in Flora Iranica has reported 5 sections and 27 species for Afghanistan and 4 sections and 5 species for Pakistan.

The aim of this paper is to revise the genus taxonomically, to give key to the accepted taxa, short diagnose for the taxa, taxonomic discussions and list of selected taxa studied.

MATERIAL AND METHODS

In order to revise the taxonomy of the genus *Acanthophyllum* in Iran, all herbarium material in herbaria of Research Institute of Forests and Rangelands (TARI), Central Herbarium of Tehran University (TUH), Mashhad University herbarium (FUMH), Research Centers of Agriculture and Natural Resources in Isfahan, Kermanshah and Kurdistan, and herbarium of Department of Biology of Isfahan University were examined. In addition, new collections from *A. mucronatum* C. A. Mey. and *A. acerosum* Sosn. have been made. The authors examined ca. 1100 herbarium specimens deposited in these herbaria. Flora Iranica (Schiman-Czeika, 1988) was used as a main source for the identification of the taxa, but following sources were considered as well (Boisser, 1861; Shishkin 1936; Huber-Morath, 1967; Ghazanfar & Nasir, 1986; Parsa, 1951; Schiman-Czeika, 1988). Range of variation of characters of taxa were measured directly on the herbarium specimens and partly in the field and then the description of taxa were prepared based on these new measurements. Plants from the type localities were studied (except *A. andersenii* Rech. f.). Selected specimens are cited in a way to show general distribution of the taxa in Iran.

RESULTS

In this investigation four sections and 21 species are recognized from Iran, five species are reduced to the rank of varieties. In addition, seven synonymies are made. *A. stenostegium* Freyn is excluded from floristic regions of Iran while it was reported as a record from Iran by Joharchi & Akhiani (2006). Shape and size of inflorescence, floral leaves, calyx and petals, shape of calyx teeth, number of ovules, indumentums and length of internodes are considered taxonomically important characters. Identification keys, descriptions and geographical distribution of all consisting taxa are included.

Description of *Acanthophyllum* C. A. Mey.

Perennial, woody spiny suffruticose or shrubs, usually hairy. Leaves hard, spiny, mucronate, opposite, simple, entire, mostly needle-like and sessile, without stipule. Flowers white, pink, purple or red, rarely solitary, mostly numerous in spherical dense heads at the top of stems. Bracts and bracteoles subulate-lanceolate. Calyx tubular, hardly obconical with 5 teeth. Petals 5, usually obovate; limb rounded, acute or emarginate at the tip. Stamens 10, exerted. Gynophore short; ovary composed of a single locule containing 4-21 ovules; embryo spherical or almost cylindrical; capsule containing only 1 seed, indehiscent, membranous at the base but dry and chartaceous at the top. Seeds reniform-ovate with a bent or marginal embryo.

Enumeration of accepted species of *Acanthophyllum* in Iran

Sect. *Macrostegia*

1. *A. bracteatum*
 - 1.1. *A. bracteatum* var. *bracteatum*
 - 1.2. *A. bracteatum* var. *gracile*
 - 1.3. *A. bracteatum* var. *pachycephalum*
 - 1.4. *A. bracteatum* var. *kandaharicum*

Sect. *Acanthophyllum*

2. *A. crassifolium*
3. *A. mucronatum*
4. *A. verticillatum*
5. *A. acerosum*

Sect. *Pleiosperma*

6. *A. spinosum*
7. *A. glandulosum*
8. *A. sordidum*

Sect. *Oligosperma*

9. *A. elatius*

- 10. *A. stocksianum*
- 11. *A. laxiusculum*
- 12. *A. andersenii*
- 13. *A. squarrosus*
- 14. *A. diezianum*
- 15. *A. brevibracteatum*
- 16. *A. pachystegium*
- 17. *A. lilacinum*
- 18. *A. adenophorum*
- 19. *A. speciosum*
- 20. *A. korshinskyi*
- 21. *A. caespitosum*

Identification key to the species of *Acanthophyllum* in Iran

- 1- Plants not cushion-like, upright 2
- Plants cushion-like 5
- 2- Leaves ovate -lanceolate or lanceolate, always shorter than the internodes, 2-5 mm broad
 - 9. *A. elatius* Bunge ex Boiss.
 - Leaves always needle-like, shorter or longer than the internodes, up to 2 mm broad 3
 - 3- Plants glabrous or slightly covered with very short hairs. Leaves circular in cross section
 - 3. *A. mucronatum* C. A. Mey.
 - Plants covered with hairs and glands. Leaves triangular in cross section 4
 - 4- Floral leaves lanceolate. Calyx teeth equal
 - 2. *A. crassifolium* Boiss.
 - Floral leaves subulate. Calyx teeth unequal
 - 4. *A. verticillatum* (Willd.) Hand.-Mzt.
 - 5- Floral leaves, bracts and bracteoles membranous and transparent, elliptical, fusiform or obovate
 - 1. *A. bracteatum* Boiss.
 - Floral leaves, bracts and bracteoles non-membranous, subulate-lanceolate or carinate 6
 - 6- Plants glabrous or slightly covered with very short and dispersed hairs 7
 - Plants completely hairy 8
 - 7- Current year stems up to 7 cm long. Leaves more than 2 mm broad. Bracteoles longer than 1 mm. Ovary including 11 to 14 ovules
 - 6. *A. spinosum* (Desf.) C. A. Mey.
 - Current year stems longer than 7 cm. Bracts up to 2 mm broad. Bracteoles at most 1 mm broad. Ovary including 4 ovules
 - 10. *A. stocksianum* Boiss.
 - 8- Ovary always with more than 4 ovules 9
 - Ovary always with 4 ovules 10
 - 9- Inflorescence compact. Floral leaves exerted out of inflorescence. Bracts thick and cartilaginous
 - 8. *A. sordidum* Bunge ex Boiss.
 - Inflorescence loose. Floral leaves not exerted out of inflorescence. Bracts soft

- 7. *A. glandulosum* Bunge ex Boiss.
- 10- Glandular hairs present 11
- Glandular hairs absent 17
- 11- Flowers large. Petals longer than 16 mm
 - 19. *A. speciosum* Rech. f. & Schiman-Czeika
 - Flowers small. Petals not longer than 16 mm 12
 - 12- Very dense plants, with extremely short branches (3 to 10 cm long). Internodes very short (less than 10 mm). Leaves covering each other. Inflorescence hidden between leaves. Petals clearly emarginate, pink or purple
 - 21. *A. caespitosum* Boiss.
 - Less dense plants, with long branches (more than 10 cm). Internodes long (more than 10 mm). Leaves not covering each other. Inflorescence obvious. Petals acute, curved or slightly emarginated and sinus-like, white, pink, lilac, purple and purplish 13
 - 13- Hairs only glandular and short (up to 1 mm long)
 - 20. *A. korshinskyi* Schischk.
 - Hairs a combination of long (more than 1 mm), simple and glandular hairs 14
 - 14- Calyx more than 8 mm long
 - 18. *A. adenophorum* Freyn
 - Calyx up to 8 mm long 15
 - 15- Bracts shorter or as long as calyx
 - 16. *A. pachystegium* Rech. f.
 - Bracts longer than calyx 16
 - 16- Inflorescence 20 mm or more in diameter. Floral leaves 10 mm long or more. Bracts more than 1 mm broad. Calyx 7-8 mm long. Petals 12-15 mm long
 - 17. *A. lilacinum* Schischk.
 - Inflorescence less than 20 mm in diameter. Floral leaves less than 10 mm long. Bracteoles up to 1 mm long. Calyx 4-6 mm long. Petals 6-9 mm long
 - 5. *A. acerosum* Sosn.
 - 17- Calyx more than 8 mm long 18
 - Calyx up to 8 mm long 19
 - 18- Internodes longer than 20 mm
 - 12. *A. andersenii* Rech. f. & Schiman-Czeika
 - Internodes up to 20 mm long
 - 14. *A. diezianum* Hand.-Mzt.
 - 19- Bracts less than 7 mm
 - 15. *A. brevibracteatum* Lipsky
 - Bracts 7 mm long or more 20
 - 20- Hairs short (1-2 mm), unicellular and scattered
 - 13. *A. squarrosus* Boiss.
 - Hairs long (more than 2 mm), multicellular and very dense
 - 11. *A. laxiusculum* Schiman-Czeika

Identification key to *Acanthophyllum* sections in Iran

- 1- Bracts ovate, obovate, elliptical or fusiform with thick transparent margin I. Sect. *Macrostegia* Boiss.
- Bracts lanceolate or carinate and long triangular 2

2- Inflorescence mostly long and along the rachis (except in *A. acerosum*). Bud leaves approximately equaling the leaves. Bracts lanceolate, long triangular and sometimes lanceolate II. Sect. **Acanthophyllum**
- Inflorescence short and terminal. Bud leaves much shorter than the leaves. Bracts always lanceolate 3

3- Ovary containing more than 4 ovules

III. Sect. **Pleiosperma** Boiss.

- Ovary always containing 4 ovules

IV. Sect. **Oligosperma** Schischk.

I. Sect. Macrostegia Boiss.

Leaves robust or thin, triangular in cross section. Inner flowers lacking bracts. Floral leaves, bracts and bracteoles cordate, obovate, obpyriform or fusiform with widely white membranous margin; middle vein purple or brownish-red or colorless. Ovary always with 4 ovules.

1. A. bracteatum Boiss., Diagn. Pl. Or. Nov. Ser. 1, 1: 43 (1843).

Plants 10 to 40 cm tall. Floral leaves, bracts and bracteoles transparent and membranous, elliptical, fusiform, cordate, obovate or obpear-shaped, sometimes cuneate at base, with wavy or smooth or sinuate margin.

1- Floral leaves and bracts revolute

1.4. *A. bracteatum* var. *kandaharicum* (Gilli) Basiri
- Floral leaves and bracts erect or slightly bended inwards 2

2- Stem and leaves not hairy. Inflorescence 8-12 cm long and 9-16 mm broad. Floral leaves approximately the same size in length and width; midrib yellow or colorless

1.3. **A. bracteatum** var. **pachycephalum** (Schiman-Czeika) Basiri

- Stem and leaves hairy or not hairy. Inflorescence 8-17 cm long and 7-23 mm broad. Floral leaves longer than their width; midrib red or colorless 3

3- Stem and leaves hairy or glabrous and sometimes with a dusty cover. Leaves robust or thin and at most 60 mm long. A bunch of dense or sparse flowers, spherical. Floral leaves obovate, elliptical or cordate, sinuate at margins

1.1. **A. bracteatum** var. **bracteatum**

- Stem and leaf glabrous and sometimes dusty. Leaves thin and up to 50 mm long. Inflorescence bell-shaped. Floral leaves fusiform or obpyriform-cuneate at base, smooth or minutely wavy at margins, sometimes sinuate at top

1.2. **A. bracteatum** var. **gracile** (Boiss.) Basiri

1.1. A. bracteatum var. **bracteatum**

Syn.: *A. leucostegium* Schiman-Czeika, Flora Iranica, 163: 272 (1988), **syn. nov.**; *A. khuzistanicum* Rech. f., Flora Iranica, 163: 273 (1988), **syn. nov.**

Stem and leaves hairy or glabrous and sometimes with a dusty cover. Leaves robust or delicate and at most 60 mm long. Inflorescence 8-17 mm long and 7-23 mm broad, dense or sparse, spherical. Floral leaves and bracts erect or slightly bent inside, longer in length than width, obovate, elliptical or cordate, sinuate at margins; midvein red or colorless.

Selected specimens seen. **Kordestan:** Saranjiana, south of Sanandaj and Dehgolan, 12 km from Dehgolan, 1650 m, Fatahi 984. - **Hamadan:** north-east of Hamadan, Qulia, 2000 m, Mozaffarian 64647. - **Esfahan:** Ghameshloo Protected Area, 2100 m, Yosofi 1705. - **Yazd:** 104 km north-west of Yazd, 2 km south-east of Aghda, 1150 m, Pabot 7070. - **Kohgiluyeh-Boirahmad:** 26 km south of Dogonbadan, 450 m, Dadash-zade 1406. - **Chaharmahal--Bakhtiari:** Lordegan, Sarkhon, Shalil to Douab-e Bazoft and Karon, 1200 m, Mozaffarian 54923. - **Fars:** 8 km S. of Lar, 1000 m, Assadi and Sardabi 41757. - **Hormozgan:** 110 km from Bandar Abbas to Sirjan, above the tunnel Tange-e Zagh, 1100-1400 m, Mozaffarian 44906. **Bushehr:** Borazjan, Dalaki to Bushkan, between Tange Eram and Faryab, about 350 m, Mozaffarian 74144. - **Khuzestan:** Ramhormoz. 6 km, Izeh road, 450 m, Riazi 9439.; 15 km from Masjed-Soleyman to Andica, 640 m, Mozaffarian 62964. - **Markazi:** 55 km of Delijan to Khomein, 1600 m, Babakhanlou and Amin 8768. - **Baluchestan:** 80 km from Zahedan on the road to Bam, 1350 m, Assadi 22718. - **Khorasan:** ca. 96 km from Mashhad on the road to Torbat-e Heydarieh, Robat-safid, 1800 to 2000 m, Assadi and Maasoumi 21291. - **Tehran:** Ziba dasht, 10 km S road of Firuzkuh, 1700 m, Bazargan and Arazm 2427.

Distribution. Iran and Pakistan, type specimen from Iran (Fars province).

Note: *A. leucostegium* was introduced from an area between Shiraz to Esfahan and was separated from *A. bracteatum* by its larger inflorescence. Some other characters also mentioned in "Flora Iranica" such as the bracteoles lacking glands and bracts being larger while they were not observed in our analysis. Based on our observations in type material and the materials from type locality, all above mentioned characters show a continuous and gradual variation, what is more, this character seems to be specially influenced by climate conditions. Therefore, these two species are regarded as synonyms in this article. For instance, among the mentioned specimens, these specimens show *A. leucostegium* characters: Mozaffarian, Banihashemi and Shahinzade 39700; Mozaffarian 44906 and these

specimens show specific characters of *A. bracteatum*: Mozaffarian 53419; Mozaffarian 52617. These specimens show intermediate forms: Assadi and Bazgosha 56021, Assadi and Bazgosha 56141a; Jamzad, Taheri and Javidtash 69395.

A. khuzistanicum was introduced from Sardasht region (province Khuzistan) and its distinctive characters from *A. bracteatum* were mentioned as: stems grey (not bluish green), inflorescence loose, calyx 10 to 12 mm long and clearly visible. Calyx teeth not equal, and triangular. Floral leaves subulate or obovate, midrib prominent and sharp, sprouting 2 mm out. In *A. bracteatum* mentioned characters are: stems usually bluish green, inflorescence dense or sparse; calyx 8 to 10 mm long; teeth equal or not equal, floral leaves obovate or obpear-shaped or elliptical or fusiform or cordate; midrib thick or thin, sprouting 1 to 2 mm out. Based on observations all mentioned characters show a gradual variation. Therefore, these two species are regarded as synonyms in this article. For instance, among the specimens, these show *A. khuzistanicum* specific characters: Mozaffarian 63225; Mozaffarian 62964 and Riazi 9439 and these show specific characters of *A. bracteatum*: Wendelbo and Foroughi 17810; Assadi and Ranjbar 82950; Yoosofi 1705 and these show gradual variation: Mozaffarian 54923; Riazi 3816; Babakhanloo and Dini 8768; Babakhanloo and Amin 8768; Dadashzade 39435.

1.2. ***A. bracteatum* var. *gracile*** (Bunge ex Boiss.) Basiri, **comb. et stat. nov.**

Syn.: *A. gracile* Bunge ex Boiss., Fl. Or. 1: 563 (1867); *A. elongatum* Preober. in Schischk., Fl. USRR. 6: 895 (1936).

Stem and leaf with hairy cover or lacking hairy cover and sometimes dusty. Leaves thin and up to 50 mm long. Inflorescence 8-17 mm long and 7-23 mm broad and bell-shaped. Floral leaves and bracts erect or slightly bend inward, longer in length than width, fusiform or obpear-shaped, cuneate at base, smooth or minutely wavy at margins, sometimes sinuate at top; middle midrib red or colorless.

Selected specimens seen. **Zanjan:** Zanjan-Miyaneh, Shur gheslugh, 1000 m, Sabeti 2420. -**Charmahal-e bakhtiari:** road from Lordegan to Yasuj, Maymand, Margh-e Chenar, Kottuk, 1750 m, Mozaffarian 54518. -**Baluchestan:** 30 km from Khash to Iranshahr road toward Irandegan, 1400 m, Mozaffarian 42863. -**Khorasan:** northeast of Bojnord, Gifan road, Soorak, 834 m, Joharchi and Zangooy'i 40530. -**Hormozgan:** Bandar Abbas, kuh-e Geno slope, S. side, 700-800 m, Wendelbo and Foroughi 15349. -**Semnan:** Touran Protected Area, 10 km from Chahjam on road to Razeh, 1320 m, Freitag and Mozaffarian 28505. -**Tehran:**

Ziba Dasht, km 10 S. of Firuzkuh, 1700 m, Bazargan and Arazm 2427.

Distribution. Turkamanestan, NW, W, C, NE, S and SE Iran. Type specimen from Iran (Semnan province).

A. gracile was introduced from Shahrud, (province Semnan) and is distinguishable from *A. bracteatum* by following characters: stem and leaves being glabrous or sometimes with a dusty cover, leaves thin and at most 50 mm long, inflorescence dense and bell-shaped, floral leaves fusiform or obpear-shaped, cuneate at base, smooth or minutely wavy at margins, sometimes sinuate at top. Above mentioned characters are as follows in *A. bracteatum*: stem and leaves covered with hairs or hairless or dusty or scabrous at stem. Leaves up to 60 mm long. Inflorescence dense or sparse, spherical. Floral leaves obovate or elliptical or cordate with sinuate margins. On basis of our observations, all the mentioned characters show a continuous and gradual variation and on the other hand, the remaining differences between the typical specimens are not enough for separating these two taxa at species level. Therefore, *A. gracile* species is reduced to a variety of *A. bracteatum* in this article. For instance, specimens: Joharchi and Zanguyi 11354, Assadi and Mozaffarian 35512, Mozaffarian, Banihashemi and Shahinzade 39200 show specific characters of *A. gracile* and specimens: Wendelbo and Foroughi 17810, Assadi and Ranjbar 82950, Yoosefi 1705 show specific characters of *A. bracteatum* while specimens: Babakhanloo 9838, Assadi 22922, Mozaffarian 53419 show intermediate forms.

1.3. ***A. bracteatum* var. *pachycephalum*** (Schiman-Czeika) Basiri, **comb. et stat. nov.**

Syn.: *A. pachycephalum* Schiman-Czeika, Flora Iranica 163: 269 (1988).

Stem and leaves without hairy cover. Leaves 17-29 mm long. Inflorescence 8-12 cm long and 9-16 mm broad, spherical. Flower leaves approximately the same size in length and width; midrib yellow or colorless.

Selected specimen seen. **Tehran:** W of Tehran, Suleghun valley, 1500 to 2000 m, Assadi and Mozaffarian 32632.

Distribution. C Iran.

A. pachycephalum is introduced from Tehran, Darband area and separated from *A. bracteatum* by its small circular inflorescence, leaves 5 to 7 cm long and 5 to 6 cm broad, oval or rather cordate, wavy and sinuate at margins and midrib colorless, calyx hairy and glandular and other parts of the plant hairless. Mentioned characters for *A. bracteatum* are found to be in these states: inflorescence often larger, elliptical or oval or spherical, bracts length longer than their width,

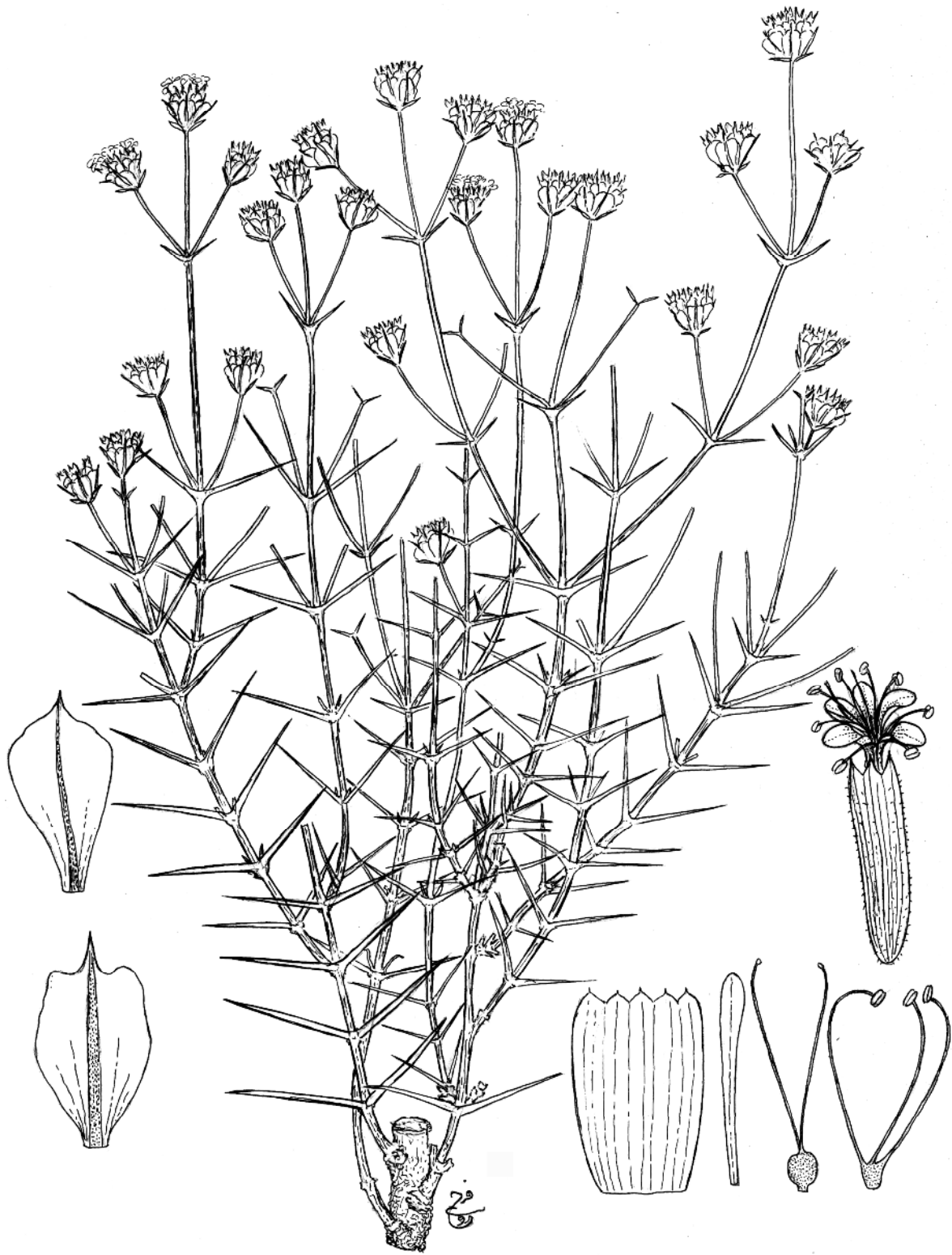


Fig. 1. *Acanthophyllum bracteatum* var. *gracile* ($\times 0.7$); details ($\times 3.5$).

elliptical or oboval or sometimes oval, with wavy margin and midrib red, calyx hairy or glandular and other parts of the plant hairy or hairless. On the basis of observations, all mentioned characters show a continuous and gradual variation and on the other hand, the cyme partial and flowers being footed or not, which is mentioned in "Flora Iranica". As the distinctive characters for these two species are very variable and they do not seem to be good characters. Same way, the remaining differences between the typical specimens are not at the extent to separate two taxa at species level. Therefore, in this article *A. pachycephalum* is reduced to a variety of *A. bracteatum* from being a species on its own. For instance, these specimens show specific characters of *A. pachycephalum*: Babakhanloo and Amin 2628; Moosavi 2595; Jamzad 57064; Assadi and Mozaffarian 32632. But these specimens show *A. bracteatum* characters: Wendelbo and Foroughi 17810; Assadi and Ranjbar 82950; Yoosefi 1705 and these specimens show intermediate forms: Mozaffarian 67765; Assadi and Sardabi 41757; Mozaffarian 53878.

1.4. *A. bracteatum* var. *kandaharicum* (Gilli) Basiri, comb. et. stat. nov.

Syn.: *A. kandaharicum* Gilli, Feddes Repert. 59: 168 (1956).

Stems and leaves without hairy cover or with very short hairs. Leaves very large and 8 to 39 mm long. Inflorescence 11 to 15 mm long and 20 to 22 mm broad, spherical, exuberant. Floral leaves revolting out, longer in length than width, fusiform or lanceolate, with sinuate margins; midrib red.

Selected specimens seen. Khorasan: Ca. 20 km to Khaf on the road from Tayebad road, 1000 m, Assadi and Amirabadi 84631; Nehbandan, Khosf, between Afzal Abad and Marghzar, 1711 m, Joharchi and Zanguyi 36242.

Distribution. Afghanistan and E Iran. Type specimen from Afghanistan (Ghandehar).

Note: *A. kandaharicum* is introduced from Nehbandan, Khorasan and the characters that separate it from *A. bracteatum* are: floral leaves and bracts fusiform, with sinuate margin and white membranous part thin; midrib revolting out. Mentioned characters in *A. bracteatum* are: floral leaves obovate or elliptical or cordate with sinuate margin, white membranous part thick, midrib not revolting out, bracts elliptical or obovate or ovate with sinuate margin, midrib not revolting out. In *A. bracteatum* var. *gracile* floral leaves and bracts are also observed to be fusiform, the revoluted midrib character is not evident and on the other hand, members of this species have thin leaves which is in contrast with *A. kandaharicum* with robust leaves. On the basis of observations, all mentioned characters show a

continuous gradual variation as in Khorasan mostly var. *gracile* is present and in Khaf and east of Birjand and Nehbandan region, this variety is seen in *A. kanadaricum* form. On the other hand, the remaining differences between the two typical specimens are not enough to separate two taxa at species level. Therefore, in this article *A. kandaharicum* is reduced to a variety of *A. bracteatum* from being a species. Among the mentioned specimens, these show specific characters of *A. kandaharicum*: Joharchi and Zangouei 36242; Joharchi and Zangouei 36245 and these specimens show *A. bracteatum* specific characters: Wendelbo and Foroughi 17810; Assadi and Ranjbar 82950; Yoosefi 1705.

II. Sect. *Acanthophyllum*

Upright plants (except *A. acerosum*). Leaves forming from buds are approximately equal with former leaves, triangular or circular in cross section. Inflorescence long and along with the axis (except *A. acerosum*). Floral leaves and bracts subulate, lanceolate or long triangular. Middle flowers with bracteoles. Calyx at most 5.5 mm long. Ovary including 4 to 8 ovules.

1. Plant cushion-like
- Plant upright

2. Stem and leaves hairless or covered with very short hairs. Leaves circular or semi-circular in cross section. Calyx teeth oval and rarely needle-like and revoluted. Petals cordate at the tip and 1.5 to 3 mm broad

3. *A. mucronatum* C. A. Mey.

- Stem and leaves hairy and or glandular. Leaves triangular in cross section. Calyx teeth triangular or lanceolate. Petals sinuate at the tips and 0.75 to 1.5 mm broad

3. Stem and leaves hairy and glandular. Floral leaves lanceolate. Calyx teeth equal. Ovary including 4 to 8 ovules

2. *A. crassifolium* Boiss.

- Stem and leaves covered with hairs but rarely glandular. Floral leaves lanceolate. Calyx teeth unequal. Ovary including 4 ovules

4. *A. verticillatum* (Willd.) Hand.-Mzt.

2. *A. crassifolium* Boiss., Diagn. Pl. Or. Nov. Ser. 1, 1: 42 (1843).

Syn.: *A. kurdicum* Boiss. & Hausskn. in Boiss., Fl. Or. Suppl. 90 (1888), **syn. nov.**

Plant upright. Stem and leaves hairy and glandular. Leaves triangular in cross-section. Calyx teeth triangular or lanceolate. Petals mostly sinuate at the tips and 0.75-1.5 mm broad.

Selected specimens seen. Hamadan: Asad-abad, 1950 m, Aryavand 1582. - **Kermanshah:** 25 km north of



Fig. 2. *Acanthophyllum crassifolium* ($\times 1$); details ($\times 6.5$).

Sahne, 1930 m, Mirabdali. - **Lorestan:** Dorud, neck mt. between Saravand and Gahar lake, 2300 to 3500 m, Mozaffarian and Sardabi 42367. - **Esfahan:** Boroudjen, 10 km south east of Hamguin, 2600 m, Aryavand and Sahebi 10111. - **Kohgilouyeh-Boirahmad:** 5 km S.W. of Sisakht on the road to Iasuj, 2400 m, Assadi and Abouhamzeh 46207. - **Chaharmahal-Bakhtiari:** Kalar mount, south west of Boroudjen, 2450 m, Aryavand 1449. - **Semnan:** Ca. 20 km. N.W. of Shahrud, above Nekarman, Kuh e Shahvar, 2300-2700 m, Assadi and Mozaffarian 40809. - **Tehran:** Rudehen, Ghaffari 165.64; 14 km from Ghazvin to Alamout, 1900 - 2000 m, Assadi and Maasoumi 50915.

Distribution. Iran, type specimen from Iran.

A. kurdicum was described from western Iran, Kermanshah and Kurdistan. It was written in original diagnose that it differs from *A. crassifolium* by having thinner leaves and entire petals (not retuce). There is great variation in leaf thickness and the petals are mostly sinuate at the apex among the studied specimens. Therefore, these characters are not constant enough to distinguish the two taxa as distinct species.

3. A. mucronatum C. A. Mey., Verz. Pfl. Cauc. 210 (1831).

Syn.: *A. microcephalum* Boiss., Diagn. Pl. Or. Nov. Ser. 1, 1: (1843), **syn. nov.**

Plant upright. Stem and leaves covered with narrow and short hairs or hairless. Leaves circular or semicircular in cross section. Calyx teeth oval and rarely revolute, needle-like. Petals cordate at the tips and 1.5 to 3 mm broad.

Selected specimens seen. **Gorgan:** Golestan forest, Almeh, 1740 m, Rowshan 6146. - **Mazandaran:** Ordogah, Haraz road, 1940 m, Panahi 2565. - **Gilan:** Rasht road, Nasar abad mountains, 1600 m, Forughian and Hariri 2431. - **Azerbaijan:** 34 km from Alamdar toward Khodafarin, between Ahmadabad and Siaahrud, 700 m, Assadi and Shahsavari 65827. - **Kordestan:** between Sanandaj and Divandarreh, before Zaghe pass, 2200 m, Assadi 78841. - **Kermanshah:** from Gahvareh to Kurzan, Chaghabur-Rahman, 1640 m, Assadi 78775. - **Hamadan:** Hamadan to Ghorveh, Dash Boulagh, Kamak-e Paein, Kankabud, 2070 - 2480 m, Mozaffarian 65009. - **Lorestan:** Borujerd to Arak, Herab, Gardaneh Zaliyan, 2220 - 2400 m, Shams 14088. - **Esfahan:** Golpayegan, Hendeh village, 2100 - 2250 m, Nowroozi and Ashtari 3067. - **Bakhtiari:** Lordegan, between Munj and Chahartagh, Tang-e Zendan, 1850 - 2100 m, Mozaffarian 62098. - **Fars:** Shiraz, 40 km on the road to Ardakan, 2130 m, Assadi and Mozaffarian 31074. - **Khorasan:** north of Bojnord, northeast of Gholaman, Sangsar montains, facing toward USSR, Joharchi and Zangouei 13281.-

Semnan: Touran Protected Area, 4 km toward Delbar on the road, 1250 m, Freitag and Jadidi 28951. - **Tehran:** Ghazvin to Alamout, Zarche-Bostan, 1750 m, Mirfakhrai 2352; Nobahar, 39 km northwest of Tafresh, 1400 m, Amin and Bazargan 18782.

Distribution. Iran, Caucasus and Middle East, type specimen from Talysh.

In this investigation *A. mucronatum* is regarded as a synonym of *A. micropcephalum*. Type specimens of *A. mucronatum* is from Talysh and Azerbaijan and that of *A. micropcephalum* is from Darband of Tehran as reported in Flora Iranica (Schiman-Czeika, 1988). The only distinctive character for these two species mentioned in Flora Iranica is the revolution of calyx edge teeth and being needle-shaped in *A. mucronatum*. In the beginning, the Azerbaijan specimens were separated from specimens of other regions and the character of revolution in teeth and being its needle-shaped was analyzed against the flat oval tip teeth character. Some species distributed in Azerbaijan had revolute needle-shaped teeth like: Assadi and Olfat 68668; Assadi and Shahsavari 65827. Some specimens had lanceolate and oval teeth while they were not revolute as: Amini 1772; Zehzad 3672; Assadi and Amini 13551. Some had oval revolute teeth like Mozaffarian and Mohamadi 37538. Some had needle-shaped both revolute and flat teeth in one sheet like Assadi and Shahsavari 65836. And this one had needle-shaped flat teeth: Jamzad, Zehzad, Taheri and Izadpanah 70336. Among Tehran distributed specimens, some had oval and lanceolate and revolute teeth like Ghaffari 165\64; Ghaffari 161\64; Amin and Bazargan 19654. and some were observed to have triangular-needle-shaped flat teeth like Babakhanlou, Amin and Bazargan 2440. Analysis resulted from this study suggests that the beak of calyx teeth which is the elongation of midribs itself, some times become thick and revolute that makes the teeth also revolute out along with itself. So the instances in which teeth seems to be needle-shaped, actually it is the beak that is observed and the revolution has caused the oval part to be hidden inside the calyx. These specimens are expressive of this theory and show the gradual and continuous variation: Amin and Bazargan 1992; Mozaffarian 54218 from Tehran and Mozaffarian and Mohamadi 37538; Assadi and Shahsavari 65827 from Azerbaijan. As a whole, character variation of the two species do not fit with the geographical distribution of the two species and also exhibits a continuous variation, partly is due to the age of the specimens. Therefore, the two species are regarded as synonymous.

4. A. verticillatum (Willd) Hand.-Mzt., Ann. Nat. Hofmus. Wien 26: 152 (1912).

Syn.: *Arenaria verticillata* Willd., Spec. Plant. Ed. 4, 2:275 (1799); *Acanthophyllum mucronatum* Fenzl, Ann. Wiener Mus. Naturgesch. 1: 37 (1836) non C. A. Mey.; *A. tournefortii* Fenzl, l.c.: 2: 310 (1840).

Plant upright. Stem and leaves covered with hairs and hardly glandular. Leaves triangular at cross section. Calyx teeth triangular or lanceolate. Petals sinuate at the tips and 0.75 to 1.5 mm broad.

Selected specimens seen. **Azerbaijan:** north of Orumieh lake, 1700 m, Assadi, Taheri and Izadpanah 68464. - **Kordestan:** Sanandaj, Cheno village, 1750 m, Fattahi and Khaledian 191. - **Tehran:** Kaboudan, 9 km northwest of Tafresh, 1950 m, Amin and Bazargan 18762.

Distribution. Turkey, Iran and Iraq, type specimen from Turkey.

5. A. acerosum Sosn., Monit. Jard. Bot. Tiflis 11: 7 (1915).

Syn.: *A. confertiflorum* Rech. f. Anz. Math. -Nat. Kl. Osterr. Akad. Wiss. 98: 10 (1961).

Plant cushion-like. Stem and leaves covered densely with hairs. Leaves circular or semicircular at cross section. Calyx teeth unequal, oval or lanceolate, mucronate at the tips. Petals obtuse or sinuate-emarginated and 1 to 1.8 mm.

Selected specimens seen. **Azerbaijan:** 48 km from Tabriz to Marand road, 1580 m, Seraj 24701; 9 km from Mahabad to Sardasht road, 1700 m, Babakhanlou 31023.

Distribution. East of Turkey, northeast of Iraq, northwest of Iran, type specimen from Turkey.

III. Sect. *Pleiosperma* Boiss.

On basis of this research, this section is consisted of cushion-like or raised plants. Leaves with triangular cross section. Inflorescence short and placed at the tip of stems; floral leaves and bracts lanceolate. Middle flowers lack bracteole. Calyx from 5.5 to 12 mm long. Petals 1.5 to 6 mm and exserted out of calyx. Ovary including 6-16 and rarely 18-21 ovules.

1. Inflorescence dense and hard. Floral leaves acute and exserted out of inflorescence. Bracts thick and cartilaginous, covered with long hairs or glandular. Calyx teeth lanceolate 8. **A. sordidum** Bunge ex Boiss. - Inflorescence dense. Flower leaves attenuate at the tips and not sprouted out of inflorescence. Bracts soft and covered with hairs or hairs with glands. Calyx teeth triangular 2

2. Stem thick and bone-colored. Leaves up to 30 mm long, glabrous, ciliate at margins and at the internal surface. Bracts light green 6. **A. spinosum** (Desf.) C. A. Mey.

- Stem diverse in size and straw-colored. Leaves up to 40 mm long, hairy or glandular or mixed cover, dense or sparse. Bracts dark green and sometimes purple at some parts 7. **A. glandulosum** Bunge ex Boiss.

6. **A. spinosum** (Desf.) C. A. Mey., Verz. Pfl. Cauc. 210 (1831).

Syn.: *Dianthus spinosus* Desf., Ann. Mus. Hist. Nat. 1: 198 (1802); *Acanthophyllum fontanesii* Boiss., Diagn. Pl. Or. Nov. Ser. 1,1: 41 (1843); *A. fontanesii* Boiss. var. *genuinum* Bornm., Beih. Bot. Centrbl. 28.2: 138 (1911) f. *tenuispinum* Bornm., l.c.

Plant cushion-like and short. Stem thick, bone-colored, usually not hairy or covered with very short hairs. Inflorescence rather loose. Floral leaves attenuate at tip and not exserted out of inflorescence. Bracts soft, covered with hairs or hairs mixed with glands. Calyx teeth triangular.

Selected specimens seen. **Esfahan:** Kashan, between Ghamsar and Rezaabad, 2450 m, Assadi, Jamzad and Azizian 80051. - **Yazd:** Shirkuh, Deh-e bala, 1650 m, Foroughi 3899. - **Kerman:** Jebal-barez mountains, 5 km north of Deh-bakri, 40 km west of Bam, 2100 m, Assadi, Edmondson and Miler 1987. - **Baluchestan:** Taftan mountains region, Tamendan valley, 2300 - 2500 m, Mozaffarian 53137.

Distribution. Iran and Afghanistan.

7. **A. glandulosum** Bunge ex Boiss., Fl. Or. 1: 565 (1867).

Syn.: *A. fontanesii* Boiss. & Buhse, Nouv. Mem. Soc. Nat. Mosc. 12: 39 (1860) non Boiss. (1843); *A. glandulosum* var. *roseum* Bornm., ex Freyn et var. *tomentellum* Freyn, Bull. Herb. Boiss. Ser. 2,3: 871 (1903); *A. fontanesii* Boiss. & Buhse var. *glandulosum* (Bunge ex Boiss.) Bornm. forma *alpinum* Bornm., l. c. 28: 138 (1911); *A. crassinodum* Yukhan. & Edmondson, Iran. Journ. Bot. 1, 2: 109 (1977), **syn. nov.**; *A. chloroleucum* Rech. f. & Aell., Bot. Jahrb. 75:360 (1951), **syn. nov.**

Plants cushion-forming, usually sticky glandular. Inflorescence rather loose. Floral leaves attenuate and not exserted out of the inflorescence. Bracts soft, hairy or glandular hairy. Calyx teeth triangular.

Selected specimens seen. **Gorgan:** Golestan, Almeh, 1700 m, Wendelbo and Cobham 14215; Golestan forest, Almeh, 1750 m, Rowshan 7767. - **Esfahan:** Ghameshloo Protected Area, Sangab, 2200 m, Yosofi 1576. - **Yazd:** Deh-bala, Shirkuh mountain, 2700 m, Foroughi and Assadi 17924. - **Kohgiluyeh-Boirahmad:** Gachsaran, 3100 m, Mehregan 83126. - **Fars:** 20 km from Estahbanat to Niriz, S of Daryach-e Bachtegan 1750 m, Mozaffarian 47121. - **Kerman:** Southern slope of Khabr mount, about 3000 m, Assadi

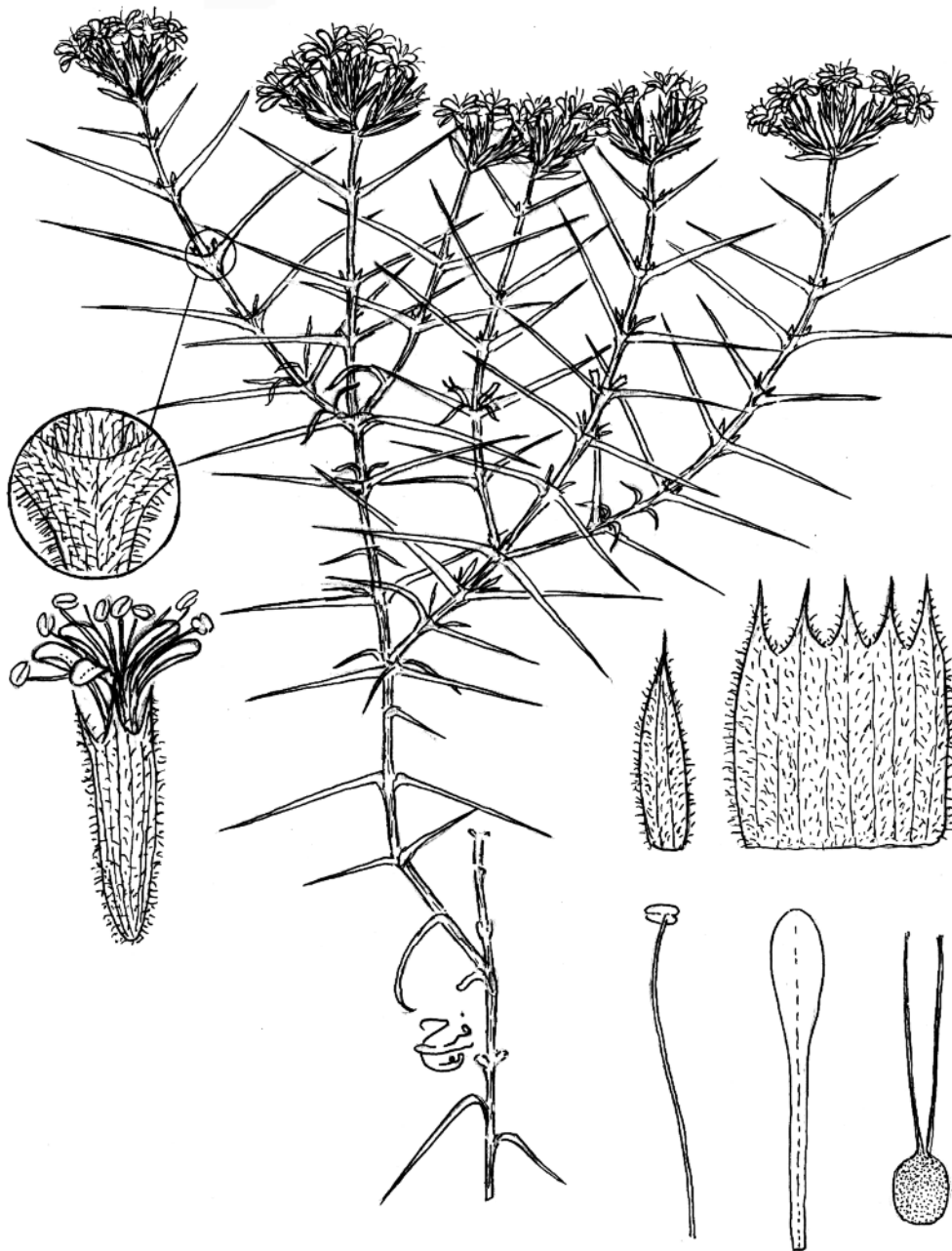


Fig. 3. *Acanthophyllum spinosum* ($\times 1$); details ($\times 5$).

and Miller 25173. - **Baluchestan:** Sangan, eastern slopes of Taftan mount, 2300 - 2900 m, Mozaffarian 53260. - **Khorasan:** Dargaz, Alahoakbar mountains, 1650 m, Ayatollahi and Zangouei 15516. - **Tehran:** 7 km north of Firuzkuh, 1900 m, Babakhanlou, Amin and Bazargan 2111.

Distribution. Iran, Middle East and Afghanistan, Type specimen from Iran (Mazandaran).

Observations resulted from this study, suggests that *A. glandulosum*, *A. crassinodum* and *A. chloroleucum* are synonymous. *A. crassinodum* which has been collected and introduced from northeast of Iran and Kopedagh Mountains (Yukhananov & Edmonson 1977; Joharchi & Akhiani, 2006), has been said to be similar to *A. glandulosum* with only one difference and that is, its stems being large and having fewer branches

at base and swollen clearly at the nodes. Leaves are longer and they may reach to 5 cm in length but in *A. glandulosum* leaves said to be up to 3 cm long and it is mentioned that the petals are twice in length than the calyx and in *A. crassinodum* ovary contains 12 ovules. The last two characters were also evident in *A. glandulosum* specimens. On the basis of observations, all the mentioned characters show a continuous and gradual variation and on the other hand there is no special correlation between the mentioned diverse forms. The specimens are collected from Shirvan, Bojnord, Esfarayen which grew very near to the type specimen and had the mentioned characters for *A. crassinodum* are: Memariyani and Zangouei 40698; Memariyani and Zangouei 41042. These specimens show specific characters of *A. glandulosum*: Faghiheniya and Zangouei 18887; Wendelbo and Foroughi 12882; Assadi and Miller 25059; Assadi and Foroughi 17924. These specimens are intermediate forms: Joharchi and Zangouei 29662; Memariyani and Zangouei 41014; Assadi 83162. Therefore, these characters are not enough to separate two taxa as distinct species.

A. chloroleucum was introduced from Hezar-masjed mountains of Khorasan and its distinctive characters from *A. glandulosum* are: calyx midribs area being clear, ovary including 8 ovules, current year branches more than 10 cm long and leaves more than 12 mm long. Mentioned characters are the same as *A. glandulosum*: hardly having 8 ovules, current year branches being at most 10 cm long and leaves at most 25 mm long. On the basis of observations, all the mentioned characters show a continuous and gradual variation and on the other hand there is no special correlation between the mentioned diverse forms. Therefore, these two species are regarded as synonymous in this article. For instance, among mentioned specimens, these specimens possess specific characters of *A. chloroleucum*: Zangouei and Arjmandi 39288; Zangouei 31640; Faghiheniya and Zangouei 22461. These had *A. glandulosum* specific characters: Mozaffarian 54267; Riazi 3914; Wendelbo and Foroughi 12756. These specimens show gradual variation between *A. glandulosum* and *A. chloroleucum*: Mashad University Herbarium 10457; Memariyani and Zangouei 38399; Zangouei 35020. This specimen shows gradual variation between *A. chloroleucum* and *A. crassinodum*: Faghihnia and Zangouei 24341.

8. **A. sordidum** Bunge ex Boiss., Fl. Or. 1: 565 (1867). Syn.: *A. sordidum* Bunge ex Boiss. var. *pruinatum* Boiss., l. c.: 566. *A. sordidum* var. *adenocalyx* Bornm., Beih. Bot. Centrbl. 28,2: 138 (1911); *A. viscidum*

Frey, Bull. Herb. Boissier Ser. 2, 3: 869 (1903); *A. spinidens* Freyn, l. c.: 870.

Plants cushion-forming, hairy or glandular or both. Inflorescence hard. Floral leaves attenuate and exerted out of inflorescence. Bracts thick and cartilaginous, covered with long hairs and sinuate or glandular. Calyx teeth lanceolate.

Selected specimens seen. **Esfahan:** 7 km to Natanz, at the pass, 1793 m, Assadi and Ranjbar 82771. - **Kerman:** Sadou mountains, Mozaffarian 80. - **Khorasan:** east of Esfarayen, 23 km passed in Arghan road, Mashhad Ferdowsi University Herbarium 11493. - **Semnan:** 62 km E. of Shahrud on the road Sabzevar, 1300 m, Assadi and Maasoumi 21211. - **Tehran:** Chitgar, 1450 m, Riazi 2037; Qom, 60 km toward Tehran, Ghaffari 24.65.

Distribution. Iran, Middle East, Afghanistan, Pakistan, type specimen from Iran (Khorasan).

IV. Sect. *Oligosperma* Schischk.

On basis of this research, this section including cushion plants with only one raised species. Leaves lanceolate but ovate-lanceolate in only one species. Inflorescence very short and dense. Lateral leaves own two bracteoles. Floral leaves, bracts and bracteoles subulate. Calyx 4-12 mm long. Ovary containing 4 ovules.

Key to the species

1. Plant high, raised. Leaves always shorter than the internodes, ovate-subulate or lanceolate
 9. **A. elatius** Bunge ex Boiss.
 - Plants cushion, leaves usually longer than internodes or rarely shorter, lanceolate 2
 - 2. Glandular hairs present 3
 - Glandular hairs not present 8
 3. Flowers large. Petals longer than 16 mm
 19. **A. speciosum** Rech. f. & Schiman-Czeika
 - Flowers small. Petals up to 16 mm long 4
 4. Flowers very dense. Branches very small. Leaves and internodes very short (usually less than 10 mm), covering each other. Inflorescence hidden
 21. **A. caespitosum** Boiss.
 - Plants less dense. Branches long. Leaves and internodes comparatively longer. Inflorescence obvious 5
 5. Hairs only glandular and short
 20. **A. korshinskyi** Schischk.
 - Hairs simple or a mixture of simple and long glandular or approximately hairless 6
 6. Calyx more than 8 mm long
 18. **A. adenophorum** Freyn
 - Calyx up to 8 mm long 7

7. Bracts shorter or at most as long as calyx
 16. **A. pachystegium** Rech. f.
 - Bracts longer than calyx 17. **A. lilacinum** Schischk.
 8. Plants approximately hairless
 10. **A. stocksianum** Boiss.
 - Plants hairy 9
 9. Calyx longer than 8 mm 10
 - Calyx up to 8 mm long 11
 10. Internodes more than 20 mm long
 12. **A. andersenii** Rech. f. & Schiman-Czeika
 - Internodes up to 20 mm long
 14. **A. diezianum** Hand.-Mzt.
 11. Bracts shorter than 7 mm long
 15. **A. brevibracteatum** Lipsky
 - Bracts 7 mm long or more 12
 12. Hairs simple, short and sparse
 13. **A. squarrosom** Boiss.
 - Hairs simple, long, multicellular and very dense
 11. **A. laxiusculum** Schiman-Czeika

9. **A. elatius** Bunge ex Boiss, Fl. Or. 1: 561 (1867).
 Syn.: *A. borsczowii* Litw, Trav. Mus. Bot. Acad. Sci. Imp. Petersburg. 7:71 (1910), **syn nov**.
 Plant raised, 30 to 100 cm high, hairless on stem but leaves and inflorescence covered with very few short hairs. Current year stems up to 40 cm long. Leaves ovate-lanceolate or lanceolate, 1.5 to 5 mm broad.
Selected specimens seen. **Khorasan:** between Abbasabad and Sabzevar, Bazargan and Rejamand, 32453. - **Semnan:** 110 km from Sabzevar to Shahrud, Ghaffari, 84/66.
Distribution. East of Iran, Afghanistan, Turkamanestan, Tajikestan.

Type specimen of *A. elatius* is from Iran and type specimen of *A. borsczowii* is from Kazakhst. These two species have been separated by their different leaf shapes. In *A. elatius* leaves are ovate-lanceolate while in *A. borsczowii* leaves are linear-lanceolate in references. However, both ovate-lanceolate and linear-lanceolate leaves were observed in specimens collected from *A. elatius* type specimen area. Henceforth records of *A. borsczowii* in Iran should be referred to *A. elatius*. These two species should be required to be considered as synonymous.

10. **A. stocksianum** Boiss., Diagn. Pl. Or. Nov. Ser. 2, 1: 81 (1854).
 Syn.: *A. heterophyllum* Rech. f., Osterr. Bot. Zeitschr. 104: 173 (1957), **syn nov**; *A. squarrosom* Boiss var: *glaberrimum* Bung, Fl. Or. 1: 562 (1867).
 Plants cushion-forming. Stem and leaves hairless or covered with short hairs and inflorescence covered with a few short hairs. Leaves lanceolate.

Selected specimens seen. **Fars:** 33 km after Lar to Bastak, southeastern mountains of Hormood village, 800 to 1100 m, Assadi and Sardabi 41814. - **Baluchestan:** 120 km from Zahedan toward Bam, just after Nosratabad, 1200 m, Assadi 22762.

Distribution. Iran, Afghanistan and Pakistan.
A. stocksianum and *A. heterophyllum* have been separated according to presence or absence of hairs. *A. stocksianum* is hairless while *A. heterophyllum* has simple, short and sparse hairs. However, these two species are regarded as synonymous in Iran because *A. stocksianum* specimens were not completely hairless and very few simple and short hairs were observed at their inflorescence. In addition, there were two specimens on one herbarium sheet numbered 22911 (TARI), both belonging to one single population but one of them was hairy while the other was hairless and glabrous. Therefore, this can propose that these two species are synonymous and *A. heterophyllum* has been based on the hairy specimens of *A. stocksianum*. Same way, *A. squarrosom* var. *glaberrimum* is a synonymy of *A. stocksianum*. This variety also had very few simple and short hairs on the inflorescence and its stem and leaves were closely hairless. Worthwhile, to mention that in Caryophyllaceae species in Iran, many species bear glabrous and hairy forms therefore it is not recommended to raise taxonomic ranks in these cases (Assadi, 1985).

11. **A. laxiusculum** Schiman-Czeika, Bull. Jard. Bot. Nat. Belgique 55: 117 (1985).
 Syn.: *A. heratense* Schiman-Czeika, Bull. Jard. Bot. Nat. Belgique 55: 117 (1985), **syn nov**.
 Plants cushion-forming, densely hairy with long multicellular hairs. Leaves lanceolate.
Selected specimens seen. **Azerbaijan:** Tabriz, 1500 m, Kiyayi, 6121.- **Esfahan:** 20 km from Ardestan to Taleghan, 1700 m, Foroughi and Wendelbo 11498.- **Yazd:** Mehriz to Khvormiz, 1600 m, Aryavand 1538.- **Kerman:** 7 km from Baft to Khabr, 2550 m, Assadi and Miller 25097.- **Baluchestan:** Khash toward Zadehan road, 100 km to Zahedan, 1900 m, Masoumi and Valizade, 1220.- **Khorasan:** Torbat-e-Heydariyeh to Mashhad, 1800 m, Ghahraman and Attar 21801.- **Tehran:** between Tehran and Karaj, 1200 m, Ghahraman 6120.
Distribution. Iran, Afghanistan and Turkmenistan.

Type specimens of *A. laxiusculum* are from Iran and type specimens of *A. heratense* are from Afghanistan. These two species have been separated on basis of internodes length, bracts length, tip shape of petal and current year branches length. However, these two species are synonyms in Iran due to some samples in which intermediate states were observed. Here is the

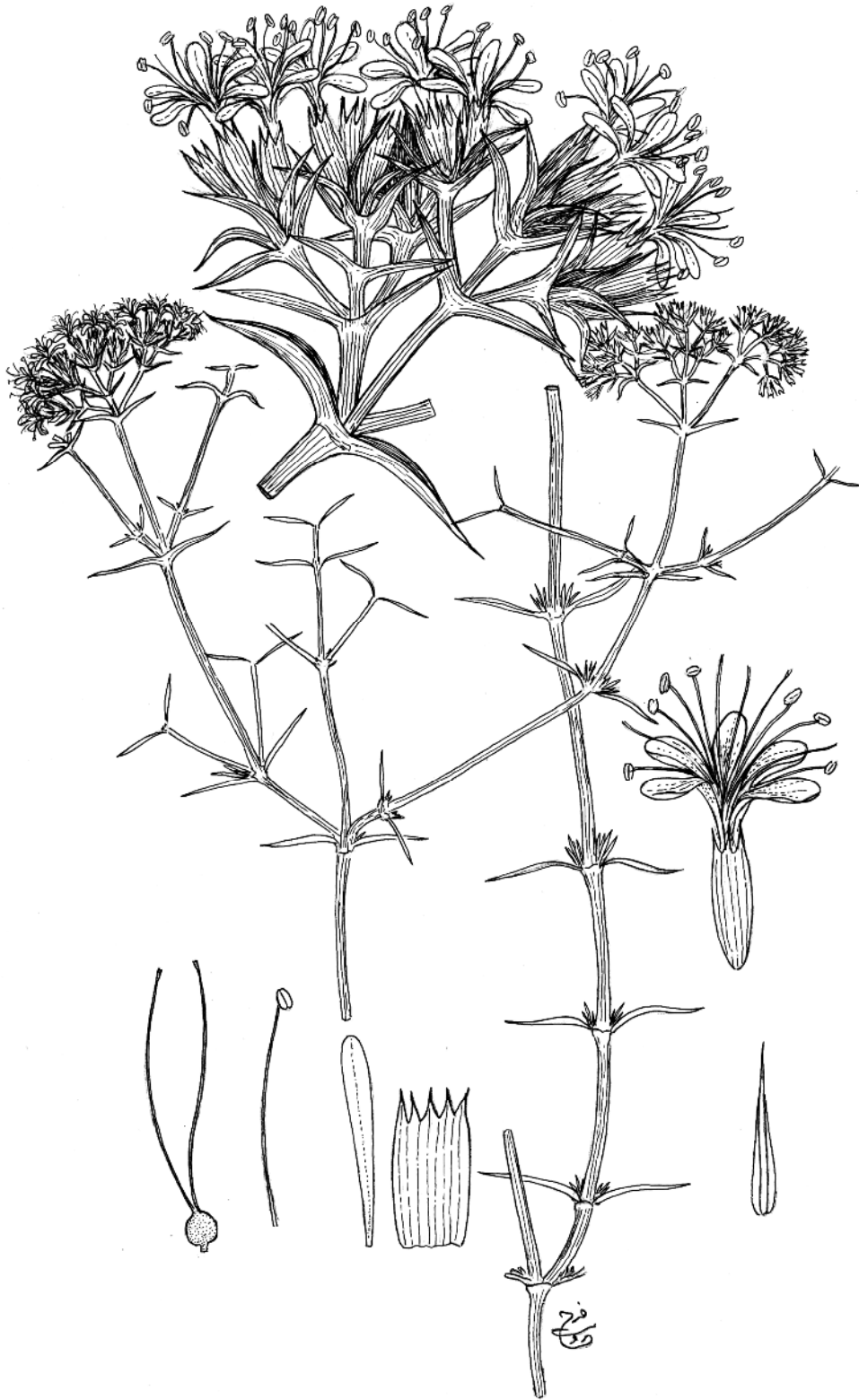


Fig. 4. *Acanthophyllum elatius* ($\times 0.66$); details ($\times 3.6$).

list and herbarium numbers of some specimens with intermediate state: Amin and Bazargan 2066(TARI), Amin and Bazargan 19328 (TARI), 1569 Yosofi (TARI), 17101 Arazm and Dini (TARI), Arazm and Dini 2434 (TARI), 2350 Foroughian and Hariri(TARI) and Mozaffarian 77455 (TARI).

12. **A. andersenii** Rech. f. & Schiman-Czeika, Flora Iranica. 163: 301, 302 (1988).

Plants cushion-forming, covered with short hairs. Hairs longer and denser on inflorescence. Leaves lanceolate. Internodes 20-40 mm long. Calyx more than 8 mm long.

No specimen seen.

Distribution. Iran.

13. **A. squarrosus** Boiss., Diagn. Pl. Or. Nov. Ser. 2, 1: 81 (1854).

Plants cushion-forming, covered with short and soft hairs. Leaves lanceolate. Petals usually acute and sometimes emarginated, mostly white and sometimes pink at base.

Selected specimens seen. **Azerbaijan:** Zanjan to Bijar road, 1420 m, Assadi and Shirdelpur 12278.- **Esfahan:** Ghameshlou protect region, Sangab, 2200 m, Yoosefi 1481.- **Yazd:** Darreh Bid, 30 km from Mehriz to Bakh, 2000 m, Edmondson and Miller 1545.- **Chaharmahal-Bakhtiari:** Farrokhsahr, Tang-e Sayad Reserve, 2200 m, Mozaffarian 57464. – **Fars:** Bamu Reserve, Tang-e Chahmahaki, 1900 m, Foroughi 17705. – **Kerman:** Hezar mount, Assadi and Foroughi 16226.- **Baluchestan:** Taftan mount, Kharestan area, 2200 m, Mozaffarian 52996.- **Khorasan:** Parvand mountains, 1000 m, Faghihnia and Zangooyi 32465. - **Tehran:** between Ghom and Arak, 1500 m, Ghahraman 6123.

Distribution. Iran, Afghanistan and Pakistan.

14. **A. diezianum** Hand.-Mzt., Verh. Zool. Bot. Ges. 72: 31(1922).

Plant cushion forming, covered with long hairs. Leaves lanceolate. Internodes 2 to 10 mm long. Calyx longer than 8 mm.

Selected specimens seen. **Khorasan:** 60 km north of Torbat-e Heydariyeh, Robotsefid, 1750 to 1900 m, Assadi and Mozaffarian 35885.

Distribution. Iran and Afghanistan.

15. **A. brevibracteatum** Lipsky, Mem. Soc. Nat. Kiew. 11, 2: 6 (1891).

Plant cushion, covered with dense and rather long hairs. Leaves lanceolate. Bracts less than 7 mm long. Calyx less than 8 mm long.

Selected specimens seen. **Gorgan::** Azadshahr to Shahrud, south of Khush-Yailagh mountains, 1800 m, Foroughi and Wendelbo 12880. - Azerbaijan: 50 to 60 km from Miyaneh to Zanjan, 1200 m, Assadi and Wendelbo 28028. - **Yazd:** Mehriz, 1700 m, Aryavand, Edmondson and Miller 1483.- **Khorasan:** between Gonabad and Ferdows, 1800 m, Joharchi and Zangooyi 23405.- **Tehran:** 113 km from Tehran toward Saveh, 1450 m, Assadi and Shirdelpur 13126.

Distribution. Iran and Turkmenistan.

16. **A. pachystegium** Rech. f., Osterr. Bot. Zeitschr. 104: 173 (1957).

Plant cushion forming with simple and short or long glandular hairs. Leaves lanceolate. Bracts shorter or up to the length of calyx. Calyx up to 8 mm long.

Selected specimen seen. **Khorasan:** northeast of Neyshabur, 1600 to 1900 m, Assadi and Mozaffarian 36076.

Distribution. Iran, Turkmenistan and Afghanistan.

17. **A. lilacinum** Schischk., Fl. URSS. 6:787 (1936).

Plant cushion forming, covered with short hairs mixed with short glandular hairs. Leaves lanceolate. Bracts longer than calyx. Calyx up to 8 mm long.

Selected specimens seen. **Gorgan:** Almesh, 1750 m, Foroughi and Wendelbo 12676.- **Khorasan:** Quchan to Darreh Gaz Road, Inche-kikankoo, 1500 m, Ghaffari 4638.

Distribution. Iran, Turkmenistan and Afghanistan.

18. **A. adenophorum** Freyn, Bull. Herb. Boissier Ser. 2, 3: 867 (1903).

Plant cushion, covered with short hairs mixed with short or sometimes long glandular hairs. Leaves lanceolate. Calyx more than 8 mm long.

Selected specimens seen. **Gorgan:** Azadshahr to Shahrud, 1250 m, Foroughi and Wendelbo 12858. - **Khorasan:** north of Mashhad, Kalat-e-Naderi, 1850 m, Assadi and Masoumi 21381; Kalat-Naderi, at the beginning of Geroo road, Izadi 36220.

Distribution. Iran, Turkmenistan and Tajikistan.

The specimen Izadi 36220 (FUMH) was named as *A. stenostegium* Freyn and recorded as a new to Iran (Joharchi & Akhani, 2006) was studied. The identification is not confirmed and the specimen is cited as *A. adenophorum* in this paper.

19. **A. speciosum** Rech. f. & Schiman-Czeika, Fl. Iranica no. 163: 314 (1988).

Plant cushion, covered with long glandular hairs. Leaves lanceolate. Petals more than 16 mm long.

Selected specimen seen. **Khorasan:** Mashhad, northeast of Kalat-e-Naderi, 1200 m, Faghiniha and Zangooyi 24041.

Distribution. Iran and Turkmenistan.

20. **A. korshinskyi** Schischk., Trav. Mus. Bot. Acad. Sci. URSS. 24; 39 (1932).

Plant cushion, covered with very short glandular hairs, leaves lanceolate.

Selected specimen seen. **Khorasan:** Mashhad to Neyshabur, 1200 m, Assadi and Mozaffarian 35950. -

Semnan: Tooran Reserve, 900 m, Jadidi and Freitag 28973.

Distribution. Iran, Afghanistan and Turkmenistan.

21. **A. caespitosum** Boiss., Diagn. Pl. Or. Nov. Ser. 1,1: 42(1843).

Plant cushion, dense, covered with short hairs mixed with short glandular hairs. Leaves lanceolate and imbricate, leaves and internodes very short (less than 10 mm). Inflorescence unclear. Petals clearly emarginated (deep pits).

Selected specimens seen. **Kordestan:** Sanandaj, Cheno village, 1750 m, Fatahi and Khaledian 190. -

Hamadan: Asadabad mountains, 2000 m, Shams 13974. **-Kermanshah:** Kenesht canyon, 1500 to 1900 m, Hamzei and Asri 87785.

Distribution. Iran and Iraq.

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