

ALLIUM L. SUBGEN. RHIZIRIDEUM SENSU LATO IN IRAN, TWO NEW RECORDS AND A SYNOPSIS OF TAXONOMY AND PHYTOGEOGRAPHY

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Based on botanical collections from NE Iran (Khorassan), two new rhizomatous *Allium* species are reported for the flora of Iran: *A. barsczewskii* Lipsky and *A. tenuicaule* Regel. A taxonomic review of all rhizomatous *Allium* species occurring in Iran is provided based on new intrageneric classification of the genus. Supplementary data and notes on geographical distribution of most species are given. An identification key and some distribution maps are provided for the Iranian rhizomatous species.

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Key words. *Allium*, *Rhizirideum*, new record, Khorassan, Iran.

گیاهان ریزوم دار جنس *Allium* L. در ایران: گزارش دو گونه جدید برای ایران و مروری بر رده‌بندی و جغرافیای گیاهی

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دو گونه ریزوم دار *A. barsczewskii* Lipsky و *A. tenuicaule* Regel به عنوان گونه‌های جدیدی برای فلور ایران از شمال شرق کشور (خراسان) گزارش می‌شوند. بر اساس جدیدترین طبقه‌بندی درون جنس *Allium*، موقعیت تاکسونومیکی تمام گونه‌های ریزوم‌دار این جنس در ایران مورد بازنگری قرار گرفته است و نقشه‌های پراکنش جغرافیایی و کلید شناسایی آنها به کمک اطلاعات تکمیلی از شمال شرق کشور ارائه می‌گردد.

INTRODUCTION

Allium L., an extremely polymorphous and taxonomically complicated genus, comprises approximately 750 species widely distributed over the holarctics from dry subtropics to boreal zone (Fritsch & Friesen 2002, Fritsch *et al.* 2001). It has a main centre of diversity in the mountainous areas of south-western and Middle Asia where widely distributed taxa as well as local endemics occur, and a second smaller one in North America (Friesen *et al.* 2006). Most of the species are hemicryptophytes or geophytes which are specially adapted to different environments by means of bulbous or rhizomatous storage organs (Cheremushkina 1992).

All rhizomatous species with basic chromosome number of 8 share many characters and, irrespective of

the different phylogenetic characters, have been included in the classical subgenus *Rhizirideum* sensu lato. It is the second largest group after subgen. *Allium* with about 210 species distributed mostly in Eurasia while a few species occur in temperate northeastern and subarctic regions of America (Hanelt *et al.* 1992, Fritsch & Friesen 2002).

In this paper, two species of rhizomatous *Alliums* are newly recorded for the flora of Iran based on botanical collections from NE Iran (Khorassan) preserved in Ferdowsi University Herbarium (FUMH). The identity of the reported species has been checked by the third author. A taxonomic review of Iranian *Allium* species included in subgenus *Rhizirideum* s. l. with its recent classification based on molecular data and an identification key to all these species are given here. Supplementary data and notes on their

Table 1. Comparison of morphological characters in *Allium barsczewskii* and *A. xiphopetalum*.

Habit \ Species	<i>A. barsczewskii</i>	<i>A. xiphopetalum</i>
Leaves	± canaliculate, 1-3 mm wide	flat, falcate, 3-5 (-10) mm wide
Umbel	commonly many-flowered	densely few-flowered
Pedicels	unequal, ebracteolate	subequal, usually bracteolate
Perianth	pale rose or rosy-violet, white	rosy-violet
Anthers	yellow	mostly violet

geographical distribution have been provided including some distribution maps mainly based on herbarium records in FUMH and Middle Asia, and also in Flora Iranica (Wendelbo 1971), Flora of Iraq (Wendelbo 1985) and Flora of Turkey (Davis 1984).

NEW RECORDS FOR IRAN

Allium barsczewskii Lipsky

Khorassan: SW Bojnord, Salook Mts., 2400 m, Zangoeei & Hosseinzade, 24473 (FUMH); SW Mashhad, 12 km from Majd to Binalood, 2250 m, Joharchi & Zangoeei, 22008 (FUMH); N Mashhad, 50 km towards Kalat, 1250 m, Faghihnia & Zangoeei, 23998 (FUMH); Kalat, Khesht Mts., 1500 m, Faghihnia & Zangoeei, 29018 (FUMH); Mashhad towards Sarakhs, Ghorghore Mts., 1000 m, Joharchi & Zangoeei, 21949 (FUMH); S Fariman, mountains around the Fariman Dam, 1500m, Zokaei, 882 (FUMH); NE Neyshabur, Binalood Mts., on the slopes facing to Fereizi, 2500 m, Rafeie & Zangoeei, 26072A (FUMH); E Neyshabur, Kharve Bala, 1650-1750 m, Rafeie & Zangoeei, 27005 (FUMH).

This species (Fig. 1), incorrectly spelled as *A. barszczewskii* (Gregory *et al.* 1998), was recorded by Wendelbo (1971) in Flora Iranica from Afghanistan and Pakistan with general distribution in Hindukush, Pamir - Alai and Tien Shan. According to the descriptions given in Flora Iranica (Wendelbo 1971) and Flora of USSR (Vvedensky 1968), the most important distinguishing features of this species from closely related *A. xiphopetalum* Aitch. & Baker are yellow anthers not violet ones, and the leaves which are more or less canaliculate not flat. In herbarium materials, comparison of a combination of characters in table 1 can be helpful.

Allium tenuicaule Regel

Khorassan: SW Mashhad, Moghan mountains, 2500 m, Joharchi, 33666 (FUMH); NE Neyshabur, Binalood Mts., on the slopes facing to Fereizi, 2500 m, Rafeie & Zangoeei, 26072B (FUMH).

In Flora Iranica, Wendelbo (1971) reported this species from Afghanistan & Pakistan with general

distribution in Hindukush and Pamir - Alai mountains. This species can be easily distinguished from *A. barszczewskii* and *A. xiphopetalum* with its characteristic ovary apex crowned around the style base, and its shorter scapes and rhizomes with 10 - 20 (-30) cm and 1 - 2 cm long, respectively (Fig. 2).

NOTES ON TAXONOMY AND PHYTOGEOGRAPHY

The low number of recognizable characters in dried herbarium specimens presents difficulty in *Allium* taxonomy because it does not reveal any gross morphological derivative characters among intrageneric groups (Fritsch *et al.* 2002).

Wendelbo (1969) reported subgen. *Rhizirideum* (Koch) Wendelbo, as a new combination and status and in his treatment in Flora Iranica recorded only three sections for it: *Rhizirideum*, *Schoenoprasum* and *Cepa*. Fritsch (1992) reported that sections *Campanulata*, *Oreiprasum*, *Petroprason* and *Reticulato-Bulbosa* form a peculiar group within the subgenus based on general similarities of their excretory canals. Hanelt *et al.* (1992) explicitly regarded subgen. *Rhizirideum* s. l. as a polyphyletic assemblage of different phylogenetic lines. Dubouzet *et al.* (1997) proposed the first molecular phylogeny of subgen. *Rhizirideum* s. l. based on nuclear DNA markers. In the most recent intrageneric classification of genus *Allium*, Friesen *et al.* (2006) have split this polyphyletic subgenus into six new subgenera and created morphologically relatively homogenous groups. The presence of visible rhizome was the key character of the former subgen. *Rhizirideum*. The phylogenetic analysis by Friesen *et al.* (2006) indicates that rhizomes independently evolved several times in the groups of the former subgen. *Rhizirideum*. Their newly defined sections are also monomorphic with regard to the bulb tunics, thus avoiding contradicting character distribution in the former subgenus.

According to the recent classification, all rhizomatous *Allium* species (subgen. *Rhizirideum* sensu lato) occurring in Iran (ten wild and one cultivated species) are divided into 3 new subgenera and 6 sections (table 2):



Fig. 1. *Allium barsczewskii* Lipsky

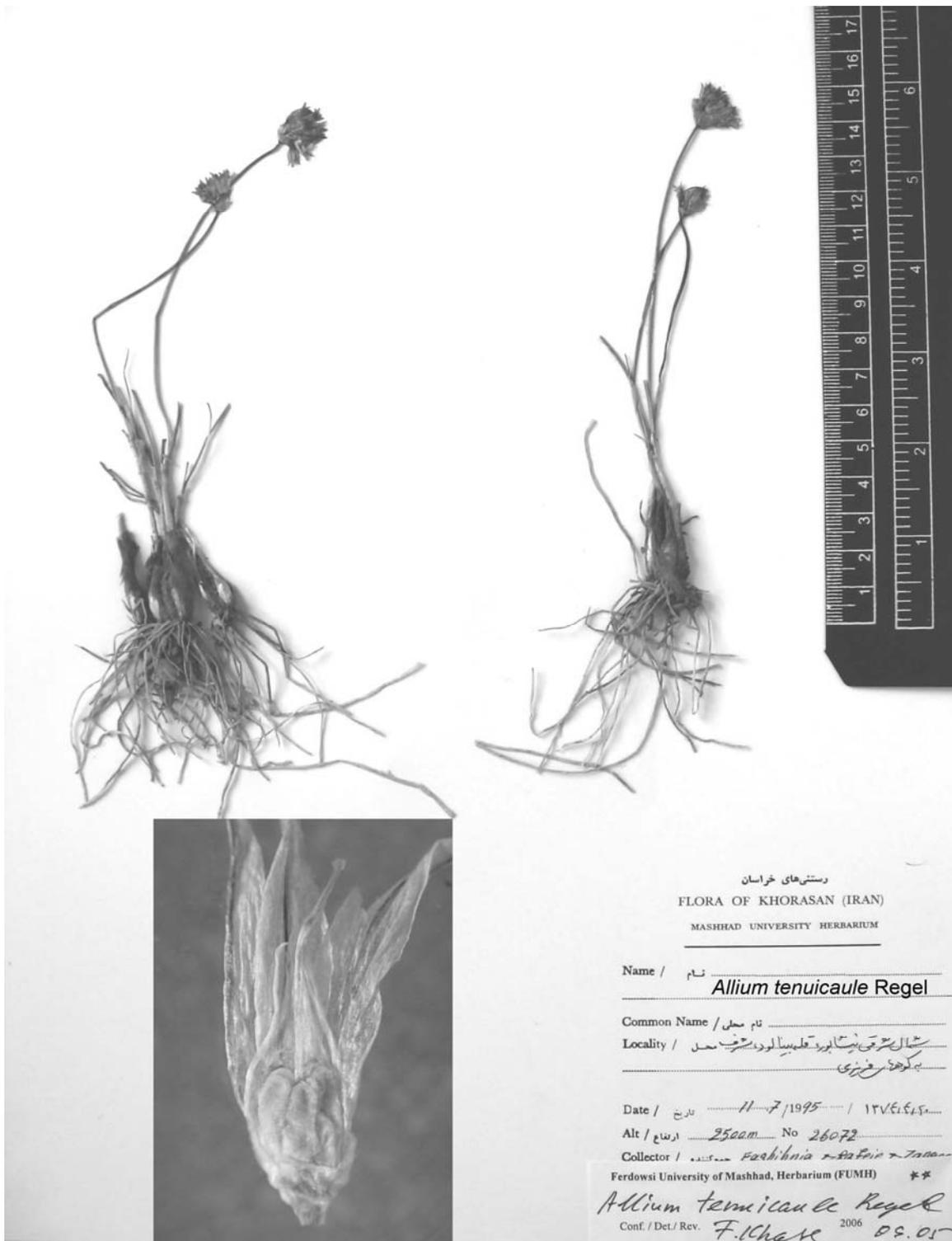


Fig. 2. *Allium tenuicaule* Regel , below picture shows ovary apex crowned around the style base.

1. Subgen. *Reticulobulbosa* (Kamelin) N. Friesen**1a. Sect. *Scabriscapa* (Tscholok.) N. Friesen**

A. scabriscapum Boiss. & Ky. is mainly distributed in montane and submontane areas of Alborz, Zagros and Khorassan-Koppet Dagh ranges and a few localities westward in E Anatolia, NE Iraq and Transcaucasia (Fig. 3a). *A. eriocoleum* Vved. is a very close species which grows in West Tien – Shan, but still they are separated.

1b. Sect. *Campanulata* Kamelin

The distribution range of *A. xiphopetalum* Aitch. & Baker stretches from Central Zagros and Alborz mountains to Khorassan-Koppeh dagh, Afghanistan and Pamir-Alai (Fig. 3b). New plant records of *A. barszczewskii* Lipsky and *A. tenuicaule* Regel from NE Iran in this paper extend the range of both species more westward specially for *A. barszczewskii* (Fig. 4).

A. tenuicaule is distinctly separated species and it grows in the high mountainous zone (higher than 2500 m) only. The group of *A. barszczewskii* (*A. jodanthum* Vved., *A. longiradiatum* Vved. and *A. lutescens* Vved.-endemics of West Tien-Shan) is highly complicated one. The main characters used by *Allium* taxonomists (form of the inflorescence, sizes of tepals and pedicles, color of anthers, form and width of the leaves) are variable. It could be very important to make DNA analysis of the above mentioned taxa in order to reveal the definition of the species level.

1c. Sect. *Reticulobulbosa* Kamelin s. str.

A. brachyodon Boiss. is an endemic species to SW Iran in mountains of Fars province (Fig. 5). The occurrence of this species in Koppeh dagh was doubted by Wendelbo (1971) because of certain differences in flower morphology between the Koppeh dagh plants and the type specimen from Fars province.

2. Subgen. *Polyprason* Radic´.**2a. Sect. *Falcatifolia* N. Friesen**

A. hymenorrhizum Ledeb. occurs in alpine zones of Damavand (Alborz) and north Afghanistan (Fig. 5) with general distribution in Central Asia and W Siberia (Wendelbo 1971, Vvedensky 1968).

3. Subgen. *Cepa* (Mill.) Radic´.**3a. Sect. *Schoenoprasum* Dumort.**

Ecologically, *A. schoenoprasum* L. is a mesophytic species inhabiting moist and marshy places and remarkably showing the most widespread and continuous holarctic distribution with smallest genome size in the genus *Allium* (Ohri *et al.* 1998). In Iran, it occurs in southern slopes of Central Alborz and alpine zones of Sahand and Sabalan Mts., NW Iran (Fig. 5).

3b. Sect. *Cepa* (Mill.) Prokh.

Members of Sect. *Cepa* show a tendency towards adaptation to dry conditions with xerophilic characters (Dubouzet *et al.* 1997, Ohri *et al.* 1998). Usually

axillary bulbs are developed on short rhizomes. A gradual reduction of rhizome can be seen within the section, leading finally to a flat, disc-like corm or basal plate of the common onion, *A. cepa* L. (Fritsch & Friesen 2002).

A. oschaninii O. Fedtsch. is distributed in Central Asia, Afghanistan and NE Iran, ecologically growing on scree slopes. Finding a population of this species in Golestan National Park extends its range of distribution much further westward (Fig. 6):

Khorassan: W Bojnord, eastern parts of Golestan National Park, Almeh, 1700 m, Rafeie & Zangooei, 29549 (FUMH).

A. vavilovii M. Pop. & Vved. is an endangered subendemic species of Central Koppeh dagh range in Turkmenistan and NE Iran. Akhiani (1999) reported this species for the first time in Iran from Golestan National Park. The second Iranian locality of this species was reported by Aydani (2004) from Aladagh mountains, Khorassan (Fig. 6):

Khorassan: W Bojnord, Darkesh, Piaz kuh (Allium Mt.), 35729 (FUMH).

Recently described *A. asarense* R. M. Fritsch & Matin is a local endemic in Central Alborz mountains (Karaj, Asara) where it grows on very steep scree and rocky slopes (Fig. 6). It is the second closest known relative of common onion (*A. cepa*) after *A. vavilovii* (Fritsch *et al.* 2001).

To conclude, *Allium* sect. *Campanulata* and *Allium* sect. *Cepa* are among rhizomatous species distributed in northeastern Iran and certain species of these two sections clearly show phylogeographical relationship of NE Iran and Middle Asia, like other many common species of these areas.

KEY TO RHIZOMATOUS *ALLIUM* SPECIES IN IRAN

1. Bulbs ovoid in mature; scape obviously inflated in lower half; leaves withering in anthesis; perianth stellate, greenish-white (Subgen. *Cepa*, Sect. *Cepa*) 2
2. Bulbs ± cylindrical; scape not inflated; leaves growing in anthesis; perianth broadly to narrowly campanulate or tubular, coloured or white with colored nerves, rarely white 5
2. Leaves somewhat angular-cylindrical, hollow, erect 3
- Leaves semi-cylindrical (flat above) or flat, solid, recurved 4
3. Scape slender above the inflated part; wild plants
A. oschaninii O. Fedtsch.
- Scape fairly thick above the inflated part; cultivated plants
A. cepa L.
4. Leaf blades flat; the visible sheath parts approximately much shorter than the diameter of the blades; basal parts of inner filaments triangular with small teeth
A. vavilovii M. Pop. & Vved.

Table 2. Classification and phytogeographical groups of rhizomatous *Allium* species in Iran.

Abbreviations: *Cam.*=*Campanulata*, *Cep.*=*Cepa*, *Fal.*=*Falcatifolia*, *Ore.*=*Oreiprason*, *Pol.*=*Polyprason*, *Ret.*=*Reticulatobulbosa*, *Rhi.*=*Rhizirideum*, *Sca.*=*Scabriscapa*, *Sch.*=*Schoenoprasum*

Species	Old classification ¹ Subgenus / Section	New classification ² Subgenus / Section	Chorotype ³
1. <i>A. scabriscapum</i> Boiss. & Ky.	<i>Rhi.</i> / <i>Cam.</i>	<i>Ret.</i> / <i>Sca.</i>	<i>IT</i> ^{W&C}
2. <i>A. xiphopetalum</i> Aitch. & Baker	<i>Rhi.</i> / <i>Cam.</i>	<i>Ret.</i> / <i>Cam.</i>	<i>IT</i> ^{C&E}
3. <i>A. barsczewskii</i> Lipsky	<i>Rhi.</i> / <i>Cam.</i>	<i>Ret.</i> / <i>Cam.</i>	<i>IT</i> ^E
4. <i>A. tenuicaule</i> Regel	<i>Rhi.</i> / <i>Cam.</i>	<i>Ret.</i> / <i>Cam.</i>	<i>IT</i> ^E
5. <i>A. brachyodon</i> Boiss.	<i>Rhi.</i> / <i>Ret.</i>	<i>Ret.</i> / <i>Ret.</i>	(endemic) <i>IT</i> ^W
6. <i>A. hymenorrhizum</i> Ledeb.	<i>Rhi.</i> / <i>Ore.</i>	<i>Pol.</i> / <i>Fal.</i>	<i>ES</i> – <i>IT</i>
7. <i>A. schoenoprasum</i> L.	<i>Rhi.</i> / <i>Sch.</i>	<i>Cep.</i> / <i>Sch.</i>	Subcosmopolitan
8. <i>A. oschaninii</i> O. Fedtsch.	<i>Rhi.</i> / <i>Cep.</i>	<i>Cep.</i> / <i>Cep.</i>	<i>IT</i> ^E
9. <i>A. vavilovii</i> M. Pop. & Vved.	<i>Rhi.</i> / <i>Cep.</i>	<i>Cep.</i> / <i>Cep.</i>	(subendemic) <i>IT</i> ^{KK}
10. <i>A. asarense</i> R. M. Fritsch & Matin	<i>Rhi.</i> / <i>Cep.</i>	<i>Cep.</i> / <i>Cep.</i>	(endemic) <i>IT</i> ^{Alborz}
11. <i>A. cepa</i> L.	<i>Rhi.</i> / <i>Cep.</i>	<i>Cep.</i> / <i>Cep.</i>	Cultivated

1. According to Hanelt *et al.* (1992) and partly extracted from Gregory *et al.* (1998).

2. Based on recently classification by Friesen *et al.* (2006).

3. The terminology and delimitation of the phytogeographical groups are based on Akhani (1998).

- Leaf blades semi-cylindrical; the visible sheath parts much longer than the width of the blades; basal parts of inner filaments triangular without small teeth *A. asarense* R. M. Fritsch & Matin
5. Leaves fistulous, cylindrical (Subgen. *Cepa*, Sect. *Schoenoprasum*) *A. schoenoprasum* L.
- Leaves not fistulous, flat to ± cylindrical 6
6. Outer bulb tunics ± entire (Subgen. *Polyprason*) *A. hymenorrhizum* Ledeb.
- Outer bulb tunics reticulate-fibrous (Subgen. *Reticulatobulbosa*) 7
7. Filaments clearly longer than tepals, apparently with a tooth on each side *A. brachyodon* Boiss.
- Filaments as long as or shorter than tepals, without teeth on both sides 8
8. Perianth (4-) 6 mm long, broadly campanulate, yellow (in dry material white with brown nerves). *A. scabriscapum* Boiss. & Ky.
- Perianth 7-14 mm long, campanulate, red to violet or purple 9
9. Ovary apex crowned around the style base; scape 10-20 (-30) cm long *A. tenuicaule* Regel
- Ovary apex not crowned; scape (20-) 30-60 cm long 10
10. Anthers yellow; leaves ± canaliculate *A. barsczewskii* Lipsky
- Anthers violet; leaves flat *A. xiphopetalum* Aitch. & Baker

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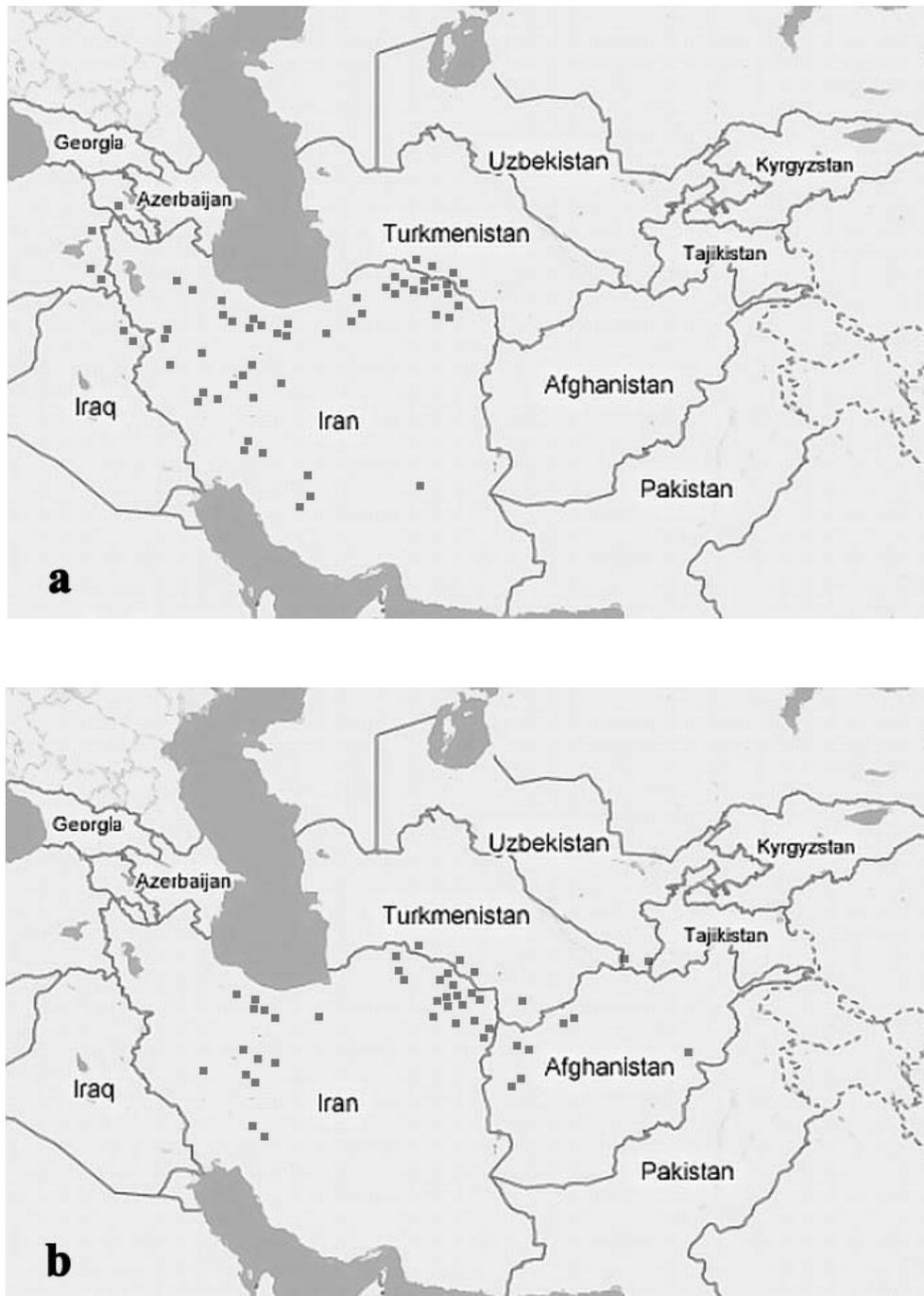


Fig. 3. Distribution map of a) *Allium scabriscapum* and b) *A. xiphopetalum*

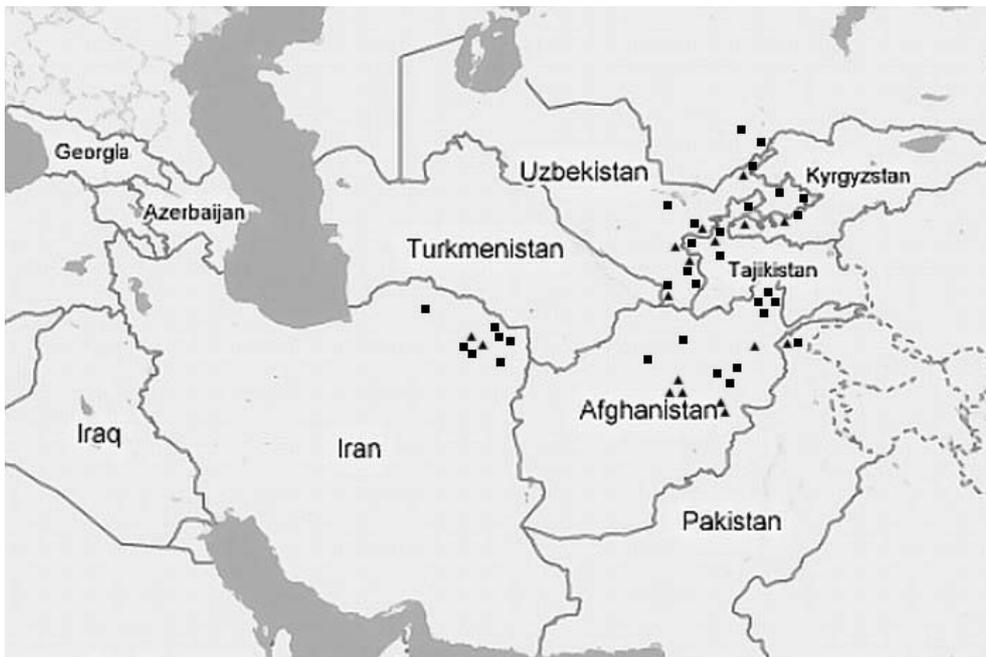


Fig. 4. Distribution map of two new *Allium* records for Iran: *A. barsczewskii* (square) and *A. tenuicaule* (triangle)



Fig. 5. Distribution map of *A. brachyodon* (star), *A. hymenorrhizum* (triangle) and *Allium schoenoprasum* (square) in Iran and adjacent countries.

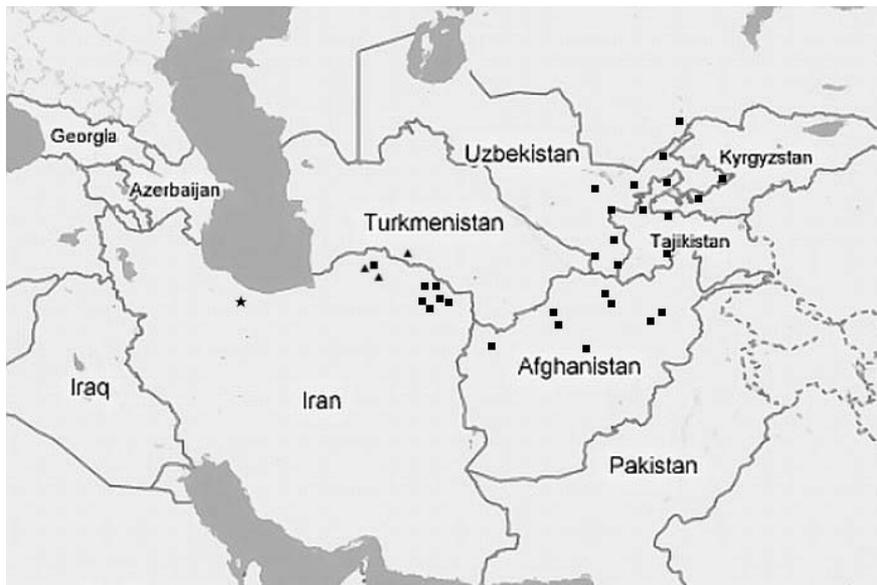


Fig. 6. Distribution map of *Allium* sect. *Cepa*: *A. oschaninii* (square), *A. vavilovii* (triangle) and *A. asarense* (star).

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