

خلاصه

در چهارچوب بازنگری رده‌بندی جنس *Allium* L. در ایران، 12 گونه و دو زیرگونه جدید از این جنس برای علم گیاه‌شناسی معرفی و توصیف می‌گردند. از بخش *Acanthoprason* متعلق به زیر جنس *Melanocrommyum* گونه‌های *Allium zagricum* R.M. Fritsch، *A. austroiranicum* R.M. Fritsch، *A. ubipetrense* R.M. Fritsch، *A. materculae* subsp. *graveolens* R.M. Fritsch و *A. hamedanense* R.M. Fritsch به عنوان آرایه‌های جدید معرفی و توصیف می‌شوند. کلیدی برای تشخیص گونه‌ها و زیرگونه‌های بخش *Acanthoprason* در ایران ارائه می‌گردد. از بخش *Melanocrommyum* زیر جنس *Melanocrommyum* گونه‌های *A. saralicum* R.M. Fritsch، *A. moderense* R.M. Fritsch و *A. keusgenii* R.M. Fritsch، *A. bisotunense* R.M. Fritsch به عنوان گونه‌های جدید توصیف می‌شوند. همچنین از بخش *Megaloprason* زیر جنس فوق زیر گونه *A. jesdianum* subsp. *remediorum* R.M. Fritsch به عنوان آرایه جدیدی برای علم گیاه‌شناسی توصیف می‌گردد. از بخش *Allium* زیر جنس *Allium*، گونه‌های جدید *A. abbasii* R.M. Fritsch و *A. clivorum* R.M. Fritsch، *A. aznavense* R.M. Fritsch معرفی و توصیف می‌شوند. گونه *A. dolichovaginatatum* R.M. Fritsch (متعلق به بخش *Longivaginata* از زیر جنس *Allium*) نیز به عنوان گونه جدید معرفی و توصیف می‌شود. براساس نمونه‌های جدید جمع‌آوری شده، نمونه اپی (epitype) برای گونه *A. akaka* S.G. Gmelin ex Roem. & Schult. انتخاب و معرفی می‌گردد، همچنین در مورد حدود و ثغور این گونه و ارتباط آن با سایر گونه‌های نزدیک بحث می‌شود. بررسی نمونه اپی تیپ *A. Akaka* و همچنین نمونه توپوتیپ (topotype) جمع‌آوری شده از گونه *A. haemanthoides* Boiss. & Reut. ex Regel نشان داد که این دو گونه بر اساس ویژگی‌های ریخت‌شناسی به خوبی از یکدیگر قابل تفکیک هستند. در این بررسی نمونه‌های لکتوتیپ (lectotype) برای گونه‌های *A. haussknechtii* Náb. و *A. straussii* Bornm. تعیین می‌شوند. همچنین اطلاعات متنوعی در مورد رده‌بندی نوین و حدود و ثغور سایر گونه‌های *Allium* در ایران ارائه می‌گردد. با احتساب آرایه‌های معرفی شده در مقاله حاضر، تعداد گونه‌ها و زیرگونه‌های گزارش شده از جنس *Allium* در ایران به 114 آرایه می‌رسد.

SUMMARY

The type plant of *Allium akaka* S.G. Gmelin ex Roem. & Schult. was probably collected in the mountains west of Bandar Anzali. Here plants fitting the original description are extant, and one was selected as epitype. This taxon in the strict sense is not conspecific with *A. latifolium* Jaub. & Spach, and is morphologically well separable from topo-typical plants of *A. haemanthoides* Boiss. & Reut. ex Regel. Therefore, *A. haemanthoides* and *A. shelkovnikovii* Grossh. were excluded from the *A. akaka* alliance. Only the minor part of the very diverse material subsumed under *A. haemanthoides sensu* Wendelbo belongs to this species in the strict sense. The majority of material differs conspicuously and was affiliated to three newly described species, *Allium zagricum* R.M. Fritsch, *A. ubipetrense* R.M. Fritsch, and *A. austroiranicum* R.M. Fritsch. Differing leaf color, length and shape of tepals, as well as relative length, shape and color of filaments were used as key characters. Only distantly related are the newly described *A. materculae* subsp. *graveolens* R.M. Fritsch and *A. hamedanense* R.M. Fritsch. All these taxa belong to subg. *Melanocrommyum* (Webb et Berthel.) Rouy sect. *Acanthoprason* Wendelbo in the narrow sense, comprising now 13 species and subspecies. A key for determination of the species and subspecies of this section is presented. Several *Allium* accessions belonging to other taxonomic groups could not be affiliated to known taxa and were newly described: *A. saralicum* R.M. Fritsch, *A. bisotunense* R.M. Fritsch, *A. keusgenii* R.M. Fritsch, and *A. moderense* R.M.

Fritsch (subg. *Melanocrommyum* sect. *Melanocrommyum*); *A. jesdianum* subsp. *remediorum* R.M. Fritsch (subg. *Melanocrommyum* sect. *Megaloprason*); *A. aznavense* R.M. Fritsch, *A. clivorum* R.M. Fritsch, and *A. abbasii* R.M. Fritsch (subg. *Allium* sect. *Allium*); and *A. dolichovaginatatum* R.M. Fritsch (subg. *Allium* sect. *Longivaginata*). Lectotypes were designated for *A. straussii* Bornm. and *A. haussknechtii* Náb..

INTRODUCTION

The genus *Allium* L. is a very diverse and taxonomically complicated group, for which no modern and complete monograph is available. A recent review of the state of *Allium* taxonomy in Iran (FRITSCH *et al.* 2007; FRITSCH 2008) provided additional evidence that a modern taxonomic revision for the territory of Iran is urgently needed in order to replace the outdated *Allium* revision for the 'Flora Iranica' area presented by WENDELBO (1971). WENDELBO himself (1971, p. 4) concluded "The number of *Allium* species within the 'Flora Iranica'-area is likely to be considerably increased in the future." and also suggested (*l.c.* p. 74, under *A. haemanthoides* Boiss. et Reuter ex Regel) critically to re-study this "rather variable species ... based on living material from many localities".

During five research missions in 2004-2008, wild *Allium* species used by the local population were recently studied on the territory of Iran (KEUSGEN & FRITSCH 2008). These investigations resulted in new ethnobotanical data published by ABBASI *et al.* (2008). Also detailed taxonomic studies were necessary in order to warrant reliable botanical naming of the material investigated. So far more than 50 different accessions looking like possible members of sect. *Acanthoprasum* from many Iranian provinces were involved in these studies in the field and under cultivation in Tehran and Gatersleben. These activities respond to the above cited advice of WENDELBO. Later (WENDELBO 1973), he even regarded *A. haemanthoides* and *A. shelkovnikovii* Grossh. as subspecies of *A. akaka* S.G. Gmelin expanding thus the range of closely related taxa.

First taxonomic results were already published (FRITSCH *et al.* 2007). Some more nomenclatorial problems and recognition of hitherto undescribed taxa

were preliminarily presented in another publication (FRITSCH 2008). The present paper aims to present further results focusing on typifications of some taxa described decades ago, to clarify the *A. haemanthoides* alliance, and to supply more detailed discussions as well as formal descriptions of several new species and subspecies found among this Iranian material.

MATERIALS AND METHODS

Wild growing *Allium* L. species were studied in the Iranian provinces: E Azarbaijan, Ardabil, Gilan, Kurdistan, Zanjan, Qazvin, Kermanshah, Hamedan, Markazi, Qom, Tehran, Mazandaran, Semnan, Golestan, Northern Khorasan, Khorasan-e Razavi, Lorestan, Esfahan, Yazd, and Fars. After collection, names and use of these plants were discussed with the local population, and later specimens were transferred in the living collections in Tehran and partly also in Gatersleben (Germany). The majority of these plants were collected in the vegetative state. Under cultivation they were repeatedly studied in detail when flowering. Details of this scientific research project (research missions, list of collected material, location of national living *Allium* collections, documentation, as well as preliminary scientific results) were reported by KEUSGEN & FRITSCH (2008). Herbarium vouchers and photographs were either taken during field work, or later from plants growing in the living collections. Additional *Allium* specimens could be compared in the herbaria of the Iranian Research Institute of Plant Protection, Tehran (IRAN), Research Institute of Forests & Rangelands, Tehran (only partly, TARI), Faculty of Science, Ferdowsi University, Mashhad (FUMH), Faculty of Science, Tehran University (TUH), Esfahan University (HIU), University of Tabriz (HCAT),

Botanical Institute of Vienna University (WU), Museum of Natural History, Vienna (W), Herbarium Haussknecht of Friedrich Schiller University, Jena (JE), Agricultural Research Centre, Khoramabad (ARCK), Agricultural Research Centre, Arak (ARCA), Research Section of Natural Resources, Kermanshah (NRK), College of Agriculture, Kermanshah (CAK), Research Centre of Forests & Rangelands, Sanandaj (HKS), Agricultural Research Institute, Shiraz (ARIS), Faculty of Science, Shiraz University (HSU) and Agricultural Research Institute, Yazd (ARIY).

RESULTS AND DISCUSSION

1. Subgenus *Melanocrommyum* (Webb et Berthel.) Rouy

1.1 General characterization of sect. *Acanthoprason* Wendelbo (*sensu stricto*)

This section is typified by *A. akaka*. WENDELBO (1971) included 14 species (*A. ramazanicum* Parsa was mentioned under the doubtful species) all occurring, except "*A. nevskianum*" *sensu* Wendelbo (= *A. hindukuschense* Kamelin et Seisums), in Iran. Later *A. bodeanum* Regel was rejected as synonym of *A. cristophii* Trautv. (FRITSCH 1999, BRUMMITT 2001), and *A. pseudobodeanum* R.M. Fritsch et Matin (FRITSCH *et al.* 2002) and *A. kuhshense* R.M. Fritsch et Joharchi (FRITSCH *et al.* 2007) were newly described from Iran.

Plants of *A. cristophii*, *A. ellisii* J.D. Hook., *A. elburzense* Wendelbo, *A. pseudobodeanum*, and *A. kuhshense* show a general stature similar to *A. akaka*, but differ by a flat star-like perigone, somewhat recurved tepals, and partly by pedicels of noticeably variable length. Recently published phylogenetic molecular analyses (GURUSHIDZE *et al.* 2008) showed that these five species belong to a phylogenetic cluster well separated from that containing *A. akaka*. Therefore they

are better affiliated to sect. *Kaloprason* K. Koch subsect. *Christophiana* Tscholok. following the classification of KHASSANOV & FRITSCH (1994). Thus sect. *Acanthoprason* in the strict sense comprises in Iran *A. akaka*, *A. breviscapum* Stapf, *A. derderianum* Regel, *A. haemanthoides*, *A. materculae* Bordz., *A. minutiflorum* Regel, *A. monophyllum* Vved., *A. shelkovnikovii* as well as five species and subspecies newly described below.

Allium brachyscapum Vved. and *A. scotostemon* Wendelbo show a similar general appearance as other members of sect. *Acanthoprason* but own reflexed and enrolling tepals. WENDELBO (1971) included them in sect. *Megaloprason* Wendelbo. However, the molecular data presented by GURUSHIDZE *et al.* (2008) indicate an independent position apart from both above mentioned sections. Further analyses of these plants seem essential to disentangle this problem.

General characters of sect. *Acanthoprason sensu stricto*

Commonly stout bulbous plants with scapes rarely more than 10 cm long, leaves commonly longer than scape (during anthesis), spathes always shorter than pedicels, inflorescences fasciculate to sub-globose, moderately dense, composed of subequal pedicels, perigone widely funnel-shaped, tepals after anthesis obliquely directed, convolute and becoming prickly (at least prickle-shaped) after end of anthesis, ovaries smooth or tuberculate, green or sometimes violet flushed (but not blackish or deep violet in early stages of anthesis).

Key for determination of species and alliances

1. Filaments at least 2/3 as long as the tepals or longer 2
- 1* Filaments up to 1/2 as long as tepals 5

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2. Filaments \pm as long as the whitish, greenish or pink tepals 3
- 2* Filaments 2/3-3/4 as long as the \pm dirty-violet tepals which do not much change after anthesis *A. monophyllum* Vved.
3. Tepals linear or lanceolate, after anthesis stiff and prickly-like; leaves thickish, ovate, base not stalk-like 4
- 3* Tepals long triangular, \pm pink, after anthesis longitudinally enrolling but weak and crumpled; leaves thick fleshy, base stalk-like narrowed
. *A. kuhshorkhense* R.M. Fritsch & Joharchi
4. Tepals linear to triangular, whitish with brown or green mid-vein
. *A. materculae* Bordz. subsp. *materculae*
- 4* Tepals \pm lanceolate, obtuse, pink, inflorescence with heavy sweet odor
. *A. materculae* subsp. *graveolens* R.M. Fritsch
5. Filaments one-colored, or base slightly darker than tip 6
- 5* Tip of filaments remarkably darker than the base 9
6. Tepals linear-triangular, whitish to pink, 14-18 mm long, (1-)1.5 mm wide, filaments slightly colored, 1/5-1/4 as long as tepals
. *A. haemanthoides* Boiss. et Reut. ex Regel s. *str.*
- 6* Tepals linear-lanceolate, widely lanceolate, or ovate-obtuse, filaments 1/4-1/2 as long as tepals 7
7. Tepals ovate-obtuse, filaments 1/3 of tepal length and touching one another with the margin above base *A. akaka* S.G. Gmelin ex Roem. et Schult.
- 7* Tepals narrower, margins of filaments above base with some distance to one another 8
8. Tepals linear-lanceolate, pink to purple, 12-14 mm long, 2 (- 2.5) mm wide,

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- filaments 1/4-1/3 as long and slightly paler than tepals, leaves yellowish-green, glossy *A. zagricum* R.M. Fritsch
- 8* Tepals widely lanceolate to sub-ovate, ± (pinkish) purple, 8-12 mm long, 2.5-3.5 mm wide, filaments 1/3-1/2 as long and as dark as the tepals
 *A. ubipetrense* R.M. Fritsch
9. Ovary smooth and glossy, with six radial bulges at the tip, tepals and filaments dark purple-brown with a much paler base *A. hamedanense* R.M. Fritsch
- 9* Ovary coarse (or dull when ± smooth), tepals whitish, pinkish, or lilac (*A. derderianum* alliance) 10
10. Leaves (broadly) lanceolate, only basally canaliculate, above even and hanging down, tepals triangular up to narrowly lanceolate, (8) 10-12 mm long, 1.2-2 mm wide *A. austroiranicum* R.M. Fritsch
- 10* Leaves ± linear or narrowly lanceolate, throughout canaliculate 11
11. Leaves straight or curved, not twisted and undulate 12
- 11* Leaves twisted and undulate, adpressed to soil, tepals acute or sub-acute
 *A. derderianum* Regel
12. Leaves 2-3 times as long as the diameter of inflorescence, tepals linear-ovate, obtuse, filaments with white base and brown or purple tip
 *A. shelkovnikovii* Grossh.
- 12* Leaves (3) 4-5 times as long as the diameter of inflorescence, tepals lanceolate, filaments white with pinkish tip *A. breviscapum* Stapf

1.2 What is *Allium akaka*?

According to the literature, "*Allium akaka* Gmelin" occurs in Transcaucasia, Turkey, Iraq and Iran, but rather different descriptions were given for this species. Therefore more than one species may have been subsumed under this name. The first description (ROEMER & SCHULTES 1830) mentioned mainly vegetative characters which are valid for nearly all species of the current sect. *Acanthoprason*, and only "*staminibus simplicibus petalis lanceolatis duplo brevioribus*" and "*petala obtusiuscula, pallida, nervo virescente*" referred to the flowers. The specimen cited "In Provincia Ghilan. Pallas." from herbarium Willdenow [No. 6511 (B)] is extant and represents one small plant with a dense inflorescence and two leaves (one broad, the second narrower). The label (unfortunately without collection date) indicates that this plant was collected by Gmelin, not by Pallas. Because Johann Gmelin, the well known explorer of Siberia, never visited Persia, this label should refer to his nephew Samuel Gottlieb Gmelin, who explored also parts of Iran on duty of the Russian tsar in the years 1771-1774. According to the available travelling data, S.G. Gmelin have had several longer stays in the Province Gilan, in the town Enzeli (now Bandar-e Anzali) from where he explored the mountain massif of "Gilanean Alps". This name certainly refers to Kouhha-ye Talesh (Talesh mountains) separating the current Provinces Gilan and Ardabil.

The north and east-facing slopes of this massif are covered by moist and dark Hyrcanian forests where heliophytes like *A. akaka* never would thrive. But already the peaks of these mountains are dry, and south- and west-facing rocky slopes are partly covered by rubble bearing steppe vegetation. During our research mission in 2005 we were able to trace such places and to find plants referable to

A. akaka in the vicinity of the town Khalkhal. One population contained many plants having whitish tepals with green median vein (Fig. 1 A) absolutely matching the original description. They represent *A. akaka* in the strictest sense. One herbarium specimen of this accession is here designated as epitype:

***Allium akaka* S.G. Gmelin ex Roemer & Schult., Syst. veget. 7, 2: 1132, 1830**
(Fig. 1)

Epitype (hic design.): Cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1054, leg. 21.04.2007 (IRAN), plants collected in Iran, Prov. Ardabil, vicinity of Khalkhal, north exposed slope near spring Aznav among rubble and rocks of marblestone, c. 1850 m, 37°34'22" N, 48°34'40" E, 04.06.2005, leg. R.M. Fritsch, S. Zarre and H. Moazzeni No. 1054. Other plants of this accession were cultivated in the Gatersleben taxonomic reference collection No. TAX6398 (voucher specimen in GAT).

Description: Bulbs depressed-globose, c. 2 cm in diameter, outer tunics grayish-brown. Scape obliquely flexuous, cylindrical-conical (thickest below inflorescence), 5-6 (7) mm in diameter, 4-6 cm long above ground, glaucous green. Leaves 2-3, lanceolate up to broadly ovate, obliquely positioned and recurved, thickish, more or less canaliculate, margin smooth, tip shortly rounded and hooded, surface above and beneath smooth, 12-40 mm wide, 10-16 cm long, dull glaucous green. Spathe finely membranous, amber with red-brown nerves, up to the base divided in 2-3 shortly triangular, patent parts. Flowers widely funnelform-starlike. Inflorescence ± semi-globose, dense, later moderately loose, 3-4 cm long, 5-6 cm in diameter. Pedicels thick, strong, straight, green or red flushed. Tepals ovate-elliptical, obtuse but tip somewhat longitudinally folded, obliquely patent, slightly recurved, 7-8 mm long,

basally 2 mm wide, whitish or faintly carmine-pinkish, with moderately broad, green or brown median vein. Filaments 1/3 as long as tepals, basally shortly united, fleshy, whitish throughout or pinkish near the very base, bases of inner filaments ovate-triangular, of outer ones triangular. Anthers ovate, 1-1.3 mm long, about 0.7 mm wide, like pollen yellow. Ovary sessile, depressed-triangular with sharp but shallow longitudinal furrows, surface very finely coarse, 2 mm long and 2.5-3 mm in diameter, green, mound of nectary pocket-like transversally widened. Style basally not sunken, long-conically, 2-3 mm long, whitish like the dot-like stigma. Capsule triangularly obovate with flattened sides and sunken at top, surface slightly glossy, 4-6 mm high and 5-7 mm long, yellowish brown.

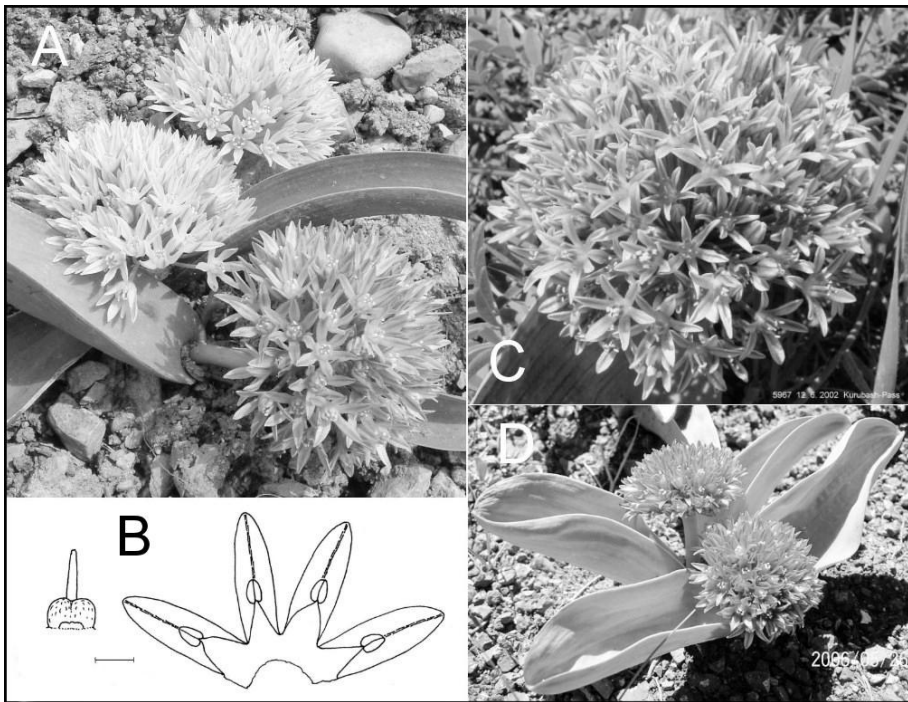


Fig. 1. *Allium akaka*: A. Cultivated plants, B. ovary and flower parts, scale bar = 2 mm (epitype location near Khalkhal, N Iran), C. Inflorescence of a related taxon (E Turkey near Van), D. taxonomically unclear plants (near Miyaneh, NW Iran, courtesy of J. Noroozi).

Distribution: Iran, Provinces Gilan, Ardabil, Zanjan and E Azarbaijan, but the borderline of the area of distribution in western direction is unclear yet.

Additional specimens seen from Iran: Prov. Ardabil, S slope near road from Asalem to Khalkhal below pass, 2100 m, 37°35'12" N, 48°37'16.6" E, leg. R.M. Fritsch, S. Zarre and H. Moazzeni 04.06.2005 No. 1053, cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran (IRAN) and in the Gatersleben taxonomic reference collection No. TAX6397 (GAT); Prov. Zanjan, Dizaj-abad, 1500 m, Moussavi, Habibi & Tehrani 19.6.1983 (IRAN); Prov. Azarbaijan, Khalkhal, Mezejin, Kouh-e Agh-Dagh, 2200-2600 m, 37°40' N, 48°44' E, leg. Termeh *et al.* 16.-17.5.1989 (IRAN); Prov. Zanjan, towards Gilvan, 50 km NE of Zanjan, Vansar Mts., 2200-2350 m, 36°50' N, 48°54' E; leg. Moussavi, Habibi & Tehrani 20.6.1983 (IRAN); Prov. Azarb., SE & N slopes of Kouh-e Sahand, 7500 Ft., leg. Furse & Synge 24.5.1960 No. 229A (IRAN); Iran, Prov. E Azarbaijan, Ghareh Chaman, leg. Daneshpajuh 15.5.1995 (IRAN); Prov. Zanjan, Benah to Chaftan, 1500-1950 m, leg. Moussavi & Tehrani 07.6.1977 (IRAN); Prov. Gilan, Amarlou, Damash, Kouh-e Zard Chen, 1750-2250 m, leg. Termé & Daryadel 04.7.1992 (IRAN); Prov. Azarb., Miyaneh, Ishligh, Kouh-e Boz-Ghoush, 2400-2900 m, leg. Termeh & Daneshpajouh 09.6.1986 (IRAN); Prov. Azarb., 6 km Khalkhal, Kuhé Aznow, 2000-2300 m, Termé & Moussavi 22.5.1974; Prov. Azarb., Sarab, Kouh-e Gharel-Gol, Sad-e Hassanjan, 2400-2700 m, Termeh & Daneshpajuh 13.6.1986 (IRAN); Prov. Azarb., Sarab, Gharieh-ye Mir-kouh-Hadji, 1700-1900 m, Termeh & Daneshpajuh 11-12.6.1986 (IRAN); Prov. Gilan, near the road from

Ghazvin 62 km to Rudbar, 1300 m, Assadi & Shah-Mohammadi 03.5.1987 No. 60342 (TARI).

Plants collected in the Iranian Prov. Zanjan (and sold at the markets of Tehran, FRITSCH *et al.* 2007; FRITSCH 2008: 58, fig. 2; also cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1138, voucher in IRAN) are generally larger in all parts than those of the epi-typical accession. Nevertheless, they share all key characters, especially the broad and fleshy, evenly colored filaments, and belong to *A. akaka* in the strict sense.

However, plants from the Bozgush Mt. range north of Miyaneh, Prov. E Azarbaijan (Fig. 1 D) differ by broader and shorter leaves, longer scapes, and flattened inflorescences. They are only known from the cited photograph and need special studies in the future.

BOISSIER (1882) and all later authors put *Allium latifolium* Jaubert et Spach [Ill. pl. orient. 2: t. 103 (1846), non *A. latifolium* Gilib., Excerc. phyt. 2: 470 (1792)] as synonym to *A. akaka*. This taxon was based on plants collected near lake Orumiyeh. According to the description and accompanying plate, it differs by ovate or lanceolate-ovate leaf blades, lanceolate (according to the table, in the text: "linearia") and acute tepals with a deeply purple median vein, subulate (in the text: "filiformia") filaments, like the style about half as long as the tepals, and puberulent, slightly capitate and obsoletely trilobate stigmata. This taxon is not con-specific with *A. akaka* in the strict sense.

Plants collected in eastern Turkey (Provinces Van and Agri) could also only be named *A. akaka* because they were much more dissimilar to every other Turkish *Allium* species characterized by KOLLMANN (1984). They differ remarkably from

A. akaka s.str. by lilac-pink, lanceolate tepals, narrower filaments with pale bases and purplish tips, and longer styles with a slightly swollen stigma (Fig. 1 C). They are also genetically well discernable from the Iranian plants (GURUSHIDZE *et al.*, 2008). Comparison of living specimens would be essential whether the above discussed name *A. latifolium* is applicable to them despite some characters seem to differ. If so, then a new name must be created in order to replace that illegitimate binomen. Otherwise the Turkish plants represent a still undescribed species.

Allium akaka occupies a different taxonomic position than expressed by WENDELBO (1971, 1973, 1985). *Allium haemanthoides* (discussed in detail below) and *A. shelkovnikovii* as characterized by FRITSCH (2008) cannot be subsumed as subspecies under *A. akaka s. str.* They belong to other alliances not closely related to *A. akaka*.

1.3 The *A. haemanthoides* alliance

Although Shahu Mts. (Prov. Kermanshah, not far from Iraq border) were mentioned as type location of *A. haemanthoides*, specimens were collected hitherto only in one side part of this range, the Atashgah massif near Paveh (Fig. 2). They must be regarded to represent the typical population. Luckily we were able to find these plants there which possess 3-6 (10) cm long scapes, glaucous, longitudinally furrowed leaves, tepals rose-pink or whitish (with a darker median vein), 14-18 mm long and narrowly triangular, sub-acute, remarkably recurved, and c. 3 mm long filaments showing initially the same colour like the tepals, later a darker coloured base. REGEL (1875) analyzed apparently plants in the early phase of anthesis mentioning in the original description only 10-15 mm long pedicels, 15 mm long

and 1-1.25 mm wide tepals, and filaments 1/3-1/4 as long as tepals. Nevertheless, the characters of *A. haemanthoides* in the strict sense are not completely covered by the description given by WENDELBO (1971).

Distribution: *Allium haemanthoides* in the strict sense occurs possibly only sporadically in north-western and central parts of Iran.

Additional specimens seen (all from Iran):

Prov. Kermanshah, Shahu mountain range near Paveh, N slopes of Mt. Atashgah near Khaneghah village, 1670 m; 35°00.889N; 46°21.542E; 17.05.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1194, living plants in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1194 and 48371-IRAN; Prov. Kermanshah, in M. Shahu, Th. Strauss Mai 1909 (WU, JE); Prov. Lurestan, pass about 20 km W Khoramabad, Yafteh Kouh, 2100 m, K.M. Rosbahani 30.5.1993 No. 962 (ARCK); Prov. Markazi, Sareband, Kouh-e Rasvand, eastern slope, 2400 m, M. Ranjbar 26.5.1999 No. 1515 (ARCA); Prov. Kurdistan, 15 km NE Banah, gardanaeh (pass) Khan, range land, 2450 m, Fattahid, Tavakely, Hatami 01.6.1989 No. 2432 (TARI); Prov. Bakhtiari, road from Lordegan to Yasouj, Maymand, Margh-e Chenar, Kottok, 1750 m, Mozaffarian 27.5.1986 No. 54469 (TARI); Prov. Esfahan, Bordekan a Kohrueh 40 km meridiem versus inter Shahreza et Semirom, substr. calc., 2700 m, Rech.f. 05.6.1974 No. 47365 (W); Prov. Esfahan, Khansar, Buin-Miandasht, Kouh-e Sangandaz, Termeh, Tehrani, & Karavar 18.6.1989, 48366-IRAN.

WENDELBO's (1971) description of *A. haemanthoides* fits much better to plants more or less widely distributed in the Provinces Hamedan, Lurestan, Kermanshah and Kurdistan. We collected somewhat less than 30 accession during



Fig. 2. *Allium haemanthoides* in the strict sense (type location, Atashgah massif near Paveh, NW Iran).

our research missions. This morphologically very variable material differs from typical *A. haemanthoides* by longer scapes, denser inflorescences, only 10-14 mm long, lanceolate tepals, and 4-5 mm long filaments. Investigation of living plants as well as the comparison of many herbarium specimens led to the conclusion, that the length and shape of tepals were correlated in the majority of vouchers, likewise the length of filaments in relation to the length of tepals. These characters as well as the mode of the coloration of filaments (one-colored against light base and remarkably darker tip) can be used as key characters. On the other hand, the shape of inflorescences was generally changing from fasciculate to sub-globose during the course of anthesis.

Plants of most local populations showed a variable leaf color with all transitions from glossy to glaucous and dull tones. Some material showed as correlated characters (Fig. 3) a very stout habit, up to 8 cm broad and glossy, yellow-green leaves (more similar to *A. macleanii* Bak. than to *A. koelzii* (Wendelbo) K. Persson & Wendelbo, and rarely with a certain glaucous bloom), narrow long tepals, and one-colored filaments scarcely longer than 4 mm. They represent a new species:

***Allium zagricum* R.M. Fritsch, species nova** (Fig. 3)

Holotype: Iran, Prov. Lorestan, N Khoramabad, Galeh Moradi towards Rimeleh mountain, Taf mount, 2285 m, 33°38.590' N, 48°27.508' E, leg. 15.5.2007, M. Abbasi, R.M. Fritsch & M. Keusgen (IRAN, also isotype in IRAN). Other plants of this accession were cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1187 and in the Gatersleben taxonomic reference collection No. TAX6643 (voucher in GAT).

Diagnosis: Characteria propria folia lata lucentia luteo-viridia, tepala 12-15 mm longa anguste lanceolate et filamenta unicolorata vix longiore 4 mm longitudinis. Differt characteribus supra citatis ab *Allio haemanthoides* propria tepala longiora anguste triangulata filamentaque pro portione breviora, et ab *Allio ubipetrensi* propria tepala latiora brevioraque filamentaque pro portione longiora.

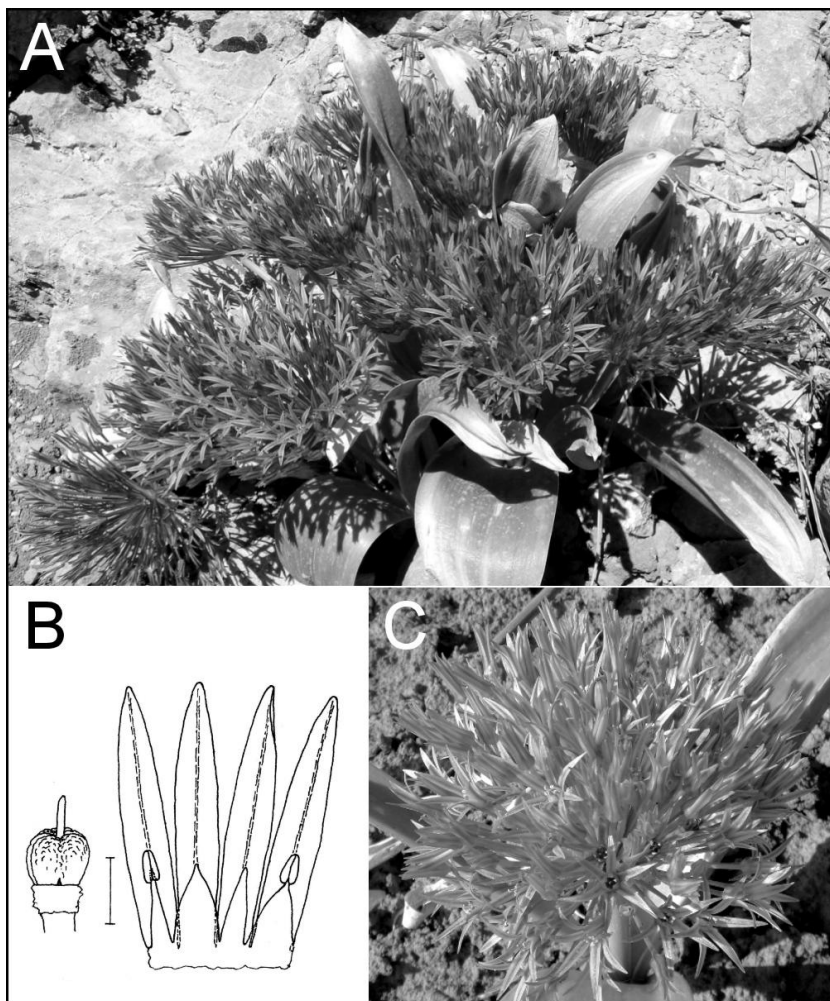


Fig. 3. *Allium zagricum*: A. Flowering plants, B. ovary and flower parts, scale bar = 4 mm, C. inflorescence (type location Mt. Taf NE Khoramabad, NW Iran).

Description: Bulbs depressed-globose, c. 3-4 cm in diameter, inner tunics papery, white; outer tunics \pm thick, slightly lengthwise splitting, but mostly disintegrating. Scape about 5-10 (15) cm long, cylindrical, smooth, 6-10 mm in diameter, \pm straight, smooth, green, dull or glossy. Leaves 2-3, blades broadly lanceolate, the most inner one lanceolate, \pm flat, thick, with a short hooded tip, margin white, densely toothed or smooth, upper side smooth and even, lower side with fine ribs, (15) 20-80 mm wide, 12-28 cm long, glossy yellowish-green, not at all glaucous. Spathe finely membranous, divided into 2-3 widely ovate parts, very shortly tipped, pale brownish with darker veins, initially adpressed to the pedicels, later patent. Flowers widely funnel-shaped, star-like, anthesis in April-May. Inflorescence broadly fasciculate to semi-globose, dense, (5) 8-10 cm in diameter. Pedicels thickish, rather soft, of nearly equal length, cylindrical, green or reddish flushed, glossy, slightly upwards bent. Tepals narrowly lanceolate-triangular, obliquely forward directed and recurved, upper part somewhat longitudinally folded narrowing in a short rounded tip, after anthesis convolute, 1.5-2 mm wide and (10) 12-15 mm long, pale lilac with rather broad green median vein. Filaments $2/5$ to $1/3$ of tepal length, fleshy, somewhat paler than tepals up to whitish, outer ones narrowly triangular, inner ones two time wider and ovate-triangular. Anthers elongate, c. 1.5 mm long and 0.8 mm wide, pinkish carmine, pollen pale yellow. Ovary three-edged globose, without stalk, 2 mm long and 2.5 mm wide, surface finely tuberculate, green, dull, with carmine flush, nectary mound basal, small. Style conical-cylindrical, 2 mm long, white, its base narrowly funnel-like sunken in. Stigma white, acute. Capsule three-edged, broadly obovate, 5-6 mm in diameter, 4-5 mm long.

Distribution: Iran, Prov. Lorestan, Zagros mountain range, rather scattered in higher elevations on not too dry and often steep steppe slopes.

Additional specimens seen (all from Iran, Prov. Lorestan).

Living plants in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1183 and 1184, and in the Gatersleben taxonomic reference collection nos. TAX 6640 and TAX6641 (vouchers in GAT), collected in Kouh-e Garri massif, valley of Kahman river above vill. Dareh-Tang, side valley in western direction; 2700 m; 33°58.213' N; 48°21.665' E; leg. 14.05.2007 M. Abbasi, R.M. Fritsch & M. Keusgen; Dorod, leg. Azizollahi 15.5.1988 (HIU).

Most common and widely distributed in the Zagros mountain range of Iran is another variable taxon characterized by an often somewhat slender stature (Figs 4 A), sub-ovate to broadly lanceolate, glaucous or \pm vividly green leaves less than 8 cm wide, lanceolate to narrowly ovate, \pm (pinkish) purple, 8-12 mm long and 2.5-3.5 mm wide tepals, and evenly colored filaments 1/3 -1/2 as long and as dark as the tepals (Fig. 4 D). Also really slender plants having up to 22 cm long scapes, only 15-35 mm wide leaves, and initially narrowly fasciculate inflorescences (*A. haemanthoides* var. *lanceolatum* Boiss., Fig. 4 B) showed the identical flower characters (Fig. 4 C) and belong thus to this new species:

***Allium ubipetrense* R.M. Fritsch, species nova** (Fig. 4)

Holotype: Kurdistan, Sanandaj towards Marivan, Ariz pass, 2000-2200 m, 35°22'14.0" N, 46°51'29.6" E, 17.5.2006, leg. M. Abbasi, R.M. Fritsch, M. Keusgen,

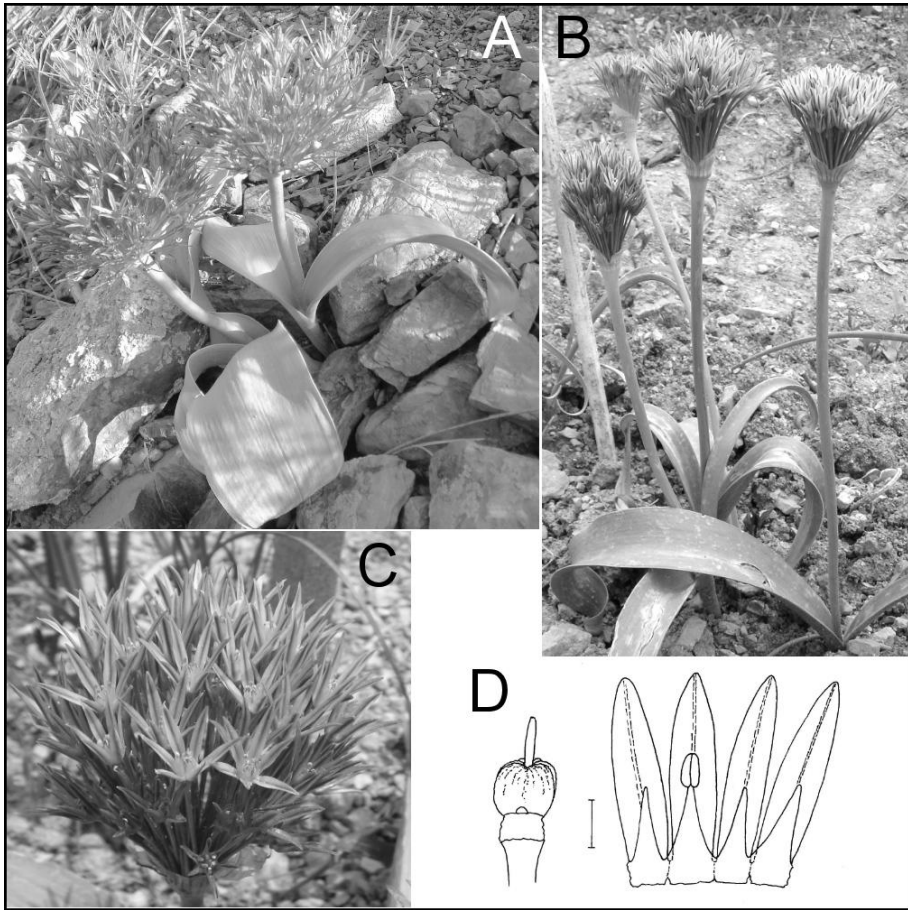


Fig. 4. *Allium ubipetrense*: A. Flowering plants (type location, Ariz pass near Sanandaj, NW Iran), B. slender plants under cultivation, C. inflorescence (Kalekan N Sanandaj, NW Iran), D. ovary and flower parts, scale bar = 2 mm.

(43975-IRAN). Other plants of this accession were cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1112 and in the Gatersleben taxonomic reference collection No. TAX6503.

Synonyms: *Allium haemanthoides* var. *lanceolatum* Boiss., Fl. orient. 5: 276, 1882.

Type: Iran, Prov. Lurestan, Sawers-Berge, Nur, Eschker, leg. Hausskn. [G (Boiss.)],

isotype JE]; ? *A. akaka* f. *major* Turrill, Curtis's Bot. Mag. 160: Tab. 9506, 1938.

Type: Plants from northern Iran were cultivated in Royal Botanic Garden Kew (K?, not seen).

Diagnosis: Characteria propria folia angustiora nonque uno modo glauca, tepala 8 usque 12 mm longa latioraque lanceolata filamentaque 4 usque 5.5 mm longa.

Species affines *A. zagricum* et *A. haemanthoides* propria tepala longiora angustioraque et filamenta breviora, *A. akaka* s.str. propria tepala filamentaque latiora.

Description: Bulbs depressed-ovate, 2-3 cm long and in diameter. Scape cylindrical, slightly conical (widest below inflorescence) (6) 10-15 cm long, basally (4) 5-6 mm, below inflorescence up to 8 mm in diameter. Leaves 1-2 (3), narrowly to widely lanceolate, basally often stalk-like narrowed, tip rather suddenly narrowed and hooded, sideways bent and upper part often once enrolled, above and below smooth or shallowly grooved, glaucous. Spathe divided in 2-3 short triangular parts, adpressed to the pedicels or tip slightly reflexed, 1-2 cm long, membranous, yellowish-brown with dark brown veins. Flowers widely campanulate-funnel-shaped, star-like. Inflorescence narrowly, later broadly, fasciculate to semi-globose or even sub-globose in fruiting stage, moderately dense, up to 8 cm wide. Pedicels straight or somewhat backwards bent, wire-like, smooth, glossy brownish-green, 4-7 cm long. Tepals widely lanceolate to sub-ovate, sub-acute, ± (pinkish) purple with darker median vein, 8-12 mm long, 2.5-3.5 mm wide. Filaments 1/3-1/2 as long as the tepals, outer filaments triangular, and somewhat shorter than the triangular-ovate inner ones, fleshy, as dark as the tepals or basally somewhat darker, margins above base with some distance to one another. Anthers ± ovate, yellow, about 1.2

mm long. Pollen yellow. Ovary tripartite depressed-globose, 2 mm long and in diameter, surface moderately coarse, green, reddish flushed, mound of nectary tube dot-like. Stylus narrowly conical, 3-5 mm long, like the undivided stigma white or rose. Capsule shortly pear-shaped, 5-6 mm in diameter, surface nearly smooth and slightly glossy.

Distribution: Iran, Provinces Lurestan, Qazvin, Kurdistan, Markazi (Arak), Zanjan and Zagros mountain range, dry stony and often rocky steppe slopes.

Additional specimens seen (all from Iran):

Prov. Qazvin, Limestone hill near the road from Takestan to Avaj, 10 km N of Abgarm, 1580 m, 35°47.49.5N, 49°21.24.2E, 08.5.2006, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1071 [living plants in Tehran]; Prov. Kurdistan, Slopes along the road via Ariz-pass near Sanandaj, 2000-2200 m, 35°22'14" N, 46°51'29.6" E, 17.5.2006, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1112 [living plants in Tehran]; Prov. Kurdistan, vicinity of the village Kalekan c. 20 km NW Divandareh, 2070 m, 36°00'57.5" N, 46°55'52.1" E, 18.5.2006, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1116 [living plants in Tehran]; Prov. Qazvin, northern slopes of Mt. Aghdag between Razan and Avaj near pass (9 km to Avaj), 2500 m, 35°31'50" N, 49°09'40" E, 21.5.2006, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1125 [living plants in Tehran]; Prov. Markazi, northern slope of Razvand massif above vill. Suraneh, slope in NE exposition, 2340 m, 33°52.255' N, 49°26.818' E, 10.5.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1149 [living plants in Tehran]; Prov. Markazi, northern slope of Razvand massif above vill. Suraneh, slope in NE exposition, 2600 m, 33°52.084' N, 49°26.222' E, 10.5.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1153 [living plants in Tehran]; Prov. Markazi, northern

slope of Razvand massif above vill. Suraneh, slope in NE exposition, 2640 m, 33°52.084' N, 49°26.222' E, 10.5.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1154 [living plants in Tehran]; Prov. Markazi, northern slope of Razvand massif above vill. Suraneh, slope in NE exposition, 2480 m, 33°52.172' N, 49°26.464' E, 10.5.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1155 [living plants in Tehran]; border of the Provinces Markazi and Lurestan, slopes near the pass Herab, granitic fine rubble and large stones, E and N exposed slopes, 2420 m, 33°53.083' N, 48°58.204' E, 12.5.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1166 [living plants in Tehran]; Prov. Lurestan, S exposed limestone rocks W of pass Chariveh Shah, on a dry limestone terrace and in clefts between perennials and *Astragalus*, 2300 m, 33°33.412' N, 48°49.829' E, leg. 12.5.2007, R.M. Fritsch, M. Abbasi, M. Keusgen No. 1168 [living plants in Tehran]; Prov. Lurestan, limestone rocks W of pass Chariveh Shah, N exposed, 2300 m, 33°33.4' N, 48°49.8' E, 12.5.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1169 [living plants in Tehran]; Prov. Zanjan, Benah towards Shaftan, 1500-1900 m, Moussavi & Tehrani 07.6.1977 (IRAN); Prov. Kurdistan, Manokh Bala village N Sanandaj, Almaloo mountain, 2100 m, Kaffash & Fany 23.5.1997 No. 4074 (HKS); Prov. Kurdistan, E Sanandaj Salawat-Abad gardaneh (pass), 1480-1950 m, Fattahi & Khaledian 07.5.1986 No. 1092 (HKS); Prov. Kurdistan, E Sanandaj, Salawat-Abad defile, 2180 m, Fattahi & Khaledian 02.6.1987 No. 1288 (HKS); Prov. Kurdistan, Divandareh: Saral area, Zardavan village, 2300 m, Hooshidary & Mandomi 21.5.2002 No. 4232 (HKS); Prov. Kurdistan, Sanandaj, Abidar mountain, 1850 m, Avideh Navzari 23.4.2004 No. 6220 (HKS); Prov. Kurdistan, Divandareh: Chelchashma area, near Alijan village, 1900 m, Maroofi & Moradi 08.5.2004 No.

6987 (HKS); Prov. Kurdistan, Sanandaj, Abidar mountain, 1750 m, Moradi 14.5.2004 No. 6875 (HKS); Prov. Kurdistan, Saral area N Sanandaj, Farhad-abad village, 2200 m, Kaffash & Fany 19.5.1997 No. 3993 (HKS); Prov. Zanjan, 50 km NE Zanjan towards Gilvan, Vansar mountains, 2200-2350 m, 36°47' N, 48°47' E, Moussavi, Habibi & Tehrani 20.6.1983 (232-IRAN); Prov. Markazi, Arak towards Malayer 20 km from Arak, Chepeghli (Ab-Robot), 2300-2700 m, 34°04' N, 49°34' E, Termeh, Karavah & Tehrani 24.5.1988 (IRAN).

All characters of *A. akaka* f. *major* shown by Tab. 9506, especially Fig. 4, the opened perigone, fit very well *A. ubipetrense*. Well cultivated plants may show larger tepals ("perianth-segments linear, acute, 1.4 cm long, 2.5 mm broad"), but the adjective "linear" as well as the proportions of filaments ("3 mm long, at the very base 2 mm broad") conflict with the dimensions shown by the figures and were very probably typographical errors.

Unfortunately, neither *A. zagricum* nor the below described *A. austroiranicum* could be included in the phylogenetic analyses presented by GURUSHIDZE *et al.* (2008). Two accessions of *A. ubipetrense* investigated in this study belong together with *A. breviscapum* and *A. derderianum* to a inhomogeneous cluster which is sister to the *A. akaka* cluster.

1.4 The *A. derderianum* alliance

Key characters of this alliance are remarkably narrower leaf blades than *A. akaka* and the species of the *A. haemanthoides* alliance, and additionally bi-colored (the tips are conspicuously darker than the base), short filaments. This group comprises *A. derderianum*, a taxonomically still somewhat unclear taxon (FRITSCH

2008), *A. shelkovnikovii*, and *A. breviscapum*. Also another taxon included by WENDELBO (1971) under *A. haemanthoides* s. lat. obviously belongs here, which owns more or less lanceolate leaves in steeply ascending position (Fig. 5 B), bi-colored filaments (Fig. 5 C), and whitish to pinkish, triangular up to narrowly lanceolate tepals (Fig. 5 D). Most likely, the details of WENDELBO's (1971: 73) description mentioning "*Perigonium ... viridi-nervosum ...in sicco saepe album*" refers to this newly described species.

***Allium austroiranicum* R.M. Fritsch, species nova** (Fig. 5)

Holotype: Iran, Prov. Fars, Neyriz, Moshkan village, Kouh-e (Gholleh) Sar-e Sefid, 2700-3000 m, Moussavi & Tehrani 25.05.1975 (IRAN).

Diagnosis: Characteria propria folia angusta longa et oblique stricta in habitu, tepala albescentia usque rosea triangulato-lanceolata, et filamenta bicoloria basalia clarissimo colorata terminaliaque perquam atrociorata. Species affinis *Allium derderianum* differt foliis solo positis tortuosis et tepalis brevioribus.

Description: Bulbs ovate to depressed-ovate, outer tunics grey-brown to blackish, in pieces (but near the tip in spirally twisted stripes) decomposing. Scape above soil (2) 5-12 cm long, cylindrical-conical or slightly flexuous, terete, smooth, green, often purplish flushed. Leaves 1-2 (3), narrowly lanceolate up to ovate, in early stages often adpressed to the soil, completely canaliculate, and the shortly tapering tip recurved and enrolled, later obliquely erect and only basally canaliculate, with upper part hanging down, margin white, smooth or with scattered teeth, upper side grooved or even, lower side even, glaucous green and dull or yellowish green and shiny, or intermediate. Spathe divided into 2-4 broadly triangular, later reflexed parts, pale brown with purple nerves. Flowers widely funnel-shaped star-like,

anthesis in May-June. Inflorescence \pm semi-globose or broadly fasciculate, (3) 5-12 cm in diameter, moderately dense. Pedicels straight, wire-like, smooth, brownish to purple. Tepals long-triangular to narrowly lanceolate, \pm acute, remarkably recurved, after anthesis convolute and prickly-like, (8) 10-12 mm long, 1.2-2 (2.5) mm wide near the base; white with green mid-vein or different pink tones with purplish

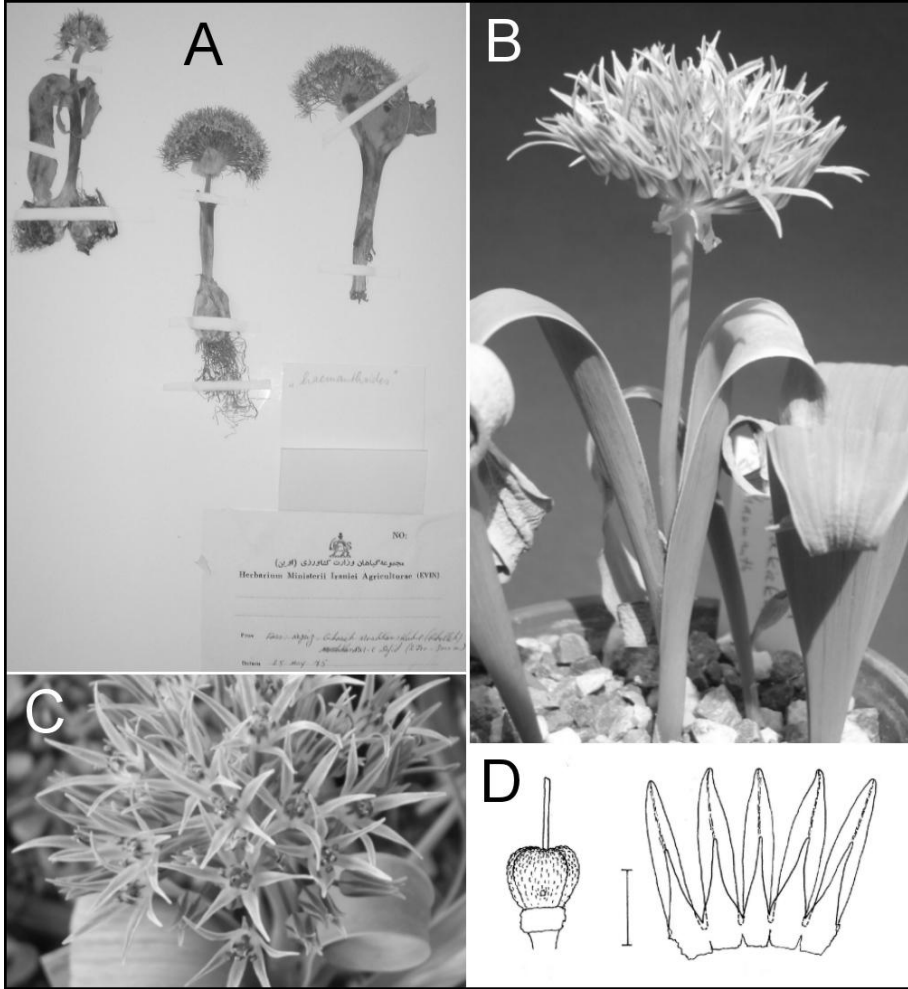


Fig. 5. *Allium austroiranicum*: A. Type sheet (holotype: plant left above); B. cultivated plant, C. inflorescence of this plant (N pass Kouhrang, C Iran; courtesy of M. Jaeger), D. ovary and flower parts, scale bar = 2 mm.

median vein. Filaments 1/3-2/5 (1/2) as long as tepals, basally shortly connate, outer filaments narrowly triangular, inner ones 1.6-1.8 times wider; basally whitish, tip pink to purplish (not in white flowers). Anthers ovate, pink or yellow. Pollen yellow. Ovary sub-globose with three furrows, not stalked, finely tuberculate, 2-3 mm long and in diameter. Style conical, 2-4 mm long, whitish, with dot-like stigma. Capsule depressed-obovate, triangular, 3-4 mm long and in diameter, brownish.

Distribution: Central Iran, Provinces Esfahan, Fars, Bakhtiari, Yazd and higher elevations of the Zagros mountain range, steep stony and often rocky steppe slopes.

It is probably a vicariant species with *A. ubipetrense*.

Additional specimens seen (all from Iran):

Prov. Yazd, NW exposed slopes of Mt. Barfkhaneh above Deh Bala, 31°31' N, 54°05' E, 2850 m, 12.5.1994, leg. R.M. Fritsch No. 1018 [living plants in the Gatersleben taxonomic reference collection No. TAX3913, herbarium vouchers in GAT]; Prov. Yazd, NW exposed slopes of Mt. Barfkhaneh above Deh Bala, 31°31' N, 54°05' E, 3500 m, 12.5.1994, leg. R.M. Fritsch No. 1025 [living plants in the Gatersleben taxonomic reference collection No. TAX3914, herbarium vouchers in GAT]; Prov. Yazd, Taft, Gharieh-ye Hedash (Deh Bala) Godar-e Nir, 2600-3000 m, Mousavi & Tehrani 10.6.1976 (IRAN); Prov. Yazd, Tezerjan, Kouh-e Barfkhaneh, 2400-2600 m, Mozaffarian 30.5.1996 No. 77535 (TARI), identical place, 2450 m, 20.05.2004 Mir Hosseini 83-9 (ARIY); Prov. Yazd, Sanich, Shirkouh massif, 14.06.1995 Mosley Arany 366, (HYU); Prov. Bakhtiari, Kouh-e Bakhtiar, NE exposed rocky limestone slopes ca. 1 km above village Amir-Abad, ca. 10 km SW Haruni, 32°22' N, 50°28' E, 2400 m, 15.5.1994, leg. R.M. Fritsch No. 1053 [living plants in the Gatersleben taxonomic reference collection No. TAX3920, herbarium

vouchers in GAT]; Prov. Bakhtiari, Kouh-e Bakhtiar, road to Chelgerd on the slope above Kouhrang river, with many limestone boulders, 32°28' N, 50°06' E, 2500 m, 16.5.1994, leg. R.M. Fritsch No. 1068 [living plants in the Gatersleben taxonomic reference collection No. TAX3923, herbarium voucher in GAT]; Prov. Bakhtiari, Shahr-e Kurd, tang-e Sayyad protected area, Pir-Kouh, 2500 m, Mozaffarian 13.5.1987 No. 59861 (TARI); Prov. Bakhtiari, c. 15 km from pole Shahriadi to Kouhrang, 2000 m, Mozaffarian 14.5.1998 No. 77883 (TARI); Prov. Bakhtiari, Gandoman, communication station, 2100-2600 m, Jamzad *et al.* 14.5.1999 No. 79967 (TARI); Prov. Bakhtiari, Kouhrang, Zardkouh, 2100-2500 m, Termeh & Tehrani 03.6.1984 (404-IRAN); Prov. Bakhtiari, Ardal, Zard-Kouh, 2700-3200 m, Iranshahr & Moussavi 14./15.6.1973 (405-IRAN); Prov. Bakhtiari, Pataveh towards Falard, 1500-1800 m, Iranshahr & Moussavi 20.5.1974 (408-IRAN); Prov. Bakhtiari, 12 km E Borujen, near Faradonbeh, 31.5.1974 Iranshahr (410-IRAN); Prov. Bakhtiari, Ardal, Zard-Kouh, 2700-3200, Iranshahr & Moussavi 12.5.1974 No. 127 (IRAN); Prov. Fars, Estahbanat, Kouh-e Bisheh, 2200-2400 m, Moussavi & Tehrani 22.5.1975 (IRAN); Prov. Fars, Nurabad: Doshman-Ziary region, vill. A-Zalou, Kouh-e Tasak, Quercus forest at mountain foot and deep rocky slit at top, 1900-2500 m, Mozaffarian 31.5.1983 No. 45763 (TARI); Prov. Fars, Fasa, Kharman-Kouh, 2900 m, Mozaffarian 06.6.1983 No. 46943 (TARI); Prov. Fars, 10 km N Sissakht, 2000 m, Iranshahr & Moussavi 12.5.1974 (IRAN); Prov. Fars, Sissakht, Gardaneh-Bijan, Kashkouli 28.6.1968 (IRAN); Prov. Fars, Bamu protect. region, 23.05.1995, Hatami & Sadeghian, 11689 (SHI); Prov. Fars, Eghlid, Kouh-e Bol, 3050 m, 04.06.1996 (collector not mentioned) (SHI); Prov. Esfahan, Khonsar Bu'in-Miyan Dasht, Kouh-e Sangandaz, 2700-3100 m, Termeh,

Tehrani & Karavar 18.6.1989 (IRAN); Prov. Esfahan, Farydan, Khamis, Tchoghgard, 2300 m, Termeh *et al.* 19.6.1989 (IRAN); Prov. Esfahan, Freyduhn Shahr, Vahdatabad village, Mt. Pish-kouh, Attar & Samani 24.6.2006 No. 36191 (TUH); Prov. Kohgiluyeh-va-Buyerahmad, Yasouj: Cheshmeh-Mishi near Kouh-e Dena, 2550 m (collector not mentioned), 12.5.1977 (IRAN); Prov. Kohgiluyeh-va-Buyerahmad, Tang-e Sorkh, 30 km SW Yasouj towards Ardekan, 2000 m, (collector not mentioned) 11.5.1977 (HIU).

Difficult to determine are albinotic forms because the darker tip of the filaments cannot be seen in the dried state. Then only the shape and the relative length of tepals remain as key characters to determine herbarium vouchers without complete leaves. White forms of *A. ubipetrense* can be recognized by only 8-10 mm long but 2-3 mm wide tepals, but white forms of *A. haemanthoides s.str.* (e.g. Prov. Kurdistan, Saghez 15 km to Divandareh, Fatah Abad, 2450 m, Sajedi & Bahramishad 16.5.2006 IRAN) may easily be merged with *A. austroiranicum*.

1.5 Two more new taxa of sect. *Acanthoprason*

Allium materculae occurs in Azarbaijan (type location in Nakhichevan), Armenia, and North Iran. It is a rather variable species characterized by narrowly fasciculate inflorescences (which enlarge conspicuously becoming sub-globose and very loose in fruiting stage), narrow sub-linear tepals becoming convolute and prickle-like after anthesis, and narrowly conical, fleshy filaments as long as the tepals. The color of the tepals is dominated by the relatively broad, green to brown median veins (Fig. 6 A), and the color of the filaments may independently vary from white to purplish. *Allium materculae* is only distantly related to *A. akaka*, to the

alliances of *A. derderianum* and *A. haemanthoides*, as well as to *A. kuhshorkhense*.

Surprisingly similar plants were growing in the vicinity of Arak (Prov. Markazi) at rocky mountain terraces as well as at loamy hills in depressions. Scape lengths and leaf shape were variable depending on habitat (plants from loamy hills were larger and had longer leaves), but generally the filaments and the lanceolate tepals were lilac to pinkish-carmine, the latter with a darker but not really prominent median vein (Figs 6 B, C). Very characteristic was the (already unpleasantly) intense sweet odor of the flowers. This taxon occupies also an own area of distribution and represents a new subspecies:

***Allium materculae* Bordz. subsp. *graveolens* R.M. Fritsch, subspecies nova**
(Fig. 6)

Holotype: Mowdere b. Sultanabad, 10. V. [1]890 Th. Strauss (WU).

Diagnosis: Characteria propria tepala elongato-ovata nervo mediano paene unicolorato, floresque intense graveolentes. Differt characteribus supra citatis ab subspecie typica quae tepala lata conspicua odoremque inconspicuam ostendit.

Description: Bulbs ovate to \pm depressed-globose, 2-3.5 cm high and 2-4 cm in diameter, outer tunics \pm strong, decomposing, yellowish-brown to black. Scape cylindrical or sub-conical, slightly flexuous, near base 3-4 (6) mm and near top 4-5 (-10) mm in diameter, (3) 5-10 (35) cm long; smooth, green or red flushed, glossy. Leaves (1) 2-3, narrowly lanceolate, below adpressed to the ground or recurved, thick, canaliculate, above more flattened, margin whitish, denticulate or smooth near base, shortly (most inner leaf long) tapering in a hooded tip, upper and lower sides \pm smooth or with broad shallow ribs, (1) 1.5-3.5 cm wide, (10) 15-35 cm long; green with a moderate glaucous bloom, near base reddish outside. Outer sheath leaf



Fig. 6. *Allium materculae*: A. subsp. *materculae*, inflorescence (Mt. Misho NW Tabriz, N Iran); B-E subsp. *graveolens*, B. plant on a loess hill (depression NE Arak, W Iran), C. flowering plant, D. ovary, filaments with anther, and tepals (left hand inner, right hand outer one), scale bar = 2 mm, E. inflorescence (type location Modere valley W Arak, W Iran).

delicately membranous, transparent, soon decaying. Spathe delicately membranous, nearly completely split in several widely triangular parts, adpressed to the pedicels or above \pm patent; brownish with reddish-brown veins. Flowers widely funnel-shaped, star-like, with strong sweet perfume-like odor, anthesis in April-May. Inflorescence moderately to widely fasciculate, dense, 3-4.5 cm long and 3-7 cm in diameter. Pedicels \pm cylindrical, relatively soft, incurved, 3-4.5 cm long, greenish with \pm strong red flush, glossy. Tepals triangular-lanceolate, in basal part often linear, longitudinally folded (after anthesis convolute and distorting, but not really prickly), oblique-patent, slightly recurved in full anthesis, shortly tapering in a plicate tip, 6-8 mm long, c. 1.5 mm wide, faintly pinkish later somewhat darker, with a broad greenish median vein narrowed towards tip and base. Filaments as long as tepals or 1/5 shorter, basally slightly connate or free, subulate, \pm fleshy, pink to carmine. Anthers oblong, c. 1.5 mm long, 1 mm wide, like pollen yellow. Ovary sessile, spherical-triangular, c. 2 mm long and in diameter, surface slightly coarse by very delicate cells, faintly glossy, green; mouth of nectary at the very base, small pocket-like. Stylus basally slightly sunken in the tip of ovary, conically thread-like, 3-6 mm long, like the undivided stigma whitish.

Distribution: Iran, Provinces Markazi and Esfahan, dry slopes of steppe hills, rock terraces and rubble slopes at elevations between 1000 and 3000 m.

Additional specimens seen (all from Iran):

Prov. Markazi, hills in the pass area from Qom c. 50 km to Arak, dry loamy-stony hillsides, 1900 m, 34°17.349' N, 50°11.741' E, 08.05.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1142 [cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran, voucher leg. 21.04.2008 in IRAN];

Prov. Markazi, near Mirzin salt lake, between Daudawat et Rizmeh, 1680 m, 34°15.731' N, 49°45.525' E, 09.05.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1145 [cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran]; Prov. Markazi, Modere valley W Arak, 1990 m, 34°06.259' N, 49°38.501' E, 09.05.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen, No. 1147 [cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran]; Prov. Markazi, mountain range ESE Arak, eastern slope, rock terraces of limestone; 2630 m, 33°58.615' N, 50°07.07' E, 11.05.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1160 [cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran]; Prov. Markazi, mountain range ESE Arak, eastern slope, limestone rubble on the top of Mt. Absar and neighbouring crest; 2816 m, 33°58.687' N; 50°06.777' E, 11.05.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1161 [cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran]; Prov. Markazi, mountain range ESE Arak, eastern slope, rock terraces of limestone below Mt. Absar, 2700 m; 33°59' N, 50°07' E, 11.05.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1164 [cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran]; Prov. Esfahan, 10 km S Mourchekhort to Natanz, 1600 m, Rahiminejad *et al.* 11.5.2002 No. 13186 (HIU); Prov. Tehran, Ghom 100 km N Ghom, 950 m, Termeh & Moussavi 04.4.1977 (IRAN); Prov. Esfahan, Kashan, Kouh-e Karkas, S Kashan, Iranshahr 27.5.1974 (IRAN); Prov. Esfahan, Soh, Zard-Kouh, 2300 m, Aryavand & Sahebi 20.5.1982 (HIU); Prov. Esfahan, 10 km S Morchekhort to Natanz, 1600 m, Rahiminejad, Sahebi, Ghaemmaghani 11.5.2002 (HIU), identical place, Rahiminejad 09.4.2002 (HIU); Prov. Esfahan, Esfahan, Mt. Sofe, southern

slope, collected by students 12.4.1974 (HIU); Prov. Esfahan, Kashan: Natanz, Tar, Kouhé Karkas, 33°25' N, 51°45' E, Iranshahr 22.5.1970 (IRAN).

During our mission in 2006, rather conspicuous plants could be studied in the flowering stage in the lower part of south-facing slopes near the Ecbatan dam south of Hamedan. The plants were as small as epi-typical plants of *A. akaka* but had extremely dark reddish-brown flowers (Fig. 7 A). Closer investigation showed that the ovaries were glossy like polished, bearing six radial bulges at the tip (Figs 7 B, C). These ovary characters are unique in this section underlining that this is a hitherto undescribed species named:

***Allium hamedanense* R.M. Fritsch, species nova** (Fig. 7)

Holotype: Iran, Prov. Hamedan, stony dry SW exposed limestone slopes beside Sangestan road, near Ecbatan dam, 2000 m, 34°45'11.3" N, 48°36'15.6" E, 11.05.2006, leg. M. Abbasi, R.M. Fritsch, M. Keusgen, (43979-IRAN). Other plants of this accession were cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1089 (voucher specimens in IRAN), and in the Gatersleben taxonomic reference collection No. TAX6487 (voucher specimen in GAT).

Diagnosis: Habitus et superficies ovarii leves *Allii akaka* similes sed differt ab ea specie tepalis perquam atrobadiis (non albescentis nec roseis), ovariiis perpolitit et apicibus ovariorum non subplanis sed gibbis radialibus latis subconicis tectis. Ceterae species habitum similem ostendunt sed differunt ab *Allio hamendanensi* ovariiis verrucosis vel tepalis valde elongatis tenuissimisque.

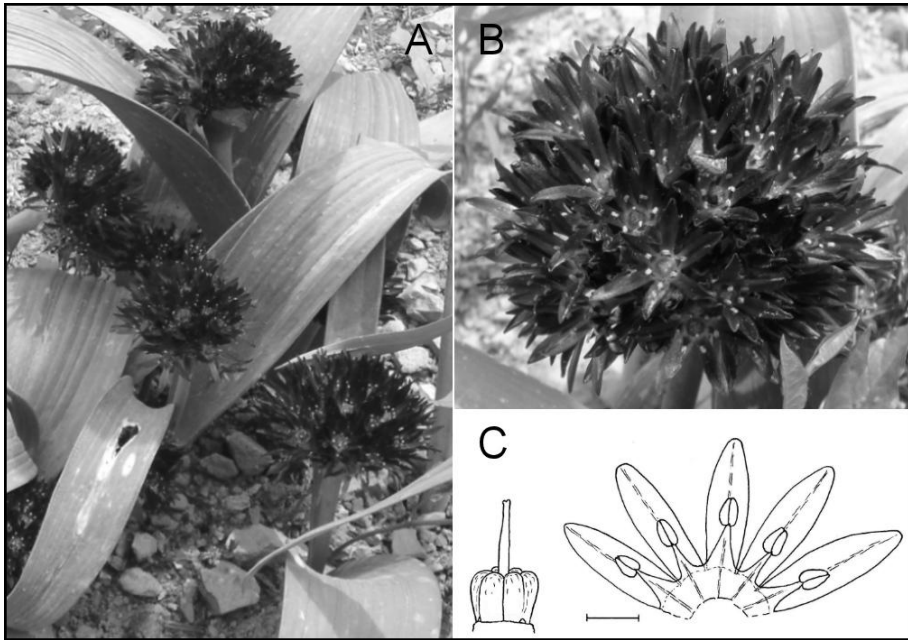


Fig. 7. *Allium hamedanense*: A. Cultivated plants, B. inflorescence, C. ovary and flower parts, scale bar = 2 mm (type location S Hamedan, NW Iran)

Description: Bulbs depressed-ovate, 2-3 cm long and in diameter, outer tunics moderately strong, brown. Scape \pm conical, flexuous, smooth, 4-6 (8) cm long above ground, above 7-8 mm and below 5-6 mm in diameter, green. Leaves 1-2, ovate up to narrowly lanceolate, obliquely upright and then recurved, the short hooded tip enrolled, basally stronger and above slightly canaliculate, thick, margin red-brown, basally very coarse and nearly smooth near tip, upper side grooved, lower side with shallow wide ribs or nearly smooth, 8-14 cm long and 2-4.5 cm wide, glaucous, very dull. Basal sheath leaf of variable length, faint, papery. Spathe membranous, above basal third split in 4-5 triangular parts, initially as long as the inflorescence, later

shorter and patent. Flowers funnel-shaped star-like, anthesis in May-June. Inflorescence sub-fasciculate to semi-globose, very dense, c. 2 cm high and 3-4 cm in diameter. Pedicels cylindrical, straight, 8-10 mm long, greenish, reddish flushed. Tepals lanceolate, obliquely spread, long narrowed in a sub-obtuse tip, 7-8 mm long, up to 2.5 mm wide, dark maroon-reddish, with inconspicuous greenish median vein, finally spine-like strongly longitudinally folded. Filaments 1/3-2/5 as long as tepals, triangular, basally shortly united and inner filaments 1.5 times broader as outer ones, dark maroon-reddish. Anthers \pm elongated, 1.3 mm long and 0.7 mm wide, pinkish brown. Pollen yellow. Ovary not stalked, six-angled depressed-globose, glossy, on the top with 6 radially directed, conical outgrowths, 2 mm long, 2-3 mm in diameter. Stylus thread-like, 2-3 mm long, whitish. Stigma undivided.

Distribution: Iran, Prov. Hamedan, known only from the type location.

The only available accession of this new species occupied a separate position among members of sect. *Acanthoprason* in the phylogenetic molecular analysis of the genus *Allium* (GURUSHIDZE *et al.*, 2008). However, this accession clustered in recent molecular studies (GURUSHIDZE, unpublished) together with most accessions of *A. materculae* subsp. *graveolens*. This seems rather strange because of remarkable morphological differences, but must be regarded as unverified result as long as more accessions are not available. The taxonomic relations of *A. hamedanense* remain therefore unclear.

**2. subg. *Melanocrommyum* sect. *Melanocrommyum* Webb et Berthel.
(*sensu stricto*)**

2.1 The *A. nigrum* alliance

According to the key and description given by WENDELBO (1971: 79), a white-flowering species found in the Saral area of the Province Kurdistan with straight 30-50 cm long scapes should be *A. kharputense* Freyn & Sintenis. However, FREYN (1892) described that species to have 2-3, up to 4 cm wide, flat leaves, and yellow filaments much longer than the tepals. But our plants showed 4-7 narrowly linear-lanceolate, canaliculate leaf blades rarely broader than 2.5 cm (Fig. 8 A), and tepals slightly longer than the purely white, fleshy, narrowly-triangular filaments (Figs 8 B, D). Most conspicuous were the initially blackish-purple, six-furrowed, completely smooth and glossy ovaries which changed to green in later stages of anthesis (Fig. 8 C). When compared with *A. orientale* Boiss., both taxa shared similar scape lengths, broadly fasciculate and rather dense inflorescences, star-like flowers, blackish-purple ovaries, and the identical relative length and form of filaments. However, *A. orientale* differs by much broader and undulate leaves, longer, ovate, spoon-shaped (not linear-lanceolate) tepals with green (not white) median veins, finely tuberculate (not smooth and glossy) ovaries, and nearly rotundate (not deeply three-furrowed) capsules. Thus the plants from Saral area represent a still undescribed species named:

***Allium saralicum* R.M. Fritsch, species nova** (Fig. 8)

Holotype: Iran, Prov. Kurdistan, Marivan, 65 km to Baneh, 2 km to Ghamchian; 1400 m, 06.05.1996, leg. Attar-Okhovat (TUH).

Diagnosis: Characteria propria folia in numero 4 usque 7 anguste-linearia vix latiora 2.5 cm, tepala alba nervis medianis albis, filamenta alba subbreviora tepalis, et ovaria laevissima polita. Species affinis *A. orientale* propria folia minus in numero, latiora undulataque, tepala nervo mediano viridi, et ovaria verrucosa. *Allium kharputense* differt foliis latis et minus in numero, filamentis luteis valde longioribus quam tepala.

Description: Bulbs depressed-globose, c. 2 cm long and in diameter, outer tunics grayish-brown. Scape cylindrical, slightly flexuous, smooth, c. 7 mm in diameter, 30-50 cm long, green, near the base red flushed and glossy. Leaves 4-7, linear, tip triangularly tapering, obliquely recurved, canaliculate up to the tip, margin whitish, cartilaginous or coarse, smooth near the tip, upper side slightly reefed, lower side with narrow ribs, dull glaucous, near base somewhat red flushed. Outer sheath leaf thin, soon decaying. Spathe papery, nearly completely split in several acute, ovate-triangular parts, finally patent or reflexed, faintly brown with brown nerves. Flowers bowl-shaped star-like, anthesis in April and May. Inflorescence fasciculate finally semi-globose, very dense, up to 4.5 cm high and 8 cm in diameter. Pedicels cylindrical, curved, rather soft, 2-3 cm long, yellow up to green, faintly glossy. Tepals \pm broadly lanceolate subobtuse, slightly concave, patent, later reflexed, finally enrolled and crumpled, c. 5 mm long and 1.2 (inner tepals) to 1.5 mm (outer ones) wide, purely white with white median vein. Filaments mostly slightly longer than tepals, fleshy, narrowly triangular (inner ones wider), near base shortly connate, white. Anthers oblong, up to 2.2 mm long and c. 1 mm wide, yellow up to brownish, pollen yellow. Ovary not stalked, nearly globose with six furrows, 1.5-2 mm long, c. 2.5 mm in diameter, smooth, blackish-red later green; surface with glossy small

cell walls, mouth of nectary small. Style basally slightly sunken in the top of ovary, thread-like, 2-4 mm long, whitish with carmine-flushed base. Stigma undivided,

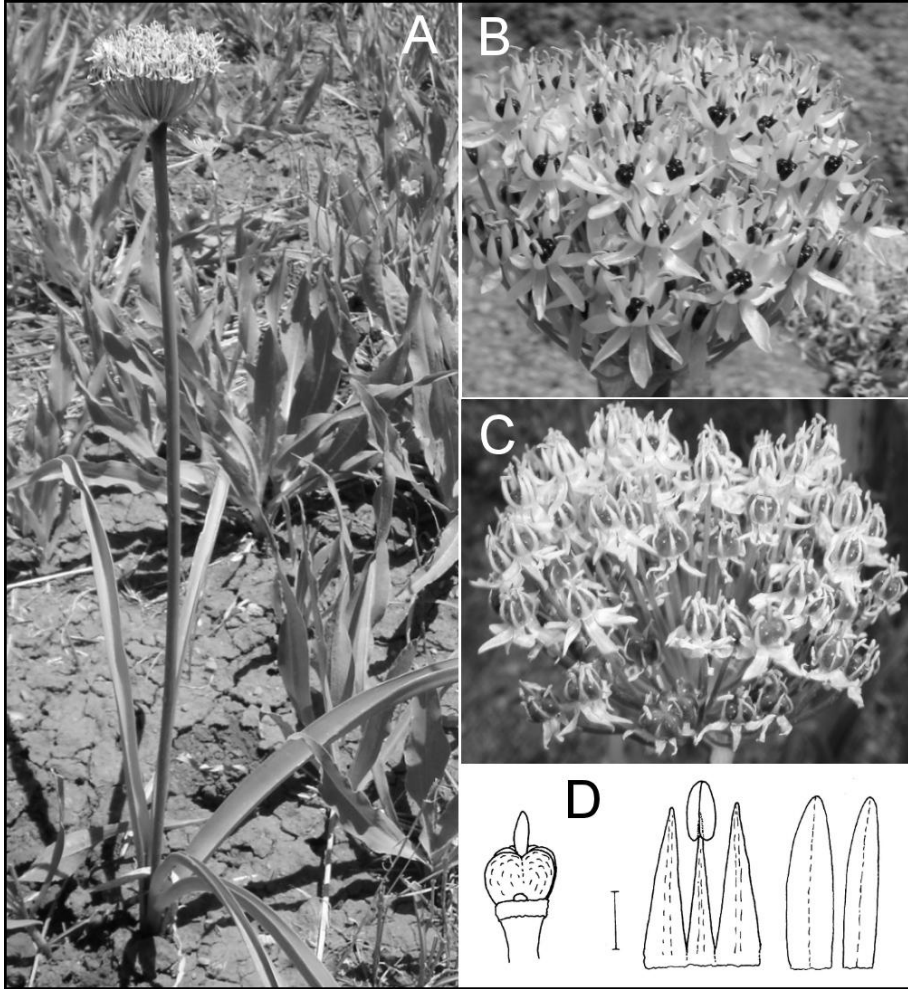


Fig. 8. *Allium saralicum*: A. Flowering plant in an abandoned field; B: inflorescence at begin and C. at the end of anthesis, D. on the left: ovary, in the middle: two inner filaments and one outer filament with anther, on the right: inner and outer tepals, scale bar = 2 mm (Saral station N Sanadaj, NW Iran).

± acute, whitish. Capsule obconical-obovate, with three deep longitudinal furrows, 5-8 mm long.

Distribution: Iran, Prov. Kurdistan, known yet from an area approximately between 35°-36° N and 46°-47°30' E.

Additional specimens seen (all from Iran, Prov. Kurdistan):

Territory of the Saral Agricultural Station c. 30 km before Divandarreh, on an abandoned field, formerly a dry meadow, 2100 m, 35°40'23" N, 047°07'22" E, 18.05.2006, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1115 [cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran]; 32 km E Sanandaj, 1500 m, Furse 2036 (W); Dez Shahpur, 1600-1700 m, Jacobs 6551 (W); between Sanandaj and Mahabad, among rocks; 4500 ft., 29.6.1960 Furse & Syngé 707 (44009-IRAN); elevations of Abbedar 5 km from Sanandaj, 1750 m, 07.05.1986 Fattahi No. 1104 (TARI) and No. 1030 (HKS); Maryvan to Baghez road, Garan station, 1320 m, Maroofi 30.4.2004 No. 7092 (HKS); Divandareh, slopes of Chehelcheshme mountain, Best village, 1970 m, Maroofi & Moradi 08.5.2004 No. 6994 (HKS); Maryvan to Saghez, Ishag-Abad pass, 2100 m, Marrofi & Sh. Nazeri 19.05.2003 No. 6156 (HKS); Shaho mountains, Daleh marz village, 800 m, Kaffash 07.4.1995 No. 3061 (HKS); Anbar-Bazan village SW Sanandaj, Kaffash & Taregat 24.5.1997 No. 4143 (HKS); Saral area N Sanandaj, Bayenchoob village, 1870 m, Kaffash & Fany 20.5.1997 No. 3971 (HKS); Saral area, N Sanandaj, Doozakh-Darreh village, Hosseini 15.5.2005 (HCAT).

Other related species are *A. reflexum* Boiss. from Iraq and *A. asclepiadeum* Bornm. from Turkey. The first mentioned taxon has narrowly linear, yellowish tepals shorter than the lanceolate, yellowish-green filaments, and *A. asclepiadeum* is

characterized by only 7-8 mm wide leaves, oblong tepals with a conspicuous median vein, and basally blackish-purple filaments much shorter than the tepals.

Allium saralicum shared identical ITS-sequences with *A. minutiflorum* and *A. noëanum* Reut. ex Regel in the molecular phylogenetic study of GURUSHIDZE *et al.* (2008). Though the relationship of this group remained unresolved, *A. nigrum* and *A. orientale* were affiliated to another, clearly separated group.

2.2 The *A. colchicifolium* alliance

Allium plants showing a stocky stature like *A. akaka* (leaf blades ovate to oblong or broadly lanceolate and longer than the short scape) but with relative broad tepals never becoming either convolute or prickle-like after anthesis are generally affiliated to sect. *Melanocrommyum*. Here *A. colchicifolium* is the only species meeting all these characters. However, this name was connected with rather diffuse flower characters and "elliptic to sub-orbicular" leaves by WENDELBO (1971) and KOLLMANN (1984), although the original description was "*perigonii albidii phyllis oblongis acutis a medio sursum eroso-denticulatis*" and "*foliis glabris oblongis utrinque attenuatis*". Both cited authors included *A. straussii* Bornm. and *A. haussknechtii* Náb. as synonyms. Probably WENDELBO (1971) was not able to recognize the variation pattern of *A. colchicifolium* because only two more vouchers beside the type specimens of the cited synonyms were available to him, and apparently all vouchers differed remarkably one from another.

The observation of our living plants belonging to this alliance showed considerable variation but without confirmation of the original characters of

A. colchicifolium. First to mention is the shape of leaves which was always tapering towards base as well as in a short or long acute tip. Also the tepals were never denticulate or crenulate but with entire margin and either long tapering, short acute, or obtuse. The ovaries (not mentioned in the original description of *A. colchicifolium*) were either smooth and glossy (and then blackish or deep violet in early stages of anthesis) or permanently green and verruculose. Three clearly different taxa could be recognized which did not correspond to any hitherto described taxon.

Plants collected east of Bisotun flowered in the Tehran collection only in the next year. They showed 10-12 mm long lanceolate, acute, whitish tepals with long, plicate tip, patent yellow or reddish filaments less than half as long as the tepals, and six-furrowed, sub-globose, silk-like glossy ovaries with an always green basal part (Figs 9 A-C). Though tepals of *A. karamanoglu* Koyuncu & Kollm. from Turkey have long tapering tips making a similar appearance, all other generative and vegetative characters of that species differ strongly. Our plants must represent a peculiar new species:

***Allium bisotunense* R.M. Fritsch, species nova** (Fig. 9)

Holotype: Cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1093, leg. 21.04.2008 (IRAN); plants collected in Iran: Prov. Kermanshah, limestone massif N of the main road from Sahneh to Kermanshah, c. 15 km E Bisotun, rubble slopes, leg. 12.05.2006 M. Abbasi, R.M. Fritsch, M. Keusgen. Other plants of this accession were cultivated in the Gatersleben taxonomic reference collection No. TAX6489.

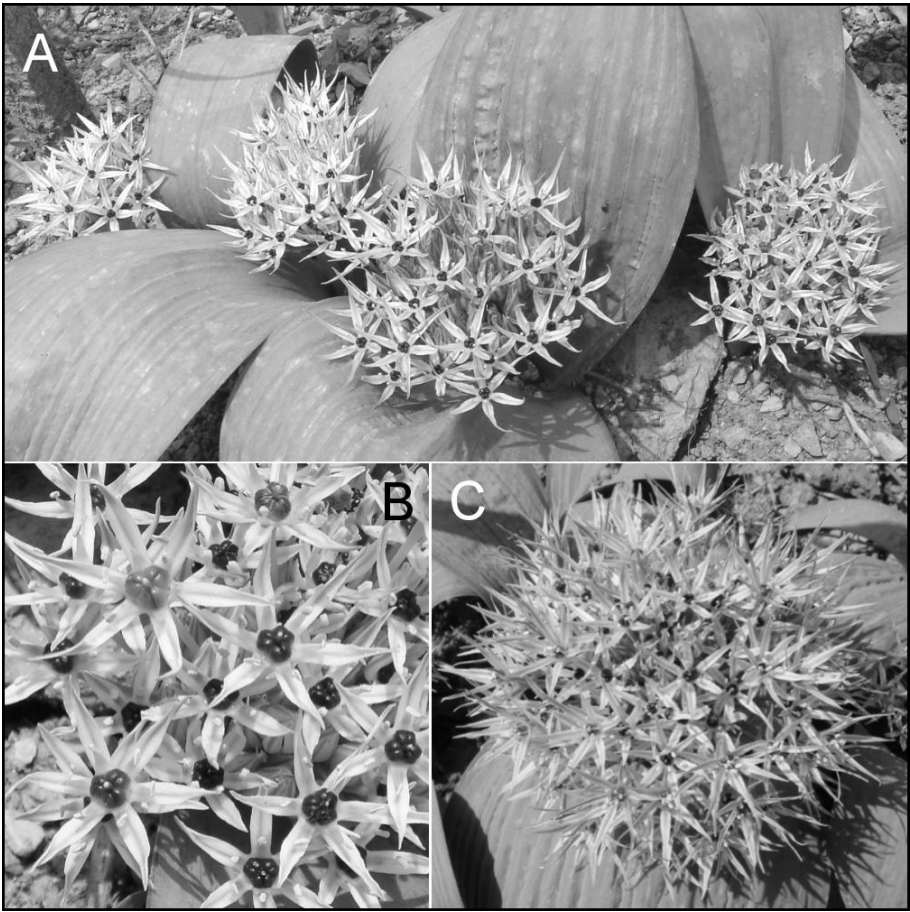


Fig. 9. *Allium bisotunense*: A. Cultivated plants, B. flowers enlarged, C. inflorescence (type location E Kermanshah, NW Iran).

Diagnosis: Characteria propria tepala acuta terminalisque valde longitudinaliter plicata, filamenta patentia lutescentia vel rubescentia longitudine minus dimidia tepalorum, et ovaria hexasulcata depresso-globosa subintense polita. Species affines *A. colchicifolium* propria tepala elongata eroso-dentata, et *A. keusgenii* propria tepala breviora obtusaque et ovaria intense polita.

Description: Bulbs depressed globose, 2-3 cm in diameter, outer tunics blackish, decomposing. Scape conical, \pm straight, below 3-5 mm above 4-6 mm in diameter, above ground 4-8 cm long, smooth, green, glaucous, near base partly violet flushed. Leaves 2, widely lanceolate to ovate, thick, flat, obliquely directed and recurved, with a short hooded tip, near base \pm canaliculate, upper part \pm flat, margin below coarse above smooth, reddish, upper side with (often zigzag-like) grooves or nearly smooth, lower side with fine ribs and humps below the grooves of upper side, 15-25 cm long, 3-10 cm wide, blue-green with strong glaucous bloom, near base often reddish. Spathe papery, $3/4$ of its length split in 2-3 widely ovate-triangular, shortly tipped parts, faintly brown with darker nerves, initially adpressed to the pedicels later patent. Flowers bowl-shaped star-like, anthesis in April-May. Inflorescence fasciculate up to semi-globose, dense, 5-6 cm high and 6-10 cm in diameter. Pedicels of unequal length, wire-like, curved, green often brown or violet flushed, \pm dull. Tepals lanceolate, sub-acute, the upper part longitudinally folded and therefore seemingly acute, obliquely patent, finally slightly crumpled, 10-12 mm long, up to 2.5-3 mm wide near the base, white or reddish outside with narrow green to brown median vein. Filaments $2/5-1/2$ as long as tepals, narrowly triangular, inner ones basally twice as wide as the outer ones, basally not connate and whitish up to yellow, upper part yellow or carmine flushed. Anthers oblong, 2 mm long and 1 mm wide, as the pollen yellow. Ovary not stalked, depressed globose with six furrows, c. 2 mm long and 3 mm in diameter, surface cells even and dull, upper half blackish red, lower half green, finally completely green, mound of nectary pore-like (slit-like?), slightly humped. Stylus basally surrounded by a narrow groove, conically

thread-shaped, 1-2 mm long, initially carmine later green. Stigma undivided, acute, whitish.

Distribution: Iran, Prov. Kermanshah, known yet only from the type location.

In 2007, we found another taxon north of Bisotun having flowers more similar to those of *A. orientale*: Tepals ovate, 6-8 (10) mm long, white, with obtuse concave tip and yellowish-green median veins. However, the initially very dark ovaries were six-furrowed, sub-globose, and glossy, the filaments three-angled, fleshy, initially purplish in the lower part and later white throughout, and the leaves were not undulate, broader and shorter (Figs 10 A, B). These plants represent another new species:

***Allium keusgenii* R.M. Fritsch, species nova** (Fig. 10)

Holotype: Iran, Prov. Kermanshah, Sahneh towards Sonqhor, Baktar Olia village, S slope of Dalikhani mountain, 2270 m, 34°38.962' N, 47°36.836' E, leg. 19.5.2007 M. Abbasi, R.M. Fritsch, M. Keusgen, (48373-IRAN). Other plants of this accession were cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1198 (voucher specimens in IRAN), and in the Gatersleben taxonomic reference collection No. TAX6651.

Diagnosis: Characteria propria tepala 6 usque 8 mm longa nervo mediano intensius colorato terminalisque obtusis, filamenta plus minus recta et basalis rubescentia, et ovaria perpolita. Species affines *A. colchicifolium* propria tepala elongata acuta eroso-dentata, et *A. moderense* propria tepala concava cochlearia ovariaque papillato-scabra.

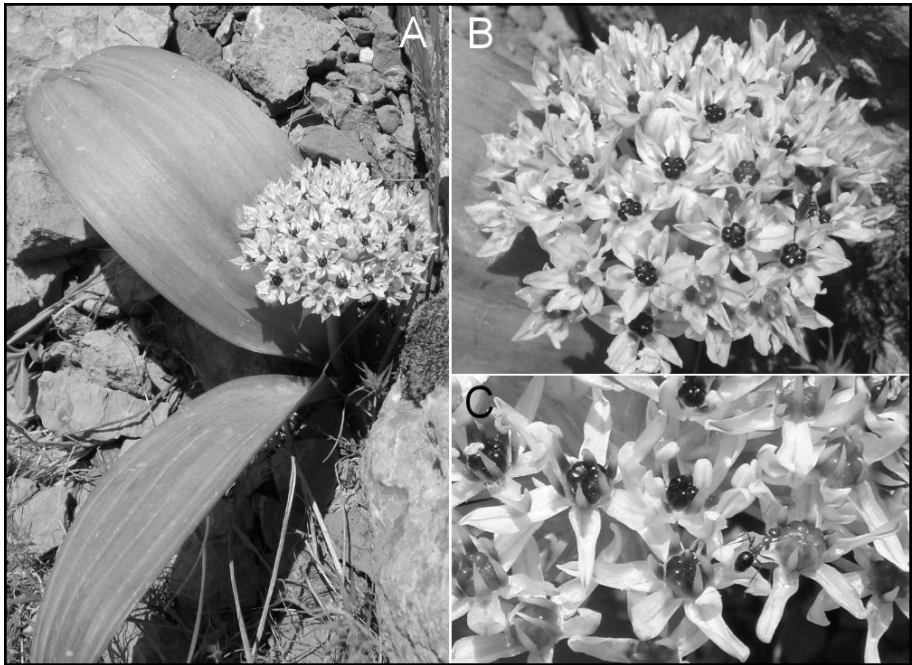


Fig. 10. *Allium keusgenii*: A. Flowering plant, B. inflorescence, C. flowers enlarged (type location E Kermanshah, NW Iran).

Description: Bulbs ovate up to depressed-globose, 2-4 cm high, 2-6 cm in diameter, outer tunics blackish, disintegrating. Scape above ground 4-15 cm long, slightly flexuous, conical, upper part 4-8 and basal part 3-6 mm in diameter, smooth, green or carmine flushed. Leaves (1) 2-3, ovate up to lanceolate, thick, near base convolute becoming slightly canaliculate towards the short hooded tip, margin narrowly reddish or white, coarse, upper side grooved or with wavy areas or \pm smooth, lower side with weak broad ribs or nearly even, 2.5-6 cm wide and 7-12 (20) cm long, bluish-green (probably initially violet flushed) with glaucous bloom, carmine near base. Spathe most often completely split in 2 triangular parts, initially adpressed to the pedicels and later reflexed, faintly brown with somewhat darker nerves. Flowers

cup- to bowl-shaped, star-like, without odor, anthesis in May. Inflorescence fasciculate to semi-spherical, dense but finally looser, c. 3 cm high and 3-8 cm in diameter. Pedicels cylindrical, soft, curved, up to 4 cm long, whitish, greenish or slightly carmine flushed, dull or slightly glossy. Tepals ovate to linear-ovate, slightly boat-shaped or lengthwise folded, with an obtuse or sub-acute tip, obliquely to right-angled patent, finally crumpled, 6-10 mm long and 3.5 mm wide, white with \pm wide, green to reddish-brown median vein. Filaments $1/2$ up to $2/5$ as long as tepals, fleshy, basally not united, inner ones widely triangular, outer ones remarkably narrower, whitish, basally \pm intensely violet flushed. Anthers oblong, c. 2 mm long and 1 mm wide, yellow. Pollen faintly yellow. Ovary attached to the strongly thickened tip of pedicels, depressed-globose with six furrows, 2 mm long, 2.5-3 mm in diameter, glossy, surface covered by fine smooth cells, initially violet and finally green, mound of nectary near the base, small, triangular. Base of the style narrowly funnel-like sunken in the tip of ovary. Stylus conical to thread-shaped, 3-4 mm long, initially carmine, later white like the undivided sub-acute stigma.

Named after Prof. Dr. Michael Keusgen, pharmacists from Marburg, Germany.

Distribution: Iran, Prov. Kermanshah, known yet only from the mountain area between Sahneh and Sonqor.

Additional specimens seen (all from Iran, Prov. Kermanshah)

Sahneh: Amruleh mountain, 2500 m, Neamati & Yusofi 23.5.1998 No. 4794 (NRK);

Sonqor Gavanban mountain, 1450 m, Neamati & Mirabdali 27.5.1992 No. 3415 (NRK).

Closely related is apparently *Allium straussii* which was only shortly characterized in the original description [Beih. Bot. Centralbl. 28 II: 515 (1911), *in*

textu] to possess a very short scape, two up to 5 cm wide leaves, a many-flowered umbel, broader sub-obtuse, white, later reflexed tepals which are somewhat longer than the basally united filaments. The only plant of the lectotype [(hic design.) Iran: Schahu, 25. V. 1905, leg. Strauss (B!)] has a c. 15 cm long, apparently smooth scape, two leaves circa 8 x 18 cm and 10 x 2.5 cm (length x width) with short triangular cucullate tips, a semi-globose inflorescence c. 5 cm long and 8 cm in diameter, white concave tepals with smooth margin, later crumpled and reflexed, outer tepals broadly lanceolate, acute, 5.5-6 mm long and 2.5 mm wide, inner ones sub-ovate, obtuse, 4.5-5 mm long and 3 mm wide, filaments basally c. 0.5 mm connate, above the outer ones subulate, the inner ones thickish, both apparently fleshy, and possibly red (brown) colored. Ovaries not stalked, \pm globose, c. 3-4 mm long and in diameter, smooth (like varnished), also the sub-globose, c. 5 mm long capsules show a glossy surface. *Allium keusgenii* differs mainly by obtuse (not acute) outer tepals, and shorter, only slightly colored filaments. Comparison of living plants will be essential to verify these differences.

According to the original description of *A. haussknechtii* [Publ. Fac. Sci. Univ. Masaryk, Brno 105: 37, 1929. Lectotype (hic design.): Syria, inter segetes c. Aleppo prope pagum Moselmia, alt. 1200' ubi id legit 14.IV.1865, C. Hausskn. (JE)], this related taxon differs by acute, less than 3 mm wide tepals, not fleshy, basally united, subulate filaments the inner ones being basally abruptly and strongly widened, and verruculose ovaries. Because the description and the figures used for the original publication were added to the voucher in JE containing only one inflorescence, it was chosen as lectotype. Unfortunately, the Iranian syn-type [Kurdestania Persica: supra pagum Rezhah dit. Kasr-i-Shirin, in humosis alt. c. 1800

m, 5. V. 1910, leg. Nábelek No. 2339] could neither be studied yet, nor were living plants available. It remains doubtful whether the Syrian and Iranian plants collected about 750 km apart really belong to one taxon.

On dry rocky slopes of the Modere valley west of the town Arak we found many flowering plants of *A. materculae* subsp. *graveolens* (described above), but a population of equally small plants on a rubble slope differed by longer and narrower, strongly furrowed, bluish-green leaves (Fig. 11 B), and flowers only in the budding stage. A few days later, some of the collected plants opened some flowers which were scentless and showed obovate, spoon-shaped, white tepals with a thick green median vein. Only two years later the plants flowered under cultivation showing again these specific characters (Fig. 11 A). They belong to another new species:

***Allium moderense* R.M. Fritsch, species nova** (Fig. 11)

Holotype: Cultivated in the Gatersleben taxonomic reference collection No. TAX6616, leg. 06.06. 2008 (GAT); plants collected in Iran, Prov. Markazi, Modere valley, W Arak, E exposed rubble slope of limestone and slate, 1930 m, 34°06.221' N; 49°38.561' E, 09.05.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1148. Other plants of this accession were cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1148.

Diagnosis: Characteria propria folia lanceolato-triangularata valde longitudinaliter sulcata, tepala cochlearia nervis incrassatis et ovaria papillosa. Species affines *A. bisotunense* et *A. keusgenii* differt foliis ovalioribus et ovarii plus minus politis. *Allium colchicifolium* differt tepalis acutis eroso-dentatis.

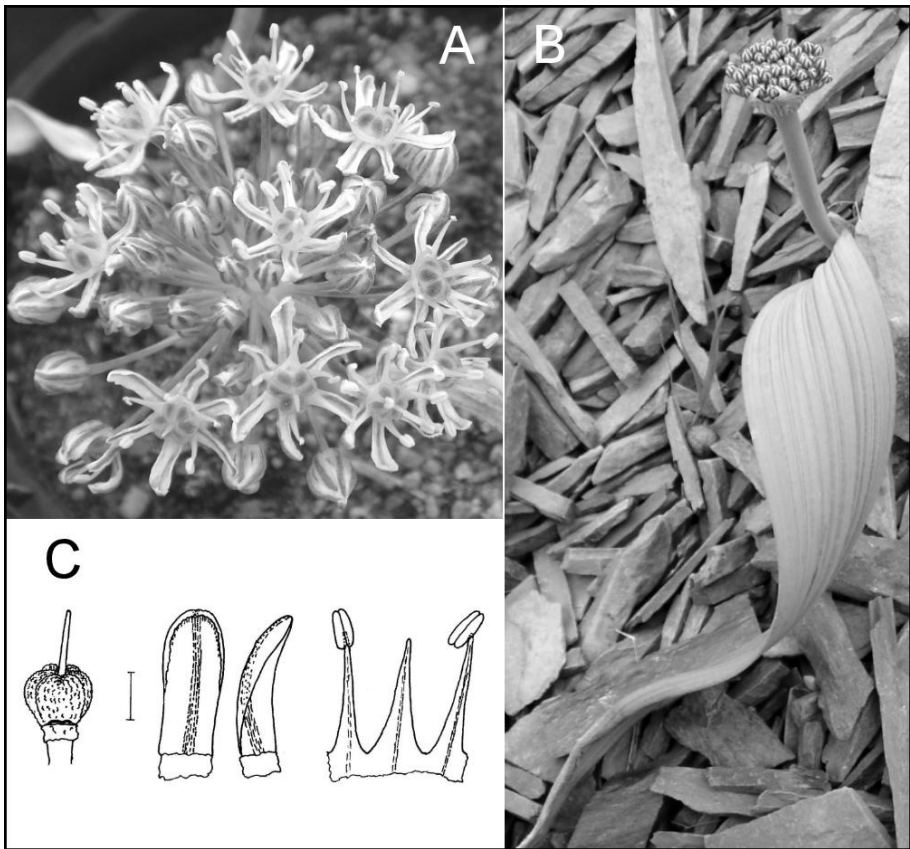


Fig. 11. *Allium moderense*: A. Inflorescence, B. plant in budding stage, C. flower parts, on the left: ovary, in the middle: left inner tepal (flattened), right outer tepal, on the right: outer filaments with anthers, and inner filament, scale bar = 2 mm (type location Modere valley W Arak, W Iran).

Description: Bulbs ovate to depressed-globose, 2-4 cm in diameter and long, outer tunics thick, more longitudinally fibrous than in pieces decomposing, inner tunics stronger, whitish. Scape subconical, mostly slightly flexuous, above ground 5-10 cm long, 4-7 mm in diameter, smooth, green, \pm violet flushed. Leaves 1-2, linear-lanceolate tapering in a long, probably not hooded tip, \pm thick, even, adpressed to

the ground, margin red and finely coarse, upper and lower sides strongly grooved, 1.5-5 cm wide, 15-30 cm long, bluish-green with strong bloom, reddish near base, becoming red when withering. Spathe membranous, splitting in several parts, whitish with dark greenish-brown veins. Flowers flat bowl-shaped, star-like, anthesis in May. Inflorescence moderately dense, 4-7 cm in diameter, rather loose in fruiting stage. Pedicels thick, stiff, ribbed, dull green. Tepals ovate-oblong, obtuse, spoon-shaped, margin and tip strongly concave, position slightly curved patent, (flattened) 6-8 mm long and c. 3 mm wide, widest place near 3/4 of its length, obtuse; white, with rather broad, dark-green median vein. Filaments nearly as long as the tepals, basally shortly united and short-triangular (inner ones wider and higher) widened, above \pm subulate; white. Anthers oblong, c. 1.5 mm long and 0.8 mm wide, reddish-grey. Pollen faintly grey. Ovary without stalk, \pm globose with three furrows, c. 2 mm long and 3 mm in diameter, green; surface coarse, in the upper part cells with long papillae, mouth of nectary inside of a rather wide, curved pocket. Base of style sharply funnel-like sunken in the tip of ovary. Stylus conically thread-shaped, 2-4 mm long, white like the undivided, acutish stigma.

Distribution: Iran, Prov. Markazi, only known from mountain massifs W and E Arak.

Additional specimens seen (all from Iran, Prov. Markazi):

Living plants cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1163, plants collected in a mountain range ESE Arak, eastern slope, limestone rubble on the top of Mt. Barfshah, 2880 m, 35°58.42' N, 50°06.695' E; 11.05.2007, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1148. Other plants of this accession were cultivated in the *Allium* reference collection in

Gatersleben No. TAX6629.

2.3 sect. *Megaloprason* (*sensu stricto*)

At the markets of the Province Kermanshah (NW Iran), fresh leaves of a medicinal plant named "sorkhe" made the general impression as belonging to *A. jesdianum* Boiss. et Buhse but differed by glossy (not dull) leaves, smooth (not basally ribbed) scapes, and thick and soft (not thin and membranous) bulb tunics (Fig. 12 D). Some sellers told us that the leaves were collected in "the mountains around". Later we were lucky to find a few flowering plants showing these characters on moderately steep, stony slopes among high perennial vegetation. The flowers showed nearly all characters of *A. jesdianum* (Fig. 12 B) but initially rose and later pinkish-purple filaments. The leaf bases and wounded parts secreted also a red liquid like typical *A. jesdianum*.

***Allium jesdianum* subsp. *remediorum* R.M. Fritsch, subspecies nova** (Fig. 12)

Holotype: Cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1106, leg. 21.04.2008 (IRAN); plants collected in Iran: Prov. Kermanshah, grassy slope SW- to W-exposed small limestone massif W of Mt. Shahu main chain above village Gheshlagh, 2320 m, 34°58'07" N, 46°27'44" E; leg. 15.05.2006 M. Abbasi, R.M. Fritsch, M. Keusgen. Other plants of this accession were cultivated in the Gatersleben taxonomic reference collection No. TAX6498 (voucher specimen in GAT).

Diagnosis: Characteria propria tunicae bulbi crassae molles in fibras solutae, folia polita, scapi leves filamentaque rosea usque roseo-purpurea. Differt characteribus supra citatis ab subspecie typica quae tunicas bulbi tenue-membranaceas, folia

impolita, scapos basales costatos filamentaque initio alba ostendit.

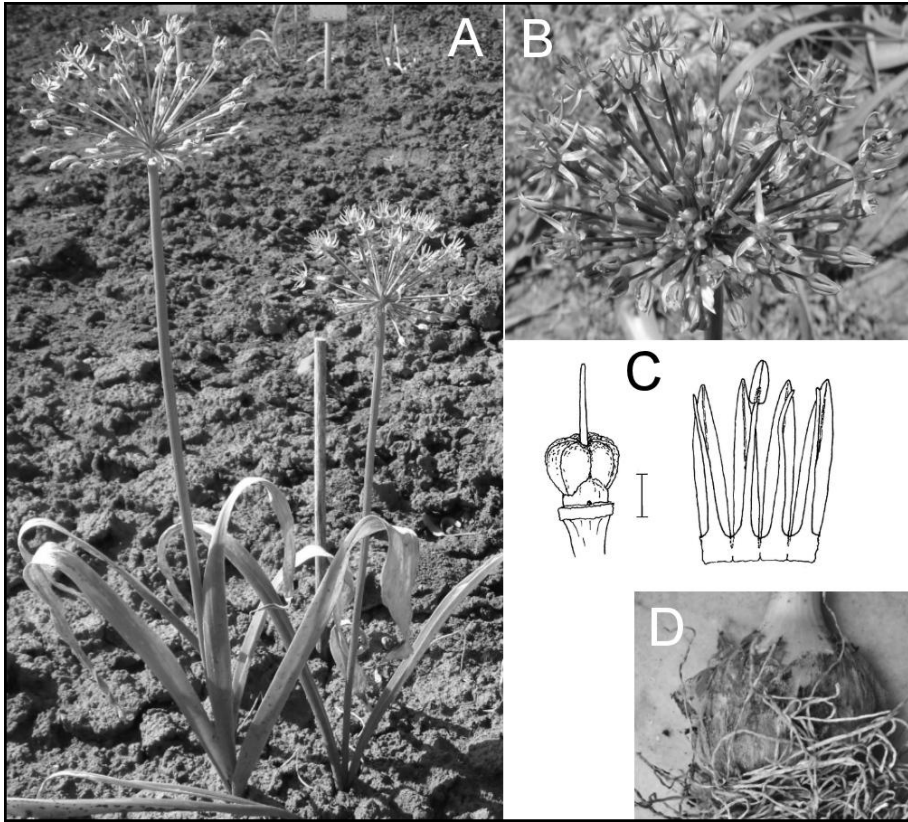


Fig. 12. *Allium jesdianum* subsp. *remediorum*: A. Cultivated plants (bulbs bought at Khoramabad market), B. inflorescence, C. ovary and flower parts, scale bar = 2 mm, D. bulb tunics (type location, Shahu massif NW Kermanshah, NW Iran).

Description: Bulbs globose up to depressed-globose, (1) 2-3 cm in diameter, outer tunics thick, soft, grayish-brown, dissolving in fine threads. Scape cylindrical, smooth, glossy, 25-40 cm long, 4-6 mm in diameter, green, basally purplish flushed. Leaves 4-7, very narrowly lanceolate, obliquely directed, upper part recurved, canaliculate, rather thin, margin smooth, upper side smooth, lower side with broad

shallow ribs, shiny, fresh green (not glaucous!), basally somewhat purplish flushed. Spathe membranous, splitting in 2-3 shortly triangular reflexed parts, faintly brown with darker nerves. Flowers cup-like stellate. Inflorescence semi-globose to globose, many-flowered, moderately loose, 6-10 cm in diameter. Pedicels thin, wiry, of nearly equal length, brownish green, glossy. Tepals linear-lanceolate, spreading, after anthesis spirally enrolled, 8-10 mm long, 1.5-2 mm wide, tip sub-obtuse to sub-acute and somewhat cucullate, pinkish-purple with purple mid-vein. Filaments 3/4-5/6 as long as tepals, subulate, basally shortly connate and c. 0.5 mm long widened to quadratic form; pinkish. Anthers oblong, c. 2 mm long, purplish, pollen faintly yellow. Ovary six-furrowed pyriform, tuberculate, basally remarkably narrowed and nearly smooth, with a small dot-like mound of nectary. Stylus filiform-conical, 3-4 mm long, pinkish, tipped by the dot-like stigma.

Distribution: Iran, Provinces Kermanshah, Lorestan and Fars, but not yet known in detail.

Additional specimens seen (all from Iran):

Living plants cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1172, from bulbs collected in Iran, Prov. Lorestan, from plants sold at Khoramabad market, said to have been collected in Kouh-e Sefid; 13.05.2007 M. Abbasi, R.M. Fritsch, M. Keusgen. Other plants of this accession were cultivated in the Gatersleben taxonomic reference collection No. TAX6635 (voucher in GAT); Iran, Prov. Fars, Sepidan to Yasouj, leg. Hatami (ARIS).

About 100 km to the North, in the Province Kurdistan, we found very similar plants, but with dull leaves and papery bulb tunics. This taxon was growing

in moist meadows and in ploughed fields. Flowers and inflorescences were again identical. The local people regarded these plants as weed and denied any use (ABBASI *et al.* 2008).

3. subg. *Allium*

3.1 sect. *Allium*

In the rocky valley above spring Aznav (near Khalkhal, Prov. E Azarbaijan) we collected a few plants in vegetative state having rather small and flat leaves like *A. macrochaetum*. In 2007 one specimen flowered in the Tehran collection and showed a peculiar combination of characters: Longitudinally ribbed bulb tunics, a sub-globose, rather dense inflorescence (Fig. 13 B), white tepals with a prominent greenish-brown median vein and very scabrid surface like *A. rotundum*, slightly exerted anthers (Fig. 13 C), and side teeth of inner filaments about two times longer than the reflexed anther-bearing cusp (Fig. 13 D). This plant is the type of a new species:

***Allium aznavense* R.M. Fritsch, species nova** (Fig. 13)

Holotype: Cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1057, leg. 22.05.2007 (48372-IRAN); bulbs collected in Iran, Prov. Ardabil and western slopes of Talesh mountain range near N Khalkhal, exposed slope near spring Aznav, among rubble and rocks of marble, 1850 m, 37°34'22.2" N, 48°34'40.2" E, 04.06.2005, leg. R.M. Fritsch, Sh. Zarre & H. Moazzeni No. 1057.

Diagnosis: Characteria propria tunicae bulborum longitudinaliter costatae, tepala alba verrucosa nervis medianis conspicuis viride-badiis, filamenta minus eminentia,

interiora cuspidate antherifera dimidium longitudinis lateralium aequante. *Allium rotundum* differt foliis maiore numero et latioribus secuaque forma tepalorum, *A. subnotabile* differt foliis angustioribus, vaginis longioribus, tepalis inaequilongis et filamentis inclusis.

Description: Bulbs ovate, c. 1 cm in diameter and 1.5 cm long, outer tunics leathery with longitudinal ribs. Scape cylindrical, straight, smooth, 30-40 cm long, 4-5 mm in diameter, green with dull glaucous bloom. Leaves 2 or 3, flat and more channeled than keeled, very narrowly lanceolate, long tapering in a rather short tip, 12-20 cm long, in the lower half up to 6 mm wide, green with glaucous dull bloom. Spathe caducous. Anthesis toward end of May. Inflorescence conical to semi-globose, later sub-globose, moderately dense and many-flowered, 3-4 cm in diameter. Pedicels straight, rather thick, about 6-10 mm long, brownish-green. Flowers cup-shaped. Tepals ovate, margin of the upper part convolute, tip obtuse, reflexed, margin densely and back more loosely tuberculate, 4-4.5 mm long, 2.5 (inner tepals) and 2 mm (outer ones) wide; whitish with moderately wide, green-brown median vein. Filaments white, approximately as long as tepals or somewhat longer, outer ones long-triangular, inner ones with an ovate lower part about 3-4 times as long as the triangular median cusp, lateral cusps tapering in filiform tip, 2-3 times longer as median cusp, all cusps recurved, margins in the basal third of all filaments densely toothed. Anthers \pm exserted, oblong, carmine. Pollen grayish-yellow. Ovary ovate, tip embraced with six periclinally extended outgrowths, c. 4 mm long and 2-3 mm in diameter. Stylus slightly conical, 2.5-4 mm long, white. Stigma \pm undivided. Capsule and seeds not seen.

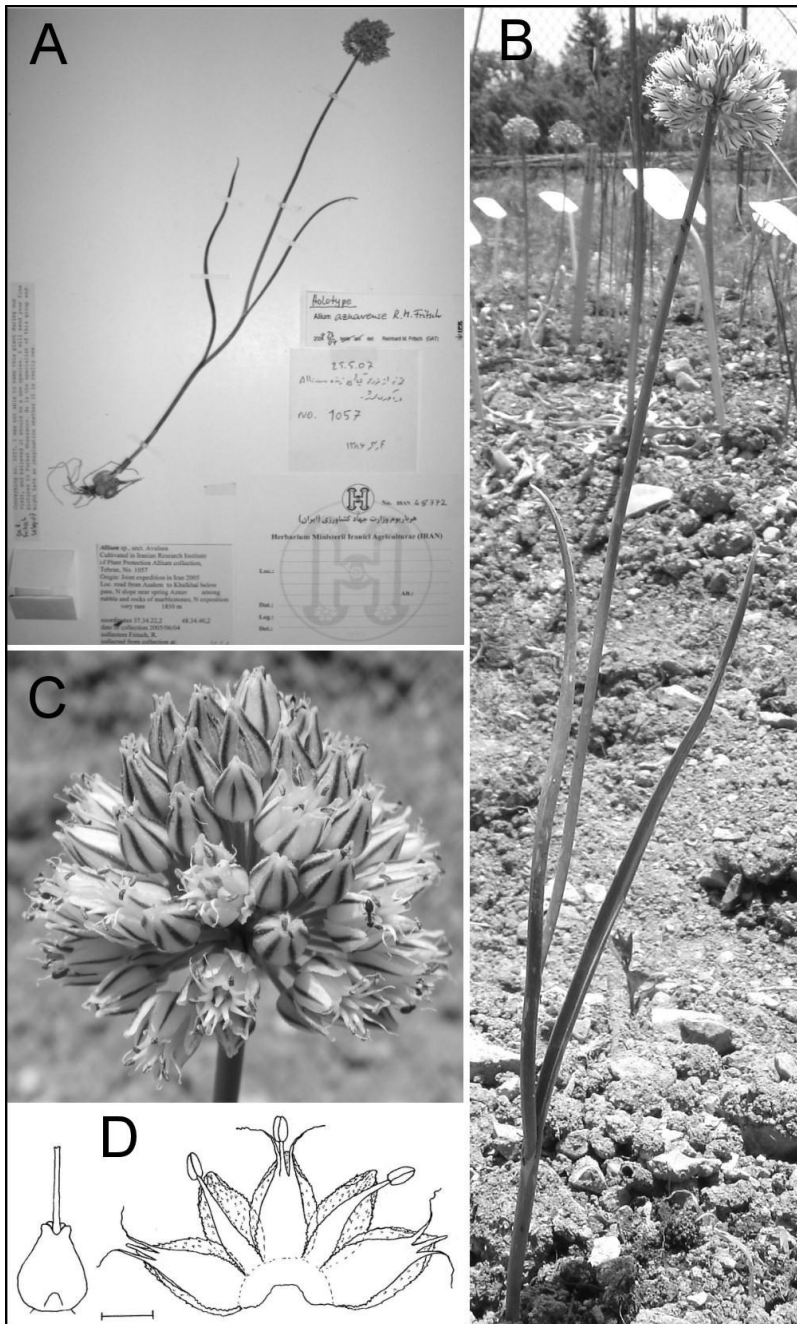


Fig. 13. *Allium aznavense*: A. Holotype sheet, B. cultivated plant, C. inflorescence, D. ovary and flower parts, scale bar = 2 mm (type location W Khalkhal, N Iran).

Distribution: Iran, Prov. Ardabil, only known yet from the type location.

The relationship of this new species was difficult to find. The distribution pattern of tubercles on the tepals is similar to the *A. rotundum* L. alliance, but the different structure of bulb tunics, the low number of leaves which are short and narrow, and the form of tepals are striking differences. *Allium longipapillatum* R.M. Fritsch et Matin has similar leaves but much shorter pedicels, different tepals, and no outgrowths on the ovary. Also *A. phanerantherum* Boiss. et Hausskn., which owns tubular cylindrical leaves and smooth tepals, is not closely related despite it shares similar forms and dimensions of tepals and filaments as well as a coronate ovary with *A. aznavense*. A closer relative is perhaps *A. subnotabile* Wendelbo showing a similar stature and scabrid-papillose tepals, but it is differing by narrower leaves with longer sheath parts, tepals unequal in lengths, and included filaments.

During the research missions in 2005 and 2006, rather small *Allium* plants were collected in the Karaj valley near the village Asara (Alburz mountain range, N Iran). Both populations were in the vegetative stage very similar one to another showing narrow tubular leaves with long sheath parts. The plants collected in 2005 flowered once (in 2006) and showed much similarity to *A. capitellatum* Boiss. (FRITSCH 2008).

The second population (collected in 2006) possessed long-stalked side bulblets (Fig. 14 A) and flowered only in 2008. Surprisingly, the urceolate flowers were brownish-purple with finely tuberculate and therefore dull tepals, and long exerted lateral cusps of inner stamina (Figs 14 C, D) gave evidence to belong to sect. *Allium*. These plants showed a similar appearance like small purple-flowered plants of *A. phanerantherum* (which also owns long-stalked bulblets), but the latter

species differs by a persistent and short-beaked (not caducous, long-beaked) spathe, as well as smooth and glossy tepals. Thus the second population represents another taxon which is newly described here as:

***Allium clivorum* R.M. Fritsch, species nova** (Fig. 14)

Holotype: Cultivated in the the Gatersleben taxonomic reference collection No. TAX6517, leg. 18.06.2008 (GAT); bulbs collected in Iran, Prov. Tehran, Alburz range, Karaj valley, vill. Asara, S-exposed steep rubble slopes N of the road, 1950 m, 36°02'12" N, 51°12' E, 23.05.2006, leg. M. Abbasi, R.M. Fritsch, M. Keusgen No. 1131 Other plants of this accession were cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1131 (voucher specimens in IRAN).

Diagnosis: Characteria propria bulbuli longe stipitati, spathae longe rostratae caducae, flores urceolatae tepalis impolitis subtile verruculosi, cuspidibus lateralibus filamentorum interiorum longe eminentibus et duo longioribus quam cuspis antherifera. Species valde affinis *A. phaneranthemum* quae differt spathis breve rostratis persistentibus, tepalis levis politis et cuspidibus lateralibus filamentorum sublongioribus quam cuspis antherifera.

Description: Bulbs ovate, c. 1 cm long and 8 mm in diameter, with brownish-greyish, longitudinally striated, membranous tunics, side bulblets shield-shaped, terminating 2-3 cm long stolons. Scape 25-35 cm long, cylindrical, ± straight, smooth, purplish; lower 1/4-1/3 covered by smooth leaf sheathes. Leaves 3-4, blades semi-cylindrical, upper side canaliculate, 2-3 mm wide, 12-20 cm long, smooth, green but violet suffused. Spathe with 2-3 cm long beak, basally disrupting and caducous. Flowers urceolate, brownish-purple. Inflorescence (sub-)capitate, few-

flowered, \pm dense, 2-3 cm in diameter. Pedicels 8-12 mm long, basal with lacinate remains of spathe but no bracteoles. Tepals obtuse, finely tuberculate, \pm ovate to oblong, unequal, outer ones naviculate, c. 4.5 mm long, inner tepals c. 5 mm long, tip slightly recurved, median vein slightly darker. Filaments somewhat longer than tepals, with ciliate margin at the base, white. Outer filaments simple, triangular, inner ones with the anther-bearing cusp about $1/3$ as long as the sub-linear basal part and $1/2$ as long as the exerted lateral cusps. Anthers c. 0.5 mm long, purplish, after anthesis with blackish back. Pollen yellow. Ovary double-triconical, with a transversal ridge above the point-like mound of nectary, green, finely tuberculate. Stylus 1-2 mm long, not protruding, with an undivided stigma, greenish. Capsule and seeds not seen.

Distribution: Iran, Prov. Tehren, Alburz mountain range, Karaj valley, known yet only from the type location near Asara.

Allium phaneranthorum is apparently the closest relative though it has inner filaments with antheriferous cusps about as long as the base and somewhat shorter than the lateral cusps. *Allium wendelboi* Matin differs not only by white flowers but owns also a bracteolate inflorescence with densely pustulose pedicels, verruculose tepals (with outer tepals longer than inner ones), and another shape of stamina. There is also superficial similarity of *A. clivorum* with small plants of *A. proponticum* Stearn & N. Özhatay from western Turkey which differs by much larger and non-stalked side-bulblets, scabrid leaf blades, a very short and persistent spathe, pedicels papillose towards the apex, shorter tepals and longer stamens, a completely differing shape of inner staminal parts, and exerted styles. *Allium stearnianum* Koyuncu, N. Özhatay et Kollmann subsp. *vanense* Kollmann et

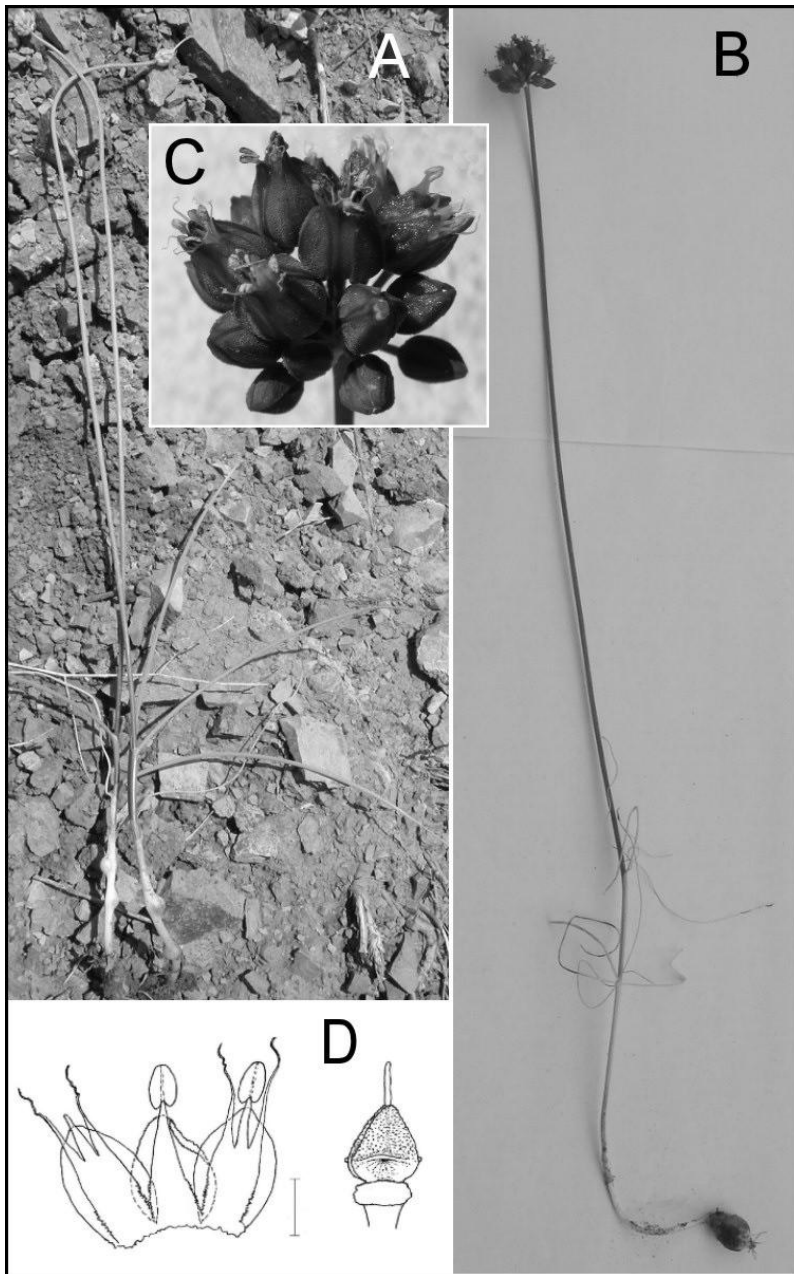


Fig. 14. *Allium clivorum*: A. Budding plants as dug up, B. cultivated plant (holotype), C. inflorescence, D. flower parts and ovary, scale bar = 2 mm (type location, Karaj valley near Asara, N Iran).

Koyuncu from E Anatolia has shorter tepals verrucose-scabrid in upper part mainly along keel and margins, longer filaments of another form, flat scabrid leaves, and a short spathe.

Allium dictyoprasum C.A. Meyer ex Kunth is a tall species growing on very dry and sunny slopes and rock terraces. The plants often develop 80-120 cm long scapes topped by globose, moderately dense inflorescences with green or brownish flowers. Green-flowering forms were formerly named *A. viride* Grossh., but now they are regarded to be a variant of *A. dictyoprasum* only. Very characteristic are thick, densely reticulate bulb tunics commonly covering the whole length of subterranean leaf sheathes as well, and fistulose, cylindrical leaves. Most accessions have nearly globose flowers, unequally long tepals, and all filaments with side teeth. One *Allium* accession from the slopes of Alvand massif near Hamedan was similar at the first glance but differed by semi-cylindrical, \pm canaliculate leaves with conspicuously large teeth along the margin (Fig. 15 C), and ovate flowers (Fig. 15 B) having tepals of nearly equal length (Fig. 15 D). These plants were thought to represent a new subspecies (FRITSCH 2008), but detailed studies in summer 2008 uncovered more deviating characters supporting recognition at species level:

***Allium abbasii* R.M. Fritsch, species nova** (Fig. 15)

Holotype: Cultivated in the *Allium* collection of Iranian Research Institute of Plant Protection, Tehran No. 1073, leg. 2007 (48379-IRAN); plants collected in Iran, Prov. Hamedan, NE slopes of Alvand massif, N exposed slope near Ganjname, rock terraces and between large rocks, 2200 m, 34°45'42.7" N, 48°26'10" E, 09.05.2006, leg. M. Abbasi, R.M. Fritsch, M. Keusgen. Other plants of this accession were cultivated in the Gatersleben taxonomic reference collection No. TAX6477 (voucher

specimen in GAT).

Diagnosis: Characteria propria tunicae bulborum laciniatae, folia semicylindrica plus minus canaliculata dentibus marginibus majoribus, flores ovaes et ovaria biconica terminalisque verrucis brevibus conicis. *Allium dictyoprasum* similis habitu sed propria tunicae bulborum reticulatae, folia levia cylindrica, flores et ovaria globosa.

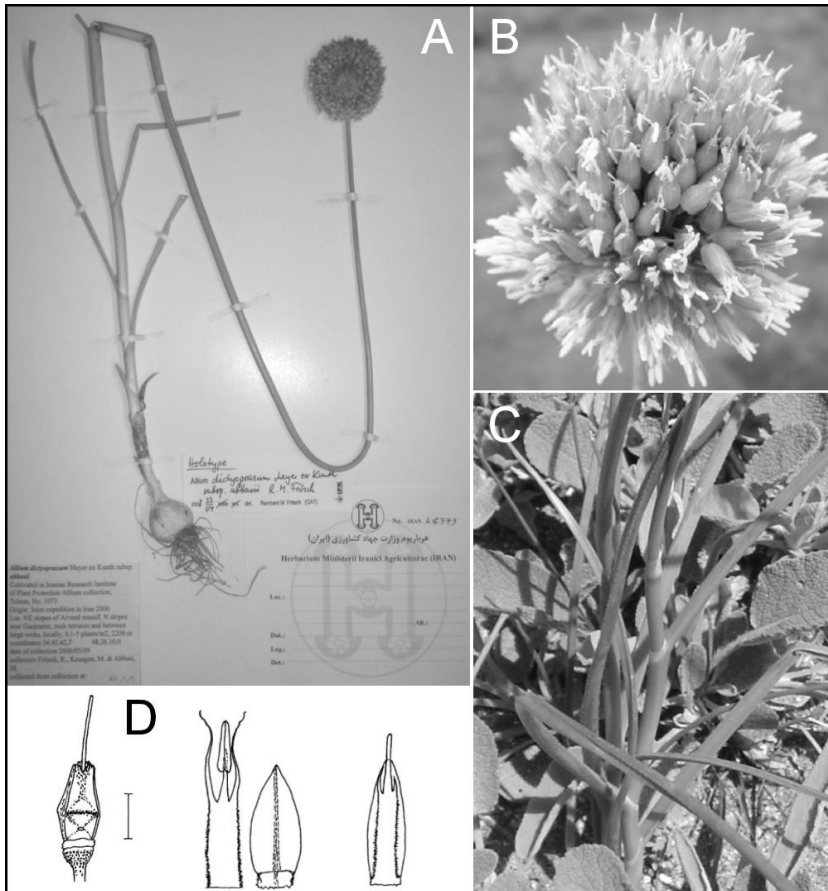


Fig. 15. *Allium abbasii*: A. Holotype sheet, B. inflorescence, C. leaf sheaths and blades, D. flower parts, on the left: ovary, in the middle: inner filament with anther, and inner tepal, on the right: outer tepal with filament, scale bar = 2 mm (type location near Hamadan, NW Iran).

Description: Bulbs globose, about 2 cm in diameter, outer tunics gray to black, splitting into stripes. Scape cylindrical, straight but somewhat zigzag-like flexuous, green, smooth; the basal 1/3 covered by leaf sheathes, about 100 cm long, 5-8 mm in diameter. Leaves 4-5, semi-cylindrical, hollow, with large teeth along the margin; 20-35 cm long, 5-7 mm wide. Spathe with a short beak, caducous. Inflorescence spherical, many-flowered, dense. Pedicels straight, wire-like, cylindrical, basally smooth and near the inflated tip tuberculate, green. Flowers long-ovate, green. Tepals lanceolate, smooth, vividly green with inconspicuous median vein; outer tepals naviculate with somewhat recurved, sub-obtuse tip, c. 5 mm long and 1.5 mm wide; inner ones less naviculate with straight sub-acute tip, slightly shorter and 1.8-2 mm wide. Filaments c. 1 mm long exserted, whitish, translucent, with long cilia along the margin below the lateral cusps, outer filaments \pm triangular with 1-2 mm long side cusps, inner ones with 2-3 mm long lateral cusps, anther-bearing cusp c. 2/5 as long as the narrowly rectangular base. Anthers elongated, c. 2.2 mm long, whitish. Pollen whitish-grey. Ovary double hexangular-conical, surface finely tuberculate by convex outer walls of epidermal cells, upper part with 6 longitudinal furrows and a few short conical outgrowths at the triangular tip; nectary tube mounding as a pore in a concave area below a transversal rail. Stylus basally sunken in the tip of ovary, thread-like, 3-4 mm long, white like the dot-like stigma.

Named after Dr. Mehrdad Abbasi, fungal taxonomist in Tehran.

Distribution: Iran, Prov. Hamedan, only known yet from the type location.

The similarity of general stature to *A. dictyoprasum* does obviously not express close relationship. Many morphological details like length of leaf sheathes,

form and dimensions of inflorescence and tepals, and ciliate margins of filaments, point to *A. phanerantherum* as possibly related taxon. Though this relationship is not close, as the differing shapes of leaf blades and filament parts, varying persistence of spathes, varying colors of anthers and styles underline. The very peculiar form of ovary is difficult to compare because of the incomplete data given by WENDELBO (1971) and in other floras. Therefore the direct relationship remains unclear.

3.2 sect. *Longivaginata* (Kamelin) F.O. Khass., R.M. Fritsch & Friesen

Rather small and inconspicuous plants in the vegetative state were collected in Binalud mountain range in 2004. They flowered first in 2005 under cultivation but were generally in a poor state after fungal infections. Only in 2008 they looked more healthy and flowered for second time showing again leaf sheathes covering the scape completely, a loose inflorescence with shortly campanulate, whitish flowers, and exerted anthers. Thus this taxon belongs to sect. *Longivaginata*, but none of the hitherto known species of this section shows sub-rectangular inner tepals as well as relatively very large bulbs with one thin white tunic layer. This new species is described here as:

***Allium dolichovaginatum* R.M. Fritsch, species nova (Fig. 16)**

Holotype: Cultivated in the Gatersleben taxonomic reference collection No. TAX6466, leg. 01.08.2008 (GAT, also isotype in GAT); bulbs collected in Iran, Prov. Khorasan-e Razavi, Binalud massif, north exposed steep limestone slope of the valley above vill. Akhlamad near way to waterfall, 1530 m, 36°35'58" N, 58°55'59" E; 22.04.2004, leg. R.M. Fritsch, M. Keusgen, and M. Amini Rad No. 1021. Other plants of this accession were cultivated in the *Allium* collection of

Iranian Research Institute of Plant Protection, Tehran No. 1021.

Diagnosis: Characteria propria bulbi magni modo tunica una tenua, flores albescentes, tepala interiora rectangularia et filamenta eminentia. Species plures communiter vaginae foliorum pertinentes usque ad inflorescentia, *A. petri* autem differt pedicellis brevioribus bractolatis, tepalis elongato-ellipticis, et appendicibus incrassatis luteis ad filamenta interiora. *Allium longivaginatium* differt floribus maioribus tepalis roseo-purpureis et filamentis inclusis. *Allium autumniflorum* species perquam serotina propria tepala vix maiora acuta oblongaque et filamenta quoque inclusa.

Description: Bulbs broadly ovate, 2-3 cm in diameter, 1.5-2 cm long, only one white-translucent papery tunic. Scape straight, cylindrical, 1.5-2.5 mm in diameter, 30-40 cm long, completely covered by leaf sheathes. Leaves 4, sheathes ribbed, very coarse on the ribs, the lower three sheathes reaching less than half of scape length, the fourth (innermost) sheath covers the upper half of scape. Leaf blades cylindrical, smooth, 2.5-4 mm in diameter, 15-25 cm long, the upper one only 4-10 cm long. Spathe divided in 2-3 shortly ovate-triangular parts, c. 0.5 cm long, yellowish-brown, persistent. Flowers shortly campanulate. Inflorescence loose, semi-globose, moderately many-flowered. Pedicels thin, wiry, straight, smooth, yellowish-brown, 15-20 mm long, basally no bracteoles. Tepals whitish with a rather broad brown median vein which is resolved in narrow brown stripes at the inner side, 3.5-4 mm long, inner tepals sub-rectangular with slightly mucronate tip, about 1.7 mm wide, outer ones elliptical with rounded tip, somewhat narrower. Filaments slightly exerted, triangular, inner ones slightly wider. Anthers shortly ovate, 0.5-0.8 mm long, initially violet flushed. Pollen yellow. Ovary ovate, upper part conical, with a

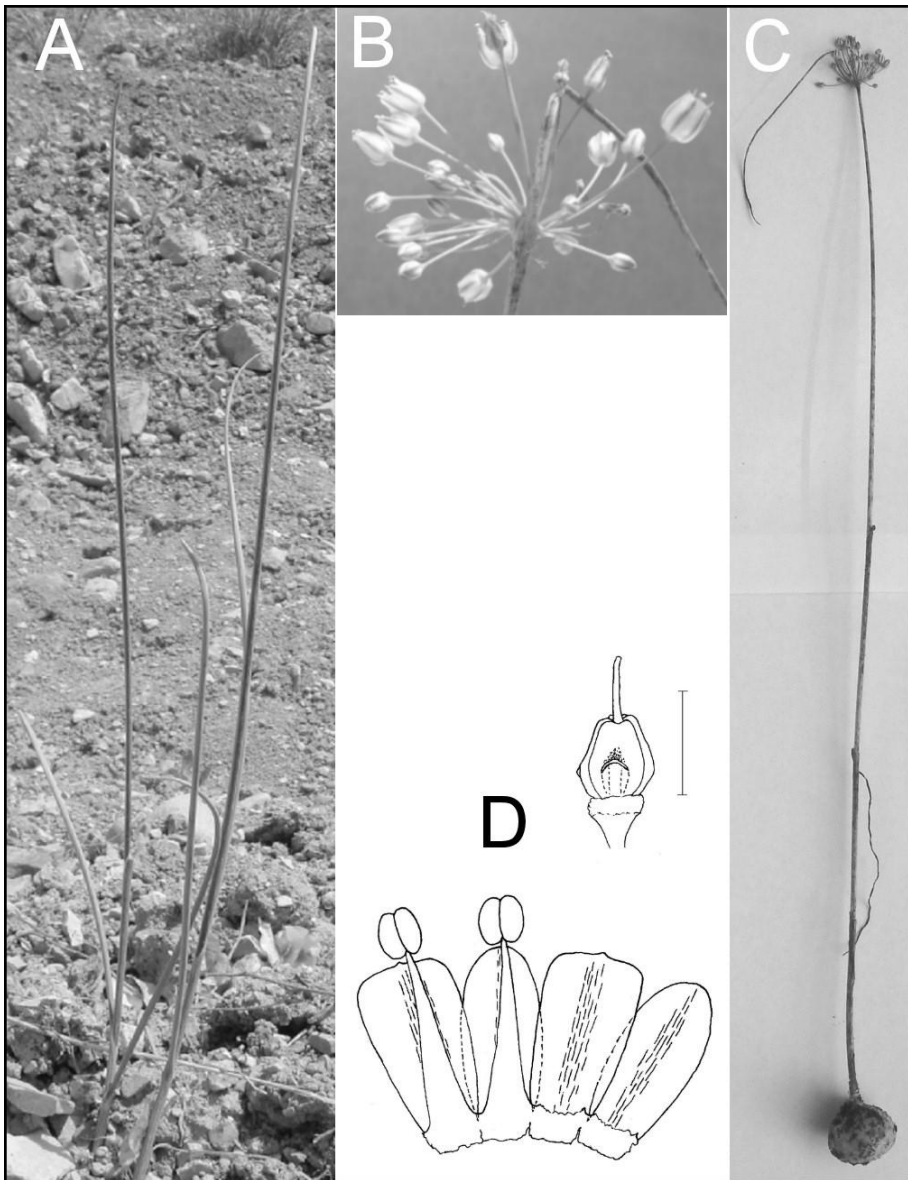


Fig. 16. *Allium dolichovaginatam*: A. Cultivated plants, upper leaf sheaths are developing, B. inflorescence, C. flowering plant (holotype), D. ovary and flower parts, scale bar = 2 mm (type location Akhlamad valley NW Mashhad, NE Iran).

bent transversal bulge covering the funnel-like end of nectary tube, whitish, about 1.5 mm long and 1 mm wide. Stylus slightly conical, about 1 mm long, like the dot-like stigma white. Capsule and seeds not seen.

Distribution: Koppe Dagh, only known yet from the type location.

The recently described species *A. petri* F.O. Khass. & R.M. Fritsch is perhaps the closest relative differing from *A. dolichovaginatum* by a denser inflorescence with bracteolate pedicels, elliptic-oblong tepals, and the very characteristic thickened, blunt, yellow appendages of the inner filaments. *Allium longivaginatum* Wendelbo (the original epitheton "*longevaginatum*" was apparently wrongly written because it was never used again by WENDELBO himself) owns larger flowers and pinkish-purplish tepals of another shape, and included filaments the inner ones bearing obtuse teeth. Also *A. anacoleum* Handel-Mazzetti shows such teeth at inner filaments but strongly exerted filaments and elliptic-oblong, purple tepals. Plants of the much later (in October) flowering *A. autumniflorum* F.O. Khass. et Akhani are much smaller; their flowers are somewhat larger than those of *A. dolichovaginatum* and show oblong tepals with an acute, recurved tip, and included filaments. *Allium microspathum* Ekberg from Eastern Turkey is a tiny plant having smaller yellow to brown flowers and side-teeth on the inner filaments.

4. Statistical conclusions to the *Allium* flora of Iran

Altogether, 93 *Allium* species were compiled by FRITSCH *et al.* (2007) to occur in Iran. Supplementing this number we have first to append *A. szovitsii* Regel and *A. talyshense* Misch. mentioned by GHAHREMAN & ATTAR (1999). During the last months *A. joharchii* F.O. Khass. et Memariani (KHASSANOV &

MEMARIANI 2007), *A. autumniflorum*, and *A. tuchalense* F.O. Khass. et Noroozi (KHASSANOV *et al.* 2007) were newly described, and *A. barszczewskii* Lipsky and *A. tenuicaule* Regel (MEMARIANI *et al.* 2007) were newly recorded for Iran. Adding the above described species *A. zagricum*, *A. ubipetrense*, *A. austroiranicum*, *A. hamedanense*, *A. saralicum*, *A. bisotunense*, *A. keusgenii*, *A. moderense*, *A. aznavense*, *A. clivorum*, *A. dolichovaginatatum*, *A. abbasii*, and the subspecies *A. materculae* subsp. *graveolens* and *A. jesdianum* subsp. *remediorum*, the number of *Allium* species and subspecies known to occur in Iran increased to 114.

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