

R. M. Fritsch & M. Abbasi

A Taxonomic Review of  
*Allium* subg. *Melanocrommyum*  
in Iran

Gatersleben 2013

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*Melanocrommyum* in Iran

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## Foreword

*Allium* is one of the largest genera of monocots comprising currently more than 900 accepted species (World Checklist) naturally occurring on the northern hemisphere (with one exception). There is a main centre of diversity in the eastern Mediterranean area, Southwest and Central Asia where *Allium* species constitute an important part of different plant societies. Worldwide about 50 species are important being widely or locally cultivated. Moreover, many wild alliums are collected by the local population for human consumption as spices, vegetables and medical plants, and also as ornamentals. Wild species own a great potential as valuable part of the daily human diet, and as part of the fodder for livestock. Well managed employment of these natural resources must be based on a detailed knowledge of the taxa involved, in order to draw realistic conclusions about the presence and the further use or the protection of the species of interest. During fieldwork to collect information about useful wild *Allium* species in Central Asia, Caucasus, and Iran, we became aware that a remarkable part of the collected *Allium* specimens could not be botanically determined applying the available botanical literature, particularly as modern floras presenting comprehensive information and descriptions together with color photos were not available for these areas. This lack became specifically noticeable in Iran, where the *Allium* revision for the "Flora Iranica" area by Wendelbo (1971) set an excellent fundament 40 years ago, mentioning about 75 species that occur on the territory of Iran. On the other hand, Wendelbo's (l. c.) statement "The number of *Allium* species within the 'Flora Iranica'-area is likely to be considerably increased in the future" certainly also included the Iran as the by far largest political unit of this area. Regrettably, this eminent opus was not extended and only very punctually supplemented up to the begin of the 21st century.

The establishment of a national living *Allium* collection in the Iranian Research Institute of Plant Protection (IRIPP) in Tehran set a reliable base for taxonomic investigations over a couple of years, following the suggestion of Wendelbo to critically re-study "rather variable species ... based on living material from many localities" (Wendelbo 1971: 74). These activities started as part of the research project entitled "Pharmaceutical values of onions and related species (*Allium* L.) in Middle Asia and the Caucasus" (funded by VolkswagenStiftung, Hannover, Germany, and substantially supported by IRIPP) resulting in a series of publications (Fritsch & al. 2007, 2007a; Abbasi & al. 2008, 2008b; Fritsch 2008; Fritsch & Abbasi 2009; Fritsch & Maroofi 2010). Parallel research activities in the IPK (Gatersleben, Germany) focused on *Allium* classification (Gurushidze 2008; Gurushidze & al. 2007, 2008, 2010, 2012; Fritsch & al. 2010; Fritsch 2012) coinciding with more restricted research activities conducted in Tehran University and Ferdowsi University of Mashhad (Mashayekhi & al. 2005; Fritsch & al. 2007a; Khassanov & al. 2007; Khassanov & Memariani 2007; Razyfard & al. 2011). All these results raised the knowledge of taxonomy of *Allium* species occurring in Iran to the current, substantially enhanced level. Because the members of subg. *Melanocrommyum* were specifically in need of a critical revision, a taxonomic project to revise *Allium* subg. *Melanocrommyum* for the territory of Iran was started some years ago and is finished with this publication. Generous funding of this research phase by IRIPP and German Research Foundation (DFG, Bonn, Germany) is gratefully acknowledged. During the course of the investigations, the co-authors contributed in different ways. M.A. prepared the missions in Iran and participated in most of them, acting as a general organizer, local leader and translator. He gained information and organized visits of herbaria along the travelling routes. In Tehran he was heavily involved in all the numerous forms of paperwork for applications, invitations and accommodation, and - a most important and time-consuming contribution - he managed the national Iranian *Allium* collection over many years, got pictures of plants and plant parts, and made herbarium vouchers for documentation purposes there. During formulation of the manuscript he deciphered and translated herbarium labels and traced hitherto undetectable collecting places. R.M.F. contributed the planning of the missions and was mainly dealing with all aspects of taxonomical research beginning with the preliminary naming and documentation of the collected plants and their characters. He investigated the plants in the national Iranian *Allium* collection in Tehran as well as in the taxonomic *Allium* reference collection in Gatersleben (as far as plants were transferred there),

and initiated molecular analyses in the IPK Gatersleben. He is responsible for all taxonomic conclusions and decisions made in this review.

Plants were collected jointly during the course of the research missions. All partners took part in the exact and complete documentation and careful transport of the plants, and finally in the planting of the material in the collection. Here we would like to express our sincere thanks to Michael Keusgen (Marburg, Germany) who participated in many of the missions and contributed equally to all duties as described.

The territory of Iran, stretching roughly over 20 degrees longitude and 15 degrees latitude, could not be visited in full during the few years of our taxonomic activities. Therefore our studies were initially also based on the information presented by Wendelbo (1971). These and other data from the literature were critically adopted to establish the schedule of fieldwork that was later specified according to details found on the labels of relevant herbarium vouchers in IRAN. During the course of our research missions we tried to visit as much herbaria as possible, in order to see plenty of vouchers and to carry out a close cooperation with local botanists. This way we were pointed to taxonomically unclear taxa, got advice about prospective areas and travelling routes to reach them, and, not rarely, we were led by local botanists to special study sites. Therefore we are much obliged to many colleagues:

Dr. H. Akhani, Dr. H. Moazzeni, Dr. S. Mashayekhi, Mr. H. Razyfard, Mr. A. Ghorbani (University of Tehran), Dr. S.M. Massoumi (Agricultural college of Kermanshah), Dr. A. Khosravi (Shiraz University), Dr. A. Movafeghi (University of Tabriz), Dr. F. Memariani, Dr. M. Joharchi, Ms. F. Neshati (Ferdowsi University, Mashhad), Mr. Mohamadzade (Research Center of Natural Resources, Tabriz), Mr. S. Ghasempoor and B. Alizadeh (Research Institute of Forests and Rangelands, Orumiye), Dr. M.J. Soleimani (Bu-Ali University, Hamadan), Mr. Mansouri (Agricultural Research Station of Dalahu, Kermanshah), Mr. S. Bahrami-Kamangar and Mr. H. Maroofi (Research Centre of Agricultural and Natural Resources, Kurdistan province, Sanandaj), Dr. A. Jafari (University of Yasuj), Dr. A. Slahi-Ardakani (Agricultural Research Center of Kohgiluyeh-va Boyer-Ahmad), Mr. N. Azadbakht (Agricultural Research Center of Lorestan). Mr. S.A.R. Esmailzadeh-Hosseini (Agricultural Research Center of Yazd), Mrs. A. Akhavan. Dr. M.R. Rahiminejad (University of Esfahan), Mr. J. Noroozi (University of Vienna). Last but not least we would also like to express our sincere thanks to Dr. M. Amini Rad, Mr. A. Pahlevani, Mr. M. Eskandari, and Mr. Bahramishad who conducted joint research missions with R.M.F. when M.A. was unable to participate.

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This taxonomic review presents detailed descriptions of 76 species and subspecies (10 of them are newly described here), plus seven more taxa too incompletely known to judge about their taxonomic state yet. The authors feel sure that this review is a step forward towards a high-level presentation of data corresponding to the contemporary level of science, but certainly no final treatment of subg. *Melanocrommyum* for the Iranian territory. Lack of knowledge is especially visible in some sections like *Acanthoprason* and *Procerallium* that are in need of studying a much larger amount of living plants from different locations in order to gain bio-statistically secured data. A remarkable part of the Iranian territory remained uninvestigated by us, and therefore we feel sure that our data are necessarily incomplete in many cases. Nevertheless, it would be a great success when this review can deliver a reliable fundament for future detailed research by Iranian institutions, particularly in hitherto not investigated areas. Our taxonomic treatment took substantial benefit from well functioning scientific research structures in Iran, particularly from herbaria and research institutions well integrated into a high-level international scientific cooperation. We are looking forward to seeing a further successful broadening of this national and international cooperation in the future.

## General introduction

Plants of bulbous *Allium* groups like the subgenera *Allium* and *Melanocrommyum* own the great disadvantage to lose many specific character states when the plants are dried for herbarium storage. They often develop artificial characters in the press because the process of drying lasts much longer than in other plants groups. George Don (1827), an early monographer of *Allium*, put this problem into the words "The genus *Allium* can only be studied satisfactorily from living specimens, for, in herbaria, the species of this genus, like other liliaceous plants, are seldom found to retain their characters, so as to be recognised with certainty". Therefore it was the main objective of the present revision to study all taxa if somehow possible from living plants in their natural habitat as well as under cultivation. This kind of work was executed during eight research missions in Iran. Concurrent missions in Turkmenistan, Tajikistan, Uzbekistan and Georgia could also be exploited to broaden the knowledge about widely distributed and related species. The missions undertaken up to 2007 were in detail reported by Fritsch (2008b). Those of the following years led through the provinces Esfahan, Fars, Yazd, Chaharmahal Bakhtiyari, Kohgiluyeh-uyeh Buyerahmad, Shiraz, Qazvin, Zanjan, East and West Azarbaijan, Semnan, Golestan, North Khorasan, and Razavi Khorasan. Altogether about 400 *Allium* accessions were collected in Iran. About 185 of them belonged to subg. *Melanocrommyum*. These accessions (only a few did not survive) were also studied under cultivation in Tehran and, if sufficient plants were available, in Gatersleben to be compared with accessions of the taxonomic *Allium* reference collection.

Members of this subgenus are naturally distributed from the Canary Islands to northwestern India (Kashmir), with a northern limit of distribution from Portugal and Spain, North of the Alps, Balkan Peninsula and Crimea to SW Siberia and western China, and a southern limit along the northwestern and northern coastal regions of Africa to northern Egypt, the Arabian Peninsula and Pakistan, with the centre of diversity in Asia Minor, Southwest Asia; and Central Asia.

Just like elsewhere, Iranian members of subg. *Melanocrommyum* occur in different ecological habitats from sea level to the alpine belt. But most species are typical xerophilous and heliophilous plants growing in dry steppes, semideserts or even sandy and gravelly deserts and on rocky and stony slopes of arid mountains. Dry shrubs and forests, open semi-humid park-like associations, humid forests, meadows, and shady gorges are more rarely inhabited. Data on ecological preferences were concluded from own observations or were adapted from other authors sharing the same circumscription of species. Most herbarium labels do not present such information. Affiliation to plant-geographic elements as proposed for several species by Heller & Heyn (1991) was not adopted.

The species will be affiliated according to the classification used by Fritsch & al. (2010). The presentation of the species starts with information about nomenclature and distribution followed by detailed descriptions and color plates if photos were available. Figures of ovaries, filaments with anthers, and tepals were also given for most species to enable comparison with soaked flowers from herbarium vouchers. The sequence of described characters begins with the subterranean organs followed by leaves and scapes, inflorescences, flower parts, and ends up with capsules and seeds. Next paragraphs will deal with karyological data, biological data, and economic traits as far as information was traced. Final parts are taxonomic remarks including molecular data, etymology of the epithet, and a list of living accessions and herbarium vouchers affiliated to that taxon.

### 1. Morphological characters<sup>1</sup>

Generally the shape of mature bulbs is described, though often it can only be concluded from the bulbs tunics of herbarium vouchers (the storage cataphylls shrivel irregularly during drying). The shape of immature bulbs is mostly ovate, and small renewal bulbs are flat and often bent in a shield-shaped way. The taxonomic value of bulb numbers (of daughter bulbs as well as small renewal bulbs) is a controversial issue because it is probably strongly influenced by growing conditions. Structure and the color of the bulb tunics are taxonomically important but are influenced by the growing conditions. Many species

<sup>1</sup> The mode of morphological variation was more detailed outlined in Fritsch (2012)

may develop thick shell-like tunics composed of many layers at undisturbed, dry places, but bear only thin tunics when cultivated under humid conditions. Herbarium specimens often lack outer tunics because the tunics remained in the soil glued to surrounding clods of earth. In those cases only the whitish to yellowish inner bulb tunics remain visible possessing an uncertain taxonomic value.

As far as known and observed during plant collecting, the roots of all species share the same general shape and functionality (growing out in autumn and dying during or after anthesis next summer). Differences in root color (known to occur in other *Allium* groups) were not reported hitherto. Contractile roots (moving the bulbs, especially of seedlings, deeper into the soil) should be a common feature because they were observed in many species.

Commonly one scape develops per bulb. Its shape, dimension, and growth form are important. Concerning the surface of living scapes, it must be underlined again, that dry scapes are always hollow and ribbed, but size and density of these ribs depend on the drying process when the cortex tissue shrivels, and irregular rib-like structures on the outer side of the sclerenchyma cylinder of the scape become visible (Fritsch 1993).

The leaf sequence begins with one or two extremely thickened storage organs (cataphylls) occupying the main volume of the bulb (and therefore not visible above the soil). Next leaves are 1-2 elongated cataphylls without laminae enclosing the developing leaf bud. Their aerial part is included in the descriptions. Later these "sheath leaves" are merely visible as tender remains enclosing the underground leaf parts of flowering specimens. Therefore they are often ignored, but were observed to possess group- and species-specific length, consistence, and color. Herbarium specimens rarely show these sheath leaves.

The number of foliage leaves per mature bulb is a species-specific character ranging between 1-2 and 10-15, most common among Iranian taxa of subg. *Melanocrommyum* are 2-6. Special features of the basal subterranean sheath part were rarely observed, contrary to the well known huge amount of morphological diversity of the supraterranean leaf lamina that possess eminent taxonomic value. Also the shape of the lamina's apical area presents many species-specific characters but must be analyzed when the laminae are still developing. After the anthesis started, the commonly hooded apex is difficult to recognize because it is often already dry and yellow.

The spathe is a  $\pm$  shortly beaked leafy organ enclosing and protecting the inflorescence prior to spreading. In members of subg. *Melanocrommyum* it is neither shed as a whole, nor ruptured to pieces, but splits longitudinally (often not completely to the base) into valves. Though some authors regard lengths of the beaks as well as consistence (most often membrane-like scarious), number, shape and color of the valves as species-specific characters, we observed these features to vary among different populations of the identical species and to depend on ecological and actual weather conditions. Therefore their taxonomic value is lower than in other *Allium* groups.

The development of inflorescences before anthesis also shows some group- and species-specific characters, but shape, dimensions, density, and number of flowers are regarded to be much more important, even though they are also influenced by the growing conditions, age, and ontogenetic stage of the plants. Only *A. regelii* may regularly bear two to five superposed inflorescence parts per scape lifted by short scape pieces and basally enclosed by extra spathes. Under unfavorable conditions (after strong frosty nights when the young inflorescence was already exposed to frost,) many species may develop single superposed inflorescences or extra bulbs among pedicels. Dry inflorescences of some Iranian species drop from the scape after seed ripening or roll (together with the adhering upper part of scape) over the soil blown by the wind ("tumble-weeds"), but most often they remain upright till autumn, distributing the seeds mainly autochorically and semachorically. The receptacle may become inflated after anthesis when it is covered by inflated pedicel bases, but such cases were not regularly observed and it is not clear, whether such inflated receptacles are species-specific characters.

The pedicels are ebracteolate in subg. *Melanocrommyum*, and their lengths (relative and absolute), shape, direction, consistence, surface, and color pattern constitute characters of taxonomic value. They are also influenced by the ontogenetic development and ecological conditions.

Many characters of the generally hexamerous flowers are highly important for taxonomic reasons, though the great majority of all flower-based characters and character states can only exactly be studied on living plants. Often several plants in somewhat differing stages of ontogenetic development are necessary for complete analysis, or plants must be re-studied after a few days. Conservation of flowers in 70% ethanol warrant a good preservation of three-dimensional features over many years and even decades, but all colors are fading away during the first days. Also an extremely careful and quick preparation of herbarium specimens conserves three-dimensional shapes only occasionally, but colors can remain visible over a few decades. However, after a century and more scarcely any difference in color tones remains detectable, and all parts of the plants will turn to brown. Such "unicolor" herbarium vouchers may arise in much shorter time when the drying process was slowed down because the drying paper was not changed often enough. Also specimens attacked by mould fungi when already in the press, loose colors completely during the drying process. Two-dimensional characters of dried flowers can be revived by cooking them in water and carefully re-shaping the soft tissue (best to be done in a drop of water on a glass slide). However, shriveled tepals and filaments surrounding ripe capsules cannot be brought back into their true shape by cooking; the shriveling process once finished is not reversible.

The general shape of flowers occupies the eminent place among taxonomic characters in *Allium*. Extremely diverse variants of star-like, rarely more or less triangular with the outer tepals more spreading than the inner ones, occur in Iranian species. Also the scent of flowers, that can be strong (and not always appreciable), may be worth of special recognition. This character is however influenced by the air temperature during the observation.

Color, dimensions, position, texture and shape of the tepals are widely used taxonomic characters, even though they often change remarkably during the course of anthesis of a single flower. Since the mode of these changes is also variable, it also has taxonomic value. Several details are important, too: especially evenness of the whole tepals, structure of the surface, shape of apex, margins, and base, dimensions of the connate bases and/or the part adnate to filaments, characters of the median vein, and in some special cases more other details.

The filaments show no less diversity than the tepals in the following characters: position and direction, general (two-dimensional as well as three-dimensional) shape and shape of the basal part, relative and absolute length, lengths of the basal connate sector commonly also adnate to the tepals, presence and location of tooth-like appendages (an important character in many *Allium* groups and also present among some Iranian members of subg. *Melanocrommyum*), and color in general and color of different filament parts.

The anthers are much less variable in their shape, dimensions and color but may present usable taxonomic characters in some cases. The pollen shows only differing color even under a hand lens, though study under the microscope allows to detect many variable features. However, the knowledge of these microscopic characters, especially the amount of intraspecific variation, is still incomplete.

The ovary is composed of three connate carpels with internal septal nectaries at the place of sutures. This composed character causes three longitudinal furrows along the suture, and three more furrows run along the median veins of the carpels. The shape of the ovaries is taxonomically important, especially the presence of a stalk-like narrowed base ("stipitate ovaries") or a pronounced central depression on the apex around the style. Although color and dimension change during the course of anthesis, they may deliver valuable information as well. Radially or obliquely outwards directed outgrowths ("hornlets") on the apex of ovaries are species-specific characters if well expressed. On the other hand, shallow bulges are a most common structure on the apex that may become more pronounced during the drying process of herbarium specimens; then these differences are unimportant. The surface may be smooth, or coarse in very different degrees of expression. Unfortunately, this character is also influenced by the ontogenetic stage and is often difficult to recognize on herbarium specimens. It has taxonomic importance but hitherto details of the differences are merely incompletely known.

The internal nectaries excrete through tubes mounding opposite the inner filaments where pocket- or funnel-like structures can easily be seen, sometimes even in dried flowers after soaking. However, small

mounds are often not larger than the surrounding cells, and are difficult to see even under the dissecting microscope. Sometimes small nectar drops indicate the position of the mounds if fresh ovaries can be analyzed. Shape and horizontal position of the mounds are taxonomically important characters. These features, like dimension of nectaries and excretory tubes as well as other anatomical characters of the ovaries, are still incompletely known and should be the target of comprehensive studies in the future. The number of ovules per locule ranges from 2 to 24 in subg. *Melanocrommyum*, but this number varies among locules and among flowers; also here broadly based and statistically secured investigations would be necessary.

The gynobasic style shows variation of shape, length, diameter, and color, features that also change during the course of anthesis. The commonly punctiform stigma in full anthesis often appears slightly capitate, but may also be shortly tripartite in a few species. It is commonly uncolored even when the style has a dark color.

The ovary develops into a loculicidal dry capsule opening along the dorsal furrow of the locules building three concave valves. Therefore shape and surface structure of the capsules can be deduced from these characters of the ovaries, but not as a shapely magnification because the shape of the valves changes in the process of drying and opening, and the surface often develops raised wrinkles when drying out. Nevertheless, color and evenness of the capsule surface as well as the mode of opening present important characters.

The seed shape is very variable showing group-specific character combinations but is also influenced by external conditions. Seed dimensions depend on the dimensions of the developing capsules, especially the space available in the locules, and the number of seeds developing per locule. Shape, dimensions (also expressed by the thousand-kernel-weight TKW), and surface sculptures visible under a hand-lens may vary remarkably in one species, but taxonomically relevant differences will probably be found when large seed samples harvested in different years can be compared. The seed color in subg. *Melanocrommyum* is commonly dull black but slightly lustrous in other subgenera.

Contrary to this morphological variation, the principal shape and sculpturing of testa cells investigated under a scanning electron microscope are rather uniform (with two exceptions among Central Asian species) and were in detail discussed by Fritsch & al. (2006). These characters were not studied yet in all Iranian species, and the detection of more specific character combinations seems possible.

## 2. Karyological data

The base number of chromosomes  $x = 8$  dominates, but  $x = 10$  was found in sect. *Decipientia*. Most Iranian species are diploids (as far as studied), and higher ploidy levels (especially when found in plants from botanical collections) need verification. Extensive karyotyping and chromosome measurements based on many chromosome plates seem necessary to detect possible species- or section-specific karyotypes (Fritsch & Astanova 1998).

## 3. Life form and annual cycle

All species of subg. *Melanocrommyum* are perennial bulb geophytes with an ephemeroïdal growth rhythm presenting assimilating (supraterranean) organs only from leaf sprouting in February to March to the withering of leaves before or during the anthesis in April to June. Later in May to July the capsules and seeds are completed from the reserves of the scape without functioning roots and leaves. Leaf differentiation of the sprout of the following year and inflorescence differentiation is continuing during the summer dormancy over a period of 4-6 months, and most species later again need several weeks of cool temperatures to induce a complete development of the flower scape and of the inflorescence to anthesis. Growth of roots starts only after the summer dormancy when the soil is moistened, but very few species are even able to extend dormancy till next autumn when the winter and spring is too dry. Therefore bulbs and especially roots will not sprout earlier when the plants are dug out of their soil prior to anthesis. On the other hand, root meristems deacease when bulbs are stored under dry conditions till mid-winter. As far as investigated, seeds need a long period with low temperatures prior to germination. During the juvenile stage, which lasts several years, the apical meristem produces only leaves, and the leaf form changes gradually from the thread-like cotyledon to the species-specific final form and leaf number. Contractile roots move the bulbs deeper into the soil.

#### 4. Chemical characters

Fructose-based polysaccharides, gluco-fructanes and other carbohydrates (but no starch!), flavonoids, alkaloids, saponins, several vitamins, and phenolic compounds seem to be present in species of all *Allium* groups. They contribute to special qualities of *Allium* plants dominated by different cysteine sulphoxides disintegrating enzymatically into strong-smelling and hot-tasting sulphur compounds when cells are destroyed in any way. Contrary to cultivated taxa like garlic, common onion and other regionally or locally important onions, members of subg. *Melanocrommyum* mostly contain low to very low concentrations of cysteine sulphoxides (commonly methiin, and isoalliin, more rarely they also contain alliin and propiin). Thus plants are nearly odorless. However, some strong-smelling species contain other cysteine sulphoxides like marasmin and pyridine cysteine sulphoxide (Kusterer & Keusgen 2009; Kusterer & al. 2009, 2011) probably important for special medical properties also known in Iran (Abbasi & al. 2008a). There are strong indications that the concentrations of all these compounds change from one species to another (Fritsch & Keusgen 2006; Keusgen & al. 2008) and may possess chemotaxonomic importance. Recent investigations presented evidence for antibiotic activity in some species of sect. *Melanocrommyum* against bacteria, yeast, and pathogenic fungi, and reported high radical scavenger activity (higher than that found in garlic!) for species containing a dithiodipyrrole cysteine sulphoxide (Keusgen & al. 2006; Jedelská & Keusgen 2008).

Many of recent chemical research activities resulted in an accumulating knowledge on *Allium* species collected in the wild by local people for medical use or for dishes highly esteemed for their tonic properties. Although chemical data still show many gaps, they implicate to be widely exploited for medical and taxonomic application in the future. Therefore more intense continuation of ethnobotanical as well as chemical research activities seem essential. Further search for species applied by local people and study of the chemical compounds responsible for the observed effect are essential.

#### 5. Molecular marker applications

The first molecular studies devoted to subg. *Melanocrommyum* applied genomic in situ hybridization (GISH), random amplified polymorphic DNA (RAPD) markers, and polymerase chain reaction amplified restriction fragments (PCR-RFLP) of noncoding regions of chloroplast DNA in order to trace intra-subgeneric phylogenetic relations (discussed in Fritsch & al. 2010). The results differed in many details of infra-subgeneric relations and hypothesized a high level of interspecific gene flow within subg. *Melanocrommyum*. Later comprehensive sequence analysis of the nuclear ITS (Internal Transcribed Spacer) region detected that most large sections were non-natural conglomerates of distantly related subunits. This phylogenetic structure was confirmed by sequences of the *trnL-trnF* region of chloroplast DNA (Gurushidze & al. 2010). The resulting more specified classification reflecting the natural relationships within subg. *Melanocrommyum* was established by Fritsch & al. (2010) and is applied here, too, though the phylogenetic relationship of all infra-subgeneric groups could not completely be resolved yet (see also p. 198). As soon as a more suitable molecular marker system will be available, a re-evaluation of a broad taxonomic sampling will be essential, if possible with the addition of hitherto missing or poorly represented species.

Recent comprehensive investigations of Gurushidze & al. (2012) showed significant differences in DNA content among phylogenetic clades, while closely related taxa showed highly similar genome size values. Estimations of ancestral genome sizes revealed lineages with increasing as well as decreasing DNA content. DNA contents of Iranian species of subg. *Melanocrommyum* are only partly known. Furthermore a confirmation of the elder values would be highly welcome in order to get a realistic estimation of the taxonomic value of this character.

#### 6. Phylogenesis

The genus *Allium* belongs to a large number of taxonomic groups that did not leave paleobotanical remains. Thus their basal phylogenetic lineages cannot be directly deduced from paleobotanical finds, but some more or less generally accepted principles can be applied. Although primary evolution may have happened in the old Central Asian mountain systems of Tianshan and Alai (Li & al. 2010 indicated that the ancestor of the *Allium* subgenera *Porphyroprason*, *Vvedenskya* (Kamelin) R.M. Fritsch,

and *Melanocrommyum* originated in eastern Asia, then dispersed to Central Asia), the diversification and rapid speciation surely took place during the Late Tertiary. The resulting taxa expanded their ranges into other areas such as western Asia and the Mediterranean and diversified in these regions. Later other dispersal events occurred in reverse and in other directions (Hanelt & al. 1992, Li & al. 2010). Thus it can be expected that phylogenetically basal as well as advanced groups occupied also the Iranian territory.

#### 7. Economical Importance

The application of wild plants as vegetables, spices, and medical plants depends on botanical (the availability of such plants) as well as human factors (the knowledge of the efficacy, the dosage, and the way of the application). A remarkable number of species own olfactory and taste qualities more or less similar to cultivated species like the common onion, garlic, rakkyo, leek, etc., all of which belong to other subgenera. Therefore it is not surprising that leaves and bulbs (rarely whole plants) of about 30 species of subg. *Melanocrommyum* were reportedly collected in the wild by local people in different Asian countries and applied as spices, vegetables, and medicinal plants (reviewed in Fritsch 2012, Iranian species in Abbasi & al. 2008) Also some attempts to cultivate excessively collected taxa were reported (Hanelt 2001). Cultivation should also be prospective for several much-collected Iranian species.

Rather many *Allium* species possess a striking ornamental habit, combining multiflowered inflorescences in different conspicuous colors and spectacular foliage. Some form dense patches with short floral stems, others grow as grand single plants or in loose groups with large flower heads on eminent scapes. Already more than 100 years ago the first members of subg. *Melanocrommyum* were introduced in European gardens. They have become popular for rock gardens, herbaceous beds and perennial borders, and even as cut flowers and for forcing. At the beginning of the 21<sup>st</sup> century the bulbs of about 25 species and a permanently growing number of selections and hybrid strains were regularly commercially offered, most of them multiplied by commercial producers of ornamental *Allium* bulbs (Intern. Checklist 1991, Kamenetsky & Fritsch 2002). Because plant enthusiasts and commercial growers of rare bulbs offer a much broader assortment of ornamental members of subg. *Melanocrommyum*, the number of cultivated ornamentals will considerably rise in the future (Fritsch 2012).

#### 8. Herbarium vouchers

About two-thirds of the c. 1270 herbarium specimens studied for this revision are housed in Iranian herbaria (for comparison: Wendelbo (1971) cited 612 herbarium vouchers of *Allium* collected in Iran, and among 174 vouchers belonging to subg. *Melanocrommyum* only 14 were traced in Iranian herbaria), but the two large Tehran herbaria contributed about 520 vouchers, and Rechinger's rich collections in Vienna about 150.

Herbarium vouchers are cited in alphabetic sequence of the (underlined) province names after the living accessions. As far as available, after the place more data are given between round brackets: coordinates, altitude, date, collector, number, and herbarium or herbaria where this/these vouchers are housed. If different collections were made at one place, they are separated by semicolons.

For several reasons the evaluation of the herbarium vouchers is certainly the weakest part of this revision:

1) The majority of the vouchers were seen and determined during the first years of the course of these studies, when the respective herbaria were visited. At that time the vouchers could only be named according to the level of knowledge of that time. The large number of vouchers and the complicated conditions for lending vouchers did not allow to bring all vouchers together at one place, and carefully to re-revise them applying the final 2013 taxonomic concept of accepted species and subspecies. Thus almost all vouchers could only be affiliated to the newly described or substantially revised taxa by judging from own scarce notes, sometimes accompanied by quickly made photographs with low resolution made during the first determination.

2) As in almost all herbaria of the world, labels of Iranian herbarium vouchers commonly present only very short indication of the collection sites not rarely insufficient for unambiguous geographic affiliation. Frequent problems are connected with identical names of settlements and localities, different ways of transcriptions from Persian language, and the customary official renaming of settlements, administrative units, etc. The affiliation to provinces is sometimes further complicated by further re-shaping of

administrational borderlines inside of Iran (thus the newly created province Alborz remained included in the province Tehran, because no detailed map was available showing the borderlines). Thus many herbarium vouchers could only be affiliated to the most probable geographic position. The indication of the exact geographic position (in degrees latitude and longitude) has recently started and should become a standard for all herbarium labels because it is quickly measured by modern, satellite-based instruments. The presentation of degrees and minutes only (or degrees with two decimal places) is sufficient for the creation of general distribution maps but avoids a possible improper use of very detailed positions.

#### 9. Etymology of scientific names

Names for plants and animals exist in many languages since most ancient times, but the current scientific names of organisms, the names of the categories used for classification, as well as many scientific termini go only back to the European era of Renaissance. Then the classical Greek and Latin names and terms (many Greek texts were accepted as Latin translations) were everywhere understood by educated persons having learnt words like garlic (Latin "allium" Greek "prason") and onion (Latin "cepa" Greek "krom[m]yon" Latinized "crommyum"). Many early scientific plant names were single words. Because accumulating knowledge requested more differentiation, and newly detected plants often share a certain set of characters with known species, names of a known plants were taken and supplemented by additions mentioning the differing characters for the new species. Hence the ancient botanists often created long sequences of words in order to describe a new taxon carefully. These "botanical phrases" were names and descriptions, but often they were unwieldy long. Later the current practice was developed that one- or two-partite names act as acronyms to descriptions delivered when a new name is published. Newly recognized *Allium* species and groups are often traditionally named by compound words applying the Latin or Latinized words for garlic or common onion even to plants only slightly similar to those plants or sharing only single olfactory characters of them. Nevertheless, the current praxis of having a name connected with a description did not delete the historical practice to express any special character in the name of a newly described taxon. Therefore the etymology of a scientific name may give a pointer to a special character accepted by the describing author. Also additional information on persons honored by an epithet might sometimes be appreciated.

Botanical terms may also constitute a part of scientific names. Also the botanical terminology was derived from Greek and Latin by restricting the application of classical words to science-specific senses and by creating new composite and derivative words. This process of creating new terms and scientific names continues till today. Some botanical termini like scapus (Latin "stick, shaft"), a leafless segment of the stem, and petalum (latinized from Greek "petalon" = leaf), the single segment of the corolla, received this restricted use already in antiquity. Other termini like filamentum (derived from Latin "filum" = thread) and stemum (latinized from Greek "stemon" = marginal pole of wickerwork), used for all kinds (also conical or flat) leafy organs bearing the anthers, were introduced in the early phase of scientific botany. The much used term tepalum, the petaloid perigon segment not differentiated into calyx and corolla, was only created in the 19th century.

#### 10. Classifications

Also *Allium* classifications trace back to pre-Linnean time, but the first groups of current subg. *Melanocrommyum* were recognized only in the 19<sup>th</sup> century. Since Wendelbo (1969) the subgeneric level is generally accepted, and several contradictory classifications were proposed (for a short historical outline see Fritsch 2012). However, all of them do not reflect true phylogenetic relationships (Gurushidze & al. 2008). Therefore a more detailed classification was proposed by Fritsch & al. (2010) that is applied here for the Iranian material. Because molecular data could not be gained for every species and a few positions must be regarded as preliminary, also the taxonomic affiliations presented in this review are no more than proposals at the current state of knowledge and are open for discussion as soon as more data will be available.

## Synoptical key for the determination of species and subspecies



1. Flowers narrowly campanulate or narrowly funnel-shaped; filaments basally connate and 1/4-3/4 of tepal length; tepals basally to 1/5-1/3 of their length connate; inflorescences with rarely more than 100 flowers, initially sometimes very dense but after anthesis commonly lax *sect. Regeloprason* 2
- 1\* Flowers cup-shaped, widely funnel-shaped, or in different modes star-like; tepals basally not or very shortly connate; inflorescences divers; filaments shorter to longer than tepals 4
2. Inflorescence and infrutescence  $\pm$  semiglobose and very loose with thin pedicels; flowers funnel-shaped  
(subject. *Diffusoumbellata*) 3
- 2\* Infrutescence  $\pm$  umbel-like, often with superposed umbels, initially dense; pedicels thick; flowers narrowly campanulate  
[73] *Allium regelii* (subject. *Regeloprason*)
3. Tepals 8-10 mm long,  $\pm$  flat, apex subobtuse  
[74] *Allium cathodicarpum*
- 3\* Tepals 12-15 mm long, apex acute and plicate  
[75] *Allium subkopetdagense*
4. (1\*) Scape above soil (1)3-20 (rarely up to 40) cm long, straight, ascendant, or S-shaped flexuous 5
- 4\* Scape 30-120(150) cm long (if 20-30 cm long than ovaries shiny and purple to black at begin of anthesis), straight or somewhat flexuous 54
5. Scape sub-cylindrical, weakest and thinnest at the tip; inflorescences loose, with mostly less than 50 flowers 6
- 5\* Scape  $\pm$  conical, thickest below inflorescence, basally narrow and weak and often only slightly lignified; inflorescence loose or dense with commonly more than 50 flowers 18
6. Scape  $\pm$  flexuous; inflorescence globose; tepals ovate to elliptic, 8-13 mm long, 5-7 mm broad, in anthesis (which begins near basal part of inflorescence) convex, after anthesis not much changing  
[1] *Allium oreophilum* (subg. *Porphyroprason* sect. *Porphyroprason*)
- 6\* Scape  $\pm$  straight; inflorescence broadly fastigiate to semi-globose, after anthesis sub-globose; tepals ovate and concave or lanceolate and claw-like inverted, after anthesis incurved or recurved,  $\pm$  crumpled or spirally contorted, anthesis begins near the top of inflorescence 7
7. Leaf laminae long-elliptic to ovate, longitudinally sulcate; scape flexuous; ovaries depressed-globose; tepals broadly lanceolate to ovate, white or greenish; ovaries not stipitate 8
- 7\* Leaf laminae less than 3 cm wide, long-elliptic to narrowly lanceolate or linear, green or glaucous; ovaries depressed turbinate to pyriform, rarely depressed-globose 13
8. Ovaries smooth, shiny, black at begin of anthesis (*Allium bistunense* alliance) 9
- 8\* Ovaries dull, green,  $\pm$  rough; filaments subulate,  $\pm$  as long as the tepals 12
9. Tepals oblong or broadly lanceolate with acute tip 10
- 9\* Tepals ovate with obtuse tip; filaments pinkish-purple above the white base  
[11] *Allium keusgenii*

1- گل ها به شکل زنگ باریک یا قیفی شکل باریک، میله های پرچم در قاعده به هم متصل،  
3/4 - 1/4 طول تپال، 1/3-1/5 طول تپال ها در قاعده به هم متصلند؛ گل آذین به ندرت با  
بیش از 100 گل، در ابتدا دارای حالت متراکم و پس از آنتزیز معمولا به حالت سست و  
رها دیده می شود

2 sect. *Regeloprason*  
\*1- گل ها فنجانی شکل، قیفی شکل پهن یا ستاره مانند، تپال ها در قاعده متصل نبوده یا دارای  
پیوستگی کوتاه می باشند، گل آذین به اشکال متنوع، میله های پرچم کوتاهتر یا بلندتر از  
تپال ها

2- گل آذین و آرایش گل ها روی ساقه به صورت کم و بیش نیمه کروی، گل ها در گل آذین  
حالت کاملا آزاد و غیر متراکم دارند، گل ها قیفی شکل با دمگل نازک

3 (subsect. *Diffusoumbellata*)  
\*2- آرایش گل ها حالت کم و بیش چتری دارد، چترها اغلب حالت مطبق دارند، گل آذین ابتدا  
حالت متراکم دارد، دمگل ها ضخیم، گل ها به شکل زنگ و باریک هستند

[73] *Allium regelii* (subsect. *Regeloprason*)  
3- تپال ها 8-10 میلیمتر طول دارند، کم و بیش مسطح، در قسمت راس تا اندازه ای کند و پخ

[74] *Allium cathodicarpum*  
\*3- تپال ها 12-15 میلیمتر طول دارند، در قسمت راس نوک تیز و تا خورده

[75] *Allium subkopetdagense*  
4- (1\*) ساقه گل دهنده راست، بالا رونده یا پیچ و خم دار و شبیه به حرف S، در قسمت بالای  
خاک 20-30 (بندرت تا 40) سانتیمتر طول دارد

\*4- ساقه گل دهنده راست یا با اندکی خمیدگی، در قسمت بالای خاک 120-30 سانتیمتر  
طول دارد (گیاهان با ساقه به طول 20-30 سانتیمتر در آغاز آنتزیز دارای تخمدان های  
ارغوانی تا سیاه درخشان هستند)

5- ساقه گل دهنده نیمه استوانه ای، سست ترین و نازک ترین قسمت ساقه در ناحیه راس، گل  
آذین تنک و غیر متراکم، غالبا با تعداد کمتر از 50 گل در هر گل آذین

\*5- ساقه گل دهنده کم و بیش مخروطی، ضخیم ترین قسمت ساقه در زیر گل آذین قرار دارد  
و ساقه در قسمت تحتانی باریک و ضعیف و اغلب اندکی خشبی شده است؛ گل آذین تنک  
یا متراکم، معمولا با بیش از 50 گل

6- ساقه گل دهنده کم و بیش حالت موجی و نرم دارد؛ گل آذین کروی؛ تپال ها تخم مرغی تا  
بیضی شکل، 13-8 میلیمتر طول و 7-5 میلیمتر پهنا دارند، تپال ها در هنگام آنتزیز (که  
معمولا از قسمت قاعده گل آذین آغاز می شود) حالت محدب می یابند و پس از آنتزیز  
خیلی تغییر نمی کنند

[1] *Allium oreophilum* (subg. *Porphyroprason* sect. *Porphyroprason*)  
\*6- ساقه گل دهنده کم و بیش راست؛ گل آذین به حالت مخروطی یا نوک دار پهن تا نیمه  
کروی دیده می شود، بعد از آنتزیز گل آذین به شکل غیر کروی تغییر می یابد؛ تپال ها  
تخم مرغی و مقعر یا واژ-نیزه ای و نوک دار هستند، این اندام بعد از آنتزیز به سمت  
درون یا به طرف بیرون خمیده می شوند، در این زمان تپال ها کم و بیش مچاله شده یا به  
هم پیچیده و ماریچ مانند دیده می شوند، آنتزیز از قسمت نزدیک به راس گل آذین آغاز  
می شود

7- پهنک برگ بیضی شکل کشیده تا تخم مرغی، به طور طولی شیاردار؛ ساقه گل دهنده نرم و  
پیچ و خم دار؛ تخمدان ها کروی فشرده؛ تپال ها نیزه ای پهن تا تخم مرغی، سفید تا متمایل به  
سبز؛ تخمدان ها فاقد پایه

\*7- پهنک برگ با پهنای کمتر از 3 سانتیمتر، بیضی شکل کشیده تا نیزه ای باریک یا باریک  
کشیده، سبز یا سبز مایل به زرد؛ تخمدان ها مخروطی و ارونه فشرده تا گلابی شکل، به  
ندرت کروی فشرده

8- تخمدان ها با سطحی صاف، درخشان، در آغاز مرحله آنتزیز سیاه رنگ (گروه *Allium*  
*bisotunense*)

\*8- تخمدان ها با سطحی مات و کدر، سبز، کم و بیش زبر؛ میله پرچم با انتهای تیز، کم و بیش  
هم اندازه تپال ها

9- تپال ها مستطیلی یا نیزه ای پهن با نوک تیز  
\*9- تپال ها تخم مرغی با نوک کند؛ میله پرچم در قاعده سفید و در بالا ارغوانی مایل به

صورتی  
[11] *Allium keusgenii*  
10- تپال ها دارای نوک باریک و بلند؛ میله پرچم کرم تا زرد رنگ

[10] *Allium bisotunense*





10. Tepals with long tapering tip; filaments crème to yellow  
 [10] *Allium bisotunense*
- 10\* Tepals oblong or lanceolate; filaments pinkish or with pink sectors 11
11. Tepals with denticulate or crenulate margins  
 [15] *Allium colchicifolium*
- 11\* Tepals with entire margins [12] *Allium straussii*
12. Tepals oblong-lanceolate, acute, less than 3 mm wide, inner filaments basally abruptly and strongly widened; ovaries verruculose  
 [16] *Allium haussknechtii*
- 12\* Tepals obovate, spoon-shaped, white with a thick green median vein; filaments basally shortly united and short-triangular; ovaries coarse, surface long-papillate in the upper part  
 [17] *Allium moderense*
13. (7\*) Leaves (3)4-7; inflorescences initially fastigate finally semi-globose and loose; flowers funnel-shaped; tepals recurved, flesh-coloured or white; filaments 1/3-1/2 of tepal length, blackish-purple like the smooth and shiny ovaries  
 [18] *Allium noëanum* (*Allium noëanum* alliance)
- 13\* Leaves 1-3; inflorescence hemispherical to spherical, rather dense; flowers flat star-like; tepals patent, canaliculate, later recurved and spirally contorted; filaments  $\pm$  as long as the tepals, straight, subulate or long-conical; ovaries green, stipitate and very coarse (sect. *Megaloprason* subsect. *Humilicognata*) 14
14. Filaments pink with purple base; plants of rocky or stony mountain slopes; leaf laminae broadly lanceolate, 2-5 cm broad, sulcate; tepals pink with slightly darker median vein  
 [57] *Allium brachyscapum*
- 14\* Filaments pink to purple or violet with white bases 15
15. Filaments straight, deep purple with short white base; plants of white-gray (shale-like) limestone rubble hills; scape flexuous, 25-35 cm long, slightly longer or as long as the leaves; leaves 2-5 cm broad,  $\pm$  flat with upper part spirally backwards bent  
 [59] *Allium kopsedorum*
- 15\* Filaments more spreading, pinkish-carmine to deep violet-purple fading towards the white bases 16
16. Filaments somewhat shorter than the tepals, long conical, deep violet-purple; leaf laminae linear to narrowly lanceolate, 0.5-1.5 cm broad,  $\pm$  smooth; tepals pink, with conspicuously darker median vein; compact plants of rocky or stony mountain slopes  
 [60] *Allium scotostemon*
- 16\* Filaments somewhat longer than the tepals, subulate, pink to purplish; desert plants 17
17. Compact plants; scape above soil 3-10(15) cm long, flexuous, much shorter than the leaves; leaf margins white to pink  
 [58] *Allium esfahanicum*
- 17\* Taller plants; scape 25-35 cm long,  $\pm$  straight, much longer than the leaves; leaves less than 2 cm wide,  $\pm$  straight; leaf margins purplish  
 [56] *Allium assadii*
18. (5\*) Flowers flat star-like; tepals patent, straight or recurved, in fruiting stage straight and sometimes hard and prickly; filaments whitish or (dark) purplish, basally united forming a cup separate from the tepals; ovaries pyriform (stipitate), dull and

10\* - تپال‌ها کشیده یا نیزه مانند؛ میله پرچم مایل به صورتی یا با بخش‌های صورتی رنگ  
11

11- تپال‌ها دارای حاشیه (لبه) به طور ظریف دنداندار یا مژرس

[15] *Allium colchicifolium*

11\* - حاشیه (لبه) تپال‌ها فاقد هرگونه تزئیناتی است

12- تپال‌ها مستطیلی-نیزه‌ای، نوک تیز، با پهنای کمتر از 3 میلیمتر، میله‌های پرچم در قسمت داخلی گل به طور ناگهانی و به مقدار قابل توجهی پهن شده‌اند؛ تخمدان‌ها به طور ظریفی زگیل دار هستند

[16] *Allium haussknechtii*

12\* - تپال‌ها و اثر تخم‌مرغی، قاشقی شکل، سفید با رگبرگ میانی ضخیم به رنگ سبز؛ میله‌های پرچم مثلی کوتاه و در قاعده مختصراً به هم متصل شده‌اند؛ تخمدان‌ها زبر، در قسمت فوقانی دارای پاپیل‌های بلند

[17] *Allium moderense*

13 (7\*) - برگ‌ها 4-7 (3) عدد؛ گل‌آذین در ابتدا به شکل مخروط در نهایت نیمه کروی و سست؛ گل‌ها قیفی شکل؛ تپال‌ها از قسمت پشتی خمیده شده‌اند، به رنگ قرمز یا صورتی روشن یا سفید؛ میله‌های پرچم 1/2-1/3 طول تپال‌ها، ارغوانی مایل به سیاه؛ تخمدان‌ها صاف و درخشان، هم‌رنگ میله‌های پرچم

[18] *Allium noëanum* (گروه *A. noëanum*)

13\* - برگ‌ها 3-1 عدد؛ گل‌آذین نیمه کروی تا کروی، غالباً مترآکم؛ گل‌ها ستاره مانند مسطح؛ تپال‌ها باز، به طور طولی شیاردار، با گذشت زمان از قسمت پشتی خمیده شده و به صورت مارپیچ تغییر شکل می‌دهند؛ میله‌های پرچم هم اندازه تپال‌ها، راست، دارای نوک تیز یا مخروطی کشیده؛ تخمدان‌ها سبز، دارای پایه و بسیار زبر

14 (sect. *Megaloprason* subsect. *Humilicognata*)

14- میله‌های پرچم صورتی با قاعده ارغوانی؛ گیاهان معمولاً روی شیب‌های سنگلاخی یا صخره‌ای کوه‌ها می‌رویند؛ پهنک برگ نیزه‌ای پهن، با عرض 2-5 سانتیمتر، شیاردار؛ تپال‌ها صورتی با رگبرگ میانی اندکی تیره‌تر

[57] *Allium brachyscapum*

14\* - میله‌های پرچم صورتی تا ارغوانی یا بنفش با قاعده سفید  
15- میله‌های پرچم راست، ارغوانی تیره با بخش کوتاه سفید رنگ در قاعده؛ رویشگاه گیاهان تپه-های پوشیده از خرده سنگ‌های سفید-خاکستری سنگ آهک؛ ساقه گل‌دهنده انعطاف پذیر و موج‌دار به طول 25-35 سانتیمتر، اندکی طویل‌تر یا هم اندازه برگ‌ها؛ برگ‌ها کم و بیش تخت با عرض 2-5 سانتیمتر، قسمت فوقانی برگ‌ها به طور مارپیچ به پشت خمیده شده‌اند

[59] *Allium kopsedorum*

15\* - میله‌های پرچم بیشتر حالت تنک و پراکنده دارند، به رنگ قرمز کارمن مایل به صورتی تا بنفش-ارغوانی تیره، رنگ میله‌های پرچم به سمت قاعده محو شده و در قاعده کاملاً سفید هستند

16

16- میله‌های پرچم مخروطی بلند، بنفش-ارغوانی تیره، اندکی کوتاه‌تر از تپال‌ها؛ پهنک برگ باریک و کشیده تا نیزه‌ای باریک، با عرض 0/5-1/5 سانتیمتر، کم و بیش صاف؛ تپال‌ها صورتی با رگبرگ میانی کاملاً تیره‌تر از دیگر قسمت‌ها؛ گیاهان معمولاً کوتاه و فشرده، روی شیب‌های صخره‌ای یا سنگی مناطق کوهستانی می‌رویند

[60] *Allium scotostemon*

16\* - میله‌های پرچم با انتهای تیز، صورتی تا ارغوانی، مقداری کوتاه‌تر از تپال‌ها؛ گیاهان در بیابان می‌رویند

17

17- گیاهان حالت کوتاه (فشرده) و جمع و جور دارند؛ ساقه گل‌دهنده نرم و پیچ و خم‌دار، در قسمت بالای خاک (15) 3-10 سانتیمتر طول دارد، بسیار کوتاه‌تر از برگ‌ها؛ حاشیه برگ‌ها

[58] *Allium esfahanicum*

سفيد تا صورتی  
17\* - گیاهان بلندتر؛ ساقه گل‌دهنده کم و بیش راست، به طول 25-35 سانتیمتر، به مراتب طویل‌تر از برگ‌ها؛ برگ‌ها کم و بیش راست با پهنای کمتر از 2 سانتیمتر؛ حاشیه برگ‌ها

[56] *Allium assadii*

18 (5\*) - گل‌ها مسطح و ستاره مانند؛ تپال‌ها گشوده و باز، راست یا به پشت خمیده شده‌اند، در مرحله میوه‌دهی راست و برخی مواقع سخت و زبر (تیغ مانند)؛ میله‌های پرچم نزدیک به سفید یا ارغوانی تا ارغوانی تیره، در قاعده به یکدیگر پیوسته و تشکیل جامی جدای از تپال‌ها را می‌دهند؛ تخمدان‌ها گلابی شکل (ساقه دار)، مات، زگیل‌دار (به ندرت صاف و براق)

19 (sect. *Asteroprason*)





- tuberculate (rarely smooth and shiny) (sect. *Asteroprason*) 19
- 18\* Flowers narrowly to broadly funnel-shaped star-like, rarely nearly ovoid; tepals straight or incurved, rarely the upper half recurved 27
19. Plants compact, scape rarely longer than 20 cm; tepals convolute, crumpled and not prickly in the fruiting stage; filaments rarely much darker than tepals (subsect. *Asteroprason*) 20
- 19\* Scape (20)30-40 cm long; leaf laminae hairy or at least densely toothed along margins; tepals in fruiting stage stiff and prickly; filaments always conspicuously darker than tepals (subsect. *Cristophiana*) 23
20. Leaf laminae linear, canaliculate, completely or at least the upper half spirally contorted, margins sparsely toothed to ciliate near base; tepals 5-7 mm long, c. 1 mm broad; filaments deep purple to violet [46] *Allium helicophyllum*
- 20\* Leaf laminae ± elliptic, glabrous; tepals 7-12 mm long, 1.5-2 mm broad; filaments only slightly darker than the tepals 21
21. Leaf laminae elliptic to narrowly oblong; ovaries with a glass-like glossy surface [45] *Allium elburzense*
- 21\* Leaf laminae elliptic to oblanceolate, remarkably narrowed towards base; ovaries very coarse 22
22. Leaf laminae thick fleshy, stalk-like narrowed toward the base; filaments white with lilac tip; ovaries green [47] *Allium kuhforskense*
- 22\* Leaf laminae moderately thick, slightly narrowed toward the base; filaments violet with whitish base; ovaries initially purplish flushed [49] *Allium pseudobodeanum*
23. (19\*) Leaf laminae (sometimes only sparsely) hairy, up to 3 cm broad; tepals after anthesis stiff and prickly 24
- 23\*. Leaf laminae not hairy, broader than 3 cm, only margins toothed; tepals after anthesis ± soft 26
24. Tepals silvery-brownish; leaf laminae lanceolate, up to 3 cm broad and ± woolly; filaments dark purple-brown [51] *Allium cristophii* subsp. *golestanicum*
- 24\* Tepals lilac to violet or pink; leaf laminae narrowly lanceolate to linear, mostly narrower than 2 cm and with a sparse indumentum 25
25. Leaf laminae narrowly lanceolate; tepals lilac to silvery-violet; filaments pinkish-purple to violet [50] *Allium cristophii* subsp. *cristophii*
- 25\* Leaf laminae ± linear, tepals purplish-pink see [50] *Allium cristophii* "masjedense"
26. (23\*) Leaves 2, laminae procumbent with enrolled tip; scape about 5 cm long; tepals lanceolate, white, ± incurved; filaments deep purple with white base; ovaries purplish [44] *Allium aladaghense*
- 26\* Leaves 1-3(5), lax, laminae linear-oblong; scape 15-30 cm long; tepals narrowly triangular, ± recurved, rose to pink with darker median vein; filaments purplish with brighter base; ovaries green, pinkish flushed [52] *Allium ellisii*
27. (18\*) Scape above soil 0-5 cm long; leaf laminae linear-lanceolate, 4-10 mm wide, margin finely ciliate; tepals pink, median vein purple, very broad in the upper part; filaments white, 1/2

18\* - گل‌ها قیفی شکل باریک تا پهن و ستاره مانند، به ندرت تقریباً تخم‌مرغی؛ تپال‌ها مستقیم یا خمیده شده به درون، به ندرت نیمه بالایی به بیرون خمیده شده است 27  
 19- گیاهان کوتاه و فشرده، طول ساقه گل‌دهنده بندرت بلندتر از 20 سانتیمتر؛ تپال‌ها به هم پیچیده و مجاله شده، در مرحله میوه دهی فاقد حالت زیر و تیغ مانند؛ میله‌های پرچم بندرت خیلی تیرمتر از تپال‌ها (subsect. *Asteroprason*) 20  
 19\* - طول ساقه گل‌دهنده 30-40 (20) سانتیمتر؛ پهنک برگ کرکین یا حداقل در امتداد حاشیه به طور متراکم مضرس؛ تپال‌ها در مرحله میوه‌دهی سفت و شق و تیغ مانند؛ میله‌های پرچم همیشه و به وضوح تیرمتر از تپال‌ها



23 (subsect. *Cristophiana*)  
 20- پهنک برگ باریک و کشیده، شیاردار، تمامی پهنک برگ یا حداقل نیمه بالایی آن به طور مارپیچ پیچانده و کج شده است، حاشیه برگ در نزدیک قاعده دارای دندان‌های تنک تا مژدار؛ تپال‌ها به طول 5-7 میلی‌متر و پهنای در حدود 1 میلی‌متر؛ میله‌های پرچم ارغوانی تیره تا بنفش  
 [46] *Allium helicophyllum*  
 20\* - پهنک برگ کم و بیش بیضی شکل، صاف؛ تپال‌ها به طول 7-12 میلی‌متر و پهنای 2-1/5 میلی‌متر؛ میله‌های پرچم فقط اندکی تیرمتر از تپال‌ها  
 21  
 21- پهنک برگ بیضی شکل تا کشیده و باریک؛ سطح تخمدان‌ها شیشه مانند و براق



[45] *Allium elburzense*  
 21\* - پهنک برگ بیضی شکل تا واژنیزه‌ای، به طور قابل ملاحظه‌ای به سمت قاعده برگ باریک شده؛ تخمدان‌ها به طور قابل ملاحظه‌ای زبر  
 22  
 22- پهنک برگ ضخیم و گوشه‌ای، به سمت قاعده باریک شده و دارای بخش ساقه مانند؛ میله‌های پرچم سفید با راس ارغوانی روشن؛ تخمدان‌ها سبز



[47] *Allium kuhorsorkhense*  
 22\* - پهنک برگ کم و بیش ضخیم، به سمت قاعده اندکی باریک شده؛ میله‌های پرچم بنفش با قاعده نزدیک به سفید؛ تخمدان‌ها در ابتدا ارغوانی مایل به سرخ

[49] *Allium pseudobodeanum*  
 23 (19\*) - پهنک برگ کرکین (برخی مواقع بسیار کم‌پشت)، با پهنای تا 3 سانتیمتر؛ تپال‌ها بعد از مرحله آنتزیز شق و تیغ مانند 24  
 23\* - پهنک برگ کرکین نیست، فقط در حاشیه مضرس، با پهنای بیش از 3 سانتیمتر؛ تپال‌ها بعد از آنتزیز کم و بیش نرم و لطیف 26  
 24- تپال‌ها نقره‌فام-قهوه‌ای؛ پهنک برگ نیزه‌ای با پهنای تا 3 سانتیمتر و کم و بیش پشمی؛ میله‌های پرچم ارغوانی-قهوه‌ای تیره  
 [51] *Allium cristophii* subsp. *golestanicum*  
 24\* - تپال‌ها یاس بنفشی تا بنفش یا صورتی؛ پهنک برگ نیزه‌ای باریک تا دراز و کشیده، غالباً با پهنای کمتر از 2 سانتیمتر و پوشیده شده با موهای بسیار ظریف و تنک



25  
 25- پهنک برگ نیزه‌ای باریک؛ تپال‌ها یاس بنفشی تا بنفش نقره‌فام؛ میله‌های پرچم ارغوانی مایل به صورتی تا بنفش  
 [50] *Allium cristophii* subsp. *cristophii*  
 25\* - پهنک برگ کم و بیش باریک و کشیده؛ تپال‌ها صورتی مایل به ارغوانی

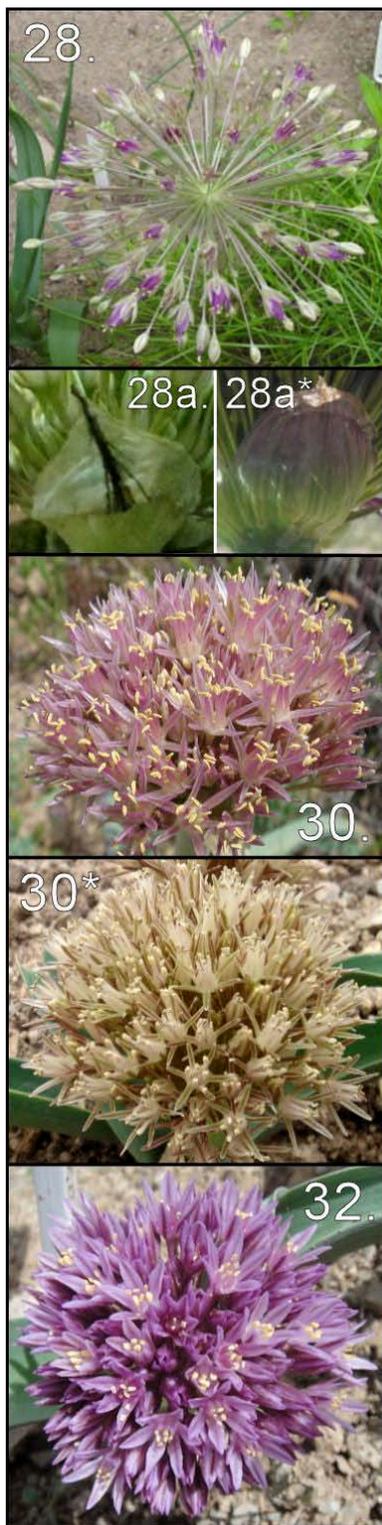


[see 50] *Allium cristophii* "*masjedense*"  
 26 (23\*) - برگ‌ها 2 عدد، پهنک برگ خوابیده روی زمین با نوک پیچیده شده؛ ساقه گل‌دهنده به طول حدود 5 سانتیمتر؛ تپال‌ها نیزه‌مانند، سفید، کم و بیش خمیده سوی درون؛ میله‌های پرچم ارغوانی پررنگ با قاعده سفید؛ تخمدان‌ها مایل به ارغوانی

[44] *Allium aladaghense*  
 26\* - برگ‌ها 3(5) 1- عدد، به حالت شل و آزاد، پهنک برگ مستطیلی باریک و کشیده؛ ساقه گل‌دهنده به طول 15-30 سانتیمتر؛ تپال‌ها مثلثی باریک، کم و بیش خمیده به بیرون، به رنگ گل سرخی تا صورتی با رگبرگ میانی تیرمتر؛ میله‌های پرچم مایل به ارغوانی با قاعده روشن‌تر؛ تخمدان‌ها سبز بارگه‌های مایل به صورتی  
 [52] *Allium ellisii*



27 (18\*) - ساقه گل‌دهنده به طول 0-5 سانتیمتر در سطح خاک؛ پهنک برگ نیزه‌ای باریک و کشیده با پهنای 0/4-1 سانتیمتر، دارای حاشیه به طور ظریف مژدار؛ تپال‌ها صورتی با رگبرگ میانی ارغوانی که در قسمت فوقانی بسیار پهن شده است؛ میله‌های پرچم سفید، به طول 1/2-3/4 تپال‌ها  
 [48] *Allium monophyllum*  
 28  
 27\* - ساقه گل‌دهنده به طول 40-5 سانتیمتر؛ پهنک برگ با پهنای بیش از 1 سانتیمتر



- 3/4 as long as the tepals [48] *Allium monophyllum*
- 27\* Scape 5-40 cm long; leaf laminae broader than 1 cm 28
28. Desert plants; scape conical, after anthesis basally soft; leaf laminae green, broadly lanceolate, canaliculate; inflorescences  $\pm$  globose, always loose with pedicels of unequal length; flowers ovate-narrowly funnel-shaped; filaments much longer than the tepals; ovaries  $\pm$  turbinate
- [55] *Allium caspium* (sect. *Kaloprason* subsect. *Kaloprason*)
- 28\* Steppe plants; scape indistinctly conical, basally not decomposing; inflorescence (at least initially) dense, fasciculate to semi-globose; tepals very narrowly lanceolate to triangular, recurved, in the dry state stiff and often prickly; filaments equal or shorter than the tepals; ovaries  $\pm$  globose (sect. *Acanthoprason*) 28a
- 28a. Median veins of spathe black, united towards the tip of the valve [83] *Allium kuhrangense*
- 28a\* Median veins of spathe green to brown, parallel up to the tip of the valve 29
29. Filaments  $\pm$  as long as the tepals that become stiff and prickly-like after anthesis, inflorescences narrowly to broadly fasciculate (*Allium materculae* alliance) 30
- 29\* Filaments shorter than the tepals that become stiff but not really prickly after anthesis, inflorescences  $\pm$  semi-globose 31
30. Flowers with strong sweet odor; tepals flesh-colored, median vein scarcely visible at the inner side [36] *Allium graveolens*
- 30\* Flowers with honey-like odor; tepals white or pale-purplish, median vein broad, brown or green [37] *Allium materculae*
31. Filaments 1/2-4/5 as long as the tepals 32
- 31\* Filaments up to half as long as the tepals 35
32. Filaments 1/2-2/3 of tepal length; scape 3-8 cm long, tepals pink to purple with dark purple median vein; ovaries smooth, nectary ducts lead in pockets with median nose-like rise [41] *Allium sabalense*
- 32\* Filaments 2/3-4/5 of tepal length 33
33. Tepals triangular, pinkish-carmine; filaments initially rose later carmine; anthers carmine; scape 10-20 cm long [35] *Allium alekij*
- 33\* Tepals linear-lanceolate, rose or whitish; filaments permanently rose or white; anthers yellow 34
34. Scape 15-30 cm long; tepals with narrow greenish median vein; filaments long-triangular to subulate; ovary finely coarse, nectary ducts lead in triangular holes near the base [81] *Allium sp. G*
- 34\* Scape 3-8 cm long; tepals with broad dark purple median vein; filaments ovate-triangular; ovary smooth, nectary ducts lead in pockets with median nose-like rise [42] *Allium sahandicum*
35. (31\*) Filaments one-colored, or base slightly darker than the tip 36
- 35\* Tip of filaments remarkably darker than the basal part 43
36. Plants very compact; leaf laminae broadly elliptic, canaliculate, apex rounded; scape very thick, as long as the diameter of the flat-umbellate, very dense inflorescence; pedicels shorter than the carmine tepals [21] *Allium akaka* subsp. *bozgushense*
- 36\* Plants often small but more slender; leaf laminae long ovate, lanceolate to linear with a shortly or long tapering tip; inflorescences narrowly fasciculate to semi-globose; pedicels longer than the tepals 37

28- گیاه مختص رویشگاه بیابانی؛ ساقه گل‌دهنده مخروطی، بعد از آنتزیز بافت قاعده ساقه نرم می‌شود؛ پهنک برگ سبز، نیزه‌ای پهن، شیاردار؛ گل‌آذین کم و بیش کروی، همیشه غیرمترکم با دمگل‌های با طول‌های نابرابر؛ گل‌ها تخم‌مرغی-قیفی شکل باریک؛ میله‌های پرچم بسیار بلندتر از تپال‌ها؛ تخمدان‌ها کم و بیش فر فرهای شکل

[55] *Allium caspium* (sect. *Kaloprason* subsect. *Kaloprason*)

\*28- گیاه مختص رویشگاه استپی؛ ساقه گل‌دهنده به صورت مخروطی ناموزون، در قاعده حالت تجزیه شده و نرم پیدا نمی‌کند؛ گل‌آذین (حداقل در ابتدا) مترکم، دسته دسته تا نیمه کروی؛ تپال‌ها نیزه‌ای بسیار باریک تا مثلثی، خمیده شده به طرف بیرون، در حالت خشک سفت و شق و اغلب تیغ مانند؛ ارتفاع میله‌های پرچم برابر یا کوتاه‌تر از تپال‌ها؛ تخمدان‌ها کم و بیش گرد

28a- رگبرگ‌های میانی برگچه‌های زیر گل آذین سیاه رنگ، رگبرگ‌ها به سمت راس هر برگچه با یکدیگر متحد می‌شوند

[83] *Allium kuhrangense*  
\*28a- رگبرگ‌های میانی برگچه‌های زیر گل آذین سبز تا قهوه‌ای، رگبرگ‌ها به حالت موازی یکدیگر تا راس برگچه ادامه می‌یابند

29- میله‌های پرچم کم و بیش هم ارتفاع تپال‌ها؛ تپال‌ها بعد از آنتزیز سفت و شق و شبه خار مانند می‌شوند؛ گل‌آذین به حالت دسته دسته باریک تا پهن

30 (گروه *Allium materculae*)

\*29- میله‌های پرچم کوتاه‌تر از تپال‌ها؛ تپال‌ها بعد از آنتزیز حالت شق و سفت پیدا می‌کنند ولی حالت تیغ مانند مشخص در آنها دیده نمی‌شود؛ گل‌آذین کم و بیش نیمه کروی

31

30- گل‌ها دارای رایحه بسیار قوی؛ تپال‌ها قرمز روشن، رگبرگ‌های میانی در سطح داخلی تپال به دشواری مشخص است

[36] *Allium graveolens*

\*30- گل‌ها با رایحه عسل مانند؛ تپال‌ها سفید یا ارغوانی رنگ پریده، رگبرگ‌های میانی تپال پهن به رنگ قهوه‌ای یا سبز

[37] *Allium materculae*

32

31- اندازه میله‌های پرچم 1/2-4/5 طول تپال‌ها

35

\*31- اندازه میله‌های پرچم نصف یا کمتر از نصف طول تپال‌ها

32- میله‌های پرچم 1/2-2/3 طول تپال‌ها؛ ساقه گل‌دهنده به طول 3-8 سانتیمتر؛ تپال‌ها صورتی تا ارغوانی با رگبرگ‌های میانی ارغوانی تیره؛ تخمدان‌ها صاف، غدد ترشح کننده شهد گل (نکتاری) محصور در ساختارهای کیسه‌ای با برآمدگی میانی دماغه مانند

[41] *Allium sabalense*

33

\*32- میله‌های پرچم 2/3-4/5 طول تپال‌ها

33- تپال‌ها مثلثی شکل، قرمز کارمن مایل به صورتی؛ میله‌های پرچم ابتدا گل سرخی و سپس به رنگ قرمز کارمن؛ بساک به رنگ قرمز کارمن؛ ساقه گل‌دهنده به طول 10-20 سانتیمتر

[35] *Allium alekii*

\*33- تپال‌ها نیزه‌ای باریک و کشیده، به رنگ گل سرخی یا مایل به سفید؛ میله‌های پرچم به طور ثابت گل سرخی یا سفید؛ بساک به رنگ زرد

34

34- ساقه گل‌دهنده به طول 15-30 سانتیمتر؛ تپال‌ها دارای رگبرگ‌های میانی باریک و متمایل به سبز؛ میله‌های پرچم بلند و سه گوش تا نوک تیز؛ تخمدان‌ها به طور ظریفی زبر؛ غدد ترشح کننده شهد گل (نکتاری) محصور در حفره‌های سه گوش نزدیک قاعده

[81] *Allium* sp. G

\*34- ساقه گل‌دهنده به طول 3-8 سانتیمتر؛ تپال‌ها دارای رگبرگ‌های میانی پهن به رنگ ارغوانی تیره؛ میله‌های پرچم تخم‌مرغی-سه گوش؛ تخمدان‌ها صاف؛ غدد ترشح کننده شهد گل (نکتاری) محصور در ساختارهای کیسه‌ای با برآمدگی میانی دماغه مانند

[42] *Allium sahandicum*

36

35\*(31)- رنگ میله‌های پرچم یک دست یا در قاعده اندکی تیره‌تر از راس

43

\*35- راس میله‌های پرچم به وضوح تیره‌تر از قاعده آن است

36- گیاهان بسیار فشرده و کوتاه؛ پهنک برگ بیضی پهن، شیاردار، دارای راس گرد؛ ساقه گل‌دهنده بسیار ضخیم، با طولی معادل قطر گل‌آذین مسطح-چتری و بسیار مترکم گیاه؛ دمگل‌ها کوتاه‌تر از تپال‌های به رنگ قرمز کارمن

[21] *Allium akaka* subsp. *bozghushense*

\*36- گیاهان اغلب کوچک و بیشتر به حالت باریک و کشیده دیده می‌شوند؛ پهنک برگ تخم مرغی کشیده، نیزه‌ای تا باریک و کشیده که در راس مختصراً یا به طور مشخص باریک و نوکدار است؛ گل‌آذین دسته‌دسته باریک تا نیمه کروی؛ دمگل‌ها از تپال‌ها بلندترند





37. Scape 2-5 cm long above soil; leaf laminae  $\pm$  linear or narrowly lanceolate,  $\pm$  procumbent, throughout canaliculate; tepals lanceolate, recurved, deep pink with purple median vein; filaments triangular, half of tepal length, basally for 1.5 mm connate, darker at the base [31] *Allium alamutense*

37\* Scape 5-15 cm long above soil; leaf laminae obliquely positioned and recurved, 15-30 cm long and 1.5-4 cm broad 38

38. Tepals linear-triangular to lanceolate, 12-18 mm long, 1.5-2 (2.5) mm wide; filaments 1/5-1/3 of tepal length

(*Allium haemanthoides* alliance) 39

38\* Tepals broadly lanceolate or ovate-obtuse, 6-12 mm long; filaments 1/3-1/2 of tepal length 41

39. Leaf laminae dull, bluish-green with strong glaucous bloom, broadly lanceolate, sulcate; tepals narrowly triangular, recurved; filaments 1/5 of tepal length [33] *Allium haemanthoides*

39\* Leaf laminae vividly green and glossy; tepals with rather broad green median vein 40

40. Leaf laminae broadly lanceolate, up to 8 cm broad; tepals lanceolate-triangular, pale lilac; filaments 1/3 to 2/5 of tepal length, fleshy, somewhat paler than the tepals [34] *Allium zagricum*

40\* Leaf laminae narrowly lanceolate; tepals long-triangular, whitish; filaments 1/3 of tepal length, yellowish or slightly pinkish

[25a] albinotic *Allium austroiranicum*

41. (38\*) Tepals ovate, obtuse, pink to purplish; filaments 1/3 of tepal length and whitish throughout or pinkish near the very base, nearly touching one another with the margins above the base [20] *Allium akaka* (*Allium akaka* alliance)

41\* Tepals broadly lanceolate to sub-ovate, sub-acute; filaments 1/3-1/2 of tepal length; margins of filaments above the base with some distance to one another (*Allium ubipetrense* alliance) 42

42. Leaf laminae narrowly to broadly lanceolate, recurved; tepals 7-12 mm long, pink to purplish like the filaments

[43] *Allium ubipetrense*

42\* Leaf laminae falcate-recurved; tepals elliptic-oblong to lanceolate, 6-7 mm long, up to 2 mm wide, purple

[23] *Allium mahneshanense*

43. (35\*) Ovaries smooth and glossy, with six radial bulges at the tip; tepals green to purple-brown with broad green median vein, after anthesis convolute; filaments purple with much paler bases, triangular widened and bowl-shaped connate

(*Allium minutiflorum* alliance) 44

43\* Ovaries dull and  $\pm$  coarse; tepals whitish, pinkish, or lilac 46

44. Tepals purple-brown, 7-8 mm long,  $\pm$  recurved, straight and stiff; ovaries in early anthesis green or upper part brown flushed

[39] *Allium hamedanense*

44\* Tepals  $\pm$  green or mixed with brown; ovaries black in early anthesis 45

45. Tepals purely green or mixed with brown, 8-10 mm long, recurved, after anthesis obliquely directed and contorted

[38] *Allium chlorotepalum*

45\* Tepals yellowish-green often with brown flush, 3-5 mm long, incurved, after anthesis connivent [40] *Allium minutiflorum*

- 37- طول ساقه گل‌دهنده در قسمت بالای خاک 5-2 سانتیمتر؛ پهنک برگ کم و بیش باریک و کشیده یا نیزه‌ای باریک، کم و بیش خوابیده روی زمین، سراسر پهنک برگ شیاردار؛ تپال‌ها نیزه‌ای، خمیده شده به طرف بیرون، صورتی تیره با رگبرگ میانی ارغوانی؛ میله‌های پرچم به شکل مثلث، با طولی معادل نصف طول تپال‌ها، در قاعده و به ارتفاع 1.5 میلیمتر به هم پیوسته؛ تیره‌تر در قاعده  
 [31] *Allium alamutense*
- 37\*- ساقه گل‌دهنده در سطح خاک 15-5 سانتیمتر طول دارد؛ پهنک برگ به طور اریب قرار گرفته و از قسمت پشتی خمیده شده است، طول پهنک برگ 30-15 سانتیمتر و پهنای آن 4-1.5 سانتیمتر است  
 38  
 38- تپال‌ها باریک و کشیده-مثلثی تا نیزه‌ای شکل به طول 18-12 میلیمتر و پهنای 2(2.5)-1.5 میلیمتر؛ اندازه میله‌های پرچم 1/3-1/5 طول تپال‌ها  
 39  
 38\*- تپال‌ها نیزه‌ای پهن یا تخم‌مرغی با راس کند (پخ) به طول 12-6 میلیمتر؛ میله‌های پرچم 1/2-1/3 طول تپال‌ها  
 41  
 39- پهنک برگ مات، سبز مایل به آبی با پوشش مومی شدید، نیزه‌ای پهن، شیاردار؛ تپال‌ها مثلثی باریک، خمیده شده به طرف بیرون؛ میله‌های پرچم 1/5 طول تپال‌ها  
 [33] *Allium haemanthoides*
- 39\*- پهنک برگ سبز روشن و براق؛ تپال‌ها دارای رگبرگ میانی سبز رنگ و نسبتاً پهن  
 40  
 40- پهنک برگ نیزه‌ای پهن، با پهنای تا 8 سانتیمتر؛ تپال‌ها نیزه‌ای-مثلثی، به رنگ یاس-بنفشی روشن؛ میله‌های پرچم 2/5 تا 1/3 طول تپال‌ها، گوشتی، تا اندازه‌ای روشن‌تر از تپال‌ها  
 [34] *Allium zagricum*
- 40\*- پهنک برگ نیزه‌ای باریک؛ تپال‌ها مثلثی بلند، تا اندازه‌ای سفید؛ میله‌های پرچم 1/3 طول تپال‌ها، زرد فام یا اندکی مایل به صورتی  
 [25a] *Allium austroiranicum* albinotic
- 41\*(38)- تپال‌ها تخم‌مرغی، با راس کند، صورتی تا مایل به ارغوانی؛ میله‌های پرچم 1/3 طول تپال‌ها، سراسر اندام نسبتاً سفید یا در بخش انتهایی قاعده مایل به صورتی، بخش بالای قاعده میله‌ها تقریباً با یکدیگر در تماسند
- (گروه *Allium akaka* subsp. *akaka*) [20] *Allium akaka*
- 41\*- تپال‌ها نیزه‌ای پهن تا تقریباً تخم‌مرغی، قدری نوک تیز؛ میله‌های پرچم 1/2 تا 1/3 طول تپال‌ها؛ کناره میله‌های پرچم در بالای قاعده اندکی از یکدیگر فاصله دارند
- 42 (گروه *Allium ubipetrense*)  
 42- پهنک برگ نیزه‌ای باریک تا پهن، از پشت خمیده شده؛ تپال‌ها به طول 12-7 میلیمتر، صورتی تا مایل به ارغوانی و هم‌رنگ میله‌های پرچم
- [43] *Allium ubipetrense*
- 42\*- پهنک برگ داسی شکل-خمیده به پشت؛ تپال‌ها بیضی-کشیده تا نیزه‌ای، به طول 7-6 میلیمتر، به عرض تا 2 میلیمتر، ارغوانی  
 [23] *Allium mahneshanense*
- 43\*(35)- تخمدان‌ها صاف و براق، دارای شش تحذب شعاعی در راس؛ تپال‌ها سبز تا ارغوانی-قهوه‌ای با رگبرگ میانی پهن و سبز رنگ، بعد از آنتزیز به هم پیچیده؛ میله‌های پرچم ارغوانی، در قاعده بسیار روشن‌تر از راس، مثلثی پهن، به هم پیوسته و جامی شکل  
 44 (گروه *Allium minutiflorum*)
- 43\*- تخمدان‌ها مات (کدر) و کم و بیش زبر؛ تپال‌ها نسبتاً سفید، مایل به صورتی یا یاس بنفشی  
 46  
 44- تپال‌ها ارغوانی-قهوه‌ای، به طول 8-7 میلیمتر، کم و بیش خمیده به طرف بیرون، راست و سفت؛ تخمدان‌ها در اوایل آنتزیز سبز یا در قسمت فوقانی با رگه‌های قهوه‌ای
- [39] *Allium hamedanense*
- 44\*- تپال‌ها سبز یا آمیخته با قهوه‌ای؛ تخمدان‌ها در اوایل آنتزیز سیاه  
 45  
 45- تپال‌ها کاملاً سبز یا آمیخته با قهوه‌ای، به طول 10-8 میلیمتر، خمیده شده به طرف بیرون، بعد از آنتزیز تپال‌ها به شکل اریب و کج متمایل شده و از شکل می‌افتند
- [38] *Allium chlorotepalum*
- 45\*- تپال‌ها سبز مایل به زرد اغلب با رگه‌های قهوه‌ای، به طول 5-3 میلیمتر، خمیده سوی درون، بعد از آنتزیز به هم جمع شده و روی هم قرار می‌گیرند
- [40] *Allium minutiflorum*
- 46\*(43)- پهنک برگ نیزه‌ای (بعضاً نیزه‌ای پهن)، با رشد مورب و به طرف بالا، در قاعده شیاردار و در قسمت بالا صاف، راس پهنک به سمت پایین‌ترین آویزان است؛ تپال‌ها نوک تیز، مثلثی تا نیزه‌ای باریک  
 47 (گروه *Allium austroiranicum*)
- 46\*- پهنک برگ کم و بیش باریک و کشیده یا نیزه‌ای باریک، کم و بیش خوابیده روی زمین، سراسر پهنک شیاردار؛ تپال‌ها نیزه‌ای تا تخم‌مرغی باریک و کشیده، در راس کم و بیش تیز یا کند و پخ؛ میله‌های پرچم صورتی یا ارغوانی تا قرمز-قهوه‌ای با قاعده نسبتاً سفید  
 50 (گروه *Allium derderianum*)



[25]



46. (43\*) Leaf laminae (broadly) lanceolate, obliquely ascending, only basally canaliculate, above even and hanging down; tepals acute, triangular up to narrowly lanceolate

(*Allium austroiranicum* alliance) 47

- 46\* Leaf laminae  $\pm$  linear or narrowly lanceolate,  $\pm$  procumbent, throughout canaliculate; tepals lanceolate to linear-ovate, sub-acute or obtuse; filaments pink or purple to red-brown with whitish bases

(*Allium derderianum* alliance) 50

47. Leaf laminae lanceolate with white margins, steeply ascending; tepals triangular to narrowly lanceolate, 8-12 mm long, 1.2-2 (2.5) mm wide near the base, whitish to pinkish

[25] *Allium austroiranicum*

- 47\* Leaf laminae oblong to broadly elliptic or ovate with purple margins,  $\pm$  procumbent 48

48. Leaf laminae oblong to elliptic; tepals narrowly oblong, obtuse but plicate at the tip, 8-9 mm long and up to 1.5 mm wide; filaments subulate, 2/3 of tepal length, with a dark colored tip and remarkably higher united at the base than adnate to the tepals

[22] *Allium subakaka*

- 48\* Leaf laminae ovate or lanceolate-ovate; tepals lanceolate; filaments about half as long as the tepals 49

49. Tepals acute with a deeply purple median vein; filaments subulate and puberulent; stigmata slightly capitate and obsoletely trilobate

[26] *Allium latifolium*

- 49\* Tepals obtuse (but apex plicate) with a greenish-brown median vein, filaments broadly triangular (inner ones basally ovate), carmine fading to whitish towards the base, stigmata punctiform

[24] *Allium iranshahrii*

50. (46\*) Filaments white with short lilac-pink apex, anthers purplish; leaf laminae long linear, falcate-undulate, 15-25 cm long, 0.5-1 cm broad; tepals white, linear with short acute tip

[27] *Allium breviscapum*

- 50\* Upper 1/2 to 1/3 of filaments pink to brown-purplish, anthers yellow or purplish; tepals lanceolate or triangular-lanceolate 51

51. Leaf laminae curved but not undulate; tepals lanceolate, obtuse, pink; upper half of filaments deep pink, anthers yellow; inflorescences fasciculate, in the fruiting stage very loose and subglobose

[30] *Allium shelkovnikovii*

- 51\* Leaf laminae undulate; tepals pinkish- or grayish-white to pink; inflorescences dense, semi-globose, in the fruiting stage globose 52

52. Tepals lanceolate-triangular, acute, 11-13 mm long, straight, pink to lilac with darker median vein; filaments from ovate base triangular, about 1/3 of tepal length, lilac, anthers yellow

[32] *Allium kurdistanicum*

- 52\* Tepals with obtuse apex, up to 10 mm long; filaments 2/5-2/3 of tepal length, anthers purplish 53

53. Leaf laminae 15 $\times$ 0.8 to 30 $\times$ 3 cm; tepals  $\pm$  lanceolate; filaments fleshy, triangular, basally 1-2 mm connate, upper two-thirds purple to red-brown

[29] *Allium egorovae*

- 53\* Leaf laminae 15 $\times$ 3 to 25 $\times$ 1 cm; tepals narrowly linear-triangular (those of alpine morphotypes lanceolate); filaments subulate, basally by c. 0.5 mm connate, from the deep pink apex fading towards the base

[28] *Allium derderianum*

47- پهنک برگ نیزه‌ای با حاشیه سفید، با رشد به طرف بالا با زاویه‌ای تند؛ تپال‌ها مثلثی تا نیزه‌ای باریک، به طول 8-12 میلی‌متر و پهنای 1.2-2(2.5) میلی‌متر در قاعده، نسبتاً سفید تا مایل به صورتی

[25] *Allium austroiranicum*

47\* پهنک برگ کشیده تا بیضی پهن یا تخم مرغی با حاشیه ارغوانی، کم و بیش خوابیده روی زمین

48- پهنک برگ کشیده تا بیضی شکل؛ تپال‌ها کشیده و باریک، در راس کند و پخ با نوک تا خورده، به طول 8-9 میلی‌متر و پهنای تا 1.5 میلی‌متر؛ میله‌های پرچم با انتهای تیز، 2/3 تپال‌ها طول دارند، در راس به رنگ تیره، میله‌های پرچم بیش از آن که به تپال‌ها پیوسته باشند به طور قابل ملاحظه‌ای در قاعده به یکدیگر متصلند

[22] *Allium subakaka*

48\* پهنک برگ تخم مرغی یا نیزه‌ای-تخم‌مرغی؛ تپال‌ها نیزه‌ای؛ میله‌های پرچم به اندازه نصف طول تپال‌ها

49- تپال‌ها نوک تیز با رگبرگ میانی به رنگ ارغوانی تیره؛ میله‌های پرچم با نوک تیز و کردار؛ کلاله به صورت جزئی دارای بخش سرمانند که به طور غیر واضحی به سه بخش تقسیم شده است

[26] *Allium latifolium*

49\* تپال‌ها با نوک کند (اما در راس تاخوردانند) و دارای رگبرگ میانی قهوه‌ای مایل به سبز؛ میله‌های پرچم مثلثی پهن (میله‌های داخلی در قاعده تخم‌مرغی)، به رنگ قرمز کارمن که به سمت قاعده محو شده و در قاعده نسبتاً سفید هستند؛ کلاله به حالت منقوط

[24] *Allium iranshahrii*

50 (46\*) میله‌های پرچم سفید با بخش کوتاهی به رنگ یاس بنفشی-صورتی در نوک، بساک‌ها مایل به ارغوانی؛ پهنک برگ بلند، کشیده و باریک، داسی-شکل-موج‌دار، با 15-25 سانتیمتر طول و پهنای 0.5-1 سانتیمتر؛ تپال‌ها سفید، باریک کشیده با نوک کوتاه و تیز

[27] *Allium breviscapum*

50\* 1/2 تا 1/3 فوقانی میله‌های پرچم صورتی تا قهوه‌ای مایل به ارغوانی، بساک‌ها زرد یا مایل به ارغوانی؛ تپال‌ها نیزه‌ای یا مثلثی-نیزه‌ای

51- پهنک برگ خمیده ولی فاقد حالت موج‌دار؛ تپال‌ها نیزه‌ای، با راس کند، صورتی؛ نیمه فوقانی میله‌های پرچم صورتی پررنگ، بساک‌ها زرد؛ گل‌آذین به حالت دسته-دسته، در مرحله میوه‌دهی کاملاً رها و غیرمترکم به شکل نیمه کروی

[30] *Allium shelkovnikovii*

51\* پهنک برگ موج‌دار؛ تپال‌ها مایل به صورتی یا سفید مایل به خاکستری تا صورتی؛ گل-آذین مترکم، نیمه کروی، در مرحله میوه‌دهی کروی

52- تپال‌ها نیزه‌ای-مثلثی، با نوک تیز، به طول 11-13 میلی‌متر، راست، صورتی تا یاس بنفشی با رگبرگ میانی تیره‌تر؛ میله‌های پرچم مثلثی با قاعده تخم‌مرغی، در حدود 1/3 طول تپال‌ها، یاس بنفشی، بساک‌ها زرد

[32] *Allium kurdistanicum*

52\* تپال‌ها با نوک کند، به طول تا 10 میلی‌متر؛ میله‌های پرچم 2/5 تا 2/3 طول تپال‌ها، بساک‌ها مایل به ارغوانی

53- پهنک برگ به ابعاد 15×0.8 تا 30×3 سانتیمتر؛ تپال‌ها کم و بیش نیزه‌ای؛ میله‌های پرچم گوشتی، مثلثی شکل، در قاعده به اندازه 1-2 میلی‌متر به هم پیوسته‌اند، 2/3 فوقانی میله‌ها ارغوانی تا قرمز-قهوه‌ای

[29] *Allium egorovae*

53\* پهنک برگ به ابعاد 15×3 تا 25×1 سانتیمتر؛ تپال‌ها مثلثی باریک و کشیده (تپال در مورفوتیپ ارتفاعات بالا نیزه‌ای)؛ میله‌های پرچم نوک تیز، در قاعده به اندازه تقریباً 0.5 میلی‌متر به هم پیوسته‌اند، در راس صورتی پررنگ که به سمت قاعده از شدت رنگ کاسته می‌شود

[28] *Allium derderianum*

54 (4\*)- غدد ترشح کننده شهد گل (نکتاری) به شکل حفره کیسه مانند محصور در یک سوم تحتانی تخمدان‌ها؛ ساقه گل‌دهنده به طول 40-70 سانتیمتر؛ برگ‌ها 3-4 عدد، پهنک برگ بیضی کشیده؛ گل‌آذین مترکم، کم و بیش کروی با قاعده تخت؛ دمگل‌ها راست، شق و نسبتاً ضخیم؛ تپال‌ها نیزه‌ای، در هنگام آنتزیز باز، قاعده تمامی میله‌های پرچم به طور جزئی متسع شده و به هم پیوسته؛ تخمدان‌ها زبر، دارای پایه بلند، با 6 شیار عمیق

[54] *Allium grande* (sect. *Decipienta*)





54. (4\*) Nectary ducts lead in pocket-like caves in the lower third of the ovaries; scape 40-70 cm long; leaves 3-4, laminae long elliptical; inflorescence dense,  $\pm$  globose with flat base; pedicels straight, stiff, and thickish; tepals lanceolate, in anthesis patent, all filament bases slightly dilated and connate; ovaries coarse, long stipitate, with 6 deep furrows

[54] *Allium grande* (sect. *Decipientia*)

- 54\* Nectary ducts lead in inconspicuous pits or short slits near the base of ovaries; scapes, inflorescences, and ovaries variously shaped 55

55. Scape during anthesis longer than about 100 cm; leaf laminae broadly lanceolate to oblong, 3-10 cm broad; flowers lilac to pinkish-purple; tepals oblong to lanceolate 56

- 55\* Scape during anthesis shorter than 100 cm 58

56. Scape dull; leaf laminae smooth with smooth margins; inflorescences very dense (up to 3000 flowers) with thin pedicels of unequal length; tepals oblong, erect after anthesis, capsules flat three-sided (but often irregularly shaped with only one seed per capsule), ripe capsules open only a narrow cleft per locule and drop down from the receptacle

[53] *Allium giganteum* (sect. *Compactoprason* subsect. *Erectopetala*)

- 56\* Scape smooth and shiny like polished; leaf laminae often hairy or toothed along the margins; tepals in late anthesis reflexed and spirally enrolled; ripe capsules flat obconical six-sided, they open widely and do not drop from receptacle

(sect. *Procerallium* subsect. *Elatae*) 57

57. Plants commonly very large (up to 150 cm scape length) and strong; leaf laminae 5-12 cm broad, most often more or less hairy, rarely only toothed along the margins and on the veins; inflorescences initially semi-globose and later depressed-globose, moderately dense bearing about 150-400 star-like, rose-pinkish to carmine (rarely white or lilac) flowers; tepals narrowly lanceolate, narrowed toward a rounded apex, 8-12  $\times$  1.3-2 mm; ovaries stipitate, depressed-globose triangular with always roughly tuberculate surface [69] *Allium stipitatum*

- 57\* Plants with a more slender habit and not so tall; leaf laminae 3.5-6 cm broad, only sparsely toothed or smooth along margins; inflorescence smaller with scarcely more than 200 flowers; tepals oblong-lanceolate with  $\pm$  spoon-shaped tip, 6-7  $\times$  c. 2.5 mm, carmine to dark purple [68] *Allium altissimum*

58. (55\*) Ovaries  $\pm$  globose with 6 narrow furrows, not stalked, at begin of anthesis at least partly  $\pm$  black, smooth, shiny, surface cells  $\pm$  even; leaf laminae narrowly linear to lanceolate; scape 20-40(60) cm long; tepals patent or soon reflexed 59

- 58\* Ovaries depressed-globose triangular (with 3 narrow and 3 wide furrows), during whole anthesis green, surface  $\pm$  rough, dull, surface cells distinctly convex to tuberculate 69

59. Leaf laminae (at least somewhat) shorter than the scape; tepals and filaments blackish-purple (rarely lilac or pinkish); tepals  $\pm$  linear or lanceolate, patent, later  $\pm$  recurved; anthers purple or brown 60

- 59\* Leaf laminae as long as the scape; tepals long-elliptic, soon reflexed; anthers yellow (*Allium asclepiadeum* alliance) 64

\*54- غدد ترشح کننده شهد گل (نکتاری) محصور در یک حفره غیرمشخص یا شکاف کوچک نزدیک قاعده تخمدان‌ها؛ ساقه‌های گل‌دهنده، گل‌آذین و تخمدان‌ها به اشکال مختلف

55

55- ساقه گل‌دهنده در طی آنتزیز طولی‌تر از حدود 100 سانتیمتر؛ پهنک برگ نیزه‌ای پهن تا کشیده با 10-3 سانتیمتر پهنای گل‌ها یا بنفشی تا ارغوانی مایل به صورتی؛ تپال‌ها کشیده تا نیزه‌ای

56

\*55- ساقه گل‌دهنده در طی آنتزیز کوتاه‌تر از 100 سانتیمتر  
56- ساقه گل‌دهنده مات؛ سطح پهنک برگ و لبه‌های آن صاف؛ گل‌آذین بسیار متراکم (تا 3000 گل در هر گل‌آذین)، با دمگل‌های نازک به طول‌های نامساوی؛ تپال‌ها کشیده، بعد از آنتزیز عمودی و شق، کیسول‌ها تخت و سه وجهی (اغلب به اشکال نامنظم با فقط یک بذر در هر کیسول)، کیسول‌های رسیده فقط با یک ترک باریک شکوفا شده و از روی نهج جدا شده و می‌افتند

[53] *Allium giganteum* (sect. *Compactoprason* subsect. *Erectopetala*)  
\*56- ساقه گل‌دهنده صاف، صیقلی و به نظر جلاداده شده؛ پهنک برگ اغلب کرکی یا در امتداد لبه‌ها دنداندار؛ تپال‌ها در اواخر مرحله آنتزیز برگشته و به طور ماریچ لوله شده؛ کیسول‌های رسیده تخت، مخروطی و ازگون و شش وجهی، این اندام به طور کامل شکوفا می‌شوند و از روی نهج جدا نگشته و ریزان نیستند

57 (sect. *Procerallium* subsect. *Elatae*)  
57- گیاهان به طور معمول بسیار بزرگ (طول ساقه گل‌دهنده تا 150 سانتیمتر می‌رسد) و تنومند؛ پهنک برگ به پهنای 12-5 سانتیمتر، در غالب موارد کم و بیش کرکین، بندرت فقط با حالت مضرس در امتداد کناره‌ها و رگبرگ‌ها؛ گل‌آذین در ابتدا نیمه کروی و سپس کروی فشرده، کم و بیش متراکم، در بردارنده حدود 150-400 گل، گل‌ها ستاره مانند، گل-سرخ مایل به صورتی تا قرمز کارمن (بندرت سفید یا یاس بنفشی)؛ تپال‌ها نیزه‌ای باریک، به سمت راس باریک شده و به نوک گرد ختم می‌شوند، به طول 8-12 میلی‌متر و پهنای 2-1.3 میلی‌متر؛ تخمدان‌ها پایه‌دار، کروی فشرده سه‌گوشه، همیشه با سطحی تقریباً زگیل دار

\*57- گیاهان باریک‌تر و کوتاه‌ترند؛ پهنک برگ با پهنای 6-3.5 سانتیمتر، فقط با دندان‌های کم پشت (مضرس) یا صاف در امتداد کناره‌های پهنک؛ گل‌آذین کوچکتر، به سختی بیش از 200 گل در هر گل‌آذین دیده می‌شود؛ تپال‌ها به طول 7-6 میلی‌متر و پهنای تقریباً 2.5 میلی‌متر، نیزه‌ای کشیده با راس کم و بیش قاشقی شکل، قرمز کارمن تا ارغوانی تیره

[68] *Allium altissimum*  
58\*(55)- تخمدان‌ها کم و بیش کروی دارای 6 شیار باریک، بدون پایه، حداقل بخشی از تخمدان در شروع آنتزیز به رنگ سیاه، صاف، صیقلی و درخشان، سلول‌های سطح تخمدان کم و بیش مسطح؛ پهنک برگ باریک و کشیده تا نیزه‌ای شکل؛ ساقه گل‌دهنده به طول (60) 20-40 سانتیمتر؛ تپال‌ها کاملاً باز، عنق‌ریب حالت خمیده و برگشته پیدا می‌کنند

59

\*58- تخمدان‌ها کروی فشرده سه گوشه (با 3 شیار باریک و 3 شیار عریض)، در تمامی طول مرحله آنتزیز به رنگ سبز، سطح تخمدان کم و بیش زبر، مات، سلول‌های سطح به طور مشخص برآمده تا زگیل مانند

69

59- پهنک برگ (حداقل تا اندازه‌ای) کوتاه‌تر از ساقه گل‌دهنده؛ تپال‌ها و میله‌های پرچم ارغوانی مایل به سیاه (به ندرت یاس بنفشی یا مایل به صورتی)؛ تپال‌ها کم و بیش باریک و کشیده یا نیزه‌ای، باز، سپس کم و بیش از پشت خمیده می‌شوند؛ بساک‌ها ارغوانی یا قهوه‌ای

60

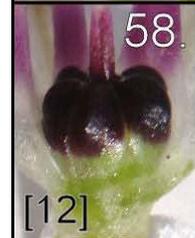
\*59- طول پهنک برگ هم اندازه ساقه گل‌دهنده؛ تپال‌ها بیضی بلند و کشیده، به سرعت برگشته و خمیده پیدا می‌کنند؛ بساک‌ها زرد (گروه *Allium asclepiadeum*)  
60- برگ‌ها 4-6 عدد؛ ساقه گل‌دهنده به طول 30-50 سانتیمتر؛ تپال‌ها مستطیلی کشیده و باریک، به طول 4-5 میلی‌متر و پهنای تقریباً 1 میلی‌متر؛ میله‌های پرچم در قاعده کم و بیش جدا و آزادند؛ تخمدان‌ها کاملاً ارغوانی (?)

[8] *Allium stenopetalum*  
\*60- برگ‌ها 2-4 عدد، به ندرت بیشتر؛ میله‌های پرچم در قاعده به هم متصل؛ تخمدان‌ها بکلی سبز رنگ یا در قسمت فوقانی به رنگ ارغوانی

61

61- میله‌های پرچم 1/2-1/3 طول تپال‌ها؛ پهنک برگ موجدار  
\*61- میله‌های پرچم 2/3 طول تپال‌ها یا بلندتر؛ پهنک برگ صاف

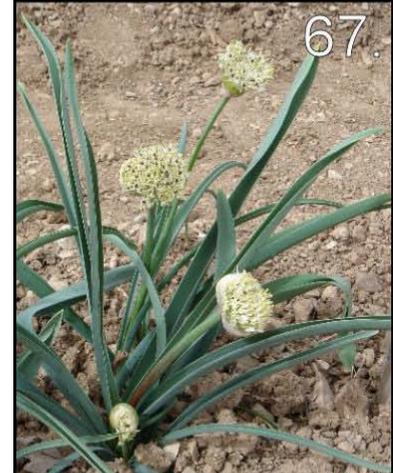
63 (گروه *Allium cardiostemon*)





60. Leaves 4-6; scape 30-50 cm long; tepals narrowly linear-oblong, 4-5 mm long, c. 1 mm broad; filaments basally  $\pm$  free; ovaries completely purple (?) [8] *Allium stenopetalum*
- 60\* Leaves 2-4, rarely more; filaments basally connate; ovaries green throughout or upper part purple 61
61. Filaments 1/3-1/2 of tepal length; leaf laminae undulate 62
- 61\* Filaments 2/3 of tepal length or longer; leaf laminae even (*Allium cardiostemon* alliance) 63
62. Leaf laminae lanceolate, margin finely ciliate, 2-3.5 cm broad; inner tepals of several flowers bear 2-3 veins; ovaries subglobose, dark purple above [72] *Allium sanandajense*
- 62\* Leaf laminae linear-lanceolate, margin smooth, 0.5-2 cm broad; tepals with one keeled median vein; ovaries ovate, green [7] *Allium shatakiense*
63. Filaments 2/3-3/4 of tepal length;  $\pm$  quadratic base of the inner filaments with 2 large, rounded teeth [13] *Allium cardiostemon*
- 63\* Filaments  $\pm$  longer than the tepals; inner filaments long-triangular without teeth [14] *Allium mariae*
64. (59\*) Tepals greenish to yellow (central flowers sometimes purple), very small 3-4(5) mm long, less than 1 mm wide 65
- 64\* Tepals white, yellowish, pinkish to carmine or purple, (4)5-9 mm long, broader than 1 mm 66
65. Scape 30-60 cm long; inflorescence semiglobose, dense; peripheral flowers ( $\pm$  greenish-) yellow but central ones purple; filaments striking yellow; tepals linear to narrowly lanceolate [2] *Allium chrysantherum*
- 65\* Larger plants up to 80 cm long; inflorescence fasciculate, more or less diffuse caused by pedicels of unequal length; flowers deep yellow throughout; tepals narrowly triangular-lanceolate; filaments green [3] *Allium mozaaffarianii*
66. Tepals purely white or yellowish 67
- 66\* Tepals white to pink (rarely purplish), slightly longer than the basally connate filaments; leaf laminae linear or linear-lanceolate 68
67. Leaves 4-7, laminae narrowly linear-lanceolate,  $\pm$  strict, canaliculate, rarely broader than 2.5 cm; tepals and filaments purely white with inconspicuous median vein; tepals  $\pm$  5 mm long, after anthesis reflexed and crumpled, slightly longer than the fleshy, narrowly-triangular filaments [6] *Allium saralicum*
- 67\* Leaves 2-3, laminae oblong, up to 4 cm wide, flat, strongly backwards incurved; tepals white or yellowish, 6-8 mm long; filaments yellow, much longer than the tepals [4] *Allium kharputense*
68. Leaves 3-5(8), laminae 1.5-2.5 cm broad, often twisted and  $\pm$  longer than the scape; pedicels 2-3 cm long; tepals narrowly oblong or lanceolate, white to purplish; filaments straight after anthesis, apex of ovaries with 6 acute outgrowths [5] *Allium olivieri*
- 68\* Leaves 1-2, laminae 3-4 mm broad, 1/3 of scape length; pedicels 1-1.5 cm long; tepals lanceolate, lilac to pink; ovaries globose, smooth [9] *Allium urmiense*
69. (58\*) Inflorescence very dense (up to 3000 flowers) with thin pedicels of unequal length; tepals oblong, erect after anthesis, capsules depressed-globose three-sided (but often irregularly

- 62- پهنک برگ نیزه‌ای، با پهنای 2-3.5 سانتیمتر، لبه‌های پهنک دارای مژگان ظریف؛ تپال‌های درونی برخی از گل‌ها دربردارنده 2-3 رگبرگ؛ تخمدان‌ها نیمه کروی، در قسمت فوقانی ارغوانی تیره  
 [72] *Allium sanandajense*
- 62\* - پهنک برگ نیزه‌ای باریک و کشیده، با پهنای 0/5-2 سانتیمتر، دارای لبه‌های صاف؛ تپال‌ها در بردارنده یک رگبرگ میانی زورقی شکل؛ تخمدان‌ها تخم‌مرغی، سبز رنگ  
 [7] *Allium shatakiense*
- 63- میله‌های پرچم 2/3-3/4 طول تپال‌ها؛ قاعده کم و بیش مربعی شکل میله‌های پرچم‌های داخلی با 2 دندانه بزرگ گرد  
 [13] *Allium cardiostemon*
- 63\* - میله‌های پرچم کم و بیش بلندتر از تپال‌ها؛ میله‌های پرچم‌های داخلی مثلثی بلند و بدون دندانه  
 [14] *Allium mariae*
- 64(59\*) - تپال‌ها مایل به سبز تا زرد (گل‌های مرکزی برخی مواقع ارغوانی)، بسیار کوچک با (5) 3-4 میلی‌متر طول و کمتر از 1 میلی‌متر عرض  
 65
- 64\* - تپال‌ها سفید، مایل به زرد، مایل به صورتی تا قرمز کارمن یا ارغوانی، به طول 9-5(4) میلی‌متر و عرض بیشتر از 1 میلی‌متر  
 66
- 65- ساقه گل‌دهنده به طول 30-60 سانتیمتر؛ گل‌آذین نیمه کروی، متراکم؛ گل‌های پیرامونی (کم و بیش مایل به سبز-) زرد اما گل‌های میانی ارغوانی؛ میله‌های پرچم زرد تند؛ تپال‌ها باریک و کشیده تا نیزه‌ای باریک  
 [2] *Allium chrysantherum*
- 65\* - گیاهان بزرگتر به طول تا 80 سانتیمتر؛ گل‌آذین دسته دسته، به علت وجود دمگل‌های با طول نامساوی کم و بیش پراکنده و افشان به نظر می‌رسد؛ گل‌ها تماماً زرد تیره؛ تپال‌ها مثلثی-نیزه‌ای باریک؛ میله‌های پرچم سبز رنگ  
 [3] *Allium mozaffarianii*
- 66- تپال‌ها کاملاً سفید یا مایل بزردی  
 67
- 66\* - تپال‌ها سفید تا صورتی (بندرت ارغوانی)، اندکی بلندتر از میله‌های پرچم؛ میله‌های پرچم در قاعده به هم پیوسته؛ پهنک برگ باریک و کشیده یا نیزه‌ای کشیده و باریک  
 68
- 67- برگ‌ها 4-7 عدد، پهنک برگ نیزه‌ای باریک و کشیده، کم و بیش محکم، شیاردار، به ندرت با پهنای بیش از 2.5 سانتیمتر؛ تپال‌ها و میله‌های پرچم کاملاً سفید، دارای رگبرگ میانی غیر مشخص؛ تپال‌ها به طول تقریباً 5 میلی‌متر، پس از آنتزیز حالت برگشته و مچاله شده پیدا می‌کنند، کمی طول‌تر از میله‌های پرچم؛ میله‌های پرچم گوشه‌تالو، مثلثی باریک  
 [6] *Allium saralicum*
- 67\* - برگ‌ها 2-3 عدد، پهنک برگ کشیده، به پهنای تا 4 سانتیمتر، تخت، شدیداً به پشت خمیده شده‌اند؛ تپال‌ها سفید یا مایل به زرد، به طول 6-8 میلی‌متر؛ میله‌های پرچم زرد، بسیار طول‌تر از تپال‌ها  
 [4] *Allium kharputense*
- 68- برگ‌ها (8) 3-5 عدد، پهنک برگ با پهنای 1.5-2.5 سانتیمتر، اغلب با پیچ‌خوردگی و کم و بیش طول‌تر از ساقه گل‌دهنده؛ دمگل‌ها به طول 2-3 سانتیمتر؛ تپال‌ها کشیده باریک یا نیزه‌ای، سفید تا ارغوانی؛ میله‌های پرچم بعد از آنتزیز راست؛ راس تخمدان‌ها با 6 برجستگی نیز  
 [5] *Allium olivieri*
- 68\* - برگ‌ها 1-2 عدد، پهنک برگ با پهنای 3-4 میلی‌متر، 1/3 طول ساقه گل‌دهنده؛ دمگل‌ها به طول 1-1.5 سانتیمتر؛ تپال‌ها نیزه‌ای، یاس بنفشی تا صورتی؛ تخمدان‌ها کروی، صاف  
 [9] *Allium urmiense*
- 69(58\*) - گل‌آذین بسیار متراکم (دربردارنده تا 3000 گل) با دمگل‌های نازک به طول‌های نامساوی؛ تپال‌ها کشیده، بعد از آنتزیز به حالت راست و شق؛ کروی فشرده سه وجهی (اغلب به اشکال نامنظم با فقط یک بذر در هر کیپسول)، کیپسول‌ها در نهایت با سه شکاف تنگ شکوفا شده و از نهج جدا می‌شوند  
 [53] *Allium giganteum*
- 69\* - گل‌آذین با تراکم کمتر، کم و بیش کروی فشرده؛ دمگل‌ها با طول تقریباً مساوی؛ بعد از آنتزیز تپال‌ها حالت برگشته پیدا کرده و به صورت کم و بیش مارپیچی لوله می‌شوند؛ کیپسول‌ها مخروطی و ازگون یا تخم‌مرغی، متصل به نهج باقی می‌مانند، حفره‌ها کم و بیش کامل باز می‌شوند، حاوی (به ندرت 1) 2-3 بذر  
 70
- 70- تپال‌ها کلش مانند و سفت و شق، تپال‌های خارجی مثلثی-زورقی دارای تا 4 رگبرگ، در ابتدای آنتزیز یا پس از آن نسبت به تپال‌های داخلی حالت برگشته پیدا می‌کنند، تپال‌های داخلی به طور قابل ملاحظه‌ای پهن‌تر هستند، این اندام واژتخم‌مرغی باقاعده مستطیلی می‌باشند؛ میله‌های پرچم در قاعده و به اندازه بیش از 1 میلی‌متر به هم پیوسته‌اند؛ میله‌های پرچم‌های داخلی دارای قاعده مثلثی بزرگی هستند؛ دمگل‌ها کم و بیش ضخیم، سفت و شق





shaped with only one seed per capsule), finally opening with three narrow fissures and dropping down from the receptacle

[53] *Allium giganteum*

69\* Inflorescence less dense,  $\pm$  depressed-globose; pedicels of subequal length; tepals after anthesis reflexed and  $\pm$  spirally enrolled; capsules obconical or ovoid, not dropping from the receptacle, locules  $\pm$  widely opening, (rarely 1-) 2-3-seeded 70

70. Tepals straw-like stiff, outer tepals triangular naviculate with up to four veins, reflexed either at begin of anthesis or later than the inner tepals, inner tepals remarkably broader, obovate with rectangular base; filaments basally for less than 1 mm connate; inner filaments with large triangular base; pedicels  $\pm$  thick, stiff (sect. *Pseudoprason* p.p.) 71

70\* Tepals soft, narrowly lanceolate to triangular, only slightly differing in shape and position, always with one median vein; the broad filament bases not or for less than 1 mm connate and above suddenly subulate; ovaries  $\pm$  stipitate, finely or coarsely tuberculate; pedicels moderately thin, wire-like 72

71. Leaves 2-3, laminae broadly lanceolate, up to 5 cm broad; scape 60-80 cm long, thickest toward the base; inflorescence rather loose, 8-10 cm in diam.; tepals pinkish-carmine, glossy, ovate-lanceolate, subacute, c.  $10 \times 3$  mm; filaments pinkish finally carmine; ovaries depressed triangular-globose with  $6 \pm$  acute swellings at the tip, strongly tuberculate

[70] *Allium hooshidaryae*

71\* Leaves 3-7, outer laminae broadly ovate to lanceolate, (3)6-12 cm broad, inner ones much narrower; scape 40-70 cm long, thickest part above the middle; inflorescence rather dense, 5-7 cm in diameter; tepals and filaments greenish-white, inner tepals spoon-shaped, soon reflexed, outer tepals naviculate, broadly elliptical, obtuse, 4-5 mm long and c. 2 mm wide, with 1-3 green median veins, later reflexed, crumpled, and involute; ovaries triangular-subglobose, surface moderately tuberculate

[71] *Allium koelzii*

72. Leaves (1-)2-3, leaf laminae linear-lanceolate, their margins basally overlapping and collar-like outside bent; scape smooth, dull, (25) 40-80 cm long; tepals lanceolate, the  $\pm$  obtuse apex longitudinally folded; ovaries turbinate-pyriform with six oblique-upwards directed and radially elongated outgrowths at the tip

[61] *Allium sarawschanicum* (sect. *Megaloprason* s. s. subsect. *Keratoprason*)

72\* Leaves (4-)5-8(-12), laminae narrow or broad, basally narrowing but not collar-like; scape smooth and glossy or in the basal part longitudinally ribbed and dull, 30-100(150) cm long; tepals elliptic or lanceolate; ovaries broadly triangular pyriform with rounded tip 73

73. Leaf laminae broadly elliptic to ovate, up to 3 times longer than wide, smooth; scape 30-80 cm long, flexuous; tepals elliptic, obtuse, patent, white to pink

[19] *Allium fedtschenkoi*

73\* Leaf laminae oblong to  $\pm$  linear-lanceolate, at least 5 times longer than wide, often longitudinally ribbed

(sect. *Procerallium*) 74

70\* - تپال‌ها نرم، نیزه‌ای باریک تا مثلثی، تنوع اندکی در شکل تپال‌های داخلی و خارجی دیده می‌شود، همیشه دارای یک رگبرگ میانی؛ قاعده میله‌های پرچم پهن، فاقد اتصال به یکدیگر یا به اندازه کمتر از 1 میلی‌متر به هم متصل شده‌اند، میله‌های پرچم در راس به طور ناگهانی به نوک تیز ختم می‌شوند؛ تخمدان‌ها کم و بیش پایه‌دار، به طور ظریف یا به درشتی زگیل‌دار؛ دمگل‌ها به طور نسبی نازک، مقتول مانند  
72

71- برگ‌ها 2-3 عدد، پهنک برگ نیزه‌ای پهن، به پهنای تا 5 سانتیمتر؛ ساقه گل‌دهنده 60-80 سانتیمتر طول دارد و به سمت قاعده ضخیم می‌شود؛ گل‌آذین به قطر 8-10 سانتیمتر، معمولاً حالت سست و تنک دارد؛ تپال‌ها قرمز کارمن مایل به صورتی، صیقلی و براق، تخم‌مرغی-نیزه‌ای، با راس کم و بیش تیز، به طول تقریباً 10 میلی‌متر و پهنای 3 میلی‌متر؛ میله‌های پرچم مایل به صورتی، سرانجام قرمز کارمن؛ تخمدان‌ها مثلثی-کروی فشرده با 6 تورم کم و بیش نوک تیز در راس، شدیداً زگیل‌دار

[70] *Allium hooshidaryae*

71\* - برگ‌ها 3-7 عدد، پهنک برگ‌های بیرونی تخم‌مرغی پهن تا نیزه‌ای، به پهنای 6-12 سانتیمتر، پهنک برگ‌های داخلی بسیار باریکتر؛ ساقه گل‌دهنده به طول 40-70 سانتیمتر، ضخیم‌ترین بخش ساقه در نیمه بالایی آن قرار دارد؛ گل‌آذین به ضخامت 5-7 سانتیمتر، معمولاً متراکم؛ تپال‌ها و میله‌های پرچم سفید مایل به سبز، تپال‌های داخلی قاشقی شکل، خیلی زود به حالت برگشته تغییر حالت می‌دهند، تپال‌های خارجی زورقی شکل، بیضی شکل پهن، با راس کند، به طول 4-5 میلی‌متر و پهنای تقریباً 2 میلی‌متر، با 3-1 رگبرگ میانی سبز رنگ، با تاخیر به حالت برگشته، مجاله و در هم پیچیده شده در می-آیند؛ تخمدان‌ها مثلثی-نیمه کروی، دارای سطح نسبتاً زگیل‌دار

[71] *Allium koelzii*

72- برگ‌ها 3-2-1 عدد، پهنک برگ نیزه‌ای باریک و کشیده، حاشیه پهنک در قسمت قاعده دارای روی هم افتادگی و یقه مانند با خمیدگی در قسمت بیرونی؛ ساقه گل‌دهنده صاف و مات، به طول 40-80(25) سانتیمتر؛ تپال‌ها نیزه‌ای، دارای راس کم و بیش کند که به صورت طولی تاخورد؛ تخمدان‌ها فرفره‌ای مانند-گلایی شکل، در راس با شش برآمدگی شعاعی طویل و اریب رو به بالا

[61] *Allium sarawschanicum* (sect. *Megaloprason* s. s. subsect. *Keratoprason*)

72\* - برگ‌ها 8-5-4 عدد، پهنک برگ باریک یا پهن، به سمت قاعده باریک شده ولی فاقد قسمت یقه مانند؛ ساقه گل‌دهنده صاف و براق یا در قاعده راه‌راه با شیارهای طولی و مات، به طول 30-100(150) سانتیمتر؛ تپال‌ها بیضی شکل یا نیزه‌ای؛ تخمدان‌ها مثلثی گلایی شکل پهن با راس گرد  
73

73- پهنک برگ صاف، بیضی پهن تا تخم‌مرغی، طول پهنک تا 3 برابر پهنای آن نیز می‌رسد؛ ساقه گل‌دهنده به طول 30-80 سانتیمتر، انعطاف‌پذیر و نرم؛ تپال‌ها بیضی شکل با راس کند، سفید تا صورتی

[19] *Allium fedtschenkoi*

73\* - پهنک برگ کشیده تا کم و بیش نیزه‌ای باریک و کشیده، طول پهنک حداقل 5 برابر پهنای آن، اغلب به صورت طولی شیاردار

74 (sect. *Procerallium*)

74- ساقه گل‌دهنده صاف، صیقلی، پوشیده شده با لایه مومی مشخص، به طول 50-80(150) سانتیمتر؛ پهنک برگ به پهنای 8(12)-5-3.5 سانتیمتر، برخی مواقع پوشیده از کرک‌های کوتاه و نرم (subsect. *Elatae*) بازگشت به شماره 57

74\* - ساقه گل‌دهنده مات و غیر براق (در صورت براق و صیقلی بودن ساقه لایه مومی روی آن دیده نمی‌شود)، به طول 20-80(100) سانتیمتر؛ پهنک برگ نیزه‌ای باریک؛ به پهنای 3.5-0.5 سانتیمتر، همیشه فاقد حالت کرک‌دار  
75

75- بخش پایینی ساقه گل‌دهنده فاقد حالت راه‌راه و شیاردار؛ پهنک برگ به پهنای 1.5-6 سانتیمتر؛ تپال‌ها نیزه‌ای پهن به طول 9-11 و عرض 1.8-2.2 میلی‌متر، صورتی پررنگ، پس از خشک شدن به رنگ ارغوانی

[63] *Allium pseudohollandicum*

75\* - بخش پایینی ساقه گل‌دهنده غالباً به طور برجسته و از درازا راه‌راه و شیاردار؛ پهنک برگ با پهنای کمتر از 3 سانتیمتر؛ تپال‌ها بسیار باریک، با عرض کمتر از 2 میلی‌متر، یاس بنفشی تا قرمز کارمن مایل به صورتی، پس از خشک شدن رنگ رفته به نظر می-رسند

76 (subsect. *Costatae*)





74. Scape smooth, glossy, glaucous, 50-80(150) cm long; leaf laminae (3.5)5-8(12) cm broad, sometimes pubescent

(back to subsect. *Elatae*) 57

74\* Scape dull (if glossy then not glaucous), 20-80(100) cm long; leaf laminae narrowly lanceolate, 0.5-3.5(6) cm wide, never pubescent 75

75. Lower part of scape not ribbed; leaf laminae 1.5-6 cm broad; tepals broadly lanceolate, 9-11 mm long, 1.8-2.2 mm broad, deep pink, in dry state purple [63] *Allium pseudohollandicum*

75\* Lower part of scape mostly lengthwise prominently ribbed; leaf laminae less than 3 cm broad; tepals of narrower shape, less than 2 mm broad, lilac to pinkish-carmine, in the dry state paler (subsect. *Costatae*) 76

76. Tepals 8-10(13) mm long; outer bulb tunics various; scapes and leaf laminae glaucous and dull or vividly green and glossy 77

76\* Tepals 5.5-8 mm long; outer bulb tunics membranous, dissolving in pieces; scapes and leaf laminae always dull, ± glaucous green 79

77. Outer bulb tunics membranous, smooth; scape 5-10 mm in diameter; leaf laminae 1.8-2.5(3) cm broad; tepals more lanceolate than triangular with a plicate, ± obtuse apex, 1-1.5(2) mm broad, pinkish-carmine; filaments initially pure white

[64] *Allium jesdianum*

77\* Outer bulb tunics strong or thick 78

78. Outer bulb tunics strong, decomposing with mesh-like ornamentation; scape 3-6 mm in diameter, leaf laminae 8-12(15) mm broad, narrowly canaliculate; tepals more triangular than narrowly lanceolate with a long tapering subacute tip, 0.8-1.2 mm broad; filaments initially pinkish

[62] *Allium bakhtiaricum*

78\* Outer bulb tunics thick, soft, dissolving in fine threads; scape 4-6 mm in diameter, basal part in early anthesis without ribs; scape and leaf laminae vividly green, glossy; tepals linear to lanceolate 1.5-2 mm wide, tip sub-obtuse to sub-acute and somewhat cucullate [65] *Allium remediorum*

79. Scape smooth (also basally?); leaf laminae 1-2 cm wide, narrowly lanceolate, flat; tepals linear-lanceolate, obtuse or subacute, 0.6-1.3 mm broad; filaments slightly longer than the tepals

[67] *Allium orientoiranicum*

79\* Scape ribbed; leaf laminae 0.5-1.5 cm wide, linear, canaliculate; tepals lanceolate to triangular, 0.9-1.3 mm wide, lilac; filaments slightly shorter than the tepals [66] *Allium kazerouni*

76- تپال‌ها به طول (13) 8-10 میلیمتر؛ پوشش سطح خارجی پیاز گوناگون؛ ساقه گل دهنده و

پهنک برگ دارای لایه مومی و مات یا سبز روشن و صیقلی

77\* - تپال‌ها به طول 5.5-8 میلیمتر؛ پوشش سطح خارجی پیاز غشایی، متلاشی شونده به قطعات

ریز؛ ساقه گل دهنده و پهنک برگ همیشه مات، کم و بیش سبز مایل به زرد

77- پوشش سطح خارجی پیاز غشایی، صاف؛ ساقه گل‌دهنده با ضخامت 5-10 میلیمتر؛ پهنک

برگ به پهنای (3) 1.8-2.5 سانتیمتر؛ تپال‌ها بیشتر نيزه‌ای و با فراوانی کمتر مثلی،

دارای راس تاخوردۀ با نوک کم و بیش کند، دارای (2) 1-1.5 میلیمتر پهنای، قرمزکارمن

مایل به صورتی؛ میله‌های پرچم در ابتدا کاملاً سفید

[64] *Allium jesdianum*

78\* - پوشش سطح خارجی پیاز محکم یا ضخیم

78- پوشش سطح خارجی پیاز محکم، طی فرآیند تجزیه تزئینات مشبک در آن ایجاد می‌شود؛

ساقه گل‌دهنده با ضخامت 3-6 میلیمتر؛ پهنک برگ با پهنای (15) 8-12 میلیمتر حاوی

شیارهای نزدیک به هم؛ تپال‌ها با 0.8-1.2 میلیمتر پهنای، بیشتر مثلی و با فراوانی کمتری

نیزه‌ای باریک، دارای راس باریک شده و بلند با نوک کم و بیش تیز؛ میله‌های پرچم در

ابتدا مایل به صورتی

[62] *Allium bakhtiaricum*

78\* - پوشش سطح خارجی پیاز ضخیم و نرم، طی تجزیه به رشته‌های ظریفی تبدیل می‌شود؛

ساقه گل‌دهنده با ضخامت 4-6 میلیمتر، قسمت قاعده ساقه در ابتدای مرحله آنتزیز فاقد

تزئینات شیار مانند؛ ساقه گل‌دهنده و پهنک برگ سبز روشن، صیقلی؛ تپال‌ها نیزه‌ای

باریک و کشیده با پهنای 1.5-2 میلیمتر، این اندام دارای راس کم و بیش کند یا کم و بیش

تیز و تاحدی بالاپوش مانند

[65] *Allium remediorum*

79- ساقه گل‌دهنده صاف (حتی در قاعده؟)؛ پهنک برگ به پهنای 1-2 سانتیمتر، نیزه‌ای باریک

و مسطح؛ تپال‌ها به پهنای 0.6-1.3 میلیمتر، نیزه‌ای باریک و کشیده، با راس کند یا قدری

تیز؛ میله‌های پرچم به طور جزئی از تپال‌ها بلندترند

[67] *Allium orientoiranicum*

79\* - ساقه گل‌دهنده شیاردار؛ پهنک برگ به پهنای 0.5-1.5 سانتیمتر، باریک و کشیده،

شیاردار؛ تپال‌ها نیزه‌ای-مثلی، به پهنای 0.9-1.3 میلیمتر، یاس بنفشی؛ میله‌های پرچم به

طور جزئی از تپال‌ها کوتاه‌ترند

[66] *Allium kazerouni*



## Abbreviations, explanations, and acronyms

- (ANS) Herbarium, Agricultural and Natural Resources Research Station of Bakhtiar province, Shahr-e Kord
- (ANY) Herbarium, Agricultural and Natural Resources Research Station of Kohgiluyeh-va Bouyerahmad, Yasuj
- (ARCA) Herbarium, Agricultural Research Centre, Arak
- (ARCK) Herbarium, Agricultural Research Centre, Khorramabad
- (ARIS) Herbarium, Agricultural Research Institute, Shiraz
- (ARIY) Herbarium, Agricultural Research Institute, Yazd
- (CAK) Herbarium, Agricultural College, Razi University, Kermanshah
- (FUMH) Herbarium, Faculty of Science, Ferdowsi University, Mashhad
- (GAT) Herbarium, Leibniz Institute of Plant Genetics and Crop Plant Research, Gatersleben
- (HCAT) Herbarium, Faculty of Science, University of Tabriz
- (HIU) Herbarium, Faculty of Science, Esfahan University
- (HKS) Herbarium, Research Center of Agricultural and Natural Resources, Kurdistan province, Sanandaj
- (HSBU) Herbarium, Shahid Beheshti University, Tehran
- (HSU) Herbarium, Faculty of Science, Shiraz University
- (HTRC) Herbarium, Research Center of Natural Resources, Tabriz
- (HYU) Herbarium, Faculty of Science, Yazd University
- (IRAN) Herbarium, Iranian Research Institute of Plant Protection, Tehran
- (JE) Herbarium Hausknecht of Friedrich Schiller University, Jena
- (NRK) Herbarium, Research Section of Natural Resources, Kermanshah
- (ORUM) Herbarium, Research Institute of Forests and Rangelands, Urmia
- (TARI) Herbarium, Research Institute of Forests and Rangelands, Tehran
- (TMRC) Herbarium, Shahid Beheshti University of Medical Sciences, Tehran
- (TUH) Herbarium, Faculty of Science, Tehran University, Tehran
- (W) Herbarium, Museum of Natural History, Vienna
- (WU) Herbarium, Botanical Institute of Vienna University, Vienna
- / alternative data and different sources of these data are separated by a slash
- [ ] (numbers between square brackets) refer to the species numbers in the Taxonomy chapter
- (on distribution maps) position in Iran
  - (on distribution maps) position outside Iran
- Azarb. (province) Azarbaijan
- IPK Leibniz Institute of Plant Genetics and Crop Plant Research, Gatersleben
- IRIPP Iranian Research Institute of Plant Protection, Tehran
- Khor. (province) Khorasan
- Raz. Khor (province) Razawi Khorasan
- TKW thousand-kernel-weight

## Taxonomy

*Allium* subg. *Porphyroprason* (Ekberg) R.M. Fritsch, *Aliso* 22: 386 (2006). - Type: *A. oreophilum* C.A. Meyer.

*Allium* sect. *Porphyroprason* Ekberg in *Bot. Notis.* 122: 65 (1969). - Kamelin, *Florog. analiz Srednej Azii*: 243 (1973). incl. *Allium* sect. *Molium* series *Oreophila* Tzag. in *Bot. mat. gerb. inst. bot. AN Kaz. SSR vyp.* 10: 14 (1977). - Type: *A. oreophilum* C.A. Meyer

1. *Allium oreophilum* C. A. Mey., *Verz. Pfl. Casp. Meer.*: 37 (1831). - Regel in *Trudy Imp. S.-Peterb. Bot. Sada* 3, 2: 210 (1875); Regel in *Trudy Imp. S.-Peterb. Bot. Sada* 10: 356 (1887). Lipsky in *Trudy Imp. S.-Peterb. Bot. Sada* 18: 133 (1900). J.D. Hooker in *Curtis's Bot. Mag.* 127: t. 7756 (1901). *Vved.*, *Flora URSS* 4: 255 (1935); *Vved.*, *Flora Uzbek.* 1: 456 (1941). Nikitina & Kashtsh., *Fl. Kirg. SSR* 3: 89 (1951). Pavlov & Polyakov, *Flora Kazakhst.* 2: 186, tab. 14/3 (1958). *Vved.*, *Flora Tad. SSR* 2: 338 (1963). Nikitina et al., *Fl. Kirg. SSR, Dopoln. vyp.* 1: 53 (1967). Wendelbo, *Flora Iranica* No. 76: 67, tab. 6 Fig. 92 (1971). *Vvedensky [& Kovalevskaya]*, *Opred. rast. Sredn. Azii* 2: 80 (1971). Kollmann, *Flora Turkey* 8: 126, fig. 3, map 13 (1984). Hanelt et al. in *Flora* 182: 69 (1989); Xu & Kamelin, *Flora China* 24: 200 (2000). *Allium oreophilum* var. *typicum* Regel in *Trudy Imp. S.-Peterb. Bot. Sada* 10: 356 (1887). *Caloscordum oreophilum* (C.A.Mey.) Banfi & Galasso in Banfi, Galasso & Soldano, *Atti Soc. Ital. Sci. Nat. Mus. Civico Storia Nat. Milano*, 152 (2): 87 (Nov 2011). - *Allium platystemon* Kar. & Kir. in *Bull. Soc. Natural. Moscou* 15: 514 (1842). Type: Altai. 1842, leg. Kar. & Kir. s. n. (lectotype LE!), design. Fritsch, 1990: 506). *Allium ostrowskianum* Regel in *Gartenflora* 30: 223 tab. 1089 (1882). Type: Ex horto bot. Petropolitano 81. 5. e Turkestanica occidentalis Fetisow misit (lectotype LE!), design. Fritsch, 1990: 506). - Type: Azerbaijan: E Caucasus, in petrosis alpinis Tufandagh, 31.7.1830, 1500', leg. Meyer (holotype LE!).

Bulbs subglobose, 1-2 cm in diam.; outer tunics thin, whitish to brownish-grey, soon decaying. Scape (often S-like) flexuous, terete, smooth; 5-15 cm long, 2-4 mm in diameter; green, at least near base brown suffused. Leaves 1-2, laminae narrowly linear-lanceolate, thick, fleshy, canaliculate, steep to flat arcuately ascending with recurved upper part; upper side smooth or somewhat grooved, lower side with a few flat ribs, shortly tapering in the not cucullate apex; margin smooth or slightly toothed; 10-15 (20) cm long, 6-15 mm broad; green with glaucous bloom, at least during outgrowth violet flushed. Sheath leaf short, hyaline, long lasting. Vernation planar. Spathe hyaline, up to the middle divided into several suborbicular to triangular, acuminate, patent valves, shorter than the pedicels; whitish with inconspicuous veins. Inflorescence broadly fastigiate to semi-globose, ± loose; 20-50-flowered; 5-6 cm in diam. Pedicels moderately thick, straight to somewhat incurved; 1-3.5 cm long; green, brown or purplish suffused. Anthesis in (May) June to July. Flowers broadly campanulate triangular. Tepals ovate to elliptic, basally free, acutish or subobtuse, dorsally slightly concave, obliquely upright positioned; after anthesis straw-like stiff and ± incurved; outer tepals 8-13 mm long, 5-7 mm broad, sometimes with 3 veins; inner tepals 2 mm shorter and 2-3 mm narrower, always with one median vein; pale to deep pink or deep brownish purple, fading towards the base, vein(s) greenish-brown, narrow. Filaments 1/3-1/2 as long as the tepals, fleshy, basally connate; inner filaments broadly ovate-triangular with short narrow tip, outer filaments twice narrower and somewhat shorter; color basally like adjacent tepals but upper part often much darker colored. Anthers ovoid, c. 1 mm long; yellow. Pollen yellow; 26.9 / 31-34 µm long; 18-20 µm broad, P/E index 1.7; brochi 0.8 µm, muri > 0.5 µm in diameter (Levan 1935 / Thunert 1967). Ovary sessile, depressed globose, triangular or nearly sexangular with 3 rather broad and 3 very narrow furrows, surface tuberculate-papillate; 2-3.5 mm long, 2-4 mm in diam., up to 9 ovules per ovary (Filimonova 1970) / 3-4 ovules per locule but only 2 develop into seeds (Hanelt et al. 1989). Nectary ducts mound in triangular pores near the base of the ovary. Style subconical, slightly angled, c. 1 mm long; green to purplish. Stigma shortly tripartite; white. Capsule enclosed by the stiff dry tepals; depressed-globose or depressed-pyriform triangular, surface very finely coarse; 5-6 mm long and 6-8 mm in diam.; brownish-yellow, widely opening; valves broadly heart-shaped with a

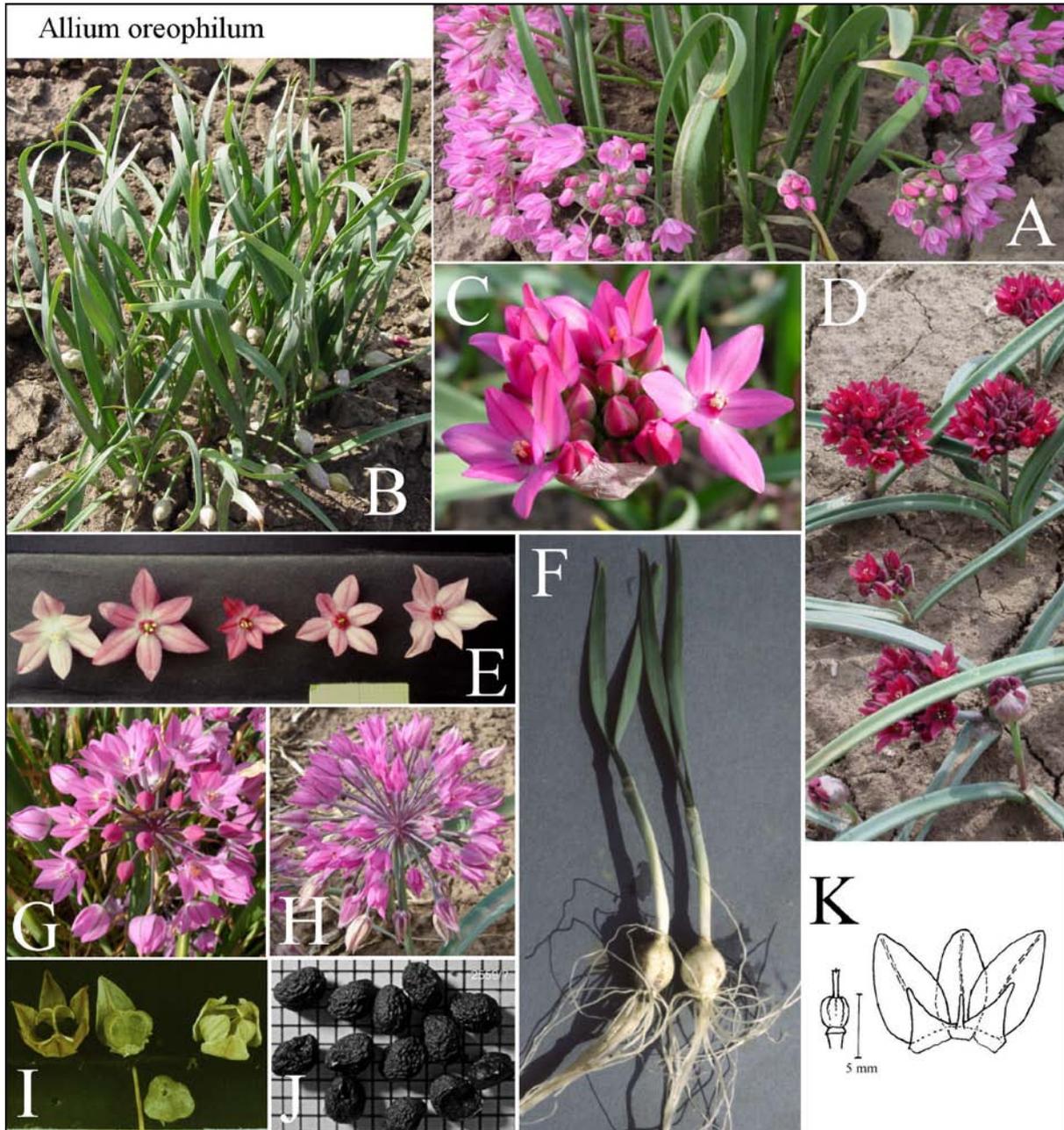
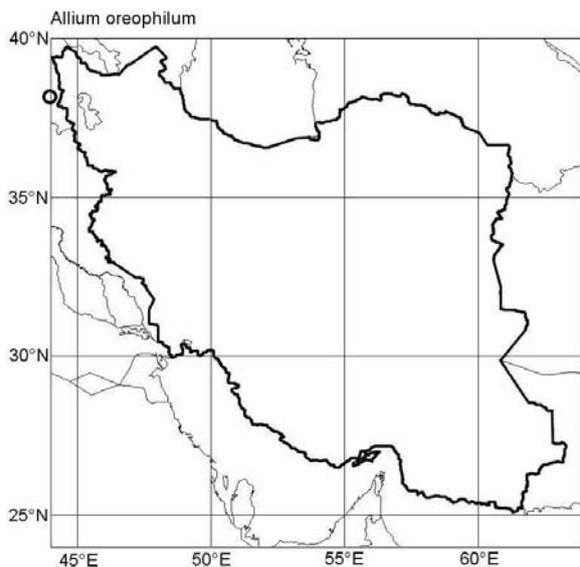


Plate T1. Cultivated plants from different countries. A: flowering plants; B: plants prior to anthesis; C: inflorescence at begin of anthesis; D: flowering plants from Tajikistan; E: diversity of shape and color of flowers of different accessions; F: vegetative plants showing sheath leaves, bulbs, and roots; G & H: inflorescences in full and late anthesis, resp.; I: capsules and dry tepals; J: seeds (background raster 1 mm); K: shape of ovary, tepals and filaments of a flower prepared from herbarium.

shallow longitudinal furrow. Seeds 1-2 (3) per locule, ovoid, minutely tuberculate with irregularly reticulate ledges; c. 2.5 mm long, 2 mm broad and thick; somewhat glossy black. Periclinal walls convex and evenly covered by small granules, anticlinal walls weakly to moderately S-undulated with small amplitude (Kruse in Hanelt & al. 1989). TKW 6.35 / 7.29 g (IPK, unpubl. data of 2 accessions).

**Chromosomes:**  $2n = 16$  Levan 1929, 1931, 1935 figs. 12k, 12n (Sweden, Denmark: Botanical collections).  $2n = 16$  Vakh-tina 1964, 1969 (Tajikistan: Shakhristan pass).  $2n = 16$  Dietrich 1967 (France: Botanical collection).  $2n = 16$  Elkington et al. 1976 (?Botanical collection).  $2n = 16$  Badr & Elkington 1977 Figs. 6 & 7 (Netherland: Botanical collection).  $2n = 16$  Jacobsen & Ownbey in Löve 1977 (Sweden: Botanical collection).  $2n = 16$  Vosa 1977 (?Botanical collection).  $2n = 14$  Pogosian 1983 fig. 15 (France: Botanical collection).  $2n = 16$  Pogosian 1983 (Armenia: Mt. Kapudzhikh).  $2n = 16$  Narayan 1988 (?Botanical collection, "*A. ostrowskianum*").  $2n = 16$  Ohle in Hanelt et al. 1989 Abb. 6 & 7 (Germany: Botanical collection).  $2n = 16$  Astanova 1990 (Tajikistan: Turkestan mountain range).  $2n = 16$  Fritsch unpubl. (Tajikistan: Turkestan mountain range).

**Distribution:** E Caucasus, E Anatolia, NE Afghanistan, N Pakistan, Central Asian mountain ranges to



subgeneric rank (Friesen & al. 2006).

southern Altai, Tarbagatai, Dzhungarian Alatau, and Tien Shan mountain ranges (W Sinkiang); petrophyte of alpine and subalpine steep rock and rubble slopes. It was reported from E Anatolia close to the Iranian border (Kollmann 1984) and could occur on tops of mountains in W Azarbaijan.

**Remarks:** This small species is characterized by narrowly linear leaves, the first prostrate and later ascending, thin scape, and large flowers showing a very specific shape of tepals. It was included in this review because of much general similarity to species of subg. *Melanocrommyum*. According to molecular markers (ITS sequences of nuclear rDNA) this species occupies a separate position beside subg. *Melanocrommyum* and deserves also

**Etymology:** The epithet refers to the alpine distribution of this species (from Greek "loving mountains").

**Biological data:** Growth form, phenology, anatomical, karyological and other characters were investigated in detail by Hanelt & al. (1989). The scape is grooved, the vascular bundles in the cortex of the scape are orbicular in cross-section (Fritsch 1993). Pistrick et al. (2001) observed the fusion of extended filament bases and shifting outwards of the originally inner stamina during ontogenetic flower development. The plants are early flowering and short-vegetating geophemmeroids; bulb scales up to 2 cm thick, root system belongs to the bulbous type and is frequently ephemeral, non-branching, diffuse with up to 40 cm deep root penetration and up to 200 roots per plant; the leaf primordia of the next year's shoot develop in April to June and the inflorescences in August to October (Kamenetsky 1992). Without a longer period of low temperatures (12 weeks at 4°C are sufficient) the bulbs do even not sprout in spring (Dubouzet et al. 1992, Maeda et al. 1994). The bulbs contain several steroid saponines and cholestan glycosides (Mimaki & al. 1993). Fresh bulbs contain in total 0.03 % cysteine sulfoxides (49 % methiin, 2 % alliin, 49% isoalliin; Fritsch & Keusgen 2006). Reported genome sizes [pg 2C DNA] were 38.8 (Vakhtina & al. 1977), and 36.7 (Zakirova 1989).

**Economic traits:** In Europe, cultivation as ornamental especially for alpine gardens started towards the end of 19th century, also some cultivars were selected. Ornamental plant listed in the "International Checklist ..." of the Royal General Bulbgrowers Association (1991) and commercially available (de Hertog & Zimmer 1993). Livestock does not eat this species because of its bitter taste (Kojima & Yoshida 1994).

**Allium subg. *Melanocrommyum*** (Webb & Berthel.) Rouy, Fl. France 12: 378 (1910), Wendelbo in Bot. Notiser 122: 27 (1969). *Caloscordum* Herb. subg. *Melanocrommyon* (Rouy) Banfi & Galasso in Banfi, Galasso & Soldano, Atti Soc. Ital. Sci. Nat. Mus. Civico Storia Nat. Milano, 152 (2): 87 (Nov 2011). - *Canidia* Salisb. sect. *Molium* G. Don ex Koch, Syn. Deut. Schweizer Fl.: 714 (1837), p. p. *Moly* Moench, Meth.: 286 (1794), type: *M. speciosum* Moench (= *A. magicum* L.). *Allium* sect. (?) *Moly* (Moench) Endl., Gen. Plant. 1: 147 (1836). - Type *A. nigrum* L.

**sect. *Melanocrommyum*** Webb & Berthel., Hist. Nat. Iles Canaries 3,2 sectio 3: 347 (1848) s. strictiss., emend. Wendelbo in Bot. Notis. 122: 28 (1969), p. p. Kamelin, Florog. analiz Srednej Azii: 240 (1973), p. p. - *Allium* sect. *Melamprason* F. Hermann, Feddes Repert. spec. nov. 46: 58 (1939). - Type *A. nigrum* L.

*Allium asclepiadeum* alliance

**2. *Allium chrysantherum*** Boiss. & Reut., Fl. orient. 5: 280 (1882). Wendelbo, Flora Iranica No. 76: 80, tab. 8/111 (1971); Kollmann, Fl. Turkey 8: 200, Fig. 9/4, map 32 (1984); Wendelbo, Fl. Iraq 8: 171, pl. 45 (1985). - Type: Iraq or N Syria: In deserto Assyriaco inter Nisibin [Nusaybin] et Sinshar [Sinjar], V. 1867, leg. Hausskn. no. 959 (lectotype G-BOIS!, hic designated, iso-lectotype W! JE!, syntypes JE! G!, also no. 958).

Bulbs ovoid to globose, up to 4 cm in diameter; outer tunics thin,  $\pm$  longitudinally splitting, grayish; inner tunics parchment-like, yellowish. Scape straight, terete, smooth; (25) 50-80 cm long, 6-10 mm in diam. Leaves (2) 6-8, laminae linear-lanceolate, flat canaliculate, gradually tapering into a narrow apex; margin toothed or smooth, brown later white; about 30 cm long, 30-35 mm broad (the innermost leaves are the narrowest). Spathe split into 2-4 ovate, shortly beaked, reflexed valves, shorter than the pedicels; pale brown with darker veins. Inflorescence fastigiate to semiglobose, dense, many-flowered; 3-5 cm in diam., in the fruiting stage up to 7 cm in diam. and subglobose. Pedicels thin but wire-like stiff, slightly incurved; green or brownish flushed. Anthesis in May to June. Flowers are very small cup-

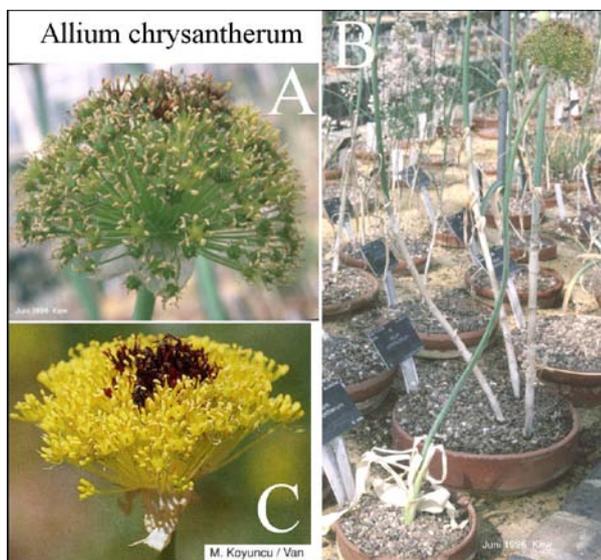
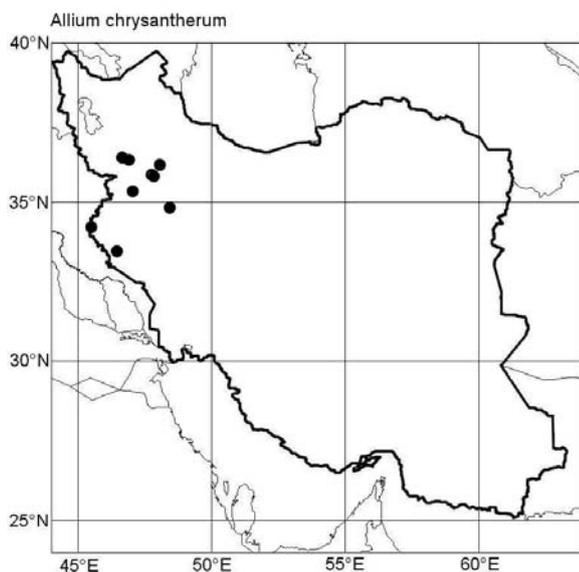


Plate T2. A & B: inflorescence and plant in anthesis (cultivated in RBG Kew); C: inflorescence with typical purple center (from Tekin 2005: 210)



notched at the apex. Seeds 1-2 per locule, flat ovoid, concave, surface finely rugose with sharp edges and irregular ribs; 3-4 mm long, 2.5-3 mm wide, 0.5-1 mm thick; dull black.

Chromosomes:  $2n = 16+B$  Koyuncu & Özhatay 1983 sek. 2d (Turkey: Adana).  $2n = 16+1B$  Genç & al. 2013 Table 3, Fig. 1 (p), Fig. 2 (p) (Turkey: prov. Malatya).

Distribution: NW Iran, S & E Anatolia, N Syria, N Iraq, Jordan; colline to lower montane steppe slopes, rock gorges, arable land (Wendelbo 1985).

Remarks: Because the vouchers in G bear different numbers, and more vouchers exist in different herbaria, the voucher bearing a complete plant in G-BOIS is designated here as lectotype.

shaped star-like (filaments and anthers are more conspicuous than the tepals). Tepals narrowly linear-lanceolate, obtuse or subacute, patent with the upper part recurved, soon reflexed and spirally contorted; 4-5 mm long, 0.7-1 mm wide; yellow or greenish-yellow, all flower parts of the innermost flowers often purple flushed to dark purple. Filaments initially for 1/4 shorter than the tepals, triangular (inner filaments somewhat broader), fleshy, nearly straight; deep to greenish yellow. Anthers oblong, 1.5-2 mm long; pale to deep yellow. Pollen yellow. Ovary sessile, depressed-globose, surface finely coarse; c. 2-3 mm in diameter and long; green. Style thread-like, 2-3 mm long; color like filaments. Stigma undivided or very short tripartite; whitish. Capsule depressed subglobose; 6-7 mm in diam., 5-6 mm long; valves

Key characters of this species are several leaves of very unequal width (outer leaf laminae are the broadest) and broadly fastigiata inflorescences composed of equal pedicels. The minute and inconspicuous tepals are variable in color from greenish to yellow commonly with completely purple central flowers and do not much differ from the yellow tepals of *A. mozaffariani*. *Allium chrysantherum* and that species share large and conspicuous, yellow anthers, but *A. mozaffariani* is characterized by pedicels of unequal length and a subovate inflorescence. According to molecular markers (ITS sequences of nuclear rDNA) both species form a separate small group sister to *A. rothii* Zucc. and *A. meronense* Fragman & R.M. Fritsch from Near East and with less close relation to *A. cardiostemon* (see p. 200). Sequences of the plastid *trnL-trnF* region support a similar separate position with some distance to *A. cardiostemon* (Gurushidze & al. 2010).

**Etymology:** The epithet points certainly to the striking yellow anthers (from Greek "golden anthers").

Herbarium vouchers: W Azarb.: 30-35 km SE Shahindez, near Mahmut-abad (36°34' N, 46°41' E, 1500 m, 04.6.1974 Wendelbo, Assadi, Shirdelpur 12168-TARI). c. 20 km NW Tekab (36°31' N, 46°56' E, 2100 m, 05.6.1974 Wendelbo, Assadi, Shirdelpur 12218-TARI). - Hamadan: Lalejin to Taherlu, Jamshidabad and Gonbadan (35°00' N, 48°28' E, 1900 m, 08.6.1988 Mozaffarian 64589-TARI). - Ilam: Reno (C.J.B.I.) (33°39' N, 46°30' E, 06.6.1973 Iranshahr 325-IRAN). Reno, cultivated in garden Evin (33°39' N, 46°30' E, 14.6.1972 Iranshahr 326-IRAN). - Kermanshah: Khosrawi (34°23' N, 45°28' E, 07.5.1950 Farahbakhsh 5055-E; 327-IRAN W NRK). - Kurdistan: Bijar to Zanjan, Bianlo village (36°00' N, 47°52' E, 1650 m, 01.6.2003 Maroofi, Naseri 6273; HKS). Sanandaj to Divandarreh, near Abbas-Abad village (35°31' N, 47°05' E, 1530 m, 26.6.2006 Maroofi 7600; HKS). In declivis argillosis 107-109 km SW Zanjan versus Bijar (36°02' N, 47°47' E, 1700 m, 30.6.1971 Rechinger 42434; W). - Zanjan: Zanjan to Bidjar, 70 km to Bidjar (36°20' N, 48°06' E, 30.6.1971 Termeh 46997-IRAN).

Determination unsure: Kermanshah: 44 km SW Shahabad inter Shahabad et Ham, (1900 m, Bent, Wright 602-604; W).

**3. *Allium mozaffarianii*** Maroofi & R.M. Fritsch in *Phyton* (Horn, Austria) 50: 22, figs. 14, 15 (2010). - **Type:** Iran: Kurdistan, 30 km from Marivan to Paveh (Tangeh Dezli), limestone gorge; 1330-1400m; 30.5.1978; Runemark, Mozaffarian (holotype 29352-TARI).

Bulbs ovoid to globose, 3-5 cm long and in diam.; outer tunics strong, splitting into pieces, grayish-blackish; inner tunics ivory, papery. Scape straight, terete, smooth; up to 80 cm long and 6-10 mm in diameter; dull yellowish green. Leaves up to 8, laminae linear to lanceolate, canaliculate; 30-40 cm long and 10-30 mm wide; green. Spathe membranous, split into 2-3 broadly triangular-ovate, patent to subreflexed valves; pale brown with inconspicuous veins. Inflorescence fasciculate, later sub-ovoid, in the fruiting stage semi-globose, very dense, many-flowered; 5 cm long, up to 7 cm in diameter. Pedicels very thin, straight or incurved, unequally long, stiff; yellowish-green. Anthesis in May. Flowers broadly funnel-shaped star-like. Tepals triangular, spreading, soon reflexed and irregularly curled, tender; c. 3 mm long, basally 0.7-0.8 mm wide; greenish, with a very narrow green median vein. Filaments triangular-subulate, fleshy, narrowly triangular (basally inner filaments slightly wider than outer ones), obliquely positioned, basally united in a ring; c. 4 mm long; yellow-green. Anthers oblong, c. 3 mm long; bright yellow. Pollen yellow. Ovary depressed-globose triangular, glossy, smooth; c. 2 mm in diameter; in anthesis blackish, later green. Style conical, c. 1.5 mm long; yellow-green. Stigma dot-like; whitish. Capsule sub-globose, 6-7 mm in diameter; grayish-brown. Seeds not seen.

**Distribution:** Iran: prov. Kurdistan, known only from a small area near the Iraqi border. Occurrence on adjacent Iraqi territories seems probable.

**Remarks:** It is a larger plant than *A. chrysantherum* characterized by fasciculate, more or less diffuse inflorescences and truly yellow flowers with triangular (not lanceolate) tepals shorter than the greenish

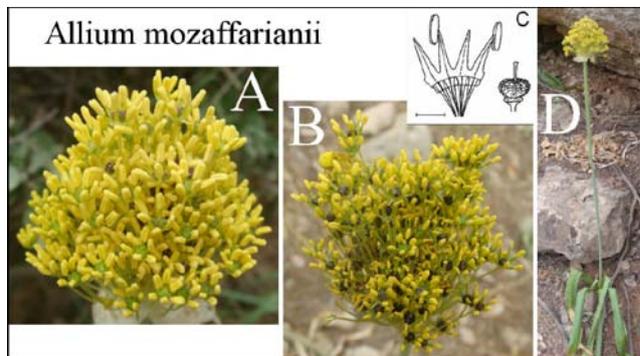
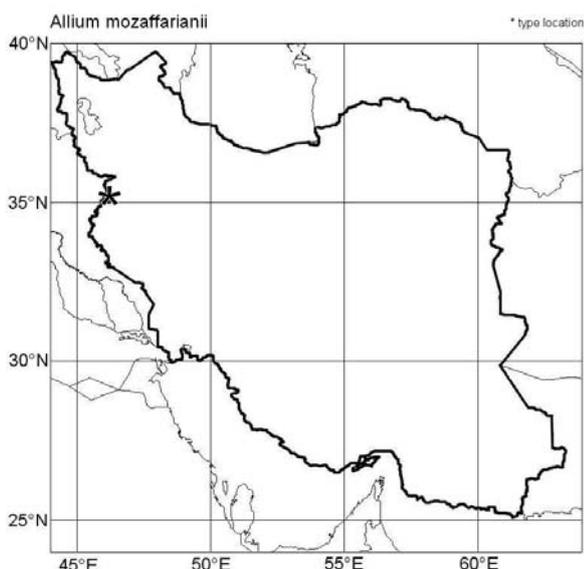


Plate T3. A: Inflorescence in early anthesis (photo courtesy of H. Maroofi); B & D: inflorescence and plants in anthesis; C: filaments with anthers, reflexed tepals, and ovary (from Fritsch & Maroofi 2010: Fig. 15).



Dezli (35°19' N, 46°12' E, 1300 m, 16.5.2008 Maroofi, Rastegar 8684, 1230 m, 10.6.2007 Maroofi, Karegar 8234; HKS).

filaments. *Allium chrysantherum* differs by semi-to subglobose inflorescences and greenish or yellow flowers beside a group of central flowers being purplish flushed. Molecular markers (ITS sequences of nuclear rDNA) confirmed a very close relationship of both species, with some Near East species as sister group and a less close relation to other Iranian species of sect. *Melanocrommyum* (see p. 200).

**Etymology:** The epithet honors the contemporary outstanding botanist of merit V. Mozaffarian acting in Tehran.

Herbarium vouchers: Kurdistan: 30 km from Marivan to Paveh (Tangeh Dezli) (35°22' N, 46°09' E, 1330-1400 m, 30.5.1978 Runemark, Mozaffarian 29352-TARI). Maryvan, Darband

**4. *Allium kharputense*** Freyn & Sint. in Oesterr. Bot. Z. 42: 378 (1892). Wendelbo, Flora Iranica No. 76: 79, tab. 8/108 (1971); Wendelbo, Fl. Iraq 8: 169 (1985). Kollmann, Fl. Turkey 8: 204, fig. 9/9, map 33 (1984). - **Type:** P. Sintenis: Iter orientale 1889. No. 711 *Allium kharputense* Freyn & Sint. n. sp. Armenia turcica, Kharput, in campis ad Miadun, 8. V. (Lectotype: the right plant, WU!; design. Fritsch & al. 2010; isotypes LD, W!, JE!, G!, B!, K, P!).

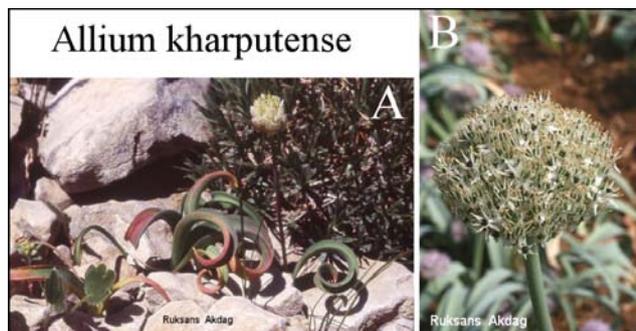


Plate T4. A: Plants growing in Turkey. B: inflorescence of a cultivated plant (photos courtesy of J. Ruksans)

Bulbs ovoid to subglobose, (1.5) 2-3 cm in diam.; outer tunics gray to blackish, disintegrating; inner tunics parchment-like, yellowish. Scape straight, terete, smooth; 25-50 cm long; green or purple flushed. Leaves 2-3, laminae lanceolate, thickish, canaliculate, obliquely ascending and subspirally recurved, shortly arcuately tapering into the cucullate apex; margin sharply and finely toothed; 15-25 cm long, 7-25 (40) mm broad. Spathe membranous, completely split into 2-3 finally reflexed valves; pale brown with purplish veins.

Inflorescence broadly fastigiate to semi-globose, dense,  $\pm$  many-flowered; (3) 4-6 cm in diam. Pedicels subequal, very thin, incurved; green to yellowish. Anthesis in May. Flowers reflexed funnel-shaped star-like. Tepals lanceolate with rounded apex, obliquely reflexed; after anthesis completely reflexed and crumpled; 5-6 mm long, 1.5 mm broad; whitish-crème. Filaments  $\pm$  as long as the tepals, outer filaments shorter and broadly subulate, inner filaments longer and narrowly triangular; near base shortly connate; yellowish or pinkish. Anthers ovate-oblong, c. 1.5 mm long; yellow. Pollen yellow. Ovary depressed globose with six longitudinal furrows, tip concave; dark green. Style thread-like, 3-4 mm long; whitish. Stigma undivided? Capsule subglobose, c. 5 mm in diameter; valves ovate. Seeds comma-shaped with  $\pm$  sharp angles; 2.5-3 mm long, 2-2.5 mm broad, 1.2-1.6 mm thick; dull black. The testa showed verrucose periclinal walls and Omega-like undulated anticlinal walls with a moderate amplitude of undulation (Fritsch & al. 2006).

**Chromosomes:**  $2n = 16$  Özhatay 1986 (Turkey).  $2n = 16$  Genç & al. 2013 Table 3, Fig. 1 (i), Fig. 2 (i) (Turkey: prov. Sanliurfa, prov. Gaziantep).

**Distribution:** E & S Anatolia, N Iraq, Lebanon, Syria; montane grassy slopes, arable land (Wendelbo 1985). Plants from W Iran (Wendelbo 1971) were transferred to *A. saralicum*.

**Remarks:** Wendelbo (1971) applied this name to *A. saralicum* because the flower characters are similar, although *A. kharputense* was described to own only 2-3 leaves that are 2-4 cm broad (Kollmann 1984). True plants from Iranian territory could not be traced hitherto, but they might occur West of lake Urmia. Molecular markers (ITS sequences of nuclear rDNA) positioned two Turkish samples (see pp. 199 & 200) widely apart from *A. saralicum* supporting a remarkable taxonomic distance between these species.

**Etymology:** The epithet refers to the type location (current name Harput) in Turkey.

**Economic traits:** Ornamental plant listed in the "International Checklist ..." of the Royal General Bulbgrowers Association (1991). Reported use of *A. kharputense* as food or medicine in Iran found in the literature (Abbasi & al. 2008) certainly refers to *A. saralicum*.

**5. *Allium olivieri*** Boiss., Fl. orient. 5: 284 (1882). Wendelbo, Flora Iranica No. 76: 78, tab. 8/107, tab. 19/1 (1971); Wendelbo, Fl. Iraq 8: 168, pl. 44 (1985). Eker & Koyuncu in Acta Soc. Bot. Pol. 80: 275 (2011). - **Type:** Iraq: Mesopotamia inter Mossul et Baghdad, leg. Olivier (lectotype G! design. Fritsch & al. 2010: 206).

Bulbs ovoid, c. 2.5 cm in diam.; outer tunics thick but brittle, dissolving into fibers forming a short neck; grayish brown. Scape  $\pm$  straight, terete, obconical, smooth; 15-30 cm long, 6-10 mm in diameter (in fruiting stage up to 15); green often purple suffused. Leaves 3-5 (8), laminae linear to narrowly lanceolate, thick, canaliculate, flat arcuately ascending and recurved, arcuately tapering into the cucullate apex; margin finely toothed; upper side flat, lower side with a few shallow and broad ribs; 20-30 cm long, 8-20 (35?) mm wide; deep green. Sheath leaf hyaline,  $\pm$  long visible. Spathe membranous, divided into (1-) 2 broad ovate, straight, shortly acute valves, half as long as pedicels; yellowish brown with purple veins. Inflorescence initially narrowly later broader fasciculate and dense, in the fruiting stage semi-globose and very loose; 15-50-flowered. Pedicels straight, unequally long, at first flowers thick and about 2 cm long, at end of anthesis up to 5 cm long; green with purple flush. Anthesis in March to April. Flowers flat star-like.

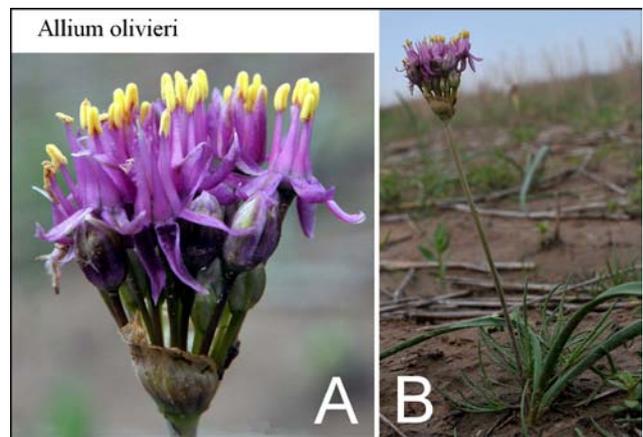
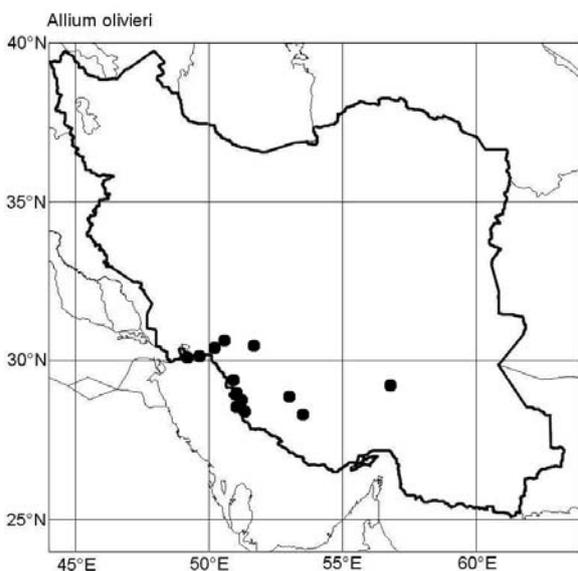


Plate T5. A & B: Inflorescence and plant in anthesis (photos courtesy of H. Akhani)



Tepals triangular-lanceolate, acute, canaliculate to navicular, patent and incurved, later completely reflexed; c. 5 mm long, outer tepals basally c. 2 mm, inner tepals c. 1.2 mm broad; pink to purple. Filaments somewhat shorter than the tepals, fleshy, straight, subulate, basally long-triangular broadened and for 1 mm connate; color like tepals. Anthers oblong, c. 2.5 mm long; yellow. Pollen yellow. Ovary shortly stipitate, ovoid sexangular, the concave apex with 6 subacute horn-like, obliquely radially directed outgrowths; ca. 2.5 mm long and 2 mm in diam.; apparently green, purplish suffused. Style narrowly conical, 4-5 mm long; pink to purple. Stigma undivided; whitish. Capsule depressed-globose, near apex with 6 horns; c. 6 mm long and in diameter. Seeds not seen.

**Distribution:** Irak, Syria, SW Iran, SE Turkey; steppe slopes, arable land; mainly in lowland (Wendelbo 1985).

**Remarks:** *Allium olivieri* shows a general habit transitional to *A. mariae* concerning leaf and flower shape, and to *A. noëanum* concerning leaf length and shape of inflorescences. However, key characters of *A. olivieri* are thick and long bulb tunics splitting into longitudinal fibers, a long and late decaying outer sheath leaf, and six subacute outgrowths ("hornlets") on the apex of ovaries not shared by either of these species. No sample was available for molecular investigations hitherto.

**Etymology:** The epithet honors the French zoologist G. A. Olivier, a traveler in the orient in the 1770ies and 1780ies.

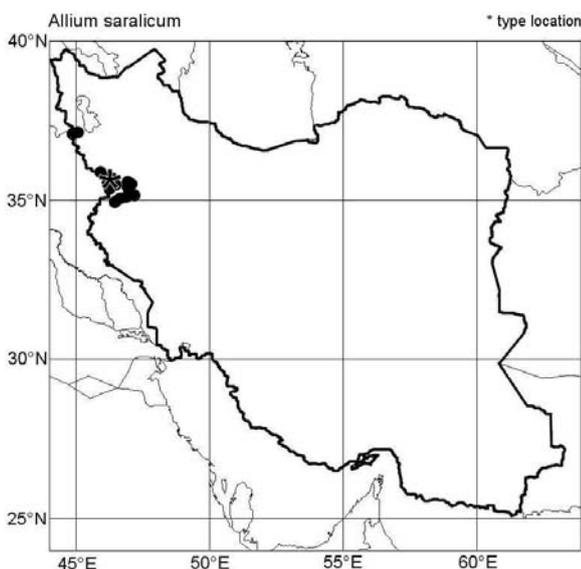
**Economic traits:** Wendelbo (1985) cited the local names 'busaila' (little onion), a general name for wild *Allium* species, and 'basal jai' (putrid onion).

Herbarium vouchers: **Bushehr:** Ahran: Chah-e-talkh, (28°56' N, 51°17' E, 28.2.1975 Iranshahr, Termeh 449-IRAN). 43 km N Busher to Borasjan, Ab-e-Tavil (29°11' N, 51°04' E, 05.3.1976 Termeh, Moussavi 448-IRAN). Mohammad-e Ameri (Med-Mery) (28°44' N, 51°05' E, 01.3.1975 Iranshahr, Termeh 450-IRAN). Bandare Genaveh 43 km E Soveireh (29°34' N, 50°57' E, 180 m, 29.2.1972 Foroughi 3180; TARI). Bushir to Bandar Lengeh, c. 11 km SE Khormuj (28°35' N, 51°23' E, c. 40 m, 19.3.1976 Bokhari, Wendelbo 44; TARI LE). - **Fars:** Jahrom, (28°30' N, 53°33' E, 22.3.1940 Koelz 14640; W). Shiraz to Jahrom 85 km Shiraz Khafr (29°04' N, 53°03' E, 1300-1450 m, 13.4.1991 Delghandi, Daneshpajouh 43096-IRAN). - **Kerman:** Baft, Kuh-e Lalezar towards Gholleh-Shah (29°25' N, 56°50' E, 3000-3800 m, 30.5.1975 Moussavi, Tehrani 508-IRAN). - **Khuzestan:** Hendijan (30°19' N, 49°42' E, 50 m, 13.3.1986 Mozaffarian; 62413-TARI or 52413-TARI). Behbahan (30°36' N, 50°15' E, 320 m, 14.3.1986 Mozaffarian 62481-TARI, 22.3.1948 Esfandiari 5074-E; 451-IRAN). NW Persian Gulf, island of Booneh (30°08' N, 49°09' E, 6 m, collector?; TUH?). - **Kohgil. Buyerahmad:** Yasuj toward Kakan 15 km NE Yasuj (30°40' N, 51°44' E, 2640 m, 27.3.1990 collector unclear 3046; ANY). Near Dehdasht (30°49' N, 50°37' E, 500 m, 18.4.1982 Assadi, Abohamzeh 38667-TARI).

**6. *Allium saralicum*** R.M. Fritsch in Rostaniha 9 Suppl. 2: 38, fig. 8 (2008 publ. 17 Jul 2009). - *Allium kharputense* sensu Wendelbo, Flora Iranica No. 76: 79, tab. 8/108 (1971). - **Type:** Iran: Kurdistan, Marivan 65 km to Baneh, 2 km to Ghamchian; 1400 m, 06.5.1996 leg. Attar-Okhovat (holotype TUH).

Bulbs depressed-globose, c. 2 cm long and in diameter; outer tunics papery, slightly splitting near base and neck; grayish-brown. Scape cylindrical, slightly flexuous, smooth; 30-50 (60) cm long, c. 7 mm in diameter; dull green, near the base red suffused and glossy. Leaves 4-7, laminae linear with triangular apex, obliquely recurved, canaliculate throughout; margin whitish, cartilaginous or coarse, smooth near the apex; upper side with some furrows, lower side with narrow ribs; dull glaucous green, near base somewhat red suffused. Sheath leaf thin, hyaline later brownish, soon decaying. Spathe papery, nearly completely split in several acute, ovate-triangular parts, finally patent or reflexed; pale brown

with brown veins. Inflorescence fasciculate finally semi-globose, very dense, many-flowered; up to 4.5 cm long and 8 cm in diameter. Pedicels cylindrical, ascending, rather soft; 2-3 cm long; yellow to green, semi-glossy. Anthesis in April and May. Flowers bowl-shaped star-like. Tepals ± broadly lanceolate subobtusate, slightly concave, patent later reflexed, finally enrolled and crumpled; c. 5 mm long and 1.2 (inner tepals) to 1.5 mm (outer ones) broad; purely white with white median vein. Filaments mostly slightly longer than the tepals, obliquely sideward directed (after anthesis connivent), fleshy, narrowly triangular (inner ones wider); near base shortly connate; white later yellowish. Anthers oblong, up to 2.2 mm long and c. 1 mm wide; yellow to brownish. Pollen yellow. Ovary



sessile, depressed globular triangular with six furrows, surface smooth and glossy; 1.5-2 mm long, c. 2.5 mm in diameter; blackish-red later green; nectary ducts lead in dots. Style thread-like, 2-4 mm long; whitish with carmine base. Stigma undivided; whitish. Capsule obconical to obovoid with three deep longitudinal furrows; 5-8 mm long; moderately widely opening. Seeds 1-2 per locule, flat ovate to drop-shaped with sharp edges, surface with irregular ledges; c. 3 mm long, 2 mm broad, 1-1.5 mm thick; dull black.

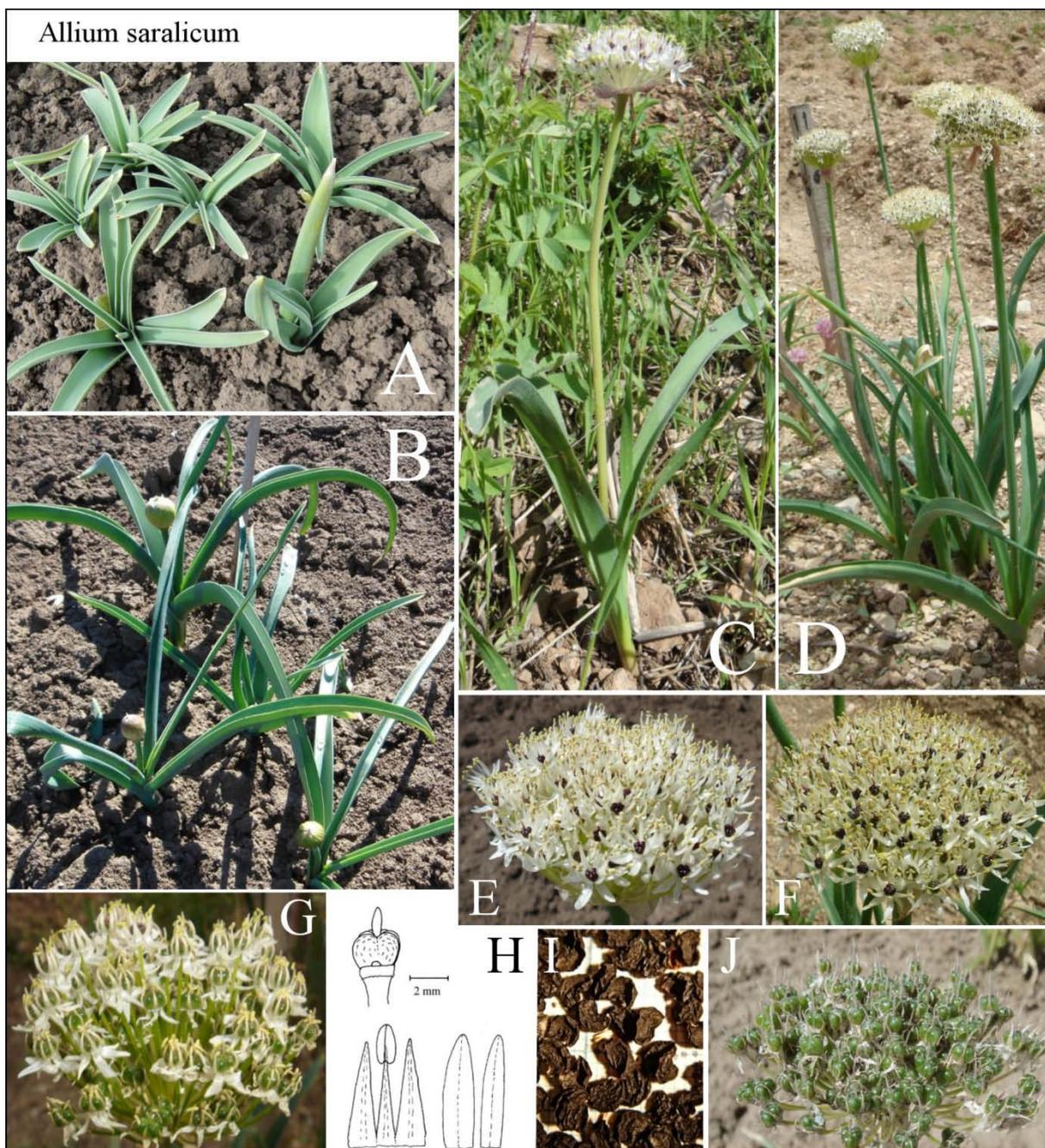


Plate T6. A & B: Leaves and scapes of cultivated plants after sprouting; C: flowering plant in Ghasemloo valley; D: cultivated plants flowering; E, F & G: inflorescences in early, full, and late anthesis, resp.; H: shape of ovary, two inner and one outer filaments, and inner and outer tepals of a flower prepared from herbarium (from Fritsch & Abbasi 2009: Fig. 8D); I: seeds (background raster 1 mm); J: inflorescence with developing capsules.

**Chromosomes:**  $2n=16$  Pogosian 1983 fig. 5 (Iran: Sanandaj, "*A. kharputense*").

**Distribution:** Iran, prov. Kurdistan, known yet from an area approximately between  $35^{\circ}$ - $36^{\circ}30'$  N and  $46^{\circ}$ - $47^{\circ}30'$  E, and from the mountains W Urmia in prov. W Azarb. Ruksans (2013) collected plants in E Turkey not far from the Iranian border.

**Remarks:** Key characters of *A. saralicum* are 4-7 leaves with canaliculate, narrowly linear-lanceolate laminae rarely broader than 2.5 cm, and purely white, c. 5 mm long tepals slightly longer than the purely white, fleshy, narrowly-triangular filaments. Other white-flowering species of subg. *Melanocrommyum* occurring in Iran own very broad leaves and are smaller plants. Also albinotic plants of other species but cannot be merged with *A. saralicum* because they are either much larger plants, or show ribbed or otherwise not smooth leaf laminae, or possess completely differently shaped tepals, filaments and ovaries. Even albinotic specimens of *A. shatakiense* (not seen hitherto), though taller plants but similar in general appearance, should be well separable from *A. saralicum* by longer and acute tepals, and much shorter filaments. Molecular markers (ITS sequences of nuclear rDNA and sequences of the plastid *trnL-trnF* region) supported affiliation to sect. *Melanocrommyum* with closest relations to *A. noëanum* (Fritsch & al. 2010; Gurushidze & al. 2010; see p. 200).

**Etymology:** The epithet refers to the Saral region in province Kurdistan where this species is very common.

**Biological data:** Genome size 42.8 pg 2C DNA (Gurushidze & al. 2012).

**Economic traits:** Local name 'gilakkeh'. Whole young plants (without scape) are used for traditional dishes in the province Kermanshah and are also sold at the local markets (Massoumi 2001, as *A. kharputense*). Reported use of *A. kharputense* as food or medicine in Iran found in the literature (Abbasi & al. 2008) very probably refers to that source.

Living accessions studied: **Kurdistan:** Saral Agricultural Station c. 30 km before Divandarreh (35°40' N, 47°07' E, 2100 m, 18.5.2006 Abbasi, Fritsch, Keusgen 1115; GAT IRAN). - **W Azarb.:** Valley Ghasemlu c. 30 km S Orumiyeh to Oshnaviyeh (37°18' N, 45°06' E, 1500 m, 12.5.2011 Pahlevani, Fritsch 1352; IRAN GAT)

Herbarium vouchers: **W Azarb.:** SW Rezaiyeh. Silvana valley. Along the road SE Dizeh (37°15' N, 44°55' E, 1400 m, 25.5.1976 Runemark, Foroughi 19841-TARI). sarm Azarb. ca. 20 km NW of Tekab, in fields (36°31' N, 46°56' E, 2100 m, 05.6.1974 Wendelbo, Assadi, Shirdelpur 12218; W G). prope Tachti-Soleiman (36°37' N, 47°13' E, ???.1898 Strauss; B JE). - **Kerman:** Plant collection of Plant Pests and Diseases Laboratory of Rafsanjan: Pariz, Kohan-Sabz (20.4.1984 Yazdani, Ghabuli; NRK). - **Kurdistan:** In jugo Khan inter Baneh et Saqqez (36°04' N, 45°58' E, 02.5.1974 Siami 2161; TARI). Dezh Shahpur, (1600-1700 m, Jacobs 6551; W). Dasht-e Zaghe on road from Hamadan to Sanandaj c. 40 km E Sanandaj (35°20' N, 47°14' E, 2000 m, 11.5.1975 Wendelbo, Assadi 16905-TARI). Hamadan to Sanandaj, 20 miles E Sanandaj (35°18' N, 47°18' E, 5000', 16.5.1962 Furse 2036; LE W). Marivan to Ban-e 65 km to Ban-e 2 km to Ghamchian, (35°43' N, 46°25' E, 1400 m, 06.5.1996 Attar-Okhovat 19554; TUH). Saral area N Sanandaj, Doozakh-Darreh village (35°46' N, 46°56' E, 15.5.2005 Hosseini; HCAT). Maryvan road of Tigtig to Eslamdast village (35°14' N, 46°41' E, 1750 m, 25.4.2000 Maroofi, Karagar 920; HKS). Saral area N Sanandaj, Bayenchoob village (35°35' N, 46°58' E, 1870 m, 20.5.1997 Kaffash, Fany 3971; HKS). Abbedar 5 km from Sanandaj (35°18' N, 46°58' E, 1750 m, 07.5.1986 Fattahi 1030, 1104; TARI). Shaho mountains, Daleh marz village (35°07' N, 46°29' E, 800 m, 07.4.1995 Kaffash 3061; HKS). Anbar-Bazan village SW Sanandaj (35°17' N, 46°54' E, 1730 m, 24.5.1997 Kaffash, Karegar 4143; HKS). Senandaj to Mahabad (4500 ft., 29.6.1960 Furse, Synge 707; 44009-IRAN). Maryvan to Saghez, Ishag-Abad pass (35°50' N, 46°27' E, 2100 m, 19.5.2003 Maroofi, Sh. Nazeri 6156; HKS). E Chenareh city Chehel-cheshmeh area, Golchidar village (35°40' N, 46°31' E, 2100 m, 08.5.1994 Mohammady, Hassany 2911; HKS). Divandareh, slopes of Chehelcheshme mountain, Best village (35°50' N, 46°31' E, 1970 m, 08.5.2004 Maroofi, Moradi 6994; HKS). Maryvan to Saghez road, Garan station (35°32' N, 46°18' E, 1320 m, 30.4.2004 Maroofi 7092; HKS).

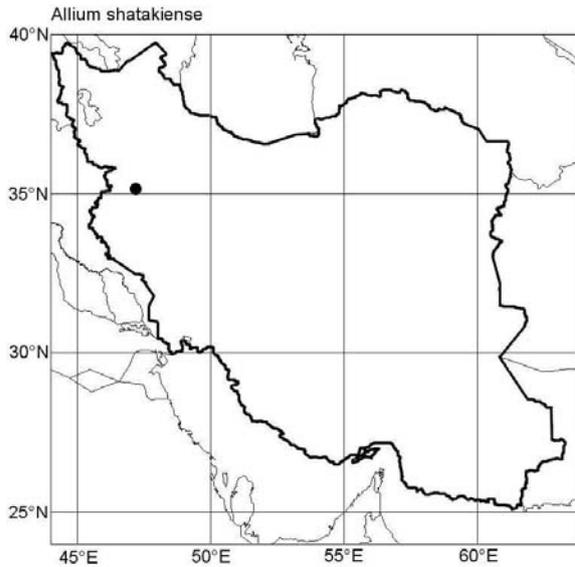
Determination unsure: **Kurdistan:** Saral area N Sanandaj, Doozakh-Darreh village (35°46' N, 46°56' E, 15.5.2005 Hosseini; HCAT). - **W Azarb.:** Urumiyeh: Shamlakan village, Bonsool valley (1900 m, 05.4.1995 Alizadeh, Ghasem-poor, Heidari, Larti, Shanaki 7624; ORUM).

**7. *Allium shatakiense*** Rech.f. in Ann. Naturh. Mus. Wien 49: 280, Fig. 7 a, b (1939). - Kollmann, Fl. Turkey 8: 207, fig. 9/15, map 34 (1984). Wendelbo, Fl. Iraq 8: 171 (1985). - **Type:** Turkey: Kurdistan, Darnis Ashagi N Shatak, 2300 m, leg. Frödin No. 240 (W? not seen).

Bulbs ovoid, c. 1-2 cm in diam.; outer tunics black; inner ones whitish, papery. Scape ± flexuous, terete, smooth; 15-25 (45) cm long, 3-6 mm in diam.; deep green or purple suffused. Leaves 2-4 (7), laminae linear-lanceolate, obliquely arcuately ascending, smooth, canaliculate, undulate, tapering into a rather short apex; 10-25 cm long, 0.5-2 cm broad; deep green. Sheath leaf fine membranous, yellowish, present till early anthesis. Spathe thin membranous, split into 2 ovate, patent to subreflexed valves, 1-2.5 cm long; whitish to pale brown with darker veins. Inflorescence fasciculate to semi-globose, dense, many-flowered; c. 2.5-4 cm in diam. Pedicels thread-like, straight, smooth, unequally long; 12-16 mm,

after anthesis up to 25 mm long; green, purple suffused. Anthesis in June. Flowers funnel-shaped to campanulate. Tepals very narrowly lanceolate, acuminate, lax, obliquely sideward directed, finally reflexed and contorted; 7-9 mm long, 1-1.4 mm wide; lilac to purple with keeled median vein. Filaments 1/2 as long as the tepals, triangular to subulate, thickish; the triangularly broadened base adnate to the tepals and connate for c. 1 mm; dark purple, pale when dry. Anthers ovoid, 1 mm long; purplish. Pollen not seen. Ovary probably ovoid and green. Style apparently 3-4 mm long. Stigma undivided. Capsule subglobose c. 5 mm broad and in diam.; valves suborbicular narrowly notched at the apex; pale brown. Seeds not seen.

**Chromosomes:**  $2n = 16$  Genç & al. 2013 Table 3, Fig. 1 (k), Fig. 2 (k) Turkey: prov. Van, ISTE-91535).



**Distribution:** E Anatolia, N Iraq, W Iran: prov. Kurdistan, in montane mountain steppe, *Quercus* shrubs, meadows, arable land (Wendelbo 1985).

**Remarks:** Living plants of *A. shatakiense* could not be studied. Judging from the few herbarium vouchers seen, the plants should be somewhat taller but otherwise similar to *A. saralicum* beside the purplish flowers having longer and acute tepals, and much shorter filaments. Samples for molecular studies were not available hitherto.

**Etymology:** The epithet refers to the town Shatak in East Turkey situated near the type location.

Herbarium vouchers: **Kurdistan:** Dasht-e Zarghe, on road from Hamadan ca. 40 km E Sanandaj (35°20' N, 47°14' E, 2000 m, 11.5.1975 Wendelbo, Assadi 16904-TARI W).

**8. *Allium stenopetalum*** Boiss. & Kotschy ex Regel in Trudy Imp. S.-Peterb. Bot. Sada 3, 2: 231 (1875), non *Allium stenopetalum* Guss., Fl. sic. syn. 1: 394 (1842 publ. 1843), nom. ined. in syn., Guss. ex

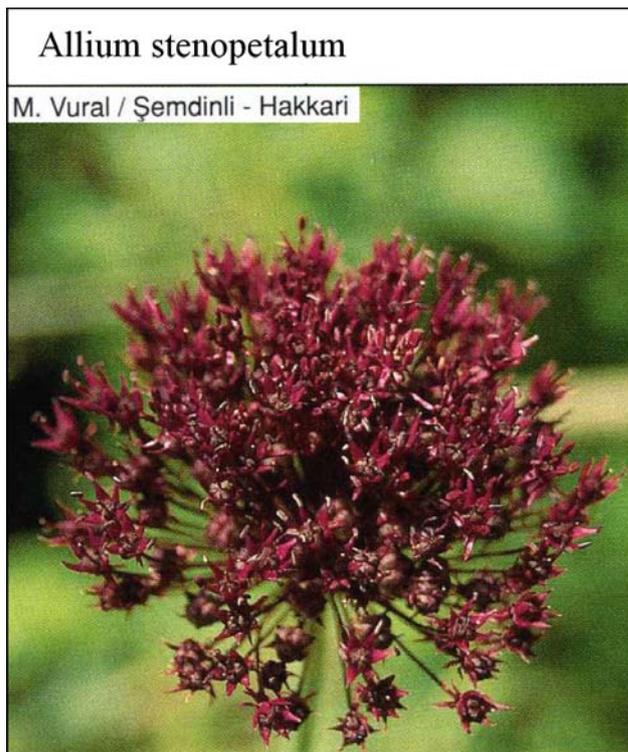


Plate T8. Inflorescence in late anthesis (from Tekin 2005: 555).

Lojac., Fl. Sicul. 3: 107 (1909), nom. illeg. - **Type:** Turkey: Plantae in montibus Kassan Oghlu ad pagum Gorumse lectae ... in devexis argillosis versus fodinas alt. 4200', 22.5.1859, leg. Kotschy No. 168 (lectotype G!; design. Fritsch 2012a: 261, isotype P!, JE!, BM!).

Bulbs ovoid to subglobose; outer tunics papery, near neck somewhat splitting, ash-gray to black; inner tunics whitish. Scape straight, terete, smooth; c. 50 cm long. Leaves 4-6, laminae linear-lanceolate, flat (?); margins toothed; up to 25 cm long and 6-10 (15) mm broad. Spathe membranous, split into 3-4 oval acuminate valves,  $\pm$  longer than the pedicels. Inflorescence broadly fastigiata to subglobose,  $\pm$  dense and many-flowered; 4-5 cm in diam. Pedicels thin, apparently straight; 1-2 cm long. Anthesis in May. Flowers reflexed star-like. Tepals narrowly linear-oblong, patent (?), obtuse; after anthesis reflexed; only at the very base connate; (3) 4-5 mm long, c. 1 mm broad;

blackish purple. Filaments 1/2-3/4 as long as the tepals,  $\pm$  straight,  $\pm$  subulate, not (?) fleshy; basally broadened (inner filaments nearly twice as broad) but not connate; deep purple (?). Anthers oblong, c. 1.5 mm long; brown. Pollen not seen. Ovary depressed-globose, probably smooth and purple. Style thread-like, c. 2 mm long. Stigma undivided. Capsule not seen. The seed testa showed verrucose periclinal walls with prominent verrucae and Omega-like undulated anticlinal walls with a moderate amplitude and short wavelength of undulation (Fritsch & al. 2006).

**Chromosomes:**  $2n = 16$  Koyuncu & Özhatay 1983 Sek. 2b (Turkey: Tarsus - Camliyayla);  $2n = 16$  Genç & al. 2013 Table 3, Fig. 1 (q), Fig. 2 (q) (Turkey: prov. Malatya).

**Distribution:** Turkey: S Anatolia C6 & C5 (Savran & al. 1997). Occurrence in Iran seems possible.

**Remarks:** The plants are most similar to *A. chrysantherum* but differ by the deep purple color of all tepals and filaments. Kollmann (1984) referred not to the description of Regel (1875) but to Boissier (1882: 280) underlining that the name *A. stenopetalum* is often wrongly used for *Allium* vouchers showing small tepals.

**Etymology:** The epithet refers to the narrow tepals (from Greek "narrow tepal").

**Economic traits:** Ornamental plant listed in the "International Checklist ..." of the Royal General Bulbgrowers Association (1991).

**9. *Allium urmiense*** Kamelin & Seisums in Novosti Sist. Vyssh. Rast. 30: 30 (1996). **Type:** Sev. Persiya, Aderbejdshan, okrug Baradast, okrestnosti s. Ichkesu [N Persia, Azarbeijan, regio Baradast, prope pagum Iczkesu], 02.6.1916, leg. Shelkovnikov, Schipczinsky No. 873 (holotype LE, photo seen).

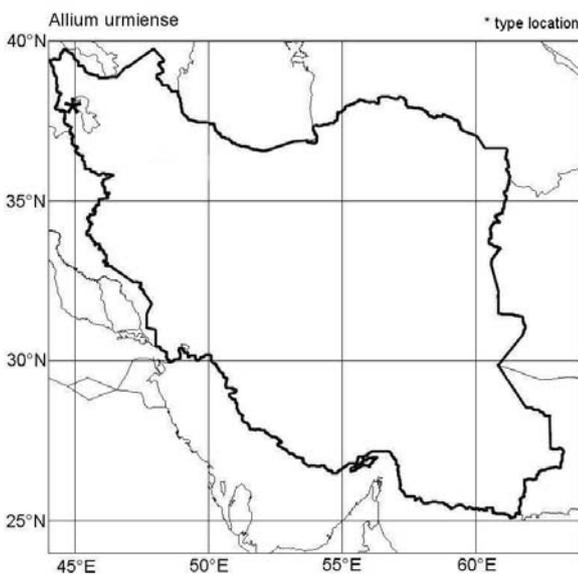
(Adopted from the original description): Bulbs not seen. Scape straight, thin, smooth; 35-40 cm long, 2 (?) mm in diam. Leaves 1-2, laminae linear with smooth margin; 10-15 cm long, 4-5 mm broad. Spathe shortly acuminate, shorter than the pedicels. Inflorescence fasciculate to semiglobose, dense; 2.5-3 cm in diam. Pedicels subequally long, 12-15 mm long. Anthesis in May to June. Flowers stellate. Tepals lanceolate, obtuse, 5 mm long, 1.2-1.3 mm broad, after anthesis reflexed; pinkish-lilac with darker

conspicuous median vein. Filaments somewhat shorter than the tepals, basally adnate to the tepals and for 1 mm connate. Ovary sessile, globose, smooth. Capsule globose. Seeds not seen.

**Distribution:** Iran, prov. W Azarbeijan, only known from the type location (most probably the current village Iystisu S Salmas is meant).

**Remarks:** The bases of filament bases were described to be ring-like united like in *A. fedtschenkoi*, but differing by the scape to be less than half as long, linear and not narrowly elliptic leaves, and only 5-5.5 mm long tepals. Living plants were not seen, and material for molecular study was not available. The taxonomic relation remain unclear.

**Etymology:** The epithet refers to the region of lake



or town Urmia where the type was collected.

### *Allium bisotunense* alliance

In Iran occur two or three very similar species characterized by white  $\pm$  oblong tepals, and glossy, at begin of anthesis blackish later green ovaries. They own a condensed habit, glaucous and longitudinally grooved, elliptic to ovate leaves, and short scapes like many taxa of sect. *Acanthoprason* but belong to sect. *Melanocrommyum* s. str.

**10. *Allium bisotunense*** R.M. Fritsch in Rostaniha 9 Suppl. 2: 43, fig. 9 (2008 publ. 17 Jul 2009). -  
**Type:** Cultivated in the national living *Allium* collection of Iran in IRIPP, Tehran no. 1093, leg.  
 21.4.2008 (holotype IRAN); plants from prov. Kermanshah, limestone massif N of the main road from  
 Sahneh to Kermanshah c. 15 km E Bisotun.

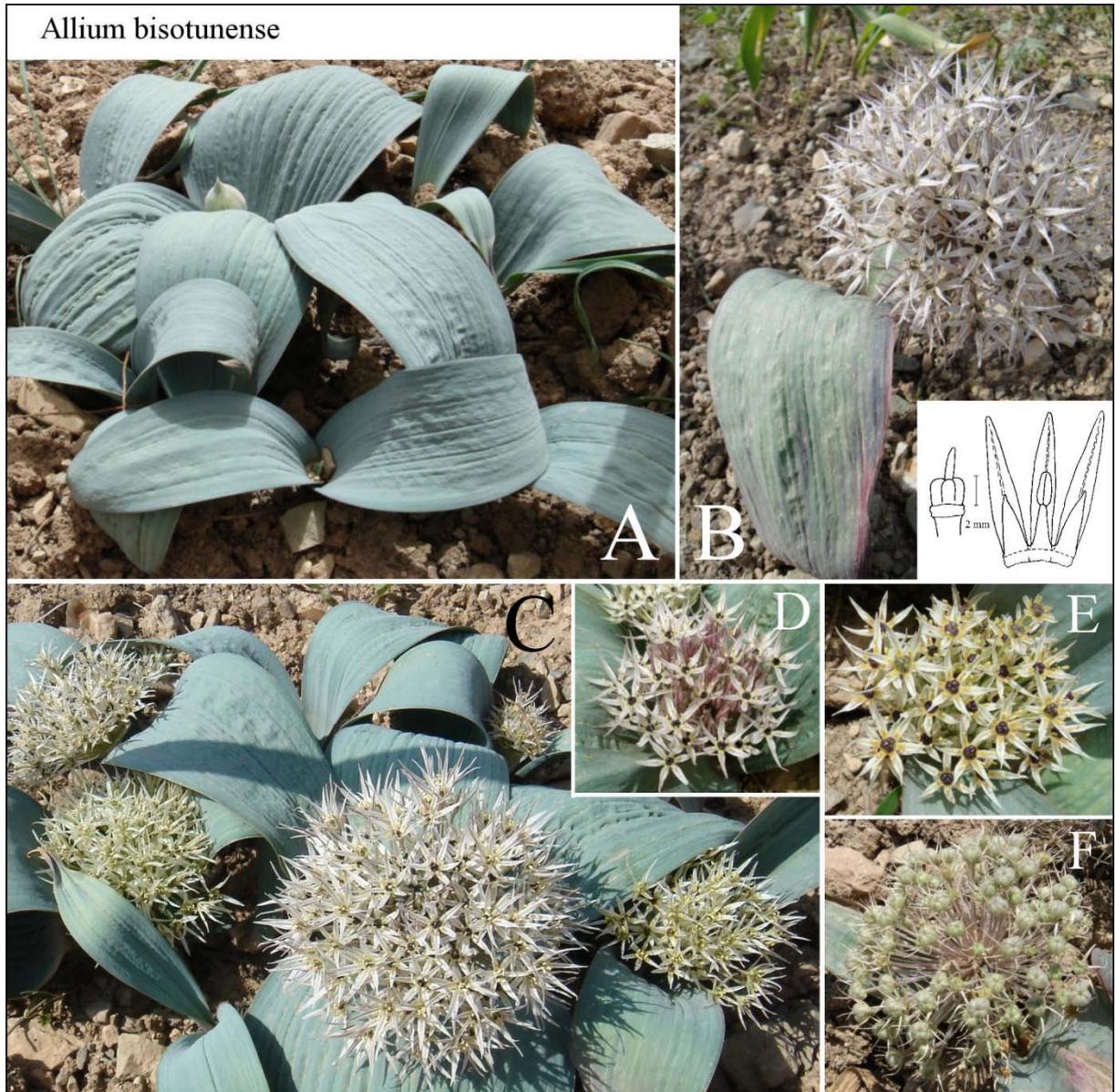
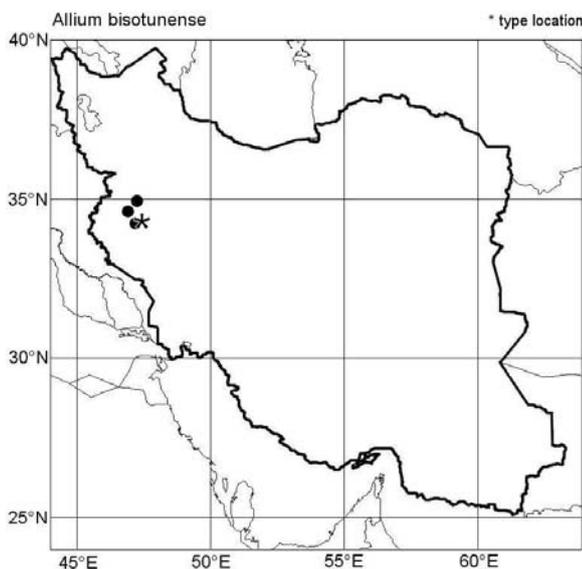


Plate T10. Cultivated plants from the type location. A: Leaves and scapes after sprouting; B & C: flowering plants, B inset: shape of ovary, tepals and filaments of a flower prepared from herbarium; D & E: inflorescences in early and full anthesis, resp.; F: inflorescence with developing capsules.

Bulbs depressed globose, 2-3 cm in diameter; outer tunics blackish, disintegrating. Scape conical,  $\pm$  straight, smooth, above ground 4-8 cm long, below 3-5 mm above 4-6 mm in diam.; green with glaucous bloom, near base  $\pm$  violet flushed. Leaves 2, laminae widely lanceolate to ovate, thick, flat but near base  $\pm$  canaliculate, obliquely directed and recurved, with a short hooded apex; margin near base 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 flushed. Sheath leaf not seen. Spathe papery, for 3/4 of its length split in 2-3 widely ovate-triangular, shortly tipped valves, initially appressed to the pedicels later patent; pale brown with darker nerves. Inflorescence fasciculate to semi-globular, dense, many-flowered; 5-6 cm long and 6-10 cm in diameter. Pedicels thick, unequally long, wire-like,

ascending; ± dull green, often brown or violet flushed. Anthesis in April to May. Flowers bowl-shaped star-like. Tepals lanceolate, sub-acute, the upper curved part long tapering and longitudinally folded and therefore seemingly very acute, obliquely patent, finally slightly crumpled; 10-12 mm long, up to 2.5-3 mm wide near the base; white or reddish with narrow (dorsally broader) green to brown median vein. Filaments 2/5-1/2 as long as the tepals, fleshy, obliquely patent; outer filaments narrower triangular than inner ones, basally not connate; whitish to yellow, upper part yellow or reddish flushed. Anthers oblong, 2 mm long and 1 mm wide; yellow. Pollen yellow. Ovary sessile, depressed-globose triangular with six furrows, surface cells even and dull; c. 2 mm long and 3 mm in diameter; upper half blackish red, lower half green, finally completely green; nectary ducts lead in pore-like (slit-like?), slightly humped pits. Style narrowly conical, 1-2 mm long; initially carmine later green. Stigma undivided, acute; whitish. Capsule depressed-globose, rounded-triangular; 7-8 mm in diam.; widely opening, pale greenish brown; valves suborbicular with a sharp longitudinal furrow and scarcely notched at the apex. Seeds 1 (rarely 2) per locule, sector-like drop-shaped, concave-convex with sharp edges; c. 3 mm long, c. 2.5 mm wide, 1.5 mm thick; surface of the convex side irregularly reticulate lacunose, finely tuberculate; dull black.



**Distribution:** Iran, prov. Kermanshah and Kurdistan, known yet from the region around the type location.

**Remarks:** The shape of the leaf laminae of this species is very common among members of the sections *Acanthoprason* and *Melanocrommyum*, but *A. bisotunense* is the hitherto only Iranian member of sect. *Melanocrommyum* possessing tepals with such a long tapering apex. Closely related species own an identical leaf shape and also smooth ovaries initially black in the upper half, but differ by flower characters: *A. keusgenii* has ovate tepals with obtuse apex and a pinkish-purple upper part of filaments, *A. colchicifolium* lanceolate, acute tepals with a crenulate margin and filaments with a basal pink or purple sector, and *A. straussii* is characterized by oblong tepals with acute apex and smooth margins,

and also filaments with a basal pink sector. *Allium keusgenii* is also the closest relatives according to molecular markers (ITS sequences of nuclear rDNA; see p. 200 and Fritsch & al. 2010) but sequences of the plastid *trnL-trnF* region point to a similar degree of relationship to the sections *Acanthoprason* and *Pseudoprason* (Gurushidze & al. 2010).

**Etymology:** The epithet refers to the famous historical Iranian place Bisotun situated near the type location.

Living accessions studied: **Kermanshah:** Limestone massif N of the main road from Sahneh to Kermanshah c. 15 km E Bisotun (34°27' N, 47°35' E, 1600 m, 12.5.2006 Abbasi, Fritsch, Keusgen 1093; GAT IRAN).

Herbarium vouchers: **Kermanshah:** Kuh-e Parrou, stony and rocky slope, limestone, (34°25' N, 47°15' E, 1700-2100 m, 07.5.1975 Wendelbo, Assadi 16744; W TARI). - **Kurdistan:** Dehgolan to Kamyaran, road side (35°07' N, 47°18' E, 2170 m, 04.4.1994 Mohammady, Khassany 2870; HKS). Cultivated Sanandaj, Zale station (15.4.2003 Hooshidari 8860; HKS). Kamiaran, Mochesh road, Quick village (34°47' N, 46°56' E, 1500 m, 09.4.2001 Hooshidari 8861; HKS).

**11. *Allium keusgenii*** R.M. Fritsch in Rostaniha 9 Suppl. 2: 46, fig. 10 (2008 publ. 17 Jul 2009). - **Type:** Iran, prov. Kermanshah, Sahneh towards Songhor, Baktar Olia village, S slope of Dalikhani mountain, 2270 m, 34°38.962' N, 47°36.836' E, leg. 19.5.2007 Abbasi, Fritsch, Keusgen (holotype 48373-IRAN).

Bulbs ovoid to depressed-globose, 2-4 cm high, 2-6 cm in diameter; outer tunics blackish, disintegrating. Scape slightly flexuous, conical, smooth; above ground 4-15 cm long, upper part 4-8 basal 3-6

mm in diameter; green, often carmine flushed. Leaves (1) 2-3, ovate up to lanceolate, thick, near base convolute becoming slightly canaliculate towards the short hooded apex; margin narrowly reddish or white, coarse; upper side grooved or with wavy areas or  $\pm$  smooth, lower side with flat 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 the base. Sheath leaf short, thickish, brown, soon decaying. Spathe

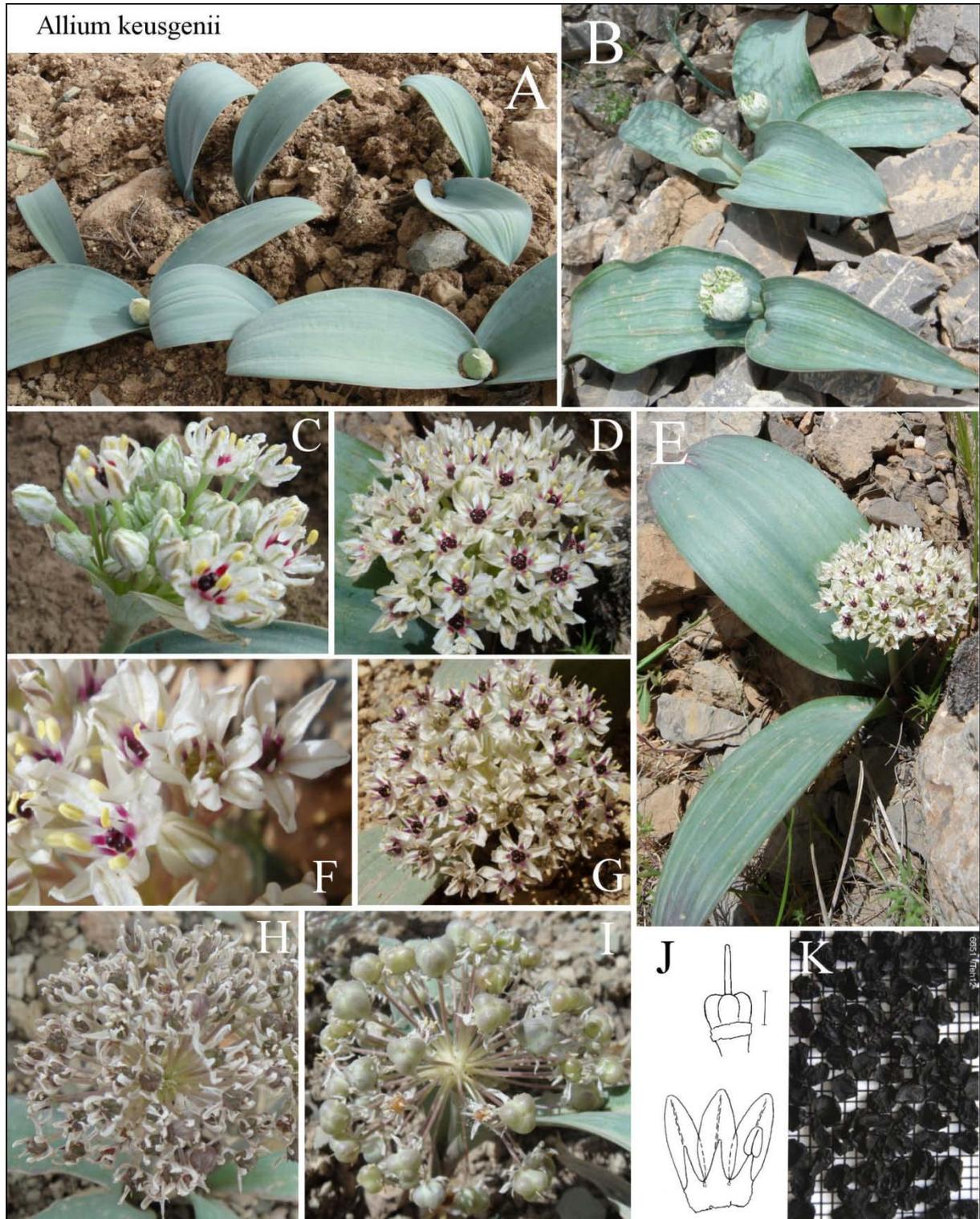
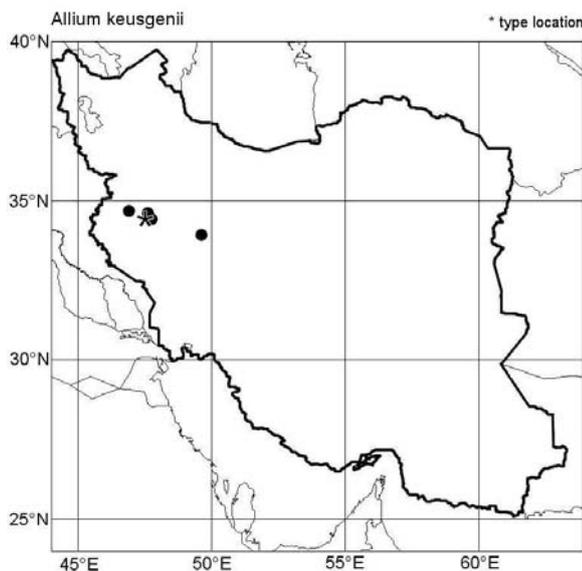


Plate T11. A : Cultivated plants after leaf sprouting; B: plants in the shooting stage at the type location; C & D: inflorescences in early and full anthesis, resp.; E: flowering plant at the type location; F: close-up of flowers; G & H: inflorescences in late anthesis and after anthesis; I: inflorescence with developing capsules; J: shape of ovary, tepals and filaments of a flower prepared from herbarium (scale bar 2 mm); K: seeds (background raster 1 mm).

membranous, most often completely split in 2 triangular valves, initially appressed to the pedicels and later reflexed; pale brown with somewhat darker nerves. Inflorescence fasciculate to semi-spherical, many-flowered, dense but finally looser; c. 3 cm high and 3-8 cm in diameter. Pedicels cylindrical, soft, incurved; up to 4 cm long; whitish, greenish or slightly carmine flushed, dull or slightly glossy. Anthesis in May. Flowers cup- to bowl-shaped, star-like, without odor. Tepals ovate to linear-ovate, slightly boat-shaped or lengthwise folded, with an obtuse or sub-acute tip, obliquely to right-angled patent, after anthesis crumpled; 6-10 mm long and 3.5 mm wide; white, median vein  $\pm$  broad, green to reddish-brown. Filaments 1/2 to 2/5 as long as the tepals, fleshy, inner ones widely triangular, outer ones narrowly triangular, basally shortly widened but scarcely united; whitish, above the white base one carmine sector, tip white. Anthers oblong, c. 2 mm long and 1 mm wide, yellow. Pollen faintly yellow. Ovary sessile, depressed-globose with six furrows also at the concave tip, 2 mm long, 2.5-3 mm in diameter, surface finely uneven but glossy, initially violet and finally green, nectary ducts lead in small, triangular pits near the base. Style conical to thread-shaped, 3-4 mm long, initially with carmine base, later completely whitish. Stigma undivided, sub-acute, white. Capsule flat globose-triangular with 3 wider and 3 narrow furrows, apex concave; about 4 mm long and 5 mm in diam.; valves suborbicular with a shallow longitudinal furrow, surface slightly rugose to reticulate lacunose, narrowly notched at the apex. Seeds 1-2 per locule, concave-convex, flat drop-like sector-shaped; concave side finely tuberculate without or with a few irregular ledges and sharp edges, convex side coarsely reticulate lacunose; c. 3 mm long, 2-3 mm wide, 1.5-2 mm thick; dull black.



**Distribution:** W Iran, prov. Kermanshah: known with certainty only from the mountains between Sahneh and Sonqor; the other vouchers need confirmation.

**Remarks:** *Allium keusgenii* shows obtuse outer tepals crumpled after anthesis and only slightly colored filaments, but *A. straussii* differs mainly by acute outer tepals becoming stiff and prickly after anthesis, and longer, only slightly colored filaments. We have not seen any voucher or picture from Iran of the third species involved, *A. colchicifolium* s. str. having eroso-dentate tepal margins and, shown by the type specimens, purplish filaments with whitish upper part. Comparison of living plants will be essential to verify these differences. Wendelbo (1971) applied *A. colchicifolium* in a broad sense including

*A. haussknechtii* and *A. straussii* as synonyms. As expected from morphological similarity, molecular markers (ITS sequences of nuclear rDNA) supported the close relations of *A. keusgenii* and *A. bisotunense* that form a separate subgroup. Less closely related are *A. saralicum* and *A. noëanum* and a larger group comprising some Near East species as well as *A. chrysantherum* and *A. mozaffarianii* (see p. 200). Analysis of sequences of the plastid *trnL-trnF* region showed rather many closely related species together in lineage II but *A. saralicum* and *A. noëanum* belonged to lineage I (Gurushidze & al. 2010).

**Etyymology:** The epithet honors the distinguished contemporary pharmacist in Marburg (Germany) M. Keusgen, co-discoverer and co-collector of the type specimen.

Living accessions studied: **Kermanshah:** Sahneh towards Songhor, Baktar Olia village, S slope of Mt. Dalikhani (34°39' N, 47°37' E, 2270 m, 19.5.2007 Abbasi, Fritsch, Keusgen 1198; IRAN; 48373-IRAN).

Herbarium vouchers: **Kermanshah:** Sonqor Gavanban mountain (34°47' N, 47°39' E, 1450 m, 27.5.1992 Neamati, Mirabdali 3415; NRK). Sahneh: Amruleh mountain (34°37' N, 47°47' E, 2500 m, 23.5.1998 Neamati, Yusofi 4794; NRK). - **Markazi:** Gipfel des Mowdere-Berges ca. 1 Meile W Sultanabad (34°07' N, 49°38' E, 20.4.1889 Strauss 395/396 p.p.; or 8.6.1890 Haussknecht; JE)

Determination unsure: **Kurdistan:** Kermanshah to Sanandaj (34°52' N, 46°58' E, ???.1977 Ghareman 4194; TUH).

12. *Allium straussii* Bornm. in Beih. Bot. Centralbl. 28 II: 515 (1911), *in textu*. - Wendelbo, Flora Iranica No. 76: 81 (1971), Wendelbo, Fl. Iraq 8: 175 (1985). Kollmann, Fl. Turkey 8: 202 (1984), omnia sub *A. colchicifolium*; Fritsch & Abbasi in Rostaniha 10 Suppl. 2: 48 f. (2009). - Type: Iran: Schahu, 25.5.1905, leg. Strauss (lectotype B! design. Fritsch & Abbasi 2009: 49).

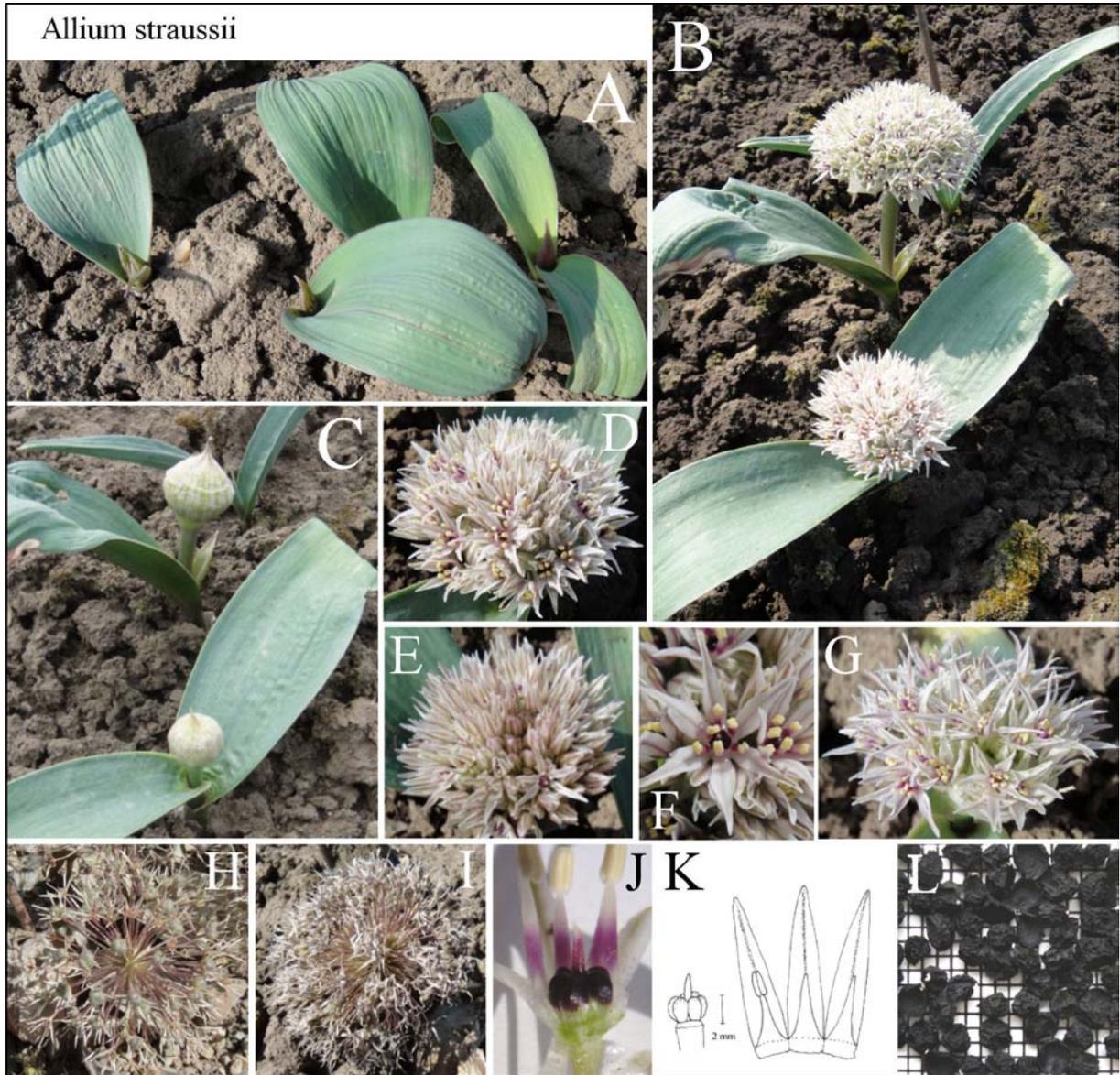
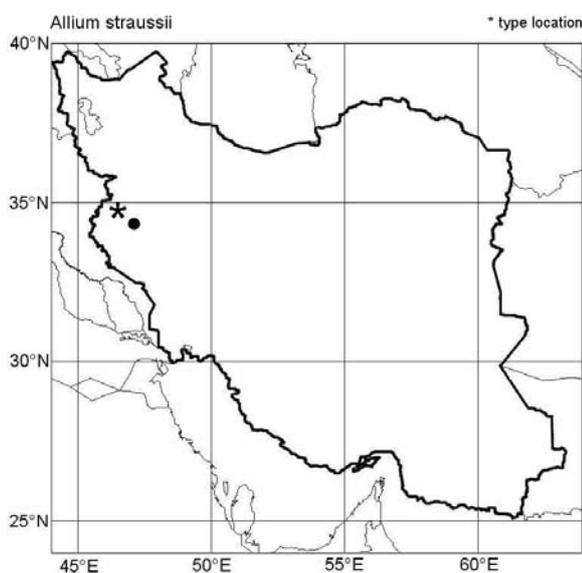


Plate T12. Cultivated plants. A & C: Leaves and scapes after sprouting; B: flowering plants; D, E & G: inflorescences in early and full anthesis, resp.; F: close-up of flowers; H & I: inflorescences with developing and full-size capsules, resp.; J: close-up of flower parts; K: shape of ovary, tepals and filaments of a flower prepared from herbarium; L: seeds (background raster 1 mm).

Bulbs depressed ovoid, 2-3 cm long and in diam.; outer tunics membranous, grayish brown, disintegrating. Scape subflexuous, terete, smooth; 5-15 cm long, 7-8 mm in diameter; greenish brown. Leaves 1-2 (3), laminae oval to oblong with short triangular cucullate tip and narrowed towards base, thick,  $\pm$  flat; margin smooth; upper side smooth or like lower side with shallow broad ribs; outer leaf 18 x 8 cm, inner leaf c. 10 x 2.5 cm; glaucous green often purplish flushed and with purple margin. Spathe membranous, split into 2-3 ovate, patent or somewhat reflexed valves, brownish to purplish with inconspicuous veins. Inflorescence semi- to sub-globose, rather dense, many-flowered; c. 5 cm long, 8 cm in diameter. Pedicels thin wiry, straight, lower ones slightly curved; green, purple suffused in the upper part. Anthesis in April to May. Flowers funnel-shaped star-like. Tepals lanceolate to narrowly ovate, concave, obliquely sideward directed; outer tepals subacute, 6-9 x 2.5 mm, inner tepals more obtuse, 5-8 x 3 mm; after anthesis longitudinally convolute and stiff but not prickly. Filaments 2/5-3/5 as long

as the tepals, fleshy, narrowly triangular (inner filaments remarkably broader); basally c. 0.5 mm connate; whitish with a purple basal sector, later throughout purplish with a paler apex. Anthers oblong, 2 x 1 mm; pale yellow. Pollen yellow. Ovary sessile, subglobose, smooth and glossy, deep hexasulcate; c. 3-4 mm in diameter; upper half deep violet, later green like lower half; nectary ducts lead in triangular pits above the base of ovary at the begin of green part. Style conical to sub-cylindrical, 2-3 mm long; whitish to pink. Stigma undivided; whitish. Capsule depressed globose, triangular with three broad longitudinal furrows, semi-glossy, surface shallowly but coarsely reticulate lacunose; c. 3 mm long and 4-5 mm in diameter; yellowish brown, often red suffused; valves transversely elliptic with a broad longitudinal furrow, apex broadly notched. Seeds (1-) 2 per locule, sector-like drop-shaped, concave-convex, concave side tuberculate with a sharp marginal ledge, convex side reticulate lacunose; 2-2.5 mm long, c. 2 mm wide, 1.5-2 mm thick; dull black.



**Distribution:** Iran, prov. Kermanshah: Only known yet from Shahu Mts. and Kuh-i Kinisht, occurrence in neighboring Iraqi areas is very probable.

**Remarks:** A rarely collected species though apparently still present in larger quantities (see under economical traits). It is most similar to *A. keusgenii* differing by another mode of filament coloration, but most characteristic are acute and longer tepals becoming convolute and stiff after anthesis in *A. straussii* but weak and crumpled in *A. keusgenii*. Comparison of living plants from other sources will be essential to verify these differences.

**Etymology:** The epithet honors the German merchant, explorer, and extraordinarily active plant collector of great merit F. T. Strauss acting mainly

in the region around Arak (prov. Markazi) from the 1880ies up to 1910.

**Economic traits:** Plants sold in a shop in Tehran were identified as this species. They are used as a cooked vegetable, are eaten with rice, or are dried for use in winter in the same way, the local name is 'kol' or 'koul', also 'valak'.

Living accessions studied: **Kermanshah:** Plants bought in a shop in Tehran - Evin, brought from southern part of Shahu mountain range, W Kamyaran (01.5.2011 Abbasi, Fritsch 1320; GAT, IRAN).

Herbarium vouchers: **Kermanshah:** In m. Kuh-e Kinisht (dit. Kermanshahan) (34°31' N, 47°09' E, Strauss; W B G). Shahu Mt. range close to Kamyaran (bought from local market at Evin) (01.5.2011 Abbasi, Fritsch 1320; 56551-IRAN).

### *Allium cardiostemon* alliance

**13. *Allium cardiostemon*** Fisch. & C.A. Mey., Index sext. sem. Hort. petrop.: 43 (1840). - Regel in Trudy Imp. S.-Peterb. Bot. Sada 3: 245 (1875). Vved., Flora URSS 4: 263 (1935); Wendelbo, Flora Iranica No. 76: 80, tab. 8/112 (1971); Wendelbo, Fl. Iraq 8: 173 (1985). Kollmann, Fl. Turkey 8: 201, Fig. 9/6, map 32 (1984). Oganessian & Agababian, Flora Armenii 10: 295, 338, tabl. 105 1a-1e (2001). - *Allium trilophostemon* Bornm. in Feddes Repert. 10: 238 (1911). Type: *Allium* Cilicia: in m. Tauro et Anti-tauro leg. Dieck 1906 cult. in Zöschchen 1907 VI. 10 com. pl. viv. (small plant in the left corner above) (lectotype B!, design. Fritsch & al. 2010: 207). *Allium atriphoeniceum* Bornm. in Feddes Repert. 38: 161 (1935). Typus: Turkey: Kars, alpine Region des Berges Khash-Khash-Dagh, 1.-10.7. 1934, leg. Kotzsch (lectotype JE! "*atrophoeniceum*", design. Fritsch & al. 2010: 203). *Allium nabelekii* Kamelin & Seisum in Novosti Sist. Vyssh. Rast. 30: 29 (1996). Typus: Turcia, distr. Musch, in jugo Chan-Scharaf-dagh inter pagos Magalisor et Czarboch, in pratis montosis, 04.6.1916, leg. Schischkin (holotype LE, photo seen). - **Type:** Azerbaijan: In argillosis vallis Komadara versus Karavansarai, 10.6. 1829, leg. Szovits No. 382 (lectotype LE!, design. Fritsch, 1990: 503; isotypes G! P! M!).

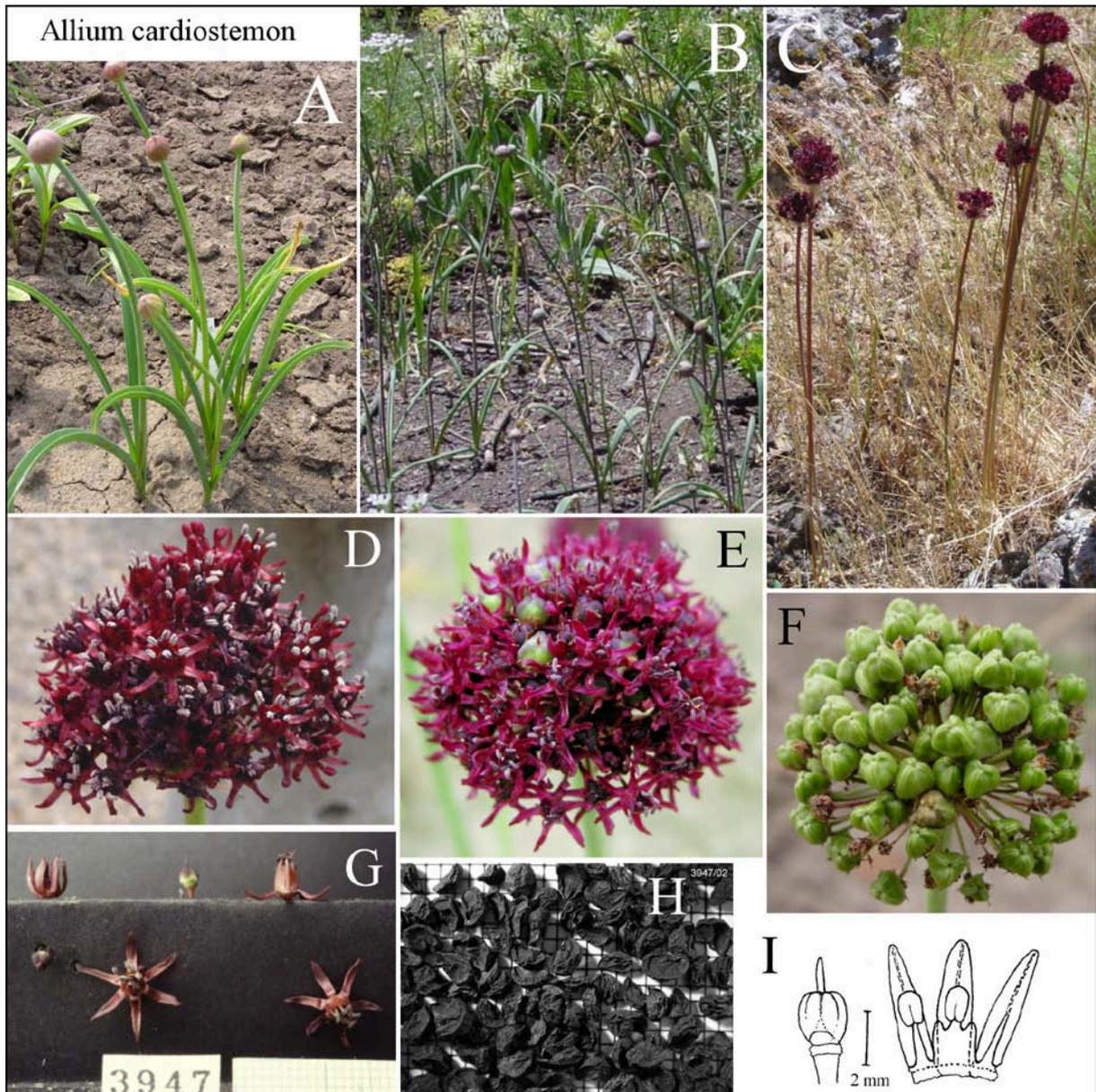
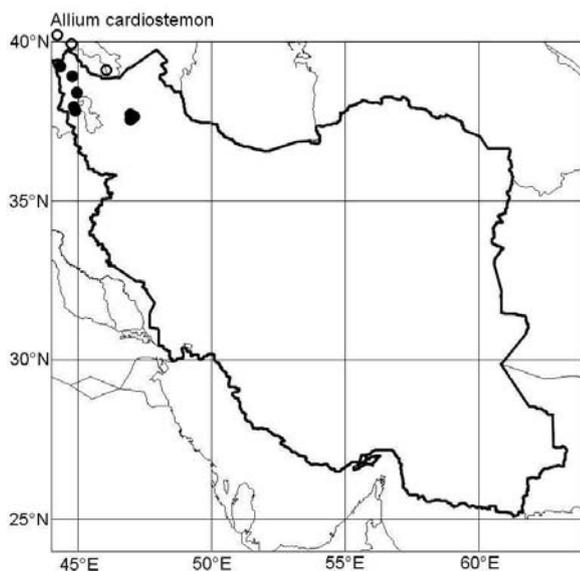


Plate T13. A & B: Plants in the shooting stage, A in cultivation, B near Tendürek pass, Turkey; C: flowering plants near Muradiye, Turkey; D & E: inflorescences at begin and near end of anthesis; F: inflorescence with full-sized capsules; G: comparison of flower parts in different stages; H: seeds, background raster 1 mm; I: shape of ovary, tepals and filaments of a flower prepared from herbarium.

Bulbs subglobose, (10) 15-30 (35) mm in diam.; outer tunics strong parchment-like, often protruding into a long neck, blackish-brown or reddish; inner tunics papery, white. Scape straight, terete, smooth; 30-60 cm long, 3-5 mm in diam.; green with strong glaucous bloom, later purple flushed. Leaves 2-4 (6), laminae linear-lanceolate, suddenly tapering into a rounded cucullate apex, straight but somewhat recurved and upper part often hanging down, rather thin, (especially basal part strongly) canaliculate; upper side  $\pm$  smooth, lower side finely ribbed; margins smooth or densely and finely toothed, narrowly white; 20-25 cm long, 5-15 (20) mm broad; dull green with glaucous bloom. Sheath leaf moderately long, fine membranous, whitish to brownish, soon decaying. Spathe membranous, split into 2-5 ovate, shortly acute, patent to subreflexed valves, shorter to longer than the pedicels; pale brown, veins inconspicuous. Inflorescence broadly fastigiata to semi-globose finally depressed-globose, many-flowered, dense; (2.5) 3-4 (6) cm in diameter. Pedicels straight, moderately thick, soft, sub-equally long; dark purplish, glossy. Anthesis in May to June. Flowers bowl-shaped star-like; with unpleasant odor like dung of sheep. Tepals triangular-lanceolate, spoon-shaped concave, patent but the subobtusate to shortly acute tip incurved; after anthesis reflexed and crumpled; 4-5 mm long, 1.2-1.5 mm broad; dark red-brown

to blackish-purple, rarely pink, with broad green median vein. Filaments 2/3-3/4 as long as the tepals; basally c. 0.5 mm connate; outer filaments subulate with triangular base; inner filaments triangular, basally 1.5 times broader and sub-quadratic with straight, obtuse, 1-2 mm long lobes; dark purple fading towards base. Anthers ovate, c. 1.5 mm long and 0.8-1.2 mm broad; purple. Pollen yellowish gray. Ovary sessile, depressed-globose triangular with 3 narrow and 3 wide furrows, surface finely tuberculate; c. 2 mm long and in diam.; dull black to carmine fading to green towards the base; nectary ducts lead in small funnel-shaped pits. Style conical, 1-3 mm long; purple. Stigma undivided or very shortly tripartite; pale purple. Capsule sessile, ovoid to globose-triangular, surface smooth, semi-glossy to dull; 3-5 mm in diam., 4-5 mm long; valves oval to orbicular notched near the apex and with a narrow longitudinal furrow. Seeds 2 per locule, surface coarsely reticulate lacunose with sharp angles; 2-2.5 mm long, c. 1.5 mm wide, 1-1.5 mm thick; dull black. The testa showed verrucose periclinal walls and transitions from U-like to shortly Omega-like undulation of the anticlinal walls (Kruse 1986; Fritsch & al. 2006).

**Chromosomes:**  $2n = 16+0-1B$  Pedersen & Wendelbo 1966 fig. 1b (Turkey: Erzincan).  $2n = 16+0-1B$  Pogosian 1983 fig. 6 (Armenia: Ararat area, Sweden: Botanical collection).  $2n = 16$  Koyuncu & Özhatay 1983, Özhatay 1986 sek. 2e (Turkey: Adana).  $2n = 16$  Vakhtina 1985 (Armenia: Ararat area).  $2n = 16$  Pogosian in Agapova & al. 1990 (Armenia: Amasija).  $2n = 16$  Pogosian in Agapova & al. 1990 (Azerbaijan: Ordubad, Alagi, "*A. mariae*").  $2n = 16$  Genç & al. 2013 Table 3, Fig. 1 (n, m), Fig. 2 (n, m) (Turkey: prov. Erzurum; prov. Mus "*A. nabelekii*").  $2n = 16+1B$  Genç & al. 2013 Table 3, Fig. 1 (o), Fig. 2 (o) (Turkey: prov. Erzurum).



**Distribution:** E Anatolia, NW Iran, Transcaucasus. Dry forests, meadows, mountain steppe, rocky slopes, arable land; in middle and upper montane belt (Wendelbo 1985, Oganessian & Agababian 2001).

**Remarks:** Like *A. mariae* it is a rather small and slender species with a deep brownish-purple flower color, but most characteristic are the shape of the inner filaments and the unpleasant odor of the flowers. Pink flowering specimens were found in some populations, and it remains unclear whether *A. nabelekii* differs by more characters. However, the amount of variation is still insufficiently known and needs to be studied from living plants including material of *A. nabelekii*, *A. trilophostemon*, and *A. atriphoenicum* from the type locations in Turkey. Molecular markers (ITS sequences of nuclear rDNA) put *A. cardiostemon* rather separately, with all other groups of the sections *Acanthoprason* and *Melanocrommyum* as sister (Fritsch & al. 2010). A recent analysis (p. 200) shows the expected inclusion in sect. *Melanocrommyum* but with unresolved relations. Sequences of the plastid *trnL-trnF* region (Gurushidze & al. 2010) support the close genetic relation to most species of sect. *Melanocrommyum* but show more distance to sect. *Acanthoprason*.

**Etymology:** The epithet certainly refers to the shape of the inner filaments (from Greek "hearth-like filaments"). The synonymous epitheta honor the Moravian botanist F. Nábělek, an explorer and plant collector in the Near East in 1909 till 1911, or refer to the flower color (*atriphoenicum* from Greek "dark scarlet"), and the shape of filaments, resp., (*trilophostemon* from Greek "three-crested filaments").

**Biological data:** Seeds are only germinating after stratification at 5°C (Nikolaeva & al. 1985). Seedlings belong to the *Allium karataviense* type (Druselmann 1992). The genome size 39 / 41 pg 2C-DNA shows perhaps geographic variation; it is similar to *A. orientale* Boiss. (44 pg) and *A. saralicum* (43 pg) (Gurushidze & al. 2012). The total cysteine sulfoxide contents in the bulbs is 0.08 %, mainly methiin is present (Pekgöz & al. 2005).

**Economic traits:** In East Anatolia the supraterranean plant parts (local names 'sirmo' and 'sirim') are added to the herb-flavored cheese (Özçelik 1994). Ornamental plant listed in the "International Check-

list ..." of the Royal General Bulbgrowers Association (1991).

Living accessions studied: W Azarb.: Pass Ghushchi bei Ghushch, SO-Hänge an der Nordseite (38°01' N, 44°56' E, c. 1800 m, 08.6.1994 Fritsch 1145; GAT).

Herbarium vouchers: W Azarb.: Khoys, Pasak, Hesar (38°34' N, 45°00' E, 2100 m, 27.6.1985 Termeh, Moussavi, Tehrani 318-IRAN). Schapur towards Rezaiyeh, Hanoush (?) (38°08' N, 44°55' E, 27.6.1965 Sharif 7027-E; 319-IRAN). In jugo SE Shahpur, (38°06' N, 44°54' E, 1750 m, 06.7.1968 Petrovitz 71; W). In monte Ghogeh Dagh W Bazorgan ad confines Turciae (39°23' N, 44°23' E, 2100-2250 m, 01.8.1971 Reching W. 43987; W). - E Azarb.: Tabriz 87 km to Mianeh road (37°49' N, 47°08' E, 1780 m, 02.6.1978 Foroughi 1684; TARI). Tabriz 77 km to Mianeh road (37°53' N, 47°00' E, 1800 m, 18.6.1972 Foroughi 3524; TARI). Tabriz to Mianeh (37°43' N, 47°00' E, 1780 m, 02.6.1971 Foroughi 1648; 43094-IRAN).

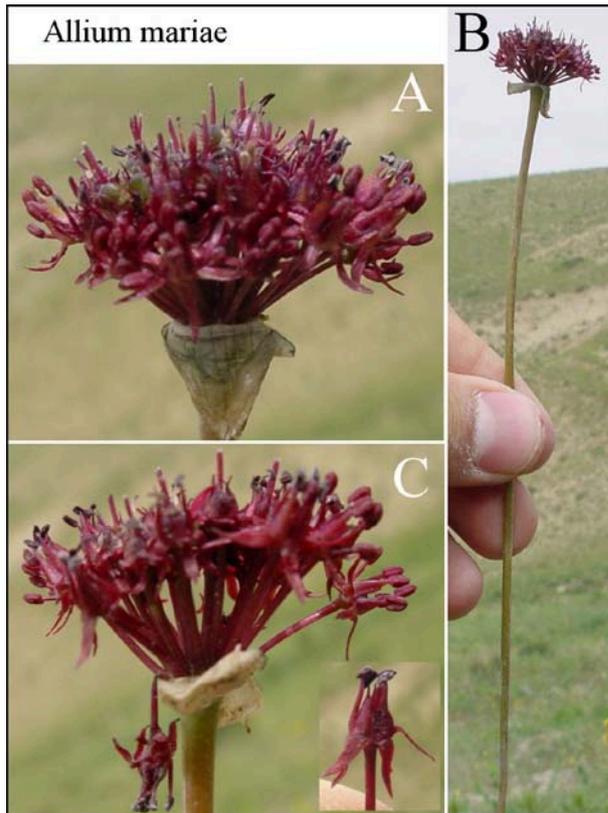
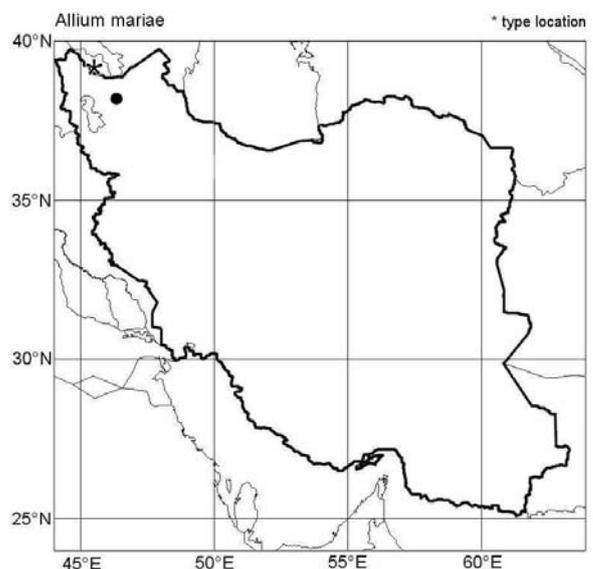


Table T14. A: Inflorescence in anthesis; B: scape and inflorescence; C: inflorescence in anthesis, inset: single flower (photos courtesy of H. Razifard)

star-like; with pleasant odor. Tepals narrowly linear-lanceolate, obliquely reflexed, basally  $\pm$  free; after anthesis completely reflexed and crumpled; 4-5 mm long, 0.7-1 mm broad; purple to deep carmine with narrow, maroon median vein. Filaments  $\pm$  longer than tepals, somewhat fleshy, straight; outer filaments subulate, inner filaments with narrowly triangular to nearly rectangular base and short subulate tip, basally very shortly connate; color like tepals. Anthers ovoid, c. 1.5 mm long; brown to purple. Pollen grayish-yellow. Ovary sessile,  $\pm$  globose, triangular, smooth; deep brown-purple; 2-4 ovules per locule. Style thread-like, 4-5 mm long; color like filaments. Stigma punctiform; whitish. Capsule ovate or subglobose with concave tip; valves ovate

**14. *Allium mariae*** Bordz. in Zap. Kievskago obshch. estestvoizp. 25, 1: 71 (1915). - Vved., Flora URSS 4: 262 (1935). Oganessian & Agababian, Flora Armenii 10: 295, 338, tab. 105 3a-3c (2001). - **Type**: Transcaucasia, distr. Nachiczewan: inter pag. Azy et Dzhulfam, 24.4.1914, leg. Roop (lectotype LE!, isolectotype TBI!, design. Seisums ex Oganessian & Agababian 2001: 338 f.).

Bulbs  $\pm$  ovoid, 1.5-2 cm long; outer tunics undivided, whitish? Scape somewhat flexuous, terete, smooth; 15-35 cm long, 3-5 mm in diam.; green often brown suffused. Leaves 2-3 (5?), laminae narrowly linear-lanceolate, somewhat canaliculate; margins finely toothed; upper side smooth, lower side with shallow toothed ribs; 15-35 cm long, 3-8 mm broad; glaucous green. Spathe membranous, completely split into 2-3 ovate to lanceolate, shortly acuminate, finally reflexed valves; pale brown with darker veins. Inflorescence fastigiate to semi-globose,  $\pm$  dense, with 17-60 flowers. Pedicels thick, straight, smooth, equally long; 8-15 mm long; purple, semi-glossy. Anthesis in May. Flowers reflexed



with smooth margin. The seed testa showed verrucose periclinal walls and transitions from U-like to shortly Omega-like undulation of the anticlinal walls (Fritsch & al. 2006).

**Distribution:** S Transcaucasus, Nakhichevan, N Iran: prov. E Azarb., dry submontane and montane steppe and stony slopes (Oganesian & Agababian 2001).

**Remarks:** This rarely collected species is characterized by the general habit like a meager variant of *A. cardiostemon* having triangular and not heart-like inner filaments and a pleasant flower odor. Unfortunately, samples for molecular study were not available hitherto to test this hypothesis.

**Etymology:** The epithet refers to the forename of the mother of this species' author, the Ukrainian botanist E. I. Bordzilowski. He was acting in Kiev in the first decades of 20th century.

Only photos seen sent by H. Razifard: E Azarb.: c. 20 km N Tabriz near vill. Golzar (38°22' N, 46°23' E, c. 1900 m).

### *Allium colchicifolium* alliance

**15. *Allium colchicifolium*** Boiss., Diagn. pl. orient. sér. II, 4: 112 (1859), Boiss., Fl. orient. 5, 1: 277 (1882). Regel in Trudy Imp. S.-Peterb. Bot. Sada 3: 247 (1875). Wendelbo, Flora Iranica No. 76: 81, tab. 8/113 (1971). Kollmann, Fl. Turkey 8: 202, map 32 (1984). Wendelbo, Flora Iraq 8: 175 (1985). Fritsch & Abbasi in Rostaniha 10 Suppl. 2: 42 ff. (2009). - *Allium bischoffii* Hausskn. in schedis, nom. nud., ex Dinsm. in G.E. Post, Fl. Syria, ed. 2, 2: 645 (1933). Type: In agris argillosis pr. Saback inter Aleppo et Aintab, 21.4.1865 leg. Hausskn. No. 880 (JE!). - Type: Turkey: in subalpinis prope Bakker Madem [Maden], V. 1851, leg. Noë No. 706 (holotype G!, isotype W!).

Bulbs ovoid to globose, 2-3 cm in diam.; outer tunics papery, brownish black; inner tunics parchment-like, whitish. Scape straight, terete, smooth; 6-18 (25) cm long, 3-15 mm in diam.; green. Leaves 2, laminae oblong to elliptical or nearly orbicular, narrowing towards tip and base, glabrous; margins smooth or white and cartilaginous; 10-18 cm long, (2.5) 4-12 cm broad; green with glaucous bloom, apparently purplish flushed. Spathe membranous, split into 2-3 patent to reflexed, broadly ovate valves 1/3 as long as pedicels; pale brown, glossy? Inflorescence broadly fastigiate to semiglobose, dense, many-flowered; 6-7 cm in diam. Pedicels thin, subequal, straight or later ascending; apparently green with purplish flush. Anthesis in May. Flowers bowl-shaped? Tepals oblong, patent and ascending, naviculate, obtuse or subacute with cucullate apex, upper margins denticulate-serrate; after anthesis reflexed and somewhat crumpled; 5-8 (10) mm long, 2-3 mm broad; white or greenish with green or brownish median vein. Filaments 3/4-5/6 as long as the tepals, near base broadly triangular (inner filaments more) widened and for 1-1.5 mm connate; purplish; upper part narrowly triangular, fleshy?, fading to white. Anthers 1.2-2.5 mm long; yellow. Pollen yellow? Ovary sessile, depressed globose triangular with three furrows, surface ± smooth, glossy? Style thread-like, 2-4 mm long. Stigma undivided. Capsule globose to rounded tripartite, surface with coarsely reticulate ledges; 5-7 mm in diam. Seeds not seen.

**Chromosomes:** 2n = 16+1B Genç & al. 2013 Table 3, Fig. 1 (h), Fig. 2 (h) (Turkey: prov. Elazig)

**Distribution:** E Anatolia, N Iraq, Syria; alpine and subalpine steppe slopes (Wendelbo 1985). Occurrence in NW Iran referred to the former synonyms *A. haussknechtii* and *A. straussii*.

**Remarks:** *Allium* plants showing a stocky stature similar to most species of sect. *Acanthoprason* but with relative broad tepals never becoming either convolute or prickly-like after anthesis are generally affiliated to sect. *Melanocrommyum*. Here *A. colchicifolium* is the classical species meeting all these characters. However, this name was connected with rather diffuse flower characters, 6-18 cm long scapes, and elliptic to sub-orbicular leaves by Wendelbo (1971) and Kollmann (1984), although the original description mentioned oblong and acute tepals with irregularly toothed or gnawed margins and oblong leaf laminae tapering toward base and apex. The type specimens are very stocky plants laid into the press in late anthesis having 5-6 cm long scapes, rather reflexed tepals, and apparently basally purplish filaments not mentioned by Boissier. Analysis of living plants from the type location in Turkey

is essential to formulate a reliable description of this species and for the analysis of molecular markers.

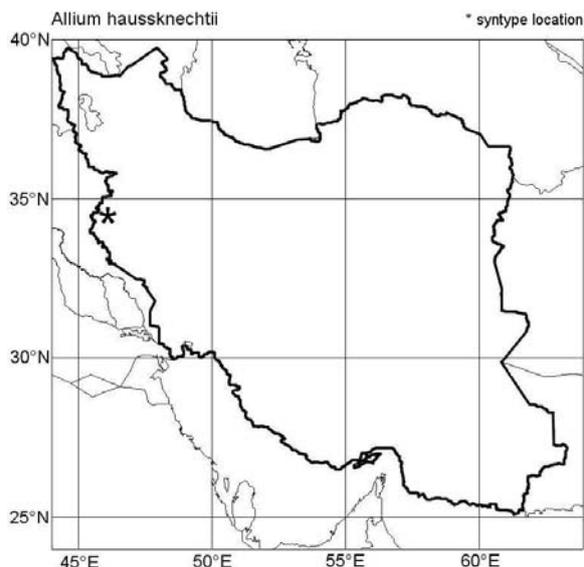
**Etymology:** The epithet apparently refers to the leaf shape (from Latin "leaf like *Colchicum*") but such oblong leaves gradually tapering toward apex and base are often found in many species of *Colchicum* as well as of the *Allium* sections *Acanthoprason*, *Asteroprason*, and *Melanocrommyum*.

**Biological data:** Seedlings belong to the *Allium karataviense* type (Druselmann 1992).

**Economic traits:** Use as food or medicine in Iran mentioned in the literature (Abbasi & al. 2008) refers very probably to *A. straussii*.

**16. *Allium haussknechtii*** Nábělek in Publ. Fac. Sci. Univ. Masaryk, Brno 105: 37, 35 f. 7., tab. 2 f. 1 (1929). - Wendelbo, Flora Iranica No. 76: 81 (1971). Wendelbo, Fl. Iraq 8: 175 (1985). Kollmann, Fl. Turkey 8: 202 (1984), omnia sub *A. colchicifolium*. Fritsch & Abbasi in Rostaniha 10 Suppl. 2: 49 ff. (2009). - **Type:** Syria, inter segetes c. Aleppo prope pagum Moselmia, alt. 1200' ubi id legit 14.4. 1865, C. Hausskn. 444 (lectotype JE!, design. Fritsch & Abbasi 2009: 49). Syntype: Iran, in Kurdistania Persica: supra pagum Rezhab dit. Kasr-i-Shirin, in humosis alt. ca. 1800 m, 5.5.1910, leg. Nábělek no. 2339 (BRA, not seen).

Bulbs large, ovoid-globose; outer tunics brown; inner tunics white. Scape  $\pm$  straight, terete, in anthesis shorter than the leaves; c. 18 cm long and 8 mm thick. Leaves two, laminae broadly oblong, acute; up to 12 cm wide, with sheath 23 cm long; margin very narrow, glabrous, white cartilaginous; glossy green. Spathe membranous, glossy, split into two rounded, shortly caudate valves, in early anthesis longer than pedicels and enclosing the inflorescence, later freeing the enlarging pedicels and inflorescence; pale green. Inflorescence semi-globose, many-flowered. Pedicels subequally long, 2-4 cm long. Anthesis in April to May. Flowers apparently funnel-shaped star-like. Tepals oblong-lanceolate, acute, basally connate and adnate to the filaments; 8-10 mm long and scarcely 3 mm wide; after anthesis flaccid; whitish-green. Filaments alternating either subulate above the basal connate part or abruptly widened and above subulate; c. 6 mm long; those with anthers incurved. Anthers yellow. Ovary depressed globose, deeply trisulcate, verruculose. Style c. 3 mm long. Capsule and seeds not seen.



**Distribution:** Syria, Iran, prov. Kermanshah: known only from the syntype location.

**Remarks:** Unfortunately, living plants of *A. haussknechtii* could not be studied yet, and also a sample for molecular investigations was not available. The species was lecto-typified to the Syrian syntype, but the collection of Nabelek from Iran could not be studied. It remains doubtful whether the Syrian and Iranian plants collected about 750 km apart really belong to one taxon. Therefore the original description is here adopted again supplemented by own observation of the lectotype. Key characters of *A. haussknechtii* are 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.

**Etymology:** The epithet honors the outstanding German explorer and botanist of merit C. Haussknecht who travelled in Near East and Iran in the second half of 19th century.

17. *Allium moderense* R.M. Fritsch in Rostaniha 9 Suppl. 2: 50, fig. 11 (2008 publ. 17 Jul 2009). -  
Type: Cultivated in the Gatersleben taxonomic reference collection no. TAX 6616 leg. 06.6.2008  
(holotype GAT); plants from Iran, prov. Markazi, Modere valley W Arak, 1930 m, 34° 06.221' N; 49°  
38.561' E, 09.5.2007, leg. Abbasi, Fritsch, Keusgen no. 1148.

Bulbs ovoid to depressed-globose, 2-4 cm in diameter and long; outer tunics thick, more longitudinally fibrous than in pieces disintegrating; inner tunics stronger, whitish. Scape subconical, mostly slightly flexuous, smooth; above ground 5-10 cm long, 4-7 mm in diameter; green,  $\pm$  violet suffused. Leaves 1-2, laminae linear-lanceolate tapering into a long, probably not hooded apex,  $\pm$  thick, even, flat ascending later laying on the ground; margin finely coarse, red; upper and lower sides strongly grooved; 1.5-5 cm wide, 15-30 cm long; bluish-green with strong glaucous bloom, reddish near base, becoming red when withering. Sheath leaf short, membranous, brownish, soon decaying. Spathe membranous, split in several ovate, acute, finally patent valves; whitish with dark greenish-brown veins. Inflorescence semi-globose, moderately dense, moderately many-flowered; 4-7 cm in diameter; rather loose in the fruiting stage. Pedicels thick, stiff, ribbed, straight, unequally long; dull green. Anthesis in May. Flowers flat bowl-shaped star-like. Tepals ovate-oblong, obtuse, patent, spoon-shaped concave; after anthesis crumpled and brownish; (flattened) 6-8 mm long and c. 3 mm wide, broadest near 3/4 of its length; white, with broad, dark-green median vein. Filaments nearly as long as the tepals,  $\pm$  subulate, basally shortly

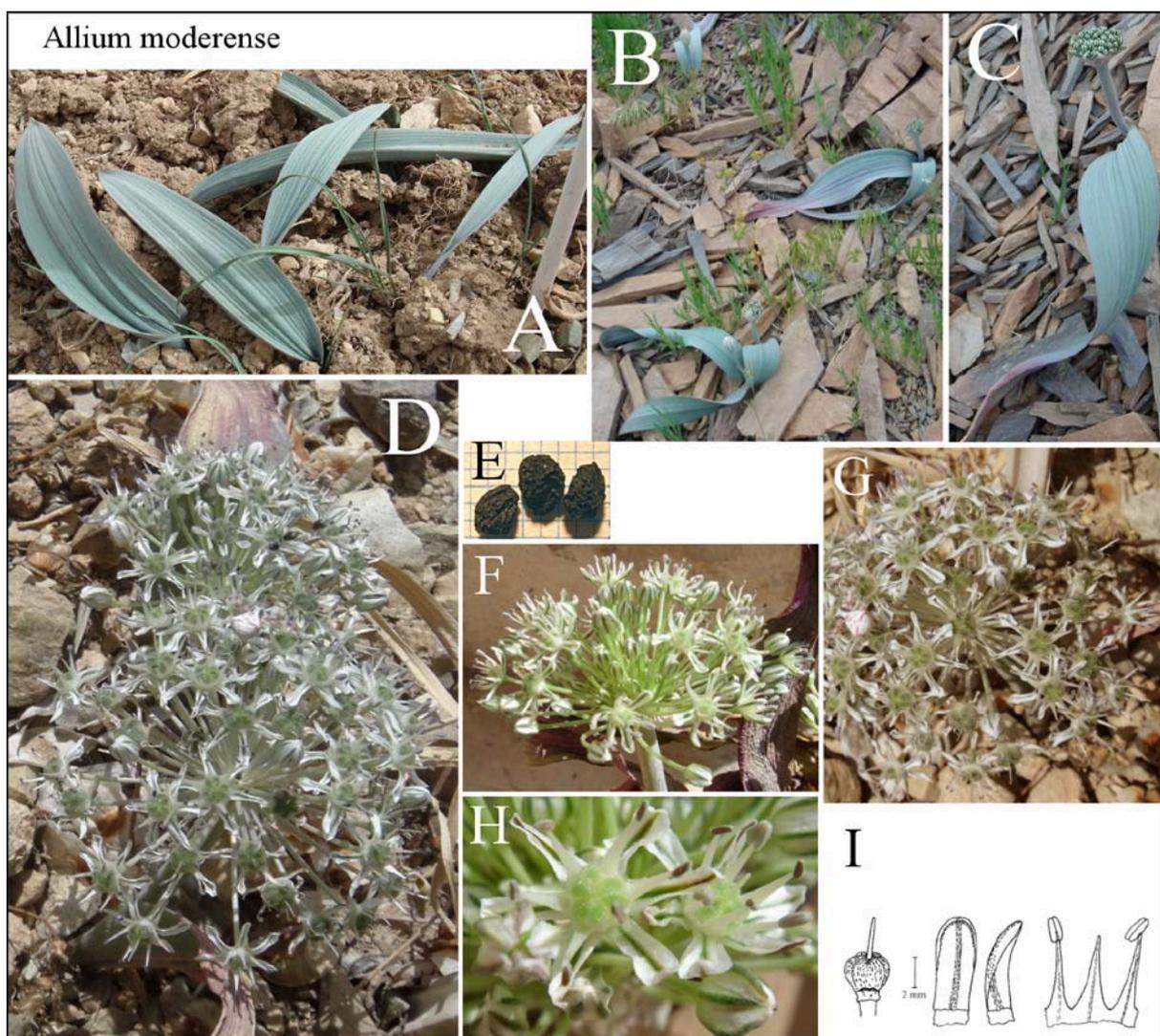
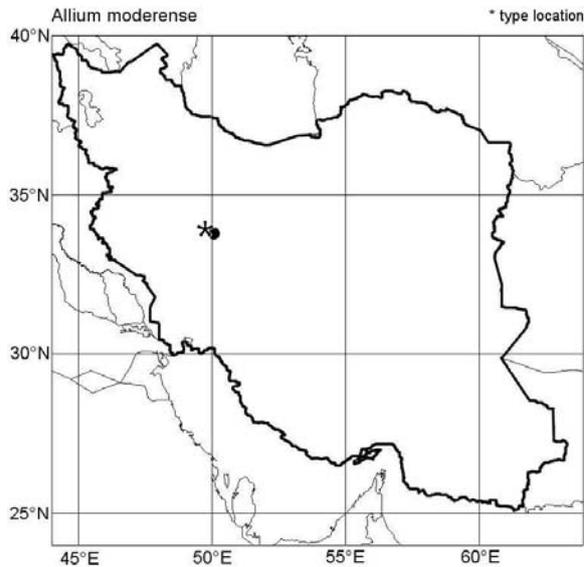


Plate T17. A: Leaves of cultivated plants after sprouting; B & C: Plants in buds at the type location; D: flowering cultivated plants; E: seeds (background raster 1 mm); F & G: inflorescences in early and late anthesis; H: close-up of flowers; I: shape of ovary, tepals and filaments of a flower prepared from herbarium (from Fritsch & Abbasi 2009: Fig. 11C)

united and short-triangular (inner ones wider and higher) broadened; white. Anthers long-ovoid, c. 1.5 mm long and 0.8 mm wide; reddish-gray. Pollen faintly grey. Ovary sessile, depressed globose hexalunate with 3 wide and 3 narrower furrows, surface coarse, in the upper part covered by long papillate cells, apex concave; c. 2 mm long and 3 mm in diameter; pale green; nectary ducts lead in rather wide, curved pockets. Style conically thread-shaped, 2-4 mm long; white. Stigma dot-like; white. Capsule flat depressed-globose triangular with 6 radial furrows at the tip, surface coarsely tuberculate; 4-5 mm long and 5-6 mm in diam., widely opening. Seeds 1-2 per locule, flat ovate to drop-shaped, densely and coarsely reticulate-lacunose; 3-4 mm long, 2.3-3 mm broad and thick; dull black.



**Distribution:** Iran, prov. Markazi: only known from the mountain massifs W and E Arak.

**Remarks:** *Allium moderense* displays a rare character combination: long lanceolate, strongly furrowed, bluish-green leaves, small scapes, obovate spoon-shaped, white tepals with a thick green median vein, and very coarse, pale-green ovaries. The plants show a certain similarity to members of subsect. *Humilicognata*, but the filaments are uncolored and the tepals are not reflexed after anthesis and crumple only. Therefore the species was affiliated to the *A. colchicifolium* alliance of sect. *Melanocrommyum* (Fritsch & al. 2010). Molecular markers of two samples (ITS sequences of nuclear rDNA, see p. 200) put them at two distant positions inside of sect. *Acanthoprason*. Sequences of the plastid *trnL-trnF* region (Gurushidze & al. 2010) positioned *A. moderense* also among many other members of sect. *Acanthoprason*. Thus the natural relationship of *A. moderense* remained unclear yet.

**Etymology:** The epithet was deduced from the name of the type location.

Living accessions studied: **Markazi:** Mountain range ESE Arak, eastern slope, limestone rubble on the top of Mt. Barfshah (33°58' N, 50°07' E, 2880 m, 11.5.2007 Abbasi, Fritsch, Keusgen 1163; GAT IRAN). Type accession from Modere valley W Arak (34°06' N, 49°39' E, 1930 m, 06.6.2008 Abbasi, Fritsch, Keusgen 1148; IRAN GAT)

### *Allium noëanum* alliance

**18. *Allium noëanum*** Reut. ex Regel in Trudy Imp. S.-Peterb. Bot. Sada 3, 2: 235 (1875) ("*noëoanum*"). Wendelbo, Flora Iranica No. 76: 78, tab. 8/106 (1971). Wendelbo, Fl. Iraq 8: 168 (1985). Kollmann, Fl. Turkey 8: 205, Fig. 9/12, map 35 (1984). - *Allium jenischianum* Regel in Trudy Imp. S.-Peterb. Bot. Sada 3, 2: 237 (1875). Type: Persia, Jenisch (lectotype LE!; design. Fritsch & al. 2010: 206). *Allium dilutum* Stapf in Denkschr. math.-nat. Cl. kais. Acad. Wien 50: 13 (1885). Type: Iter persicum Dr. J. E. Polak 1882. *Allium dilutum* Stapf. Persia borealis. Inter Kaswin et Zerschk, 5.5. leg. Th. Pichler (lectotype WU!; design. Fritsch & al. 2010: 204, isotypes JE!, K). - **Type:** N Syria: In agris pr. Hkeilan (?) c. Aleppo, 4.4.1865, leg. Hausskn. no. 398 (lectotype JE! hic designated, isotypes G! JE! W!).

Bulbs broadly ovoid, (1) 1.5-2.5 cm in diam.; outer tunics ± strong, dissolving in fibers, dark brown. Scape straight, terete, conical (narrower near base), smooth; 12-20 (30) cm long, 3-6 mm in diam.; green with glaucous bloom, often purplish in the lower part. Leaves (2) 4-7, laminae linear-lanceolate, thickish, flat arcuately ascending, often somewhat falcate, canaliculate, narrowly tapering into the ± hooded apex; upper side smooth, lower side with dense narrow ribs; margin finely toothed or ciliate; 15-25 (30) cm long, (5) 8-15 (20) mm broad, the innermost leaves are the narrowest; fresh green with glaucous bloom. Spathe membranous, split into ± 3 ovate to orbicular, acute valves, upright later patent, 1.5-3 cm long; pale brownish with darker veins. Inflorescence initially narrowly fasciculate and very dense, later broadly fasciculate and semi-loose, in the fruiting stage subglobose and very loose; (2) 5-15 cm in

diam. Pedicels thin, straight, wire-like stiff, smooth, unequally long; 3-7 cm long; green to brown, semi-glossy. Anthesis in April to May. Flowers narrowly funnel-shaped star-like; with sweet odor. Tepals lanceolate to long-ovate with subacute to obtuse, plicate apex, nearly straight and moderately recurved, only near base connate; after anthesis convolute and distorted; 9-12 (14) mm long, outer tepals 2.5, inner ones 2 mm broad; rose to pink with a grooved, narrow, darker but inconspicuous median vein. Filaments 1/3-1/2 as long as the tepals, straight, fleshy, inner filaments ovate-triangular and outer filaments triangular with short narrow tip, basally for 1-2 mm connate; red-brown to blackish-purple with narrow white base. Anthers ovoid, 1-1.5 mm long; deep pink to violet. Pollen yellow. Ovary sessile, depressed-globose with 6 furrows and convex apex, surface very finely tuberculate; c. 2 mm long, 3 mm in diam.; blackish purple later green; the nectary ducts lead in small slits near the ovary base. Style conical, 1-2.5 mm long; purplish. Stigma slightly tripartite to dot-like; white. Capsule depressed-globose triangular with 6 narrow furrows, initially smooth, later with irregularly reticulate ledges; 6-8 mm long and in diameter. Seeds 1-2 (3) per locule, flat ovate, surface tuberculate; 3.5-4 mm long, 2.5-3 mm broad, 1.5-2.5 mm thick; dull black.

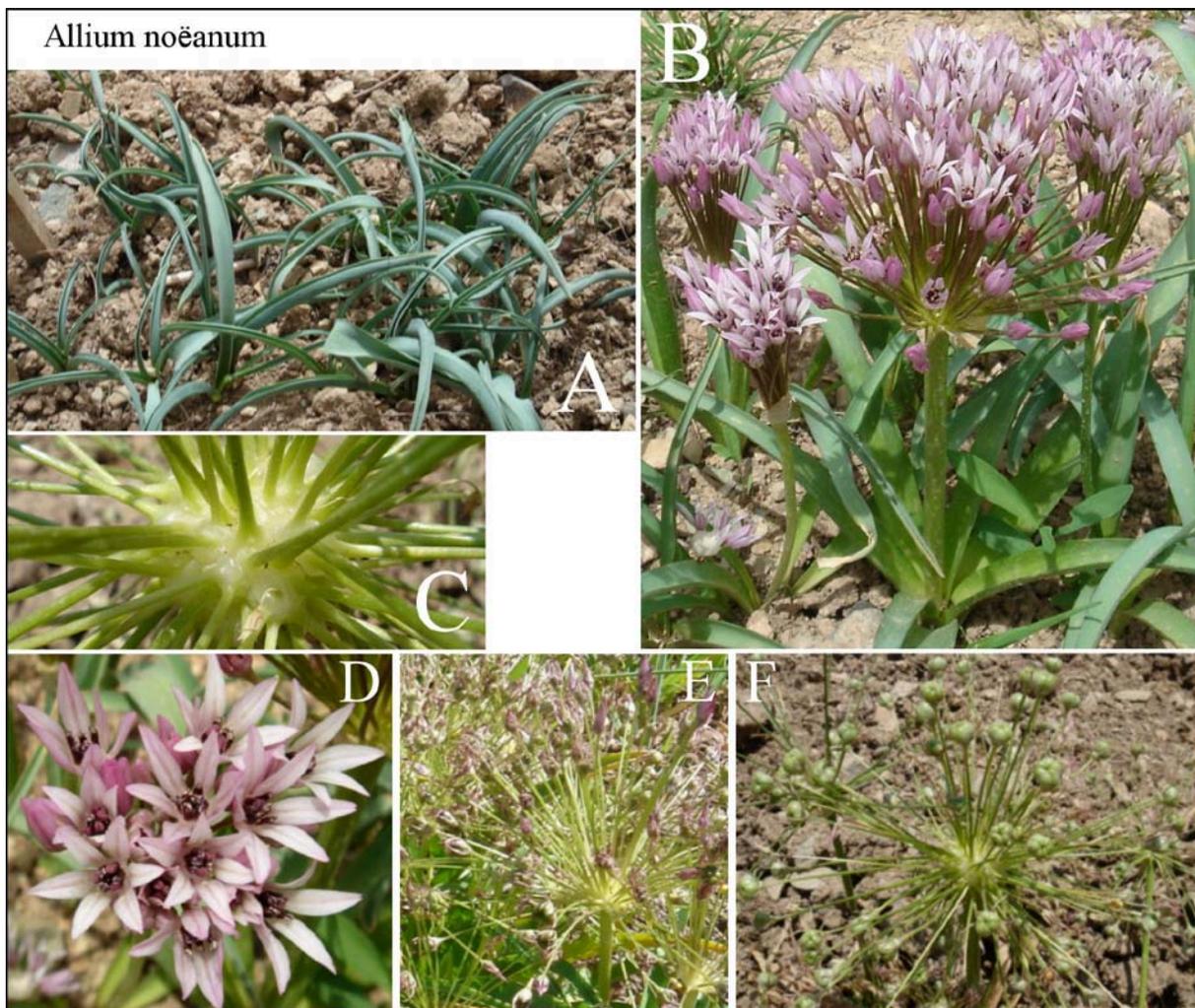


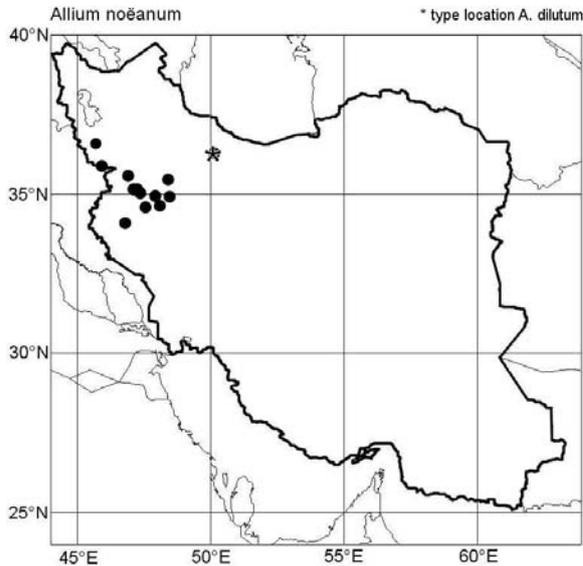
Plate T18. A: Sprouted leaves of cultivated plants; B: flowering cultivated plants; C: inflated pedicel bases; D & E: inflorescences at begin and end of anthesis; F: inflorescence with developing capsules

Chromosomes:  $2n=16$  Genç & al. 2013 Table 3, Fig. 1 (s), Fig. 2 (s) (Turkey: prov. Sanliurfa).

Distribution: N Syria, SE Anatolia, N Iraq, N Iran; colline to submontane rock slopes, arable land, steppes (Wendelbo 1985).

Remarks: This moderately small species can easily be recognized by 4-7 narrow canaliculate leaves much longer than the scape, combined with an initially dense and fasciculate and in the fruiting stage very loose and subglobose umbel bearing funnel-shaped  $\pm$  rose flowers with brown to purple filaments white at base, and blackish-purple ovaries. Unfortunately, living plants could not be collected at the type

location of *A. dilutum*, but the herbarium vouchers seen may represent small specimens of *A. noëanum*. However, the true identity of *A. jenischianum* could not be enlightened hitherto. The syntypes (Wendelbo, 1966, reported a detailed analysis) could not be re-studied, but some flowers present in G-BOIS (but without any notice from which syntype they stem) are most similar to *A. noëanum*. Therefore Wendelbo's position is adopted here putting *A. jenischianum* as synonym to *A. noëanum*.



There are several vouchers currently housed in G, W and JE fitting Regel's (1875) general formulation "Habitat in Syria boreali (Hausknecht) *A. noëanum* Reut. pl. exs. Hauskn.". Because the information on the label of the voucher in G is incomplete, one of the well conserved specimens with complete label in JE was selected as lectotype.

Molecular markers (ITS sequences of nuclear rDNA as well as sequences of the plastid *trnL-trnF* region) support a close relationship to *A. saralicum* and somewhat more genetic distance to the other Iranian species of sect. *Melanocrommyum* (Fritsch & al. 2010; Gurushidze & al. 2010; see p. 200).

**Etymology:** The epithet honors the renowned German explorer F. W. Noë travelling through the Balkan Peninsula and Near East in the 1830ies to

1850ies. The epithet "*dilutum*" most probably refers to the often weak rose color of the tepals (from Latin "faded"). *Allium jenischianum* was named after the collector of the lectotype specimen who visited North Iran in the middle of 19th century and collected many specimens but without precise locations. This person was perhaps a descendant of B. von Jenisch, curator of the Imperial Austrian Library in Vienna, co-author of a Latin book on the Persian history published in 1782.

**Biological data:** Bulb extract showed a very high radical scavenger activity (Jedelská & Keusgen 2008).

**Economic traits:** Wendelbo (1985) cited the local name 'shanak kalba' in Chaldea, perhaps a misunderstanding. Mentioned in the literature to be used as food or medicine in Iran (Abbasi & al. 2008).

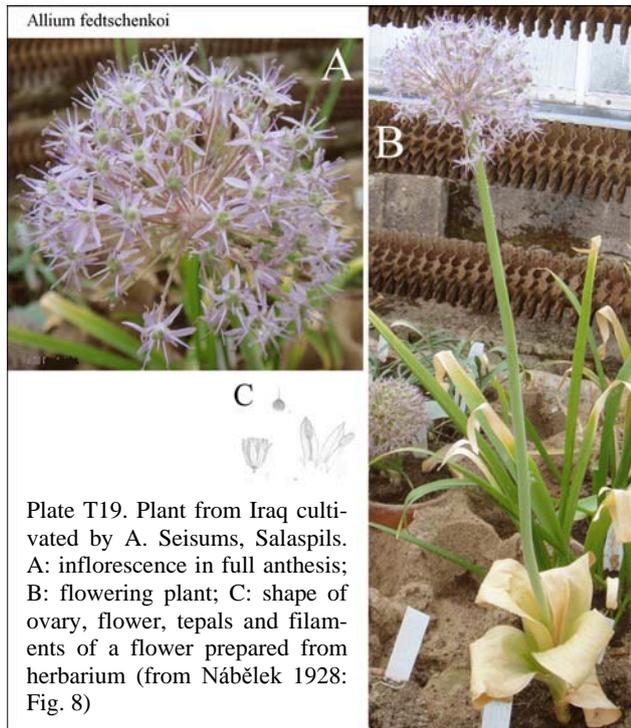
Living accessions studied: **Kermanshah:** Agricultural Education Center of Kermanshah c. 1 km E Mahi Dasht (34°17' N, 46°50' E, 1370 m, 13.5.2006 Abbasi, Fritsch, Keusgen 1094; IRAN)

Herbarium vouchers: **Hamadan:** Aq Bolagh-e Aqdaq, c. 100 km N Hamadan (35°37' N, 48°26' E, ???.1960 Rioux, Golvan 38; W). c. 41 km from Kangavar to Hamadan (34°46' N, 48°07' E, 2200 m, 09.5.1987 Maassoumi, Mirhosseini 59324-TARI). 30 km W Hamadan (34°51' N, 48°10' E, 2040 m, 23.6.1965 Danin, Baum, Plitman; HUI). 33 km N Hamadan (Cajiabad) (35°06' N, 48°30' E, 2070 m, 9.6.1959 Pabot 1485; G). - **Kermanshah:** Mahidasht, Chalabeh (34°16' N, 46°48' E, 13.5.1973 Sateii 43987-IRAN; 1450 m, 07.5.1995 Rezaei 481; CAK NRK). Felder bei Sungur (34°46' N, 47°35' E, 07.5.1905 Strauss; B; 17.5.1905 Strauss; JE). - **Kurdistan:** Dasht-e Zahge c. 40 km E Sanandaj (35°20' N, 47°13' E, 2000 m, 11.5.1975 Wendelbo, Assadi 16902-TARI W). Saral area N Sanandaj, Doozakh-Darreh village (35°46' N, 46°56' E, 15.5.2005 Hosseini; HCAT). Salwat abad Gardana SE Sanandaj (35°20' N, 47°08' E, 1480-1950 m, 07.5.1986 Fattahi, Khaledian 1059-TARI). Inter Deh Gulan et Tschachmachder (35°13' N, 47°24' E, 6200', 26.5.1906 Strauss; JE B). in jugo Khan inter Baneh et Saqqez (36°04' N, 45°58' E, 02.5.1974 Siami 2162; TARI). Hamadan to Sanandaj, 40 miles W Hamadan (35°07' N, 47°58' E, 6000 ft., 14.5.1962 Furse 2000 447-IRAN W). Salwatabad - Gardana 12 km E Sanandaj (35°20' N, 47°08' E, 2180 m, 23.5.1986 Fattahi, Khaledian 1319-HKS; TARI). Faghieh soleyman 40 km SE Sanandaj to Kamyaran (34°58' N, 47°00' E, 1300 m, 05.5.1986 Fattahi 751-HKS TARI). - **Qazvin:** Inter Kazwin et Zerschk (36°27' N, 50°10' E, Pichler; WU JE). Halbe Paßhöhe Caswin - Zerschk (36°25' N, 50°07' E, 05.5.1882 Polak; WU). - **W Azarab:** Mahabad (36°45' N, 45°44' E, 07.5.1971 Djafanmoghadam 446-IRAN, 09.5.1971 Javan Moghadamm 17; W).

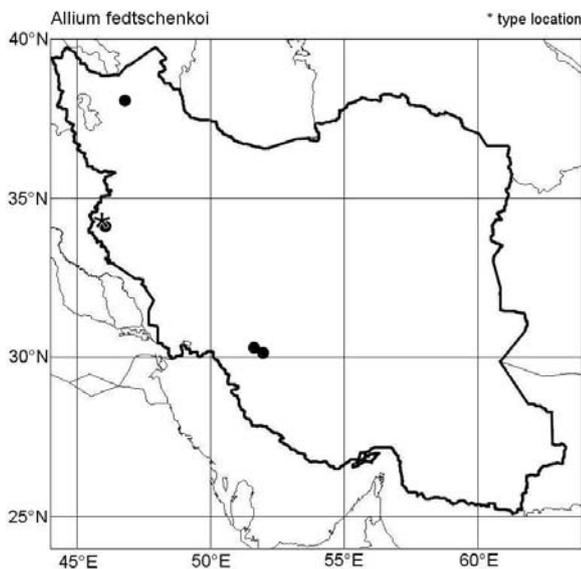
**19. *Allium fedtschenkoi*** Nábělek in Publ. Fac. Sc. Univ. Masaryk, Brno 105: 36, Fig. 8/1, 2, tab. 2/1 (1929). - Wendelbo, Flora Iranica No. 76: 79, tab. 8/109 (1971); Wendelbo, Fl. Iraq 8: 176 (1985). - **Type:** Iran: Kurdistan, Supra pagum Rezab dit. Kasr-i-Shirin ubi in herbis humosis, ca. 1800 m, 5.5.1910, leg. Nábělek No. 2313. (holotype BRA, not seen).

Bulbs ovoid to globose, 3-5 cm in diam.; outer tunics blackish, disintegrating; inner tunics white. Scape straight, terete, smooth; 35-70 (100?) cm long, 8-12 (15) mm in diameter; green. Leaves up to 6, lami-

nae elliptical to ovate, shortly arcuately tapering into the short cucullate apex, smooth; 15-20 cm long, 4-7 cm broad; sheath leaf short, quickly decaying. Spathe membranous, split into 2 ovate, shortly acute valves,  $\pm$  as long as the pedicels; pale brownish. Inflorescence semi- to subglobose, dense, many-flowered; 5-8 cm in diameter. Pedicels thin, stiff,  $\pm$  straight, subequally long; 2-3 cm long. Anthesis in May to June. Flowers flat star-like. Tepals linear-oblong with short acute tip, patent, basally for c. 1 mm connate; after anthesis reflexed and spirally incurved; c. 7-8 mm long, 2 mm wide; whitish or pale purple with inconspicuous, only dorsally better visible median vein. Filaments somewhat shorter than the tepals, subulate, rather straight; basally shortly triangular (inner tepals broader) widened; pale purple fading towards base. Anthers oblong, c. 2 mm long; pale purplish. Pollen pale yellow. Ovary apparently stipitate, depressed-globose triangular with 3 broad and 3 narrow longitudinal furrows, surface very coarse by transversal rows of acute warts; c. 3 mm long and in diameter; grayish green. Style narrowly conical, 3-7 mm long; whitish with purplish apex. Stigma punctiform; whitish. Capsule subglobose; c. 6 mm in diameter. Seeds not seen.



**Distribution:** W Iran, Iraq; humid places in the montane belt (Wendelbo 1985).



**Remarks:** It is a rarely collected species. Wendelbo (1985) presented arguments to conclude that the type specimen was an incompletely developed plant, and some characters of the original description must be corrected. A cultivated plant from Iraq (see plate above) showed shape and dimensions of the opening buds to be very similar to the flower characters as described by Nábělek, flat star-like lilac flowers, and grooved, very coarse ovaries. Thus the description by Wendelbo (1985) can widely be accepted. Molecular markers (ITS sequences of nuclear rDNA, see p. 199) positioned this sample beside *A. hooshidarye* and hitherto unnamed samples from the province Kermanshah differing remarkably in flower characters.

A few specimens from other parts of Iran fit also better to *A. fedtschenkoi* than to any other species. Re-collection and a detailed comparison of all known populations seems essential to clear if all vouchers really belong to one taxon.

**Etymology:** Most probably named after the eminent Russian botanist of merit B. A. Fedtschenko, a contemporary of F. Nábělek, who also contributed to the botanical exploration of North Iranian territories close to Turkmenistan.

Herbarium vouchers: **Kermanshah:** Kerend, Noah Kuh (34°18' N, 46°06' E, ??, 6.1910 Strauss; JE).

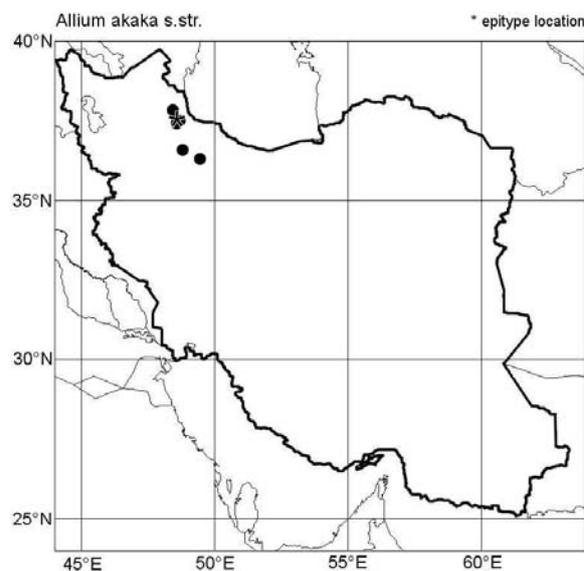
Determination unsure: - **Fars:** Sapidan (30°20' N, 52°00' E, 26; HSU). - **Kohgil. Buyerahmad:** Tange Surkh (30°26' N, 51°41' E, 2500 m, 03.7.1995 Mortazavi 3195; ANY). Mahparviz pass (30°31' N, 51°40' E, 2150 m, 10.6.1995 Mortazavi 3186; ANY). - **W Azarb.:** Tabriz 50 km to Ahar (38°14' N, 46°50' E, 1509 m, 13.7.2003 Rahininejad, Dehghan 14649; HIU).

*Allium* sect. *Acanthoprason* Wendelbo in Bot. Notiser 122: 27 (1969). - *Allium* sect. *Melanocromyrum* subsect. *Acanthoprason* (Wendelbo) Kamelin, Florog. analiz Srednej Azii: 240 (1973). - Type: *A. akaka* S.G. Gmel.

*Allium akaka* alliance - *Allium* subsect. *Acanthaceae* Tscholok. in Not. Syst. Geogr. Inst. bot. Tbiliss. 31: 52 (1975). Type: *A. akaka* S.G. Gmel.

**20. *Allium akaka*** S.G. Gmel. ex Schult. & Schult. f. in Roemer & Schult., Syst. veget. 7, 2: 1132 (1830). - Regel in Trudy Imp. S.-Peterb. Bot. Sada 3, 2: 242 (1875). Vved., Flora URSS 4: 260 (1935). Wendelbo, Flora Iranica No. 76: 74, tab. 7/98, tab. 25/3 (1971). Kollmann, Fl. Turkey 8: 196, fig. 9/18, map 31 (1984). Wendelbo, Fl. Iraq 8: 166 (1985). Agababian & Oganessian in Willdenowia 30: 95 fig. 1, 3 (2000); Oganessian & Agababian, Flora Armenii 10: 297, 345, tabl. 108 (2001), p. p.? Fritsch in Proceedings, First Kazbegi Workshop: 58, fig. 2 (2008); Fritsch & Abbasi in Rostaniha 10 Suppl. 2: 9 ff., figs. 1A, 1B (2009). - Type: Iran: Ghilan-Provinz, leg. Pallas, Herb. Willdenow No. 6511 (B). Epitype: Cultivated in the national living *Allium* collection of PPDR I Tehran no. 1054 leg. 21.4.2007 (IRAN), plants from Iran, prov. Ardabil, spring Aznav near Khalkhal, c. 1850 m, 37° 34' 22" N, 48° 34' 40" E. - **subsp. *akaka***

Bulbs depressed-globose, c. 2 cm long and in diameter, outer tunics grayish-brown, disintegrating. Scape obliquely flexuous, terete to conical (thickest below inflorescence); aerial part 4-6 cm long, 5-6 (7) mm in diameter; dull green with glaucous bloom. Leaves 2-3, laminae lanceolate to broadly ovate, short-arcuately tapering into the cucullate apex, flat arcuately ascending and recurved to soil, thickish, broadly canaliculate; margin smooth, purplish to white; upper and lower side smooth; 10-16 (20) cm long, 1.2-4 (6) cm broad; dull green with glaucous bloom. Sheath leaf  $\pm$  short, finely membranous, quickly decaying. Spathe membranous, partly divided into 3-4 subreflexed valves; pale brown with darker veins. Inflorescence  $\pm$  semi-globose, dense, later moderately loose; 3-4 cm long, 5-6 cm in diameter. Pedicels thick, strong, straight, subequally long; base green upper part red to brown flushed. Anthesis in late April to May. Flowers widely funnel-shaped star-like. Tepals narrowly ovate-elliptic, obtuse but apex somewhat plicate, obliquely patent, slightly recurved; after anthesis  $\pm$  convolute and straight; 7-8 mm long, basally 2 mm wide; whitish or pale carmine-pinkish, with moderately broad, green or brown median vein. Filaments 1/3 as long as the tepals, fleshy, inner filaments ovate-triangular, outer ones triangular, margins slightly touching the next filaments, basally shortly united; whitish throughout or pinkish near the very base. Anthers broadly ovoid, c. 0.8-1.2 mm long, 0.7 mm broad; yellow. Pollen



yellow. Ovary sessile, depressed-globose triangular with sharp but shallow longitudinal furrows; surface very finely coarse; 2 mm long and 2.5-3 mm in diameter; green; nectary ducts lead in rounded pockets at 1/3 of ovary length. Style  $\pm$  narrowly conical, c. 2 mm long; white. Stigma undivided; white. Capsule triangularly obovoid with flattened sides and concave apex, surface slightly glossy; 4-6 mm long and 5-7 mm in diameter; widely opening; valves broadly elliptic with a shallow notch near the apex, surface reticulate-lacunose; yellowish brown. Seeds 1-2 (3) per locule, flat ovoid, surface rugose with irregular ledges, 2-2.5 mm long, 1.5-2 mm broad and thick; dull black. The testa showed moderately Omega-like undulated anticlinal walls and coarsely verrucate periclinal walls (Fritsch & al. 2006).

Chromosomes:  $2n=16$  Gurushidze et al. 2012 (Iran: Khalkhal, Aznav, epitype location).

**Distribution:** NW Iran: W of the Caspian Sea outside the Hyrcanian area; montane to subalpine, sunny and dry stony slopes; occurrence outside of the Kuha-ye Talesh mountain range needs confirmation.

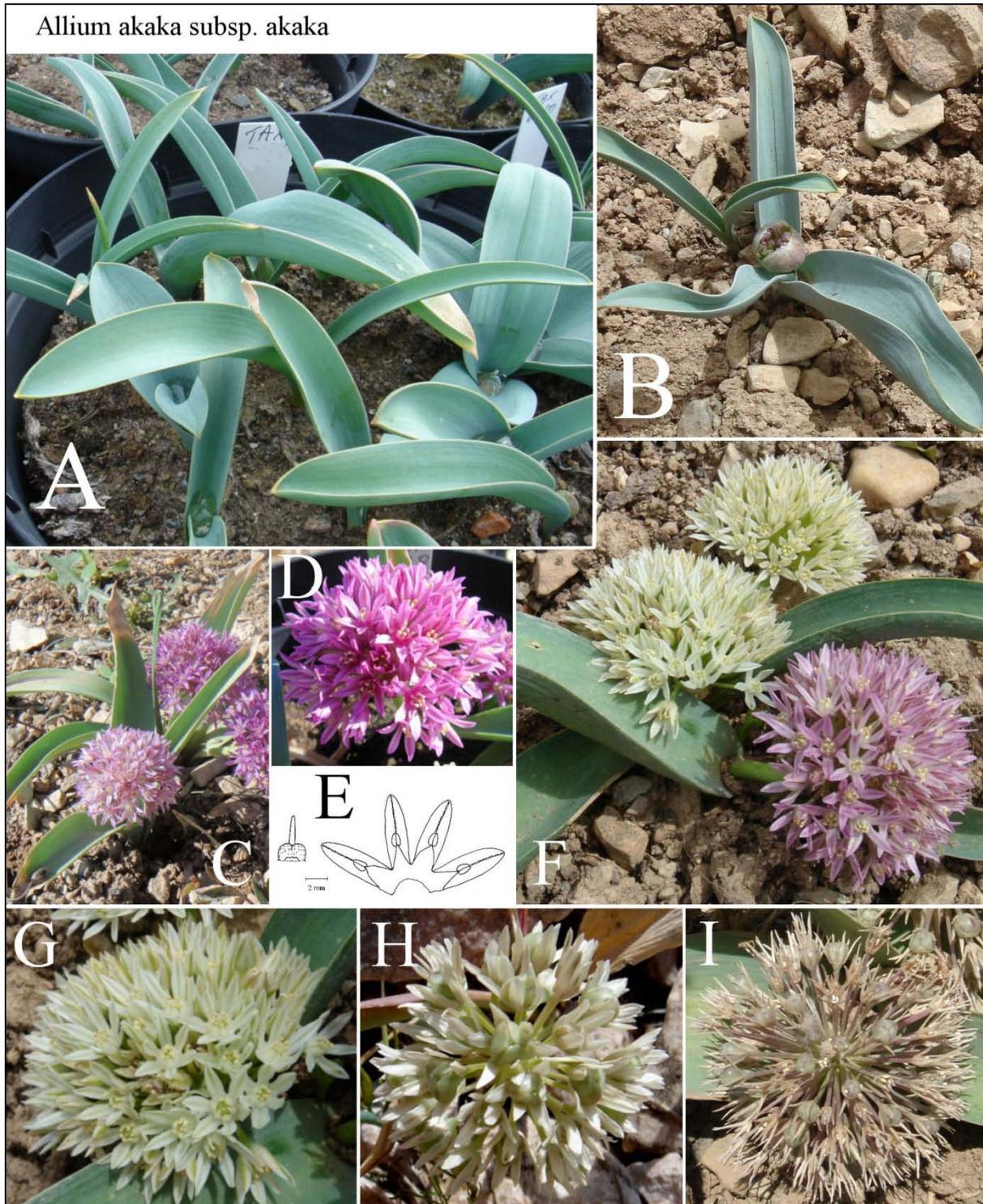


Plate T20. Cultivated plants from the epitype location. A & B: in vegetative stage; C & F: during anthesis; D & G: inflorescences in anthesis; E: shape of ovary, tepals and filaments of a flower prepared from herbarium (from Fritsch & Abbasi 2009: Fig. 1B); H: inflorescence after anthesis; I: inflorescence with developing capsules.

**Remarks:** The *A. akaka* alliance was contradictorily treated by different authors and developed into a large and diffuse conglomerate in the 1970ies, when Wendelbo (1973) subsumed also formally *A. haemanthoides* and *A. shelkovnikovii* as subspecies, and Pogosian (1985) and other authors did even not hold *A. materculae* separately. However, this taxonomic concept turned out to be impracticable, and the Iranian botanists were very discontented when the key in "Flora Iranica" led to identical names for visibly

different plants. In the last decade, comprehensive and detailed comparisons of living plants in the national *Allium* collection in Tehran and in Gatersleben clearly showed that several different and well separable morphotypes were involved. Therefore some elder names were revived from synonymy, and several species and subspecies were newly described in earlier publications as well as in this revision. Unfortunately, living plants corresponding to several unclear herbarium specimens could not be collected and studied hitherto. Thus it is expected that a few more taxa remained undetected. Because only the geographical region (the historical Iranian province Ghilan) but not the exact collection site of the type specimen is known, Iranian material from that area conforming well to the original description was studied (Fritsch 2008) and designated as epitype (Fritsch & Abbasi 2009). The description given above refers to these plants, which are characterized by whitish or pinkish, ovate-elliptic, obtuse (but with plicate apex) tepals remaining straight also after anthesis, short filaments without colored upper part and margins slightly touching one another, as well as finely coarse ovaries and  $\pm$  smooth capsules. They are heliophytes occurring with certainty on the western slopes of Talesh mountain range but their presence in the Hyrcanian forests of the eastern slopes is improbable. The borderline in southern directions is unclear yet; in northern direction the area of Ardabil and the Kuhha-ye Sabalan massif (where *A. sabalense* occurs) might mark a natural borderline. The same might be true for the massifs of Kuh-e Bozqush (subsp. *bozqushense*) and Kuh-e Sahand S Tabriz (*A. sahandicum*) in western direction where similar but morphologically well separable taxa replace epitype *A. akaka*. Also *A. latifolium*, distributed NW of lake Urmia, is accepted here as independent species and not as synonym of *A. akaka* s. str. Molecular markers strongly support to split *A. akaka* in the broadest sense into several species. According to ITS sequences of nuclear rDNA (see p. 200), *A. sabalense* and *A. sahandicum* are the closest genetic relatives, and the group of *A. subakaka*, *A. materculae*, *A. egorovae*, and *A. alekii* is less closely related. A still larger genetic distance was found to the *A. derderianum* - *A. alamutense* as well as the *A. breviscapum* groups, and again less genetic similarity to *A. mahneshanense*, *A. hamedanense*, *A. graveolens*, and *A. shelkovnikovii* s. str. A low degree of direct genetic relationship was also stated for *A. kurdestanicum*, *A. ubipetrense*, *A. haemanthoides* s. str., and the group of *A. austroiranicum* - *A. zagricum*. Sequences of the plastid *trnL-trnF* region (Gurushidze & al. 2010) presented a lower resolution of *A. akaka* and its segregates that were positioned in the basal lineage I and the derived lineage II including several derived haplotypes.

**Etymology:** The epithet refers most probably to a name, clearly indicated by the not declined form of the epithet and the upper case first letter presented in the original description. Derivation from Greek "akakos" = harmless, innocuous, would be convincing, but then the correct grammatical form would have been *A. akakon* or *A. akakum*.

**Biological data:** Germination occurs only after stratification at 5°C (Nikolaeva & al. 1985). The genome size (39 pg 2C DNA) of diploids (6398) does not differ from *A. subakaka* (as *A. akaka* 5980) but is much lower than in other species of sect. *Acanthoprason* s.str. (Gurushidze & al. 2012).

**Economic traits:** [Citations refer to *A. akaka* s. latiss.] Local name: 'valak, vaalak'. Young to flowering plants are eaten as vegetable and spice with medicinal properties. Inflorescence are pickled in vinegar to make a special spice 'torshi', fresh leaves are also cooked with rice to make a traditional dish 'vaalak polu', a mixture of rice and *Allium* leaves (without details mentioned also by Facciola 1990). The natural resources of this species may be endangered (Fritsch & al. 2007; Abbasi & al. 2008). The bulbs are eaten and therefore sold at markets in Iran (Uphof 1968). Ornamental plant listed in the "International Checklist ..." of the Royal General Bulb growers Association (1991).

Living accessions studied: **Ardabil:** Road from Asalem to Khalkhal below pass, N slope near spring Aznav (37°34' N, 48°35' E, 1850 m, 04.6.2005 Fritsch, Zarre, Moazzeni 1054; GAT IRAN). Road from Asalem to Khalkhal below pass, S slope, (37°35' N, 48°37' E, 2100 m, 04.6.2005 Fritsch, Zarre, Moazzeni 1053; GAT IRAN). - **Zanjan:** Bulbs bought on the "Tajrish" market in Tehran Shemiran, said to have been brought from Zanjan (26.5.2006 Abbasi, Fritsch, Keusgen 1138; IRAN).

Herbarium vouchers: **Ardabil:** Khalkhal - Mazjin village (37°40' N, 48°44' E, 1800-2000 m, ??6.1992 Hekmatjou 576; HTRC). Near the road from Khalkhal to Asalem (37°35' N, 48°37' E, 1860-2050 m, ??6.1992 Hekmatjou 595; HTRC). Khalkhal: near the road of Khalkhal to Asalem (37°35' N, 48°37' E, 1860 m, 15.6.1992 Hekmatju 5200; HTRC). 6 km Khalkhal, Kuhé

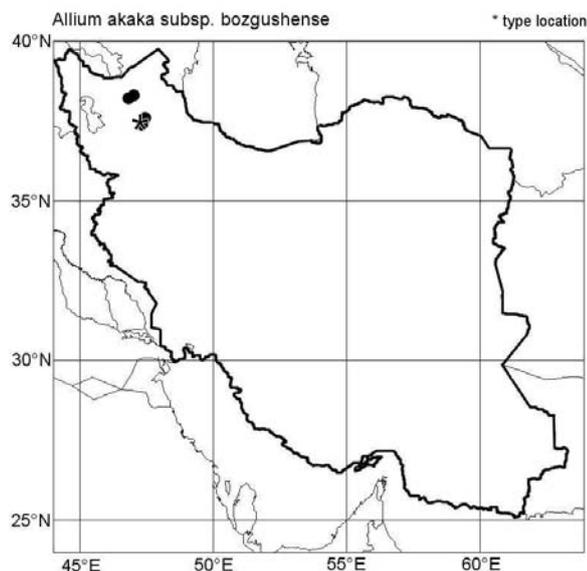
Aznaw (37°34' N, 48°35' E, 2000-2300 m, 22.5.1974 Termé, Moussavi 213-IRAN). Asalem to Khalkhal after pass near Khalkhal, mountain slope (37°35' N, 48°37' E, 2000 m, 29.5.1978 Wendelbo, Assadi 27810-TARI). Khalkhal, Mezejin, Kouh-e Agh-Dagh (37°40' N, 48°44' E, 2200-2600 m, 16.-17.5.1989 Termeh, Karavar, Tehrani 43049-IRAN). Assalem to Khalkhal, 16 km Khalkhal (37°40' N, 48°39' E, 2000 m, 22.5.1974 Termé, Moussavi 41836; 215-IRAN). - Gilan: Near the road from Ghazvin 62 km to Rudbar (36°29' N, 49°30' E, 1300 m, 03.5.1987 Assadi, Shah-Mohammadi 60342-TARI). - Zanjan: Kuh Anguran 35-42 km SW Tashvir inter Manjil et Zanjan (36°46' N, 48°51' E, 1900-2200 m, 02.6.1971 Lamond, Iranshah 40875 40875; W).

Determination unsure: Ardabil: 43 km from Kivi to Ardebil, road from Meresht to Arpachai village, good pasture (38°00' N, 48°28' E, 2250-2600 m, 18.6.1980 Mozaffarian, Nowrozi 34309-TARI).

**21. *Allium akaka* subsp. *bozgushense* R.M. Fritsch, *subspecies nova*.** - *Allium akaka* auct., p. p., Fritsch in Proceedings, First Kazbegi Workshop: 58, fig. 3A (2008); Fritsch & Abbasi in Rostaniha 10 Suppl. 2: 9 ff., fig. 1D (2009). - **Type**: Iran: prov. E Azarb., Miyaneh, Ishligh, Kuh-e Boz-Ghoush (37°40' N, 47°30' E, 2400-2900 m, 09.6.1986 Termeh, Daneshpajouh (holotype: the upper left plant of voucher 210-IRAN)).

Differt ab subspecie typica foliis brevioribus et latioribus apicibus rotundatis, inflorescentiis applanato-umbellatis et densissimis, et pedicellis brevioribus quam tepala.

Bulbs depressed-globose, 2-3 cm in diameter and 1.5-2.5 cm long; outer tunics greyish-brown, disintegrating. Scape subflexuous, terete, narrowly obconical, smooth; aerial part 3-8 cm long, (4) 5-8 mm in diam.; green with glaucous bloom, towards base purplish flushed. Leaves 1-2, laminae linear-lanceolate to broadly oblong, thick, strongly canaliculate, arcuately ascending ± recurved towards soil, shortly arcuately tapering into the rounded or subcucullate apex; margin smooth (?), initially red later whitish; upper side with some furrows, lower side with broad and shallow ribs; (8) 10-25 cm long, (1.5) 2-6 (9) cm broad; dull green with glaucous bloom, purplish flushed in the lower part. Sheath leaf hyaline, short, soon decaying. Spathe membranous, partly split into 2-3 ± ovate valves, initially ± adpressed to the pedicels, later patent to reflexed; pale brownish with darker veins. Inflorescence broadly fasciculate to semiglobose, many-flowered, very dense later rather loose; 3-5 cm in diameter. Pedicels thick, stiff wire-like, unequally long, initially descending later straight; purplish to dull brownish green. Anthesis in April to May. Flowers funnel-shaped star-like. Tepals lanceolate with acute apex, often plicate, steep obliquely positioned, recurved, basally c. 1 mm connate; 8-10 mm long, inner tepals 2 mm wide, outer ones somewhat narrower; pink to purplish with a broad green-purple median vein. Filaments about 1/3 as long as the tepals, straight, inner filaments ovate-triangular, outer filaments triangular and slightly shorter and narrower; basally adnate to the tepals and touching one another with the margins; purplish-violet with darker base. Anthers ovate, c. 0.7 mm long; yellow. Pollen yellow. Ovary sessile, cylindrical-globose triangular with three furrows, c. 2 mm long and in diameter; greyish-green with darker sutures;



nectary ducts lead in transversal pockets at 1/3 of length. Style conical, 2-3 mm long; rose. Stigma dot-like or slightly divided; white. Capsule subglobose, 3-4 mm long and in diam., surface reticulate lacunose; brownish yellow; widely opening; valves broadly elliptic with a deep longitudinal furrow and shortly notched at the apex. Seeds 1 per locule, sector-like drop- to comma-shaped, often with one concave side, surface irregularly and coarsely reticulate lacunose; c. 2.5 mm long, c. 2 mm wide and 1.5-2 mm thick; dull black.

**Chromosomes:**  $2n = 32$  Gurushidze & al. 2012 (Iran: Asalem to Khalkhal, accession 6397).

**Distribution:** Iran, prov. E Azarb.: Bozgush and Talesh massifs, montane gravelly and stony slopes.

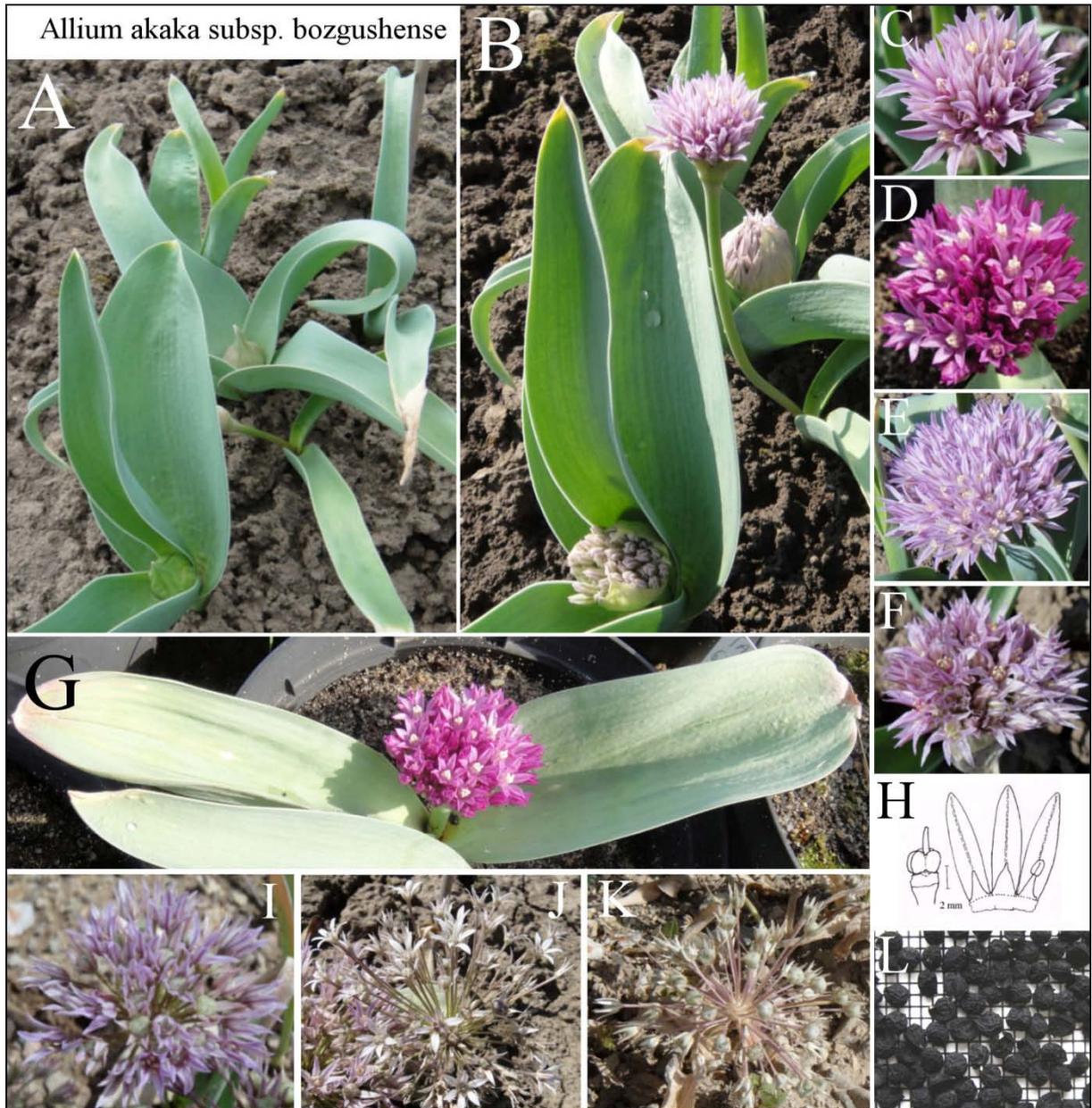


Plate T21. Cultivated plants. A: leaves and small scapes sprouting; B: plants prior and at begin of anthesis; C, D & E: inflorescences of different color forms in early anthesis; F & I: inflorescences in full and late anthesis; G: plant of the purple flower form in early anthesis; H: shape of ovary, tepals and filaments of a flower prepared from herbarium; J & K: inflorescences after anthesis and with developing capsules; L: seeds (background raster 1 mm)

**Remarks:** Molecular markers (ITS sequences of nuclear rDNA) confirm a very close relationship to the typical subspecies but also to *A. sabalense* and *A. sahandicum* (see p. 200).

**Etymology:** The epithet refers to the Bozghush massif between Sarab and Miyaneh (prov. Azarbaijan-e Sharqi) from where information on this species was first received.

Living accessions studied: E Azarb.: northern slopes of Bozqush mountain range, near vill. Asb Forushan (37°47' N, 47°28' E, 2520 m, 06.5.2011 Fritsch, Pahlevani 1335; IRAN GAT). - Ardabil: Road from Asalem to Khalkhal below pass, S slope 37°35' N, 48°37' E, 1850 m, Fritsch, Zarre 1054; GAT IRAN).

Herbarium vouchers, determination unsure: E Azarb.: pass c. 20 km S Ahar on road to Tabriz (38°22' N, 46°52' E, 1700-1800 m, 31.5.1978 Wendelbo, Assadi 27959-TARI). Near the road from Tabriz to Mianeh 1 km to Torkaman chay (37°34' N, 47°23' E, 1550 m, 08.6.1992 Mohamadzade 583; HTRC). Near the Ahar road, Amam Agoji (38°29' N, 47°04' E, 1500 m, 02.6.1992 Mohamadzade, Razban 586; HTRC). Ghareh Chaman (15.5.1995 Daneshpajuh 43052-IRAN).

22. *Allium subakaka* Razyfard & Zarre in Ann. Bot. Fenn. 48: 358, Figs. 7, 8 (Oct 2011). - *Allium akaka* auctt., p. p., Fritsch in Proceedings, First Kazbegi Workshop: 58, fig. 3B (2008); Fritsch & Abbasi in Rostaniha 10 Suppl. 2: 9 ff., fig. 1C (2009). - *Allium atropatanum* ined. in schedis. - **Type:** Iran, prov. West Azarbaijan, W Uromieh, Targevar valley, W Solak, 2000 m, 23.5.1976 Runemark & Foroughi (holotype 19746-TARI). Paratypes: Iran, prov. West Azarbaijan, Siah Chashmeh to Kelisa Kandi, Khan Goli region (39°12' N, 44°07' E, 2450 m, 23.6.2005 Moazzeni, Ghorbani 1110; TMRC). Piranshahr, Dalanpar mountains, 2800-3600 m, 03.6.2004 Solyman Hariri 6913 (HKS).

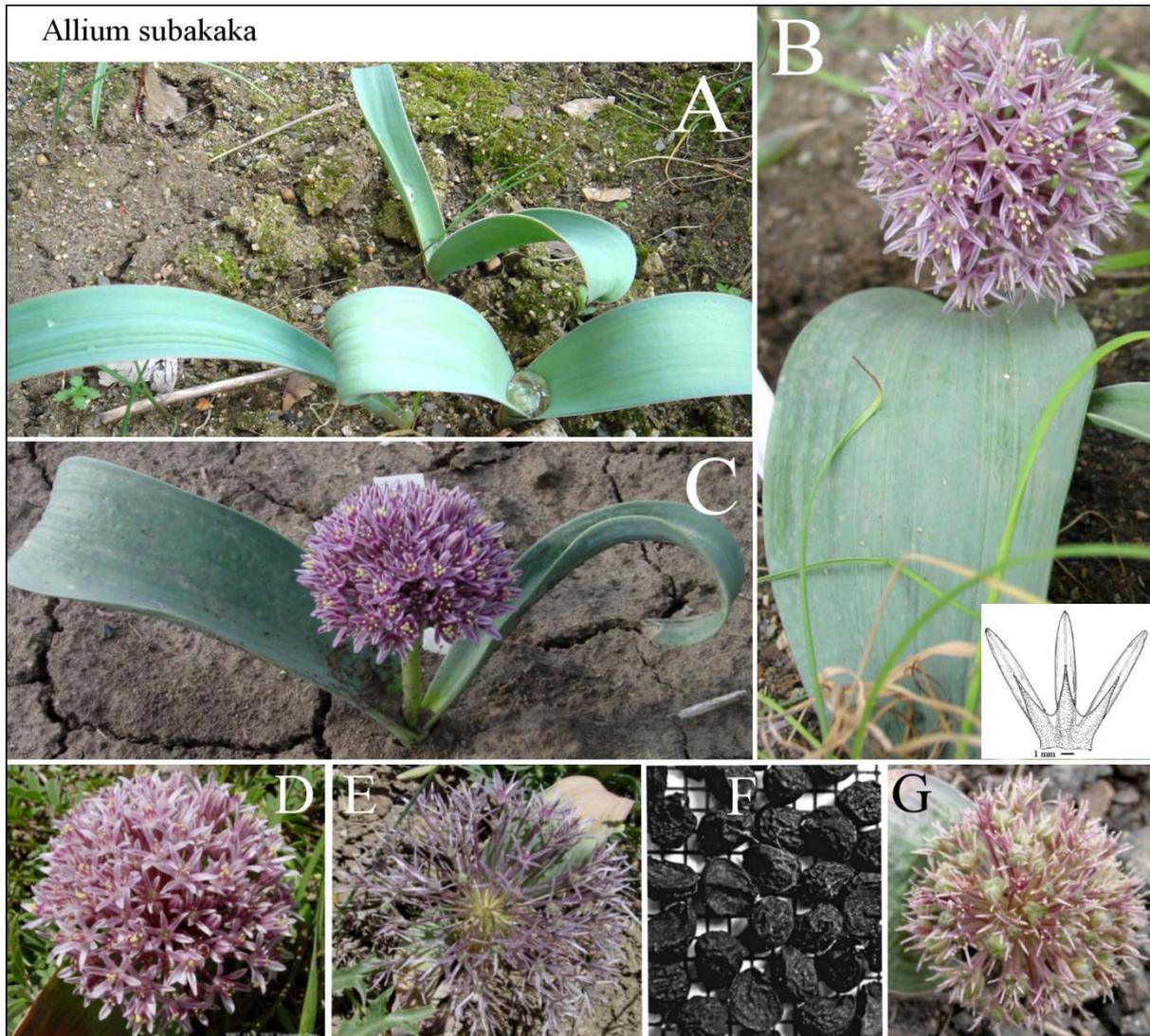
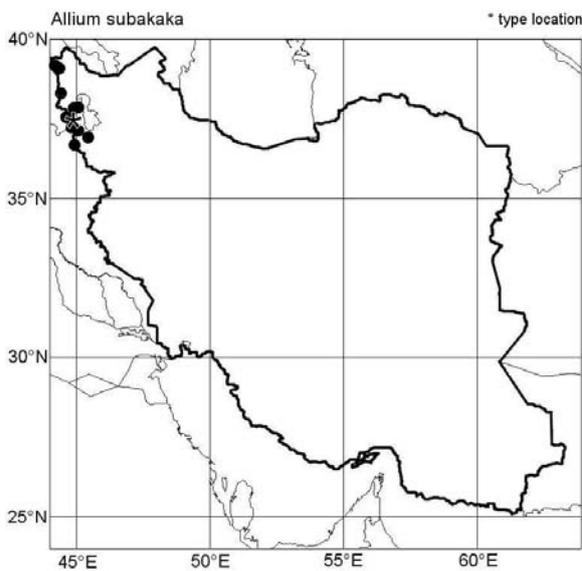


Plate T22. A: Cultivated plants after sprouting; B: flowering plant at Güzeldere pass, Turkey, inset: tepals and filaments (from Razyfard & al. 2011: Fig. 8B); C: cultivated plant in anthesis; D & E: inflorescences in early and late anthesis; F: seeds (background raster 1 mm); G: inflorescence with developing capsules

Bulbs ovoid-spherical, 20-25 mm long and in diameter; outer tunics blackish, irregularly splitting. Scape straight or  $\pm$  flexuous, terete, smooth, aerial part 3-4 cm long, ca. 3 mm in diameter (widest below the inflorescence). Leaves 2, laminae oblong to elliptic, thick and fleshy, obliquely arcuately ascending and recurved to the soil, shortly gradually tapering into the rounded and cucullate, often backwards enrolled apex; upper and lower side  $\pm$  sulcate; margin finely toothed, white to purple; 7-9.5 cm long and 2.5-5 cm wide; yellowish to bluish green with glaucous bloom. Sheath leaf short, brownish, decaying prior to anthesis. Spathe membranous, split incompletely into 2-3 broadly ovate, patent to subflexed valves; whitish with brown nerves. Inflorescence semi-globose, dense, many-flowered; 4-6 cm in diameter. Pedicels thick, straight,  $\pm$  equal long; 1.5-3 cm long; brown to deep purple. Anthesis in June to July. Flowers broadly funnel-shaped star-like. Tepals narrowly oblong to lanceolate, obliquely patent and slightly recurved with obtuse and plicate apex; after anthesis convolute and stiff with thick

median vein; 8-9 mm long and 1.5-2 mm wide in the middle; pink to lilac with darker median vein. Filaments 3/5-2/3 as long as the tepals, fleshy, straight, triangular (inner filaments broader); basally c. 2 mm connate and 1 mm adnate to the tepals; rose to lilac with a remarkably darker apex. Anthers ovoid, c. 1.5 mm long; yellow. Pollen deep yellow. Ovary obovoid triangular with 3 narrow and 3 somewhat broader furrows, finely tuberculate; 2-4 mm long and 3-4 mm in diameter; dull light green, often purplish suffused. Style conical, up to 3 mm long; whitish. Stigma undivided; white. Capsule depressed-globose triangular with three broad and 3 narrow furrows; c. 4 mm long and 5 mm in diameter; moderately widely opening; valves transversely elliptic with a broad and shallow notch at the apex; yellowish-brown. Seeds one per locule, obovate to drop-shaped with one flat or concave side, surface coarsely reticulate lacunose; 2-3 mm long, ca. 2 mm wide and 1 mm thick; dull black.

**Chromosomes:**  $2n = 16$  Pedersen & Wendelbo 1966 (Turkey: Erzurum, Iran: ?, "*A. akaka*").  $2n = 16$  Pogosian 1983 fig. 1 (Iran: Azarbaijan, Rezajyeh, Qarah Ziah-Uddin, "*A. akaka*").  $2n = 16$  Özhatay 1986 (Turkey, "*A. akaka*").  $2n = 16$  Gurushidze & al. 2012 (Turkey: Dogubeyazit, 5980 "*A. akaka*").



**Distribution:** NW Iran, E Turkey, E Iraq?, Republic Azerbaijan (Nakhichevan); montane to subalpine rock slopes, mountain steppes.

**Remarks:** This is another taxon only recently recognized among the species subsumed by Wendelbo (1971) under the broadly accepted name *A. akaka*. It is distinguished by more elongated leaf laminae with purple margins, lilac-pink, lanceolate tepals, narrow filaments with pale bases and purplish tips, and longer styles with a slightly swollen stigma. Molecular markers (ITS sequences of nuclear rDNA) put it in one subgroup with *A. materculae*, *A. egorovae*, and *A. alekii* in some distance to *A. akaka* s. str. and to *A. haemanthoides* s. str. (see p. 200). However, one paratype specimen (suak6913H, p. 200) was positioned close to *A. iranshahrii* and

belongs probably to that species. *Allium subakaka* was still included in *A. akaka* s. l. when sequences of the plastid *trnL-trnF* region were investigated that resulted in three different locations for *A. akaka* (Gurushidze & al. 2010).

**Etymology:** The epithet refers to the similarity with *A. akaka* (from Latin "sub~ = somewhat, not completely").

**Economic traits:** Local name 'kuzukulagi', all plant parts are added to herb-flavored cheese in East Anatolia (Özçelik 1994, as *A. akaka*).

**Herbarium vouchers:** W Azarb.: Maku to Khoy, mountains SW Kelisa-Kandi (39°21' N, 44°14' E, 2400-2650 m, 29.6.1978 Assadi, Mozaffarian 30358-TARI). Rezajeh, near Turk. border, kouran pasture (37°40' N, 44°40' E, 2800 m, 19.7.1972 Mohsenian 25222-TARI). Makou, Sari-chaman towards Guerkhlar (39°15' N, 44°25' E, 2200-2600 m, 13.6.1970 Termé 225-IRAN). Mahabad 50 km to Urumiyeh (37°06' N, 45°28' E, 55640-IRAN). Shahpour to Rezaieh, 32 km Shahpur, Ghoushtchi (38°02' N, 45°06' E, 1700-2000 m, 12.6.1977 Moussavi, Tehrani 43051-IRAN). W Rezaiyeh, hills W Silvana village (37°24' N, 44°51' E, 1550-1800 m, 21.5.1976 Runemark, Foroughi 19593-TARI). W Rezaiyeh. Targevar valley W Solak (2000 m, 23.5.1976 Runemark, Foroughi 19746; TARI). 14 km from Piranshahr to Naqade, Silveh village, Sefid Kuh (Sepiarez Mt.) (36°51' N, 44°59' E, 2500-3175 m, 01.7.2010 Amini Rad, Torabi 56029-IRAN). Urumiyeh: Sero road, Eshkansoo village (37°43' N, 44°40' E, 1700 m, 23.5.1995 Alizadeh, Ghasempoor, Heidari, Larti, Shanaki 7620; ORUM). Khoy: Ghotur, Balajook, police station Ghirbooran (38°29' N, 44°27' E, 2600 m, 10.5.1997 Alizadeh, Ghasempoor, Heidari, Larti, Shanaki 7621; ORUM). 14 km from Piranshahr to Naqade, Silveh village, Sefid Kuh (Sepiraz Mt.) (36°51' N, 44°59' E, 2500-3175 m, 01.7.2010; collector unclear, IRAN). Urumiyeh: Ghasemloo valley, Khan valley, 34 km Oshnaviyeh road (37°18' N, 45°06' E, 1430 m, 25.4.1995 Alizadeh, Ghasempoor, Larti 4639; ORUM).

**Determination unsure:** W Azarb.: Urumiyeh: Golmankhaneh village, Gharehdag mountain (1300-1750 m, 11.5.1994 Alizadeh, Khodakarimi 2560; ORUM). Ghazemlu (37°18' N, 45°06' E, 06.7.1973 Eivazzadeh, Mosta'an 17; W). Urumiyeh: Gharebag village, between Gharebag and Ghooshchi (1300-1400 m, 16.5.1994 Alizadeh, Ghasempoor, Khodakarimi 3412; ORUM).

Urumiye: between Gharehbag and Agziarat village, Bamay mountain (1300-1700 m, 19.4.1994 Alizadeh, Ghasempoor 3197; ORUM). Urumiye: Ghooshchi pass, Uchmeshah valley (38°01' N, 44°56' E, 1550-1950 m, 04.5.1994 Alizadeh, Ghasempoor, Bachchi, Khodakarimi 2892; ORUM).

**23. *Allium mahneshanense*** Razyfard, Zarre & R.M. Fritsch in Ann. Bot. Fenn. 48: 356, Fig. 5, 6. (Oct 2011). - Type: Iran, prov. Zanzan, Mah Neshan, Anguran village, Belgheis Mountains, 2700-2900 m, 36° 45' N, 47° 40' E, 25.4.1987, Maassoumi (holotype 64855-TARI).

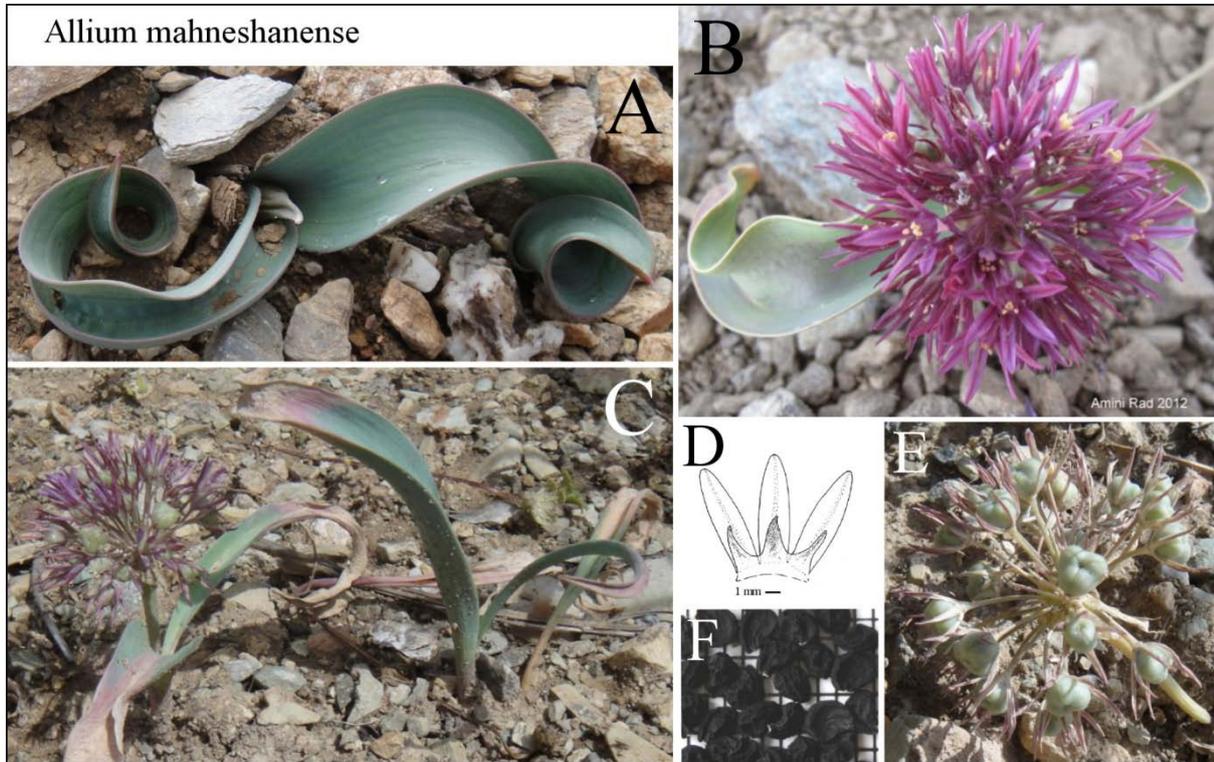
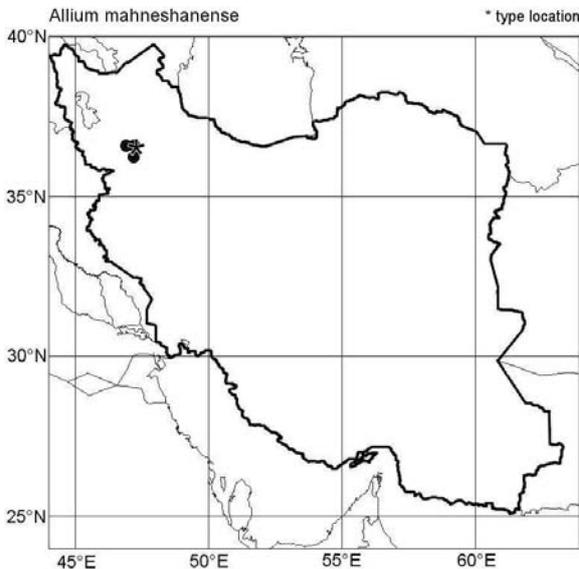


Plate T23. A: Developing plant at the type location; B: plant in anthesis at the type location (photo courtesy of M. Amini Rad); C: cultivated vegetative and flowering plants in late anthesis; D: tepals and filaments (from Razyfard & al. 2011 Fig. 6B); E: inflorescence with full sized capsules; F: seed (background raster 1 mm).

Bulbs ovoid-globose, 15-25 mm in diameter; outer tunics black, coriaceous, irregularly splitting. Scape conical, terete, straight or  $\pm$  flexuous, smooth; aerial part 1-5 cm long, ca. 3-6 mm in diam., widest below the inflorescence; green, purplish suffused. Leaves 2-3, laminae lanceolate to elliptic, arcuately ascending with often enrolled upper part, thick and fleshy, hooded at the apex; upper and lower side smooth or slightly sulcate; margin finely toothed especially near the base, greenish-white; 15-18 cm long and 2-5 cm wide, the outermost lamina usually larger than the others; bluish green with glaucous bloom. Spathe membranous, split into 2 or 3 ovate to triangular, patent valves; pale brown with brown veins. Inflorescence  $\pm$  semi-globose, dense, moderately many-flowered (30-50 flowers); 3-5 cm in diameter. Pedicels  $\pm$  thin, straight,  $\pm$  equally long, 1-2 cm long; brown to purplish. Anthesis in April to May. Flowers funnel-shaped star-like. Tepals elliptic-oblong to sub-lanceolate, obliquely upright and somewhat recurved, arcuately tapering into a rounded (inner tepals) or subobtuse apex, becoming stiff by convolute margins after anthesis; 6-7 mm long and up to 2 mm wide in the middle;  $\pm$  purple with darker median vein. Filaments 1/3-2/5 as long as the tepals, ovate to triangular, fleshy; basally for 1.5 mm connate to each other and 1 mm adnate to the tepals; purple throughout and hardly darker at the apex. Anthers ovoid, ca. 1 mm long; yellow. Pollen yellow. Ovary spherical, surface tuberculate; 3 mm long and in diameter; light brown to green. Style conical, 2 mm long; pinkish. Stigma undivided; whitish. Capsule depressed obovate triangular with concave apex, finely tuberculate, semi-glossy with some small reticulate ledges; 4-5 mm long, 5-7 mm in diam.; pale greenish brown; valves suborbicular with a shallow longitudinal furrow, broadly notched at the apex. Seeds 1 (-2) per locule, sector-like drop-shaped, concave-convex, concave side finely tuberculate without or with a few irregular ledges surround-

ded by sharp edges, convex side irregularly reticulate lacunose; c. 2.5 mm long, 1.5-2 mm wide, c. 1.5 mm thick; dull black.



**Distribution:** Iran, prov. Zanjan; montane and sub-alpine meadows and loamy slopes.

**Remarks:** Some characters of the original description had to be revised when living plants from the type location were studied. We confirmed falcate to undulate leaves and purple flowers, but the tepals are more lanceolate and the ovate-triangular filaments are purple without darker tip. Thus *A. mahneshanense* is most similar to *A. alekii* but is a smaller species with narrower leaves, a semiglobose and not fasciculate inflorescence, shorter tepals with a more pronounced median vein, and relatively shorter and more fleshy filaments. Another similar but larger species is *A. sabalense* differing by a generally paler flower color, larger and denser

inflorescences, larger tepals, and relatively shorter and paler filaments. Molecular markers (ITS sequences of nuclear rDNA) of additional accessions confirmed the position of *A. mahneshanense* jointly with *A. graveolens*, *A. shelkovnikovii* s. str. and *A. ubipetrense* accessions in a weakly supported subclade of sect. *Acanthoprason* (Fritsch & al. 2010, as *A. aff. akaka*; see p. 200) far from *A. akaka* s. str., *A. alekii*, and *A. sabalense*.

**Etymology:** The epithet refers to the town Mahneshan situated not far from the type location.

Living accessions studied: **Zanjan:** Top of Mt. Belgheis near the heaps of mines (36°38' N, 47°24' E, 2720 m, 04.5.2011 Fritsch, Pahlevani 1332; IRAN GAT)

Herbarium vouchers: **Zanjan:** Mahneshan, Anguran village, Belgheis Mts. (36°38' N, 47°24' E, 2700-2900 m, 25.4.1987 Maassoumi 64855-TARI). Alam-Kandy, Ghar-Ghalan mountains (36°46' N, 47°16' E, 2500-2800 m, 27.6.1983 Moussavi, Habibi, Tehrani 231-IRAN).

Determination unsure: **E Azarb.:** Hashtrud: Gharah Aghaj 15 km S, Khadem Kandi vill. Ojagh Daghi (37°00' N, 46°57' E, 2380 m, 29.5.1995 Gharemani, Imani; HTRC). - **W Azarb.:** Tekab: Saiin bulagh (36°24' N, 47°14' E, 2500 m, Odishoo 7527; ORUM).

**24. *Allium iranshahrii* R.M. Fritsch, species nova.** - *Allium euatropatanum* R.M. Fritsch ined., in sched. - **Type:** W-Azarb.: Piranshahr, Silveh, Zivke, Mt. Chighidarreh 36°47' N, 44°55' E, 3130-3570 m, 04.7.2012 leg. Amini Rad, Torabi (holotype 57432-IRAN, isotype GAT).

Inflorescentia similia Allio egorovae sed species differt tepalis brevioribus, antheris flavis, et praesertim foliis ovatis valde sulcatis. Differt ab Allio subakaka staturis minoribus, foliis brevioribus, et tepalis brevioribus diverse coloratis.

Bulbs subglobose, 2-3 cm long and in diameter; outer tunics ± papery, disintegrating; blackish brown. Scape subflexuous, terete, smooth; aerial part 1-5 cm long, 3-5 mm in diam.; green, purplish suffused, perhaps with glaucous bloom. Leaves 1-2, laminae broadly ovate to elliptic, ± patent lying on the soil, flat, arcuately tapering into the short cucullate apex; margin smooth (?) and initially purple, later whitish; upper side with deep furrows, lower side probably with shallow broad ribs; initially deep green, and finally purple suffused, with glaucous bloom. Sheath leaf short, hyaline, soon decaying. Spathe thin membranous, split into 2-3 ovate, shortly acuminate, patent valves, pale ochre with inconspicuous veins. Inflorescence initially broadly fasciculate later semiglobose, dense, many-flowered, 3-5 (6) cm in diameter. Pedicels thick, straight, 1-2 cm long; brown to purplish. Anthesis in June to July. Flowers broadly funnel-shaped or campanulate star-like. Tepals lanceolate, obliquely patent, flat, the subacute apex concave; after anthesis connivent and longitudinally convolute; 5-7 mm long, c. 1.5 mm broad; whitish to rose with a broad green to brown median vein. Filaments 1/3-1/2 of tepal length, inner fila-

ments ovate-triangular, 2 times broader than the broadly triangular outer ones; basally connate; carmine fading along the lower one-third towards the whitish base. Anthers  $\pm$  ovoid, c. 1.5 mm long; carmine. Pollen grayish yellow. Ovary apparently depressed globose, angular, surface finely tuberculate; c. 2.5 mm long and in diameter; green with purple flushed furrows. Mounds of nectary ducts not seen. Style probably thread-like, 2-3 mm long; whitish. Stigma dot-like; white. Capsule subglobose, 4-5 mm long and in diameter; green, not seen in the ripe state. Seeds not seen.

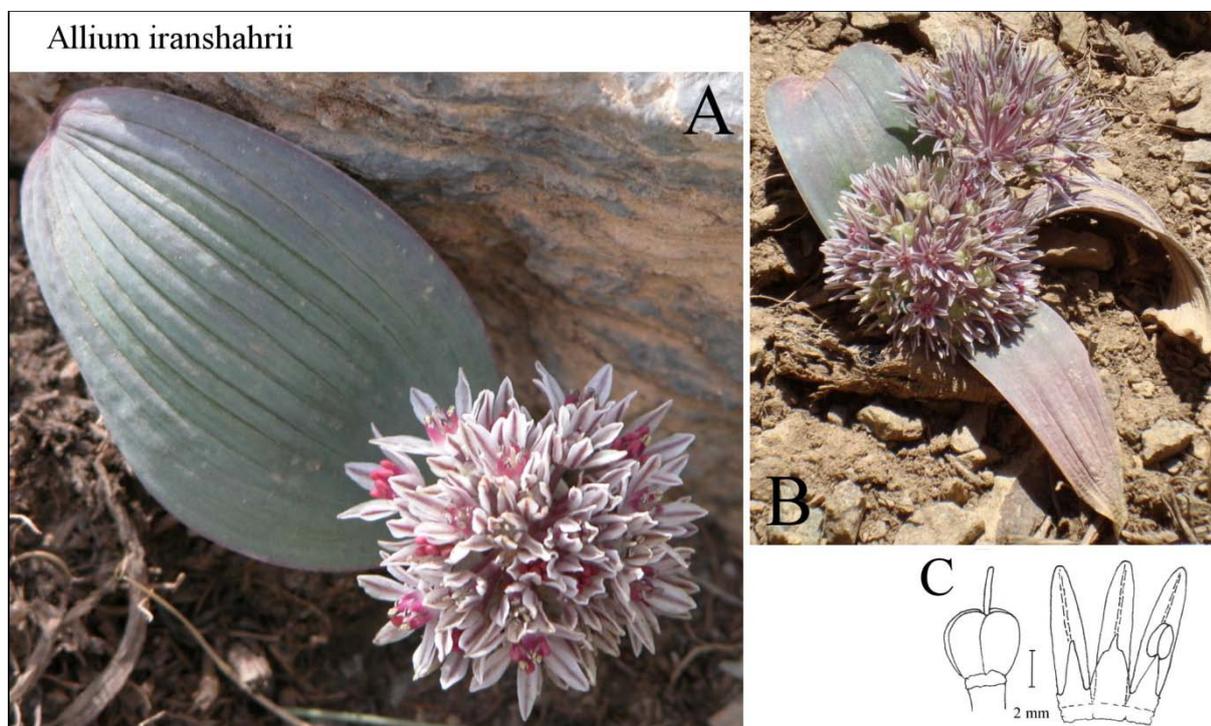
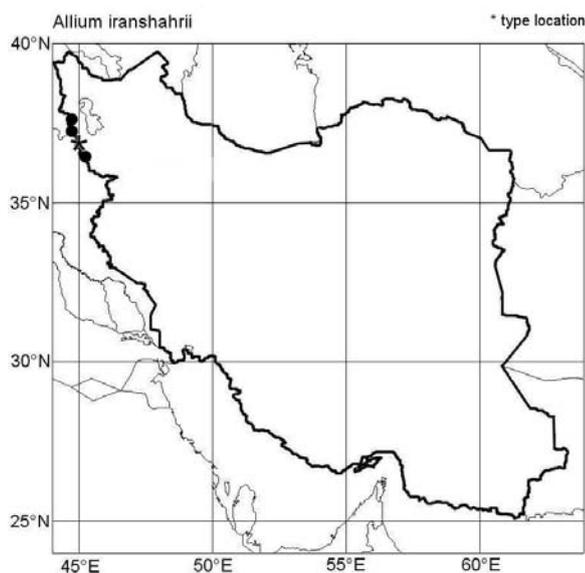


Plate T24. A: Flowering plant at the type location; B: plants in late anthesis at Mt. Shaidan, (photos courtesy of M. Amini Rad); C: shape of ovary, tepals and filaments of a flower prepared from herbarium

**Distribution:** Iran: prov. W Azarbeijan, mountain tops SW of lake Urmia.



**Remarks:** This subalpine species represents an intermediate morphotype sharing some characters of the inflorescence and flowers of *A. egorovae* and the often short and broad leaves of *A. subakaka*. However, plants of *A. iranshahri* are smaller than both mentioned species, and differ beside the ovate and strongly furrowed leaf laminae by shorter tepals, relatively shorter filaments, and yellow anthers from *A. egorovae*. *Allium subakaka* is an again larger plant with commonly longer and less furrowed leaves, larger tepals of different color, and the relatively longest filaments that are rose to lilac at the base, among these taxa. Molecular markers (ITS sequences of nuclear rDNA) did not trace closely genetically related species; moderately closely related are *A. breviscapum* and the *A. ubipetrense* -

*A. haemanthoides* - *A. kurdistanicum* group (see p. 200).

**Etymology:** Named after the distinguished contemporary botanist M. Iranshahr from Tehran.

Herbarium vouchers: **W Azarb.:** Piranshahr, Dalanpar mountain (36°42' N, 45°08' E, 2800-3600 m, 03.6.2004 Solyman Hariri 6913; HKS). Rezajeh, near the Turkish border, Kovran pasture (37°40' N, 44°40' E, 2800 m, 19.7.1972 Mohsenian 25222-TARI). Orumieh, Movana, Marmisho (2902 m, 02.7.2012 Amini Rad & Torabi 57429-IRAN). Shaidan mountain W Urmia

near Turkish border (3320 m). (27°24' N, 44°39' E, 3320 m, Amini Rad; IRAN). Piranshahr, Silveh, Gerdasor, Mt. Chighi-darreh (~3200 m, 24.7.2011 Amini Rad, Torabi 57035-IRAN).

Determination unsure: W Azarb.: Urumieh, Khalilkuh (37°23' N, 44°48' E, 2490-3155 m, 08.7.2005 Mozaffarian 87450-TARI).

*Allium austroiranicum* alliance

**25. *Allium austroiranicum*** R.M. Fritsch in Rostaniha 9 Suppl. 2: 26, fig. 5 (2008 publ. 17 Jul 2009). - *Allium haemanthoides* sensu Wendelbo, Flora Iranica No. 76: 73 (1971), p.p. *Allium haemanthoides* var. *lanceolatum* Boiss., Fl. orient. 5: 276 (1882). Type: Iran: Lurestan: Sawers-Berge, Nur, Eschker, leg. Hausskn. (G-BOIS, quoad isotype JE!). - Type: Iran: prov. Fars, Neyriz, Moshkan village, Kuh-e (Gholleh) Sar-e Sefid, 2700-3000 m, Moussavi & Tehrani 25.5.1975 (holotype IRAN).

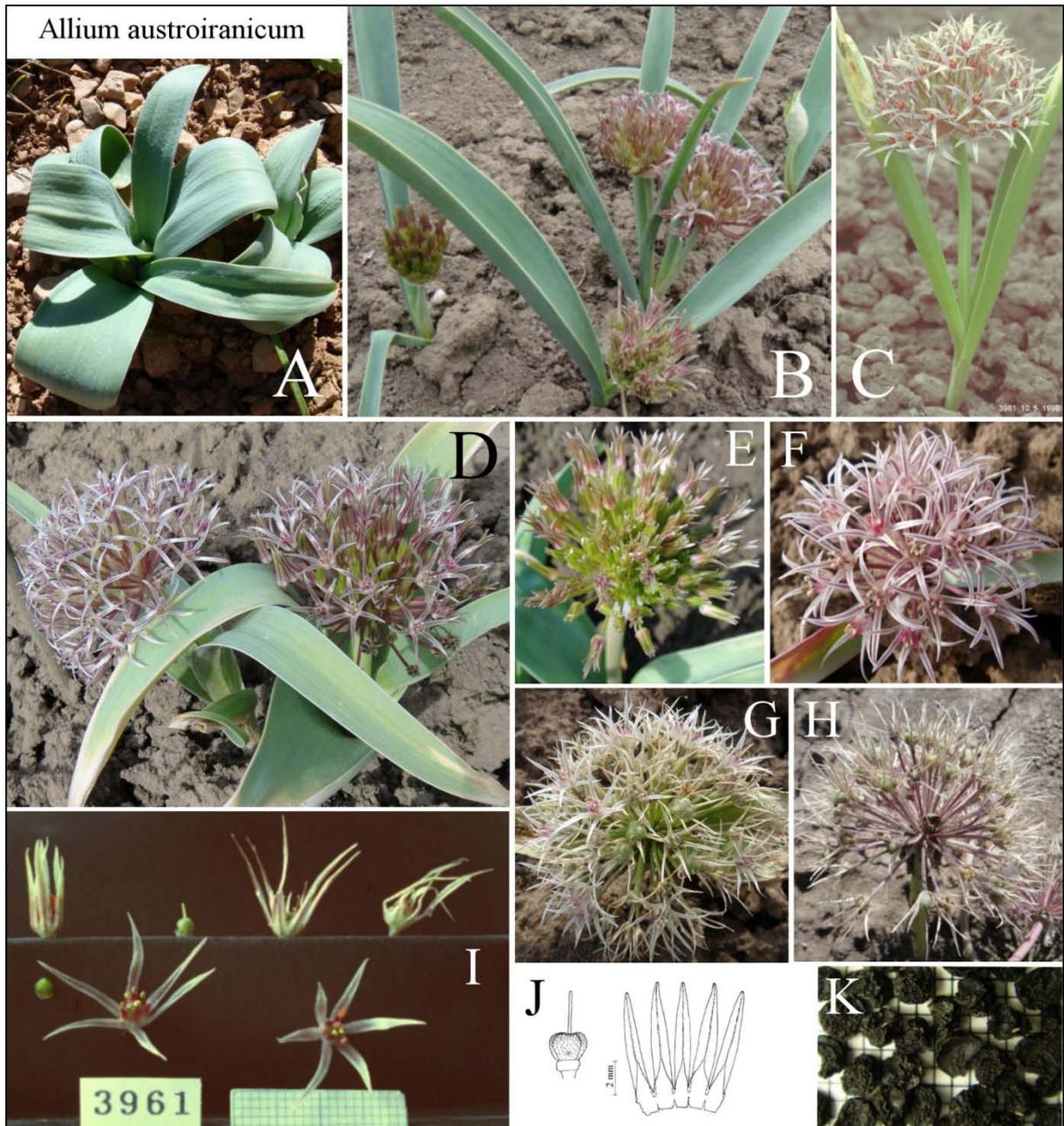
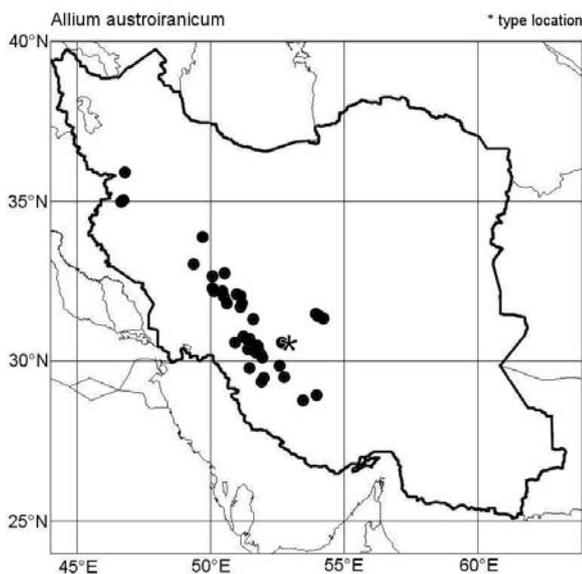


Plate T25. Pictures of cultivated plants. A: leaves after sprouting; B, C & D: plants in early and full anthesis, resp.; E, F & G: inflorescences in early, full, and late anthesis, resp.; H: inflorescence with developing capsules; I: comparison of flower parts in different stages; J: shape of ovary, tepals and filaments of a flower prepared from herbarium; K: seeds (background raster 1 mm).

Bulbs ovoid to depressed-ovoid, 1.5-3 cm long and in diameter; outer tunics grey-brown to blackish, in pieces (but near the tip in spirally twisted stripes) disintegrating. Scape slightly flexuous, subconical or terete, smooth; aerial part (2) 5-12 cm long, (3) 4-6 mm in diameter; green, often purplish flushed. Leaves 1-2 (3), laminae narrowly lanceolate up to ovate, in early stages often adpressed to the soil, shortly arcuately tapering into the cucullate apex, strongly canaliculate, and the upper part 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; color covering the whole range between dull glaucous green to shiny yellowish green. Sheath leaf short, hyaline brownish, soon decaying. Spathe membranous, split into 2-4 broadly triangular, later reflexed valves; pale brown with purple nerves. Inflorescence  $\pm$  semi-globose or broadly fasciculate, moderately loose to dense, many-flowered; (3) 5-12 cm in diameter. Pedicels straight, wire-like, smooth,  $\pm$  subequally long; brownish to purple. Anthesis in May to June. Flowers widely funnel-shaped star-like. Tepals long-triangular to narrowly lanceolate,  $\pm$  acute, remarkably recurved, subpatent; after anthesis convolute and prickly-like; (8) 10-12 mm long, 1.2-2 (2.5) mm wide near the base; white with broad and  $\pm$  diffuse green median vein or different pink tones with purplish median vein. Filaments 1/3-2/5 (1/2) as long as the tepals, straight, fleshy, outer filaments narrowly triangular, inner ones 1.6-1.8 times wider and often  $\pm$  ovate; basally shortly connate; basally whitish, tip pink to purplish (not in white flowers). Anthers ovoid, c. 1 mm long; pink to purplish or yellow. Pollen yellow. Ovary sessile, sub-globose with three furrows, surface finely tuberculate; 2-3 mm long and in diameter; green; nectary ducts lead in broad, narrowly notched pockets near the base of the ovary. Style conical, 2-4 mm long; whitish. Stigma dot-like; white. Capsule depressed-obovate, triangular; 3-4 mm long and in diameter, widely opening; brownish; valves transversely ovate, shallowly notched at the apex. Seeds 1-2 per locule, flat ovoid to sector-shaped, surface with irregularly reticulate ledges and often sharp edges along the margins; 2.5-3 mm long, 2-2.5 mm broad, 1-1.5 mm thick; dull black.



**Distribution:** Central and South Iran: higher elevations of the Zagros mountain range, steep montane stony and often rocky steppe slopes. It is probably a vicariant species with *A. ubipetrense*.

**Remarks:** This species was formerly included in *A. akaka* s. latiss. under *A. haemanthoides* sensu Wendelbo (1971: 73), where very probably the details "Perigonium ... viridi-nervosum ... in sicco saepe album" refer to this recently described species. *Allium austroiranicum* is most similar to the typical form of *A. derderianum* but owns more or less lanceolate leaves in steeply ascending position; whitish to pinkish, longer, triangular, and stronger recurved tepals also after anthesis, as well as relatively shorter, often more contrasting bi-colored

filaments. True *A. haemanthoides* is easily separable by much longer tepals and relatively shorter, uni-colored filaments. *Allium austroiranicum* is very variable. In the southern part of province Shiraz dominate smaller plants having less flowers per inflorescence and only 8-10 mm long, more lanceolate tepals. Also most populations growing in other areas contain some individuals with pale flowers of different tones. Then the apex of filaments is still remarkably darker than the basal part, but this is difficult to recognize with herbarium vouchers. Albinotic forms are problematic because the darker tip of the filaments cannot be seen neither in the living nor in the dried state. If they belong to a mixed population and differ only by the missing red color in all plant parts, the decision is easy. However, often albinotic plants differ from typical plants by yellow-green, more flat positioned, glossy leaves of perhaps more triangular shape, often with red margin. The tepals are often somewhat smaller. Also the filaments are somewhat shorter, and the inner filaments more ovate in shape. Completely albinotic populations are

also not rare, and then separation from similar species may be difficult. Flower characters can help in preliminary determination: *A. austroiranicum* has up to 12 mm long and up to 2 mm broad (or somewhat broader) tepals, and c. 4 mm long filaments. *Allium haemanthoides* s. str. can be separated by tepals about 15 mm long and scarcely 1.5 mm broad and 3-4 mm long filaments, whereas *A. ubipetr-ense* shows 8-10 mm long but 2-3 mm wide tepals and about 4 mm long filaments. However, secure determination needs comparison of all available characters. Only fresh and excellently prepared herbarium specimens allow to differentiate between normal and albinotic plants, and affiliation of many vouchers remained unclear. Therefore the herbarium vouchers cited below were not differentiated.

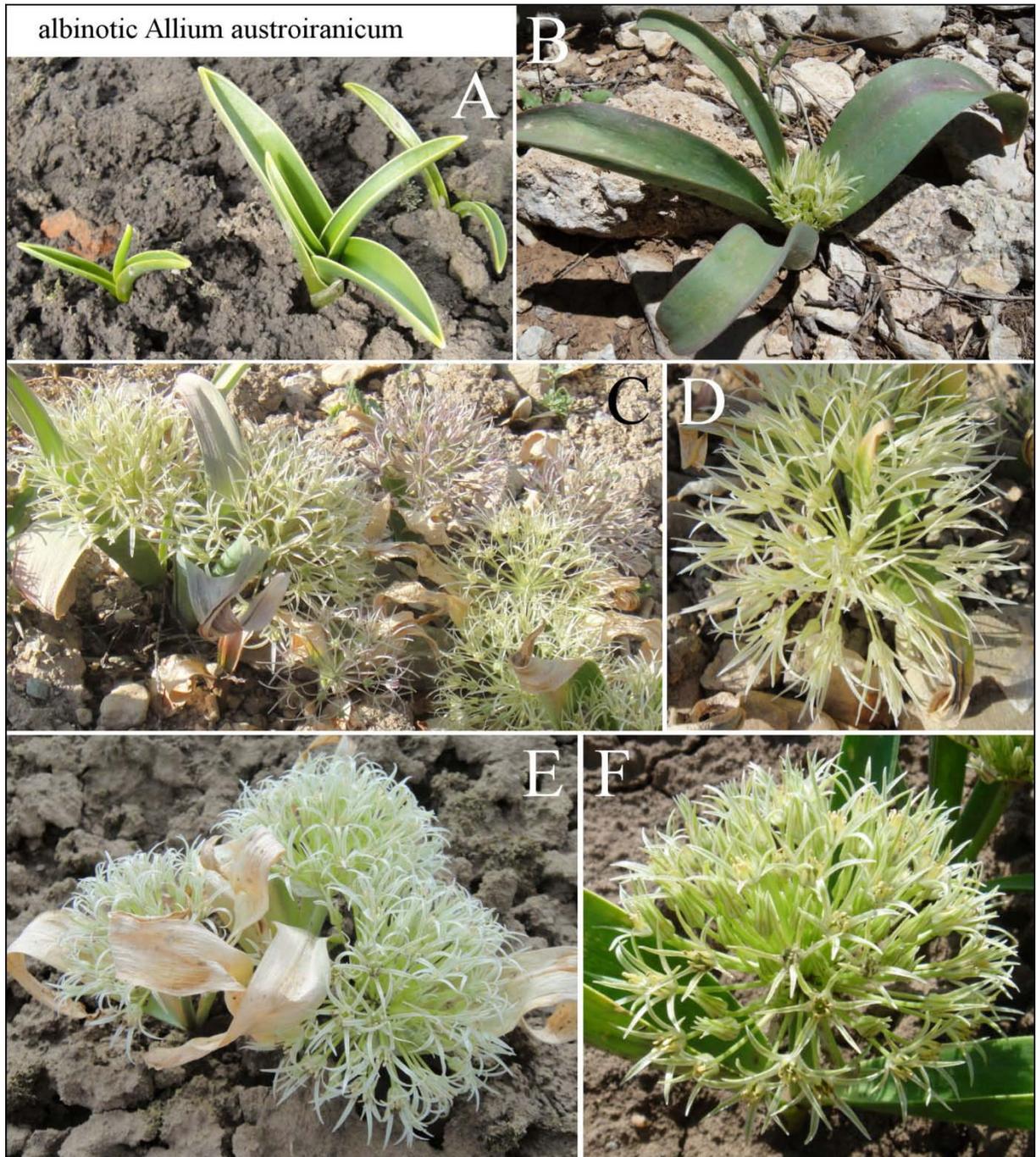


Plate T25a. A: Sprouting leaves; B: Plant in early anthesis in Dasht-e Rom mountains; C: mixed population in cultivation; D & F: inflorescences in early anthesis; E: cultivated plants in full anthesis.

Molecular markers (ITS sequences of nuclear rDNA) support a rather basal position of *A. austroiranicum* in sect. *Acanthoprason* with a close relationship only to *A. zagricum* and a moderate genetic distance to Iranian members of sect. *Melanocrommyum* (Fritsch & al. 2010; see p. 200).

*Allium austroiranicum* occurs with certainty only south of 34° N latitude. The vouchers from more northern areas are unclear (pressed when in buds or after anthesis) and might belong to *A. haemanthoides* s. str. (indicated by molecular characters); re-study of living plants is essential.

**Etymology:** The epithet refers to the area of distribution of this species (from Latin "South Iranian").

Living accessions studied: **Chaharm. Bakhtiyari:** Road from Posegani to Chelgerd (Ruksans ?; GAT). Slopes near the begin of Kuhrange tunnel (32°26' N, 50°06' E, 2400-2700 m, 16.5.1994 Fritsch 1068; GAT; 2590 m, 29.4.2010 Fritsch, Keusgen, Abbasi 1279; GAT IRAN; 2500 m, 29.4.2010 Fritsch, Keusgen, Abbasi 1280; GAT IRAN). Deh Cheshme, mountains above spring Pir Ghar (32°12' N, 50°33' E, 2382 m, 28.4.2010 Fritsch, Keusgen 1271, normal and albinotic plants; GAT IRAN). Bakhtiar-Berge ca. 1 km oberhalb Amir Abad ca. 10 km SW Haruni (32°22' N, 50°28' E, 2400-2700 m, 15.5.1994 Fritsch 1049, Fritsch 1053; GAT). Tang-e Sayad protected area c. 15 km SE Shahr-e Kord (32°16' N, 51°01' E, 2400-2490 m, 30.4.2010 Fritsch, Keusgen, Abbasi 1283, 1285; GAT IRAN). Crest of a premountain hill near NW corner of Chelgerd (32°28' N, 50°07' E, 2553 m, 29.4.2010 Fritsch, Keusgen, Abbasi 1275; GAT IRAN). Stony crest near the pass NW of Chelgerd (32°29' N, 50°06' E, 2662 m, 29.4.2010 Abbasi, Fritsch, Keusgen 1277; IRAN). Bakhtiar-Berge, Fahrweg am Hang oberhalb des Kuhrange-Flusses nach Chelgerd (32°28' N, 50°06' E, 2400-2600 m, Fritsch 1068; GAT). - **Esfahan:** S to SW directed slope of Mt. Dalun massif E Analujeh (32°55' N, 50°33' E, 3000 m, 09.4.2008 Abbasi, Fritsch 1221; GAT IRAN; Abbasi, Fritsch 1223; IRAN). Side towards Isfahan of the pass road N Sefiddasht (32°15' N, 51°11' E, 2280 m, 30.4.2010 Fritsch, Keusgen, Abbasi 1290; GAT IRAN). - **Fars:** Rocky limestone slopes above the ski sport area Poladkaf NE town Sepidan in direction to Komehr (30°24' N, 51°55' E, 2770 m, 14.4.2008 Abbasi, Fritsch 1242; GAT IRAN; 30°18' N, 51°58' E, 2600-2700 m, 14.4.2008 Abbasi, Fritsch 1237, 1238; GAT IRAN; 30°23' N, 51°55' E, 2850 m, 07.5.2010 Fritsch, Keusgen, Abbasi 1316; GAT IRAN). Limestone massif on the other side of the valley opposite to Dasht-e Arzhan (29°37' N, 52°01' E, 2450 m, 13.4.2008 Abbasi, Fritsch 1235, normal and albinotic plants; GAT IRAN). Limestone hills near the main road from Shiraz to Kazeroun c. 10 km E Dasht-e Arzhan (29°41' N, 52°03' E, 2030 m, 13.4.2008 Abbasi, Fritsch 1231; GAT IRAN). - **Kohgil. Buyerahmad:** Pass Bizhan between Sisakht and Podena (30°43' N, 51°52' E, 3240 m, 05.5.2010 Fritsch, Keusgen, Abbasi 1304; GAT IRAN). Dasht-e Rom mountains c. 3 km W Mansur Abad, locality Paserna, (30°33' N, 51°27' E, 2670 m, 06.5.2010 Fritsch, Keusgen, Abbasi 1310, normal and albinotic plants; GAT). Pass area between Kakan and Komehr, N slopes c. 1 km S of the road (30°31' N, 51°50' E, 2700-2750 m, 07.5.2010 Fritsch, Keusgen, Abbasi 1314; GAT IRAN). Mahparviz pass area c. 5 km S Vezg (30°30' N, 51°41' E, 2600-2800 m, 08.5.2010 Fritsch, Keusgen, Abbasi 1317, normal and albinotic plants; GAT IRAN). - **Yazd:** Nordwesthang am Berg Barf Khone, oberhalb Deh Balla (31°31' N, 54°15' E, ca. 2850 m, 12.5.1994 Fritsch 1018; 2800-3500 m, Fritsch 1025; GAT). Photos sent by Mr. M. Jaeger, plants collected in Iran: 5 km östlich von Daran, JZZ-43; Kuh-e Kallar, JZZ-67, JZZ-68; S Schachriaripaß, 32°15' N, 50°13' E, JMMZ-71; N Paß Kuhrang, 32°17' N, 50°13' E, JMMZ-77; von Abadeh nach Semirom, bei Melmand am Stausee "Hanna", JMM-25; Kuh Rang, Paß Gardaneh ye Cheri, JMM-65.

Herbarium vouchers: (Place not traced) in alpe Kuh-delu (???.1842 Kotschy 859; P G-BOIS). Hort. Genev. 4.5.1870 ex Persia ... (Hauskn.)/ culta in fenestri e bulbis Hausknechtii 05.5.1869 Reuter (G-BOIS). "Persia" (Aucher-Eloy 2210; P G). - **Chaharm. Bakhtiyari:** Farsan, Dehno, Ghorogh (32°13' N, 50°33' E, 2470 m, 27.5.1997 Gholamian 1323, 1324; ANS). Naghan, Bareh mordeh village (2360 m, 26.4.1998 Gholamian 2183; ANS). Borougen, Dareh-riz bejgerd (2610 m, 20.5.1996 Ghaedi 282; ANS). Gandoman, uoord rafeean (31°52' N, 51°10' E, 2870 m, 20.5.1997 Gholamian 3506; ANS). c. 15 km from pole Shahriadi to Kuhrang (2000 m, 14.5.1998 Mozaffarian 77883-TARI). Gandoman, communication station (31°52' N, 51°10' E, 2100-2600 m, 14.5.1999 Jamzad & al. 79967-TARI). Borujen, Ganduman Kuh-e Baraftab (31°52' N, 51°12' E, 2300 m, 31.5.1986 Mozaffarian 54749-TARI). Ardal, Zard-Kouh (32°00' N, 50°39' E, 2700-3200 m, 12.5.1974 Iranshahr, Moussavi 127; 221-IRAN; 14.-15.6.1973 Iranshahr, Moussavi 41837-IRAN). In declivibus montium 12 km a Borujen versus Sefid Dasht. (32°00' N, 51°13' E, 2300-2700 m, 02.6.1974 Rechinger 47055; W G). (Tang-e Sayed prot. region) in monte Pir Kuh 32 km E Shahr Kord. (32°12' N, 51°07' E, 2400-2700 m, 03.6.1974 Rechinger 47193; W). 12 km E Borujen, prope Faradonbeh (32°00' N, 51°13' E, 410-IRAN). Pataveh towards Falard (30°58' N, 51°16' E, 1500-1800 m, 20.5.1974 Iranshahr, Moussavi 408-IRAN). Kouhrang, Zardkouh (32°22' N, 50°10' E, 2100-2500 m, 03.6.1984 Termeh, Tehrani 43992-IRAN, 404-IRAN). Shahr-e Kurd, tang-e Sayyad protected area, pir Kuh (32°12' N, 51°07' E, 2500 m, 13.5.1987 Mozaffarian 59861-TARI). - **Esfahan:** Farydan, Khamis, Chogha-gard (2300 m, 19.6.1989 Termeh & al. 43053-IRAN). Bordekan a Kohrueh 40 km meridiem versus inter Shahreza et Semirom (31°31' N, 51°37' E, 2700 m, 05.6.1974 Rechinger 47365; W). Kuh-e Surmandeh (Kuh-e Alijug) N Semirom, in declivibus boreo-orientalibus (31°30' N, 51°42' E, 3900 m, 07.6.1974 Renz 47502; W B G). Fereyduh Shahr, Vahdatabad village, Mt. Pish-kuh (32°50' N, 50°07' E, 24.6.2006 Attar, Samani 36191; TUH). Khonsar Bu'in - Miyan Dasht Kouh-e Sangandaz (33°09' N, 50°17' E, 2700-3100 m, 18.6.1989 Termeh, Tehrani, Karavar 43054-IRAN). - **Fars:** Tang-e sorkh, 30 km SW Yasouy versus Ardekan (30°25' N, 51°45' E, 2000 m, 11.5.1977; HIU). Fars 10 km N Sissakht (30°58' N, 51°30' E, 2000 m, 12.5.1974 Iranshahr, Moussavi 407-IRAN). Nurabad: Doshman-Ziary region, vill. A-Zalou, Kuh-e Tasak (29°59' N, 51°30' E, 1900-2500 m, 31.5.1983 Mozaffarian 45763-TARI). 60 km S Abadeh, Kuh-e Bul, prope Aglid (30°48' N, 52°43' E, 2950 m, 25.5.1975 Foroughi 17328-TARI, 17329-TARI). Inter Abadeh et Dowlatabad, (1500-2000 m, 26.4.1956 Schmid 5265; G). Fasa, Kharman Kuh (28°59' N, 53°29' E, 2900 m, 06.6.1983 Mozaffarian 46943-TARI). Shiraz, Dasht-e Arjan, old road to Kazeroun, Kotal Pirehzan first pass (29°33' N, 51°57' E, 2100-2250 m, 28.5.1975 Foroughi 17476-TARI). Neyriz, Moshkan village, Kuh-e Kansar-e Sefid (2700-3000 m, 25.5.1975 Moussavi, Tehrani; IRAN). Estahbanat, Kuh-e Bisheh (29°08' N, 54°01' E, 2200-2400 m, 22.5.1975 Moussavi, Tehrani 43055-IRAN). Sissakht, Gardaneh-Bijan (30°53' N, 51°31' E, 28.6.1968 Kashkouli 411-IRAN). - **Kohgil. Buyerahmad:** Ab Sepa (2300 m, 06.5.1989 unclear collector 2980; ANY). Yasouj, Sepidar, Mt. Savers (30°42' N, 51°10' E, 2400-3100 m, 08.6.2011 Amini Rad, Torabi; IRAN).

Sisakht, Cheshmeh Mishi, Mt. Dena (30°53' N, 51°30' E, 2970 m, 09.6.2011 Amini Rad, Torabi; IRAN). Kuh-e Dinar (30°51' N, 51°27' E, 22.6.1975 Bauer, Kramer VO 6248 75/667; TUB). Yassoudj: Tcheshmeh-Mishi prope Kuh-e Dena (30°51' N, 51°29' E, 2550 m, 12.5.1977 (unknown collector) 44028-IRAN). Bizhan pass (30°53' N, 51°32' E, 23.6.1994 unclear collector 3054; ANY). Dashtak to Sisakht (30°54' N, 51°25' E, 2570 m, 25.5.2009 Mirinejad 7209 7039; ANY). Dehdasht, Sar Fayab, Mt. Nil (30°49' N, 50°55' E, 2965 m; 30°46' N, 50°58' E, 2270-2965 m, 10.6.2011 10.6.2011 Amini Rad, Torabi; IRAN). Tak Siseh (2500 m, 13.5.1990 (unclear collector) 2968; ANY). - Kurdistan: SW Sanadaj, Koremyryam mountain (35°12' N, 46°46' E, 2550 m, 09.6.2007 Maroofi, Karegar 8196; HKS). Sanandaj to Maryvan, Shaneshein mountain to Sarhovieh village (35°10' N, 46°42' E, 1800-2000 m, 04.5.2002 Said Shahab Khezri 5013; HKS). Saghez 15 km to Divandarreh, Fatah Abad (36°05' N, 46°50' E, 2450 m, 16.5.2006 Sajedi, Bahramishad 4022-Iran). - Lorestan: Najiu, (2200 m, 12.5.1937 Koeie 556; W). Sawers (30°42' N, 51°09' E, ???.7.1868 Haussknecht; P G-BOIS JE). - Markazi: Arak (34°04' N, 49°45' E, 06.6.1967 Kelet 406-IRAN). - Yazd: Tezerjan, Kuh-e Barfkhane (31°34' N, 54°09' E, 2400-2600 m, 30.5.1996 Mozaffarian 77535-TARI). Deh-Bala, Shirkuh mountain, sandy stony soil (31°36' N, 54°04' E, 3300 m, 21.6.1975 Foroughi, Assadi 17954-TARI). Taft. Gharieh-ye Hedash (Deh-bala) Godar-e Nir (31°37' N, 54°06' E, 2600-3000 m, 10.6.1976 Moussavi, Tehrani 43025-IRAN).

Determination unsure: Chaharm. Bakhtiyari: Taleh, on shale slope (10000', 07.5.1940 Koelz 15214; W). - Fars: Marvdasht, Abraj Kuh-e Ghaleh (30°11' N, 52°38' E, 1800 m, 06.5.1994 Zareh; HSU). Eglid, Kuhe Bol (30°47' N, 52°45' E, 04.6.1996 Hatami, Khozravi 10477; ARIS). Kakan (30°38' N, 51°48' E, Kashkouli ? 8045-E; 414-IRAN). Zhian Beiza (2650 m, 05.6.1988 Hatami 1160; HSU). Bamu protect. region (29°41' N, 52°46' E, 23.5.1995 Hatami, Sadeghian 11689; HSU). Eghlid, Kuhe Bol (30°47' N, 52°45' E, 3050 m, 04.6.1996 unclear collector; HSU). Sepidan Nasser valley (30°16' N, 51°58' E, 2600 m, 20.5.1989 Nikokar & al.; ARIS). - Kohgil. Buyerahmad: Dena, Bardshah (2800-3000 m, 25.6.1975 Safayian 56; TARI). c. 25 km E Yasuj on Ardekan road on Marl (30°39' N, 51°48' E, 3100 m, 22.5.1975 Bokhari 1647; TARI). - Lorestan: 58 km on road from Aligodarz to Shoulabad, pass N Chali Kuh (33°13' N, 49°24' E, 2900 m, 29.6.1977 Runemark, Lazari 26164-TARI). - Yazd: Sanich, Shirkuh massif (31°41' N, 54°00' E, 14.6.1995 Mosley Arany 366; HYU). Mt. Shirkuh (31°37' N, 54°04' E, 09.6.2002 unclear collector; ARIY). Tezerjan, Barfkhaneh mount (31°34' N, 54°09' E, 2450 m, 20.5.2004 Mir Hosseini 83-9; ARIY).

**26. *Allium latifolium*** Jaub. & Spach, Ill. pl. orient. 2: t. 103 (1846), non *Allium latifolium* W. Young, Cat. Arbr. Amer.: 28 (1783), nom. nud., necque *Allium latifolium* Gilib. Exerc. Phyt. 2: 470 (1792), opus utique oppr. - Regel in Trudy Imp. S.-Peterb. Bot. Sada 3: 242 (1875), Vved., Flora URSS 4: 260 (1935), Wendelbo, Flora Iranica No. 76: 74 (1971), Wendelbo, Fl. Iraq 8: 166 (1985), Kollmann, Fl. Turkey 8: 196 (1984), omnia sub *A. akaka*. Fritsch & Abbasi 2009: 13 f. - *Allium jaubertii* R.M. Fritsch in Phytion (Horn, Austria) 49: 182 (2010) [nom. nov. superfl.]. - Type: Iran: In Persiae hodernium provincià Aderbidjan (prope Said-Caidji et ad lacum Ourmiah), leg. Aucher Eloy No. 5384 (Holotype P?, not seen, isotypes P!, G-BOIS!, G!).

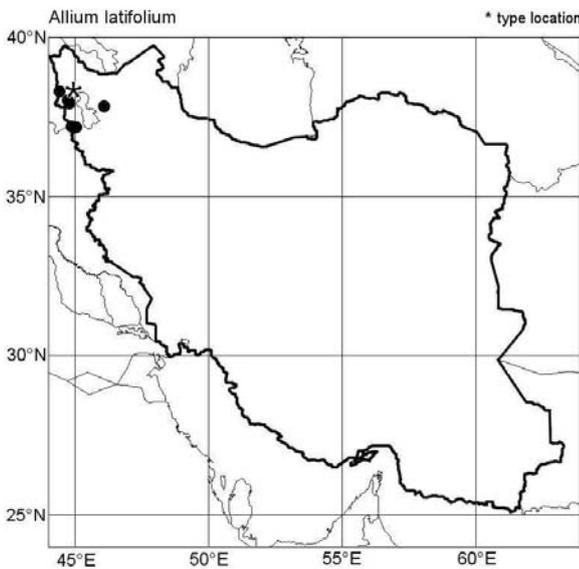


Plate T26. Flowering plant in prov. W Azarb. (photo courtesy of H. Razifard)

Bulbs subglobose. Scape terete, c. 20 cm long. Leaves 2, laminae ovate or sublanceolate, somewhat fleshy, glabrous; upper and lower side with broad ribs; margin subcartilaginous, purplish, tapering into a short cucullate apex; 8-12 cm long, 2.5-5 cm broad; green with glaucous bloom, basally purplish suffused. Spathe membranous, scarious, divided into 4 acute or acuminate, subovate, initially obliquely straight later reflexed valves, pale brown with darker veins. Inflorescence broadly fastigiate to subglobose, dense, many-flowered, 4-7 cm in diam. Pedicels thick, straight, longer than the spathe; purplish. Flowers funnel-shaped star-like. Tepals linear-

lanceolate, obliquely straight, subacute, somewhat recurved, subcanaliculate, acute; after anthesis convolute; 7-10 mm long, 1-1.5 mm broad; pale to deep pinkish-lilac with purple median vein. Filaments 3/5-3/4 as long as the tepals, triangular, fleshy, straight; pink throughout. Anthers oblong; yellow. Pollen yellow. Ovary pear-shaped, 3-sulcate, trilobulate, locules 2-ovulate, ovules anatropous, attached to the bottom. Style narrowly conical, 2-3 mm long; pinkish. Stigma punctiform, coarse; whitish. Capsule obovate-subglobose, deeply trisulcate, subcoriaceous, 1/2 as long as the tepals. Seeds 2 per locule, obovate,

bent, black, with elevated dots.



**Distribution:** Iran, prov. W Azarbaijan, montane to subalpine rocky and gravelly slopes.

**Remarks:** The characters of this description were combined from the original description, flower characters of the isotypes studied in W and G-BOISS (which differ remarkable in length and shape of tepals), and from a photo kindly supplied by H. Razifard. Thus some character states are open to verification by future analysis of living specimens. Samples suitable for molecular investigations could not be traced yet. Although the type location was twice visited, plants of *A. latifolium* could not be found there, but *A. materculae* was a common species in the mountains above the current settlement Sayed Hajadin. Because the isotypes clearly do not

belong to *A. materculae*, the type specimens were most probably collected at an unknown place near the lake Urmia. Plants of *Allium akaka* s. latiss. distributed West and North of lake Urmia belong to three species: *A. latifolium* and *A. subakaka* share broadly lanceolate to ovate leaves, a larger stature, and filaments 3/5 -3/4 as long as tepals, but *A. latifolium* is characterized by pink tepals crumpled after anthesis and unicolor pink filaments, whereas *A. subakaka* differs by more lilac and after anthesis stiff tepals and filaments very dark near the apex and fading towards the base. The third species is *A. iranshahrii*, a smaller species with inflorescences and pale pink flowers like *A. egorovae* but the filaments are only 1/3-1/2 as long as the tepals and carmine in the upper two-thirds fading towards the whitish base, and ovate to elliptic, deeply furrowed leaf laminae.

Only after publication of *A. jaubertii* as new name for *A. latifolium* Jaub. & Spach it became evident that the eldest identical binomen *A. latifolium* W. Young (1783) was not accompanied by a description and is therefore invalid. *Allium latifolium* Gilib. owns also no nomenclatural validity because it was published in a suppressed publication.

**Etymology:** The epithet refers to the broad leaf laminae, a character often met with in the genus *Allium*. The epithet *jaubertii* honors the renowned French botanist and politician H. F. Jaubert acting in the 19th century.

**Economic traits:** Mentioned in the literature to be used as food or medicine in Iran (Abbasi & al. 2008).

Herbarium vouchers: **W Azarb.:** bei Said-Caidji, und am Urumia-See (38°21' N, 45°03' E, Aucher-Eloy 5384; P W G-BOIS). Mogatel village, Bejour mountain, 54 km N Urmia (1310-1550 m, 26.5.1992 Alizadeh 1081, 02.5.1994 Alizadeh, Ghasempoor, Akhsanollahi 2788; ORUM). Ad radices Kuh-e Aq Kan Dagh, 64 km N Rezaiyeh, (38°05' N, 44°49' E, 2000 m, 24.5.1962 Furse 2255; W). In monte Chalil Kuh prope Razhan (37°22' N, 44°48' E, 2600-3200 m, 02.7.1974 Rechinger, Renz 48781; W G). In valle fluvii Qotur W Khvoy versus fines Turcicas (38°29' N, 44°27' E, 1800-2000 m, 10.6.1971 Rechinger 41587; W).

Determination unsure: **E Azarb.:** Tauris (?) (38°00' N, 46°08' E, ????.1863 Bèlangèr 83; P). - **W Azarb.:** in distr. Salmas prope opp. Deliman(?) (38°12' N, 44°45' E, G-BOIS). Sir Klisa village, Sir mountain, 20 km SW Urmia (37°21' N, 45°05' E, 1750-2150 m, 03.5.1994 Alizadeh, Ghasempoor, Bachshi 2926; ORUM).

### *Allium derderianum* alliance

**27. *Allium breviscapum*** Stapf in Denkschr. math.-nat. Cl. kais. Acad. Wien 50: 14 (1885). - Wendelbo, Flora Iranica No. 76: 73, tab. 7/96 (1971). - **Type:** Iran: Auf steinigen Abhängen bei Gentschnahme, 19 (?) Mai, second label: "*Allium breviscapum* Stapf, In declivibus saxosis ad Ganjname, 19/5. 82, leg. Th. Pichler" (lectotype WU!; design. Fritsch & al. 2010: 203).



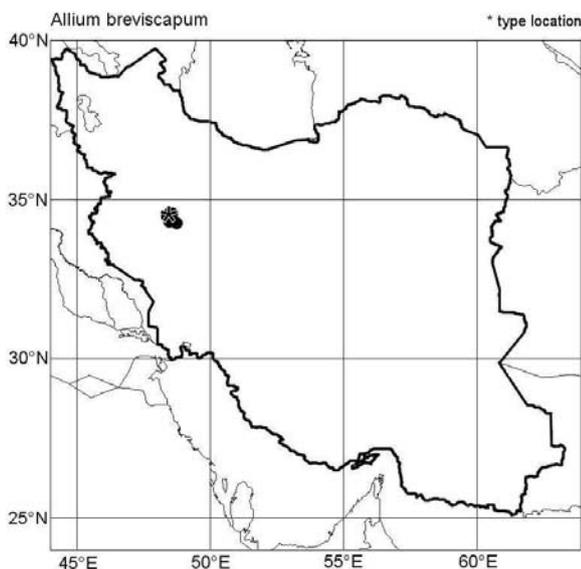
Plate T27. Plants from the type location. A: sprouting leaves; B: plants at begin of anthesis; C & D: flowering plants near Ganjname; E: shape of ovary, tepals and filaments of a flower prepared from herbarium; F: flowering plants, below left an albinotic plant; G, H & I: inflorescences in early and late anthesis; J: inflorescence with developing capsules; K: seeds (background raster 1 mm).

Bulbs ovoid, 2 cm in diam., 2.5 cm long; outer tunics leathery, blackish gray, near tip and base splitting; inner tunics white. Scape  $\pm$  flexuous, terete, smooth; aerial part 1-6 cm long, 4 mm in diam.; green basally reddish flushed. Leaves 2-4 (6), laminae long linear, falcate to undulate, canaliculate, flat arcuately ascending and recurved to the soil, thickish, rather long tapering towards the moderately hooded apex; margin narrowly cartilaginous, white, sparsely and very short ciliate, near base coarsely papillose; upper side mostly even and smooth, lower side with narrow and sharp ribs; 10-15 (25) cm long, 5-10 mm broad; dull grayish green, reddish flushed near the base. Sheath leaf short, thin membranous, whitish, soon decaying. Spathe thin membranous, incompletely split into 2 ovate to narrowly triangular,

acute, patent to reflexed valves; pale brownish with darker veins. Inflorescence broadly fastigiate later subglobose, dense, moderately many-flowered; 2-3 cm in diam., c. 2 cm long. Pedicels thickish, stiff, straight, unequally long; outer pedicels 10-14, inner ones 8-10 mm long; brown to purplish, later greenish. Anthesis in April to May. Flowers flat funnel-shaped star-like. Tepals linear-lanceolate, plicate, apex subobtusate,  $\pm$  patent, slightly recurved; basally shortly connate; after anthesis  $\pm$  obliquely forward directed, stiff by convolute margins but not prickly; 6-10 mm long, 1.5-2 mm broad; whitish with greenish to brown, after anthesis thickened median vein. Filaments  $2/5$ - $3/5$  as long as the tepals, fleshy; outer filaments triangular, inner filaments ovate with narrow apex and twice broader; basally 1 mm connate; white with  $\pm$  carmine tips. Anthers ovoid to oblong, c. 1.5 mm long, 0.7 mm broad; purplish. Pollen yellowish. Ovary sessile, depressed globular triangular, with 3 narrow and 3 wider furrows, surface finely coarse; c. 2 mm long and 2.5 mm in diameter; greenish with purple flush; nectary ducts lead in broad, transversal, pocket-like holes. Style 1.5-3 mm long, conical; white. Stigma punctiform; white. Capsule depressed-globose subtriangular; 4-5 mm long and in diam., widely opening; valves broadly obovate scarcely notched at the apex. Seeds 1-2 per locule, flat globose to drop-shaped with some angles, surface reticulate lacunose; 2.5-3 mm long, 2-2.5 mm wide and thick, dull black. The testa showed moderately Omega-like undulated anticlinal walls and coarsely verrucate periclinal walls (Fritsch & al. 2006).

Chromosomes:  $2n = 16$  Pogosian 1983 (Iran: Hamadan, Alvand Kuh, partly "*A. bodeanum*").

Distribution: W Iran; only known from the Alvand massif near Hamadan; upper montane to subalpine stony and gravelly slopes.



Remarks: Wendelbo (1971) cited the Takht-e Soleiman massif W Zanzan as second place. However, the voucher is unclear. It contains also a second label "Persia borealis: Elburs, Kalakan-Berge 20.5.1934 leg. Gauba" determined as "*A. derderianum* (= *A. breviscapum*)" by Bornmüller. At least two large inflorescences (voucher in B) fit much better to *A. derderianum*. Therefore this voucher is not cited here under *A. breviscapum*. Molecular markers (ITS sequences of nuclear rDNA) put *A. breviscapum* into a separate subgroup genetically closer related to *A. haemanthoides* s. str., *A. kurdistanicum*, *A. ubipetrense*, and *A. iranshahrii* (Fritsch & al. 2010; see p. 200) than to other subgroups of sect. *Acanthoprason*. Sequences of the plastid *trnL-trnF* region support a closer relationship to *A. materculae* and *A. egorovae* (as *A. shelkovnikovii*, Gurushidze & al. 2010).

Etymology: The epithet refers to the characteristic short scape of this species (from Latin).

Biological data: Genome size 46 pg 2C DNA (Gurushidze & al. 2012).

Economic traits: Local name 'kul'. Leaves and young stems, sometimes also bulbs, are used for a traditional soup-like dish 'aash', but apparently not much collected for culinary purpose (Fritsch & al. 2007).

**28. *Allium derderianum*** Regel in Trudy Imp. S.-Peterb. Bot. Sada 3, 2: 242 (1875). - Vved., Flora URSS 4: 259 (1935), p. p. Wendelbo, Flora Iranica No. 76: 72, tab. 7/95 (1971). Fritsch & Abbasi in Rostaniha 10 Suppl. 2: 25 ff. (2009). - *Allium ramazanicum* Parsa in Kew Bull. 1949: 34 (1949). Type: S Iran: Shahzad-i-Kuh, 3100 m, 30.4.1941, leg. Parsa (K!). - Type: Persia borealis, leg. Derderian (lectotype LE, photo seen, design. Agababian & Oganessian 2000). Epitype: Iran, prov. Tehran, Karaj, Chalus road, Asara, slopes N of the road. 23.5.2006 Abbasi, Fritsch, Keusgen (IRAN 44046;

design. Fritsch & al. 2010: 204).

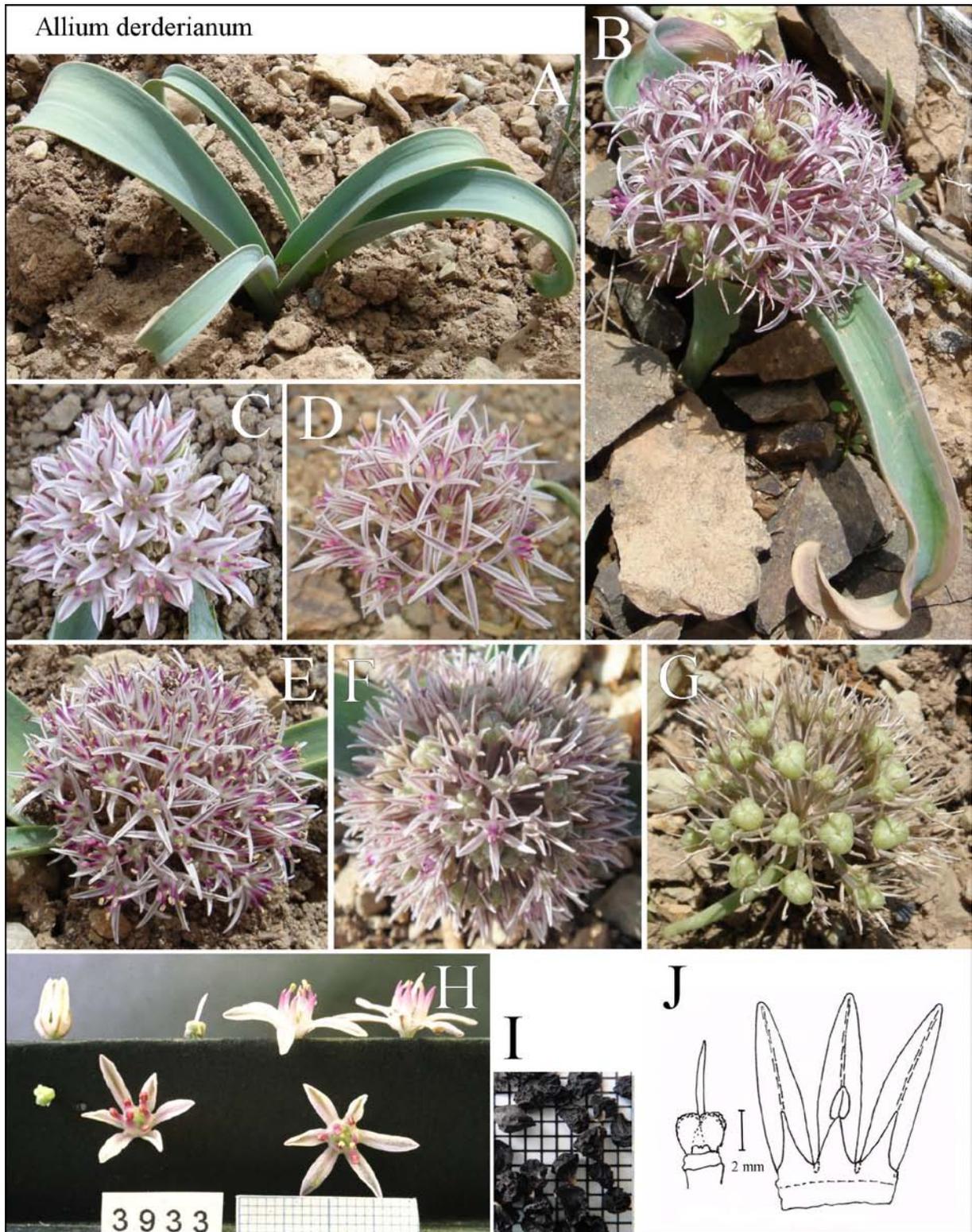
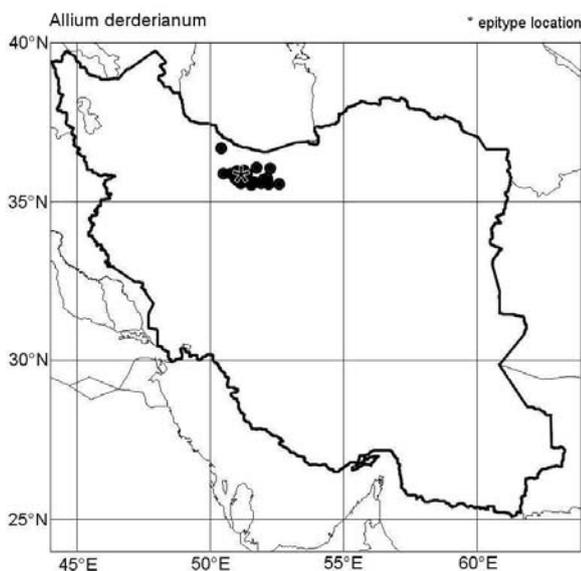


Plate T28. A: Sprouting leaves; B: flowering plant at the epitype location; C: inflorescence in anthesis of the alpine variant from Kandavan pass; D, E & F: inflorescences of the epitypical variant in early, full, and late anthesis, resp.; G: inflorescence with developing capsules; H: comparison of flower parts of a cultivated plant in different stages; I: seeds (background raster 1 mm); J: shape of ovary, tepals and filaments of a flower prepared from herbarium.

Bulbs broadly ovoid, 10-15 mm in diam.; outer tunics greyish, disintegrating; inner tunics membranous, white. Scape mostly subflexuous, terete, smooth; aerial part 1-4 (8) cm long, 3-5 mm in diam.; dull green with glaucous bloom, purplish towards base. Leaves 2 (-3), laminae linear-lanceolate, canaliculate, arcuately ascending and recurved to the soil, often undulate; margin hyaline, finely toothed, arcuately tapering in a short, cucullate, often circularly recurved apex; 8-13 cm long, 5-15 (25) mm broad; dull green with glaucous bloom, often red-brown flushed near the base. Sheath leaf short, hyaline, soon decaying. Spathe membranous, divided into 2-3 ovate or triangular, acute, finally reflexed valves  $\pm$  shorter than the pedicels; whitish with brown veins. Inflorescence semi- to subglobose, moderately many-flowered, dense; 4-5 cm in diam., 2-3 cm long. Pedicels moderately thick, stiff, subequally long; (8) 12-20 mm long; brown to purple. Anthesis in April to May. Flowers flat funnel-shaped star-like. Tepals narrowly linear-lanceolate, patent and recurved, apex  $\pm$  plicate and subacute; basally very shortly united; after anthesis with convolute margins, obliquely directed; 8-10 mm long, 1-1.5 mm broad; dirty white with narrow, brownish-green median vein, much broader and darker at the outer side; subalpine variant with 7-8 mm long and 2-2.5 mm wide, broadly lanceolate, obtuse tepals. Filaments 2/5-1/2 as long as tepals, triangular-subulate (inner filaments somewhat broader); basally very shortly connate; tip carmine fading towards the white base. Anthers ovoid, c. 1 mm long; purplish. Pollen yellow; 32.5-35.5  $\mu\text{m}$  long, 17-20  $\mu\text{m}$  broad, ratio 1.9, exine 0.8  $\mu\text{m}$  thick, ornamentation rugulate, perforations 0.12  $\mu\text{m}$  in diam. (Namin & al. 2009). Ovary sessile, obovoid to pear-shaped, triangular with 3 broad and 3 narrow, purple flushed furrows, surface finely coarse; 2-2.5 mm long, c. 3 mm in diam.; dull green; nectary ducts lead in transversal pockets. Style conical to thread-like, 2-5 mm long; whitish to rose. Stigma undivided; whitish. Capsule broadly pear-shaped with 3 wide furrows; 4-5 mm long and in diam.; widely opening; valves broadly ovate, notched at apex. Seeds 1-2 per locule, sector-shaped, surface irregularly reticulate lacunose with coarse sharp longitudinal ledges; c. 2.5 mm long, 1.5 mm broad and thick; dull black.

Chromosomes:  $2n = 16$  Pedersen & Wendelbo 1966 (Iran: Alborz mountain range).

Distribution: NW and N Iran; montane to alpine slopes of Central Alborz mountain range.



Remarks: According to the lecto-typification, this name must be applicable to plants from Alborz mountain range (because this species is not known to occur in any other area in North Iran). However, here different plants occur and were discussed by Fritsch & Abbasi (2008). Therefore an epitype was designated showing narrowly linear-triangulate tepals about 10 mm long and 1 mm wide (Fritsch 2008: 61, fig. 8A) as originally described by Regel (1875). Strong cultivated plants possess often longer and broader tepals. Plants growing in higher elevations show often shorter and broader tepals (Fritsch 2008: 61, Fig. 8B) as well as narrower but more tortuous leaves. They are regarded as a subalpine variant only because they conserved these characters in a lower degree when cultivated in Tehran

(Fritsch & Abbasi 2009). Molecular markers (ITS sequences of nuclear rDNA) confirm a somewhat isolated position in sect. *Acanthoprason* where it forms a group jointly with *A. alamutense* (see p. 200). *Allium austroiranicum*, another morphologically similar species, occupies a rather distant position basal in sect. *Acanthoprason*. Though an analysis of sequences of the plastid *trnL-trnF* region did not involve the above mentioned species, the position of *A. derderianum* was similar (Gurushidze & al. 2010).

Wendelbo (1971: 96) presented some arguments that the type of *A. ramazanicum* (unfortunately, more vouchers of this species are not known) was collected in the Alborz mountain range. The details shown by the scan of the type voucher agree rather well with Wendelbo's (1971) point of view, that this species is only an alpine variant of *A. derderianum*. The true identity can perhaps only be cleared by a careful search for similar plants in the type area indicated by Parsa in southernmost Iran (but after a rainy spring) as well as at Mt. Shahzad-i Kuh in Central Alborz.

**Etymology:** The epithet honors perhaps the Armenian missionary Joh. Derderian who acted in the Esfahan area in the 1830ies. Plant collected by Derderian in 1841 were reported from Sofi mountains (near Esfahan) and in "mont. Ginubine", prov. Chahamahale-Bakhtiyari, and perhaps elsewhere. The source of the epithet *ramazanicum* was not indicated, perhaps it refers to the settlement Ramazan situated NW Chabahar in southernmost Iran (prov. Sistan-o Baluchestan).

**Biological data:** Anatomical characters of the scape (certainly merged with another species because the scape does not bear trichomes and is not elliptic in cross section): 1.9 mm in diameter, 1 row of vascular bundles, 9 vascular bundles in the peripheral layer, largest vascular bundles 0.09 mm in diameter, 3 or 4 layers of "thick walled parenchyma" (Namin & al. 2009b). Genome size 43.4 pg 2C DNA (Gurushidze & al. 2012). Bulb extract showed a very high radical scavenger activity (Jedelská & Keusgen 2008).

**Economic traits:** Local name 'valak' or 'uolak'. Fresh leaves are eaten as vegetable (cooked with rice for pillaw, remark on the voucher Kotschy 150) or as salad. The local name and use is nearly identical to that of *A. akaka*; both species are possibly merged by some people (Fritsch & al. 2007).

Living accessions studied: **Tehran:** Kandovan pass area (36°09' N, 51°19' E, c. 2700 m, 19.5.1994 Fritsch 1099; 2980 m, 31.5.2005 Fritsch, Zarre 1045; GAT IRAN). Karaj valley, vill. Asara, slopes N of the road (36°02' N, 51°12' E, 1950 m, 19.5.1994 Fritsch 1095; 23.5.2006 Abbasi, Fritsch, Keusgen 1130; GAT IRAN, 3100 m, 15.5.2008 Razyfard 1260; IRAN). Tochal massif, Palanchal valley N Tehran (35°52' N, 51°23' E, 2750 m, 23.5.2007 Abbasi, Fritsch, Keusgen 1207; GAT IRAN). NW exposed limestone slope near pass Emam-Sadeh-Hashem (35°47' N, 52°02' E, 2615 m, 02.6.2005 Fritsch, Zarre, Moazzeni 1049; GAT IRAN). O exposed slope near village Abali (35°45' N, 51°57' E, 2100 m, 02.6.2005 Fritsch, Zarre, Moazzeni 1047; GAT). Dizin pass between Gajereh and Shemshak (36°02' N, 51°25' E, 3300 m, 24.5.2006 Abbasi, Fritsch, Keusgen 1135; GAT IRAN).

Herbarium vouchers: **Mazandaran:** Elika, Kamarbon, Kuh-e Varvasht (36°13' N, 52°18' E, 3200-3650 m, 13.-14.7.1980 Termeh, Daneshpazhuh, Zargani 44003-IRAN). Kojur, M. Uloj. (36°15' N, 51°46' E, 3200-3400 m, 09.8.1948 Reching 6479; W). 4 km SW Javaherdeh (36°51' N, 50°27' E, 2500-2800 m, 29.6.1976 Runemark, Masoumi 20867-TARI). E slope of Kuh-e Damavand, above Malar (35°55' N, 52°11' E, 2550-3600 m, 24.6.1979 Assadi, Mozaffarian 33166-TARI). In valle fluvii Chalus, (36°32' N, 51°22' E, 05.6.1937 Reching 508-c; W). - **Tehran:** Kandovan (36°09' N, 51°18' E, 3050 m, 2480 m, 20.6.1972 Amin, Musavi 14162-TARI; 19.5.1994 Fritsch 346-IRAN; 19.6.1996 Mazhari, Rahmanpour, Azargashb 75694-TARI). Karaj, Chalus road, Asara, slopes N of the road (36°02' N, 51°12' E, 1960 m, 23.5.2006 Abbasi, Fritsch, Keusgen 44046-IRAN). From Istgah Humand to Daryacheh-e Tar (35°43' N, 52°13' E, 2800-2950 m, 20.6.1996 Mazhari, Rahmanpour, Azargashb 75701-TARI). Lar valley, below Rudkhaneh Abru (Sefid Ab) (35°53' N, 52°01' E, 2300 m, 28.5.1974 Wendelbo & al. 11834-TARI). 16 km W Firuzkuh, stony slopes (35°43' N, 52°38' E, 2400 m, 02.7.1962 Furse 3053; W). 10 km Karaj Chalus (35°52' N, 51°03' E, 1750 m, 23.5.1973 Babakhanlou, Amin 14161-TARI). Basti prope Lashkargah, in declivibus saxosis (35°41' N, 51°37' E, 1800 m, 12.5.1977 Reching 55327; G). Karadj (35°49' N, 51°02' E, 06.8.1957 Gauba 409-IRAN). Abali to Tehran, S steep [slope?] (35°45' N, 51°57' E, 2050-2150 m, 16.5.2004 Mashayekhi, Moazzeni 34907-TUH; GAT). Bileghan, Karaj valley (35°50' N, 51°03' E, 1520 m, 15.5.1972 Riazi 3519; TARI). Chitgar (35°44' N, 51°11' E, 1320 m, 24.5.1972 Amini 3529; TARI). Kuha-ye Sadd-e Latyan (35°47' N, 51°40' E, 09.5.1975 Matin, Termeh 342-IRAN). Dizin road to Dizaj-abad, before pist ski (36°03' N, 51°25' E, 2700 m, 23.6.1993 Navaii, Baher 71909-TARI). Abasabad 9 km Firuzkuh (1800 m, 16.5.1973 Bazargan, Arazm 14175-TARI). Karaj - Manjil (1250 m, 22.5.1973 Sabeti 14177-TARI). Karaj - Kalak (35°48' N, 51°03' E, 1850 m, 20.5.1974 Dini 8891-TARI). Between Karaj and Chalus, Kandovan pass (36°09' N, 51°03' E, 2600-3000 m, 23.6.1979 Assadi, Mozaffarian 32818-TARI; 3250 m, 10.6.1997 Assadi, Pakravan, Aminian, Nikchehreh 76595-TARI). Jajrud, Haraz road, on tunnel (35°42' N, 51°31' E, 1650 m, 03.6.1974 Foroughi, Sanii, Moayed, Amini 12416-TARI). Rostamabad road of Firuzkuh (2550 m, 27.6.1972 Dini, Arazm 14157-TARI). W Tehran, Emamzadeh Davood (35°48' N, 51°21' E, 23.5.1999 Jamzad, Nickchehreh 78399-TARI). Between Tehran and Karadj, above Kalak village (35°48' N, 51°03' E, 1600 m, 01.6.1972 Forughian 14174-TARI; 1500-1900 m, 09.5.1978 Assadi, Mozaffarian 27559-TARI). Between Tehran and Karaj, Kuh-e Garm-darreh (35°46' N, 51°05' E, 1700 m, 08.5.1979 Assadi, Mozaffarian, Nowroozi 33351-TARI). Bomehen road of Tehran Abali (35°45' N, 51°57' E, 2000 m, 02.5.1973 Bazargan, Arazm 14159-TARI). Karaj, Chalus road near Azadbar, Kuh-e Zardgol, N slope (2700 m, 02.6.1991 Assadi, Shahsavari 69700-TARI). W Tehran, Sangan (35°52' N, 51°14' E, 24.6.1986 Jamzad 57091-TARI). Karadj. Kondor valley (35°51' N, 51°07' E, 2300 m, 15.5.1972

Riazi 3520; TARI). Ariamehr Bot. Garden, spontaneous (35°44' N, 51°11' E, 1320 m, 12.5.1974 Sani 11306-TARI; W; 1200 m, 18.4.1978 Freitag 14521; B KAS). Emamzadeh Hashem (35°47' N, 52°02' E, 3000 m, 01.7.1972 Dini, Arazm 14163-TARI). Abali (35°46' N, 51°58' E, 2750 m, 24.5.1973 Amin 14160-TARI). Karaj, above Velian (36°03' N, 50°50' E, 2000 m, 16.5.1978 Assadi & al. 32558-TARI). Supra Ab Ali, 64 km E Tehran, (35°45' N, 51°57' E, 2700 m, Furse 2571; W). Tochal (35°50' N, 51°20' E, 2500-2600 m, 21.6.2006 Amini Rad, Torabi, 48350-IRAN). Tehran, Tochal, between Sosd. (?) and 5th st. (26.5.2004 Mashayekhi, Moazzeni 34912-TUH; GAT). Karaj, Kuh-e-Dashteh (35°52' N, 51°01' E, 1500-1900 m, 19.5.1975 Matin, Termeh 43022-IRAN). W Tehran, Chitgar Park (35°44' N, 51°13' E, 30.4.1983 collector unclear 44015-IRAN). Karaj towards Qazvin, Abyek mountains (36°04' N, 50°32' E, 25.4.1976 Termeh, Matin 43021-IRAN). SW Sat-e Latyan (35°47' N, 51°39' E, 1900 m, 22.5.1973 Arazm, Bazargan 14172-TARI). Prope Tehran, Hügel hinter Doschantepe (30.5.1909 Bruns; B). Dizin, Golleh-ye Siah (36°03' N, 51°25' E, 3000-3500 m, 23.6.1982 Moussavi, Habibi, Tehrani 43023-IRAN). Mountains NW Tehran, Suleghun (1600 m, 01.5.1979 Assadi, Mozaffarian, Nowroozi 33663-TARI). Evin (35°48' N, 51°24' E, 2000 m, 30.5.1967 Mirzayans 345-IRAN). Karaj, Atashgah (35°55' N, 50°59' E, 1800-2000 m, 18.5.1975 Termeh, Matin 43024-IRAN). Central Alburz, Velenjak (35°49' N, 51°23' E, 19.6.1972 Termeh, Zargani 44014-IRAN). Alborz, Kolak-Chal (35°51' N, 51°27' E, 1900-2550 m, 22.5.1975 Matin, Termeh 343-IRAN). Kouhé Vélénjak (35°49' N, 51°23' E, 08.5.1973 Termé, Zargani 413-IRAN). Alborz: Elika, Varvasht (montis) (36°13' N, 52°18' E, 4000 m, 03.8.1972 Termeh 224-IRAN). Darband towards Tochal (35°50' N, 51°25' E, 01.7.1968 Termeh, Izadyar 44001-IRAN). Haraz valley, just at the entrance of Ab-Ali (35°45' N, 51°57' E, 2050-2150 m, 16.5.2004 Zarre, Mashayekhi, Moazzeni 35026; B). Taleqan (2400 m, 12.7.1972 Mirfakhrai 14164-TARI).

Determination unsure: Mazandaran: Larijan, Rineh Kuh-e Damavand, (35°53' N, 52°10' E, 2750 m, 20.6.1982; Moussavi, Habibi, Tehrani; IRAN). In solo schistoso m. Elbrus prope Derbent (35°50' N, 51°26' E, 6000-8000', 15.5.1843 Kotschy 150; G G-BOIS.). Chitgar (35°44' N, 51°11' E, 1320 m, 30.4.1970 Foroughi 79; TARI). 81 km après Téhéran (2500 m, 07.6.1963 Jacquemart 8812; BR).

**29. *Allium egorovae*** M.V. Agab. & Ogan. in Willdenowia 30: 95, Fig. 1, 4 (2000), Oganessian & Agababian, Flora Armenii 10: (2001) 298, 345, tabl. 110. - Vved., Flora URSS 4: 259, (1935) p. p. quoad pl. transcauc., Agababian & Oganessian in Willdenowia 30: 96, Fig. 6 (2000), Oganessian & Agababian, Fl. Armenii 10: 298, 348, tabl. 111 (2001), Kudryashova in Bot. Zh. 86, 4: 130 (2001), omnia sub *Allium derderianum*. - Type: Azerbaijan, Nakhichevan: Vyshe s. Aravsá, bassejn verkhnego pritoka Alindzhachaj. Raznotrav'e, 1700-2200 m, 28.6.1963 leg. Mulkidzhanian (holotype 81409-ERE, isotypes B and 81410-ERE, 81416-ERE).

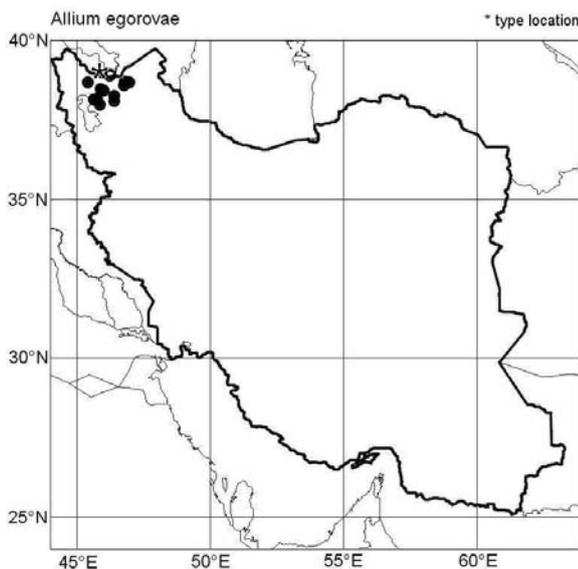
Bulbs ovoid to globose, 2-3 cm in diam.; outer tunics papery, blackish; inner tunics white. Scape ± flexuous, terete, stiff, smooth or slightly papillous; aerial part 2-7 cm long, 2-4 mm in diam.; green with glaucous bloom, purplish towards base. Leaves (1) 2-3 (4), laminae linear-lanceolate, obliquely arcuate recurved to the soil, canaliculate, arcuate or gradually tapering into the hooded apex; margins reddish to white, smooth or very finely toothed; 10-20 (30) cm long, 8-30 mm broad (inner leaves much narrower than outer ones); green with glaucous bloom, near base sometimes purplish flushed. Sheath leaf nearly invisible above soil, fine membranous, brownish, soon decaying. Spathe membranous, split into 2-3 ovate acute valves, as long as the pedicels or shorter, patent; pale yellowish brown with darker veins. Inflorescence broadly fastigiate to semi-globose, in the fruiting state subglobose, dense, moderately many-flowered; 4-5 cm in diam., 2-3 cm long. Pedicels subequally long, thick, stiff; 12-20 mm long; greenish-purple with paler base. Anthesis in May to June. Flowers broadly funnel-shaped star-like, with very sweet odor. Tepals oblong to linear-lanceolate with obtuse to rounded, slightly cucullate apex, obliquely patent; basally for 1 mm connate and adnate to filaments; after anthesis incurved with dry margins, mucronate tip, and thick median vein; (6) 8-9 mm long, c. 1.5 mm broad; dirty white to pinkish with greenish-purple median vein. Filaments about 1/2 as long as the tepals, fleshy; outer filaments long-triangular, inner filaments ± ovate with short narrow apex and slightly longer; basally for 1.5-2 mm connate; ± purple or deep brown with white base. Anthers ovoid to obcordate, 1-1.5 mm long; pink to violet. Pollen pale yellow. Ovary depressed-globose triangular with 3 narrow and 3 broad furrows, surface finely coarse; 2-2.5 mm in diameter, 2 mm long; green with purple flush; nectary ducts lead in transversal nose-like pockets near the base of ovary. Style conical, 1.5-3 mm long; white to pinkish. Stigma undivided; white. Capsule ovate to pyriform with 3 broad and deep furrows on the apex and along the upper part; 5-6 mm long and in diam.; widely opening; valves broadly elliptical, rarely with elongated apex, shallowly notched at the apex; greenish-ochre. Seeds 1-2? per locule, flat ovate to kidney-shaped, surface strongly reticulate lacunose; 2.5-3 mm long, 2-2.5 mm broad, 1.5-2 mm thick;

subglossy black.



Plate T29. A: Leaves and scapes after sprouting at Mt. Kustup, Armenia; B: leaves and young scapes near vill. Kalder, Armenia; C: flowering plant at Mt. Chama; D: shape of ovary, tepals and filaments of a flower prepared from herbarium; E & F: plants in early and full anthesis, resp.; G & I: inflorescences in early and full anthesis, resp. (near Kalder); H: inflorescence in early anthesis (at Mt. Misho); J: inflorescence in full anthesis (at Mt. Chama); K & L: inflorescences in late anthesis and with developing capsules, resp.; M: inflorescence with full-sized capsules (at Mt. Chama); N: seeds (background raster 1 mm).

**Chromosomes:**  $2n = 16+0-1B$  Pogosian 1983, 1985b tab.3 (Armenia: Mt. Khustup, "*A. derderianum*").  $2n = 16+0-1B$  Pogosian 1983 fig. 3+3 (Armenia: Mt. Kapudzhikh, "*A. derderianum*").



**Distribution:** S Transcaucasus: Nakhichevan, Armenia, N Iran; middle and upper montane, herbaceous, rubble and stony slopes (Oganesian & Agababian 2001).

**Remarks:** This species is sometimes not easy to separate from the alpine variant of *A. derderianum* because the leaves may look similar, although the areas of distribution differ remarkably. *Allium egorovae* is characterized by more oblong-lanceolate, obtuse tepals crumpled after anthesis, and fleshy short filaments having deeply maroon to purple upper parts, whereas the mentioned variant possess lanceolate, subacute tepals straight and prickly in the dry state, and slender long filaments pink colored towards the apex. The plants named

with some doubt as *A. shelkovnikovii* by Fritsch (2008: 60) do also belong to *A. egorovae*. According to molecular markers (ITS sequences of nuclear rDNA, see p. 200), *A. egorovae* clusters jointly with *A. materculae*, *A. subakaka*, and *A. alekii* in one group in some distance to the group of *A. derderianum*. Sequences of the plastid *trnL-trnF* region (as *A. shelkovnikovii*, Gurushidze & al. 2010) confirmed the close relation to *A. materculae* and more distance to *A. akaka*.

**Etymology:** Named after the outstanding contemporary Russian botanist and nomenclatorist T. Egorova acting in Leningrad/St. Petersburg.

**Biological data:** Different genome sizes were reported [pg 2C DNA]: 27.1 (Vakhtina & al. 1977 as *A. akaka*), 25.6 (Zakirova 1989 as *A. akaka*), and 41.7 / 39.4 (Gurushidze & al. 2012 as *A. shelkovnikovii*).

Living accessions studied: **E Azarb.:** Mt. Kuh Chama N Marand (38°08' N, 45°55' E, 2360 m, 05.6.2005 Fritsch, Zarre 1063; GAT IRAN). Southern slope of Mt. Misho E village Payam S Marand (38°20' N, 45°48' E, 2060 m, 05.6.2005 Fritsch, Zarre 1062; GAT IRAN). Pass between Hamamlu and Meshg Anbar c. 70 km NE Tabriz (38°26' N, 46°26' E, 2400 m, 09.5.2011 Fritsch, Pahlevani 1344; GAT IRAN). Arasbaran, Kaleibar, Mahmudabad road, Aghadash crossroad (38°16' N, 46°28' E, 1200 m, Razyfard 1261; IRAN). Munguglu secure zone in Marakan protected area near Jolfa, 38°51' N, 45°27' E, 1279 m, 08.4. 2009 Nafisi; photo seen)

Herbarium vouchers: **E Azarb.:** c. 30 km NE Marand, Kuh-Kamar village (38°38' N, 45°55' E, 2000-2600 m, 17.6.1988 Assadi, Shahsavari 65614-TARI). Kiyamaki prot. region, Kiyamaki Dagh in monte Mohammad Salah (38°36' N, 46°02' E, 2600-2900 m, 17.6.1977 Rechinger W. 56936; W B; 3000-3100 m, 17.6.1977 Rechinger W. 56953; G). Kiyamaki prot. region, Kiyamaki Dagh in monte Kenar Dagh (38°36' N, 46°02' E, 2600-3200 m, 17.6.1977 Renz J. 57013; W B). Arasbaran prot. area, 9.5 km from Mazrud to Nabijan vill., Kuh-e Doghrun (2570 m, 16.6.1997 Gharemani, Imani 6489; HTRC). Arasbaran, Doghoron mountain (38°46' N, 46°49' E, 2250 m, 12.6.2008 Maroofi, Karegar 8480; HKS). 58 km from Tabriz to Marand, Yam village, Kuh-e Misho Dagh (38°20' N, 45°47' E, 1950 m, 11.5.2001 Gharemani, Imani 7116; 2000 m, 13.5.2002 Gharemani, Imani 7630; HTRC). Tabriz: Golzar vill. Kuh-e Kazbeh (38°25' N, 46°26' E, 2450 m, 19.6.2002 Gharemani, Imani 7896; HTRC). - **Gilan:** Amarlou, Damash, Kuh-e Zard Chin (1750-2250 m, 04.7.1972 Termé, Daryadel 214-IRAN; 30.5. 1973 Termé, Daryadel 128; 223-IRAN).

Determination unsure: **E Azarb.:** Arasbaran protected region. Western part of Makidi. (38°51' N, 46°53' E, c. 2300 m, 08.6.1976 Assadi, Massoumi 20228-TARI). Arasbaran to Ahar 7 km to Barzid village (38°51' N, 47°01' E, 1800 m, 13.7.1991 Zehzad, Jamzad, Taheri, Izadpanah 70664-TARI). Arasbaran protected area, between Kharil and Makidi (38°50' N, 46°54' E, c. 2000 m, 29.5.1977 Assadi, Vosoghi 24865-TARI). Arasbaran protected area, Kalan mountain on the W side of guard station (38° 52' N, 46° 50' E, 2470-2550 m, 11.7.1991 Jamzad, Zehzad, Taheri, Izadpanah 70245-TARI). Shabestar: Benis village Kuh-e Misho Dagh - Darah (38°19' N, 45°41' E, Kasebi, Gharemani, Imani 6448; HTRC).

**30. *Allium shelkovnikovii*** Grossh. in Beih. Bot. Centralbl. 44, II: 205 (1928). - Wendelbo, Flora Iranica No. 76: 74, tab. 7/99, tab. 25/4 (1971), p. p. - *Allium akaka* subsp. *shelkovnikovii* (Grossh.) Wendelbo in Kew Bull. 28: 29 (1973), p. p. - **Type:** Iran: Atropatania, ad lacum Urumia, Danalu, 10.5. 1916, leg. Shelkovnikov (Lectotype LE, hic designated).

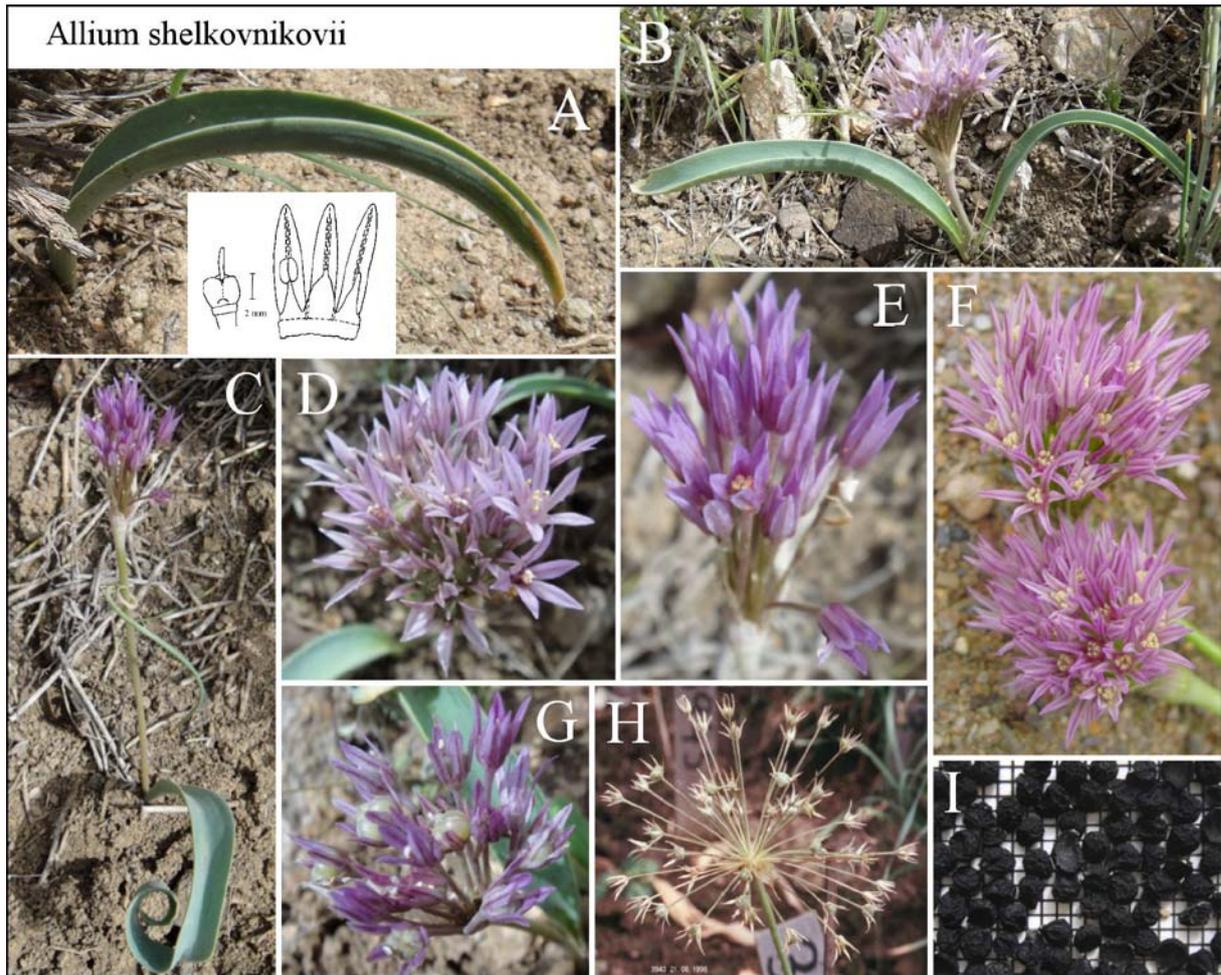
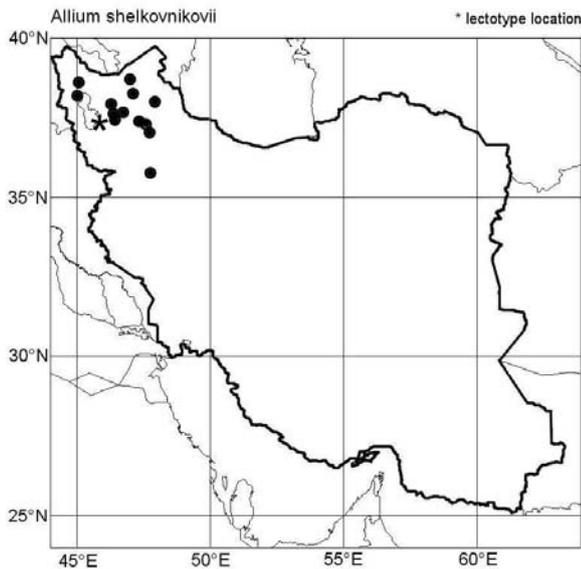


Plate T30. A: Vegetative plant at lectotype location; inset: shape of ovary, tepals and filaments of a flower prepared from herbarium; B & C: flowering plants at lectotype location; D & E: inflorescences in late and early anthesis, resp.; F: inflorescences in full anthesis; G & H: inflorescences after anthesis and with full-size capsules, resp.; I: seeds (background raster 1 mm).

Bulbs subglobose, 1.5-2 (3) cm long and in diam.; outer tunics papery, somewhat longitudinally splitting, brownish gray or purplish; inner tunics white. Scape  $\pm$  flexuous, terete, smooth; 5-12 (20) cm long, 4-6 mm in diam.; fresh green or brown with glaucous bloom. Leaves 1-2, laminae linear-lanceolate, moderately canaliculate, thick, obliquely arcuately ascending and reflexed to the soil, gradually tapering into the short cucullate apex, upper 1/3 of laminae often backwards enrolled; margin basally toothed becoming smooth towards the tip; upper side smooth, lower side with shallow broad ribs; 8-12 (20) cm long, 5-15 (30) mm broad; green with glaucous bloom, often purplish suffused near the base. Sheath leaf hyaline, subterranean, soon decaying. Spathe membranous, partly split into 2(-3) triangular acute valves, straight or upper part reflexed; pale brown or purplish with greenish or brownish veins. Inflorescence narrowly fastigiata, moderately many-flowered, initially dense and 2-4 cm in diam., after anthesis 5-6 cm in diam., in the fruiting stage loose and often subglobose, up to 10 cm in diam. Pedicels rather thin, unequally long, smooth; initially lax and recurved 1-2.5 cm long, later stiff and straight, up to 5 cm long; green, purplish suffused. Anthesis in April to May. Flowers narrowly campanulate to funnel-shaped star-like. Tepals narrowly oblong to lanceolate,  $\pm$  acute, obliquely straight directed, somewhat recurved; after anthesis margins convolute and median vein thick and stiff; 7-8 (10) mm long, c. 2 mm broad; pink or lilac-pinkish with greenish-brown, rather broad median vein. Filaments 2/5-1/2 as long as the tepals,  $\pm$  fleshy, straight, inner filaments ovate, outer filaments  $\pm$  narrowly triangular; basally shortly connate; pinkish, darker towards apex. Anthers oval, c. 1 mm long; yellow. Pollen pale yellow. Ovary sessile, depressed-globose triangular with 6 furrows and  $\pm$  concave apex, surface finely tuberculate; c. 2 mm long and 2-2.5 mm in diameter; dull pale green. Nectary ducts lead in transversal pockets. Style narrowly conical, 1-4 mm long; whitish. Stigma undivided; white. Capsule depressed globose with 3

deep furrows; c. 4 mm long, 5 mm in diam., widely opening; valves transversely ovate, deeply notched at the apex. Seeds 1(-2) per locule, sector-like drop-shaped, some seeds with a concave side finely tuberculate without or with a few irregular ledges surrounded by sharp edges, convex side(s) irregularly reticulate lacunose; c. 2.5 mm long, c. 2 mm wide, 1.5-2 mm thick; dull black.



**Distribution:** E Turkey?, NW Iran, prov. W & E Azarbaijan, submontane to montane, dry rocky and rubble slopes.

**Remarks:** The protologue of *A. shelkovnikovii* mentioned two syntypes, one of which without collector and from an unclear place ("prope Tabris, 1400 m, in schistosis, 16. VI."). Therefore the second syntype is designated here as lectotype.

The characters mentioned in the original description are applicable to more than one *Allium* taxon occurring in the vicinity of lake Urmia, and the syntypes could not be studied hitherto. Fortunately, living plants could be found and studied at the lectotype location. They showed  $\pm$  narrow leaves, initially fasciculate and finally subglobose, very

loose inflorescences, lanceolate tepals, and filaments with a darker apex. These are distinct morphological differences to *A. akaka* and *A. haemanthoides* as well as to those plants named with some doubt as *A. shelkovnikovii* by Fritsch (2008: 60) and later identified as *A. egorovae*. Molecular markers (ITS sequences of nuclear rDNA) underlined a larger genetic distance of *A. shelkovnikovii* s. str. to *A. akaka* sensu Wendelbo. These data put *A. shelkovnikovii* into one subgroup with *A. graveolens*, *A. hamedanense* and *A. mahneshanense*, whereas *A. akaka*, *A. haemanthoides*, and *A. egorovae* belong to different well supported groups (see p. 200).

**Etymology:** The epithet honors to the Russian zoologist and botanist A. B. Shelkovnikov acting in the first decades of the 20th century. He collected the lectotype specimen.

Living accessions studied: **E Azarb.:** Tuff- und Basalthänge in SE- bis SW-Lage am Fluß Kesel-Owsan ca. 27 km vor Mianeh (37°13' N, 47°46' E, 1200 m, 23.5.1994 Fritsch 1115; GAT). Hill near the shore of lake Orumiyeh 200 m from the ancient port Bandar-e Danalu c. 7 km W Ajabshir (37°29' N, 45°49' E, 1350-1400 m, 11.5.2011 Pahlevani, Fritsch 1351; IRAN, GAT).

Herbarium vouchers: **E Azarb.:** S slope of Kuh-e Sahand (37°37' N, 46°28' E, 2600-3500 m, 05.7.1978 Assadi, Mozaffarian 30759-TARI). Kuh-i Sahand supra Liqvan (37°47' N, 46°25' E, 2400-3000 m, 31.5.1962 Furse 2332; W). 50 km to Zanjan on the road from Tabriz (37°51' N, 46°46' E, 1300 m, 13.6.1976 Assadi, Massoumi 20607-TARI). 10 km on the road from Mianeh to Zanjan (37°28' N, 47°37' E, 1000 m, 27.5.1976 Runemark, Foroughi 19932-TARI). Kalibar, Nabadjan, Kouha-ye Doghroun (38°52' N, 47°02' E, 2720 m, 26.6.1978 Termeh, Moussavi, Habibi 211-IRAN). Miyaneh: 1 km to Turkman Chay (37°34' N, 47°23' E, 1550 m, 07.6.1992 collector unclear 5198-HTRC). Road of Toupkhaneh after Ashayehri to Mahmoodabad (2300 m, 16.6.2005 Ghahreman, Attar, Hamzeh'eh 35574; TUH). Ahar, Tazehkand towards Nabijan, Kuhha-ye Sarpeh-darreh (38°25' N, 47°08' E, 2500-2700 m, 23.6.1978 Termeh, Moussavi, Habibi 344-IRAN). - **W Azarb.:** S foothills Kuhha-ye Sabalan, 32 km W Ardabil (38°10' N, 47°57' E, 2100 m, Furse 2452; W). - **Kurdistan:** Zanjan to Bijar, pass S Khur-Khureh (35°57' N, 47°47' E, 1750 m, 31.5.1974 Wendelbo, Shirdelpur, Assadi 11929-TARI).

Determination unsure: **E Azarb.:** near Tabriz (38°06' N, 46°20' E, Razyfard 34268; TUH). - **W Azarb.:** Seid Hadji (38°21' N, 45°03' E, Aucher-Eloy 9384; W). In faucibus calc. 86 km NW Marand (38°47' N, 45°07' E, 1000 m, 08.6.1971 Rechingler 41527; W). ? M. Karaghan (media), inter Schurab et Ahwe (Pichler; WU).

**31. *Allium alamutense*** Razyfard, Zarre & R.M. Fritsch in Ann. Bot. Fenn. 48: 353, fig. 1, 2. (Oct 2011). - *Allium derderianum* auct., p.p. - **Type:** Iran, prov. Qazvin, Alamut mountains, a few kilometers before Moalem Kalayieh, near Evan Lake, 1700 m, 36°31' N, 50°28' E, 19.5.2008, Salmaki, Razyfard (holotype 34349-TUH!).

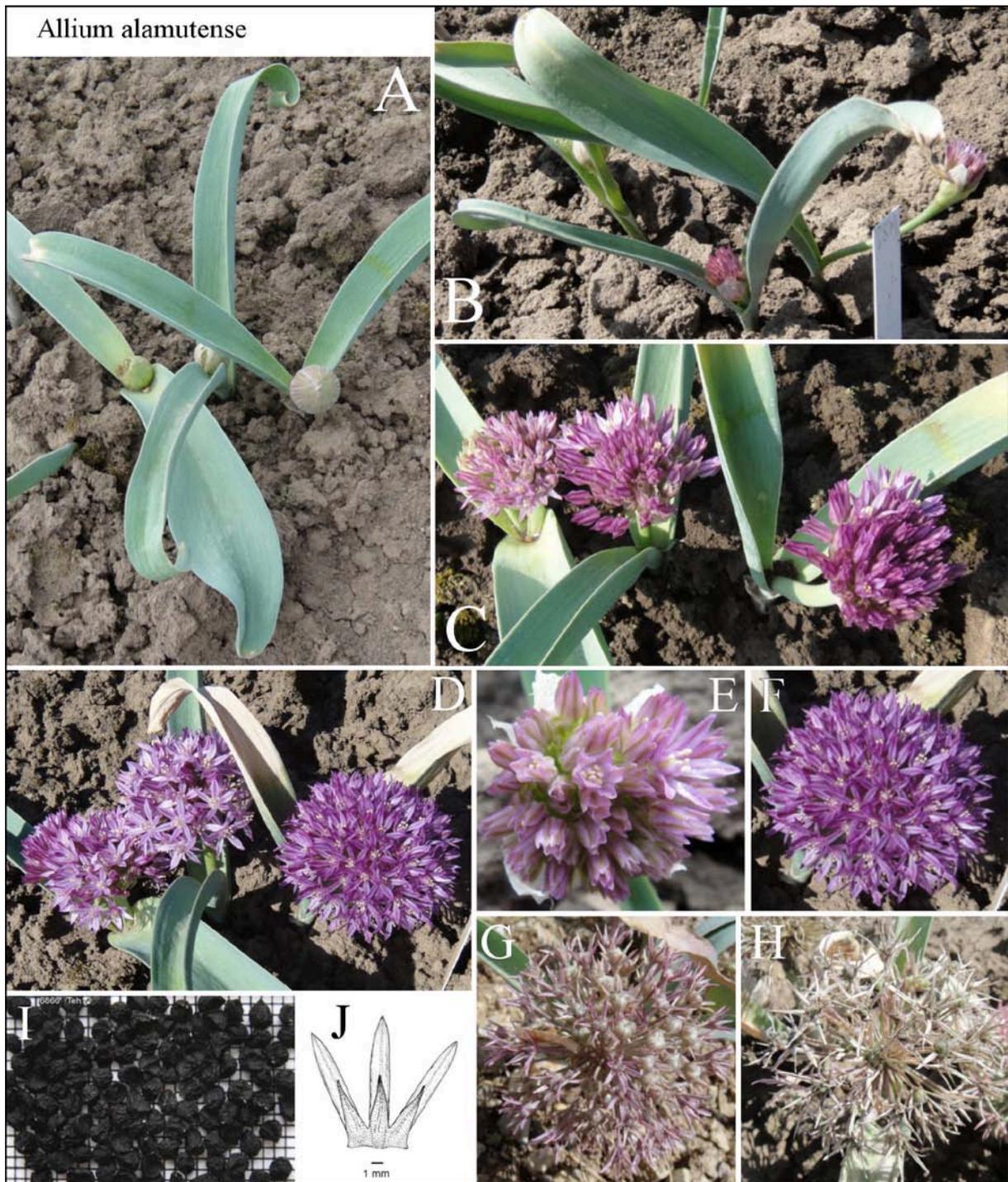
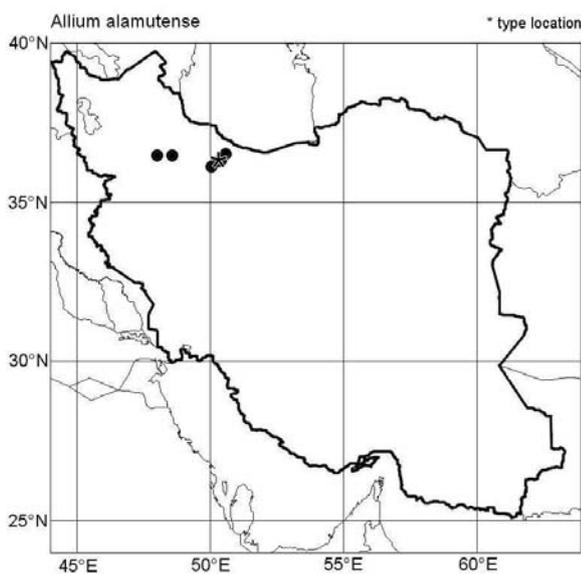


Plate T31. A: Leaves and scapes after sprouting; B, C & D: plants prior to anthesis, in early, and in full anthesis, resp.; E & F: inflorescences in early and full anthesis; G & H: inflorescences after anthesis, and with developing capsules, resp.; I: seeds (background raster 1 mm); J: tepals and filaments of a flower prepared from herbarium (from Razyfard & al. 2011: Fig. 2B).

Bulbs ovoid-globose, 15-23 mm in diam.; outer tunics blackish-brown, disintegrating. Scape terete,  $\pm$  flexuous, smooth; aerial parts 2-5 cm long, c. 3-4 mm in diam.; green, glaucous, basally often brownish flushed. Leaves (1)-2, laminae linear-oblong to lanceolate, thick and fleshy,  $\pm$  falcate, steep arcuately ascending and recurved to the soil, broadly canaliculate, shortly arcuately tapering into the hooded apex; upper side smooth, lower side slightly furrowed; margin finely toothed (sometimes smooth), white; 10-15 cm long and 1-1.5 cm broad; pale yellow-green, purplish flushed towards the base. Sheath leaf thin membranous, translucent, quickly decaying. Spathe membranous, splitting into 2 or 3 ovate,  $\pm$  acute, patent to reflexed valves; whitish with brown veins. Inflorescence semi-globose, dense, moderately many-flowered; (2) 4-6 cm in diam. Pedicels thickish, straight, stiff, up to 15 mm long; brownish

green to purple. Anthesis in May. Flowers  $\pm$  broadly funnel-shaped star-like. Tepals lanceolate, obliquely patent, subacute with shortly plicate apex; after anthesis longitudinally convolute, stiff and straight; 8-10 mm long and up to 2 mm wide in the middle; pink to dark lilac, with a broad purple median vein. Filaments 2/5 as long as the tepals, straight, fleshy, inner filaments triangular, outer filaments subulate; basally triangular broadened and for 1.5 mm connate and adnate to the tepals; initially pink at the apex and finally darker at the base. Anthers subovoid, ca. 1 mm long; yellowish. Pollen yellow. Ovary obovoid triangular, surface smooth and dull; 2-3 mm long and in diam.; light green; nectary ducts lead in triangular pits at half of ovary length. Style narrowly conical, ca. 2 mm long; whitish. Stigma undivided; white. Capsule depressed-globose triangular with three furrows, surface somewhat reticulate-lacunose; ca. 4 mm long and 4-5 mm in diam.; initially grayish-green with purple flush, finally yellowish-brown; valves  $\pm$  transversely elliptic with a broad longitudinal furrow, apex broadly notched. Seeds 1-2 per locule, sector-like drop-shaped, concave-convex, concave side finely tuberculate without or with a few irregular ledges surrounded by sharp marginal ledges, convex side irregularly reticulate lacunose; c. 2.5 mm long, 2-2.5 mm wide, 1.5-2 mm thick; dull black.



**Distribution:** Iran, prov. Qazvin; montane stony slopes with slightly moist soils; occurrence in prov. Zanjan needs confirmation.

**Remarks:** At first glance, the species is most similar to *A. derderianum* and *A. egorovae* because of its small size and  $\pm$  narrow leaves. It differs from *A. derderianum* by darker and lanceolate (not triangular) tepals, and filaments darker at the base (not darker at the tip) though both taxa share undulate leaves. *Allium egorovae* differs still more by having straight leaves, whitish tepals, sublinear outer tepals, and purple to red-brown upper part of filaments. Molecular markers (ITS sequences of nuclear rDNA) of the type specimen of *A. alamutense* (Fritsch & al. 2010 as "A. sp. 9", see p. 200) confirmed a position very close to *A. derderianum*.

confirmed a position very close to *A. derderianum*.

**Etymology:** The epithet refers to the geographic area of the type location.

Living accessions studied: **Qazvin:** Gypseous slopes near the main road from Shahrud valley to Qazvin below pass (36°28' N, 50°22' E, 1400 m, 02.5.2011 Pahlevani, Fritsch 1326; IRAN GAT). Granitic massif near the road from Qazvin to Shahrud valley S pass (36°23' N, 50°13' E, 2260 m, 02.5.2011 Fritsch, Pahlevani 1325; GAT; 36°22' N, 50°12' E, 2140 m, 02.5.2011 Pahlevani, Fritsch 1322; IRAN). Photos sent by M. Jaeger, plants collected in Iran: Paß N Quazvin, JZZ-135, JZZ-137; 40 km W Hashdrud, 37°19' N, 46°43' E, JJMZ-248. - **Zanjan:** Spurs of Mt. Damarlu W Zanjan, (36°39' N, 48°04' E, 2370 m, 04.5.2011 Fritsch, Pahlevani 1330; GAT IRAN).

Herbarium vouchers: **Qazvin:** Alamut Mts., a few kilometers before Moalem Kalayieh, near Evan lake (36°20' N, 50°12' E, 1700 m, Salmaki, Razyfard 34349-TUH). Qazvin, in collibus (36°18' N, 50°05' E, 1200-1300 m, 11.5.1902 Bornmüller 8316; B). Alamout area, above the village Evan, S slope of Mt. Khash-e chal (36°30' N, 50°28' E, 2800-3300 m, 10.7.1984 Assadi, Maasoumi 51105-TARI). Evan village, Khashe-chal, Hodekan (36°29' N, 50°27' E, 3100 m, 18.7.1996 Jamzad, Akbarnia, Charkhchian 75885-TARI). - **Zanjan:** Dizaj-abad (36°39' N, 48°37' E, 1500 m, 19.6.1983 Moussavi, Habibi, Tehrani 30717-IRAN).

Determination unsure: inter Schurab et Ahwe (???.1882 Pichler; 11.5.1882 Polak; WU). c. 40 km S Ramsar, N slope of Mt. Khash-e Chal (36°41' N, 50°38' E, 2900-3600 m, 11.7.1984 Assadi, Maasoumi 51174-TARI).

**32. *Allium kurdistanicum*** R.M. Fritsch & Maroofi in Razyfard & al., Ann. Bot. Fenn. 48: 353, Fig. 3, 4. (Oct 2011). - **Type:** Iran, Prov. Kurdistan, Baneh, Gardaneh Khan, 15 km NE Baneh, 2450 m, 36° 02' N, 45° 56' E, 01.6.1989 Fattahi, Tavakoli, Hatami no. 2432 (holotype TARI!, isotype HKS). Paratype: Iran. prov. Kurdistan, Marivan, Dalani mountain, 2000 m, 16.4.2001 Hooshidari 8863 (HKS).

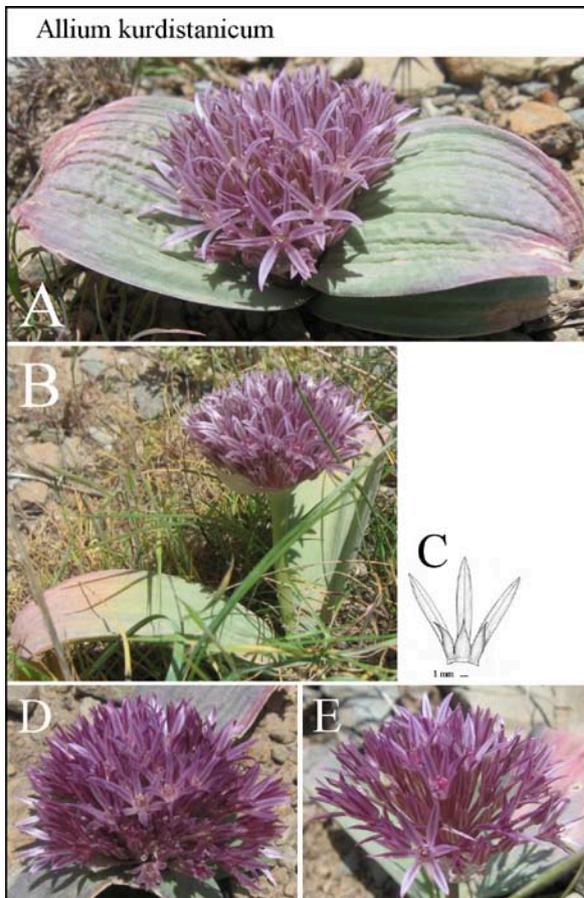


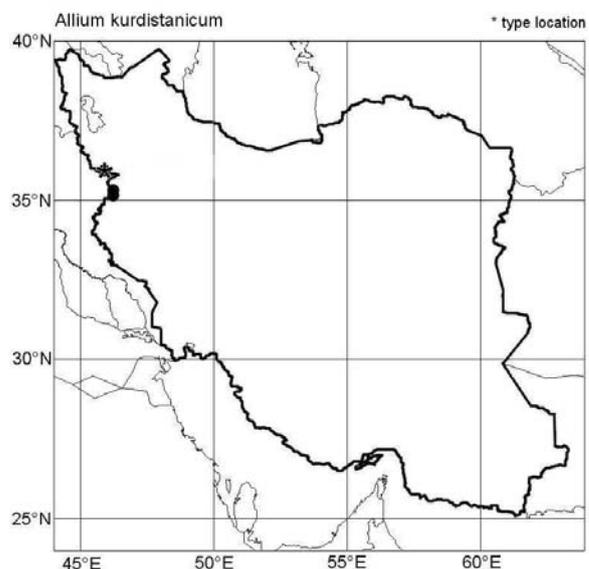
Plate T32. A & B: Flowering plants; C: tepals and filaments of a flower prepared from herbarium (from Razyfard & al. 2011: Fig. 4B; D & E: inflorescences in early anthesis (photos courtesy of A. Akhavan).

yellowish-purple. Pollen yellow. Ovary obovoid; 2-3 mm long and 2-3 mm in diameter; light green. Style narrowly conical, c. 3 mm long; lilac. Stigma undivided; whitish. Capsule depressed globose triangular with three furrows; ca. 4 mm long and 5 mm in diameter; yellowish-brown. Seeds one per locule, depressed-obovate, flattened, elliptic in outline; c. 2-3 mm long, 2 mm wide and 1 mm thick; black.

**Distribution:** Iran, prov. Kurdistan; montane stony and rocky slopes. Occurs probably also in Iraq.

**Remarks:** *Allium kurdistanicum* belongs to a group of species subsumed by Wendelbo (1971) under the broadly accepted name *A. haemanthoides* and only recently split off (Fritsch & Abbasi 2008; Razyfard & al. 2011). The description was based on type and paratype specimens. Photos of living plants show also rather broad inner leaves and  $\pm$  deep lilac tepals and filaments, the latter with a dar-

Bulbs ovoid to spherical, 2-5 cm in diameter, 20-45 mm long; outer tunics blackish-brown, irregularly splitting. Scape conical, terete, straight or  $\pm$  flexuous, smooth; aerial parts 2-5 (8) cm long, c. 3-6 mm in diam., widest below the inflorescence; green basally purplish suffused. Leaves 2-3, one usually larger than the others, broadly or narrowly lanceolate (undulate), thick and fleshy, shortly arcuately tapering into the cucullate apex; upper and lower parts slightly sulcate; margin finely toothed (sometimes smooth), purple; 7-17 cm long and 1-5 cm broad; pale yellow-green to finally glaucous green. Spathe membranous, split incompletely into 2-3 ovate, patent, shortly pointed valves; pale brown with darker veins. Inflorescence broadly fastigiata to semi-globose, dense, many-flowered; 5-6 cm in diameter. Pedicels thickish, straight or slightly incurved, unequally long; up to 25 mm long; purple. Anthesis in May - June. Flowers funnel-shaped star-like. Tepals lanceolate-triangular,  $\pm$  acute, obliquely forward directed; after anthesis stiff; 11-13 mm long and 2.5-3 mm wide in the middle; pink to deep lilac with darker median vein. Filaments c. 1/3 as long as the tepals, triangular, fleshy; basally ovate and for 1.5 mm connate and adnate to the tepals; lilac throughout with darker apex. Anthers ovoid, ca. 2 mm long;



ker apex. Thus some characters of the original description must be revised. *Allium kurdistanicum* differs from *A. haemanthoides* s. str. by shorter and broader tepals of darker color and by broader, darker and relatively longer filaments with a dark apex. Another similar taxon is *A. austroiranicum* that owns much narrower tepals and filaments of much paler color and much looser inflorescences. Recent molecular investigations (ITS sequences of nuclear rDNA) positioned *A. kurdistanicum* (Fritsch & al. 2010, as "A. sp. 10", see p. 200) among accessions of *A. austroiranicum* and *A. ubipetrense* from province Kurdistan beside *A. haemanthoides* from the type location. These new data support affiliation to the *A. austroiranicum* alliance and not to the *A. derderianum* alliance proposed by Fritsch & al. (2010).

**Etymology:** The epithet refers to the Iranian province Kurdistan where this species occurs.

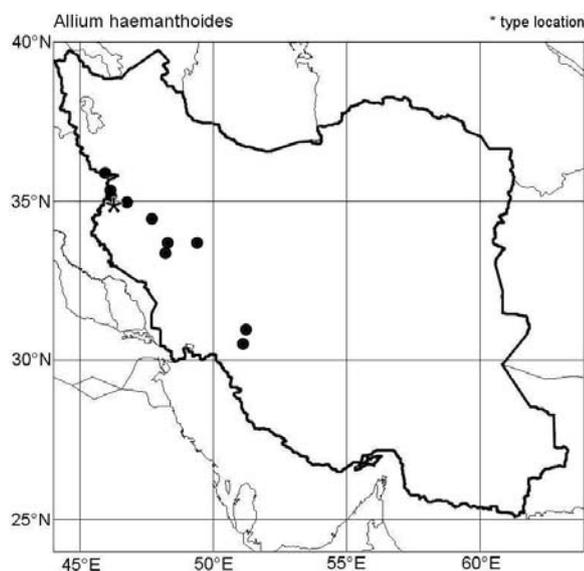
Herbarium vouchers: Kurdistan: Maryvan, Dalani mountain (35°20' N, 46°09' E, 2000 m, 16.4.2001 Hooshidari 8858, 8863; HKS). 15 km NE Baneh, gardanaeh Khan (36°03' N, 45°58' E, 2450 m, 01.6.1989 Fattahi, Tavakoly, Hatami 2432; TARI NRK); Saghez to Baneh, above Khan ghaut (36 03' N, 45 59' E, 2251 m, Akhavan photos)

Determination unsure: Kurdistan: Maryvan, Ghamishala village (35°29' N, 46°16' E, 1900 m, Basiri 8734; HKS TARI).

### *Allium haemanthoides* alliance

**33. *Allium haemanthoides*** Boiss. & Reut. ex Regel in Trudy Imp. S.-Peterb. Bot. Sada 3, 2: 240 (1875), s. str.. - Fritsch & Abbasi in Rostaniha 10 Suppl. 2: 14 ff., fig. 2 (2009). *Allium haemanthoides* sensu Wendelbo, Flora Iranica No. 76: 73 (1971), p. p. min.; *A. akaka* S.G. Gmel. subsp. *haemanthoides* (Regel) Wendelbo in Kew Bull. 28: 29 (1973), p. p.; Wendelbo, Fl. Iraq 8: 167 (1985) p. p. - *Allium haemanthoides* f. *majus* Bornm., Beih. Bot. Centralb. 33 II: 210 (1915), in textu. Type: Iran: Sungur: in m. Kuh-i-Emrullah, leg. Strauss 03.6.1908 (JE!). - **Type:** Iran: Hortus Genev. 28 Avril 1864 ex monte Schahu Haussknecht Reuter (lectotype G!, design. Fritsch 2012a: 261; vouchers from the type location "topotypes" WU! JE!).

Bulbs nearly orbicular, 1.5-3 cm in diam.; outer tunics grayish-brown, disintegrating. Scape ± straight, terete, smooth; aerial part 3-6 (15) cm long, 3-6 mm in diam.; semi-glossy green with glaucous bloom. Leaves 2-3, laminae broadly-lanceolate, flat arcuately ascending and recurved to soil, thick, arcuately or gradually tapering into the triangular, cucullate, often deflexed apex; margin smooth or dentate near the base, white; upper side grooved, lower side with broad flat ribs; 12-18 cm long, 2-6 cm wide; green with strong glaucous bloom, basally red flushed. Sheath leaf short, membranous, brownish, soon decaying. Spathe papery, ± completely divided into 1-2 triangular, finally reflexed valves; pale brown, veins somewhat darker. Inflorescence broadly fastigiata to semi- or subglobose, ± dense, many-flowered; 6-8 (12) cm in diameter. Pedicels moderately thin, stiff wire-like, straight or somewhat incurved, unequally long; green, brown, or purplish, semi-glossy. Anthesis in mid to end of May. Flowers widely funnel-shaped star-like. Tepals narrowly lanceolate triangular, obliquely forward directed and somewhat recurved, canaliculate, acuminate; 12-15 (18) mm long, basally 1.2-1.5 mm wide; after anthesis margin somewhat involute and finally prickly; white to pink with narrow, green to purplish median vein. Filaments 1/5-1/4 as long as the tepals, ± narrow triangular, inner filaments somewhat broader and longer, basally not connate; color like the tepals. Anthers ovoid, c. 1.3 mm long and 0.8 mm broad; yellow. Pollen yellow. Ovary depressed-globose with 3 narrow and 3 broad furrows, surface finely coarse; 2-3 mm long and in diameter; green, nectary ducts lead in transversely elliptic, pocket-like holes. Style conical, 2-3 mm long; whitish. Stigma punctiform; white. Capsule depressed obovoid tri-



angular, obliquely forward directed and somewhat recurved, canaliculate, acuminate; 12-15 (18) mm long, basally 1.2-1.5 mm wide; after anthesis margin somewhat involute and finally prickly; white to pink with narrow, green to purplish median vein. Filaments 1/5-1/4 as long as the tepals, ± narrow triangular, inner filaments somewhat broader and longer, basally not connate; color like the tepals. Anthers ovoid, c. 1.3 mm long and 0.8 mm broad; yellow. Pollen yellow. Ovary depressed-globose with 3 narrow and 3 broad furrows, surface finely coarse; 2-3 mm long and in diameter; green, nectary ducts lead in transversely elliptic, pocket-like holes. Style conical, 2-3 mm long; whitish. Stigma punctiform; white. Capsule depressed obovoid tri-

sulcate, c. 4 mm long and in diameter, surface finely reticulate lacunose, widely opening; valves broadly ovate, apex shortly notched. Seeds 1-2 per locule, ovoid to drop-like, sometimes one side concave, surface reticulate lacunose; 2.5-3 mm long, 2-2.5 mm broad, c. 2 mm thick; dull black.

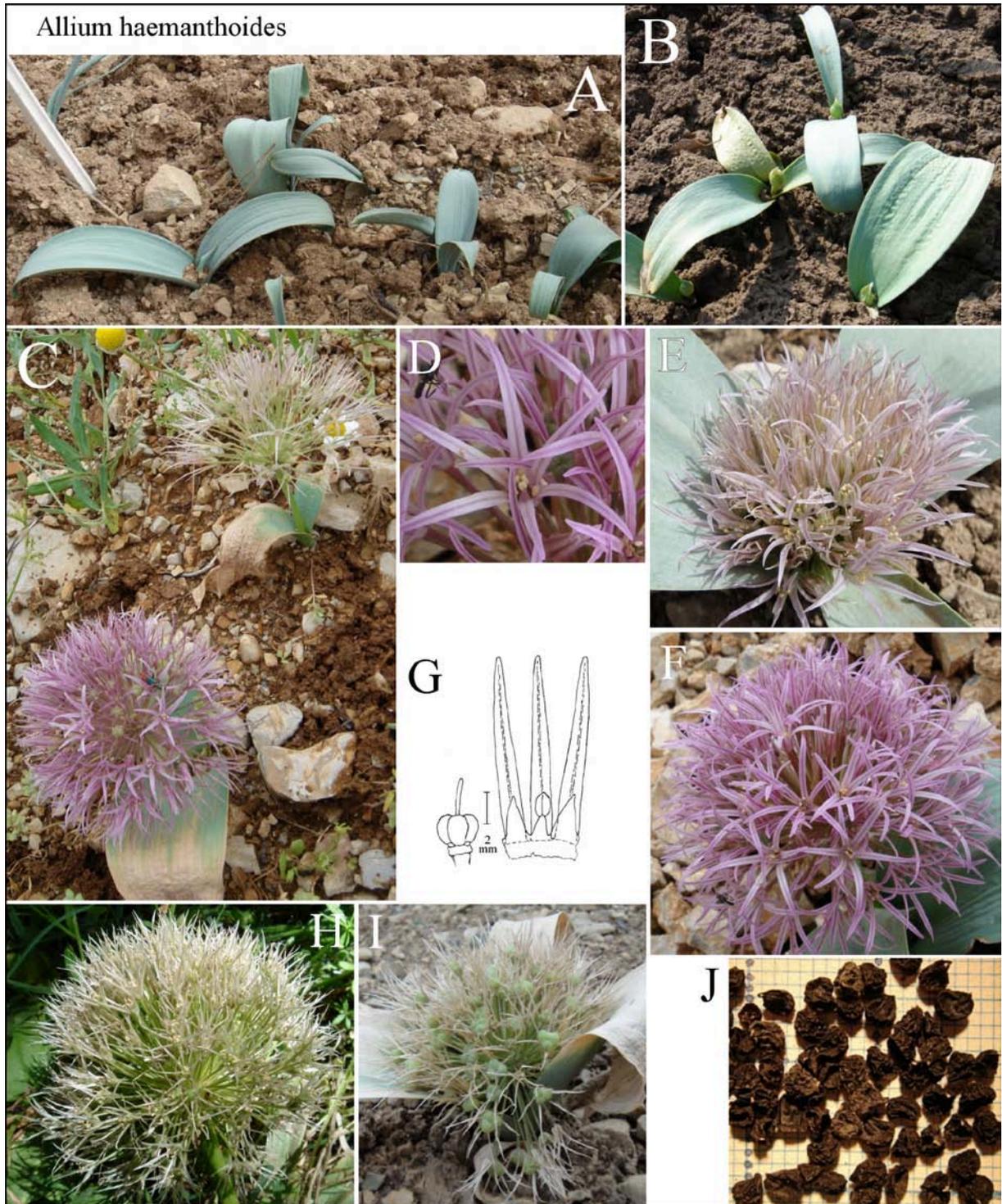


Plate T33. A & B: Cultivated plants after sprouting and in early shooting stage, resp., C: flowering plants at the type location; D: close-up of a flower; E & F: inflorescences in early and full anthesis, resp.; G: shape of ovary, tepals and filaments of a flower prepared from herbarium; H & I: inflorescences in late anthesis and after anthesis, resp., J: seeds (background raster 1 mm).

**Distribution:** Iran; SW Zagros mountain range; submontane to subalpine steppe and rock slopes. Occurrence in adjacent areas of Iraq is expected.

**Remarks:** The original description cited as source "... pl. exsc. Hausknechtianae", but only a sheet containing two scape parts with inflorescences and one leaf from plants cultivated in Geneva could be traced

hitherto and was designed as lectotype. Living plants of true *A. haemanthoides* were collected hitherto only in one part of the Shahu mountain range (type location "e monte Schahu"), the Ateshgah massif near Paveh. This extant population must be regarded to represent the typical population characterized by 3-6 cm long scapes, pink to rose or whitish, 14-18 mm long and narrowly triangular, remarkably recurved tepals, and c. 3 mm long filaments (Fritsch 2008: 59, Fig. 4). *Allium haemanthoides* is accepted here in this narrow sense. According to molecular markers (ITS sequences of nuclear rDNA, see p. 200), this taxon shares one subgroup with *A. ubipetrense* and *A. kurdistanicum* from prov. Kurdistan, with *A. breviscapum* as sister group and close but unresolved relations to *A. moderense*, the *A. derderianum* - *A. alamutense* group, as well as to the group of *A. graveolens*, *A. mahnesanense*, and *A. shelkovnikovii* s. str. *Allium akaka* s. str. is more distantly related. Sequences of the plastid *trnL-trnF* region confirmed the main aspects of this topology but with lower resolution (Gurushidze & al. 2010).

**Etymology:** It seems more probable that the epithet reflects a similarity to any *Haemanthus* (Amaryllidaceae) species possessing rather long and narrow tepals. Deducing the epithet from Greek diminutive "haemanthoides = somewhat blood-red flowers" contrasts to the fact that this species was originally described to have white flowers.

**Biological data:** Bulb extract showed a high radical scavenger activity (Jedelská & Keusgen 2008).

**Economic traits:** Mentioned in the literature to be used as food or medicine in Iran (Abbasi & al. 2008).

Living accessions studied: **Kermanshah:** Paveh, Khaneghah village towards Mt. Atashgah (35°01' N, 46°22' E, 1670 m, 17.5.2007 Abbasi, Fritsch, Keusgen 1194; 48371-IRAN GAT).

Herbarium vouchers: **Chaharm. Bakhtiyari:** Road from Lordegan to Yasuj, Maymand, Margh-e chenar, Kottok (31°09' N, 51°16' E, 1750 m, 27.5.1986 Mozaffarian 54469-TARI). - **Kermanshah:** In M. Shahu Ateshgah (35°01' N, 46°22' E, ??). 1909 Strauss; WU JE W B). - **Kurdistan:** Novsoud 65 km to Marivan, on the pass (35°19' N, 46°12' E, 1900-1920 m, 10.5.2004 Zarre, Mashayekhi 34902-TUH; GAT). Sanandaj, cultivated in Zaleh station (1450 m, 03.5.2002 4517, 18.5.2002 4361; HKS). (not Divandarreh but) Baneh to Saggez, altitude of tunnel-e Khan (36°03' N, 45°58' E, 2000-2200 m, 13.5.2004 Zarre, Mashayekhi 34914-TUH; GAT). M. Shahu, cult. in Hort. Genev. (28.4.1868 Haussknecht; G-BOIS). - **Lorestan:** pass about 20 km W Khorramabad Yafteh Kuh (33°32' N, 48°14' E, 2100 m, 30.5.1993 Rosbahani 962; ARCK). M. Saverz, (30°42' N, 51°09' E, 3050-3960 m, Haussknecht; G-BOIS). - **Markazi:** Sareband, Kuh-e Rasvand, eastern slope (33°52' N, 49°25' E, 2400 m, 26.5.1999 Ranjbar 1515; ARCA).

Determination unsure: **Kermanshah:** Sungur: in m. Kuh-i-Emrullah (34°38' N, 47°45' E, 03.6.1908 Strauss; JE). Kuh-e Bozab, macrowave station, stony slope (2300 m, 09.5.1975 Wendelbo, Assadi 16799-TARI). - **Kurdistan:** Galein village SW Sanandaj (35°08' N, 46°48' E, 2300 m, 15.6.1997 Kaffash, Kargar 4594; HKS). Maryvan (35°31' N, 46°10' E, c. 1400 m, 12.4.2007 Soumeih Hoseini 8464; HKS). Saghez to Baneh, Piromaran village, Nacarouz mountain (36°04' N, 45°57' E, 2550 m, 24.5.2006 Maroofi, Khezri 7709; HKS). - **Lorestan:** Aleshtar Kahman (33°53' N, 48° E, 1850 m, 11.7.1996 Mehrnia 2786; ARCK).

**34. *Allium zagricum*** R.M. Fritsch in Rostaniha 9 Suppl. 2: 17, fig. 3 (2008 publ. 17 Jul 2009). - **Type:** Iran, prov. Lorestan, N Khorramabad, Galeh Moradi towards Rimeleh mountain, Taf mount, 2285 m, 33° 38.590' N, 48°27.508' E, leg. 15.5.2007 Abbasi, Fritsch, Keusgen (IRAN, isotypes IRAN).

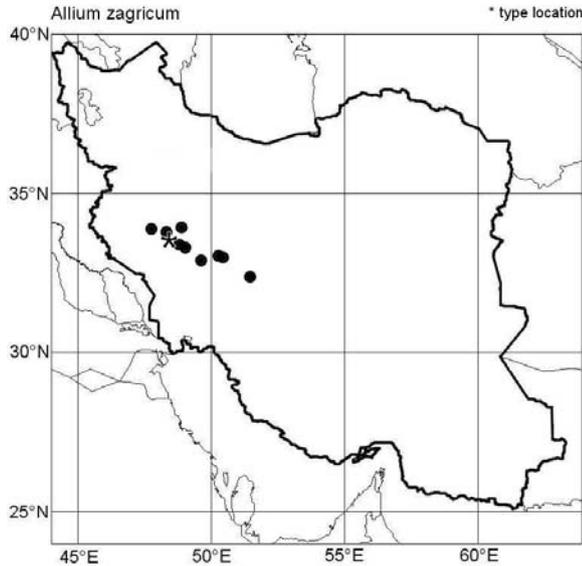
Bulbs depressed-globose, c. 3-4 cm in diameter; inner tunics papery, white; outer tunics ± thick, slightly lengthwise splitting, but mostly disintegrating; brown to gray. Scape ± straight, terete, smooth; c. 5-10 (15) cm long, 6-10 mm in diameter; dull or glossy green, lower part somewhat brown suffused. Leaves 2-3, laminae broadly lanceolate, canaliculate later ± flat, thick, arcuately tapering into the short hooded apex; margin brown later white, densely toothed or smooth; upper side smooth and even, lower side with fine ribs; 12-30 cm long, (1.5) 2-8 cm wide (the innermost leaves distinctly narrower); glossy yellowish-green, rarely with glaucous bloom. Sheath leaf short, greenish to brownish, quickly decaying. Spathe finely membranous, divided into 2-3 widely ovate, very shortly acuminate valves, initially appressed to the pedicels, later patent; pale brownish with darker veins. Inflorescence broadly fasciculate to semi-globose, dense, many-flowered; (5) 8-10 cm in diameter. Pedicels thickish, rather soft, ± equally long, straight or slightly upwards bent, smooth; green or reddish suffused, glossy. Anthesis in April - May. Flowers widely funnel-shaped star-like. Tepals narrowly lanceolate-triangular, obliquely forward directed and recurved, upper part somewhat plicate with a short rounded apex; after anthesis convolute and stiff; (10) 12-15 mm long and 1.5-2 mm wide; lilac to pink with rather broad green median vein. Fila-



Plate T34. A & C: Glossy and glaucous leaves, resp., and scapes after sprouting; B: flowering plants at the type location; D: flowering cultivated plants; E, G & H: inflorescences in early, full, and late anthesis, resp.; F: shape of ovary, tepals and filaments of a flower prepared from herbarium; I: inflorescence with developing capsules; J: seeds (background raster 1 mm).

ments  $2/5$  to  $1/3$  as long as the tepals, fleshy, outer filaments narrowly triangular, inner ones ovate-triangular and two times wider; color somewhat paler than the tepals up to whitish. Anthers oblong, c. 1.5 mm long and 0.8 mm wide; pinkish carmine. Pollen pale yellow. Ovary sessile, subglobose triangular with concave tip and 3 narrow and 3 wide,  $\pm$  deep furrows, surface finely tuberculate; 2 mm long and 2.5 mm in diameter; dull green, carmine suffused; nectary ducts lead in small pits near the base. Style conical-cylindrical, 2 mm long; white. Stigma acute; white. Capsule broadly obovoid triangular, surface with fine irregular ledges; 5-6 mm in diameter, 4-5 mm long, widely opening; valves suborbicular, rather

shallowly notched at the apex; pale yellowish brown. Seeds 1-2 per locule, depressed ovoid to drop-shaped, often one side concave, surface coarsely reticulate lacunose; c. 2.5 mm long, 2 mm broad and thick; dull black.



**Distribution:** Iran, Zagros mountain range mainly in prov. Lorestan; rather scattered in montane, not too dry and often steep, steppe slopes.

**Remarks:** *Allium zagricum* is morphologically intermediate between *A. haemanthoides* s. str. and *A. ubipetrense* concerning tepal and filament lengths, but the leaves are broad, glossy, and yellow-green (rarely dull green with glaucous bloom). However, molecular markers (ITS sequences of nuclear rDNA) positioned *A. zagricum* in one subgroup with the more dissimilar *A. austroiranicum* (Fritsch & al. 2010; see p. 200), but sequences of the plastid *trnL-trnF* region did not point to the closest relatives in sect. *Acanthoprason* (Gurushidze & al. 2010).

**Etymology:** The epithet refers to the occurrence in the Zagros mountain range.

Living accessions studied: **Lorestan:** Limestone rocks W of pass Chariveh Shah, S exposed (33°33' N, 48°50' E, 2300 m, 12.5.2007 Abbasi, Fritsch, Keusgen 1168, 1169; IRAN). N. Khorramabad, Ghaleh Moradi towards Rimeleh mountain, SW slopes; (33°39' N, 48°28' E, 2285 m, 15.5.2007 Abbasi, Fritsch, R., Keusgen 1187; IRAN GAT). Kuh-e Garri massif, valley of Kahman river above vill. Dareh-Tang (33°58' N, 48°22' E, 2700 m, 14.5.2007 Abbasi, Fritsch, Keusgen 1183, 1184; GAT IRAN). Slopes N vill. Kalvar, S exposed slope with rocks (34°04' N, 47°48' E, 2150 m, 16.5.2007 Abbasi, Fritsch, Keusgen 1193; IRAN).

Herbarium vouchers: **Hamadan:** Kuh-e Sibdar (34°06' N, 48°56' E, 2440 m, 19.5.1942 Koelz 18592; W). - **Lorestan:** Dow Rud, (33°29' N, 49°04' E, 7000', 01.5.1941 Koelz 17382; W). Dorod (33°29' N, 49°04' E, 15.5.1988 Azizollahi; HIU). In convallibus borealis montium Khali Kuh 50-60 km ab Aligudarz meridiem versus (33°04' N, 49°40' E, 2300-2800 m, 12.-14.6.1974 Rechinger 48009; W). Dow Rud (33°29' N, 49°04' E, 1680 m, 21.5.1940 Koelz 15675; W).

Determination unsure: (no collection site) (???.1927 Nábělek 2316; B). **Esfahan:** Feridown Shahr, Meydanak, Sardab-e Safla, Kuh-e Tok Tok (2550 m, 25.5.1981; HIU). Falavargan (32°33' N, 51°30' E, ??4.1988 Manocheri; HIU). Darreh-bid between Damaneh and Khunsar (33°10' N, 50°28' E, collector unclear; HIU). Khunsar, Golestan Kuh (33°13' N, 50°19' E, 30.5.1980 Aryavand, Sahebi; HIU).

### *Allium materculae* alliance

**35. *Allium alekii*** R.M. Fritsch & M. Agabab., **species nova.** - **Typus:** Armenia, Kafan district, left side valley of Aras river above the village Nrnadzor, dry slopes in eastern exposition, 570 m, 38°54'47" N, 46°26'47" E, 03.6.2010 leg. Malkhasyan, Agababian, Fritsch (holotype ERE).

Differt ab *Allio matercula* tepalis et filamentis et antheris intensiore kermesinis, filamentis latioribus et brevioribus, et stigmatibus indivisis.

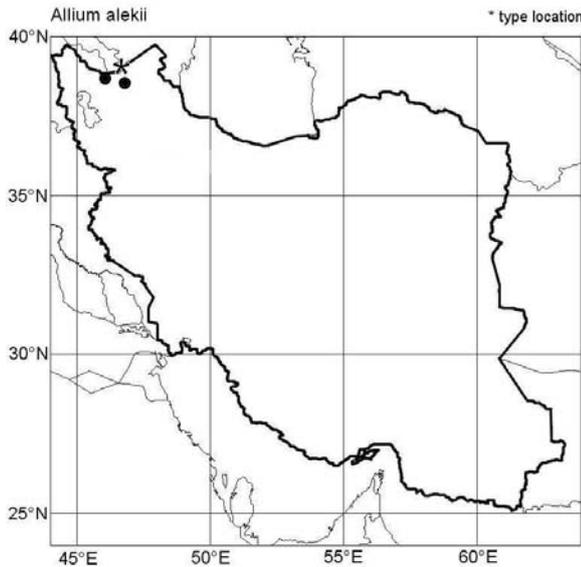
Bulbs depressed-ovoid, 3-4 cm in diameter, c. 2 cm long; outer tunics grayish brown, disintegrating. Scape flexuous, subconical, smooth; 10-20 cm long, basally 5-8 mm, below inflorescence 6-10 mm in diameter; dull green with  $\pm$  glaucous bloom, near base slightly reddish flushed. Leaves 2-3, laminae long-elliptic to lanceolate, obliquely arcuately ascending and recurved to the soil,  $\pm$  flat, basally canalliculate, shortly arcuately tapering into the cucullate apex; margin finely toothed, purplish later white; upper side smooth with some longitudinal grooves, lower side with rather broad and flat ribs; initially violet-green purplish flushed, later dull grey-green with glaucous bloom. Sheath leaf long, papery, greenish to brown. Spathe membranous, initially straight and as long as the pedicels, finally reflexed and papery, split into 2-3 ovate valves; pale yellowish-brown with somewhat darker veins. Inflorescence initially fasciculate and dense, later semi-globose, finally subglobose and rather loose; 4-6 (fruiting up to 12)

cm in diameter. Pedicels thin, wire-like stiff, smooth, subequally long; brown to purple, basally pale. Anthesis in May. Flowers broadly funnel-shaped star-like. Tepals lanceolate with rounded tip, obliquely patent, basally shortly connate; after anthesis straight and slightly incurved with convolute margins and thickened median vein; 8-10 mm long, inner tepals c. 2.5 mm, outer ones c. 2 mm wide and slightly keeled; pinkish to darker carmine, with brown, at the outer side conspicuous and broader median vein.



Plate T35. A: Leaves and young scapes after sprouting; B & C: flowering cultivated plants; D, E & G: inflorescences in early, full, and late anthesis, resp.; F: close-up of flowers; H: inflorescence with full-sized capsules at type location; I: shape of ovary, tepals and filaments of a flower prepared from herbarium; J: seeds (background raster 1 mm).

Filaments 2/3-3/4 (4/5) as long as tepals, triangular (inner filaments basally c. 1/3 wider); basally shortly connate; initially pinkish and somewhat darker at the base, later colored as the tepals. Anthers long elliptic, 1.2-1.5 mm long; carmine. Pollen greyish yellow. Ovary sessile, depressed-globose with three wide and three narrow furrows, surface finely coarse; 2-3 mm in diameter, 1.5-2.5 mm long; green; nectary ducts lead in short pockets at 1/3 of ovary length. Style narrowly conical, 3-5 mm long; pink to carmine. Stigma undivided; whitish. Capsule triangular depressed-globose, 4-5 mm in diameter, surface reticulate lacunose; yellowish-brown; valves transversely elliptic. Seeds 1-2 per locule, ovoid, surface with irregularly reticulate ledges; 2.5 mm long, 2 mm wide, c. 1.5 mm thick; dull black.



**Distribution:** Armenia, Iran: Rocky slopes of the Aras valley. The type location lies on the Armenian bank of Aras river within sight of Iranian as well as Azerbaijan territories. Occurrence in Republic Azerbaijan is expected.

**Remarks:** This species has the general appearance of a strong *A. materculae* plant differing by pinkish-carmine tepals, filaments, and anthers, by broader and relatively shorter filaments, and by the entire stigmata. Another similar species is *A. sabalense* that differs by shorter scapes and leaves, shorter filaments, yellow (not purple) anthers, and smooth (not finely coarse) ovaries. Molecular markers (ITS sequences of nuclear rDNA) confirm a close relationship to *A. materculae*, but *A. sabalense* belongs

to a less closely related group (see p. 200).

**Etymology:** The species is named after the contemporary Armenian zoologist Alek Malkhasyan, the discoverer of this taxon.

Determination unsure: **E Azarb.:** 51 km from Jolfa to Duzal, margin of Aras river (38°52' N, 46°06' E, 500-600 m, 15.4.2002 Gharemani, Imani 7463; HTRC). **Ahar:** 85 km from Tabriz to Ahahr - Goyja Bel (38°43' N, 46°50' E, 1700 m, 17.6.1993 Nusrati 3291; HTRC).

**36. *Allium graveolens*** (R.M. Fritsch) R.M. Fritsch in *Phyton* (Horn, Austria) 49: 180 (2010); *Allium materculae* Bordz. subsp. *graveolens* R.M. Fritsch in *Rostaniha* 9 Suppl. 2: 31, fig. 6 (2009). - *Allium materculae* auct., p. p. - **Type:** Mowdere b. Sultanabad, 10.5.(1)890 leg. Strauss (holotype WU).

Bulbs ovoid to ± depressed-globose, 2-3.5 cm high and 2-4 cm in diameter; outer tunics ± strong, disintegrating; yellowish-brown to black. Scape subflexuose, terete, obconical, smooth; (3) 5-10 (35) cm long, near base 3-4 (6) mm and near top 4-5 (-10) mm in diameter; green or red flushed, glossy. Leaves (1) 2-3, narrowly lanceolate, lying on the ground or flat ascending and recurved, thick, canaliculate but towards apex flattened; margin whitish, denticulate or smooth near the base, shortly or (innermost leaf) long tapering into the hooded apex; upper and lower sides ± smooth or with broad shallow ribs; (1) 1.5-3.5 cm wide, (10) 15-35 cm long; green with a moderate glaucous bloom, basally reddish outside. Sheath leaf delicately membranous, transparent, soon decaying. Spathe fine membranous, nearly completely split into several widely triangular parts, appressed to the pedicels or above ± patent; brownish with reddish-brown veins. Inflorescence moderately to broadly fasciculate, dense; 3-4.5 cm long and 3-7 cm in diameter. Pedicels cylindrical, relatively soft, ascending, unequally long; 3-4.5 cm long; greenish with ± strong red flush, glossy. Anthesis in April to May. Flowers widely funnel-shaped star-like; with strong sweet perfume-like odor. Tepals triangular-lanceolate, in basal part often linear, obliquely patent, slightly recurved in full anthesis, apex plicate and obtuse; after anthesis convolute and distorting, but not really prickly; 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 the tepals or by 1/5 shorter,  $\pm$  straight, subulate,  $\pm$  fleshy; basally slightly connate or free; pink to carmine. Anthers oblong, c. 1.5 mm long, 1 mm wide; yellow. Pollen yellow. Ovary sessile, globose to triangular, surface slightly coarse by delicate cells, faintly glossy; c. 2 mm long and in diameter; green; nectary ducts lead in small pockets at the very base. Style conically thread-like, 3-6 mm long; whitish. Stigma undivided; whitish. Capsule depressed obovoid with three furrows; c. 4-6 mm in diam. and long, widely opening; surface finely reticulate-lacunose; valves broadly ovate, apex deeply and narrowly notched. Seeds 1-2 per locule, flat ovoid to comma-shaped; c. 2 mm long, 1.5-2 mm broad, 1-1.5 mm thick; dull black.

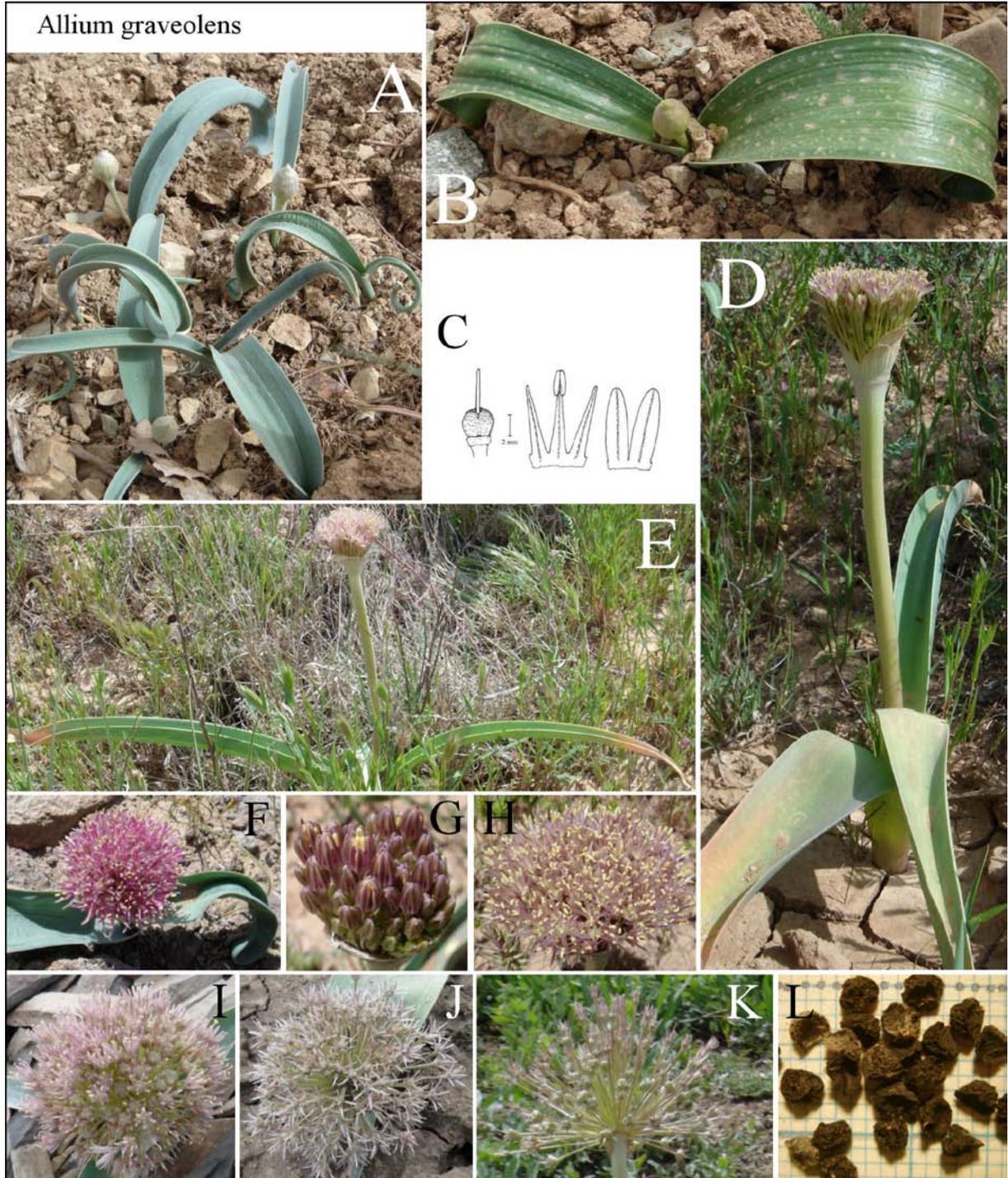
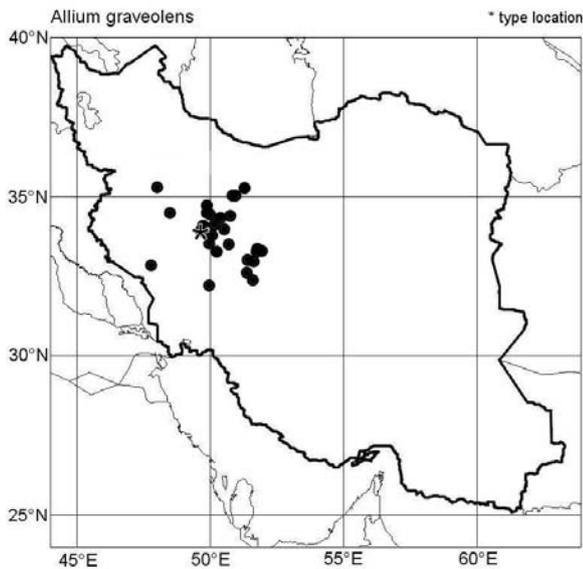


Plate T36. A: Cultivated plants with glaucous leaves and young scapes; B: plant with glossy leaves and scape; C: shape of ovary, tepals and filaments of a flower prepared from herbarium; D & E: plants growing near Meighan kawir in early anthesis; F: plant in full anthesis in the mountains near Arak; G: inflorescence in buds; H, I & J: inflorescences in full, late, and after anthesis, resp.; K: inflorescence with developing capsules; L: seeds (background raster 1 mm).



**Distribution:** W Iran, mainly in the provinces Markazi and Esfahan; dry colline to montane slopes of steppe hills, rock terraces, and rubble slopes.

**Remarks:** Only excellently prepared herbarium specimens showing pinkish filaments, and tepals with inconspicuous median vein can safely be assigned to *A. graveolens*. Living plants can easily be recognized by these characters and by the heavy sweet odor of the flowers. The weak morphological differences to *A. materculae* (honey-like odor, dark median vein) speak against recognition at species level, but the well separated areas of distribution of both taxa as well as molecular markers support separation. ITS sequences of nuclear rDNA affiliated these taxa to well separated subclades (see p.

200) indicating a rather long separate evolutionary history apart from *A. akaka*, the alliances of *A. derderianum* and *A. haemanthoides*, as well as *A. kuh-sorkhense* (Fritsch & al. 2010: 180). Sequences of the plastid *trnL-trnF* region displayed much variation of the haplotypes only rarely sharing the positions of *A. materculae* (Gurushidze & al. 2010).

**Etymology:** This epithet refers to the (unpleasantly) strong sweet odor of the flowers (from Latin "strong-smelling").

**Biological data:** Genome size 45.2 pg 2C DNA (Gurushidze & al. 2012), that is larger than the morphologically close *A. materculae* (42.7 pg).

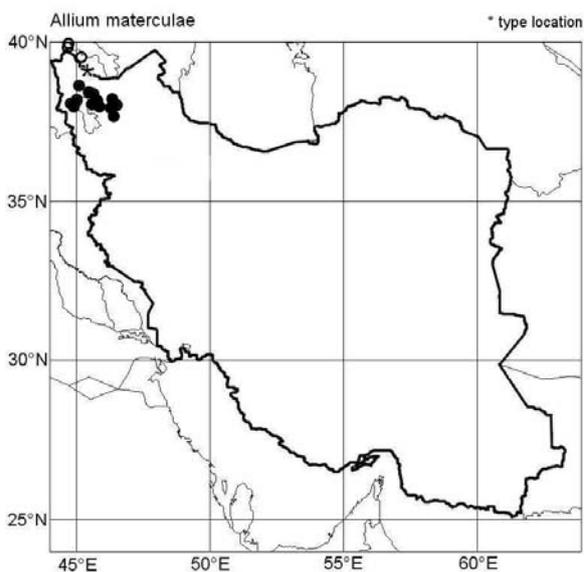
Living accessions studied: **Esfahan:** Semi-desert c. 1 km S divorce to Natanz in direction to Isfahan (33°29' N, 51°58' E, 1656 m, 07.4.2008 Abbasi, Fritsch 1212; IRAN). - **Markazi:** Modere valley W Arak (34°06' N, 49°38' E, 1990 m, 09.5.2007 Abbasi, Fritsch, Keusgen 1147; GAT IRAN). Pass area from Qom c. 50 km to Arak (34°17' N, 50°12' E, 1900 m, 08.5.2007 Abbasi, Fritsch, Keusgen 1142; GAT IRAN). Meighan salt lake between Daudawat et Rizmeh (34°16' N, 49°46' E, 1680 m, 09.5.2007 Abbasi, Fritsch, Keusgen 1145; GAT IRAN). Mountain range ESE Arak, Mt. Absar and neighboring crests (33°59' N, 50°07' E, 2600-2800 m, 11.5.2007 Abbasi, Fritsch, Keusgen 1160, 1161, 1164; GAT IRAN). Photos sent by Mr. M. Jaeger, plants collected in Iran: 80 km NE Arak, 34°27' N, 50°26' E, JJMZ-5.

Herbarium vouchers: **Esfahan:** Mooteh prot. region: in montibus a Muteh (Mooteh) septemtrionem versus (33°41' N, 50°44' E, 1950-2000 m, 2100-2450 m, 31.5.1974 Reching 46890, 46943; W). 10 km S Morchekhort to Natanz (33°11' N, 51°26' E, 1600 m, 11.5.2002 Rahiminejad, Sahebi, Ghaemmaghani; HIU). Soh, Zard Kuh, (32°24' N, 50°00' E, 2300 m, 20.5.1982 Aryavand, Sahebi; HIU). Esfahan, Mt. Sofe, southern slope (32°34' N, 51°39' E, 12.4.1974 "students"; HIU). 10 km S Mourchekhort to Natanz (33°11' N, 51°26' E, 1600 m, 09.4.2002 Rahiminejad; 11.5.2002 Rahiminejad & al. 13186; HIU). Gham-eshloo protected area, Chaval (32°47' N, 51°24' E, 1800-1950 m, 30.4.1996 Uosofi 653; TARI). Ad Gulpaigan (33°27' N, 50°16' E, ???.1898 Strauss; JE). Kuh-e Karkas, ridge near television-mast (33°32' N, 51°47' E, 2880 m, 27.5.1974 Reching 46601; W B G; 2900 m, 14.5.1974 Wendelbo, Foroughi 11437-TARI; 27.5.1974 Iranshahr 43026-IRAN). Natanz, Tar, Kouhe' Karkas (33°25' N, 51°45' E, 22.5.1970 Iranshahr 444-IRAN). - **Hamadan?:** Kohrud (35°28' N, 48°04' E, ???.1905 Strauss; JE). - **Lorestan:** In montes Kuh-i-Besri (33°01' N, 47°50' E, 04.6.1910 Strauss; JE). - **Markazi:** Kuh Waf ad Gulpaigan ???.1898 (33°43' N, 50°00' E, 10.6.1905 Strauss; B JE). 2 km N Arak, Mighan (34°09' N, 50°33' E, 1570 m, 08.5.1979 Babakhanlou, Amin 18022-TARI). 20 km Saveh to Azgin (1750 m, 08.5.1974 Bazargan, Dini 8222-TARI). In m. Kuh Gäsawend (34°55' N, 49°55' E, 01.7.1909 Strauss; JE). Mowdar, (34°06' N, 49°38' E, 10.5.1890 Strauss; WU). In montibus Tefresh (34°37' N, 50°01' E, ???.1898 Strauss; JE). Tschal (34°38' N, 49°55' E, 25.5.1892? Strauss; JE). 48 km W Qom, volcanic sterile soil (34°30' N, 50°25' E, 1600 m, 05.5.1961 Stutz 1044; W). - **Tehran:** 100 km N Ghom (35°27' N, 51°20' E, 950 m, 04.4.1977 Termeh, Moussavi 43993-IRAN). 68 km Tehran to Qom (35°12' N, 50°59' E, 1250 m, 24.4.1973 Babakhanlou, Amin 14176-TARI). Schotter im Flussbett bei Taghrarud W Kum (34°34' N, 50°47' E, 1100 m, 23.4.1951 Soder 237; G).

Determination unsure: **Hamadan:** Mt. Alvand (34°40' N, 48°31' E, 3000 m, 28.6.1965 Danin, Baum, Plitman 65-801; HUI). - **Markazi:** Sultanabad (34°06' N, 49°42' E, 31.5.1890 Strauss; WU). Tafresh, the road pass of Vaiysmand, stony clay (34°41' N, 49°59' E, 1900-2000 m, 10.5.1999 Ranjbar 1442; ARCA). Saveh, kuh-e Zireh, northern slope (35°12' N, 50°52' E, 2200 m, 01.5.2000 Ranjbar 1815; ARCA).

**37. *Allium materculae*** Bordz. in Zap. Kievskago obshch. estestvoizp. 25, 1: 73 (1915). - Vved., Flora URSS 4: 260 (1935). Wendelbo, Flora Iranica No. 76: 75, tab. 7/100 (1971). Agababian & Oganessian in Willdenowia 30: 94 fig. 1, 2 (2000); Oganessian & Agababian, Flora Armenii 10: 296, 342, tabl. 107 (2001). Kudryashova in Bot. Zh. 86, 4: 129 (2001) sub *A. akaka*. - *Allium materculae* var. *albiflorum* Bordz. in Zap. Kievskago obshch. estestvoizp. 25, 1: 74 (1915). Type: Azerbaijan, prope pagum Dzhulfam, 24.4.1914, leg. Th. Roop (LE?). *Allium akaka* var. *regale* Tamamsch. in Feddes Repert. 38: 163 (1935). Typus: Armenia: m. Eranos, in decliv. meridionalis 15.6.1931 leg. Tamamschjan, Malejev (Lectotype 17914-ERE!, hic design., isotypes 17925-ERE!, G! s. n.). *Allium akaka* auct. mult., p. p. - **Type:** Azerbaijan: Nakhichevan, prope oppidum Nachiczevan, 14.(27.)4.1914, leg. Th. Roop (lectotype LE, design. Seisums ex Agababian & Oganessian 2000: 2).

Bulbs ovoid to depressed-globose, 15-25 mm long, up to 3 cm in diameter; outer tunics moderately strong, gray to black, disintegrating or longitudinally splitting. Scape often  $\pm$  flexuous, conical (thickest below inflorescence), terete, smooth; 8-13 (30) cm long, 6-9 mm in diam.; dull green. Leaves 2-4 (5), laminae lanceolate to oblong, thickish, widely canaliculate, obliquely arcuately ascending and recurved to soil, upper part later reflexed and  $\pm$  enrolled or lax and hanging down, shortly or gradually tapering into the cucullate apex; margin white, cartilaginous or with short bristles or teeth; upper side initially with a few furrows later smooth, lower side rather densely ribbed; 10-20 (30) cm long, 1-4 cm broad (inner leaves always narrower); grayish green, purplish suffused near base. Sheath leaf rather long, hyaline, quickly decaying. Spathe membranous, incompletely divided into 2-5 ovate to triangular, acute valves, the upper half reflexed; pale brown with darker veins. Inflorescence fastigiate to semi-globose (subglobose in the fruiting state), dense, many-flowered; 4-7 cm in diameter, c. 5 cm long. Pedicels unequally long, thick, rather stiff, backwards curved; 1.5-6 cm long; brown to purplish. Anthesis in April to May. Flowers narrowly funnel-shaped star-like. Tepals oblong-triangular with subobtusate tip, slightly incurved, canaliculate, obliquely patent; after anthesis straight with convolute margins and prickle-like; (5) 7-9 mm long, 0.8-1.2 mm broad; pinkish or brownish with broad green to brown median vein. Filaments as long as the tepals or slightly longer, fleshy, inner filaments long triangular, outer filaments subulate; basally for 1-1.5 mm connate; white to lilac. Anthers ovate, c. 1.2 mm long; yellow to white. Pollen grayish to brownish yellow. Ovary sessile, depressed obovoid triangular, tip concave, surface finely tuberculate, semi-glossy; 2-3 mm long and in diameter; pale green purplish suffused; nectary ducts lead in broad pockets near the base. Style thread-like, 5-8 mm long; whitish to rose. Stigma dot-shaped; whitish. Capsule broadly ovate to subglobose triangular, smooth; c. 4 mm long, 5-6 mm in diam.; yellow-brown, broadly opening; valves broadly ovate with a longitudinal furrow, shallowly notched at the apex. Seeds 1-2 per locule, flat drop-like with one concave, tuberculate side, the convex side coarsely reticulate lacunose; c. 2.5 mm long, 2 mm broad, 1-1.5 mm thick; dull black. The testa showed moderately Omega-like undulated anticlinal walls and coarsely verrucate periclinal walls (Fritsch & al. 2006).



type location

**Chromosomes:**  $2n = 16$  Araratian & Tonian 1945 (Armenia).  $2n = 30, 32, 36$  Vakhtina 1969 (Armenia: Garni).  $2n = 16$  Zakirova & Vakhtina 1974 (Armenia: Vedin, Azerbaijan: Ordubad "A. akaka"; Armenia: Ararat area).  $2n = 16$  Pogosian 1981 tabl. 1 (Armenia: Vedin area, "A. akaka").  $2n = 16$  Pogosian 1983 (Armenia: Ararat area).  $2n = 16$  Pogosian 1983, 1985b fig. 5, 7 (Azerbaijan: Nakhichevan, Armenia: Urts massif, "A. akaka").  $2n = 16$  Pogosian 1985b karyotype (Armenia: Ararat area, Abojan area, "A. akaka").  $2n = 16$  Pogosian in Agapova & al. 1990 (Armenia: Garni, "A. akaka", Azerbaijan: Ordubad).

**Distribution:** Transcaucasia, E Anatolia, N & NW Iran; colline to montane, loamy and stony steppe and semi-desert slopes, limestone outcrops and terraces (Oganessian & Agababian 2001).



Plate T37. A & B: Leaves of cultivated plants; C: vegetative plants near Sayed Hajadin; D: inflorescence of var. *albiflorum* in early anthesis; E: flowering plants of var. *albiflorum* at Mt. Chama; F: cultivated flowering plants; G & H: inflorescences in early and late anthesis, resp.; I: infrutescence with open capsules near Noravank, Armenia; J: comparison of flower parts of var. *albiflorum* in different stages; K: seeds (background raster 1 mm); L: shape of ovary, tepals and filaments of a flower prepared from herbarium.

**Remarks:** This is a rather variable species characterized by fasciculate inflorescences (which become subglobose and very loose in the fruiting stage), narrow tepals, 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 vein (Fritsch 2008: 62, Fig. 9A), and the color of the filaments may independently vary from white to purplish. The reasons for separation from the morphologically very close *A. graveolens* are discussed under that species above. Plants from Armenia and Azerbaijan formerly named *A. akaka* were correctly affiliated by Agababian & Oganessian (2000).

**Etymology:** The epithet is a general honor to the mother of the Ukrainian botanist E. I. Bordzilowski (from Latin diminutive of "mother"). He was acting in Kiev in the first decades of the 20th century.

**Biological data:** Germination occurs only after stratification at 5°C (Nikolaeva & al. 1985). Reported genome size [2C DNA] was 48.6 pg (Vakhtina & al. 1977), and 45.9 pg (Zakirova 1989).

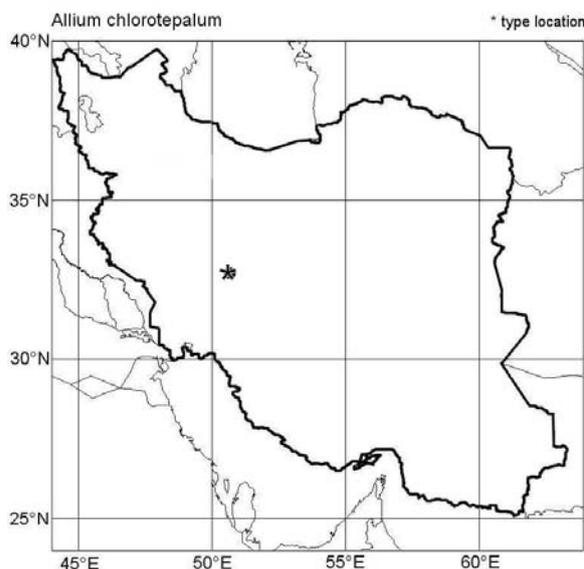
Living accessions studied: *W Azarb.*: 8 km östlich Salmas, Sandebene neben der Strasse an den roten Felsen (38°14' N, 44°50' E, ca. 1350 m, 25.5.1994 Fritsch 1150; GAT). Sandstone massif S village Sayed Hajadin c. 10 km S Khoy (38°21' N, 45°04' E, 1650 m, 13.5.2011 Pahlevani, Fritsch 1360; IRAN GAT). - *E Azarb.*: Grobschottriger Hang am Hügel östlich und südlich des Dorfes Sorkhe zwischen Marand und Khoy (38°36' N, 45°30' E, 1300-1500 m, 24.5.1994 Fritsch 1130; GAT). Mt. Kuh Chama N of Marand (38°08' N, 45°55' E, 2400 m, 05.6.2005 Fritsch, Zarre 1064; GAT IRAN). Mt. Misho E village Payam S of Marand (38°20' N, 45°48' E, 1940-2000 m, 05.6.2005 Fritsch, Zarre 1060; 2050 m, 08.5.2011 Fritsch, Pahlevani 1343; IRAN, GAT).

Herbarium vouchers: *W Azarb.*: Urumieh to Salmas Khan Takhti (38°08' N, 44°56' E, 22.5.1984 Zargani, Arghand 43986-IRAN). Tabris in argillosis (38°06' N, 46°20' E, 02.5.1884 Knapp; WU). Between Ivogly and Garehziyaadin (38°48' N, 45°08' E, 950 m, 16.5.2002 Alizadeh 6588; ORUM). Prope Seyyed Hajjin, in vineis (38°21' N, 45°03' E, Szovits; G). Livan (Swan?) in lapidosis (37°50' N, 46°26' E, 08.5.1884 Knapp; WU). - *E Azarb.*: Khamneh 1 km from Daryan (38°13' N, 45°38' E, 15.6.1992 Mohamadzade, Razban 582; HTRC). Golzar village (38°23' N, 46°23' E, 1700 m, 23.5.1993 Nusrati 3255; HTRC). Shabestar: Benis village - Kuh-e Misho Dagh (38°19' N, 45°41' E, 2200 m, 28.5.1997 Kasebi, Gharemani, Imani 6419; HTRC). Tabriz: NE Tabriz, Kuh-e Onebneh Ali (1720 m, 06.5.1994 Gharemani, Kasebi 3826; HTRC). - *Markazi*: Arak, Komijan, between Amereh vill. Chereghan, pass of Chereghan (2200-2300 m, 09.5.1999 Ranjbar 1418; ARCA).

Determination unsure: *E Azarb.*: In declivibus saxosis 20-40 km ENE Tabriz, usque 1 km ultra pontem trans fluvium Talkeh Rud (Atschi Tschai) (38°11' N, 46°33' E, 31.5.1971 Rechinger 40730; W B G). In jugo inter Marand et Sufijan (38°19' N, 45°46' E, 1600-1750 m, 06.6.1971 Rechinger 41200; W). 2-12 km W Zonuz (38°33' N, 45°41' E, 1500-1700 m, 07.6.1971 Rechinger 41352; W).

### *Allium minutiflorum* alliance

**38. *Allium chlorotepalum*** R.M. Fritsch & M. Jaeger in *Phyton* (Horn, Austria) 50: 18, Figs. 12, 13 (2010). - **Type:** Cultivated in the IPK taxonomic reference collection no. TAX 6694 leg. 19.5.2009 (holotype GAT); bulbs from Iran, province Esfahan, S to SW directed slope of Mt. Dalun massif E of village Analujeh, 32° 55'12" N, 50° 33'50" E, 2700 m, 09.4.2008 leg. Abbasi, Fritsch 1217.



Bulbs depressed-globose, 2-3 cm in diameter and 1.5-2 cm long; outer tunics thickish but easily disintegrating, grayish-brown. Scape flexuous, terete, conical, smooth; aerial part 5-10 cm long, diameter 4-5 mm below the inflorescence, 2.5-4 mm near the soil; green, brown flushed. Leaves 1-2, long-ovate to lanceolate, gradually recurved and tapering in a short hooded apex, thickish, slightly canaliculate; upper side grooved, lower side finely ribbed; margin initially purplish, later white; green with glaucous bloom, basally somewhat brown flushed. Sheath leaf short, fine membranous, brownish, soon decaying. Spathe membranous, incompletely splitting into 2-3 broadly ovate valves without beak, shorter than the pedicels, initially straight, later

partly reflexed; yellowish-brown with darker veins. Inflorescence broadly fasciculate, dense, many-flowered; finally 4-5 cm in diameter. Pedicels straight, stiff, thickish, unequally long; green to brown. Anthesis in May. Flowers flat star-like. Tepals linear-lanceolate, obtuse, plicate, patent, somewhat recurved; after anthesis brown to pale red, convolute with thickened median vein, warped, not prickly; 6-7 (8?) mm long, c. 1.5 mm wide; pale green to purplish-green with wide green median vein. Filaments broadly triangular, basally ring-like united, obliquely sideward spreading and slightly incurved forming a separate cup; c. 2-3 mm long; apex blackish-purple, towards base paler and base of basal ring whitish. Anthers ovate, c. 1 mm long; purple to violet. Pollen yellowish or greenish. Ovary depressed tripartite turbinate, nearly smooth, silk-like glossy; c. 2 mm long, 2-3 mm in diam.; above blackish-purple, basally green; nectary ducts lead in small longitudinal slits. Style  $\pm$  cylindrical, 2-3 mm long; deep purple. Stigma dot-like; whitish. Capsule depressed-globose, glossy? Seeds not seen.

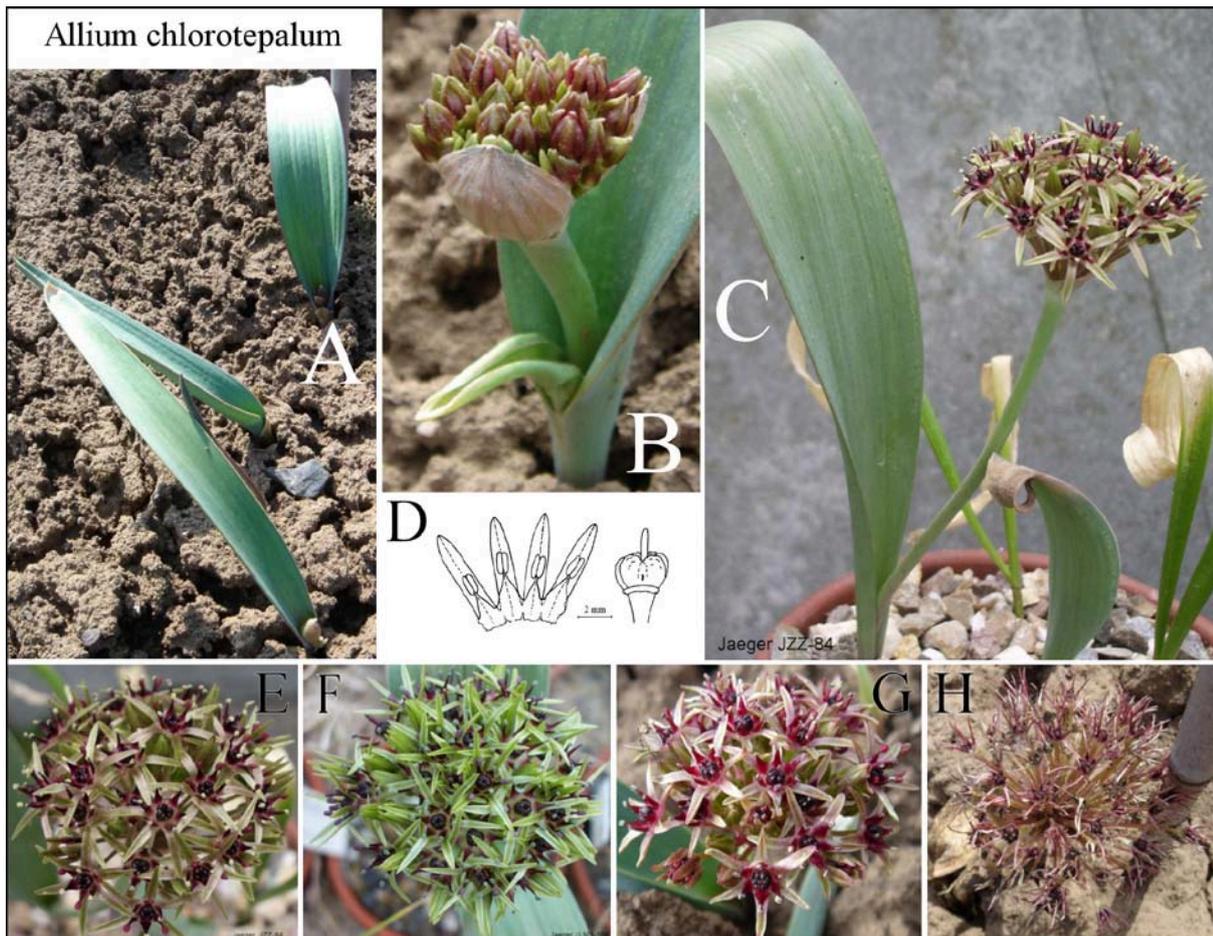


Plate T38. A: Cultivated plants after sprouting; B: plant in early shooting stage; C & E: cultivated plant flowering and its inflorescence (photos courtesy of M. Jaeger); D: shape of ovary, tepals and filaments of a flower prepared from herbarium; F: inflorescence of the variant having green tepals (photo courtesy of M. Jaeger); G & H: inflorescences in early anthesis and after anthesis, resp.

**Distribution:** Iran, known yet only from NW edge of prov. Esfahan; montane rock terraces and rubble areas of dry stony and rocky slopes.

**Remarks:** This recently described species shows a rare character combination of long, narrow, and recurved tepals with very short, broadly triangular filaments united into a broad cup, and short, black,  $\pm$  glossy ovaries. Most similar is *A. minutiflorum* differing only by lanceolate smooth leaves, much shorter tepals, and narrower, straight, triangular filaments positioned around the ovary as common. These characters favor affiliation to sect. *Melanocrommyum*, but the median veins of the tepals become finally incrassate, and molecular markers (ITS sequences of nuclear rDNA, Fritsch & al. 2010) positioned *A. chlorotepalum* inside of sect. *Acanthoprason*, but with unclear relations. Recent addition of two more accessions showed closer relations to the group of *A. graveolens* including *A. hamedanense* (see p. 200).

**Etymology:** The epithet refers to the more or less green tepals (from Greek + Latin), a rare character in subg. *Melanocrommyum*.

Living accessions studied: Esfahan: S to SW directed slope of Mt. Dalun massif E of Analujeh (32°55' N, 50°33' E, 2700 m, 09.4.2008 Abbasi, Fritsch 1217; 3000-2800 m, 09.4.2008 Abbasi, Fritsch 1221; GAT IRAN). Photos sent by M. Jaeger, plants collected in Iran: Analujeh, Kuh e Dalan, direkt hinter dem Ort unterhalb der Felsen im steilen Schotterhang; 32°56' N, 50°35' E; JLMS-103, JZZ-84.

Herbarium vouchers: Esfahan: Esfahan to Daran. Ghahis protected area. (32°53' N, 50°42' E, 2500 m, 20.5.1981 Nowroozi 343; TARI).

**39. *Allium hamedanense*** R.M. Fritsch in Rostaniha 9 Suppl. 2: 35 fig. 7 (2008 publ. 17 Jul 2009). - **Type:** 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, 11.5.2006 leg. Abbasi, Fritsch, Keusgen, (holotype 43979-IRAN).

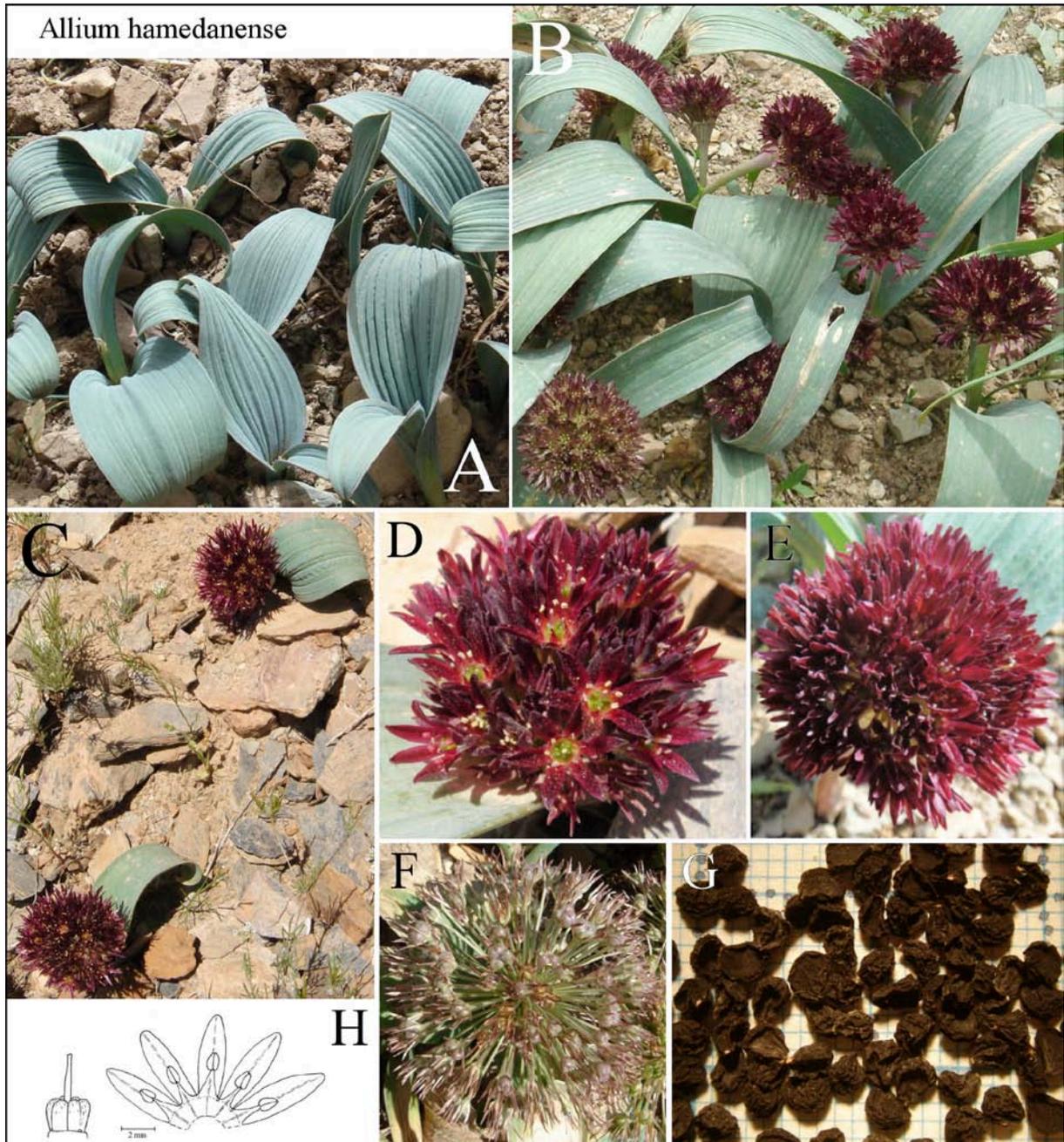
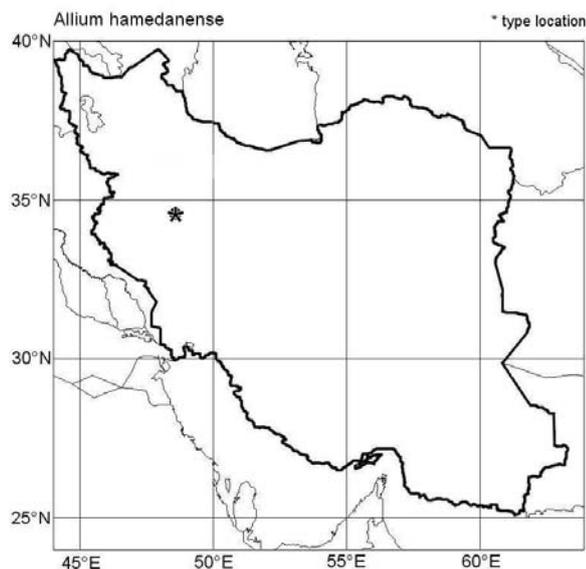


Plate T39. A & B: Cultivated plants after sprouting and in full anthesis, resp.; C: flowering plants at the type location; D & E: inflorescences in early and late anthesis; F: inflorescence with developing capsules; G: seeds (background raster 1 mm); H: shape of ovary, tepals and filaments of a flower prepared from herbarium (from Fritsch & Abbasi 2009: Fig. 7C).

Bulbs depressed-ovoid, 2-3 cm long and in diameter; outer tunics moderately strong; brown. Scape flexuous,  $\pm$  conical, smooth; aerial part 4-6 (8) cm long, above 7-8 mm and below 5-6 mm in diameter; green. Leaves 1-2, laminae ovate to narrowly lanceolate, obliquely arcuately ascending and recurved, the short hooded apex enrolled, broadly canaliculate, thick; margin red-brown, basally very coarse but nearly smooth near the tip; upper side strongly grooved, lower side with shallow wide ribs or nearly smooth; 8-14 cm long and 2-4.5 cm wide; very dull green with glaucous bloom; sheath leaf of variable length, papery, whitish, soon decaying. Spathe membranous, above basal third split into 4-5 triangular valves; initially as long as the inflorescence, later shorter and patent to reflexed; pale brown with darker veins. Inflorescence sub-fasciculate to semi-globose, very dense, many-flowered; c. 2 cm long and 3-4 cm in diameter. Pedicels thick, stiff, straight, unequally long; 8-12 mm long; greenish with reddish flush. Anthesis in April to May. Flowers funnel-shaped star-like. Tepals lanceolate, canaliculate, obliquely positioned, apex sub-obtuse; after anthesis margins longitudinally convolute and spine-like stiff; 7-8 mm long, up to 2.5 mm wide; dark maroon-purplish with inconspicuous, broad, greenish median vein. Filaments 1/3-2/5 as long as the tepals, triangular (inner filaments 1.5 times broader than outer ones), basally shortly united; dark maroon to reddish with white base. Anthers oblong, 1.3 mm long and 0.7 mm wide; pinkish brown. Pollen yellow. Ovary sessile, six-angled depressed-globose, glossy, on the top with 6 radially directed, conical outgrowths; 2 mm long, 2-3 mm in diameter; green, often with small blackish spots; nectary ducts lead in small triangular pits at 1/5 of nectary length. Style conical, 2-3 mm long; whitish. Stigma undivided; whitish. Capsule depressed globose-triangular; c. 4 mm long and 4-5 mm in diameter, moderately widely opening; valves broadly ovate, apex deeply notched, sub-glossy. Seeds 1-2 per locule, ovate-angular, surface with irregular ledges or coarsely reticulate lacunose, mostly one side concave and only rugose; 2.5-3 mm long, 2 mm broad and 1.5 mm thick; dull black.



**Distribution:** Iran, province Hamedan, known only from the type location; submontane dry and rocky steppe slopes.

**Remarks:** The small plants of *A. hamedanense* are attractive by the dark flower color. They were collected at the type location before this site was flooded after raising the top of Ecbatan dam. Search for surviving plants is essential. Their flower color and glossy ovaries bearing six conical outgrowths at the apex are unique characters in sect. *Acanthoprason*. Molecular markers (ITS sequences of nuclear rDNA) positioned *A. hamedanense* in one group with *A. mahneshanense*, *A. shelkovnikovii* s. str., *A. graveolens*, and *A. chlorotepalum* (see p. 200). A similar position was deduced from the sequences of the plastid *trnL-trnF* region (Gurushidze & al. 2010).

**Etymology:** The species was named after the old and important Iranian town Hamedan situated nearby the type location.

**Biological data:** Genome size 46.3 pg 2C DNA (Gurushidze & al. 2012).

**Economic traits:** Local names 'kul', 'mu-sir'. Bulbs and leaves are sliced and added to yoghurt as spice (Fritsch & al. 2007).

Living accessions studied: **Hamadan:** NE slopes of Alvand massif c. 15 km SE Hamadan, Sangestan road, around Ecbatan dam (34°45' N, 48°36' E, 2000 m, 11.5.2006 Abbasi, Fritsch, Keusgen 1089; 43979-IRAN GAT).

Herbarium voucher: **Hamadan:** Around Shahnaz Pahlavi dam (34°45' N, 48°36' E, 1900 m, 27.4.1973 Shamlou 44031-IRAN).

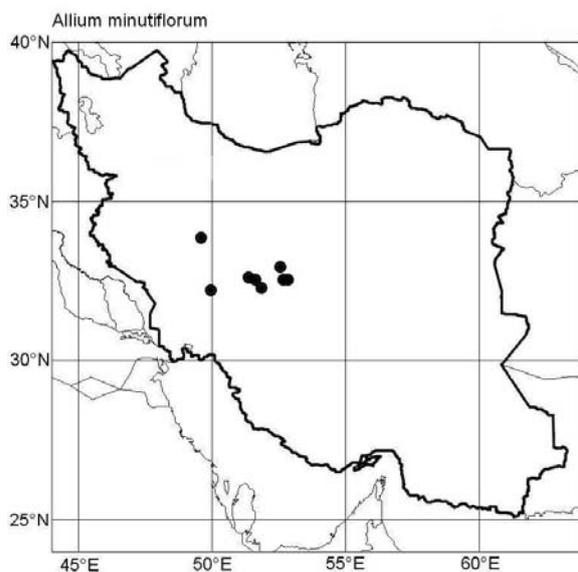
**40. *Allium minutiflorum*** Regel in Trudy Imp. S.-Peterb. Bot. Sada 3, 2: 242 (1875).- Wendelbo, Flora Iranica No. 76: 75, tab. 7/101 (1971). ? *Allium stenopetalum* var. *pumilum* Parsa in Kew Bull.: 34 (1949), sensu Wendelbo, Fl. Iranica 76: 75 (1971), Type: Iran: Shir Kuh, mountainside, 3600 m, leg. Guiseppi 18.4.1932 No. 43 (K, scan seen). - Type: Persia australis, in montibus bakhtiaricis, leg. Bode (LE, only photo seen).

Bulbs ovoid to globose, c. 2.5 cm in diam.; outer tunics membranous, undivided; brown to grey. Scape terete, smooth; 5-10 cm long, 3-5 mm in diam. Leaves 2-3, laminae linear-lanceolate, broadly canaliculate or upper part flat, arcuately ascending and recurved to the soil, thick, smooth, arcuately tapering into the short cucullate apex; margin brown later white, cartilaginous, finely toothed; 15-25 cm long, 1-2 cm broad; glaucous green. Sheath leaf short, membranous, whitish; soon decaying. Spathe membranous, split into 2 ovate, acute valves 1/2 to nearly as long as the pedicels; pale brown to purplish with darker veins. Inflorescence broadly fastigiate to semi-globose, dense, moderately many-flowered; c. 5-8 cm in diameter. Pedicels thin,  $\pm$  straight, unequally long; 1-2.5 cm long; purplish. Anthesis in May to June. Flowers broadly to flat funnel-shaped star-like. Tepals long-ovate to triangular,  $\pm$  concave, obtuse, basally for 1 mm connate, obliquely patent; after anthesis nearly straight with convolute margins



Plate T40. A: Vegetative plant at Mazareh-Yazdi; B & C: cultivated plants after sprouting; D: comparison of flower parts in different stages.

and thickened, stiff vein; 3.5-5 mm long, basally c. 2 mm broad; pale green with broad dark green median vein. Filaments about 2/3 as long as the tepals, triangular, inner filaments remarkably broader, fleshy, connate at base; purple with white base. Anthers ovoid, c. 0.8 mm long; purple. Pollen pale yellow. Ovary sessile, subglobose-cylindrical triangular with 3 broad and 3 narrow furrows, surface smooth and glossy; c. 2.5 mm long and in diameter; initially black later green. Style cylindrical, 2-3 mm long; purplish. Stigma undivided; white. Capsule depressed globose, c. 4 mm in diameter. Seeds not seen.



and upper part flat, arcuately ascending and recurved to the soil, thick, smooth, arcuately tapering into the short cucullate apex; margin brown later white, cartilaginous, finely toothed; 15-25 cm long, 1-2 cm broad; glaucous green. Sheath leaf short, membranous, whitish; soon decaying. Spathe membranous, split into 2 ovate, acute valves 1/2 to nearly as long as the pedicels; pale brown to purplish with darker veins. Inflorescence broadly fastigiate to semi-globose, dense, moderately many-flowered; c. 5-8 cm in diameter. Pedicels thin,  $\pm$  straight, unequally long; 1-2.5 cm long; purplish. Anthesis in May to June. Flowers broadly to flat funnel-shaped star-like. Tepals long-ovate to triangular,  $\pm$  concave, obtuse, basally for 1 mm connate, obliquely patent; after anthesis nearly straight with convolute margins

Distribution: W & C Iran; colline to submontane, gravelly and sandy semi-desert slopes.

Remarks: This species is apparently well adapted to desert conditions where the general appearance of the plants is strongly influenced by the growing conditions, and only the short and narrow tepals and filaments are rather constant characters. It is probably also able (like *A. cathodicarpum* and *A. regelii*) to suppress growth after a very dry winter and spring (the plants "remain sitting") over one year. This could be a sound explanation that herbarium vouchers were rather sporadically collected. Own attempts to re-collect this species in the very dry spring of 2010 failed completely. Also samples for molecular study were not available hitherto.

Etymology: The epithet refers certainly to the short and narrow tepals of this species (from Latin "very small flowers").

Living accessions studied: Esfahan: Abzweig Mazareh-Yazdi an der Hauptstraße Nain - Yazd (32°43' N, 52°43' E, 2200 m, 11.5.1994 Fritsch 1008; GAT).

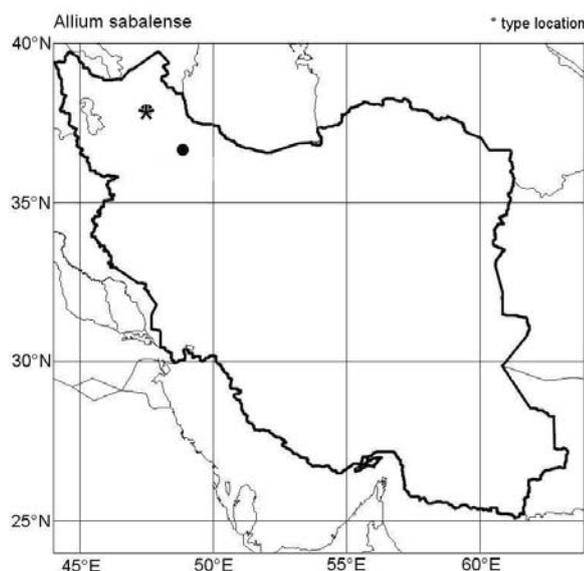
Herbarium vouchers: Kerman?: Tehran to Kerman, between Dzhoukent and Namstanekom (?) (17.4.1906 Adamowa 66; LE). Tehran to Kerman, Dzhoukent (16.4.1906 Adamowa 59; LE). - Chaharm. Bakhtiyari: Kouhrang, Zardkouh, Tar (32°24' N, 50° E, 2100-2500 m, 03.6.1984 Termeh, Tehrani 43010-IRAN). - Esfahan: Ghameshloo protected area Koppeh Palang (32° 47' N, 51° 24' E, 2200 m, 26.5.1996 Uosafi 1223, 817; TARI). 90 km E Isfahan versus Naeen (32°44' N, 52°51' E, 06.5.1982 Aryavand, Sahebi; HIU). Esfahan (32°28' N, 51°54' E, Aucher 5389; P G). 41,8 km SE Ardestan - 52,8 km NW Nain (33°07' N, 52°36' E, 2090 m, 11.5.1961 Pabot 7129; G). 100 km E Esfahan prope Naeen, Badafshan (32°44' N, 52°52' E, 2000-2200 m, 05.5.1982 Aryavand; HIU). - Markazi: 5 km S Arak, Sanjan village (34°03' N, 49°38' E, 09.7.2005 Mohajerani 19; HSU).

### *Allium ubipetrense* alliance

**41. *Allium sabalense* R.M. Fritsch, species nova.** - Type: Cultivated in the national living *Allium* collection of Iran, IRIPP, Tehran, no. 1338 leg. 07.5.2012 (holotype IRAN), bulbs from Iran, prov. East Azarbayjan, northern slopes of Mt. Sabalan massif N Sarab, 2500 m, 38°07'34" N, 047°32'38" E, leg. 07.5.2011 Fritsch & Pahlevani no. 1338.

Species similes *Allio alekii* sed differt scapis, foliis, et filamentis brevioribus, antheris flavis, et ovarii levibus. Differt ab *Allio akaka* tepalis longioribus intensiore coloratis nervo saepe atro-purpureo, et filamentis longioribus.

Bulbs depressed-ovoid, c. 2 cm long and in diameter; outer tunics blackish, rather strong. Scape terete, flexuous, smooth; aerial part 3-8 cm long, 4-6 mm in diameter; green with some red flush. Leaves 1-2, laminae lanceolate to long-ovate, canaliculate, arcuately ascending and recurved back to the soil, thickish, with thin white dentate margin and short hooded apex, upper and lower side smooth; 10-16 cm long, 1.5-5 cm wide; green with glaucous bloom. Sheath leaf short, membranous, smooth, hyaline, soon decaying. Spathe membranous, initially appressed to the pedicels, later reflexed and crumpled, split into 2-3 ovate, acute valves; brownish with darker brown veins. Inflorescence fasciculate later semi-globose, dense, ± moderately many-flowered; up to 8 cm in diam. Pedicels straight, thick, stiff, smooth, semi-glossy; 1.5-4 cm long; violet-purple later greenish. Anthesis in May. Flowers funnel-shaped star-like. Tepals long-ovate to linear, apex rounded, inner tepals slightly broader, basally shortly connate; 7-9 mm long, about 2 mm wide; pink to purple, with dark purple to green, moderately broad median vein. Filaments 1/2-2/3 as long as the tepals, outer filaments triangular, inner ones ovate, all nearly touching with the margins, fleshy; initially whitish, later purple as the tepals. Anthers c. 1 mm long, ovoid; yellow. Pollen yellow. Ovary short-globose, triangular, smooth but dull; 2-2,5 mm long and in diam.; green with darker sutures, sometimes with purplish spots; nectary ducts lead in nose-like pockets at 1/4 of ovary length. Style cylindrical-inflated, later conical, 4 mm long; initially whitish later purplish.



Stigma dot-like; white. Capsule depressed-globose triangular, surface with minute transversal ledges; c. 3 mm long and 4-5 mm in diam.; pale yellowish brown; valves broadly elliptic with a deep and broad longitudinal furrow broadly notched at the apex. Seeds 1 (-2) per locule, sector-like drop-shaped, surface finely tuberculate, some seeds with a concave side show no or a few irregular ledges surrounded by sharp marginal ledges, convex side or both sides coarsely and irregularly reticulate lacunose; c. 3 mm long, c. 2 mm wide and 1.5-2 mm thick; dull black.

Distribution: Iran, prov. E Azarb., northern montane steppe slopes of Mt. Sabalan massif; occurrence in the Vansar massif needs confirmation.

Remarks: Similar to *A. alekii* but differs by shorter scapes and leaves, shorter filaments, yellow (not purple) anthers, and a smooth (not finely coarse) ovary, and from *A. akaka* s. str. by longer, pink to purple tepals with often dark purple median vein, longer filaments, and the nectary ducts lead in pockets with central nose-like rise. Molecular markers (ITS sequences of nuclear rDNA, see p. 200) confirm a close



Plate T41. A: Leaves of plants at the type location; B & C: cultivated plants prior to anthesis and in early anthesis, resp.; D: cultivated plants in full and late anthesis, inset: shape of ovary, tepals and filaments of a flower prepared from herbarium; E, F (cultivated plant from Azerbaijan) & G: inflorescences in early, full, and late anthesis, resp.; H: inflorescence with full-sized capsules; I: seeds (background raster 1 mm).

genetic relationship to *A. akaka* and *A. sahandicum*, with *A. alekii*, *A. materculae*, *A. egorovae*, and *A. subakaka* as sister group.

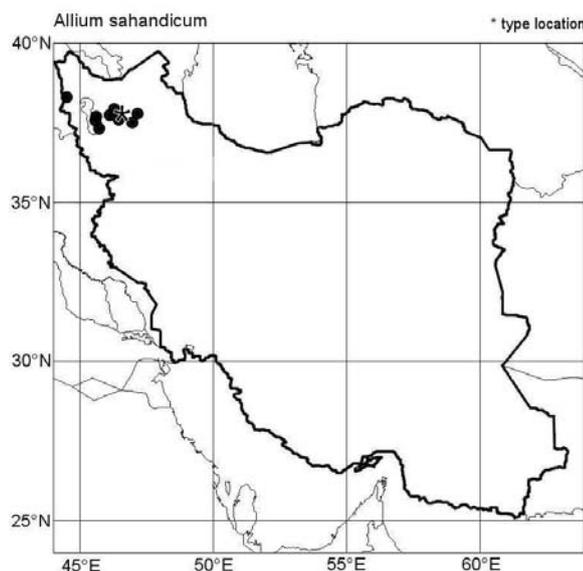
Living accessions studied: E Azarb.: N slopes of Mt. Sabalan massif N Sarab, Mir-Kuh-Haji, Narmigh (38°08' N, 47°33' E, 07.5.2011 Fritsch, Pahlevani 1338; IRAN).

Herbarium vouchers: E Azarb.: Sarab, Kouh-e Gharel-Gol, Sad-e Hassanjan (2400-2700 m, 13.6.1986 Termeh, Daneshpajuh 48881-IRAN). Sarab, Gharieh-ye Mir-kouh-Haji (38°05' N, 47°32' E, 1700-1900 m, 11.-12.6.1986 Termeh, Daneshpajuh 212-IRAN). - Zanjan 50 km NE Zanjan towards Gilvan, Vansar Mts. (36°50' N, 48°54' E, 2200-2350 m, 20.6.1983 Mous-savi, Habibi, Tehrani 43048-IRAN).

**42. *Allium sahandicum*** R.M. Fritsch, **species nova**. - Type: Iran, W Azarb., Bostonabad 6 km to Tabriz, slopes above sandstone rocks near the main road, 1900 m, 38°00'37" N, 46°30'57" E, leg. 08.5.2011 Pahlevani & Fritsch no. 1342 (holotype 57031-IRAN).

Species similes *Allio* akaka sed tepalis acutis linearo-lanceolatis nervo late atropurpureo et filamentis interioribus basi lineari-dilatatis.

Bulbs ovoid to depressed-globose, 1-2 cm long and in diam.; outer tunics rather brittle, grayish brown. Scape flexuous, terete, obconical, smooth; aerial part 2-7 cm long, 4-6 mm in diameter near the soil, 7-8 mm below the inflorescence; glaucous green, purple suffused. Leaves 1-2, laminae oblong to lanceolate, falcate to  $\pm$  S-shaped, initially rather flat lying on the soil later arcuately ascending and recurved to the soil, strongly canaliculate, thick, shortly arcuately tapering into the cucullate apex; margin smooth, initially purple, later white; (8) 12-20 cm long, 1-2 (3) cm broad; glaucous green. Spathe membranous, split into 2-3 ovate acuminate,  $\pm$  patent valves; pale yellowish brown with inconspicuous veins. Inflorescence initially very dense and broadly fasciculate, later semi-globose and rather loose, many-flowered; 3-5 (8) cm in diam. Pedicels thick, stiff, straight; 8-10 (15) mm long; green with purplish flush fading towards the base. Anthesis in April to May. Flowers campanulate to funnel-shaped star-like. Tepals linear-lanceolate, subacute, obliquely forward directed and upper half somewhat recurved, basally 1 mm long connate; 7 mm long and 2 mm wide (outer tepals slightly narrower than the inner ones); rose with broad dark purple median vein. Filaments 2/3-4/5 as long as the tepals, fleshy, inner filaments basally linear above triangular, outer filaments triangular and somewhat shorter and narrower; basally 1 mm connate and adnate to the tepals; whitish to rose throughout. Anthers ovoid, about 0.8 mm long; yellow. Pollen yellow. Ovary short cylindrical-globose triangular, surface smooth and dull; c. 3 mm long and in diam.; greenish-grey with darker greenish and slightly rough sutures, nectary ducts lead in nose-like transversal pockets near the base. Style cylindrical, 2-3 mm long; white. Stigma undivided; white. Capsule depressed globose triangular, surface finely reticulate lacunose; c. 3 mm long and 3-4 mm in diam.; pale yellowish brown; valves widely opening, broadly elliptic with a  $\pm$  shallow longitudinal furrow, shallowly notched at the apex. Seeds 1-2 per locule, sector-like drop-shaped, concave-convex, concave side finely tuberculate without or with a few irregular ledges surrounded by sharp marginal ledges, convex side irregularly reticulate lacunose; 2.5-3.5 mm long, 2-2.5 mm wide, 1.5 mm thick; dull black.



Distribution: Iran, prov. E Azarb., montane to sub-alpine stony and loamy slopes of the mountains around Tabriz.

Remarks: Similar to *A. akaka* s. str. and *A. sabalense* but characterized by linear-lanceolate acute tepals with broad dark purple median vein, filaments 2/3 to as long as the tepals, inner filaments basally linear widened, and nectary ducts leading in pockets with central nose-like rise. Molecular markers (ITS sequences of nuclear rDNA, see p. 200) support a close relationship to those species.

Living accessions studied: E Azarb.: Slopes near the main road from Bostonabad 6 km before Tabriz (38°01' N, 46°31' E, 1900 m, 08.5.2011 Pahlevani, Fritsch 1342; IRAN GAT). Northern slopes of Mt. Sahand massif, above village Iranaq c. 20 km S Tabriz (37°48' N, 45°31' E, 2760 m, 10.5.2011 Fritsch, Pahlevani 1345; 2600 m, Fritsch, Pahlevani 1347; IRAN, GAT).

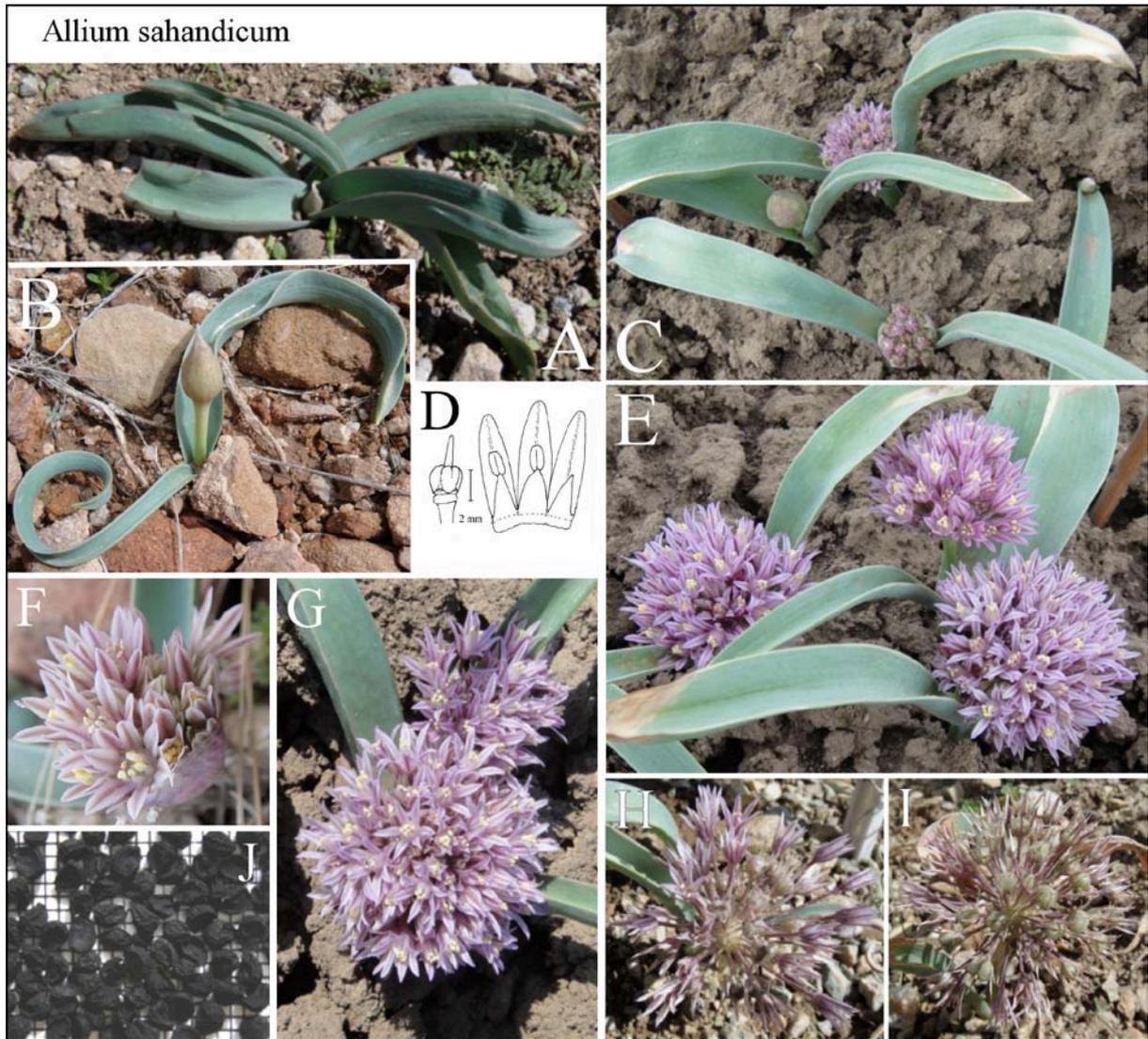


Plate T42. A & B: Plants after sprouting at the type location; C & E: cultivated plants in early and full anthesis, resp.; D: shape of ovary, tepals and filaments of a flower prepared from herbarium; F & G: inflorescences in early and full anthesis, resp.; H & I: inflorescences in late anthesis and with developing capsules, resp.; J: seeds (background raster 1 mm).

Herbarium vouchers: E Azarb.: SE & N slopes of Kuh-i-Sahand (37°46' N, 46°30' E, 7500 Ft. 24.5.1960 Furse, Syngé 229A; 226-IRAN). Tabriz (38°06' N, 46°20' E, 27.5.1960 Brown 2721; 30719-IRAN). Tabriz to Bostonabad (37°55' N, 46°32' E, 1950 m, 05.7.1965 Danin, Plitman, Baum 65-1775; HUI). Tabriz: Jazireh-ye Islami - Bahram Abad village (37°55' N, 45°31' E, 1450 m, 30.4.2002 Gharemani, Imani 7535; HTRC). Oskou to Sahand, Kouh-e Soltan (2600-3130 m, 22.6.1985 Termeh, Moussavi, Tehrani 230-IRAN). 75 km from Mianeh to Tabriz, rock mountain near road (37°41' N, 47°00' E, 1810 m, 21.5.1971 Foroughi 44375; W). - W Azarb.: Ghatour toward Khoy, Kouhé Ghatour (38°29' N, 44°27' E, 1900 m, 10.6.1971 Iran-shahr 222-IRAN). Kaboudan Island (37°29' N, 45°38' E, 1275-1500 m, 20.5.1998 Sangari, Termeh, Tehrani 185;43994-IRAN).

Determination unsure: E Azarb.: campus of Tabriz University (38°04' N, 46°20' E, Razyfard 34269; TUH). Near the road from Bostanabad to Sarab (37°58' N, 47°12' E, 1600-1800 m, 09.6.1992; HTRC). Dirt road of Kandavan to Esphanjan (37°54' N, 46°10' E, 2090 m, 27.5.1987 Olfat 581; HTRC). Tabriz: Jazireh-ye Islami, 15 km from Sarag to Agh Gombad vill. (37°47' N, 45°32' E, 1350 m, 21.4.1996 Kasebi, Imani 5625; HTRC).

**43. *Allium ubipetrense*** R.M. Fritsch in Rostaniha 9 Suppl. 2: 20, fig. 4 (2008 publ. 17 Jul 2009). - *Allium haemanthoides* auct. p.p., *Allium akaka* subsp. *haemanthoides* (Regel) Wendelbo, Flora Iraq 8: 167 (1985). *Allium haemanthoides* var. *lanceolatum* Boiss., Fl. orient. 5: 276 (1882). Type: Iran: Lurestan: Sawers-Berge, Nur, Eschker, leg. Hausskn. (holotype G-BOIS!). ? *Allium akaka* f. *major* Turrill, Curtis's Bot. Mag. 160: Tab. 9506 (1938). Type: Plants from northern Iran cultivated in Royal Botanic Gardens Kew (K?, not seen). - Type: Kurdistan, Sanandaj towards Marivan, Ariz pass, 2000-2200 m, 35°22'14.0" N, 46°51'29.6" E, 17.5.2006 leg. Abbasi, Fritsch, Keusgen, (holotype 43975-IRAN).

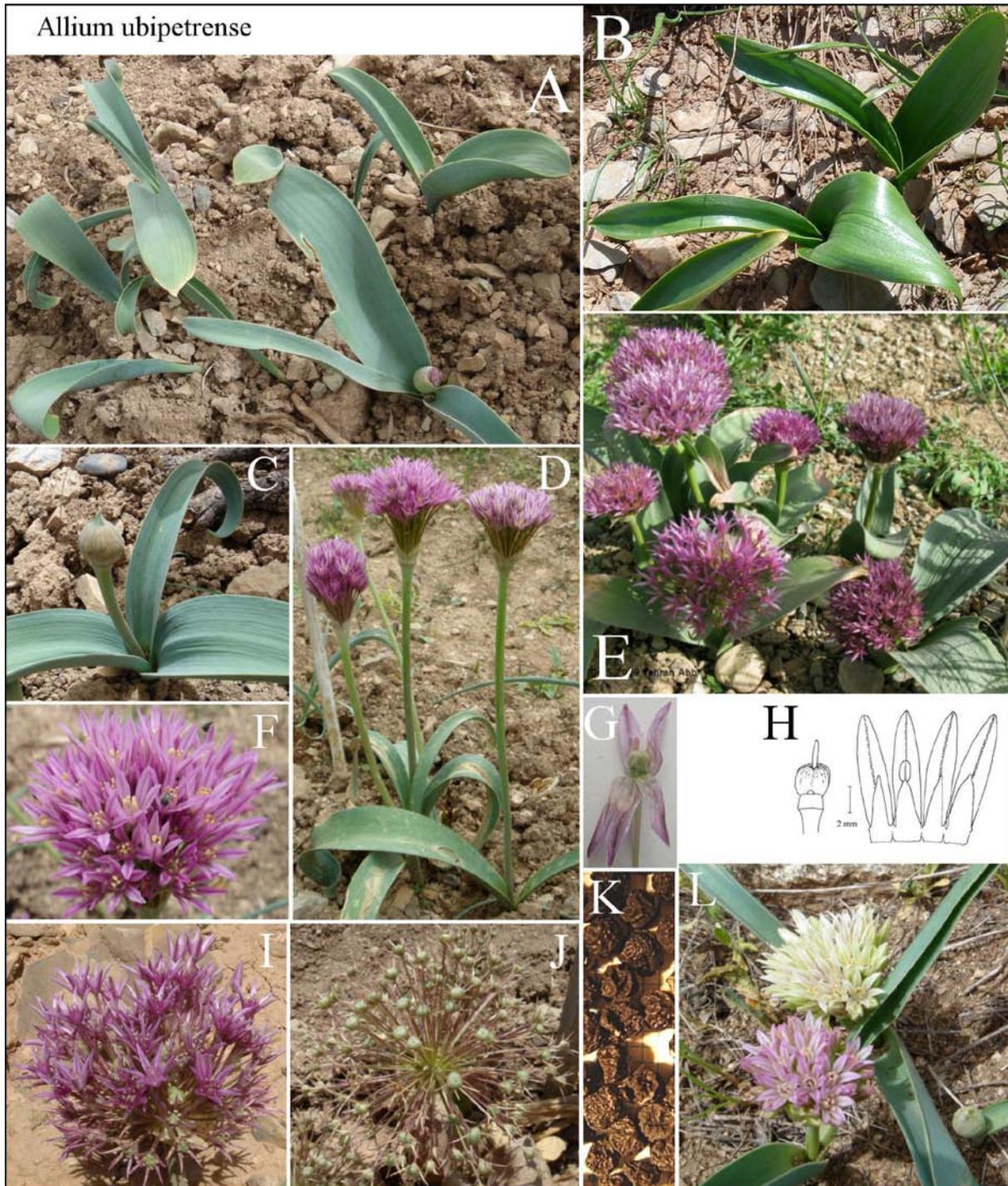
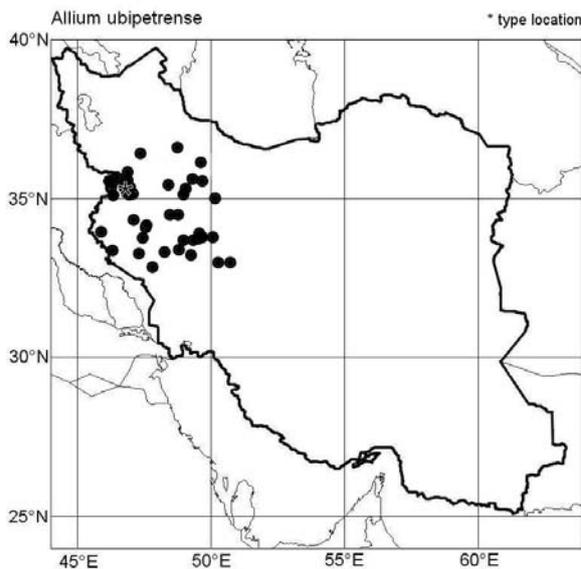


Plate T43. A: Cultivated glaucous plants after sprouting; B: glossy plants at Mt. Razvand; C: cultivated plant in the shooting stage; D: flowering plants of the slender morphotype (*A. haemanthoides* var. *lanceolatum*); E: flowering plants from the type location; F: inflorescence in full anthesis; G: close-up of a dissected flower; H: shape of ovary, tepals and filaments of a flower prepared from herbarium; I: inflorescence in late anthesis; J: inflorescence with developing capsules; K: seeds (background raster 1 mm); L: flowering plants of different flower color at the pass Herab.

Bulbs depressed-ovoid, 2-3 cm long and in diameter; outer tunics grayish-brown, disintegrating. Scape  $\pm$  flexuous, terete, narrowly obconical (widest below the inflorescence), smooth; (6) 10-15 (20) cm long, basally (4) 5-6 mm, below inflorescence up to 8 mm in diameter; deep green, basally often purplish suffused. Leaves (1) 2-3, narrowly to widely lanceolate, basally often stalk-like narrowed, gradually or short arcuately tapering into the hooded apex,  $\pm$  steep arcuately ascending and recurved to the soil, upper part often backwards enrolled; margin brown later white, at least towards the base densely toothed; upper and lower side smooth or with a few shallow furrows; fresh green with glaucous bloom.

Sheath leaf very short, translucent greenish to brownish, decaying prior to anthesis. Spathe membranous, split into 2-3 short triangular valves, appressed to the pedicels or upper part patent to subreflexed, 1-2 cm long; yellowish-brown with dark brown veins. Inflorescence narrowly to broadly fasciculate and dense, later semi- or even sub-globose in the fruiting stage, moderately dense, many-flowered; 3-8 cm wide. Pedicels unequally long, straight or somewhat recurved, wire-like, smooth; 4-7 cm long; glossy brownish-green. Anthesis in April to May. Flowers widely funnel-shaped star-like. Tepals widely lanceolate to narrowly oblong, obliquely patent, somewhat recurved, sub-acute; after anthesis convolute and somewhat connivent; 8-12 mm long, 2.5-3.5 mm broad (inner tepals somewhat broader); lilac or pink to purple with dark greenish-brown median vein. Filaments 1/3-1/2 as long as the tepals, fleshy, outer filaments triangular and somewhat shorter than the triangular-ovate inner filaments, margins above base with some distance to one another; color as the tepals or basally somewhat darker. Anthers  $\pm$  ovoid, about 1.2 mm long; yellow. Pollen yellow. Ovary depressed-globose triangular, moderately coarse; 2 mm long and in diameter; green, reddish suffused; nectary ducts lead in broad and short pockets near the ovary base. Style narrowly conical, 3-5 mm long; white or rose. Stigma undivided; white or rose. Capsule shortly pear-shaped triangular, 5-6 mm in diameter, surface nearly smooth and slightly glossy, widely opening; valves suborbicular, slightly notched at the apex. Seeds 1-2 per locule, ovoid to drop-shaped, surface coarsely reticulate lacunose; c. 2.5 mm long, 2 mm broad and thick; dull black.



**Distribution:** Iraq?, Iran: NW parts of Zagros mountain range, montane dry stony and often rocky steppe slopes.

**Remarks:** This recently described species is characterized by uni-colored filaments like *A. haemanthoides* that is differing by much longer tepals and (absolutely as well as relatively) much shorter filaments. *Allium akaka* s. str. differs by broader tepals and broader filaments. *Allium ubipetrense* is a morphologically variable species. Also really slender plants having up to 22 cm long scapes, only 15-35 mm wide leaves, and initially narrowly fasciculate inflorescences (formerly named *A. haemanthoides* var. *lanceolatum*, see Fritsch & Abbasi 2009, Fig. 4 B, C) showed the identical flower characters and

belong to *A. ubipetrense*. Although all characters of *A. akaka* f. *major* Turritt shown by Tab. 9506 fit very well to cultivated plants of *A. ubipetrense*, "perianth-segments linear" as well as the proportions of filaments conflict with the dimensions shown by the figures and were very probably typographical errors. Also molecular markers underline a remarkable variation. ITS sequences of nuclear rDNA positioned samples from province Kurdistan close to *A. haemanthoides* s. str. and *A. kurdistanicum*, but *A. ubipetrense* collected in prov. Markazi composed another subgroup closer to the base of sect. *Acanthoprason* (Fritsch & al. 2010; see p. 200). Sequences of the plastid *trnL-trnF* region belonged to three different haplotypes of lineage II (Gurushidze & al. 2010).

**Etymology:** The epithet refers to the widespread occurrence on rocky slopes (from Latin "commonly growing among rocks").

**Biological data:** Genome size 43.5 pg 2C DNA (Gurushidze & al. 2012).

**Economic traits:** Bulbs and leaves are sliced and added to yoghurt as spice (Massoumi 2001, as *A. haemanthoides*).

Living accessions studied: **Kurdistan:** Vicinity of the village Kalekan c. 20 km NW Divandarreh (36°01' N, 46°56' E, 2070 m, 18.5.2006 Abbasi, Fritsch, Keusgen 1116; GAT IRAN). Sanandaj towards Marivan, Ariz pass (35°22' N, 46°51' E, 2000-2200 m, 17.5.2006 Abbasi, Fritsch, R., Keusgen 43975-IRAN 1112; IRAN GAT). - **Lorestan:** Slopes near the pass Herab (33°53' N, 48°58' E, 2420 m, 12.5.2007 Fritsch, Keusgen M. 1166; GAT IRAN). S exposed limestone rocks W of pass Chariveh Shah,

(33°33' N, 48°50' E, 2300 m, 12.5.2007 Abbasi, Fritsch, Keusgen 1168; GAT IRAN). - Markazi: N slope of Razvand massif above vill. Suraneh (33°52' N, 49°26' E, 2340 - 2640 m, 10.5.2007 Abbasi, Fritsch, Keusgen 1149, 1153, 1154, 1155; IRAN GAT). Buinzahra towards Bardeh, Nashuh village, Mt. Nashuh (35°12' N, 50°12' E, 2500 m, 20.5.2008 Razyfard 1257; IRAN). - Qazvin: N slopes of Mt. Aghdag between Razan and Avaj near pass (9 km to Avaj) (35°32' N, 49°10' E, 2500 m, 21.5.2006 Abbasi, Fritsch, Keusgen 1125; GAT IRAN). - Zanjan: Limestone hill near the road from Takestan to Avaj, 10 km N of Abgarm (35°48' N, 49°21' E, 1580 m, 08.5.2006 Abbasi, Fritsch, Keusgen 1071; IRAN GAT). Pass before Takht-e Soleyman (36°36' N, 47°23' E, 2620 m, Ruksans; GAT). Photos sent by Mr. M. Jaeger, plants collected in Iran: 10 km W Sanandaj, JJMZ-150; 35 km W Sanandaj, 35°23' N, 46°43' E, JJMZ-162; pass W Mahabad, 36°44' N, 45°32' E, JJMZ-218; S Arak bei Shahsinde, am Berg Raswand, 33°52' N, 49°27' E, JLMS-130.

Herbarium vouchers: Esfahan: Esfahan (???.1962 Asefi AE 02; G). Khonsar to Buin -Miandasht, Kouh-e Sargandaz (33°11' N, 50°18' E, 2700-3100 m, 18.6.1989 Termeh & al.; IRAN). 17 km before Damaneh from Khunsar (33°10' N, 50°46' E, 2658 m, ????.2013 Moazzeni; photos). - Hamadan: inter Kengower et Nehawend (07.5.1903 Strauss; JE). In monte Elwend Gulp-eyghan (34°40' N, 48°30' E, 15.5.1895 Strauss; JE; 20.6.1908 Strauss; B JE). Road Hamedan to Avaj (35°18' N, 49°00' E, 1600 m, 13.5.1974 Dini, Bazargan 8546; TARI). Region de Aq Bolaq (90 km de Hamadan N) (35°36' N, 48°26' E, 2000 m, ????.1960 Rioux, Golvan AB 38; G). - Kermanshah: In monte Kuh-i Kinischt (dit. Kermanschahan) (34°31' N, 47°09' E, 08.6.1909 Strauss; W B JE). In monte Kuh Schiris (34°20' N, 47°38' E, 19.5.1904 Strauss; JE). - Kurdistan: Abbedar 5 km from Sanandaj (35°18' N, 46°58' E, 1750-1850 m, 09.5.1986 Fattahi, Khaledian 1030-TARI, 1104-HKS; 1750 m, 14.5.2004 Moradi 6875; 1850 m, 23.4.2004 Avideh Navzari 6220; HKS). Divandareh: Saral area, Zardavan village (35°34' N, 46°49' E, 2300 m, 21.5.2002 Hooshidary, Mandomi 4232; HKS). Divandarreh: Chelchashma area, near Alijan village (35°50' N, 46°31' E, 1900 m, 08.5.2004 Maroofi, Moradi 6987; HKS). In jugo Ariz 20 km W Sanandaj (35°22' N, 46°51' E, 2200 m, 04.7.1971 Rechanger 42832; W). (no site) (1680 m, 09.5.2006 Abasi, Maroofi, Gharemanloo; HKS). 15 km SW Divandareh to Sanandaj, road of Koolah to Dozakh Darreh, near Kapak village (35°44' N, 46°55' E, 1950-2000 m, 13.5.2004 Zarre, Mashayekhi 34909-TUH; GAT). Sanandaj 15 km to Divandareh (35°44' N, 46°55' E, 1700-1750 m, 13.5.2004 Zarre, Mashayekhi 34906-TUH; GAT). Kurdistan centralis, on mountain crest (1600-1900 m, 14.5.1960 Jacobs 6576; W). 16 km E Sanandaj, rocky slopes (35°19' N, 47°07' E, 2000 m, 17.5.1962 Furse 2071; W). E Sanandaj, Salawat-Abad defile (35°20' N, 47°08' E, 1480-1950 m, 07.5.1986 Fattahi, Khaledian 1092; HKS; 2180 m, 02.6.1987 Fattahi, Khaledian 1288; HKS TARI). Saral area N Sanandaj, Farhad-abad village (35°34' N, 46°47' E, 2200 m, 19.5.1997 Kaffash, Fany 3993; HKS). Maryvan (35°31' N, 46°10' E, 12.4.2007 Soumeih Yari 8465; HKS). Ghorveh towards Sanandaj (data incomplete, 16867; TUH). Manokh Bala village N Sanandaj, Almaloo mountain, (35°32' N, 47°01' E, 2100 m, 23.5.1997 Kaffash, Fanj 4074; HKS). 91 km from Baneh to Marivan (35°41' N, 46°22' E, 2150 m, 30.5.1978 Runemark, Mozaffarian 29348-TARI). 20 km W Sanandaj to Marivan, hillside (35°25' N, 46°54' E, 7050', 20.5.1960 Bent, Wright 520-102; W). - Lorestan: in monte Kuh-Tarikha (33°57' N, 47°29' E, 11.5.1904 Strauss; B JE). Khoramabad - Dorud Oshtorankuh (33°20' N, 49°18' E, 2200 m, 06.5.1973 Riazi 9653; TARI). Shah Bazan, (1200 m, 27.4.1937 Koeie 1660; W). Azna. Darehtakht, Oshtorankuh N slope (33°24' N, 49°16' E, 2000 m, 07.5.1973 Rowshan 9717; TARI). In montes Kuh-i-Besri (33°01' N, 47°50' E, 04.6.1910 Strauss; JE). - Markazi: Tchal (34°39' N, 49°55' E, Strauss ? 33; ????.1892 Strauss 868 ?; B). Tschal, Kuh Nogneh Kemer (34°38' N, 49°55' E, Strauss?; JE). In dit. urb. Sultanabad: m. Raswend (33°52' N, 49°25' E, ????.1897 Strauss; B JE). 15 km S Arak, E Gavar vill., Mt. Shamsabad (33°58' N, 49°42' E, 30.5.1986 Akhani 612; TARI). Arak area, Kuh- Bharf Khaneh (33°58' N, 50°07' E, 2300-2800 m, 04.5.1975 Wendelbo, Assadi 16477-TARI). Arak towards Malayer 20 km from Arak, Chepeghli (Ab-Robot) (34°04' N, 49°34' E, 2300-2700 m, 24.5.1988 Termeh, Karavah, Tehrani 412-IRAN). m. Mowdere pr. Sultanabad (34°06' N, 49°38' E, 08.6.1890? Strauss; JE). c. 30 km SW Arak, Kuh-e Sefidkhani (33°55' N, 49°34' E, 2000-2700 m, 24.5.1998 Assadi 78992-TARI). - Qazvin: 24 km Razan to Avaj 11 km to Mahnian village (35°30' N, 49°06' E, 2000-2020 m, 10.5.2004 Zarre, Mashayekhi 34908-TUH; GAT). Yazan 50 km S Takestan (35°44' N, 49°44' E, 1550 m, 12.5.1974 Dini, Bazargan 8450; TARI). - Zanjan: 50 km NO Zanyan towards Gilvan, Vansar mountains (36°47' N, 48°47' E, 2200-2350 m, 20.6.1983 Moussavi, Habibi, Tehrani 41838-IRAN). Benah to Shaftan (1500-1950 m, 07.6.1977 Moussavi, Tehrani 44002-IRAN).

Determination unsure: E Azarb.: Tabriz to Ghar-e Chaman, before this place (1100 m, 05.6.1994 Ghahreman, Attar, Dadjou 17362-TARI). Gilan between Ghazvin and Rudbar, Kuhin (36°19' N, 49°40' E, 1600 m, 27.5.1978 Wendelbo, Assadi 27663-TARI). - Ilam: Ilam towards Mehran, Marbereh (33°33' N, 46°21' E, 02.5.1968 Iranshahr 8096-E; 30718-IRAN). - Kermanshah: Kuh Sefid (dit. Kermanshahan) (34°05' N, 47°20' E, 12.5.1905 Strauss; JE). Harsin - Ahvaz mountain (34°17' N, 47°35' E, 1700 m, 03.5.1992 Nori, Neamati 3196; NRK). 15 km Ghilan-e garb to Islamabad (34°08' N, 45°55' E, 03.5.1992 Mirzaie, Mirabdali 3215; NRK). - Kurdistan: Saral area N Sanandaj, Doozakh-Darreh village (35°46' N, 46°56' E, 15.5.2005 Hosseini; HCAT; 2430 m, 28.7.1998 Kaffash, Mohammady 2833; HKS). Degaga village E Koch-Salan mountain, (35°17' N, 46°23' E, 1100 m, 08.5.1996 Khanaghahi, Sabzy 3574; HKS). - Lorestan: Khorramabad, Sefid Kuh (33°30' N, 48°19' E, 2300 m, 28.8.1996 Mehrnia 2660; ARCK). - Markazi: coll. in horto Leichtlini a bulb. Sultanabad a Strauss collect. (34°04' N, 49°45' E, 14.4.1894; JE). "Flora of Sultanabad" (03.5.1890 Strauss; WU).

*Allium* sect. *Asteroprason* R.M. Fritsch in Phytion (Horn, Austria) 49: 184 (2010). Type: *A. elburzense* Wendelbo

*Allium* subsect. *Asteroprason* R.M. Fritsch in Phytion (Horn, Austria) 49: 184 (2010). Type: *A. elburzense* Wendelbo

44. *Allium aladaghense* Memariani & Joharchi in Phytotaxa 56: 29, fig. 1 A-D (published 07 Jun 2012). - Type: Iran. North Khorasan: SW Bojnord, Rein towards Marjan rangeland, Bali, northern slopes of Aladagh Mt., 2350–2400 m, 28 May 2006, Memariani & Zangoeei 37801 (holotype FUMH!).

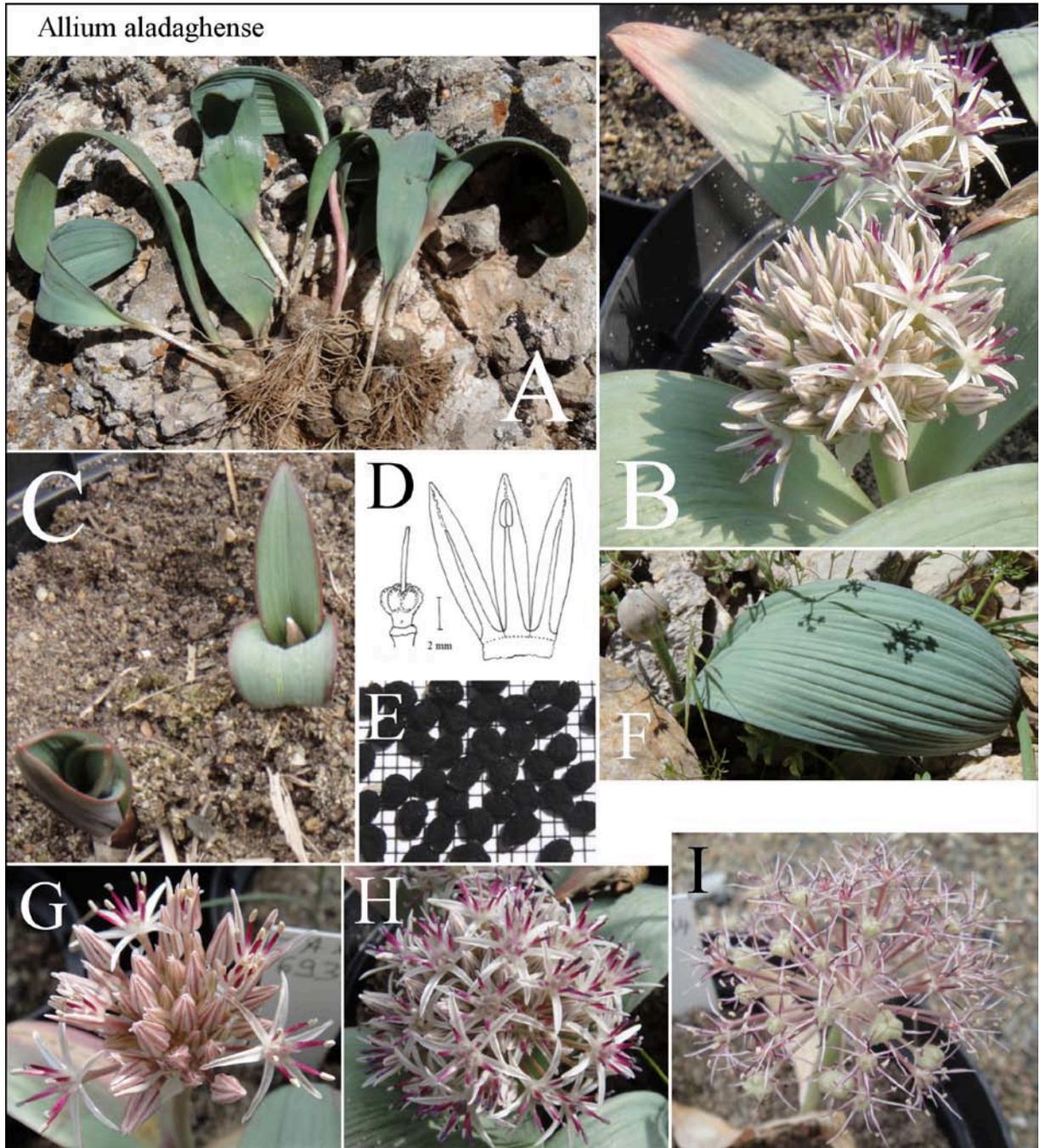
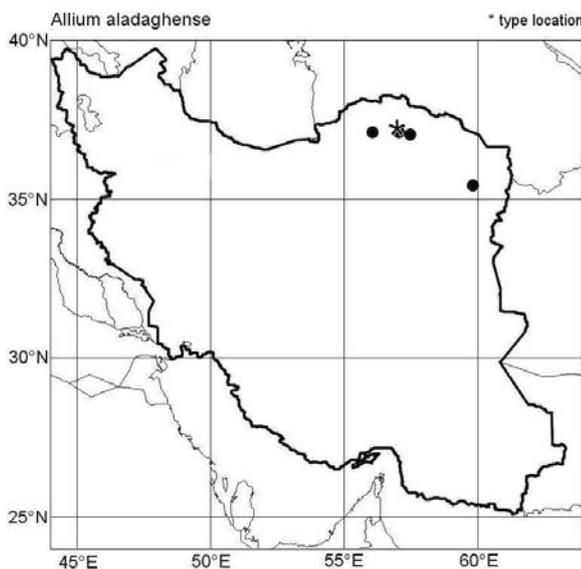


Plate T44. A: vegetative plants; B: cultivated plants in anthesis; C: sprouting leaves and scape; D: ovary, tepals and filaments prepared from herbarium; E: seeds, background raster 1 mm; F: leaf and developing inflorescence; G & H: inflorescences at begin and in full anthesis, resp.; I: inflorescence after anthesis.

Bulbs subglobose, c. 2 cm in diameter; outer tunics greyish-brown, disintegrating. Scape terete, straight, smooth; 2-8 cm long above soil, 4-5 mm in diameter; glaucous green basally purple flushed. Leaves 1 or 2, laminae elliptic to oblong, thick fleshy, nearly flat, arcuately tapering into a short hooded apex, the upper side sulcate, lower side with broad ribs, margin toothed, initially red, 7-20 cm long, 1.5-4 cm wide; glaucous green, reddish-brown flushed towards the base. Sheath leaf short, smooth, papery, brownish. Spathe membranous, incompletely split into 2-4 broadly ovate, shortly acuminate valves, patent to reflexed; whitish with brownish nerves. Inflorescence semi- to subglobose, dense, many-flowered; 3-5 cm in diameter. Pedicels thick, straight, subequally long, 1-2 cm long; purplish with paler base. Anthesis in May to June. Flowers flat star-like. Tepals long-triangular, plicate, subacute, patent; after anthesis irregularly crumpled and convolute but not prickly stiff; 5-7 mm long, basally 0.5-1 mm wide; whitish with green to purple, inconspicuous median vein. Filaments 4/5 to nearly as long as the tepals, subulate, obliquely patent; basally shortly triangular widened, connate and adnate to the tepals; apex deep purple fading towards the whitish base. Anthers  $\pm$  ovate, c. 1.5 mm long; violet. Pollen yellow to greenish-grey. Ovary stipitate, depressed pear-shaped tripartite with 3 deep and 3 narrow furrows, surface coarse by acute tubercles; 2-3 mm long and in diameter; violet or green, violet flushed, after anthesis pale green; nectary ducts lead in small slits near the base. Style narrowly conical, 3-4 mm long; pinkish to whitish. Stigma undivided; whitish. Capsule depressed pyriform tripartite with six furrows; 3-4 mm long, 5-6 mm in diameter; in fresh state greenish, in dry state brownish; valves widely opening, broadly elliptic with a deep notch near the apex, surface dull with small irregular ledges. Seeds 1-2 per locule, depressed ovate; 2.5-3 mm long, c. 2 mm wide, 1-1.5 mm thick; surface irregularly reticulate lacunose; dull black.



**Distribution:** Iran, prov. North Khorasan; montane steppes on N- and NW-facing slopes of Aladagh range and Salook summit. The doubtful voucher from Fariman area needs verification.

**Remarks:** This recently described species was earlier regarded as variant of *A. kuhshorkhense* differing by a generally smaller stature, smaller flowers with white, not pinkish, tepals and purple, not white and pink tipped filaments, as well as smaller capsules and seeds. Molecular markers (ITS sequences of nuclear rDNA) underline a close genetic relationship of both taxa (see p. 199). Plants of *A. pseudobodeanum* are much larger with much longer leaves and larger, violet flushed tepals though the color of filaments and ovaries is similar to *A. aladaghense*.

**Etymology:** The epithet refers certainly to the geographic area of the type location.

Living accessions studied: **N Khor.:** Aladagh mountain range, gorge above vill. Ruein (37°13' N, 57°30' E, 1690 m, 11.05.2012 Fritsch, Eskandari, Bahramishad 1378; GAT IRAN).

Herbarium vouchers: **N Khor.:** SW Bojnurd, Saluk mount, 13 km on the road of Saluk protected region from Shughan road (37°17' N, 56°06' E, 2500-2800 m, 10.6.2010 Memariani, Arjmandi 43929; FUMH). SW Bojnurd, Raeen, Marta-e Marjan road, Bali (37°23' N, 57°03' E, 2350-2400 m, 28.5.2006 Memariani, Zangooei 37801; FUMH). SW Bojnurd, Hesar-Shughan road, road of Saluk protected region, before security station (37°17' N, 57°06' E, 2502 m, 01.6.2008 Joharchi, Zangooei 40624; FUMH).

Determination unsure: **Raz. Khor.:** Fariman, Ghalandarabad, Bozeh Khoshk mountain (35°36' N, 59°52' E, 1700 m, 23.5.1982 Ayatollahi, Zangooei 17455; FUMH).

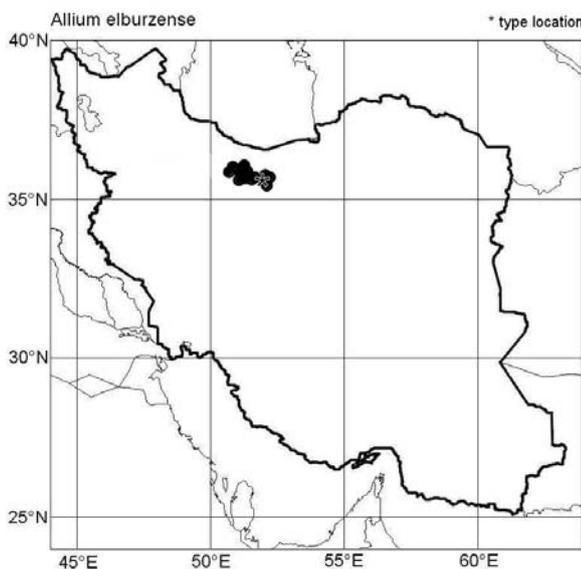
45. *Allium elburzense* Wendelbo in Bot. Notiser 122: 36 (1969); Wendelbo, Flora Iranica No. 76: 77, fig. 7/105 (1971). - Typus: Iran: Tehran: Elburz, Ab-e-Ali, south of Demavend, 1900 m, 15.5.1959, leg. Wendelbo No. 752 (holotype BG, isotype TAK[?], not seen).



Plate T46. A: Leaves of cultivated plants after sprouting; B: flowering plant from the type location; C: flowering plants of the pale form at Mt. Tochal; D & F: inflorescences of the pale form in early and in full anthesis, resp.; E: inflorescence of the typical form in full anthesis; G & H: inflorescences with developing capsules; I: seeds (background raster 1 mm); J: shape of ovary, tepals and filaments of a flower prepared from herbarium

Bulbs  $\pm$  depressed globose, 1.5-3 cm in diam.; outer tunics leathery, grayish brown, disintegrating. Scape flexuous, strong, smooth, terete; aerial part 5-15 cm long, 5-8 mm in diam.; green with glaucous bloom. Leaves 1-2, laminae narrowly elliptic to oblong with narrower base, short-arcuately tapering into the hooded apex, flat arcuately ascending and recurved to soil, thick, nearly flat; margins purplish, smooth; upper side grooved, lower side with broad and shallow ribs; 12-15 (20) cm long, 2-7 cm broad;

bluish-green with strong glaucous bloom, purplish flushed near the base. Sheath leaf short, purple, quickly decaying. Spathe membranous, nearly completely divided into 3-4 rounded mucronate, straight to patent valves, up to 2.5 cm long; pale brownish with darker veins. Inflorescence broadly fastigiate, dense, moderately many-flowered; 5-8 cm in diameter. Pedicels thick, stiff,  $\pm$  straight; 2-3.5 cm long; brown to purple with greenish base. Anthesis in May. Flowers flat star-like. Tepals narrowly lanceolate, patent and slightly recurved, canaliculate with plicate but subobtuse apex; after anthesis convolute and somewhat warped; 8-10 (12) mm long, 1.5-2 mm broad; pale lilac, lilac or pale carmine with grayish green, narrow median vein, scarcely visible on the inner side. Filaments c. 2/3-4/5 as long as the tepals, outer filaments subulate with narrowly triangular base, inner filaments narrowly triangular with broad-triangular base; basally shortly connate; whitish throughout or with carmine apex. Anthers linear-oblong, c. 2 mm long; violet or yellow. Pollen yellow or bluish gray, shape oblate, 32 / 34-37  $\mu$ m long, 17 / 18.5-21.5  $\mu$ m br, P/E index 0.5, L/S index 1.81, sculptures rugulate to micro-rugulate / -striate, wall 1  $\mu$ m exine 0.7  $\mu$ m thick, perforations 0.14  $\mu$ m in diameter (Neshati & al. 2009 / Namin & al. 2009). Ovary shortly stipitate, subglobose with 3 broad and 3 narrow furrows also at the tip, surface smooth with colorless epidermal cells; 4 mm in diam., 2-2.5 mm long. Nectary ducts lead in pits near the base. Style narrowly conical, 3-5 mm long; whitish or pink towards the tip. Stigma undivided; whitish. Capsule depressed-globose to ovate, triangular, with three broad furrows; 5-8 mm long and in diam.; widely opening; valves ovate with sharp longitudinal furrow, distinctly notched near the apex, surface variably reticulate-lacunose; greenish later yellowish-brown. Seeds 1-2 per locule, flat ovate, surface strongly reticulate-lacunose; c. 3 mm long, 2-2.5 mm broad, 1.5-2 mm thick; dull black.



**Distribution:** N Iran; Alborz mountain range; montane rocky and rubble slopes.

**Remarks:** Plants from the type location of *Allium elburzense* showed under cultivation a remarkable variation of flower colors ranging from purple (the only color given in the original description) to pale lilac. Even paler and sometimes pure white flowers dominate in the Alborz mountains closer to Tehran. Most characteristic of this species are glossy ovaries possessing glass-like transparent epidermal cells. Molecular markers (ITS sequences of nuclear rDNA as well as sequences of the plastid *trnL-trnF* region) gave evidence that *A. elburzense*, *A. cristophii* and *A. ellisii* do not belong to sect. *Acanthoprason* but to the new sect. *Asteroprason* (Fritsch & al. 2010; Gurushidze & al. 2010). Here it constitutes a separate subgroup (see p. 199).

tutes a separate subgroup (see p. 199).

**Etymology:** The epithet refers to the Alborz mountain range where the type specimens were collected.

**Biological data:** Anatomical characters of the scape: "elliptic" in cross section, 3.75 mm in diameter, 1 row of vascular bundles, 21 vascular bundles in the peripheral layer, 3 or 4 layers of "thick walled parenchyma", largest vascular bundles 0.12 mm in diameter (Namin & al. 2009). Fresh bulbs contain in total 0.63 % cysteine sulfoxides (70 % methiin, 20 % alliin, 10 % isoalliin, Keusgen & al. 2008, as *A. pseudobodeanum*). Bulb extract inhibited growth of some (mainly Gram-positive) bacteria species and showed a very high radical scavenger activity (Jedelská & Keusgen 2008, partly as *A. pseudobodeanum*). Genome size is 51.3 / 51.7 pg 2C DNA (Gurushidze & al. 2012 as *A. pseudobodeanum*).

**Economic traits:** Local name: 'vaalak'. The leaves are used for the traditional dish 'kuku' and are also cooked with rice. Lipid lowering effect is granted to this plant (Abbasi & al. 2008).

Living accessions studied: **Tehran:** Tochal massif, Darakeh valley N Tehran (35°51' N, 51°23' E, 2290 m, 23.5.2007 Fritsch, Keusgen, Abbasi 1206, 1208; GAT, IRAN). O exposed slope near village Abali, (35° 45' N, 51° 57' E, 2100-2200 m, 02.6.2005

Fritsch, Zarre, Moazzeni 1047; GAT IRAN). Kalkfels-Steilhänge am unteren Ende der Ortschaft Asara (36°01' N, 51°09' E, 1850-2000 m, 19.5.1994 Fritsch 1088, 1096; GAT). Osthang an der Straße am unteren Ortsrand von Polekhab (36°01' N, 51°09' E, ca. 1800 m, 19.5.1994 Fritsch 1106; GAT). Karaj valley from Gachsar to Kandavan pass, near the deviation to Gajereh (36°07' N, 51°20' E, 2300 m, 31.5.2005 Fritsch, Zarre 1043; 2350 m, 23.5.2006 Abbasi, Fritsch, Keusgen 1134; GAT, IRAN).

Herbarium vouchers: Mazandaran: 3 way of Dizin (?) (36°03' N, 51°25' E, 05.5.2004 Zarre, Mashayekhi 34911-TUH; GAT). Mazandaran, (1400-2350 m, 30.5.1980 Termeh, Zargani, Daneshpazhuh 43067-IRAN). - Tehran: Qazvin vers Karaj, entre Khur et Fashand (36°01' N, 50°44' E, 1750-1950 m, 22.5.1976 Moussavi, Tehrani 43065-IRAN). Inter Karaj et Gach-i Sar, (36°02' N, 51°11' E, 1200-2500 m, 16.5.1956 Schmid 5713; G). Jovestan Taleqan (36°11' N, 50°52' E, 1600 m, 06.5.1974 Dini, Bazargan 8743; TARI). Montée au Varvasht, au dessus de la bergerie de Djirtal (village de Ki-kuh) (3800 m, 07.6.1971 Klein 176; G). Exclosure Lashkarak (35°48' N, 51°35' E, 2000 m, 18.6.1972 Dini, Arazm 14173-TARI). M. Tuchal (35°50' N, 51°20' E, 1800-3700 m, ???.5./6.1930 Egger 75; B). Just at the entrance of Ab-Ali from Tehran (35°45' N, 51°57' E, 2100-2200 m, 16.5.2004 Zarre, Mashayekhi, Moazzeni 35027; B). Homand-e Abesard (Firouzkuh road) (35°37' N, 52°09' E, 2600 m, 27.5.1973 Bazargan, Arazm 14155-TARI). Auf Schutthalden zw. Lashkerek und Ashun Pashan, (35°49' N, 51°34' E, 14.5.1910 Bruns; B). M. Elburs occid. Flanc sud de l'Afzal (Hafkan) au dessus d'Ab-i-zar (35°37' N, 52°09' E, 3460 m, 30.6.1971 Klein 1706; W G). Central Alburz, Velenjak (35°49' N, 51°23' E, 19.6.1972 Termeh, Zargani 44014-IRAN). Damavand, soily mountain NW of the city (Kashe-zard). (35°43' N, 52°04' E, 1950 m, 05.5.1977 Mozaffarian 32182-TARI). Kuh-e Dashteh (35°52' N, 51°42' E, 1400-2350 m, 20.5.1996 Ghaffari, Djavadi, Bakhsheshi 43064-IRAN). Deux versants d'un col situé au dessus de Ab-Ali (35°45' N, 51°57' E, 2400-2900 m, 9.-10.5.1956; G). Mountains NW Tehran, Suleghun (1600 m, 01.5.1979 Assadi, Mozaffarian, Nowroozi 33663-TARI). m. Elburs, ad basin septentr. alpium Totschal, prope Scheheristanek (35°58' N, 51°21' E, 2200 m, 04.6.1902 Bornmüller 8307; G). Karaj road to Chalus, Doab to Shahrestanak (Darreh) (36°15' N, 51°17' E, 1700 m, 15.5.1977 Riedl, Habibi 37230E; 43066-IRAN W). Au N-O de vill. Kelvan, sous le Naz (Mishenou) (36°05' N, 51°05' E, 3120 m, 19.6.1971 Klein 1084; G). Sorkhe Hesar National Park, Goli spring (35°42' N, 51°35' E, 17.5.1986 collector unclear 44011-IRAN). 56 km Karaj to Chalus (36°07' N, 51°20' E, 1900 m, 11.6.1972 Amin, Musavi 14156-TARI). Lashkarak (35°49' N, 51°35' E, 1850 m, 23.5.1974 Dini 8994; TARI). Vardavard valley (35°46' N, 51°07' E, 1700 m, 12.5.1974 Wendelbo 11282-TARI; 1850 m, 27.5.1974 Wendelbo, Sanii, Assadi 11756-TARI). Damavand towards Tar lake (35°52' N, 52°15' E, 24.5.2004, 2745 m, 2650 m, Amer.-Iran. Bot. Delegation 34075, 34079; TUH MSB). Prope Shahrestanak, in jugo Ladd alpium Totschal (35°58' N, 51°22' E, 2600 m, 04.6.1902 Bornmüller 8306; B). Gajereh (36°04' N, 51°24' E, 2800 m, 13.6.1972 Amin, Musavi 14154-TARI). Damavand, at the top between main road and Havir (35°56' N, 52°06' E, 3000 m, 26.5.1979 Assadi, Mozaffarian 33273-TARI). Abali to Tehran, S steep [slope?] (35°45' N, 51°57' E, 2100-2200 m, 16.5.2004 Mashayekhi, Moazzeni 34903-TUH; GAT). Demovend (Persia) (35°57' N, 52°06' E, ???.1878 Medvedev; TBI).

Determination unsure: Tehran: Shah-Alborz, au N de la vallée de Taleghan, sur le versant méridional (3200 m, 08.7.1972 Klein 3125; G). 20 km Sapeh to Azgien (1750 m, 08.5.1974 Dini, Bazargan 8255; TARI). S Lavasan (35°49' N, 51°37' E, 2300 m, 26.5.1973 Bazargan, Arazm 14158-TARI).

**46. *Allium helicophyllum*** Vved. in Byull. Sredneaz. gosud. Univ. 19: 127 (1934); Vved., Flora URSS 4: 256 (1935); Vvedensky [& Kovalevskaya], Opred. rast. Sredn. Azii 2: 80 (1971). Wendelbo, Flora Iranica No. 76: 91, tab. 9/132, tab. 28/1 (1971). Kamelin ex Nikitin & Gel'dikhanov, Opredel. rast. Turkmen.: 127 (1988). - Type: Turkmenistan: Kopetdag, cult. in Hort. bot. turkmen. 31.5.1931 leg. Androsov (holotype TASH! isotype ASH?).

Bulbs oval to globose, 1.5-2 cm long and in diameter; outer tunics papery but sometimes accumulating into thick layers, ± prolonged into a neck; blackish; inner tunics whitish. Scape obconical, ± straight, smooth, 10-20 cm long, basally 4-6 mm, above up to 10 mm in diam., dull green. Leaves (3) 5-6, laminae narrowly linear-lanceolate, thick, canaliculate, spirally enrolled (in humid years only the upper part); upper side smooth, lower side finely ribbed, margins sparsely toothed to ciliate in the basal part, long tapering into the scarcely hooded apex; 20-30 cm long, (3) 5-10(15) mm broad (innermost leaves are the narrowest); dull greyish green with glaucous bloom. Sheath leaf membranous, silk-like glossy, quickly decaying. Spathe membranous, hyaline, completely divided into 2-4 shortly triangular, acute valves; brownish with darker veins. Inflorescence initially ± broadly fasciculate, later semi-globose and finally subglobose, many-flowered, moderately dense. Pedicels stiff wire-like, unequally long, thickish and near apex inflated, ascending; brownish green to purplish, glossy. Anthesis in May to June. Flowers flat star-like. Tepals linear-oblong, patent, concave, obtuse with claw-like deflexed apex, after anthesis subreflexed, convolute and crumpled; 5-7 mm long, c. 1 mm broad; pale pinkish-brownish, median vein very broad (up to 4/5 of tepal width), dark green to purple. Filaments slightly shorter than the tepals, subulate, fleshy, basally shortly connate and short-triangular broadened (inner filaments c. 1.5 times wider than outer ones and sometimes with 2 short-triangular side teeth); deep purple or violet,

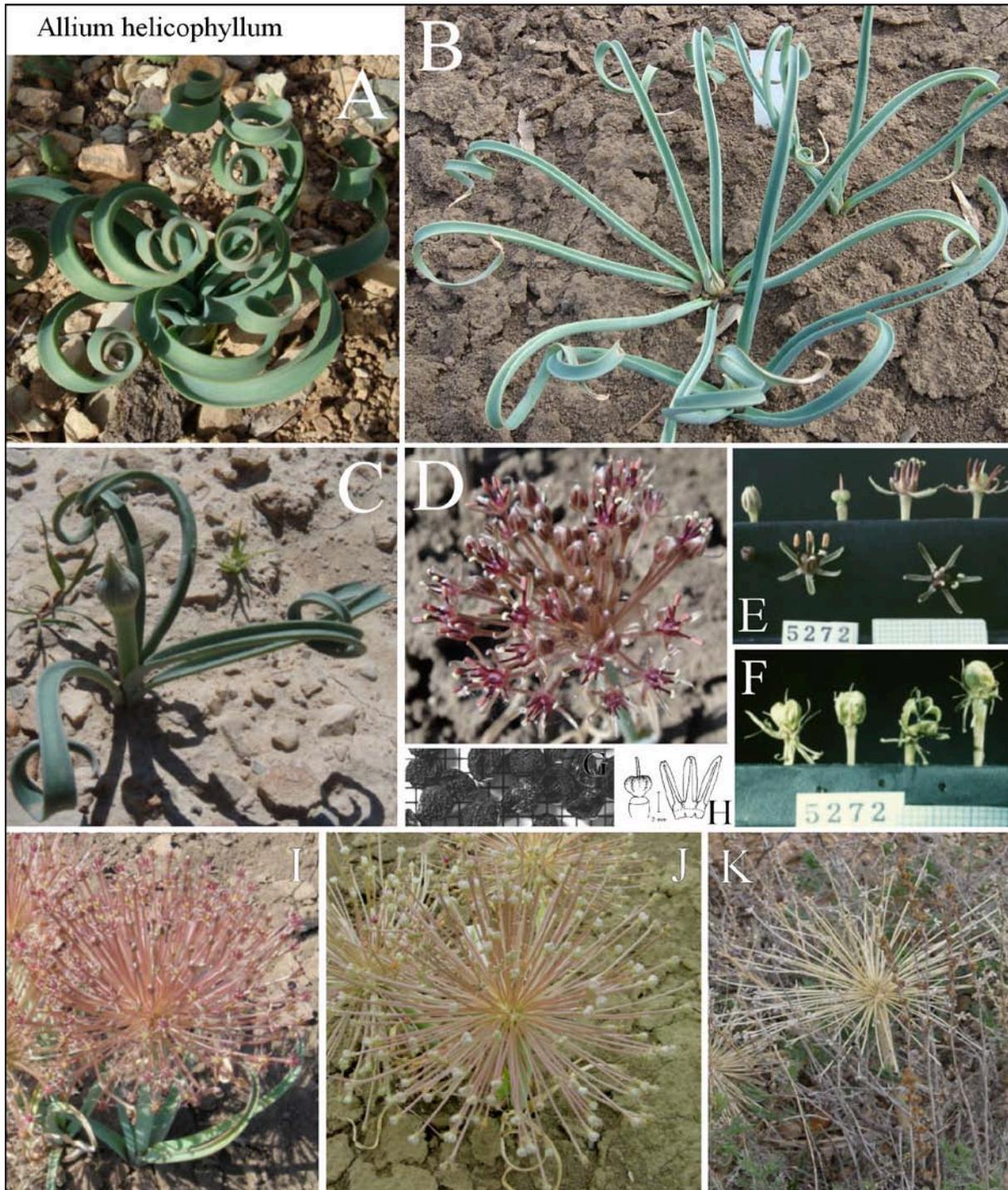
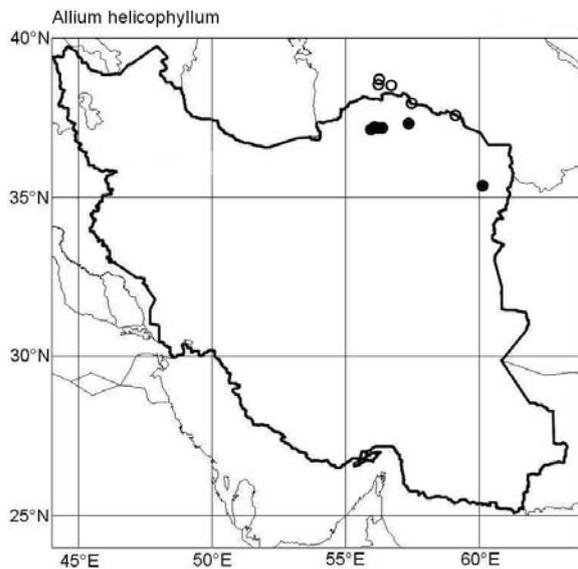


Plate T46. A: Leaves of a cultivated plant in a very dry spring; B: Leaves and young scape of a cultivated plant in normal spring; C: plant in the shooting stage near Ashkhaneh; D: inflorescence in early anthesis; E: comparison of flower parts in different stages; F: capsules; G: seeds (background raster 1 mm); H: shape of ovary, tepals and filaments of a flower prepared from herbarium; I, J & K: plants in late anthesis, with full-sized capsules, and with open capsules, resp.

fading towards the base. Anthers oblong, 2 mm long, 0.8 mm wide; orange to violet. Pollen pale yellow, shape oblate, E 26  $\mu\text{m}$ , P 17  $\mu\text{m}$ , P/E 0.6, sculpture striate, wall 0.9  $\mu\text{m}$  thick (Neshati & al. 2009). Ovary very shortly stipitate, depressed-globose triangular with 3 narrow and 3 broader furrows, apex concave, 2.5-3 mm long, 3-3.5 mm in diameter, surface finely coarse by convex periclinal walls; green, initially  $\pm$  violet flushed; nectary ducts lead in short slits near the base of ovary. Style narrowly conical, 3-5 mm long;  $\pm$  violet. Stigma undivided, whitish. Capsule  $\pm$  broadly obovate, tripartite at the apex, ca. 4-5 mm in diam., moderately widely opening; valves suborbicular with deeply notched apex; yellowish brown. Seeds 2 per locule, flat ovate to drop-shaped, somewhat angled; surface finely tuberculate and

densely and finely reticulate lacunose; 2.5-3 mm long, 2-2.3 mm broad, 1.5-2 mm thick; dull black. The testa showed verrucose periclinal walls, the anticlinal walls transitions from U- to Omega-like undulation with moderate wavelength (Fritsch & al. 2006).

**Chromosomes:**  $2n = 16$  Pogosian 1983 (Iran: Gorgan, Almehr).  $2n = 16$  Fritsch unpubl. (Turkmenistan: Kyzyl-Arwat).



**Distribution:** Turkmenistan, Iran: in Koppe Dagh mountain range; montane rubble slopes, rock outcrops, semidesert plains.

**Remarks:** This species was first mentioned in Flora Turkm. 1, 2: 287 (1932) without description. It is easily recognizable by the leaf shape unique among Iranian *Alliums* and the large but loose inflorescence with small flowers and brown to purple filaments. The plants are rather inconspicuous in anthesis and are often only recognized when the pale-yellow infrutescences are blown through the semidesert by the wind ("tumble-weeds"). Molecular markers (ITS sequences of nuclear rDNA) strongly support affiliation to sect. *Asteroprason* (Fritsch & al. 2010; see p. 199) but sequences of the plastid *trnL-trnF* region put it in a larger distance to most species of this section but closer to the sect. *Megaloprason* s. str., *A. kuhshorkhense*, and a few taxa of sect. *Regeloprason* (Gurushidze & al. 2010).

**Etymology:** The epithet refers to the spirally enrolled upper part of leaf laminae (from Greek "spiral-shaped leaf").

**Biological data:** 2-3 ovules per locule occur. Seedlings belong to the *Allium karataviense* type (Druselmann 1992). The plants contain dithiodipyrrole (Gurushidze 2008).

Living accessions studied: **Golestan:** S border of Golestan Park near vill. Dasht (37°19' N, 56°00' E, 1100 m, 19.4.2004 Keusgen, Fritsch 1010; GAT IRAN). Golestan reservation between vill. Mizabaylu and Jakhtikalon, semidesert plain (37°21' N, 56°15' E, 1300 m, 20.4.2004 Fritsch observed; GAT). - **N Khor.:** Semi-desert beside the main road from Cheshme Khan to (55 km) Ashkhaneh (37°22' N, 56°23' E, 1385 m, 10.05.2012 Fritsch, Eskandari, Bahramishad 1370; GAT, IRAN).

Herbarium vouchers: **Golestan:** Jangal-e-Golestan, Dasht-e-Calpush (37° 18' N, 56° 01' E, 920-1000 m, 21.5.1976 Termeh, Matin 415-IRAN). Wildlife Park, below Almehr (37°22' N, 56°08' E, 1250-1400 m, 20.6.1974 Wendelbo, Foroughi 12725-TARI; W). National Park: in planitie ("dasht") ad viam versus Almehr ducentem N Robat-e Qareh Bil (37°19' N, 56°26' E, 1200 m, 05.6.1975 Rechinger 52913; W B G M). Shapazand to Bojnur, along the road to Almehr (Dasht) (37°19' N, 56°00' E, 1200 m, 06.6.1975 Termeh 43041-IRAN). - **N Khor.:** W Mirza-Balyu station (37°21' N, 56°14' E, 1200 m, 27.5.1995 Akhiani 10941; W). Between Bojnurd and Babaaman (37°29' N, 57°24' E, 1000 m, 03.6.2003 83689-TARI).

Determination unsure: **Raz. Khor.:** 33 km SE Fariman versus Torbat-e Jam, in arenosis (35°33' N, 60°10' E, 1200 m, 21.4.1967 Rechinger 33213; W).

**47. *Allium kuhshorkhense*** R.M. Fritsch & Joharchi in Rostaniha 7 Suppl. 2: 265, fig. 5 (2006 publ. 14 Jul 2007). - **Type:** Iran, Prov. Khorasan, Kashmar, Kuh Sorkhe, 9.5.1995, Faghiniha & Zangooei No. 25356 (holotype FUMH!, isotypes TARI, FUMH!).

Bulbs nearly spherical, 2-3 cm in diameter; outer tunics greyish-brown, somewhat longitudinally splitting and disintegrating. Scape cylindrical, straight, smooth; aerial part 5-8 cm long, c. 6 mm in diameter; glaucous green and basally reddish-brown suffused. Leaves 1-2, laminae elliptic to oblanceolate, thick fleshy, towards base stalk-like narrowed, the upper part  $\pm$  flat; upper side slightly sulcate, dull, lower side smooth, shining; margin red, finely toothed or nearly smooth towards the short apex; 15-25 cm long and 5-8 cm wide; dull green with strong glaucous bloom, basally the lower side is reddish-brown suffused. Sheath leaf short, thickish, brown later whitish, decaying during anthesis. Spathe membranous, split into 2-4 shortly acute, patent to reflexed valves; pale brownish with inconspicuous veins. In-

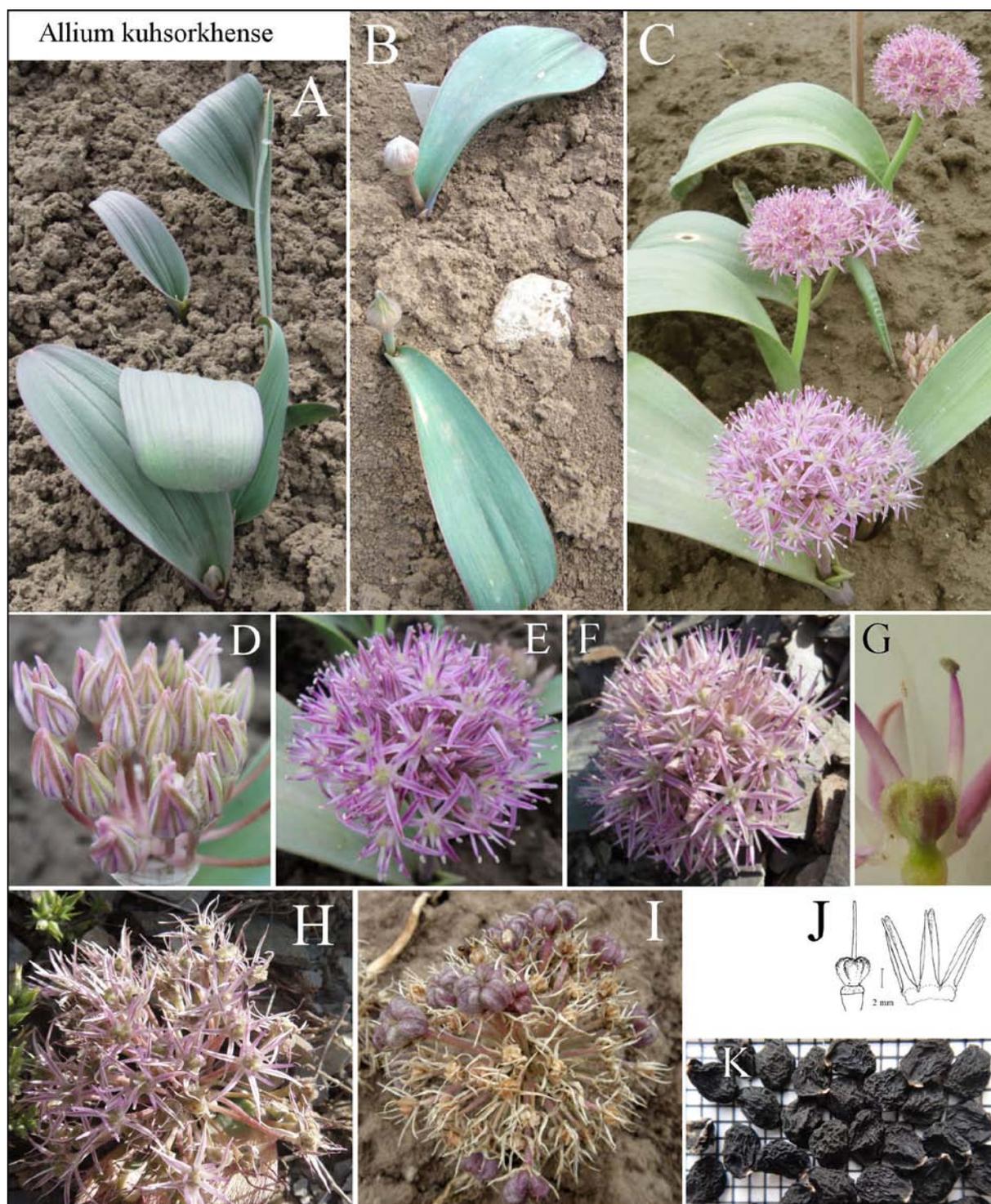
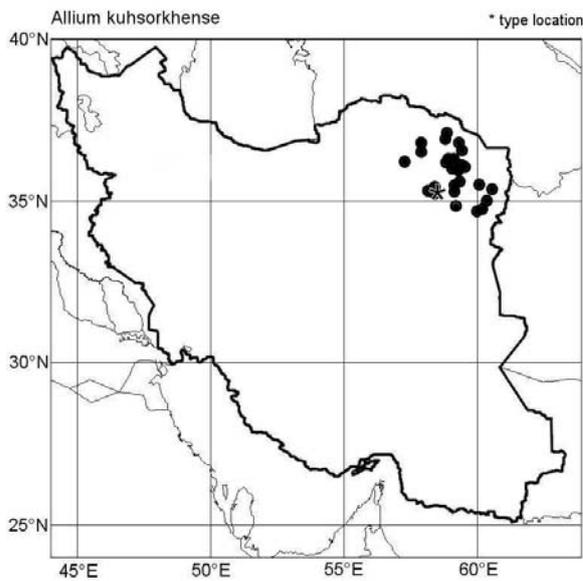


Plate T47. A & B: Sprouting leaves and scapes of cultivated plants; C: cultivated plants in early anthesis; D, E, F & H: inflorescences in bud stage, in early, full, and late anthesis, resp., G: close-up of flower parts; I: inflorescence with full-sized capsules; J: shape of ovary, tepals and filaments of a flower prepared from herbarium; K: seeds (background raster 1 mm).

florescence initially semi-globose later subglobose, dense, many-flowered; 4-6 cm in diameter. Pedicels straight, stiff, somewhat thickened; initially 6-8 mm and finally up to 25 mm long; greenish brown, semi-glossy. Anthesis in May to June. Flowers broadly funnel-shaped star-like; very sweet scented. Tepals long-triangular, longitudinally folded, gradually tapering into the subacute apex; after anthesis strongly convolute and finally narrowly conical but not stiff or curled; 7-9 mm long, basally 1.5-2 mm wide; pink to brownish-red (sometimes white) with much darker median vein. Filaments nearly as long as the tepals, subulate, fleshy; basally shortly connate and united with the tepals; carmine to violet fading to white at the base. Anthers oblong, c. 1.5 mm long; yellowish to slightly violet. Pollen

greyish yellow to green, shape oblate to peroblate, 30-33  $\mu\text{m}$  long, 16-17  $\mu\text{m}$  broad, P/E index 0.5, sculptures rugulate to microrugulate, wall 0.9  $\mu\text{m}$  thick (Neshati & al. 2009). Ovary depressed globose with three deep furrows, surface very coarse with somewhat angled ledges along the middle furrow; 3-4 mm long and 4-5 mm in diameter; green, reddish flushed. Nectary ducts lead in small dot-like holes near the base of the ovary. Style long conical, 4-5 mm long; white. Stigma slightly head-like, rarely shortly tripartite; white. Capsule depressed ovate tripartite with sharp angles and deep furrows; c. 5 mm long and 6-8 mm in diameter; unripe with six longitudinal ledges close to the suture; greenish-grey with brown-violet surface; in the dry state pale brown, widely opening; valves transversally elliptic with a deep longitudinal furrow and two short crumbled bumps below the narrowly notched apex. Seeds one per locule, depressed-ovate, rather densely reticulate lacunose; 3-4 mm long, 2-2.5 (3) mm wide and 1.5-2 mm thick; dull or brownish black.



**Distribution:** Iran, prov. Razavi Khorasan; dry montane stony slopes, rock outcrops, and rock terraces.

**Remarks:** *Allium kuhsorkhense* belongs to the remarkable number of species rather similar to *A. akaka* in general appearance. Most characteristic for *A. kuhsorkhense* are triangular tepals becoming early convolute but remain soft also when dry, subulate filaments somewhat shorter than the tepals, very coarse and deeply furrowed ovaries, as well as capsules broader than long. It is a rather polymorphous species developing fleshy leaves long tapering toward the base only under more humid conditions, the flower color varies from pinkish to brownish-pink, and the outer edges of the ovaries may be rounded or angled. Molecular

markers (ITS sequences of nuclear rDNA) confirmed affiliation to sect. *Asteroprason* where it occupies a basal position sister to the other members (Fritsch & al. 2010; see p. 199). Analysis of sequences of the plastid *trnL-trnF* region put the only investigated sample of *A. kuhsorkhense* in some distance to the other species of this section (Gurushidze & al. 2010).

**Etymology:** The epithet refers to the Kuh-e Sorkh massif in NE Iran (prov. Razavi Khorasan) where the type location is situated.

**Biological data:** Genome size 46.5 pg 2C DNA (Gurushidze & al. 2012).

**Economic traits:** Leaves are used as vegetable only by some people (Fritsch & al. 2007).

Living accessions studied: **Raz. Khor.:** Binalud massif W Mashhad below vill. Kang (36°20' N, 59°16' E, 1520-1550 m, 13.05.2012 Fritsch, Eskandari, Bahramshad 1389; GAT IRAN). Binalud massif near vill. Kharv e Olya (36°12' N, 59°05' E, 1700 m, 25.4.2004 Keusgen, Fritsch 1034; GAT IRAN).

Herbarium vouchers: **N Khor.:** Esfarayen, Safiabad, Ghanbarbaghi (36°42' N, 57°56' E, 1700 m, 14.5.1991 Faghihnia, Zangouei 20156; FUMH). - **Raz. Khor.:** Chenaran, Frizi, on the beginning of Darmeh road (36°29' N, 58°56' E, 1765 m, 01.5.2005 Emadzadeh, Memariani, Zangooei 36026; FUMH). NW Sabzevar, between Sarugh and Nazargah mount, Soltan Seyed Ghoreshy (36°23' N, 57°19' E, 2482 m, 30.5.2009 Joharchi 42727; FUMH). 12-20 km N Kashmar (35°23' N, 58°26' E, 1150-1700 m, 04.5.1975 Iranshahr 44008-IRAN). S Torbat-e Heidarieh, Dasht-e Kheir-abad (34°51' N, 60°01' E, 900 m, 04.5.1991 Joharchi, Zangooei 19919; FUMH). Neyshabur, Pivehjen (36°03' N, 59°21' E, 1200 m, 29.4.2007 Eskandari, Javadi, Torabi; IRAN). Mt. Kameh-Olia 25 km N Torbat-e Heidarieh (35°29' N, 59°10' E, 1780-1850 m, 11.6.1996 Termeh, Delghandi, Karavar 48359-IRAN). Chenaran, Frizi, Darmeh valley (36°29' N, 58°53' E, 1918 m, 15.5.2005 Emadzadeh, Memariani, Zangooei 36150; FUMH). Quchan, Emam Qoli to Darreh-Gaz, Gappi (37°18' N, 58°51' E, 2000 m, 15.7.1986 Termeh, Moussavi, Therani 48358-IRAN). Golmakan, mountain between Talkh-abad and Cheshmeh sabz (36°28' N, 59°10' E, 1800 m, 14.5.1990 Joharchi, Faghihnia 18546; FUMH). Chenaran, between Abghad and Frizi, Du-abi (36°29' N, 59°01' E, 1475 m, 01.5.2005 Emadzadeh, Memariani, Zangooei 35978; FUMH). SW Mashhad, Binalud, Farasgah mountain (36°14' N, 59°10' E, 2100 m, 03.6.1990 Faghihnia, Zangooei 18742; FUMH). E Neyshabur, Kharv-e Olia (36°10' N, 59°03' E, 1650-1750 m, 19.5.1996

Rafeie, Zangoie 26997; FUMH). Mashhad, N slope of Binalud Mts. above Zashk vill., Rudkhane Abdollah (36°20' N, 59°10' E, 2100-2300 m, 03.4.1984 Mozaffarian 48896-TARI). N Torbat-e Jam, between Tayamnak-e Bala and Dusangeh (35°29' N, 60°36' E, 1200 m, 11.5.1994 Faghinia, Zangoie 23873; FUMH). Neishabur, Darrud (36°09' N, 59°07' E, 1800 m, 13.5.1983 Rezaei 10219; FUMH). Golmakan, highlands located at southern Asjil (36°29' N, 59°09' E, 1500 m, 04.5.1985 Joharchi 12547; FUMH). SW Torbat-Jam, Kordian (34°56' N, 60°13' E, 1500-1600 m, 01.5.1985 Ayatollahi 12493; FUMH). Kuh-e Bezgh c. 50 km NNE Kashmar (35°33' N, 58°32' E, 1900-2500 m, 13.6.1981 Assadi, Mozaffarian 35779-TARI). Mountains NW Neyshabur, above Mirabad (36°22' N, 58°52' E, 1600-1900 m, 17.6.1981 Assadi, Mozaffarian 36112-TARI). Kang, Binalud mountain (36°19' N, 59°13' E, 1800 m, 22.5.1990 Faghinia, Zangoie 18627; 1500 m, 22.6.2003 Zangoie 34793; FUMH). Dehbar Mts. above Dehbar vill. (36°15' N, 59°16' E, 2260 m, 09.3.1988 Shad, Wafaii, Pezhman 1108; TARI). S Mashhad, Moghan mountain (36°08' N, 59°21' E, 2500 m, 03.6.2001 Joharchi 33672; FUMH). SW of Torbat-Jam, Bezd mount (35°11' N, 60°22' E, 09.5.1996 Faghinia, Zangoie 26770; 06.5.2007 Zangoie, Neshati 38764; FUMH). N Torbat-e Heydariyeh, Kameh-Sofla, Serisha mountains (35°29' N, 59°12' E, 1600 m, 05.5.1991 Joharchi, Zangoie 20011; FUMH). Mashhad Zoshk (36°20' N, 59°12' E, 1550 m, 23.5.1972 Foroughi 3516; TARI). Mashhad - Torghabeh (36°18' N, 59°25' E, 1350 m, 03.5.1971 Foroughi 1434; TARI). SW Mashhad, 12 km from Maj towards Binalud (36°08' N, 59°16' E, 2250 m, 21.6.1992 Joharchi, Zangoie 22007; FUMH). SW Mashhad, Deh-Najafi mountain (36°16' N, 59°31' E, 24.4.1985 Joharchi, Safari 12120; FUMH). Mashhad towards Torbat-e Heydariyeh, Bazeh-hur, telecom tower (35°47' N, 59°23' E, 1650 m, 26.5.1997 Hojjat, Zangoie 28722; 19.6.2005 Nasseh, Zangoie 36738; FUMH). Gardaneh Shotur Rah 20 km N Kashmar, (35°24' N, 58°29' E, 1850 m, 04.5.1975 Rechingher 51226; W). Kashmar, SW Rivash (Sorkhkuh), Band-e Ghoraa (35°30' N, 58°12' E, 1800 m, 08.5.1995 Faghinia, Zangoie 25356; FUMH TARI).

Determination unsure: Raz. Khor.: 40 km N Torbat-e-Jam (35°34' N, 60°36' E, date & collector not translated; FUMH). S Mashhad, towards Moghan cave (36°08' N, 59°21' E, 1900 m, 21.5.1991 Faghinia, Zangoie 20391; FUMH). Kashmar, Rivash (Kuh-surkh), mountain between Targh and Kalateh-Teimori (36°58' N, 59°21' E, 1800 m, 04.5.1994 Faghinia, Zangoie 23861; FUMH). Koppe Dag c. 35 km E Quchan (37°06' N, 58°51' E, date & collector not translated; FUMH). Binalud c. 50 km Quchan (36°59' N, 57°57' E, date & collector not translated; FUMH). Kuh-e Sorkh c. 40 km N Kashmar (35°36' N, 58°26' E, date & collector not translated; FUMH). c. 30 km ENE Chanaran (36°44' N, 59°27' E, date & collector not translated; FUMH). c. 25 km S Torbat-e-Heydariyeh (35°02' N, 59°14' E, date & collector not translated; FUMH). c. 20 km SW Torbat-e-Jam (35°09' N, 60°23' E, date & collector not translated; FUMH). E Fariman (35°41' N, 60°07' E, date & collector not translated; FUMH). Binalud c. 20 km S Chanaran (36°30' N, 59°11' E, date & collector not translated; FUMH). c. 50 km SW Torbat-e-Jam (34°55' N, 60°10' E, date & collector not translated; FUMH). Binalud c. 25 km E Neyshabur (36°22' N, 59°05' E, date & collector not translated; FUMH). c. 30 km SW Mashhad (36°06' N, 59°26' E, date & collector not translated; FUMH). c. 30 km N Torbat-e-Heydariyeh (35°31' N, 59°09' E, date & collector not translated; FUMH). Binalud W Torqabe (36°21' N, 59°05' E, date & collector not translated; FUMH). c. 55 km N Torbat-e-Heydariyeh (35°39' N, 59°11' E, date & collector not translated; FUMH). Mashhad, Moghan, slopes opposite to cave (36°09' N, 59°25' E, 1000 m, 04.5.1982 Ghorashi 1567G; FUMH). S Mashhad (36°13' N, 59°34' E, date & collector not translated; FUMH).

**48. *Allium monophyllum*** Vved. ex Czerniak. in Repert. Spec. Nov. Regni Veg. 27: 266 (1930), descr. germ., ex Czerniak. in Izv. glavn. bot. sada SSSR 29: 135 (1930), descr. ross., Vved., Fl. Turkm. 1: 290 (1932), descr. ross., et in Bull. Univ. As. Centr. 19: 128 (1934), descr. latin. ampl.; Vved., Flora URSS 4: 259, tab. 15 f. 3a (1935); Vved. [& Kovalevskaya], Opred. rast. Sredn. Azii 2: 81 (1971). Wendelbo, Flora Iranica No. 76: 72, tab. 7/94 (1971). Kamelin ex Nikitin & Gel'dikhanov, Opredel. rast. Turkmen.: 127 (1988). - Type: Turkmenistan: Tsentral'nyj Kopetdag, gora Chapan, verkhov'ya ushchel'ya Ion-dere, kamenistye uchastki u lednika. 20.7.1928, leg. Jarmolenko & Gontsch. 1152 (lectotypus LE!), design. Vvedensky 1934, see Fritsch 1990: 505).

Bulbs ovoid to globose, 8-25 mm in diam., outer tunics thin, disintegrating, brownish-blackish, rarely accumulating into a thin shell. Scape flexuous, terete, smooth, aerial part 2-3 cm long, 3-4 (5) mm in diam.; green, brownish near the soil. Leaves single (rarely 2), laminae linear-lanceolate, ± gradually tapering into the cucullate sometimes ± spirally enrolled apex, margin purplish, smooth or sparsely ciliate, 6-15 cm long, 4-10 mm broad; soft dark green, lower side ± glossy, basally purplish flushed; sheath leaf short, purplish, thickish, decaying prior to anthesis. Spathe membranous, divided into 2-3 ovate-suborbicular, shortly pointed valves; pale with inconspicuously brown veins. Inflorescence semi-globose, ± dense, moderately many-flowered; 3-5 cm in diameter. Pedicels thickish, stiff, ± unequally long, straight or slightly incurved; pale green, purple suffused. Anthesis in June to July (August). Flowers flat funnel-shaped star-like. Tepals linear-lanceolate, obliquely patent, plicate towards the subobtusate apex, basally nearly free; after anthesis subconvolute, contorted, and color darker; 5-7 mm long, 1-1.2 mm broad; rose to pink, median vein purple, in the upper half very broad, strongly narrowing towards

the base. Filaments 2/3-3/4 as long as the tepals, subulate; basally shortly triangular widened (inner filaments nearly twice wider) and shortly connate; white to rose. Anthers oblong, c. 1.5 mm long; yellow. Pollen yellow. Ovary substipitate, depressed globose triangular with 3 wider and 3 narrow furrows, surface coarse by rounded tubercles; 2-3 mm long and in diam.; 2-3 ovules per locule; nectary ducts lead in dot-like holes near the very base. Style conical to thread-like, 2-4 mm long; yellow  $\pm$  purplish suffused. Stigma undivided; yellowish. Capsule sessile, depressed-globose triangular, 2 mm long, 2-3 mm in diam., surface moderately coarsely reticulate lacunose; valves suborbicular, apex shortly and broadly notched. Seeds 1-2 per locule, ovoid to drop-shaped, surface coarsely reticulate lacunose; 1.5-2 mm long, c. 1.5 mm broad and thick; dull black.

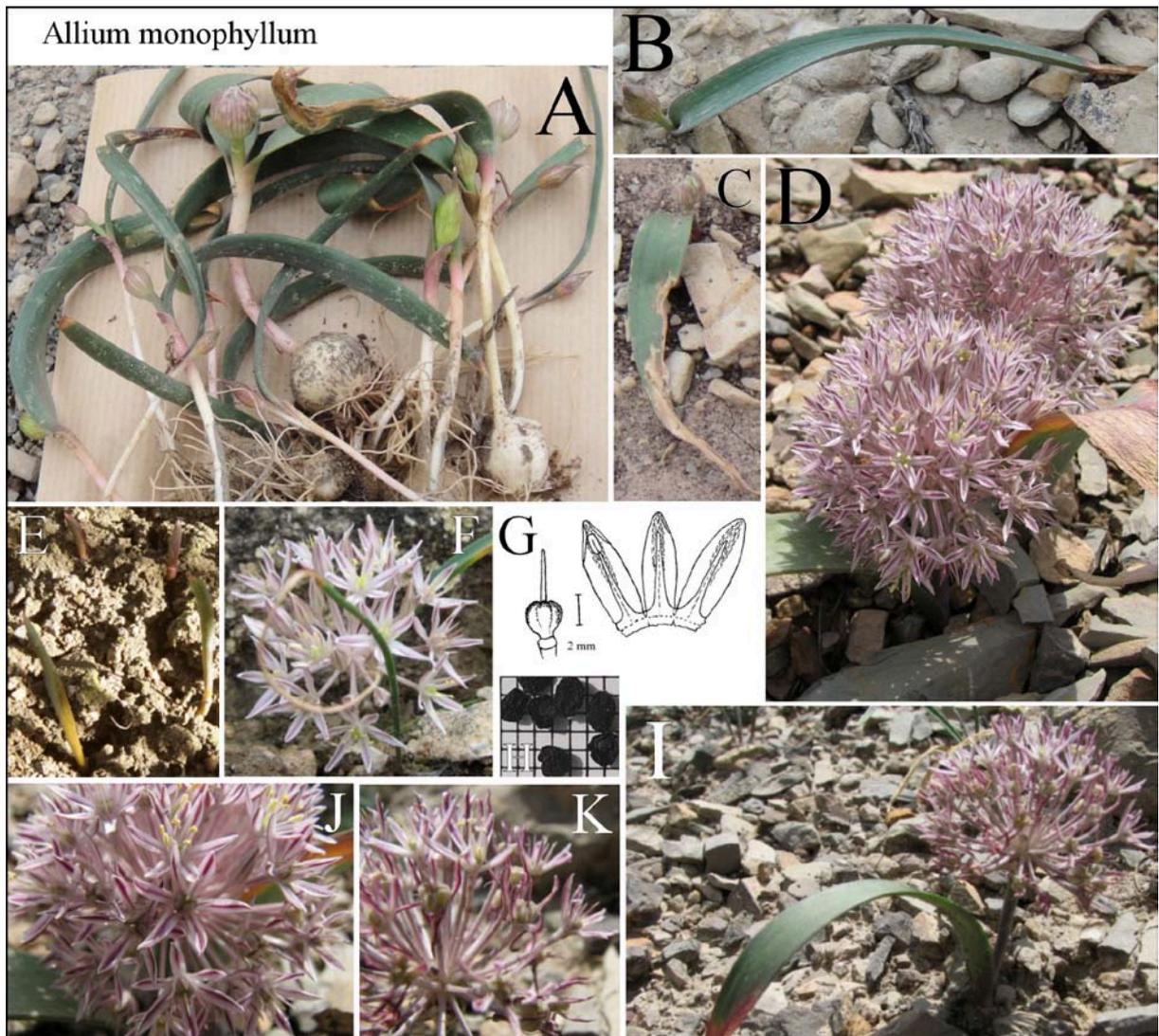


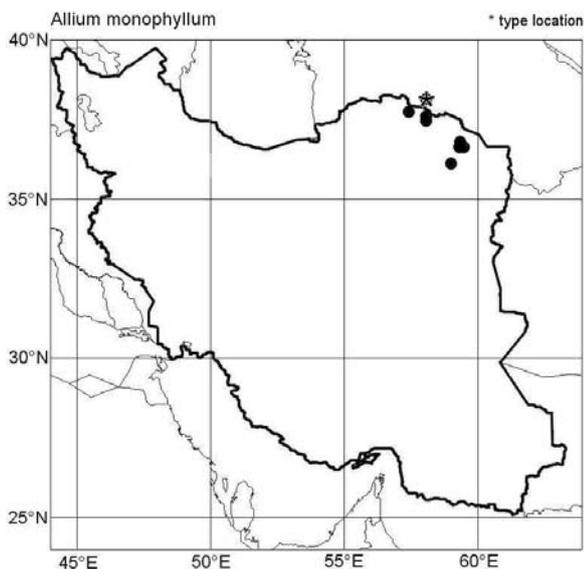
Plate T48. A: Plants collected near Mareshk; B & C: plants in the shooting stage near Mareshk; D: flowering plants in Hezar Masjed massif; E: leaves of cultivated plants during sprouting; F: inflorescence in early anthesis; G: shape of ovary, tepals and filaments of a flower prepared from herbarium; H: seeds (background raster 1 mm); I: plant in late anthesis in Hezar Masjed massif; J & K: inflorescences in full and late anthesis, resp. (photos D & I - K courtesy of H. Razifard).

Chromosomes:  $2n = 64$  Kurita 1956 (Great Britain: Botanical collection).

**Distribution:** Iran, Turkmenistan: Koppe Dagh mountain range; stony and rubble slopes and rock terraces in the upper montane belt.

**Remarks:** *Allium monophyllum* is probably the smallest species of subg. *Melanocrommyum* occurring in Iran. The aerial part of the scape matches scarcely 5 cm, the leaf is only about 8 - 12 mm broad, the dense inflorescence bears commonly less than 20 flowers with 5-7 mm long tepals that are completely reflexed and spirally enrolled after anthesis, and filaments 2/3 - 3/4 as long as the tepals. This species

could be merged with small specimens of *A. kuhsorkhense* but that species displays inflorescences having more than 30 flowers, 5-8 cm wide leaves, 7-9 mm long tepals straight and longitudinally enrolled after anthesis, and filaments about as long as the tepals. The only available sample for molecular studies (ITS sequences of nuclear rDNA, see p. 199) was most basally positioned in sect. *Asteroprason* confirming the inclusion in that section proposed by Fritsch & al. (2010).



**Etymology:** The epithet refers to the mostly solitary leaf of this species (from Greek "single leaf").

Living accessions studied: Raz. Khor.: Hesar Masjed massif c. 6-7 km N vill. Mareshk (36°49' N, 59°31' E, 1950 m, 15.5.2012 Fritsch, Eskandari, Bahramishad 1401; GAT, IRAN).

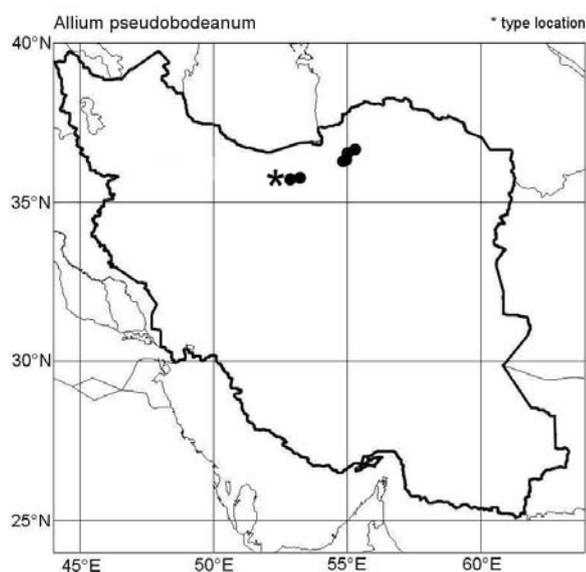
Herbarium vouchers: N. Khor. Gulul Sarani Schutzgeb., Kopet Dag, Hochplateau, auf Kalk (37°46' N, 58°07' E, 2100-2300 m, 12.-13.6.1975 Rechinger 53350; W). Koppe Dag c. 50 km NNE Bojnurd (37°54' N, 57°28' E, date & collector not translated; FUMH). Koppe Dag 45 km NNE Shirvan (37°47' N, 58°06' E, date & collector not translated; FUMH). Shirvan, Namanlou, Golule, Chesme-Gabri (37°38' N, 58°06' E, 2400 m, 19.7.1986 Termeh, Moussavi, Tehrani 445-IRAN). - Raz. Khor.: Montes Hazar Masdjid (Wdb. 71: Hazar Masjed) (36°58' N, 59°21' E, 2000 m, 08.-09.6.1948 Rechinger ? 5137; M W B G; 3132 m, 04.8.2010 Joharchi, Behroozian 44192; FUMH; 2500 m, 24.6.1996 Faghinia,

Zangoie 27566; FUMH; 3000 m, 17.6.1997 Hojjat, Zangoie 29249; FUMH). Hezar-Masjed protected region, between Cheshmeh Mish and Aalikel (36°57' N, 59°25' E, 2700 m, 04.8.2010 Joharchi, Behroozian 44173; FUMH).

Determination unsure: Raz. Khor.: N Mashahd, Talghur (36°49' N, 59°21' E, 1550 m, 18.5.1985 Ayatollahi, Joharchi 13033; FUMH). NE Neishabur, Binalud peak, with a view to Frizi mountain (36°18' N, 59°03' E, 2500 m, 11.7.1995 Faghinia, Rafeie, Zangoie 26082; FUMH).

**49. *Allium pseudobodeanum*** R.M. Fritsch & Matin in Stapfia 80: 389, plate 2C, 2E (2002). - *Allium bodeanum* sensu Wendelbo, Fl. Iranica 76: 76 (1971), p. p., Wendelbo, Tulips & Irises Iran: 22, 23 (1977). Fritsch in Taxon 48: 577 (1999). - **Type:** Iran, Mazandaran: Nadjafdar, 50 km from Firuzkuh, Mametch-Kuh, 2150-2750 m, 29.5.1980 leg. Termeh, Daneshpadju, Zharani (holotype 291-IRAN!).

Bulbs depressed-globose, 3-4 cm in diameter and 2.5-3 cm long; outer tunics brownish, disintegrating. Scape terete, ± straight, completely smooth; 5-15 (20) cm long, 5-8 mm in diameter; green basally reddish suffused. Leaves 1-2, laminae narrowly lanceolate, basally narrowed, initially stiff erect later recurved and finally lying on the soil, smooth above but



with broad flat ribs below, margin completely smooth; (15) 20-30 cm long, 2.5-4 (6) cm broad; blue-green with glaucous bloom. Spathe finely membranous, deeply divided into 2-4 ovate, acute, finally reflexed valves; brownish with darker veins. Inflorescence initially fasciculate, later semiglobose or sub-globose, very dense, moderately many-flowered; initially 4-6 cm, finally up to 12 cm in diam. Pedicels thickish, straight, unequally long, 2-4.5 cm long (those of the last flowers are the longest); dull or semi-glossy, reddish-brown or upper part greenish. Anthesis in April to May. Flowers ± flat star-like. Tepals narrowly lanceolate-triangular, with plicate, slightly rounded apex; margin ± convolute, patent and slightly recurved; after anthesis

longitudinally convolute and somewhat obliquely forward directed; (8) 10-12 mm long, basally c. 2 mm wide and shortly united; (rose-) lilac with slightly darker or greenish, somewhat thickened median vein. Filaments 4/5 to nearly as long as the tepals, somewhat fleshy, subulate; basally for c. 1 mm united and triangular widened; violet, basally white. Anthers oblong, c. 2-2.5 mm long and 2 mm wide; violet. Pollen yellowish gray. Ovary stipitate, depressed-globose to shortly pear-shaped triangulate, with 3 deep and 3 narrow furrows, surface very coarsely tuberculate; c. 2.5 mm long and in diam.; initially violet later pale dull green with purplish furrows; nectary ducts lead in basal dot-like holes. Style narrowly conical, 3-8 mm long; violet later lilac. Stigma undivided; whitish. Capsule depressed globose-tripartite with 3 very broad and deep and 3 shallow furrows; 6-7 mm in diam., widely opening; valves broadly ovate with a rather broadly notched apex, surface coarsely lacunose, completely dull; greenish brown. Seeds 2 per locule, flat drop-shaped, surface very coarse; 3-4 mm long, 2.5-3 mm broad, c. 2 mm thick; dull black.

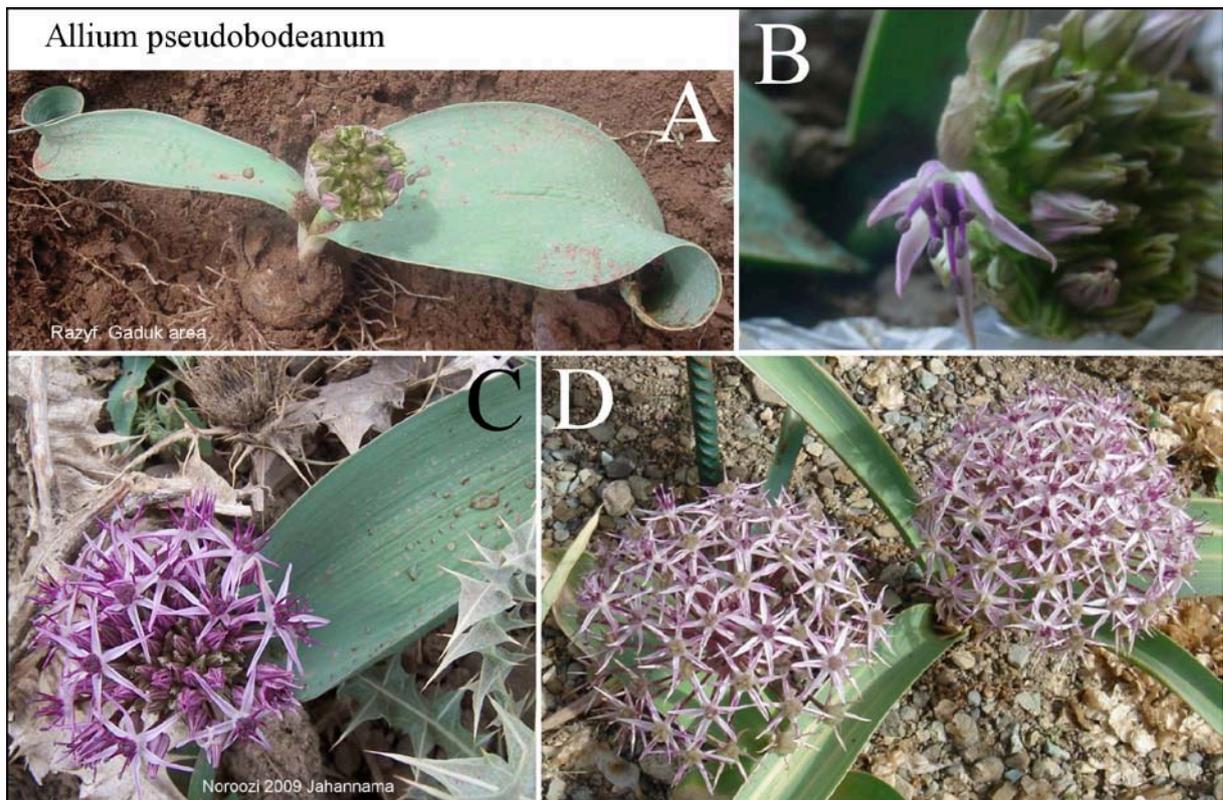


Plate T49. A & B: Plant in the shooting stage, and first opening flower, resp., in Gaduk area (photos courtesy of H. Razifard); C: plant in early anthesis N Semnan (photo courtesy of J. Noroozi); D: flowering plants cultivated in Latvia.

**Distribution:** Iran: E Alborz and W Koppe Dagh mountain ranges; montane rock and rubble slopes.

**Remarks:** Wendelbo (1977) used the name *A. bodeanum* for small and compact plants with smooth broad leaves, shorter scape, and whitish-lilac flowers as pictured in his book "Tulips and Irises of Iran". After rejection of the name *A. bodeanum* (Brummitt 2001), the taxon meant by Wendelbo remained without name and was described as *A. pseudobodeanum*. Later investigations showed that two taxa were involved, pale forms of *A. elburzense*, and *A. pseudobodeanum*. The former is characterized by weak lanceolate tepals, white (or with carmine apex) filaments, and smooth and glossy ovaries, the latter by stiff and more triangular tepals with convolute margins and dark median vein, violet (basally white) filaments, and very coarsely tuberculate ovaries. Molecular markers (ITS sequences of nuclear rDNA, see p. 199) confirmed *A. pseudobodeanum* to be distantly related to *A. elburzense*, but closely related to *A. ellisii* that shows also very coarsely tuberculate ovaries. The latter taxon differs by leaf laminae densely toothed along the margins, and narrowly triangular, rose to pink tepals with inconspicuous median vein.

**Etymology:** The epithet reflects a morphological similarity to plants named *Allium bodeanum* by Per Wendelbo (from Greek "pseudo~ = resembling but not equalling").

**Economic traits:** Prospective as ornamental, presented by Davies (1992, as *A. bodeanum*).

Herbarium vouchers: **Mazandaran:** Firuzkuh to Shahi, Gaduk (35°51' N, 52°54' E, 2300 - 265 m, 30.5.1980 Termeh & al.; IRAN). Veresk, Vesmilash, Kouhha ye Galzar (Ghorogh) (35°55' N, 52°57' E, 1900-2750 m, 26.5.1980 Termeh, Daneshpajuh, Zargani 43050-IRAN). Nadjafdar, 50 km from Firuzkuh, Mametch-Kuh, (35°47' N, 52°23' E, 2150-2750 m, 29.5.1980 Termeh, Daneshpadju, Zharani 291-IRAN). Tehran on Ghaemshar, Firuzkuh road (prior to 1995 Termeh, Daneshpajouh 43068-IRAN). - **Semnan:** Inter Shahrud et Siaret (36°30' N, 55°00' E, 23.5.1858 Bunge 24; P G-BOIS). In saxosis calc. jugi Abr a Shahrud boreo-orientem versus (36°43' N, 55°03' E, 1950-2000 m, 22.5.1977 Reching 55433; W). Mountains above Hikuh ca. 50 km N Semnan (35°56' N, 53°17' E, 2400-2700 m, 29.7.1982 Assadi, Mozaffarian 40711-TARI).

Determination unsure: **Semnan:** Between Shahpassand and Shahrud (36°49' N, 55°20' E, 2200 m, 19.5.1978 Wendelbo, Assadi 29716-TARI). Shahrud. Kuh Ghatry (36°27' N, 54°53' E, 2330 m, 08.6.1973 Foroughi 10197-TARI).

**Allium subsect. *Cristophiana*** Tscholok. in Not. syst. geogr. inst. bot. Thbiliss. 31: 52 (1975), sub sect. *Acanthoprason*. Type: *A. cristophii* Trautv.

**50. *Allium cristophii*** Trautv. in Trudy Imp. S.-Peterb. Bot. Sada 9: 268 (1884) [nom. & orth. cons., Brummitt in Taxon 50: 561 (2001)]. - Regel in Trudy Imp. S.-Peterb. Bot. Sada 10: 299, 357, t. VII f. 1, 1a, 1b (1887). Vved., Flora Turkm. 1, 2: 288 (1932). Vved., Flora URSS 4: 261 (1935). Wendelbo, Flora Iranica No. 76: 75, tab. 7/102, tab. 26/1 (1971). Vved. [& Kovalevskaya], Opređ. rast. Sredn. Azii 2: 82 (1971), sub *A. bodeanum* Regel. Kollmann, Fl. Turkey 8: 196, fig. 9/19 (1984). Kamelin ex Nikitin & Gel'dikhanov, Opređel. rast. Turkmen.: 128 (1988). *Caloscordum cristophii* (Trautv.) Banfi & Galasso, in Banfi, Galasso & Soldano, Atti Soc. Ital. Sci. Nat. Mus. Civico Storia Nat. Milano, 152 (2): 87 (Nov 2011). - *Allium bodeanum* Regel in Trudy Imp. S.-Peterb. Bot. Sada 3, 2: 238 (1875), nom. rej.[Brummitt in Taxon 50: 561 (2001)], s. str. quoad typum. Type: Persien [without place and date] leg. Bode (LE!). *Allium walteri* Regel in Trudy Imp. S.-Peterb. Bot. Sada 10: 357, t. VII fig. 3, 3a (1887). Type: Turkmenistan: Wand der Karanki('Karange')dagh Schlucht, über 5000', 25.5.1886 ("1887"), leg. Walter (LE!). *Allium albopilosum* C.H. Wright in Gard. Chron. third ser., 1903 (2) [No. 864]: 34, tab. opp. p. 40 (1903). Lectotype: *Allium albopilosum* C.H. Wright in Gard. Chron. XXXIV p. 34, with fig. 138-02. Ellis. Hort. Kew. 9 June 1903. Figured for Bot. Mag. 7982 (K!, design. Fritsch & al. 2010: 202). - **Type:** Turkmenia: Achalteke ('Dubium est utrum in Turcomania australis (Achalteke) anne in Karabach specie haec a Cristoph reperta sit') leg. Cristoph No. 7511, mis. 1883 M.N. Smirnov (holotype LE!). - **subsp. *cristophii***.

Bulbs depressed-globose, 2-5 cm in diam.; outer tunics papery, dissolving into fibers; pale gray, finally blackish-brown and disintegrating; inner tunics membranous, yellowish. Scape straight, smooth, terete; (10) 20-60 cm long, (3) 5-12 mm in diam.; green with glaucous bloom. Leaves 2-7 (11) (depending on the bulb weight: Zimmer & al. 1985), laminae linear-lanceolate, arcuately ascending sometimes falcate, canaliculate, upper part finally lax and hanging down, thin; upper side with narrow and shallow furrows and rarely hairy, lower side with flat, broad and often hairy ribs, arcuately tapering into the cucullate apex; margin rarely toothed more often with short or long hairs; 15-30 (45) cm long, 1-3 (5) cm broad; green with strong glaucous bloom. Sheath leaf thin hyaline, soon decaying. Spathe membranous, completely divided into 2-3 (5) ovate often acuminate, finally reflexed valves; pale brown with darker veins. Inflorescence fastigiate to semiglobose, finally subglobose, many-flowered but loose; 8-18 cm in diam., in the fruiting stage also > 25 cm in diameter and dropping from the scape. Pedicels rather thin, stiff and elastic, initially subequally finally unequally long, straight or somewhat inflexed; brown to red-brown, glossy. Anthesis in April to May. Flowers flat star-like. Tepals narrowly triangular-lanceolate, patent, slightly recurved, somewhat plicate, gradually tapering into the subobtuse apex, basally very shortly connate; after anthesis stiff with convolute margins and thick vein, prickly; 10-15 (20) mm long, near the base (1.5) 2-3 mm broad; pale silvery lilac to metallic purplish-blue, median vein green

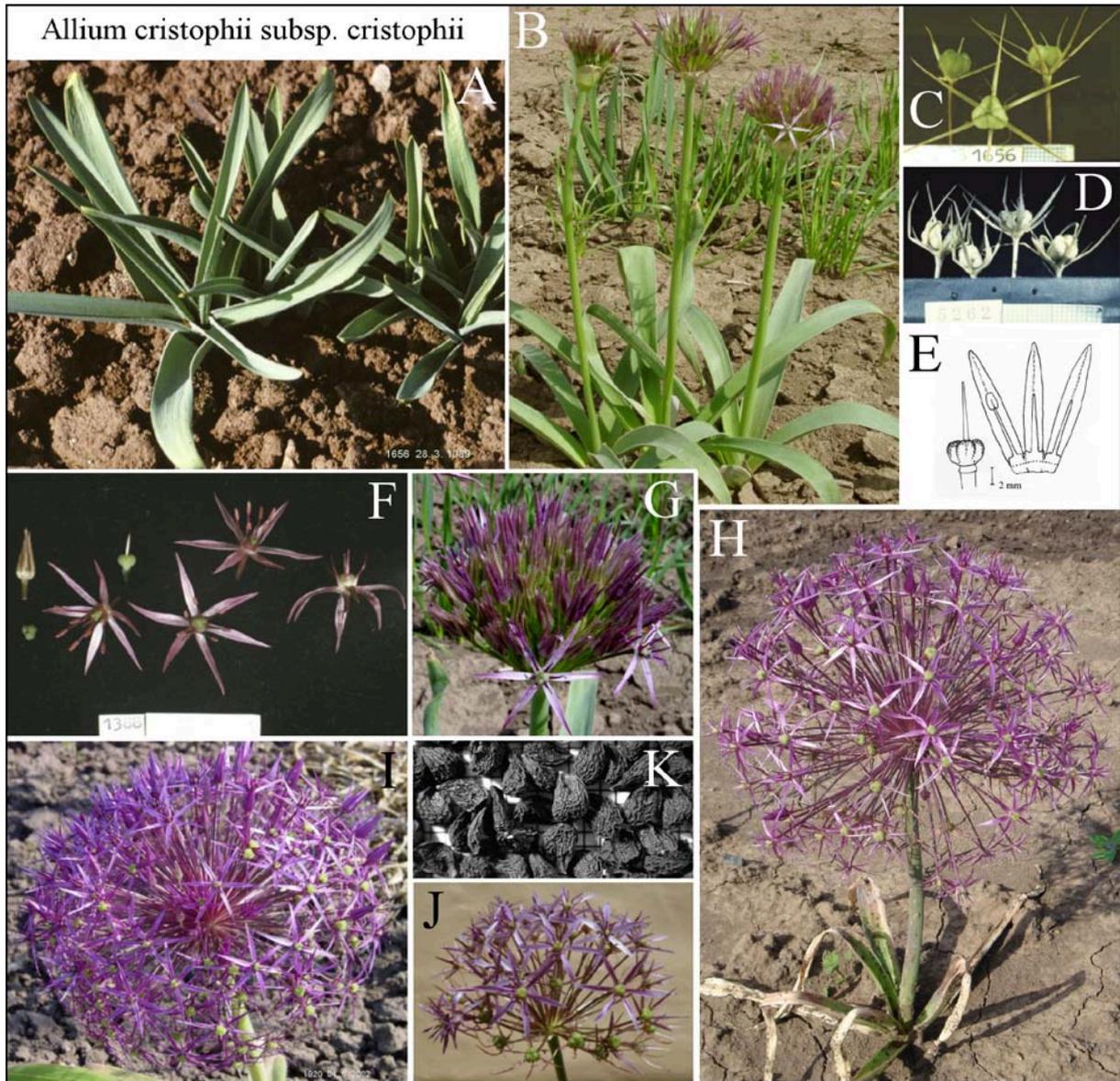
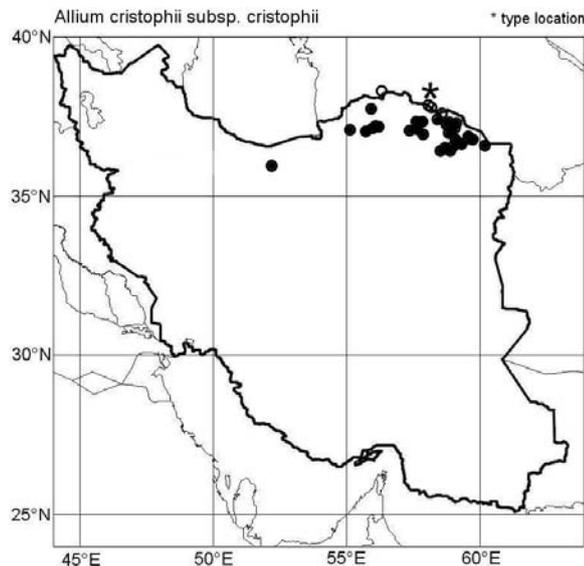


Plate T50. Only cultivated plants are shown. A: sprouting leaves; B: plants prior to anthesis and in early anthesis, resp.; C: full-sized capsules; D: ripe capsules; E: shape of ovary, tepals and filaments of a flower prepared from herbarium; F: comparison of flower parts in different stages; G: inflorescence in early anthesis; H: flowering plant; I & J: inflorescences in full and in late anthesis, resp.; K: seeds (background raster 1 mm).

with purple margin, thicker at the outer side. Filaments  $2/5$ - $2/3$  as long as the tepals, straight later recurved, subulate-triangular; basally shortly triangular widened (inner filaments somewhat broader) and very shortly connate; purple. Anthers linear-oblong, 2-2.5 mm long; pinkish-violet. Pollen grayish-yellow; 27.5-35.5  $\mu\text{m}$  long, 17-19.5  $\mu\text{m}$  wide, wall 0.8  $\mu\text{m}$  thick, shape oblate to peroblate, sculptures microrugulate to rugulate, simple perforate, perforations 0.12  $\mu\text{m}$  in diam. (Levan 1935; Namin & al. 2009; Neshati & al. 2009). Ovary shortly stipitate, depressed globose to ovoid, with 3 broad and 3 narrow furrows, surface finely coarse; green, initially violet flushed; up to 6 ovules per locule (Filimonova 1970). Nectary ducts lead into small holes near the base of the ovary below the bottom of the locules (Fritsch 1992b). Style thread-like, 3-6 mm long; violet with whitish base, later whitish. Stigma undivided; pink to whitish. Capsule broad conical triangular, surface coarse; 6-8 (10) mm in diameter, 6-8 mm long; greenish yellow to dark brown,  $\pm$  widely opening; valves broadly elliptic, notched at the apex, with a broad longitudinal furrow. Seeds 2-3 (6) per locule, flat and angled ovate, reticulate lacunose, at the back with more ledges; 3-3.5 mm long, 2.5-3 mm broad, 2-2.5 mm thick; semi-glossy black. The testa showed verrucose periclinal walls, and the anticlinal walls transitions from S-like to U-like undulation with short wavelengths (Kruse 1986, Fritsch & al. 2006). TKW 6.06 / 6.61 / 6.81 g (IPK, unpubl. data).

**Chromosomes:**  $2n = 16$  Levan 1935 (Netherlands: Botanical collection "*A. albopilosum*").  $2n = 16$  Vakhtina 1964, 1969 fig. 3/1 (Turkmenistan: Kopetdag mountain range).  $2n = 16$  Pedersen & Wendelbo 1966 (Iran: Mazandaran, Haraz valley).  $2n = 16$  Dietrich 1967 (France: Botanical collection "*A. albopilosum*").  $2n = 16$  Zakirova & Vakhtina 1974 (Turkmenistan: Kopetdag mountain range).  $n=8$  Vakhtina & al. 1977 total length of chromosomes (Russia: Botanical collection).  $2n = 16$  Vosa 1977 (?Botanical collection "*A. albopilosum*").  $2n = 16$  Labani & Elkington 1987 (Netherlands: Botanical collection).  $2n = 16$  Ohri & al. 1998 (Hungary: Botanical collection).  $2n = 16$  Astanova unpubl. (Tajikistan: Botanical collection).  $2n = 16$  IPK *Allium*-Referenzkollektion karyotype (Great Britain: Botanical collection).



**Distribution:** Turkmenistan, NW Iran: Koppe Dagh mountain range; colline to submontane steppe slopes, along the margins of shrub areas, stony slopes with shallow soil. Occurrence in C Anatolia (Turkey, Erciyas Da.) needs verification.

**Remarks:** This is an extremely polymorphous taxon especially concerning shape and density of indumentums of leaf laminae, length and diameter of scapes, dimension and density of inflorescences, as well as shape and color of tepals. The oldest available binomen is *A. bodeanum*, but this name was rejected favoring *A. cristophii* (with conserved orthography, Brummitt 2001), a name much used in horticulture. An exact type location of *A. cristophii* is not traceable (the historical region

"Achalteke" stretches along the northern spurs of Koppe Dagh mountain range at least from Baharden to Kaachka), but several accessions of slender plants with narrow and curved leaf laminae and  $\pm$  deep silvery-violet tepals were collected in this region and compared under cultivation with more stocky plants having straight and broad leaf laminae and pale silvery-brown tepals collected in higher elevations. They represent two morphologically well recognizable subspecies. It remained unclear whether small and stocky plants from very high elevations are only montane variants of subsp. *cristophii* or represent another taxon. A few herbarium vouchers (bearing only leaf remains and bleached flowers) imply that also at least another tall and probably red-flowered taxon could exist in the northeastern corner of Iran territory named "*masjedense*" in the key. Two vouchers of typical plants were collected by Wendelbo in the prov. Mazandaran (In valle Haraz: Darli supra Panjab, W) far outside the known area of distribution. Confirmation of this outpost as natural spot and not escape from garden is essential. Molecular markers (ITS sequences of nuclear rDNA) presented strong evidence that *A. cristophii* is no member of sect. *Kaloprason* or sect. *Acanthoprason* but of sect. *Asteroprason* (Fritsch & al. 2010). Recent addition of more samples imply that subsp. *golestanicum* could be more basal and subsp. *cristophii* more advanced (see p. 199). Sequences of the plastid *trnL-trnF* region (Gurushidze & al. 2010) underline close relations to other members of sect. *Asteroprason* and a large distance to the sections *Acanthoprason* and *Kaloprason*.

**Etymology:** Three epithets honor botanists of the 19th century that collected the type specimens: Dr. Cristoph was a physician and plant collector travelling in the Caucasus, North Iran, Transcaspia, and the Amur region, Dr. Walter accompanied G.F. Radde during research missions in Transcaucasia, and baron K.K. Bode undertook scientific research missions in Iran when he was Prime Secretary of the Russian embassy in Iran. The epithet *albopilosum* refers to the long white hairs often present on the leaf laminae (from Latin "hairy with distinct white long ascending hairs").

**Biological data:** The seedlings belong to the *Allium karataviense* type (Druselmann 1992). The growth form is characterized by one lateral shoot arising in the axil of the uppermost leaf (Kruse 1992). Some anatomical scape characters were shown, but not discussed at species level (Fritsch 1993 Fig. 7C). Anatomical characters of the scape: "elliptic" in cross section, 7.15 mm in diameter, 2 rows of vascular bundles, 9 vascular bundles in the peripheral layer, 4 layers of "thick walled parenchyma", largest vascular bundles 0.13 mm in diameter (Namin & al. 2009b). Details of temperature regimes influencing time

and ability to flower as well as some parameters of roots, leaves, scapes, and inflorescences were studied by Aoba (1967) in Ellis & al. (1985, as *A. albopilosum*); Zimmer & al. (1985); Zimmer & Weckeck (1989); Dubouzet & al. (1992); Maeda & al. (1994). Seeds germinate only at 5-9°C, even a short period of 13°C causes inhibition (Zimmer & al. 1985; Ellis & al. 1985; Specht & Keller 1997). The bulbs contain different steroid saponins and cholestan glycosids (Mimaki & al. 1993). Fresh bulbs contain in total 0.2 % cysteine sulfoxides (83 % methiin, 2 % alliin, 15 % propiin, Keusgen & al. 2008). Bulb extract inhibited growth of some (mainly Gram-positive) bacteria species and showed a moderate radical scavenger activity (Jedelská & Keusgen 2008). The plants contain dithiodipyrrole (Gurushidze 2008). Different genome sizes [2C DNA] were reported: 44.5 pg (Vakhtina & al. 1977), 42.0 pg (Zakirova 1989), 24.1 pg (Labani & Elkington 1987), 48.7 pg (Ohri & al. 1998; Gurushidze & al. 2012).

Economic traits: Much cultivated in Europe (even in the St. Petersburg area of Russia) as ornamental for flower beds and borders and for the decorative dry infrutescences used for florist's decorations; introduced in the first decade of the 20th century by the Dutch bulb grower van Tubergen under the synonym *A. albopilosum*. It is commercially available still today (De Hertog & Zimmer 1993) and was listed in the "International Checklist ..." of the Royal General Bulbgrowers Association (1991). Androsov (1941) recommended this species as ornamental for Turkmenistan. It was also used for breeding hybrid cultivars and is a parent of 'Globemaster' but not of 'Globus' (Friesen & al. 1997).

Living accessions studied: Khorasan?: Seed from Bot. Garden Tehran (1985, no. 107) collected from the nature (GAT).

Herbarium vouchers: Raz. Khor.: W of Daregaz, Gadganlu (37°29' N, 58°54' E, 1200 m, 01.5.1988 Joharchi, Zangooei 16343; FUMH). Daregaz, between Shekar-ab and Tandureh (37°24' N, 58°53' E, 1650-2000 m, 08.6.1997 Rafeie, Zangooei 29102; FUMH). Kalat towards Charm-Kohneh (37°02' N, 59°36' E, 1200 m, 01.6.1997 Faghinia, Zangooei 29011; FUMH). 5 km Darr-e gaz to Lotfabad (37°27' N, 59°10' E, 450 m, 01.5.1989 Mozaffarian 67729-TARI). Allah-o Akbar pass, Dare-Gaz (37°16' N, 58°57' E, 1600 m, 27.5.1977 Zargari 2036; FUMH). Ghoochan, Kuhé Allaho-Akbar (37°15' N, 59°00' E, 1710 m, 27.5. 972 Foroughi; TARI; 1090 m, 28.5.1972 Foroughi 3514; TARI). N Mashhad, old road of Kalat, Sandugh-shekan pass (36°56' N, 59°47' E, 1550 m, 26.5.2009 Zangooei 42692; FUMH). Ghuchan, E Bajgiran, Hasalmeh (Aasalmeh) (37°35' N, 58°27' E, 1600 m, 14.5.2000 Faghinia, Zangooei 32794; FUMH). Daregaz, Tandureh, between Shekar-ab and Chehel-mir (37°24' N, 58°52' E, 1000-2300 m, 27.05.1991 Joharchi, Zangooei 20499; FUMH). Garneh towards Rishkhar, 9 km from Garneh, Alehza region (37°10' N, 58°57' E, 2050 m, 09.6.1997 Rafeie, Zangooei 29143; FUMH). Radkan, mountain S of Marichgan (36°43' N, 59°00' E, 12.5.1985 Ayatollahi, Zangooei 12779; FUMH). NW Mashhad, Talghur (36°49' N, 59°21' E, 1550 m, 18.5.1985 Ayatollahi, Joharchi 13043; FUMH). Chenaran, valley of Akhlamad waterfall (36°36' N, 58°33' E, 1550 m, 16.5.2001 Joharchi, Zangooei 33563; FUMH). SW Kalat-e Naderi, Zharf Kalat mountain (36°59' N, 59°45' E, 2100 m, 19.5.1994 Faghinia, Zangooei 23953; FUMH). Hammam Ghaleh, Kalat (36°56' N, 59°46' E, 1150 m, Zargari; FUMH).

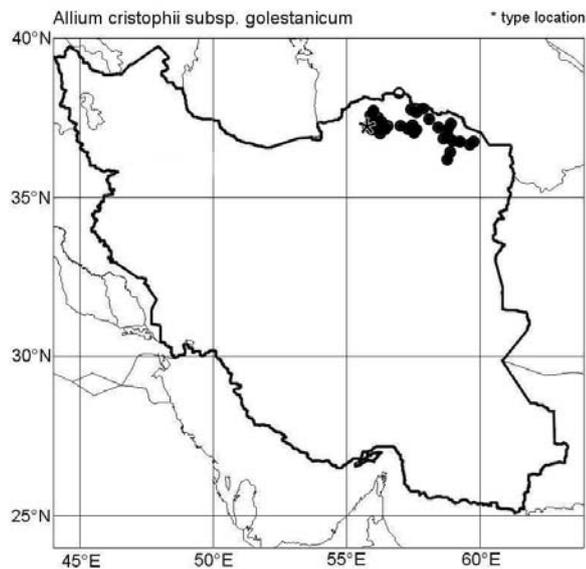
Determination unsure: Golestan: Alongside Atrak river, 4-6 km W Moraveh (37°54' N, 55°55' E, 300 m, 19.5.1976 Hewer 3793-TARI). Gonbad-e Kavus, (37°15' N, 55°10' E, 05.5.1948 Sharif 5069-E; 334-IRAN; Gauba 1539; W). Gorgan, Gonbad (37°15' N, 55°10' E, 05.5.1948 Sharif 334-IRAN). Near Ghazanghayeh E. of Maravetappeh (37°54' N, 55°57' E, 300 m, 23.4. 1986 Assadi, Maassoumi 55575-TARI). Park-e Golestan, Almeh (37°22' N, 56°08' E, 1350-1700 m, 05.6.1987 Mozaffarian, Abouhamzeh; TARI). Gorgan, Maraveh-tappeh, Sojakh, 25 km S Maraveh-tappeh (37°54' N, 55°57' E, 900 m, 22.5.1985 Moussavi, Tehrani 337-IRAN). Shahpasand vers Bojnurd, l'embranchement de la route Almeh (37°21' N, 56°15' E, 1200-1300 m, 07.6.1975 Termeh 339-IRAN). Gonbad-e Kavus, (37°15' N, 55°10' E, ???.1948 Sharif 58; W G). In silvis Gulestan, 65 - 80 km E Gonbad-e Kavus (37°12' N, 55°45' E, 900 m, 13.5.1966 Furse 7275; W). - N Khor.: Esferayen, N slope of Kuh-e Shah Jahan from Darparchin-e bala village (37°07' N, 57°55' E, 1700-2500 m, 07.6.1984 Mozaffarian 48452-TARI). Aladag c. 25 km SW Shirvan (37°16' N, 57°41' E, date & collector not translated; FUMH). c. 30 km betw. Esferayen and Bojnurd Assadli neck Mt (37°13' N, 57°25' E, 1800-2000 m, 29.6.1984 Mozaffarian 48725-TARI). c. 30 km E Bojnurd (37°31' N, 57°39' E, date & collector not translated; FUMH). N of Shirvan, Sarani mountain (37°31' N, 57°52' E, 2200 m, 02.7.2001 Joharchi 33828; FUMH). - Raz. Khor.: c. 20 km E Bajgiran (37°39' N, 58°36' E, date & collector not translated; FUMH). Hammam Ghaleh, Kalat (36°56' N, 59°46' E, 1150 m, date & collector not translated; FUMH). Mountains above Akhlamad, Binalud Mts., N slope (36°36' N, 58°55' E, 1850 m, 20.5.1988 Shad, Wafaii, Pezhman 1527; TARI). Kalat (37°02' N, 59°46' E, 1000 m, ???.1966 Remaudière 335-IRAN). c. 20 km SW Radkan (36°41' N, 58°44' E, date & collector not translated; FUMH). c. 30 km E Radkan (36°50' N, 59°18' E, date & collector not translated; FUMH). Close to borderline c. 75 km NE Mashhad (36°44' N, 60°14' E, date & collector not translated; FUMH). c. 10 km W Gonbad-e-Kabud (36°59' N, 59°39' E, date & collector not translated; FUMH). 5 km from Darr-e gaz to Lotfabad (37°28' N, 59°10' E, 450 m, 01.5.1989 Mozaffarian; TARI). c. 10 km W Dargaz (37°29' N, 59°02' E, date & collector not translated; FUMH). c. 30 km W Dargaz (37°25' N, 58°47' E, date & collector not translated; FUMH). S Kalat-e Naderi, Zharf village, Sabzeh Meydan area (36°59' N, 59°48' E, 1950-2100 m, 17.6. 1996 Rafeie, Zangooei 27387; FUMH) c. 30 km NNE Radkan (36°57' N, 59°07' E, date & collector not translated; FUMH). 15 km S Dargaz (37°18' N, 59°05' E, date & collector not translated; FUMH). - Mazandaran: In valle Haraz: Darli supra Panjab,

margin of forest (36°07' N, 52°13' E, 2200 m, 11.5.1959 Wendelbo 622; W; 30.7.1959 Wendelbo 1597; W). Semnan: E of Azadshahr near Bidak, Hosseinabad, Kalpush (37°18' N, 56°01' E, 22.5.1995 Faghiniha, Rafeie, Zangoie 25492; FUMH).

**51. *Allium cristophii* subsp. *golestanicum* R.M. Fritsch, subspecies nova.** - Type: Vers Bojnurd 160 km de Shahpasand, 1120-1300 m, 22.5.1976 Termeh, Matin (holotype 331-IRAN).

Differt ab subspecie typica foliis latioribusque brevioribus et strictis in adulescentiae, tepalis argento-fuscis, et filamentis badiis.

Bulbs broadly ovoid, 1.5-4 cm broad, 2-4 cm long; outer tunics grayish brown, parchment-like, longitudinally splitting, sometimes accumulating to a thick but brittle shell. Scape ± straight, smooth; 20-40 (70) cm long, basally 4-8, above up to 12 mm in diam.; dull green. Leaves broadly lanceolate, upper and lower sides densely covered by long hairs; up to 5 cm wide and 40 cm long; straight when growing out. Sheath leaf moderately long, thickish, pale to deep brown, soon decaying. Spathe membranous, split into 1-2 broadly ovate, acuminate, patent to subreflexed valves; pale brown with inconspicuous veins. Inflorescence fasciculate, later semi-globose, 5-8 cm long, finally 12-18 cm in diam. Pedicels thin wiry, stiff, ± straight, cylindrical; pale greenish to purple flushed. Flowers flat starlike, after anthesis moderately funnel-shaped. Tepal shape like in subsp. *cristophii*; silvery-brownish, brownish to buff; median vein broad, green to brown. Filaments maroon, whitish near the very base. Anthers and ovary do not differ from the typical subspecies. The nectary ducts lead in small slits near the very base of the ovary. Capsules depressed-globose, triangular, sitting, surface reticulate lacunose with some stronger irregular ledges; 3-4 mm long and 5-6 mm in diam.; greenish to ochre; valves broad-elliptic with a longitudinal furrow and a shallow notch at the apex. Seeds 1-2 per locule, ovoid; surface coarsely reticulate lacunose; dull black.



Chromosomes:  $2n = 16$  Pogosian & Seisums 1992 (Turkmenistan: Kopetdag mountain range, Mt. Dushak, "*A. bodeanum*").

Distribution: Turkmenistan, NE Iran: Koppe Dag mountain range, submontane grassy sand rocky slopes at elevations above 1000 m up to 1800 m.

Remarks: Important key characters of subsp. *golestanicum* are 20-40 cm long scapes, broader and shorter (and often really woolly) leaves straight when growing out, silvery-brownish tepals, and maroon filaments (a detailed discussions see under the typical subspecies). Living plants are well separable from typical *A. cristophii* as well as from its montane form. The molecular relationship was already discussed under subsp. *cristophii*.

Biological data: Genome size 46 pg 2C DNA (Gurushidze & al. 2012). Fresh bulbs contain in total 0.33 % cysteine sulfoxides (71 % methiin, 3 % alliin, 26 % isoalliin, Keusgen & al. 2008).

Living accessions studied: Golestan: Region near pass Jakhtikalon, SE border of Golestan reservation (37°24' N, 56°12' E, 1700 m, 20.4.2004 Keusgen, Fritsch 1016; GAT IRAN). - N Khor: Slope near the main road 38 km from Bojnurd to Esfaryen (37°19' N, 57°20' E, 1860 m, 11.5.2012 Fritsch, Eskandari, Bahramishad 1377; GAT IRAN).

Herbarium vouchers: Golestan: Jangal-e-Golestan, Dasht-e-Calpush (37°18' N, 56°01' E, Termeh, Matin 333-IRAN). Center 2-4 km N AlmeH flats and S slopes of Qara-Qineh mountain (37°22' N, 56°06' E, 1800-1950 m, 29.5.1995 Akhani 11003; W). 1-2 km N AlmeH, mountain steppe (37°22' N, 56°08' E, 27.5.1995 Akhani 10965; W). Jangal-e-Golestan, Dasht-e-Calpush (37°18' N, 56°01' E, 2200-2500 m, 14.6.1975 Termeh, Matin 332-IRAN). Golestan National Park, Dasht bifurcation (37°19' N, 56°00' E, 1070-1150 m, 19.6.1993 Termeh, Matin 340-IRAN). Shahpasand vers Bojnurd, AlmeH (37°22' N, 56°08' E, 10.6.1975 Termeh 338-IRAN). Golestan Forest, Tange Gol (37°24' N, 56°00' E, 19.5.1976 Termeh, Matin 336-IRAN). Park-e Golestan, AlmeH (37°22' N, 56°08' E, 1350-1700 m, 05.6.1987 Mozaffarian, Abouhamzeh 59073-TARI). E AlmeH undulating slopes (37°22' N, 56°08' E, 1700-1820 m, 30.5.1995 Akhani 11023; W). 18 km from Maravetappeh to Ashkhaneh (37°41' N,

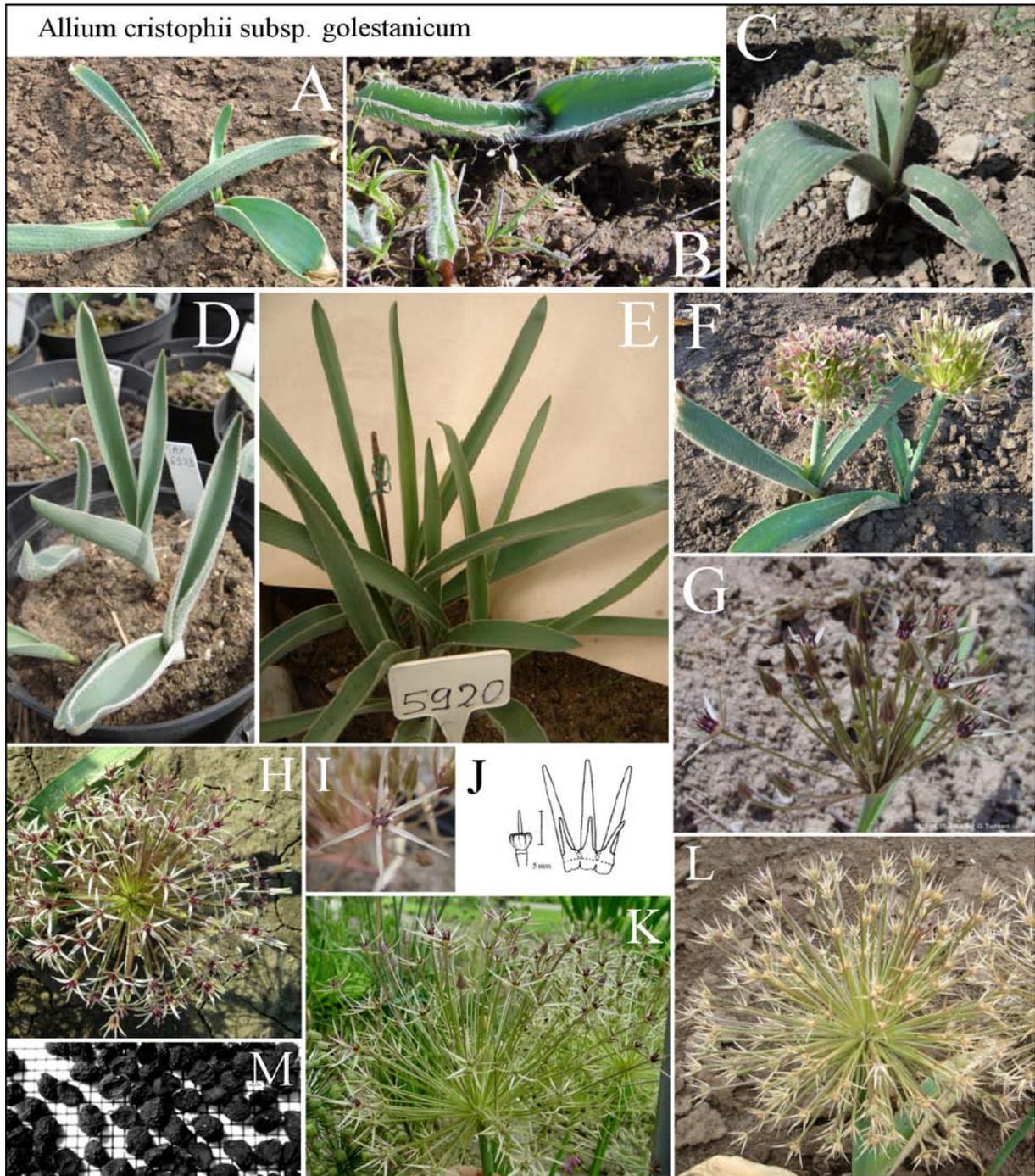


Plate T51. A, D & E: Leaves in different development stages; B: sprouting leaves in Kumyshdash, Turkmenia; C: cultivated plant in the shooting stage; F: cultivated plants at the begin of anthesis; G: inflorescence at the begin of anthesis (cultivated in Tashkent, Uzbekistan); H, K & L: inflorescences in full, late, and after anthesis, resp.; I: close-up of a flower; J: shape of ovary, tepals and filaments of a flower prepared from herbarium; M: seeds (background raster 1 mm).

56°12' E, 850 m, 24.4.1986 Assadi, Maassoumi 55601-TARI). Almehr (37°22' N, 56°08' E, 1500-1800 m, 08.-10.6.1975 Reching 53051; W B G). Kuh-e Aghaman (1100 m, 18.5.1975 Reching 54009; W). Wildlife Park, Almehr, small valley (37°22' N, 56°08' E, 1750 m, 19.6.1974 Wendelbo, Foroughi 12616-TARI; W). SE of Maraveh Tapeh, Shalmi mountain (37°53' N, 56°02' E, 28.5.2000 Faghihnia, Zangoie 32879; FUMH). Golestan National Park W Soolegerd Guard Station, steppe (37°27' N, 56°08' E, 27.4.1995 Akhani 10502; M). North Gonbad, 22 km S Moraveh Tappeh on road to Gonbad (37°45' N, 55°56' E, 780 m, 22.4.1976 Hewer T. H. 3837; W). - N Khor.: Shirvan, Namanlu, Kuhha-ye Gulul (37°39' N, 58°05' E, 2200-2500 m, 14.6.1975 Termeh; 332-IRAN). Koppe Dag c. 30 km NE Shirvan (37°37' N, 58°10' E, date & collector not translated; FUMH). Bojnurd, Ghorogh-e Kur-Khud, between Behkadeh Razavi and Robat-e Gharehbil (37°50' N, 57°40' E, 1600 m, 31.5.1998 Hojjat, Zangoie 31177; FUMH). Aladag c. 20 km N Esfarayen (37°14' N, 57°34' E, date & collector not translated; FUMH). Koppe Dag c. 50 km N Bojnurd (37°56' N, 57°27' E, date & collector not translated; FUMH). c. 80 km WSW Bojnurd (37°20' N, 56°30' E, date & collector not translated; FUMH). c. 55 km W Ashkhaneh (37°33' N, 56°21' E, date & collector not translated; FUMH). c. 100 km W Bojnurd (37°26' N, 56°10' E, date & collector not translated; FUMH). Shirvan, Badamlogh,

Malek Aman mountain (37°18' N, 57°40' E, 1600 m, 08.6.1998 Faghinia, Zangooei 31357; FUMH). SW of Bojnurd, Raeen, N and W slopes of Tupal-Rayeh mount (37°25' N, 57°05' E, 1950-2050 m, 07.6.2005 Memariani, Zangooei, Arjmandi 37922; FUMH). Between Shirvan and Bojnurd, Dryland agriculture research station of Khorassan, Simab (37°27' N, 57°30' E, 16.5.1988 Joharchi, Zangooei 16657; FUMH). Between Ghuchan and Daregaz, mountain located on North of Tivan road maintenance (37°16' N, 58°46' E, 2100 m, 05.6.2003 Ajani, Zangooei 34690; FUMH). E Ghuchan, Emaarat (37°05' N, 58°51' E, 20.5.1986 Joharchi, Zangooei 14432; FUMH). SW Bojnurd, Raeen towards Arkan, N and NE slopes of Gharanghehzu mount (37°24' N, 57°03' E, 2050 m, 20.5.2006 Memariani, Zangooei, Arjmandi 37567; FUMH). Alamli (Wendelbo 1971: Kopet Dag: in jugo Alam Ali) (37°22' N, 58°29' E, 2000 m, 03.6.1948 Rechinger, Aellen, Esfandiari 4816; 290-Iran W M). 75 km road of Bojnurd towards Allmeh (37°25' N, 56°34' E, 1250 m, 28.5.1998 Hojjat, Zangooei 31025; FUMH). Bojnurd, Robot-e Gharehbil, 20 km on the old road of Jajarm (37°11' N, 56°17' E, 1600 m, 29.5.1998 Hojjat, Zangooei 31086; FUMH). SW Bojnurd, Raeen, Marta-e Marjan road, Barzanlu (37°24' N, 57°02' E, 2220 m, 08.6.2006 Memariani, Zangooei, Arjmandi 37990; FUMH). Between Shirvan and Esfarayen, Takht-mirza, Kalateh sohrab highland (37°11' N, 57°35' E, 2100 m, 15.6.1998 Rafeie, Zangooei 13590; FUMH). (Gulul Sarani prot. region) Kopet Dag: in altiplanitie ("dash") ad custodelam, substr. calc. (37°46' N, 58°08' E, 2100-2300 m, 12.-13.6.1975 Rechinger 53349; W B G). NE of Bojnurd, Gifan, Meisi-Nu mountain (37°54' N, 57°28' E, 1800-2000 m, 17.6.1991 Joharchi, Zangooei 20818; FUMH). - Raz. Khor.: Koppe Dag c. 35 km NE Radkan (36°56' N, 59°17' E, date & collector not translated; FUMH). Koppe Dag c. 20 km SW Gonbad-e-Kabud (36°50' N, 59°40' E, date & collector not translated; FUMH). Koppe Dag c. 25 km SW Dargaz (37°20' N, 58°51' E, date & collector not translated; FUMH). Koppe Dag c. 25 km N Radkan (36°57' N, 59°00' E, date & collector not translated; FUMH). N of Neishabur, around waterfall of Baar village (37°00' N, 58°44' E, 1850-1900 m, 20.5.1996 Rafeie, Zangooei 27053; FUMH). Binalud c. 20 km N Neyshabur (36°21' N, 58°49' E, date & collector not translated; FUMH). N Mashhad, old road of Mashhad towards Kalat, Sandugh-shekan pass, towards Kalat crossroads (36°56' N, 59°47' E, 1400-1450 m, 04.5.2007 Zangooei, Neshati 38752; FUMH). Montes Kuh-e Nishapur, Darreh Abshar supra Akhlamad (Fl.Iran.) (36°36' N, 58°55' E, 1600-1800 m, 30.5.1948 Rechinger 4605; W G). Koppe Dag c. 15 km E Quchan (37°04' N, 58°39' E, date & collector not translated; FUMH). Koppe Dag c. 15 km W Dargaz (37°29' N, 58°58' E, date & collector not translated; FUMH).

Determination unsure: Golestan: Inter Tang-e Rah et Tang-e Gol in saxosis fruticosis, substr. calc. (37°25' N, 55°45' E, 400-600 m, 03.6.1975 Rechinger 52584; W B G). Golestan Forest, Tange Rah towards Tange Gol (37°24' N, 55°50' E, 420-470 m, 04.6.1975 Termeh 341-IRAN).

**52. *Allium ellisii*** Hook. f. in Curtis's Bot. Mag. 129: t. 7875 (1903). - Wendelbo, Flora Iranica No. 76: 76, fig. 7/104 (1971). Kamelin ex Nikitin & Gel'dikhanov, Opre del. rast. Turkmen.: 128 (1988), sub *A. bodeanum*. *Allium bodeanum* subsp. *ellisii* (Hook. f.) Seisums, Obzor Melanocr.: 28 (1994), comb. inval. - Type: *Allium* ex affinitate *A. karataviensis* Regel Bot. Mag. 6451 from Hon. Ch. Ellis, Haslemere, June, 1900. Collected in Persia by Ney Elias ... *Allium Ellisii*, Hook. f. June 6. 1900, Type of Bot. Mag. (lectotype K!, design. Fritsch & al. 2010: 204).

Bulbs short-ovoid, 15-25 mm in diam.; outer tunics parchment-like strong, slightly splitting near top and base; brownish to blackish. Scape flexuous, terete, smooth; 10-30 cm long, 8-15 mm in diam., green with glaucous bloom, basally purplish flushed. Leaves 2-5, laminae oblong to linear, thick, broadly canaliculate, flat arcuately ascending and recurved to the soil, arcuately tapering into the cucullate apex; margin purplish or white, densely toothed; upper and lower sides shallowly grooved; (8) 20-30 cm long, 2-5 (12) cm wide; initially (mainly lower side) violet flushed, later dull green with glaucous bloom. Sheath leaf short, fine membranous, brownish, soon decaying. Spathe membranous, completely divided into several short or narrowly triangular valves, finally patent and shorter than the pedicels; pale brown with darker veins. Inflorescence initially fasciculate later semi-globose, moderately many-flowered, dense; 8-12 cm in diam. and 3-8 cm long. Pedicels thickish, stiff and strong, smooth, unequally long; 3.5-5 cm long; green to purplish brown, glossy. Anthesis in April to May. Flowers flat star-shaped. Tepals triangular lanceolate with a plicate but subobtuse apex, patent, slightly recurved; after anthesis more obliquely-patent with convolute margins, ± prickly; (9) 10-13 (16) mm long, basally 2-3 mm broad; pale to deep pink, paler towards the base, outer side often purplish, with broad, inconspicuous, at the outer side greenish median vein. Filaments 2/3-4/5 as long as the tepals, subulate with subquadratic (inner filaments broader), shortly connate base; basally straight and for 2/3 obliquely reflexed; ± carmine with a whitish base. Anthers oblong, c. 2 mm long; pinkish to brownish-purple. Pollen grayish or yellow; shape oblate, 29-31 µm long, 16-18 µm broad, P/E index 0.5-0.6, wall 0.7-1.0 µm thick, sculptures microrugulate to rugulate (Neshati & al. 2009). Ovary shortly stipitate, subglobose with 3 broad and 3 narrow furrows, surface coarsely tuberculate; about 3-4 mm in diameter, 3 mm long; initi-

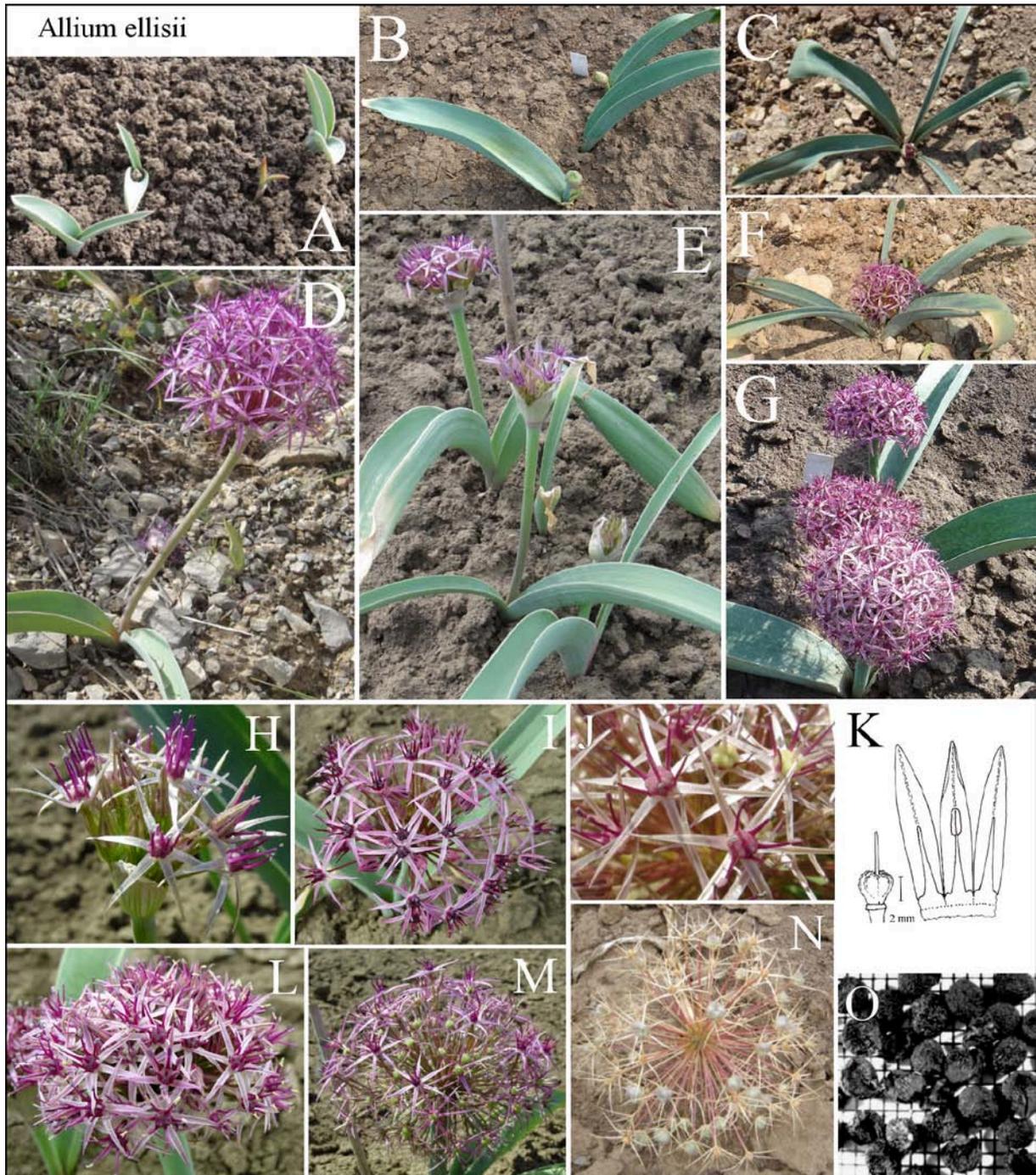
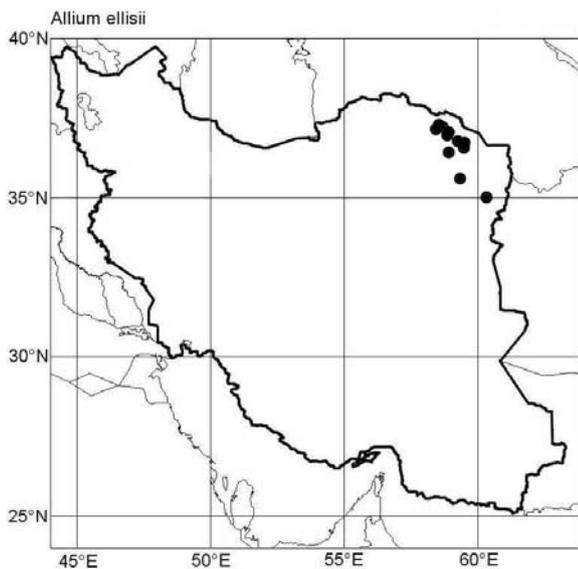


Plate T52. A: Sprouting leaves of cultivated plants; B & C: leaves and scapes after sprouting; D: flowering plant near vill. Gush; E, F & G: cultivated plants in early and full anthesis, resp.; H & I: inflorescence in early anthesis; J: close-up of flowers; K: shape of ovary, tepals and filaments of a flower prepared from herbarium; L, M & N: inflorescences in full, late, and after anthesis, resp.; O: seeds (background raster 1 mm).

ally carmine flushed, later green; nectary ducts lead in small triangular holes near the base; several ovules per locule. Style conical to thread-like, 3-5 mm long; carmine. Stigma undivided, punctiform; whitish. Capsule depressed globose triangular; 5-6 (7) mm in diam., c. 5 mm long; widely opening, dull reddish to greenish brown; valves broadly ovate with a slightly notched apex, a shallow longitudinal furrow and irregularly transverse ledges. Seeds 1-2 per locule, drop-like comma-shaped, surface reticulate lacunose; 2.5-3 mm long, 1.5-2 mm wide, 1.3-1.5 mm thick;  $\pm$  semi-dull black.

**Distribution:** NE Iran: Koppe Dagh and Binalud mountain ranges; montane rocky and stony slopes, mountain steppes, rock terraces.



**Remarks:** Although the type location remained unknown, plants from Binalud massif and Koppe Dagh mountain range correspond very well to the original description that reflects the characters of plants cultivated in England. *Allium ellisii* differs from all forms of *A. cristophii* by much broader, grooved, and never hairy leaves, broader tepals, and very coarse, in early anthesis purple flushed (not slightly coarse and green) ovaries. Plants of *A. pseudobodeanum* own leaves and ovaries very similar to those of *A. ellisii* but differ by longer and broader white bases of the filaments and pale lilac-purplish, not white to purple, tepals. Molecular markers (ITS sequences of nuclear rDNA) affiliate *A. ellisii* to sect. *Asteroprason* where it jointly with *A. pseudobodeanum* constitutes a subgroup some-

what separated from *A. cristophii* and *A. helicophyllum* (see p. 199). Sequences of the plastid *trnL-trnF* region confirmed this topology but with lower resolution (Gurushidze & al. 2010).

**Etymology:** Named after the English explorer Ch. Ellis who has bulbs from Mashhad area collected and sent to London in about 1900.

**Biological data:** Genome size 44.7 pg 2C DNA (Gurushidze & al. 2012). The plants contain a red dye (Keusgen & al. 2008).

**Economic traits:** Leaves and flowers are collected in springtime for consumption (Keusgen & al. 2008).

Living accessions studied: **Raz. Khor.:** Central Kopetdag, slope near main road to Dargaz NE of main pass (37°30' N, 58°35' E, 1750 m, 23.4.2004 Keusgen, Fritsch 1025; GAT IRAN). Central Kopetdag NE of vill. Cheve Ly (37°26' N, 58°35' E, 2200 m, 23.4.2004 Keusgen, Fritsch 1024; GAT IRAN). Road from Quchan to Dargaz, near pass over Hesar Masjed massif (37°29' N, 58°34' E, 2100 m, 12.5.2012 Fritsch, Eskandari, Bahramishad 1385; 37°27' N, 58°35' E, 2350 m, no. 1387, 1388; GAT, IRAN). Binalud massif, slopes of the valley above Akhlamat (36°36' N, 58°56' E, 1500 m, 22.4.2004 Keusgen, Fritsch 1019; GAT IRAN). Near the road from Mashhad c. 50 km to Mareshk above vill. Gush (36°44' N, 59°32' E, 1740 m, 15.5.2012 Fritsch, Eskandari, Bahramishad 1399; GAT IRAN).

Herbarium vouchers: **Raz. Khor.:** Between Ghoochan and Darreh-Gaz, Tandoreeh National Park, Shekarab (37°23' N, 58°46' E, 2300 m, 27.5.1984 Assadi, Maassoumi 50658-TARI). E of Ghuchan, Yadak (37°08' N, 58°53' E, 1700 m, 15.5.1985 Joharchi, Zangooei 12887; FUMH). Daregaz, Tandureh National Park, 2 km Tivan towards Urta-bulagh (37°28' N, 58°34' E, 2215-2280 m, 12.6.2004 Memariani, Zangooei 35535; FUMH). N Mashhad, 1km N Kharkat, Hezar-Masjed protected region (36°54' N, 59°33' E, 2025 m, 09.5.2011 Joharchi, Memariani 44294, 44295; FUMH). Daregaz, Tandureh National Park, Tivan (37°28' N, 58°34' E, 2280-2310 m, 19.5.2004 Memariani, Zangooei 35387-8; FUMH). Tandooreh National Park between Ghoochan and Darreh-Gaz, between Shekarab and Chehel-mehr (37°14' N, 58°57' E, 1600-1900 m, 28.5.1984 Assadi, Maassoumi 50738-TARI). Daregaz, Tandureh National Park, 8 km Chehel-mir towards Shekar-ab (37°24' N, 58°47' E, 1330 m, 01.6.2004 Memariani, Zangooei 35457; FUMH). 37 km road of Boghmach to Hezar-Masjed peak (36°57' N, 59°15' E, 2400 m, 16.6.1997 Hojjat, Zangooei 29245; FUMH). Daregaz, Tandureh National Park, Shekar-Ab mount (37°22' N, 58°42' E, 2300 m, 27.5.1991 Joharchi, Zangooei 20449; FUMH). SW of Torbat-Jam, Bezd mount (35°11' N, 60°22' E, 06.5.2007 Zangooei, Neshati 38764; FUMH). Akhlohad, Neishabour mountain, Darreh-Abshar mountain (36°35' N, 59°00' E, 30.5.1948 Rechinger, Esfandiari, Aellen 4605; 292-IRAN). NE Chenaran, 78 km road of Boghmach to Hezar-Masjed (36°58' N, 59°17' E, 2400 m, 30.4.2000 Hojjat, Zangooei 32736; FUMH).

Determination unsure: **Raz. Khor.:** Ghouchan 31 km Darrehgaz road (37°20' N, 58°29' E, 1940 m, 27.5.1972 Foroughi 3532; TARI). S Mashhad, Robot-e Sefid (35°46' N, 59°23' E, 1700 m, 04.6.2003 Ajani, Zangooei 34654; FUMH).

**Allium sect. Compactoprason** R.M. Fritsch, Genus *Allium* taxon. problems genetic resources: 74 (1992) emend. R.M. Fritsch in Linzer Biol. Beitr. 26: 976 (1994). Type: *A. giganteum* Regel

**Allium subsect. Erectopetala** F.O. Khass., Genus *Allium* taxon. problems genetic resources: 158 (1992) emend. F.O. Khass. in Linzer Biol. Beiträge 26: 977 (1994). Type: *A. giganteum* Regel

**53. *Allium giganteum*** Regel in Gartenflora 32: 97, t. 1113 (1883), et in Trudy Imp. S.-Peterb. Bot. Sada 8: 663, t. 20 f. h, t. 21 f. m (1883), corr. in Trudy Imp. S.-Peterb. Bot. Sada 10: 362 (1887). - Baker in Curtis's Bot. Mag. 111: t. 6828 (1885). Vved., Flora Turkm. 1, 2: 294 (1932); Vved., Flora URSS 4: 274 (1935); Vved., Flora Uzbek. 1: 463 (1941); Vved., Flora Tad. SSR 2: 354 (1963); Vved. [& Kovalevskaya], Opred. rast. Sredn. Azii 2: 86 (1971). Wendelbo, Flora Iranica No. 76: 88, tab. 9/127, tab. 26/4 (1971). Kamelin ex Nikitin & Gel'dikhanov, Opredel. rast. Turkmen.: 128 (1988). Fritsch in Nordic J. Bot. 16: 15 (1996). - *Allium procerum* Trautv. ex Regel in Trudy Imp. S.-Peterb. Bot. Sada 8: 663, t. 20 f. d-f (1884). Type: Tajikistan: Chodscha-Kadian ad orientem a Kabadian, 6000', 21. IV./3.V.1883, leg. A. Regel (lectotype LE, design. Fritsch, 1990: 504). - Type: Ex horto bot. Petropolitano 82.6 *Allium giganteum* Rgl., two inflorescences on the left side. (lectotype LE; design. Fritsch & al. 2010: 205).

Bulbs ovoid to subglobose, (2.5) 5-7 (10) cm in diam., (3) 5-8 (12) cm long; outer tunics parchment-like (sometimes building a many-layered shell), longitudinally splitting; initially greyish, later blackish or blackish-carmine; inner tunics papery, whitish. Scape straight, strong, terete, smooth; (50) 80-150 cm long, near base 1-2.5 cm in diameter; green with glaucous bloom. Leaves 4-7 (10), laminae oblong to broadly lanceolate, thick, broadly canaliculate, short arcuately ascending and recurved, the shortly arcuately tapering, somewhat cucullate apex is often incurved; upper side smooth or with some coarse furrows, lower side with broad and obtuse ribs; margin smooth, initially red, later white; 25-50 (60) cm long, (1.5) 3-10 (16) cm broad (the innermost leaves are the narrowest); green, mostly with strong glaucous bloom. Sheath leaf hyaline, silk-like semi-glossy, quickly decaying. Spathe membranous, divided into 2-3 ovate to suborbicular, shortly acute, patent, later reflexed valves; 2-3 cm long; pale brown with darker veins. Inflorescence globose, very dense and pluri-flowered; initially c. 5 cm, finally c. 15 cm, in the fruiting stage up to 20 cm in diam. Pedicels very thin, stiff, straight or slightly ascending, unequally long; initially 2-3 and finally 6-8 cm long; pure green or reddish flushed; in the fruiting stage dropping down from the receptacle. Anthesis in April to May or begin of June. Flowers bowl-shaped star-like. Tepals oblong, patent, spoon-shaped concave and incurved, obtuse, only very basally united, after anthesis irregularly crumpled; 5-6 mm long, 2.5-3 mm broad; pinkish-lilac to deep carmine fading during anthesis. Filaments about 1.5 times longer than the tepals, straight, outer filaments thin subulate, basally very short triangularly broadened, inner filaments narrow triangular with 1.5 times broader triangular base; basally connate for c. 0.5 mm; color somewhat paler than the tepals. Anthers oblong, c. 2 mm long; pale yellow with pink flush. Pollen yellowish grey, the shape oblate to peroblate, 29 µm long, 13 µm broad, P/E index 0.5, sculptures rugulate to microrugulate, wall 0.9 µm thick (Neshati & al. 2009). Ovary shortly stipitate, depressed globose-triangular, with 3 broader pale and 3 narrow, dark violet furrows, surface finely papillose; 3-3.5 mm long and in diameter; pale greenish violet; up to 4 (Filimonova 1970) or only 2 ovules per locule (Hanelt 1992). Nectary somewhat lobed, ducts lead in dot-like holes near the base of the ovary below the bottom of the locules (Fritsch 1992b). Style narrowly conical to thread-like, 7-8 mm long; carmine. Stigma undivided dot-shaped; paler than the style. Capsule flat globose-tripartite, surface dull, finely rugose; 3-4 mm long, 6-8 mm in diam., often with unequal parts, opening with 3 narrow slits; valves suborbicular with a deep longitudinal furrow; brown. Seeds single per locule, subglobose with often one concave side, surface reticulate lacunose; c. 2.5 mm long, 2-2.5 mm broad and thick; dull black. The testa showed verrucose periclinal walls, the undulation of the anticlinal walls varied from U-like to Omega-like forms with low to moderate amplitude and moderate wavelengths (Kruse 1984, Fritsch & al. 2006). TKW 4.38 / 4.64 / 4.96 / 5.11 / 5.50 g (IPK, unpubl. data).

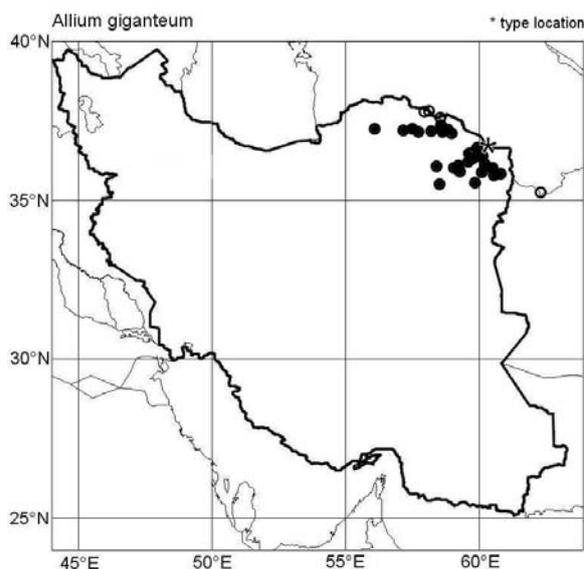
Chromosomes: 2n = 16 Levan 1935 (Netherlands: Botanical collection). 2n = 48 Mensinkai 1939, 1941 (Great Britain: Botanical collection). 2n = 16 Vakhtina 1964, 1969 (Tajikistan: Khoja-Kazian). 2n = 16 Ved Brat 1965a (?Botanical collection). 2n = 16 Dietrich 1967 (France: Botanical collection). 2n = 16 Zakirova & Vakhtina 1974 (Turkmenistan: Botanical collection). 2n = 16 Vakhtina 1985 (Tajikistan: Koj-Pios-Tau, type location of *A. procerum*). 2n = 16 Labani & Elington 1987 (Netherlands: Botanical collection). 2n = 16, 32 Astanova 1990 (Tajikistan: Khoja-Kazian). 2n = 16 Fritsch & Astanova 1998 Table 2 (Germany: Botanical collection).



Plate T53. A: Leaves of cultivated plants after sprouting; B: cultivated plant in the late shooting stage; C: normal and small flowering plants; D: plants in the shooting stage near Kharv-e Olia; E: leaves in early shooting stage; F & G: inflorescence in early and full anthesis, resp.; H: seeds (background raster 1 mm); I: bulbs; J: inflorescence after anthesis; K: comparison of flower parts in different stages; L: shape of ovary, tepals and filaments of a flower prepared from herbarium.

**Distribution:** NE Iran, N & W Afghanistan, Turkmenistan, Uzbekistan, Tajikistan; colline to submontane loess slopes, stony steppe slopes, rock outcrops, rock crevices and terraces.

**Remarks:** This species was described from cultivated plants sent from the firms P. Miles (Bingham, England) and M. Leichtlin (Baden-Baden, Germany) to Regel in St. Petersburg (Russia). These bulbs were collected probably at 4 August 1881 in the valley of Chahchaheh river along the northern spurs of eastern Koppch Dag mountain range ('deli guzella') by O'Donovan (Dadd 1987), probably outside current Iranian territory. *Allium giganteum* reaches the SW edge of its area of distribution in Iran. It



grows rarely in elevations above 2000 m. A recent report from Turkey (C9 Hakkari; Behcet & al. 2012) is an error: the plants described in that paper differ from *A. giganteum* in many characters of generative organs and belong very probably to a species of sect. *Procerallium*. In Central Asia and European gardens, *A. stipitatum* is sometimes merged with *A. giganteum*. Molecular markers (ITS sequences of nuclear rDNA) verified *A. giganteum* to belong neither to sect. *Megaloprason* s. str. nor to sect. *Procerallium* but to an own section with *A. macleanii* Baker as the closest relative (Fritsch & al. 2010; see p. 202). Other molecular markers (*trnL-trnF* sequences of cp DNA) did not resolve a separation from sect. *Procerallium* but confirmed the other relations (Gurushidze & al. 2010).

**Etymology:** The epithet refers certainly to the magnificent large stature of flowering plants (from Latin "gigantic").

**Biological data:** The seedlings belong to the *Allium karataviense* type (Druselmann 1992). High summer to winter dormancy, high summer flowering, complete withering of leaves before spathe opening were reported as phenological characters (Pistrick 1992). The bulbs must be stored at low temperatures for a rather long period to warrant complete development of inflorescences (Dubouzet & al. 1992; Maeda & al. 1994). Very good germination was reported at 5°C, but very bad above 10°C (Specht & Keller 1997), or partly successful germination at 5°C but 20°C are not dormancy-breaking (Aoba 1967 in Ellis & al. 1985). The bulb contains steroid saponines (Kawashima & al. 1991; Mimaki & al. 1994). Sokolov (1994) mentioned angiosid to occur in the whole plant, and glucose, fructose, saccharose, oligosaccharids and glucofructans as well as vitamin C in the subterranean parts. The plants contain dithiodipyrrole (Gurushidze 2008), that was in detail investigated by Vogt & al. (2008). Fresh bulbs contain in total 0.33 / 0.02 / 0.38 % cysteine sulfoxides (100 / 52 / 89 % methiin, 0 / 48 / 11 % isoalliin) (Jedelska & al. 2005; Keusgen & al. 2008, plants from Iran / Uzbekistan / Tajikistan). Bulb extract inhibited growth of some (mainly Gram-positive) bacteria species (Jedelská & Keusgen 2008) and showed a very high radical scavenger activity (Jedelska & al. 2005; Jedelská & Keusgen 2008). Variation of genome sizes [2C DNA]: 28 pg (Vakhtina & al. 1977), 20.6 pg (Labani & Elkington 1987), 26.5 pg (Zakirova 1989), 42.8 pg (Gurushidze & al. 2012).

**Economic traits:** In Tajikistan the fresh leaves 'model' (also the dried leaves, Keusgen & al. 2005) are collected and used for traditional dishes. The bulbs are used as spice, and the old bulb tunics for staining silk reddish (Sokolov 1994). Fedtschenko & al. (1932) assumed that the bulbs are collected for export to India as surrogate of Salep. Local name 'evoj pijoz', it belongs to the most important edible species in the Uzbek mountains (Khassanov 2008). In the prov. Khorasan, the leaves are collected and used as vegetable similar to onion, local name 'kuria' (own unpublished data). Much cultivated in European gardens (several cultivars exist) as attractive solitary plants with striking flower-heads on magnificent stalks in herbaceous beds and as cut flowers, valuable for the long-lasting bloom (Kamenetsky & Fritsch 2002), also promised for Turkmenistan (Androsova 1941). Experimental hybrids with other species and hybrids could be obtained (Dubouzet & al. 1994; Bijl 1995), some of them only after embryo rescue and in vitro cultivation (Dubouzet & al. 1998). Ornamental plant listed in the "International Checklist ..." of the Royal General Bulbgrowers Association (1991) and commercially available (De Hertog & Zimmer 1993).

Living accessions studied: **Raz. Khor.:** Binalud massif near vill. Kharv-e Olya (36°12' N, 59°05' E, 1750 m, 25.4.2004 Fritsch, Keusgen 1035; GAT IRAN). Central Kopetdag, slope near main road to Dargaz NE of main pass (37°32' N, 58°37' E, 1450 m, 23.4.2004 Keusgen, Fritsch 1028; GAT IRAN).

Herbarium vouchers: Golestan: W of Bojnurd, Almeh highlands (37°22' N, 56°08' E, 1700 m, 09.7.1997 Rafeie, Zangooei 29561; FUMH). - N Khor.: c. 15 km SW Shirvan (37°19' N, 57°49' E, date & collector not translated; FUMH). Aladag c. 20 km SW Bojnurd (37°23' N, 57°11' E, date & collector not translated; FUMH). c. 120 km W Bojnurd (37°27' N, 56°07' E, date & collector not translated; FUMH). c. 30 km ESE Shirvan (37°21' N, 58°15' E, date & collector not translated; FUMH). SW of Shirvan, Zo-eram highlands (37°19' N, 57°44' E, 1500 m, 07.6.1998 Faghiniha, Zangooei 31331; FUMH). Bojnurd, Saluk, Zu-e Garivan (W Firuzeh) (37°19' N, 57°14' E, 1450 m, 01.6.1998 Hojjat, Zangooei 31210; FUMH). SE Bojnurd, Chenaran vilage, Zuchenaran (37°24' N, 57°32' E, 1363 m, 27.5.2008 Joharchi, Zangooei 40430; FUMH). - Raz. Khor.: Mashhad, 18 km from Chahchaheh (36°35' N, 60°10' E, 900 m, 09.5.2001 Ghahreman, Attar, Okhovvat, Mehdigholi 27475; TUS). 45 miles from Mashhad to Kalat-Naderi (36°20' N, 60°22' E, 1750 m, 05.6.1973 Iranshahr, Zargani 402-IRAN). Fahrman to Shahan Garmab (35°43' N, 59°53' E, 1400 m, 12.7.1972 Iranshahr 403-IRAN). Sarakhs, road of Agh-darband, N slope of Darband mountain (36°00' N, 60°50' E, 500 m, 20.5.1990 Joharchi, Zangooei 18595; FUMH). Mashhad to Neyshabur, Piveh-jan (36°03' N, 59°21' E, 1630-2000 m, 21.6.2002 Djavadi, Sadeghi 43030-IRAN). Torbat-e-Jam (35°12' N, 60°33' E, date & collector not translated; FUMH). Binalud c. 45 km E NB [Neyshabur] (36°16' N, 59°16' E, date & collector not translated; FUMH). c. 70 km E Mashhad (36°18' N, 60°23' E, date & collector not translated; FUMH). c. 20 km S Mozduran (35°58' N, 60°36' E, date & collector not translated; FUMH). N of Mashhad, Kardeh dam (36°39' N, 59°40' E, 1500 m, 14.6.1983 date & collector not translated 10450; FUMH). Between Shahan-Garmab and Tappeh-Naderi (CJBI) (36°14' N, 58°26' E, 01.6.1973 Iranshahr 401-IRAN). Kopet Dag inter Quchan et Lutfabad, in jugo Allah Akbar, (37°15' N, 59°00' E, 1800 m, 14.-15.7.1937 Rechinger 1713; W G). 70 km from Dargaz to Ghouchan (37°19' N, 58°40' E, 1650 m, 08.6.2006 Djavadi, Eskandari, Torabi 48349-IRAN). Mashhad, Sha-taghi, Dizbad (36°06' N, 59°17' E, 1800 m, 04.8.1984 Mozaffarian 48904-TARI). S Daregaz, 20 km on the old road, Abgarm (37°18' N, 58°58' E, 1000 m, 26.5.1977 Zargari 2035; FUMH). Dargaz - Chelmir (37°24' N, 58°53' E, 900 m, 14.6.1988 Vafae 285; TARI). 70 km from Neyshabur to Kashmar (35°41' N, 58°33' E, 1550-1950 m, 11.6.1981 Assadi, Mozaffarian 35479-TARI). Mashhad to Sarakhs 5km after Mozdavand (36°10' N, 60°33' E, 970 m, 14.6.2005 Djavadi, Eskandari, Torabi 44045-IRAN). Koppe Dag c. 45 km NE Mashhad (36°40' N, 59°50' E, date & collector not translated; FUMH). Binalud c. 50 km ESE Neyshabur (36°04' N, 59°21' E, date & collector not translated; FUMH). c. 30 km NE Mashhad (36°29' N, 59°47' E, date & collector not translated; FUMH). N town Mashhad (36°23' N, 59°38' E, date & collector not translated; FUMH). Torog-Talsperre, Moran-Berge, Osthang (36°10' N, 59°33' E, 1500 m, 16.6.1988 Shad, Wafaii, Pezhman 1128; TARI). 50 km on the road of Mashhad towards Kalat-e Naderi (36°35' N, 60°01' E, 1250 m, 24.5.1994 Faghiniha, Zangooei 23992; FUMH). Mozdavand to Sarakhs (36°10' N, 60°35' E, 300-800 m, 18.6.2002 Djavadi, Sadeghi 43031-IRAN). Mashhad 55 km Sarakhs road (36°04' N, 60°08' E, 640 m, 23.5.1972 Foroughi 3533; TARI). Between Fardavand and Sarakhs, Ghorghoreh (36°14' N, 60°29' E, 1000 m, 08.6.1991 Joharchi, Zangooei 20647; FUMH). Koppe Dag c. 25 km SE Gonbad-e-Kabud (36°50' N, 59°59' E, date & collector not translated; FUMH).

*Allium* sect. *Decipientia* (Omelczuk) R.M. Fritsch in *Phyton* (Horn, Austria) 49: 168 (2010); *Allium* sect. *Melanocrommyum* series *Decipientia* Omelczuk in *Ukr. Bot. Zh.* 19, 3 (1962) 71. Type: *A. decipiens* Fisch.

54. *Allium grande* Lipsky in *Trudy Imp. S.-Peterb. Bot. Sada* 13: 343 (1894). Vved., *Flora URSS* 4: 267 (1935). - *Allium chelotum* Wendelbo in *Acta Horti gothob.* 28: 42, f. 11 (1966), Typus: Iran: [Alborz,] Haraz valley, Darli above Panjab 36°10' N, 52°17' E, ca. 2100 m, 11.5.1959, leg. Wendelbo 643 (holotype BG, not seen); Wendelbo, *Flora Iranica* No. 76: 87, tab. 9/126, tab. 21/1 (1971); Fritsch in *Nordic J. Bot.* 16: 15 (1996). - Type: Russia: In declivibus humidis ad Petrovsk (Daghestania) inter frutices, 2.5.1891, leg. Lipsky (holotype LE!, isotype TBI!).

Bulbs subglobose, 2-3.5 cm in diam.; outer tunics grayish brown, disintegrating; inner tunics papery, yellowish. Scape straight, terete, smooth; 40-80 cm long, (5) 6-8 (12) mm in diam.; dull green, lower part brown flushed. Leaves 2-4 (6), laminae elliptic-oblong to lanceolate with a narrow base, flat ascending, broadly canaliculate, rather thick, the obtuse apex cucullate; margin smooth, reddish; upper side smooth, lower side with flat broad ribs; 25-35 cm long, 4-13 cm wide; yellowish green, near the base purple flushed, ± glossy. Sheath leaf short, membranous, whitish, soon decaying. Spathe hyaline, completely divided into 2-4 triangular acute, finally reflexed valves; 2-2.5 cm long; yellowish brown with darker veins. Inflorescence ± broadly ovate, dense, many-flowered; c. 5 cm in diam. and long. Pedicels moderately thick, straight, stiff, strong, subequally long; 2-2.5 cm long; deep green, purplish flushed. Anthesis in May. Flowers flat bowl-shaped star-like. Tepals narrowly elliptic to oval with a triangular, often claw-like split apex, patent with incurved tip, margin sometimes with some teeth; after anthesis crumpled and enrolled; 6-8 mm long, c. 2 mm broad; rose to pink with inconspicuous, narrow median vein.

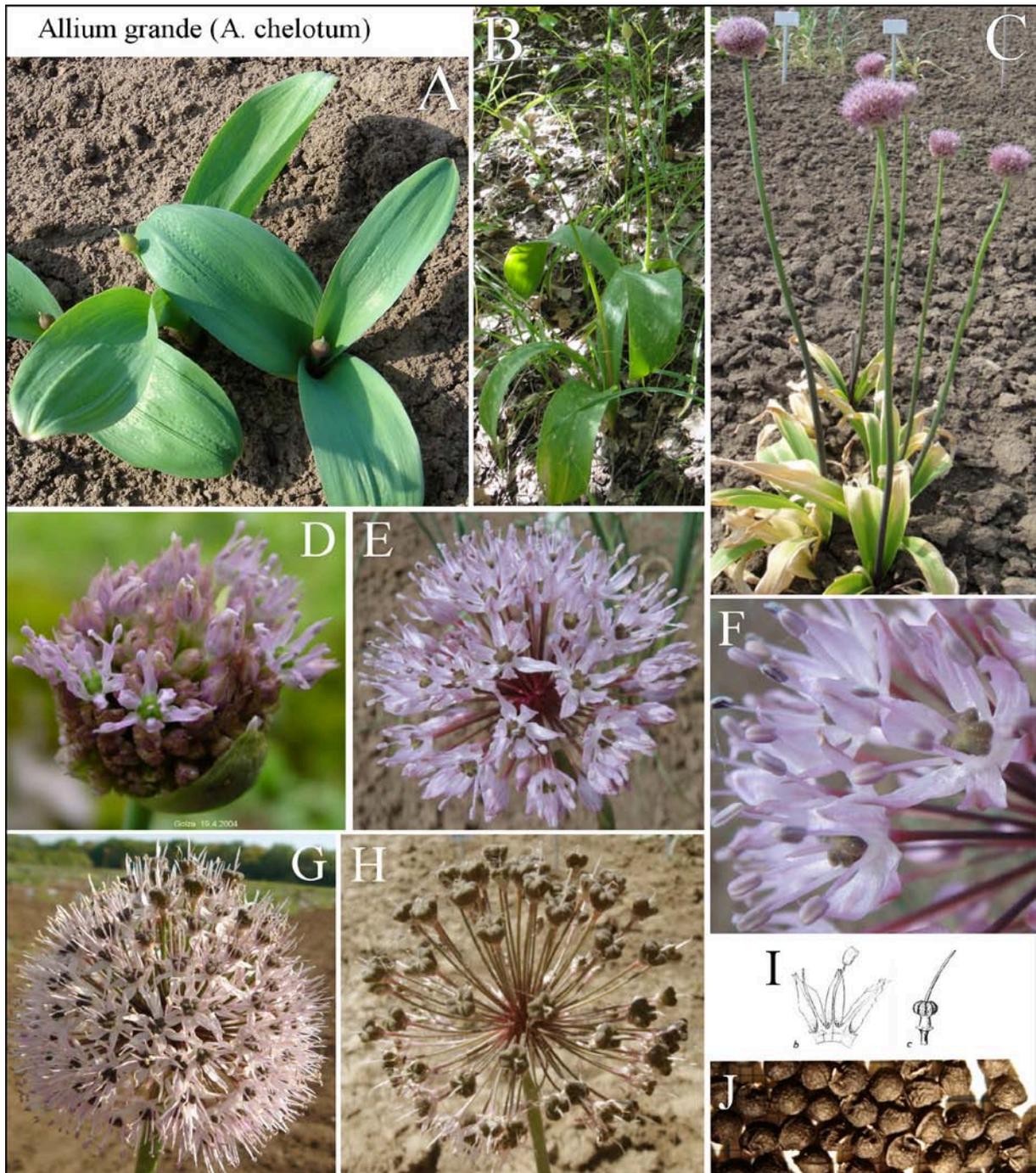
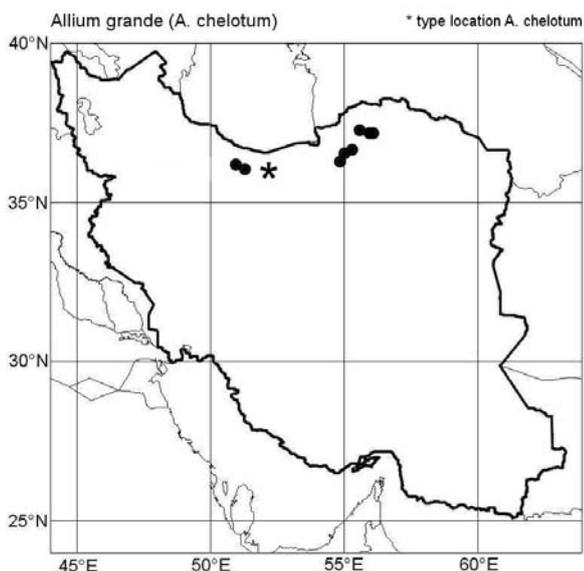


Plate T54. A: Leaves and scapes of cultivated plants after sprouting; B: shooting plants in Kuh-e Abr; C: flowering cultivated plants; D & E: inflorescences at begin of anthesis; F: close-up of flowers; G & H: inflorescence in late anthesis and with developing capsules, resp.; I: shape of ovary, tepals and filaments of *A. chelotum* flower (from Wendelbo 1966: Fig. 11); J: seeds (background raster 1 mm).

Filaments slightly longer than the tepals, thread-like; basally broadened and for c. 1 mm connate, inner filaments basally with two short lobe-like teeth; tip pinkish-carminé fading towards the base. Anthers ovate to oblong, c. 1.5 mm long and 0.8 mm wide; pinkish. Pollen pale yellow. Ovary long stipitate, depressed-globose with 3 narrow and 3 broader furrows, tip nearly flat-starlike with 6 radial bulges, coarsely tuberculate; c. 2 mm long and 2-3 mm in diam.; green, later with violet flush, nectary ducts lead in very small slits at the base of the ovary. Style narrowly conical to thread-like, 3-5 mm long; pink to carmine, paler towards the tip. Stigma dot-like; pinkish. Capsule broadly pear-shaped with 3 broad furrows; 3-4 mm long and 4-5 mm in diam.; widely opening; valves broadly elliptic, scarcely notched at the apex, surface finely coarse, brownish-yellow. Seeds 1-2 per locule, globose to drop-shaped, surface finely rugose with an equatorial ledge; c. 3 mm long and wide, 2.5 mm thick; dull black.

**Chromosomes:**  $2n = 20$  Pedersen & Wendelbo fig. 1c 1966 (Iran: Mazanderan, Haraz valley, type location of *A. chelotum*).  
 $2n = 20$  Vakhtina 1974 (Russia: Makhachkala).  $2n = 20$  Zakirova & Vakhtina 1974 (Russia: Makhachkala).



**Distribution:** N & NE Iran: Hyrcanian spots in the Alborz mountain range; E Caucasus: Daghestan, mesophyt of submontane forests and montane forest patches.

**Remarks:** At first glance, these plants look rather similar to members of the sections *Compactoprason* and *Megaloprason* but they are not closely related. In Iran this relic species occupies only Hyrcanian areas and spots (e.g. on the top of mountains); the area of distribution in the Republic Daghestan on the northeastern slopes of Caucasus mountain range comprises mesophytic submontane forests (Dibirov & al. 2012). According to molecular markers (ITS sequences of nuclear rDNA), *A. grande* belongs to the phylogenetically most basal clade of subg. *Melanocrommyum* (Fritsch & al.

2010; see p.199) with the South-Siberian *A. tulipifolium* Ledeb. as sister. Also sequences of the plastid *trnL-trnF* region support these relations (Gurushidze & al. 2010).

**Etymology:** The epitheta refer to the magnificent appearance of flowering plants (from Latin "large, tall"), and to the claw-like apex of the tepals (from Greek "chele = claw").

**Biological data:** The genome size 39.7 pg 2C-DNA is much larger than in *A. fetisowii* Regel (26, 28 pg) and *A. chychkanense* R.M. Fritsch (34 pg, Gurushidze & al. 2012) that belong to the same molecular clade (Fritsch et al. 2010). Bulb extract showed a very high radical scavenger activity (Jedelská & Keusgen 2008). Fresh bulbs contain in total 0.5 % cysteine sulfoxides (81 % methiin, 6 % alliin, 9 % isoalliin, 4 % propiin, Keusgen & al. 2008).

Living accessions studied: **Golestan:** Golestan National Park, Golza valley (37°22' N, 56°01' E, 950 m, 19.4.2004 Keusgen, Fritsch 1006; GAT IRAN). - **Semnan:** Kuh-e Abr c. 5 km NW vill. Abr (36°43' N, 55°03' E, 1900 m, 9.05.2012 Fritsch, Eskandari, Bahramishad 1365; GAT IRAN).

Herbarium vouchers: **Golestan:** Gorgan, Golestan Forest, Tange-Gol (37°24' N, 56°00' E, 600-650 m, 19.5.1976 Termeh, Matin 43095-IRAN). Wildlife Park c. 6 km E Tang-e Gol, forest (37°24' N, 56°01' E, 820 m, 30.4.1974 Wendelbo, Foroughi, Sanii, Shirdelpur 10957-TARI; W). Golestan forest (37°21' N, 56°00' E, 12.4.1967 Iranshahr, Desfulian 7069-E; 324-IRAN; 16.4.1967 Iranshahr, Dezfulian 7069-E-a; 324-IRAN). Golestan forest (37°21' N, 56°00' E, 06.5.1973 Iranshahr 41834; 323-IRAN). Golestan Center: near Janlar spring (37°26' N, 55°37' E, 1750-1950 m, 18.6.1995 Akhani 11305; W). Golestan Center: c. 2 km W Almehr towards Sharleq (37°22' N, 56°08' E, 1700-1750 m, 22.5.1995 Akhani 10795; W M). - **Mazandaran:** Kelardasht. Kuhe Takhte Soleyman (36°22' N, 51°01' E, 3100 m, 11.7.1973 Fotovat 10194-TARI). Siahisheh. Chalus valley. (36°13' N, 51°19' E, 2420 m, 17.5.1970 Foroughi 168; TARI). Elburs-Gebirge, Alam-Kuh (36°22' N, 50°59' E, 2900 m, 24.6.1977 VO 6257; TUB; collector unclear; 77-588 BFU; BSB). - **Semnan:** Shahrud, Kuh-e Abr, Kuh-e Ghatrri (36°27' N, 54°53' E, 2500 m, 23.6.1974 Wendelbo, Foroughi 12942-TARI; W). Between Shahpassand and Shahrud (36°49' N, 55°20' E, 2200 m, 19.5.1978 Wendelbo, Assadi 29713-TARI).

***Allium* sect. *Kaloprason*** K. Koch in Linnaea 22: 234 (1849); Wendelbo in Bot. Notis. 122: 29 (1969).

***Allium* subsect. *Kaloprason*** (K. Koch) Kamelin, Florogen. analiz Srednej Azii: 241 (1973), s. str. - *Allium* sect. *Melanocrommyum* ser. *Caspia* Omelczuk in Nov. sist. vyssh. rast. Kiev 3: 57 (1976 publ. 1977). Type: *A. caspium* (Pallas) M. Bieb.

**55. *Allium caspium*** (Pall.) M. Bieb., Fl. taur. cauc. 1: 265 (1808). - Hook. in Curtis's Bot. Mag. 77: t. 4598 (1851). Regel in Trudy Imp. S.-Peterb. Bot. Sada 3: 251 (1875). Vved., Flora Turkm. 1, 2: 294 (1932); Vved., Flora URSS 4: 275 (1935); Vved., Flora Uzbek. 1: 464 (1941); Vved., Flora Tad. SSR 2: 357, p. p. maj. (1963); Vved. [& Kovalevskaya], Opred. rast. Sredn. Azii 2: 87 (1971). Pavlov & Pol-

yakov, Fl. Kazakhst. 2: 192, tab. 14/4 (1958). Wendelbo, Flora Iranica No. 76: 90, tab. 9/131, tab. 24 a-b (1971). Kamelin ex Nikitin & Gel'dikhanov, Opredel. rast. Turkmen.: 128 (1988). *Crinum caspium* Pall., Reise 2, Anhang: 41, Nr. 105, t. Q (1773). - *Allium brahuicum* Boiss., Fl. orient. 5: 278 (1882). Type: Pakistan: "Belutschia superiore", in jugo [Brahui] prope Mungochar, leg. Stocks No. 936 (G-BOIS!). - Type: Pall., Reise 2, Anhang: 41, Nr. 105 tab. Q (lectotype design. Fritsch, 1990: 503). - **subsp. *caspium***

*Allium caspium* subsp. *baissunense* (Lipsky) F.O. Khass. & R.M. Fritsch grows in S Pamir-Alai area on gypseous and saline slopes; it is not expected to occur in Iran.

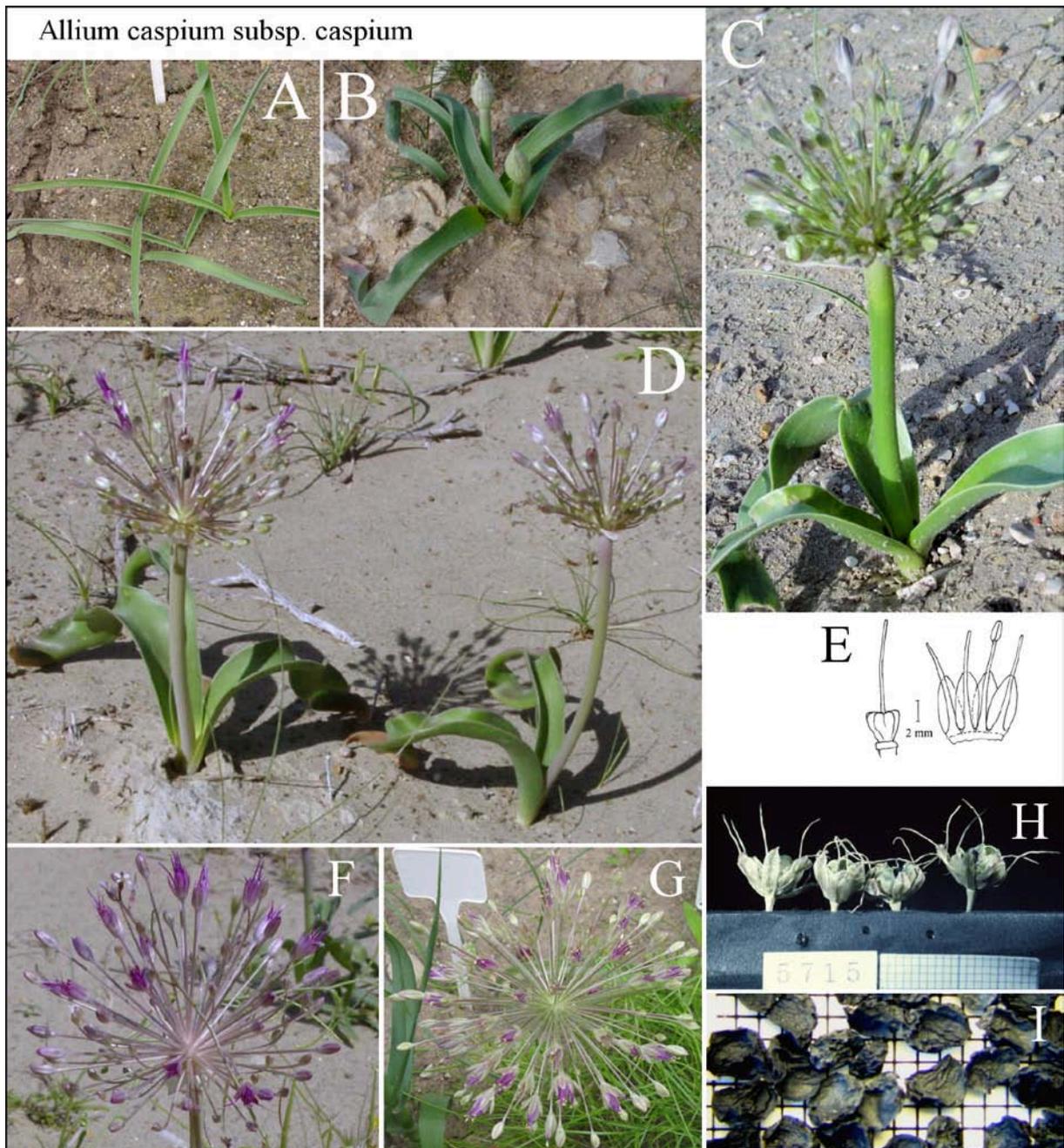
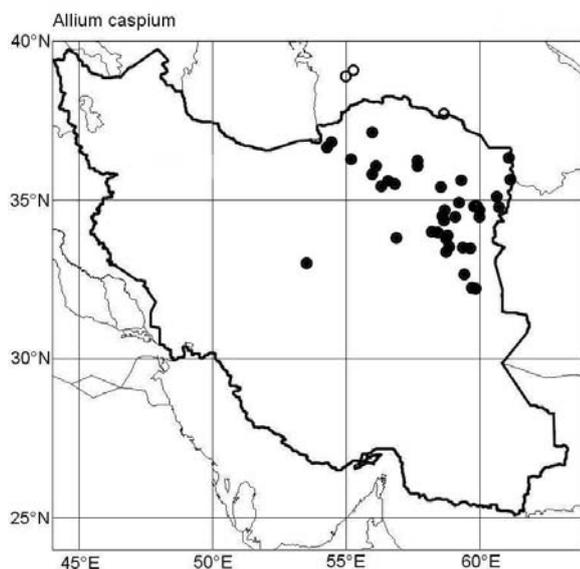


Plate T55. A & B: Cultivated plants and plants near Turkmenbashi (Turkmenistan), resp., in the early shooting stage; C: plant near Turkmenbashi in the bud stage; D: plants near Gazandzyk (Turkmenistan) in early anthesis; E: shape of ovary, tepals, and filaments of a flower prepared from herbarium; F & G: inflorescences of a plant near Gazandzyk and a cultivated plant, resp., in full anthesis; H: ripe open capsules; I: seeds (background raster 1 mm).

Bulbs  $\pm$  depressed globose, (1) 1.5-3 cm in diam., (1) 1.5-2.5 cm long; outer tunics papery to parchment-like, longitudinally splitting; yellowish brown to greyish-black; inner tunics pale brown to white, thin but strong. Scape straight, strong, terete, obconical (below the inflorescence somewhat thicker than

basally), smooth; (7) 10-30 (50) cm long, 4-10 (15) mm in diameter; green, upper part purplish flushed. Leaves 2-3 (4), laminae narrowly oblong to lanceolate, canaliculate, thick, obliquely or arcuately ascending and recurved to the soil, upper part often undulate and spirally enrolled and lax, shortly tapering into the cucullate apex; upper side smooth or slightly grooved, lower side ribbed; margin basally somewhat toothed or cartilaginous, above smooth, initially purplish later whitish; 20-30 cm long, (5) 10-35 mm broad; green with strong glaucous bloom. Sheath leaf moderately long, fine membranous, pale brownish, decaying when the inflorescence expands. Spathe thin membranous, divided into 2-3 ovate, acuminate, finally reflexed valves; 12-25 mm long; brownish, veins darker. Inflorescence semi-globose to globose, many-flowered, very lax, 6-10 cm in diam., 5-7 cm long, in the fruiting stage up to 25 cm in diam. Pedicels straight, thickish, initially subequally later very unequally long, 3-12 cm long; semi-glossy, pale brownish-green, often purple flushed. Anthesis in April to June. Flowers narrowly campanulate (in full anthesis narrowly funnel-shaped) triangular. Tepals ovate to narrowly oblong, spoon-shaped, basally shortly united, apex obtuse or  $\pm$  acute, straight; after anthesis stiff and strong but shape not changing; 5-8 (11) mm long, 2.5-4 mm broad, inner tepals longer and wider than outer ones; pinkish to greenish-violet with darker, after anthesis thicker and broader, outside coarse median vein. Filaments 1.5-2 times as long as the tepals, subulate, basally somewhat broader and shortly connate; pink to deep violet. Anthers ovate, 1.5-2 mm long, 0.8-1 mm broad; yellow or violet. Pollen yellowish or grey, the shape is oblate to peroblate, 32  $\mu$ m long, 16  $\mu$ m broad, P/E index 0.5, sculptures rugulate to microrugulate, wall 0.9  $\mu$ m thick (Neshati & al. 2009). Ovary long stipitate, obovoid or obconical, sexangular by six longitudinal furrows (thus the flat apex nearly star-shaped), 3.5-4 mm long, c. 3 mm in diam., surface finely coarse, smoother towards the base; grayish-green to greenish-violet; up to 6 ovules per locule (Filimonova 1970). Style conical to thread-like, up to 12 mm long; whitish with violet apex. Stigma undivided; yellowish. Capsule conical to pyramidal-triangular, apex rather flat with six flat verrucae; 6-8 mm in diam., 5-7 mm long; valves suborbicular with a longitudinal furrow only in the upper part and a short notch near the apex; yellowish brown. Seeds 1-2 per locule, drop-shaped with sharp edges, surface coarsely reticulate lacunose; 2.5-3 mm long, 2.2-2.5 mm broad, 1.8-2 mm thick; semiglossy black. The testa showed verrucose periclinal walls with prominent (but hidden) verrucae. The anticlinal walls showed also S-like and an intermediate type between U-like and Omega-like undulation with varying amplitude and short wavelengths (Kruse 1994, Fritsch & al. 2006).

**Chromosomes:**  $2n = 16+0-1B$  Vakhtina 1964, 1969 p. 147 (Uzbekistan: Nukus).  $n = 8$  Vakhtina & al. 1977 total length of chromosomes (Russia: Botanical collection).  $2n = 16$  Vakhtina 1985 (Turkmenistan: Sundukli).  $2n = 16+B$  Vakhtina 1985 (Turkmenistan: Chardzhou).  $2n = 16+B$  Zakirova & Nafanailova 1990 (Kazakhstan: Ustyurt).  $2n = 16$  Fritsch unpubl. (Uzbekistan: Navoi).



**Distribution:** NE and C Iran; deserts from Caspian Sea to W Tianshan and N Pamir-Alai area, Afghanistan, Pakistan; lowland to colline sandy desert plains and depressions, dunes, rock slopes.

**Remarks:** This is a very polymorphous species preferring locations without any precipitation during the summer. Specific characters are moderately narrow tepals, widely protruding filaments, and a turbinate ovary. Iranian specimens show more or less acute tepals, whereas plants from the Caspian-Aral deserts own commonly obtuse or sometimes nearly spatulate tepals; all kinds of transitions also occur. Molecular markers (ITS sequences of nuclear rDNA) present strong evidence for a close relationship to *A. bucharicum* Regel, *A. protensum* Wendelbo, *A. alexeianum* Regel, and *A. nevskianum* Vved. ex Wendelbo. More distantly related are *A. gypsaceum* Popov & Vved., *A. aroides* Popov & Vved., and the *A. lipskianum* Vved. alliance of sect. *Regelo-*

*prason* which form well separated, small groups (Fritsch & al. 2010; see p. 201). According to sequences of the plastid *trnL-trnF* region (Gurushidze & al. 2010), also some members of the sections *Megaloprason*, *Procerallium*, and *Stellata* (F.O. Khass. & R.M. Fritsch) R.M. Fritsch are closer related.

**Etymology:** The epitheta refer certainly to the geographic areas of the type locations near the Caspian Sea and in the Brahui massif in Pakistan.

**Biological data:** Anatomical characters of the scape: outer margin of sclerenchyma is smooth (Fritsch 1993 Fig. 6C). The genome size (31.3 pg 2C-DNA) is somewhat lower than in subsp. *baissunense* (35 pg, Gurushidze & al. 2012). Fresh bulbs contain in total 0.007 % methiin (Fritsch & Keusgen 2006) or 0.15 / 0.09 % cysteine sulfoxides (51 / 62 % methiin, 49 / 38 % isoalliin) (Jedelska & al. 2005; Keusgen & al. 2008, plants from Turkmenistan / Uzbekistan).

**Economic traits:** *Allium caspium* is said to contain much saponin and thus to be poisonous for livestock (Pavlov & Polyakov 1958). Androsov (1941) promised the species as ornamental for Turkmenistan. Local name 'zhua', the bulbs are eaten and taste like common onion (Khassanov & Umarov 1989). Belongs to the most important edible species in the Uzbek deserts; is used instead of garlic and onion (Khassanov 2008).

Herbarium vouchers: **Esfahan:** 60 km NE Nain (33°12' N, 53°34' E, 1800 m, 18.5.1975 Iranshahr 307-IRAN). - **Golestan:** Ad marginem orientalem deserti Kavir, Ozbagu, Dasht (37°18' N, 56°00' E, Ruttner 290; W). Gorgan (steppe) (36°50' N, 54°20' E, 09.5.1948 Sharif 5067-E; 308-IRAN). Dasht-e Gorgan, (37°00' N, 54°30' E, ??5.1948 Sharif 61; W). - **Raz. Khor.:** S Torbat-e Heidarieh, Dasht-e Kheir abad (34°51' N, 60°01' E, 900 m, 04.5.1991 Joharchi, Zangooei 19884; FUMH). Torbat-Jam, E of Saleh-abad, between Saghar cheshmeh and Garmab-e olia (35°45' N, 61°13' E, 523-550 m, 25.4.2007 Joharchi, Nasseh 38724a; FUMH). Road of Torbat-e Heidarieh, between Robot-e sefid and tunnel, after gypsum factory, gypsum hills around the road (35°48' N, 59°19' E, 1652 m, 12.6.2006 date & collector not translated 37470; FUMH). Gonabad towards Torbat-e Heidarieh, 93 km S of Torbat-e Heidarieh (34°36' N, 58°43' E, 900 m, 01.5.1981 Zokaie 797; FUMH). Km 26 road of Kakhk towards Ferdos (34°09' N, 58°28' E, 1900 m, 21.5.1997 Rafeie, Zangooei 28686; FUMH). Torbat-Jam, E of Saleh-abad, between Saghar cheshmeh and Garmab-e olia (35°52' N, 61°12' E, 450-500 m, 30.4.2003 Zangooei 34449; FUMH). Torbat-e Heidarieh, km 7 road of Omrani towards Band-e Ozbak (34°41' N, 59°07' E, 900 m, 1100 m, 26.4.1993 Faghinia, Zangooei 22911, 22925; FUMH). 80 km N of Gonabad, Lot-e Omrani (34°32' N, 58°42' E, 1100 m, 29.4.1991 Faghinia, Zangooei 19868; FUMH). S Torbat-e Heidarieh, Bend-e Ozbak (34°40' N, 59°06' E, 05.5.1986 Ayatollahi, Zangooei 14094; FUMH). Shir Geshk prope Tabas, (36°24' N, 57°43' E, Ruttner 566; W). Robot Sefid 60 km N of Torbat-e Heydarieh, gypsum soil (35°46' N, 59°23' E, 1750-1900 m, 15.6.1981 Assadi, Mozaffarian 35897-TARI). In argillosis inter segetes ad radices montium 8 km N Aliabad versus Asfak (33°59' N, 56°54' E, 800 m, 12.5.1975 Rechinger 51723; W B G). 70 km SW Torbat-e Heydarieh inter Jannatabad et Alui (35°35' N, 58°35' E, 850 m, 08.5.1975 Rechinger 51386 51386; W). 24 km from Gonabad to Torbad-e Heydarieh, Rige Omran, sand dunes (34°29' N, 58°42' E, 1000 m, 20.5.2003 Assadi 84806-TARI). Sarakhs. Cheshmeshur (36°30' N, 61°07' E, 490 m, 21.5.1972 Foroughi 3512; TARI). Sabzevar (36°14' N, 57°42' E, ??5.1976 Ferduosi University staff 63; TARI). 20-25 km to Tayebad from Turbat-e Jam (34°57' N, 60°46' E, 890 m, 25.4.1989 Mozaffarian 67532-TARI). Khorasan 25 km from Gonabad, Lot-e Omrani (34°32' N, 58°42' E, 950 m, 23.4.1990 Faghinia, Zangooei 18303; FUMH). Near Torbat-e-Jam (35°17' N, 60°41' E, date & collector not translated; FUMH). S of Torbat-e-Heydariyeh (35°06' N, 59°15' E, date & collector not translated; FUMH). 20 km E Roshtkhar (34°58' N, 59°49' E, date & collector not translated; FUMH). c. 70 km SW Torbat-e-Jam (34°58' N, 59°57' E, date & collector not translated; FUMH). c. 15 km NW Rud (34°39' N, 60°02' E, date & collector not translated; FUMH). c. 20 km S Feyzabad (34°51' N, 58°44' E, date & collector not translated; FUMH). c. 30 km N Gonabad (34°40' N, 58°39' E, date & collector not translated; FUMH). From Ferdous c. 25 km NE in direction Gonabad (34°12' N, 58°15' E, date & collector not translated; FUMH). **S Khor.** Ghaien-Gonabad road, near Khezri, Pirmardanshah (34°03' N, 58°50' E, 19.5.1986 Ayatollahi, Zangui 14386; FUMH). c. 20 km E Birjand (32°51' N, 59°27' E, date & collector not translated; FUMH). Ghaien, Zirkuh, Mohammad abad (33°32' N, 58°47' E, 1050 m, 15.5.1989 Joharchi, Zangooei 17369; FUMH). Birjand, Hojat-abad towards Gazdez (32°24' N, 59°57' E, 1700 m, 29.4.1998 Faghinia, Zangooei 30199; FUMH). c. 80 km SE Birjand (32°25' N, 59°45' E, date & collector not translated; FUMH) SE of Birjand, km 20 road of Sarbisheh towards Nehbandan (32°25' N, 59°50' E, 1650 m, 29.4.1996 Rafeie, Zangooei 26452; FUMH). 25 km W Qa'en (33°43' N, 58°53' E, date & collector not translated; FUMH). Km 37-43 Ghaien towards Haji-abad (33°38' N, 59°42' E, 1300 m, 20.5.1998 Rafeie 30782; FUMH). Ghayen: Between Sinider and Esfeden (33°41' N, 59°40' E, 1235 m, 05.5.2002 Ghareman & al. 28502; TUH). 25 km SE Qa'en (33°41' N, 59°24' E, date & collector not translated; FUMH). Between Gonabad et Qa'en c. 45 km S Gonabad (33°58' N, 58°47' E, date & collector not translated; FUMH). - **Semnan:** Just E of Turan protected area (SE of Shahrud) between Sabri and Zamanabad (35°40' N, 56°52' E, 1150-1250 m, 17.5.1978 Freitag 15493; B KAS). Touran protected area. From Delbar to Qaleh Bala (35°59' N, 56°02' E, 08.5.1978 Freitag, Jadidi 28920-TARI). Touran protected area. Sand dunes between Sabri and Yeke-rig (35°36' N, 56°22' E, 1150-1250 m, 17.5.1978 Freitag, Jadidi TARI 29105). Prolongation of Kuh-e Yazd SE Dastjird c. 400 m NE of pass road (36°15' N, 56°08' E, 1180 m, 08.5.1978 Freitag 15187; KAS). (Turan protected area) 5-10 km S Akhmadabad, versus Zamanabad (35°46' N, 56°36' E, 900-950 m, 30.4.1975 Rechinger 50723, 50724, 507; W). 45 km to Meyamey from Shahrud, 4 km on a sandy road toward the desert (36°27' N, 55°13' E, 1300 m, 26.5.2009 Zarre, Salmaki, Ebrahimi 38044; 54612-IRAN MSB).

Determination unsure: **S Khor.:** W of Ghaien, Tajan highlands (33°43' N, 58°54' E, 1900 m, 23.5.1998 Rafeie, Hossein-Zade 30914; FUMH).

*Allium* sect. *Megaloprason* Wendelbo in Bot. Notiser 122: 28 (1969), s. strictiss.; *Allium* sect. *Kaloprason* subsect. *Megaloprason* (Wendelbo) Kamelin & Seisums in Seisums, podrod Melanocrommyum: 27 (1994), comb. inval. Type: *A. rosenbachianum* Regel

As 40 years ago, correct determination of herbarium specimens belonging to sect. *Megaloprason* s. l. remained a very difficult task, especially when the specimens are not complete, or were laid into the press prior to or after anthesis. This was perhaps the reason that Wendelbo (1971) presented a concept of a broadly circumscribed section that seemed rather simple. However, his taxonomic point of view was revised already in the pre-molecular era (Fritsch 1992a, 1993b; Khassanov & Fritsch 1994; Seisums 2000) when several sections and subsections were split off. Detailed molecular investigations based on a rich material (Fritsch & al. 2010) presented final evidence that sect. *Megaloprason* in the sense of Wendelbo is composed of several well separated, only distantly related subunits. Members of the segregate sections *Compactoprason*, *Decipientia*, and *Procerallium*, as well as the subsections *Elatae*, *Costatae*, *Humilicognata*, and *Keratoprason* occur also on Iranian territory and are presented here. Also new species concepts were established.

*Allium* subsect. *Humilicognata* R.M. Fritsch in Phytion (Horn, Austria) 49: 183 (2010). Type: *A. brachyscapum* Vved.

**56.** *Allium assadii* Seisums in Iranian J. Bot. 8: 230 (2000). - Fritsch & al. in Stapfia 80: 391, plate 2D, 2F (2002). - *Allium brachyscapum* sensu Wendelbo, Fl. Iranica 76: 81 (1971), p. p. - Type: Iran: Prov. Markazi, Saveh pass, Rude Shur, leg. Bonvan 22.4.1968 No. 9697 (holotype TARI?, not seen).

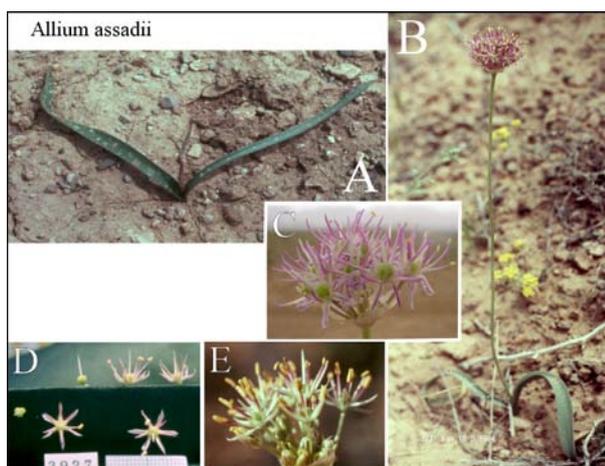
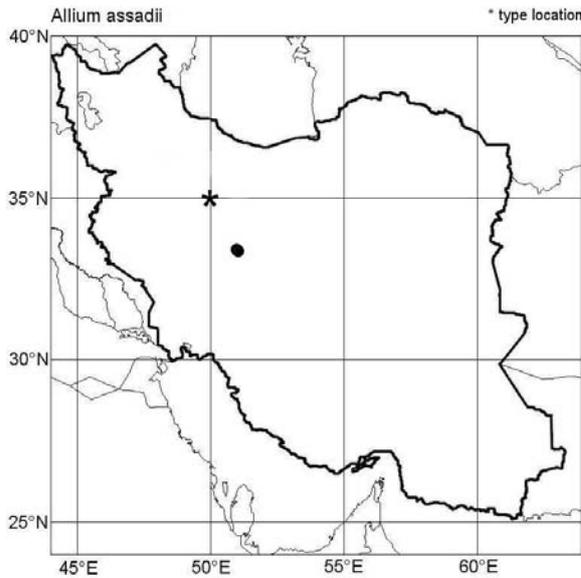


Plate T56. A & B: Vegetative and flowering plants near Delijan; C: inflorescence in anthesis (near Shiraz, courtesy of H. Razifard); D: comparison of flower parts in different stages; E: inflorescence of a cultivated plant in early anthesis.

Bulbs depressed globose, 1.5-2 cm long, 2-3.5 cm in diam.; outer tunics papery, grey or pale brown finally blackish or reddish, disintegrating. Scape slightly flexuous, terete; (12) 15-30 (45) cm long, 2-4 mm in diam.; green or reddish flushed. Leaves 1-2 (3), laminae linear to narrowly lanceolate, flat recurved to the soil with often outwards rolled tip, undulate, thickish, broadly canaliculate; upper side smooth, lower side with few broad and sharp ribs; margin reddish later white, smooth, cartilaginous or with a few fine teeth, gradually tapering into the cucullate apex; (15) 25-30 cm long, 8-15 mm broad; initially violet-green later bluish green, with glaucous bloom. Sheath leaf thin membranous, colorless, quickly decaying. Spathe membranous, incompletely split

into 2-5 triangular patent valves, shorter or  $\pm$  as long as the pedicels; brownish, veins somewhat darker. Inflorescence fastigiate or semi-globose, semi-dense with 30-60 flowers; 2-4 cm in diameter, 2-3.5 cm long. Pedicels straight, thickish, rather soft; 15-25 mm long; brownish green. Anthesis in May. Flowers flat star-like; with strong honey odor. Tepals triangular-lanceolate, subobtuse,  $\pm$  canaliculate, patent, during anthesis recurved and later spirally enrolled; 5-6 mm long, c. 1-1.3 mm broad; rose to pinkish, later pink, with conspicuously dark greenish-purple median vein. Filaments as long as or by 1/4 longer than the tepals, fleshy, steep obliquely directed, subulate; basally very shortly triangular widened and connate; upper part pink fading towards the whitish base; after anthesis stiff? Anthers oblong, up to 2 mm long and 1 mm broad; yellow. Pollen yellow. Ovary stipitate, depressed-globose up to pear-shaped with 3 narrow and 3 wider furrows, surface coarse by acute verrucae and tubercles; (2) 3-4 ovules per locule; style growing from a moderately deep depression; 2-3 mm long and in diameter; green. Style narrowly conical, 4-6 mm long; whitish. Stigma punctiform; white. Capsule broadly pyriform; valves cordate in outline. Seeds not seen.



**Distribution:** Iran, prov. Markazi, Esfahan, and probably Fars; colline to submontane semidesert plains.

**Remarks:** This rarely collected taxon is one of the rather tall species of subsect. *Humilicognata* occurring in Iran. It is characterized by 25-35 cm long scapes, straight leaves less than 2 cm wide and shorter or as long as the scape, rose-pinkish tepals with conspicuously brown median veins, and deep pink filament tips. All specimens cited in the description were collected in the North of province Markazi, other vouchers in the north of province Esfahan. A photo of a flowering plant was communicated to have been taken near Shiraz, province Fars. Perhaps *A. assadii* can be found in large parts of the deserts along the northeastern spurs of the Zagros mountain range. The second tall species of

this subsection is *A. kopsedorum* occurring on very dry limestone hills of Koppe Dagh mountain range in Khorassan [59] differing by deep pink to purple tepals with inconspicuous median vein, deep violet filaments not fading towards the base, and spirally enrolled leaf laminae. Molecular markers (ITS sequences of nuclear rDNA) show a very close genetic relationship of all taxa of subsect. *Humiliscapa* (Fritsch & al. 2010; see p. 199).

**Etymology:** The epithet honors the outstanding contemporary botanist M. Assadi from Tehran.

Living accessions studied: **Esfahan:** Halbwüste nahe der Hauptstraße von Esfahan nach Teheran ca. 60 km S Delijan (33°32' N, 51°04' E, 18.5.1994 Fritsch 1080a; GAT).

Herbarium vouchers: **Esfahan:** Mooteh protected region ad bifurcatione viae publicae versus Muteh (Mooteh) ducentis, ca. 140 km ab Esfahan boreo-occid. (33°36' N, 51°01' E, 1950 m, 30.5.1974 Rechinger 46801; W B G)

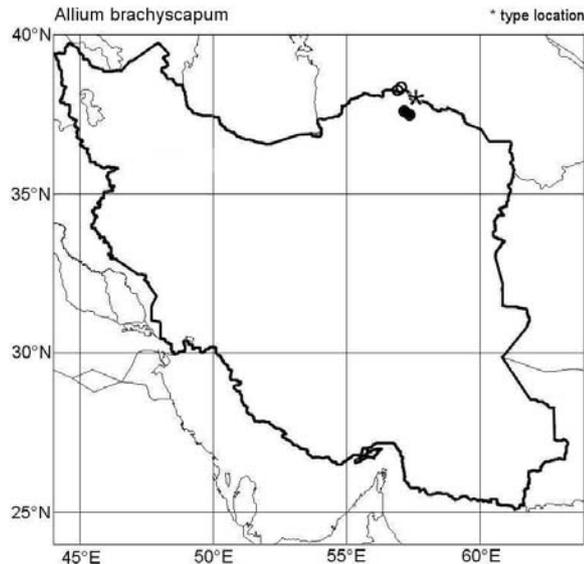
**57. *Allium brachyscapum*** Vved., Fl. Turkm. 1: 291, f. 104 (1932), descr. ross., et in Byull. Sredneaz. gosud. Univ. 19: 129 (1934), descr. lat.; Vved., Flora URSS 4: 261 (1935); Vved. [& Kovalevskaya], Opređ. rast. Sredn. Azii 2: 82 (1971). Wendelbo, Flora Iranica No. 76: 81, tab. 8/114 (1971), p. p. maj.; Kamelin ex Nikitin & Gel'dikhanov, Opređel. rast. Turkmen.: 128 (1988). - **Type:** Turkmenistan: Kopetdag, Sulyuklyu, po shchebnisto glinistomu sklonu, 20.5.1923, leg. Androsov, No. 118720 (lecto-type and isotypes TASH!, design. Khassanov & Fritsch 1994: 983).

Bulbs ovoid to globose, 0.8-1.5 cm in diameter; outer tunics papery, grey to purplish, disintegrating. Scape flexuous, terete, smooth; 5-10 cm long, 3-4.5 mm in diam.; green with reddish flush. Leaves 1 (-2), laminae lanceolate, flat arcuately lying on the soil, undulate or upper part screw-like enrolled; margin red, ± smooth; 10-15 cm long, 8-25 mm wide; dull green with glaucous bloom. Sheath leaf hyaline, soon decaying. Spathe membranous, split into 3 broadly triangular valves 1/2 as long as the pedicels, finally patent or reflexed, yellowish-brown with dark nerves. Inflorescence broadly fastigiate to semi-globose, many-flowered, moderately dense, 4-6 cm in diameter. Pedicels thick, straight, stiff wire-like, subequally long, (12) 15-20 mm long; brown to purple, glossy. Anthesis in May. Flowers flat bowl-shaped star-like. Tepals lanceolate with subobtusate, ± incurved tip, often ± convolute, patent; basally c. 1 mm long connate; after anthesis reflexed, ± crumpled and spirally enrolled; 5-7 (10) mm long, (1.5) 2-3 mm broad; pinkish-carmine with narrow green median vein fading towards the apex. Filaments as long as the tepals or by 1/4 longer, subulate, obliquely positioned; near the base triangular widened (inner tepals 1.5 times wider than outer ones) and for about 0.5 mm connate; pinkish-carmine with darker base. Anthers oblong, 1.5-2 mm long; pinkish-yellow. Pollen grayish-yellow. Ovary shortly stipitate, depressed-globose with 3 wide and 3 narrow furrows, surface very coarse by acute tubercles; 2.5-3 mm in diam., 2-2.5 mm long; pale green. Nectary ducts lead in dot-like pores near the base of the

ovary. Style narrowly conical to thread-like, 4-8 mm long; rose, finally purplish pink. Stigma undivided; whitish. Capsule somewhat depressed-globose triangular, 4 mm long and 5 mm in diam., widely opening; valves broadly elliptic with a broad longitudinal furrow and shortly notched at the apex. Seeds 1-2 (-3) per locule, drop-like comma-shaped, surface densely reticulate lacunose, one side often with a sunken area near the hilum, c. 3 mm long, 2.5 mm broad, 1-2 mm thick; dull black.

Chromosomes:  $2n = 16$  Pogosian & Seisums 1992 (Turkmenistan: Kopetdag mountain range).

Distribution: Turkmenistan, NE Iran: Koppe Dagh mountain range; montane stony and rubble slopes.



Remarks: As far as known yet, this taxon has the shortest scapes among all members of subsect. *Humilicognata* commonly shorter than 5 cm above the soil. Additional key characters are pink tepals, pink filaments darker in the basal part, and strongly furrowed leaves spirally enrolled towards the apex. Vouchers of this species from outside the Koppe Dagh mountain range mentioned by Wendelbo (1971) belong to *A. assadii* and *A. esfahanicum*. Molecular markers (ITS sequences of nuclear rDNA) support a very close genetic relationship to *A. scotostemon* and *A. assadii* (Fritsch & al. 2010) as well as to the newly described *A. esfahanicum* and *A. kopsedorum* (see p. 199). Sequences of the plastid *trnL-trnF* region present additional evidence that the subsections *Humilicognata*, *Megaloprason* R.M. Fritsch s. str., and *Spiralitunicata* R.M. Fritsch are closely related, but less closely to sect. *Asteroprason* and to some members of sect. *Regeloprason* (Gurushidze & al. 2010).

*prason* R.M. Fritsch s. str., and *Spiralitunicata* R.M. Fritsch are closely related, but less closely to sect. *Asteroprason* and to some members of sect. *Regeloprason* (Gurushidze & al. 2010).

Etymology: The epithet refers to the characteristic short scape of this species (mixture of Greek and Latin word elements).

Biological data: Fresh bulbs contain in total 0.44 % cysteine sulfoxides (96 % methiin, 4 % propiin, Keusgen & al. 2008).

Living accessions studied: N Khor.: Limestone rubble hills near the road from Bojnurd to Gifan after leaving the gorge (37° 39' N, 57°25' E, 1000 m, 11.05.2012 Fritsch, Eskandari, Bahramishad 1384; GAT IRAN).

Herbarium vouchers: N Khor.: 68 km on the road from Bojnurd to Gifan after Amirabad (37°46' N, 57°12' E, 1200 m, 22.5.1984 Assadi, Maasoumi 50287-TARI).

**58. *Allium esfahanicum* R.M. Fritsch, species nova.** - Type: Iran, prov. Esfahan: Kouha-ye Kolah Ghazi, 1620-2000 m, leg. Matin & Termeh 09.6.1962 (holotype IRAN).

Differt ab *Allio assadii* scapis 3 usque 8 cm longis, foliis 20-30 cm longis usque 2.5 cm latis, tepalis lilacinis et nervis medianis paullo nigrescentibus, et apicis filamentorum multo nigrescentibus.

Bulbs depressed-ovoid, 2-3 cm in diameter and 1.5-2 cm long; outer tunics greyish-black, disintegrating. Scape ± flexuous, terete, smooth, 3-8 cm long above the soil; glaucous green, often purplish suffused. Leaves (1) 2-3, linear-lanceolate, flat recurved to the soil, thickish, canaliculate, often the hooded tip outwards enrolled; 8-20 cm long, (6) 8-30 mm wide; glaucous green. Sheath leaf very short, hyaline, soon decaying. Spathe membranous, finally split into several reflexed parts; pale brown with darker veins. Inflorescence semi- to subglobose, rather dense with 30-50 flowers; 3-5 cm in diameter. Pedicels straight, stiff, unequally long, smooth; green with purple flush. Anthesis in April to May. Flowers flat star-like. Tepals lanceolate with subacute apex, patent, soon reflexed and spirally enrolled; 6-7 mm long, inner tepals 2-2.5 mm wide in the lower one-third and concave, outer ones c. 1.5 mm wide and canaliculate; pink to lilac with a darker but diffuse median vein. Filaments straight, narrowly triangular, inner filaments basally about 1.5 times broader than the outer ones, somewhat fleshy; basally very shortly

connate; tip deep pinkish-carmine fading towards the white base. Anthers oblong, c. 2.5 mm long, 1 mm wide; yellow. Pollen yellow. Ovary stipitate, pear-shaped with six deep longitudinal furrows, surface coarsely verrucose; 3-4 mm long and in diameter; green; nectary ducts lead in small pits near the very base of the ovary. Style thread-like, 6-7 mm long; whitish to finally pink. Stigma acute; white. Capsule tripartite-globose, basally conical, surface reticulate lacunose; 6-8 mm long and in diameter; yellowish brown; valves  $\pm$  transversely elliptic, with a shallow longitudinal furrow, apex deeply notched. Seeds 1-2 (-3) per locule, flat drop-shaped, often one side concave, coarsely reticulate-lacunose; 3-4 mm long, 2.5-3 mm wide, c. 1.5 mm thick; dull black.

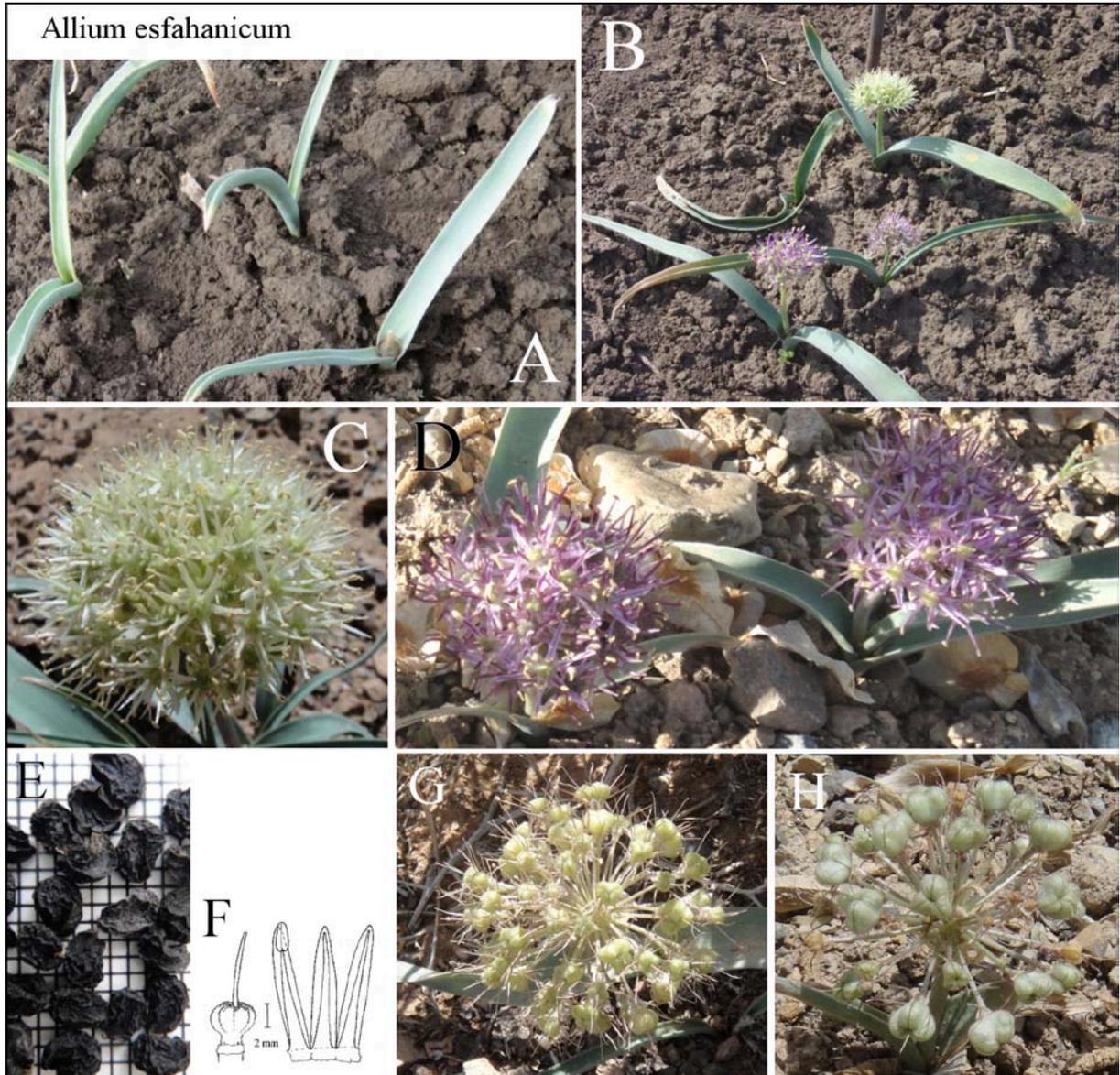
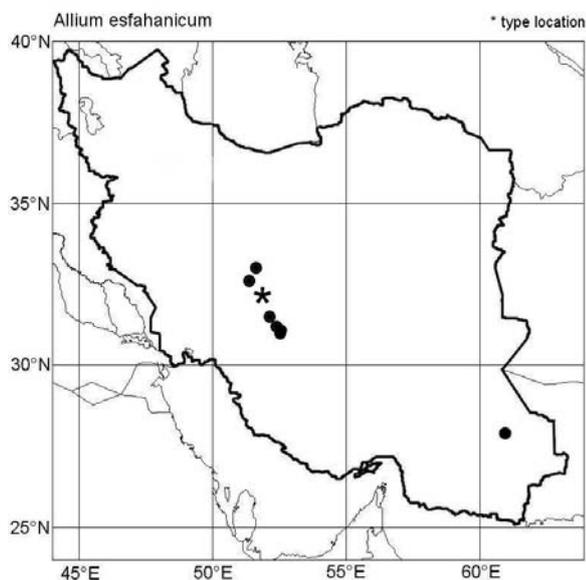


Plate T58. A & B: Cultivated plants after sprouting and in early anthesis, resp.; C: inflorescence of an albinotic plant in anthesis; D: inflorescences in late anthesis; E: seeds (background raster 1 mm); F: shape of ovary, tepals and filaments of a flower prepared from herbarium; G: inflorescence after anthesis near Esfahan; H: inflorescence with full-sized capsules.

**Distribution:** C Iran: desert areas of the provinces Esfahan and Shiraz, occurrence in more eastern regions needs verification.

**Remarks:** This new taxon was first recognized as low variant of *A. assadii*, but comparison of living plants (also under cultivation in Germany) showed constant differences. Specimens of *A. assadii* had 25-35 cm long scapes, straight leaves less than 2 cm wide and as long as the scape or less, rose-pinkish tepals with conspicuously brown median veins, and deep pink filament tips, but plants of *A. esfahanicum* owned short scapes 3-8 cm (only after a very wet spring up to 15 cm) long, narrowly lanc-

olate leaves 20-30 cm long, and up to 2.5 cm wide, lilac tepals with slightly darker median veins, and much darker filament tips. Another related species is *A. kopsedorum* occurring only on limestone hills of the Koppe Dagh mountain range and differing from both above mentioned species by deep pink to purple tepals, deep violet filaments not fading towards the base, and  $\pm$  strongly spirally enrolled tips of the leaf laminae. Molecular markers (ITS sequences of nuclear rDNA) confirmed affiliation to subsect. *Humiliscapa* without further differentiation (see p. 199).



11.5.1999 Taiebi; ARIS). - Sistan-va Baluch: 30 km Khash towards Iranshahr (28°06' N, 61°00' E, 1700 m, 16.6.1968 Pazouki, Hashemi 8042-E; 300-IRAN).

Determination unsure: Esfahan: Inter Esfahan et Abadeh, (31°42' N, 52°10' E, 1500-2500 m, 27.4.1956 Schmid 5391; G). - Fars: Abadeh, 5 km N Abadeh, vill. Enayatabad (31°11' N, 52°34' E, 1950 m, 08.5.1993 Farokhi 69; HSU). 24 km after Izedkhist to Abadeh (31°24' N, 52°23' E, 2020 m, 10.5.2007 Khozravi; HSU). Abadeh, Sorjestan (31°23' N, 52°26' E, 2000 m, 19.5.1999 Hatami; HSU). - Markazi: Sarehs Zavand protected station (1250 m, 09.5.1973 Babakhanlou, Amin 14169-TARI).

**Etymology:** The epithet reflects that this species was first identified in the vicinity of the important town and historical Iranian capital Esfahan.

Living accessions studied: Esfahan: semidesert plains near the highway 52 km N Isfahan (33°08' N, 51°40' E, 1786 m, 27.4.2010 Abbasi, Fritsch, Keusgen 1268; GAT IRAN).

Herbarium vouchers: Esfahan: Esfahan towards Shahinshahr, Chal-siah, Ghamishlou (protected region) (32°47' N, 51°24' E, 1900-2200 m, 10.6.1992 Termeh, Matin 51097-IRAN). In argillosis arenosis et in agris derelictis 24 km a Murcheh Khvort boreo-orientem versus (33°16' N, 51°40' E, 1750 m, 27.5.1974 Rechinger 46654; W G). 40-45 km S Esfahan, Kouha-ye Kolah Ghazi (32°18' N, 51°56' E, 1620-2000 m, 09.6.1962 Matin, Termeh; 51085-IRAN). - Fars: Abadeh, 16 km N Abadeh (31°16' N, 52°35' E, 2000 m, 20.5.1993 Khosrawi, Farrokhi 2038; HSU). Izedkast 24 km to Abadeh (31°24' N, 52°32' E, 2020 m, 10.5.2007 Khozravi; HSU). Abadeh, Shorjestan, (31°23' N, 52°26' E, 2000 m, 11.5.1999 Hatami; ARIS).

**59. *Allium kopsedorum* R.M. Fritsch, *species nova*.** **Type:** Iran: prov. Khorasan, NW of Bojnurd, 1 km W Shirin dareh dam, E slope of hills around dam, 700-750 m, 37°43'13,6" N, 57°06'08,9" E, 26.4.2009 Memariani, Zangooei (holotype 41896-FUMH).

Differt ab *Allio assadii* et *Allio esfahanico* tepalis intense caryophyllaceo-purpureis, filamentis intense violaceis vix pallescentibus usque ad bases, et apicibus foliorum plus minusque spiraliter contortibus.

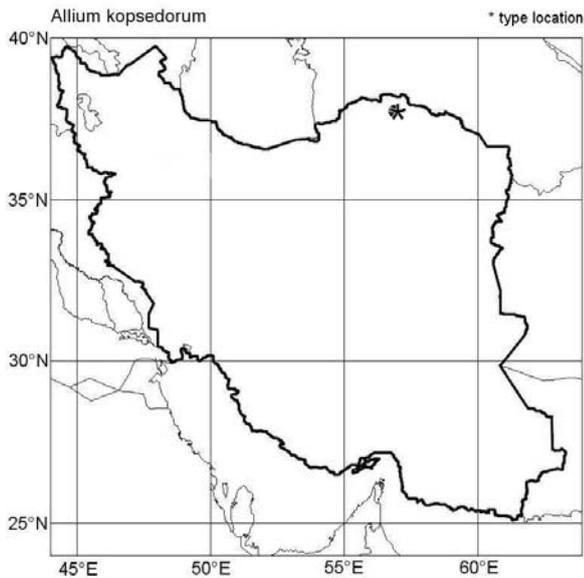
Bulbs depressed-globose to depressed-ovoid, 1-4 cm in diam.; outer tunics grayish, parchment-like, disintegrating. Scape  $\pm$  straight, conical, smooth, 20-40 (60) cm long, basally 3-8, above (2) 3-6 mm in diam.; semi-glossy green, often  $\pm$  strongly purple flushed. Leaves 2-3 (4), linear-lanceolate to narrowly-triangular with screw-like enrolling cucullate tips, flat recurved to the soil; 10-20 (40) cm long, 8-20 (35) mm broad; violet-greenish with purple margin. Sheath-leaf strong, paper-like, with teeth on the veins, long-lasting but scarcely visible above the soil. Spathe membranous, split into 3-4 shortly triangular finally patent parts; whitish with inconspicuous veins. Inflorescence fasciculate to semi-globose,  $\pm$  many-flowered, moderately dense; 4-6 (8) cm in diameter. Pedicels  $\pm$  straight, thin wiry stiff, smooth; finally 20-25 mm long; dull green, purple flushed. Anthesis in May. Flowers flat star-like. Tepals linear to narrowly oblong, obtuse, patent, naviculate; later reflexed, finally spirally contorted and crumpled; 7-10 mm long, about 1.5 mm wide; deep pink to carmine, with narrow, brown to greenish median vein. Filaments 4/5 to 6/5 as long as the tepals, subulate; basally very shortly connate and short-triangular widened; deep purple to violet. Anthers  $\pm$  ovate, c. 2 mm long; yellow to grayish. Pollen yellowish. Ovary short depressed obconical, rather shallowly six-furrowed; surface very coarse; 2-3 mm long, 3-4 mm wide; green; nectary ducts lead in short slits near the base. Style conical, 3-5 mm long; pinkish. Stigma undivided; whitish. Capsule depressed-globose triangular, surface very coarsely tuberculate, widely

opening; 4-5 mm long and 5-6 mm in diam.; yellow-brown; valves obovate with indistinct longitudinal furrow and  $\pm$  deeply notched at the apex. Seeds 1-2 (-3) per locule, sector-like drop-shaped, surface coarsely and irregularly reticulate lacunose; c. 3 mm long, c. 2 mm wide and 1.5-2 mm thick; dull black.

Distribution: NE Iran: colline dry white limestone rubble slopes in the Koppe Dagh mountain range.



Plate T59. A: Sprouting leaves of cultivated plants. B: plants in late anthesis near Bojnurd; C: cultivated plants in early anthesis; D: flowering plants at the type location; E, F & G: inflorescences in early and full anthesis, resp.; H: seeds (background raster 1 mm); I: sheath leaves and sprouting leaves of cultivated plants; J: shape of ovary, tepals and filaments of a flower prepared from herbarium.



**Remarks:** Molecular markers (ITS sequences of nuclear rDNA) confirmed this species as a member of subsect. *Humilicognata* occupying a somewhat more derived position than *A. assadii* and *A. esfahanicum* (see p. 199).

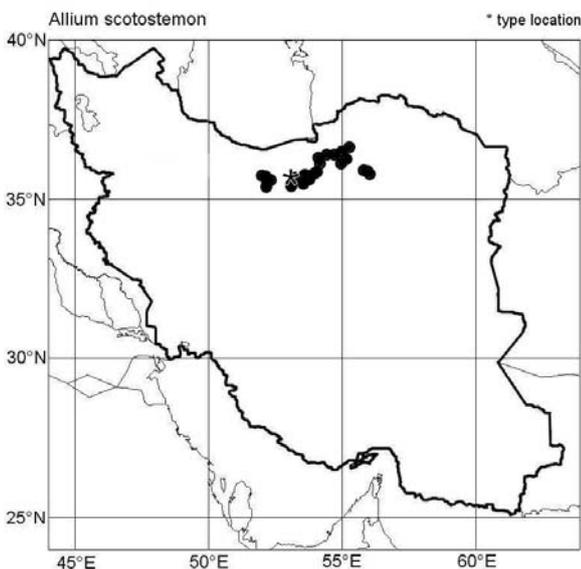
**Etymology:** The epithet was abridged from "koppe-sefidorum" derived from the Persian language ("koppe sefid = white rounded hill").

Living accessions studied: N Khor.: Pass area of the first mountain massif N Eshq Abad (37°54' N, 56°56' E, 1226 m, 10.5.2012 Fritsch, Eskandari, Bahramishad 1376; GAT IRAN).

Herbarium vouchers: N Khor.: NW Bojnurd, 1 km W Shirin dareh dam (37°43' N, 57°06' E, 700-750 m, 26.4.2009 Memariani, Zangooei 41896; FUMH).

**60. *Allium scotostemon*** Wendelbo in Acta Horti gothob. 28: 51, f. 14 (1966), Wendelbo, Flora Iranica No. 76: 82, tab. 8/115, tab. 19/2a,b (1971). - **Type:** Iran: Nezva Kuh, northern side of western top (Wendelbo 1971: Kuh-i Nizwa), 3100 m, 8.7.1959, leg. Wendelbo no. 1292 (holotype BG, not seen).

Bulbs broadly ovoid, 15-25 mm in diam.; outer tunics papery, undivided, grayish-brown to black, disintegrating; inner tunics rather strong, whitish. Scape flexuous, terete, smooth; aerial part 3-5 cm long, 4-6 mm in diam.; glaucous green, purplish suffused. Leaves (1) 2-3, laminae linear to narrowly lanceolate, flat arcuately ascending, thick,  $\pm$  canaliculate, often undulate or apex spirally enrolled, gradually tapering into the cucullate apex; margin purplish later white, finely toothed or ciliate; 10-15 (20) cm long, 4-15(30) mm broad; dull green with glaucous bloom. Sheath leaf moderately long, membranous, brownish, decaying prior to anthesis. Spathe papery, splitting into 3-4 triangular shortly acuminate, reflexed valves, 8-12 mm long; yellowish-brown with purple veins. Inflorescence very dense, many-flowered, semi- to sub-orbicular; 3-5 cm in diam. Pedicels thin, straight, wire-like stiff; 15-25 mm long; glossy green. Anthesis in May to June. Flowers flat star-like, with sweet odor. Tepals narrowly oblong, obtuse, patent subrecurved, concave or plicate; after anthesis strongly recurved to deflexed and crumpled; 4-6 mm long, c. 1.5 mm broad; white to rose with green to brown, rather broad median vein. Filaments as long as the tepals, obliquely sideward directed, somewhat fleshy, outer filaments subulate, inner filaments long triangular; basally for c. 1.5 mm connate; purple fading towards the white base, often blackish when dry. Anthers oval, c. 1 mm long; pale purplish. Pollen grayish. Ovary depressed-



globose, hexasulcate with flat tip, surface coarsely tuberculate; 2-3 mm long and about 3 mm in diam.; pale green with purplish furrows; 2 ovules per locule. The nectary ducts lead in dot-like holes at 1/3 of ovary length. Style narrowly conical, 3-4 mm long; yellowish. Stigma undivided; white. Capsule pear-shaped with 3 wide and 3 narrower furrows; c. 4 mm long and 3 mm in diam.; valves suborbicular to ovoid, with a shallow or deep longitudinal furrow, shortly and broadly notched at the apex. Seeds 1 (-2) per locule, depressed drop- to comma-shaped, surface reticulate-lacunose; 3-3.5 mm long, 2-2.5 mm wide, 1.5-2 mm thick; dull black.

**Chromosomes:**  $2n = 16$  Goldblatt 1974 (Iran: Chalus pass).

**Distribution:** N Iran: stony montane rubble slopes

and dry colline hill slopes in the Alborz mountain range and the southern mountain spurs.

**Remarks:** This is the only species of subsect. *Humilicognata* distributed in the Alborz mountain range. It is characterized by often rather narrow leaf laminae, pale tepals, and more triangular than subulate filaments very dark in the upper part. Molecular markers (ITS sequences of nuclear rDNA and sequences of the plastid *trnL-trnF* region) confirmed close relations to *A. brachyscapum* and *A. assadii*, and underlined a slightly larger genetic distance to subsect. *Spiralotunicata* and sect. *Asteroprason* (Fritsch & al. 2010; Gurushidze & al. 2010). Additional samples confirmed *A. scotostemon* as a basal species of subsect. *Humilicognata* (see p. 199).

**Etymology:** The epithet applies to the dark purplish filaments (from Greek "dark filament") which form a marked contrast to the pale tepals.

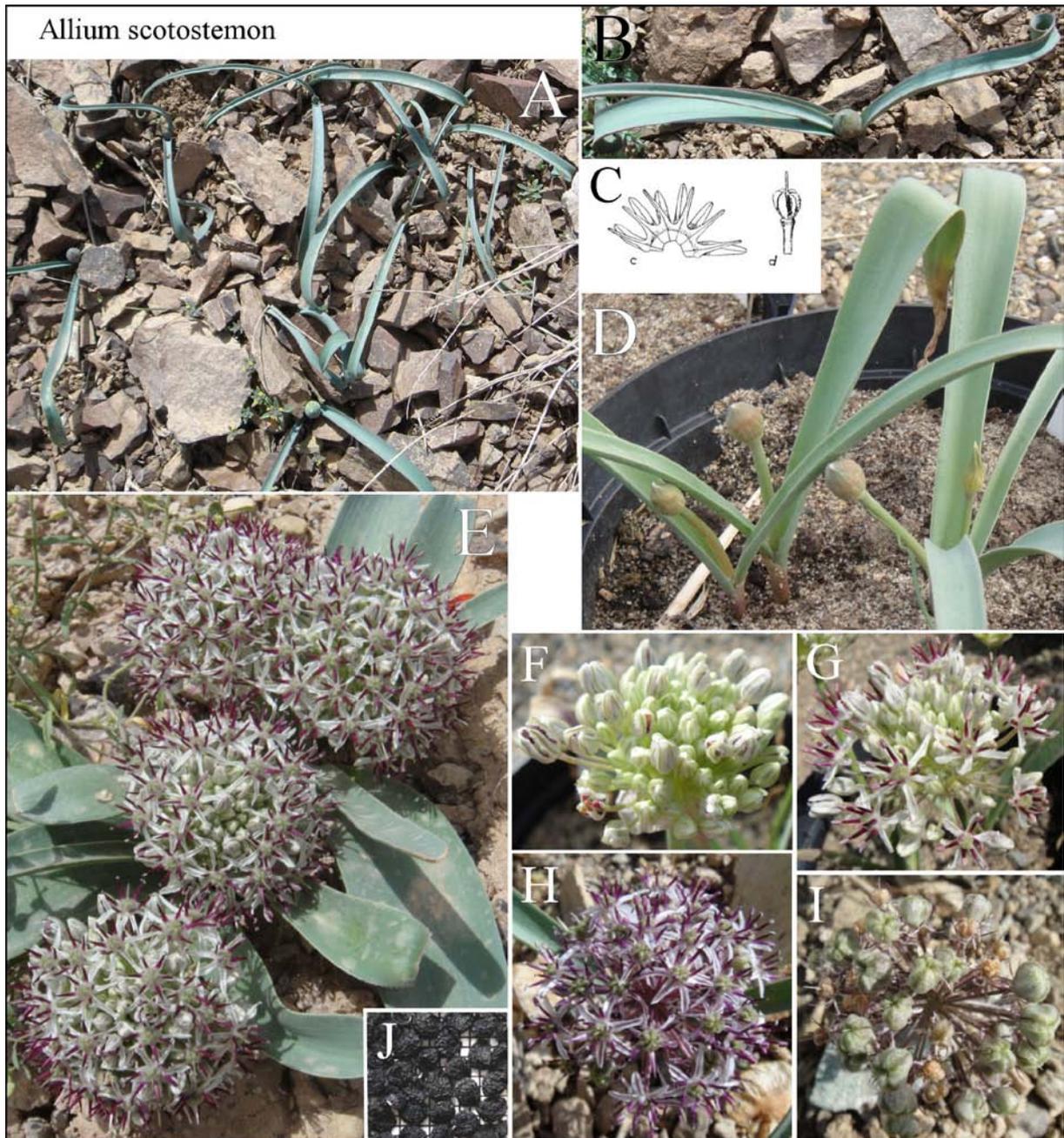


Plate T60. A & B: Leaves and scapes after sprouting near Najafdar; C: shape of ovary, tepals and filaments (from Wendelbo 1966: Fig. 14); D: shooting cultivated plants; E: flowering plants between Semnan and Danghan; F, G & H: inflorescences in buds and in early and full anthesis, resp.; I: inflorescence with full-sized capsules; J: seeds (background raster 1 mm).

Living accessions studied: Semnan: Hills E main road from Semnan 60 km to Damghan (35°48' N, 53°48' E, 1790 m, 08.5.2012 Fritsch, Eskandari, Bahramishad 1363; GAT IRAN). - Tehran: Alborz mountain range c. 50 km W Firuzkuh, slopes S village Najafdar (35°47' N, 52°23' E, 2600-2800 m, 25.4.2008 Abbasi, Fritsch 1254; IRAN GAT).

Herbarium vouchers: Golestan: In declivibus australibus M. Shahvar supra Nekarman, in glareosis calc. (36°35' N, 54°46' E, 3600-3800 m, 20.-26.7.1948 Rechinger 5964; W B G). In jugo Khash Aylan, c. 70 km ab oppido Shahrud orientem versus, (36°50' N, 55°20' E, 2000-2200 m, 17.6.1948 Rechinger 5443; W). Jahan-Nama protect. area, Chaharbagh towards Shahkuh (36°35' N, 54°28' E, 2171 m, 24.5.2006 Jafari 2104; TARI). - Mazandaran: Hariar-Lar, Damavand - N Sar Bandan (2500 m, 20.6.1974 Amin, Bazargan 19100; TARI). Larijan, Rineh Kuh-e Damavand (35° 53' N, 52° 10' E, 2750 m, 20.6.1982 Mousavi, Habibi, Tehrani 44004-IRAN). Zentral Elburs: Oberlauf des Tscheschme-i Ali SE kuh-i Nizwa (35°55' N, 53°16' E, Behboudi & Aellen 4335; G). - Semnan: Parvar prot. region, in montibus inter Shahmirzad et Fulad Mahalla, 53 km NE Semnan (35°57' N, 53°39' E, 2000 m, 30.5.1975 collector ? 52244; W). In montibus prope Tuweh a Damghan boreo-occidentem versus (36°17' N, 54°13' E, 1900-2250 m, 07.6.1977 Rechinger 56479; G). 51 km NE Semana, steppe à Artemisia ... (35°55' N, 53°50' E, collector unclear; G). c. 35 km N Damghan, above Tuyeh, SW slope (36°29' N, 54°09' E, 2200 m, 16.5.1978 Wendelbo, Assadi 29478-TARI). 15 km S Shahrud at road to Torud (36°17' N, 55°00' E, 1420 m, 21.4.1978 Freitag, Mozaffarian 28299-TARI; 22.4.1978 Freitag, Mozaffarian 28407-TARI). c. 47 km SW Damghan (35°56' N, 54°00' E, 1500 m, 05.5.1974 Wendelbo, Foroughi, Sanii, Shirdelpur 11226-TARI). c. 30 km NW Shahrud. Mt. Shahvar above Tash (36°34' N, 54°44' E, 3000 m, 11.7.1976 Assadi, Massoumi 21115-TARI). Shahpassand to Shahrud, after pass (36°47' N, 55°19' E, 1800-1950 m, 18.5.1978 Wendelbo, Assadi 29673a-TARI). Parvar prot. region: in montibus inter Shahmirzad et Fulad Mahalla 68 km NE Semnan, in declivibus saxosis (35°57' N, 53°39' E, 2200 m, 30.5.1975 Rechinger 52312; W). Shahrud, between Ghal'eh-Bala and Delbar (35°58' N, 56°03' E, 1100 m, 27.4.1975 Iranshahr 565-IRAN). 43 km SW Damghan (36°00' N, 54°03' E, 1300 m, 25.4.1975 Rechinger 50259; W B G). 14 km S Zeydar versus Biarjmand (36°05' N, 55°50' E, 1300 m, 26.4.1975 Rechinger 50289; W). Kuh-e Molhadu, N side, 4 km W Tezin (1500-1600 m, 06.5.1978 Freitag; KAS). Shahrud-Bustam (Turan Schutzgebiet: Delbar E Qaleh Bala (36°00' N, 56°00' E, 1100 m, 28.4.1975 Rechinger 50489; W). Shahrud-Bustam Biarjmand (36°30' N, 55°02' E, 1100 m, 26.4.1975 Rechinger 50297; W). Shahrud, 15 km S de Zeydar (36°29' N, 55°01' E, 1300 m, 26.4.1975 Iranshahr 568-IRAN). 21-23 km NE Semnan (35°40' N, 53°35' E, 1650 m, 25.4.1975 Iranshahr 566-IRAN). Shahrud, 22 km E Shahrud (36°26' N, 55°12' E, 1300 m, 26.4.1975 Iranshahr; IRAN). Turan prot. region: inter Qaleh Bala et Del bar, in arenosis compactis (35°58' N, 56°04' E, 1100 m, 27.4.1975 Rechinger 50457; W). ca. 30 km SW Damghan (36°02' N, 54°05' E, 1200 m, 05.5.1974 Wendelbo, Foroughi, Sanii, Shirdelpur 11219-TARI; W). Turan protected region, between Khankhody and Ghazazan (36°05' N, 56°01' E, 950 m, 03.5.1996 Matin, Daneshpazhuh, Ghanbari; IRAN). c. 20 km NW Shahrud, above Nekarman, Kuh-e Shahvar (36°35' N, 54°46' E, 3600-3900 m, 02.8.1982 Assadi, Mozaffarian 40909-TARI). 22 km E Shahrud (36°40' N, 55°01' E, 1300 m, 26.4.1975 Iranshahr 567-IRAN). Shahmirzad towards Chasm (35°51' N, 53°16' E, 22.5.1974 Iranshahr, Zargani 564-IRAN; 28.6.1992 Termeh, Moussavi, Tehrani 561-IRAN). Touran protected area. Delbar to Galeh Bala, Kuh-e Yazdoo (35°59' N, 56°02' E, 1250-1350 m, 08.5.1978 Freitag, Jadidi 28915-TARI). - Tehran: Nadjafdar, 50 km Firuzkuh, Mametch-Kuh (35°47' N, 52°23' E, 2150-2750 m, 29.5.1980 Termeh, Daneshpajuh, Zargani 563-IRAN). 33 km NW Semnan to Firuzkuh, steppic vegetation (35°35' N, 53°08' E, 2450 m, 24.6.1974 Wendelbo, Foroughi 13016-TARI). Road of Momenabad to Firouz-Kuh 5 km SE Momen-abad (1180 m, 29.4.1998 Moussavi, Tehrani, Karavar 54134-IRAN). Damavand, Daryache-ye Tar, Kuh-e Miandarya (35°44' N, 52°14' E, 2800-3300 m, 08.6.1980 Mousavi, Habibi, Tehrani 562-IRAN). Rineh, Alefchin, S side of Kuh-e Damavand (35°53' N, 52°10' E, 2250-2700 m, 13.6.1991 Djavadi 43027-IRAN). Damavand towards Tar lake (35°34' N, 52°12' E, 2548 m, 24.5.2004 American-Iranian bot. delegation 34120; TUH).

Determination unsure: Tehran: Damavand, at the top between main road and Havir (35°55' N, 52°02' E, 3000 m, 26.6.1979 Assadi, Mozaffarian 33273-TARI; TARI).

***Allium* subsect. *Keratoprason*** R.M. Fritsch in Phytion (Horn, Austria) 49: 195 (2010). Type: *A. sarawschanicum* Regel

**61. *Allium sarawschanicum*** Regel in Trudy Imp. S.-Peterb. Bot. Sada 3, 2: 244 (1875), in Izv. Imp. obshch. lyub. estestv. antr. etn. 21, 2: t. XVII f. 1-4 (1876), in Trudy Imp. S.-Peterb. Bot. Sada 10: 300, 358 (1887). - Lipsky in Trudy Imp. S.-Peterb. Bot. Sada 18: 136 (1900). Vved., Flora Turkm. 1, 2: 293 (1932), p. p. quoad adnot.; Vved., Flora SSSR 4: 273 (1935); Vved., Flora Uzbek. 1: 463 (1941); Vved., Flora Tad. SSR 2: 353 (1963) "*A. zeravschanicum*"; Vved. [& Kovalevskaya], Opred. rast. Sredn. Azii 2: 86 (1971). Wendelbo, Flora Iranica No. 76: 87, tab. 9/125 (1971). Seisums in Latv. Zinatnu Akad. Vēstis B No. 4: 79 (1992). Fritsch in Nordic J. Bot. 16: 13 (1996). - *Allium pseudozeravschanicum* Popov & Vved., Flora Turkm. vyp. 1, 2: 293 (1932), in adnot. Type: Turkmenistan, Zakasp. obl. Krasnovod. u., Karakalin. pristavstvo, Sev. skl. g. Syunt, 8.5.1912, leg. Lipsky No. 3318 (lectotype LE! design. Fritsch, 1990: 506). - **Type**: Uzbekistan: Sarawshanskaya dolina, gore Aksai [Saravshan valley, mount Aksai] 2700-7000', 15.5.1869, leg. O. Fedtschenko (holotype LE!, isotype TASH-Fedt.!).

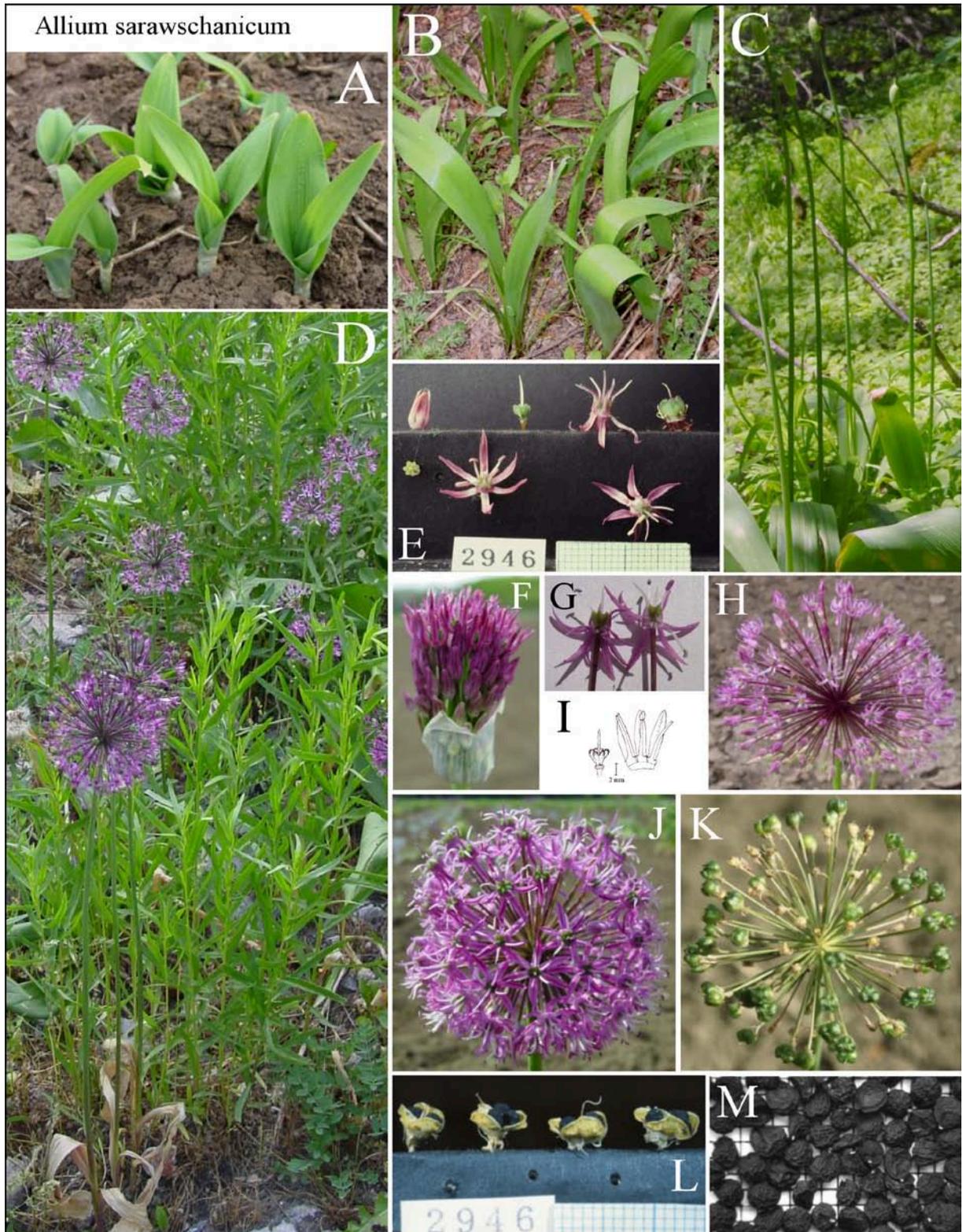
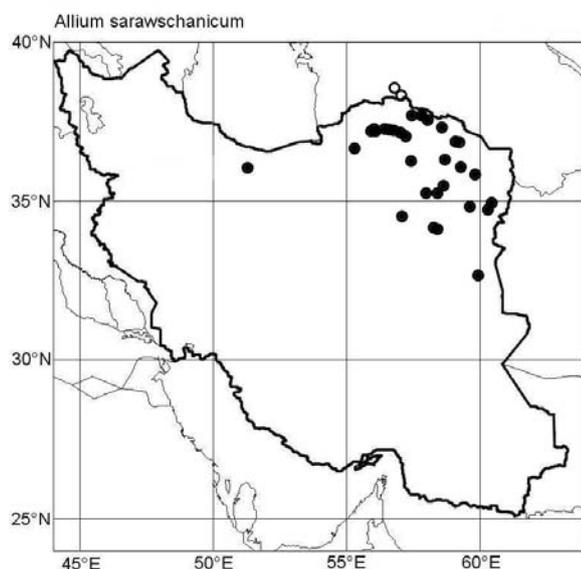


Plate T61. A: Sprouting leaves of cultivated plants; B: plants in the early shooting stage in the Golestan reservation; C: plants in the late shooting stage near Dushanbe, Tajikistan; D: flowering plants in the Shing valley, Tajikistan; E: comparison of flower parts in different stages; F, H & J: inflorescences in buds, in early anthesis and in full anthesis, resp.; G: close-up of dissected flowers; I: shape of ovary, tepals and filaments of a flower prepared from herbarium; K: inflorescence with full-sized capsules; L: ripe open capsules; M: seeds (background raster 1 mm).

Bulbs depressed-globose, 1.3-3 cm long and 2-4 cm in diameter; outer tunics  $\pm$  papery, longitudinally striate but not splitting, only slightly prolonged into a neck; whitish or grey. Scape straight, terete, smooth; 18-50 (80) cm long, 3-6 (10) mm in diam.; dull green, often basally brownish suffused. Leaves (1) 2-3 (5), laminae narrowly oblong-lanceolate to linear-lanceolate, basally thick, upper part thin, near the soil

margins collar-like overlapping, somewhat higher deep canaliculate soon becoming flat, gradually tapering into a short subcucullate apex, stiff obliquely directed but upper part hanging down; laminae initially strongly plicate, later upper and lower side with broad flat ribs; margin only in the lower part rather loosely toothed or shortly ciliate glabrous towards apex; (15) 25-40 (50) cm long, (0.7) 2-6 (10) cm broad; vividly to deep green with glaucous bloom, near the base often brownish suffused. Sheath leaf thin, rather short, yellowish brown, finely coarse, soon decaying. Spathe membranous,  $\pm$  completely split into 2-3 ovate, long acuminate, finally reflexed valves; pale brown with darker veins. Inflorescence depressed-globose to subglobose, moderately dense, many-flowered; 6-10 (12) cm in diameter. Pedicels straight, subequally long, wire-like stiff; glossy greenish brown to maroon with purple base. Anthesis in May to June. Flowers bowl-shaped star-like. Tepals linear-lanceolate, incurved, canaliculate, subacute, basally free, patent, during the course of anthesis reflexing and spirally enrolled; 5-8 mm long, c. 1.5 mm broad; pinkish carmine with narrow greenish-brown median vein conspicuous at the dorsal side. Filaments 2/3-4/5 as long as the tepals, subulate; straight, in the middle outwards bent; basally very shortly broadened and connate for 0.5-1 mm; inner filaments basally with 2 often very short side teeth; initially white with pinkish-carmine base, later pinkish-carmine throughout. Anthers oblong, 2-2.5 mm long, c. 1 mm broad; deep pink. Pollen pale yellow, the shape is oblate to peroblate, 30  $\mu$ m long, 17  $\mu$ m broad, P/E index 0.6, sculptures rugulate to microrugulate, wall 1  $\mu$ m thick (Neshati & al. 2009). Ovary stipitate, depressed globose hexasulcate, apex concave surrounded by 6 radially-backwards directed,  $\pm$  sharp bulges; surface densely covered by acute tubercles; 2-3 mm long, 3-4 mm in diameter; pale to vividly green. Up to 4 ovules per locule, 10 per ovary (Filimonova 1970). Nectary ducts lead in pores at the base of ovary below the bottom of locules (Fritsch 1992b). Style narrowly conical, 2-5 mm long; whitish finally pink. Stigma dot-shaped; whitish. Capsule short pyriform-tripartite with a concave apex and 3 broad and deep and 3 broad and shallow furrows separated by longitudinal ledges, surface rather coarse; 4-6 mm long and in diameter, widely opening; valves transversally obovate with a broad and deep longitudinal furrow and shortly notched at the apex; yellowish brown. Seeds 1-2 per locule, surface coarsely reticulate lacunose, c. 3 mm long, 2.5 mm broad, 2 mm thick; somewhat glossy black. The testa showed verrucose periclinal walls. The undulation of the anticlinal walls was variable showing transitions from S-like to U-like and to Omega-like forms with moderate to short wavelengths and low amplitudes (Kruse 1994, Fritsch & al. 2006). TKW 3.37 / 3.68 g (IPK, unpubl. data).

**Chromosomes:**  $2n = 16$  Pedersen & Wendelbo 1966 (Afghanistan: Mairana).  $2n = 16$  Vakhtina 1964, Vakhtina & al. 1977 chromosome length (Uzbekistan or Tajikistan: Zeravshan mountain range).  $2n = 16$  Zakirova & Vakhtina 1974 (Tajikistan: Hissar mountain range).  $2n = 16$  Astanova 1990 (Tajikistan: Gazimajlik massif).  $2n = 16$  Fritsch & Astanova 1998 Table 2 (Tajikistan: Hissar mountain range, Gazimajlik massif).



**Distribution:** NE Iran: mainly in the Koppe Dagh mountain range; Turkmenistan, N Afghanistan, Uzbekistan, Tajikistan; mesophyt of submontane stony or rocky slopes, among shrubs, or in the shadow of trees and rocks.

**Remarks:** There are several species bearing six oblique-upwards directed and radially elongated outgrowths on the apex of the ovaries. Those of *A. sarawschanicum* are more pronounced than those of *A. hooshidaryae*, but not so "horn-like" than the outgrowths of *A. olivieri*. The plants of *A. sarawschanicum* own a general stature like members of subsect. *Costatae* but differ by broader linear-lanceolate leaf laminae with collar-like bent and overlapping margins near the base. However, molecular markers (ITS sequences of nuclear rDNA and sequences of the plastid *trnL-trnF* region) proved a large genetic distance to that subsection and sect. *Megaloprason* s. str. (Fritsch & al. 2010; see p. 201) where

lateral markers (ITS sequences of nuclear rDNA and sequences of the plastid *trnL-trnF* region) proved a large genetic distance to that subsection and sect. *Megaloprason* s. str. (Fritsch & al. 2010; see p. 201) where

*A. sarawschanicum* was formerly affiliated. Solely *trnL-trnF* sequences showed close relations to *A. jesionum* incl. subsp. *angustitepalum* (Gurushidze & al. 2010). *Allium sarawschanicum* is a rather polymorphous species with a wide area of distribution up to Tajikistan. However, the cited molecular markers do not support recognition of *A. pseudoseravschanicum* or other infraspecific taxa (Fritsch & al. 2010).

**Etymology:** The epithet refers probably to the Saravshan mountain range in Uzbekistan where the type location is situated.

**Biological data:** Very good germination at 5°C, but very bad above 10°C (Specht & Keller 1997). Antibacterial and anti-fungal activities were found by Sokolov (1994). Cultivation trials including morphological parameters correlated to stages of development and agrotechnical measures were reported by Inamov (1971). Reported genome sizes [2C DNA] were 37.4 pg (Vakhtina & al. 1977), 35.4 pg (Zakirova 1989), 34.2 pg (Hissar)/36.2 pg (Iran) (Gurushidze & al. 2012). Detailed analysis of seed storage proteins showed more similarity to *A. rosenbachianum* Regel than to other tall species (Maass 1992, Fig. 5 "sara"). Fresh bulbs contain in total 0.03 / 0.04 % cysteine sulfoxides (62 / ? % methiin, 37 / ? % alliin, 2 / ? % isoalliin) (Fritsch & Keusgen 2006; Keusgen & al. 2008).

**Economic traits:** Used as ornamental, medicinal plant, and vegetable species (Inamov 1971). Leaves are eaten (Sokolov 1994) and used as spice (Kochkareva & Chukavina 1985), but this application could not be confirmed, merging with the similar leaves of *A. rosenbachianum* s. str. is assumed (Keusgen & al. 2005). Local name 'evoj pijoz', belongs to the most important edible species in the Uzbek mountains (Khassanov 2008).

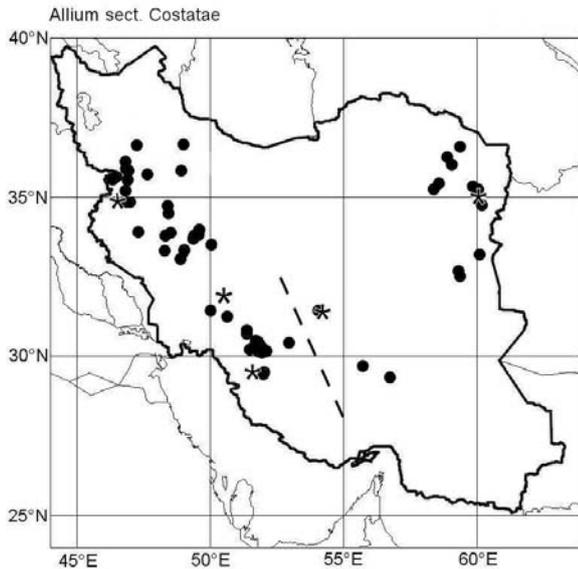
Living accessions studied: **Golestan:** SE part of Golestan Reservation, valley Derekhushk (37°27' N, 56°05' E, 1400 m, 20.4.2004 Keusgen, Fritsch 1018; GAT IRAN). - **Raz. Khor.:** Central Kopetdag, slope near main road to Dargaz NE of main pass (37°32' N, 58°37' E, 1450 m, 23.4.2004 Keusgen, Fritsch 1029; IRAN GAT).

Herbarium vouchers: **Golestan:** Jangal-e-Golestan, Kuhha-ye-Almeh (37°22' N, 56°08' E, 1500-1800 m, 08.-10.6.1975 Reching 53053; G W B; 25.5.1976 Termeh, Matin 507-IRAN; 10.6.1975 Termeh 510-IRAN; 1300-1700 m, 05.6.1987 Gharehman, Mozaffarian 5936; TUS). Between Shahpassand and Shahrud, Kosh Yeilagh (36°51' N, 55°21' E, 1600-1800 m, 18.5.1978 Wendelbo, Assadi 29620-TARI). Park-e Golestan, between Tang-e Rah and Cheshme-Khan (37°22' N, 55°58' E, 1100 m, 05.6.1987 Mozaffarian, Abouhamzeh 59012-TARI). Khosh-yeilagh high land, 60 km SE of Azad-Shahr (36°51' N, 55°21' E, 1700 m, 22.5.1995 Faghinia, Rafeies, Zangooei 25453; FUMH). Gorgan to Shahrud, Gardaneyeh Khoshyeylagh (36°50' N, 55°21' E, 10.6.1973 Foroughi 10198; 511-IRAN). - **N Khor.:** Kopet Dagh range, 45 km NNE Shirvan, Kuh-e-Alam c. 6 km N Cheshmeh-e Gabri (37°44' N, 58°04' E, 2400 m, 01.7.1973 Edmondson 1206; W). Gulul Sarani protected area, Kopet Dagh, in altiplanitie ad custodelam (37°46' N, 58°07' E, 2100-2300 m, 12.-13.6.1975 Reching 53354, 53351; G, W). Shirvan: Namanlu, Kuhha-ye-Gulul (37°39' N, 58°05' E, 14.6.1975 Termeh 506-IRAN). NE of Bojnurd, Ghaleh-Mohammadi towards Izman-Olia, 3-4 km Ghaleh-Mohammadi (37°52' N, 57°32' E, 1860-1910 m, 17.6.2009 Memariani, Zangooei 43186; FUMH). W Bojnurd, 3 km W of Jozak, protected area (37°26' N, 56°39' E, 1320-1370 m, 23.5.2010 Memariani, Arjmandi 43689; FUMH). W Bojnurd, Ghurkhud protected area, below Agh-mazar pass (37°26' N, 56°28' E, 2000-2300 m, 16.6.2010 Memariani, Arjmandi 44041; FUMH). Between post Chaek and Kheirabad (Persia) (37°52' N, 57°51' E, 26.4.1912 Lipsky 2254; LE). NW Esfarayen, Saluk National Park, Sarmaran, Juz valley (37°12' N, 57°15' E, 1798 m, 04.5.2008 Joharchi, Zangooei 39775; FUMH). W Bojnurd, between Havar and Barfandy (37°24' N, 56°49' E, 1700-1900 m, 06.6.2004 Joharchi, Aydani 35477; FUMH). W Bojnurd, Juzak, Cheshmeh Eshgh (37°25' N, 56°40' E, 1179 m, 7.5.2007 Memariani, Zangooei 38769; FUMH). SW Bojnurd, Hesar towards Shughan, Saluk protected region (37°19' N, 57°04' E, 2033 m, 01.6.2008 Joharchi, Zangooei 40584; FUMH). NE Bojnurd, Gifan, Meisi-Nu mountain (37°54' N, 57°28' E, 1800-2000 m, 17.6.1991 Joharchi, Zangooei 20816; FUMH). - **Raz. Khor.:** Daregaz, Tandureh National Park, Tiven towards Urteh-Bulagh, 2 km Tivan (37°28' N, 58°34' E, 2215-? m, collector unclear 35521; FUMH). Between Roshtkhar and Khaf, Pir Yahu (36°00' N, 59°51' E, 2000 m, 30.4.1985 Ayatollahi 12400; FUMH). Kashmar, Kuh sorkh (Rivash), between Tajrud and Kharv (35°26' N, 58°02' E, 1900 m, 07.5.1995 Faghinia, Zangooei 25329; FUMH). Tandureh National Park, between Tivan and Ali-Bulagh, Urta-Bulagh (37°31' N, 58°37' E, 1450-1500 m, 19.5.2004 Memariani, Zangooei 35399; FUMH). Daregaz, Gharaghat valley (37°01' N, 59°15' E, 2500 m, 28.5.2001 Joharchi 33584; FUMH). NW Neishabur, Bar village, Bar waterfall (36°29' N, 58°44' E, 2000 m, 29.6.2003 Zangooei 34896; FUMH). - **S Khor.:** c. 75 km ESE Birjand (32°45' N, 59°58' E, date & collector not translated; FUMH). Gonabad, Senu, Nakhu valley (34°18' N, 58°26' E, 1600 m, 25.4.1991 Faghinia, Zangooei 19610; FUMH). - **Yazd:** Tabass, Ozbagu, Alimorad's mine (34°41' N, 57°07' E, 22.4.1986 Ayatollahi, Zangooei 13868; FUMH). - **Mazandaran:** Siah-bisheh (36°13' N, 51°19' E, 17.5.1970 Foroughi 43097-IRAN).

Determination unsure: **Raz. Khor.:** 20 km W Tabas (36°26' N, 57°28' E, date & collector not translated; FUMH). c. 50 km N Kashmar (35°38' N, 58°36' E, date & collector not translated; FUMH). 12 - 20 km N Kashmar (35°23' N, 58°26' E, 1150-1700 m, 04.5.1975 Iranshahr 509-IRAN). Koppe Dag c. 40 km NNE Radkan (37°02' N, 59°08' E, date & collector not translated; FUMH). Binalud c. 45 km E Neyshabur (36°15' N, 59°17' E, date & collector not translated; FUMH). Kuh Sorh c. 30 km N Kashmar (35°31' N, 58°27' E, date & collector not translated; FUMH). c. 20 km NW Kadkan (35°41' N, 58°43' E, date & collector not translated; FUMH). Near Roshtkhar (35°00' N, 59°39' E, date & collector not translated; FUMH). c. 45 km SW Torbat-e-Jam (34°54' N, 60°21' E, date & collector not translated; FUMH). c. 30 km W Gonabad (34°20' N, 58°19' E, date & collector not translated; FUMH). c. 25 km SW Torbat-e-Jam (35°07' N, 60°29' E, date & collector not translated; FUMH). - **S Khor.:** c. 70 km E Birjand (32°57' N, 60°00' E, date & collector not translated; FUMH).

*Allium* sect. *Procerallium* R.M. Fritsch in *Phyton* (Horn, Austria) 49: 199 (2010). - sect. *Megaloprason* Wendelbo in *Bot. Notiser* 122: 28 (1969) p. p. Type: *A. stipitatum* Regel

*Allium* subsect. *Costatae* R.M. Fritsch in *Candollea* 48: 424 (1993) sub sect. *Megaloprason*. Type: *A. jesdianum* Boiss. & Buhse



The Iranian members of subsect. *Costatae* are closely related and morphologically very similar. Thus also the herbarium vouchers are difficult or even impossible to determine, when bulbs or bulb tunics are missing, or small plants growing in rather deep shadow were collected with flowers in the bud stage. Such flowers open then already in the press, but the flower parts do not expand completely and do not show the natural morphological proportions. Living plants are rather well to differentiate, and the different morphotypes possess rather well circumscribed areas of distribution. Therefore they are recognized here as separate taxa. Although some herbarium specimens can be interpreted to represent transitions between these taxa, truly intermediate plants were not seen yet among the rather few

plants cultivated in Tehran and in Germany. Thus future confirmation of this taxonomic concept by broad investigation of many living plants with careful documentation is essential. Molecular markers (ITS sequences of nuclear rDNA, see p. 202) point to a conspicuous genetic differentiation inside of this section (indicated by broken lines): Species naturally distributed in the Zagros mountain range and the mountains East of lake Urmia belong to one molecular group (jointly with *A. stipitatum* from Northwest and South Iran), but another well separated group is composed of *A. jesdianum* s. str., *A. jesdianum* subsp. *angustitepalum* mainly distributed in Afghanistan, and *A. orientoiranicum* from Northeast Iran. The molecular differences reflect a rather long independent evolutionary history of both groups contradictory to lump all plants similar to *A. jesdianum* together in one variable species.

**62. *Allium bakhtiaricum*** Regel in *Trudy Imp. S.-Peterb. Bot. Sada* 3, 2: 222 (1875). - Wendelbo, *Flora Iranica* No. 76: 96 (1971). Fritsch in *Nordic J. Bot.* 16: 12 (1996). Seisums in *Iran. J. Bot.* 8: 225 (2000) sub *A. kazerouni*. Fritsch & al. in *Stapfia* 80: 391 (2002). - *Allium jesdianum* sensu Wendelbo, *Flora Iranica* No. 76: 84 (1971), p. p., ? Wendelbo, *Fl. Iraq* 8: 176 (1985), p. p. - **Type:** Iran: Montys Bakhtianis, leg. Bode init. Maji 1840 (holotype LE!). **Epitype:** Iran, prov. Chaharmahal-Bakhtiyari, 5 km S Farsan, Deh Cheshmeh Pirghar, 17.5.1994 leg. Fritsch (286-IRAN, design. Fritsch & al. 2010: 203).

Bulbs ovoid to subglobose, 1-3 cm in diam., 1.5-3 cm long; outer tunics strong with large mesh-like ornamentation; grayish brown to blackish. Scape terete, straight, smooth, lower part with a few shallow ribs in varying distance disappearing towards the tip; 20-60 cm long, 3-6 mm in diam.; green, near the base sometimes reddish flushed. Leaves 2-3 (4), laminae lanceolate, arcuately ascending and recurved to the soil, thickish, canaliculate or towards tip plicate; 25-40 cm long, 8-12 (16) mm wide; upper side with some furrows, lower side with some ribs; margin smooth, gradually tapering into the hooded tip. Sheath leaf tender, translucent, soon decaying. Spathe fine membranous, completely splitting into 1-2 long acute triangular, subreflexed valves, about 2/3-3/4 as long as the pedicels; pale brownish with inconspicuous veins. Inflorescence fastigiate to depressed-globose, moderately dense, many-flowered; 6-10 cm in diameter, 3.5-8 cm long. Pedicels thin, stiff wire-like, initially straight later ascending; green to purplish. Anthesis in May. Flowers bowl-shaped star-like. Tepals narrowly lanceolate-triangular, patent, canaliculate; upper part plicate long tapering into the claw-like incurved apex, after anthesis reflexed and spirally enrolled; (6) 8-11 mm long, 0.8-1.2 mm broad; rose to pinkish-carmine, rarely

whitish with narrow, darker median vein, conspicuous at the dorsal side. Filaments  $\pm$  as long as the tepals, subulate,  $\pm$  straight; basally shortly triangular to nearly quadratic widened and for 0.3-0.5 mm connate; rose to pink finally dark pink. Anthers oblong, 2 mm long and 0.7-1 mm wide; pink or yellowish. Pollen grayish-yellow. Ovary stipitate, depressed-globose with 3 broad and 3 narrow but sharp

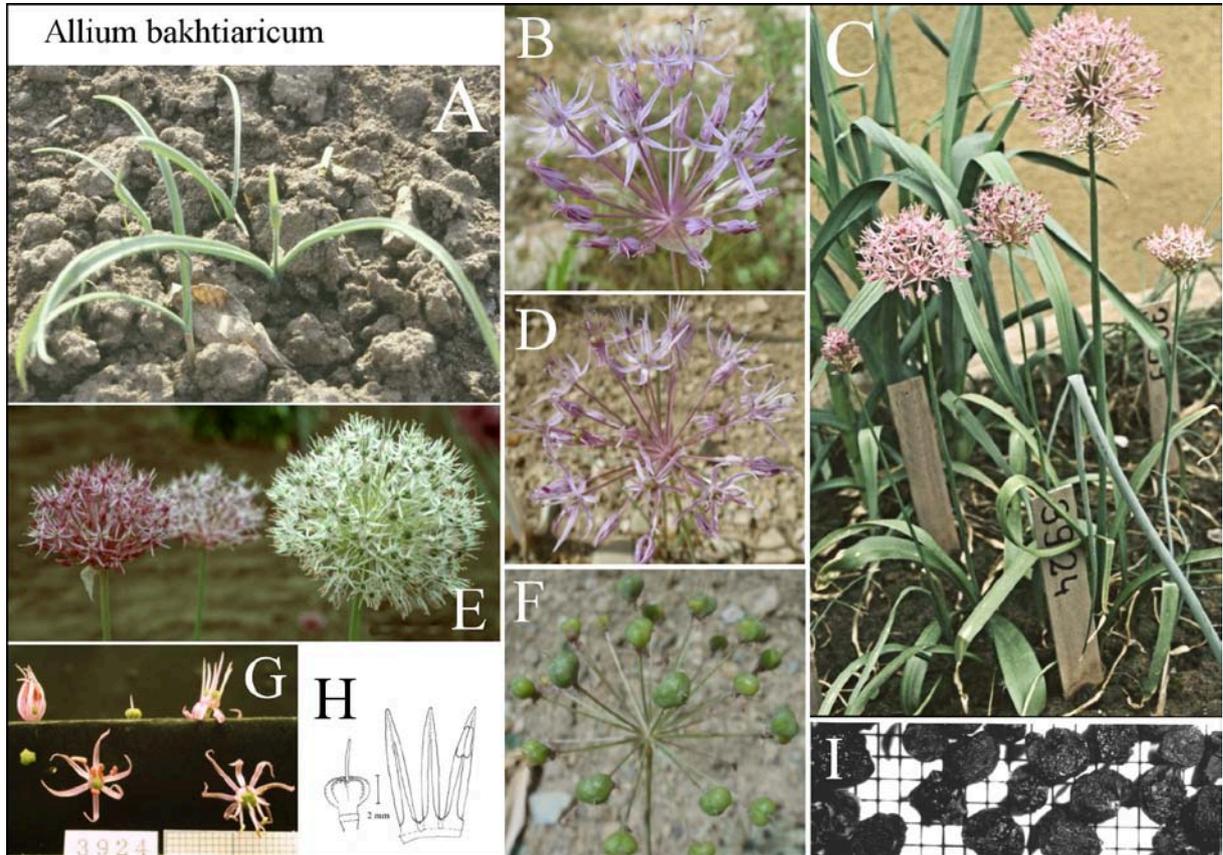
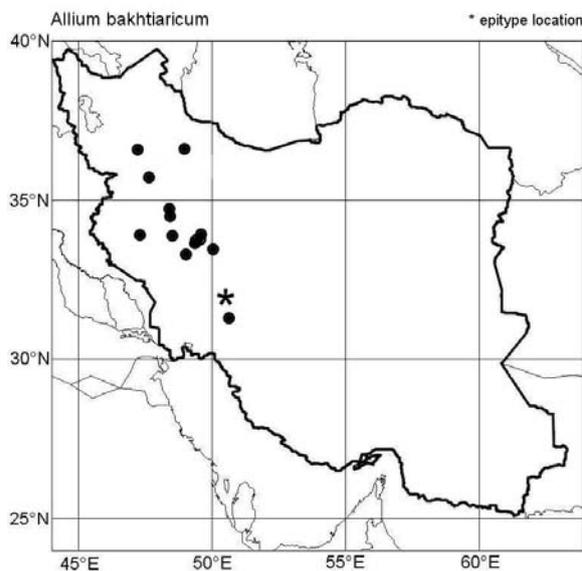


Plate T62. A: Cultivated plants in the early shooting stage; B & D: inflorescences in early and full anthesis, resp.; C: flowering cultivated plants; E: different flower colors of plants from the epitype location; F: inflorescence with full-sized capsules; G: comparison of flower parts in different stages; H: shape of ovary, tepals and filaments of a flower prepared from herbarium; I: seeds (background raster 1 mm).

furrows, surface strongly papillose, area around the style depressed; c. 2 mm long and 2.5 mm in diam.; dull grayish green. Style narrowly conical to thread-like, 2-4 (finally up to 7) mm long; whitish to pink. Stigma undivided, dot-shaped; pinkish. Capsule depressed-globose triangular, surface with thin reticulate ledges, yellowish brown; 3-4 mm long, 4-5 mm wide; widely opening; valves suborbicular with a



shallow longitudinal furrow, scarcely notched at the apex. Seeds 1-2 per locule, flat ovate-globose, surface reticulate lacunose with a few prominent ledges; 3-3.5 mm long, 2.5-3 mm wide, 1.5-2 mm thick; dull black.

**Chromosomes:**  $2n = 16$  Fritsch unpubl. (Iran: Pirghar, epitype location).

**Distribution:** NW Iran: with certainty only in the prov. Chahmahal-e Bakhtiari; shady montane slopes, among rocks, in rock crevices and on terraces.

**Remarks:** This circumscription of *A. bakhtiaricum* adopts the characters of the epitypical plants that possess glaucous, dull scapes and leaf laminae like *A. jesdianum*, but differ by strong, mesh-like decomposing outer bulb tunics, thinner scapes, narrower

leaf laminae, narrower, subacute, and more triangular tepals, and also initially pinkish filaments. Typical *A. jesdianum* plants possess broader scapes and leaves, membranous outer bulb tunics, and initially pure white filaments. *Allium remediorum* shows soft and thick fiber-like dissolving outer bulb tunics, vividly green and glossy scapes and leaves, somewhat broader tepals, and always pinkish filaments. Two more species are also rather similar and share membranous bulb tunics as well as glaucous scapes and leaves with *A. bakhtiaricum* but own shorter tepals. These are *A. kazerouni* characterized by ribbed scapes, canaliculate and somewhat broader leaves, and filaments shorter than the lilac, lanceolate-triangular tepals, and *A. orientoiranicum* that possess smooth scapes, ± flat leaves, and filaments slightly longer than the pinkish, linear-lanceolate tepals. Surprisingly, molecular markers (ITS sequences of nuclear rDNA; see p. 202) showed *A. stipitatum* as the closest genetic relatives of *A. bakhtiaricum*, less closely related are *A. remediorum*, *A. kazerouni*, *A. hollandicum* R.M. Fritsch, and *A. pseudohollandicum* (Fritsch & al. 2010). Sequences of the plastid *trnL-trnF* region confirmed this relationship without giving more details (Gurushidze & al. 2010).

**Etymology:** The epithet refers to the (historical) geographic area of the type location.

**Biological data:** The genome size (41.28 pg 2C DNA) is larger than in *A. jesdianum* incl. subsp. *angustitepalum* (38.3 - 38.6 pg) and smaller than in *A. stipitatum* (~44 pg, Gurushidze & al. 2012). The plants contain dithiodipyrrole (Gurushidze 2008).

Living accessions studied: **Chaharm. Bakhtiyari:** Deh Cheshme, rocks above spring Pir Ghar, rock terraces directly above spring area (32°13' N, 50°33' E, c. 2000 m, 17.5.1994 Fritsch 1070; 2080 m, 28.4.2010 Fritsch, Keusgen, Abbasi 1273; GAT IRAN). - **Markazi:** Northern slope of Razvand massif above vill. Suraneh (33°52' N, 49°26' E, 2530 m, 10.5.2007 Abbasi, Fritsch, Keusgen 1158; GAT).

Herbarium vouchers: **Chaharm. Bakhtiyari:** Taleh, (3000 m, 06.5.1940 Koelz 15201; W). Kuh Rang, in faucibus Shah Abbas, (2400 m, 01.6.1959 Wendelbo 1700; W). Lordegan between Monj and Chahartagh, tang-e Zendan (31°28' N, 50°41' E, 1850 m, 15.5.1987 Mozaffarian 59933-TARI). - **Hamadan:** Bahar (34°55' N, 48°27' E, 15.6.1965 Babaii 7018-E; 275-IRAN). Alvand (34°40' N, 48°28' E, 15.6.1895 Strauss; JE, G). - **Kurdistan:** near Bijar (35°53' N, 47°41' E, 01.7.1971 Termeh; IRAN). - **Lordestan:** Dow Rud (33°29' N, 49°04' E, Koelz 17389, 17427; W). - **Markazi:** Kuh Rasvand and other places near Arak (33°52' N, 49°25' E, no date Strauss; WU; 15.6.1889 Strauss 397; JE; ???.1889, 10.6.1890, 02.6.1895, ???.1895, ???.1897 Strauss; JE; 04.6.1892 Strauss 152; JE B G; 18.6.1895 Strauss 266; JE B). Dschapelakh (33°50' N, 49°24' E, ???.1898 Strauss; JE). Kuh Sefid (34°05' N, 47°20' E, 21.5.1893 Bormüller; JE; 12.6.1904 Strauss; JE B). Arak to Malayer 20 km of Arak, Chepeghli (Ab-Robat) (34°03' N, 48°33' E, 24.5.1988 Termeh, Karavar, Tehrani 287-IRAN). - **Zanjan:** Zanjan to Manjil, Tashvir (36°47' N, 49°00' E, 800-2200 m, 29.5.1974 Termeh, Moussavi 288-IRAN).

Determination unsure: **Hamadan:** in monte Elwend (34°40' N, 48°29' E, 15.6.1895 Strauss 61; B G). Bahar (34°55' N, 48°27' E, 17.4.1965? Babaii 284-IRAN). - **Markazi:** In dit. Sultanabad: Chomein (33°38' N, 50°05' E, ???.1895 Strauss; JE). Mowdere(h) (34°06' N, 49°38' E, ???.1899 Strauss; JE). In einer Schlucht des Raswend bei dem armenischen Dorfe Abbas abad ca. 4 fersach S Sultanabad (33°55' N, 49°26' E, 15.6.1889 Strauss; B). - **Zanjan:** Mahneshan, Alam-Kandy, Ghar-ghalan mountains (36°46' N, 47°16' E, 1900-2200 m, 27.6.1983 Moussavi, Habibi, Tehrani 285-IRAN).

**63. *Allium pseudohollandicum* R.M. Fritsch, species nova.** - *Allium hollandicum* sensu Seisums in Iranian. J. Bot. 8: 226 (2000). - **Type:** Iran, prov. W Azarb.: Ghasemloo valley, Khan valley, 34 km Oshnaviyeh road, 1380-1550 m, 06.5.1994 Alizadeh, Ghasempoor 3138 (holotype ORUM).

Differt ab *Allio hollandico* statura graciliore, scapis sublongioribus et basaliter incostatis, foliis angustioribus livido-viridibus, et tepalis angustioribus tantum 1.8-2 mm latis saepe purpurascensibus in herbario.

Bulbs 2-3 cm in diam., depressed-globose; outer tunics membranous; grayish. Scape ± straight, terete, smooth; (35) 50-90 cm long, basally 5-8 (10) mm in diam.; ± dull green. Leaves (3), 4-7, narrowly lanceolate with a long tapering, only slightly cucullate apex, canaliculate, completely smooth; upper side smooth, lower side with narrow ribs; (25) 30-50 cm long, 1.5-3 (outermost up to 6) cm wide; vividly green. Sheath leaf long, membranous, smooth, hyaline, soon decaying. Spathe thin membranous, translucent; split into 2-4 broadly triangular valves; yellowish with brown veins. Inflorescence ± globose, semi-dense; 5-7 cm in diam. Pedicels thin, straight; semi-glossy green to brown, basally more purplish. Anthesis in mid May. Flowers cup-shaped star-like. Tepals lanceolate, concave, inwards bent, tip ± acute, 9-11 mm long, 1.8-2.2 mm wide, after anthesis reflexed and spirally enrolled; deep pink with greenish but blurred median vein, in the herbarium often violet. Filaments ± as long as the tepals, from

the subquadratic but not united base suddenly contracted into the subulate upper part, slightly paler than the tepals, finally carmine. Anthers oblong; c. 2 mm long and 1 mm broad; brown to purple. Pollen grayish. Ovary depressed-globose with 6 shallow furrows, long stipitate, c. 3 mm in diam. and long, surface densely papillose; green. Nectary ducts lead in small dots near the base. Style 3-6 mm long, conical, deep pink. Stigma white, acute. Capsule depressed globose triangular, surface coarsely reticulate-tuberculate; 4 mm long and 4-5 mm in diam.; greenish brown; valves broadly elliptic with a broad,

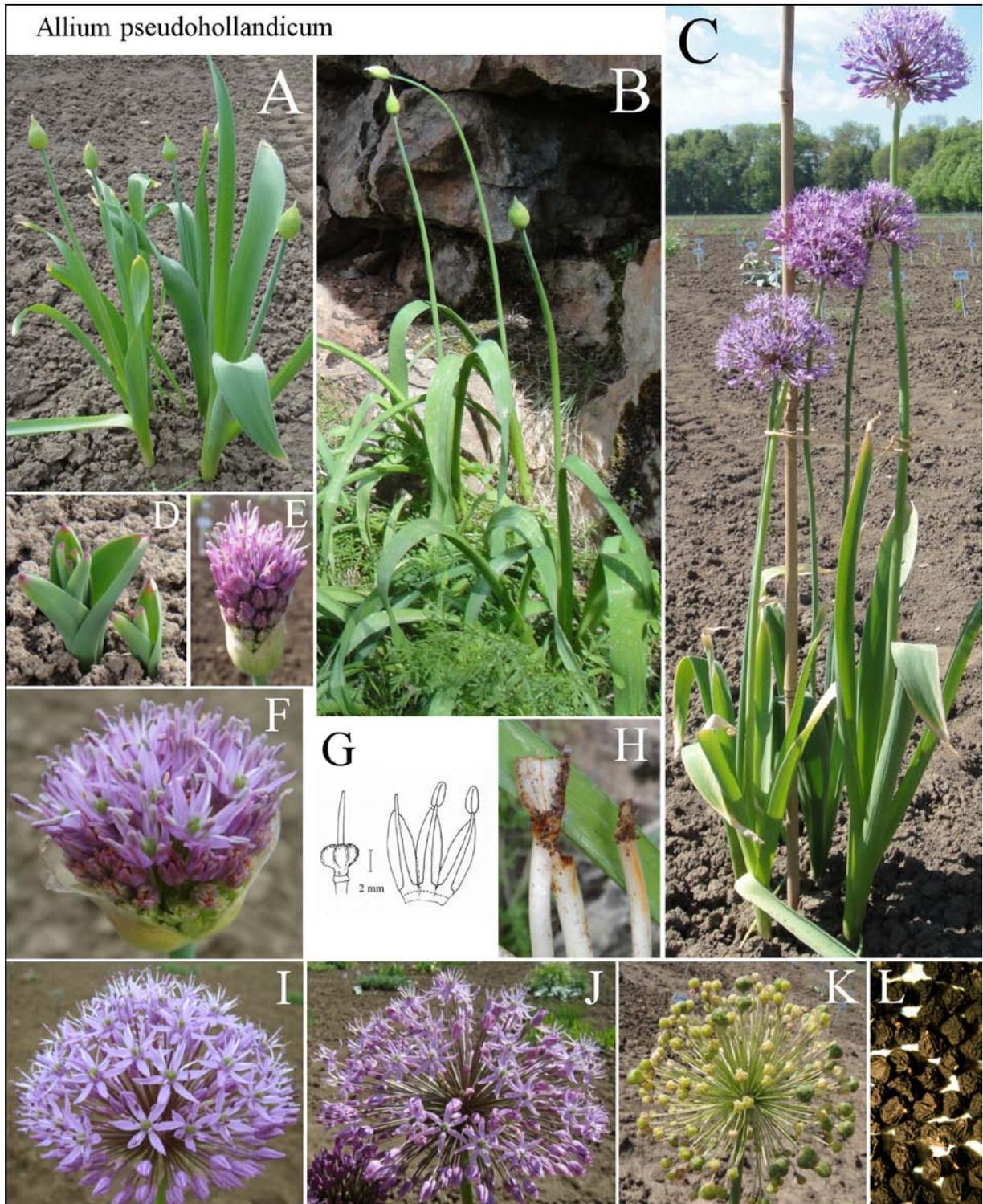
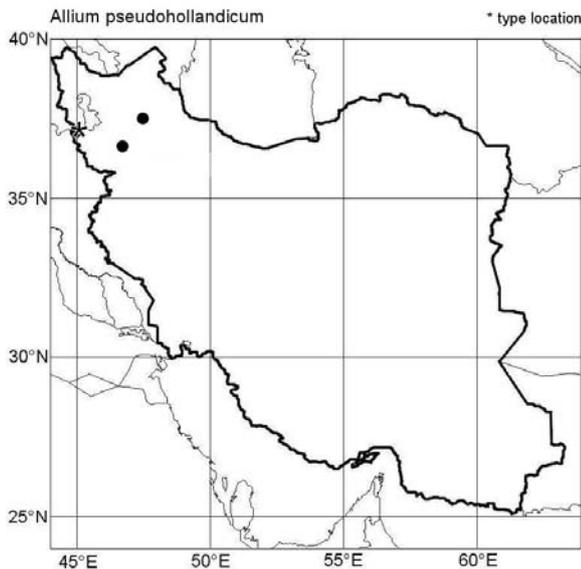


Plate T63. A: Cultivated plants in the early shooting stage; B: shooting plants in the Ghasemlu valley; C: cultivated flowering plants; D: sprouting leaves of cultivated plants; E, F, I & J: inflorescences in the bud stage, in early anthesis, and in full anthesis, resp., G: shape of ovary, tepals and filaments of a flower prepared from herbarium; H: red color of ruptured leaf bases is caused by dithiodipyrrole; K: inflorescence with full-sized green and sterile yellowish capsules; L: seeds (background raster 1 mm).

longitudinal furrow, scarcely notched at the apex. Seeds 1-2 per locule, sector-like drop-shaped, some seeds with one concave side, surface finely tuberculate without or with a few irregular ledges surrounded by sharp marginal ledges, convex side(s) irregularly and densely reticulate lacunose; c. 2.5 mm long, c. 2 mm wide, 1.5-2mm thick; dull to semi-glossy black.



**Distribution:** Iran, prov. W Azarbaijan, shady montane slopes, among rocks and under shrubs; presence outside the mountains W of Urmia needs verification, occurrence on Turkish and NE Iraqi territories seems probable.

**Remarks:** Seisums (2000) included plants from W Iran and NE Iraq in *A. hollandicum* although these were taller (scape up to 1 m long) and differed also by smooth scapes (lower part not ribbed), narrower greyish-green leaves, and only 1.8-2 mm (not 2.2-2.5 mm) wide tepals. Molecular markers presented evidence that the wild plants from NW Iran and cultivated *A. hollandicum* are closely related but clearly separated taxa (Fritsch & al. 2010; see p. 202). Two vouchers from Shahin Dez area and Bozqush mountains need to be re-collected for molecular

study.

**Etymology:** The epithet refers to the morphological similarity to *A. hollandicum*.

**Biological data:** The plants contain dithiodipyrrole (Plate T63 H).

Living accessions studied: **Kermanshah:** Plants sold on the market in Kerend, source unknown (14.5.2006 Abbasi, Fritsch, Keusgen 1102; GAT IRAN). Plants sold on the market of Eslam Abad, source unknown (14.5.2006 Abbasi, Fritsch, Keusgen 1103; IRAN). - **W Azarb.:** Valley Ghasemlu c. 30 km S Orumiyeh to Oshnaviyeh (37°18' N, 45°06' E, 1620 m, 12.5.2011 Pahlevani, Fritsch 1355; GAT IRAN)

Herbarium vouchers: **E Azarb.:** Miyaneh, Ishligh, Kuh-e Boz-Ghoush (37°40' N, 47°30' E, 2400-2900 m, 09.6.1986 Termeh, Daneshpajouh 43042-IRAN).

Determination unsure: **W Azarb.:** Inter Rezaiyeh et Oshnaviyeh, Qasemlu (37°18' N, 45°06' E, 18.5.1973 collector unclear 32; 21.5.1974 collector unclear 2155; TARI; 01.6.1978 Matin, Daneshpajouh 282-IRAN). SW of Rezaiyeh, Silvana valley, along the road SE Dizeh (37°15' N, 44°55' E, 1400 m, 25.5.1976 Runemark, Foroughi 19854-TARI). Marmishov valley, after police station, opposite Turkey (1970 m, 12.5.2004 Ghasempoor 7111; ORUM). Ghasemloo valley, Khan valley, 34 km Oshnaviyeh road (37°18' N, 45°06' E, 1380-1550 m, 22.5.1993 Alizadeh, Ghasempoor, Evasi 1275). Dasht-e Bel (02.6.1974 Siami 2164; TARI). Shahindej: Norozloo and Chapo villages (36°48' N, 46°45' E, 2400 m, 18.5.2001 Alizadeh 7628; ORUM).

**64. *Allium jesdianum*** Boiss. & Buhse in Nov. Mém. Soc. Imp. Natur. Moscou 12: 217 (1860). - Regel in Trudy Imp. S.-Peterb. Bot. Sada 3: 240 (1875). Wendelbo, Flora Iranica No. 76: 84, tab. 8/119, tab. 20/1, p. p. (1971); Wendelbo, Fl. Iraq 8: 176, pl. 46 (1985), p. p. Fritsch in Nordic J. Bot. 16: 10 (1996), Fritsch & Abbasi in Rostaniha 9 Suppl. 2: 53 (2008 publ. 17 Jul 2009). - **Type:** Iran: Jesder Gebirge beim Dorfe Deh-Ballo, 24.4.1849, leg. Buhse No. 1341/1346. (lectotype LE!, design. Fritsch, 1990: 504; isotypes LE!, G!). - **subsp. *jesdianum***

*Allium jesdianum* subsp. *angustitepalum* (Wendelbo) F.O. Khass. & R.M. Fritsch in Linzer Biol. Beiträge 26: 98 (1994) is distributed in eastern Afghanistan and in adjacent parts of Uzbekistan and perhaps Tajikistan. It is not expected to occur in Iran.

Bulbs depressed globose, 1.5-5 cm in diam., 1.5-3.5 cm long; outer tunics smooth, membranous, outer layers blackish disintegrating. Scape slightly flexuous, terete, basal part with flat but sharp ribs disappearing towards the tip; 25-50 (80) cm long, (3) 4-8 (10) mm in diam.; green, basally red flushed. Leaves 2-3 (6), laminae narrowly lanceolate, canaliculate, arcuately ascending and recurved to the soil, rather thick; upper side ± smooth, lower side with broad and flat ribs; margin smooth, gradually tapering

into a narrow, cucullate tip; 30-40 (60) cm long, (8) 18-25 (30) mm broad; green with glaucous bloom. Sheath leaf hyaline, tender, quickly decaying. Spathe thin membranous, completely divided into 1-2 ovate-triangular, reflexed valves, shorter than the pedicels; pale brown with inconspicuous veins. Inflores-

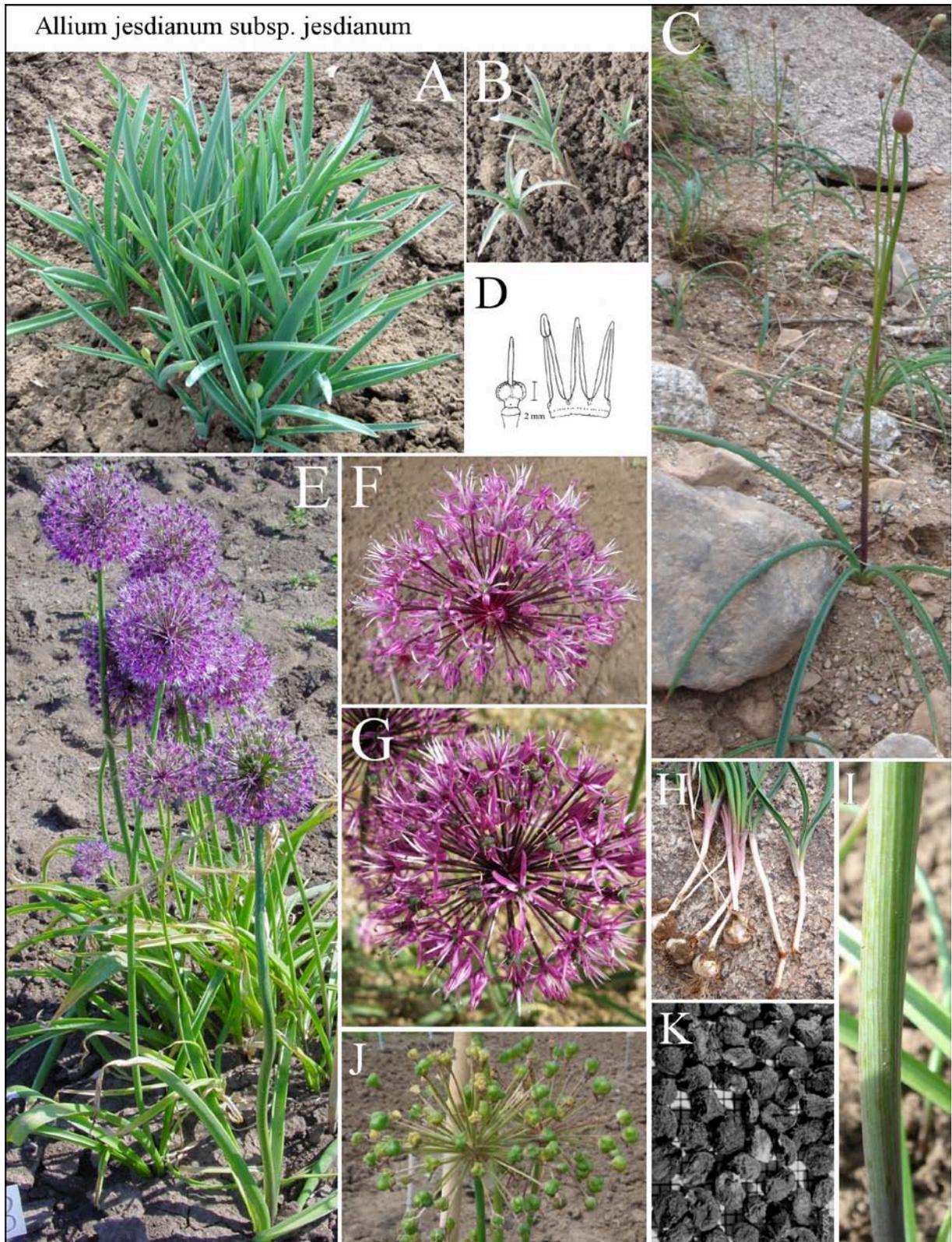
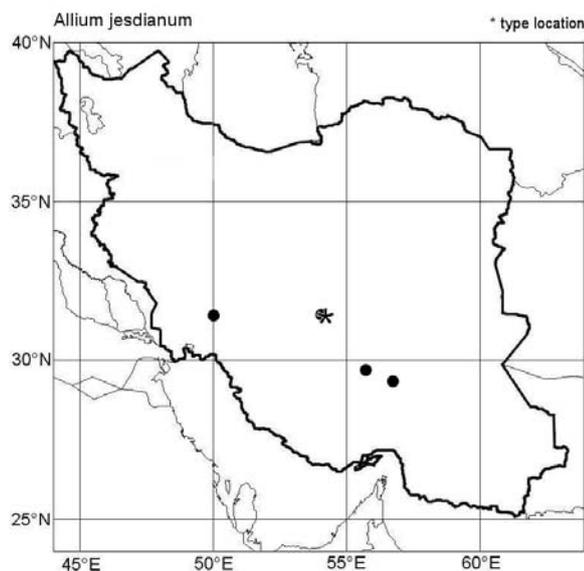


Plate T64. Plants from the type location. A & B: cultivated plants after and during sprouting, resp.; C: plants in the shooting stage near Deh Balla; D: shape of ovary, tepals and filaments of a flower prepared from herbarium; E: flowering cultivated plants; F & G: inflorescences in early and late anthesis, resp.; H: plants dug out near Deh Balla, red color of wounded tissue is caused by dithiodipyrrole; I: ribbed lower part of the scape; J: inflorescences with full-sized capsules; K: seeds (background raster 1 mm).

cence subglobose, moderately dense, many-flowered; 4-8 (in the fruiting stage up to 14) cm in diam. Pedicels rather thick, straight, stiff wire-like; brown to purple, finally green, semi-glossy. Anthesis in (April to) May. Flowers cup-shaped star-like. Tepals long lanceolate-triangular, patent and claw-like incurved, long tapering into a narrow but obtuse apex with semi-convolute margins; later reflexed and spirally enrolled; 8-10 (13) mm long, 1-1.5 (2) mm broad; pinkish-carmine with narrow darker median vein. Filaments  $\pm$  as long as the tepals, subulate; basally shortly widened and connate for 0.5-0.8 mm; initially with pink base and pure white upper part, later color like the tepals. Anthers long ovoid, c. 2 mm long and 1 mm broad; carmine. Pollen grayish yellow. Ovary shortly stipitate, depressed globose or shortly pear-shaped triangular with 3 longitudinal furrows, surface tuberculate; 3-3.5 mm long and in diam., green; nectary ducts lead in small pits at the very base of the ovary. Style  $\pm$  thread-like, 5-6 (finally 9) mm long; whitish finally pink. Stigma undivided; whitish. Capsule stipitate depressed-globose triangular with 3 broad furrows; c. 8 mm in diameter and 6-7 mm long; widely opening, valves rather broadly elliptical, shortly and broadly notched at the apex, with a broad longitudinal furrow; greenish yellow-brown. Seeds 1-2 per locule, flat ovoid-globose,  $\pm$  angled, surface finely reticulate lacunose; 3-3.5 mm long, 2.5-3 mm broad, c. 2 mm thick; dull black. The testa showed verrucose periclinal walls. The undulation of the anticlinal walls was variable showing transitions from S-like to U-like and to Omega-like forms with low amplitudes (Fritsch & al. 2006).

**Chromosomes:**  $2n = 16$  Gurushidze & al. 2010, 2012 (Iran: Yazd, Deh Balla, type location).



**Distribution:** Iran: prov. Yazd, Kerman; shady montane gorges, arable land under trees.

**Remarks:** Plants collected at the type location and studied also under cultivation showed remarkable differences to several characters given by Wendelbo (1966, 1971, 1985). Thus this species is accepted here in a narrow sense. It is characterized by thin membranous bulb tunics, dull glaucous leaves, bright pink flowers, and filaments initially pure white with a rose base. Plants collected in more western regions own thick bulb tunics or tunics decomposing into threads, partly glossy and yellow-green leaves, some also lilac flowers, and commonly filaments pink or lilac already in the early stage of anthesis. They are accepted as separate species.

Nearly all these species could be involved in molecular investigations. ITS sequences of nuclear rDNA positioned *A. jesdianum* from the type location, the only available accession of *A. orientoiranicum* (named jesd6261), and *A. jesdianum* subsp. *angustitepalum* in one subgroup that is sister to one subgroup of the Central Asian *A. rosenorum* R.M. Fritsch (Fritsch & al. 2010). Next relatives but with a remarkable genetic distance are species occurring exclusively in the northwestern part of Iran: *A. remediorum*, *A. kazerouni*, *A. bakhtiaricum*, and also *A. pseudohollandicum* and all accessions of *A. stipitatum* from the Zagros mountain range (see p. 202). Sequences of the plastid *trnL-trnF* region (Gurushidze & al. 2010) showed a still sharper separation when *A. jesdianum* incl. subsp. *angustitepalum* was positioned in the derived lineage VI, but *A. remediorum* (incl. one accession mis-named as *A. jesdianum*), *A. bakhtiaricum*, and *A. stipitatum* in the distant lineage IV.

A similar species in Central Asia, *A. rosenorum*, is sometimes also named *A. jesdianum* but differs by scapes ribbed over the whole length and narrower, nearly linear leaves. The separation from *A. jesdianum* is well supported by molecular markers (Fritsch & al. 2010).

**Etymology:** The epithet certainly refers to the well known and important town Yazd that also named the geographic region of the type location.

**Biological data:** Seedlings belong to the *Allium karataviense* type (Druselmann 1992). Very good germination occurs at 5°C, but very bad above 10°C (Specht & Keller 1997). The genome size [2C DNA] was reported as 24.1 pg (Jones & Rees 1968, "*A. jesolianum*") and 38.3 pg (Gurushidze & al. 2012). The plants contain dithiodipyrrole (Plate T64 H; Gurushidze 2008). Bulb extract inhibited growth of some (mainly Gram-positive) bacteria species and showed a very high radical scavenger activity (Jedelská & Keusgen 2008). Fresh bulbs contain in total 0.5 % cysteine sulfoxides (91 % methiin, 9 % isoalliin, Keusgen & al. 2008).

**Economic traits:** Ornamental plant listed in the "International Checklist ..." of the Royal General Bulb-growers Association (1991). However, several strains from European Botanical Gardens were only *A. rosenorum*. The population in Deh Balla did not use this species for food (Fritsch 1996).

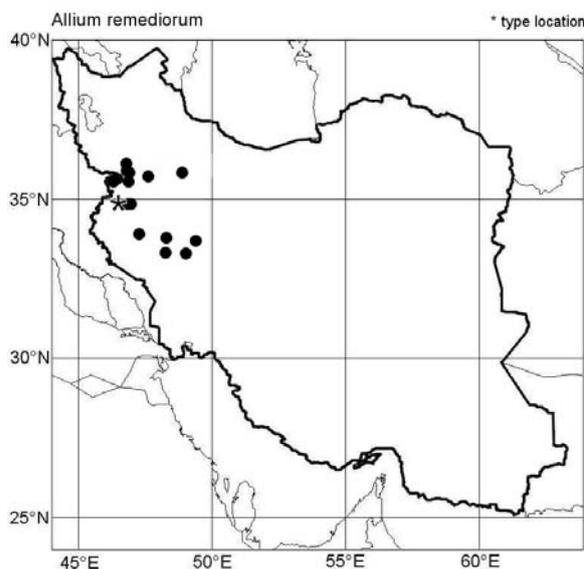
Living accessions studied: **Yazd:** Deh Balla, Obstbäume am unteren Dorfrand (31°32' N, 54°13' E, ca. 2400 m, 12.5.1994 Fritsch 1013, 1015; GAT). Shir Kuh massif, granitic rock slopes in a side valley E vill. Deh Balla (31°37' N, 54°06' E, 2660 m, 18.4.2008 Abbasi, Fritsch 1247; GAT).

Herbarium vouchers: **Kerman:** Pariz, Kohan-Sabz (29°53' N, 55°45' E, 21.4.1984 Yazdani, Ghayomi 44013-IRAN). - **Khuzestan:** Ramhormoz. Izeh. Abkhogan (31°36' N, 50°03' E, 1550 m, 01.5.1973 Rowshan 9500; TARI). **Yazd:** Tezerjan, Kuh-e Barfkhane (31°34' N, 54°09' E, 2400-2600 m, 30.5.1996 Mozaffarian 77536-TARI). Deh Balla, Shir Kuh (31°32' N, 54°13' E, 10.6.1976 Moussavi, Tehrani 428-IRAN; 3200 m, 21.6.1975 Faroughi, Assadi 17947-TARI G). Shirkuh (31°37' N, 54°04' E, 3000 m, 26.5.1977 Unknown collector 43046-IRAN; 3420 m, 06.7.1972 Foroughi 3966; TARI). Deh-bala village (31°37' N, 54°06' E, 12.5.1994 Fritsch 429-IRAN). Jesder Gebirge beim Dorfe Deh-Ballo (31°32' N, 54°13' E, 24.4.1849 Buhse 1341/1346; LE G-Boiss).

Determination unsure: **Kerman:** Baft, Kuh-e-Lalesar (29°33' N, 56°46' E, 30.5.1975 Moussavi, Tehrani; IRAN).

**65. *Allium remediorum*** (R.M. Fritsch) R.M. Fritsch, **comb. nova**. Basionym: *Allium jesdianum* subsp. *remediorum* R.M. Fritsch in Rostaniha 9 Suppl. 2: 53, fig. 12 (2008 publ. 17 Jul 2009). - **Type:** Cultivated in the National Iranian *Allium* collection Tehran no. 1106, leg. 21.4.2008 (holotype IRAN); plants from prov. Kermanshah, Mt. Shahu main chain above village Gheshlagh, 2320 m, 34°58'07" N, 46°27'44" E; leg. 15.5.2006 Abbasi, Fritsch, Keusgen no. 1106.

Bulbs globose to depressed-globose, (1) 2-3 cm in diameter; outer tunics thick, soft, grayish-brown, dissolving in fibers. Scape straight, terete, smooth; 25-40 cm long, 4-6 mm in diameter; glossy green, basally purplish suffused. Leaves 4-7, laminae very narrowly lanceolate, obliquely arcuately ascending, upper part recurved, canaliculate, rather thin; margin smooth; upper side smooth, lower side with broad shallow ribs; glossy vividly green (not glaucous!), basally somewhat purplish suffused. Sheath leaf long, membranous, pale brown, decaying when the scape is shooting. Spathe membranous, splitting in 2-3 shortly triangular, reflexed valves, faintly brown with darker nerves. Inflorescence semi-globose to glo-



bose, many-flowered, moderately loose, 6-10 cm in diameter. Pedicels thin, wiry, of nearly equal length, brownish green, glossy. Anthesis in April to May. Flowers cup-shaped star-like. Tepals linear-lanceolate with a subobtuse to subacute and somewhat cucullate apex, patent; after anthesis spirally enroled; 8-10 mm long, 1.5-2 mm wide; pinkish-purple with purple median vein. Filaments 3/4-5/6 as long as the 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 stipitate, six-furrowed pyriform, basally remarkably narrowed; surface above tuberculate becoming smooth towards the base, green; nectary ducts lead in small dots near the base of the ovary. Style conical to thread-like, 3-4

mm long; pinkish. Stigma dot-like; pinkish. Capsule depressed-globose triangular with 3 shallow furrows, c. 4 mm long, 5 mm in diam., widely opening; valves sub-orbicular, surface coarsely reticulate lacunose, dull yellowish brown. Seeds 1-2 per locule, ovoid to comma-shaped with sharp edges, sometimes with concave sides; 2.5-3 mm long, 2-2.5 mm broad and thick, dull black.

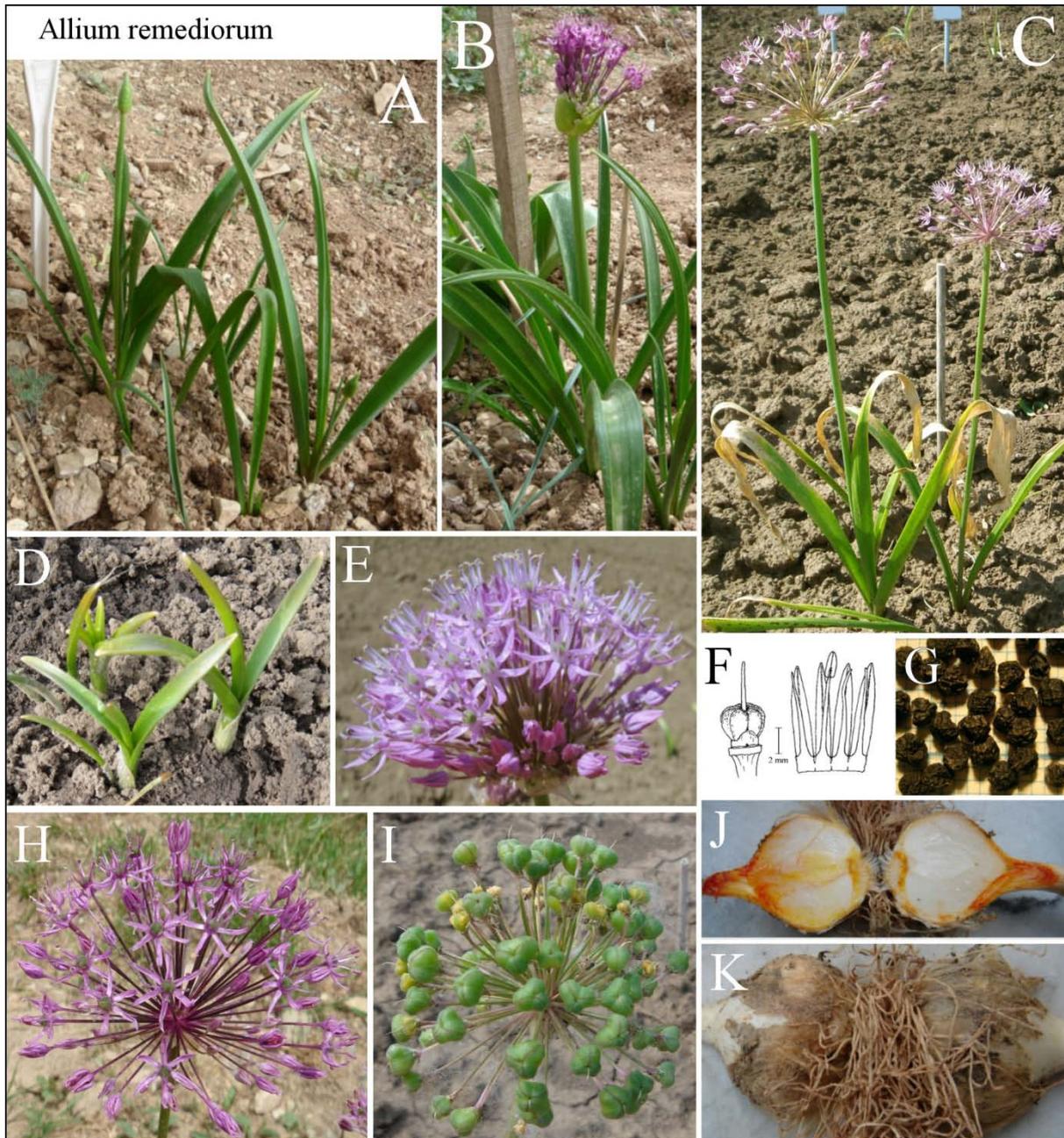


Plate T65. Cultivated plants. A: in the early shooting stage; B: in early anthesis; C: in full anthesis; D: sheath leaves and sprouting leaves; E & H: inflorescences in early and full anthesis, resp.; F: shape of ovary, tepals and filaments of a flower prepared from herbarium; G: seeds (background raster 1 mm); I: inflorescence with full-sized capsules; J: small bulb in longitudinal section, red color of wounded tissue is caused by dithiodipyrrole; K: tunics of the same sectioned bulb.

**Distribution:** SW Iran, provinces Kermanshah, Lorestan, and Fars, but not yet known in detail; montane steppe slopes dominated by perennials. Probably reported from Iraq as *A. jesdianum* (Wendelbo 1985).

**Remarks:** *Allium remediorum* shows only gradual morphological differences to typical *A. jesdianum*: vividly green and glossy (not glaucous and dull) leaves, smooth (not basally ribbed) scapes, thick and soft (not thin and membranous) bulb tunics, and initially rose (not pure white with pink base) filaments. However, molecular markers (ITS sequences of nuclear rDNA and sequences of the plastid *trnL-trnF* region, Gurushidze & al. 2010; Fritsch & al. 2010; see p. 202) presented evidence for a remarkable

genetic distance (explained in detail under *A. jesdianum*) strongly supporting recognition as separate species. A close relationship exists to *A. kazerouni* showing many character states mentioned above for *A. jesdianum* but differing from *A. remediorum* by shorter and lilac (not pinkish-purple) tepals, and lilac filaments longer than the tepals (not shorter than the tepals and pinkish).

**Etymology:** The epithet refers to the medical application of the leaves (from Latin "as remedy").

**Biological data:** Genome size 41.3 pg 2C DNA (Gurushidze & al. 2012 as *A. bakhtiaricum*). The plants contain dithiodipyrrole (Plate T65 J).

**Economic traits:** Local names 'suraneh', 'sorkkeh', 'sorkhe', 'bosor', 'bonsor', and 'sorpa'. Fresh leaves are mainly medically used and also as general tonic, fresh salad and mixed with yoghurt, or as separately cooked vegetable with medical application (Fritsch & al. 2007). They are also used for the traditional dish 'aash'. This species is widely collected and sold on markets in many towns in western Iran; it is endangered because of over-harvesting from the wild (Abbasi & al. 2008, under *A. jesdianum*). The local names cited and explained in Wendelbo (1985) under *A. jesdianum* imply that *A. remediorum* is an edible species also in Iraq.

Living accessions studied: **Kermanshah:** Limestone massif W of Mt. Shahu above village Gheshlagh (34°58' N, 46°28' E, 2320 m, 21.4.2008 Abbasi, Fritsch, Keusgen 1106; IRAN GAT). - **Lorestan:** Kuh-e Garri massif, valley of Kahman river above vill. Dareh-Tang (33°59' N, 48°21' E, 1950 m, 14.5.2007 Abbasi, Fritsch, Keusgen 1178; 2100 m, Abbasi, Fritsch, Keusgen 1180; GAT IRAN). Plants sold at Khorramabad market, said to have been collected in Kuh Sefid mountain range (33°30' N, 48°19' E, 13.5.2007 Abbasi, Fritsch, Keusgen 1172; GAT IRAN). Plants bought on the market in Dorud, said to have come from the mountains around (33°29' N, 49°04' E, 13.5.2007 Abbasi, Fritsch, Keusgen 1175; IRAN). - **Markazi:** Northern slope of Razvand massif above vill. Suraneh (33°52' N, 49°26' E, 2750 m, 10.5.2007 Abbasi, Fritsch, Keusgen 1156; GAT). - **Kurdistan:** Meadow close to the village Kalekan c. 20 km NW Divandarreh (36°01' N, 48°56' E, 2060 m, 18.5.2006 Abbasi, Fritsch, Keusgen 1117; IRAN). Wheat field c. 25 km NW of Divandarreh (36°04' N, 46°52' E, 2300 m, 18.5.2006 Abbasi, Fritsch, Keusgen 1119; IRAN).

Herbarium vouchers: **Kermanshah:** Schahu (35°00' N, 46°30' E, ???.1909 Strauss; JE B).

Determination unsure: Persia (Aucher 2212; G). - **Kermanshah:** Kuh Sefid (34°05' N, 47°20' E, 12.5.1904 Strauss; JE). - **Kurdistan:** 38 km SE Sanandaj to Kamyaran W slopes of Narran village (35°02' N, 47°00' E, 1850 m, 17.5.1987 Fattahi, Khaledian 81; TARI HKS; 2200-2600 m, 15.6.1987 Assadi 60493-TARI). 15 km SW Divandareh to Sanandaj, road of Kooleh to Dozakh darreh, Kapak village (35°44' N, 46°55' E, 2000 m, 13.5.2004 Zarre, Mashayekhi 34904-TUH; GAT). 21 km from Chenareh to Saghez above the pass (35°43' N, 46°22' E, 2200 m, 25.6.2003 Assadi 85077-TARI). Masood-Abad village N Divandarreh (36°17' N, 46°50' E, 1870 m, 24.5.1993 Mohammady 2771; HKS). In monte Hamreh Arab SE Bijar (35°53' N, 47°40' E, 2200-2600 m, 01.7.1971 Lamond, Termé 4335-M, 42590; W B G M). Bijar: Hamza-arab mountain (35°53' N, 47°41' E, 2200 m, 09.4.2002 Maroofi, Sh. Nazeri; IRAN). Saghez Cheheh cheshmah mountain (35°49' N, 46°30' E, 2800 m, 13.5.1999 Kaffash, Karegar 1645; HKS). Divandareh towards Saghez, 20 km NW Divandareh, Obato plain, c. 5 km N Kalkan village (36°00' N, 46°56' E, 18.5.2006 Abbasi, Fritsch, Keusgen 1117; 43974-IRAN). Nashoor village S. Sanandaj, Avalan mountain (35°01' N, 46°52' E, 2200 m, 07.6.1988 Khaledian 2621; HKS). - **Markazi:** in districtu Dschapelakh (33°50' N, 49°24' E, ???.1898 Strauss; B JE). - **Zanjan:** Khoda-Bandeh, via Garmab to Zeynal, Kuh-e Chang-Almas (2150-2300 m, 03.6.1997 Moussavi, Tehrani, Karavar 44005-IRAN).

**66. *Allium kazerouni*** Parsa in Kew Bull. 1949: 33 (1949). - Wendelbo, Flora Iranica No. 76: 84 (1971), Wendelbo, Fl. Iraq 8 (1985) 176, ambae sub *A. jesdianum*. Fritsch in Nordic J. Bot. 16: 10 (1996); Fritsch & al. in Stapfia 80: 391f. (2002). Seisums in Iran J. Bot 8: 224 (2000). - **Type:** *Allium Saporis* Stapf cult. hort Vindob. 1886 Bulb. in jugo Kotael Henan prope Kasrun legit Stapf, second label: *Allium Kazerouni* Parsa in Kew Bull. 1949, 34. Determinavit 22.IV.47 G. Parsa (lectotype K!, design. Fritsch & al. 2010: 206). Paratypes: Kotal Abdui between Kazeroun et Shiraz, 17.5.1885 leg. Stapf; Tang Kaeldu between Kazeroun et Shiraz, 26.5.1885 leg. Stapf.

Bulbs depressed-globose, 15-25 mm in diam.; outer tunics finely reticulate-fibrous, brownish grey. Scape straight, terete, near the base shallowly ribbed; 20-50 (60) cm long, 2-5 mm in diam.; green or reddish flushed. Leaves 2-4 (5), laminae linear-lanceolate, canaliculate, obliquely ascending and recurved; margin smooth, gradually tapering into the cucullate apex; 20-30 (35) cm long, 10-15 mm broad; deep green, semi-glossy. Sheath leaf long or short, finely membranous, hyaline to brownish, soon decaying. Spathe ±

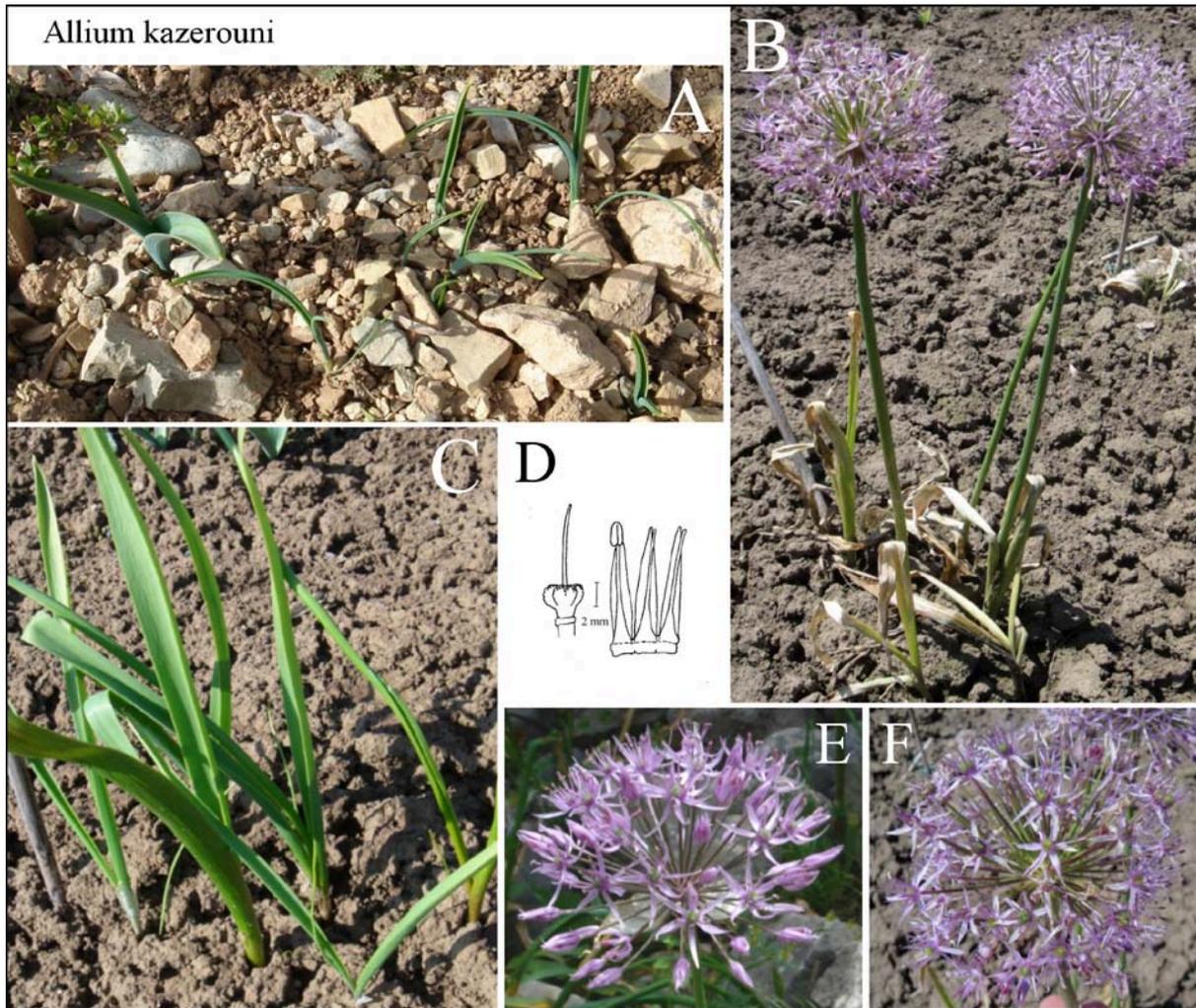
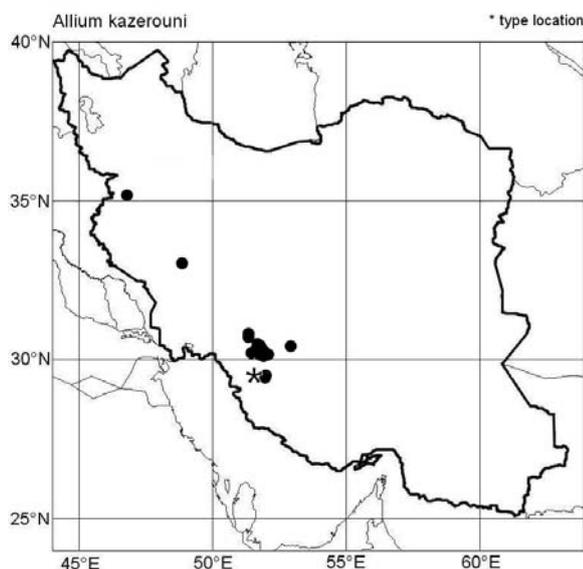


Plate T66. A & C: Sprouting leaves of cultivated plants; B: flowering cultivated plants; D: shape of ovary, tepals and filaments of a flower prepared from herbarium; E & F: inflorescences in early and full anthesis, resp.

finely membranous, split into 2-3 ovate acute valves,  $\pm 1/2$  as long as the pedicels, patent to reflexed. Inflorescence semi- to subglobose, moderately dense, moderately many-flowered; 4-8 cm in diam. Pedicels rather thin, stiff, straight or slightly incurved,  $\pm$  unequally long; green to brown with whitish base. Anthesis in May. Flowers bowl-shaped to flat star-like. Tepals lanceolate-triangular,  $\pm$  patent, slightly incurved, gradually tapering into the subacute apex; after anthesis gradually bending back with curling

margins, crumpled or spirally enroled; 6-8 (10) mm long, outer tepals c. 1 mm, inner tepals 1.3-1.5 mm broad; deep lilac with inconspicuous green median vein. Filaments as long as the tepals or slightly longer, subulate; basally shortly triangular widened (the inner filaments by 1.5 times broader) and for 0.5-1 mm connate; lilac with darker base. Anthers oblong, c. 2 mm long; carmine. Pollen yellowish grey. Ovary stipitate, depressed-globose to short pear-shaped, triangular with 3 shallow furrows; surface tuberculate; c. 3 mm long and in diam.; deep green; 2-3 ovules per locule. Style conical to thread-like, 3-6 mm long; lilac. Stigma undivided, whitish. Capsules short pear-shaped to depressed globose triangular; valves obovate or heart-shaped. Seeds not seen.



**Distribution:** S Iran, prov. Fars and adjacent areas; montane slopes in the shadow of trees or rocks. It is expected to occur also in Iraq.

**Remarks:** There were misprints in the original description making Wendelbo (1966) as well as Seisums (2000) to present rather different corrections and circumscriptions of this species. The description given here is based on plants collected near Dasht-e Arzhan and also studied under cultivation where they became stronger and larger. We apply the name *A. kazerouni* for *A. jesdianum*-like plants found in the province Fars characterized by membranous bulb tunics and ribbed scapes combined with relatively short and more lilac than pink tepals. Plants with a similar stature occurring in more northwestern regions own thicker bulb tunics, with or without ribbed scape, and longer pink to purplish tepals; they are affiliated to *A. bakhtiaricum* and *A. remediorum*. Molecular markers (ITS sequences of nuclear rDNA and sequences of the plastid *trnL-trnF* region) put *A. kazerouni* in the same subgroup with *A. remediorum*, *A. bakhtiaricum*, *A. pseudohollandicum*, and all accessions of *A. stipitatum* from the Zagros mountain range, but *A. jesdianum* subsp. *jesdianum* and subsp. *angustitepalum* are positioned in another more distantly related subgroup (Fritsch & al. 2010; Gurushidze & al. 2010; see p. 202).

**Biological data:** Seisums (2000) reported 2(-3) ovules per locule.

**Economic traits:** Local names and use mentioned by Abbasi & al. (2008) under *A. jesdianum* may partly refer to *A. kazerouni* that was not held separate at that time. A local name 'bon sorkh' and use as vegetable cooked with rice were noted on the voucher Hatami 14332.

Living accessions studied: **Fars:** Limestone massif on the other side of the valley opposite to Dasht-e Arzhan (29°37' N, 52°01' E, 2250 m, 13.4.2008 Abbasi, Fritsch 1233; GAT IRAN). Limestone hills near the main road from Shiraz to Kazeroun c. 10 km E Dasht-e Arzhan (29°41' N, 52°03' E, 2030 m, 13.4.2008 Abbasi, Fritsch 1232; IRAN). ? **Kohgil. Buyerahmad:** N slopes E of vill. Vezg c. 20 km from Yasuj to Ardakan (30°31' N, 51°41' E, 2380 m, 04.5.2010 Abbasi, Fritsch, Keusgen 1299; GAT).

Herbarium vouchers: **Fars:** Shiraz, Arzhan desert, Galukhajah mountains (2250-2400 m, 18.5.1975 Moussavi, Tehrani 289-IRAN). Sepidan to Yasuj (30°19' N, 51°57' E, 2500 m, 01.5.2002 Hatami 117; HSU ARIY). cult. hort Vindob. 1886 Bulb. in jugo Kotael Henan prope Kasrun (29°37' N, 51°39' E, Stapf; K).

Determination unsure: **Fars:** Marvdash, Kamfiruz, Tange Bostanak (30°19' N, 52°11' E, 07.5.1999 Hatami 14332; HSU). Sepidan, road of Deh Kohneh to Keshtir (30°22' N, 51°48' E, 12.5.1996 Hatami 10406; HSU). Kakan (Wdb. 71: Kakun), Kachian mountain (30°38' N, 51°48' E, Kashkouli 7079-E; 283-IRAN). Sepidan to Komehr, Chehel Cheshmeh (30°19' N, 51°57' E, 2500 m, 13.5.1997 Hatami 11522; HSU ARIS). Shiraz, Dasht-e Arjan, old road to Kazeroun, first pass (29°40' N, 52°02' E, 2200 m, 27.5.1975 Foroughi 17456-TARI). Sepidan (Ardakan), Margunm (Margoona) waterfall (30°31' N, 51°54' E, 2300 m, 29.4.2009 Eskandari & Bahramishad 54397-IRAN). Kuh-e Tamer 20 km SW Yasoj versus Ardekan (30°30' N, 51°39' E, 2350 m, 11.5.1977; HIU). Neyriz, Moshkan village, Kuhe Sar-e Sefid (30°37' N, 52°57' E, 2700-3000 m, 25.5.1975 Mousavi, Tehrani 430-IRAN). Yassoudj: 20 km SW versus Ardekan (30°32' N, 51°43' E, 11.5.1977 collector unknown 43047-IRAN). Yasuj 51 km Fahlian road (30°23' N, 51°30' E, 1660 m, 28.4.1972 Foroughi 3542; TARI). Kakan, Kochian (montes) (30°38' N, 51°48' E, 15.6.1967 Kashkouli 283-IRAN). Khaniman, Behesht-e gomshodeh (30°21' N, 52°12' E, 1900 m, 26.4.2009 Eskandari, Bahramishad 54398-IRAN). - **Kohgil. Buyerahmad:** Pataveh, Mt. Shurum (30°59' N, 51°22' E, 2710 m, 11.5.1989 collector unclear 3022; ANY). Delimir (2150 m, 10.5.1990 collector unclear 3150; ANY). Dena Mt. S slope (31°00' N, 51°23' E, 2500 m, 31.5.1995 Mortazavi 3175, 3187; ANY). Tootnadeh to Dashtak, road to Dashtak pass (30°54' N, 51°23' E, 2270 m, 25.5.2009 Mirinejad 7139; ANY). Dean Mt., N Absepah (2500 m, 15.8.2003 Assadpour, Mortazavi 138; ANY). Fahlian, 19 km to Yasuj, E slope (30°24' N, 51°30' E, 1800 m, 26.4.1973 Riazi 9350; TARI). Kakan, Baba Hassan pass (30°40' N, 51°44' E, 2720 m, 03.6.1989 collector unclear 2965-ANY; Jafari 3016 3040; ANY). - **Kurdistan:** Sanandaj, Ariz area (35°22' N, 46°51' E, ??5.2002 Faezeh Bidarpur; IRAN). - **Lorestan:** Sepid Dasht, along the Vask river (33°13' N, 48°53' E, 1800 m, 15.5.1993 Rosbahani 963; ARCK).

**67. *Allium orientoiranicum*** Neshati, Zarre & R.M. Fritsch in Acta Bot. Fennica 46: 599, Fig. 1 (2009). - **Type:** Iran, prov. Khorasan: Torbat-e Jam, Bezd mountains, gravelly E slope, 1780-1820 m, 06.5.2007 Neshati & Zangoui 35912 (holotype TUH, isotypes FUMH!, TARI).

Bulbs 1.3-2.5 cm in diam., oblong-ovoid; outer tunics grayish brown. Scape subflexuous, terete, upper part smooth, basal part with shallow ribs; 30-75 cm long, 5-8 mm in diam.; green, near the base brown suffused. Leaves 2-4 (6), laminae narrowly lanceolate, rather thin, canaliculate, arcuately ascending and

recurved to the soil, long to short arcuately tapering into the cucullate apex; margin, upper and lower side completely smooth; 20-35 cm long, 1.2-2 (3) cm broad; green with glaucous bloom, sometimes brown suffused toward the base. Sheath leaf long, membranous, smooth, brownish, soon decaying. Spathe membranous, divided into 2-3 ovate, shortly acuminate valves, patent to subreflexed, shorter than the pedicels; brownish with purple veins. Inflorescence semi- to sub-globose, moderately loose, many-flowered, 5-8 (10) cm in diameter. Pedicels straight, moderately thick, wire-like stiff, 3-4.5 cm long, green with purplish flush, semi-glossy. Anthesis and fruiting in April to May. Flowers bowl-shaped star-like. Tepals lanceolate-triangular, canaliculate and incurved, tip subacute, patent, after anthesis reflexed and crumpled up to spirally enrolled, 5.5-8 mm long, 0.6-1.3 mm broad; pinkish-carmine with narrow greenish-brown median vein. Filaments slightly longer than the tepals, straight, subulate, basally for 0.5-1 mm connate, base of inner filaments shortly triangular dilated; initially pure white with pink base, later pink with darker base. Anthers oblong, 1.5-1.7 mm long, purplish. Pollen grayish yellow, shape oblate, 31  $\mu\text{m}$  long, 17  $\mu\text{m}$  broad, P/E index 0.6, sculptures microrugulate, wall 0.9  $\mu\text{m}$  thick (Neshati & al. 2009). Ovary obovoid to globose, with 6 indistinct apical outgrowths (hornlets), surface

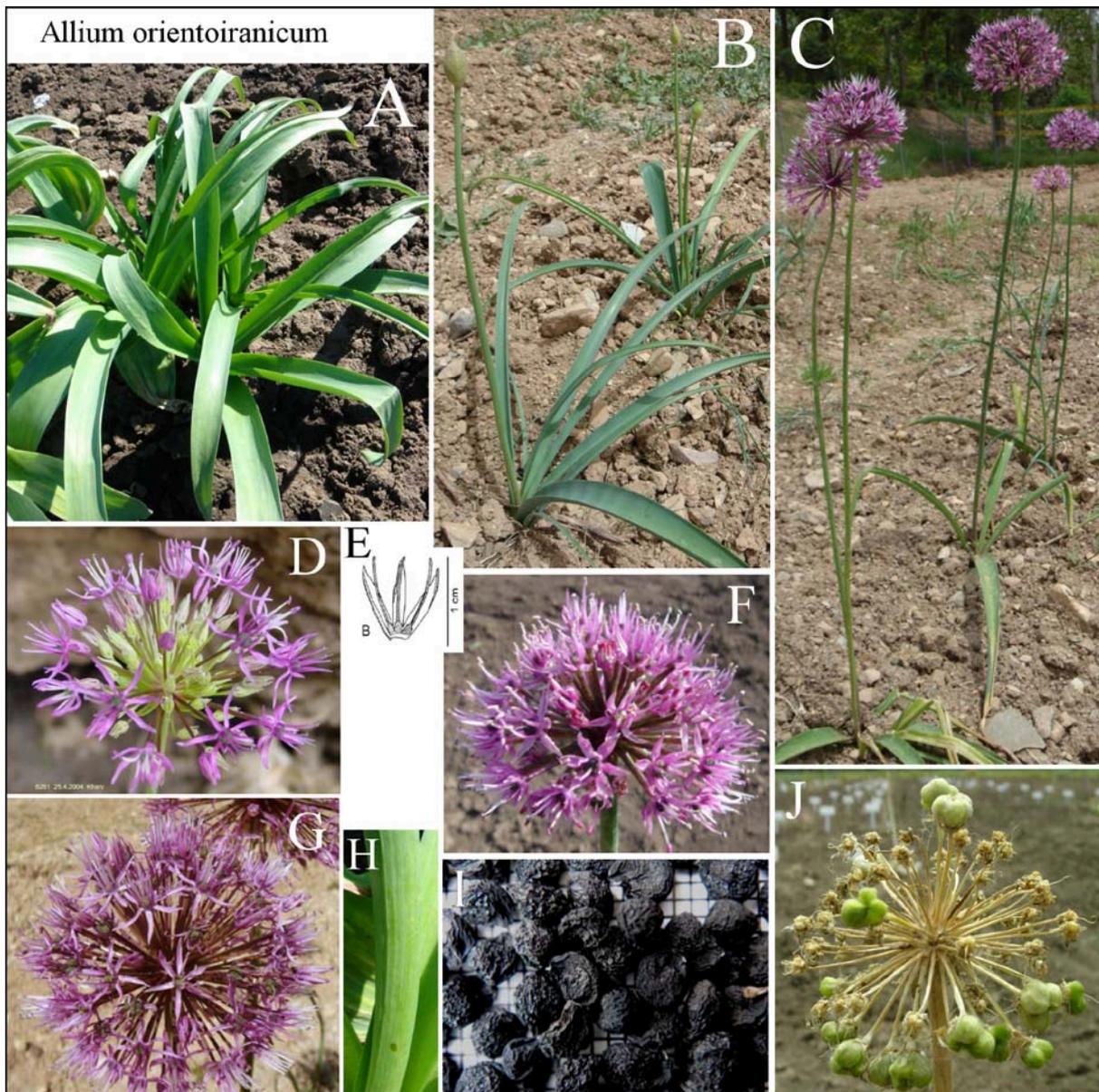
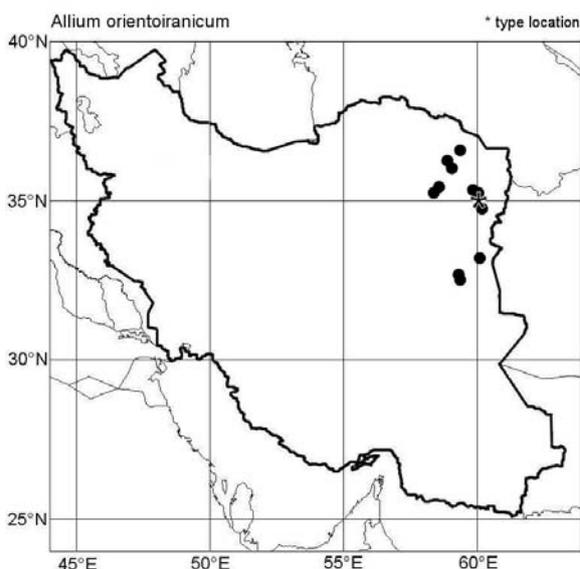


Plate T67. A: Leaves of cultivated plants after sprouting; B: cultivated plants in the shooting stage; C: flowering cultivated plants; D: inflorescence in early anthesis near Kharv; E: filaments and tepals (from Neshati & al. 2009: Fig. 1B); F & G: inflorescences in full and late anthesis; H: shallow ribs at the base of the scape; I: seeds (background raster 1 mm); J: inflorescence with full-sized fertile capsules and shriveling sterile capsules.

tuberculate; nectary ducts lead in pits near the base of the ovary. Style filiform, 5.5-7.5 mm long; initially white later pink. Stigma undivided, white. Capsule depressed-globose triangular with 3 rather broad furrows, 4-5 mm long, 5-7 mm in diam., surface tuberculate; widely opening; valves transversally elliptic with a deep longitudinal furrow and broadly notched at the apex; yellowish brown. Seeds 1(-2?) per locule, dull black, rugose with irregular reticulate ledges, c. 3 mm long, 2.5 mm broad, 1.5 mm thick.

**Chromosomes:**  $2n = 16$  Gurushidze & al. 2012 (Iran: Khorasan, Kharv-e Olya, "*A. jesdianum*").

**Distribution:** Iran, prov. Khorasan; gravelly slopes in (sub)montane mountain steppes, in the shadow of rocks.



**Remarks:** *Allium orientoiranicum* strongly resembles typical *A. jesdianum* differing only by filaments somewhat longer than the tepals and with more quadratic bases. Plants collected in Binalud mountain range did not much differ from plants from the type location of *A. jesdianum* when cultivated in Tehran (Fritsch 2008: 66), especially quadratic bases of the outer filaments were not visible. Molecular markers (ITS sequences of nuclear rDNA) positioned this sample in one large group with all subspecies of *A. jesdianum* (as *jesd6261*, Fritsch & al. 2010; see p. 202). Further detailed investigations will have to present evidence that *A. orientoiranicum* is more than only a variant of *A. jesdianum*.

**Etymology:** The epithet refers to the distribution of this species in East Iran (from Latin).

**Biological data:** Genome size 38.3 pg 2C DNA is identical to *A. jesdianum* from the type location (Gurushidze & al. 2012).

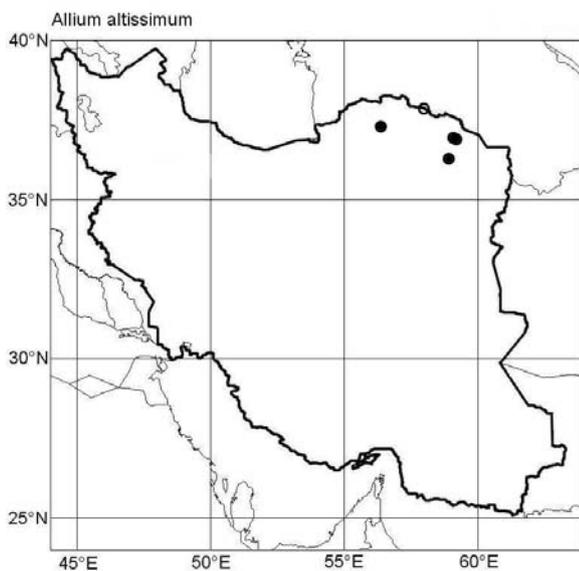
Living accessions studied: **Raz. Khor.:** Binalud massif near vill. Kharv e Olya (36°12' N, 59°05' E, 1700 m, 25.4.2004 Keusgen, Fritsch 1033; GAT, IRAN).

Herbarium vouchers: **Raz. Khor.:** Chenaran, Frizi area, N slope of Dahaneh-e Jaji (36°26' N, 58°56' E, 1890-2107 m, collector unclear 36379; FUMH). SW Turbat-e Jam, Kurdian (34°56' N, 60°13' E, 1500-1600 m, 01.5.1985 Ayatollahi 12464; FUMH). SW Turbat-e Jam, Bezd mount (35°11' N, 60°22' E, 06.5.2007 Zangoeei, Neshati 38758, 38762; FUMH). NW Turbat-e Jam, Bardu forest (35°25' N, 60°05' E, 1500-1600 m, 24.6.2003 Joharchi 34822; FUMH). Neyshabour, Kharv (36°12' N, 59°05' E, 25.4.2004 Amini Rad, Keusgen, Fritsch 44017-IRAN). Between Kashmar and Neishabur, Chalpu (35°36' N, 58°34' E, 1700 m, 29.5.1997 Hojjat, Zangoeei 28911; FUMH). SE Fariman, Ghalandar Abad, Bozeh Khoshk mountain (35°31' N, 59°53' E, 1800 m, 25.5.1989 Ayatollahi, Zangoeei 17456; FUMH). NW Torbat Heidarieh, Bezgh (35°37' N, 58°41' E, 1500 m, 27.5.1997 Hojjat, Zangoeei 28818; FUMH). In saxosis montium 13 km N Kashmar versus Rivash (35°23' N, 58°26' E, 1300-1400 m, 04.5.1975 Rechingner 51185; W B G). Kashmar, Rivash (Kuh Sorkh), mountain between Targh and Kalateh-teimuri (35°30' N, 58°26' E, 1800 m, 04.5.1994 Faghinia, Zangoeei 23853; FUMH). SW Turbat-e Jam, Miansara mountain (35°08' N, 60°23' E, 1300 m, 23.4.2002 Joharchi 34039; FUMH). Hezar-Masjed mountains, mountains above Ardak dam (36°45' N, 59°24' E, 1400 m, 28.5.2009 Zarre, Salmaki, Ebrahimi 38144; M). Kuh-e Bezgh c. 50 km NNE Kashmar (35°37' N, 58°35' E, 1900-2500 m, 13.6.1981 Assadi, Mozaffarian 35733-TARI). - **S Khor.:** E Birjand, Akbar abad towards Hassan abad (32°52' N, 59°21' E, 2300 m, 28.4.1998 Faghinia, Zangoeei 30166; FUMH). Ghayen, Zirkuh, Dahaneh-e Ahangaran (33°22' N, 60° 08' E, 1435 m, 19.5.2005 collector unclear 36279; FUMH). SE Birjand, Barzaj (32°42' N, 59°24' E, 2200 m, 30.4.1998 Faghinia, Zangoeei 30262; FUMH).

**Allium subsect. *Elatae*** R.M. Fritsch in *Candollea* 48: 426 (1993), sub sect. *Megaloprason*. - *Allium* sect. *Molium* series *Altissima* Tzag. in *Bot. mat. gerb. inst. bot. AN Kaz. SSR vyp. 10: 14* (1977), type: *A. altissimum* Regel. - Type: *A. stipitatum* Regel

**68. *Allium altissimum*** Regel in Trudy Imp. S.-Peterb. Bot. Sada 8: 666, t. 21 Fig. k, l, m (1884), Regel in Trudy Imp. S.-Peterb. Bot. Sada 10: 302, 361 (1887). Vved., Flora URSS 4: 269 (1935). Nikitina & Kashtsh., Fl. Kirg. SSR 3: 95 (1951); Nikitina & al., Fl. Kirg. SSR, Dopoln. vyp. 1: 52 (1967). ? Pavlov & Polyakov, Fl. Kazakhst. 2: 192, tab. 14/9 (1958). Vved., Flora Tad. SSR 2: 350 (1963); Vved. [ & Kovalevskaya], Opred. rast. Sredn. Azii 2: 85 (1971). Wendelbo, Flora Iranica No. 76: 83, tab. 8/113, tab. 26/3 (1971), p. p. Kamelin ex Nikitin & Gel'dikhanov, Opredel. rast. Turkmen.: 128 (1988). Fritsch in Nordic J. Bot. 16: 14 (1996). Seisums in Iranian J. Bot. 8: 228 (2000), ? p. p. Fritsch & al. in Stapfia 80: 392 (2002). - *Allium jesdianum* Boiss. & Buhse var. *latipetalum* Lipsky in Trudy Imp. S.-Peterb. Bot. Sada 18: 145 (1900). *Allium jesdianum* sensu Vved., Flora Turkm. 1, 2: 292 (1932), p. p. - Type: Ex horto bot. Petropolitano 84. 6 In Turkestanica occid. semina mis. Dr. A. Regel (lectotype LE!, design. Fritsch, 1990: 502).

Bulbs depressed-globose, 2-4 cm long, 3-6.5 cm in diam.; outer tunics papery, yellowish gray, somewhat splitting into fibers. Scape straight, terete, smooth; 50-80 (100) cm long, 6-10 (12) mm in diam.; ± dull green with purple flush in the lower part. Leaves 4-6, laminae narrowly linear-oblong, stiff obliquely directed and somewhat longitudinally twisted, thickish, broadly canaliculate; margins smooth or somewhat toothed near the base, shortly arcuately tapering into the cucullate apex; upper side smooth, lower side with shallow broad ribs; 30-50 (80) cm long, 2-6 (9) cm broad; yellowish to deep green with moderate glaucous bloom. Sheath leaf moderately long, thickish, later decaying, mostly maroon. Spathe membranous, completely split into 2-3 acuminate, ± reflexed valves, 1/3-1/2 as long as the pedicels; pale brown with inconspicuous veins. Inflorescence subglobose, many-flowered, dense, 4-6 cm



in diam., in the fruiting stage up to 9 cm in diam. Pedicels thickish, straight, stiff wire-like, unequally long; 15-40 mm long; greenish purple, glossy. Anthesis in April to May. Flowers flat bowl-shaped star-like. Tepals linear-oblong or linear-lanceolate, ± canaliculate with a concave acute tip, patent; later reflexed, crumpled, and spirally enrolled; 6-8 mm long, c. 2.5 mm broad; deep pink to purplish carmine with a darker median vein. Filaments 2/3-4/5 as long as the tepals, subulate, nearly straight; basally triangular broadened (inner filaments remarkably broader) and c. 0.5 mm long connate; carmine with paler base. Anthers oblong, c. 3 mm long and 1 mm broad; pink. Pollen grayish yellow, shape oblate, 34 µm long, 20 µm broad, P/E ratio 0.6, sculptures rugulate to microrugulate, wall 1 µm

thick (Neshati & al. 2009). Ovary stipitate, depressed-globose triangular with 3 broad and 3 narrow furrows, surface densely acute-papillose; dull green. Filimonova (1970) counted up to 6 ovules per locule and 15 ovules per ovary. Nectary ducts lead in small pores near the base of the ovary. Style narrowly conical to thread-like, 2-4 mm long; pink. Stigma dot-shaped; whitish. Capsule stipitate, depressed globose triangular with a concave apex, surface finely tuberculate, semi-glossy; 4-7 mm long and 8-10 mm in diam.; valves transversely elliptic, deeply notched at the apex; pale yellowish brown. Seeds 2-3 per locule, flat ovoid to drop-shaped, surface coarsely reticulate lacunose; 2.5-3 mm long, c. 2.5 mm broad, 1.5-2 mm thick, semi-glossy black, TKW 6.9 g (IPK, unpubl. results). The testa showed periclinal walls with prominent verrucae and transitions from S-like to U-like undulation on the anticlinal walls (Fritsch & al. 2006).

Chromosomes: 2n = 16 Ohri & al. 1998 (Kazakhstan: Botanical collection).

Distribution: NE Iran, Turkmenistan, Afghanistan, Tajikistan, Uzbekistan, Kyrgyzstan, Kazakhstan; among shrubs and under trees on not too dry submontane to montane rocky and steppe slopes.

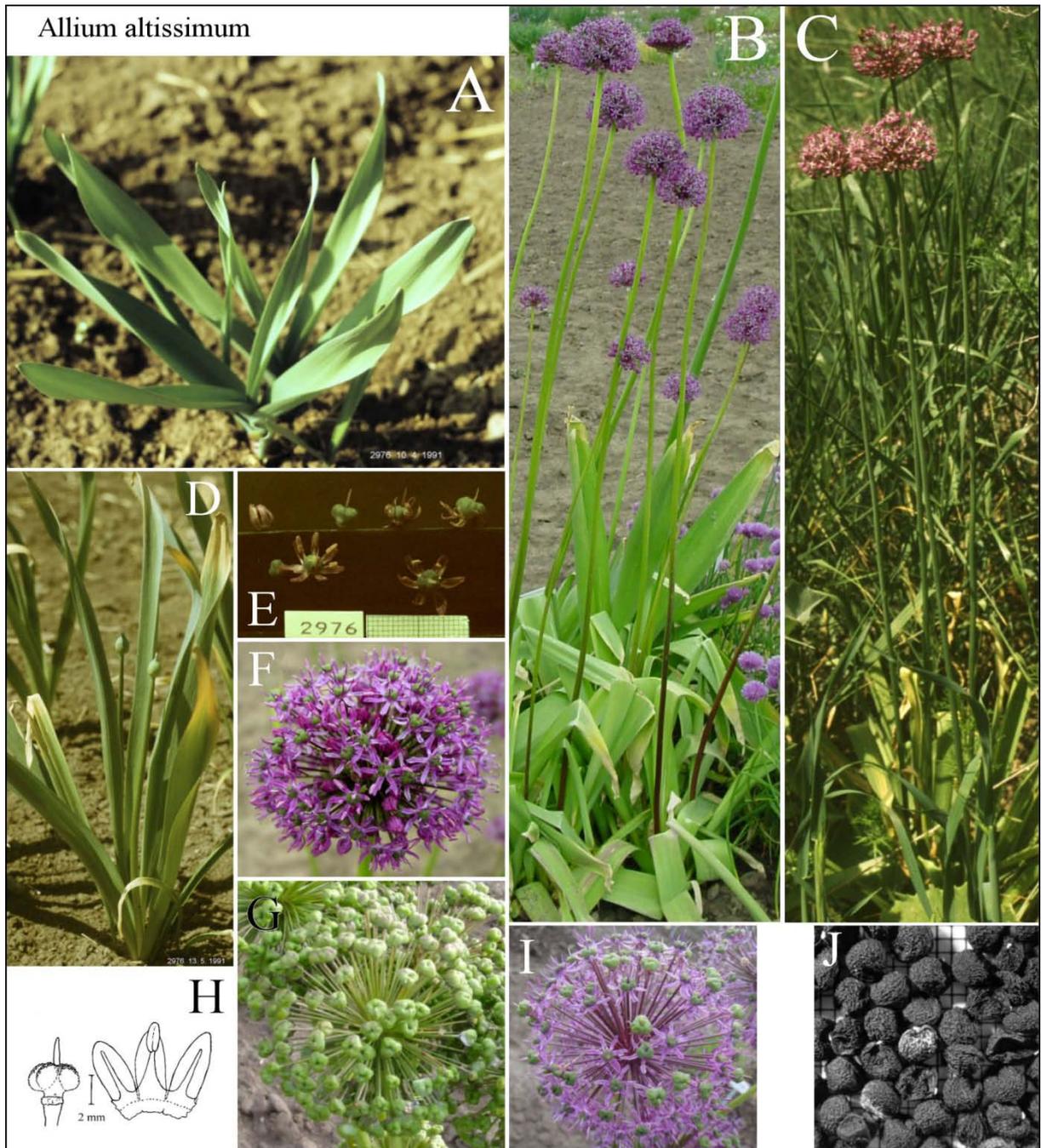


Plate T68. A: Sprouting leaves of cultivated plants; B: flowering cultivated plants; C: flowering Turkmenian plants in Ashgabat; D: cultivated plants in the shooting stage; E: comparison of flower parts in different stages; F & I: inflorescences in early and full anthesis, resp.; G: inflorescences with full-sized capsules; H: shape of ovary, tepals and filaments of a flower prepared from herbarium; J: seeds (background raster 1 mm)

**Remarks:** The lectotype of this species is incomplete and shows no clear differences to glabrous plants of *A. stipitatum*. The main key character in the original description, the snail-like olive and whitish speckled apex of the scape is not visible on the lectotype and was also never mentioned in later descriptions. Because the type location is not exactly known ("... from the West of province Buchara "Baldschuan" ", but this settlement is located in the eastern part of that historical province), authentic material could not be re-collected. Also the discussion of Seisums (2000) does not deal with plants from the type location and therefore cannot contribute to the knowledge of *A. altissimum* in the strict sense. Thus this species is here accepted as being more slender and somewhat smaller than typical *A. stipitatum* possessing narrower and glabrous (or at the most only sparsely toothed) leaves, a smaller umbel, and more intensely colored, sublinear, in late anthesis spirally enrolled tepals. These plants were obtained from a taxonomic collection without documented source, and correspond very well to

the original description and to the lectotype. Wendelbo's photo (1971: Tab. 26 - 3, an inflorescence from NW Afghanistan) corresponds also well to the mentioned key characters. Molecular analyses (ITS sequences of nuclear rDNA, sequences of the plastid *trnL-trnF* region) positioned our cultivated strain of *A. altissimum* among many accessions of Central Asian *A. stipitatum* underlining a high genetic similarity (Fritsch & al. 2010; Gurushidze & al. 2010; see p. 202).

**Etymology:** The epithet reflects the striking grand appearance of the flowering plants (from Latin "the highest").

**Biological data:** Some anatomical scape characters were shown, but not discussed at the species level (Fritsch 1993 Fig. 7A). This species is an early flowering and short-vegetating geophemeroid; the bulb scales are up to 2 cm thick, the root system belongs to the bulbous type and is frequently ephemeroïdal, nonbranching, diffuse with up to 40 cm deep root penetration and up to 200 roots per plant; the leaf primordia of the next year's shoot develop in April to June and the inflorescences in August to October (Kamenetsky 1992). Bulbs are up to 4 cm long and 6.5 cm in diam., c. 10 cm deep buried in the soil, with up to 300 white or yellow, unbranched, up to 72 cm long roots penetrating up to 25 cm deep into the soil (Bajtulin & Kamenetskaya 1984). The storage scales are pale to dark yellow; the ability of generative multiplication is reduced, only 33 % of the flowers set seed (Yur'eva & Kokoreva 1992). Anatomical and phenological phases of the development were described by Kamenetsky & Japárova (1997). Seedlings belong to the *Allium karataviense* type (Druselmann 1992). Very good germination occurs at 5°C, but very bad above 10°C (Specht & Keller 1997). The plants contain steroids, also phenolcarbon acids, chlorogens, and flavonoids; the bulbs can be used as glue (Sokolov 1994). The bulbs contain c. 0.4 % 2-pyridyl-cysteine sulphoxide and 0.49 - 0.86 % methiin (Kusterer & al. 2010). Reported genome size [2C DNA]: 38.7 pg (Vakhtina & al. 1977), 36.5 pg (Zakirova 1989), 47.7 pg (Ohri & al. 1998), 44 pg identical with *A. stipitatum* (Gurushidze & al. 2012).

**Economic traits:** Ornamental plant listed in the "International Checklist ..." of the Royal General Bulb-growers Association (1991). In Moscow cultivated as ornamental of cemeteries (Bochkin & Nasimovich 1999). All *A. altissimum* strains grown in IPK from seeds received from European botanical gardens were ± glabrous forms of *A. stipitatum* (Fritsch, unpubl. data). The true strain distributed from the Imperial St. Petersburg Botanical Garden at the end of 19th century seems to be extinct, but the strain collected by Wendelbo in NW Afghanistan (Wdb. 8237, discussed above) could still exist somewhere. In Kazakhstan the bulbs are regarded as edible and are collected (Pavlov & Polyakov 1958); the leaves (Saidov 1986) and the aerial and subterranean plant parts (Sokolov 1994) are eaten as vegetables.

Herbarium vouchers: **Raz. Khor.:** S Daregaz, Rishkhar (37°07' N, 59°07' E, 1800 m, 28.5.1990 Joharchi, Zangooei 18647; FUMH). Chenaran, Frizi area, Gosh-Khar valley (36°28' N, 58°58' E, 1616 m, 21.5.2005 (no collector) 36335; FUMH). Bin-lud mountains, Kang (36°19' N, 59°13' E, 1800 m, 22.5.1990 Faghinia, Zangooei 18639; FUMH).

Determination unsure: **N Khor.:** W Bojnurd, Ghorkhod protected region, Kastan village, Zoijanan (37°28' N, 56°25' E, 1450-1500 m, 09.6.2011 Memariani, Arjmandi 44388; FUMH).

**69. *Allium stipitatum*** Regel in Trudy Imp. S.-Peterb. Bot. Sada 7: 546 (1881), in Gartenflora 30: 355, t. 1062 Fig. 1-3 "a, b, c," (1881), Regel in Trudy Imp. S.-Peterb. Bot. Sada 10 (1887) 301, 302, 360. Vved., Flora URSS 4: 267 (1935); Vved., Fl. Turkm. 1, 2: 292 (1932); Vved., Flora Uzbek. 1: 461 (1941); Vved., Flora Tad. SSR 2: 349 (1963); Vved. [& Kovalevskaya], Opred. rast. Sredn. Azii 2: 85 (1971). Nikitina & al., Fl. Kirg. SSR, Dopoln. vyp. 1: 51 (1967). Wendelbo, Flora Iranica No. 76: 85, tab. 9/121 (1971). Kamelin ex Nikitin & Gel'dikhanov, Opredel. rast. Turkmen.: 128 (1988). Fritsch in Nordic J. Bot. 16: 13 (1996). - *Allium hirtifolium* Boiss., Fl. orient. 5: 281 (1882). Type: In Persia prope Ispahan, leg. Aucher No. 5389 (lectotype G!, iso-lectotype K; design. Fritsch & al. 2010: 205). *Allium atropurpureum* Waldst. & Kit. var. *hirtulum* Regel in Trudy Imp. S.-Peterb. Bot. Sada 3, 2: 248 (1875), *A. atropurpureum* "M. Bieb." sensu Regel in Trudy Imp. S.-Peterb. Bot. Sada 10: 359 (1887), p. p. maj. - **Type:** Zaravshanskij bassejn, pereval Anzob, vysota 10000', 20.6.1870, leg. O. Fedtschenko (lectotype LE!, iso-lectotype TASH-Fedt!, design. Fritsch, 1990: 508).

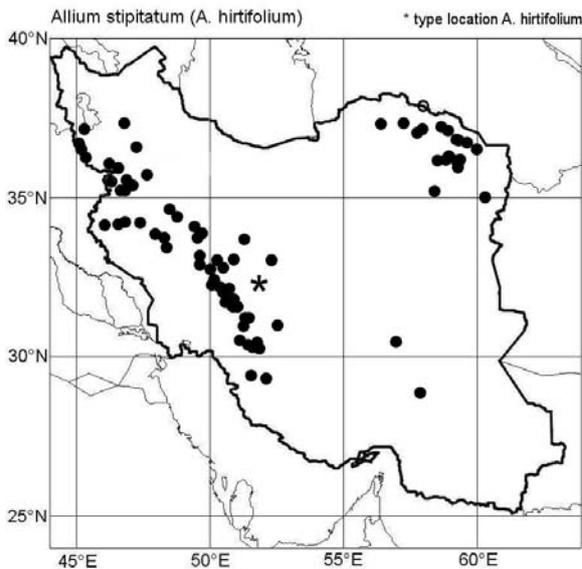


Plate T69. A & B: Cultivated plants sprouting and in early shooting stage, resp.; C & D: flowering cultivated plants; E: inflorescence at start of anthesis; F: shape of ovary, tepals and filaments of a flower prepared from herbarium; G: seeds (background raster 1 mm); H: sheath leaf and bases of laminae of a moderately hairy plant; I: roadside population near Sanandaj; J, K & L: inflorescences in full anthesis, J: inflorescence of the albinotic form, K & L: the typical form from the type location in Tajikistan, and near Sanandaj, resp.; M: inflorescence with full-sized capsules; N: bulbs presented for sale at Kermanshah market; O: infructescence with open capsules in Tajikistan.

Bulbs depressed to flat-globose, 3-8 (12) cm in diameter, 2-4 cm long; outer tunics papery, splitting into longitudinal fibers, yellowish to dark gray. Lateral bulbs small, shield-shaped, terminating 1-2 cm long, flat stolons. Scape straight, terete, smooth and glossy like polished, 70-100 (150) cm long, 6-12 (15) mm in diam.; green often purple suffused in the lower part and with some glaucous bloom. Leaves 4-7 (10), laminae narrowly to broadly oblong to lanceolate, steep arcuately ascending and recurved to the soil or upper part hanging down, rather thick, broadly canaliculate; margin shortly arcuately tapering into the cucullate apex; upper side with shallow furrows, lower side with broad ribs, densely to loosely ciliate on both sides, sometimes only with sparse cilia or tooth in the basal part on ribs and along the margins (single glabrous plants sometimes occur); 30-65 (80) cm long, (1.5) 3-8 (14) cm broad (the innermost leaves are the narrowest but only slightly shorter); glaucous or vividly green with glaucous bloom, often semi-glossy. Sheath leaf rather long, glossy, thickish, brownish green to deep purple, moderately long persisting. Spathe papery, completely split into 2-3 (5) oval, shortly acuminate, finally reflexed valves; pale yellowish brown with inconspicuous veins. Inflorescence initially broadly fastigiate later depressed globose, dense, many-flowered (up to 300 flowers); (3) 5-8 (12) cm in diam., in the fruiting stage also larger. Pedicels rather thick, straight or slightly ascending, stiff wire-like, subequally long, (1) 2-5 cm long; brownish to purplish green, semi-glossy. Anthesis in May to June. Flowers flat star-like. Tepals narrowly oblong to lanceolate-triangular, apex  $\pm$  cucullate, subacute, basally  $\pm$  free, patent and slightly incurved; after anthesis deflexed and crumpled to enrolled; (7) 10-12 mm long, basally 1.3-2 mm broad; pale to deep pink to purplish with a purple to greenish median vein darker on the dorsal side. Filaments  $3/4$  to as long as the tepals, subulate,  $\pm$  straight; base triangular widened (inner filaments remarkably broader) and for 0.5-0.8 mm connate; color paler than the tepals and darker towards the apex. Anthers oblong, 2.3-3 mm long, c. 1 mm broad; lilac. Pollen pale yellowish gray; 27.5 / 30 / 35.5-37.5  $\mu\text{m}$  long, 15 / 17.5-20  $\mu\text{m}$  broad, P/E index 0.5, shape oblate to peroblate, sculptures rugulate to microrugulate, wall 1.1  $\mu\text{m}$  thick, exine 0.7  $\mu\text{m}$  thick, perforations 0.1  $\mu\text{m}$  in diam., (Levan 1935; Neshati & al. 2009; Namin & al. 2009). Ovary stipitate, depressed globose tripartite to sexangular with 6 longitudinal furrows, surface covered by acutely papillose cells in transverse rows; 2-2.5 mm long, 3-4 mm in diam.; dull pale green; nectary ducts lead in pits at the base of the ovary below the bottom of the locules (Fritsch 1992b); up to 5 ovules per locule, 14 ovules per ovary (Filimonova 1970). Style narrowly conical to thread-like; whitish. Stigma undivided; white. Capsule depressed globose triangular with 3 broad and 3 narrow furrows, at the apex concave, surface papillose semi-glossy; 4-8 mm long, (5) 7-10 mm in diam., widely opening; valves suborbicular, rather shallowly notched at the apex; pale yellowish brown. Seeds 1-2 (3) per locule, ovoid to flat drop-shaped, surface finely tuberculate with irregularly reticulate ledges; c. 3.5 mm long, 3 mm broad, 2.5 mm thick; semi-dull black. The testa showed verrucose periclinal walls with a moderate or high number of verrucae. The anticlinal walls showed transitions from S-like to U-like and to Omega-like forms with moderate to short wavelengths and low amplitudes (Kruse 1984; Fritsch & al. 2006). TKW 8.46 / 9.44 g (IPK, unpubl. data of 2 accessions).

**Chromosomes:**  $2n = 16$  Levan 1935 fig. 16h (Netherlands: Botanical collection).  $2n = 16$  Vakhtina 1964, 1969 (Uzbekistan: Zeravshan mountain range).  $2n = 16$  Vakhtina 1964, 1969 p. 148 (Tajikistan: Hissar mountain range, "*A. altissimum*").  $2n = 16$  Ved Brat 1965a fig. 7, 1965b (Italy: Botanical collection).  $2n = 16$  Pedersen & Wendelbo 1966 (Iran: Bakhtiari, Kuh Rang, "*A. hirtifolium*").  $2n = 16$  Dietrich 1967 (France: Botanical collection).  $2n = 16$  Zakirova & Vakhtina 1974 (Tajikistan: Hissar mountain range, Turkmenistan: Ashkhabad, "*A. altissimum*").  $n = 8$  Vakhtina & al. 1977 total length of chromosomes (Russia: Botanical collection, "*A. altissimum*").  $2n = 16$  Vosa 1977 (?Botanical collection).  $2n = 16$  Gohil & Kaul in Löve 1981 (India: Kashmir, Srinagar).  $2n = 16$  Pogosian 1983 (Iran: Azarbayejan, Khoy, "*A. hirtifolium*").  $2n = 16$  Astanova 1984 (Tajikistan: Wakhs mountain range).  $2n = 16$  Labani & Elkington 1987 (Netherlands: Botanical collection).  $2n = 16$  Ohri & al. 1998 (Netherlands: Botanical collection).  $2n = 16$  Fritsch & Astanova 1998 Table 2 (Germany: Botanical collection, Tajikistan: Hissar mountain range, near type location).  $2n = 16$  Gurushidze & al. 2010, 2012 (Iran, Chaham. Bakhtiari, Farsan, Chelgerd).  $2n = 16$  Gurushidze & al. 2012 (Netherlands: Botanical collection, Turkmenistan: Kopetdag mountain range).  $2n = 16$  IPK *Allium*-Referenzkollektion karyotype (Kyrgyzstan: Turkestan mountain range).

**Distribution:** Iran, Afghanistan, all Central Asian republics, Pakistan; submontane to montane loamy steppe slopes, among trees and shrubs, in the shadow of large trees, on well manured ruderal places.



**Remarks:** *Allium stipitatum* is an extremely polymorphous species concerning plant height, color and indumentum of the leaves, dimensions of the inflorescences and flower organs, as well as number and color of the flowers. A reliable character is the smooth and glossy (like polished) surface of the scape that becomes ribbed only when dried. Density and dimensions of these ribs are accidental features without taxonomic value. Although the leaves bear at least sparse hairs, plants bearing only some teeth along ribs and margins can be found in most populations near the type location. Specimens having glabrous leaves were discussed under *A. altissimum*. Because rather many *Allium* species possess more or less distinctly stipitate and tuberculate ovaries, the specific characters of leaves,

scapes, inflorescences and flower parts must be considered to recognize this species correctly. Morphological comparison of a large number of *A. stipitatum* accessions from Iran and different countries of Central Asia under cultivation in Germany did not result in detection of intraspecific groups. Also a RAPD analysis of 10 samples from different countries did not yield clues for any geographic groups (Friesen & al. 1997). Some data on genome size do also not point to differences (Gurushidze & al. 2012). Thus only one botanical species exist that must be named *A. stipitatum* because *A. hirtifolium* has been described some months later. However, ITS sequences of nuclear rDNA presented evidence that two molecular groups exist with geographical correlation. One group comprises *A. stipitatum* distributed from Kazakhstan to the Iranian Koppe Dagh mountain range, and the other group *A. hirtifolium* occurring in the Zagros mountain range (Fritsch & al. 2010; see p. 202). Independent evolutionary lineages seem to have converged on similar phenotypes (Gurushidze & al. 2008), but offspring by hybridizations seems not probably (Gurushidze & al. 2010). Sequences of the plastid *trnL-trnF* region confirmed the presence of one basal and several derived haplotypes (Gurushidze & al. 2010). Thus we may conclude that these two groups result from long-lasting independent evolution in separate areas. Two herbarium vouchers from SE Iran need confirmation, but existence of relic outposts on more humid spots in an otherwise very dry area would be quite clear.

**Etymology:** The epitheta refer to the stalked ovary and to the  $\pm$  hairy leaf laminae (from Latin, *stipitatum* = "provided with a little stalk", and *hirtifolium* = "with hairy leaves").

**Biological data:** Very good germination occurs at 5°C, but very bad above 10°C (Specht & Keller 1997). Inamov (1971) reported 36-38 % germination at 0-6°C, after stratification (January till March) in the soil 80-90 % germination; cultivation trials and morphological character as well as the stages of development were also described. The plants need low temperatures in winter, otherwise they do not flower (Dubouzet & al. 1992). The depressed-globose (with a weak tip at the apex) bulbs have  $\pm$  deep yellow storage scales, reach a weight of 100-200 g, and may divide up into 2 (or more) unequal daughter bulbs. Side-bulbs occur often, they develop on  $\pm$  long stolons and measure 8-20 mm in diameter (Yur'eva & Kokoreva 1992). Usually several shoots arise in the axils of the upper leaves to build daughter bulbs (Kruse 1992). In vitro cultivation is possible (Keller 1992). Radical scavenger activity of bulb extracts was low (Jedelská & al. 2005a). The bulbs contain up to 60 % glucose, fructose, saccharose, oligosaccharids and glucofructans, the inflorescences diosgenin, juttagenin, alliogenin und anzuogenin (Vollerner & al. 1988a, b). Fresh bulbs contain in total 0.044 / 0.05 / 0.96 % cysteine sulfoxides (98 / 80 % methiin, 2 / 20 % isoalliin; Keusgen 1999; Fritsch & Keusgen 2006; Keusgen & al. 2008); they contain 0.12-0.31 % strongly antibiotic pyridyl-cysteine sulphoxide and 0.03-0.48 % methiin (Kusterer & al. 2010). Analysis of seed storage proteins showed differences to other tall species investigated (Maass 1992, Fig. 5 "stip"). Genome sizes reported [2C DNA]: 27.3 pg (Labani & Elkington 1987), 51.1 / 49.8 pg (Ohri & al. 1998 as *A. aflatunense*), 44 pg (Gurushidze & al. 2012).

**Economic traits:** Used as ornamental, medicinal plant, and vegetable species (Inamov 1971). The plants are applied in the folks medicine (Sokolov 1994). In Central Asia and Iran the incompletely developed new bulbs are pickled in aromatic vinegar (Tajik 'pijozi anzur', Uzbek 'anzur pijozi', Persian 'mu-sir'). Though medicinal use is much more in focus in Iran (Keusgen & al. 2006; Fritsch & al. 2007; Abbasi & al. 2008), bulbs (traditionally but wrongly named 'shallot') are very commonly chopped and mixed with yoghurt. Despite this species is widely collected and sold at markets in many towns in western Iran, most natural populations are still large (own observations). Locally *A. stipitatum* occurs as serious weed of ploughed fields (Abbasi & al. 2008). In the Uzbek mountains, the pickled bulbs were a favorite 'titbit' in the 20th century. For decades this species was collected in large amounts, and 'anzur' became really rare there. Nowadays this species is no longer endangered (Khassanov 2008). Cultivation for bulb production was recommended by Yunusov (1985), and trials have been successful (Hanelt 2001). People interviewed in all investigated areas of Central Asia and Iran confirmed that the leaves are not used (Keusgen & al. 2005). Ornamental plant listed in the "International Checklist ..." of the Royal General Bulbgrowers Association (1991) and commercially available (De Hertog & Zimmer 1993). In Europe much cultivated in herbaceous beds for the striking flower-heads and infrutescences on magnificent stalks, mentioned already by Androsov (1941) for Turkmenistan. Many cultivars were selected, *A. stipitatum* was also the parent of a few hybrids (details given by Friesen & al. 1997). Because of a similar general appearance, *A. stipitatum* is not rarely misnamed as *A. giganteum* in European gardens, and variants having very sparsely hairy or glabrous leaves are often misnamed as *A. altissimum* or *A. aflatunense* B. Fedtsch.

Living accessions studied: **Chaharm. Bakhtiyari:** Bakhtiar-Gebirge ca. 16 km N Farsan, steilgestellte Kalksteinklippen (32° 13' N, 50°33' E, c. 2400 m, 14.5.1994 Fritsch 1038; GAT). Weizenfeld bei Noghan, (31°59' N, 50°55' E, 2400 m, 05.7.2008 Hammer; GAT). Bakhtiar-Berge ca. 1 km oberhalb Amir Abad ca. 10 km SW Haruni (32°22' N, 50°28' E, 2400-2700 m, 15.5.1994 Fritsch 1055; GAT). Slopes near the begin of Kuhrange tunnel, (32°26' N, 50°06' E, c. 2400 m, 15.5.1994 Fritsch 1065; GAT; 2500 m, 29.4.2010 Fritsch, Keusgen, Abbasi 1281; GAT IRAN). Crest of a premountain hill near NW corner of Chelgerd (32°28' N, 50°06' E, 2526 m, 29.4.2010 Abbasi, Fritsch, Keusgen 1274; IRAN GAT). Bakhtiar-Berge, Sari-Tal gegenüber Berg Sarob, an der Straße von Chelgerd ca. 55 km von Shah-e-Kord (32°21' N, 50°21' E, c. 2400 m, 15.5.1994 Fritsch 1069; GAT). Fritillaria meadows "Dasht-e laleh" NE of Chelgerd (32°36' N, 50°11' E, 2450 m, 02.5.2010 Abbasi, Fritsch, Keusgen 1294; GAT IRAN). - **Fars:** Rocky limestone slopes above the ski sport area Poladkaf NE town Sepidan in direction to Komehr (30°24' N, 51°55' E, 2770 m, 14.4.2008 Fritsch 1240; GAT IRAN). - **Hamadan:** NE slopes of Alvand massif c. 15 km SE Hamadan, slopes near the Sangestan road above Ekbatan Dam (34°44' N, 48°37' E, 2000 m, 11.5.2006 Abbasi, Fritsch, Keusgen 1090; IRAN). Bulbs bought from a man selling it near the main road from Assadabad to Hamadan (10.5.2006 Abbasi, Fritsch, Keusgen 1086; GAT). Bulbs bought in a shop in Assadabad (10.5.2006 Abbasi, Fritsch, Keusgen 1085; GAT IRAN). Bulbs bought on the market in Hamadan, said to have been brought from Assadabad (09.5.2006 Abbasi, Fritsch, Keusgen 1076; IRAN GAT). - **Kohgil. Buyerahmad:** N slopes E of vill. Veze c. 20 km from Yasuj to Ardakan (30° 31' N, 51°41' E, 2350 m, 04.5.2010 Abbasi, Fritsch, Keusgen 1300; IRAN). - **Kurdistan:** Slopes along the road via Ariz pass near Sanandaj (35°22' N, 46°52' E, 1900 m, 17.5.2006 Abbasi, Fritsch, Keusgen 1111; GAT IRAN). Dasht-e Rom mountains c. 3 km W Mansur Abad, locality Paserna (30°33' N, 51°28' E, 2350 m, 06.5.2010 Abbasi, Fritsch, Keusgen 1306; IRAN). - **Lorestan:** Kuh-e Garri massif, valley of Kahman river above vill. Dareh-Tang (33°58' N, 48°20' E, 1920 m, 14.5.2007 Abbasi, Fritsch, Keusgen 1177; GAT, IRAN). - **Raz. Khor.:** Binalud massif W Mashhad below vill. Kang (36°20' N, 59°16' E, 1500 m, 13.05.2012 Fritsch, Eskandari, Bahramishad 1390; IRAN, GAT).

Herbarium vouchers: Persia (???.1837 Aucher 2219; P). Persia austr. (???.1842? Kotschy 1023; W). **E Azarb.:** Hashtrude: Nazarkahrizy 40 km to Kuh-e Sahand - Malla Ghayasy (37°30' N, 46°50' E, 2250 m, 30.5.2002 Gharemani, Imani 7775; HTRC). - **W Azarb.:** Piranshahr: Curichaveh village (36°42' N, 45°08' E, 11.4.2000 Ghasempoor, Heidari, Shanaki 7635; ORUM). Urumiyeh: Mahabad road, Dizag dol village (37°19' N, 45°20' E, 1850 m, 03.4.2000 Alizadeh, Khodakarimi, Heidari 7630; ORUM). Jaldian, Doab (36°52' N, 45°08' E, 18.5.1973 Zehzad 31; TARI). - **Chaharm. Bakhtiyari:** Chelgerd, Kuhrang dam (32°26' N, 50°06' E, 2250 m, 24.5.1991 Delghandi, M. R., Abbasi, Tehrani, H. 416-IRAN; 16.5.1994 Fritsch 421-IRAN). Borougen, Zenhal spring (2315 m, 18.5.1996 Ghaedi 200; ANS). Semirom, Kuhe Pashmaku (31°25' N, 51°30' E, 2650-3000 m, 06.6.1974 Iranshahr 419-IRAN). Borujen to Lordegan, Deh-Tooth (31°45' N, 51°05' E, 2000-2100 m, 18.5.1983 Nowroozi 2673; TARI). Shahr-e Kord, Eidar (2150-2500 m, 01.6.1986 Mozaffarian 54793-TARI). Farsan, S slope of Sefid Daneh mount (32°13' N, 50°33' E, 2580 m, 25.5.1997 Gholamian 2580; ANS). Damaver, (3600 m, 05.5.1940 Koelz 15180; W). Sabz Kuh, Chahartagh (31°46' N, 50°54' E, 2350 m, 16.5.1987 Mozaffarian 59950-TARI). Farsan, protected area close to Kuhrange tunnel (first tunnel) (32°13' N, 50°33' E, 17.5.1998 Gholamian 2351; ANS). Wastegan towards Naghan Chahar-Taga enclosure (31°54' N, 50°38' E, 1900 m, 15.5.1999 Jamzad & al. 79929-TARI). Shahr-e Kord Baba-Heydar sefid daneh (2380 m, 21.5.1986 Mozaffarian 54366-TARI). Gahar, on damp plain (2100 m, 28.5.1941 Koelz 17872; W). Salamzar, Naghan (31°58' N, 50°49' E, 13.5.2002 Rahiminejad; HIU). Sari valley opposite Mt. Sarob, near road from Chelgerd c. 55 km from Shahr-e Kord (32°26' N, 50°06' E, 2400 m, 16.5.1994 Fritsch 13/1994; 421,2-IRAN). Between Brojen and Dourahah

Godar-e Kabk, Kuh-e Dodely (2200-2600 m, 14.5.1987 Mozaffarian 59878-TARI). Shahr-e Kord, Golestan Kuh (32°19' N, 50°46' E, 15.4.1970 Vaezi 426-IRAN). - Esfahan: In montibus prope Damaneh 35 km SE Daran 115 km NW Esfahan (33°00' N, 50°30' E, 10.6.1974 Renz 47625; W B G). Shahreza towards Izad-khast between Hana village and Vanak village, 24 km of Semrom, Sohran Mts. (2300-2500 m, 15.5.1975 Moussavi, Tehrani 417-IRAN). Feridown shahr, Meydanak, Dareh Chark (32°56' N, 50°07' E, 2550 m, 25.5.1982 Nowroozi 400; TARI). Esfahan, (32°28' N, 51°54' E, Aucher 5389; G-Boiss). Khuansar, Darreh-Bid, (33°13' N, 50°19' E, 2600-2800 m, Norouzi, Etemadi; HIU). Dalankuh. Dotoo to Khonsarak (32°57' N, 50°33' E, 2650-2750 m, 21.5.1981 Nowroozi 364; TARI). Faridun-Shahr, above Makedin (32°57' N, 50°04' E, 2200 m, 24.5.1983 Nowroozi, Khajeddin 2716; TARI). Feridown Shahr, Meydanak Kuhe Bozab (2500-2600 m, 25.5.1982 Nowroozi 395; TARI). Pashma Kuh, a Semiron 5 km occidentem versus (31°25' N, 51°30' E, 2700-3000 m, 06.6.1974 Rechinger 47436; W B G). Kashan Niasareh (33°52' N, 51°20' E, 1700 m, 29.5.1974 Dini-Bazargan 8031; TARI). Arestan to Esfahan road 95 km NE Esfahan (33°13' N, 52°21' E, 1720 m, 12.3.2009 Mirinejad 7140; ANY). Khonsar Golestan Kuh (33°13' N, 50°19' E, 2560 m, 02.7.1982 Nowroozi, Etemadi 557; TARI). Kuh Syil S Khonsar (33°13' N, 50°19' E, 2600 m, 17.5.1973 Babakhanlou, Amin 14168; TARI). - Fars: Ghorog-e Margan sepidan (1320 m, 08.5.1990 Zare & al.; HSU). Abadeh, Sharmian Kusk-e Zar, Dareh-e Gol (31°10' N, 52°34' E, 2550-3000 m, 04.6.1975 Wendelbo, Foroughi 17860-TARI G). Kakan (30°38' N, 51°48' E, 25.6.1967 Kashkouli 8048-E, 8113-E; 424-IRAN; GOTH). Kazerun (29°36' N, 51°35' E, 30.4.1973 Modjib 418-IRAN). About 25 km of Yasuj on road to Ardekan (30°39' N, 51°46' E, 2500 m, 22.6.1975 Bokhari 1642; TARI). Shiraz towards Arzhan plain, Mt. Bill (29°30' N, 52°09' E, 01.6.1992 Hatami; HSU). Margon, S Sisakht (30°31' N, 51°54' E, 2200-3700 m, ???.1994 Mesbah 7926; HSU). - Hamadan: Ad Bisitun (34°24' N, 47°26' E, 24.4.1903 Strauss; JE). Elwend (34°39' N, 48°50' E, 15.5.1895 Strauss; JE). Dermen mountains (34°16' N, 49°27' E, 15.5.1902 Strauss 385; JE). Maryanj, Emam-Zadeh Kuh road towards Emam-Zadeh Kuh (34°51' N, 48°28' E, 1870 m, 11.5.2006 Abbasi, Fritsch, Keusgen 43973-IRAN). 3 km after Yalfan village (34°44' N, 48°37' E, 2000 m, 10.5.1987 Maassoumi 59344-TARI). - Kerman: Montes Djamal Bariz inter Bam et Djiroft, supra Deh Bakri (29°03' N, 58° E, 2400 m, 8.-10.5.1948 Rechinger & al. 3752; W). Kuh Milleh Michan (34°20' N, 46°36' E, 1905? Strauss; JE). Kolyai, Gorjiban (29.5.1951 Sharif 5078-E; 425-IRAN). Ozbah-Kuh (Ozbagu), schisti, in cultis (30°40' N, 57°00' E, 30.4.1964 Ruttner 383; W). - N Khor.: S Shirvan, Borzli (37°13' N, 57°47' E, 1610 m, 26.6.1995 Raafei, Zangooei 25993; FUMH). Bojnurd: Esfidan (37°30' N, 57°18' E, 1500 m, 04.5.2007 Eskandari, Javadi, Torabi 51084-IRAN). Between Bojnurd and Golestan forest, N slope of Kuh-e Kurkhud (37°29' N, 56°27' E, 2000-2700 m, 18.7.2003 Assadi, Hamdi 85593-TARI). c. 10 km S Shirvan (37°20' N, 58°00' E, date & collector not translated; FUMH). - Raz. Khor.: SW Torbat-e Jam, Kuh-e Bezd (Bizd) (35°11' N, 60°21' E, 04.-06.7.1937 Rechinger 1487; W). Koppe Dag c. 60 km NE Mashhad (36°42' N, 60°02' E, date & collector not translated; FUMH). 14 km from Kashmar to Neyshabour (35°23' N, 58°26' E, 1400-1500 m, 12.6.1981 Assadi, Mozaffarian 35634-TARI). S Chenaran, Frizi, Binaloud mount, Hayat-e Shaaban (36°26' N, 58°58' E, 1800 m, 15.6.1993 Faghinia, Zangooei 23368; FUMH). Montes Hezar Masjed inter Ardak et Talqur (36°58' N, 59°21' E, 1200-1600 m, 07.-10.6.1948 Rechinger 5032; W G). Environs de Mughan et versant nord de la Kuh-i-Binalud (36°07' N, 59°21' E, 20.-21.6.1965 Schmid 6225; G, W). Mountain NW Neyshabour, above Mirabad (36°22' N, 58°52' E, 1600-1900 m, 17.6.1981 Assadi, Mozaffarian 36124-TARI). Nishabour, Kuh-e Binalod from Bojan village (36°20' N, 58°33' E, 1500-2700 m, 04.7.1984 Mozaffarian 48970-TARI). S Daregaz, Gharaghat valley (37°01' N, 59°15' E, 2500 m, 28.5.2001 Joharchi 33603; FUMH). Mashhad, between Azghad and Maj, Kalateh (36°09' N, 59°18' E, 2000 m, 27.5.2001 Joharchi 33570; FUMH). Binalud c. 20 km SE Mashhad (36°22' N, 59°25' E, date & collector not translated; FUMH). Binalud c. 25 km SW Chananar (36°32' N, 58°58' E, date & collector not translated; FUMH). Koppe Dag c. 35 km NNE Radkan (37°02' N, 59°04' E, date & collector not translated; FUMH). Koppe Dag c. 40 km NNE Quchan (37°22' N, 58°41' E, date & collector not translated; FUMH). Daregaz, Tandoreh National Park, around Babanestan security station (37°23' N, 58°46' E, 1150 m, 10.5.1999 Hojjat, Zangooei 32357; FUMH) Nishabour, Kuh-e Binaloud, Bojan village (36°20' N, 58°33' E, 1500-2700 m, 04.7.1987 Mozaffarian; TARI). S Kalat-e Naderi, Zharf village, Sabzeh meydan area (36°54' N, 59°40' E, 1950-2100 m, 17.6.1996 Raifei, Zangooei 27389; FUMH). Tandooreh Protected National Park, c. 25 km SW Darreh-Gaz, near Chehel-Mehr (37°16' N, 58°58' E, 1200 m, 28.5.1984 Assadi, Maasoumi 50754-TARI). E Neishabur, 12 km on the road of Dizbad-e Olia (36°04' N, 59°17' E, 1700-1800 m, 19.5.1996 Raafei, Zangooei 26945; FUMH). Mountains NW of Neyshabour, above Mirabad (36°22' N, 58°52' E, 1600-1900 m, 17.6.1981 Assadi, Mozaffarian 36124-TARI). S Chenaran, Frizi towards Binalud mountain, Dahane- Jaji (36°26' N, 58°56' E, 1700 m, 01.6.1994 Faghinihnia, Mehrvar 24078; FUMH). - Kohgil. Buyerahmad: 10.5 miles N Pataweh (31°09' N, 51°18' E, 6.600', 10.5.1973 Hewer H2003; GOTH). Dehdasht, Deligan, Savers mountain (30°42' N, 51°09' E, 2150-2500 m, 10.5.1990 Termeh, Tehrani, Karavar 422-IRAN). Zagros mountains, 36 miles N Pataweh on Kuh-i Sekquer (31°25' N, 51°21' E, 7000-8500', 13.5.1973 Hewer H2027; K ? GOTH). Kakan Abnahr N slope (30°38' N, 51°48' E, 2270 m, 12.5.1987 collector unclear 3109; ANY). 20 km SW Yasouj towards Ardekan (30°30' N, 51°39' E, 11.5.1977 collector unknown 44007-IRAN). - Kurdistan: 15 km SW Divandareh to Sanandaj, road of Kooleh to Dozakh darreh, Kapak village (35°44' N, 46°55' E, 2000 m, 13.5.2004 Zarre, Mashayekhi 34905-TUH; GAT). 32 km WNW of Sanandaj towards Marivan (35°23' N, 46°42' E, 20.5.1966; GOTH). 91 km from Baneh to Marivan (35°4' N, 46°22' E, 2150 m, 30.5.1978 Runemark, Mozaffarian 29330-TARI). Saghez, Hajimamedan village (36°14' N, 46°17' E, 1940 m, 27.5.2002 Maroofi, Naseri 4911; HKS). Between Divandarreh and Saqqes (36°06' N, 46°39' E, 2200 m, 31.5.1974 Wendelbo, Shirdelpur, Assadi 11932-TARI). Gardana Ariz, 20 km W Sanadaj to Marewan (35°25' N, 46°54' E, 1900 m, 12.5.1986 Fattahi, Khaledin 461; TARI). 64 km N Sanandaj, stony ground (35°34' N, 47°08' E, 1700 m, 18.5.1962 Furse 2109; W). Bijar, Kuh-e Hamzeh Arab (35°53' N, 47°41' E, 2391 m, 27.6.2004 Maassoumi, Safavi 85988-TARI). 15[-32] km W[NW] Sanandaj inter Sanandaj et Marivan (34°24' N, 46°52' E, [2220 m], 19.5.1960 Bent, Wright 519-1202; W). - Lorestan: Alashtar Kahman (33°53' N, 48°20' E, 2100 m, 18.6.1996 Sepahvand 2472; ARCK). Pass about 30 km SE Khorramabad Taf (33°39' N, 48°27' E, 1700 m, 28.5.1993 Ahmadi 565; ARCK). 96 km N Khorramabad versus Kermanshah (34°02' N, 48°00' E, 1800 m, 09.5.1962 Furse 1867; W). Aligudarz,

In valleys and hills near Ghalikuh (33°22' N, 49°40' E, 2200 m, 14.6.1974 Iranshahr 420-IRAN). Nijin (Wdb. 71: Najuu) (1900 m, 12.5.1937 Koeie 534; W). Khalilabad c. 40 km SE Aligudarz (33°14' N, 50°55' E, 2300-2450 m, 03.5.1975 Wendelbo, Assadi 16437-TARI). 38 km to Shulabad on the road from Aligoodarz (33°10' N, 49°35' E, 2200 m, 24.5.1998 Assadi 79041-TARI). In convallibus borealibus montium Khali Kuh 50-60 km ab Aligudarz meridiem versus (33°04' N, 49°40' E, 2300-2800 m, 12-14.6.1974 Reching 47997; W G). Kharon (2200 m, 05.6.1937 Koeie 1667; W). Khorram-abad, Kuhha-ye Hashtad-Pahlou (33°30' N, 48°22' E, 2100 m, 28.5.1994 Daneshpajouh 43090-IRAN). - Markazi: Arak (34°04' N, 49°45' E, ???.1897, 24.4.1903 Strauss; JE). Giranschlucht ca. 1 Meile SE Sultanabad (34°03' N, 49°44' E, 21.4.1889 Strauss 401; JE). Arak, Khan-e Miran, Sefid Khany Mt. (33°55' N, 49°34' E, 2100-2300 m, 12.6.1984 Mozaffarian, Maassoumi 47779-TARI). In dit. urb. Sultanbad Burudgird, in montis (34°03' N, 49°44' E, ???.1897 Strauss; JE). - Zanjan: Mahneshan, Alam-Kandy, Gargalan mountains (36°46' N, 47°16' E, 1900-2000 m, 29.6.1983 Moussavi, Habibi, Tehrani 30716-IRAN).

Determination unsure: W Azarb.: Inter Piranshahr and Sardasht (36°26' N, 45°20' E, 18.5.1974 Zehzad 30; TARI). - Kerman-shah: In m. Noa-Kuhe (dit. Kinrud) (34°19' N, 46°06' E, 07.6.1909 Strauss; B). - Kurdistan: Saral area N Sanandaj, Doozakh-Darreh village (35°46' N, 46°56' E, 15.5.2005 Hosseini; HCAT)

*Allium* sect. *Pseudoprason* (Wendelbo) K. Perss. & Wendelbo in Bot. Notiser 132: 196 (1979); *Nectanoscordum* sect. *Pseudoprason* Wendelbo, Fl. Iranica No. 76: 2 (1971), *Allium* sect. *Melanocrommyum* subsect. *Pseudoprason* (Wendelbo) Kamelin & Seisums in Seisums, podrod Melanocrommyum: 26 (1994), comb. inval. Type: *A. koelzii* (Wendelbo) K. Perss. & Wendelbo

**70. *Allium hooshidaryae*** Mashayekhi, Zarre & R.M. Fritsch in Feddes Repert. 116: 193, Fig. 1 (2005). - Type: Iran, prov. Kurdistan, SW Divandarreh, 15 km to Divandarreh from Sanandaj, Kooleh to Doozakhdarreh village, 2200 m, 07.5.2002, Hooshidary 119 (holotype TUH!, isotype TARI).

Bulbs broadly ovoid-globose, 3-3.5 cm diam. and ca. 3 cm long; outer tunics grayish brown; inner tunics whitish, membranous. Scape straight, cylindrical, smooth; c. 60-80 cm long, (6) 8-12 mm in diam.; green, basally reddish flushed. Leaves (2) 3-5, laminae broadly oblong-lanceolate, arcuately ascending and recurved to the soil, thickish; upper side smooth?, lower side with broad shallow ribs; about 20 cm long, 2-5 (8) cm wide; apex cucullate?; green with glaucous bloom. Spathe finely membranous, split into two ovate, acuminate, reflexed valves; pink or pale brown to purplish with darker veins. Inflorescence semi- to subglobose, initially dense later moderately loose, many-flowered; (5) 8-10 cm in diam.

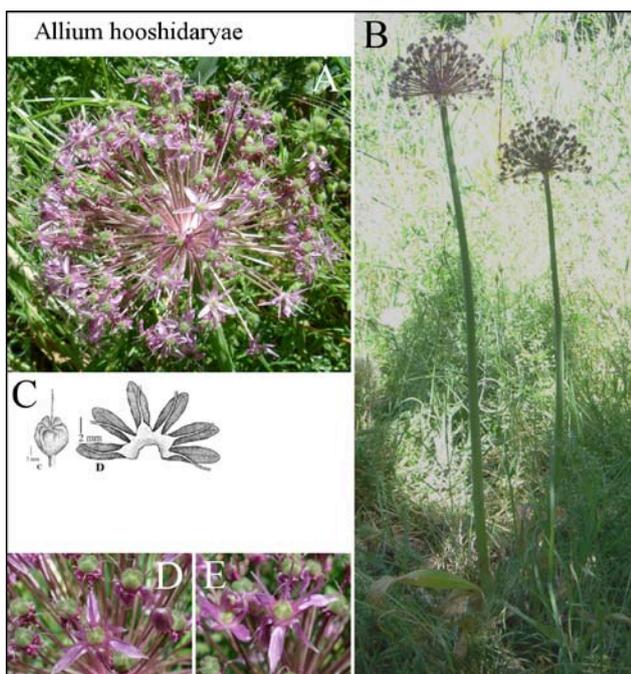
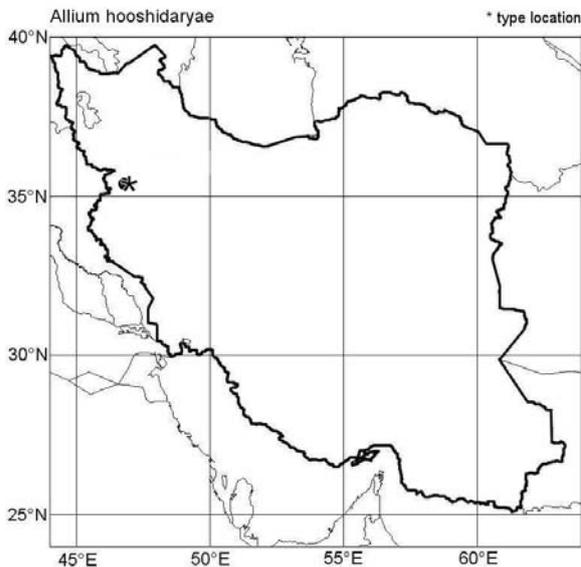


Plate T70. Plants cultivated in Sanandaj. A & B: inflorescence and plants in late anthesis; C: shape of ovary, tepals and filaments of a flower prepared from herbarium (from Mashayekhi & al. 2005: Fig. 1 C & D); D & E: close-up of flowers and developing capsules.

Pedicels thin, stiff wire-like, subequal; up to 3.5 cm long; greenish-brown basally pale red. Anthesis in May. Flowers initially widely funnel-shaped star-like, outer tepals soon reflexed. Tepals elliptic-oblong with obtuse or subacute tip, basally shortly united, initially  $\pm$  patent, soon slightly reflexed later completely reflexed and finally spirally twisted, concave; 6-7 (10) mm long and inner tepals 2.5-3 mm, outer tepals 1.5-2 mm broad; glossy pinkish finally carmine, median vein slightly darker and only conspicuous when the tepals are reflexed. Filaments nearly as long or somewhat longer than the tepals, inner filaments subulate, outer ones triangular; basally triangular widened and for 1.5-2 mm connate and ca. 1 mm adnate to the tepals; pink to purple, basally darker. Anthers oblong, c. 2.5 mm long; pale violet. Pollen grayish-yellow. Ovary sessile, obovoid to ellipsoid, with six apical radial bulges and three longitudinal furrows, surface coarsely tuberculate; 4-6 mm in diameter, 3-4 mm long; green. Style

initially conical later filiform, 4-6 mm long; pink, fading towards the base. Stigma dot-like; whitish. Capsule depressed subglobose, slightly triangular, the upper half with 6 furrows; 3-5 mm long and 4-5.5 mm in diameter, widely opening; brown. Seeds ellipsoid; ca. 4 mm long and 2-2.5 mm wide; black.



**Distribution:** NW Iran, prov. Kurdistan: known yet only from the type location.

**Remarks:** This species is distinguished by broad leaf laminae, a rather loose inflorescence with finally unequally long pedicels, rather broad tepals of straw-like consistence becoming gradually reflexed and finally spirally enrolled, very coarse ovaries bearing radially directed bulges at the apex (which become more prominent in herbarium specimens), as well as widely opening capsules. These characters do not completely agree neither to sect. *Compactoprason* nor to sect. *Megaloprason* s. lat. Molecular markers (ITS sequences of nuclear rDNA) positioned the only investigated sample close to *A. koelzii* in a group composed of unclear taxa and *A.*

*fedtschenkoi* (Fritsch & al. 2010, see p. 199). Thus *A. hooshidaryae* is here treated as member of sect. *Pseudoprason*, but closer investigation of more accessions is essential. Sequences of the plastid *trnL-trnF* region (Gurushidze & al. 2010) confirmed a certain distance to *A. koelzii* and showed a similar distance to most members of sect. *Acanthoprason*. The plants of the below cited herbarium vouchers present a somewhat differing general appearance and may represent another taxon; re-collection and study of living plants of those accessions will be needed.

**Etymology:** The epithet honors the contemporary botanist F. Hooshidary acting in Sanandaj, who collected the type specimen.

Herbarium vouchers, determination unsure: **Kurdistan:** N to NW Sanandaj, Saral area, Hanaglan village (35°34' N, 46°49' E, 2300 m, 01.6.2007 Maroofi 8051; HKS). Sanandaj Zahleh station, cultivated (03.5.2002 Yousofi, Maroofi 4516; HKS).

**71. *Allium koelzii*** (Wendelbo) K. Perss. & Wendelbo in Bot. Notiser 132: 196 (1979), emend. Fritsch & al. in Rostaniha 7 (Suppl. 2): 269, fig. 6 (2006 publ. 2007); *Nectaroscordum koelzii* Wendelbo in Acta Horti gotob. 28: 53, f. 15 (1966); Wendelbo in Flora Iranica No. 76: 2, tab. 1/1a, 1b (1971). - *Allium orientale* Boiss. β *majus* Bornm. in Beih. Bot. Centralbl. 28 II: 514 (1911), in textu. Type: Kuh Schachscheken, 26.5.1905 leg. Strauss (JE!) - **Type:** Iran, Luristan, Kalvar, 5000', 29.5.1940, leg. Koelz No. 15913 (holotype W!).

Bulbs nearly spherical, 3-6 cm in diameter and 3-5 cm long; with irregularly disintegrating, brownish outer tunics. Scape terete, slightly flexuous, spindle-shaped, smooth; 40-70 cm tall, 6-10 mm in diameter, basally narrower; green or purple with glaucous bloom. Leaves 3 to 7, outer laminae broadly ovate to broadly lanceolate, rounded with an acute cucullate apex; 15-25 cm long and (3) 6-12 cm wide; inner laminae much narrower with a broadly acute, cucullate apex, as long as the outer ones but only 1-3.5 cm wide; margins white, smooth or toothed; upper side smooth, lower side with broad shallow ribs; yellowish to vividly green, mostly with glaucous bloom, semi-glossy. Sheath leaf short, smooth, hyaline, soon decaying. Spathe membranous, often split into 2-3 acute, reflexed valves; brownish-yellowish with inconspicuous veins. Inflorescence semi- to sub-globose, rather dense, many-flowered; 4-7 cm in diameter. Pedicels moderately thick, straight, wiry, unequally long; 25-35 mm long; pale green. Anthesis in May to June. Flowers three-angled with irregularly spreading and reflexed tepals. Outer tepals naviculate, broadly elliptical, obtuse; 4-5 mm long and c. 2 mm wide with 1-3 green median veins; initially

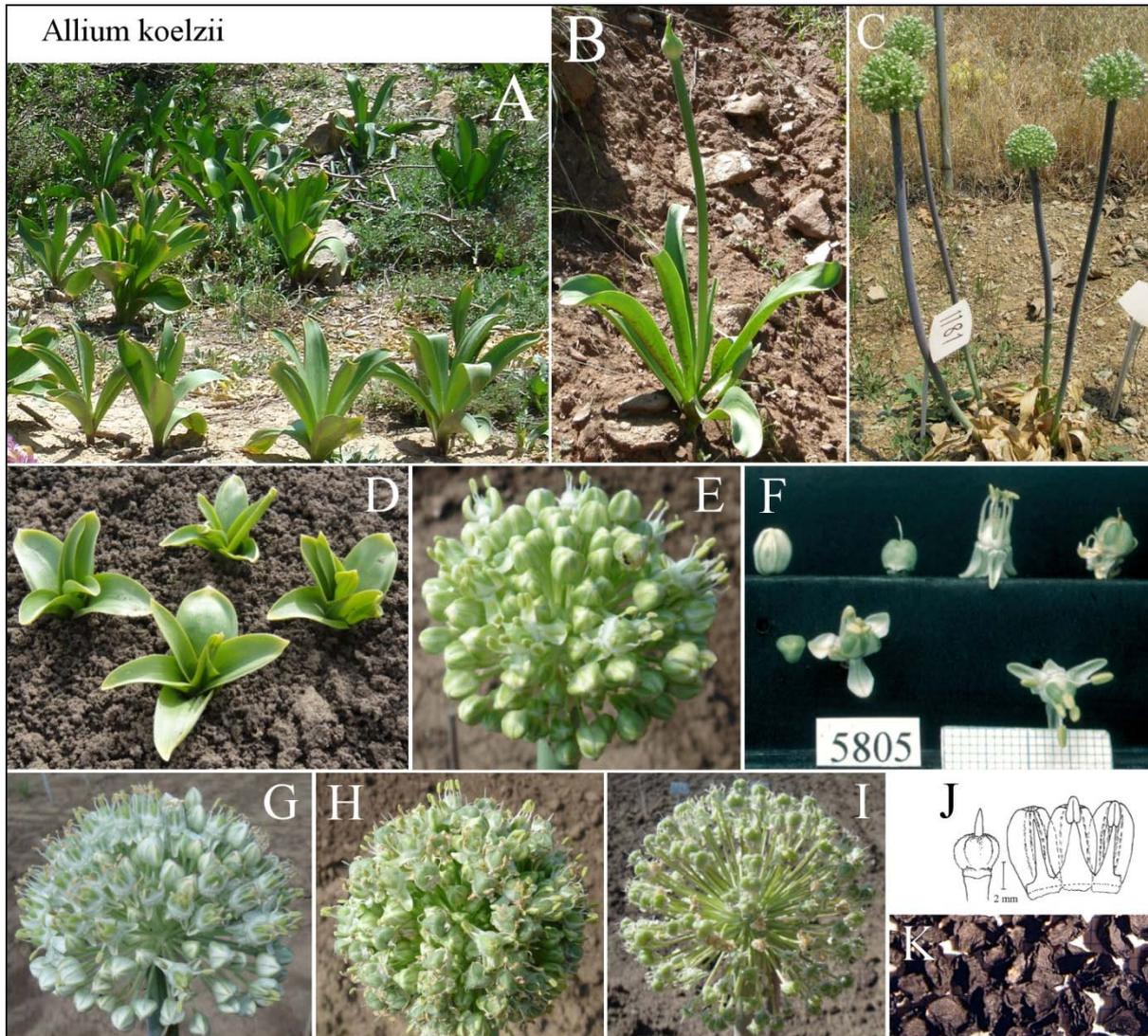


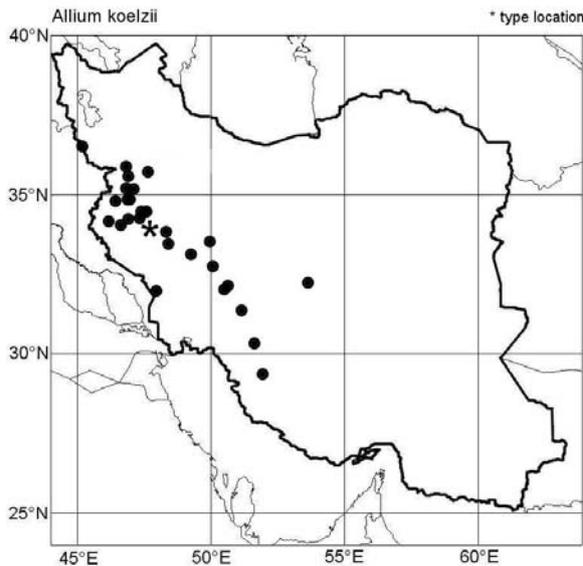
Plate T71. A & B: Plants in the shooting stage at Mt. Taf and near Kermanshah, resp.; C: flowering plants cultivated in Tehran; D: sprouting leaves of cultivated plants; E: inflorescence in early anthesis; F: comparison of flower parts in different stages; G & H: inflorescences in full anthesis; I: inflorescence with developing capsules; J: shape of ovary, tepals and filaments of a flower prepared from herbarium; K: seeds (background raster 1 mm).

straight forward and later obliquely forward directed, finally like the spoon-shaped inner tepals completely reflexed, crumpled, and involute. Inner tepals slightly shorter than the outer ones, basally about 1.5 mm and above up to 3 mm wide, with 3-7 green veins. Filaments 3-4.5 mm long, subulate; basally the inner ones widely, the outer ones slightly three-angled broadened and c. 1 mm long united; white. Anthers oblong, ca. 2.5 mm long; greenish-yellow. Pollen yellow. Ovary subglobose to shortly pear-shaped triangular with three wide furrows, c. 3 mm long and wide, finely tuberculate; nectary ducts lead in pocket-like pits near the base; grayish green. 4-8 ovules per locule are present (Persson & Wendelbo, 1979). Style thread-like, 2-4 mm long; white. Stigma undivided; white. Capsule tripartite ovate with broad longitudinal furrows, less widely opening; 5-6 mm long and in diam.; valves transversally ovate to triangular with a sharp longitudinal furrow, scarcely notched at the apex, surface rugose; pale greenish brown. Seeds 1-2 (3) per locule, ovate to drop-shaped with one concave side, irregularly and coarsely lacunose; 3-4 mm long, 2-2.5 mm wide, c. 2 mm thick; dull black.

**Chromosomes:**  $2n = 16$  Persson & Wendelbo 1979 fig. 4C (Iran: Botanical collection; Arak, Golpayegan).

**Distribution:** W Iran: Zagros mountain range; montane loamy and stony steppe slopes.

**Remarks:** This is a morphologically well characterized species although the original description of *A. koelzii* had to be revised (Fritsch & al. 2006). This corrected description is adopted also here. Key characters are rather broad, yellowish-green leaves, smooth and spindle-shaped scapes, and outer tepals



having three or more median veins and becoming earlier reflexed and involute than the inner tepals, which show one or three median veins. Molecular markers (ITS sequences of nuclear rDNA) underlined a rather separate taxonomic position of this species. Also the closest relatives (*A. hooshidaryae*, *A. fedtschenkoi*, *A. sanandajense* and a few hitherto undetermined samples) are rather distantly related (see p. 199), and less closely related are some subgroups of sect. *Melanocrommyum* but with an unresolved degree of relation (Fritsch & al. 2010). Analysis of sequences of the plastid *trnL-trnF* region (Gurushidze & al. 2010) showed much genetic diversity inside of *A. koelzii*, confirmed a close relationship to *A. hooshidaryae*, and stated equally close relations to several species of sect. *Acanthoprason*.

**Etymology:** The epithet honors the distinguished American plant collector W.N. Koelz. He was acting in Central Iran in 1939 and 1940.

**Biological data:** Gurushidze & al. (2012) reported a genome size of 54.9 pg 2C DNA. Bulb extract showed a high radical scavenger activity (Jedelská & Keusgen 2008).

**Economic traits:** Local name: 'haaz'. Leaves are mixed with wheat and used for making the traditional soup-like dish 'shalamo' in the Kermanshah province (Abbasi & al. 2008). The very specific use of the bulbs may have been merged by the informant with that of *A. stipitatum* (Fritsch & al. 2007).

Living accessions studied: **Chaharm. Bakhtiyari:** Deh Cheshme, rocks above spring Pir Ghar (32°13' N, 50°33' E, 2123 m, 17.5.1994 Fritsch 1070; 28.4.2010 Abbasi, Fritsch, Keusgen 1272; GAT IRAN). Slopes above pass Alghadir c. 65 km S Borujen (31°33' N, 51°12' E, 1920 m, 03.5.2010 Fritsch, Keusgen, Abbasi 1295; GAT IRAN). — **Kermanshah:** Limestone massif c. 5 km NW Nojivaran 30 km NE Kermanshah (34°26' N, 47°23' E, 1680 m, 16.5.2006 Abbasi, Fritsch, Keusgen 1110; GAT, IRAN). Rocky places c. 5 km W Mahi Dasht below Chaharsebar pass (34°14' N, 46°40' E, 1700 m, 13.5.2006 Abbasi, Fritsch, Keusgen 1095; GAT IRAN). Mt. Dalakhani near vill. Baktaar N Sahneh (34°39' N, 47°37' E, 2490 m, 19.5.2007 Abbasi, Fritsch, Keusgen 1201; GAT IRAN). Small limestone massif W of Mt. Shahu above village Gheshlagh (34°58' N, 46°28' E, 2500 m, 15.5.2006 Abbasi, Fritsch, Keusgen 1107; GAT IRAN). - **Kohgil. Buyerahmad:** N slopes E of vill. Vezg c. 20 km from Yasuj to Ardakan (30°31' N, 51°41' E, 2350 m, 04.5.2010 Abbasi, Fritsch, Keusgen 1302; IRAN). - **Kurdistan:** Stony hill c. 25 km NW of Divandarreh (36°04' N, 46°52' E, 2300 m, 18.5.2006 Fritsch, Keusgen M. 1118; GAT IRAN). Loamy-stony slope in the valley Banajar above vill. Noshur Olia, near Mt. Avalan (35°01' N, 46°54' E, 1850 m, 19.5.2006 Abbasi, Fritsch, Keusgen 1122; IRAN). - **Lorestan:** Kuh-e Garri massif, valley of Kahman river above vill. Dareh-Tang (33°58' N, 48°21' E, 2200 m, 14.5.2007 Abbasi, Fritsch, Keusgen 1181; GAT IRAN). Rimeleh massif near Ghaleh Moradi, SW slopes of Mt. Taf (33°39' N, 48°28' E, 2300 m, 15.5.2007 Abbasi, Fritsch, Keusgen 1188; GAT IRAN). Photos sent by Mr. M. Jaeger, plants collected in Iran: Kerend, Noah Kuh, JZZ-104.

Herbarium vouchers: **Chaharm. Bakhtiyari:** Saroshjan inter Shahrekord et Kuhrang (32°19' N, 50°40' E, 2050 m, 05.6.1982 Aryavand, Sahebi; HIU). Shahre Kord, E slope of Kuh-e Jahanbin from Kharaji (32°10' N, 47°59' E, 2100-2400 m, 09.7.1986 Mozaffarian 57618-TARI). Borougen kuhe Kaj Domy (2460 m, 18.5.1996 Ghaedi 3413; ANS). Noghon, Chahrtagh (2200 m, 28.6.1997 Mozaffarian 77342-TARI). - **Esfahan:** Fereydun shahr, Masir, Kuh-e Vanizan (32°57' N, 50°07' E, 2500 m, 08.7.1996 Mozaffarian 77245-TARI). Golpayegan, Hendeh (33°43' N, 50°00' E, 2200-2800 m, 27.6.1969 Iranshahr 650-IRAN). — **Fars:** 33 km NW Ardekan (32°26' N, 53°40' E, 2300 m, 18.6.1975 Bauer, Kramer, VO 19.541 75-475; TUB). 12 km S Dasht-e Arjan, Kotal-pirzan pass near macrowave station (29°33' N, 51°57' E, 2000-2100 m, 05.7.1989 Zehsad, Taheri & al. 67050-TARI). - **Hamadan:** c. 20 km S Nahavand, Kuh-e Garu, above Chesme-Gamasab (34°03' N, 48°20' E, 1800-2200 m, 09.7.1981 Assadi, Mozaffarian 36940-TARI). - **Kermanshah:** Kuh Schachscheken (34°25' N, 46°56' E, 26.5.1905 Strauss; JE). Bisotun to Songhor, Kamijeh (34°39' N, 47°26' E, 1810-2060 m, 11.6.2003 Hamzehee, Asri 87963-TARI). Sarabé - Kerend (24.6.1968 Iranshahr, Dezfoulian 648-IRAN TARI). Mountains above Kerend, begin of the road Dalahu (34°19' N, 46°12' E, 1700-2000 m, 18.6.1987 Assadi 60818-TARI). N of Kerend gharb, Darband, Kuhe zardah (34°21' N, 46°12' E, 1570-1980 m, 20.6.1987 Hamzehe, Hatami 1340; TARI). Kuh-e Bimar near Deh-e Hukani S Kerend (1500 m, 08.5.1975 Wendelbo, Assadi 16758b-TARI). - **Kurdistan:** In graminosis siccis jugi prope Salvatabad 25 km E Sanandaj (35°20' N, 47°08' E, 2300 m, 03.7.1971 Rechingher 42754; W G; 2000-2400 m, 01.8.1995 Assadi 75354-TARI). Narran village 38 km SE Sanandaj, Sanandaj - Kamyaran route (35°02' N, 47°00' E, 1500-2400 m, 15.6.1986 Fattahi, Tavakoly, Khaledian 811; TARI HKS; 2200-2600 m, 15.6.1987 Assadi 60408-TARI). Gartenmaterial aus Marab (10.6.1908 Strauss; JE). 15 km from Sanandaj

to Marivan (35°22' N, 46°52' E, 1875-2000 m, 29.6.2010 Amini Rad, Torabi 56028-IRAN). Bidjar, Kouhé Hamyé-Arab (35°53' N, 47°41' E, 01.7.1971 Termé 649-Iran). Saral area N Sanandaj, Doozakh-Darreh village (35°46' N, 46°56' E, 15.5.2005 Hosseini; HCAT). Salavatabad pass near Sanandaj, begin of the road to Ghorveh (35°18' N, 47°09' E, 2000-2400 m, 01.8.1995 Assadi; TARI). - Lorestan: Kalvar (34°04' N, 47°47' E, 9000', 29.5.1940 Koelz 15913; W). Gahar lake, Oshtoran Kuh (33°18' N, 49°17' E, 08.7.1993 Khorameian 34; ARCK). Oshtorankuh, above the vill. Tihun (33°21' N, 49°18' E, 2000-2500 m, 12.7.1981 Assadi, Mozaffarian 37116-TARI). In der Schlucht der Lisha bei Kale Rustam am Shuturunku (33°20' N, 49°21' E, 20.6.1889, 21.6.1889 Strauss 402; JE B). In monte Shuturunku (33°20' N, 49°18' E, 28.7.1902, 25.6.1905 Strauss; JE B). - Markazi: Golpayegan, Hende, (33°43' N, 50°00' E, 2200-2800 m, 27.6.1969 Iranshahr 8033-E; 650-IRAN). Determination unsure: W Azarb.: Piranshahr: Gurichaveh village (36°42' N, 45°08' E, 11.4.2000 Ghasempoor, Heidari, Shanaki 7634; ORUM). - E Azarb.: in argillosis 52 km a Siah Chaman versus Maragheh (1600-1750 m, 14.6.1977 Reching 56760; B G). - Kurdistan: Saral area N Sanandaj, Doozakh-Darreh village (35°46' N, 46°56' E, 15.5.2005 Hosseini; HCAT).

**72. *Allium sanandajense*** Maroofi & R.M. Fritsch **species nova**. - Type: Iran, Kurdistan: NW Sanandaj, between Chatan to Zardavan villages, 2060 m, 35°29' N, 46°50' E, 23.5.2011 leg. Maroofi, Ahmadi (holotype 10303-HKS). Paratype: Iran, Kurdistan: Cultivated in the Zaleh station, Sanandaj, collection site not registered, leg. 04.5.2011 Maroofi & Ahmadi 10557-HKS.

Inflorescentiae et color florum specie novae similes Allio ubipetrenso sed differ ab ea pluribus et lanceolatis foliis, scapis longioribus, tepalis strictis interdum bi- vel trinervatis, ovariis nigrescentibus semi-lucentibus et antheris kermesinis.

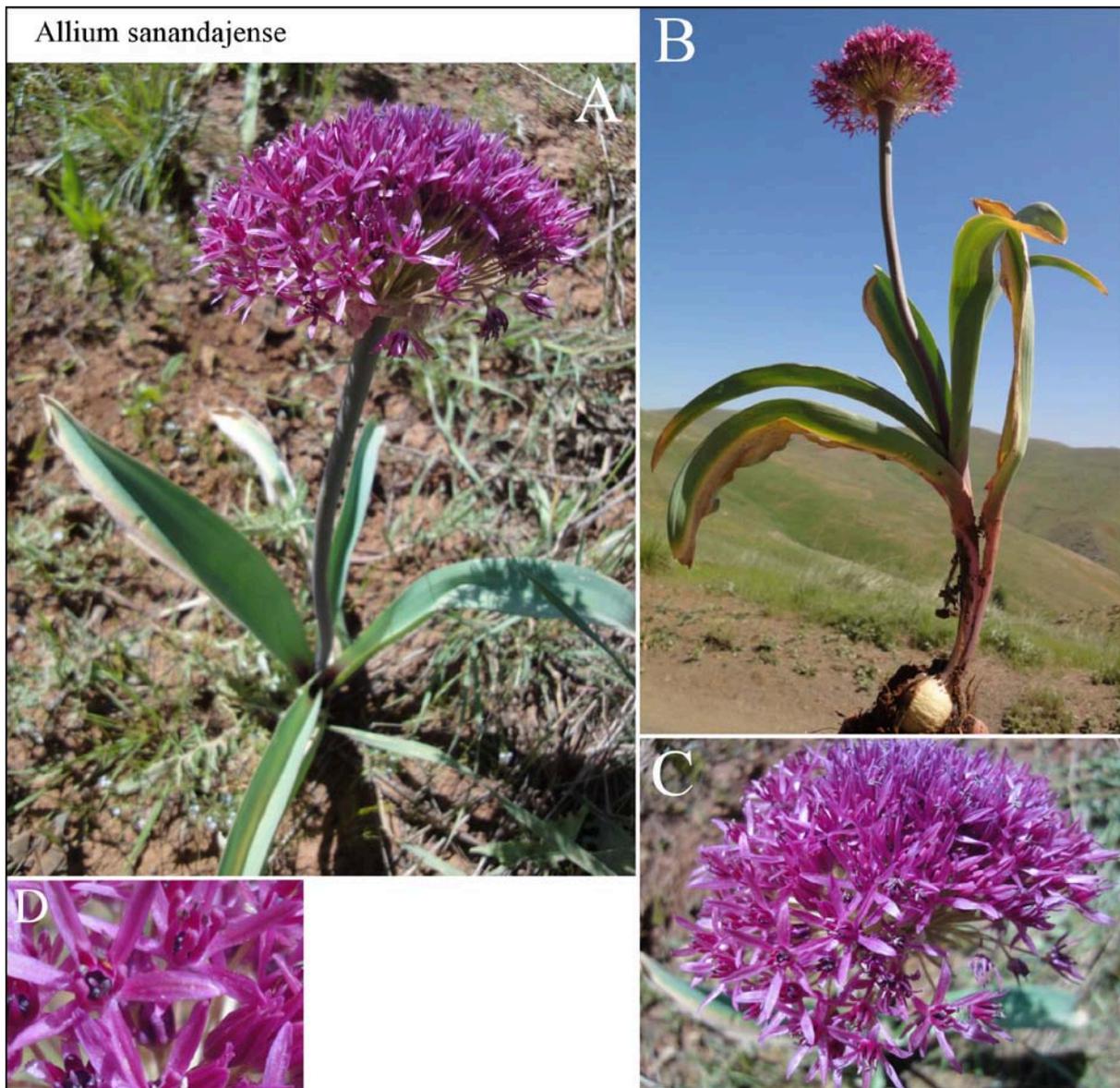
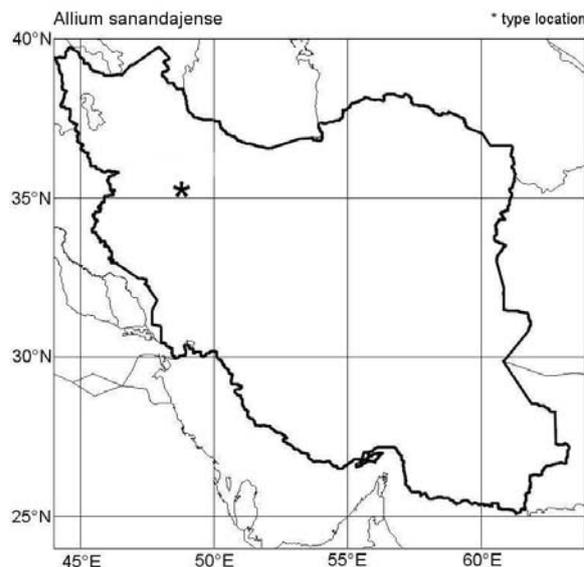


Plate T72. Plants from the type location, all photos courtesy of H. Maroofi. A: flowering plant; B: type specimen after excavation; C: inflorescence in full anthesis; D: close-up of flowers, tepals having one and two veins are visible.

Bulbs ovate to subglobose, c. 4.5-5 cm in diam., outer tunics parchment-like, lengthwise splitting, grayish, inner tunics ivory. Scape flexuous, terete, slightly thickest below the inflorescence, smooth, c. 25 cm long, 7-9 mm in diam., greenish, near the base purple flushed. Leaves 6, laminae lanceolate, patent, 18-21 cm long and 2-3.5 cm wide,  $\pm$  undulate, canaliculate, apex (sub)acute, margin finely ciliate, glaucous, purple suffused, vaginal part mainly purple. Spathe papery-membranous, split into several triangular valves, whitish with purplish flush. Inflorescence broadly fasciculate to semi-globose, dense, 4.5 cm long and 10 cm wide. Pedicels flexuous, terete or sometimes angled, up to 4 cm long; yellowish with purple flush. Anthesis in May. Flowers flat star-like. Tepals linear to narrowly lanceolate, canaliculate, patent, near the base for c. 1.5 mm connate, subacute, after anthesis somewhat crumpled and convolute, 7-9 mm long and 1.2-2 mm broad; deep purple, mainly with a darker median vein and rarely with 2 inconspicuous lateral veins. Filaments about 1/3-1/2 as long as the tepals, triangular, near the base for c. 1 mm connate, deep purple. Anthers oblong-elliptic, c. 2 mm long and 1 mm broad, dark purple. Pollen pale yellow-whitish. Ovary subglobose, not stipitate, c. 2.5 $\times$ 2 mm; dark purple above. Style 3 mm long, yellowish with purple flush. Stigma dot-like, yellowish-white. Capsule sub-spherical, c. 5-5.5 mm in diameter. Seeds not seen.

**Distribution:** Iran, prov. Kurdistan; vicinity of Sanandaj, open montane ranges with deep and fertile soil covered by perennial grasses and forbs.



**Remarks:** Inflorescences and flower color appear like *A. ubipetrense*, but *A. sanandajense* owns more and lanceolate leaves, and a moderately long scape like *A. koelzii*. Important differences to both mentioned taxa are the straight tepals and carmine anthers, and especially the semi-glossy, blackish ovaries most similar to members of sect. *Melanocrommyum* s. str. A special character of the new species is the presence of 2-3 veins on the inner tepals supporting affiliation to sect. *Pseudoprason*. Two more vouchers cultivated in the Zahleh station, Sanandaj, collection site not registered (4522-HKS, 7880-HKS) show also some 2-3-veined tepals but possess only 3 but much broader leaves and larger (up to 14 mm long and 3 mm broad) tepals (below presented in detail [80]).

Determination unsure: **Kurdistan:** Sanandaj Zahleh station, cultivated (03.5.2002 Yousefi, Maroofi 4522-HKS, 26.4.2006 Maroofi 7880-HKS).

*Allium* sect. *Regeloprason* Wendelbo in Acta Horti Gotob. 28: 36 (1966); Wendelbo in Bot. Notiser 122: 29 (1969). Type: *A. regelii* Trautv.

*Allium* subsect. *Regeloprason* (Wendelbo) Kamelin, Florogen. analiz Srednej Azii: 241 (1973) subsect. *Melanocrommyum*, s. str. Type: *A. regelii* Trautv.

**73.** *Allium regelii* Trautv. in Trudy Imp. S.-Peterb. Bot. Sada 9: 275 (1884), 466 no. 206 (1886). Regel in Trudy Imp. S.-Peterb. Bot. Sada 10: 354 (1887). Vved., Flora Turkm. 1, 2: 295 (1932); Vved., Flora URSS 4: 278 (1935); Vved. [ & Kovalevskaya], Opred. rast. Sredn. Azii 2: 89 (1971). Wendelbo, Flora Iranica No. 76: 95, tab. 10/139a-b, tab. 22/1, tab. 23, tab. 28/3 (1971). Kamelin ex Nikitin & Gel'dikh-anov, Opred. rast. Turkmen.: 129 (1988). Fritsch, Plant life SW Central Asia, Tashkent: 63, plate 1 A (2000). *Allium cupuliferum* var. *regelii* (Trautv.) O. Kuntze in Trudy Imp. S.-Peterb. Bot. Sada 10: 242 (1887). - *Allium yatei* Aitch. & Baker in Trans. Linn. Soc., Second Ser., 3: 117 (1888). Syntypes: Afghanistan: Hari-rud valley, 21. & 26.4.1885, Aitchison 289, 09.5.1885, Aitchison 414 (K!). ? *Allium regelii* subsp. *salangense* Kamelin & Seisums ex Seisums, Podrod Melanocr.: 27 (1994), nom. nud., type (ined.): Salang pass, north side, 8000' ... leg. 5.6.1964 Furse 6614. - Type: Turkmenistan: Achalteke. Specimina omnia anomala biumbellata ... leg. Cristoph No. 4711, mis. M. N. Smirnov 1883 (holotype LE).

Bulbs  $\pm$  broadly ovoid, 1-2.5 cm in diam., 1-3 cm long; outer tunics parchment-like, prolonged into a neck, longitudinally splitting (sometimes fibre-like), often accumulating into a brittle brownish to reddish shell; inner tunics papery, yellowish. Scape straight or somewhat flexuous, terete, smooth; 20-70 (100) cm long, 3-8 mm in diam.; dull green, basally and above purple suffused. Leaves (1) 2-4 (5), laminae narrowly lanceolate, stiff to flat obliquely arcuately ascending, thin or fleshy, canaliculate, long tapering into the subacute, slightly cucullate apex; upper side smooth or with some furrows, lower side with few broad and shallow ribs; margin smooth or slightly ciliate; 15-35 cm long, 5-40 mm broad; glaucous green, purplish suffused near the base. Sheath leaf short or long, membranous, soon decaying. Spathe fine membranous, split into 2-3 triangular, long acuminate, patent valves; pale yellowish brown with darker veins, basal part often initially purplish suffused. Inflorescence composed of 1-3 (6) superposed partial inflorescences (separated by short partial scapes of decreasing diameter terminated by a spathe), fasciculate later semi-globose, dense; the lowest partial inflorescence bears 20-50, the uppermost 8-15 flowers. Pedicels thin to rather thick, stiff wire-like, very unequally long (pedicels of the first opening flowers are much shorter than those of the last opening flowers; pedicels of the lowest partial inflorescence are much longer than those of the uppermost partial inflorescence); green, purple to brown suffused below the flowers, color fading during anthesis. Anthesis in April to May (early June). Flowers narrowly campanulate to funnel-shaped. Tepals lanceolate, subobtusate, straight or slightly recurved, basally for 1/3-2/5 connate, (9) 13-17 mm long (inner tepals somewhat shorter), at the base of the free part inner tepals 2-2.5 mm broad, outer tepals up to 3 mm broad, after anthesis shriveling; pale lilac or mauve to pinkish-carmine with conspicuous greenish, brown or purple median vein. Filaments c. 1/2 as long as the tepals, basally for 2/3 connate with the tepals, over that for 1/5-1/2 connate, free parts of the outer filaments subulate to triangular, of inner filaments triangular to ovate, twice broader and somewhat longer than the free parts of outer filaments; whitish. Anthers ovoid to arrow-shaped, c. 1.8 mm long, at the base c. 1 mm broad, violet to maroon. Pollen reddish-grey; shape oblate, 28 / 38-42  $\mu$ m long, 16 / 27-30  $\mu$ m broad, P/E 0.6 / 1.4, brochi c. 0.3  $\mu$ m, muri 0.3-0.5  $\mu$ m, sculptures rugulate to micro-rugulate and perforate, wall 0.9  $\mu$ m thick (Thunert 1967; Neshati & al. 2009). Ovary long ovoid-triangular, shortly stipitate, semi-glossy, surface very finely coarse, tip concave; green with violet flush; 8-10 (20) ovules per locule (IPK unpubl. data); up to 4 ovules per locule, 11 locules per ovary (Filimonova 1970). Nectary ducts lead in small pits at the base of the ovary. Style narrowly conical to thread-like, 1.5-5 mm long; pink to purple. Stigma very shortly tripartite, pinkish. Capsule ovoid to long-ovoid three-angled, surface  $\pm$  smooth and semi-glossy with a few irregular ledges; 6-8 mm long and 5-6 mm in diam.; yellowish brown, widely opening; valves long-oval, with a broad longitudinal furrow only near the base and scarcely notched at the apex. Seeds 2-5 per locule, flat ovate with sharp ledges along the

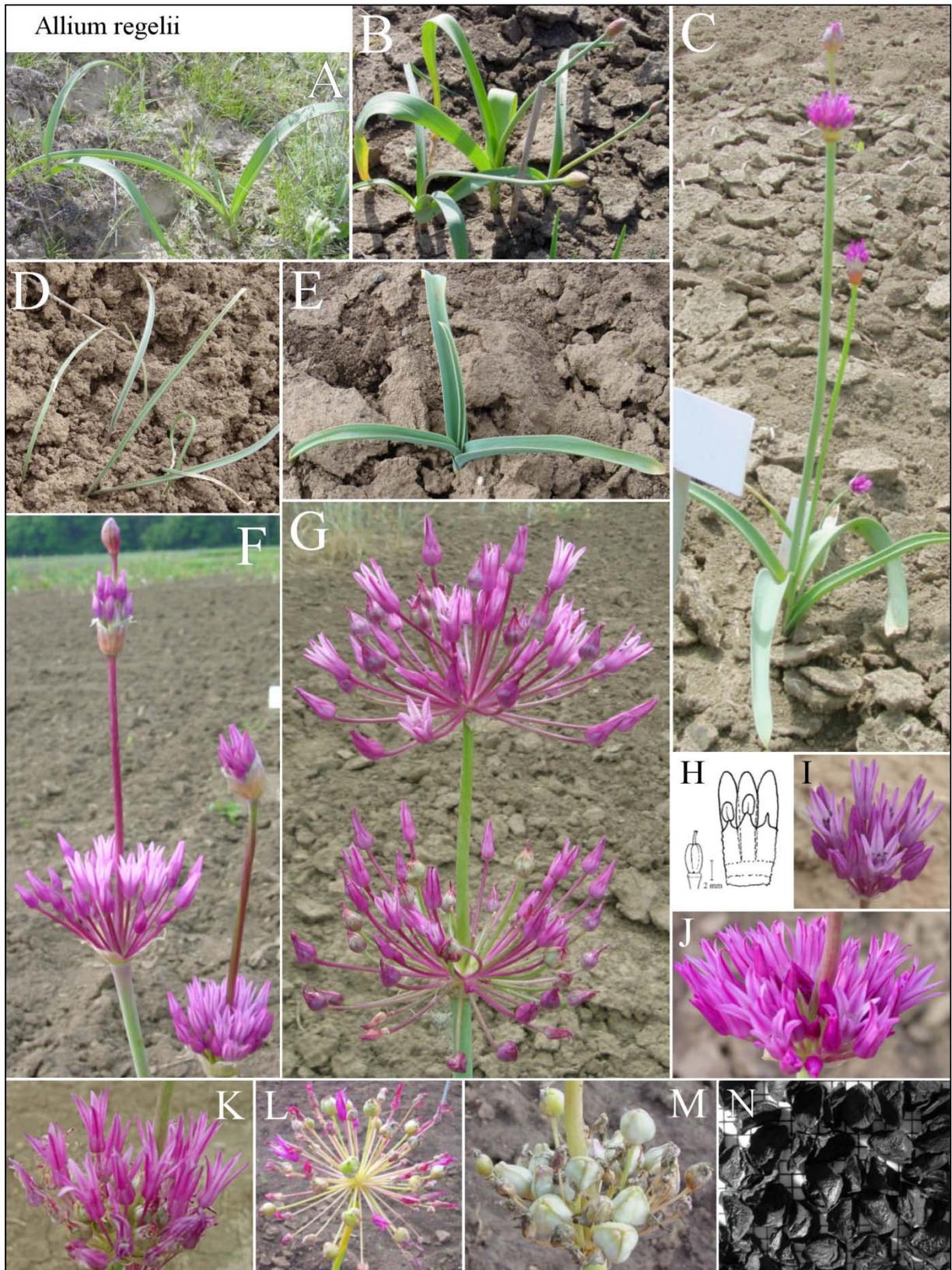
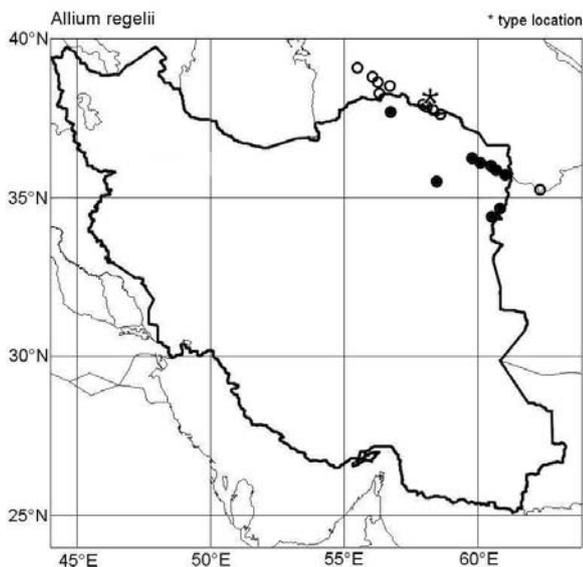


Plate T73. A & B: Plants in the shooting stage near Gaudan, Turkmenistan, and under cultivation, resp.; C: cultivated plants in the bud stage; D & E: sprouting leaves of weak and strong plants, resp.; F & G: superposed inflorescences in early and late anthesis, resp.; H: shape of ovary, tepals and filaments of a flower prepared from herbarium; I: simple inflorescence of a weak plant in early anthesis; J & K: partial inflorescences in full and late anthesis, resp.; L: inflorescence with developing capsules; M: partial inflorescence with full-sized capsules; N: seeds (background raster 1 mm).

purple median vein. Filaments c. 1/2 as long as the tepals, basally for 2/3 connate with the tepals, over that for 1/5-1/2 connate, free parts of outer filaments subulate to triangular, of inner filaments triangular to ovate, twice broader and somewhat longer than the free parts of outer filaments; whitish. Anthers ovoid to arrow-shaped, c. 1.8 mm long, at the base c. 1 mm broad, violet to maroon. Pollen reddish-grey; shape oblate, 28 / 38-42  $\mu\text{m}$  long, 16 / 27-30  $\mu\text{m}$  broad, P/E 0.6 / 1.4, brochi c. 0.3  $\mu\text{m}$ , muri 0.3-0.5  $\mu\text{m}$ , sculptures rugulate to microrugulate and perforate, wall 0.9  $\mu\text{m}$  thick (Thunert 1967 / Neshati & al. 2009). Ovary long ovoid-triangular, shortly stipitate, semi-glossy, surface very finely coarse, tip concave; green with violet flush; 8-10 (20) ovules per locule (IPK unpubl. data); up to 4 ovules per locule, 11 locules per ovary (Filimonova 1970). Nectary ducts lead in small pits at the base of the ovary. Style narrowly conical to thread-like, 1.5-5 mm long; pink to purple. Stigma very shortly tripartite, pinkish. Capsule ovoid to long-ovoid three-angled, surface  $\pm$  smooth and semi-glossy with a few irregular ledges; 6-8 mm long and 5-6 mm in diam.; yellowish brown, widely opening; valves long-oval, with a broad longitudinal furrow only near the base and scarcely notched at the apex. Seeds 2-5 per locule, flat ovate with sharp ledges along the edges, at least one side concave, surface tuberculate or glossy and reticulate lacunose; 2.5-3.5 mm long, 2-2.5 mm broad, c. 1 mm thick, dull black. The periclinal walls of the testa were flat and granulous, without verrucae or with many verrucae, the anticlinal walls showed mostly Omega-like undulation with low to moderate amplitude (Kruse 1988; Fritsch & al. 2006).



**Chromosomes:**  $2n = 16$  Vakhtina 1964 (Turkmenistan: Jer-Ajlanduz).  $2n = 16$  Pedersen & Wendelbo 1966 (Afghanistan: Qataghan)

**Distribution:** Turkmenistan, N Afghanistan, NE Iran: Koppe Dagh mountain range; submontane loamy steppe slopes, loess and rubble slopes.

**Remarks:** Strong specimens of this species are easily recognizable by the inflorescences composed of several superposed "etages". We observed in the culture that plants collected with a simple inflorescence changed to the common shape under better conditions. There were no reports yet whether plants from populations showing solely simple inflorescences mentioned by Wendelbo (1971: 96) changed in the same manner when cultivated, and

whether the morphological peculiarities described by Botschantzev & al. (1978) for Badhyz "*A. yatei*" are also true for Iran and Afghan plants. Also the true taxonomic state of plants with pale lilac flowers was not elucidated hitherto. Occurrence of *A. regelii* in the western Tianshan mountain range of Kyrgyzstan near Chaek (Yoshida & al. 1995) seems extremely improbable. Molecular markers (ITS sequences of nuclear rDNA) put *A. regelii* rather close to all investigated members of subset *Humilicognata* but rather distant to all other groups of sect. *Regeloprason* (Fritsch & al. 2010; see p. 199). Sequences of the plastid *trnL-trnF* region support closer relations to *A. hissaricum* Vved., *A. winklerianum* Regel, and to several species of sect. *Megaloprason* s. str. (Gurushidze & al. 2010).

**Etymology:** Named after the distinguished German horticulturist and botanist Eduard Regel acting mainly in St. Petersburg (Russia). He was the author of the last monograph of the genus *Allium* (Regel 1875).

**Biological data:** Seedlings belong to the *Allium karataviense* type (Druselmann 1992). Fresh bulbs contain in total 0.35 / 0.26 % cysteine sulfoxides (77 / 74 % methiin, 23 / 15 % isoalliin, 0 / 11 % propiin) (Keusgen & al. 2008 / partly as *A. yatei*). Genome size 42.8 pg 2C DNA (Gurushidze & al. 2012).

**Economic traits:** Ornamental plant listed in the "International Checklist ..." of the Royal General Bulb-growers Association (1991). This species was already included in a list of ornamentals proposed for Turkmenistan (Androsov 1941).

Living accessions studied: Raz. Khor.: N slopes of Kuh-e Sorkh massif S Atalyeh c. 55 km S Neyshabur (35°41' N, 58°30' E, 1600 m, 16.5.2012 Fritsch, Eskandari, Bahramishad 1402; GAT IRAN). Hill crest NE the pass above vill. Mazdavand c. 100 km from Mashhad to Sarakhs (36°10' N, 60°33' E, 1000 m, 14.5.2012 Fritsch, Eskandari, Bahramishad 1395; IRAN GAT).

Herbarium vouchers: N Khor.: NW of Bojnurd, Kal-Eimani town, 4-5 km on the road of Kal-Emani towards Buzdaghi (37°52' N, 56°47' E, 835-850 m, 30.5.2007 Memariani, Zangooei 39062; FUMH). — Raz. Khor.: c. 110 km E Mashhad (36°02' N, 60°43' E, date & collector not translated; FUMH). c. 30 km ENE Mashhad (36°23' N, 59°52' E, date & collector not translated; FUMH). c. 140 km ESE Mashhad (35°52' N, 61°01' E, date & collector not translated; FUMH). c. 55 km E Mashhad (36°16' N, 60°13' E, date & collector not translated; FUMH). Mashhad, W of Miaami, Arduluk mountain (36°15' N, 60°06' E, 950-1000 m, 19.5.1991 Joharchi, Zangooei 20316; FUMH). NE of Mashhad, Azhdar-kuh (mountain around cement factory) (36°27' N, 59°46' E, 1300 m, 30.5.1992 Joharchi, Zangooei 23212; FUMH). Sarakhs, Agh-darband mine (36°04' N, 60°46' E, 600 m, 20.5.1990 Joharchi, Zangooei 18616; FUMH). Karat c. 75 km S Torbat-e-Jam (34°34' N, 60°34' E, date & collector not translated; FUMH). Torbat-e Jam, N of Saleh-Abad, Zalu mount (35°54' N, 61°05' E, 1250-1300 m, 2.6.2003 Joharchi, Zangooei 34603; FUMH). Taibad, 15 km road of Taibad towards Karaat (34°35' N, 60°35' E, 900 m, 01.5.1993 Faghinia, Zangooei 23054; FUMH). Tayebad to Dougharon (34°44' N, 60°54' E, 800 m, 25.4.1989 Mozaffarian 67582-TARI). Inter Tayyebat et Kisil Islam Qaleh (34°43' N, 60°58' E, 700 m, Rechinger 33228; W).

**Allium subsect. *Diffusoumbellata*** R.M. Fritsch in *Phyton* (Horn, Austria) 49: 201 (2010). Type: *A. cupuliferum* Regel

**74. *Allium cathodicarpum*** Wendelbo in *Acta Horti gothob.* 28: 37, f. 9 (1966), Wendelbo, *Flora Iranica* No. 76: 94, tab. 10/138, tab. 22/2a,b (1971). Fritsch, *Plant life SW Central Asia*, Tashkent: 66 (2000). - Type: SE Iran, Prov. Kerman, in reg. alp. montis Kuh-i-Nasr et montis Kuh-i-Sirdsch, 3000-3700 m, 23.-24.5.1892, leg. Bornm. no. 4770 (holotype B!). Paratypes: In monte Kuh-i-Dschupar, (29°55' N, 57°12' E, 3700-3800 m, 12.6.1892 "*Allium carmanicum* Hausskn. & Bornm. ineditum" Bornmüller 4778; B!); Machiz, Khane sorkh pass (Wendelbo 1971: Inter Mashiz et jugum Khan-e Sorkh) 27.4.1948 Rechinger, Esfandiari, Aellen 3035 (320-IRAN! W! G!); prov. Kerman et Fars: Inter Saidabad et jugum Chah-e Chaghak (Wendelbo 1971: Chah Choghuk) (27°49' N, 55°50' E, c. 1900 m, 28.4.1948 Rechinger 3525 (W!)).

Bulbs ovoid, c. 1.5 cm long, 1-1.5 cm in diam.; outer tunics strong, undivided but neck somewhat splitting; blackish; inner tunics yellowish. Scape straight or flexuous, terete, smooth; 10-20 cm long, 3-4 mm in diameter; green, near the base purplish flushed. Leaves single, lamina narrowly linear-lanceolate, obliquely or arcuately ascending and recurved to the soil, thick, canaliculate, gradually tapering into the hooded apex; margin narrowly purplish, finely toothed; 10-20 cm long, 8-16 mm broad; glaucous green with purple flush. Sheath leaf short, membranous, brownish, soon decaying. Spathe thin membranous, splitting completely into 1-2 ovate, obliquely upright valves c. 1 cm long; ochre-pinkish with purple veins. Inflorescence narrowly fastigiate later depressed-globose, very loose, with 5-30 flowers; (3) 10-15 cm in diameter. Pedicels thin, ± straight, wire-like stiff, unequally long; dull purplish green. Anthesis in April. Flowers funnel-shaped star-like. Outer tepals narrowly oblong-lanceolate, inner tepals narrowly ovate-triangular, basally c. 2 mm connate, obliquely directed, in anthesis recurved, apex subobtusate; after anthesis straight and wilted, finally convolute and irregularly bent; 8-10 mm long, 2-3 mm broad; pink with a narrow purple median vein. Filaments about half as long as the tepals, fleshy, outer filaments narrowly triangular, inner ones broadly triangular; basally for 0.5-1 mm connate; pinkish. Anthers ovate, c. 1 mm long; purple. Pollen yellow. Ovary obovoid, 2-3 mm long and in diam., surface finely coarse; green; 3-4 ovules per locule. Style conical, c. 2.5 mm long; whitish. Stigma dot-like. Capsule subglobose, 4-5 mm in diam.; not seen in the ripe stage. Seeds 1(?) per locule, surface rugose with irregular ledges; c. 2.4 mm long; black.

Distribution: W & C Iran; submontane to subalpine dry rock and rubble slopes, semi-deserts.

Remarks: This species is morphologically well characterized by the very loose inflorescence expanding during the course of anthesis, and funnel-shaped flowers having basally long connate tepals. According to our observations, this species is well adapted to very dry conditions and is able to suppress growth after a very dry winter and spring (the plants "remain sitting") till the next spring. According to molecular markers (ITS sequences of nuclear rDNA), *A. cathodicarpum* is the closest genetic relative of *A.*

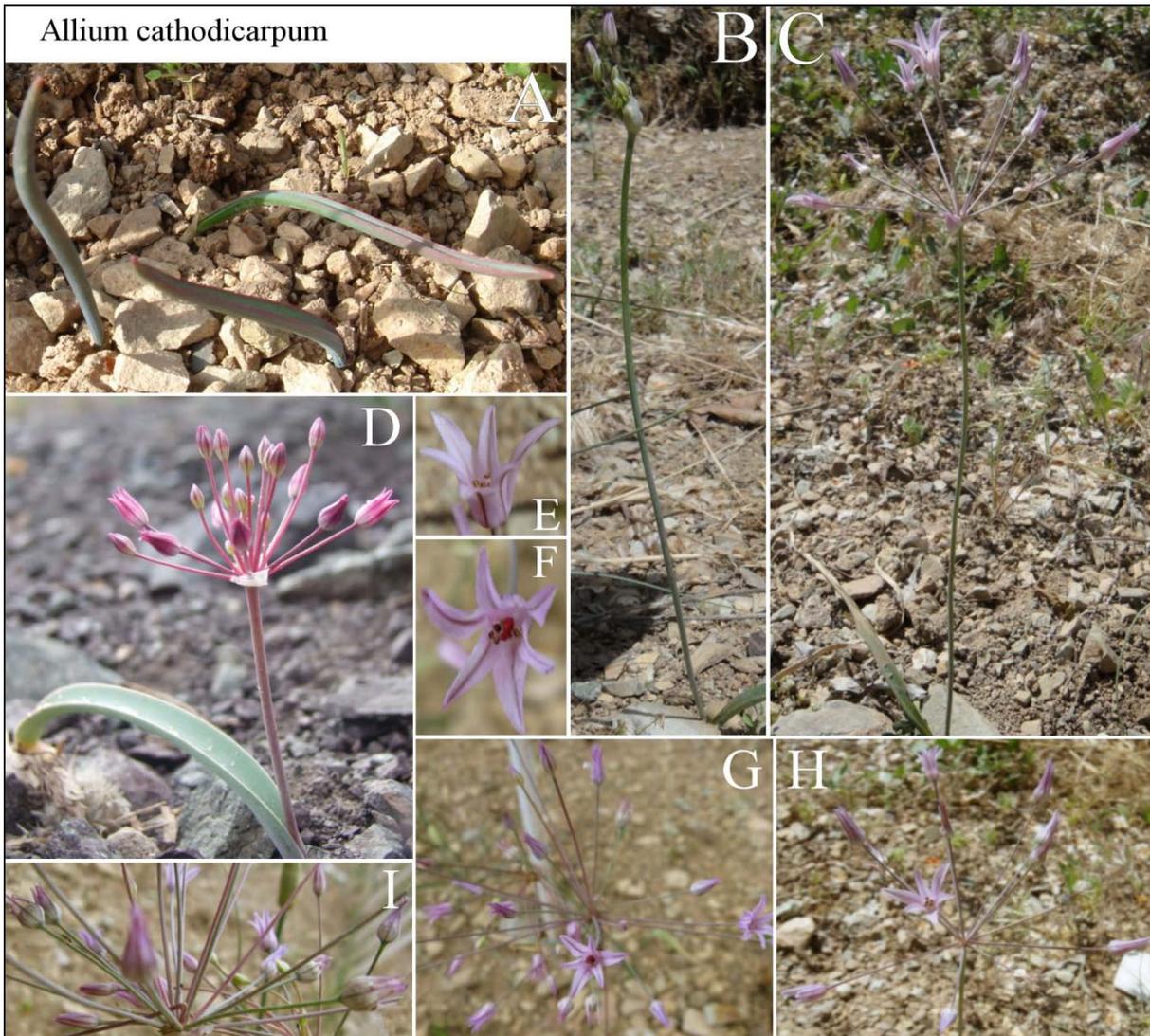


Plate T74. A: Sprouting leaves of cultivated plants; B & C: plants in the bud stage and in anthesis, resp., cultivated in Tehran; D: plant in early anthesis in the prov. Kerman (photo courtesy of H. Moazzeni); E & F: close-up of flowers; G, H & I: inflorescences in different stages of anthesis showing buds, open flowers, and developing capsules.

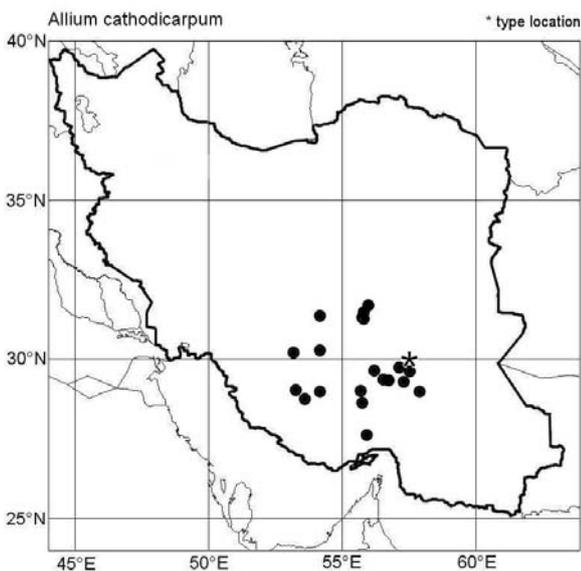
*subkopetdagense*, less closely related are *A. balkhanicum* (R.M. Fritsch & F.O. Khass.) R.M. Fritsch, and a few Central Asian species of sect. *Regeloprason* as well as the Central Asian sect. *Stellata* (see

p. 201). The morphologically similar *A. regelii* (see p. 199) belongs to a very distant molecular clade.

**Etymology:** The epithet refers probably to the pedicels recurved in the fruiting stage (from Greek "with descending fruits").

Living accessions studied: **Fars:** Limestone slopes near the main road between Safar Shahr and Qaderabad (30°24' N, 53°13' E, 2200-2300 m, 11.4.2008 Abbasi, Fritsch 1230; IRAN).

Herbarium vouchers: **Fars:** Fasa, Mianjanga (28°56' N, 53°39' E, 1862 m, 04.5.2007 Furughi; HSU). Shiraz 97 km to Fasa road (29°14' N, 53°18' E, 1680 m, 01.5.1972 Foroughi 3539; TARI). 18 km after Estahban on Neyriz road (29°10' N, 54°12' E, 2300 m, 29.4.1991 Khozravi, Nikookar 1635; HSU). — **Hormozgan:** Bandar-Abbas: Pass 75 km S Sirjan (28°50' N, 55°47' E, 1900 m, 10.4.1975 Wendelbo, Foroughi 15834-TARI; W). Pass (with tunnel) c. 53 km from Sirjan on road to

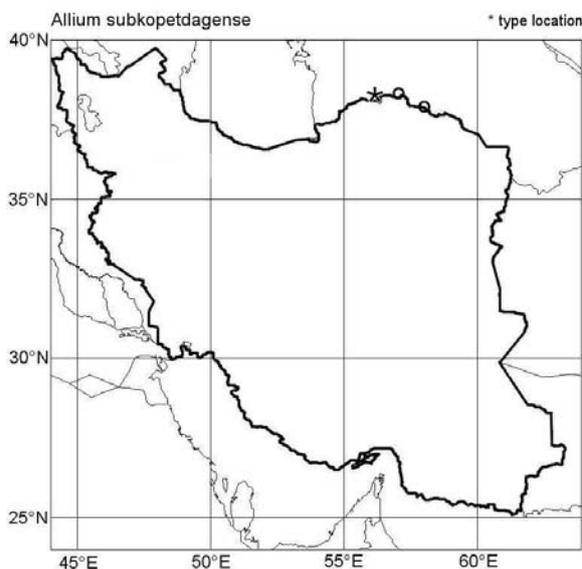


Bandar-Abbas (29°12' N, 55°44' E, 1700-1900 m, 11.4.1975 Wendelbo, Foroughi 15864-TARI; 26.4.1984 Mozaffarian 49501-TARI). — Kerman: Sirjan à Kerman à 82 km de Sirjan (29°50' N, 56°15' E, 2250 m, 03.5.1972 Léonard 5990; 52141-IRAN; BR). In the mountains S of Kerman (29°57' N, 57°10' E, 18.5.1943 Stscherbitov?; LE). Dekhbakri (29°11' N, 57°56' E, 2000-2500 m, 06.5.1969 Pasouki, Haschemi 321-IRAN). In regionibus alpinibus montis Kuh-e Nasr, et Kuh-i Sirj. (30°14' N, 57°27' E, 3000-3700 m, Bornmüller 4770; B). 130 km from Bam to Kerman, along the road (29°48' N, 57°34' E, 2100 m, 05.5.1977 Assadi 23239-TARI). Baft: Gugher, Bondar (29°33' N, 56°34' E, Mirtadzedini 31991; TUH). Kuh-e Lalezar, Zarda valley, sandy stony ground along fields (29°33' N, 56°46' E, 3000 m, 17.6.1975 Foroughi, Assadi 16329-TARI). — Yazd: 54 km from Bafgh to Sheitoor (31°40' N, 55°50' E, 2200 m, 28.5.1986 Assadi, Bazgosha 56036-TARI). 50 km E Bafgh, Mt. Bonlakhar (31°27' N, 55°50' E, 2400-2700 m, 30.5.1986 Azadi, Bazgosha 56120-TARI, 56131-TARI). 54 km from Bafgh to Sheitoor (31°40' N, 56° E, 2200 m, 28.5.1986 Assadi, Bazgosha; TARI). Aliabad toward Marvast (30°29' N, 54°13' E, 03.5.2004 Mir Hosseini; ARIY). Fakhrrabad Mountains, Manshad (31°33' N, 54°13' E, 03.6.1995 Mosley-Arany; HYU). Behabod (31°52' N, 56°01' E, 2020 m, 27.4.2003 Mir Hosseini 82-6; ARIY).

Determination unsure: Kerman: Mt. Hezar (29°29' N, 57°21' E, 3000-3200 m (Rajaei & al. 2011: 119) 494-IAUH).

**75. *Allium subkopetdagense*** (R.M. Fritsch & F.O. Khass.) R.M. Fritsch in Phytion (Horn, Austria) 49: 186 (2010); *Allium isakulii* subsp. *subkopetdagense* R.M. Fritsch & F.O. Khass., Plant Life S-W. Central Asia, Tashkent: 65, plate 1 I (2000). - *Allium iliense* sensu Wendelbo, Flora Iranica No. 76: 94 (1971), p. p., quoad pl. Kopetdag. ? *Allium cupuliferum* sensu Kamelin ex Nikitin & Gel'dikhanov, Opreded. rast. Turkmen.: 129 (1988). - Type: Ex culturae in horto Gaterslebensis No. TAX 5278/96, leg. 22.7.1996 [ex Turkmenistan: Zentraler Kopetdag ca. 5 km S der Ortschaft Chuli, Kalkschotterhänge bei ca. 800 m NN] (holotype GAT).

Bulbs depressed-globose, (1.2) 2-3 cm in diam., (1.5) 2-2.5 cm long; outer tunics membranous, finally decomposing, gray-brown. Scape terete, slightly flexuous, smooth, (18) 30-40 cm long, above 3-4, basally up to 6 mm in diam.; green, basally reddish flushed, very glaucous. Leaves 1-2, narrowly lanceolate, flat ascending-recurved, ± thick, basally strongly, above slightly canaliculate; upper side smooth or furrowed, lower side with broad and shallow ribs; margins basally toothed becoming nearly smooth towards the tip, initially narrowly red-brown; ± shortly tapering into the hooded apex; 12-25 (35) cm long, 5-20 mm broad; deep green, glaucous. Sheath leaf thin, ± strong, with silky sheen. Spathe thin membranous, undivided or split into 2 ovate long-acute valves, ± appressed to the scape; yellowish brown with narrow inconspicuous veins. Inflorescence broadly fasciculate, finally subglobose, loose, (5) 10-15 cm in diam. Pedicels thin wire-like, somewhat ascending; dull brownish-green. Anthesis in June. Flowers narrowly campanulate, star-like. Tepals lanceolate-triangular, basally straight and for 3-4 mm connate, the free parts recurved, acute with plicate apex; 12-15 mm long, basally 3-4 mm broad; deep pink to pinkish-carmine, paler towards the base, with narrow, brown-green to carmine median vein. Filaments 2/5 as long as the tepals, for 3/4 adnate to the tepals, basally c. 3 mm long connate, free parts broadly triangular with a short subulate apex; pale pink. Anthers ovoid, c. 2 mm long, 1.5 mm broad, initially violet. Pollen grayish yellow. Ovary subglobose with three narrow furrows; 2-3 mm long and



and in diam., very shortly stipitate, surface finely coarse; pale green with violet patches. Style narrowly conical, 2-3 mm long; white to finally pink. Stigma undivided, finally subcapitate; pale. Capsule globose, covered by the remains of the tepals and filaments, 4-5 mm long and in diam., widely opening, valves suborbicular. Seeds 1-2 per locule, flat drop-like to comma-shaped, finely rugose with irregular ledges; 2.3-3 mm long, 1.5-2 mm broad and thick; dull black.

Distribution: Turkmenistan: C Kopetdag mountain range, presence on Iranian territory is very probable; submontane limestone rubble slopes and rock terraces.

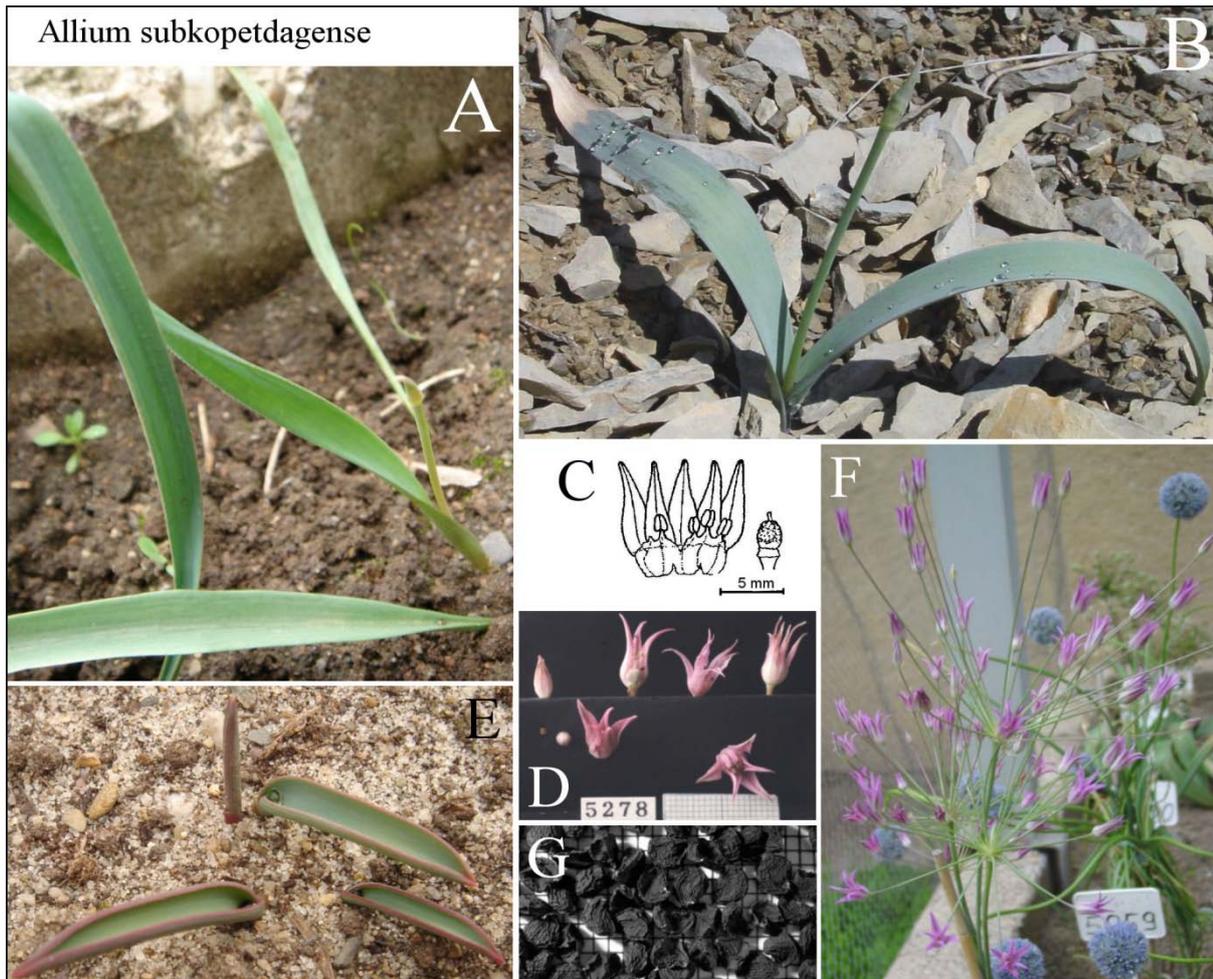


Plate T75. A & B: Plants in the shooting stage in cultivation and in the valley Chuli, Turkmenistan, resp; C: shape of ovary, tepals and filaments of a flower prepared from herbarium (from Fritsch 2000: Plate 1 I); D: comparison of flower parts in different stages; E: sprouting leaves of cultivated plants; F: inflorescences of cultivated plants in anthesis; G: seeds (background raster 1 mm).

**Remarks:** This species differs from *A. cathodicarpum* by lanceolate leaves strongly toothed near the base, and acute, strongly recurved tepals with plicate apex. According to molecular markers (ITS sequences of nuclear rDNA) both species are close genetic relatives (see p. 201).

**Etymology:** The epithet refers to the occurrence on spurs of the Koppe Dagh mountain range (from Latin "sub~" = not completely, below).

**Biological data:** Genome size 41.4 pg 2C DNA (Gurushidze & al. 2012). Fresh bulbs contain in total 0.14 % cysteine sulfoxides (50 % methiin, 50 % isoalliin, Keusgen & al. 2008).

### Vouchers and photos of uncertain affiliation

A few herbarium vouchers seen particularly in the years prior to 2010 could even not preliminarily be determined. Beside those cases when the collection sites could not be detected, the study of such vouchers initiated visits of the collection sites, but not always the plants in demand could be found there. Such unclear vouchers will be shortly discussed here with special emphasis to morphologically similar species. If we were able to make a molecular analysis, the results will be discussed.

It cannot be excluded that a few of these vouchers may represent hybrid plants, as far as one can judge from morphological characters. However, after having conducted over 30 years of fieldwork to *Allium* species, R.M.F. would like to state here to have very rarely seen specimens showing clear hybrid characters in the nature.

**76. *Allium* sp. A**

Voucher: Iran, prov. Fars: road of Sepidan to Komehr near Pist-e Eski, Kuh-e Ronge, 3190 m, 51°57' 07.89" E, 30°21'44.04" N, leg. A. Arazi 04.6.2006 (HSU).

These plants combine the characters of *A. austroiranicum* [25] and *A. kazerouni* [66] showing intermediate measures of scape length, width and length of leaves, and consistence of tepals (neither stiff nor weak, reflexed and enrolled but slightly contorted after anthesis). On the other hand, diameter of the scape and leaf number are close to *A. kazerouni*, but color and shape of tepals as well as the relative length and color of filaments do not differ from *A. austroiranicum*. Flower buds are not present, therefore one cannot draw any conclusion on presence of anthers and pollen; whose absence would be a strong hint to a hybrid state. Nevertheless, the large genetic distance between both mentioned species makes a hybridization very improbable.



Incomplete description: Bulbs nearly ovate, 2-3 cm in diam. and long; inner tunics whitish, parchment-like. Scape cylindrical, smooth, flexuous; 20-25 cm long, 3-4 mm in diam., green, lower half purplish suffused. Leaves 3-5, linear to sub-lanceolate; upper and lower side apparently smooth; margins smooth?; apex shortly tapering, hooded; 0.5-1.5 cm wide and about 15 cm long; green, purplish flushed towards the base. Inflorescence semi- to sub-globular, dense, many-flowered; 6-7 cm in diameter. Pedicels thickish, straight, stiff; purple. Flowers  $\pm$  flat star-like. Tepals narrowly lanceolate, patent?; about 8-10? mm long. Filaments straight, subulate?, shorter than the tepals.

**77. *Allium* sp. B**

Vouchers: 1. Iran: Kermanshah, (CAK), 2. Iran, Kurdistan: Saral area NW of Divandarreh, leg. Hosseini, 14.5.2005 (HCAI).

Both vouchers of this taxon were improperly prepared, and the shape of the leaves as well as most flower details cannot be seen with certainty. According to the small flowers it could be related to *A. chysanth-erum* [2] or to *A. minutiflorum* [40], but in both cases the leaves are completely different and would not fit to either of these relationships. Molecular markers (ITS sequences of nuclear rDNA) put voucher 2 (as Un10, Fritsch & al. 2010; see p. 199) in a close relationship to *A. koelzii* and *A. hooshidaryae* [70, 71]



(sect. *Pseudoprasum*), strongly dissimilar in flower characters.

Incomplete description: Bulbs nearly globose, 2-3 cm in diam.; inner tunics yellowish; outer tunics brown. Scape cylindrical, smooth, straight; about 30 cm long, c. 5 mm in diam., green, lower half reddish suffused. Leaves single?, ovate to oblong; upper side furrowed; margins smooth?, red; apex very shortly hooded?; about 6-8 cm wide and 10-

12 cm long; bluish green? Inflorescence broadly fasciculate to semi-globular, dense, many-flowered; 5-7 cm in diameter. Pedicels thin, straight? Flowers small, flat or reflexed star-like. Tepals lanceolate, reflexed?; about 5-6 mm long. Filaments straight, subulate?, shorter than the tepals.

### 78. *Allium* sp. C

Voucher: Iran, Azarbayjan-e Sharqi, Kaleybar: Arasbaran prot. area, 1 km from Karil-Hachasi to Kalasourn village, 2320 m, 16.6.1997 leg. Ghahaemani, Imami 6473 (HTRC).

Only at first glance, this plant looks like an extremely compact specimen of *A. alekii* [35]. However, the tepals are much longer and broader, the filaments are relatively shorter, and also the violet-purplish flower color is missing. This voucher does also not belong to *A. sabalense* [41] and *A. akaka* subsp. *bozgushense* [21] that own shorter and narrower tepals as well as more ovate filaments touching one another with the margins but may have pink flowers, too.



Incomplete description: Bulbs sub-globose, 4-5 cm in diam. and long; outer tunics grey to blackish, disintegrating. Scape cylindrical, smooth, flexuous; aerial part 8-10 cm long, 6-8 mm in diam., green. Leaves 3, ovate to oblong, canaliculate towards the base; upper and lower side apparently grooved; margins smooth, whitish; apex very shortly tapering, hooded; 5 - 8 cm wide and 15-20 cm long; green, purplish flushed toward the base. Inflorescence sub-globular, very dense, many-flowered; 10-12 cm in diameter. Pedicels thickish,  $\pm$  straight, stiff; green? Flowers  $\pm$  broadly funnel-shaped star-like. Tepals narrowly lanceolate to triangular; about 14-16 mm long, basally 3-3.5 mm wide. Filaments straight, triangular, half as long as the tepals. Anthers ovate, pollen yellowish.

### 79. *Allium* sp. D

Voucher: Iran, Azarbaijan-e Sharqi: Arasbaran protected region. Western part of Makidi, c. 2300 m, leg. Assadi & Masoumi 08.6.1976 (20228-TARI).



This specimen was laid into the press when in buds and opened the flowers only in the press. Therefore the flower characters and also the scape length remain more or less uncertain. The general appearance is similar to *A. iranshahrii* [24], but all plant parts are much larger, the plant has 3 leaves, and the tepals are relatively broader. Other plants on this sheet belong to *A. egorovae*.

Incomplete description: Bulbs  $\pm$  globose, 2-3 cm in diam.; outer tunics grayish. Scape conical, flexuous; aerial part 2-3 cm long, 6-8 mm in diam., green. Leaves 3, ovate to oblong, canaliculate towards the base; upper side apparently grooved, lower side ribbed; margins densely toothed, whitish?, very shortly tapering into the hooded apex; 3-6 cm wide and c. 12 cm long; green. Inflorescence sub-globular, very dense, many-flowered; finally perhaps 8-10 cm in diameter. Pedicels thickish, probably straight, stiff; green? Flowers  $\pm$  broadly funnel-shaped star-like. Tepals broadly lanceolate or elliptic, apex  $\pm$  obtuse; median vein striking and dark; probably 7-9 mm long, about 3.5-4 mm wide. Filaments shorter than the tepals.

**80. *Allium* sp. E**

Vouchers: Iran, prov. Kurdistan: Cultivated in the Zaleh station Sanandaj, original collection sites not registered (4522-HKS, 7880-HKS).



These vouchers were also laid into the press at begin of anthesis or even earlier. The plants own the general appearance of a member of sect. *Compactoprason* but with a very short scape and very short filaments. However, the tepals show up to three veins, a character typical for sect. *Pseudoprason*. ITS sequences of nuclear rDNA showed a singular position inside sect. *Acanthoprason* as unsupported sister to *A. austroiranicum* (Fritsch & al. 2010, as "A. sp. 8 7880H"). This result needs verification because it could point to a hybrid plant or a good new species. The presence of two or three tepal veins supports affiliation to sect. *Pseudoprason*. The shape of the leaves is indeed very similar to *A. koelzii*, but the

flowers differ remarkably. Morphological differences to *A. sanandajense* [72] were already discussed under that species. Re-detection of the true collection site and careful study of living plants seem essential.

Incomplete description: Bulbs depressed-globose, 4-5 cm in diam., 3.5-4 cm long. Scape conical,  $\pm$  straight; 10-15 cm long, 8-10 mm in diam., green, smooth. Leaves 3, ovate to linear-oblong, canaliculate towards the base; upper and lower side apparently smooth; margins smooth; apex very shortly tapering, hooded; (3) 5-10 cm wide and 15-25 cm long; green. Inflorescence semi-globose finally globose, very dense, many-flowered; 5-12 cm in diameter. Pedicels thin, probably straight, stiff; green? Flowers  $\pm$  broadly funnel-shaped star-like. Tepals linear-lanceolate, glossy, apex  $\pm$  acute; apparently deep pink with 1-3 purple veins; probably 7-9 mm long, about 2-2.5 mm wide. Filaments about 1/2 of tepal length.

**81. *Allium* sp. F**

Vouchers: Iran, prov. Khorasan: SE Kalat between Jalil-abad and Ghaleh-nu, 36°55' N, 59°49' E, 1200 m, 10.6.2009 Joharchi (43005-FUMH, 43006-FUMH).



These plants look like very large specimens of *A. monophyllum* [48] possessing the stature of small specimens of *A. aladaghense* [44], but the single leaves are very narrow, and the few-flowered inflorescence as well as shape and position of tepals are more similar to *A. monophyllum*. Careful study of living plants seems essential to clear up the taxonomic state of these plants.



## 82. *Allium* sp. G



Bulbs collected in Iran 1998, prov. Tehran or Qom: c. 80 km on the road from Tehran to Qom, Seisums & al. SLIZE 092.

Living plants of this taxon could be studied, but herbarium vouchers were not available to select a type specimen. According to the general habit, these plants would have formerly included in *A. akaka* in the broadest sense. They share relatively narrow tepals with a remarkably long linear sector with the morphologically related *A. graveolens* [36] and *A. materculae* [37], but it is a larger plant than these species showing also relatively shorter filaments. The pale flower color with an



inconspicuous median vein is more similar to *A. kuhshense* [47], a species of sect. *Asteroprason*, that differs by strongly coarse ovaries. Unexpectedly, ITS sequences of nuclear rDNA positioned this accession among the group of mainly Turkish members of sect. *Melanocrommyum* (see p. 199) far away from possible relatives discussed above. Re-collection and molecular re-evaluation of this taxon would be essential in order to clear up whether an error occurred.

Preliminary description of plants cultivated by J. Ruksans in Latvia: Bulbs not seen. Scape 20-30 cm long, above 6, near base 8 mm in diam., straight or flexuous, terete, smooth, dull green with glaucous bloom. Leaves 3-4, linear-lanceolate, stiff, upper part reflexed to backwards curled, flat (basally canaliculate), thickish, upper side smooth, lower side distantly ribbed, margin white, finely toothed, apex shortly cucullate; glaucous green. Spathe patent to subreflexed, bipartite, valves triangular, membranous, whitish with yellow to brownish nerves. Inflorescence broadly fastigiate to semi-globular, very dense, many-flowered, 6-8 cm in diam. Pedicels straight, wire-like, thickish, smooth; semi-glossy green. Anthesis in May to June. Flowers flat star-like. Tepals linear-lanceolate, patent, slightly reflexed with incurved apex, later  $\pm$  plicate and crumpled, 5-7 mm long, 1-1.5 mm wide, white with basal rose flush, median vein green, rather narrow, fading near the base. Filaments about  $3/4$  as long as the tepals, outer filaments  $\pm$  subulate, inner ones long triangular, basally slightly connate, fleshy, white. Anthers 1.5 mm long, 0.7 mm wide, yellow. Pollen yellow. Ovary flat hexasulcate globular, not stipitate, 2-2.5 mm long, 2.5-3 mm in diameter, longitudinal furrows deep and sharp, surface coarse by fine cells, dull green; nectary ducts lead in triangular holes near the base. Style subconical filiform, 3-6 mm long, white. Stigma sub-tripartite, white. Capsules and seeds not seen.

Added in proof:

sect. *Acanthoprason*, *Allium austroiranicum* alliance

83. *Allium kuhrangense* Akhavan, Saeidi & R.M. Fritsch (in press)



Preliminary description: Bulbs ovoid-globose, 30–35 mm in diam., outer tunics blackish and irregularly splitting. Leaves two, one usually larger and broader, light green, 6.5–8 cm long and 3–5 cm wide, oblong to ovate, thick and fleshy, hooded at the apex or sometimes obtuse, upper and lower sides sulcate; margin finely toothed especially at the base, greenish-white. Scape cylindrical,  $\pm$  flexuous, smooth (sulcate in the dry state), aerial part 1–2 cm long, ca. 2–3 mm in diam., widest below the inflorescence. Spathe membranous, splitting incompletely into 2 or 3 segments, whitish with



distinct black nerves along the median. Inflorescence semi-globose, dense, many-flowered (50 or more flowers), 4.5–6.5 cm in diam. Pedicels straight, of  $\pm$  equal length, up to 30 mm long, greenish to purple in the dry state. Flowers widely campanulate to funnel-shaped, star-like in the fruiting state. Tepals narrowly oblong to elliptic, apex obtuse, 7–10 mm long, up to 2 mm wide in the middle, white, median vein green (purple in the dry state), becoming darker after anthesis. Filaments fleshy, nearly two thirds as long as the tepals, base white, apex dark purple, triangular, basally 1 mm connate to each other and adnate by 1

mm to the tepals. Anthers ca. 1.5 mm long, pinkish yellow. Ovary light green, obovoid, 2.5–5 mm long

and 3–4 mm in diam. Style ca. 2 mm long, whitish ?; stigma undivided. Capsule with three furrows, ca. 5 mm long and 4 mm in diam., yellowish to greenish. Seeds one per locule, depressed-obovate, 1.5–2.5 mm long, ca. 1.5 mm wide, 1 mm thick, black.

**Distribution:** SW Iran, prov. Chaharmahal Bakhtiari, Zagros mountain range: NW of Kuhrang mountains, known only from the type locality.

**Remarks:** The new species shows broad leaves and filaments with purple tips. Morphologically it should belong to the *A. austroiranicum* alliance differing from that species by whitish, broader, and relatively shorter tepals, and particularly by the conspicuous black median veins of the spathe uniting towards the tip of the valve. There are also strong similarities to *A. ubipetrense*, but the purple tips of filaments do not fit to that alliance. Unfortunately, clear molecular data to determine the true relationship are still missing.

**Etymology:** The epithet refers to the type locality.

to be inserted at p. 146:

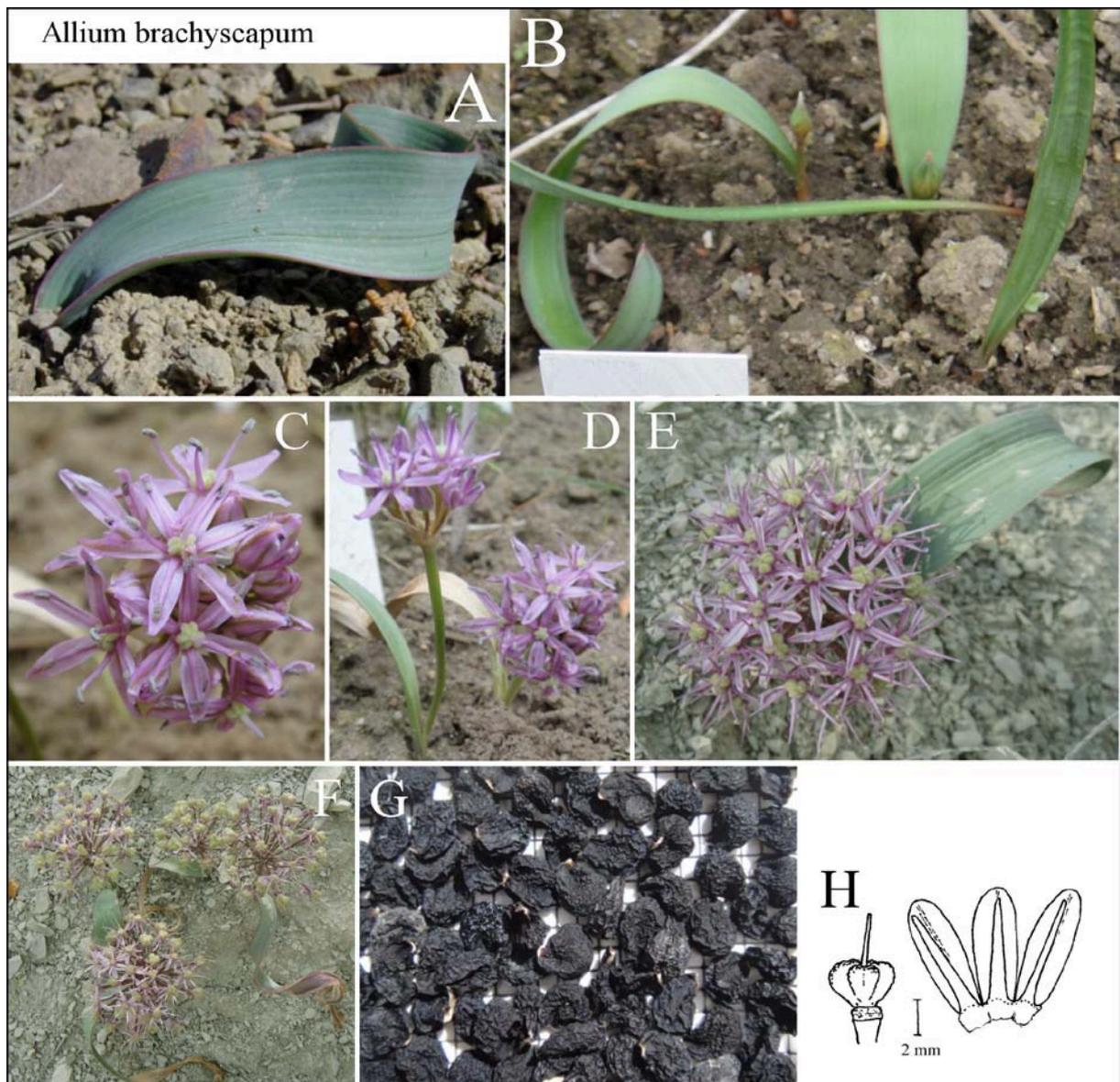


Plate T57. A & B: Sprouting leaves and scapes of cultivated plants; C & D: inflorescence and cultivated plants in early anthesis, resp.; E & F: plants in late anthesis and after anthesis, resp., between Bojnurd and Gifan; G: seeds (background raster 1 mm), H: shape of ovary, tepals and filaments of a flower prepared from herbarium.

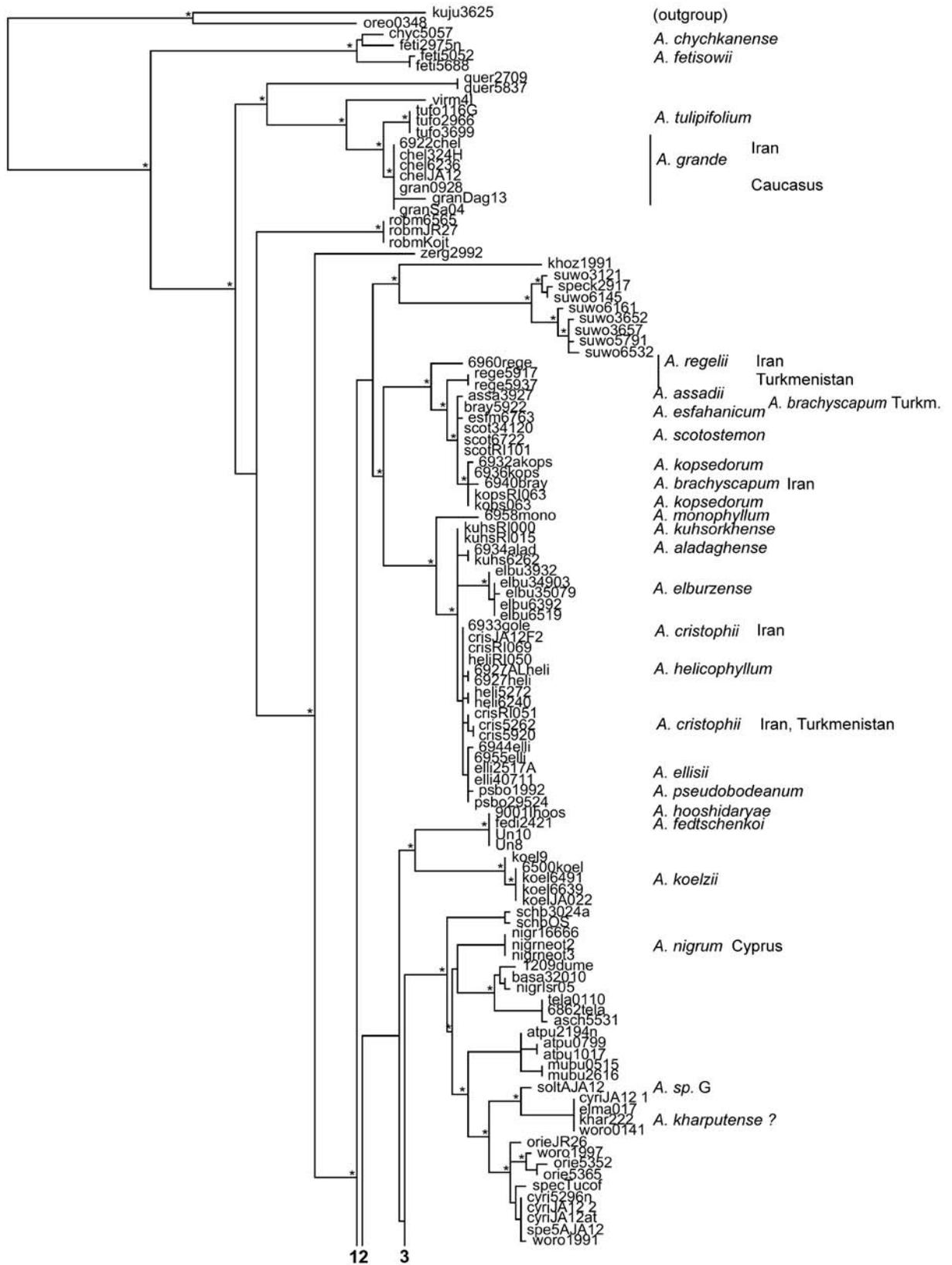
## Phylogenetic relationships of species based on ITS

There are several molecular markers applicable for taxonomic investigations, but in the genus *Allium* the Internal Transcribed Spacer regions (ITS1, ITS2) of nuclear DNA turned out to present the most detailed results at intrageneric as well as intra-subgeneric levels (Friesen & al. 2006; Gurushidze & al. 2006, 2007, 2008; Fritsch & al. 2010). The last comprehensive molecular analysis of subg. *Melanocrommyum* was based on 578 accessions (Fritsch & al. 2010: 151). These molecular studies continued during the last years in order to clear former unsecure results by including more material, and to find the phylogenetic relations of newly recognized (or at least presumed) taxa. Altogether about 150 additional samples were collected or sent by collaborating taxonomists for molecular study, resulting in a sample of 722 accessions available for computing. The resulting neighbor joining dendrogram covered more than 7 pages when printed, and computing a Bayesian analysis would have taken more than 10 days using the most modern PC available. Therefore the accession numbers of homogeneous clusters were reduced, and finally a Bayesian analysis of 421 accessions was computed. This dendrogram is presented on pp. 199-202.

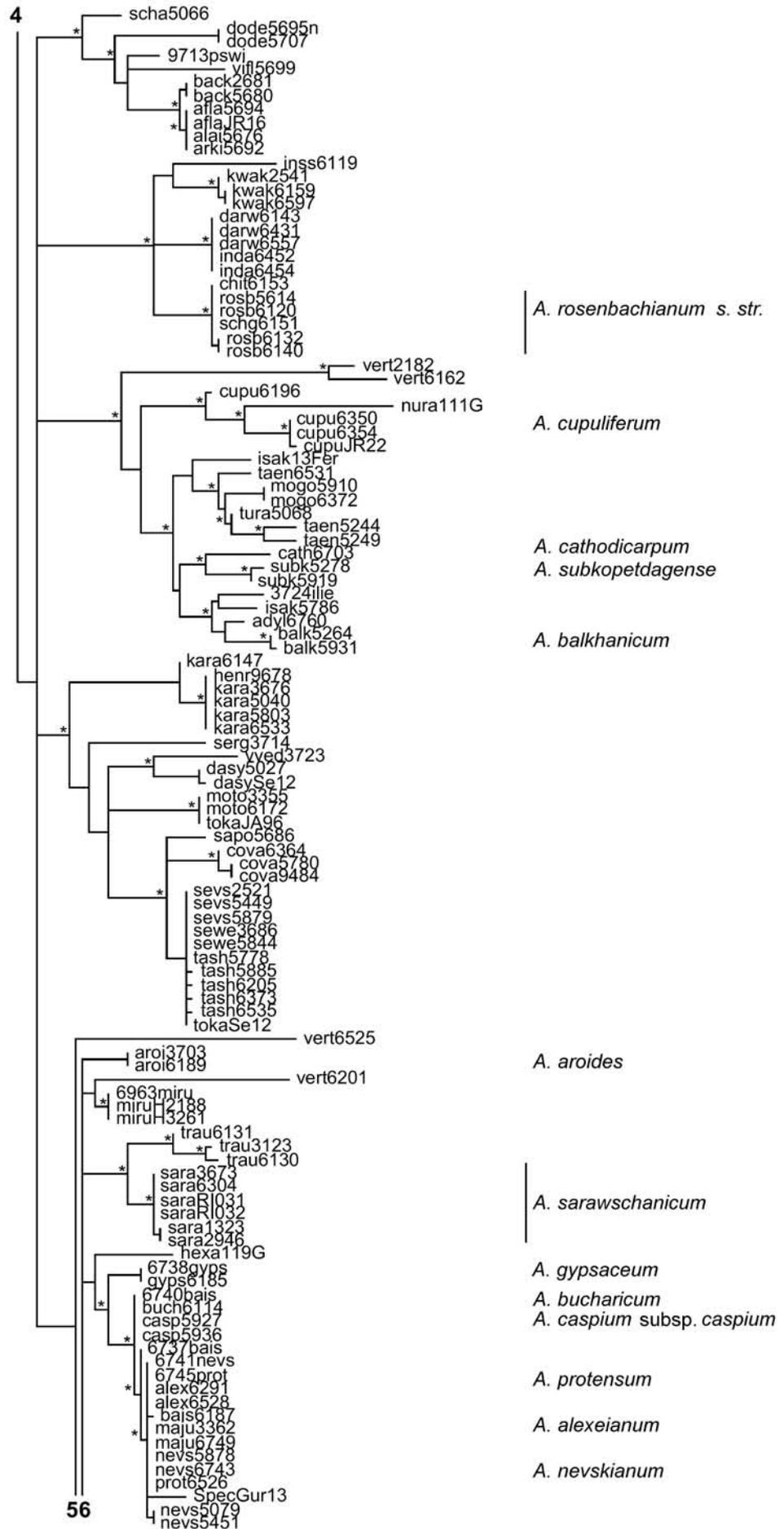
Material and Methods: The equipment, working techniques, and software used were already described in Gurushidze et al (2008) and Fritsch & al. (2010: 151). Also most of the accessions presented in the new dendrogram were characterized there. Material from Near East was explained in Fragman-Sapir & Fritsch (2012, *Herbertia* 65, 31-50). Additional accessions are as follows: 1312reme: *Allium* sp., Iran, Procerallium, bought on a market. - 1404giga: *Allium giganteum*, Iran, Compactoprason, 353816N, 0583108E. - 4156alek: *Allium* aff. *alekii*, Turkey, Acanthoprason, Batman-04156 Iğdir. - 6722: *Allium scotostemon*, Iran, Megaloprason, 354707N; 0522233E. - 6763: *Allium assadii*, Iran, Megaloprason, 330809N, 0513957E. - 6768: *Allium bakhtiaricum*, Iran, Procerallium, 321300N, 0503237E. - 6774: *Allium austroiranicum*, Iran, Acanthoprason, 322623N, 0500612E. - 6777: *Allium austroiranicum*, Iran, Acanthoprason, 321618N, 0510122E. - 6782: *Allium austroiranicum*, Iran, Acanthoprason, 321433N, 0511101E. - 6790: *Allium remediorum*, Iran, Procerallium, 303045N, 0514034E. - 6821: *Allium alekii*, Armenia, Acanthoprason, 385617N, 0462224E. - 6822: *Allium egorovae*, Armenia, Acanthoprason, 390805N, 0461950E. - 6870: *Allium alamutense*, Iran, Acanthoprason, 362746N, 0502152E. - 6875mah: *Allium* aff. *mahneshanense*, Iran, Acanthoprason, 363917N, 0480303E. - 6876mah: *Allium* aff. *mahneshanense*, Iran, Acanthoprason, 363757N, 0472419E. - 6878boz: *Allium akaka* subsp. *bozghushense*, Iran, Acanthoprason, 374646N, 0472746E. - 6880saba: *Allium sabalense*, Iran, Acanthoprason, 380456N, 0473207E. - 6882: *Allium sabalense*, Iran, Acanthoprason, 380734N, 0473238E. - 6884akaa: *Allium* sp., Iran, Acanthoprason, 380902N, 0473433E. - 6885akaa: *Allium* sp., Iran, Acanthoprason, 381006N, 0473442E. - 6886: *Allium sahandicum*, Iran, Acanthoprason, 380037N, 0463057E. - 6889: *Allium sahandicum*, Iran, Acanthoprason, 374625N, 0463036E. - 6891: *Allium sahandicum*, Iran, Acanthoprason, 374740N, 0453100E. - 6894shel: *Allium shelkownikovii*, Iran, Acanthoprason, 372857N, 0454924E. - 6898: *Allium pseudohollandicum*, Iran, Procerallium, 371815N, 0450628E. - 6902mate: *Allium materculae*, Iran, Acanthoprason, 382037N, 0450321E. - 6922: *Allium grande*, Iran, Decipientia, 364317N, 0550249E. - 6927: *Allium helicophyllum*, Iran, Asteroprason, 372205N, 0562322E. - 6932kops: *Allium kopsedorum*, Iran, Megaloprason, 375428N, 0565553E. - 6933: *Allium cristophii* subsp. *golestanicum*, Iran, Asteroprason, 371845N, 0572029E. - 6934: *Allium aladaghense*, Iran, Asteroprason, 371259N, 0573027E. - 6936kops: *Allium kopsedorum*, Iran, Megaloprason, 373733N, 0572340E. - 6940: *Allium brachyscapum*, Iran, Megaloprason, 373856N, 0572437E. - 6944: *Allium ellisii*, Iran, Asteroprason, 372726N, 0583524E. - 6952giga: *Allium giganteum*, Iran, Compactoprason, 360959N, 0603253E. - 6955: *Allium ellisii*, Iran, Asteroprason, 364407N, 0593146E. - 6958: *Allium monophyllum*, Iran, Asteroprason, 364855N, 0593050E. - 6960: *Allium regelii*, Iran, Regeloprason, 354128N, 0583029E. - 6963mirum: *Allium mirum* Wendelbo, Afghanistan; Thaumasioprason, from collection A. Seisums. - 9713pswi: *Allium* sp., Kirgizstan?, Regeloprason, ARJA-9713. - adyl6760: *Allium* sp., Uzbekistan, Regeloprason, Fergan depression. - botsK2010: *Allium botschantzevii* Kamelin, Uzbekistan, Procerallium, near Dekhkanabad (type location). - brscRI208: *Allium breviscapum*, Iran, Acanthoprason, WHIR-208. - cath6703: *Allium cathodicarpum*, Iran, Regeloprason, 302339N, 0531258E. - chelJA12: *Allium grande*, Iran, Decipientia, from collection J. Ruksans. - chr02125: *Allium chrysantherum*, Syria, Melanocrommyum, Aleppo-Raqqa roadside. - cova9484: *Allium* aff. *rudolfii* Turak., Uzbekistan, Acropetala, Angren. - crisJA12F2: *Allium cristophii* hybrid, Asteroprason, from collection J. Ruksans. - crisRI051: *Allium cristophii*, Iran, Asteroprason, WHIR-051. - crisRI069: *Allium cristophii*, Iran, Asteroprason, WHIR-069. - cupuJR22: *Allium* sp., Armenia, Regeloprason, Spitak from collection J. Ruksans. - cyriJA12 2, cyriJA12at: *Allium* aff. *cyrilli*, Melanocrommyum, from collection J. Ruksans. - cyriJA12: *Allium* sp., Melanocrommyum, from collection J. Ruksans. - dasySe12: *Allium dasyphyllum* Vved., Kirgizstan, Acropetala, Kara-Archa. - elma017: *Allium* sp., Melanocrommyum, Turkey JRRK-017. - fedi2421: *Allium fedtschenkoi*, Iraq, Melanocrommyum, Rix2421 Hakkari. - gran0928: *Allium grande*, Rep. Azerbaijan, Decipientia, AZAR09-28, 35 km SW Quba. - granDag13: *Allium grande*, Russia: Daghestan, Decipientia. - granSa04: *Allium grande*, Caucasus Salev04, Decipientia, from collection J. Ruksans. - haem13715: *Allium* sp., Iran, Acanthoprason, SLIZE137. - heliRI050: *Allium helicophyllum*, Iran, Asteroprason, WHIR-050. - henr9678: *Allium karataviense* subsp. *henrikii* Ruksans, Uzbekistan, Miniprason, Chatkal mountain range (type location). - I1300stip: *Allium stipitatum*, Iran, Procerallium, 30.30.44,7N, 51.40.34E. - I1306stip: *Allium stipitatum*, Iran, Procerallium, 30.33.29N, 51.27.47E. - I1308reme: *Allium* sp., Iran, Procerallium, 30.33.29N, 51.27.47E. - isak13Fer: *Allium* sp., Uzbekistan, Regeloprason, Fergan depression. - kazeJR19: *Allium* sp., Iran, Procerallium, Zardekuh leg. Seisums. - khar09709: *Allium* aff. *kharputense*, Turkey, Melanocrommyum, RIGA-097. - khar222: *Allium* sp., Turkey, Melanocrommyum, SASA-STAE222. - khoz1991: *Allium khozratense* R.M. Fritsch, Tajikistan, Thaumasioprason, near Panj valley, leg. A. Seisums. - kopsRI063, kops063: *Allium kopsedorum*, Megaloprason, Iran, WHIR-063. - kuhsRI000, kuhsRI015: *Allium kuhsoorkhense*, Iran, Asteroprason, Kuh-e Sorkh (type location). - lips8266: *Allium lipskyanum*, Uzbekistan, Regeloprason, RKM-8266. - loraSei12: *Allium* aff. *loratum* Baker, Pakistan, Compactoprason, from collection A. Seisums. - mahnRI158: *Allium* sp., Iran, Acanthoprason, WHIR158. - mate6809: *Allium materculae*, Armenia, Acanthoprason, 395338N, 0444405E. - minu09513: *Allium* sp., Iran, Acanthoprason, SLIZE095. - miruH2188: *Allium mirum*, Afghanistan; Thaumasioprason, Kotal-i Shuturgardan. - miruH3261: *Allium mirum*, Afghanistan; Thaumasioprason, Panjir-Tal bei Dehe Kalan. - orieJR26: *Allium* aff. *orientale*, Turkey, Melanocrommyum, Akseki. - psbo1992: *Allium* aff. *pseudobodeanum*, Iran, Acanthoprason, Stevens s. n. E Firuzkuh. - remeIraq: *Allium* sp., Procerallium, from Bot. Garden Prague "from Iraq". - robmJR27: *Allium robustum* Ledeb., Decipientia, Kazakhstan, Urdzhar, from collection J. Ruksans. - robmKojt: *Allium robustum*, Kazakhstan, Decipientia, W Kojtubas. - saba0912: *Allium* sp., Rep. Azerbaijan, Acanthoprason, AZAR-0912 Talysh Zuvand. - saraRI031: *Allium sarawschanicum*, Iran, Megaloprason, WHIR-031. - saraRI032: *Allium sarawschanicum*, Iran, Megaloprason, WHIR-032. - scotRI101: *Allium scotostemon*, Iran, Megaloprason, WHIR-101. - shel31629: *Allium* sp., Iran, Acanthoprason, SLIZE316. - (to be continued at p. 202)

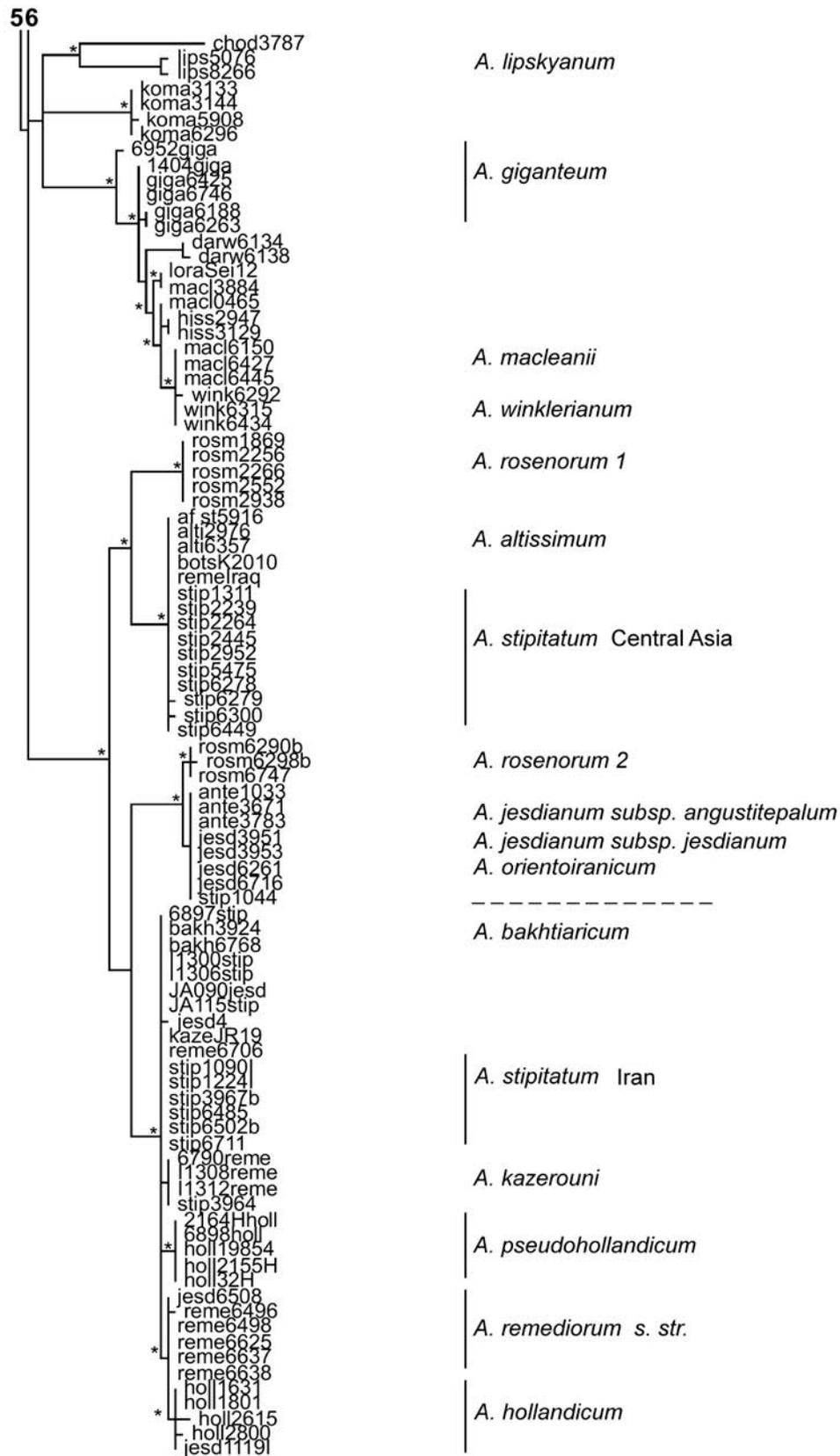
Phylogenetic tree calculated with Bayesian phylogenetic inference from ITS sequences

Posterior probabilities  $\geq 0.95$  are indicated by asterisks; only species discussed in this review are mentioned; connecting points of the four parts of this dendrogram are marked by identical numbers in bold. (These molecular data were contributed by Maia Gurushidze and Frank R. Blattner)









(cont. from p. 198:)

spe5AJA12: *Allium* sp., from collection J. Ruksans. - SpecGur13: *Allium* sp., Uzbekistan, Baissun mountains. - specTucof: *Allium* aff. *colchicifolium*, Turkey, Melanocrommyum - tokaJA96: *Allium* aff. *tokaliense*, Acropetala, Uzbekistan, Bashkzyylsai ARJA-96. - tokaSE12: *Allium tokaliense* Kamelin & Levichev, Uzbekistan, Acropetala, Mt. Chimgan. - ubipRI198: *Allium* aff. *ubipetrense*; Iran, Acanthoprason, WHIR-198. - woro0141: *Allium* sp., Turkey, Melanocrommyum, EH0141 61 W Gecidi pass. - woro1991: *Allium woronowii*?, Turkey?, Melanocrommyum, near Karakala Vardaovit. - woro1997: *Allium woronowii*?, Turkey, Melanocrommyum, EH 1997S08 N Anharz.

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پیش‌گفتار

مقدمه

کلید تشخیص گونه‌ها و زیر گونه‌ها

اختصارات، تعاریف و سرنام‌ها

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([70] *Allium hooshidaryae*: 178; [71] *A. koelzii*: 179; [72] *A. sanandajense*: 182)

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([73] *Allium regelii*: 184; [74] *A. cathodicarpum*: 187; [75] *A. subkopetdagense*: 189)

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([76] *Allium* sp. A: 191; [77] *Allium* sp. B: 191; [78] *Allium* sp. C: 192; [79] *Allium* sp. D: 193; [80] *Allium* sp. E: 194; [81] *Allium* sp. F: 194; [82] *Allium* sp. G: 195; added in proof [83] *Allium kuhrangense*: 196)

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رینهارد میشاییل فریج و مهرداد عباسی

بازنگری تاکسونومیک

*Allium* subg. *Melanocrommyum*

در ایران



گاترزیلین ۲۰۱۳

