KARL HEINZ RECHINGER (1906-1998)

Karl Heinz Rechinger was born on October 16, 1906 at Vienna (Austria). He was the only son of Dr. Karl Rechinger and Rosa Elisabeth Rechinger née Favarger. His father was also a plant taxonomist.

The principal focus of K.H. Rechinger was flora writing. He was the author of Flora Aegaea and founder and editor of "Flora Iranica". In 1929, Rechinger started to work as an unpaid volunteer in the Department of Botany at Natural History Museum of Vienna.

He has collected plants in all five continents, mainly in the Balkan Peninsula and south west Asia. During 1930-36, he had excursions in south of Europe in Croatia, Dalmatia, Bulgaria, Greece, Macedonia and Italy. Rechinger was promoted Doctor of Philosophy on May 15, 1931 in Vienna University. In 1927, he set out his first great botanical excursion to Greece.

Rechinger had ten expeditions during 1937-77 in "Flora Iranica" area. His first voyage to Iran was in 1937, before World War II, by invitation of Dr. Erwin Gauba, Professor of botany in Agricultural College of Karaj.

In March 1938, Austria was occupied by "Deutsche Wehrmacht". During the occupation of Austria by Nazi invaders (very severe and terrible time), Rechinger finished the manuscript of his "Flora Aegaea". At the time he continued the identification of Iranian plants collected by him at 1937, and published his "Ergebnisse einer botanische Reise nach dem Iran".

During early 1948, Rechinger received a visit from Dr. A.A. Azizi, cultural attaché of Iran in Vienna. Dr. Azizi encouraged Rechinger to visit Iran again. Therefore, Rechinger's second expedition to Near East was accomplished in the same year. Dr. E. Esfandiar was to act as host for the Rechingers (in this expedition,
Dr. Frida Rechinger, his first wife accompanied him. In Iran, E. Esfandiari, P. Aellen and A. Manuchehri accompanied Rechingers in the excursions.

In 1955, Rechinger was appointed as Director of Department of Botany in "Natural History Museum" of Vienna. In 1956, he accepted an appointment as visiting Professor at Baghdad University, where he laid the foundation of the "University Herbarium" (BUH). He left Vienna on October 3, 1956 accompanied by his second wife Wilhelmina Rechinger née Goedemans. They stayed ca. one year in Iraq and collected plants from Iraqi Kurdistan, in Flora Iranica area. In October 3, 1957, they returned to Vienna. In 1961, he was elected as "Erster Director" of the Natural History Museum. In 1962 and three years later in 1965, he visited Afghanistan and Pakistan as well. In December 1963, the first "Lieferung" of Flora Iranica (Araceae) was published. In 1967, he had a further expedition, accompanied by Wilhelmina and their children Lilian and Björn to Afghanistan. Rechinger retired by the end of December 1971.

Rechinger’s expedition to Iran in 1971, 1974-75 and 1977 were performed in different regions of the country: 1971 (in Azerbaijan and Kurdistan), 1974 (Central Desert and Lorestan), 1975 (Tooran protected area in Central Desert) and his last expedition in 1977 (Baluchistan).

Prof. K.H. Rechinger died in December 30, 1998, aged 92 in a hospital at Vienna. He was buried in the family tomb in Vienna "Zentralfriedhof".
TYPE SPECIMENS COLLECTED BY
K.H. RECHINGER IN "FLORA IRANICA" AREA

M. IRANSHAHR
Iranian Research Institute of Plant Protection, Tehran, Iran

Karl Heinz Rechinger, during his botanical tours in "Flora Iranica" area has collected 566 type specimens which are kept in "W" Herbarium of Natural History Museum, Vienna. Some isotypes are deposited in following Herbaria: B, BG, BM, E, G, IRAN, K, KUH, LD, M, TARI, TUR, WU and ZT. The number of types are distributed as follows in Flora Iranica area: Afghanistan 195, Iran 266, Iraq 64, Pakistan 41.

The names of plant families as well as the type names are arranged on alphabetical orders:

Gymnospermae
Ephedraceae
1) Ephedra holopota H. Riedl, Iran: Rech. 5331

Angiospermae-Monocotyledonae
Gramineae
2) Agropyron podporae Nab., var. veluimum Melderis, Iraq: Rech. 10915.
5) Oryzopsis microcarpa Pilger var. pubescens Bor, Afghanistan: Reh. 31363.
6) Oryzopsis rechingeri Bor, Afghanistan, Rech. 37277.

Juncaceae
7) Eleocharis palastris (L.) Roemer & Schultes, subsp. iranica Kukkonen, Pakistan: Rech. 30668.
10) Schoenoplectus rechingeri Kukkonen, Pakistan: Rech. 30675.
**Liliaceae**
13) *Allium jactum* Wendelbo, Pakistan: Rech. 30991.

**Typhaceae**

**Angiospermae-Dicotyledonae**
**Apocynaceae**

**Asclepiadaceae**

**Berberidaceae**

**Boraginaceae**
56) Trichodesma macrocarpum Rech. f., Aell. & Esfandi, Iran: Rech. 3321.

Campanulaceae
57) Asyneuma nizanderanicum Rech. f., Iran: Rech. 6533.

Caryophyllaceae
64) Acantophyllum karakolicum Schiman-Czeika, Afghanistan: Rech. 31069.
65) Acantophyllum luxurisculum Schiman-Czeika, Iran: Rech. 42342.
68) Arenaria serpyllifolia L., var. macrosepala Rech. f., Iran: Rech. 901.
69) Dianthus binahdensis Rech. f., Iran: Rech. 56272.
70) Dianthus erinus SM., subsp. kermanensis Rech. f., Iran: Rech. 3827.
73) Dianthus orientalis Adams in Weber & Mohr, subsp. gorganicus Rech. f., Iran: Rech. 52444.
74) Diaphanoptera khursaniaca Rech. f., Iran: Rech. 1515.
75) Diaphanoptera xerocalycina Rech. f. & Schiman-Czeika, Iran: Rech. 52881.
76) Gypsophila bezorganica Rech. f., Iran: W. Rechinger in Rech. 43961.
77) Gypsophila leotoclaud Rech. f., Iran: Rech. 47263.
79) Gypsophila macrospila Rech. f., Iran: Rech. 1239.
81) Gypsophila wilhelminae Rech. f., Iran: W. Rechinger in Rech. 43962.
82) Gypsophila xanthechloa Rech. f., Iran: Rech. 5836.
94) Silene caroli-henrici Meltz., Iran: Rech. 47518.
95) Silene commelinifolia Boiss., var. ovatifolia Meltz., Iran: Rech. 48535.
97) Silene salangensis Meltz., Afghanistan: Rech. 37486.
98) Sphaerocoma aucheri Boiss., var. rechingeri Chaudhri, Pakistan: Rech. 27904.

Cheopodiaceae
101) Chenopodium foliosum Aschers., subsp. monianum Uutila, Iran: Rech. 6046.

Compositae
102) Achillea bibersteini Aftan. x A. nobiles L. subsp. neilreichii (Kerner) Formanek, Iran: Rech. 57025.
103) Anthemis altissima L., var. discaidea Iranshahr, Iran: Rech. 52356.
104) Anthemis atrapatana Iranshahr, Iran: Rech. 41648.
106) Anthemis gracilia Iranshahr, Iran: Rech. 47304.
109) Anthemis mirheydari Iranshahr, Iran: Rech. 3305.
110) Anthemis moghanica Iranshahr, Iran: Rech. 40203.
111) Anthemis triumfettii (L.) All. subsp. decumbens Iranshahr, Iran: Rech. 40641.
112) Anthemis triumfettii (L.) All. subsp. khorasanica (Rech. f.) Iranshahr, Iran: Rech. 1802.
116) Centaurea ancheri (DC.) Wagenitz, subsp. indistincta Wagenitz, Iran: Rech. 48045.
117) Centaurea aziziana Rech. f., Iran: Rech. 6576.
118) Centaurea galactochrom Rech. f., Iran: Rech. 1633.
119) Centaurea intricata Boiss., subsp. kermanshahensis Wagenitz, Iran: Rech. 14611.
120) Centaurea kandavanensis Wagenitz, Iran: Rech. 6316.
121) Centaurea lachnopus Rech. f., Iran: Rech. 1244.
122) Centaurea ochrocephala Wagenitz, Iran: Rech. 48965.
123) Centaurea pseudoscabiosa Boiss. & Buhse, subsp. armata Wagenitz, Iran: Rech. 48679.
Type specimen collected by K.H. Rechinger in Flora Iranica area.

127) *Cirsium hypophysanum x obvatuum; C. x mazanderanicum* Petruk, Iran: Rech. 6294-c.
130) *Cirsium irati* Petruk, Pakistan: Rech. 19417.
138) *Cosmia crispa x gmelini; C. kamarchandensis* Rech. f., Iran: Rech. 6435.
139) *Cosmia crispa x sphaerocephala; C. hybrida* Rech. f., Iran: Rech. 6457.
140) *Cosmia decumbens* Rech. f., Iran: Rech. 6003.
142) *Cosmia eucalypta* Borrm. & Rech. f., Iran: Rech. 1454.
143) *Cosmia fabrorum* Rech. f., Iran: Rech. 56129.
156) *Cosmia lignosissima* Rch.f., Iran: Rech. 55857.
166) *Cosmia qarehibilensis* Rech. f., Iran: Rech. 52908.
<table>
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<th>No.</th>
<th>Plant Name</th>
<th>Author, Location</th>
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<td><em>Cousinia nekarmanica</em></td>
<td>Rech. f., Iran: Rech. 5820</td>
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<td>173</td>
<td><em>Cousinia parjumanensis</em></td>
<td>Rech. f., Afghanistan: Rech. 19027</td>
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<td>174</td>
<td><em>Cousinia porphyrostephana</em></td>
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<td>175</td>
<td><em>Cousinia qandilica</em></td>
<td>Rech. f., Iraq: Rech. 11003</td>
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<td>176</td>
<td><em>Cousinia qarehbulensis</em></td>
<td>Rech. f., Iran: Rech. 52908</td>
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<td>177</td>
<td><em>Cousinia quartzica</em></td>
<td>Rech. f., Pakistan: Rech. 29056</td>
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<td>178</td>
<td><em>Cousinia raphiolepis</em></td>
<td>Rech. f., Iran: Rech. 51741</td>
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<td>179</td>
<td><em>Cousinia rechingerae</em></td>
<td>Bornm., Iran: Rech. 1927</td>
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<td>180</td>
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<td>Bornm. &amp; Rech. f., Iran: Rech. 1951</td>
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<td>Rech. f., Afghanistan: Rech. 16234-b</td>
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<td>Rech. f., Iran: Rech. 53669</td>
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<td>183</td>
<td><em>Cousinia salangensis</em></td>
<td>Rech. f., Afghanistan: Rech. 31300</td>
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<td>Rech. f., Iran: Rech. 49113</td>
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<td><em>Cousinia shahrizanica</em></td>
<td>Rech. f., Afghanistan: Rech. 36730</td>
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<td><em>Cousinia shahrivariica</em></td>
<td>Rech. f., Iran: Rech. 5996</td>
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<td>187</td>
<td><em>Cousinia shorughanensis</em></td>
<td>Rech. f., Afghanistan: Rech. 55734, G</td>
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<td>188</td>
<td><em>Cousinia singularis</em></td>
<td>Rech. f., Afghanistan: Rech. 17781</td>
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<td>189</td>
<td><em>Cousinia sirostratis</em></td>
<td>Rech. f., Iran: Rech. 43086-b</td>
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<td><em>Cousinia trachyphylla</em></td>
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<td>192</td>
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<td>196</td>
<td><em>Crepis sancta</em> (L.) Babcock, subsp. <em>azerbajiana</em></td>
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<td><em>Echinops armatus</em> Boiss. &amp; Hausskn., var. <em>pappilus</em></td>
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<td><em>Echinops hololeucus</em></td>
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<td><em>Echinops kerdjensis</em></td>
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<td><em>Echinops mosulensis</em></td>
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<td><em>Echinops rectangularis</em></td>
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<td><em>Echinops registanicus</em></td>
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<td>211</td>
<td><em>Echinops salamonini</em></td>
<td>Rech. f., Pakistan: Rech. 29994</td>
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<td>212</td>
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<td>Rech. f., Iraq: Rech. 9714</td>
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<td>213</td>
<td><em>Erigeron acer</em> L., subsp. <em>arctophila</em> (Rech. f.)</td>
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236) *Sclerorrhachis leptoclada* Rech. f., Iran: Rech. 56215.
242) *Scorzoneria microcalatha* (Rech. f.) Rech. f., Iran: Rech. 1535.
244) *Scorzoneria tenax* Rech. f., Iraq: Rech. 11572.
247) *Tanacetum bulbipurpureum* (Rech. f.) Tsvel., Iran: Rech. 1880.
248) *Tanacetum sauvignoni* Podl., Iran: Rech. 40536.
251) *Taraxacum hydrophilum* v.S., Iran: Rech. 51245.
252) *Taraxacum iranicum* v.S., Iran: Rech. 5061.
257) *Taraxacum pseudo-calophulum* v.S., Iran: Rech. 4811.
261) *Taraxacum rechingeri* v.S., Iran: Rech.
Tragopogon bakhtiaricus Rech. f., Iran: Rech. 47225.

**Convolvulaceae**

**Crassulaceae**
270) Rosularia adenotricha (Wall. ex Edgew.) Janss., subsp. linearifolia Janss., Afghanistan: Rech. 18551.

**Cruciferae**
272) Aethionema trinervium (DC.) Boiss., var. apterocarpum (Rech. f. & Aell.) Hedge, Iran: Rech. 5063.
293) Sisymbrium integrifolium Rech. f. & Aell., Iran: Rech. 4521.

**Dipsacaceae**
296) Scabiosa desertica Rech. f., Iraq: Rech. 12806.

**Euphorbiaceae**
298) Andracne merxmulleri Rech. f., Iran: Rech. 47405.
300) Euphorbia gedrosiaca Rech. f., Iran: Rech. 4074.
303) Euphorbia multiflora Rech. f., Aell. & Esfand, Iran: Rech. 4220.
Type specimen collected by K.H. Rechinger in Flora iranica area

Frankeniaceae

Fumariaceae
305) Corydalis griffithii Boiss., subsp. salangensis Wendelbo, Pakistan: Rech. 31547.

Geraniaceae

Hippocastanaceae
308) Aesculus indica (Wall. ex Camb.) Hook., var. concolor Browicz, Pakistan: Rech. 30867.

Labiatae
311) Ballota plagioma Rech. f., Iran: Rech. 6634.
312) Dracophylum suramidicum Rech. f., Iran: Rech. 47516.
313) Ereoxostachys aevstivijcica Rech. f., Iran: Rech. 40785.
320) Nepeta griffithii Hedge, Afghanistan: Rech. 30467.
325) Nepeta rechingeri Hedge, Afghanistan: Rech. 16636
330) Salvia rechingeri Hedge, Afghanistan: Rech. 18915.
332) Scutellaria bornmuelleri Hausskn. ex Borm, subsp. mianensis Rech. f., Iran: Rech. 42258.
334) Scutellaria ghorana Hedge, Afghanistan: Rech. 19022.
M. Iranzadeh

338) *Stachys inflata × taeomanica* x *S. parapleia* Rech. f., Iran: Rech. 5456-b.

**Malvaceae**

349) *Alcea criscaulis* I. Riedl, Iran: Rech. 42352.
351) *Alcea laxiflora* I. Riedl, Iran: Rech. 32616.
352) *Alcea lineariloba* I. Riedl, Iran: Rech. 32585.
356) *Alcea scabridula* I. Riedl, Iran: Rech. 42215.
357) *Alcea wilhelmii* I. Riedl, Iran: Rech. 41764.
358) *Alcea xanthochroa* I. Riedl, Iran: Rech. 43659.
359) *Sida quettensis* I. Riedl, Pakistan: Rech. 29481.

**Onagraceae**

360) *Epilobium rechingeri* Raven, Iran: Rech. 6752.

**Papaveraceae**


**Papilionaceae**

363) *Astragalus alienus* Podlech, Iran: Rech. 47846.
366) *Astragalus aspericitoki* Podlech, Iran: Rech. 51096.
369) *Astragalus chehregani* Zurr & Podlech, Iran: Rech. 41877.
371) *Astragalus cystosus* Zurr & Podlech, Iran: Rech. 53642.
Type specimen: collected by K.H. Rechinger in Flora iranica area

376) Astragalus ghassghaicus Tietz & Zaree, Iran: Rech. 47424.
383) Astragalus perdrum Podlech, Iran: Rech. 6042.
387) Astragalus pseudonerviflorus Podlech, Iran: Rech. 41956.
389) Astragalus qoturensis Podlech, Iran: W. Rechinger & Renz in Rech. f. 49644.
397) Astragalus tawilicus C.C. Townsend, Iraq: Rech. 12369, W (isotypus)
399) Hedyserum dainghanicum Rech. f., Iran: Rech. 55375 (fl.) et 56498 (fruct.)
400) Lotus compactus Chrtkova-Žertová, Pakistan: Rech. 27975.
404) Lotus michauxianus Stirj. in DC., var. glabratus Chrtkova-Žertová, Iran: Rech. 110.
405) Medicago makanica C.C. Heyn, Pakistan: Rech. 27934-b.
408) Onobrychis comuta (L.) Desv. subsp. leptacantha Rech. f. Afghanistan: Rech. 32365 (fl.); 32331 (fruct.)
409) Onobrychis kermanensis (Stirj. & Rech. f.) Rech. f., Iran: Rech. 3180.
413) Onobrychis lariistanica Rech. f., Iran: Rech. 48136.
414) Onobrychis mazanderanica Rech. f., Iran: Rech. 52383.
418) Oxytropis bicornis Vassilez., Iran: Rech. 53020.
422) Tephrosia rechingeri Ali, Pakistan: Rech. 29465.
423) Trifolium mazanderanicum Rech. f., Iran: Rech. 2031.
426) Trigonella subeineri Rech. f., Iran: Rech. 53660.
427) Vieta rechingeri Chriková-Žertová, Iran: Rech. 41710.

Parnassiaceae
428) Parnassia nubicola Royle, subsp. occidentalis Schönbeck-Temesy, Pakistan: Rech. 19590.

Plumbaginaceae
441) Acantholimon ophiocladum Rech. f., Iran: Rech. 6736.
Type specimen collected by K.H. Rechinger in Flora Iranica area


Polygonaceae
453) Polygonum hyrcanicum Rech. f., Iran: Rech. f. 1892.

Primulaceae

Ranunculaceae
468) Delphinium wilhelmitae Iranshahr, Pakistan: Rech. f. 30576.
472) Ranunculus renzi Iranshahr & Rech. f., Iran: W. Rechinger & J. Renz. in Rech. f.

Resedaceae

Rhamnaceae
475) Rhamnus pallasii Fisch. & C.A. Mey., subsp. sinenisii (Rech. f.) Browicz & Zielinski, Iran: Rech. f. 1780.
Rosaceae

476) *Alchemilla gigatodus* Fröhner, Iran: Rech. 6482-a.
477) *Alchemilla pectiniloba* Fröhner, Iran: Rech. 6482-b.
478) *Alchemilla rechingeri* Rothm. in Rech., Iran: Rech. 935.
479) *Alchemilla surculosa* Fröhner, Iran: Rech. 6540.
480) *Amygdalus jagata* Browicz, Afghanistan: Rech. 19081.
481) *Amygdalus x kerejensis* Browicz, Iran: Rech. 803.
482) *Cerasus rechingeri* Browicz, Pakistan: Rech. 29365.
483) *Colomeaster rechingeri* Klotz, Pakistan: Rech. 29879.
488) *Sorbus orientalis* Schönbeck-Ternes, Iran: Rech. 6647.

Rubiaeae

489) *Asperula comosa* Schönb.-Tem., Iraq: Rech. 10890.
491) *Asperula inopinata* Schönb.-Tem., Iraq: Rech. 10981.
493) *Asperula rechingeri* Ehrend. & Schönb.-Tem., Iran: Rech. 47337.
495) *Galium angustatum* Ehrend. & Schönb.-Tem., Iran: Rech. 5699.
496) *Galium azerbaijanicum* Ehrend. & Schönb.-Tem., Iran: Rech. 41858.
497) *Galium decumbens* (Ehrend.) Ehrend. & Schönb.-Tem., Iran: Rech. 5983.

Saxifragaceae

500) *Saxifraga mazanderanica* Rech. f., Iran: Rech. 6323.

Scrophulariaceae

502) *Scrophularia azerbaijanica* Grah., Iran: Rech. 41450.
504) *Scrophularia flava* Grah., Iran: Rech. 47605.
505) *Scrophularia gorganica* Rech. f., Iran: Rech. 6135.
507) *Scrophularia kardica* Eig, subsp. *gibbrir* Grah., Iran: Rech. 48719.
508) *Scrophularia rechingeri* Grah., Iran: Rech. 42238.
510) *Scrophularia valida* Grah., Iran: Rech. 51216.
Type specimen collected by K.H. Rechinger in Flora iranica area

**Solanaceae**

514) *Hyoscyamus mutans* Schönbeck-Temesy, Iran: Rech. 27200.
516) *Solanum carmanicum* Schönbeck-Temesy, Iran: Rech. 3630.

**Umbelliferae**

536) *Hareleum rechingeri* Manden., Iran: Rech. 43416.
538) *Sohrenopsis stricticaulis* (Rech. f.) M. Pimen., Iran: Rech. 1749.
541) *Lentea rechingeri* (Leute) M. Pimen., Iraq: Rech. 11345.
542) *Lomatnopodium staurophyllum* (Rech. f.) Rech. f., Iran: Rech. 1510.
543) *Malabada isfahaniaca* Alava, Iran: Rech. 46721.
559) *Semenovia subscaposa* (Rech. f.) Alava, Iran: Rech. 6060.

**Urticaceae**

**Vitaceae**

**Zygophyllaceae**

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FLORA IRANICA: FACTS AND FIGURES AND A LIST OF PUBLICATIONS BY K.H. RECHINGER ON IRAN AND ADJACENT AREAS

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Abstract

This paper provides a synopsis of all published volumes of the mammoth work "Flora Iranica" edited by the eminent Austrian botanist the late Prof. Karl Heinz Rechinger (1906-1998) and gives a bibliographic list of his botanical publications on Iran and some adjacent areas. From 1963 to 2005, 176 fascicles of Flora Iranica were published with 9977 species and 1471 genera. A total number of 3318 species was mentioned as endemic to the Flora Iranica area (33%), out of which 1490 species are known as endemic to Iran (24%). All 176 volumes of Flora Iranica, include 10065 text pages and 5873 pages of high quality black/white tabulae (pictures) of herbarium specimens and 204 colour illustrations of 397 pictures. Ninety seven botanists from 20 countries have contributed to Flora Iranica. The completion of Flora Iranica awaits only the remaining parts of Astragalus, the second part of Scrophulariaceae (Antirrhineae) and the Pteridophytes. The main language of Flora Iranica is “Latin”. According to published fascicles of Flora Iranica and other published data after the Flora Iranica, the total number of Iranian flora is about 7300 species.

Keywords: K.H. Rechinger, Flora Iranica, Flora of Iran, Irano-Turanian area, Endemism

Introduction

The University Prof. Dr. Karl Heinz Rechinger was born a century ago on
Oct. 16th, 1906 and died on Dec. 30th, 1958 (LACK 1999). He was one of the most famous botanists of the last century who devoted his life to explore and document the plant diversity of the Orient in his mammoth work Flora Iranica. The geographic area of Flora Iranica covers the entire political boundaries of Iran and Afghanistan, N. Iraq, mountains of Turkmenistan, small parts of Azerbaijan (Talesh) and the western Pakistan to the Sind river (Fig. 1). This is not necessary to mention that covering a Flora in such a vast area and having extensive collections from such a difficulty accessible parts of the world from hot deserts to high peaks (RECHINGER 1980) show the capacity of a man who deserve to be an example in text books. On several papers various aspects of Rechinger’s life and his scientific activities have been published by his close friends and colleagues (RIEDL 1971; LACK 1986, 1987, 1996, 1999, 2000; RENZ 1987; PODLECH 1996; VITEK 1999; FAVARGER 1996; SCHIMAN-CZEIKA 1996; GRAU 1996; SPITZENBERGER 1996; LAMOND 1996; LEUTE 1996; EISEL'T 1996; TERMEH 1996). A biography of the author and an introduction to the Flora Iranica has been published in Farsi language (AKHANI 1994). Hundreds of high quality scientific papers have been presented to Rechinger through publication of four Festschriften on the occasion of 65th, 80th and 90th Rechinger’s birthday in Annalen des Naturhistorischen Museums in Wien (Vol. 75; 1971), Plant Systematics and Evolution (Vol. 155, 1987), Proceedings of the Royal Society of Edinburgh (Vol. 89B, 1986) and Annalen des Naturhistorischen Museums in Wien (Vol. 98B suppl., 1996).

In this paper, a synoptic table of all 176 published volumes of Flora Iranica is presented including the number of genera, species and endemic species and respective numbers for Iran and the number of pages and illustrations (Table 1). The subspecific taxa are not listed. The name of all contributing authors of Flora Iranica, their official working place cited in the Flora and the number of volumes which they have contributed is given in Table 2. A statistical analysis of the nationality of all authors of the Flora Iranica is given in Table 3. In the second part of the paper, a bibliographic list of botanical papers written by late Prof. K.H. Rechinger is listed which are related to Flora of Iran and adjacent areas together with all his own
Fig. 1: Cover page of last volume of Flora Iranica showing the geographic boundary of the flora.
contribution to the Flora Iranica. The author will be grateful receiving any feedback of the omitted references in this bibliography.

Conclusion and critics

Since 1963, 176 volumes of Flora Iranica are published in which 9977 species and 1471 genera are dealt with. Except 311 species in first six volumes, where there are no descriptions, all other taxa are described. Altogether, 3318 species are mentioned as endemic to the Flora Iranica (33%) area which 1490 species are known as endemic to Iran (24%). The 176 volumes of Flora Iranica, include 10065 text pages and 5873 pages of high quality black/white pictures (tabulae) of herbarium specimens and illustrations of the whole or parts of the plants and 204 colour pages of 397 photographs (Table 1). A total of 97 botanists from 20 countries have contributed to the Flora Iranica. Austrian botanists with 17 contributors ranks first which followed by the British and German botanists each by 13 authors and Sweden by 9 authors as the highest number of contributors. The completion of Flora Iranica awaits only parts of the remaining two volumes of Astragalus, the second part of Scrophulariaceae (Antirrhineae) and the Pteridophytes. Except the Antirrhineae account which is still in preparation, the manuscripts of Astragalus and Pteridophytes are in final editing or publication process. From the data available it is possible to estimate the total number of species in Iran. According to Maassoumi (2005) the total number of taxa of the genus Astragalus in Iran is 804. Therefore, ca. 500 more species of Astragalus are expected to be published in Flora Iranica from Iran and ca. 100 species in Scrophulariaceae and the Pteridophytes. Based on the data collected by the author ca. 500 species have been added to the Iranian flora as new records or new species after the Flora Iranica. In conclusion the occurrence of 7300 species in Iran is a reliable figure. The author does not expect much of an increase the total number of species in Iran. The reason is that many authors in Flora Iranica and in post Flora Iranica publications have used a very narrow species concept. Therefore it is expected that several published names, particularly in the genus Astragalus, will be reduced as synonym of other species.

Not only in several reviews (e.g., a latest review by HEDGE 2006) and
personal discussions of many botanists, the "Latin" language of the Flora Iranica and its extremely expensive of individual volumes or whole series (ca. 6930 US$ according to Koeltz Scientific Books catalogue) are the main criticisms on Flora Iranica. Rechinger as a man of old school of European scientists had chosen the "Latin" language for this Flora because the knowledge of Latin language in botany was necessary at that time and still it is crucial for professional botanists. Therefore, it was expected that every botanist should have a sufficient knowledge of "Latin". As once Prof. D. Podlech, the Rechinger's friend and my former supervisor said, it would be much worse for local botanists when Rechinger had written the Flora in his mother language, German. Certainly it was easier for Rechinger to write and edit the Flora in Latin than English. A very positive feature of the Flora Iranica which facilitates its use for non-professional and professional botanists are the high quality pictures of herbarium specimens or in many cases line drawing and colour illustrations. All other Floras of the surrounding countries do not have this advantage.

One major problem with Flora Iranica is that many authors of Flora Iranica have never been in the area and based their interpretations only on sometimes scanty herbarium specimens. Therefore misinterpretations have happened in many plant groups. A good example is the family Boraginaceae (No. 48). A revision of the genus Heliotropium (AKHANI & FÖRTH 1994) resulted in the reduction of Iranian species to almost half of the total in the Flora Iranica. Another criticism on the Flora Iranica project is that the editor did not incorporate the local botanists especially from Iran (Table 3). Except one botanist (Dr. M. Iranshahr from Iranian Research Institute of Plant Protection) which has contributed in earlier volumes of Flora Iranica, only recently the present author has contributed to the Chenopodiaceae and Dr. A.A. Maassoumi (Research Institute of Forests & Rangelands) and Dr. Sh. Zurre (University of Tehran) have contributed to Astragalus accounts of the Flora Iranica. All we three have collaborated with this project through the generous helps and invitation by Prof. D. Podlech. Involving more local botanists in this project would have advantages such as training more botanists in the area and opening the way for possible supporting the project by local funds. Accordingly, the existing botanical isolation of Iran would not be obvious
H. Akhani

(HEDGE 2004) and access to botanical facilities including herbaria would be much easier not only for local young botanists but also for Western botanists to exchange their knowledge and material.

In conclusion, even when the language of Flora Iranica is difficult to use by many young local botanists and its high price limits its availability in many botanical and biological laboratories and private owner, this is and will be for many decades the only and hardly replaceable source for identification of flora in Iran, Afghanistan and adjacent areas. There is no doubt that the recent progress on botanical activities in Iran owes so much to the publication of the magnificent Flora Iranica and the huge contribution that Karl Heinz Rechinger made to botany in Iran, Iranians will always remember him, and this memorial issue of Rostaniha (The Botanical Journal of Iran) indicates that they are duly grateful.

Acknowledgments

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References


Flora Iranica: Facts and figures and a list of publications by ...  

Table 1. Synoptic table of the published volumes of "K.H. Rechinger (ed.) Flora Iranica; No. 1-176 (1963-2005)", including numbers of genera, species, endemic species (with relevant numbers in Iran), page and tabular numbers. Explanations and abbreviations: Family: The families arranged by the publication number and publication year; Gen.: Genera numbers; Gen. Ir.: Number of genera in Iran; Spec.: Number of species; Spec. Ir.: Number of species in Iran; End. Ir.: Number of endemic species in Iran; Page: Number of text pages; BWT: Number of black and white tables (line drawing tables in the text are also added); COT: Number of colour tables (numbers in parenthesis showing the numbers of colour photos); Year: Publication year. Additional notes are given at the footnotes for the numbers are marked with an asterisk.

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| Total              | 1471| 1156| 9977| 6193| 3318| 1490| 10065| 5873| 204(397) |

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Table 2. List of the authors of *Flora Iranica*, their working city (in parenthesis) and respective number of *Flora Iranica* which they have contributed. The indicated authors with cross sign (†) are no longer alive, as far as have been checked in the web site of ‘Authors of Plant Names’ and data provided by I.C. Hedge

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ALLIUM JOHARCHII, A NEW SPECIES FROM KHORASAN PROVINCE (IRAN)

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Academy of Sciences, Tashkent, Uzbekistan and Research Institute for Plant Sciences, Ferdowsi University, Mashhad, Iran

Abstract

Allium joharchii is described as a new species belonging to Irano-Turanian sect. Eremoprasum (Kamelin) F.O. Khass., R.M. Fritsch et Friesen. Key for determination of all the species of this section is given.

Keywords: Allium joharchii, Khorasan, Iran

Introduction

During a revision of Allium specimens in the Ferdowsi University of Mashhad Herbarium (FUMH), some undeterminable materials closely related to A. sabulosum Stev. were traced. These plants have been collected by M.R. Joharchi at two localities in the southern salty hills of eastern Koppet-Dagh mountain range along the road from Mashhad to Sarakhs in 1991 and 2003. Here one plant of this new species could be re-collected during a research mission in May, 2006. Thus, the following description considers also characters of living plants.
Allium joharchii F.O. Khass. et Memariani sp. nov.
Holotype: Iran, Khorasan, S.W. Sarakhs, southern hills of Rahmat-Abad village, alt. 690-700 m, 02.06.2003, M.R. Joharchi & H. Zangooei (FUMH, Fig. 1).

Ab A. confragosum perigonii phyllis pallide coloratis differt.
Habitat in gypsaceis montium Koppet-Dagh orientalis (Persia).
Species in honorem M.R. Joharchi Mabthadensis denominatae est.

Bulbs oblong-ovate, 2-2.5 cm long and 1-1.5 cm wide, outer tunics grayish, without longitudinal ribs. Bulblets apparently missing. Scape 30-50 cm long. Leaves 3(4), shorter than scape, 1-2 mm wide, hollow, glabrous, channelled, semi-cylindrical. Spathe as long as inflorescence, membranous, with a beak. Inflorescence subglobose, many-flowered. Pedicels of nearly equal length, 10-20 mm long, with long basal bracts. Flowers cup-shaped, tepals 3-3.5 mm long, ovate, rugose, cymbiform, acute. Filaments triangular, twice longer than tepals. Style exserted. Capsule subglobose, larger than flower.

On morphological reasons (Fig. 2), this species clearly belongs to Irano-Turanian sect. Eremoprasum which comprises seven more species in Central Asia (Fig. 3). A. sabulosum was mentioned only from one location for Iran (Persia: Prope Shurah inter Esfahan et Teheran, Bunge, 13) by P. WENDELBO (1971). Allium joharchii represents the second species of this section occurring in Iran (Fig. 4). The new species is closely related to A. confragosum and A. sabulosum, differing from the first species by less intensely colored tepals and emarginate form of inner tepals from the second one. Additionally, A. joharchii is the only species of
Allium joharchii, a new species from Khurasan Province (Iran)

sect. Ereoprasum without bulblets. Allium sabulosum is widely distributed and grows usually on sandy dunes (from Caspian Sea towards the east), but all other species are local endemics growing on gypseous slopes in Pamir-Alai, Tien-Shan and Kopet-Dagh mountain ranges.

Fig. 1. Holotype of Allium joharchii.
Fig. 2. *Allium joharchii*: A. Inflorescence, B. Flower and C. Capsule.
Allium joharchii, a new species from Khuzestan Province (Iran)

Fig. 3. Distribution map of Allium sect. Eremoprasum in C. Asia. Allium sabulosum (black circle), A. incrassatum (black square), A. scrobiculatum (grey circle), A. transvesiens (white square), A. popovií (dark-grey square), A. jazarecticum (light-grey square) and A. confragosum (white circle).

Fig. 4. Distribution map of Allium sect. Eremoprasum in Iran, Allium sabulosum (black circle) and A. joharchii (grey circle).
Key for determination of Sect. *Eremoprasum* (Kamelin) F.O. Khass., R.M. Fritsch et Friesen

1. Tepals rugose
   Tepals smooth
   2
   5

2. Tepals obtuse, the inner ones emarginate
   Tepals acute; the inner ones not emarginate
   3
   4

3. Tepals greenish, outer tunics and bulblets with crests
   Tepals brownish, outer tunics and bulblets without crests
   *A. incrasta* Vved.
   *A. sabulosum* Stev.

4. Bulblets brownish-blackish, tunics with dense minute pits and wart-like projections
   Tepals brown (when dried violetish)
   *A. confragosum* Vved.

   Bulblets absent, outer tunics without pits and wart-like projections, tepals, pinkish-brownish (when dried brownish)
   *A. foharchii* F.O. Khass., et Memariani

5. Outer tunics without crests, scape thickish
   Outer tunics with crests, scape not thickish
   *A. scrobiculatum* Vved.
   6

6. Filaments shorter than tepals
   Filaments longer than tepals
   *A. jaxarticum* Vved.
   7

7. Tepals obtuse, black
   Tepals acute, whitish with purple vein
   *A. transvestites* Vved.
   *A. popovii* Vved.

Acknowledgement

The senior author is greatly indebted to the authorities and staff of Research Institute for Plant Sciences, Ferdowsi University of Mashhad (Mashhad, Iran), for invitation and financial support.

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Luk zhiv (Kaz.) piez (tadzh.). in Vvedensky, A.I. & Kovalevskaya, S.S. (eds)
Opredefitel rastenij Srednej Azii. Kriticheskij konspekt flory; 2. Izd. "FAN"
**Allium joharchii**, a new species from Khurasan Province (Iran)


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NUMERICAL TAXONOMY OF *TULIPA* SUBGENUS *TULIPA* (LILIACEAE) IN IRAN

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Shahid Beheshti University, Tehran, Iran

Abstract

Phenetic studies were performed on 97 populations of 13 *Tulipa* species and varieties belonging to the subgenus *Tulipa* of Iran in order to reveal inter-population variations, inter-specific differences and relationships as well as checking taxonomic position of *T. ulophylla*. Statistical analyses showed that, populations differ significantly in most of the quantitative morphological characters while species differ significantly in certain characteristics, which may be used in the species delimitation. Clustering and discriminant analysis supported taxonomic treatment of the subgenus *Tulipa* and also inclusion of *T. ulophylla* in the section Eichleres.

Key words: *Tulipa*, Phenetic study, Clustering, Discriminant analysis

Introduction

Tulips (*Tulipa* L.) are among important plants widely used as ornamentals. They have been originated in Eastern countries and via Iran and Turkey were introduced to Europe (WENDELBO 1977). The number of *Tulipa* species occurring in Iran varies from seven to 23 according to different authors. However, MATIN (1998) in the most recent taxonomic work on *Tulipa* of Iran reports 19 species and

* Corresponding author
varieties of Tulips distributed in two subgenera of Eriostemon Boiss. and Tulipa (Leiostemon Boiss.).

Although, Tulips have been studied extensively throughout the world, a limited number of biosystematic studies are available from Iran (SHEIDAI et al. 2002a & b, KHANAFSHAR et al. 2004). The present study considers phenetic analyses of morphological characters among the species of subgenus Tulipa in order to identify inter-population diversity and the interspecific relationships. The position of T. ulophylla Wendelbo, which is controversial, has also been considered.

Materials and Methods

Plant material

In total, 97 populations belonging to 12 species and two varieties from five different sections of the subgenus Tulipa were studied for morphological characters. The species studied and their respective sections are as follows:


Three to five plants from each population were used for morphometric studies. Details of the localities and the voucher numbers may be provided on request from the senior author. Voucher specimens are deposited in TARI, IRAN and Herbarium of Shahid Beheshti University (HSB).

Morphometry

In total, 53 morphological characters (15 quantitative and 38 qualitative) were studied (Table 1). Characters were selected based on those reported by VAN...
RAAMSDONK & DE VARIÉS (1995) and our own field observations. In order to detect any significant difference in quantitative morphological characters among the species studied, analysis of variance (ANOVA) followed by the least significant difference (LSD) tests were performed.

For phenetic analyses, the mean of quantitative characters were used while qualitative characters were coded as binary/multistate characters. Since different types of variables (quantitative and qualitative) and codes (binary and multistate) were used, variables were standardized (mean=0, variance=1) for multivariate statistical analyses (CHATFIELD & COLLINS 1995, SHEIDAI et al. 2002 a).

The phenetic analyses were performed with the following aims: 1. To indicate inter-population differences, 2. To determine the species interrelationships, and 3. To check the taxonomic position of *T. ulophylla*.

In order to reveal inter-population differences cluster analysis, using UPGMA (Unweighted Pair Group Method using Arithmetic Averages) and WARD (Minimum Variance Spherical Clusters) as well as ordination based on Principal Component Analysis (PCA) were performed among different populations of a single species (INGROUILLE 1986, SHEIDAI et al. 2002 a). As suggested (CHATFIELD & COLLINS 1995), in UPGMA clustering, the Euclidean distance and in WARD clustering, squared Euclidean distance was used as dissimilarity coefficient.

In order to determine the species interrelationships, clustering and PCA ordination were carried out. In order to determine the most variable morphological characters among the species studied, factor analysis based on principal components analysis (PCA) was performed (SHEIDAI et al. 2002 a, VAN RAAMSDONK & DE VARIÉS 1995).
Table 1. Morphological characters and their coding

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Character</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stem length</td>
<td>Cm</td>
</tr>
<tr>
<td>2</td>
<td>Stem pubescent</td>
<td>Presence (1)/absence (0).</td>
</tr>
<tr>
<td>3</td>
<td>Number of leaves</td>
<td>Cm</td>
</tr>
<tr>
<td>4</td>
<td>Length of lowest leaf</td>
<td>Cm</td>
</tr>
<tr>
<td>5</td>
<td>Length of second lowest leaf</td>
<td>Cm</td>
</tr>
<tr>
<td>6</td>
<td>Width of lowest leaf</td>
<td>Cm</td>
</tr>
<tr>
<td>7</td>
<td>Width of second lowest leaf</td>
<td>Cm</td>
</tr>
<tr>
<td>8</td>
<td>Leaf with deviating margin color</td>
<td>Presence/absence</td>
</tr>
<tr>
<td>9</td>
<td>Leaf margin color</td>
<td>1. like blade, 2. red, 3-white</td>
</tr>
<tr>
<td>10</td>
<td>Leaf pubescent</td>
<td>Presence/absence</td>
</tr>
<tr>
<td>11</td>
<td>Leaf margin ciliate</td>
<td>Presence/absence</td>
</tr>
<tr>
<td>12</td>
<td>Lowest leaf form</td>
<td>1. crisp, 2. falcate, 3. straight</td>
</tr>
<tr>
<td>13</td>
<td>Second lowest leaf form</td>
<td>1. crisp, 2. falcate, 3. straight</td>
</tr>
<tr>
<td>14</td>
<td>Uppermost leaf form</td>
<td>1. crisp, 2. falcate, 3. straight</td>
</tr>
<tr>
<td>15</td>
<td>Lowest leaf undulation</td>
<td>Presence/absence</td>
</tr>
<tr>
<td>16</td>
<td>Second lowest leaf undulation</td>
<td>Presence/absence</td>
</tr>
<tr>
<td>17</td>
<td>Color of outer tepal at abaxial side</td>
<td>1. red, 2. yellow, 3. orange, 4. white, 5. purple, 6. pink, 7. silvery, 8. coppery/violet</td>
</tr>
<tr>
<td>18</td>
<td>Color of outer tepal at adaxial side</td>
<td>1. red, 2. yellow, 3. orange, 4. white, 5. purple, 6. pink, 7. silvery, 8. coppery/violet</td>
</tr>
<tr>
<td>19</td>
<td>Tepal with deviating margin color</td>
<td>Presence/absence</td>
</tr>
<tr>
<td>20</td>
<td>Color of inner tepal at abaxial side</td>
<td>1. red, 2. yellow, 3. orange, 4. white, 5. purple, 6. pink, 7. silvery, 8. coppery/violet</td>
</tr>
<tr>
<td>21</td>
<td>Color of inner tepal at adaxial side</td>
<td>1. red, 2. yellow, 3. orange, 4. white, 5. purple, 6. pink, 7. silvery, 8. coppery/violet</td>
</tr>
<tr>
<td>22</td>
<td>Length of outer tepal</td>
<td>Cm</td>
</tr>
<tr>
<td>23</td>
<td>Width of outer tepal</td>
<td>Cm</td>
</tr>
<tr>
<td>24</td>
<td>Length of inner tepal</td>
<td>Cm</td>
</tr>
<tr>
<td>25</td>
<td>Width of inner tepal</td>
<td>Cm</td>
</tr>
<tr>
<td>26</td>
<td>Outer tepal blotch</td>
<td>1. absent, 2. black/dark purple, 3. purple, 4. brown/violet, 5. yellow</td>
</tr>
</tbody>
</table>
Table 1. (contd.)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>27</td>
<td>Inner tepal blotch</td>
</tr>
<tr>
<td>28</td>
<td>Tip of outer tepal pubescent</td>
</tr>
<tr>
<td>29</td>
<td>Margin of outer tepal pubescent</td>
</tr>
<tr>
<td>30</td>
<td>Midrib of outer tepal pubescent</td>
</tr>
<tr>
<td>31</td>
<td>Tip of inner tepal pubescent</td>
</tr>
<tr>
<td>32</td>
<td>Margin of inner tepal pubescent</td>
</tr>
<tr>
<td>33</td>
<td>Midrib of inner tepal pubescent</td>
</tr>
<tr>
<td>34</td>
<td>Occurrence of yellow/white margin around blotch</td>
</tr>
<tr>
<td>35</td>
<td>Tip of outer tepal form</td>
</tr>
<tr>
<td>36</td>
<td>Filament length</td>
</tr>
<tr>
<td>37</td>
<td>Anther length</td>
</tr>
<tr>
<td>38</td>
<td>Anther color</td>
</tr>
<tr>
<td>39</td>
<td>Pollen color</td>
</tr>
<tr>
<td>40</td>
<td>Filament color contrasting with flower color</td>
</tr>
<tr>
<td>41</td>
<td>Ovary length</td>
</tr>
<tr>
<td>42</td>
<td>Stigma color</td>
</tr>
<tr>
<td>43</td>
<td>Width of bulb</td>
</tr>
<tr>
<td>44</td>
<td>Tunic type</td>
</tr>
<tr>
<td>45</td>
<td>Color of bulb tunic</td>
</tr>
<tr>
<td>46</td>
<td>Occurrence of hairs at upper part of bulb tunic</td>
</tr>
<tr>
<td>47</td>
<td>Occurrence of hairs at middle part of bulb tunic</td>
</tr>
<tr>
<td>48</td>
<td>Occurrence of hairs at base of bulb tunic</td>
</tr>
<tr>
<td>49</td>
<td>Bulb tufted at top</td>
</tr>
<tr>
<td>50</td>
<td>Type/form of tunic hairs</td>
</tr>
<tr>
<td>51</td>
<td>Occurrence of carpophore at the base of capsule</td>
</tr>
<tr>
<td>52</td>
<td>Capsule length</td>
</tr>
<tr>
<td>53</td>
<td>Capsule width</td>
</tr>
</tbody>
</table>
In order to check the position of *T. udophylla*, discriminant analysis (DA) was also carried out along with clustering and PCA ordination (CHATFIELD & COLLINS 1995). STATISCA, ver. 5, (1995) was used for multivariate statistical analyses.

**Results and Discussion**

**Inter-population variations**

The normal distribution of the quantitative characters in all populations studied was checked using normal probability plot showing that, almost all of them give good fit to normal distribution and may be used in multivariate analyses.

In the first attempt, 30 populations of *T. montana* var. *montana* were the OTUs studied for inter-population variation. Clustering and PCA ordination produced similar results in which three populations of Tehran 1, Golestan 1 and Hamedan stand separate from the other populations due to their morphological differences (Fig. 1). Factor analysis revealed that, the first six PCA factors comprise about 77% of total variation and characters like stem length, first and second leaf length as well as outer tepal length and width, possess the highest factor loads (> 0.60) and, therefore, are the most variable morphological characters among *T. montana* var. *montana* populations. This is also supported by descriptive statistic analyses of characters like standard error and standard deviation as well as ANOVA performed among the populations (ANOVA showed a significant difference in these characters, see also Table 2).

A similar analyses were performed among 30 populations of *T. montana* var. *chrysantha*. Clustering and PCA ordination gave similar results (Fig. 2), in which three populations of Kashan, Semnan and Semnan 2, stand separate from the other populations due to their morphological characters. Descriptive statistics (Table 2), ANOVA and PCA analyses showed that, these populations differ in characters such as: stem length, second leaf length, outer tepal length and width and first and second leaf undulation.
Table 2: Descriptive statistics mean and standard error of quantitative morphological characters in Zeling species.

<table>
<thead>
<tr>
<th>Character</th>
<th>Cuning</th>
<th>Dohna</th>
<th>Heterosogy</th>
<th>Hsien-shui</th>
<th>Lin B</th>
<th>Lin M</th>
<th>Mount Om</th>
<th>Shui</th>
<th>Tai-ch'engb</th>
<th>W. ho</th>
<th>Yen K. S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stem height</td>
<td>138.5</td>
<td>137.0</td>
<td>138.4</td>
<td>140.2</td>
<td>139.8</td>
<td>137.8</td>
<td>140.0</td>
<td>138.8</td>
<td>140.9</td>
<td>137.8</td>
<td>140.1</td>
</tr>
<tr>
<td>Fruit set length</td>
<td>2.47</td>
<td>2.45</td>
<td>2.45</td>
<td>2.45</td>
<td>2.47</td>
<td>2.46</td>
<td>2.46</td>
<td>2.45</td>
<td>2.46</td>
<td>2.45</td>
<td>2.45</td>
</tr>
<tr>
<td>Stem length right turn</td>
<td>3.15</td>
<td>3.14</td>
<td>3.15</td>
<td>3.15</td>
<td>3.14</td>
<td>3.14</td>
<td>3.14</td>
<td>3.15</td>
<td>3.15</td>
<td>3.15</td>
<td>3.15</td>
</tr>
<tr>
<td>Leaf length left turn</td>
<td>3.15</td>
<td>3.14</td>
<td>3.15</td>
<td>3.15</td>
<td>3.14</td>
<td>3.14</td>
<td>3.14</td>
<td>3.15</td>
<td>3.15</td>
<td>3.15</td>
<td>3.15</td>
</tr>
<tr>
<td>Leaf length right turn</td>
<td>3.15</td>
<td>3.14</td>
<td>3.15</td>
<td>3.15</td>
<td>3.14</td>
<td>3.14</td>
<td>3.14</td>
<td>3.15</td>
<td>3.15</td>
<td>3.15</td>
<td>3.15</td>
</tr>
</tbody>
</table>

Notes: C = Cuning, D = Dohna, H = Heterosogy, M = Hsien-shui, B = Lin B, M = Lin M, O = Mount Om, S = Shui, T = Tai-ch'eng, W = Yen K. S.
Fig. 1. PCA ordination of *T. montana* var. *montana* populations.

Fig. 2. UPGMA clustering of *T. montana* var. *chrysanthu* populations studied.
Numerical taxonomy of *Tulipa* subgenus *Tulipa* (Liliaceae) in Iran

The same analyses performed among seven populations of *T. linifolia* collected from Iran and Afghanistan showed distinctness of these populations (Fig. 3), as the specimens collected from Iran separated from those collected from Afghanistan. Statistical analyses revealed that, they differ in morphological characters such as; stem length, number of leaves, first and second leaf length, leaf margin and its color, shape of the last leaf, second leaf undulation, outer tepal length and width as well as ovary length.

Phenetic analyses performed among three populations of *T. clusiana*, two populations of *T. huarazensis*, two populations of *T. micheliana*, four populations of *T. ulophylla*, three populations of *T. lehmaniana*, and four populations of *T. schwerenki* showed that, differences are due to almost the same quantitative characters mentioned before.

Inter-specific variations

The mean value and standard error of quantitative characters in each species are presented in Table 2. ANOVA followed by LSD test performed among the species studied revealed presence of a significant difference almost in all quantitative morphological characters.

For studying the species interrelationships, *Tulipa* species were considered as OTUs and clustering as well as PCA ordination was performed producing similar results (Fig. 4). Members of the sect. Clusianae i.e. *T. montana* var. *montana*, *T. montana* var. *chrysanthba* and *T. linifolia* show phenetic similarity and are placed close to each other while *T. clusiana* and *T. huarazensis* stand little far from the other species.

The species belonging to the sect. Tulipanum i.e. *T. hoogiana*, *T. systola* and *T. kaschakensis* are placed close to each other. From the members of the sect. Eichleres, two species of *T. ulophylla* and *T. wendelboi* show similarity and are placed close to each other while, *T. micheliana* stands far from them.
Fig. 3. WARD clustering of *T. linifolia* populations.

Fig. 4. WARD clustering of *Tulipa* species studied (species code: C = clusiana, CH = chrysantha, H = harazensis, LEH = lehmani, LIN = linifolia, M = micheliana, MONT = montana var. montana, O = montana var. montana with orange flowers, SCH = scherinkii, LAF = linifolia from Afghanistan, U = ulophylla, W = wendelboi, HOOG = hoogiana, K = kutchakensis, and S = systola).
Two species of *T. lehmaniana* (from the sect. *Kolpakovskyiinae*) and *T. scherenkii* (from the sect. *Tulipa*) also show similarity to each other and are placed close together. In general the phenetic results support MATIN (1998) taxonomic treatment of the subgenus *Tulipa*.

Factor analysis of morphological characters revealed that, the first four factors comprise about 70% of total variation and the following characters possessed the highest positive factor loads (> 0.70): length and width of the first and second leaf, inner and outer tepal length and width, hair type, filament and anther length, color of outer tepal at adaxial side, color of inner tepal at abaxial side. Therefore, as a result, these characters are considered the most variable morphological characters among the species studied.

Position of *T. ulophylla*

RECHINGER (1990) placed *T. ulophylla* in the sect. *Tulipanum*, while MATIN (1998) considered it as a member of sect. *Eichleres*. Therefore, phenetic analyses were used to determine the position of *T. ulophylla*, the results of which are presented in Figs 5 & 6. Clustering of the species belonging to two sections of *Tulipanum* and *Eichleres* revealed that, *T. ulophylla* show more similarity to *T. wendelboi* and *T. micheliana* of the sect. *Eichleres* as they are placed in a separate cluster far from the members of the sect. *Tulipanum*.

DA was also performed considering *T. ulophylla* as a member of *Eichleres*, which showed 100% of correction for such classification. Two DA factors were produced on which species ordination was performed (Fig. 6), supporting inclusion of *T. ulophylla* in the sect. *Eichleres*.
Figs 5 and 6. UPGMA clustering and DA ordination, checking the taxonomic position of *T. ulophylla* (species code as in Table 2).
Numerical taxonomy of *Tulipa* subgenus *Tulipa* (Liliaceae) in Iran

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**Address of the authors:** Dr. M. SHEIDAI (E-mail: msheidai@yahoo.com), SH. KHANAFSHAR and SH. ZOJAIFAR, Department of Biology, Shahid Beheshti University, Tehran, Iran.
LEAF ANATOMY IN THE FAMILY MORACEAE

D. AZIZIAN*, D. CUTLER and M. GREGORY
University of Shahid Beheshti, Tehran, Iran and
Royal Botanic Gardens, Kew, UK

Abstract

Moraceae, morphologically, is a heterogeneous family of trees, shrubs, lianes and herbs growing mainly in the tropics and subtropics, with a few species in temperate regions of both hemispheres. Leaf anatomy of 63 species in 32 genera is described. Characters of taxonomic value within the family include the shape of epidermal cells, cuticle structure and type of hairs. Characters of diagnostic importance at the family level include the occurrence of cystoliths and crystals in the mesophyll, the presence of hypodermis and laticifers, anomocytic stomata (except in Dorstenia species where mainly anisocytic), usually dorsiventral mesophyll, with a palisade tissue of 1-3 layers in several genera (but Dorstenia species with short, distinctively lobed cells). Leaf anatomy shows characteristic features within the family, but the family forms such a closely knit complex that some tribes and genera are difficult to delimit.

Keywords: Cystoliths, Laticifers, Trichomes, Anatomy, Moraceae

* Corresponding author
Introduction

The Moraceae is a family comprising 38-59 genera and well over 1300 species (CORNER 1962, BERG 1973, 1980, CRONQUIST 1981, BRUMITT 1992, MABBERLY 1997), widespread in tropical and subtropical areas but much less common in temperate regions. The systematic relationships within the family have been discussed for many years (WOODSON & SCHREY 1960, CORNER 1962, HUTCHINSON 1967) and more recently by HUMPHRIES & BLACKMORE (1989), TAKHTAJAN (1987, 1997). CORNER (1962) has subdivided the family into six tribes defined almost entirely on inflorescence characters, but the most important contribution to establishing major subdivisions of Moraceae is that of BERG (1973, 1980, 1983). BERG (1973) discussed CORNER's (1962) treatment of the Moraceae, and reduced the number of tribes in the family to four by including Atrocarpeae in Moreae. Later, BERG (1989) investigated the systematics and phylogeny of the Urticales and proposed five tribes within Moraceae, i.e. Moreae, Atrocarpeae, Castilleae, Dorstenieae and Ficeae. The delimitation of tribes was based on various characters such as inflorescences, type of flower and fruit. For example Ficeae characterized by woody habit, inflorescence (eyeonta) basically bisexual and cymose/castilleae group is woody but inflorescence capitata and involucrata, unisexual (racemose), while Dorstenieae exhibit woody and herbaeous habit with complex inflorescence, often with reduced flowers, Atrocarpeae characterized by woody habit, inflorescence usually unisexual racemose and Moreae mainly woody and (in Ficus) herbaeous, inflorescence relatively simple, mostly racemose and unisexual. However, the delimitation of genera was more or less problematic. As ROHWER (1993) mentioned, the family forms such a closely knit complex that tribes and genera are difficult to delimit. HUMPHRIES & BLACKMORE (1989) have again reviewed the classification of Moraceae and TAKHTAJAN (1997) has subdivided the family into five tribes as BERG did in 1980 (Table 1).
Leaf anatomy in the family Moraceae

<table>
<thead>
<tr>
<th>Author</th>
<th>Tribe</th>
<th>Genera</th>
</tr>
</thead>
<tbody>
<tr>
<td>BERG 1989</td>
<td>Ficeae</td>
<td><em>Ficus</em>, <em>Antiars</em>, <em>Castilla</em>, <em>Neotropica</em>, <em>Helicostylis</em>, <em>Maquira</em>, <em>Mesogyne</em>, <em>Noucleopsis</em>, <em>Prebea</em>, <em>Pseudodolmedia</em></td>
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<tr>
<td></td>
<td>Dorstenieae</td>
<td><em>Bosquiciopsis</em>, <em>Brosimum</em>, <em>Dorstenia</em>, <em>Hellanthostylis</em>, <em>Scyphoxycce</em>, <em>Trilepisium</em>, <em>Trymatoxoccus</em>, <em>Utsetela</em></td>
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<td></td>
<td>Antocarpeae</td>
<td><em>Antiarpia</em>, <em>Artocarpus</em>, <em>Bagassa</em>, <em>Batoecarpus</em>, <em>Buffetia</em>, <em>Paratoecarpus</em>, <em>Praeina</em>, <em>Soroea</em>, <em>Sparattoxycce</em>, <em>Trecalia</em></td>
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<td><em>Bluysredia</em>, <em>Broussonetia</em>, <em>Fauta</em>, <em>Maclura</em>, <em>Milicia</em>, <em>Moras</em>, <em>Streblus</em>, <em>Trophius</em></td>
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<td>HUMPHRIES &amp; BLACKMORE 1989</td>
<td>Ficeae</td>
<td><em>Ficus</em>, <em>Antiars</em>, <em>Castilla</em>, <em>Perebea</em>, <em>Helicostylis</em>, <em>Maquira</em>, <em>Mesogyne</em>, <em>Noucleopsis</em>, <em>Pseudodolmedia</em></td>
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<td>Dorstenieae</td>
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<td>Castilleae</td>
<td><em>Antiarpia</em>, <em>Artocarpus</em>, <em>Bagassa</em>, <em>Batoecarpus</em>, <em>Buffetia</em>, <em>Paratoecarpus</em>, <em>Praeina</em>, <em>Soroea</em>, <em>Sparattoxycce</em>, <em>Trecalia</em></td>
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<td>Moreae</td>
<td><em>Bluysredia</em>, <em>Broussonetia</em>, <em>Fauta</em>, <em>Maclura</em>, <em>Milicia</em>, <em>Moras</em>, <em>Streblus</em>, <em>Trophius</em></td>
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<td>Ficeae</td>
<td><em>Ficus</em></td>
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Compared with size of the family, little is published on the vegetative anatomy of Moraceae. The description in the classical work on anatomy of dicotyledons is given by METCALFE & CHALK (1957), who studied various genera of the family and mentioned the characteristic features of leaf, stem and wood anatomy in Moraceae. SHAH & KACHOO (1975) investigated the trichomes in some genera of Moraceae and recognized three types of glandular trichomes. In addition, various works have been published on individual genera and species such as Ficus species (LERSTEN & PETERSON 1974, KUMAR & JAIN 1986, BAUNATH & NAIDOO 1979, HARDIN 1981, BISHT et al. 1989, VAN VEE NENDAAL & DEN OUTER 1990, AZIZIAN 1998, 2001, 2002). This paper presents the range of leaf anatomy within the family based on a study on 63 species in 32 genera and discusses its use for taxonomic and diagnostic purposes.

Materials and Methods

Anatomical studies were carried out on living collections at the Royal Botanic Gardens, Kew, and on herbarium materials mainly from the Royal Botanic Gardens, Kew (K) and some from herbarium of Research Institute of Forests & Rangelands (TARI), Iran. A list of the species examined together with the source of the material is given in the appendix.

The materials were examined by light and scanning electron microscopy. For light microscope observation, fresh material was fixed in FAA for 48 hours. Dried material was expanded and softened by boiling in water before fixing. Material was then stored in 70% ethanol. Epidermal preparations were made using Jeffrey's solution. Sections were cut on a Reichert OME sliding microtome, cleared in paraffin, stained with safranin and alcian blue, dehydrated through an alcohol series, passed through histoclear and mounted in euparal. Photographs were taken using a Leitz photomicroscope. For SEM observation, small pieces of lamina were fixed on aluminium stubs with double-sided adhesive tape, coated with platinum in a sputter coater and photographed in a Cambridge Stereoc Scan 240 SEM at the Jodrell Laboratory, Kew (UK).
Leaf anatomy in the family Moraceae

Results

Leaf surface

Cuticle: finely striated in most species, e.g., Broussonetia, Ficus, Maclura, Morus (Figs 1-5). Epidermal cells varying in shape, with wavy, sinuous or straight anticlinal walls (Figs 7, 8). Stomata usually anomocytic except in Dorstenia where mainly anisocytic and some anomocytic often showing a range of sizes (Fig. 9). Stomata usually confined to lower surface, but also occurring on upper surface in some species, e.g., Maclura pomifera and Morus alba, although less abundant. Stomata may be sunken below surface in Brosimum and Ficus species: more or less arranged in groups between projecting network of veins on lower surface of leaf in Ficus lutea, F. deltoidea and Chlorophora excelsa (= Milicia excelsa) and with prominent cuticular ledge in Ficus pretoriae, F. binnendijkii and F. benghalensis (Figs 10, 11).

Hairs: A few species, such as Clarisia ilicifolia, Mesogyne insignis, Pararocarpus venenosus, Perebea xanthochyma, Pseudolmedia laevigata, Soroea saxeocarpa and Trymatococcus altiglandnus, almost glabrous. Nonglandular and glandular hairs present in most other species examined:

A: Nonglandular hairs: usually unicellular, simple, moderately thick-walled, varying from long to short and straight to curved, present in most genera, sometimes reduced to very short globose hairs or resembling papillae as in Broussonetia kazinoki (Fig. 12) and Clarisia ilicifolia. Variation and peculiarities in hair shape sometimes valuable for identification of genera and species: e.g. (i) long, clothing hairs in Broussonetia papyrifera (Fig. 13), Castilia ulci (Fig. 14), C. tineae, Ficus species (Figs 15-17) and Trymatococcus paraneus; (ii) prickle hairs with swollen base sunken in mesophyll, always containing a cystolith, in Morus spp., Ficus spp., Poulienia armata and Streblus asper, Dorstenia elata (Figs 18-21); (iii) structures resembling cystoliths sometimes also occurring in tips or suspended from walls of large hairs in species of Antiaris, Artocarpus, Broussonetia and Ficus (Figs 19-20).

B: Glandular hairs: usually with uniseriate stalk of one or more cells and 4-8-16-celled, spherical or ellipsoidal head, with longitudinal and transverse walls; this type is present in all genera investigated but is more abundant in Antiaris toxicaria, Bosquetopsis gigantea, Morus nigra, M. alba, Brosimum costaricanum, Maclura

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*pomifera*, *Castilla ulae*, *Helicostylis tomentosa*, *H. scabra*, *Dorstenia elata*, *Sonorea savocarpa*, *Trymutococcus amazonica*, frequent in *Artocarpus* spp. and *Chlorophora excelsa*, but less frequent in *Ficus* spp. (Figs. 15, 22, 23).

**Leaf transverse section (T.S.)**

**Epidermis:** usually consisting of one layer of cells, but frequently more than one layer present adaxially particularly at the base of hairs; distinctly two-layered in *Sparattosyce dioca* and *Treculia madagascarica*. Epidermal cells sometimes of different sizes and levels, as in *Helicostylis tovarensis* and some may contain mucilage, as in *Brosimum*, *Ficus* and *Pseudolmedia*. Hypodermis generally occurring only beneath adaxial surface in certain species, e.g. *Chlorophora excelsa* (1-2 layers) and *Ficus lutea*, *F. deltoidea*, *F. berghalensis*, *F. villosa*, and *F. binnendijkii* (1-4 layers) (Figs 24-26).

**Mesophyll:** leaves more or less mesomorphic in all species studied; mainly dorsiventral, palisade tissue generally making up 1/2 to 1/3 of total thickness of mesophyll; composed of tall cells mainly in one layer in *Bosqueiopsis*, *Brosimum*, *Naucleopsis*, *Helicostylis* and *Cudrania* species (Figs 24-28); cells very short in *Antiarpis decipiens*, *Clarisia ilicifolia*, *Ficus pretoridea* (Fig. 29), *F. deltoidea* (Fig. 30), *Prainea papuanus* and *Seyphosyce pondurata*; *Dorstenia* species unique, having short, distinctively lobed cells (Figs 31, 32), but isobilaterally and in 2-3 compact layers in various species such as *Chlorophora excelsa* (Fig. 26), *Castilla ulae* (Figs 33, 34), *Antiarpis toxicaria* spp. *Welwitschii* (Fig. 35) and *Sorocera guilleminima* (Fig. 36). Cells of spongy mesophyll more or less branched or lightly rounded and compact in most species examined, but very loose arm-cells in *Antiarpis decipiens*, *Artocarpus rigidus*, *Bosqueiopsis* gilletii, *Brosimum costaricanum*, *Ficus lutea*, *Maclura pomifera*, *Mesogyne insignis*, *Naucleopsis glabra* (Fig. 27), *Parartocarpus venenosus*, *Pseudolmedia laevigata* and *Treculia madagascarica*.

**Midrib:** Usually with prominent arc of several bundles abaxially and small bundles in ground tissue adaxially. Vascular bundles collateral, in one row in lamina. Bundle sheath of major bundles composed of several layers of collenchyma; bundle sheath extensions collenchymatous, usually both ad- and abaxially in most genera; absent
Leaf anatomy in the family Moraceae

from *Dorstenia*, *Mesogyne*, *Parartocarpus*, *Perebea*, *Scypiosycye*, *Sorocea*, *Treculia* and *Trymatococcus*.

**Laticifers:** unbranched, present mainly in mesophyll and around veins in lamina, sometimes extending to hypodermis or even epidermis in species examined of *Antiaria*, *Artocarpus*, *Castilla*, *Dorstenia*, *Ficus*, *Maclura*, *Treculina* and *Morus* (Fig. 37). Crystals; in addition to those in cystoliths, druses or solitary crystals present in nearly all species studied as crystal idioblasts in mesophyll (Figs 38, 43) and around vascular bundles. On the other hand, true cystoliths with more or less large lithocyst frequently observed in abaxial surface and sometimes also in adaxial surface in *Castilla*, *Chlorophora*, *Ficus*, *Morus*, *Poutsea*, *Sparattosycye* and *Streblus*, but absent from *Fatoea*, *Mesogyne*, *Prainea* and *Soroceae* (Figs 39-42).

**Discussion**

Except for *Ficus*, our survey of the Moraceae is based on only a few species of each genus. The results exhibit several notable features within the family which are quite compatible with the information summarized by METCALFE & CHALK (1950). Most species have regularly-shaped epidermal cells in one layer, but certain species of *Chlorophora*, *Ficus* have more than one layer, particularly at the base of hairs. Epidermal cells sometimes of different sizes and levels such as *Helicostylis tovarensis* and *Brosimum*. Cuticle striation showed variation and characteristic features within genera as in *Broussonetia* and *Ficus* (Figs 1-8). All species examined have anamocytic stomata, except *Dorstenia* where they are mainly anisocytic and some anamocytic. GANGADHARA & INAMDAR (1977) recorded other forms in the family, such as actinocytic in *Artocarpus communis* and anisocytic and partly also heliocytic in *Dorstenia indica*. The stomata are mainly restricted to the lower surface of the lamina; in species of *Ficus* they tend to be arranged in groups between the projecting network of veins on the abaxial surface. The stomata are usually superficial but may be sunken (Figs 17, 19). Trichomes are present in many members of the family (SHAH & KACHROO 1975).
Leaf anatomy in the family Moraceae

Leaf anatomy in the family Moraceae

Glandular trichomes are present in all genera and are uniformly unbranched, either with a spherical 1-2-celled head, as in Monus, or with forms of discoid 1-4-8-celled heads, as in other genera. Non-glandular trichomes are mostly unicellular and predominantly unbranched. They may be long and dense, covering both surfaces (Fig. 13, 14). Variations in the shape of trichomes sometimes provide diagnostic character for the identification of genera and species, e.g. prickle hairs with a swollen base sunk in the mesophyll and usually containing a cystolith are characteristic feature in Ficus species.

Anatomically, all the genera examined have certain characteristics in common: presence of solitary crystals or druses in the mesophyll, vascular bundles in one row, mesophyll dorsiventral, palisade tissue usually in one to two layers of tall cells, but in Dorstenia unique with short, distinctively lobed cells. The distribution of laticifers in Moraceae has been discussed for many years by various authors; VAN VEELENDAAL & DEN OUTER (1990), BRUMMITT (1992) and TAKHTAJAN (1997).

Acknowledgement

The authors thank Dr. M. Assadi [Research Institute of Forests & Rangelands herbarium (TARI), Tehran, Iran] for material and assistance and the director and staff of the Royal Botanic Gardens, Kew, for providing facilities and materials from the living collections and herbarium. Thanks are also due to colleagues in the Jodrell Laboratory (Kew) for useful discussions.

Appendix, Taxa examined

Nos 1-21 are from living material at Kew, the rest from herbarium material at Kew (K) and Iran (TARI).

Species and Kew accession Nos in the Botanic Gardens, Kew (living plants):

1. Artocarpus heterophylla Linn. 1986-2200.
Leaf anatomy in the family Moraceae

12. Ficus carica L. 433-794628.

Herbarium materials:
25. Artocarpus rigidus Bl. ssp. rigidus. Indonesia, K. Siddartha 442.
34 *Dorstenia foetida* (Fossa.) Schweinf. & Engl. Oman, Dhofar Province. A. Radcliffe-Smith (K).
36 *Fatoua Pilosa* Gardich. Australia. C.R. Dunlop 7897 (K).
37 *Fatoua villosa* Hawai (cult.). Joel Lau 2403 (K).
38 *Ficus benghalensis* L. Iran. Hormozgan, Bandarabas, Assadi & Mozaffarian (TARI) 47150.
39 *Ficus benghalensis* L. Arabia, Dhafran. J.S. Ingham 304 (K).
40 *Ficus carica* L. Turkey, Erzinm. Davis 47643 (K).
41 *Ficus carica* ssp. *Afghanistanica*. Iran, Khuzistan. Assadi & Nikchehrnehe 76365 (TARI).
42 *Ficus carica* ssp. *carica*. C. Iran, Kashan. Bateoli 76576 (TARI).
43 *Ficus carica* ssp. *carica*. C. Iran, Kashan. Bateoli 76575 (TARI).
46 *Ficus carica* ssp. *rapaestris*. Iran, Chaharmahal-o Bukihtari, V. Mozaffarian 57605 (TARI).
47 *Ficus carica* ssp. *rapaestris*. Iran, 21 km N. of Tehran, Kan, Amin & Baziargan 18538 (TARI).
48 *Ficus aff. carica* ssp. *rapaestris*. Iran, Kashan. Bateoli 76577 (TARI).
49 *Ficus carica* var. *rapestris* Hausskn. Iran, Dorud-Sefiddashat, Z. Rowshan 9741 (TARI).
50 *Ficus carica* var. *rapestris*. N. Iran. Rezaieh, Sabeli 7601.
51 Ficus carica var. rupestris. Iraq, Penjwin, Al Kaisi & K. Hamid 43519 (K).
52 Ficus johannis Boiss. ssp. afghanistanica (Warb.) Browicz. S. Iran, Kerman, Sotboli 1001 (TARI).
53 Ficus johannis Boiss. ssp. afghanistanica. S. Iran, Fars, Assadi & Abukamzeh 46582 (TARI).
54 Ficus johannis ssp. johannis. Iran, Kazeroon, Davis & Bokhari 55862. Syn.: Ficus geranifolia Miq. (K).
58 Helicosyly scabra. Brazil, Amazonas, C.A. Cid et al. 8463 (K).
60 Helicosyly inovarensis (Kloizsch & Karsten) C.C. Berg. Ecuador, NAPO, Archidona, Walter Palacios & E. Freire 5092 (K).
62 Maquira coriacea (Karst.) C.C. Berg. Brazil, Humaitá to Porto Velho Rd. Prance, Pena & Ramos 3514 (K).
64 Mesogyne insignis Engl. Tanzania, S.T. Iversen & M. Steiner 86787 (K).
65 Morus alba L. Iran, Esfahan. Assadi & Azizian et al. 97-4 (TARI).
66 Morus alba L. Iran, Esfahan. M. Usofi 1861 (TARI).
67 *Neuclepsis gilbra* Baill, Brazil, Aripuana, near Humboldt Center. Prince, Berg. Bisby et al. 18241 (K).
68 *Parartocarpus venenosus* Becc. Indonesia, N. Sulawesi, J.S. Burley, Tüküre et al. 3686 (K).
69 *Perebea xanthochyma* Karsten, Costa Rica, Aiguaigua, Karsten Thomsen 191 dupl. 4 (K).
70 *Pausieia armata* (Miq.) Standl. British Honduras W.A. Schipp 1154 (K).
71 *Praecoea pupana* Becc. Papua New Guinea, J.R. Crot et al. 68819 (K).
72 *Pseudoimis laevis* Tréc. Venezuela, Merida. J. de Brujin 1504 (K).
75 *Soroceca guilleminiiana* Gaud. Brazil, State of Pará. Daly, Taylor, Rosário & dos Santos 1677 (K).
76 *Soroceca saveocarpa* Lanj. & Boer, Ecuador, Esmeraldas, T.D. Pennington, L. Veloz et al. 14150 (K).
77 *Sparattosyce dioica* Bur., New Caledonia. H.U. Stauffer 5774 (K).
79 *Streblis glaber* (Merr.) Corner. Sarawak. Carlo Hansen 545 (K).
80 *Streblis taxoides* Malaya. Kochurnen 32521 (K).
82 *Treculia madagascariana* N.E. Brown, Madagascar. L.J. Dorr 3560 (K).
83 *Trilepisium madagascarnense* DC. Nigeria. Chapman 3837 (K).
84 *Trymatoceccus alligandrus* (R. Ben.) Lanj. Surinam, S. Mori & A. Bohlen 8457 (K).
85 *Trymatoceccus amazonicaus* P. & E. Brazil, Rio Vapues. M.L. Kawasaki 180 (K).
86 *Trymatoceccus paraensis* Ducke. S. America, Nassau. J. Lanjou & J.C. Lindeman (K).
References


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DIFFERENT TYPES OF FOLIAR TRICHOMES
IN THE FAMILY BORAGINACEAE

F. ZARINKAMAR
Tarbiat Modares University, Tehran, Iran

Abstract

The objective of this study, is description of different types of trichome in Boraginaceae. The foliar trichome of certain members of Boraginaceae including Anchusa ovata, Asperugo procumbens, Buglossoides arvensis, Heliotropium ellipticum, Lappula barbata, Myosotis sylvatica, Onosma dichroanthum, O. microcarpum and Symphytum asperum are studied. In Boraginaceae, trichome as epidermal attachments have various shapes, structure and function such as protect and support the leaf. A trichome is formed by single- or multi-celled, branched or unbranched, living or dead. Trichome as observed in Boraginaceae includes four types: a) simple unicellular short trichome (Anchusa ovata), b) bicellular simple trichome which is unbranched and cystolith commonly present at the bases of the trichome surrounded by 1-3 layers of subsidiary cells (Asperugo procumbens, Heliotropium ellipticum), c) multicellular, which trichome is extremely large (O. microcarpum), and d) glandular, multicellular trichome consists of two or three stalk cells, and a terminal more or less spherical gland cell (Symphytum asperum). The function of trichome within Boraginaceae is also evaluated in this study. Rough trichome such as cystolith-like trichome in above-mentioned species, decreases air movement on the leaf surface and creates a zone of still air through which water vapor diffuses when moving from the leaf interior to the relatively dry air of the surrounding atmosphere. This is also avoiding transpiration losses by influencing the
water diffusion boundary layer of the transpiring leaf surface. It is well known that plants from dry habitats possess progressively more pubescent leaves or densely covered with trichome (Onosma dichroanthum and O. microcarpum). In addition to directly influencing transpiration, trichomes may also indirectly influence water economy of plants through temperature regulation.

**Key words:** Boraginaceae, Trichome, Cystolith, Adaptation, Arid area

**Introduction**

Anatomical aspects of plants have been studied by taxonomists and enormous information is accumulated. Studies of pollen, wood, leaf, epidermis, cuticle, trichome and stomatal types in different species provide extensive taxonomic data. Anatomy of trichome has immense significance in classification at all levels, from the circumscription of families down to the separation of species and even varieties. The results of various foliar trichome have played a big part in the modern classification of the family at all levels. One of the objectives of this study is to evaluate the systematic relevance of their diversity as compared to recent findings of systematic relationships within the family in particular phylogenetics. Trichomes are appendages of diverse form, structures and function. Anatomy of trichome has immense significance in classification at all the levels, from the circumscription of the family down to the separation of species and even varieties (STACE 1980). Trichomes as epidermal attachments have various shapes, structures and functions such as protecting and supporting the leaves, producing glands in the form of scales, different papilla and, in roots, often absorbing hairs. Often a trichome is formed by just one cell though sometimes several cells are involved. The results of various foliar trichomes have played a big part in the modern classification of the family at all levels (HILGER et al. 2004). The aim is to evaluate the systematic relevance of their diversity as compared to recent findings of systematic relationships within the family in particular phylogenetic.

The Boraginaceae are herbs, shrubs or trees, perennial, biennial, or annual comprising of nearly 156 genera and 2500 species, including 67 endemic species, distributed throughout the tropical, subtropical, and temperate regions of the world
Different types of foliar trichomes in the family Bonaginaceae

(ZHU et al. 1989). That have simple leaves are, mostly entire, and alternate; stipules are lacking, characterized by leaves with rough trichomes.

Materials and Methods

Nine species from seven genera of Bonaginaceae were collected from different localities. The epidermal from both the abaxial and adaxial surfaces of the leaves by conventional methods is studied. They were fixed in FAA (formalin, acetic acid, alcohol) and stained with safranin. The stained slides were examined under the light microscope. Various anatomical features including shape of trichomes were studied. The list of species under study, their localities and altitudes as well as their herbarium accession numbers as follows and the herbarium specimens are preserved in "TARI". The nomenclature for the species given is based on Flora Iranica. The species under study are as follows:

Anchusa ovata Lehm. - Heidarkanloo, 1300 m, nafy, 1514.

Asperugo procumbens L. - Arasbaran, Aghdash to Mazegar, Daier area, 2300m, 81282.

Buglossoides arvensis (L.) Johnston- Azerbaijan, larkosh, 2110 m, NE, ?

Heliotropium ellipticum Ledeb. - Azerbaijan, Between Veinagh and Gheghalou, 500-800 m, 20543.

Lappula barbata (M.B.) Gurke- Arasbaran, Tohia-Ali, 650 m, 24943.

Myositis sylvatica Ehrh., ex Hoffm. - Azerbaijan, Aghdash, Mazegar, 2300 m, 81338.

Onosma dichroanthum Boiss. - Arasbaran, Toopkhaneh, 450 m, 81816.

Onosma microcarpum DC. - Azerbaijan, between Hejirandust to Makidi, 1400-1750 m, 20184.

Symphytum asperum Lepsch. - Azerbaijan, Doghoon mountain, 2500-2800 m, 24036

Observation

Anchusa ovata characterized by scales trichome curved outwards at the tip. Simple unicellular, unbranched, short cystolith trichome present on both leaf surfaces (Fig. 1 D).
Fig. 1. A-G: Surface view of adaxial epidermis showing trichomes of the Boraginaceae. A-B. *H. ellipticum*, C. *Asperugo procumbens*, D. Cystolith-like structures in the hairs of *Anchusa ovata*, E-G. *O. microcarpus*. A-C (×75), B (×150), D (×300), E-G (×30).

Both leaf surfaces in *Asperugo procumbens*, *Heliotropium ellipticum* and *Myosotis sylvestris* are more or less densely covered with different types of multicellular, uniseriate, simple trichome forming an indumentum of variable texture and density. Each trichome includes enormous circle basal cells accompanied by distal with curve or straight encrusted by crystal (Fig. 1 A, B & C).
Different types of foliar trichomes in the family Boraginaceae

Trichomes in *Asperugo procumbens* vary in size, from extremely long to medium size and extremely short (Figs 1 C & 2 B). All are found on either side of the lamina, especially on veins, leaf margins, and petioles. On veins the trichomes are often enlarged and the trichome type is indistinct but with different density. Multiseriate simple and glandular trichome lack completely. Sometimes there are gradual transitions between trichome. For an unambiguous determination of the trichome type THEOBALD *et al.* 1979, and HARRIS (1994) have presented key for all types found in the family.

Simple unicellular, unbranched, short trichomes are observed on both leaf surfaces of *Buglossoides arvensis*, while abaxial surface is more pubescent. Glandular trichome is absent.

Both leaf surfaces in *Onosma dichroanthum* and *O. microcarpum* are variably pubescent. Trichome includes three types: a) simple unicellular short trichome, b) bicellular simple trichome, unbranched and cystolith commonly present at the bases of the trichome with 1-3-layered, multicellular, which extremely large (Fig. 1 F & G); c) glandular, multicellular trichomes consist of two or three stalk cells and a terminal more or less spherical gland cell (Fig. 2 G).

In *Symphytum asperum*, both leaf surfaces are highly pubescent including three types of trichomes: a) simple trichome is extremely short and seen at the top in the shape of a hook (Fig. 2 A), b) simple trichome in medium long with curve at the top (Fig. 2 F), and c) glandular trichomes with multicellular stalk and oval heads (Fig. 2 H).

**Discussion**

The presence of trichomes on leaves and young stems, help adjust the microclimate on the surfaces by reflecting solar radiation and prevent evaporation of critical water supplies. The frequency and duration of water on leaf surfaces have effective consequences for plant growth and photosynthetic gas exchange which is important as an adaptation to arid condition (FAHN 1992).
Leaf trichomes reduce the area of leaf surface covered by moisture. Ecophysiological importance is suggested by correspondence between leaf surface, wettability and habitat (BREWER et al. 1997). Trichome can be found at plant surfaces in manifold shapes, can be single- or multi-celled, branched or unbranched, living or dead. Commonly different combinations in the morphological characters mentioned above, when matched by well-defined geographical and ecological patterns, lead to the delimitation of the species (SELVI et al. 2003). Many trichomes, particularly rough ones as observed in Boraginaceae, help avoiding
transpiration losses by influencing the water diffusion boundary layer of the transpiring leaf surface. Rough trichomes such as cystolith-like trichome in abovementioned species, decrease air movement the leaf surface and creates a zone of still air through which water vapor diffuses when moving from the leaf interior to the relatively dry air of the surrounding atmosphere (WOOLLEY 1964). It is well known that plants from dry habitats possess progressively more pubescent leaves or densely covered with trichome. In addition to directly influencing transpiration, trichome may also indirectly influence the water economy of plants through temperature regulation. Dense trichome layer substantially increase leaf reflection for all wavelengths of solar radiation between 400 and 3000 nm and reduce radiation absorptions, which results in the reduction of heat load (EHLEINGER 1984). Based on the microscopic analysis in Boraginaceae trichomes, the leaf reflection is increased because of oxalate calcium incrusted in their wall.

The microscopic analysis of samples also shows cystolith-like and dead trichome cells offer three advantages as suggested by BARTLETT (1997).

The lumen of dead cells is air-filled. It gives them a silvery-whitish appearance. A large proportion of the incoming light is thus reflected. A thick layer of wax has the same effect. Only weak circulation takes place at the leaf surface, thus reducing water loss to a minimum. Death of the trichome cells reduces the surface area, where water could be lost drastically. If the cells are living, a high water loss would occur due to the largely increased surface of the branched hair cells.

Dead trichomes (cystolith) and glandular trichomes in Boraginaceae are hypothesized to increase plant resistance to herbivores. They have also specifically evolved to act as defense mechanisms. Such strategy assists the growth and self conservation of this family in xerophytic condition. In this family, the wall incrusted by oxalate calcium enforced rigidity of trichomes and protect plant from animals by making its tissue less edible or hospitable to feeding and breeding insects.
Reference


Address of the author: Dr. F. ZARINKAMAR, Department of Plant Biology, Faculty of Basic Sciences, Tarbiat Modares University, Tehran 14115-175, Iran. (E-mail: zarinkamar@modares.ac.ir)
ONOSMA KHORASSANICA, A NEW SPECIES FROM NORTHEAST OF IRAN

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Abstract

*Onosma khorassanica* is described from Khorasan Province and compared with its related taxon. Its illustration is also presented herewith.

**Keywords:** *Onosma*, New species, Iran

Introduction

*Onosma* L. has about 100 Mediterranean and Irano-Turanian species in the wideworld (SHISHKIN 1974). This genus with 50 taxa (including 17 endemic species) is the one of the largest genus of Boraginaceae in Iran. (REIDL 1948, GHAHREMAN & ATTAR 1999, KHATAMSAAZ 2002). *Onosma* is divided in two large groups based on the bristles with tubercle at the base that can be glabrous or hairy. *Onosma khorassanica* with glabrous tubercle of bristles is inserted in the first groups. The nearest species to the *O. khorassanica* is *Onosma azureum* that is distributed in Middle Asia. The corolla color in both species is sky blue that is rare color in the species of on *Onosma* in Iran and Middle Asia. Also habit of them is very similar by bluish stem, crowded cymes, calyx lobes and spreading lanceolate leaves.
Onosma khorassanica Attar & Juharchi, Sp. Nov. (Fig. 1)

Perennial, multicaule, usque ad 30 cm alta, bari lignosa, caules numerosi, lani relictis siccis foliorum enanctiorum, setis erectibus tuberculatis et pubibus brevibus tuberculatis vestiti. Folia basalia spatulata, lasin versus attenuata, breviter petiolata, usque ad 20 mm longa et 6 mm lata, folia caulina ca 25 mm longa, lanceolata, sessilia. Basii cuneata vel leviter rotundata; folia omissa margin convexit. Inflorescentia scorpioidaea, terminalis, primo subcapitata, demum paulo elongata. Bracteae lanceolatae vel triangulares, acutae, 12 mm longae et 4 mm latae, Pedicelli floriferi 4 mm longi, fructiferi usque ad 6 mm accrescentes. Calycos ± 18 mm longi, dense setosi, satis albis, rigidis patentibus. Corolla 21 mm longa, primo azurea, demum brunea, infundibularis glabra, lobis 5, triangularibus, suberectis vel revolutis, 3 mm longis, 2.5 mm latis. Antherae 9 mm longae, basibus cohaerentibus, apice sternali 0.5 mm longo dentatae. Anulus nectarifer glaber, lobatus. Filamento basi versus paulo dilatata. Stylus corollae longior. Nucliae usque ad 6 mm longae.

Perennial, multistemmed, up to 30 cm high, woody at base. Stems, numerous, covered by erect dense tubercled bristles, with short small erect tubercled hairs, with dried remains of primary leaves at base. Basal leaves, spatulate, attenuate toward base into short petiole, up to 20 mm long and 6 mm wide, stem leaves ca. 25 mm long and lanceolate, sessile, acute, cuneate or slightly rounded at base, all leaves recurved at margin, with long dense tubercled bristles in upper surface, with short small erect or spreading hairs between bristles, lower surface with tubercled bristles only on midrib, limb with sparse erect hairs; tubercles completely glabrous. Inflorescence crowded scorpioid cymes. Bracts lanceolate, 12 long and 4 mm wide, with dense erect tubercled bristles in both surfaces. Pedicel 5-6 mm long. Calyx free up to base, lobes linear, 18 mm long and 1.5 mm wide, with dense white bristles at the base and along length. Corolla 21 mm long, sky blue, infundibular, glabrous outside lobes broad triangular, 3 mm long and 2.5 mm wide. Filament oblong; anthers ca. 9 mm long, inserted at middle of length of corolla, sterile part longly exceeding the corolla. Nectary glabrous. Nutlets ca. 4 mm long, ovate, gradually tapering to apex into a long beak, slightly wrinkled, with smooth surface.
Onosma khorassaniea, a new species from Northeast of Iran

Type: Khorasan Province: Hezar Masjed mountain, west of Dar-e Gaz, 1000 m, Joharchi & Zangui, 6.5.1988 (16398-FUHM holotype).

Fig. 1. Onosma khorassaniea: A. Habit, B. Calyx and corolla, C. Stamens, D. Calyx, E. Lower surface of leaf, F. Upper surface of leaf, G. A part of stamen with bristles, H. Tubercled bristles and hairs, I. Sterile part of anther.
Affinities: *Onosma khorassanica* is very closed to *O. azuréum* but differs from it by following characters: bristles erect or spreading (not appressed); leaf up to 2.5 cm long (not 4-5 cm long); calyx 18 mm long (not 12-15 mm long); corolla 21 mm long (not 23-27 mm long); anthers exerted (not include); nectary glabrous (not hairy); nutlets with smooth surface and long beak (not tubercled and acute).

Acknowledgment
Authors wish to thank Mr. M. Mehranfard for preparing the illustration.

References


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A NEW CHROMOSOME BASE NUMBER IN
ERYSIMUM (CRUCIFERAEE) STATED IN
E. SISYMBRIOIDES FROM IRAN

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Naturhistorisches Museum, Botanische Abteilung, Wien, Austria

Abstract
For Erysimum sisymbrioides from Iran, the chromosome number 2n=10 is stated. The base number x=5 has been found for the first time within the genus Erysimum. Another count for E. sisymbrioides from Afghanistan shows 2n=18. It is not possible to distinguish these collections morphologically. For E. griffithianum 2n=16 is stated for the first time and for E. repandum 2n=16 is confirmed.

Key words: Flora of Iran, Cruciferae, Erysimum, E. griffithianum, E. repandum, E. sisymbrioides, E. huber-morathii, Chromosome counts, Chromosome base number

Introduction
Chromosome numbers are an important character within the genus Erysimum. Seeds of specimens allowed the investigation of Iranian populations of E. sisymbrioides, E. repandum and E. griffithianum.

Materials and Methods
Seeds have been germinated on quartz sand and fixed in ethanol-acetic acid (3:1). The chromosomes have been stained with carmine acetic acid.
Results and Discussion

*Erysimum sixnbiroides* C.A. Mey. belongs to a closely related group of annual members of the genus (POLATSCHEK 1968b). Three of the four species, *E. repandum* L., *E. griffithianum* Boiss., and *E. sixnbiroides* C.A. Mey., their distinguishing characters and distributions have been discussed in POLATSCHEK (1968a). *E. huber-morathii* Polatschek was described later (POLATSCHEK 1985).

*Erysimum griffithianum* and *E. huber-morathii* have the chromosome number 2n=16 (x=8). For *E. repandum*, many published counts in Europe give 2n=16 (x=8). This chromosome number is confirmed for Iran (Table 1).

### Table 1. Chromosome numbers and relevant specimens

| **E. sixnbiroides** | **Iran:** Fars, Abadeh, Eghlid, Azadehgan, 6.6.1969, Termé & Izadyar; 34358E (W 1976-14216, IRAN) - (Fig. 1a). Additional plants, cultivated from seeds in the Alpengarten Belvedere (W 1977-13911, W 1977-13912) | 2n=10 |
| **Afghanistan:** Badakhshan, Rukhui-Tal, an der Mündung des Sitan-Tales, 3750 m, 16.9.1965, D. Podlecki 12782 (W 1966-244419) - (Fig. 1b). POLATSCHEK 1968 | 2n=18 |

| **E. griffithianum** | **Iran:** Kerman, Rafsanjjan-Khenamun, 60 km von Rafsanjjan entfernt, Gnil-Salar, 2.5.1977, H. Riedl & D. Ershad 37072 (W 1978-19777) - Additional plants, cultivated from seeds in the Alpengarten Belvedere (W 1978-12981, 1983-08621) | 2n=16 |

| **E. huber-morathii** | POLATSCHEK (1985) | 2n=16 |

| **E. repandum** | Many published counts for Europe | 2n=16 |
| **Iran:** Kermanshah, Shalan-Dalahou, 1020-1800 m, 25.7.1967, Iranshahr & Termé 31829 (W 1976-02772, IRAN) - Additional plants, cultivated from seeds in the Alpengarten Belvedere (W 1976-14342) | 2n=16 |
| **Iran:** Kermanshah, Shalan-Dalahou, 1020-1800 m, 25.7.1967, Iranshahr & Termé 31829 (W 1976-02772, IRAN) - Additional plants, cultivated from seeds in the Alpengarten Belvedere (W 1976-14342) | 2n=16 |
| **Iran:** N. Shiraz, Pasargad, 27.3.1978, H. Zbuzek (W 1978-19879) | 2n=16 |
A new chromosome base number in *Erysimum* (Cruciferae) stated in...

An earlier count for *E. sisybrioides* (POLATSCHEK 1968a) showed 2n=18 (x=9) [On the label of this collection in MSB is a note “2n=14-16” by DIETERLE (unpublished). It was not possible to check this divergence of results with the available material].

The new count for *E. sisybrioides* shows 2n=10. Though the chromosome numbers of the Iranian and Afghanistan plants differ, it is not possible to distinguish them morphologically. Both populations have to be referred to *E. sisybrioides*.

The new chromosome count for *Erysimum sisybrioides* with 2n=10 is a very surprising result. This is a new base number within the genus. Only the base numbers 6, 7, 8, and 9 have been reported till today. Because of this outstanding and surprising result, this count was controlled independently by Dr. W. Tutz (1941-1983, Institute of Botany, University of Vienna) in 1980. Since that time, this result waited for publication in the hope for additional material to get an idea, how the different chromosome numbers within *E. sisybrioides* are correlated with the distribution area.

References


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TWO NEW SPECIES OF THE GENUS ALLIUM
(ALLIACEAE) FROM IRAN

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University of Tehran, Tehran, Iran

Abstract

Allium autumniflorum F.O. Khass. & Akhani and A. uchadense F.O. Khass. & Noroozi are described as new species from Iran. The first species was collected in rocky habitat from N.E. Iran near Maraveh Tappeh (Golestan Province). The affinity of the species is not clear and because of extending of leaf sheath to the umbel, probably belongs to sect. Longivaginata. The second species was collected from alpine and subalpine meadows of the Tuchal mountains in N. Tehran. It belongs to subgen. Allium, sect. Pallasia (Tzagh.) F.O. Khass., R.M. Fritsch et N. Friesen. The habitat and phytogeographical importance of both species are discussed with their living images and distribution map.

Keywords: New records, Allium, Alliaceae, Iran

*Corresponding author
Introduction

The genus *Allium* is a large genus with ca. 750 species classified into more than 50 subgenera, sections and subsections (GREGORY et al. 1998). The Flora Iranica area is one of the major centers of diversity of this genus. Altogether, 139 species have been accounted for this genus from the Flora Iranica area out of which 74 species are recorded from Iran (WENDELBO 1971). After publication of Flora Iranica, several other new species/records have been added for the Iranian flora (FRITSCHE 1996, FRITSCHE & KHASSANOV 2002, FRITSCHE et al. 2001, MATIN 1980, AKHANI 1999, SEISUMS 2000 etc.).

Recently, the senior author visited Iran to study the genus in the field and in the herbarium of Ferdowsi University of Mashhad (Mashhad) and the private herbarium of H. Akhani (Tehran). Our joint studies resulted distinguishing of two new species. The holotypes of these species are preserved in the herbarium of Iranian Research Institute of Plant Protection (IRAN) and the isotypes in the herbarium of Institute of Botany, Tashkent (TASH) and H. Akhani’s private herbarium.

*Allium autumniflorum* F.O. Khass. & Akhani sp. nov. (*subgen. Allium*)


Bulbus 1-1.5 cm in diametro, ovoideus, tuniceis externis coriaceis pallide griseis. Bulillii ut videtur nulli. Scapus 20-30 cm altus, usque ad apicem glaber vaginis foliorum involutis. Folia 4, quam scapus brevior, quarrant 2 mm latum, 3-4 cm longum, cylindricum, fistulosum. Spatha circa 5 mm longa, bivalvis, persistentia. Umbella hemisphaericat, multiflora. Pedicelli subaequilongi 10-20 mm longi, ebracteolati. Perigonium cylindrico-campanulatum, albidum nervis brunneis. Tepala 4-5 mm longa, anguste elliptico-oblonga, obtusa apice attenuata. Filamenta simplicia, circa 4 mm longa. Antherae infuscatae. Stylus inclusus. Capsula 3.5 mm lata, valvis obovatis.

Species affinitate incerta.

Habitat in Persia boreali.
Two new species of the genus *Allium* (Alliaceae) from Iran

Bulbs ovate, 1.1-1.5 cm in diameter, with greyish coriaceous outer tunics. Bulblets probably absent. Scape 20-30 cm long, over the whole length covered by leaf sheaths. Leaves 4, shorter than scape, the last one 2 mm thick, 3-4 cm long, glabrous, cylindrical. Spathe 5 mm long, bipartite, persistent. Inflorescence subglobose, many-flowered. Pedicels of nearly equal length, 10-20 cm long, without basal bracts. Flowers narrowly campanulate, whitish with brown midvein. Tepals 4-5 mm long, narrowly oblong, the tip acute, recurved. Filaments simple, triangular, 4 mm long. Anthers brownish. Style included. Capsule 3.5 mm in diameter, valves cordate.

This species is unique because of very late flowering time (October). According to its general habit, *A. autumniflorum* probably belongs to subgen. *Allium* sect. *Longivaginata* (Kamelin) F.O. Khass., R.M. Fritsch et N. Friesen sharing leaves extending to the inflorescence with *A. longivaginatum* Wendelbo and *A. petri* F.O. Khass. et R.M. Fritsch (Fritsch & Khassanov 2002). The new species differs from other species of subgen. *Allium* in general habit as well as form of flowers, filaments, nectaries and capsules. The habitat of the species was on dry stony ground beside a small *Rhamnus pallasii* shrub. Phytogeographically, this species belongs to Khorassan (Kopetdagh) Province of Irano-Turanian area. This is an additional late flowering endemic species in the area such as *Eriocycla ghafooriana* Akhani, *Seseli tortuosum* L. subsp. *klabinii* Akhani and *Johonnia golestanica* Rech. f. (Akhani 1998).


Other specimens examined: Tehran, Tuchal mountains, Isagh-e Haft (7th Telecabin Station), 3700-3800m, 2-8.2003, J. Noroozi 235 (Hb. Akhani), Ibid. 4.8.2005, 3700 m, Noroozi 980 (TASH, Hb. Akhani).

Bulbus 1-1.5 cm in diameter, tunicae exterioribus papyraceis, atrocinereis. Bulbili nulli. Scapus 10-20 cm altus. Folia 2-3. scapo pleurisque breviora, canaliculata, filiformia. Spatha 0.5 cm longa, bivalvis, persistenta. Umbella
sphaerica, multiforma, dense. Pedicells circa 1 cm longi, basi bracteolati. Perigonium campanulatum. Tepala 2-2.5 mm longa, lucide-rosea, nervis violascensibus percursum, late lanceolata, obtusa. Filamenta 3-3.5 mm longa, lucide-rosea, basi connata et tepalis adnata, triangulari subulata. Antherae purpureae. Stylus exsertas. Capsula valvis circa 2.5 mm longis, ochordatis. Ab Allio capitellato tepalis brevioribus et floribus lucide-roseis differt.

Habitat in montibus Tuchulensis (Alborz centralis, Persia borealis).

Bulbs 1-1.5 cm in diameter, with dark greyish papery outer tunic. Bulblets absent. Scape 10-20 cm long. Leaves 2-3, shorter than scape, thread-like, cylindrical. Spathe 0.5 mm long, bipartite, persistent. Inflorescence globose, many-flowered, dense. Pedicels about 1 cm long, with basal bracts. Flowers campanulate. Tepals 2-2.5 mm long, pinkish with violet midvein, widely lanceolate, obtuse. Filaments 3-3.5 mm long, pinkish, triangular, at the base united with themselves and the tepals. Style exserted. Capsule 2.5 mm in diameter, valves cordate.

This species clearly belongs to sect. Pallasia because of the general habitat as well as form of tepals and filaments. Allium capitellatum Boiss. and A. tuchulense are the most western representatives of this group, growing on the high altitude alpine meadows.

According to present knowledge, A. tuchulense is known from alpine area of Tuchul mountains (Central Alborz, N. Tehran) at altitude ranging from 3600 to 3800 m. As it occurs in most of plant communities in the area, its occurrence is most likely in other surrounding alpine area. This species occurs in many of the xerophytic communities to alpine snow bed. Most of these communities belong to the class Oxytropideetum persicae Klein (KLEIN 1994). It was found in some alpine communities such as Jurinellellum frigidae association, Acanthohimum-Onobrychis cornuta community (Acantholimo-Onobrychidetum cornutae unpublished) and Crepis heterotricha community (Crepietum heterotrichiae unpublished). In Table 1, a selection of 14 phytosociological relevés are given in the Oxytropideetum persicae.
Two new species of the genus *Allium* (Alliaceae) from Iran

Fig. 1. A. *Allium autumniflorum*, B. distribution map of *A. autumniflorum* (dot) and *A. tuchalense* (triangle), C. *A. tuchalense*, D. The view of Acantholimon-Oxybrychis comata community, habitat of *A. tuchalense*.

Furthermore, the new species was found in the communities of *Cousinia multiloba* (*Cousinia multiloba*e unpublished) which intermingle communities of *Cataarosella parviflora* and *Trachydiyum depressum* (*Cataarosella parviflora* and *Trachydiyum depressum*; Table 2). In the *Cataarosella parviflora* communities, it is restricted to *Allium tuchalense-Tragopogon kotschyi* community (*Allio-Tragopogon kotschyi* unpublished). This community is covered by snow until the late June. The most dominant species of this community is *Astragalus iodoaepis* Boiss. & Hohen. with a vegetation cover up to 70%. The most characteristic species of this habitat are: *Tragopogon kotschyi* Boiss., *Astragalus iodoaepis* Boiss., *Cousinia crispa* Jaub. & Spach, *Helichrysum psychrophilum* Boiss., *Taraxacum brevirostre* Hard-Mzt., *Cataarosella parviflora* (Boiss. & Buhse) Alexeev ex R.R. Mill., *Polygonum serpyillum* Jaub. & Spach, *Draba pulchella* Willd., *Scorzonera meyeri* (C. Koch.) Lipsch., *Fipiptherum laterale* (Regel) Roshev., *Bromus tomentosus* Tris. and *Silene acrieriana* Boiss.

The flowering time of *A. tuchalense* is usually from mid July to early August with the earliest in *Juriniietum frigidae* and the latest in *Astragalo-Cousiniion crispa* communities.

The most important factors which threat this species and many other species in the area are trampling and disturbances caused by high number of people who come for picnic and sport using the cable car (Telecabin) and animal overgrazing. Usually, the areas is over-crowded during the weekends and extremely over-grazed during July to August.
Table 1. A selection of 14 phytosociological relevés from *Oxytropideae persicae* communities in which *Allium tenuifolium* is associated.

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<th>708</th>
<th>954</th>
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<td>2.2</td>
</tr>
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</table>

| Allium tenuifolium | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Hordeum violacei | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Hordeum violaceum | 3 | 3 | 2 | + | + | + | + | + | + | + | + | + | + |
| Polygonum serpillococcum | 1 | 2 | 2 | 1 | 1 | + | + | + | + | + | + | + | + |
| Tejolia radicans | 3 | 3 | 3 | + | + | + | + | + | + | + | + | + | + |
| Helichrysea pyriformis | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Helichrysea pyriformis | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Silene aubertana | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Consolida multiflora | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Consolida multiflora | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Catanancha nudiflora | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Catanancha nudiflora | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Catanancha nudiflora | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Astragalus lobatus | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Astragalus lobatus | + | + | + | + | + | + | + | + | + | + | + | + | + |

| Acantholino-Oborzychidetum cornutae | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Oborzychidetum cornutae | + | + | + | + | + | + | + | + | + | + | + | + | + |

<p>| Oborzychidetum cornutae | + | + | + | + | + | + | + | + | + | + | + | + | + |</p>
<table>
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<th>Common in different habitats</th>
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<td>Elymus trachycaulus</td>
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<td>Pterygium laterale</td>
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</table>

Species with low frequency: Erigeron uniflorus (595: +); Gagea confusa (600: +, 669: 1); Ranunculus crymphylla (595: +); Herminium incunabula (600: +, 700: +, 702: +, 813: 1); Gagea sp. (655: 1); Minuartia reniglans (679: 1); Polygonum multiforme (840: 1, 679: 1, 592: 1); Gagea alexenokana (591: +).
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<td>270</td>
<td>295</td>
<td>270</td>
<td>45</td>
<td>270</td>
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<tr>
<td>Slope (degree)</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>10</td>
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<td>15</td>
<td>15</td>
<td>15</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Total cover %</td>
<td>90</td>
<td>75</td>
<td>70</td>
<td>75</td>
<td>65</td>
<td>55</td>
<td>75</td>
<td>80</td>
<td>75</td>
<td>70</td>
<td>70</td>
<td>80</td>
<td>80</td>
<td>85</td>
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<tr>
<td>Richness</td>
<td>9</td>
<td>14</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>13</td>
<td>12</td>
<td>13</td>
<td>13</td>
<td>10</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Shannon diversity index</td>
<td>1.6</td>
<td>2.1</td>
<td>1.8</td>
<td>1.9</td>
<td>1.8</td>
<td>1.8</td>
<td>2.1</td>
<td>1.8</td>
<td>1.7</td>
<td>2</td>
<td>1.3</td>
<td>1.8</td>
<td>2.1</td>
<td>2.1</td>
</tr>
</tbody>
</table>

**Table 2. Associated species and plant communities of Allium uchalerense based on 14 selected relevés of the alliance Astragalus-Coutinia crispae belonging to the order Cumbreselia parviflora.**

*Allium* uchalerense

| Species | 4 | 1 | 2 | 4 | 4 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

*Tragopogon luteus*

| Species | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**Astragalus-Coutinia crispae**

*Astragalus heiligenetis*

| Species | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 4 | 2 | 2 | 2 | 1 |

*Coutinia crispae* (Conspicuous)

| Species | . | . | 2 | 2 | 2 | 2 | 1 | 1 | 3 | . | 3 | 3 | 3 | 3 |

*Helichrysum pygmaeum*

| Species | . | 1 | + | 1 | + | 1 | 2 | 1 | 2 | . | . | 2 | 1 | . |

**Cumbreselia parviflora**

*Picea pungens brevifolia*

| Species | . | . | 2 | 1 | + | 1 | 1 | 1 | 1 | + | . | . | . | . |

*Cumbreselia parviflora*

| Species | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 |

*Pedicularis virginiana*

| Species | 3 | 2 | + | 1 | 1 | . | . | 1 | 1 | + | . | . | . | 1 |

*D machinery*

| Species | . | . | 1 | + | 1 | + | 1 | 1 | + | 1 | 1 | 1 | 1 | 1 |

*Scouleriana myrtifolia*

| Species | . | 1 | . | . | . | . | + | . | . | . | . | . | . | . |

*Populus latifolia*

| Species | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |

*Bromus inermis*

| Species | . | . | 1 | + | 2 | 2 | . | . | . | . | 1 | 1 | 1 | 1 |

*Allium uchalerense*

| Species | . | . | . | . | . | . | . | 1 | + | . | . | . | . | . |
Table 2. (cont’d.)

Species with low frequency: Gagea alexeenkoana (757: 1; 786: 1; 788: 1); Poa araratica (788: 1); Veronica hiratica (786: 1); Silene marshallii (642: 1; 788: 1); Cousinia multiloba (633: 1); Arenaria insignis (629: 1); Erigeron uniflorus (629: +, 636: +, 644: +, 788: 1); Gagea confusa (629: 1; 645: 1; 632: +, 758: 1); Ziziphus cinopoda (629: 1); Erysimum eaeptorum (636: +, 642: +); Erysimum lanatum (757: +, 758: 1; 766: 1) Gagea sp. (648: 1); Potentilla argyroloma (757: 1).

References


Two new species of the genus *Allium* (Alliaceae) from Iran


**Addresses of the authors:** Dr. F.O. KHASSANOVOV, Institute of Botany, Academy of Sciences, Tashkent, Uzbekistan; Dr. H. AKHANI (E-mail: akhani@khayam.ut.ac.ir) and J. NOROCZI, School of Biology, University of Tehran, P.O. Box 14155-6455, Tehran, Iran.
NOTES ON THE FLORA OF IRAN 6: EIGHT NEW PLANT RECORDS FROM IRAN COLLECTED FROM KHORASAN AND GOLESTAN PROVINCES (N.E. IRAN)*

M.R. JOHARCHI and H. AKHANI**
Ferdowski University of Mashhad and University of Tehran, Iran

Abstract
Based on recent collections from different parts of Golestan Province and former Khorasan Province (now splits into three smaller provinces), following species are reported for the first time from Iran: Acanthophyllum kandaharicum Gilli, A. stenostegium Freyn, Anemone tschernjaceaei Regel, Cephalorrhynchus picridiformis (Boiss.) Taul., Elatine hydropiper L., Gaillonia dubia Aitch. & Hemsl., Pseudosedum longidentatum Boriss., and Scrophularia nikitini Gorsch. Furthermore the occurrence of Leptaleum hamatum Hemsl. & Lace in Iran is confirmed. Notes are given on the taxonomy and distribution of most species and a line drawing illustration is provided for Cephalorrhynchus picridiformis and Scrophularia nikitini.

Key words: Flora of Iran, Golestan, Khorasan, Acanthophyllum, Anemone, Cephalorrhynchus, Elatine, Gaillonia, Leptaleum, Pseudosedum, Scrophularia

* Continued from GHORADNEJHAD et al. 2004, AKHANI 2000
** Corresponding author
Introduction

The Khurasan and Golestan Provinces with a surface area of 267,893 square kilometre covers 16.2% of the Iranian territory. Large parts of the area are consisted of Irano-Turanian floristic region which replaced by the Hycanian Province of the Euro-Siberian Region in North-western parts. Floristically, the area is very rich as was documented by the occurrence of 1362 species in Golestan National Park which is only 0.34% of the surface area of the two provinces (AKHANI 1998, 2005). Based on recent botanical collections by the staff of Herbarium of Ferdowsi University of Mashhad and during preparation of the second volume of “The Illustrated Flora of Golestan National Park” by the second author eight new records for Iran are recognized. The identity of most reported species in this paper have been checked during the second author’s visit to the Royal Botanical Gardens Kew. All specimens were deposited in Herbarium of Ferdowsi University of Mashhad (FMUH) and Herbarium H. Akhani, located in Ferdowsi University of Mashhad and University of Tehran, respectively.

Enumeration of species

Asteraceae

Cephalorhynchos picridiformis (Boiss.) Tuosl. Ann. Nat. Mus. Wien 72: 619 (1968) (Fig. 1)

Type: Pakistan: Quetta, Sir-i-ab, Stockes 1075 K!

Material examined:


This species was known as endemic in Afghanistan and neighbouring areas in Pakistan (Chitral and Quetta) (RECHINGER 1977). The new locality extends the range of species further westwards to eastern Iran. The identity of the above cited specimen was checked with the type specimen (Stockes 1075) and other identical specimens in Kew.
Fig. 1. The line drawing illustration of *Cephalothyneus pteridiformis* (Boiss.) Tuisl.
Brassicaceae

Type: Pakistan, Quetta, Sheila Bagh, 1800 m, Lace 3325 (R1).
Material examined:

This species was not known from Iran in Flora Iranica (RECHINGER 1968) and additions to the Iranian Cruciferae after Flora Iranica (AKHANI 2003). When this paper was in final preparation, we understood that *L. hamatum* is reported by MEHRNIA (2006) from a locality “between Esfahan to Shahr-eza, 32°26′08″N, 51°46′31″E, 1734 m, Mehrnia (5475 (n.v.).” The identity of above cited specimen was confirmed by comparing with the type specimen. *L. hamatum* differs from its relative *L. linifolium* by presence of glandlose hairs and hooked siliqua. The hairs in *L. linifolium* are branched and the fruits are not hooked at apex. In accordance with MEHRNIA (I.e.), the distinction of both species is well justified by constant characters.

Caryophyllaceae

Acanthophyllum kandaharicum Gilli, Feddes Repert. 59: 168 (1956)
Material examined:

This species with its characteristic broadly membranous bracts and bracteoles belongs to sect. *Macrostegia* Boiss. (SCHIMAN-CZEIKA 1988). It is characteristic by a number of characters such as having the same deep-green colour of leaves and stems, sparse and very short hairs in the stem but longer and denser hairs in the inflorescence and on calyx. The leaves are triquetrous in section, strongly rigid and arranged horizontally-patent and slightly curved upwards.

*A. kandaharicum* is an endemic species in S. Afghanistan with one reported locality in N. Pakistan (SCHIMAN-CZEIKA 1988). The species is newly recorded from Iran (Fig. 2).
Notes on the flora of Iran 6: Eight new plant records from Iran...

_Acanthophyllum stenostegium_ Freyn, Bull. Herb. Boissier Sér. 2, 3: 866 (1903)

Material examined:

A characteristic species with 4-5 cm long herbaceous leaves which are horizontally patent. The species differs from other species of _Acanthophyllum_ by loosely and herbaceous habit and umbel-like inflorescences.

Ecologically, it is restricted to sand dunes over its range from Turkmenistan (Kara-Kum desert). Afghanistan to Iran (Fig. 2). The previously known localities in Turkmenistan are located close to the Iranian border (SCHIMAN-CZEIKA 1988).

_Crasulaceae_


Materials examined:
Khonsan: S.E. Ghaen, between Dozq and Ahangaran, 1500 m, 15.5.1989, Jolantchi & Zangoeei 17363 (FUMH); Between Ghien and Gomahal, near Khezri, Pir-muntan Shah, 19.5.1986, Ayatollahi & Zangoeei 14385 (FUMH); S Birjand, Omar Shah dam (Band-e Omar Shah), 18.5.1986, Ayatollahi & Zangoeei 14301 (FUMH).

A first record from Iran; _Pseudosedum longidentatum_ is distinguished from the widespread _P. multicuicale_ by petals which are connate at 1/3 to the middle of corolla length. Geographically two species seem to be vicariant. The main distribution range of _P. longidentatum_ is Central Asia (Tien Shan, Parnir-Alaj) and Afghanistan (JANSSON & RECHINGER 1970).

_Elatinaceae_

_Elatine hydropiper_ L. Sp. Pl. 367 (1753)

Material examined:

An interesting discovery, being a new genus record for Iran and the Flora Iranica area (RECHINGER 1966). This is seventh aquatic new records which were

Ranunculaceae

*Anemone tscherinaevii* Regel, Acta Horti Petrop. 8: 690 (1884)


The finding of *A. tscherinaevii* in Iran is not surprising, as the species was commonly recorded in Afghanistan and from Kopet-dagh mountains in Turkmenistan near the Iranian border (Rechinger 1992, see also distribution map of species in ZIMAN et al. 1996, Fig. 1, p. 61). The species was also known from Tian Shan, Pamir, Altai and territories of Tadzjikistan, Uzbekistan and Pakistan (RECHINGER L.c., ZIMAN et al. L.c.).

The most important distinguishing features of this species from closely related *A. biflora* DC. are the ternate basal leaves which their segments are not deeply lobed but are shallowly crenate-dentate, radical leaves solitary, with sessile primary segments, and sessile involucral leaves (ZIMAN et al. 1996).

Rubiaceae

*Gaillonia dubia* Aitch. & Hemsl., Trans. Linn. Soc. Ser. 2, 3: 73, tab. 30 (1888)

Material examined:


This species was recorded as endemic from various localities in N.W. and West Afghanistan by EHRENDORFER & SCHONBECK-TEMESY (2005). The new locality from Iran is also not very far from localities in Afghanistan (Fig. 4). The species is characteristic with 3-4,5 cm internodes, mostly 3-nu leaves, which are 17-23 mm long and 1-2 mm broad and pedicellate basal flowers.
Scrophulariaceae

*Scrophularia niktini* Gorsk., Not. Syst. Leningrad 16: 333 (1954) (Fig. 3)

Material examined:

*Scrophularia niktini* Gorsk. is easily distinguishable by broad ovate and petiolar leaves which are slightly dentilicate at the margin (Fig. 3). The species shows a habit like *Digitalis* with a spike-like inflorescence. The flowers are green with equal lobes and capsules are glabrous.

The species was originally known from Turkmenistan, Bashk., Urgum Gjas-Gjadyk, in Rashmarur mount. (GRAU 1981). It is known from several localities in the lower mountain zone in N.W. of Afghanistan (Fig. 4).

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Fig. 2. Distribution map of *Acanthophyllum kandaharicum* (triangle) and *A. stenostegum* (dot) and. The new records in Iran are indicated by arrows.
Fig. 3. Line drawing illustration of *Srophularia nikiforii* Gorschk.
Notes on the flora of Iran 6: Eight new plant records from Iran,

Fig. 4. Distribution map of *Galtonia dubia* (triangle) and *Scrophularia nikitini* (dot). The new records in Iran are indicated with arrows. The type location of *S. nikitini* is indicated by a question mark.

Acknowledgments

We acknowledge Ms. Mona Karimizadeh for providing the line drawing illustrations and Hekmat Safavi, the former Keeper of Herbarium of Ferdowsi University (Mashhad) for her various helps. The financial support by the Royal Society to visit Royal Botanic Gardens Kew and supporting of the study through the research project “Geobotanical Studies in Different Parts of Iran III” by the Research Council University of Tehran for H. A. are much appreciated.

References


Notes on the flora of Iran 6: Eight new plant records from Iran,


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A SHORT SURVEY OF
ILAM PROVINCE VEGETATION (IRAN)

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Abstract

During my study between 2003-2006 on the Flora of Ilam Province (S.W. Iran), I visited about 134 localities from early spring to late autumns and have collected 980 species from the province. The species belong to 91 families. There are Compositae and Papilionaceae as the two large families among the 91 families. During my work getting acquainted with various climatic condition in the province, based on physiognomies, ecological and floristic criteria, Ilam Province is divided into two main parts: 1) Nobo-Sindian Province, and 2) Kurdo-Zagrosian Province. Each of the above two parts is further divided into four subdivisions. The determined plants species are introduced in each division and subdivision. The mentioned plants list shows variations of climatic and floristic criteria in the province. The great work of collecting and determining of plants species in Ilam Province is dedicated to late Prof. Dr. K.H. Rechinger due to his extraordinary attempt to introduce Iranian plants species in Flora Iranica as his eternal work.

Key words: Ilam, Iran, Vegetation

Introduction

The Ilam Province with an area of ca. 1, 908871 ha., is located in S.W. Iran, bordered from North by Kermanshah and Lurestan Provinces, from South and South
West by Iraq, from East and South by Khuzestan and Lurestan and from West by Kerrianshah Provinces.

**Topography**

Two characteristic parts as vast lowlands of Mesopotamian continuation plains and Zagrosian mountainous area of oak forests (*Quercus brantii*) are distinguished in the province.

Lowland Plain and hills of the province from geological point of view are composed mostly of gypsum and calcareous soils and mountainous part are composed mostly of calcareous, sandstone to conglomerate rocky mountains and fertilized agricultural plains. The highest mountains of province are Kabirkuh located between lowlands and mountainous parts of province which continued from North West to South East with the altitude of 2790 m from Sea level, Guhan, Manesht, Ghalarang and Reno around the Ilam are the continuation of Zagros mountains. The lowlands of the province are neighbouring with Mesopotamian plains with warm and free frost climate. The province includes big and small cities, namely, Evan, Ilam, Lamar, Badre, Darrehshahr, Salehabad, Mehran, Dehloran, Abdanan and Malekshahi.

**Climates**

A vast part of province is more or less a semi-arid region and other parts have temperate climate and very short period of winter frost.

The average of annual precipitation is about 674 mm in 12 years data collection, mostly occurs in winters and spring. Thus, it is useful for the vegetation growth specially in high mountains which is snowy.

From the climatical point of view, the province can be divided into three characteristic regions: 1) Vast plains of lowlands semi-arid region, including plains and calcareous foothills, 2) More or less dry Zagrosian oak forest dominated by *Quercus brantii*, and 3) High mountains with cushion-shaped vegetation.

According to the phytogeographer's point of view (ZOHARY 1973), the province belong to Saharo-Sindian and Irano-Turanian regions.
A short survey of Ilam Province vegetation (Iran)

Rivers

There are many seasonal and permanent rivers with fresh waters which is used by people for drinking and irrigation of farms and gardens. The largest permanent rivers are Godarkhosh, Cham-sorkh, Kunjancham, Gavi, Changule, Meime and Abdanan which originated from Kabirkuh and the overflow of them currents to lowland of Iraq.

Vegetation

Because of the various climatic conditions (average of rainfalls, temperature, topographic condition).

The province has a very rich flora but because of being unaccessible, most of Botanical literature pointed to Ilam by name of Poshtkah as a part of Lurestan Province. As a result the area has been poorly investigated botanically in comparison with many other parts of Iran. However, the province has been visited by several collectors in the past, for example Bent & W.R., F. Nabelek, Jacobs, E. Behboudi, Iranshahr and Mirzayans. Recently, other Iranian botanists visited the province and have collected plants which held in two large Herbariums of TARI, IRAN (Evin), and private herbarium of H. Akhani. The author as a botanist and member of scientific board of TARI has begun further botanical collections. According to K.H. Rechinger's Flora Iranica (1963-2006), about 250 plant species had been introduced from Ilam Province, but the author during his excursions (2003-2006) visited about 134 localities from early spring to late autumns and had collected about 980 species from the province. The collected species belong to 91 families while the largest families are Compositae with 130, Papilionaceae 110, Gramineae 81, Labiatae 64, Umbelliferae 63, Cruciferae 44, Boraginaceae 34, Caryophyllaceae 33, Chenopodiaceae 26, and Rosaceae 23 species. Among these, 35 species are cultivated as ornamental trees or shrubs.

In spite of the number of species in the families, there are some small families which are dominated in the province for example goose foot family with only 26 species is well spread family in the lowlands of the province.

Some species like: *Vitex pseudonegundo*, *Ziziphus munnularia*, *Hammada salicornica*, *Capparis spinosa*, *Silybum marianum*, *Tamarix ramosissima*,
Pterygrynum naufichum, Satureja khazstanica, Salsoya lachnantha, Centaurea intricata, Astragalus fasciculifolius, and Astragalus kentrophyllus, are well spread and make the physiognomical features of the province in lowlands, and Quercus brantii, Astragalus brachycalyx, Daphne mucronata, Fisacia altaitica and Astragalus microcephalus in mountainous area of the province.

Based on physiognomical, ecological and floristic criteria, Ham Province is divided into two main parts and each of them in four divisions as follow:

1. The Nobo-Sindian Province included
   1.1. Vast desertic parts
   1.2. Stabilized dunes
   1.3. River beds
   1.4. Shrublands hills and badlands

2. Kurdo-Zagrosian Province included
   2.1. Degraded Quercus forest mostly cultivated by indigenous people
   2.2. Rocky, calcareous and deep slopes Quercus forest vegetation
   2.3. Shrubby parts upper than Quercus growing line
   2.4. High mountains and cushion-shaped vegetation

In this article, the author tries to give a more or less sufficient information about main plants vegetation in each parts, it is noticeable that in plant collection and determination of them, the author has collected some new unknown plant species currently are under evaluation and studies to confirm as a new species and could be introduced later.

1.1. Vast desertic parts dominated by:
   Allagi manfisera
   Annual grasses
   Capparis spinosa
   Hammada salicornica
   Proxopis jaica
   Silybum marianum
   Vitex pseudonigundo
   Ziziphus nummularia
A short survey of Ilam Province vegetation (Iran)

Other spontaneous plants are mostly goosefoot families plants, specially in the autumn and some ephemeral plants in spring like:

- *Anabasis setifera*
- *Astragalus fasicalifolius*
- *Atriplex leucochlaena*
- *Centaurea braguierana*
- *Centaurea hyalolepis*
- *Coronula monacantha*
- *Echinops kermandshahanicus*
- *Eucaria hispanica*
- *Gypsophila obconica*
- *Gypsophila lineariifolia*
- *Halochoris sulphurea*
- *Haplophyllum tuberculatum*
- *Heliotropium denticulatum*
- *Heteranthemum pityferum*
- *Notobasis syriaca*
- *Pycnocheta flabelifolia*
- *Salvia jordaniaca*
- *Salvia lachmantha*
- *Salvia nitaria*
- *Salvia orientalis*
- *Salvia tomentosa*
- *Seidtizia rosmarinus*
- *Stipa capensis*
- *Verbascum assurgent *

Some cultivated trees and shrubs of the cities in lowland part of province are:

- *Acacia farnesiana*
- *Acacia salicina*
- *Acacia saligna*
- *Albizia lebbeck*
- *Bougainvillea glabra*
- *Bougainvillea spectabilis*
- *Buhinia purpurea*
- *Callistemom viminalis*
- *Caryus sinensis*
- *Cicerodendron inermis*
- *Calotropis procera*
- *Dodonaea viscosa*
- *Eucalyptus camaldulensis*
- *Eucalyptus microtheca*
- *Hibiscus rosa-sinensis*
- *Lantana camara*
- *Leucaena leucocephala*
- *Morus alba*
- *Nerium oleander*
- *Parkinsonia aculeata*
- *Prosopis juliflora*
- *Tamarix aphylla*
- *Washingtonia filifera*
- *Ziziphus spina-christi*

1.2. Stabilized sand dunes plants species are:

- *Acanthophyllum brevifolium*
- *Alliaria petiolata*
- *Astragalus fasicalifolius*
- *Calligonum intextum*
- *Capparis spinosa*
- *Carthamus oxyacantha*
- *Centaterialia braguierana*
- *Centaurea hyalolepis*
- *Citrullus colocynthis*
- *Convolvulus oxyphyllus*
- *Coronulae aucheri*
- *Cyperus eremicus*
- *Diplolaxis harra*
- *Echinops poamphilus*
- *Eucaria hispanica*
- *Haplophyllum tuberculatum*
- *Heliotropium ramossimum*
- *Hyparrhenia hirta*
- *Launaea macronota*
- *Molukiopsis ciliate*
- *Olivieriana decumbens*
- *Onopordon leprous*
- *Pimpinella barbarica*
- *Plantago Boissieri*
- *Stipagrostis plumose*
1.3. Permanent riverbed dominated by:
- Allium manihot
- Arundo donax
- Capparis spinosa
- Lycium shawii
- Mentha longifolia
- Phragmites australis
- Populus euphratica
- Prosopis farcta
- Salsola foetida (imbricata)
- Tamarix ramosissima
- Vitis pseudonegundo

1.4. Mostly shrublands and calcareous badland and hilly parts covered by:
- Acacia nilotica blackelkiki
- Acanthophyllum bracteatum
- Achillea eligocephala
- Allocas acheri
- Allium manihot
- Amygdalus arbores
- Amygdalus lycoides
- Anchusa strigosa
- Aristida adscensionis
- Aristida caerulea
- Artemisia sieberi
- Arundo donax
- Astragalus fasciculifolius
- Astragalus gossypinus
- Astragalus kentrophyllus
- Astragalus meridionalis
- Astragalus trifoliatus
- Capparis spinosa
- Carthamus oxyacantha
- Centaurea interica
- Chenopoda rhyzodesperma
- Cleome oxypetala
- Convolvulus reticulatis
- Corokia monacantha
- Cuscuta stenocphala
- Diplolaxis harra
- Echinops kermanshahanus
- Echinops pachyphyllus
- Echinops tenerrinus
- Enneapogon persicus
- Ephedra foliata
- Ephedra transitoria
- Erechium oxythrix
- Ferula behboodiana
- Ferula macrocarpa
- Ficus rupestris
- Galiliana bruguieri
- Glaucium oxylobum
- Halothamnus itricus
- Haplopappus tuberculatum
- Helianthemum lippii
- Heliotropium denticulatum
- Hyparrhenia hirta
- Mozaicaria insignis
- Noaea macroura
- Onosma dasyrachium
- Onosma longirostris
- Periploca aphylla
- Phelmos olivieri
- Pistacia chinjic
- Populus euphratica
- Prosopis farcta
- Pieropyrum naefelium
- Pycnocula flagellifolia
- Reseda acheri
- Rumex ephedroides
- Saccharum ravus
- Salsola jordanica
- Salsola orientalis
- Salvia palaciosina
- Satureja khuzistanica
- Scrophularia striata
- Scutellaria pinnatida
- Stipagrostis plumosa
- Taverniera nunularifolia
- Teocrum olivierianum
- Teocrum pubescens
- Thymus spicata
- Thymus densifolius
- Trachymene venetam
- Verbascum alboides
- Vitis pseudonegundo
- Ziziphus numularia
- Zoega leptaurea
- Zygophyllum eurypterum
In this parts, *Ferula behboudiana* is a widespread species. In this calcareous soils, there are some microclimatical station with damp and wet lands including special vegetation such as: *Mozaffariania insignis, Populus euphratica, Pycnocycla flabelligolia, Artemisia sp., Daurosia flabelligolia, Hyoscyamus orthocarpus, Ferula behboudiana, Albarania fugax and Trachomitum venenum*. *Mozaffariania insignis* belongs to Apiaceae family and recently PIMENOV & MAASSOUMI (2002) introduced it to science from Khuzistan and now we know it as a wide spread species in Khuzistan and Ilam Provinces.

2. **Kurdo-Zagrosian Province included a very vast mountainy area**

Mostly covered by *Quercus brantii* as a dominant species and can be divided at least in four parts.

2.1. Degreaded *Quercus* forest mostly cultivated by indigenous people

*Quercus brantii* as a more or less pure species followed by *Pistacia atlantica* subsp. *kurdica, Aecer monspessulanum* and *Crataegus azarlanus* as dominant species together with loose and spreading species of trees and shrubs like:

- *Amygdalus elaeagnifolia*
- *Amygdalus haussknechtii*
- *Amygdalus lycoideus*
- *Astragalus fasciculariolius*
- *Celtis caucasica*
- *Cerasus mahaleb*
- *Cerasus microcarpa*
- *Cercis griffithii*
- *Cotoneaster bucharica*
- *Crataegus sp.*
- *Cupressus sempervirens var. horizontalis*
- *Daphne mucronata*
- *Daphne oleoides*
- *Ficus carica*
- *Ficus rupestris*
- *Fraxinus rotundifolia*
- *Hedera helix*

- *Lonicera nummularifolia*
- *Myrurus communis*
- *Olea europea*
- *Paliurus spinosa christii*
- *Pistacia kizinuk*
- *Populus euphratica*
- *Pierocarya fraxinifolia*
- *Pyrus glabra*
- *Pyrus syriaca*
- *Rhamnus pallasii*
- *Rosa canina*
- *Rosa elymatica*
- *Rosa foetida*
- *Tamarix ramosissima*
- *Ulmus carpinifolia*
- *Ulmus glabra*
- *Vitex pseudonegundo*
Against the wide spreading area covered by *Quercus brantii* because of cultivation and destroying the area, some invader species like:

- *Aegilops triuncialis*
- *Bromus danthoniae*
- *Bromus tectorum*
- *Carlina oxyacantha*
- *Centaurea solstitialis*
- *Cephalaria dichotoma*  

are wide spread under the degraded forest.

### 2.2. Rocky and calcareous part and deep slopes of the *Quercus brantii* forest

The most important species are:

- *Allugi persarum*
- *Amygdalus lycoides*
- *Arctaria squamata*
- *Astragalus adscendens*
- *Astragalus compactus*
- *Astragalus ecbatanius*
- *Astragalus fasciculiferus*
- *Astragalus giganteus*
- *Astragalus microcephalus*
- *Astragalus neo-mozaaffariani*
- *Astragalus pipocephalos*
- *Astragalus rhodosemius*
- *Capparis parviflora*
- *Capparis spinosa*
- *Carrhannus oxyacantha*
- *Centaurea eleganica*
- *Centaurea eymatia*
- *Centaurea iritana*
- *Centaurea kebaana*
- *Centaurea paradoxa*
- *Chaerophyllum macropodium*
- *Cirsium congestum*
- *Cirsium spectabile*
- *Codonopholus*
- *Convolutionus chondrilooides*
- *Cousinia cylindracea*
- *Cousinia jacobsi*
- *Daphne meconetria*
- *Dianthus orientalis*
- *Dionysia gaubae*
- *Dionysia lucorum*
- *Dionysia zagrica*
- *Dorema aucheri*
- *Echinops hermannshahanicus*
- *Echinops mesdensis*
- *Echinops pachyphyllus*
- *Echinops tenerrimus*
- *Eryngium creticum*
- *Eryngium glomeratum*
- *Eryngium noexanum*
- *Euphorbia denticulata*
- *Euphorbia maculata*
- *Ferula haussknechtii*
- *Ferula osypeda*
- *Ferula angulata*
- *Ferula contracta*
- *Ferula macrocarpa*
- *Ferula stellata*
- *Glycyrrhiza glabra*
- *Gandelia tournefortii*
- *Gypsophila pulida*
- *Hepatica anisoptera*
- *Hordeum bulbosum*
- *Hypericum helianthemoide*
- *Hypericum acutum*
- *Linaria fastigiata*
- *Matricaria vulgare*
- *Marsdenia erecta*
- *Nepeta kotschyi*
- *Nepeta persica*
- *Onopordon carduchorum*
- *Onopsona laszyrihicum*
- *Onosma sericeum*
- *Phagnalum rupestreis*
- *Phlomis bruguieri*
- *Phlomis oliveri*
- *Phlomis pungens*
- *Pircis trigoxa*
- *Pinpinella oliviriana*
- *Pteros ferulacea*
- *Pteros aloptera*
- *Pterocephalus canus*
<table>
<thead>
<tr>
<th>Rubus anatolicus</th>
<th>Smyrnopsis aucheri</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rumex ephedroides</td>
<td>Smyrnium cordifolium</td>
</tr>
<tr>
<td>Salvia bracteosa</td>
<td>Sutachy benthamiana</td>
</tr>
<tr>
<td>Salvia multicaulis</td>
<td>Sutachy inflate</td>
</tr>
<tr>
<td>Salvia palaeastina</td>
<td>Sōpa spp.</td>
</tr>
<tr>
<td>Scariolea orientalis</td>
<td>Trigonella elliptica</td>
</tr>
<tr>
<td>Serratula cerinthifolia</td>
<td></td>
</tr>
</tbody>
</table>

### 2.3. Shubby parts upper than *Quercus* growing line

Mostly have plants species like:

- *Acer monspessulanum*
- *Alkanna orientalis*
- *Amygdalus claeagnifolia*
- *Amygdalus haussknechtii*

and other herbaceous plants like:

- *Acantholimon erinaceum*
- *Acanthophyllum microcephalum*
- *Artemisia haussknechtii*
- *Asperula glomerata*
- *Astragalus abundans*
- *Astragalus brachycaulus*
- *Astragalus lagonis*
- *Astragalus microcephalus*
- *Astragalus myricanthus*
- *Astragalus neo-jozaffariani*
- *Astragalus sonnankiess*
- *Asyneuma multicaulis*
- *Arachis spinosa*
- *Cebriella parviflora*
- *Bunium luristanicum*
- *Bupleurum falcatum*
- *Celtis caucasica*
- *Centaura irvinens*
- *Ceonanous mahaleb*
- *Cerasus microcarpa*
- *Cerasus pseudoprostalis*
- *Cicer spinoceras*
- *Cotoneaster luristanica*
- *Cousinia cylindracea*
- *Cousinia haussknechtii*
- *Craetaegus azarolus*
- *Daphne macrantha*
- *Dianthus orientalis*
- *Dionysia zagrica*
- *Euphorbia haussknechtii*
- *Fibigia macrocarpa*
- *Galium mite*
- *Glycyrrhiza glabra*
- *Gandella tournefortii*
- *Hesperis lanacea*
- *Hyoscyamus niger*
- *Linaria fastigiata*
- *Lonicerum nummulariifolia*
- *Marrubium astracanicum*
- *Minuartia kievigata*
- *Ninausia linearis*
- *Nectaroscordum tripedale*
- *Nepeta persica*
- *Noaea multiflora*
- *Onobrychis comosa*
- *Onosma haussknechtii*
- *Oxymema pulicaria*
- *Pholmis olivieri*
- *Pimpinella deverroides*
- *Pimpinella triglum*
- *Pistacia atlantica*
- *Pistacia chinju*
- *Prunus amurensis*
- *Pterocephalus kurdiaticus*
- *Rhamnus pustulata*
- *Salix sanguinolens*
- *Salvia bracteata*
- *Salvia haussknechtii*
- *Salvia lactuca*
- *Satureja bachtiarica*
- *Soraphoria frigida*
- *Solananthus cincinnatus*
- *Stachys acerosa*
- *Synnemum cordifolium*
- *Tannacetum polyccephalum*
- *Tulipa styloca*
- *Ziziphus clinopodioides*
2.4. High mountains and cushion-shaped plants area

Acantoholinon eriaceum  
Athoxina graniflora  
Agropyrum spp.  
Artemisia haussknechti  
Astragalus adscendens  
Astragalus microcephalus  
Astragalus myriacanthus  
Bupleurum falcatum  
Euphorbia macrostegia  
Ferulago angulata  
Festuca ovina

Fibigia macrocarpa  
Johreniopsis scoparia  
Lantum album  
Marrubium astracanicum  
Onobrychis cornuta  
Parietaria judaica  
Parlatoria cakiloides  
Pterocephalus kurdicus  
Rosularia elymatitea  
Tanacetum polycephalum

References


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PRELIMINARY SURVEY ON THE GENUS ASTRAGALUS IN ILAM PROVINCE (IRAN) WITH A NEW SPECIES FROM ORNITHOPODIUM

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Research Institute of Forests & Rangelands, Tehran, Iran

Abstract
Ilam Province (S.W. Iran), with rich vegetation were investigated. In this research, 35 distinct species of the genus Astragalus were carefully identified. A new species, namely, A. heinzianus is described for the first time in the honour of late Prof. Dr. K.H. Rechinger for his long term effort and investigation on Flora Iranica.

Keywords: Astragalus, Ornithopodium, Ilam, Iran

Introduction
Ilam Province with a surface approximately 1,908,871 hectares situated in the south western part of Iran. From the phytogeographical point of view and vegetation feature, this area is the crossing of two Irano-Turanian and Saharo-Arabian floristic regions (Fig. 1). Saharo-Arabian district is a flat area with an altitude about 150-900 m above sea level and high temperature; in this district some species such A. kentrophyllus and A. fasciculifolius make the uniform association but in Irano-Turanian district with the mountainous of high altitude and existing of Kabir kuh prolonging from north west to south east in this district with an altitude about 900-3000 m above sea level presenting a total different ecological condition. In this
district.

*Quercus brani* in the form of scattered woodland with some species such as *A. gossypinus, A. microcephalus* and *A. brachycalyx* make a dense and permanent community of Tragacanthic species. This province was previously included in Lorestan Province together quoted a known floristic area as Posht Kuh in the west of the country.

Fig. 1. Ilam Province map showing crossing of two phytogeographical regions in which the localities number for *Astragalus* spp. has been collected.
Majority of localities and previous collection mentioned in Flora Iranica obscurely belongs to this overlapped area. According to Flora Iranica enumeration, approximately 250 species of all plant families and 10 species of the genus *Astragalus* reported from this area.

Based on new collection occurred by second author since 2004-2006, our botanical knowledge on Ilam Province seems to get very rich. It is estimated that, total number of the species from this small but very rich area in flowering plant will be more than 950 species.

**Main localities of Ilam Province (Table 1):**

Table 1. Showing the 34 different localities surveyed

<table>
<thead>
<tr>
<th>No.</th>
<th>Locality</th>
<th>Altitude (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ilam, Michkhas, margin of fields</td>
<td>1320</td>
</tr>
<tr>
<td>2</td>
<td>Dehloran, Andimeshk, close to Chame-Headi</td>
<td>180</td>
</tr>
<tr>
<td>6</td>
<td>Salehabad, Rika, Hills S. of Rika</td>
<td>760</td>
</tr>
<tr>
<td>7</td>
<td>Abiliran, Dinar ku</td>
<td>-</td>
</tr>
<tr>
<td>8, 10, 27</td>
<td>Ilam, Kuh-e Ghulmang, Ghulmangar pass</td>
<td>2160</td>
</tr>
<tr>
<td>9, 79</td>
<td>Ilam, Meime to Malekshahi, Chesnem Fahn</td>
<td>1550</td>
</tr>
<tr>
<td>12</td>
<td>Ilam to Chavar</td>
<td>1090</td>
</tr>
<tr>
<td>14, 93, 114</td>
<td>Ilam, Chavar, Tang-e Dalab</td>
<td>1370-1900</td>
</tr>
<tr>
<td>15, 39, 67</td>
<td>N. slope of Reno tunnel</td>
<td>1730</td>
</tr>
<tr>
<td>26</td>
<td>Ilam, Arghavan valley</td>
<td>1600</td>
</tr>
<tr>
<td>29</td>
<td>slope of Kabir-kuh from Meime</td>
<td>1900-2200</td>
</tr>
<tr>
<td>30</td>
<td>Ilam, Guchan mountain</td>
<td>2200-2400</td>
</tr>
<tr>
<td>31</td>
<td>Ilam, Ghulmang, Malegavan</td>
<td>2200</td>
</tr>
<tr>
<td>37</td>
<td>Mehran, c. 5 km from Gonbad-e</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Firmohammad to Malekshahi</td>
<td></td>
</tr>
<tr>
<td>40, 87</td>
<td>Chenar Bushi</td>
<td>1060</td>
</tr>
<tr>
<td>68</td>
<td>Salehabad, Kulek</td>
<td>700</td>
</tr>
<tr>
<td>69</td>
<td>Salehabad, Sarrnt to Meimak</td>
<td>400</td>
</tr>
<tr>
<td>70</td>
<td>Close to diviation Meimak Sumar-Eivan</td>
<td>450</td>
</tr>
<tr>
<td>74</td>
<td>Salehabad, S. of Salehabad, Kure Surkh</td>
<td>540</td>
</tr>
<tr>
<td>77</td>
<td>Ilam, around Ilam Dam</td>
<td>1070</td>
</tr>
<tr>
<td>81</td>
<td>Abiliran, Anjire to Anamin</td>
<td>-</td>
</tr>
<tr>
<td>82</td>
<td>Abiliran to Murmary</td>
<td>805</td>
</tr>
<tr>
<td>86</td>
<td>Badre, Tang-e Kafari</td>
<td>700</td>
</tr>
<tr>
<td>118</td>
<td>Eivan, Bankul</td>
<td>1880-2000</td>
</tr>
<tr>
<td>120</td>
<td>Eivan, Charmale</td>
<td>1450</td>
</tr>
<tr>
<td>123</td>
<td>c. 4 km from Meime to Zarrinabad</td>
<td>-</td>
</tr>
<tr>
<td>126</td>
<td>Ilam, Mishkhas, Kuh-e Seivan</td>
<td>2400</td>
</tr>
</tbody>
</table>
From this area, we had few information on the genus *Astragalus*. Following species such as *A. ovinus*, *A. ferruminatus*, *A. abnormalis*, *A. kentrophyllus*, *A. trifoliolatus*, *A. gossypinus*, *A. verus*, *A. zarreiatus* where only two species described from Ilam Province such as *A. ferruminatus* and *A. zarreiatus*.

Recently, Ilam Province with its known political boundaries and rich vegetation, were intensively investigated. New gathering occurred from this area show that against our previously imagination on the floras and vegetations of this area has rich flora and higher pressure of endemism.

For this investigation, about 130 localities in which 35 of those accurately concerning for the genus *Astragalus* which are distributed from all its political surface. The political map of the province with mentioned localities is given.

After careful identification, nearly 33 distinct species of the genus *Astragalus* identified from this area. In this research a new species, several distinct species with the enlarged distribution, few new records together with and more taxonomic notes will be given in this paper. All herbarium materials preserved in Central Herbarium of Iran (TARI).

**Treatment**

Following species are discussed below:

**Taxa & Number(s) of Localities**

*A. abnormalis* Rech. f. (93, 10, 14)

This species with single leaf (or very rarely with few pairs of leaflets), is distinguishable within the sect. *Incami*. Distribution pattern of this species is nearly broad but in the same region, Bakhtaran and Lorestan Provinces.

*A. adukeriatus* Podlech (79, 93)

This species described from the same area. New collections confirm the distribution of the species from Ilam Province but in different locality.

*A. aduncus* Bunge (81)

*A. brachycaulis* Fischer (29)

This species in the great part of the Zagros range create, the uniform association, this feature from south of Zagros prolonging to northern range and gradually penetrate in to the Turkish territory.
A. caryophylus (123)

This species usually grows in the margin of the fields and very rarely penetrates to the wild dry places.

A. compactus (14, 26, 6)

This species shows very large distribution in the mountainous area, up to 1800 m and with other tragacanthic species such as: A. verus, A. rhodosemius, and A. microcephalus create the mixed associations.

A. crispocarpus Nab. (74, 81)

Type specimen has been collected from Iraq. This is a first occurrence of the species from neighbouring area where is close to Iraq. First gathering from Tehran Province “A. mardabalexis” with long distance and different ecological condition reduced as synonymous.

Based on new collection, this species is widely distributed in Ilam Province where the ecological condition is completely different from those of its previous synonymous.

A. curvirostris (93)

This curious species shows wide distribution nearly in southern Iranian territory and show a big morphological variation which is relevant to ecological conditions.

A. echiantus Parsa (12, 7)

It is a a wide distributed species in Quercus brantii forest.

A. fasciculifolius Bunge (10)

Species largely distributed on all Zagros range and participate as an elements of associated formation particularly in low altitude of Saharo-Sindian region.

A. ferruginatus Maussouni (118)

This species is described for the first time from Ilam Province. New collections show enlarged distribution pattern of this species.

A. flexipes Bornm. (118, 121)

According to our data, the distribution of this species is only in Bakhtaran Province. This species is not found frequently in each of those provinces. Hence, it is believed that, very narrow distribution occurs for this species. Based on new collection, the distribution of this species enlarged beyond the Bakhtaran Province
where the first gathering occurred.

*A. glunaceus* Bunge

Within the sect. *Hymenostegix*, this species with very broad bracts is distinguished from other related species. Majority of this species distribution, is in western part of the country.

*A. gossypinus*

This species with the white gum production is well known. In Ham Province, this species as a canopy in the woodland of *Quercus brantii* make the pure community particularly in low altitude. This species distributed on the great part of country such as: Khorassan, Esfahan, Markazi, Fars, Khuzestan, Tehran, Bakhtaran, Kurdistan and Azarbayejan Provinces.

*A. hanosus* L. (I)

Annual species growing on the great part of the country.

*Astregalus heinzianus* Maassoumi & Mozaff., sp. nov. e sect. *Ornithopodium* Bunge. This is in the honour of Prof. Karl Heinz Rechinger for his one half century investigation to produce the monumental of *Flora Iranica*.

**Diagnose**

*Inter speciebus e sect. *Ornithopodium* Bunge ab unijugus foliolatis vel unifoliolatis insignis. Similis ab A. (Onobrychoidei) trifoliolatus Boiss. sed diifert leguminibus linearis (nee anguste ellipticum), inflorescentiae remotissimae, laxe (nee dense subcapitatae).*

Plants 60-70 cm tall, densely covered with symmetrically to asymetrically modified, appressed hairs. Caulex 8-17 mm thick, with a pluricipital root-crown. Stems several, quadrangular, erect, angular-sulcate, very densely covered with white hairs 0.2-0.3 mm long. Stipules hyaline-membranous, 3 mm long, free from the petiole, behind the stem 1 mm jointed to each other, vaginate-connate, free tips narrowly triangular, densely hairy, at the margin with basified hairs. Leaves 0.7-3.5 cm long, lower ones with short petiole 1 cm long, upper ones nearly, c. 1 mm petiolate; rachis hairy like the stem. Leaflet in 1 pair, in upper leaves unifoliolate, narrowly elliptic or narrowly ovate, 13-25 mm long and 4-5 mm wide, acute at the apex, on both sides densely covered with short asymmetrically...
appressed hairs 0.2-0.3 mm long. Pedicelles 4-7 cm long, white hairy like the stem. Racemes nearly loose, 10-15-flowered. Bracts 1-1.5 mm long, narrowly triangular-acuminate, white hairy, at the margin with basifixed hairs. Pedicels 0.5 mm long, hairy. Calyx 8-10 mm long, shortly tubular, obliquely cut at the mouth, covered with appressed white hairs 0.3 mm long; teeth subulate, unequal, 2-2.5 mm long, densely covered with white hairy in the inner side. Otherwise densely covered with white basifixed hairs. Petals creme or pale bluish-purple. Standard 14 mm long; the limb c. 7 mm wide, shortly rhombic-elliptic, in upper part shallowly ligulate-attenuate, emarginate at the apex, at the base gradually narrowed. Wings 12.5 mm long; the limb narrowly oblong, rounded at the apex, 8 mm long and 1.5 mm wide; auricle c. 1 mm long; claw 5 mm long. Keel 10 mm long; the limb obliquely oblong to elliptic, subacute at the apex, 5 mm long and 2.2 mm wide; auricle very short, claw 5.5 mm long. Ovary sessile, linear, appressed hairy; style glabrous. Pods (immature) sessile, spreading at first later deflexed, straight to arcuate, 20-25 mm long, 2 mm high and wide, beak c. 2 mm long, glabrous, yellowish, dorso-ventrally carinate, incompletely bilocular; valves green, densely covered with strongly asymmetrically bifurcate, appressed, white hairs.

Holotypus: Ilam: 10-25 km from Zarrinabad to Kavar to Mehran-Dehloran main road, on the gypsum soil, 907 m, 31.05.2006, N: 32.58.45; E: 46.50.57. Mozaffarian 88357 (Hol, TARI) (Fig. 2).

A. ibicinus (118)

A. insularis Maassoumi & Podlech (68)

This species described from an island in the Urmia lake. Surprisingly this species recollected beyond the type locality with different ecological condition.

A. iranicus Bunge (93)

The species shows very large distribution on the major parts of the country.

A. kentrophyllus Podlech (6)

This species is a widespread in the low altitude and makes the scattered cushion-shaped association together with Ziziphus nummularia extends to the Iraq boundary.
Fig. 2. *Astragalus heinzianus*: A. Habit, B. Flowers, C. Flower dissection.
Preliminary survey on the genus *Astragalus* in Ilam Province (Iran).

*A. kirrindicus* Burge (114, 9)

The name of epithet comes from Kirrind area where it is very close to Ilam Province. This species largely distributed on the great part of the country.

*A. meridionalis* Burge (82)

Significant species of the southern part of Iran such as: Fars, Hormozgan, Khuzestan Provinces.

*A. microcephalus* ssp. *pycnocladas* (30, 15)

*A. myricanthes* (126)

Species in high altitude, more than 2000 m with several other Tragacanthic species makes the uniform association which is using for the gum production.

*A. neo-mozaffarianii* Mansourni (27)

This is a distinct tragicant species which grows in the fissure of the calcareous rocks like *A. zoharyi*. Within tragicant species, these species with growing on the special edaphic on rocky mountain is distinguished from all other species. *A. neo-mozaffarianii* has been described from Hamadan Province, Garrin mountain at an altitude about 2000 m., Recently, this species collected from Ilam Province as a nupeserial plant but in different other ecological condition. Based on new materials, distribution pattern of this species extends largely to Ilam Province.

*A. octopus* (30, 10)

This is a first collection from this area where it is very close to Iraq territory which is mentioned by Townsend in Flora of Iraq (1973).

*A. oleacfolius* (6)

Based on previous collection, this species is widely distributed at high altitude in several localities of central and western part of the country. This is a first gathering from Ilam Province with a different ecological condition.

*A. ovinus* Boiss. (8, 10)

This species is previously mentioned from Ilam Province.

*A. piptocephalus*

A dense prostrate species, growing in several parts of the Zagros range such as Hamadan, Fars, Yasuj, Esfahan and Kurdistan Provinces.
A. *podocarpus* (74)

This species like other species of sect. *Malacothrix*, shows very large distribution in west, center and south western part of the country. This is first collection from Ilam Province.

A. *podosphaerus* (87)

A. *rhodosemiuss* (37)

This species with several Tragacanthic species participates as an element *Astragalus* association on the great part of Zagros range.

A. *saetiger* Podlech (6)

This species is described for the first time from Hamadan Province. Several other collections confirm this occurrence from the same area. Based on new collection, distribution pattern of this species enlarged beyond the type locality.

A. *sanandajianus* Tietz. (126)

This species is recently described from Kurdistan Province. According to the new gathering from Ilam Province, it will be reasonable to enlarge the distribution of the species beyond the type locality.

A. *sevanensis* (18)

A common fodder species in high altitude.

A. *sieberi* (3)

Based on a single specimen, distribution of the species doubtfully enlarged to Hamadan Province. According to new collection, distribution of the species is accurately closed to this area in the western parts of the country.

A. *siliquosus* (118, 10)

This species within herbaceous *Astragalus*, largely distributed in all Iranian territories.

A. *stepporum* Podlech (69, 70)

This species is recently described from Khuzestan Province in Sáhuro-Anbian phytogeographical region. Based on new collection, distribution of this species enlarged to Ilam Province where part of the province shows the same vegetation.

A. *sumarensis* Maassoumi (7, 71)

This species is recently described from Bakhtaran Province. Based on this
new collection, distribution of this interesting species, extends to Ilam with high
temperature and low altitude.

*A. asterias* (86)

This species is normally distributed in S. Iran. This is a first gathering from
western parts of the country.

*A. trifoliatus* Boiss. (69, 70)

Based on previous investigation, this species is growing only in Ilam
Province.

*A. venus* Oliv. (27, 29)

Great part of the country, is covered with this species. In different parts of the
mountainous area, this species with other Tragacanthic species, make the dense and
permanent association which is a distinct species for the gum production.

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TWO NEW SPECIES OF THE GENUS COUSINIA FROM IRAN

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Iranian Research Institute of Plant Protection, Tehran and University of Tehran, Tehran, Iran

Abstract

Two new species of Cousinia, C. taybadensis and C. khorasanica, collected from Khorasan province in eastern Iran are described, mapped and illustrated. C. taybadensis can not be exactly assigned to any of the known sections, whereas, C. khorasanica belongs to sect. leioautes Bunge due to its morphological characters discussed in the paper.

Keyword: Cousinia, Asteraceae, Khorasan, Iran

Introduction

The family Asteraceae with 1535 genera and 23000 species is one of the largest families of angiosperms (BREMER 1994) and is considered by most taxonomist the highest in the scale of evolution. The family is divided into several tribes, which are often arranged into three subfamilies: Barnadesioideae, Cichorioideae and Asteroideae (BREMER 1994).
The genus *Cousinia* Cass. belongs to the Arctium group tribe Cardueae subtribe Cardueae (HÄFFNER 2002, SUSANNA et al. 2003). The latest revision classified it into three subgenera; Cynaroides, Hypacanthodes and Cousinia, including 50 sections (TSCHERNEVA 1988 a, b).


According to RECHINGER (1986), *Cousinia* is unique in the diversification of all parts and definitely unique in the restricted distributional area compared with high number of species. After *Senecio* with c. 1500 species and *Veronica* with c. 1000 species, *Cousinia*, with c. 662 species, is the third largest genus in Asteraceae (RECHINGER 1986). Out of these, 379 species are endemic within the Flora Iranica area, i.e., the mountainous parts of the Irano-Turanian region (although, according to the last studies the number of species is ca. 700 and the number of endemics is about 390). As the plant geographical relationships between the “Flora Iranica” area and the “central Asia mountain provinces” are much stronger than those between the Iranian and Turanian section of the Irano-Turanian flora, RECHINGER (1986) proposes the phytogeographically division of the Irano-Turanian Region into a Turanian (Aralo-Caspian), comparatively poor in species and endemics, and an Irano-Turkestanian Region, which is rich in endemics at generic, specific and infraspecific levels. Therefore, it can be considered as an important center of origin and conservation of palaeo-xeromorphic mountain floras.

According to KNAPP (1987), in the western part of Cousinia’s distribution, like in the eastern, four centers of diversity, but less well developed, can be distinguished; Koptedaghi (66 species in Iran, 33 in Turkmenia), Elburz (66 species), the northern part of Zagros (44 species) and Azerbaijan (36 species). In Khorasan, 79 species has been listed, of which the greater part is concentrated in the mountain area of Koptedaghi (RECHINGER 1972, 1979). Here, the number of species decreases sharply towards the west, Turanian lowlands and central deserts of Iran.
Two new species of the genus Cousinia from Iran.

This paper is on the basis of a field trip to the poorly investigated areas of Khurasan province in June 2006. In this trip many species were collected, but among them, two new species have been collected in only one locality in the east (boundary area between Iran and Afghanistan) and north (boundary area between Iran and Turkmenistan) of Khurasan province respectively (Fig. 1). Initial attempts to name them using Flora Iranica (RECHINGER 1972, 1979) and Flora of the USSR (CHERNEVA 1997), were not successful. After more studying in detail, it was concluded that they are new species to science.

![Distribution of the two new species of Cousinia.](image)

Fig. 1. Distribution of the two new species of Cousinia.
Cousinia taybedensis Djavadi & Attar, sp. nova (Figs 2-4)

Type: Iran, Khurasan province, Khaf to Taybad, 45 km to Taybad, 1400 m, 3 June 2006, Djavadi, Eskandari & Torabi, IRAN 43543 (holotypus IRAN).

Suffruticoso-caespitoso, perennis. Caulis 8-18 cm altus, breviter ramosus, foliatus, albo-eburneus, glaber. Folia coriacea, ornina spinosa, sinuato-obtusa, glabra, virida; folia basalia et caulina inferentia elliptica 2-4 x 1.5-2 cm, petiolata, petiolo usque 2 cm longo suffulta, basi truncata; folia caulina triangularea 2-2.5 x 1.5-2 cm, sessilia, non decurrentia, basi subcordata, ± auriculata; nervatura centralia alba, prominens. Capitula plus minusve 35 florae, spinis inclusis 1.5-2 cm longa, 1.5 cm lata, breviter pedunculata, ad summos ramos solitaria; involucrum absque spinis c. 9 mm longum, oblongum, supra indistincte constrictum, indistincte arineosum vel glabrum; phylla plus minusve 40, 8- seriata; phylla exteriora et intermedia linearia, basi appressa, superne in spinam patulam, raro apice reflexo-hamatum abventia; phylla intimae recta, purpurea, araneosa, acuminata, margine scariosa, quam intermedia longiora. Receptaculi setae laeves. Corolla purpurea, 15 mm longa, tubo 6 mm, limbo 9 mm, lacinias 3 mm longis. Antheramur tubus purpurascens, glaber. Achenea matura ignota, verissimiliter atrobrunneae, pyramidalata, basi attenuata.

Perennial, suffruticosous, caespitose. Stem 8-18 cm tall, shortly branched, leafy, ivory white, glabrous. Leaves coriaceous, triangular or oblong, all spiny, sinuato-obtuse, glabrous, deep green, basal and lower stem leaves 2-4 x 1.5-2 cm, with 2 cm long petiole, truncate at the base, stem leaves 2-2.5 x 1.5-2 cm, sessile, non decurrent, subcordate or auriculate at base; midrib thick, ivory white, prominent. Head solitary, more or less 35-flowered, including spines 1.5-2 x 1.5 cm in diam.,
Two new species of the genus *Cousinia* from Iran.

Fig. 2. *Cousinia aybyadensis*: (A) Habit, (B) Flower, (C) Involucral bracts, (D) Achenes.
shortly peduncled; involucre without spines 9mm long, oblong, constricted above, indistinctly arachnoid vel glabrous; bracts more or less 40, 8-seriate, outers and medians linear, appresse at base, alternate toward apex into long reflexed or hamate spines; inners and innermost bracts erect, purple, arachnoid, acuminate, longer than medians. Receptacle bristles smooth. Corolla purple, 15 mm long, tube 6mm, limb 9mm and lobes 3 mm long. Anther tube purple, glabrous. Matured achenes not seen, but apparently deep brown, pyramidal, attenuate towards base.

*Cousinia taybadensis* can not be exactly assigned to any of the known sections. Although it seems to belong to sect. *Stenocephalae* Bunge, but, it differs from all members of sect. *Stenocephalae* Bunge by the limited number of capitules, the larger size of capitule and the more high number of flowers per capitule.

Figs 3 & 4: *Cousinia taybadensis* in nature.

*Cousinia khorasanica* Djavadi & Attar, sp. nova (Fig. 5)

Type: Iran. Khorasan province, Dargaz to Ervan-Gholi, Raham-Gholi-Baig, 1050m, 8 June 2006, Djavadi, Eskandari & Torabi, IRAN 43544 (holotypus IRAN).

Perennis. Caulis 20-22 cm longus, erectus, leviter arachnoideus, valde glabrescens, foliatus, a medio fere furcatu-ramosus, polycephalus. Folia omnia tenutiter coriacea, discoloria, supra viridian, valde glabrescentia vel omnia glabra, lucida, subitus appresse albo-araneosa-tomentosa, nervatura pinnato-reticulata, utrinque prominentes, nervis in spinas marginales alteratim breviores et longiores excurrentibus, apice longius spinosa; folia basalia 7-8 x 3.5 cm, sessilia, non decurrentia, sinuato-lobata, lobo terminali apice rotundata, margine spinoso-dentata,
Two new species of the genus *Corymbia* from Iran.

*Lateritius quinquelobatus*, ovato-late lanceolate, lobis in spinam terminalem fere longam excurrentibus, margine spinoso-dentata; folia caulina inferiora c. 5 x 3 cm, sessilium, ± oblonga, spinoso-dentata; folia caulina superiora sessilia, basi rotundata-cordata, acuminata, margine spinoso-dentata; folia summa decrescens, a capitulis remotis. Capitula unguiculata, terminalia, spinis inclusis c. 2.5 cm diametro, multiflora; involucrum absque spinis c. 1.5 cm, ovatum, basi rotundatum, superne constriatum, araneosum. Involucral phylla numerosus, multiserrata, coriacea, lanceolata, e basi appresse sessilis in spinam terminalem vulnerantes 5 mm longam attenuata, recurvata, exima virescens, lateraliter utrinque spinis 2 brevioribus praedita; phylla intermedia lanceolata ± 5 mm lata sensim in apicem acutam; phylla intima prominentia, scariosa, lineari-lanceolata, sinus acuminata, superne purpureo-violacea, araneosa. Receptaculi setae leaves. Corolla pallide rosa, c. 22 mm longa, tubo 9.5 mm, laciniis ± 3 mm longis. Antherarum tubas roseus, glaber. Achaenia matura ignota.

Perennial. Stem 20-22 cm high, upright, slightly arachnoid, glabrescent, leafy, divaricate-furcate-branched almost in upper half, branches one-headed. Leaves leaf-like, prickly along edge, green and slightly arachnoid above, mostly turning glabrous, appressed-white-tomentose beneath, nervation pinnate-reticulate, prominent on both surfaces, nerves in long and short marginal spines excurrent, terminal spine long; bottom leaves 7-8 cm long, 3.5 cm wide, sessil, lyre-shaped, apical segment rounded, prickly-toothed along margin, lateral segments 5 pairs in number, oval-broad lanceolate, sharp-pointed-prickly at apex, fine-prickly-toothed at margin; lower caulin leaves c.5 cm long, 3 cm wide, sessile, ± oblong; middle caulin leaves sessile, cordate at the base, dentate-spinose at margin, extended in prickles at apex; uppermost leaves ± diminished. Heads ovate, c. 1.5 cm wide (excluding spines), c. 2.5 cm wide (including spines), 22 mm long, arachnoid. Involucral bracts numerosus, leaf-like, close-appressed at base, sickle-shaped-curved, spine-sharp-pointed, ± 6 mm long; external ones terminated in 5 mm spine, with 1-2 spinelets along margin; middle ones ± 5 mm wide at the base; inner ones ± scarious, lanceolate, sharp-pointed in thin spines, purple-coloured, densely araneose-pubescent mostly along margins. Receptacle’s bristles smooth. Crollis pale pink.
Fig 5. *Cousinia khorasanica*: (A) Habit, (B) External involucral bract, (C) Flower, (D) Achene.
Two new species of the genus *Cousinia* from Iran.

c. 22 mm long, tube 9.5 mm, lobes c. 3 mm long. Anther tube purple, glabrous, Achenes (mature) not seen.

*Cousinia khorasanica* belongs to section *leiocaulis* Bunge. The most important morphological characters of this section are as follow:

Perennial with woody pycnocephalous rootstocks or undershrubs. Stem short or long, glabro or later glabrescent, branched in upper part, branches one-headed, Basal leaves short-petioled, stem leaves sessile, not decurrent, uppermost leaves diminished. Capitulum solitary, terminally, numerous or scanty, small or medium size. Heads spherical-ovate; involucral bracts from ovate base sharp-pointed in robust, arched-unbent or almost upright, long or short spines. Flowers yellow or whitish. Achenes inversely ovoid or inversely pyramidal, longitudinally striate, toothed above.

*Cousinia khorasanica* is related to *C. antonowii* C. Winkl. and *C. affinis* Schrenk. The three species are compared in Table 1.

<table>
<thead>
<tr>
<th>Characters</th>
<th>Species</th>
<th><em>C. khorasanica</em></th>
<th><em>C. antonowii</em></th>
<th><em>C. affinis</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Form of plant</td>
<td>perennial with</td>
<td>undershrubs with</td>
<td>perennial with</td>
<td></td>
</tr>
<tr>
<td></td>
<td>single stem</td>
<td>many stems</td>
<td>single stem</td>
<td></td>
</tr>
<tr>
<td>Heads</td>
<td>spherical</td>
<td>ovoid</td>
<td>spherical</td>
<td></td>
</tr>
<tr>
<td>Capitulum size</td>
<td>15-18 mm wide</td>
<td>8 mm wide</td>
<td>18-20 mm wide</td>
<td></td>
</tr>
<tr>
<td>(excluding spines)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of</td>
<td>numerous</td>
<td>60-80</td>
<td>numerous</td>
<td></td>
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<tr>
<td>involucral bracts</td>
<td>with 1-2 spinules</td>
<td>without spinules</td>
<td>without spinules</td>
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</tr>
<tr>
<td></td>
<td>along margin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External bracts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of flowers</td>
<td>± 50</td>
<td>± 25</td>
<td>numerous</td>
<td></td>
</tr>
<tr>
<td>per capitula</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corollas</td>
<td>pale pink</td>
<td>light cream or</td>
<td>pale yellow or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>whitish</td>
<td>whitish</td>
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</tbody>
</table>

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References


Two new species of the genus Cousinia from Iran.


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PHYLOGENETIC STATUS OF *OREOPHYSA MICROPHYLLA* (FABACEAE-GALEGEAE) BASED ON nrDNA (ITS REGION) AND cpDNA (trnL INTRON/trnL-trnF INTERGENIC SPACER) SEQUENCES

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Abstract

This study represents molecular phylogenetic status of the monotypic genus *Oreophysa* on the basis of nuclear ribosomal DNA internal transcribed spacers and 5.8S region sequences (nrDNA ITS) and the cpDNA *trnL* intron and *trnL-trnF* intergenic spacer sequences (cpDNA *trnL-F*) for the first time. A total of 23 and 21 ingroup taxa and two *Caragana* species as outgroups, all belonging to the tribe Galegeae, were analyzed for nrDNA ITS and cpDNA *trnL/F* sequences, respectively. The results of phylogenetic analyses of each dataset separately and in combination, using maximum parsimony method, revealed that *Oreophysa microphylla* is a member of Coluteoid clade and in turn nested among two/three sampled *Colutea* species as allied with *C. persica*. Based on these data, *Oreophysa microphylla* was synonymized with *Colutea* (sect. *Oreophysa*) *triphylla*.

* Corresponding author
Keywords: Fabaceae, nrDNA-ITS, Oreophyta, phylogeny, cpDNA trnL-F

Introduction

BROWICZ (1963) in a short article, reviewed the taxonomic history of the enigmatic monotypic genus Oreophyta (Bunge ex Boiss.) Bomml. Based on a herbarium specimen (Aucher-Eloy s.n.), Oreophyta microphylla (Jaub. & Spach) Browicz, was first described and placed in Sphaerophysa DC. as S. microphylla Jaub. & Spach (JAUBERT & SPACH 1843, cited in BROWICZ 1963), because of its superficial similarity in suffructicose growth and shape and size of its fruits. Then, on the basis of two herbarium specimens (Kotschy 292 and Bunge s.n.), it was included in the genus Colutea L. as a new species, C. triphylla Bunge ex Boiss. and was established a monotypic sect. Oreophyta Bunge ex Boiss for this species (BOISSIER 1872). BORNMULLER (1905) elevated this taxon from the sectional to generic rank as Oreophyta triphylla (Bunge ex Boiss.) Bomml. without examining the type specimen of Sphaerophysa microphylla.

Some 60 years later, BROWICZ (1963) revised several specimens of the species, keeping it at the generic level in agreement with BORNMULLER (1905), and introducing Oreophyta microphylla as a new combination based on the type specimen of Sphaerophysa microphylla. This species is similar to Colutea in some features, including the shape of the style, bent on top and densely hairy beneath stigma, and the presence of typical swellings at the base of the standard. These were the basic characters that BOISSIER (1872) used to refer the species to Colutea.

It, however, differs from all species of that genus in a number of characters such as: condensed suffructicose growth, ca. 50 cm long, subdichotomous branches of the shoots, considerable length of internodes, mostly trifoliate leaves, 1-2 flowered inflorescences, broad obovate-oblong wings, (2) 4 (6) ovules and broad inflated pyriform pods. Plants of O. microphylla are exclusively found in northern Iran, in the central Elburs mountains (area close to north of Tehran) at 1600-2300 m.

BROWICZ (1963) hypothesized that, this species has affinity with Colutea, however, no information is available on the phylogenetic status of Oreophyta except for an assumed speculation by LOCK & SCHRIER (2005) based on general molecular phylogenetic trees depicted in “The Legumes Of The World”. The present
study is the first report about phylogenetic status of this taxon using nrDNA internal transcribed spacer and 5.8S region (nrDNA ITS) and cpDNA trnL intron and trnL-trnF intergenic spacer (here abbreviated as cpDNA trnL-F) sequence data.

Materials and Methods

Total genomic DNA was extracted from dried leaves of individual plants by modified 2X CTAB procedure of DOYLE & DOYLE (1987). The complete nrDNA ITS was amplified using primers ITS4 and ITS5 of WHITE et al. (1990). The cpDNA trnL-F region was amplified using primers trnL-c and trnL-F of TABERLET et al. (1991). Purified PCR products were then used in the cycle sequencing reactions using the same primers of nrDNA ITS and of cpDNA trnL-F.

nrDNA ITS and cpDNA trnL-F sequences for Oreophsa microphylla, nrDNA ITS for Biseornula pelcicinus L, and cpDNA trnL-F for six other taxa were newly generated and the remainders were obtained from GenBank (see Table 1).

Phylogenetic analyses were performed on the aligned data matrices both separately (25 and 23 species for nrDNA ITS and cpDNA trnL-F, respectively) and in combination (23 species) using maximum parsimony method (MP) as implemented in the version 4.0b10 of PAUP (SWOFFORD 2002) on a Macintosh computer. The heuristic search was selected using 100 replications of random addition sequence and TBR branch-swapping with MultiTrees on and steepest descent off. Bootstrap values (FELSENSTEIN 1985) with 100 replications were calculated using the heuristic search option, simple sequence addition and TBR branch swapping. To root the trees, two species of Caragana were used as outgroups according to WOJCIECHOWSKI et al. (1999) and KAZEMPOUR OSALOO et al. (2003, 2005).
Table 1. Species included in the present nrDNA ITS and cpDNA trnL-F phylogenetic analyses

<table>
<thead>
<tr>
<th>Species</th>
<th>DNA source (location, voucher)*</th>
<th>GenBank Accession No.</th>
<th>nrDNA ITS</th>
<th>cpDNA trnL-F</th>
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</thead>
<tbody>
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<td>Asyneuma adungense Pallas</td>
<td>China: USDA 462310, W &amp; S 267</td>
<td>AF121674</td>
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<tr>
<td>A. attenuata Hohen.</td>
<td>Iran: Risemark &amp; Mozaf 30057 (TARI)</td>
<td>AB051917</td>
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<tr>
<td>A. attenuata Hohen.</td>
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<td>A. echevaria Murray</td>
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<td>AB051938</td>
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<td>A. erizonicus A. Gray</td>
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<td>AF126973</td>
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<td>A. hirtella var. alpina (L.)</td>
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<td>A. umbellata Rupr. &amp; Maxim.</td>
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<td>(syn. Asyneuma pelecinus (L.) Bambey</td>
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<td>LI0798-9</td>
<td>AF127002</td>
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<td>Iran: Assadi &amp; Shamsavar 65834 (TARI)</td>
<td>AB051905</td>
<td>AB287413</td>
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<tr>
<td>Caragana grandiflora (M.B.) DC.</td>
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<td>AB051906</td>
<td>AB287413</td>
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<tr>
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<td>US0520-1</td>
<td>AF127000</td>
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<td>U69644-5</td>
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<tr>
<td>Species</td>
<td>Location</td>
<td>Accession Numbers</td>
<td>Notes</td>
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<td>----------------------------------------------</td>
<td>---------------------------------------------------</td>
<td>-------------------</td>
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<td>Oxytropis lambertii Pursh</td>
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<td>Iran: Mozaei, et al. 39103 (TARI)</td>
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<td>AB287417</td>
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<tr>
<td>Maassoumi &amp; Kazempur Osho [= Astragalus vogelii subsp. faimensis (Chiov.) Maire]</td>
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<td>U56011-2</td>
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<td>Ansulac: DLEG 00185, W &amp; S 236</td>
<td>U56007-8</td>
<td>AF126999</td>
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</tbody>
</table>

*Abbreviations used in DNA source: A. Arnold Arboretum/ Gray Herbarium, Harvard University, Cambridge; AB., Abou., Abouhamzeil; ARIZ, University of Arizona Herbarium, Tucson; COLO, University of Colorado Herbarium, Boulder; DLEG, Desert Legume Program (University of Arizona), Tucson, AZ; Mass., Maassoumi; Mozaei, Mozaei; RENO, University of Nevada W & S, Wojciechowski and Sanderson; TARI, Herbarium of the Research Institute of Forests & Rangelands, Tehran, Iran; USDA, U.S. Department of Agriculture, Plant Introduction Station.

*Full length in DNA ITS1-5.8S-ITS2 region for these taxa were sequenced at the present work.

*Full length cpDNA trnL intron, trnL exon 3, and trnL-trnF intergenic spacer for these taxa were sequenced at the present work.
Results

The length of nrDNA ITS was variable from 430 base pairs (bp) in Sphaerophysa saxula (Pallas) DC. (without having 5.8S gene) to 613 bp in Chesneya australiaca Jaub. & Spach, and in Oreophyta microphylla was 602 bp. The aligned nrDNA ITS dataset comprised 642 nucleotide sites, of which 131 sites were parsimony informative. MP analysis of the dataset resulted in 41 equally most parsimonious trees having a length (L)=324 steps and a consistency index (CI)=0.605 and a retention index (RI)=0.721 (excluding uninformative characters). The strict consensus tree of these 41 trees with accompanying bootstrap values is presented in Fig. 1. In this tree, Chesneya australiaca is sister to a polytomous assemblage, the so-called “Astragalitean clade” [see SANDERSON & LISTON (1995), WOJCIECHOWSKI et al. (1999), WOJCIECHOWSKI (2005)], of eight lineages from Astragalus umbellatus Bunge to a well supported (94% bootstrap value) trichotomic clade of Smirnovia turkestanica Bunge through Colutea persica Boiss. Within this clade, Oreophyta microphylla is nested among three sampled Colutea species as moderately (74 %) united with C. persica.

The length of cpDNA trnL intron varied from 428 bp in Swainsona pterostylis (DC.) Bakh. f. to 551 bp in Astragalus adscortens Pallas, and the length of trnL-trnF intergenic spacer varied from 99 bp in Podlechiella vogelii subsp. fatimensis (Chiov.) Maassoumi & Kazempour Osaloo to 369 bp in Caragana grandiflora (M.B.) DC. In the case of Oreophyta microphylla, the length of trnL intron and the intergenic spacer were 509 bp and 107 bp, respectively. The aligned cpDNA trnL-F dataset comprised of 990 nucleotide sites, of which 61 were parsimony informative. MP analysis of this dataset resulted in 8466 equally most parsimonious trees with 97 steps (CI=0.773, RI=0.845). The strict consensus tree of these 8466 trees with accompanying bootstrap values is presented in Fig. 2. In the cpDNA tree, Chesneya australiaca is sister to “Astragalitean clade” composed of three smaller clades including a monophyletic Dorytropis, the Biserrula-Astragalus s. str. clade and the so-called “Coluteoid clade” [WOJCIECHOWSKI et al. (1999), WOJCIECHOWSKI (2005), and KAZEMPOUR OSALOO et al. (2003, 2005)].
Within this “Coluteoid clade”, Oreophyta forms a trichotomy with C. persica and C. arborescens L., as supported moderately (74%). In trnL intron sequences, O. microphylla is characterized by a single nucleotide site and a 5 base pair indel, as autapomorphic character states. The combined nrDNA ITS- cpDNA trnL-F dataset composed of 1632 nucleotide sites, of which 189 sites were parsimony informative. MP analysis of the dataset resulted in 3 equally most parsimonious trees of 408 steps with a CI=0.645 and an RI=0.745. The strict consensus tree of these three trees with accompanying bootstrap values is presented in Fig. 3. The strict consensus tree of the combined data like that of both nrDNA ITS and cpDNA trnL-F data show that, Cheoneya astrogalina is again sister to “Astragalean clade”.
Fig. 2. Strict consensus tree of 8466 most parsimonious trees resulting from phylogenetic analysis of 23 trnL-F sequences (Length=97 steps, CI=0.773, RI=0.845). Numbers above branches are bootstrap values for 100 replicate analyses; values < 50% are not indicated.

This clade is composed of two weakly supported subclades including Oxytropis-Biserrula-Astragalus, str. assemblage and “Coluteoid clade”. However, Oreophyta forms a strongly supported (98%) subclade with Colutea persica, and for them C. arborescens is a sister taxon, being nested all within the “Coluteoid clade”.

Discussion

As mentioned above, the resulting phylogenetic trees revealed that, Oreophyta microphylla is a member of the Coluteoid clade and in turn nested among sampled Colutea species as well allied with C. persica (see Fig. 3). Oreophyta microphylla, due to its specialized morphological features (as noted in the introduction), was treated an isolated taxon in the tribe Galegeae (BROWICZ 1963, 1984, POLHILL 1981, GHAHREM 1995).
Phylogenetic status of *Oreophyta microphylla* (Fabaceae-Galegaeeae).

Fig. 3. Strict consensus of three most parsimonious trees resulting from phylogenetic analysis of 23 combined nrDNA ITS-cpDNA trnL-F sequences for *Oreophyta* and related genera (Length=408 steps, CI=0.645, RI=0.745). Numbers above branches are bootstrap values for 100 replicate analyses; values < 50% are not indicated.

LOCK & SCHRIER (2005), based upon molecular phylogenetic analyses presented in WOJCIECHOWSKI et al. (1999, 2000) and KAZEMPOUR OSALOO et al. (2003), speculated that, *Oreophyta* is allied with the genera *Colutea*, *Sintriosia*, *Eremosparton* and *Sphaerocephala* – without exact relationship- within “Coluteoid clade” of “Astragalean clade”. Our molecular data clearly revealed that *Oreophyta microphylla* is a member of “Coluteoid clade” and solely allied with *Colutea* (see also BROWicz 1963) as positioned sister to *C. persica*. The two species, *O. microphylla* and *C. persica*, do share only three apomorphic nucleotide sites in combined dataset and each of them is characterized by a single autapomorphic nucleotide site, suggesting that they are more recently diverged from a common ancestor.
Taxonomic Treatment

According to both nrDNA ITS and cpDNA trnL-trnF phylogenies presented here, the generic status of Oreophyta is no longer tenable, and thus we synonymized it with Colutea triphylla.

Colutea (sect. Oreophyta Bunge ex Boiss.) triphylla Bunge ex Boiss., Fl. Or. 2: 196 (1872).

Syn.: Sphaerophyta microphylla Jaub. & Spach, III. Pl. Orient., 1: 126, tab. 64 (1843).


Acknowledgements

We are grateful to Prof. Dr. W. Greuter for checking the nomenclature of Colutea triphylla.

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Phylogenetic status of Oreophyes microphylla (Fabaceae-Galegeae).


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USEFUL WILD ALLIUM SPECIES IN NORTHERN IRAN

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Pharmaceutical Chemistry, Marburg, Germany

Abstract

During field-work in several provinces of northern Iran, wild Allium species
were collected and shown to the local population. These people were interviewed
about name, use, and mode of application of the plants shown. All data were
compiled in an electronic database, and the collected plants were planted in a living
Allium collection in Tehran.

In total, 18 wild species were reported to be used as vegetable, spice, and/or
medicinal plants which belong to the subgenera Allium (five species), Amerallium
(one species), Cepa (two species), Nectarioscordum (one species), and
Melanocrommyum (nine species). Thirteen species were reported to be used as
vegetable, six species as medicinal plants, and five species as spices (multiple uses
of six species). Occurrence, taxonomic characters, and specific use of all species
were discussed.

Key words: Allium, Useful plants, Vegetable, Spice, Medicinal plants, Wild plants,
Folk's names

* Corresponding author
Introduction

More than 90 wild *Allium* species are known to occur on the territory of Iran which belongs to the main centre of diversity of this genus (FRITSCH & FRIESEN 2002). Though the cultivated species common onion and garlic play an eminent role in the daily diet of Iranian people, also several wild species are more or less regularly sold on local markets (Fig. 1). This fact demonstrates that the knowledge about the potential of wild species is still present among native population indicating a similar situation like in Central Asian countries (KEUSGEN et al. 2006).

Unfortunately, the genus *Allium* is taxonomically complicated and the wild species are difficult to determine. Thus it is not surprising that hitherto available information about the use of wild *Allium* plants in Iran given in the Persian literature (ABBASI 2006) contains incongruent and partly contradictory data. The botanical

Fig. 1. "Sorkhe" (leaves of *A. aff. jesdianum*) offered at a small market in Kermaunshah.
affiliation of these data cannot be verified because voucher photographs or herbarium specimens of the investigated plants were not preserved.

Therefore, a research project funded by *VolkswagenStiftung* (Hannover, Germany) was initiated for collecting new data, which follows another strategy to minimize error sources.

**Materials and Methods**

Information was gained during joined research missions with Iranian cooperation partners in 2004, 2005, and 2006. In the areas of interest, at first *Allium* plants were collected in the nature and then shown to the native population of this region. Alternatively, active plant collectors were interviewed concerning *Allium* species present at a specific site. Because of strict ethnological rules, only male persons were asked, but these often showed plant material to further members of the family, also female persons. People were interviewed in their native language asking about the local name and whether they are using these plants, and if so, which part is taken, for what purpose, and how is it prepared and stored. Results were not related to the age of interviewed persons, but in most cases they had an age of about 50 to 60 years. Afterwards, the presented plant material was transferred to the living *Allium* collection in Tehran (on the territory of Iranian Research Institute of Plant Protection; curator: Dr. M. Abbasi) for further cultivation, documentation, and taxonomic determination. If sufficient plants could be collected, also voucher specimens of the accessions were deposited in the herbarium (IRAN). Duplicates of some accessions were also transferred to the Taxonomic *Allium* Reference Collection of the Leibniz-Institute of Plant Genetics and Crop Plant Research (IPK), Gatersleben, Germany, to be re-determined if necessary. All data concerning collecting, cultivation, and questioning the native population were assembled in an electronic database.
Results and Discussion

General results

We were able to state that considerable amounts of knowledge about use of indigenous wild *Allium* species exist among Iranian people. On the markets of many towns, in spring and early summer green grocers are regularly selling *Allium* plants or plant parts collected in the wild (Fig. 2). In Sanandaj, a specialized shop is offering exclusively plants collected in nature (Fig. 3). Also along main roads, wild *Allium* species were frequently offered for sale (Fig. 4). Often the sellers were able to explain broadly the possibilities to use these plants displaying a comprehensive specialist’s knowledge. Others knew only that this plant part is used as a medicine or as condiment for special dishes. Several interviewed people stated that some species are not generally used but by certain families or groups only.

In some cases, the interviewed people did not know at all the plants shown, or knew simply that this plant is edible because other persons have collected it for consumption. In other cases, such kind of answers may only reflect the individual

![Fig. 2. Plant parts collected from the nature are offered in Ravansar](image)
Useful wild *Allium* species in Northern Iran

levels of education and knowledge. On the other hand, a gradual loss of traditional knowledge about useful wild plants like in other countries must also be stated for the Iran. Therefore further efforts should be done in order to conserve still existing knowledge by appropriately documented scientific investigations.

The results of the research missions are shown in Table 1. Data of wild *Allium* taxa unknown to the questioned persons or characterized as "not used" were not included.

![Fig. 3. Special shop for plants collected in the nature in Sanadaj](image)

Accession numbers refer to the living *Allium* collection in Tehran. In 2004, parts of Mazandaran and Khorasan Provinces were visited (accession numbers up to 1036), in 2005 parts of Zanjan, Gilan and E. Azarbaijan Provinces (accession numbers up to 1067) and in 2006, Hamadan, Kermanshah and Kordestan Provinces (higher accession numbers).
Fig. 4. Seller of "Mu Sir" at the roadside near Assadabad.

**Taxonomic affiliation of the species**

1. subg. *Allium*  
1.1. sect. *Allium*  

*Allium atroviolaceum* Boiss.  

This species is widely distributed over nearly all provinces of Iran. It is a very common species of dry meadows and cultivated areas where it is sometimes a serious weed. Like other species, it is used for the traditional dish "Aash".

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Useful wild *Allium* species in Northern Iran

*Allium iranicum* (Wendelbo) Wendelbo

This plant is also a very common species in northern Iran but grows mainly at steep and stony slopes. Formerly taxonomists treated it as a subspecies of *A. ampeloprasum* to which also the cultivated vegetables Tareh, Leek and Kurrat belong (FRITSCH & FRIESEN 2002). Indeed, *A. iranicum* is similar in terms of plant morphology and taste. The whole plant or at least the leaves are cooked as a vegetable and used for the traditional dish "Aash". It belongs to the most often used wild *Allium* species in the investigated area bearing several names (see Table 1). Special medicinal properties of this species (increasing of iron level in blood) were only once reported and need verification.

*Allium subvincte* Wendelbo

Unlike most other wild *Allium* species it is growing in wet meadows, wet field plots, and along creeks where it often forms very dense patches. The plants multiply by side bulblets and by air bulblets which soon drop down from the inflorescence and establish new plants close to the mother plant. The habit of this species is somewhat similar to grasses but the narrow leaves are hollow (tube-like) with rather thin tissue. Nevertheless, this species bears a characteristic name and is obviously eaten as spice. In the town of Van (E. Turkey) this species is also sold along the streets for use as spice and green for dishes (R.M.F., own observation in 2002). Apparently *A. subvincte* is not over-used in Iran.

*Allium* sp. sect. *Allium*

These plants had semi-cylindrical, solid leaves when collected, which is characteristic for several species. Because the plants did not flower after having been planted in the living *Allium* collection in Tehran, a definite determination cannot be given here. The plants are used for culinary purpose like several other species.

1.2 sect. *Avulsea* F.O. Khass.

*Allium fibrosum* Regel

It is a rather small species with thin, cylindrical, and hollow leaves occurring at stony slopes of Binalud and Koppeh Dagh mountain ranges in Khurasan Province
and in neighbouring Turkmenistan. It bears the same name and has the same use as
A. iranicum. Perhaps it is mainly used as “filler” when not enough material of other
“Malil kuhi” could be collected, and seems not be endangered by over-collecting in
Iran.

2. subg. *Amerallium* Traub sect. *Briseis* (Salish.) Stearn

*Allium paradoxum* (M. Bieb.) G. Don var. *normale* Stearn

These plants are growing in wet broad-leaved forests near the coast of Caspian Sea and more rarely in wet parts of Koppeh Dagh mountain range of Iran
and Turkmenistan. They grow only in the shadow in humus-rich soil mostly in
northern exposition. In Turkmenistan, this species is used as spice and fresh
vegetable in an identical manner (ANDROSOV 1942). As far as we have seen
during our mission, the supplies of *A. paradoxum* seem rather restricted, and further
intense collection will endanger this taxon. MASSOUMI (2001) mentioned this
species to be used in Kermanshah Province which was certainly mistaken for
*A. tripedale* (see below).


*Allium asarifense* R.M. Fritsch et Matin

This recently described taxon is a very local endemic restricted to the central
area of the Karaj valley over a distance of about 25 km. At this location, many
thousands of bolting plants were seen in 2006. This species is very closely related to
common onion, and especially the bulbs are used in an identical manner. Current
collecting activities of the inhabitants of Asara village seem not to endanger it.

*Allium oschaninii* O. Fedii

This species is mainly distributed in Central Asia with the most western
outpost in the Binalud Mts. There it grows on rock terraces and stony slopes (Fig. 5).
Like *A. asarifense*, it is also a close relative of common onion and identically used.
This kind of use is also reported for Central Asia (KEUSGEN et al. 2006). Over-use
in the past could be the reason that *A. oschaninii* is rare at least in the vicinity of
settlements in Iran.
Useful wild *Allium* species in Northern Iran

We were not able to find any remark in the literature mentioning the ability of any wild relative of common onion to cause cancer. Thus, the information from Binalud is new, and we cannot decide whether it is true. It could also be an allegation in order to prevent people from further collecting of this rare plant.

Fig. 5. *Allium oshchaninii* plants growing on a rocky slope of Akhlamad valley.

Allium tripedale Trautv.

Formerly this subgenus was accepted at generic level, but recent molecular investigations presented more proof for having evolved from inside the genus Allium (FRIESEN et al. 2005). This species grows in the mountains of Transcaucasia and Zagros mountain range (PERSSON & WENDELBO 1979). The reported use of this plant fits best the English term "Nutraceutical", which means food with a specific pharmaceutical (healing or protective) effect. Additionally, most members of the genus Allium have specific tasteful properties becoming thus also powerful spices. We got informed that the use of this species is very popular, and supply cannot always meet the demand. Probably the natural supplies of A. tripedale are already over-used today.

Also leaves of an Eremurus species were sold in Samadaj (Fig. 3) under the local name "pichak". The shape of these leaves is somewhat similar, but the taste should be completely different. Allium longisepalum Bertol. (syn. A. eriophyllum Boiss.) may also be named “Pichak” (MASSOUMI 2001).

5. subg. Melanocrommyum (Webb et Berth.) Rouy

5.1 sect. Acanthoprason Wendelbo

Allium akaka S.G. Gmel. ex Schult. et Schult. F. s.l.

This name is taxonomically still somewhat unclear, but most often it is applied for small broad-leaved plants distributed in the mountains of northern Iran and the adjacent Turkish and Transcaucasian territories. This taxon grows on sunny rocks and stony slopes.

Also A. akaka is a "nutraceutical" being used as a vegetable and spice with medicinal properties. Because large amounts of these plants were offered (and very probably also sold) in Tehran, we must assume that the natural resources of this species may be endangered by too much collecting already today.

Allium breviscapum Stapf

This endemic species grows only on stony and gravelly slopes of Mt. Alvand massif near Hamadan. In this small area it is a rather common species which is
apparently not much collected for culinary purpose. We did not see it to be sold at markets.

*Allium derderianum* Regel

This is also an endemic species but from Alborz mountain range where it occupies stony and rocky slopes and rock terraces at higher elevations. It also seems to be not commonly used and is apparently not endangered. The local name and use is nearly identical to that of *A. akaka*; both species are possibly merged by some people.

*Allium haemanthoides* Boiss. et Reuter

In the mountains of Hamadan, Kermanshah and Kordeshan Provinces, it is a rather common species growing on dry and often stony or rocky slopes. We found a special form of this species with dark brownish-purple flowers in the vicinity of Hamadan which was named "mu sir" and used as spice like *A. stipitatum* described below. The typical form with pink flowers is used in the same way (MASSOUMI 2001).

*Allium kuhsorkhense* R.M. Frisch et Joharchi ined.

Again it is an endemic species morphologically somewhat similar to *A. akaka* but occurring only in the southern part of Binalud and in Sorkhe Kuh mountainous ranges on hot and dry rocky slopes. These plants are only rarely used as vegetable but we do not know whether it is generally a rare species.

5.2 sect. *Megaioprasum* Wendelbo

*Allium* sp. aff. *A. jesdianum* Boiss., et Buhse

This taxon differs by shining (not dull) leaves, smooth (not basally ribbed) scapes, and thick and soft (not thin and membranous) bulb tunics from typical *A. jesdianum*. The latter occurs on shady places among trees in the mountains west of Yazd (Shir Kuh mountain range). Rather large amounts of "Sorkhe" are sold at the markets of Kermanshah Province which were said to have come from "the mountains". However, during own field-work only once we were able to find a few
plants of this taxon in the nature among large perennials. Thus we must conclude
that the natural supplies are over-used currently.

"Sorkhe" is mainly used as a medicinal plant. In Central Asia, 
*A. rosenbachianum* Regel and *A. roseriorum* R.M. Fritsch are used as general tonic 
in a similar manner (KEUSGEN *et al.* 2006). These species are closely related to 
*A. jesdianum*. All these species secrete a red dye at leaf bases and wounded parts 
from which the name "Sorkhe" could be deduced.

*Allium stipitatum* Regel

In Iran, this species was formerly named *A. hirtifolium* Boiss., but both 
names refer to one botanical species. The name was given by Boissier somewhat 
later and became thus a synonym.

This taxon occurs over wide parts of Central Asia and Iran where it occupies 
loamy slopes and terraces with good soil, often in the shadow of bushes and trees. 
Only the bulbs of *A. stipitatum* are used as spice which was also earlier reported 
from Bakhtiari Province (FRITSCH 1996). In Central Asia, pickling of the young 
bulbs in vinegar as spice is the dominating use (KEUSGEN *et al.* 2006), but in Iran 
medicinal use is much more in focus.

*Allium kharputense* Freyn et Sint. s. lat.

In Iran, this species is only reported to grow in Saral region in Kordestan near 
Sadabad on dry meadows and sunny slopes. However, MASSOUMI (2001) reported 
this species to be used for traditional dishes also in Kermanshah Province. We were 
not able to receive information about the amount of plants consumed in Saral region.

5.4 sect. *Pseudoprason* (Wendelbo) K. Persson et Wendelbo 
*Allium koezii* (Wendelbo) K. Persson et Wendelbo

According to PERSSON & WENDELBO (1979) it is a rather rare species 
growing in the central parts of Zagros mountain range. During our fieldwork we 
were able to find this species at several places in Kermanshah and Kordestan 
Provinces, but always a restricted number of specimens. The very specific use of the 
bulbs may have been merged by the informant with that of *A. stipitatum*.
<table>
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<tr>
<th>Accession</th>
<th>Local name</th>
<th>Preliminary scientific name</th>
<th>Definite scientific name</th>
<th>Use</th>
<th>Manner of application</th>
<th>Province and location</th>
<th>Remarks</th>
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<td>Tarch kulti</td>
<td><em>A. porrum</em> (M. Bieb.) G. Don var. <em>normale</em> Stein</td>
<td>foot</td>
<td>especially leaves and bulbs used as fresh vegetable</td>
<td>Mazandaran, Golestam National Park, Gilan valley</td>
<td>widely collected and sold at markets in many towns, price 100 Tuman per bundle, but said by others to cause cancer</td>
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<tr>
<td>1023</td>
<td>A. aschersoni O. Fedr.</td>
<td>foot</td>
<td>used as vegetable like common onion</td>
<td>Khorasan, Binalud masif, slopes of the valley above vill. Akhsham, close to waterfall</td>
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<td>Malil kulti</td>
<td><em>A. tricoccum</em> (Wendelbo) Wendelbo</td>
<td>foot</td>
<td>whole plant is eaten as vegetable</td>
<td>Khorasan, Binalud masif, valley N.E. of vill. Kharve Olya</td>
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<td>1034</td>
<td>A. huhus hirsea R. M. Fritsch et Joharchi ined.</td>
<td>foot</td>
<td>leaves are used as vegetable</td>
<td>Khorasan, Binalud masif, valley used only by some people, other do not</td>
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<td>1036</td>
<td>Malil kulti</td>
<td><em>A. frisia</em> Regel</td>
<td>foot</td>
<td>whole plant is eaten as vegetable like <em>A. transica</em></td>
<td>Khorasan, Binalud masif, valley N.E. of vill. Kharve Olya</td>
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<td>1038</td>
<td>Piyaz kulti</td>
<td>A. asaarensi R.M. Fritsch</td>
<td>foot</td>
<td>whole plants and especially the bulbs are used for soups and other dishes like common onion</td>
<td>Tehran, Alborz range, Karaj valley ca. 1 km above vill. Asara</td>
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<td>1073</td>
<td>Gehaghy</td>
<td><em>Allium sp. sect. Allium</em></td>
<td>foot</td>
<td>leaves and young stems, sometimes also bulbs are made into a traditional soup-like dish &quot;Ash&quot;</td>
<td>Hamadan, Alvijad masif, N. slopes near vill. Ganjname</td>
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<tr>
<td>1074</td>
<td><em>A. barreisii</em> Stapf</td>
<td>food</td>
<td>leaves and young stems, sometimes also bulbs are used for a traditional soup-like dish &quot;Aash&quot;</td>
<td>Hamadan, Alvand masif, N. slopes near vil. Ganjinaneh</td>
<td></td>
<td></td>
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<tr>
<td>1075</td>
<td><em>A. haemanthoides</em> Boiss.</td>
<td>food</td>
<td>leaves and young stems, sometimes also bulbs are used for a traditional soup-like dish &quot;Aash&quot;</td>
<td>Hamadan, Alvand masif, N. slopes near vil. Ganjinaneh</td>
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<tr>
<td>1076</td>
<td><em>A. stiphra</em> Regel</td>
<td>Medicine, Food (spice)</td>
<td>fresh (and possibly dried) bulbs used against pains of backbone, legs, and feet, bulbs are eaten pickled in vinegar or chopped and mixed with yoghurt</td>
<td>Hamadan, sold at the market in Hamadan, said to have been brought from Ariaqabad, not consumed by the local population south of Hamadan near Eshbatan Dam</td>
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<tr>
<td>1081</td>
<td><em>A. stiphra</em> Regel</td>
<td>food</td>
<td>used for the traditional dish &quot;Aash&quot;</td>
<td>Hamadan, S. side of Alvand masif, village Oshtrnaz, Hamzeh Khan castel</td>
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<tr>
<td>1087</td>
<td><em>A. haemanthoides</em> Boiss.</td>
<td>food</td>
<td>whole plant is eaten in dishes</td>
<td>Hamadan, Alvand masif, valley above village Emaen Zadah Kahr c. 15 km N.W. Hamadan</td>
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<tr>
<td>1088</td>
<td><em>A. haemanthoides</em> Boiss.</td>
<td>food</td>
<td>whole plant is eaten like vegetable or for soup</td>
<td>Hamadan, Alvand masif, valley above village Emaen Zadah Kahr c. 15 km N.W. Hamadan</td>
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<tr>
<td>1089</td>
<td><em>A. haemanthoides</em> Boiss.</td>
<td>food</td>
<td>bulbs and leaves are sliced and added to yoghurt</td>
<td>Hamadan, Alvand masif, slopes near the road along Eshbatan Dam c. 15 km S.E. Hamadan</td>
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<tr>
<td>No.</td>
<td>Name (Synonym)</td>
<td>Species</td>
<td>Usage</td>
<td>Remarks</td>
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<tr>
<td>1102</td>
<td>Soddhe</td>
<td><em>Allium sp. aff. A. junceum Boiss. et Bulbe</em></td>
<td>medicinal plant</td>
<td>as a general tonic and against rheumatism</td>
<td>Kermandeh, sold at the market in Kermandeh</td>
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<tr>
<td>1103</td>
<td>Soddhe</td>
<td><em>Allium sp. aff. A. junceum Boiss. et Bulbe</em></td>
<td>medicinal plant</td>
<td>as a general tonic and against rheumatism</td>
<td>Kermandeh, sold at the market in Kermandeh</td>
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<tr>
<td>1104</td>
<td>Pichak</td>
<td><em>Allium sp. aff. A. junceum Boiss. et Bulbe</em></td>
<td>medicinal plant</td>
<td>leaves are cut and added to ordinary dough which is fired in oil</td>
<td>Kermandeh, sold at the market in Esfand Abad</td>
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<tr>
<td>1110</td>
<td>A. kerrii (Wendelbo) K. Persson et Wendelbo</td>
<td>medicinal plant</td>
<td>the bulb is cooked and used against skin diseases</td>
<td>Kermandeh, limes, one mastiff c. 5 km N.W. Nojivand, 30 km N.E. Kermandeh, people in the village Nojivand did not know this plant</td>
<td></td>
<td></td>
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<tr>
<td>1115</td>
<td>Gilacheh</td>
<td><em>Allium sp. aff. A. junceum Boiss. et Bulbe</em></td>
<td>footprint</td>
<td>whole young plants (without scape) are eaten as vegetable</td>
<td>Kermandeh, territory of the Sarl Agricultural Station c. 30 km N. Sanadaj to Divandareh, said to be also sold at the local markets</td>
<td></td>
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<tr>
<td>No.</td>
<td>Locality</td>
<td>Scientific Name</td>
<td>Use</td>
<td>Additional Information</td>
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<td>1135</td>
<td>Valak, between Gajereh and Shemshak</td>
<td><em>A. densirhizum</em> Regel</td>
<td>food, fresh leaves are eaten as vegetable (cooked with rice) or as salad</td>
<td>information given by a man from Shemshak.</td>
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<td>1136</td>
<td>Tardeh-kahli</td>
<td><em>A. fruticosum</em> (Wendelbo)</td>
<td>food, medicinal, fresh leaves are eaten as vegetable (cooked with rice) or as salad; use of this plant increases the iron level of blood</td>
<td>Tehran, Alborz range, c. 3 km below Dizin pass to Shemshak; information given by a man from Shemshak.</td>
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<tr>
<td>1138</td>
<td>Valak, young to flowering plants are eaten as vegetable and are applied against rheumatism and other pains</td>
<td><em>A. virginica</em> (C. B. Cl. et S. F.)</td>
<td>Tehran, sold at the <em>Tajrish</em> market in Tehran, Shemshak, said to have been brought from Zanjan by <em>Foolagh</em>.</td>
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</table>

*Voucher*: Italicized names refer to voucher specimens deposited at the Herbarium of the National Herbarium in Tehran.

*Sources*: All information is based on personal observation and interviews with local inhabitants.
Acknowledgements

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ASPERULA OPPOSITIFOLIA SSP. RECHINGERI (RUBIACEAE-RUBIEAE), A NEW TAXON FROM N. KHORASAN PROVINCE, IRAN

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University of Tarbiat Moallem, Tehran and Ferdowsi University of Mashhad, Mashhad, Iran

Abstract

Asperula oppositifolia ssp. rechingeri is described from Khorasan Province, Iran. Asperula oppositifolia comprises six subspecies mainly distributed in E. Afghanistan, Pakistan, and Middle Asia. Describing these taxa from Iran, shows the extent of diversity of this species in Iran. Mothological evidence supports taxonomic position of these taxa in A. oppositifolia, and the subspecies appears to be most closely related to subsp pseudo-cynanchica Ehrend.

Key words: Asperula oppositifolia, Iran, New taxon, Khorasan

Introduction

The genus Asperula (Rubiaceae-Rubieae) includes nearly 90 Eurasian species, with concentration in Mediterranean area (MABBERLEY 1997). Based on

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Flora Iranica ( SCHÖNBECK-TEMESY & E HREN DORFER 2005), this genus includes 15 species in Iranian plateau. Eight species of Asperula thrive in Iran, five of which are endemic ( SCHÖNBECK-TEMESY & E HREN DORFER l.c.).

Asperula oppositifolia with six subspecies is distributed in Afghanistan, Tadjikistan, Pakistan, N.W. Himalaya, Tian Shan and Pamir-Alaj ( SCHÖNBECK- TEMESY & E HREN DORFER l.c.).

In this study, a new subspecies of Asperula oppositifolia is described from Khorasan Province (N.E. Iran). The species belongs to the sect. Oppositifolae Shishk. ex Schörb.-Tern. This section mainly characterized by its subfuscoide to chamaephytic, polymeric growth form with strong tap root (but never with rhizemic stolons), opposite leaves (often rarely with stipules), 4-lobed corollas, the glabrous stigma and the ± truncate ovaries and mericarps. This section belongs to the Oriental-Turanian and W. Himalayan floristic element ( SCHÖNBECK- TEMESY & E HREN DORFER 2005).

Asperula oppositifolia Regel & Schmalh. subsp. rechingeri F. Ghahtemani., Joharchi & Aydani subsp. nova (Figs 1 & 2)

**Type:** Iran: Khorasan Province, W. Bajinord, Ala-dagh Mt., Kanimokhtar Vall., 37° 23' N, 56° 46' E, 2100 m, 20.6.2004, Mohammad Reza Joharchi and Marjaneh Aydani 35596 (holotype FUMH; isotype FUMH, FAR).

Planta perennis, ± glandulosa-papillosa, vel fere glabre. Caulis 13-30 cm longus. Folia plerumque linearia. 5.0-20 mm longa, 0.5-1.5 mm lata. Inflorescentia cylindrica vel corymbiformis, laxa vel sublaxa. Flores pedicellis usque 11.0 mm longis vel sessiles. Corolla rosea vel rubra, 3.5-7.0 mm longa, tubo lobo breviora vel eo subaequans. Tubi 1.5-3.0 mm longi; lobi 2.5-4.0 mm, 0.8-1.5 mm lati. Mericarpium rugosum, 1.0-1.7 longum, 0.5-1.0 mm latum.

Differt a subsp. pseudocyanthia Ehrend. pedicellis longioribus; mericarps rugosis glandulosis.

Plants perennial, ± glandular-papillos to nearly glabrous, stems 13-30 cm long. Leaves usually linear, 5-20 mm long, 0.5-1.5 mm wide. Inflorescence cylinder to corymbiform, lax to nearly lax. Flowers with pedicels to 11 mm long, or without pedicels. Corolla pink to red, 3.5-7 mm long, its tubes nearly shorter than or as long
Asperula oppositifolia ssp. rehingeri (Rubiaceae: Rubiaceae)...

as the lobes, tubes 1.5-3 mm long; lobes 2.5-4 mm long, 0.8-1.5 mm wide. Mericarps obconic, rugose, 1-1.7 mm long, 0.5-1 mm wide.

Fig. 1. Asperula oppositifolia ssp. rehingeri (from the holotype: M. Joharchi & M. Aydani 35596, FUMH).

Fig. 2. Asperula oppositifolia ssp. rehingeri.
Paratypes: Iran: Khorasan Province, W. Bojnord, Ala-dagh Mt., between Darkesh and Havar, 37° 24' N, 56° 46' E, 1700-1900 m, 6.6.2004, Joharchi and Aýdani 35497 (FUMH, PAR); Khorasan Province: W. Bojnord, Jozak, Cheshmeh-Eshgh, 1000 m, 9.5.2000, Joharchi and Zangooei 32752 (FUMH).

Flowering and fruiting time: May-June

Etymology

The subspecific epithet, rechingeri, is named in honor of late Prof. Dr. Karl Heinz Rechinger (1906-1998).

Three localities where the new taxon is found, are close to each other and grows only in the valleys of N.W. Ala-dagh Mt., Khorasan, Iran. It may have a wider distribution in other unexplored areas of northeastern and N. Iran. It is endemic to the northeastern Iran and is distributed at altitudes between 1000-2100 m (Fig. 3). The new subspecies is apparently rare and geographically localized and is very fragrant with a sweet smell.

Fig. 3. Map showing locality of *Asperula oppositifolia* ssp. rechingeri.
List of *Asperula oppositifolia* ssp. based on SCHÖNBECK-TEMESY & EHRENDORFER (2005) are:

1. ssp. *cabolica* Ehrend; endemic to E. Afghanistan
2. ssp. *chitalensis* Schönbl.-Tem. & Ehrend; endemic to Pakistan (Chital)
3. ssp. *grandiflora* Ehrend; endemic to E. Afghanistan
4. ssp. *pseudo-cynanchica* Ehrend; E. Afghanistan, Tadjikistan, Tian Shan and Pamir-Alaj
5. ssp. *rechingeri* F. Ghahremani, Joarchi, & Aycani; endemic to Iran
6. ssp. *sikaramenis* Schönbl.-Tem. & Ehrend; endemic to E. Afghanistan
7. ssp. *swatensis* Schönbl.-Tem. & Ehrend; endemic to Pakistan

Morphologically, the closest relative of this subspecies is ssp. *pseudo-cynanchica* which is distributed in Afghanistan, Tadjikistan, Tian Shan and Pamir-Alaj. It differs from it in pedicel length (0-11.1 not 1-5 mm), corolla length (3.5-7 not 3-4.5 mm), ratio of the corolla’s tubes to the lobes (3/4 to equal not 1/2), mericarp size (1-1.7 x 0.5-1 not 2 x 1-1.25 mm) and glandular mericarp (not glabrous).

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**References**


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BIOGEOGRAPHICAL PATTERNS IN THE RUBIACEAE OF "FLORA IRANICA"

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Abstract
A biogeographical analysis of the Angiosperm family Rubiaceae in S.W. Asia is presented. This analysis is based on the treatment of 20 genera with 152 species and numerous subspecies in vol. 176 of “Flora Iranica” and other relevant literature. In the territory of this flora 32.9% of the Rubiaceae species are endemic. According to their center of distribution all species of the family are placed into phytogeographical groups: Oriental-Turanian (54.6%), Hyrcanian + temperate Eurasian + N. Hemisphere (18.4%), Himalayan and Sino-Japanese (9.9%), Mediterranean (9.2%) and Paleotropical and Saharo-Sindian (7.9%). Relevant biogeographical problems, aspects of morphological and ecological diversification as well as questions of evolution, phylogeny and taxonomy are discussed in greater detail in the following chapters: Paleotropical and Himalayan relationships, old and recent links with the Mediterranean, the Oriental-Turanian region as a center of diversification, the Hyrcanian Province and contacts with the N. Hemisphere.

Key words: Biogeography, Rubiaceae, S.W. Asia, Flora Iranica, Iran.

Introduction
It is now 60 years that the author started to work on the Rubiaceae growing in Iran under the guidance of K.H. Rechinger at the Museum of Natural History in Vienna, Austria. This research has culminated recently in the completion of vol. 176 of “Flora Iranica” containing the treatment of this Angiosperm family.
(EHRENDORFER et al. 2005). The appearance of the present issue of “Rostaniba” in honor of the 100th birthday of K.H. Rechinger, offers a good opportunity to comment on some phytogeographical aspects of Iranian Rubiaceae. This general topic was always of interest to him and he has published some fundamental relevant papers (RECHINGER 1951, 1970, 1986; RECHINGER & WENDELBO 1985).

General comments

The following biogeographical interpretations of S.W. Asiatic Rubiaceae are based on the results of many former studies (EHRENDORFER 1971, EHRENDORFER et al. 1976, EHRENDORFER & SCHÖNBECK-TEMESY 1980, 1982, NATALLI et al. 1996 etc.). In vol. 176 of “Flora Iranica” (EHRENDORFER et al. 2005) 20 genera and 152 species of Rubiaceae were accepted, arising from shrubs and basally woody chamaephytes to perennial herbs (hemichryptophytes) and annuals (therophytes). For a calculation of the proportion of endemic species in the “Flora Iranica” territory, some small, closely adjacent and ecologically linked areas had to be included (i.e. the mountainous parts of N.E. Iraq, Nakhichevan and Talish in S. Azerbaijan, and the Kopet Dag in S. Turkmeniya). Under this precondition not less than 50 species, 32.9% of the total number of Rubiaceae, can be considered endemic to the territory, and that percentage increases, if one considers subspecies as well. For the following more detailed analyses of the phytogeographic relationships of the “Flora Iranica” Rubiaceae, the floristic zones and regions as outlined by MEUSEL & JÄGER (1991-92) have been used with one exception: The Hyrcanian Province is not treated as part of the Oriental-Turanian region but together with the Colchic and Caucasian Provinces as part of the submeridional Eurasian zone. Even in this somewhat narrower sense, the Oriental-Turanian region (formerly called “Irano-Turanian”, see ZOHARY 1973) extends considerably beyond the “Flora Iranica” area In Pakistan, Iraq, the Levante, E. and C. Anatolia, Armenia, Azerbaijan, Turkmeniya, Uzbekistan, Kirgiziya, Kazakhstan and adjacent N.W. China.

According to the present phytogeographical classification of the “Flora Iranica” Rubiaceae, the most dominant component, that is 83 species or 54.6%, are limited to and characteristic for the Oriental-Turanian floristic region. This region
also covers by far the largest surface in the “Flora Iranica” territory. Particularly in its S.W. part there is an admixture of species (14, 9.2%) which have their major occurrence in the Mediterranean region. In the north, the Hyncean Province, regional but also wider distributed submeridional to temperate Eurasian species dominate of (28, 18.4%). In the monsoon influenced mountain regions of N.W. Pakistan and N.E. Afghanistan Himalayan and even Sino-Japanese species (15, 9.9%) reach their western limits. Saharo-Sindian and paleotropic species (12, 7.9%) are concentrated in the southern regions towards the Persian Gulf and the Arabian Sea.

**Paleotropical and Himalayan relationships**

In their great majority Rubiaceae are tropical woody plants. It is significant that some genera, clearly centered in the paleotropics, have reached the “Flora Iranica” area. Wendlandia with about 70 species in (sub) tropical Asia is represented in S.W. Asia by W. arabica Defler in Yemen (and Somalia) and the shrubby W. ligustroides (Boiss. & Hohen.) Blakelock, an isolated relic species, growing in limestone gorges of Iraq Kurdistain, possibly related to W. longifolia (Hance) Hutch, in S.W. China. In contrast, paleotropical members of Kohoutia and Olderlandia have reached the “Flora Iranica” territory only with widely distributed perennial or annual herbs, characterized by African and Asiatic affinities and a less specialized ecology.

The most important links of “Flora Iranica” Rubiaceae with tropical or (sub) meridional clades in the east is through the Himalayan region and the mountains between N.E. Afghanistan and N.E. Pakistan, affected by monsoon summer rains. This “Flora Iranica” area is reached by the shrubby and wide-spread Himalayan Himalodendron tetraspermum (Wall.) Yamazaki and by perennial herbs, as Rubia cordifolia L., Galium elegans Wall. and G. asperifolium Wall. (with extensive distribution areas, also in China). G. cryptanthum HemsL., G. asperuloides Edgew. and G. hoffmeisteri (Klotzsch) Ehrend. & Schönb.-Tem. (mostly in in the Himalayas) or G. subtrinervum Ehrend. & Schönb.-Tem. (from the C. Asiatic group of G. hirtiflorum Rehnd.). On the other hand, this area has allowed species of Oriental-
Turanian origin to expand into the W. Himalaya, as *Rubia himalayensis* Klotzsch or *R. infundibularis* Hemsl. & Läke.

**Old and recent links with the Mediterranean**

The new and DNA-supported circumscription of the Rabinaceae-Rubioidae tribe Rutaceae (BACKLUND et al. In Press) includes the closely related (but better not fused) genera *Galantia*, *Croceylina*, *Aitchisonia*, *Pseudogallya*, *Pterogallya*, *Jauberia*, *Putoria* and *Plocama*. Their distribution area reaches from Socotra, Somalia (with an extension to the Namib in S.W. Africa), through Arabia, S.W. Asia, the Mediterranean and N. Africa to Macaronesia, thus corresponding to the Tertiary Paleomediterranean Tethys. With the exception of the chasmophytic Mediterranean *Putoria* (which comes close to the “Flora Iranica area in the Levante”), the other taxa have adapted to semidesert conditions and can be characterized as Saharo-Sindian or Oriental-Turanian elements (EHRENDORFER et al. 2005). It appear likely, that the eco-geographical differentiation of this tribe *Rutaceae* dates back at least to the Miocene (Tertiary).

The genus *Rubia* is centered with its greatest species diversity in the Oriental-Turanian region of S.W. Asia. It extends to E. Asia and Africa, links the “Flora Iranica” area through *Rubia tenuifolia* D’Urs. with the E. Mediterranean and also reaches Macaronesia with other species. A similar situation is seen in *Crucianella*. Its most plesiomorphic large-flowered perennial species (in sect. *Roseae*) again occur in the Oriental-Turanian region, whereas the more apomorphic taxa expand from there into the Mediterranean, as the coastal perennials of sect. *Maritima* and many small-flowered annuals of sect. *Crucianella*. Among the latter, *C. angustifolia* L. is widespread in the Mediterranean and occurs only marginally in the “Flora Iranica” area, whereas *C. ciliata* Lam. has successfully penetrated into the Saharo-Sindian region. The most plesiomorphic perennial species of *Galium* sect. *Jubogalium* (EHRENDORFER 1958) grow from Yemen and W. Arabia to Jordan and Sinai, other perennial species extend from the Levante into E. and S.W. Anatolia and Crete. In the latter area, apomorphic annual species have originated, and one of them, *G. setaceum* Lam., has occupied an enormous
distribution area from the whole Oriental-Turanian region through the Mediterranean to Macaronesia.

Various other annual clades of Rubieae evidently had their origin in the Oriental-Turanian region and then expanded into therophyte-rich Mediterranean and secondary ruderal or vegetal habitats in Europe etc. Examples are: *Asperula* sect. *Asperula*, *Gallium* sect. *Kogynae* with *G. spurium* L., *G. cerasopodium* Boiss. (diploid) + *G. tricornutum* Dandy (tetraploid), *G. verrucatum* Danth. and *G. nupercreatum* M. Pop. + *G. mucron* (L.) All. In the first two clades additional derivate taxa expanding into the alpine zone of Oriental-Turanian mountain systems have originated: *Asperula setosa* Jaub. & Spach and *Gallium spurium* L. subsp. *ibicinum* (Boiss. & Haussk.) Ehrend. The small therophyte genus *Calliptelis* has one species endemic to the Levante (+ Iraq), another endemic to SW Iran and Iraq, and the third, *C. cucullaris* (L.) DC., again with an enormous area covering all of the Oriental-Turanian and Mediterranean regions.

There are other cases to document the close floristic relationships between the Oriental-Turanian and the Mediterranean regions. An evidently old, relic and throughout diploid clade is *Asperula* sect. *Thilpithisa* (SCHÖNBECK-TEMESY & EHRENDORFER 1985). It is centered with about 24 species in the E. Mediterranean, but there are three closely related, vicarious and chasmophytic species which replace each other in the Elburz mountain system: *A. microphylla* Boiss. in the west, *A. mazanderanica* Ehrend. in the center and *A. gorganica* Schönbb.-Tern & Ehrend in the north.

The very species-rich, polymorphic and diploid to polyploid *Asperula* sect. *Cynanchica* extends throughout the Mediterranean and European to the Caucasian and Anatolian area. Only one species, closely allied with the C. and S. Anatolian *A. stricta* Boiss. subsp. *latibracteata* (Boiss.) Ehrend., occurs in the “Flora Iranica” area, *A. inopinata* Schönbb.-Tern., endemic to the Kurdic mountains of N. Iraq. Within *Gallium* sect. *Kogynae*, the *G. calhaerens* group occupies with several taxa the E. Mediterranean/Oriental-Turanian contact zone between the Levante, S. and S.E. Anatolia and N. Iraq + W. Iran. The small omnimediterranean and perennial to annual genus *Valantia* has reached the western “Flora Iranica” region with the widespread annual *V. hispida* L.
A center of diversification: the Oriental-Turanian region

There are references to the Oriental-Turanian phytogeographical region in all chapters of the present communication. Here, emphasis is given to the importance of the region as an active center of evolutionary diversification and on the resulting diversity of endemic taxa in different provinces of the region (RECHINGER 1986 on the extremely species-rich genus *Cousinia*).

Historical processes of differentiation and eco-geographical radiation become evident from the presence of polymorphic species composed of numerous subspecies and of ± closely related species clusters. They can be regarded as initial (more recent) or as advanced (older) phases of evolutionary diversification and speciation. Examples of species with subspecies among Oriental-Turanian clades of “Flora Iranica” Rubiaceae are: *Crucianella gilanica* Trin. (12 subsp.), *Asperula glomerata* (M.B.) Griseb. (11 subsp.), *A. oppositifolia* Regel & Schmalz. (6 subsp.), and *Caucasia taurica* (Pall.) Ehrend. (4 subsp.). Corresponding aggregates of ± closely related species are more common and are seen in *Gaillonia* sect. *Eriantha* and sect. *Gaillonia*, *Rubia* sect. *Campylanthara*, *Crucianella* sect. *Roseae* and sect. *Caucasia*, *Asperula* sect. *Trichodes* and sect. *Asperula*, *Galium* sect. *Hylaea*, sect. *Galium*, sect. *Orientalgalium* and sect. *Kolyda*, in *Callipteris* and in *Caucasia*. Some of these examples have been discussed already, a few more will be presented in the following paragraphs.

*Crucianella* sect. *Roseae* consists of four perennial species (one of them extremely polymorphic), whose distribution areas only slightly exceed the limits of “Flora Iranica” (SCHÖNBECK-TEMESY & EHRENDOERFER 1989, maps, Figs 7-8). The clade is monophyletic and appears to be diploid throughout (2n=22). Its gradual eco-geographical radiation is demonstrated by transitional populations linking the wide-spread allopatric subspecies of *C. gilanica* Trin. and its close morphological affinities but distinctness relative to the other, allo- to parapatric species of the section. These are *C. platyphylla* Ehrend. & Schönbeck-Tern. (endemic to N. Iran: E. Elburz and Golestan Mts.), the most plesiomorphic taxon of the section, and a more apomorphic and disjunct species pair of the N. Iranian/N.E.
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Anatolian mountains, *C. suaveolens* C.A. Mey. (endemic to Talish, Gilan, Iranian Azerbaijan and Artvin) and *C. sintenisii* Bornm. (endemic to Gorgan, N. Khorasan and the Kopet Dagh). According to the morphological advancement indices of these taxa, one can try to reconstruct their evolution in space and time. The ancestors of the section, reminiscent of *C. platyphylla*, could have grown in rocky openings of the later Tertiary humid and warm and deciduous Hymenian forests of N. Iran. With increasing drought towards the Pleistocene and the expansion of Oriental-Turanian vegetation types one can postulate the differentiation into the three additional extant species, *C. suaveolens* in the N.W., *C. sintenisii* in the N.E. and *C. gilanica* and in the Elburz. Subsequently, the two former did not change much, whereas *C. gilanica* continued to radiate and to expand: in the north with six allopatric subspecies into different eco-geographical niches of the Elburz and its southern slopes; towards the west with subsp. *gilanica* and subsp. *transcaucasica* (Ehrend.) T.N. Popov & Takht. (both parapatric in Azerbaijan and behaving already ± like different species); further to N.E. Anatolia with the relatively isolated subsp. *Pontica* (Ehrend.) Ehrend. and to W. Iran, S.E. Anatolia and N. Iraq with subsp. *kotschyi* (Ehrend.) Ehrend. and subsp. *carduchorum* Ehrend. & Schönb.-Tem.; to the S.W. into the Zagros Mts. with subsp. *Glaucia* (A. Rich.) Ehrend.; and to the east in N.E. Iran, Afghanistan etc. with subsp. *Transcaspica* (Ehrend.) Ehrend. & Schönb.-Tem.

*Cruciata taurica* (Pall.) Ehrend. corresponds to another perennial and most polymorphic aggregate of more western Oriental-Turanian distribution (EHRENDORFER 1971). It extends from a center of diversity in Anatolia to Elboea, Crimea, the Kuban and Caucasus areas, the Levante, N. Iraq, W. and N. Iran, and S.W. Turkmenia. It is a polyploid complex with 2x, 4x, 6x and 8x populations, strongly influenced by hybrid reticulation and still badly understood taxonomy. About 15 species have been described in the aggregate, of which only *C. taurica* with several subspecies and possibly 2-3 species from the Armenian mountains and the main Caucasus can be maintained. The phylogeny of the complex has started with different 2x taxa which have survived in ecologically diverse localities of N.E., C., S.W. and W. Anatolia. All the remaining areas have been occupied by polyploid taxa in the course of the eco-geographical radiation of the aggregate.
Asperula sect. Cruciana and its seven perennial species (one of them with many subspecies) form another impressive example for clades in successive phases of diversification from the Oriental-Turanian region. A. kotschyana (Boiss. & Hohen.), A. aterocephala Bornm., and A. comosa Schönb.-Tern., vicarious limestone chasmophytes from the Kurdic mountains of N. Iraq (+ adjacent S.E. Anatolia) and A. ozvitsii Ehrend. & Schönb.-Tern from N.W. Iran, all rare and of local distribution, constitute the evidently ancient basis of this section. A. proxirata (Adams) C. Koch (with two subspecies) is a more variable species from different altitudes of the mountains in N. Iraq, C. and N. Anatolia, the Caucasus area and N.W. Iran. A. molku-ginoides (M.B.) Reichb., a more mesophilic taxon, occurs in the Caucasus area and in N.W. Iran. By far the most variable and xerophilic species is A. glomerata (M.B.) Griseb. With at least 17 subspecies, vicarious but connected by numerous transitional populations, this taxon has occupied ecological niches from the lowland semideserts to high alpine regions of the whole Oriental-Turanian region with extensions to the Levante mountains and the Caucasus area.

Galium sect. Orientigalium is by far the most species-rich and complex clade among the Oriental-Turanian Rubiaceae. Its center of diversity is in W., N. and S. Iran, Iraq, Anatolia and the Caucasus area (for the latter see SCHANZER & EHRENDORFER 2002), but extensions reach the Levante and the E., C. and even W. Mediterranean mountains (EHRENDORFER et al. 1976). The main bulk of the section consists of the so-called G. subvelutinum alliance with about 48 species of which, partly with overlapping distribution, 24 occur in Anatolia, 20 in the “Flora Irnica” area and 11 in the Caucasus area. Not less than 11 species are endemic within the “Flora Irnica” limits. There is great diversity in growth form, habit, indumentum, shape and size of leaves, inflorescences, all characters of ± adaptive relevance. Through vicarious differentiation the alliance placed its taxa into most diverse ecological niches up to high alpine levels. As a consequence, a patchwork of distribution areas is found, from quite extensive to very local; examples are G. mite Boiss. & Hohen. in xeric habitats from C. and S. Anatolia to N. Iraq and W. Iran, G. czerepanovii Pobed. on limestone rocks of the Araxes river basin or G. schoenbeck-temesvae Ehrend. only on Kuh-e Dinar in Fars. In principle,
areas of taxa within G. sect. Orientigalium are allo- or parapatric, but hybrid contacts occur, and for some taxa polyploidy has been documented. What taxa to classify as varieties, subspecies or species often is very difficult to decide as evolutionary diversification is still in progress. Furthermore, relationships between the many taxa are still very insufficiently understood.

A contrasting example for Oriental-Turanian diversification and subsequent reduction are the related Asperula sect. Trichodes (1), Crucianelloides (2) and Tricosella (3) with only four annual species, separated by drastic morphological differences. Only the uniform A. trichodes J. Gay (1), better known under the generic name “Leptunis”, is wide-spread in the C. and E. part of the Oriental-Turanian region, all the others, A. seticornis Boiss., (1), A. sherardiioides (Boiss.) Jaub. & Spach (2) and A. insignis (Vatke) Ehrend. (3) are local or regional endemics, limited to Fars (1), Gilan (2) and Kurdistn Provinces (3). It appears that divergent evolution in this annual clade has been more rapid than in comparable perennials but has come to a standstill.

There are also some other Oriental-Turanian taxa which have expanded beyond the limits of the floristic region. From Afghanistan and N. Pakistan Rubia infundibularis Hemsl. & Lace reaches to the Punjab and Oman, R. chitravensis Ehrend. to the mountains of S. Kazakhstan. Asperula sect. Oppositifoliiæ has its diversity center in the mountain systems of “Asia Media” with extensions into E. Anatolia, Tibet and the W. Himalaya. Galium songaricum Schrenk, a member of the peculiar annual Galium sect. Depauperata, has a wide distribution in the mountains of C. Asia but is linked with the “Flora Iranica” through populations in the Kopet Dagh, whereas other species of the section reach the Himalaya, China and even N. America. From Galium sect. Kologda the annual group of G. nigricans Boiss. And G. floribundum Sm. extends into the E. Mediterranean and some other less diversified taxa, like the perennial Galium humifusum M.B. and the annual G. tenaxissimum M.B. have reached S.E. Europe. From the western Oriental-Turanian Province the aberrant annual Cruciata articulata (L.) Ehrend. has expanded into Transcaucasia, the Levante and Egypt.

The remarkable amount of floristic diversification within the extensive Oriental-Turanian region makes it possible to characterize different subregions by

**The Hyrcanian Province and contacts with the N. Hemisphere**

From its climate, vegetation and flora the Hyrcanian Province between the crest of the Elburz Mts. and the Caspian Sea belongs to the warm and humid submeditreal zone of W. Eurasia and not to the Oriental-Turanian Province. Among the many relic and endemic taxa of the western part of this area, mostly of late Tertiary age, the monotypic Rubiaceae genus *Phaeopsis* with the perennial *P. stylosa* (Trin.) Hook. f. is of particular interest. It is distantly related to the wide-spread, primarily W. Oriental-Turanian and Mediterranean, annual and also monotypic *Sherardia arvensis* L. A Hyrcanian endemic from *Galium* sect. *Galium* is *G. capsicum* Steven, obviously related and disjunct with the W. Mediterranean *G. maritimum* L.

Taxa represented in the Hyrcanian region, but with larger, Caucasian and European- (Sub) Mediterranean distribution are *Asperula* sect. *Glabella* with
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G. Fischer, Stuttgart etc.

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TYPIFICATION OF ASTRAGALUS SPECIES IV
(FABACEAE), MOSTLY OF THE
SECT. RHACOPHORUS

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Abstract
One hundred and seventy six taxa of the genus Astragalus or from genera belonging to it are typified here.

Key words: Typification, Astragalus, Rhacophorus, Fabaceae

Introduction
Astragalus is the largest genus of plants with perhaps 3,000 species with ca. 2,500 species in the Old World. More than 5500 species have been described where half of them are synonyms of other species. To attribute all these names to the right species, it is necessary to typify them in the right way. In older times, it was often not used to design a type, but in this case all cited specimens were, therefore, syntypes. In case of heterogeneous materials, this has caused a lot of confusion. In order to stabilize the nomenclature in this huge genus, we have typified most of the species in several papers (POdlech 1998, 1999, 2001, Podlech & Sytin 1996). Nevertheless, there is a rest of untypified taxa which are typified here. The great bulk are taxa of the large and taxonomically difficult sect. Rhacophorus, of which

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only the accepted names of species belonging to the "Flora Iranica area" are typified in the forthcoming volume of "Flora Iranica" (Papilionaceae V, Astragalus III). All synonyms and all the numerous taxa outside this area, will be typified here. All specimens seen by us are marked with !


Typification of *Astragalus* species IV (Fabaceae)...

Akscheher (Wilayet Konia), ca. 1100 m, 6.7.1899. J.F.N. Bornmüller 4420 (B!: iso: BRNM!).


*A. arenarius* L. var. multijugus* Rochel, Pl. Banat. rar.: 52, tab. XV, fig. 33. 1828. - Type: the herbarium of Rochel in DR was destroyed in World War II - Lectotype, iconotype (designated here): t.c., tabula et fig.).

*A. argenteus* Vis., Flora 12, Ergbl. 1: 18. 1829. - Type: in saxosis apries agri Scardoniti, sibenicensis, in monte aureo. - Lectotype (designated here):


A. australis (L.) Lam. var. glaberrimus Kotula, Distr. pl. vasc. mont. Türr.: 284. 1889-1890. Type: not indicated. - Lectotype (designated here): Tatra, Piervont, 5.8.1879, Kotula (as var. glaberrimus) (W!).


Typification of Astragalus species IV (Fabaceae)...

Adserhidalchan prope Seid-abhid, T. Bienert (P!: foto MSB!; iso: G-BOIS!: "inter Agkent et Mianeh").


1849, E. Boissier & G.F. Reuter (K!, W!). - Lectotype (designated here): circa Barcinonem, G.F. Reuter (G!: iso: G!).

A. christianus L. subsp. suboccidentalis Ponent, Feddes Repert. 83: 621. 1873. - Lectotype (designated here): [Turkey] Nigde, Taspınar, F.H. Davis & al. 18845 (K!: iso: BM!, E!). Note: The type has not been seen by the author.


Typification of Astragalus species IV (Fabaceae)...


- Lectotype (designated here): Uzbekistan, Baissan, versus Derbent, 1000 m, 21.8.1913, Bommlüller 1120 (LE!; iso: B!).


Pass, 4350 m, H. von Handel-Mazzetti (W!). - Lectotype (designated here): China, NSseite des von Muli gegen Dschungdien führenden Rückens, 3900 m, 4.8.1915, H. von Handel-Mazzetti 7426 (WU!; iso: EI, W!).


Typification of *Astragalus* species IV (Fabaceae).

(K!; photo MSB); Sultanabad, Schutanunkuh, 24.6.1889. Th. Strauss. - Lectotype (designated here): Sultanabad, Schutanunkuh, 24.6.1889. Th. Strauss (sub *A. andalanicus*) (B!).


taxon collected before the publication is found, a neotypification is necessary.

Neotype (the only extant specimen of Borbás, designated here): in arenosis curipí Rákosi ad Budapestinum, 11.7.1888, V. de Borbás (BP!).


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Typification of Astrapogon species IV (Fabaceae).


A. giraldianus Ulbr., Bot. Jahrb. Syst. 36, Beibl. 82: 64. 1905. Lectotype (designated here): [China] Äußerster Norden von Shensi [Shaanxi] bei In fan to, G. Giraldi 4277 (FI!; the type material at B is destroyed, drawing at K!).


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Typification of *Astragalus* species IV (Fabaceae)...


450 (B!): - Lectotype (designated here): Lycaonia, m. Karuadagh supra Suleiman-Hadji-Maliki, 17.6.1911, Andriasovszký 456 (B!).
Typification of *Astragalus* species IV (Fabaceae)...


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A. microcephalus Wild. var. argaeus Sirj., Repert. Spec. Nov. Regni Veg. 47: 204. 1939. - Syntypes: Cappadocia, m. Argaees, 1400 m, 1836 B. Balansa 939 (G-BOIS!: sub num. 199, GOET!); ibid., 1600 m, E. Zederbauer; ibid., Kysile-depe, 2000 m, [7.7.1898]. Siehe 190 (B!: frig., K, LE!, WU!). - Lectotype (designated here): [Turkey] Cappadocia, m. Argaees, 1600 m, E. Zederbauer (WU!: sheet marked as lectotypus; iso: WU!).


Typification of *Astragalus* species IV (Fabaceae)...


A. *parrowianus* Boiss. & Hausskn. in Boissier, Fl. Or. 2: 320. 1872. - Lectotype (designated here): in m. Parrow supra Kermanmschah, 9000', ix.1867, H.C. Haussknecht 352a (G-BOIS!; sheet marked as lectotypus; iso: G-BOIS!, JE!, K!, LE!, PI!, W!).


18.5.1901, P.E.E. Sintenis 1682b (BRNM!, L.DI); ibid., 31.5.1901, P.E.E. Sintenis 1682c (BRNM!, JE!: 1682, L!: 1682, LD!). - Lectotype (designated here): Sülükü, 7.8.1900, Sintenis 1061 (BRNM!, iso: B!, BM!, BP, E! G!, JE!, K!, LD!, MSB!, P!, STU!, W!, WU!, Z!).


*A. psilodontius* Boiss., Diagn. pl. orient., ser. 1, 9: 86, 1849. - Lectotype (designated here): in regione inferiori Libani vel Antilibari (loci proprii non memini), viii.1846, E. Boissier (G-BOIS!; sheet marked as lectotypus; iso: G-BOIS!).


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Typification of Astragalus species IV (Fabaceae)


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Lectotype (designated here): Antilibanon, oberhalb Râşcheya, 7,000-9,000' Th. Kotschy 170 (B!; isotype: MSB!, W!).


*A. transjordanicus* Eig, Syst. Stud. Astrag. Near East: 12. 1955. Syntypes: Southern Syria, Hauran, inter Gabagaeb et Samanein, ca. 660 m, 7.5.1933, G. Samet-Tossin; Bosra, 7.5.1886, Post (B!, K!). - Lectotype (designated here): Southern Syria,
Typification of Astragalus species IV (Fabaceae)...

Hauran, inter Gabagueh et Saramein, ca. 660 m, 7.5.1933, G. Samuelsson (HUJ; iso: W!).


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http://www.botanik.biologie.uni-muenchen.de/botsys/theslit.html


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THE GENUS ALLIUM (ALLIACEAE) IN IRAN: CURRENT STATE, NEW TAXA AND NEW RECORDS

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Abstract
After a short review on taxonomic contributions to Iranian Allium species after "Flora Iranica" (1971), Allium longipapillatum R.M. Fritsch & Matin, A. montelburzense R.M. Fritsch, Y. Salmaki & SH. Zarre, and A. kuhseorkhense R.M. Fritsch & Joharchi were newly described. Allium fuscoviolaceum Fomin and A. moschatum L. were newly recorded for Iran, and the occurrence of A. lamondiae Wendelbo was confirmed. Descriptions and maps of distribution were given for all these species including a diagnostic key for the A. capitellatum Boiss. alliance. Morphological characters of sect. Pseudoprason Wendelbo were discussed and supplemented by a key for Allium species having tepals with more than one midvein.

Key words: Allium, Iran, Taxonomy, Classification, Distribution, Description

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Introduction

*Allium*, is one of the largest (about 850 species, FRIESEN et al. 2005) and taxonomically most diverse and complicated genera of the monocots with a main centre of diversity in the mountainous areas of Southwest and Central Asia (FRITSCHE & FRIESEN 2002). The territory of Iran belongs to this centre. Here the genus *Allium* is typical for the Irano-Turanian phyto-geographical region and displays a high level of specific endemism (MATIN 1992).

During the last 30 years, in Iran many herbaria were established and having respectable scientific collections. Well-known Herbaria like "TARI" and "IRAN" expanded by addition of thousands of newly collected voucher specimens. Nowadays, at least the threefold amount of materials could be used compared with the last complete revision of the genus for Iran by WENDELBO (1971) who recognised 75 *Allium* species in Iran. However, this wealth was only used for revision of small groups (like sect. *Megaleprason*, FRITSCHE 1996). Rarely *Allium* species new for Iran were recorded (MATINE 1976, MATIN 1991, AKHANI 1999), and only sporadically newly identified taxa have also been described (MATIN 1989, KAMELIN & SEISUMS 1996, FRITSCHE et al. 2001, FRITSCHE et al. 2002, MASHAYEKHI et al. 2005). However, the record of *A. hollandicum* R.M. Fritsch in Iran published by SEISUMS (2000) was a misapplication (FRITSCHE et al. 2002). Scientific progress led to nomenclatorial alterations of names used by WENDELBO (1971): *Allium boissianum* Regel became a nomen rejicendum (BRUMMITT 2001) and was sunk into synonymy of *A. cristophii*; *A. hirtifolium* Boiss. is con-specific with the somewhat earlier described *A. stipitatum* Regel (FRITSCHE 1996), and the Iranian specimens of *A. brachyscapum* Vved. turned out to represent a new species *A. assadi* Seisums (SEISUMS 2000). Because strong evidence accumulated that, *Nectarscorodion* can no longer be accepted as separate genus but belongs to *Allium* (FRIESEN et al. 2005), two species were formally transferred to *Allium*. The resulting "landmark" of 88 species occurring in Iran is the starting point of our investigations.

These data strongly underline a modern revision of the genus *Allium* in Iran is urgently needed which will become an integral part of the currently edited "Flora of Iran" in Persian. Such an extensive analysis can not be currently written in
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one go because re-groupings and description of new taxa will be unavoidable. This and other English papers will announce the progress to the community of taxonomists acting as precursors of or contributions to this revision.

WENDELBO (1971) applied the then most modern classification of the genus. He accepted 140 *Allium* species for the area of "Flora Iranica" belonging to four subgenera and 15 sections (several of which he had described himself shortly before). After Wendelbo, a rather large number of infrageneric taxonomic groups was created but only a part of them is applicable to *Allium* species occurring in Iran. The most recent classification proposal for the whole genus *Allium* (FRIESEN et al. 2005) accepts 15 subgenera and 72 sections. According to this new classification, the *Allium* species currently recognized for Iran belong to seven subgenera and 29 sections. This classification will be applied here and in later papers.

**Taxonomic part**

1. subg. *Allium*

As STEARN (1978) pointed out, sect. *Scorodoen* in the sense of WENDELBO (1971) with C. Koch as author and *A. rubellum* M. Bieb. as type species is nomenclatorically incorrect. This section has earlier been described by W.D.J. Koch, and *A. moschatum* L. was chosen as lectotype species which now belongs to subgenus *Polyziros* Radič (FRIESEN et al. 2005; see below). The other 11 Iranian species which WENDELBO (1971) included under sect. *Scorodoen* remained in subg. *Allium* but were transferred by KHASSANOV (2000) and FRIESEN et al. (2005) to other sections:

- *A. callidicynos* C.A. Mey. to sect. *Brevispatha* Valsecchi
- *A. burgei* Boiss. and *A. sabulosum* Stev. ex Burge in GOEB. to sect. *Frenioprosos* (Kamelin) F.O. Khiss., R.M. Fritsch & Friesen

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- A. capitellatum Boiss. to sect. Caerulea (Omel.) F.O. Khass. Here we have to add a new species from central Alborz mountain range described below:

While most Allium species in Iran are spring flowering, a remarkable number of species belonging to subg. Allium are flowering in summer when plant collecting becomes more difficult. Then especially rather small and otherwise inconspicuous plants are often overlooked and rarely collected for the herbaria. Thus more of hitherto unrecognized or new taxa for Iran belong to subg. Allium than to other subgenera.

1.1 Allium longipapillatum R.M. Frisch & Matin, sp. nova (sect. Allium)
Holotype: Iran: Prov. Lorestan, Khormambad: Cham-Diyar, 1400 m, 25.05.1999 leg. Veiskaram, No. 23982 (TUH) [N 33°30', E 48°19'30"] (Fig. 1 & 2)
Description: Bulbus ovoideus, 8 mm in diametro et 10-12 mm longus; tunicae membranaceae fusco-badiae. Bulbilli in numero 3-5, breve stipitati tunicis atrobrunneis. Folia in numero 2-3, anguste lanceolata, plena in statu vivendi convoluta, manifeste papillata, 8-16(20) cm longa et 3-4(5) mm lata, margin (sub-)ciliatis, vivide usque glauce viridis. Scapus flexuosus subcylindricus levis, basi decima partis vaginis foliiorum involutis, glauce viridis basi atorubro suffusa. Spatha rostris longitudinis 15-20 mm. Umbella sphaerica ca. 2 cm in diametro, 15-30 flora, pedicelli 3-8 mm longi stricti. Bracteoli plus minusque lanceolati. Perigonium cupuliforme 3-4 mm longum et 2.5-3.5 mm latum. Tepala lanceolata, dorso et margine equaliter longis asperi-papillatis; interna 1.2-1.5 mm lata, externa sublatiora; lateo-rosea fuscato-nervosa. Filamenta tepalis aequantia vel sublongiora, interna tricuspida tepalis latiora, cuspidie antherifera minus dimidio longitudinis ovatae bases filamenti attingente, cuspidie lateralia longissima; filamenta externa indivisa triangularia. Stylus exsertus 2-2.5 mm longus. Ovarium subsphaericum ca. 2 mm longum leve. Capsula et semina ignota.

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Bulb ovoid, ca. 10-12 mm long and 8 mm in diameter, with membranous, dark reddish-brown tunics. Side-bulbs 3-5, shortly stalked, blackish-brown. Leaves 2-3, sheathing the lower tenth of the scape; blades narrowly lanceolate, 8-16(20) cm long and 3-4(5) mm wide, plane, in the living remarkably convolute, roughly papillose, (sub-)ciliate along margin, viscid to glaucous green. Scape flexuous, subcylindrical, smooth, 20-30 cm long and 3-4 mm in diameter, glaucous green, basally dark reddish brown. Spathe with 15-20 mm long beak. Inflorescence head-like, about 2 cm in diameter, with 15-30 flowers. Pedicels 3-8 mm long, straight. Bracteoles present, more or less lanceolate. Flowers 3-4 mm long and 2.5-3.5 mm wide, cup-shaped. Tepals lanceolate, yellowish-pinkish with darker midvein, on abaxial surface and along margin loosely but equally covered with strongly enlarged cells bearing long papillae, inner ones 1.2-1.5 mm wide, the outer ones slightly broader. Filaments as long as tepals or subexserted; inner ones tricuspidate with the anther-bearing cusp less than half as long as the ovate basal lamina which is wider than inner tepals, lateral cusps very long; outer filaments undivided, triangular. Style exserted during anthesis, 2.2-2.5 mm long. Ovary subglobose, ca. 2 mm long, smooth. Capsule and seeds not seen.

Distribution and habitat: Known only from the Zagros mountain range in the Lorestan and Bakhtiar Provinces. The habitat of the type collection was not mentioned. The plants from Bakhtiar Mts. grew on a dry rocky limestone slope.

Relationship: The presence of remarkably larger cells which bear long papillae in the tissue of leaf blades and tepals is the most prominent character of this species. It belongs to the alliance of *A. rotundum* L. and is more closely related to *A. quandehense* Feimbr. than to *A. notabile* Feimbr. and *A. subnotabile* Wendelbo which do not own flat leaves. Also the very short leaf sheathes and yellowish-pinkish flowers are distinguishing characters. Length of tepals, the subexserted filaments, and the colour of bulb tunics do not much differ from *A. notabile*, but the colour of the much larger side bulblets is similar to *A. subnotabile*.

Phenology: Anthesis apparently from end of May till June.

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Fig. 1. Holotype of *Allium longipapillatum.*
Additional specimens examined:

This new species was collected by R.M.F. in the Bakhtiari Mts. near Shah-e Kord (N 32°21', E 51°04') already in 1994 when only plants prior to anthesis were found. During analysis and discussion of these plants jointly with Ms. Matin, we concluded that, this should be a distinct species. Unfortunately, these plants did not survive transplanning to the Allium collection in Gatersleben, and a Type specimen could not be selected.

Fig. 2. Allium longipapillatum: A. Tepals and filaments (scale bar = 1 mm), B. Distribution map.

1.2. Allium montelburzense R.M. Friese, Y. Salmaki & SH. Zarre, sp. nova (sect. Caerulea)

Holotype: Iran, Prov. Mazandaran, Central Alborz protected area, 2 km after Kandavan tunnel to Siah-Bisheh, N 51° 10' 49'', E 36° 12' 11'', 2780 m, 17.07.2005 leg. SH. Zarre & H. Moazzemi 36583 (TUHI; isotypes: B!, M!, TARJ) (Figs 3 & 4).

Description: Bulbus solitarius, ovatus, ca. 1.5 cm longus et 2 cm in diametro, tunicis interioreis papyraceis, albis. Scapus erectus, ca. 15-20 cm longus, glabrus. Folia in numero 1-2, fistulosa, circumdata, 10-13 cm longa ca. 2 mm in diametro, glabra. Spatha membranacea, bivalva, ovato-lanceolata, rosea usque purpurea, ca. 5 mm longa. Inflorescentia semi-glabora, 15-30-flora. Pedicelli inaequali 5-10 mm longi. Tepala anguste lanceolato-oblonga, obtusa, 3-3.2 mm longa 1.2-1.5 mm lata, rosea usque purpurea. Filamenta 7-8 mm longa, basi 1.5-2 mm longitundinis connatae et
tepala adnata. Antherae 2.5 mm longae, purpureae. Ovarium obovato-globosum, minutae tuberculata, sessile. Stylus filiformis, ca. 4.5 mm longus. Capsula obovata, 3-5 mm in diametro. Semina nigra, convesa, elliptica, ca. 4 mm longa et 2-2.5 mm lata.

Affinis Allio capitellato sed differt filamenti staminum duplo (nec paulo) longioris, antheris purpureoetibus (nec flavis), tepalis lanceolato-oblongis (nec ovatis) et foliis fistulosis (nec semiteretibus-canaliculatis); differt ab A. taenosicco bulbi tunicis esteriores densitacantibus purpureis (nec cinerascentibus brunneis et reticulato-fibrosis) et filamenti staminum duplo longioris (nec aequilongis).

Bulb single, ovate, ca. 1.5 cm diam. and ca. 2 cm long, outer tunics greyish brown to black, inner tunics papery to hyaline, white, collum 2-2.5 cm long. Scapum filamentosum, erectum, ca. 15-20 cm long, ca. 2 mm diam., greyish green, glabrous. Leaves 1-2, fistulosae, circinatae, 10-13 cm long and ca. 2 mm wide, glabrous or on the nerves finely covered with short sebroid hairs. Spathe ± membranous, divided into two ovate-lanceolate acuminate parts, pink to purplish with darker veins, ca. 5 mm long. Inflorosance semi-globoso, 15-30-flowered. Pedicelli unaequal in length, pink, thin, 5-10 mm long. Tepala narrowly lanceolato-oblongae, obtusa at tip, 3-3.2 mm long and 1.2-1.5 mm wide, basally 1-2 mm united, slightly deflexae and involute, pink to purple with darker veins. Filamenta 7-8 mm long, about two times longer than tepala, basally for 1.5-2 mm connatae to each other and for the same length adnatae to tepala, lanceolato-linear, pink to purple. Antherae 2.5 mm longae, purplish. Ovary obovato-globose, finely tuberculata, sessile. Style filiforme, ca. 4.5 mm. Capsulae obovatae, 3-5 mm diam. Semina negra, convesa, elliptica in outline, ca. 4 mm longa et 2-2.5 mm lata.

Phenology: Flowering and fruiting time July to August.

Distribution and Habitat: Allium montelburzense is known only from meadows at North slopes of Alborz Mountains (Fig. 3) especially at humid rocky places. Like other related species it is flowering in summer, while most other species of Allium in Iran are spring flowering.

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Fig. 3. Distribution map of *Allium montelburzense*.

*A. lalesaricum*, and *A. sabulosum* are the most important members of this group, but the new species shows the longest filaments (for a detailed comparison see the key below). WENDELBO (1971) defined *A. capitellatum* much wider than in the original description (BOISSIER 1846) and determined a few specimens of *A. montelburzense* as *A. capitellatum* like other voucher specimens from N. Alborz. However, these materials obviously belong to two different taxa. According to our point of view, *A. capitellatum* has yellow and not purple anthers, and the filaments are not longer than 4.5 mm and cannot reach 5.5 mm as WENDELBO (1971) considered.

**Additional specimens examined:**

Iran: Prov. Mazandaran: Kelardasht, Kuh-e Takht-e Suleyman, 3620 m, 12.7.1973, M. Fotovat 10195 (TARI); ca. 10 km after tunnel-e Kandavan, mountains above Pol-e Zanguleh, ca. 2400 m, 12.8.2006, SH. Zare & H. Mouzzeni 36584 (TUH, TARI).
Fig. 4. *Allium montelburzense*: A. Holotype (TAR), B. Inflorescence in natural condition (scale bar: A = 1 cm, B = 5 mm).
The genus *Allium* (Amaryllidaceae) in Iran: Current state, new taxa...

**Diagnostic key to Iranian species of *Allium* sect. *Scorodon* sensu Wendelbo**

1. Bulb tunics reticulate-fibrous in texture, collum at least 3 cm long .................................................. *A. latescaricum*
   - Bulb tunics papery in texture, collum at least 3 cm .................................................. 2
2. Inflorescence with at least 100 flowers; leaves 5-7 mm wide; tepals greenish to white; pedicels 1.5-2 cm long .................................................. *A. sabulosum*
   - Inflorescence with up to 80 flowers; leaves narrower than 2.5 mm; tepals pink to red or purple; pedicels at most 12 mm long .................................................. 3
3. Filaments up to 4.5 mm long; anthers yellow; tepals ovate .......... *A. capitellatum*
   - Filaments 6-8 mm long; anthers purple; tepals lanceolate-oblong .................................. *A. monteliburzense*

2. **subg. Melanocrommyum** (Webb & Berth.) Rony

2.1. *Allium kulsoorkhense* R.M. Fritsch & Joharchi, species nova (sect. *Acanthoprason*) (Fig. 5)

Holotype: Iran, Prov. Khorasan, Kashmar, Kuh Sorkhe, 9.5.1995, Faghinia, No. 25356 (FUMH; Isotype: TARI)

Description: Bulbus subglobosus 2-3 cm in diametro; tunicae cinereae-badiae paulo longitudinaliter fissae. Folia singula vel bini, elliptica usque oblongo-ellatica, crassa, carnosa, basis versus stipitato-acutata, basi amplexicaulis, superne plana, supra subbulbosa impolita, inferne levia nitida; margine dentata atque sublevia usque subtiliter acuminata, rubra; 15-25 cm longa 5-8 cm lata, glaucissima, basis inferne rubro-badia suffusa. Scapus cylindricus erectus levis, pars suprateramina 5-8 cm longa, ca. 6 mm in diametro, glauco-viridis basi atroruber suffusus. Spatha membranea 2-4-partita partibus brevibus acuminatis, pallide fulva nervis inconstipuis. Inflorescentia initio semiglobosa deinque subglobosa densa multiflora, 4-6 cm in diametro. Pedicelli ereti stricti paulius incrassati initio 6-8 mm longi deinque usque 25 mm longi, viride-fusci. Flores stellati. Tepala longe-triangularia convoluta acuta. 7-9 mm longa basi 1-5 mm lata, rosea usque alba interdum alba fasciato-nervosa, post anthesin valde convoluta ultimam anguste-conica nec rigida. Filamenta subulata tepalis subsequentia, alba apice kermesina vel violacea, basi brevissimae et tepalis

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adnata. Antherae elongatæ flavæ asque subviolaceæ. Ovarium depresse-globosum intense trisulcatum, aspernum, 3-4 mm longum 4-5 mm in diameter, viride rubrosuffusum. Stylus conicus 5-4 mm longus stigmae indiviso. Capsula depressa tripartita acuto-angulata profunde sulcata, ca. 5 mm longa 8-9 mm in diametro, in vivo viride-cinerea fuscoviolacea tincta exsiccatis fulvis. Semina in quoque loculis solitariis, depresse-ovata, 3-5-4 mm longa ca. 3 mm lata ca. 2 mm erassa, impolita nigra.

Affinitas incerta, fortasse distans affinis Alliæ brachyscape. Quamquam statuta similis ab A. akata et speciebus affinis differt omnibus ponderosis characteribus floribus.

Bulbs nearly spherical, 2-3 cm in diameter, tunics greyish-brown, somewhat longitudinally splitting. Leaves one or two, elliptic to oblanceolate, thick fleshy, towards base stalk-like narrowed and very basally enclosing the scape, the upper part ± flat, upper side slightly sulcate, dull, lower side smooth, shining; margin finely toothed or nearly smooth towards the short tip, red; 15-25 cm long and 5-8 cm wide, very glaucous, basally lower side reddish-brown suffused. Scape cylindrical, straight, smooth, 5-8 cm long above soil, c. 6 mm in diameter, glaucous green and basally reddish-brown suffused. Spathe membranous, splitted in 2-4 shortly acute parts, pale brownish with inconspicuous nerves. Inflorescence 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. Flowers star-like. Tepals long-triangular, longitudinally folded, acute, 7-9 mm long basally 1.5-2 mm wide, pink to brownish-red (sometimes white), midvein much darker; after anthesis strongly convolute and finally narrowly conical but not stiff. Filaments nearly as long as tepals, white with carmine to violet tip, subulate, basally shortly connate and united with tepals. Anthers elongate, yellowish to slightly violet. Ovary depressed globose with three deep furrows, very coarse, 3-4 mm long and 4-5 mm in diameter, green, reddish flushed. Style conical, 4-5 mm long, white, stigma undivided. Capsule depressed tripartite with sharp angles and deep furrows, c. 5 mm long and 8-9 mm in diameter, fresh greenish-grey with brown-violet surface, in dry state pale brown. Seeds one per locule, depressed-ovate, 3.5-4 mm long, c. 3 mm wide and c. 2 mm thick, dull black.
Phenology: Flowering and fruiting in May to June.

Distribution and habitat: This species is known from Binalud and Kuh Sorkhe mountain ranges but is expected to occur in the whole Northeast Khorasan Province. The plants are growing at south exposed places like dry stony slopes, rock outcrops, and rock terraces.

Relationship: At a first glance this species looks like A. akaka s. str. However, several clear differences underline different taxonomic positions.

Fig. 5. Allium kuhsorkhense: A. Plant from type locality. B. Distribution map.
Other short-stemmed species from the *A. derderianum* Regel alliance differ remarkably by linear leaves and much shorter and basally dilated filaments. Narrow filaments were also reported for *A. egorovae* M.V. Agababian & Oganesian and *A. vasiievskiae* Oganesian from Armenia, but these taxa have also linear leaves and long scapes.

Perhaps *A. brachyscapum* Vved. from Turkmenian Koppeh Dagh mountain range is somewhat closer related. It differs by filaments much longer than the lanceolate and finally reflexed tepals but shares with *A. kuhsorkhense* some characters of the leaves, the coarsely tuberculate ovary, and tepals not becoming stiff in dry state. *Allium kuhsorkhense* is apparently a rather variable species. The population at the type location showed generally pink flowers, but in Binalud also plants with brownish flushed tepals were intermixed (Table 1).

Table 1. Comparison between *A. Akaka* and *A. kuhsorkhense*

<table>
<thead>
<tr>
<th>Character</th>
<th><em>A. akaka</em> s. str.</th>
<th><em>A. kuhsorkhense</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflorescence</td>
<td>± semi-globose</td>
<td>(sub-) globose</td>
</tr>
<tr>
<td>Tepals</td>
<td>ovate</td>
<td>triangular</td>
</tr>
<tr>
<td>Dry tepals</td>
<td>With thickened midvein, stinging stiff</td>
<td>without thickened midvein, soft, not stinging</td>
</tr>
<tr>
<td>Filament length</td>
<td>1/2 of tepals</td>
<td>slightly shorter than tepals</td>
</tr>
<tr>
<td>Inner filaments</td>
<td>Basally triangular widened</td>
<td>throughout subulate</td>
</tr>
<tr>
<td>Ovary</td>
<td>ovate with flat tip, shining, surface finely sub-tuberculate</td>
<td>depressed-globose, dull, surface coarsely tuberculate</td>
</tr>
<tr>
<td>Distribution</td>
<td>N.W. Iran, E. Anatolia</td>
<td>N.E. Iran (Hamadan Prov.)</td>
</tr>
</tbody>
</table>

Additional specimens examined:
Iran: Prov. Khurasan: Binalud massif. valley with river N.E. of vill. Khav-e Olya, 1700 m, N 36°12'01", E 59°05'14", 25.04.2004 R.M. Fritsch & M. Keusgen (*Allium* reference collection: IRAN-1034); North of Torbat-e Heydarieh, Kameh-Sofla, Serisha mountains, 1600 m, 5.5.1991, Joharchi & Zangooei No. 20011 (FUMH); Esfarayen, Safabad, Ghanbarbaghi, 1700 m, 14.5.1991, Faghrihnia & Zangoui 20156 (FUMH); Kashmar, Rivash, Kuhsorkhkh. between Targh and Kalateh Teymour, 1800 m, 4.5.1994, Faghrihnia & Zangoui 23861 (FUMH); North of
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Torbat-e Jam, between Tiranak-Balu and Dosange, 1200 m, 11.5.1994, Faghhiinia & Zangwiri No. 23873 (FUMH); Kashmar, S.W. Rivash (Sorkhkuh), Band-e Ghara, 1800 m, 8.5.1995, Faghhiinia & Zangwiri No. 25356 (FUMH).

2.2. **Supplemented descriptions for sect. *Pseudoprason* Wendelbo and *Allium koelzii* (Wendelbo) Persson & Wendelbo**

Regrettably, the formal description of sect. *Pseudoprason* (WENDELBO, 1971) contained more excluded than accepted characters: "Folia sine vaginis supraterraneis. Flores parvi disco potius indistincto. Tepala interna non distincte uruguaytana," leaving open which vegetative characters this section really owns. When PERSSON & WENDELBO (1979) transferred this section and its only species from *Nectaroscordum* to *Allium* subg. *Melanocrommyum*, they based this decision mainly on chromosomal data and mentioned the presence of several nerves in the tepals as the only morphological argument in summary and conclusion parts of that paper. Nevertheless, much more morphological characters mentioned by WENDELBO (1966, 1971) were discussed and confirmed by PERSSON & WENDELBO (1979). They may be extracted from the text as typical characters of sect. *Pseudoprason* and *A. koelzii*:

All leaves basal and not keeled; tepals 4-5 mm long with 3-7 nerves in the outer and 1-3 nerves in the inner tepals; filaments broadly connate, adnate above the base of the tepals; ovary verruculose without a clearly defined disc, distinctly superior, containing 4-8 ovules per locule.

During fieldwork in northern provinces of Iran in 2006, at several locations in the Zagros mountain range we were able to study living plants with 4-7 ovate to lanceolate leaves being up to 10 cm broad and vivid to yellowish-green (Fig. 6 A). The small inflorescences at the top of very short scapes were still completely hidden by the beaked spathe. A few plants flowered after transfer to the living *Allium* collection at "IRAN" Herbarium (Evin) showing up to 60 cm long scapes and subglobose inflorescences with white flowers. The outer tepals had three medium veins and were earlier reflexed and became involute than the inner tepals which had one or three midveins (Fig. 6 B).
According to morphological characters, these plants can only belong to subg. *Melanocrommyum*. Many flower characters, especially the 3-veined tepals, match very well the description of *A. koelzii*, but other ones mentioned above as well as some leaf characters disagree. May these plants also belong to *A. koelzii*? This question can be answered with certainty only after plants from type location will have been analysed. Nevertheless, some arguments for a positive answer can be gained independent from such a study.

The presence of more and broader leaves could be accepted without problems because up to 5 cm wide leaves were already discussed in the original description (WENDELBO 1966). Additionally, it is a common experience of *Allium* researchers that tall growing species are mainly represented by small plants and rarely by “normal” tall plants in the herbaria. This is probably caused by easier handling of small plants during transport, drying, and preparation of herbarium specimens. Thus the few specimens seen by Wendelbo represent probably only the "low fraction" of this species.

Fig. 6. *Allium koelzii*: A. Plant in vegetative state (Kordestan Prov., No. 1118), B. Part of inflorescence with buds.

The differences in the posture of the tepals can perhaps best be explained by the assumption that the holotypical plant was laid into the press when the buds were still very young. In such cases the buds cannot open in normal manner, and
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miformed flowers arise. Additionally, the posture of the tepals was not at all discussed by Persson & Wendelbo (1979), and also the campanulate shape of perianth was not confirmed for A. koelzii. One can only assume that the living plants, which were used for karyological studies, did not flower at least until the manuscript was submitted. The fact, that the figures accompanying the first description were later re-used without substantial changes may also point to missing additional data.

Reflexed white tepals were also recorded for the holotype specimen of another Iranian species. Wendelbo’s (1971) description of A. fedtschenkoi Náb. said "Perigonium late campanulatum ... demum reflexa et contorta ...", and also some other characters of this species fit rather well the plants shown in Fig. 4. However, the tepals shall be 7-8 mm long and linear-lanceolate. After having seen two vouchers from Iraq, Wendelbo (1985) changed the description: Tepals purplish, failing to white in dried specimens. Therefore the plants under discussion cannot belong to A. fedtschenkoi.

How much veins have the tepals of this taxon, and can it belong to sect. Pseudoprason? Wendelbo did not mention this character neither in “Flora Iranica” nor in “Flora of Iraq”, but Nábělek (1929) wrote in the original description "nervo apicem non attingentem percorso" expressing the presence of one vein. Nevertheless, re-examination seems essential.

Supplemented description of Allium koelzii

Bulbs nearly spherical, 3-6 cm in diameter and 3-5 cm high, with irregularly decomposing, brownish outer tunics. Scape subcylindrical, straight, smooth, 40-70 cm tall, 6-10 mm in diameter, glaucous, green or reddish flushed. Leaves 3-7, leaf sheaths below the soil, outer leaf blades broadly ovate to broadly lanceolate, rounded with acute tip, 15-25 cm long and (3)6-12 cm wide, inner ones much narrower with broadly acute tip, as long as the outer ones but 1-3, 5 cm wide, yellowish to vivid green, mostly glaucous. Spathe membranous, often split into two acute parts, brownish-yellowish with inconspicuous nerves. Inflorescence ± orbicular, rather dense. Pedicels straight, wiry, 25-35 mm long, pale green. Flowers three-angled with irregularly spreading white tepals. Outer tepals
naviculate, broadly elliptical, obtuse, 4-5 mm long and ca. 2 mm wide with 1-3 green midveins, initially straight forward and later obliquely forward directed, finally like the spoon-shaped inner ones 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, basally c. 1 mm long united and the inner ones widely, the outer ones slightly, three-angled broadened, above subulate. Anthers greenish-yellow, elongated, pollen yellow. Ovary orbicular with three edges, ca. 3 mm long and wide, finely tuberculate. Stylus conical, 2.4 mm long, white like the undivided stigma. Capsule tripartite ovate, 5-6 mm long. Seeds dull black, concave, irregularly and coarsely lacunose, 3-4 mm long, 2.2-5 mm wide, ca. 2 mm thick.

Additional specimens examined:


Tepals with several nerves are rarely found in the genus Allium. They are characteristic only for subg. Nectaroscirium (Lindl.) Asch. & Graebn. and sect. Pseudoprason, but are sometimes also present in A. oreophilum C.A. Mey., the only species of subg. Porphyroprasion (Ekberg) R.M. Fritsch (FRITSCH, 1992). According to our current knowledge, any Allium specimen having tepals with more than one vein must belong to one of these groups and can be assigned using this key:
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**Key for *Allium* species characterized by (at least outer) tepals with more than one vein**

1. Plants small, leaves linear, flat, 5-10 mm broad, much longer than the 10-20 cm long scape, flowers star-like, tepals pink to dark red.................. *A. oreophilium*
   - Plants large, leaves much shorter than the 50-120 cm long scape ..................... 2
2. Leaves strongly keeled with three sharp edges, flowers campanulate, tepals 12-15 mm long, inner ones with a distinct claw and a heart-shaped lamina ..........
   - Leaves flat, elliptic to broadly lanceolated, all tepals 4-5 mm long, white, elliptic, strongly concave, initially three (and later all ones) reflexed and inside curled ................................................................. *A. kelzii*

**New records of *Allium* for the Flora of Iran**


   Holotype: Pakistan, Prov. Quetta, inter Qila Abdullah et Sheila Bagh, 1600-1900 m, LAMOND 1055 (E).

   **Specimens examined from Iran:**

   Iran: Prov. Baluchestan: 30 km from Khash to Iranshahr, ca. 1160 m; 16.4.1968, Pazouki & Hashemi 438 (IRAN); S du Dasht-e Lut, route entre Neh et Zahedan, 1050 m, 15.4.1972, Léonard 5571 (IRAN); 20 km on road from Rusk to Chahbahar, ca. 300 m, 8.3.1977, Runemark, Assadi & Sardabi 22383 (TARI); Barn to Zahedan, 23 km S. Nosratabad, 1100-1200 m, 20.4.1983, Termeh, Moussavi & Tehrani 437 (IRAN); 20 km from Khash to Iranshahr deviation of Iranegan (LM2), ca. 1420 m, 12.4.1983, V. Mozaffarian 42812 (TARI).

   *Allium lamondiae* was recorded from Afghanistan and Pakistan, and has been recorded from both countries from areas adjacent to Iran (WENDELBO 1971). Therefore, its occurrence in Iran was not unexpected. It has been reported earlier by MATIN (1975, 1976) and independently by LÉONARD (1981) from Iran each based on only one specimen. The species is closely related to *A. fibrosum* but differs from it in having a scape shorter than leaves and leaves not more than 3 (against 4-6 leaves in *A. fibrosum*) in number. Based on the new collections of this rare species a
short description is given below. A distribution map of *A. lamanidiaceae* in Iran is given in Fig. 7.

![Distribution map of Allium lamanidiaceae in Iran.](image)

**Fig. 7.** Distribution map of *Allium lamanidiaceae* in Iran.

Bulb single, ovate, c. 1 cm diam. and ca. 1.5 cm long, outer tunics greyish brown to light brown, inner tunics papery to hyaline, white to cream. Scape single, erect, 20-25 cm long, 1.5-2 mm diam., yellow-green, glabrous. Leaves 2-3, fistulos, 18-23 cm long and ca. 1.2-1.4 mm wide, glabrous, leaf sheath white with brown or green veins. Spath ± membranous, divided into two parts, white, ca. 3 mm long. Inflorescence semiglobose. Pedicels yellow, thin, up to 7-10 mm long. Tepals elliptic-oblong, obtuse at tip, 4-4.5 mm long and ca. 1.5 mm wide, white with green midvein. Filaments 3-3.5 mm long (shorter than the tepals), basally for 1 mm connate to each other and at the same length adnate to tepals, inner ones subulate from ovate at base, outer ones narrowly triangular; anthers 1 mm long, yellow. Ovary ovate-oblong, finely tuberculate on surface; style ca. 1.1 mm; stigma capitate. Capsules 2-2.5 mm long and 3 mm diam. Seeds black, convex, elliptic to kidney-shaped in outline.

2. **subg. Allium sect. Allium**

Holotype: Turkey, Prov. Kars, in monte Askjar-dagh prope Sarykamysch, leg. Michailowsky (TBI)
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**Specimens examined from Iran:**

Iran: Prov. Azerbaijan: Mt. Mishi, E. village Payam, S. of Marand, 2040 m, N 38°19'38", E 45°48', 05.06.2005, R.M. Fritsch, SH. Zaree & H. Moazzeni (*Allium* reference collection: IRAN-1061); slope near the main road from Tabriz to Miandréh ca. 35 km to Miandréh, 1500 m, N 37°30'49", E 47°23'26", 06.06.2005 R.M. Fritsch, SH. Zaree & H. Moazzeni (*Allium* reference collection: IRAN-1066); Prov. Kermanshah: Limestone rock outcrop near the first pass on the road 4 km to Rijab, N 34°26'34", E 46°01'09", 1300 m, 14.05.2006, M. Abbasi, R.M. Fritsch & M. Keusgen (*Allium* reference collection: IRAN-1098) (Fig. 8).

This species occurs in E. Anatolia and Transcaucasia and was also cited from Iran by other floras (see KOLLMANN 1984) but was not recorded by WENDELBO (1971). Thus the occurrence in north-western part of Iran was expected.

![Image of Allium fuscoviolaceum](image)

**Fig. 8. Allium fuscoviolaceum:** A. Inflorescence during anthesis, B. Distribution map in Iran.

*Allium fuscoviolaceum* belongs to the *A. sphaerocephalon* alliance differing by scabridulous leaves, presence of bracteoles, ciliate filaments, a less dense inflorescence, and completely smooth tepals.

Bulb ovoid, 0.8-1 cm diam., outer tunic papyraceous, grey. Scape 30-70 (100) cm long, cylindrical, smooth. Leaves 3-4, fistulose, semicylindrical, canalicate, usually subscabrid at the margin of channel. (2)3-4 mm wide, shorter.
than scape. Spathe split in two shortly beaked parts, half as long as the (hemi-) spherical, dense, many-flowered inflorescence. Pedicels subequal, 8-12 mm long, bracteolate at base. Tepals oblong-ovoid, connivent, smooth, outer ones obtuse, keeled, ca. 4 mm long, mostly dark-brownish purple and sometimes paler in the lower half, with darker midvein. Filaments somewhat longer than tepals, ciliate along margin, median cusp of inner filament equalling lateral cusps and half as long as narrowly linear basal lamina. Style purple, exserted. Capsule broadly elliptic, c. 4 mm.

Flowering and fruiting time: June till August.


Sect. Scorodon in the narrow sense is a small section. KHASSANOVA (2000) included here also A. chloroneurum Boiss, probably referring to the initial decision of Boissier who put this species among rhizomatous taxa. Indeed, the short rhizome of the type species A. moschatum L. is sometimes difficult to recognize (FRIESEN et al. 2005).

Allium moschatum L., Sp. pl. 298 (1753).

Lectotype: "Moly moschatum capillaceo folio" (Hb. BAUHIN, BAS)

Specimens examined from Iran:

Prov. Gilan: Hashtrud, 18 km to Nouleh Boulaagh, N 37°49', E 48°45', 500 m, 05.09.1982, Termez, Matin & Zargani (IRAN!); Prov. E. Azerbajan, Arasbaran protected area, Tazekandi-Anza, 1500 m, A. Ghahteman & V. Mozaffarian No. 17604 (TUH) (Fig. 9).

WENDELBO (1971) did not mention this species for the area of "Flora Iranica", and KOLLMANN (1984) recorded it only for Turkey-in-Europe. The area of distribution stretches from western Europe to Caucasus and Transcaucasia. Thus it was not surprising to find outposts in northern Iran.
The genus *Allium* (Amaryllidaceae) in Iran: Current state, new taxa.

![Image of Allium moschatum flower and distribution map in Iran](image)

Fig. 9. *Allium moschatum*: A. Inflorescence during anthesis, B. Distribution map in Iran.

*Allium moschatum* is morphologically somewhat exceptional among rhizomatous Iranian *Allium* species by possessing thread-like leaf blades and longitudinally split bulb tunics which are only reticulate near a small colhum. Commonly the bulbs are not clustered on a rhizome. The plants grow singularly showing at base only a rhizome of 1-3 mm length.

Bulb more conical-oblance than ovoid, c. 1 cm diam., outer tunics separating into fibres, reticulate at apex. Scape 10-30 cm long, 1-2 mm diam. Leaves 3-6, filiform, 0.5-1 mm wide, almost equal. Spathe divided into linear parts with a broader base, patent, shorter than pedicels, persistent. Inflorescence fastigate, with up to 15 campanulate flowers. Pedicels 1-2 cm long, almost equal. Tepals
lanceolate, acute, 6-7 mm long, pink with darker midvein or white with brown midvein. Filaments simple, shorter than tepals with purple anthers included. Ovary ovoid with tapering tip, papillose. Stylus filiform with dot-like stigma. Capsule globose, 3-4 mm diam.

Statistical conclusion

Three newly described species (A. longipapillatum, A. montelburzense, and A. kuhsoorkense) and two new records (A. fuscoviolaceum, A. moschatum) expand the number of Allium species occurring in Iran to 93 which belong to seven subgenera and 29 sections.

Acknowledgements

The senior author would like to thank Dr. D. Ershad and Dr. M. Alibasi (who also provided the picture shown in Fig. 6B) from Iranian Plant Protection Res. Inst., Tehran for working facilities in herbarium (“IRAN”) and for organisation and generous assistance during research missions in northern Iran. Thanks also to Dr. H. Akhani (Univ. of Tehran), Dr. A. Movafeghi (Tabriz Univ.), Mr. Mansari (Kerend), Dr. M.J. Soleimani (Hamadan Univ.), as well as Mr. Kamangar and Mr. Maroofi (Agric. Res. Centre of Kurdistan, Sanandaj) for supporting field-work at many places. We are also indebted to Mr. H. Moazzeni for his helps. We would also like to thank the keepers of the herbaria “TARI” and “HCAT” and those in Hamadan, Kermanshah, and Sanandaj for working facilities. Financial support by VolkswagenStiftung (Hannover, Germany, as part of the “PharmAll” Project) is gratefully acknowledged.

References


The genus *Allium* (Alliaceae) in Iran: Current state, new taxa...


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POLLEN MORPHOLOGY AND STAMINAL STRUCTURE IN SALVIA AND ZHUMERIA (LAMIACEAE)

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Abstract

Pollen of 23 Iranian species of *Salvia* and *Zhumeria* were studied using scanning electron microscopy and light microscopy. The staminal structure and floral morphology were examined and compared with palynological data. Pollen in all examined species is hexacolpate isopolar, oblate spheroidal (P/E=0.88-0.99 μm), suboblate (P/E=0.75-0.87 μm) or prolate spheroidal (P/E=1.01-1.02 μm). In polar view two of the mesocolpia are larger than the remaining four. Exine has different ornamentations in apocolpium and mesocolpium. Exine is bireticate or reticulate perforate. With a few exceptions, three different pollen types could be recognized in *Salvia* which corresponds with the following three different stamen types: Type I includes species with lower fertile thecae. Pollen exine of this type is bireticate, lumen with equal size perforations. Type II includes species with sterile dolabrilform lower thecae usually connected to each other. Pollen exine of this type is bireticate, lumen with one or two prominently large perforations. Type III includes species with completely aborted lower thecae. Pollen exine of this type is reticulate perforate, lumen with equal size perforations. In *Zhumeria majilae* pollen is hexacolpate with two larger mesocolpia, exine is bireticate, lumen with equal size perforations. Pollen shape and exine ornamentation in *Zhumeria* is similar to *Salvia* Type I.

* Corresponding author
Key words: Pollen morphology, Staminal structure, *Salvia*, *Ziumeria*, Lamiaceae

Introduction

*Salvia* (Lamiaceae) is a cosmopolitan genus with approximately 700 species (ALZIAR 1988-1993). Three centers of diversity have been recognized for the genus: Central and South America, Central Asia/Mediterranean and Eastern Asia.

In *Salvia*, the flowers have two fertile stamens, a characteristic which is also recognized in some other genera in Lamiaceae tribe Mentheae i.e. *Monarda*, *Rosmarinus*, *Ziziphora*, *Ziumeria*, *Dorystoechas* and *Meriandra*. The staminal structure of *Salvia* is characteristic of the genus because of having two anther lobes that are separated by an elongate connective. It is often associated with a pollination syndrome called lever-like mechanism (WALKER et al. 2004). Also the stamen in *Salvia* is recognized as a unique character, but there is considerable diversity in staminal structure in the genus. Length of the connective, shape of lower thecae, its fertility and length of filaments are variable in *Salvia* species. These differences are somehow related to corolla structure and have been the basic characteristics for taxonomic treatment of the genus (BENTHAM 1848, 1879, BRIQUET 1895-1897).

In the first comprehensive study of *Salvia* by BENTHAM (1848), 12 infrageneric divisions were proposed including four subgenera, two of Old World: *Salvia* and *Sclarea*, one of the New World species: *Calospathae* and finally subgenus *Leonia* containing species from both the Old and New World. Members of six *Salvia* sections of Bentham's classification are distributed in S.W. Asia (Euphace, Hymenospathae, Drynospathae, Horminum, Aethiopis and Plethiospathae). HEDGE (1974, 1982a & b) treated *Salvia* based on staminal structure in four species-groups.

Micro-morphological characters have been useful in taxonomic treatments and phylogenetic inference in different taxa. ERDTMAN (1945) classified Lamiaceae into two subfamilies based on pollen: Nepetoideae with hexacolpate and Lamiioideae with tricolpate pollen. The pollen grain of Lamiioideae has been studied in more detail to define its phylogenetic implication (ABU-ASAB & CANTINO 1992). They suggested reticulate, spinulose and verrucate supratectal sculpturing as derived character states and based on this, they considered Lamiaceae a polyphylectic
family. In Nepetoideae, Mentheae pollen morphology was implicated to interpret the phylogeny (WAGASTAFF 1992). More data about pollen morphology of Nepetoideae have been provided by studies of several authors (HENDERSON et al. 1968, HUSAIN & HEYWOOD 1982; AFZAL-RAHII 1983, HARLEY 1992, JAMZAD et al. 2000). The comprehensive work of AFZAL-RAHII (Le.) on Salvia provided palynological and cytological data. She suggested the evolutionary trends in the genus based on these characters.

Zhameria is a monotypic genus of Lamiaeae endemic to Southern Iran. It has the following characteristic features which gives an isolated position to it within the family: Four exerted stamens, antherior pair fertile; posterior pair with much reduced thecae, not or scarcely fertile, corolla indistinctly bilabiate (BOKHARI & HEDGE 1976, Fig. 6). It was considered as a possible relative of tribe Meriandraceae Briq. Other isolated genera of this tribe are Meriandra with two species (N.E. India, N.E. Africa and S.W. Arabia); Dorytocoelas with one species in Turkey and Perovskia with a few species in Asia.

In this investigation, we aim to study the pollen morphology of Iranian species of Salvia including those that have not been examined in previous works and infer its association with the floral and staminal structures and define monophyletic natural groups of species and examine its implication in taxonomic treatment of the genus.

Additionally, pollen of Zhameria majdae is examined and compared with those of Salvia, Meriandra and Dorytocoelas to find its affinity to the above mentioned genera.

Materials and methods

Pollen of 23 species of Salvia and Zhameria were taken from herbarium specimens in the Research Institute of Forests & Rangelands (TARI, Table 1). In most cases two specimens of each species were examined. Pollen grains were acetolysed and prepared for light (LM) and scanning electron microscopy (SEM) using methods described by HARLEY et al. (1992). Pollen was examined using an Olympus, BH2-RFCA LM and a LEO 4401 SEM. For LM measurements means and ranges of 10-15 pollen grains were taken.
Flowers of herbarium specimens were soaked in water and then dissected. The position and shape of stamens within individual flowers were observed and measured using a stereomicroscope and drawings were prepared for each species.

Results
Pollen morphology

Pollen grains of species examined in this study are hexacolpate isopolar. The polar outline of the grains is mostly elliptical. In polar view two of the six mesocolpia are larger than the remaining four. Pollen shape is oblate sphenoidal (P/E=0.88-0.99 μm), suboblate (P/E=0.75-0.87 μm) or prolate spheroidal (P/E=1.01-1.02 μm) (Fig. 1 and Table 1). There is no relation between pollen shape and species affinities, the same class of shape appears in species belonging to different sections or groups. Interestingly the pollen size was somehow related to the flower size, species with larger flowers possess larger pollen grains for example in *S. arisata*, *S. bracteata*, *S. hypochionaea*, *S. suffruticosa* and *S. compressa* with larger flowers, pollen grains are prominently larger than the grains of *S. aegyptiaca*, *S. santolinifolia*, *S. syriaca* and *S. verticillata* which are in group of species with small flowers (Table 1). The same relation has also previously been observed in *Nepeta* spp. (JAMZAD et al. 2000). Wall thickness is 2-4 μm. The colpus membrane is granular (Fig. 2). Exine is reticulate-perforate or bireticate. Lumen shape may be irregular, polygonal, more or less circular or elliptic with diameters between 1-4 μm. The number of perforations in each lumen varies between three and 37. The perforation size in some species reaches up to 1 μm. Exine ornamentation in apocolpium and mesocolpium show different patterns, within a species usually the number and size of perforation in apocolpium is smaller than in mesocolpium. Meanwhile the lumen size is smaller in apocolpium (Fig. 2).

In spite of a relatively stenophytic pollen in *Salvia*, there are differences in exine ornamentation including lumen shape, size and perforation pattern which can be used as diagnostic characters. Three different patterns of exine ornamentation are recognized in examined species:

Type I: Lumen shape irregular, exine bireticate, with more or less equal size perforations. This group includes *S. arisata*, *S. bracteata*, *S. suffruticosa*,

Type II: Lumen rounded, ± elliptic or polygonal, exine bireticate, lumen with one or two distinctly larger perforation (0.3-1 μm) in each lumen. This group includes; S. aethiopis, S. atropatana, S. compressa, S. lachnocalyx, S. limbata, S. macrosiphon, S. mirzayanii, S. sahendica, S. sclavus and S. microstegia (Fig. 4).

Type III: Lumen rounded or ± elliptic, exine reticulate-perforate, lumen with more or less equal perforations. This type includes S. vericillata (Fig. 7).

In Zhumeria majdae, pollen is hexacolpate, isopolar, in polar view two of the six mesocolpia are larger than the remaining four. Pollen shape is suboblate (P/E=0.80 μm), wall thickness is 3 μm. Exine is bireticate in mesocolpium, but perforate near colpi. The lumen in apocolpium is much smaller than in mesocolpium but with distinctly larger perforations. The number of perforations in each lumen is less than in mesocolpium (Fig. 5).

Fig. 1. Pollen grains of Salvia spp. A. S. compressa (light microscopy, polar and equatorial view, high and low focus), B. S. lerifolia, C. S. limbata (polar view), D. S. arisiata (pollen group), E. S. mirzayanii, F. S. jamzadii (equatorial view).
Fig. 2. Granular colpus membrane and different lumen shape and size in apocolpium and mesocolpium. A & D. S. aehtios, B, & C. S. sahendica (A & B apocolpium, C, & D. mesocolpium).

Fig. 3. Pollen exine in mesocolpium in group I. A. & B. S. aristata, C. S. braccicata, D. S. buzumanica, E. S. jamzudii, F. S. santolinifolia.
Pollen morphology and staminal structure in *Schizo* and *Zhumeria*.

Fig. 4. Pollen type II. Exine in mesocolpium. A. *S. atropauana*, B. *S. microsperma*, C. *S. lachnocalyx*, D. *S. kimhata*, E. *S. xclarea*, F. *S. mirzayanii*, G. *S. macrospiphon*, H. *S. compressa*.

Fig. 5. Pollen of *Zhumeria majidae*. A. Equatorial view, B. Polar view, C. Apocolpium, D. & E. Mesocolpium and colpus membrane.
Fig. 6. Flowers and stamen shapes in different groups of *Salvia* spp. and *Zinnia*. 

- A. *S. aristata*
- B. *S. bracteata*
- C. *S. verticillata*
- D. *Z. majdae*
- E. *S. aegyptiaca*
- F. *S. bazianica*
- G. *S. laehnocalyx*
- H. *S. microsiegia*
- I. *S. compressa*
Fig. 7. Exine in mesocolpium: A. S. hypochina, B. S. kerifolia, C. S. syriaca, D. S. virgata, E & F. S. verticillata (F. apocolpium, E. mesocolpium).

Stamen

The staminal structure of *Salvia* is a diagnostic character. The upper thecae are fertile in all species, but their length varies among different species. The lower thecae are usually infertile, dolabriform and connected to each other in some group of species (*S. aethiopis, S. sclarea, S. linnata, S. reuterana, S. mirzayanii, S. lachnocalyx, S. aropatana, S. kerifolia, S. compressa* etc.) and entirely aborted in *S. verticillata* group but partly fertile and slightly smaller than upper thecae in others.
In *S. aristata*, pollen grains in upper thecae and lower thecae were examined and counted separately. 17% of the pollen grains in lower thecae were fertile (grains with normal shapes) but in upper thecae 43% of the counted grains were fertile. In *Zhumeria* four distinct stamens are observed but the posterior pair with smaller thecae and less fertile (Fig. 6).

**Discussion**

Pollen exine in most examined species of *Salvia* like majority of subfamily Nepetoideae is supraneculate (including bireticate) (HUSAN & HEYWOOD 1982, AFZAL-RAFII 1983, WAGSTAFF 1992, HARLEY 1992), a character state which has been considered as derived within Lamiaceae (ABU-ASAB & CANTINO 1992). It was hypothesized that supraneculate pollen is a synapomorphy of a large clade composed of gynobasic-styled Lamiaceae, tribe Scutelleriae, some genera of Ajugeae and some genera of Verbenaceae (ABU-ASAB & CANTINO 1992). Considering the evolutionary trends of stamen within Lamiaceae, the species with four fertile stamens are primitive and reduction of fertile stamens is derived. In *Salvia* spp. the reduction of fertile thecae and the presence of sterile lower thecae (dolabriform) in *S. aethiopis* group and the entirely aborted lower thecae in *S. verticillata* group indicate apomorphic character states. Meanwhile the species with fertile lower thecae are indicated as primitive, for example *S. aristata* group. Pollen exine in species with one or two distinctly larger perforations in each lumen (*S. aethiopis* group) seems to be apomorphic character state. It was also hypothesized by AFZAL-RAFII (1983) that, *S. atropatana* which is a member of the above group is the most advanced species in *Salvia*.

Considering the genera with four fertile stamens as primitive in Lamiaceae, *Zhumeria* stands in primitive status comparing with *Salvia*. Pollen grains of *Perovskia, Meriandra* and *Dorystoechas* (Meriandreae) are characterized by having six equal mesocolpia (HENDERSON et al. 1968) but in *Zhumeria* and *Salvia* unequal mesocolpia was observed.

Comparing pollen of *Perovskia, Meriandra* and *Dorystoechas* (Meriandreae) with *Zhumeria* suggests that, *Zhumeria* should not be considered in Meriandreae,
Pollen morphology and staminal structure in *Salvia* and *Znanoria*...

but possibly a position close to *Salvia* in Mentheae. However, the flower morphology in *Salvia* and *Znanoria* is different. Further investigation is needed to elucidate the evolutionary position of *Znanoria*. The closest species of *Salvia* group to *Znanoria* are: *S. aegypiiaca*, *S. bazmanica*, *S. santolinifolia*, *S. macilenta* and *S. eremophila*.

Based on floral and staminal morphology and palynological characters, the following monophyletic groups can be determined in examined *Salvia* spp.:  
Group I: The upper lip of corolla ± straight, lower thecae bearing fertile pollen but smaller than upper thecae. Pollen exine bireticulate, lumen is irregular with ± equal perforations. The species in this group are: *S. aristata*, *S. bazmanica*, *S. braekeata*, *S. jamzadii*, *S. santolinifolia* and *S. suffraticosa*.

Group II: The upper lip of corolla falcate, lower thecae infertile, dolabridiform. Pollen exine is bireticulate, lumen rounded, elliptic or polygonal with one or two larger perforations. The species of this group are as follows: *S. aethiopis*, *S. atropatana*, *S. compressa*, *S. lachnocalyx*, *S. limbata*, *S. macrospiron*, *S. microseghia*, *S. mirzuyanii*, *S. sahendica*, *S. sclarea* and *S. virgata*. *Salvia compressa* was previously recognized in group I but close examination of stamens and pollen revealed that it belongs to group II.

Group III: The upper lip of corolla ± straight, lower thecae completely aborted. Pollen exine is reticulate-perforate, lumen rounded or elliptic with ± equal perforations. The only species of this group is *S. verticillata*.

The exceptions are *S. syriaca*, *S. hypochionaea* and *S. leriguia* which are placed in group II based on their staminal characters but in group I based on pollen type (Fig. 7). The distinctly larger perforation usually placed in centre of the lumen, the characteristic of group II is not present among the above species. They may possibly be considered as a subtype under this type. Future works on molecular phylogeny of the genus may elucidate their position within the genus.

Acknowledgements

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Table 1. Materials used for this study and pollen measurements. P: polar length, E: equatorial width, P/E: shape, WT: wall thickness.

<table>
<thead>
<tr>
<th>Species</th>
<th>Collecting data</th>
<th>P</th>
<th>E</th>
<th>P/E</th>
<th>WT</th>
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<tbody>
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<td><em>Salvia aegyptiaca</em> L.</td>
<td>Bokhari &amp; Wendelbo 146 (TARI)</td>
<td>(34-) 38.33</td>
<td>(40-) 45.50</td>
<td>0.84</td>
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<td></td>
<td>(-42)</td>
<td>(-51)</td>
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<td>Runemark &amp; Mozaissarian 27171 (TARI)</td>
<td>(35-) 38.42</td>
<td>(37-) 42.50</td>
<td>0.90</td>
<td>2-3</td>
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<td></td>
<td></td>
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<td>(-50)</td>
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<td>Froughi &amp; Assadi 13954 (TARI)</td>
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<td>(42-) 50.75</td>
<td>0.87</td>
<td>2-3</td>
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<td>(-54)</td>
<td></td>
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<td>(35-) 41.10</td>
<td>(39-) 50.20</td>
<td>0.82</td>
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<td></td>
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<td>(-60)</td>
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<td>(64-) 68.73</td>
<td>0.88</td>
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<td>(-78)</td>
<td></td>
<td></td>
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<td><em>Salvia aristata</em></td>
<td>Fattahi &amp; Khaledian 72 (TARI-duplicate)</td>
<td>(52-) 56.00</td>
<td>(56-) 64.60</td>
<td>0.87</td>
<td>2.5:3.5</td>
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<tr>
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<td>(-72)</td>
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<tr>
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<td>Jamzal et al. 70251 A</td>
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<td>(48-) 62.67</td>
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<td>(44-) 53.11</td>
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<td>(38-) 47.96</td>
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<td>(-66)</td>
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<td>Assadi &amp; Mozaftarian</td>
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<td><strong>Salvia</strong></td>
<td>Assadi &amp; Ranjbar 83023</td>
<td>(TARI)</td>
<td>(48-) 54.85</td>
<td>(44-) 54.42</td>
<td>1.01 3-4</td>
</tr>
<tr>
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<td></td>
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<td>(-63)</td>
<td>(-60)</td>
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<td><strong>Salvia</strong></td>
<td>Assadi &amp; Mozaftarian</td>
<td>Paryab 5006</td>
<td>(50-) 54.13</td>
<td>(50-) 59.79</td>
<td>0.91 2-3</td>
</tr>
<tr>
<td>lerifolii</td>
<td>(TARI-duplicate)</td>
<td></td>
<td>(-59)</td>
<td>(-69)</td>
<td></td>
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<tr>
<td><strong>Salvia</strong></td>
<td>Maddah 1901</td>
<td>(TARI-duplicate)</td>
<td>(40-) 59.33</td>
<td>(50-) 60.52</td>
<td>0.98 2-5.3</td>
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<tr>
<td>lerifolii</td>
<td></td>
<td></td>
<td>(-75)</td>
<td>(-72)</td>
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<tr>
<td><strong>Salvia</strong></td>
<td>Assadi &amp; Mozaftarian</td>
<td>Jamsud et al.</td>
<td>(50-) 56.10</td>
<td>(50-) 61.19</td>
<td>0.92 3-4</td>
</tr>
<tr>
<td>limbata C.A.</td>
<td>30127 (TARI)</td>
<td>70251 B</td>
<td>(-60)</td>
<td>(-69)</td>
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<td>Mey.</td>
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<td>Assadi &amp; Mozaftarian</td>
<td>Froughi 5428</td>
<td>(50-) 54.10</td>
<td>(46-) 54.79</td>
<td>0.99 3-4</td>
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<td>limbata C.A.</td>
<td>29970 (TARI)</td>
<td></td>
<td>(-58)</td>
<td>(-61)</td>
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<td>Ranemartk et al.</td>
<td>(TARI)</td>
<td>(53-) 62.44</td>
<td>(55-) 62.38</td>
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<td>(-71)</td>
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<td><strong>Salvia</strong></td>
<td>22619 (TARI)</td>
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<td>(45-) 57.83</td>
<td>(53-) 58.68</td>
<td>0.99 2-5.5</td>
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<tr>
<td>microstegia</td>
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<td>(-65)</td>
<td>(-66)</td>
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<tr>
<td><strong>Salvia</strong></td>
<td>Froughi 1154</td>
<td>(TARI)</td>
<td>(53-) 57.00</td>
<td>(62-) 65.10</td>
<td>0.88 2-5.5</td>
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<td>(-68)</td>
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<td>Rech. f. &amp;</td>
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<tr>
<td>Esfand.</td>
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<tr>
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<td>Froughi 1154</td>
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<td>(47-) 55.90</td>
<td>(52-) 60.80</td>
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<td>(-67)</td>
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<td>(TARI-duplicate)</td>
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<td>Buhse</td>
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<tr>
<td><strong>Salvia</strong></td>
<td>Wendelbo &amp;</td>
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<td>(49-) 57.98</td>
<td>0.97 3-4</td>
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<td>santolinifolia</td>
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<td>(-76)</td>
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<td>(38-) 43.33</td>
<td>(42-) 47.79</td>
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<td>Year(s)</td>
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<td><em>Salvia saxifraga</em> L.</td>
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<td>2028</td>
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<td>(-65)</td>
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<td><em>Salvia ocymoides</em> L.</td>
<td>J.R. Edmondson &amp; A.G. Miller</td>
<td>1647</td>
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<td>(-59)</td>
<td>53.40</td>
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<td>(TARI)</td>
<td>(-61)</td>
<td>(-75)</td>
<td>55.10</td>
</tr>
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<td>(-52)</td>
<td>(-52)</td>
<td>48.00</td>
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<td>Mozaffarian 45752 (TARI)</td>
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<td>(-40)</td>
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<td>(-34)</td>
<td>(-40)</td>
<td>(-40)</td>
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<td>(-39)</td>
<td>(-46)</td>
<td>(-46)</td>
<td>35.55</td>
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<td><em>Salvia virgata</em> Jacq.</td>
<td>Zare &amp; Mashayeli 6458 (TARI)</td>
<td>(-54)</td>
<td>(-80)</td>
<td>(-80)</td>
<td>47.50</td>
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<td><em>Salvia virgata</em> Jacq.</td>
<td>Amani &amp; Zare 6503 (TARI-duplicate)</td>
<td>(-49)</td>
<td>(-51)</td>
<td>(-51)</td>
<td>44.50</td>
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<td><em>Zalmoxis majalae</em> Rech.</td>
<td>Zaefi 1952</td>
<td>(-60)</td>
<td>(-72)</td>
<td>(-72)</td>
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References


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CHANGES TO POTENTILLA S.L. (ROSACEAE) IN "FLORA IRANICA"

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University & Jepson Herbaria, University of California, Berkeley, USA and
University of Tehran, Tehran, Iran

Abstract
As a summary of independent investigations by multiple authors, numerous updates are now required for the 1969 treatments of Potentilleae (Rosaceae) in "Flora Iranica". Following the convergence of morphology-based conclusions by Soják and molecular phylogenetic analysis by ERIKSSON et al., several sections of Potentilla L. are now treated as segregate genera. Potentilla sect. Fruticosae (Th. Wolf) Gross. becomes Dasiphora Raf., with D. dryadeaoides Juz. replacing P. phyllocalex (Juz. Schiman-Czeika. Potentilla sect. Bifurcae (Th. Wolf) Gross. becomes Schischophyllum (Juz. ex Fed.) Ikonn., with the single species S. bifurcata (L.) Ikonn. replacing P. bifurca L. Potentilla sect. Xylorrhizae (Th. Wolf) Schiman-Czeika becomes Tylosperma Botsch. encompassing P. lignosa Willd. (as T. lignosa (Willd.) Botsch.) and P. xerischophyllum Parker (combination in Tylosperma inc.). Potentilla sect. Rupestres (Th. Wolf) Grossh. becomes Drymacallis Fourn. ex Rydb., with D. poterifolia (Boiss) Soják replacing P. poterifolia Boiss. Two other species of Drymacallis are added to the flora: D. rupestris (L.) Soják and D. schiraziana (Khat.) Ertter & Attar, the latter a new combination provided for P. schiraziana Khat. In addition, Combretum salesovianum (Stephan) Bunge is replaced by Farinopsis salesoviana (Stephan) Chrtek & Soják. Additions to

**Key words:** Potentilla, tribe Potentilleae, Taxonomical changes, Rosaceae, Iran

**Introduction**

The nature of floristic information is such that any printed work represents knowledge at a specific slice in time, with updates to the printed work required on a regular basis to accommodate a constant stream of new data and new interpretations of existing data. This holds true even for the most carefully done flora, including Karl Heinz Rechinger’s Flora Iranica, and it is particularly true for biogeographically rich areas and taxonomically complex plant groups. The genus *Potentilla* s.l. (Rosaceae) in the area covered by Flora Iranica is a prime example on both counts.

The Iranian highlands and surrounding areas as defined by Rechinger encompass Iran, Afghanistan, and parts of W. Pakistan, northern Iraq, Azerbaijan, and Turkmenistan. This is a vast, rugged, area, with complex physiography and geology, diverse climates, intersecting biogeographic provinces, and remote areas that have only been sparsely botanized. Much of the region lies in the Irano-Turanian floristic region, characterized by a high number of endemic genera and a species endemism of probably no less than 25%, with the richest flora being that of
Changes to *Potentilla* s.l. (Rosaceae) in Flora Iranica

the Iranian Plateau (TAKHTAJAN 1986). In all these regards the region is biogeographically comparable to western N. America, where an average of 40 new plants per year have been described at a steady rate for the last several decades, even in well-populated areas (ERTTER 2000, HARTMAN & NELSON 1998). It is reasonable to expect that, an equivalent wealth of botanical diversity remains to be added to Flora Iranica.

The genus *Potentilla* L. is likewise complex, with a steady stream of new taxa being described worldwide and taxonomic adjustments occurring on a regular basis. Several hundred species of *Potentilla* are currently recognized worldwide, mostly in arctic and temperate regions of Eurasia and North America. Some belong to species complexes that are notoriously apomorphic and prone to rampant hybridization, undermining any effort to carve up infrageneric biodiversity into well-defined, cleanly circumscribed species. The circumscription of *Potentilla* itself has been a matter of controversy, with *Duchesnea* Smith, *Sibbaldia* L., *Comarum* L., *Dasiphora* Raf., and *Drymocallis* Fourr. ex Rydb., among others, sometimes treated as distinct genera and sometimes included within a broadly defined *Potentilla*. Even strawberries (*Fragaria* L.) have been included within *Potentilla*, as was recently done by MABBERLEY (2002). Tribe *Potentilloideae* Sweet is often used to encompass these genera within Rosaceae.

In volume 66 of Flora Iranica, published in 1969, the following members of *Potentilla* s.l. were given full treatment: three species of *Fragaria* (SCHÖNBECK-TEMESY 1969a), one species of *Duchesnea* (SCHÖNBECK-TEMESY 1969b), 51 species of *Potentilla* arranged in 18 sections (SCHIMAN-CZEIKA 1969a), one species of *Comarum* (SCHIMAN-CZEIKA 1969b), and two species of *Sibbaldia* (SCHIMAN-CZEIKA 1969c). An additional seven species of *Potentilla* were mentioned as "species incertae et incomplete notae", and a third *Sibbaldia* was mentioned as "Zweifelhaute Angaben".

As previously indicated, the norm for any published floristic work is that changes begin to accumulate almost immediately, and the treatment of *Potentilloideae* for Flora Iranica (SCHIMAN-CZEIKA 1969a, 1969b, 1969c; SCHÖNBECK-
TEMESY 1969a, 1969b) was no exception. Within the first decade following publication, ASSADI & WENDELBO (1977) reported *P. porphyrantha* Luz. from Azarbeyjan Province, Iran, along with a recent collection of *P. petraea* Wildl. ex Schltdl., which SCHIMAN-CZEIKA (1969a) had known only as an image of the type specimen. In the 1980’s, KHATAMSAZ undertook work on Rosaceae in Iran, as part of an effort by the Iranian Research Institute of Forests and Rangelands to produce a flora of Iran in Farsi. As a result of extensive herbarium visits and field work, she described the new species *Potentilla schirazianna* Khat. from Fars Province, related to *P. poteriifolia* Boiss. (KHATAMSAZ 1987). In addition, she reported several species of *Potentilla* as new to Iran and Flora Iranica (KHATAMSAZ 1987, 1988). Numerous changes to the *Potentilleae* in Flora Iranica also resulted from the extensive studies of Czech botanist Jiří Soják, who collected in Iran in 1977 and whose conclusions on Eurasian *Potentilla* were published in a series of papers beginning in the 1969’s. All of these additions are incorporated in Table 1.

Equally, significant has been the realization that tribe *Potentilleae* consists of two fundamental evolutionary lines, first elucidated by SOJÁK (1989). The *Fragaria*-line, characterized by anthers with a single horseshoe-shaped theca that opens by a marginal slit and sub-basal or lateral styles, consists not only of *Fragaria* but also those species sometimes placed in *Comarum, Daviphora* (or *Petasphyllodes* Duhamel, a superfluous name), *Drymocallis, Farinosis Chrt. & Soják, Schistophyllium* (Luz. ex Fed.) Bonn., *Sibbaldia* and *Sibbaldiosis Rydb.* The second evolutionary line, comprised of *Potentilla* s.s., *Duchesnea*, and the North American genera *Ivesia* Torr. & A. Gray, *Horkelia Cham. & Schltdl.*, and *Horkelielia* Rydb., is characterized by subterminal styles and anthers with two thecae divided by the connective apex that opens by two lateral slits. The species potentially comprising *Argentina* Hill (e.g. *P. ansentina* L.) and the Asian genus *Tyloesperma* Botsch. were more problematic. SOJÁK (1989) accordingly recognized the seven segregate genera falling in the fragarioid lineage and created the additional combinations needed for Eurasian members of *Potentilla* sect. *Rupestres*, which
became the genus *Drymocallis*. Except for *Drymocallis*, Soják was in concordance with the nomenclature used by his Russian colleague B.A. Yurtsev in a flora of the arctic Soviet Union (1984). Soják’s generic conclusions are reflected in his subsequent papers in which *Argentina* is sometimes treated as distinct (e.g. Soják 2004), and *Pentaphylloides* is replaced by *Daaphora* (Soják 1983).

Several years later, Eriksson & Donoghue (1995) presented a molecular phylogenetic analysis of the Potentilleae that provided independent confirmation of the fundamental distinction between a potentilloid clade and a fragaroid clade, with species representing the various generic segregates recognized by Soják falling into the clades that corresponded to Soják’s evolutionary lines. Further studies (Eriksson et al. 1998, Eriksson et al. 2003) confirmed and expanded the results, showing moreover that *Chamaerhodos* Bunge, *Alchemilla* L., and related taxa were also nested in the fragaroid clade, and that the position of *P. anserina* (representing *Argentina*) was indeed ambiguous.

In the face of these independent lines of investigation, there is no question that the species currently treated as *Potentilla* s.l. that fall into the fragaroid clade cannot be retained in *Potentilla* without that genus being widely polyphyletic, unless *Fragaria*, *Chamaerhodos*, *Alchemilla* L., *Aphanes* L., and *Lucemilla* Ryd. are also included. The alternative is to remove all taxa in the fragaroid clade from *Potentilla*, and it is this option that is currently being implemented in Europe (Kurtto & Eriksson 2003) and N. America (Erlander et al., under prep.). The requisite updates for Flora Iranica, using the generic circumscriptions of Soják (e.g. 2004) are incorporated in Table 1, including a new combination to transfer *Potentilla schiraizana* into *Drymocallis*.

The status of *Duchesnea indica* (Andrews) Focke is more problematic, in that it involves a controversy of scientific philosophy. Although *Duchesnea* has a superficial resemblance to *Fragaria* in its enlarged fleshy fruiting structure, this is clearly an example of convergence in that both the morphological and molecular evidence show that *Duchesnea* is a member of the potentilloid clade and is in fact closely related to *Potentilla* sect. *Potentilla*. If, as affirmed by Eriksson et al.
(1998, 2003), only non-paraphyletic taxa are worthy of recognition, then *Duchesnea indica* must be replaced with *Potentilla indica* (Andrews) Th. Wolf. This philosophical stance, however, is not universally accepted, especially among florists who believe that paraphyly alone should not dictate generic delimitations (e.g. BRUMMITT 2002, DIGGS & LIPSCOMB 2002, HÖRANDL 2006), in which case *Duchesnea* can be maintained as a distinct genus.

An updated synopsis of *Potentillaeae* (Rosaceae) in Flora Iranica, excluding *Sibbaldia* and *Fragaria* is presented below. Sequence and numbering follows that of Flora Iranica, except as indicated. Additions and significant nomenclatural changes are noted in boldface; deletions from the Flora are in square brackets [.]. Changes in author citations follow SOJÁK (2004); unless otherwise indicated, changes to sections follow Reveal in ERTTER et al. (ind.)

**Duchesnea** Smith,


**Dasiphora** Raf. – replaces *Potentilla* sect. *Fruticosae* (Th. Wolf) Grossh. and *Pentaphyllumoides* Duhamel, the latter a superfluous and therefore illegitimate name (SOJÁK 1969, 1983; KURTTO & ERIKSSON 2003)

1. *Dasiphora dryadanthoides* Juz. - according to SOJÁK (pers. comm. 2006), it is this species, not *Potentilla phyllocalyx* (Juz.) Schimun-Czeika, that occurs in the territory of Flora Iranica.


Changes to *Potentilla* s.l. (Rosaceae) in Iranica

*bifurca* subsp. *orientalis* (Juz.) Soják, as the subspecies occurring in Flora Iranica, but the necessary combination in *Schistophyllum* has not yet been validly made (cv. SOJÁK 2004).


4. *Potentilla sericophylla* Parker - Soják (mss. ined.) considers this to be a species of *Tylosperma*, but the necessary combination has not yet been published.


9. **Drymocallis poterifolia** (Boiss.) Soják = *Potentilla poerifolia* Boiss. fide SOJÁK (1989)


- **Drymocallis rapestræ** (L.) Soják = *Potentilla rapestræ* L., reported from Iran by KHATAMSZA (1987)

**Potentilla** L.


5. *Potentilla bifloræ* Willd.


6. *Potentilla speciosa* Willd. subsp. *gymnocarpa* Soják & Termeh -- newly described subspecies occurring in eastern Turkey, western Iran, and northern Iraq (SOJÁK 1993); according to SOJÁK (pers. comm. 2006), *Potentilla straussii* Bornm. is not a distinct species but rather intermediate between *P*. *speciosa* subsp. *speciosa* and *P*. *speciosa* subsp. *Gymnocarpa*.
• *Potentilla discipulum* Davis -- reported from Iran, Prov. Azarbeyjan (Khatamsaz 1987)

*Potentilla* sect. *Curvifolia* (Th. Wolf) Schiman-Czeika


8. *Potentilla microsperma* Ramond ex DC.


10. *Potentilla multifida* L.

10a. *Potentilla virgata* Lehm. - mentioned as occurring in Afghanistan (SOJÁK 1988), but included within *P. multifida* in Hora Iranica

11. *Potentilla sonangurica* Bunge - also occurs in N.E. Iran (SOJÁK, pers. comm. 2006)

12. *Potentilla sericea* L. - the report of this species in Afghanistan is based on a morphologically similar species, fide SOJÁK (1987a, pers. comm. 2006)

12a. *Potentilla alexeenkoii* Lipsky -- reported from Iran, Prov. Azerbaycan (Khatamsaz 1987) but considered to be a synonym of *P. sericea* by SOJÁK (1987d)


• *Potentilla agrimonioides* M. - Bieb. var. *intercedens* Sojak - the species was reported from Iran, Prov. Azerbaycan (Khatamsaz 1987) during the same year that the variety was newly described as the only one occurring in Iran, the Himalayas, and Mongolia (SOJÁK 1987d).

• *Potentilla bactriana* Sojak -- newly described species occurring in Afghanistan and adjacent parts of Tajikistan and Pakistan (SOJÁK 1992)

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Changes to *Potentilla* s.l. (Rosaceae) in *Flora Iranica*

- *Potentilla bactriana* var. *bamiiana* Soják – newly described variety from Afghanistan (SOJÁK 1992)
- *Potentilla lomakinii* Grossh – replaces report of *P. approximata* Bunge (among “Species incertae” in *Flora Iranica*) northern Iran (SOJÁK 1987d)
- *Potentilla pamirica* Th. Wolf - mentioned as occurring in northern Iran (SOJÁK 1988)
- *Potentilla pamiroalaica* Juz. var. *pamiroalaica* - mentioned as occurring in Afghanistan (SOJÁK 1988)

*Potentilla* sect. *Hemaetochris* (Rydb.) B.C. Johnst.


16. *Potentilla argentea* L.


20. *Potentilla recta* L.

21. *Potentilla pedata* Nestler


[23. *Potentilla hirta* L. - SOJÁK (pers. comm. 2006) believes that this species does not occur the territory of *Flora Iranica*]
24. Potentilla iranica (Rech. f.) Schiman-Czeikä - SOJÁK (pers. comm. 2006; In Press) considers this to be intermediate between P. divaricata and P. recta.


- Potentilla gorganica Sojak -- newly described species occurring in Iran, Prov. Golestan, and Turkmenistan (SOJÁK 1991)

- Potentilla laciniosa Walst. & Kit. ex Nestl. -- collected in NE Iran in 1977 by SOJÁK (pers. comm. 2006)

- Potentilla asulejica Sojak - newly described species from Iran, Prov. Gilan (SOJÁK 2006)

Potentilla sect. Rivalis Poeverl.


27. Potentilla desertorum Bunge


28. Potentilla burgeri Boiss.

29. Potentilla elvendensis Boiss.

30. Potentilla argae Boiss. & Balansa

31. Potentilla coetexis Gilli.

32. Potentilla flabellata Regel & Schmalh.

33. Potentilla argyroloma Boiss. & Hohen.

34. Potentilla persica Boiss. & Hauksn.

35. Potentilla kurdica Boiss. & Hohen.

36. Potentilla pannosa Boiss. & Hauksn.

37. Potentilla malloka Boiss.

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Changes to *Potentilla* s.l. (Rosaceae) in Iranica

38. *Potentilla komaroviana* Th. Wolf - to be treated as a variety of *P. mollissima* Lehm. by SOJÁK (2004, pers. comm. 2006)


40. *Potentilla flaccida* Th. Wolf

41. *Potentilla aucheriana* Th. Wolf


* Potentilla ghazniensis* Soják -- newly described species from Afghanistan (SOJÁK 1987a)

* Potentilla porphyrantha* Juz. - reported from Iran, Prov. Azarbeyejan (ASSADI & WENDELBO 1977)


[44. *P. adsharica* Sommier & Levier -- included within *P. divaricata* in *P. sect. Reticae*, fide SOJÁK (2004)]

[45. *Potentilla szovitsii* Th. Wolf - based on a mixture of *P. divaricata* (No. 25 in *P. sect. Reticae*) and *P. thuringiaca* Bernh. ex Link, fide SOJÁK (2004)]

* Potentilla algida* Soják - mentioned as occurring in NE Afghanistan (SOJÁK, pers. comm. 2006, In Press); a nom. nov. for *P. sericata* Th. Wolf 1908, nom. Greene 1887

*Potentilla* sect. *Aureae* (Ryd.) Juz.

46. *Potentilla gelida* subsp. *borissii* (Ovcz. & Kochk.) Soják - newly described subspecies occurring in northern Afghanistan (SOJÁK 1988); *P. gelida* subsp. *gelida* occurs in Turkey, Caucasia and Transcausasia, but not in Afghanistan (SOJÁK, pers. comm. 2006)
[47. *Potentilla tephroleuca* Th. Wolf - not in territory of Flora Iranica (SOJÁK, pers. comm. 2006)]

48. *Potentilla kurrumensis* Th. Wolf - SOJÁK (pers. comm., 2006) considers this to be no more than a subspecies or variety of *P. turczaninowiana* Stschegl.


- *Potentilla doujonneana* Cambess. - mentioned as occurring in northern Afghanistan, where confused with *P. gelida* (SOJÁK 1988)

- *Potentilla crantzii* (Cranz.) Beck ex Fritsch - reported from Iran, Prov. Gilan (KHATAMSAZ 1987), and indicated as occurring within the area of Flora Iranica by earlier sources (e.g. SOJÁK 1960)

- *Potentilla adenophylla* Boiss. & Hohenack - reported from Iran, Prov. Mazindaran (KHATAMSAZ 1988)

*Potentilla sect. Potentilla* - replaces *P. sect. Tormenilliæ* (Rydbe.) Juz. (SOJÁK 1987c), as a result of *P. reptans* L. having been designated the type of *Potentilla* by Rydberg (N. Amer. Fl. 22: 293. 20 Nov. 1908)

50. *Potentilla reptans* L.

*Potentilla sect. Pentaphyllioides* Tausch - replaces *P. sect. Potentilla* (misapplied), fide SOJÁK (1987, 2005), or alternatively treated as a distinct genus, *Argentina* Hill. (e.g. SOJÁK 2004)

51. *Potentilla anserina* L. - alternatively treated as *Argentina anserina* (L.) Rydbe. (e.g. SOJÁK 2004)

*Potentilla*: “Species incertae et incomplete notae” in Flora Iranica

[1. *P. approximata* Bunge - see *P. lomakinii* in *P. sect. Pennsylvanicae]*

2. *Potentilla gaueana* Borreman,

3. *Potentilla kandivanensis* Borreman. & Gaulba


7. *Potentilla umbrosa* Steven ex M. Bieb.

**Farinopsis** Chrtek & Sojak -- established as a monotypic genus by CHRTEK & SOJÁK (1984), though also treated as *Potentilla* sect. *Farinopsis* Chrtek & Sojak, SOJÁK (1987c). The remaining species in *Comarum* s.s. and *C. palustre* L., does not occur in Flora Iranica.


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Changes to *Potentilla* s.l. (Rosaceae) in Flora Iranica


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A SYNOPSIS OF SECT. CYNAROIDES
(COUSINIA, COMPOSITAE), DISTRIBUTION
PATTERNS AND DIVERSITY CENTERS

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Abstract

The name of sect. Cynaroides Bunge is corrected to sect. Cynaroides
Bunge. Cousinia caroli-kennici is described and illustrated as a new species from
sect. Cynaroides Bunge. The following species are synonymed: C. albicaulis Boiss.
& Bhiuse and C. sabzevarensis Rech. f. with C. ontaporoides Ledeb.,
f. with C. pergamocea Boiss. & Hausskn. A complete description of
sect. Cynaroides is given. Distribution patterns, diversity centers and distribution
map of sect. Cynaroides are presented in Iran (Maps 1-36). Also the check list of
species, synonyms and endemics of section are given.

Key words: Cynaroides, Cousinia, Compositae, Diversity

Introduction

The genus Cousinia Cass. (Compositae family, Cardueae tribe) has about
705 taxa (TCHERNEVA 1962, RECHINGER 1972 & 1979, GHAHREMAN &
ATTAR 1999, ATTAR 2000, etc.) in the world which are distributed in S.W. Asia.
Cousinia Cass. is the richest genus after Astragalus L. in Flora of Iran.
RECHINGER (1972, 1979) has introduced 220 taxa of this genus from Iran in Flora Iranica. Now, the number of Cousinia taxa increasing to 255 taxa (including of published new species, records and some which are under Press). Among them 198 taxa are endemic to Iran.

Cousinia Cass. has the four following diversity centers: (1) Pamir-Alaj, (2) Tian-shan, (3) Badakhshan, Chitral and Tajik and (4) Kopet-dagh regions (KNAPP 1987). Moreover, there is another diversity center for the genus (sect. Cynaroides) in Zagros elevations (Azerbaijan, Kurdestan, Kermanshah, Hamadan, Bakhtiari and Lorestan Provinces) in Iran, which is including more than 50 endemic taxa. (ATTAR 2000).

Chorologically, all taxa of Cousinia are found in Irano-Turanian region. Majority of species have a limited distribution and grow as individual or in small isolated patches. These species are very rare or can be endangered. Some species have widespread distribution in Iran such as: Cousinia calocephala Joub. & Spach (sect. Cynaroides), C. cylindracea Biss., (sect. Stenocephalae), C. congesta Bunge (sect. Congestae) and C. bekangeri DC. (sect. Pugioniferae).

Based on literature, sect. Cynaroides Bunge had 70 species in the world (RECH. F. 1972, 1979, HUBER-MORATH 1975) which in the present study, the number of species is increased to 89.

Iran with 74 taxa and 59 endemic is the richest country followed by Iraq and Turkey in the number of taxa, respectively.

Section Cynaroides has the various morphological characters between individuals of species and also taxonomical complexes. There are some new unpublished species which will be presented with the identical key soon.

Materials and Methods

To carry out our research on this section, we collected many specimens from different localities especially “Locus classicus” or near it. All specimens are preserved in TUH. Also, all specimens of other Herbaria of Iran, such as TARI, IRAN, FUHM, KAR and THE (HOLMGREN et al. 1990). Also, some specimens belong to Turkey and Iraq Flora were studied. All of the specimens determined by using of different Floras (Flora Iranica, Flora of Turkey, Flora of USSR, etc.). Also
the specimens compared with the type photographs which prepared at the Vienna and Leningrad Herbaria. In the check list of species, type locals, "Locus classicus", herbarium number of studied specimens and endemics are presented.

**Sect. Cynaroides Bunge**

Monocarpic biennial or perennial. Stems interrupted- or continuously winged by decurrent leaves. Leaves coriaceous or herbaceous, variable in shape, entire, dentate, lobed to pinnatifid-pinnatisect, spinose at margin, tomentose-arachnoid or floccose, rarely glabrous or glabrescent; basal sometimes rosette, usually dried at flowering time; caulines shortly or longly decurrent; uppermost sometimes involucrate and cup-like. Capitulum solitary, terminal, 1.5-9 cm in diameter. Involucre spherical, oblong, weakly or hardly constricted above, arachnoid or glabrous. Bracts 40-170, appendiculate (especial characters for section); innermost bracts linear and exappendiculate; margin of bracts can be entire or spinose; number of spines (if present) 1-4 on each side in different species; shape of appendages triangular, rhombiform, trapezoid or sagitate. Receptacle bristles smooth or scabrous. Number of flower 50-400; corolla yellow, white, pink or purple, 15-50 mm or more. Anther tube glabrous, yellow, white, pink or purple. Achenes pyramidal or obovate, striate, atro-maculate, 3-7 mm long, denticulate or entire above; pappus short, scabrous, deciduous.

*Cousinia caroli-henrici* Attar & Ghahreman, (sect. Cynaroides Bunge) Sp. nova (Fig. 1)

*Cousinia* pergamaea similis sed cinerascens glauca (nec viridia); tota persistente araneoso-floccoso-tomentella (nec valde glabrescens); involucrum araneosum (nec glabrum); phylla appendicibus 5 mm latis, margine utrinque spinulosa (nec ultra 10 mm latis, margine integerrima); corolla 17 mm longa (nec 25 mm longa).

Monocarpic perennial, up to 60 cm high, grayish-canescen. Stem solitary, densely leafy, broadly interrupted or continuously winged, densely floccose-tomentose, branched from base, with corymbiform branches above; branches monoecephalous. Leaves coriaceous, densely tomentose-floccose-arachnoid on both surfaces, nervation pinnate-reticulate; basals sessile, oblong, 12-17 cm long and
5-7 cm wide, with white prominent rigid midrib, undulate, dentate-spinose or lobed-spinose at margin; medians similar to basals but longly decurrent, undulate, forming broad wings on the stem; upper and uppermost similar to others but gradually smaller, uppermost leaves closed to capitulum. Capitulum solitary, terminal, more or less 80-flowered; involucre nearly spherical, constricted above, yellow-arachnoid; bracts more or less 110, appendiculate, strongly imbricate; outers small, appendage 5-8 x 3 mm, triangular, acute, with numerous spines at margin; appendages of median bracts sagitate, 9 x 5 mm, with 1-2 spines on each side, gradually acuminate; inner bracts longer than the outers and medians, appendage smaller, sagitate, entire; innermost bracts linear, acuminate, exceeding. Receptacle bristles scabrous. Corolla yellow, 17 mm long, limb 10 mm and tube 7 mm long; anther tube glabrous, white with pink tip. Matured achene not seen.

Fig. 1. *Cousinia neorechingeri*: Habit and bracts.
Holotype: Kurdistan: Baneh, Attar & Ghahreman, 22455-TUH.

The related species to *Cousinia caroli-hennici* is *C. pergamaecea* Boiss. & Hausskn. in Boiss. that distributed in Baneh and Sardasht in Kurdistan Province. *Cousinia caroli-hennici* is distinguished by the following characters: greyish-glaucous habit, persistent indumentum, spinose margin of bract appendages, width of bract appendages and length of corolla.

*Cousinia caroli-hennici* dedicated to 100th birth anniversary of Prof. Karl Heinz Rechinger.

**Synonyms and nomenclature note:**

Based on comparison of the collected specimens from the "Locus classicus" with type photographs following species are synonymed:

*C. albicandis*, *C. subglaucens*, *C. pichleriana*, and *C. fursei* are synonymed with *C. onopordoides*, *C. echinatensis*, and *C. pergamaecea*, respectively.

The name of sect. *Cynaroides* Bunge (RECHINGER 1972), is corrected to sect. *Cynaroides* Bunge. Based on code of nomenclature of taxonomy "oideae" is using for subfamily.

**Distribution patterns and diversity centers in Iran**

Morphologically, achenes of sect. *Cynaroides* is heavy with short caducous pappus. Thus these achenes can not easily transport far areas by wind. Also achenes are resiniferous and most of them use by insects. Thus the entire achenes are few in each head. Monocarpical duration is the other important character of this section. All of above causes, are limited distribution of species. These species are distributed in the special isolated locals and may be gradually endanger and extinct. Rarely, some species as *C. onopordoides* is widely distributed in Iran, Turkmenistan, Afghanistan and Pakistan. This may be due to high number of flowers which may reach up to 400 in each head. Also the achenes often can not use by insects.

From the diversity point of view, Iran is the main center of diversity of sect. *Cynaroides* Bunge in the world due to this fact that about 84% of the total species of this section are found in Iran.

A few species of the section are placed in Iraq, Turkey, Talish, Turkmenistan and Afghanistan. There are some species in western neighbours of Iran, Iraq and
Turkey, which are more frequent in eastern neighbours. Three species also have been reported from northern neighbours of Iran.

The geographical distribution of *Cousinia* occurs in Zagros mountains, central Alborz mountains and some elevations in the central deserts of the Iranian plateau such as Shir-kuh-e Yazd, Jehal-e Barez and Hezar in Kerman Province. A few number of species such as *C. onopordioides, C. grandiceps, C. verbascifolia, C. lyra* and *C. monocephala* can be found in N.E. Iran. Sarakhs area is the farthest distribution limit in the E. Iran. *Cousina lyra* and *C. verbascifolia* have been found in small patches in Sarakhs area. *Cousina grandiceps* and *C. onopordioides* joint together with wider distribution in a section of S.E. towards W. Khorasan Province and also into margin of Kavir desert, elevations in Kerman Province, Shir-Kuh in Yazd and from W. Serman to Ahvan pass. Other species such as *C. calocephala, C. behboudiana* and *C. keredjensis* grow in the Dena bestd and Mt., Kandavan elevations and places above Karaj in Central Alborz. Diversity of this section is rapidly increased toward W. and N.W. Iran. Diversity centers are found in the elevations of Azerbaijan, Alvand Mt. (in Hamadan Province), Shahzand Mt. (in Arak), Oshor-kan-Kuh (in Lorestan Province) and in western parts of Iran such as Oramanat Mt. and Shahu (Kermanshah and Kurdistan Provinces). Therefore, Azarbeyjan with 13 species has the high species diversity in Iran than other areas. There are eight species in Hamadan Province, the endemic species *"C. elvenensis"* is only placed in Alvand Mt. On the other hand, Kurdistan Province with 11 species shows high diversity of *Cynaroides* section too.

Toward S. Iran, there is a decreasing in species diversity. The farthest limit of southern distribution of sect. *Cynaroides* occurs in Shahbazan area in 60 km N. Dezful where they have been only collected a single species, namely, *C. disulfensis*. No specimens and any traces found in two visits to the area. Other species in southwest of Iran is *C. sefidiana* which grows in elevations around Karun river. Two species named *C. onopordioides* and *C. grandiceps* are found in Jehal Barez and Jougar mountains in southeast of Iran. In Tables 1 & 2, the number of species and endemics between Iran and other countries in southwestern Asia are compared.
Conclusion

The distribution patterns of sect. of *Cynaroides* Bunge, that presented in this study, show that species diversity rapidly decreases toward “Pakistan, Afghanistan and Turkmenistan” in eastern borders of Iran and also toward south and southeast. Species diversity increases toward west of Iran mainly in Zagros mountain, and decreases toward Iraq, Turkey and Talish. Thus, diversity centers for sect. *Cynaroides* Bunge can be cited in Azerbaijan (13 species), Kurdistan (11 species) Kermanshah (10 species), Hamadan (9 species) and Bakhtiari (7 species) Provinces (Table 3).

The check list of sect. *Cynaroides* Bunge including of synonym names:
   Type: Iraq: Nowandu, 2600-3000 m, 11465. Specimens studied: 30533-TARI. Rare. Map 16
   Type: Iran: Kermanshah: Chalan to Dalahu. Endemic. Specimens studied: 29256-TARI. Rare. Map 32
   Type: Iran: Fars: mt. Dinar. Endemic. Rare. Any specimens not found. Map 8
   Type: Iran: Tehran: Marunak. Endemic. Specimens studied: 21970-TUH; 11654-TUH; 11663-TUH; 21342-TUH; 4134-TARI; 10718-TARI; 404-TARI; 4195-TARI; 4191-TARI; 4103-TARI; 55250-TARI; 9580-TARI; 4165-TARI; 18960-TARI; 321
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4144-TARI; 9827-TARI; 4188-TARI; 4156-TARI; 33880-IRAN; 8857-IRAN; 169-IRAN (Type); 40826-IRAN; 50930-IRAN. Map 19


Type: Iran: Kerman: mt. Jupar. Endemic. Specimens studied: 2901-TARI; 18086-TARI; 4376-TARI; 18042-TARI; 34034-IRAN; 17528-TARI. Map 21

Syn.: *Cousinia squarrosa* Boiss.
Type: Iran: Hyrcania. Endemic. Specimens studied: 33991-IRAN; 33990-IRAN; 6988-TARI; 34246-TARI; 33995-IRAN; 67973-TARI; 7640-TARI; 30711-TARI; 33589-TARI; 50984-TUH; 89340-IRAN; 8998-IRAN; 8820-IRAN; 33885-IRAN; 33700-IRAN; 33880-IRAN; 33909-IRAN; 33910-IRAN; 8851-IRAN; 33890-IRAN; 40350-TARI; 33998-IRAN. Map 17

Type: Iraq: Kurdistan: Arbil and Sarki Sakran. Specimens studied: 27592-TUH. Map 31

Type: Iran: Kurdistan: Baneh. 22455-TUH. Endemic. Specimens studied: 22455 (Holotype). Rare. Map 33

Type: Iran: between Mazibon and Avihaing. Endemic. Specimens studied: 20562-TUH; 14296-TUH; 9003/1-IRAN; 9004/1-IRAN; 71607-TARI; 74767-TARI; 60054-TARI; 1160-TARI; 75191-TARI; 71596-TARI. Map 1

Syn.: *Cousinia schultzjiana* Jaub. & Spach.
Type: Iran: mt. Chiya-e Gara. Specimens studied: 21811-TUH; 72092-TARI; 48159-TARI; 47990-TARI; 47862-TARI; 13192-TARI; 13145-TARI; 48159-TARI; 18960-TARI; 72077-TARI. Map 20

Syn.: *Carthamus cynaroides* M.B.; *Onobroma cynaroides* (M.B.) Spreng.; *Arctium cynaroides* (M.B.) O. Kuntze
Type: Azerbaijan: mt. Talish. Specimens studied: 22568-TUH. Rare. Map 16


Type: Iran: Khuzestan: 60 km N. Dezful, 1200 m. Endemic. Specimens studied: 26304-TUH. Rare. Map 11

Type: Iran: Hamadan. Endemic. Specimens studied: 22368-TUH (Locus classicus)
Syn.: *Cousinia echitanensis* Bornm. ex Rech. f. Map 9

Type: Iran: Hamadan: mt. Alvand. Endemic. Specimens studied: 20566-TUH (Locus classicus); 20566-TUH; 65047-IRAN; 74761-TARI. Rare. Map 7

Type: Turkey. Specimens studied: 68887-TUH. Map 5
Type: Iran: Shiraz, near Perspolis. Endemic. Specimens studied: 22514-TUH; 22521-TUH; 22508-TUH; 71330-TARI; 66869-TARI; 71524-TARI; 71542-TARI. Map 27

Type: Iran: Azerbaijan: mt. Sabalan, above Meshkin-shahr. Specimens studied: 7507-TUH; 27886-TARI; 20942-TARI; 65915-TARI; 20513-TARI; 24528-TARI; 24574-TARI; 71677-TARI; 20942-TARI; 13871-TARI; 35001-TARI; 17240-TUH; 21808-TUH (Locus classicus). Map 23


Type: Iran: Sabzevar. Endemic. Specimens studied: 21061-TARI; 40759-TARI; 22050-TUH (Locus classicus). Map 26

25. *C. grandis* C.A. Mey. in DC., Prodr. 6: 557 (1838).
Type: Iran: Azerbaijan: Ahar, mt. Seyyed Khajeh. Specimens studied: 20577-TUH (Locus classicus); 6791-TARI. Rare. Map 6

Type: Iran: Azerbaijan: 23 km W. Urumieh. Endemic. Specimens studied: 20587-TUH (Locus classicus); 70086-TARI; 68256-TARI. Map 3

Type: Turkey: mt. Hakkary. Specimens studied: 45467-TUH; 70301-TARI. Rare. Map 13

Type: Hamadan: 28 km S. Nahavand toward Malayer, mt. Garrin. Endemic. Specimens studied: 720551-TUH (Locus classicus); 33895-IRAN (Type); 75116-TARI; 65082-TARI; 36912-TARI. Map 3.
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29. C. inflata Boiss. & Hausskn. in Boiss., Fl. Or. 3: 512 (1875).
Type: Iran: Ker. Kermanh.: nr. Shah, Specimens studied: 20573-TUH; 20561-TUH; 17829-TUH; 22375-TUH; 1221-TARI; 23465-TUH; 20575-TUH; 74816-TARI; 74608-TARI; 46727-TARI. Map 4

Type: Iran: Arak: nr. Rasval, near Chehel Khatan. Endemic. Specimens studied: 75038-TARI (Locus classicus); 21881-TUH (Locus classicus). Map 28

Type: Iran: Ilam. Endemic. Specimens studied: 22370-TUH (Locus classicus). Rare. Map 14

32. C. keredjensis Bornm. & Gaube, Feddes Repert. 36: 328 (1934).
Type: Iran: nr. Keredj, Kuh-Dashteh. Endemic. Specimens studied: 21807-TUH (Locus classicus); 12525-TARI; 32774-TARI; 57089-TARI; 33614-TARI; 32627-TARI; 12524-TARI; 12526-TARI; 12320-TARI; 21705-TARI. Map 8

Type: Iran: Kermanh. Esfarvar-Gharp, Mahidasht region, Bujan pass. Endemic. Specimens studied: 19180-TUH (Holotype); 2525-TARI (Paratype). Rare. Map 11

34. C. khamaricus Attar & Ghahreman, Nordic J. Bot. 23: 589-592.
Type: Iran: Esfarvan: Khamsar. Endemic. Specimen seen: 2033-TUH (Holotype). Map 33

Type: Iran: Lorestan: Khorramabad, road of Keashvar, Nuan pass. Endemic. Specimens studied: 19180-TUH; 2525-TARI; 21851-TUH; 42345-TARI; 37050-TARI; 42281-TARI; 34000-IRAN; 76852-TARI; 26124-TARI. Map 1

37. *C. kirindica* Bomn. & Rech. f., Feddes Repert. 48: 141 (1940)

Syn.: *Cousinia lurorum* Bomn. var. *recurvata* Bomn.; *C. lurorum* Bomn. var. *kaneigera* Bomn.

Type: Iran: between Kermanshah & Kerend. Endemic. Specimens studied: 19962-TUH (Locus classicus); 1873-TARI; 12200-IRAN. Rare. Map 22


Type: Iraq: Soleymanieh, mt. Ghareh-dagh. Specimens studied: 70067-TARI. Rare. Map 17


Syn.: *Cousinia medororum* Bomn. & Gauba.

Type: Iran: Hamadan, mt. Alvand. Endemic. Specimens studied: 22369-TUH; 20533-TI; 20550-TUH; 33916-IRAN. Map 25


Syn.: *Cousinia silboides* Jaub. & Spach

Type: Iran: Boyer-Ahmad, mt. Dena. Endemic. Specimens studied: 20552-TUH; 20558-TUH; 33903-IRAN; 33897-IRAN; 13136-IRAN; 489-IRAN. Map 15


Type: Iran: Esfahan: near Daran. Endemic. Specimens studied: 20037-TUH (Locus classicus); 34024-IRAN. Rare. Map 24


Syn.: *Cousinia cymbolepis* Boiss. var. *subintegriola* Bomn.

Type: Iran: Kermanshah: between Kungavar and Sahnheh. Endemic. Specimens studied: 20568-TUH. Rare. Map 21


Syn.: *Cousinia caesia* C. Winkl.; *Arctium lyratum* O. Kuntze

Type: Iran: Sabzevar. Specimens studied: 21912-IRAN; 21241-TARI; 79147-TARI. Map 26

A synopsis of sect. *Cynioides* (*Cousinia*, Compositae)...

Syn.: *Onobroma macrocephalum* C.A. Mey.; *Arctium macrocephalum* (C.A. Mey.) O. Kuntze

Type: Azerbaijan: mts. Talish. Specimens studied: In the Flora of USSR was mentioned from N. Iran but specimens not found.

   Type: Iran: Kurdistan: mt. Chehel-Cheshmah. Endemic. Specimens studied: 16673-TUH; 20557-TUH; 9114/1-IRAN; 34035-IRAN; 70058-TARI; 74843-TARI; 3443-TARI. Map 2

   Type: Kermanshah: between Eslamabad and Kerend-e Gharb. Endemic. Specimens studied: 20569-TUH (Holotype); 22378-TUH; 1425-TARI; 60789-TARI. Rare. Map 22

   Type: Iran: Khorasan: Hekmatabad near Mashhad. Endemic. Specimens studied: 21931-TUH (near Locus classicus). Rare. Map 12

   Type: Iran: Fars: between Nurabad and Karezan. Endemic. Specimens studied: 71266-TARI (Holotype). Rare. Map 18


   Type: Iran: Kermanshah, near Kerend-e Gharb. Endemic. Specimens studied: 58049-TARI. Rare. Map 18

   Syn.: *Cousinia albicaulis* Boiss. & Buhse; *C. salzeriennis* Rech. f.; *Arctium, A. albicaule* et *A. karelinii* O. Kuntze.
   Type: Eastern coast of Caspian Sea, between Mangishlak and Ghar-e Boghaz. Specimens studied: 21735-TUH; 21923-TUH; 21430-TARI; 12861-TARI; 21509-TARI; 21894-TUH; 21930-TUH; 21890-TUH; 21901-TUH; 13709-TARI; 21191-
Type: Iran: Hamadan: Road of Malayer, 20 km Hamadan, above Ekbatun dam, 1800 m. Endemic. Specimens studied: 20553-TUH (Holotype). Rare. Map 25

53. *C. pergamacea* Boiss. & Hausskn. in Boiss., Fl. Or. 3: 513 (1875).
Syn.: *Cousinia fursei* Rech. f.
Type: Iraq: Penjvein. Specimens studied: 22481-TUH (Locus classicus); 18314-TUH; 12219-IRAN; 33913-IRAN; 42653-TAR; 22571-TUH; 5504-TAR; 12198-IRAN; 25936-TARI. Map 2


55. *C. phyllocephala* Bornm. & Gaubu, Feddes Repert. 36: 330 (1934).
Syn.: *Cousinia koeieana* Bornm. Incl. var. *adenoloba* Bornm.
Type: Iran: Lorestan: Khorramabad. Endemic. Specimens studied: 21827-TUH; 21838-TUH; 21825-TUH; 34025-IRAN; 9187-IRAN; 5760-IRAN; 26054-TARI; 37024-TARI; 9183/3-IRAN. Map 10

56. *C. purpurea* C.A. Mey. in DC., Prodr. 6: 555 (1837).
Syn.: *Arctium purpureum* (C.A. Mey.) O. Kuntze
Type: Azerbajian: between Khoy and Nakhchijovan. Specimens studied: not seen. Rare.

Type: Iraq: Arbil: mt. Qandil, 1200 m, Rech. f., 11003. Specimens studied: 22009-TUH. Rare. Map 3

Type: Iran: Lorestan, between mt. Oshtoran-kuh and mt. Sus, Sefidab. Endemic. Specimens studied: 21884-TUH (Locus classicus); 57633-TARI; 10276-TARI. Rare. Map 5

Type: Iran: between Ardebil and Sar-ein. Endemic. Specimens studied: 22572-TUH (Holotype). Rare. Map 15

Type: Iran: Arak, Modar. Endemic. Specimens studied: 21880-TUH; 21879-TUH; 21882-TUH; 28204-TARI; 63737-TARI; 63849-TARI; 22371-TUH. Map 23

Type: Iran: Kurdistan: 48 km W Sanandaj. Endemic. Specimens studied: 20571-TUH; 14200-TUH; 64994-TUH; 33291-TARI. Map 9

Type: Iran: Kurdistan: Sardasht. Specimens studied: 70049-TARI. Rare. Map 4

Type: Iran: Kerman: 40 km from Jiroft to mt. Sarzeh. Endemic. Specimens studied: 25326-TARI (Holotype). Rare. Map 24


Syn.: *Cousinia cymbolepis* Boiss. var. *sefidana* Pau
Type: Iran: Bakhtiari, near Karun River, mt. Sefid. Endemic. Specimens studied: 54903-TARI; 74482-TARI. Rare. Map 20

Type: Iran: Mianeh to Tabriz, Shebli pass. Endemic. Specimens studied: 20580-TUH (Holotype). Rare. Map 29
Type: Iran: Lorestan: Khorramabad, Shulabad. Endemic. Specimens studied: 21874-TUH (Holotype); 27593-TUH (Paratype). Rare. Map 35

Type: Kurestan: 114 km from Marivan to Saqqez. Endemic. Specimens studied: 21148-TARI. Rare. Map 19

Type: Iran: Arak: Gerdu, Modar and Shazand. Specimens studied: 21882-TUH (Locus classicus). Map 28

Type: Hamadan: Nahavand, nt. Gurrin. Endemic. Specimens studied: 33912-IRAN. Rare. Map 1

Type: Iran: Khorasan, Neyshabur. Endemic. Specimens studied: 21907-TUH; 21349-TARI; 33968-IRAN; 5249-IRAN; 33935-IRAN; 33860-IRAN; 33955-IRAN; 23313-TARI; 21938-TARI, 21281-TARI, 35975-TARI. Map 12

Type: Iran: Azerbajian: Tabriz. Specimens studied: 21343-TUH; 16038-TUH; 9776-TUH; 69907-TARI; 65432-TARI; 30532-TARI; 8558-TARI; 64324-TARI; 74886-TARI. Map 6


Type: Iran: Bakhtiar, between Gandoman and Borujen. Endemic. Specimens studied: 21887-TUH (Holotype); 20038-TUH (Paratype). Map 36
A synopsis of sect. Cynaroides (Cassia, Compositae)...

Table 1. Section Cynaroides Bunge in the S.W. of Asia

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<th>Species</th>
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<td>1. C. acanthophylla Rech. f.</td>
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<td>2. C. antibennis Boiss. &amp; Hausskn.</td>
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<td>5. C. anoplaphylla Rech. f.</td>
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<td>6. C. ananeosa DC.</td>
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<td>7. C. arborensis C. Winkler &amp; Borrn.</td>
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<td>9. C. beckeri Trautv.</td>
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<td>11. C. bireiikensis Hub.-Mor.</td>
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<td>22. C. dakahuensis Attar &amp; Ghahreman</td>
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<td>C. Iranica C.Winkl. &amp; Str.</td>
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<td>C. kermanshahensis Attar &amp; Ghah.</td>
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<td>C. kirimdic Boiss. &amp; Rech. f.</td>
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<td>C. kornhuberi Heimerl</td>
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<td>C. karlic C. Winkler &amp; Bornm.</td>
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<td>C. macrocephala C.A. Mey.</td>
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<td><em>C. nana-shirinensis</em> Rech. f.</td>
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<td><em>C. nobayenii</em> Ghahreman &amp; Attar</td>
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<td><em>C. persopolitanus</em> Attar &amp; Ghahreman</td>
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<td><em>C. phylocephala</em> Boran. &amp; Gauba</td>
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<tr>
<td>78</td>
<td><em>C. sefidiana</em> Puu</td>
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<tr>
<td>79</td>
<td><em>C. shehliensis</em> Ghah., Iransh &amp; Attar</td>
<td></td>
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<td></td>
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<tr>
<td>80</td>
<td><em>C. shalabadiensis</em> Attar &amp; Ghahreman</td>
<td></td>
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<tr>
<td>81</td>
<td><em>C. straterolepis</em> Rech. f.</td>
<td></td>
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<tr>
<td>82</td>
<td><em>C. straussii</em> Hausskn. &amp; C. Winkl.</td>
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<tr>
<td>83</td>
<td><em>C. subinflata</em> Bornm.</td>
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Table 1. (contd.)

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<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>84. C. vanensis Hub-Mor.</td>
<td></td>
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<tr>
<td>85. C. verbascifolia Bunge</td>
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<tr>
<td>86. C. wettestiniana Bomm.</td>
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<tr>
<td>87. C. wheeleri hainsii Rech. f.</td>
<td></td>
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<tr>
<td>88. C. zagrica Attar, Ghahreman &amp; Assadi</td>
<td></td>
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<tr>
<td>89. C. zardakahensis Attar &amp; Ghahreman</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: Ir=Iran, Tk=Turkey, Iq=Iraq, Af=Afghanistan, Pk=Pakistan, Tu=Turkmenistan, RA=Republic of Azerbaijan.

Table 2. Comparison of taxa between different countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Taxa</th>
<th>Endemics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iran</td>
<td>74</td>
<td>59</td>
</tr>
<tr>
<td>Iraq</td>
<td>17</td>
<td>9</td>
</tr>
<tr>
<td>Turkey</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Turkmenistan</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Republic of Azarbaian</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Pakistan</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Afghanistan</td>
<td>2</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 3. List of *Cousinia* spp. in different provinces

<table>
<thead>
<tr>
<th>Province</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azerbaijan (W &amp; E) (15 spp.)</td>
<td><em>aigurdina, bobeckii, calocephala, cymbolepis, eriocephala, grandis, grantii, hakkarica, macrocephala, purpurea, qandilica, qaradalaghensis, shebliensis, wettestiniana, zagrica</em></td>
</tr>
<tr>
<td>Kordistan (13 spp.)</td>
<td><em>anoplophylla, calocephala, caroli-henrici, concinna, gigantolepis, inflata, kapi-karadalaghensis, kotschyi, millefontana, pergomeaceae, sagitata, sanandajensis, stroteroilepis</em></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Region</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kermanshah (10 spp.)</td>
<td>calocephala, dalahuenis, inflata, subinflata, juccebris, kermanshahensis, kirkindica, lurorum, mobayanit, noeana</td>
</tr>
<tr>
<td>Hamadan (10 spp.)</td>
<td>cebatanensis, ekhendensis, hamadanensis, kornhuberi, kotschyi, parsam, sagittata, sanandajensis, subinflata</td>
</tr>
<tr>
<td>Bakhtiari (8 spp.)</td>
<td>aitigdarzensis, calocephala, chlorophaera, kornhuberi, noeana, rhombiformis, sifidiana, zarikahensis</td>
</tr>
<tr>
<td>Lorestan (6 spp.)</td>
<td>calocephala, carduchorum, khorramabadensis, phyllocephala, sagittata, shalabadensis</td>
</tr>
<tr>
<td>Khomasan (5 spp.)</td>
<td>grandiceps, lyata, monocephala, onopordioides, verbascifolia</td>
</tr>
<tr>
<td>Ardebil (5 spp.)</td>
<td>calocephala, cynaroides, gilliatti, grandis, sabakanica</td>
</tr>
<tr>
<td>Fars (4 spp.)</td>
<td>bornmulleri, farsistanica, mozaffariani, perspolitanus</td>
</tr>
<tr>
<td>Atrak (4 spp.)</td>
<td>iranica, nana, sagittata, straussii</td>
</tr>
<tr>
<td>Tehran (4 spp.)</td>
<td>calocephala, behboudiana, kereljensis, onopordioides</td>
</tr>
<tr>
<td>Isfahan (4 spp.)</td>
<td>bornmulleri, calocephala, khorasanus, lactiflora</td>
</tr>
<tr>
<td>Semnan (4 spp.)</td>
<td>behboudiana, calocephala, grandiceps, onopordioides</td>
</tr>
<tr>
<td>Kerman (3 spp.)</td>
<td>grandiceps, onopordioides, sarzechensis</td>
</tr>
<tr>
<td>Boyer-Ahmad (2 spp.)</td>
<td>araneosa, barheyi</td>
</tr>
<tr>
<td>Markazi (2 spp.)</td>
<td>calocephala, cynbolepis</td>
</tr>
<tr>
<td>Khuzestan (2 spp.)</td>
<td>disfulensis, kotschyi</td>
</tr>
<tr>
<td>Qazvin (2 spp.)</td>
<td>behboudiana, calocephala</td>
</tr>
<tr>
<td>Zanjan (2 spp.)</td>
<td>calocephala, kotschyi</td>
</tr>
<tr>
<td>Baluchestan (1 sp.)</td>
<td>onopordioides</td>
</tr>
<tr>
<td>Gorgan (1 sp.)</td>
<td>onopordioides</td>
</tr>
</tbody>
</table>
Distribution map of *Cousinia* spp. (sect. *Cynaroides*) in Iran

Map 1. ▲ *C. coccinea*; ● *C. sabinaflata*

Map 2. ● *C. pergaminacea*; ▲ *C. millienii*

Map 3. ▲ *C. quadrica*; ● *C. dalbiisensis*

Map 4. ▲ *C. inflata*; ● *C. sandasikensis*

Map 5. ▲ *C. criocophala*; ● *C. rhombiformis*

Map 6. ▲ *C. grandit*; ● *C. wettestaniana*
A synopsis of sect. Cynaroides (Cassinae, Compositae)...

Map 7. ▲ C. chironopera; ● C. chenendes

Map 8. ▲ C. kerendjena; ● C. annueda

Map 9. ▲ C. echelenensis; ● C. samandjena

Map 10. ▲ C. khorramdahemis; ● C. phyllopha

Map 11. ▲ C. disjulensis; ● C. kemunshahemis

Map 12. ▲ C. versasellenis; ● C. moracephala
A synopsis of sect. Cynocephaloides (Cynocephaloides, Compositae)...

Map 31. ▲ C. digardazensis; ● C. carduchonum

Map 32. ▲ C. hamadornis; ● C. ephedrophylla

Map 33. ▲ C. evelharmi; ● C. khanaricus

Map 34. ▲ C. khorvanahadian var. purpurea; ● perspillatus

Map 35. ▲ C. shahabudensis; ● C. qaraqhanensis

Map 36. ▲ C. zaridzehensis; ● C. zagrica
F. Attar and A. Ghahtreman

Acknowledgments

The authors are grateful to Dr. M. Iranshahr for advising and editing of the Latin diagnoses during this study, Dr. M. Assadi for advising and preparing facilities to use "TARI" Herbarium specimens and Mr. B. Hamzeh'ee for editing the text. Also thanks are due to Mrs. S.B. Javadi, Mrs. F. Aghaieigi, Mr. M.R. Jokarchi and Mr. T. Maassourni for preparing facilities to use specimens of "IRAN", "FUHM" and Kanj Herbaria, respectively.

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Addresses of the authors: Dr. F. ATTAR and Prof. A. GHAHTREMAN, Central Herbarium of Tehran University, Department of Botany, School of Biology, University College of Science, University of Tehran, Tehran, Iran.
A REVISION OF CENTAUREA
(COMPOSITAE-CARDUEAE) IN THE
FLORA OF IRAQ

G. WAGENITZ
Göttingen University, Göttingen, Germany

Abstract
A taxonomic revision of the genus Centaurea L. and the closely allied
Cyanus Mill. and Stizolophus Cass. for the Iraq is presented. Centaurea has 40,
Cyanus three and Stizolophus two species in the area. Keys, synonymies with
indication of types, descriptions and lists of specimens for the rare species seen are
provided.

Key words: Taxonomic revision, Centaurea, Cyanus, Stizolophus, Compositae,
Asteraceae, Iraq

Introduction
In recent years, the genus Centaurea has been revised in floras for all the
countries adjacent to the Iraq: Turkey (WAGENITZ 1975), Iran (WAGENITZ
1980), Palestine (FEINBRUN-DOTHAN 1978), Lebanon and Syria (WAGENITZ
in Mouterde 1984a) and Arabia (WAGENITZ 1984b). Iraq is not rich in species of
the genus as compared to Turkey and Iran and there are only two species endemic to
Iraq. The limited number of species makes determination of the Iraqi species
much easier than in the countries mentioned above. A botanist trying to determine a
Centaurea specimen from Iraq can use the “Flora of Lowland Iraq” (RECHINGER
1964) but if the specimen comes from the mountainous area he must in addition try
to determine it with the "Flora of Turkey" or the "Flora Iranica". I was asked to prepare an account of Centaurea for the "Flora of Iraq" in 1978. I had studied before material especially at Vienna (W), Berlin (B) and Geneva (G) and I went to the Herbarium at Kew (K), which has probably the richest holding of Iraqi specimens in Europe due to a long cooperation. Very useful for my work was of course the introductory volume to the "Flora of Iraq" (GUEST 1966). My manuscript was sent to the Royal Botanic Gardens Kew in 1983 and carefully revised especially as to the place-names and the indications of habitat and distribution by the late Mr. E. Guest and by Mr. C.C. Townsend. I am very thankful for his help. Regrettably for financial and political reasons, the work on the "Flora of Iraq" was abandoned!

For this revision, materials from the following herbaria has been used (abbreviations according to "Index Herbariorum", see Internet): B, BM, E, F, G, GOET, H, HUI, JE, K, KIEL, LD, LE, NY, PR, PRC, S, SAV, US, W, WU. I thank all those who have made this possible. In order to shorten the text, the citation of specimens has been given only in the very rare species and the types are solely indicated for the accepted names.

In the meantime, the circumscription of the genus Centaurea has been revised on the basis of micromorphological and caryological characters (WAGENITZ & HELLWIG 1996) and molecular studies (GARCIA-JACAS et al. 2001, HELLWIG 2004). The nomenclatural consequences can be found in the publication by GREUTER (2003). As for the Iraqi species, the former sections Cyanus and Stizolophus are now treated as separate genera, they are however included in the key.

**Key to groups**

1. Outer: radiant flowers (comflower) blue (in garden forms also white or red); phyllaries with a black or brown border widely decurrent
   - Flowers never blue; phyllaries not with a widely decurrent black or brown border
   2. Median (and upper) leaves distinctly decurrent
      - Leaves not decurrent
      3

3. Plants annual, with small heads, involucres up to 12 mm broad
   - Plants perennial or biennial, if biennial then with much larger heads
   4. Plants annual or sometimes biennial
      - Plants perennial
      Group A
      Group B
      Group C
      Group D
      Group E

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A revision of Centaurea (Compositae-Caesalpiniaceae) in the flora of Iraq

Key to species

Group A (Cyanus)

1. Annual plants; anther-tube of central flowers strongly curved
   - Perennial plants; anther-tube only slightly curved 1. Cyanus triumfettii
2. Upper leaves oblong or lanceolate; cilia of appendage 1.5-2 mm; pappus 5-9 mm long
   - Upper leaves linear, 1-2 mm broad; cilia of appendage 0.5-1 mm; pappus 2-3.5 mm long 2. Cyanus depressus
3. Cyanus segetum

Group B

1. Decurrent wings of the leaves entire
   - Decurrent wings dentate 2. C. solstitialis
2. Stems and leaves +/− cobwebby with long glossy hairs; achene 2.2-2.8 mm long, the hilum nearly 1/3 of its length
   - Stems and leaves with very short stiff hairs; achene 3-3.5 mm long, the hilum only about 1/4 of its length 22. C. solstitialis
24. C. pseudocinaica

Group C

1. Phyllaries without an appendage, or with a minute micro up to 1.5 mm long
   - Phyllaries with a distinct appendage 2. C. polypodiolata
2. Stem and leaves nearly glabrous
   - Stem and leaves with crisped hairs 3. C. behen
3. Basal leaves obovate with very large terminal segment and few lateral segments; involucre 10-18 mm broad; inner row of pappus distinctly shorter than the preceding
   - Basal leaves pinnatisect with several pairs of lateral lobes; involucre 5-8 (-10) mm broad; inner row of pappus about as long as the preceding 17. C. koetana
4. Appendage a simple spine (sometimes with a pair of minute lateral spines)
   - Appendage not a simple spine 5. C. rigida
5. Involucre 6-9 mm broad
   - Involucre more than 14 mm broad 6. C. amadensis
6. Capitula on short peduncles forming a raceme; pappus 10-15 mm, the inner row long
   - Capitula on long divaricate branches; pappus 8-9 mm long, the inner row shorter 16. C. alveicola
7. Basal part of phyllaries totally covered by the appendages 8.
- Basal part of phyllaries not totally covered by the appendages
- Capitula 4-5 cm in diameter, on peduncles 10-15 cm long; terminal spine 4-15 mm long
- Capitula 3-4 cm in diameter, on very short peduncles; terminal spine only 1-3 (-4) mm long

9. Flowers yellow
- Flowers rose-purple or whitish

10. Biennial plant with several capitula in a raceme; terminal spine of appendages distinct, longer than cilia
- Perennial plant with 1-3 capitula; terminal spine of appendages scarcely distinct from the cilia

11. C. handelii

Group D

1. Outer phyllaries with a green foliaceous appendage, median ending in a simple spine
- Phyllaries not with green foliaceous appendage

2. Flowers yellow
- Flowers rose-purple or whitish

3. Appendages triangular with several pairs of cilia, ending in a stiff spine, c. 2-4 mm long
- Appendages consisting of a much longer rigid spine, +/- dilated at the base

4. Appendages cartilaginous, c. 3 mm broad at base excluding the cilia, with 8-12 cilia on each side; achenes 5-6 mm long
- Appendages not cartilaginous, only 1 mm broad at base, with 4-6 cilia on each side; achenes 3-3.5 mm long

5. Phyllaries with a broad hyaline border, spines without lateral spinules or with one pair near the base
- Phyllaries without a hyaline border; spines with 2-4 pairs of lateral spinules often going up to the middle of the spine

6. Phyllaries with a fine, appressed, mealy tomentum; achenes 2.3-2.5 mm long; flowers remaining yellow when dry
- Phyllaries sparsely arachnoid (cobwebby); achenes 2.8-3.2 mm long; flowers drying bluish

7. Appendage a rigid spine with 1-3 pairs of lateral spinules near base
- Appendage triangular with 5-10 pairs of cilia and ending in a slender spine

8. Main stem very short, central capitulum nearly sessile; achenes 2.5 mm long, pappus 3-4 mm long
- Main stem elongated; achenes 1.8-2.3 mm long, pappus 2-3 mm long

12. C. regia
13. C. imperialis
15. C. gudranensis
14. C. gigantea
31. C. bruguieriana
1. Sizolophus balsamia
2. Sizolophus balsamoides
29. C. hyalolepis
25. C. mesopotamica
26. C. microCryptus
28. C. therica
7. C. laxa

6. C. annuocyanus
7. C. laxa
Group E

1. Appendage a firm spine, simple or with 1-2 pairs of short spinules at or near the base
   - Appendage spiny or not, but always with several pairs of lateral cilia or teeth
   2. Stem erect, median leaves entire or with few teeth; pappus 7-8 mm long
      - Stem ascending or prostrate, median leaves pinnatisect or pinnatifoliate; pappus absent
      25. C. delbesiana
   3. Flowers yellow
      - Flowers purplish or whitish
      4. Appendage very small, narrowly triangular with few cilia; pappus 1-2 mm long
         9. C. rhizantha
      - Appendage large, with numerous irregular cilia; pappus 15-20 mm long
         10. C. auckeri
   5. Plant copiously branched with numerous small capitula; involucre 3-10 mm broad
      - Plant with few branches with one large head; involucre more than 15 mm broad
      6. Appendage nearly round with irregularly dentate or ciliate margin; involucre 8-10 mm broad
         8. C. foveolata
      - Appendage triangular with distinct regular cilia; involucre 3-6 mm broad
      7. Appendage ending in a very short pappus shorter as or as long as the lateral cilia
         - Appendage ending in a spine or slighty to distinctly longer than the lateral cilia
      8. Capitula crowded in fascicles at the end of the branches; upper leaves lanceolate or oblong
         - Capitula solitary at the end of the branches; upper leaves linear
      9. Involucre 4-6 mm broad; capitula with c. 10-20 hermaphrodite flowers
         - Involucre 3-4 mm broad; capitula with 5-8 hermaphrodite flowers
         5. C. singaresiensis
      10. Terminal spine of appendage stout; appendage usually with a purple-brown spot; often two heads close together
          - Terminal spine slender, awn-like; appendage light brown; heads solitary
          3. C. virgata
      11. Appendage with short spine or mucro, this only up to 8 mm long in the median phyllaries
          - Appendage with a distinctly longer spine
          12. Appendages totally concealing the basal part of the phyllaries; involucre c. 25 mm broad
          37. C. hadacii
- Appendages not totally concealing the basal part of the phyllaries; involucre 15-20 mm broad 35. C. longipedunculata
13. Appendages totally or nearly totally concealing the basal part of the phyllaries
- Appendages not concealing the basal part of the phyllaries
14. Plants branched from near the base 32. C. urvillei
- Plants unbranched or with few branches in the upper part
15. Basal and lower leaves usually lyrate; appendages triangular, very gradually narrowed into the spine 34. C. ochrocephala
- Basal and lower leaves interruptedly pinnatisect to sublyrate; appendages with triangular basal part, but rather abruptly narrowed into the spine 33. C. elegantissima
16. Pappus 10-15 mm long; innermost phyllaries with very broad rounded appendage 8-15 mm broad 38. C. luristanica
- Pappus 5-10 mm long; appendages of innermost phyllaries usually not as broad as in the preceding species
17. Stem branched from near the base 40. C. irritana
- Stem simple or branched in or above the middle (branching from the base may occur in damaged plants)
18. Involucre tormentose 39. C. davisi
19. Leaves lyrate, nearly glabrous 36. C. persica
- Leaves interruptedly pinnatisect to sublyrate, +/ hirsute, rarely subglabrous 33. C. elegantissima

**Centaurea L.**

**Sect. Acrolophus** (Cass.) DC.


C. pauciflora C. Koch in Linnaea 24: 433 (1851)


A revision of Centauria (Compositae: Caucaloeae) in the flora of Iraq.


Perennial with woody base. Stem erect, (30-)40-75 cm high, branched in the upper part. Leaves thinly arachnoid-tomentose when young, glabrescent, scabrous; lower and median leaves lyrate with a large lanceolate terminal segment 8-20 cm broad and 2-5 pairs of much smaller linear-lanceolate lateral segments; upper leaves entire, lanceolate or oblong, sometimes with a pair of lobes at base. Heads numerous, crowded in fascicles of 3-5(-10) at the end of the branches. Involucre nearly cylindrical, 10-13 mm long, 3.5-5 mm broad. Phyllaries in several series, longitudinally nerved, the appendages small, only partly concealing the basal part of the phyllaries, brown, triangular, slightly spreading, with 6-8(-9) cilia 1.5-2 mm long on each side and ending in a very short macro 0.5 mm long. Flowers rose-purple, the marginal scarcely radiate, few; central flowers hermaphrodite, c. 10-12. Achenes 2.8-3 mm long. Pappus 2.5-3.5 mm long, the inner row short.

Hab.: In the mountains, on rocky slopes; alt. 1000-2150 m; fl. & fr. June-July (-Aug.).

Distrib.: Apparently widespread in the mountain region of Iraq; MAM, MRO, MSU, - Turkey, W. & N.W. Iran, Transcaucasia.

A variable species. Only the subsp. aggregata, described above, has been found in Iraq. It occurs throughout the range of the species.

Icon.: Fl. Iran. 139 b: tab. 309 (1980).

Perennial with a woody base and several erect stems, (30-)40-50 cm high, branched from below the middle with ascending branches, each with several shorter one-headed branchlets. Stem and branches angular, thinly tomentose on the faces, lanate at the base. Basal and lower leaves withered at flowering time, petiolate, lanceolate-spathulate, undivided and indistinctly dentate or lyrate; median leaves linear-spathulate, 1-3 mm broad, nearly glabrous, punctate with sessile glands; upper leaves linear, very small, only 3-5 mm long, the uppermost similar to the phyllaries. Capitula solitary on the branches. Involucre nearly cylindrical, but narrowed at base with unusually gradual transition into the peduncle, 11-13 mm long, 3-4 mm broad.
Phyllaries in several series, indistinctly nerved in the lower part with small appendages. Appendages appressed, light brown, with 5-6 cilia 1 mm long on each side and ending in a short mucro (0.5-1 mm). Flowers probably purplish (pale when dry), marginal not radiant, only 4-6 hermaphrodite flowers. Achene 3.5 mm long. Pappus 1.5-2.5 mm long.

Hab.: Mostly in pine forest on rocky limestone ledges; alt. 450-1150 m; fl. & fr. (Jul.) Aug.-Oct.

Distrib.: Uncommon in the mountain region of Iraq; MAM: Dobuk, Guest 1589 (K); Sarıgöl, Feinbrun & Schwarz s.n. (HUJ); Zawita, Guest 3729 (GOET, K), 4500 (K), 4564 (K), 4756 (K), 4828 (K), 4839 (K), 4930 (K), s.n. (HUJ), Rech. f. 2011 (E, W); Bikhair (Jabal Bekher), Rawi 23061 (K).

Distrib.: Endemic, only known from a limited area near the Turkish frontier.


*Acosta virgata* (Lam.) Holub in Folia Geobot. Phytotax. 7: 314 (1972).

Perennial with a woody base and several stems. Stems (20-)30-70 cm high, ± erect, repeatedly and divaricately branched from the base or the median part. Leaves thinly arachnoid-tomentose, the basal and lower petiolate, pinnatifid or partly bi-pinnatifid with linear segments, rarely lyrate, often withered at flowering time; median leaves pinnatifid with few distant segments 1-2(-3) mm broad, the upper linear, undivided. Capitula small, solitary or often in pairs at the end of the numerous branches, forming a panicle, usually easily deciduous when fruiting. Involucre nearly fusiform, 7-9 mm long, 3-4 mm broad; phyllaries in several series, the basal part with elevated longitudinal nerves, not totally concealed by the appendages. Appendages spreading or reflexed, triangular, straw-coloured, but at least the upper ones usually with a purple spot, ciliate, cilia 5-10 on each side, 1-1.5(2) mm long, the terminal spine ± hooked and 1-2 mm long, rarely only 0.5-1 mm and straight. Flowers rose-purple, 5-8 flowers hermaphrodite and the very few marginal ones scarcely radiant. Achene 3-3.8 mm long. Pappus 1-2(-3.5) mm long, rarely absent.

In Iraq only represented by:


*C. squarrosa* Willd. var. *coletensis* C. Koch in Linnaea 24: 434 (1851).


Core: Fl. Iran. 139 b: tab. 310 + 409, fig. 3 (1980).

Cilia 5-8 on each side, 1-1.5 mm long; terminal spinule hooked, (1-1.5)2-2.2 mm long. Pappus 1-2 mm long.

*Hab.*: On rocky slopes and stony plateaux, in pine and oak forest; alt. (700-) 1000-1500 (-2000) m; fl. (May) June-July (-Aug.).

*Distri.*: Very common in the mountain region of Iraq MAM, MRO, MSU. - Bulgaria, Syria, Lebanon, Turkey, Iran, Afghanistan, Pakistan, C. Asia (Turkmenia).

A species widespread in the mountainous part of S.W. Asia. In subsp. *squarrosa* the capitula remain closed at fruiting time, are easily deciduous and can be dispersed epizoochorously by means of the hooked spinules of the involucre. The plants found in Iraq are relatively uniform as to the characters of the involucre and may thus all be assigned to subsp. *squarrosa*. They are however remarkably variable in the shape of the basal leaves which are lyrate in some gatherings - a character absent from the greater part of the area of the subspecies.


Perennial suffrutescent plant, (10-)20-40 cm high. Stems woody, the old dead ones subspinose, divaricately branched from near the base, the ultimate branches delicate, all appressed, grey-tomentose. Leaves thinly tomentose, glabrescent, the lower dry at flowering-time, pinnatipartite with 2-4 pairs of linear-lanceolate, entire
or dentate segments, more rarely the basal leaves pinnatifid or entire; median leaves narrowly linear-lanceolate, 1-1.5 mm broad, 10-15 mm long, entire or with few teeth; upper leaves minute, filiform. Heads solitary at the end of the branches, often easily deciduous. Involucres nearly fusiform, 8-10 mm long, 3-3.5 mm broad.

Phyllaries in several series, the inner ones striate. Appendages small, light brown, 0.6-0.8 mm broad at base excluding the cilia, with 3-8 pairs of cilia 0.5-2.5 mm long, ending in a patent or recurved slender mucro or spinule (1.5-2.3-3.4 mm long).

Flowers pale purplish (whitish when dry), only 5-8 flowers hermaphroditic and marginal sterile ones few, inconspicuous. Achene c. 3 mm long, Pappus 1-1.5 mm.

Hab.: On conglomerate hills and steppe plains; alt. 150-800 m; fl. & fr. May-June.

Distrib.: In one region nr. the centre of the steppe region of Iraq and in another near the frontier of Iran. FAR: 7 km E. of Mähmar. Gillett 11218 (K) - FFF: Kurr Sang, nr. Mandali, Rawi 20655 (K), Hadač, Haines & Walid al-Hashimi 4604 (PR); 10 km E. of Mandali, Rech. f. 9655 (E, W); Makatu, 16 km N.W. by N. of Mandali, Hadač, Haines & Walid al-Hashimi 4629 (PR); 10 km E. of Mandali, Rech. f. 9655 (E, W).

Iran

The specimens from Iraq belong to subsp. intricata, with easily deciduous heads and appendages ending in a slender mucro 1.5-3(4) mm long, with 5-8 pairs of cilia, 1.5-2.5 mm long. The Iraqi specimens differ slightly from the type by the shorter cilia (1-2 mm) and mucro (1.5-2.5 mm).

5. C. singarensis Boiss. et Hausskn. in Boiss., Fl. Orient. 3: 654 (1875). - Type:
In fissuris rupium calc. m. Singarâ, V. 1867, Haussknecht [558] (lectotype: G-Boiss, isotype: K).

Perennial suffrutescent plant, 25-50 cm high. Stems divaricately branched from near the base, greyish, appressed-arachnoid. Leaves thinly tomentose, the lower sometimes glabrescent; basal leaves petiolate, liriate, up to 11 cm long with two pairs of lanceolate lateral segments and a much larger terminal segment of similar outline; median and upper stem-leaves sessile, linear, the uppermost very small, 1 mm broad, 3-5 mm long. Capitula solitary at the tip of the branches, easily deciduous. Involucres oblong, 12-13 mm long, 4-6 mm broad. Appendages of phyllaries rather small, only partly concealing basal part of phyllaries, narrowly
triangular (excluding the cilia scarcely 1 mm broad at base), central part reddish-brown, with 5-8 whitish cilia c. 2 mm long on each side and ending in a spine 2-4 mm long. Flowers rose-purple, 10-20 hermaphrodite, marginal sterile flowers few and inconspicuous (or sometimes even lacking?). Achene c. 3 mm long, Pappus 3-3.5 mm long, the inner row much shorter.

Hab. & distr.: In rocky clefts in limestone mountains; alt. 250-1450 m. - MIS: Jabal Sinjar, Hausken, s.n. (G, K, type); Gillett 11084 (K); Anders 1989 (W). - FUJ: Jabal Khatchra, between Balad Sinjar and Tal Afar, Field & Lazar 637 (F, K, W).

A rare local endemic, allied to C. intricata but with distinctly larger heads.

**Sect. Ammocyanus Boiss.**


Icon: Fl. Palaest. 3, pl. 660 (1977); Fl. Iran. 139 b: tab. 312 (1980).

Annual, slightly araneose-tomentose, the primary stem usually very short, 1-3 cm long, several prostrate or ascending branches c. 10-30 cm long arising below the terminal head, often further branched. Basal leaves spatulate to lanceolate in outline, undivided, pinnatifid or sublunate; median leaves lanceolate, entire or with few lobes or teeth; uppermost leaves linear-lanceolate, inserted directly below the capitulum and usually longer than the involucres; involucres ovoid, 10-12(13) mm long, 5-7(-8) mm broad. Phyllaries in several series, green, the inner often with purple tinge in the upper part, glabrous, only partly concealed by the appendages. Appendages triangular, brown or blackish brown, decurrent, ciliate, cilia 5-7(-8) on each side, 1.5-2.5 mm long, the appendage ending in a slender macro 2-4 mm long. Flowers rose-purple, the marginal slightly radiant. Achene c. 2.5 mm long, the lateral hilum bearded, 1/3-1/4 the length of the achene. Pappus 3-4 mm long.

Hab.: Silty desert soils, sandy gravel and stony plains; alt. 200-650 m.
Distrib.: Common in the Western Desert of Iraq; also quite common in the Southern Desert. FUJ, DLJ, DWD, DSD, LSM. - Syria, Palestine, Jordan, Egypt (Sinai), Saudiya, N. Iran.


Annual, 10-30 cm high, plant branched from near the base, the erect main stem often overtopped by the upper branches but always well developed. Basal and lower leaves lanceolate and undivided or pinnatifid; median usually lyrate with 2-3 pairs of segments or lobes near the base; the upper linear-lanceolate with 2 pairs of small teeth at the base or entire. Involucres ovoid, 10-11 mm long, 5-6(-7) mm broad. Phyllaries in several series, green, the inner often with a purple tinge, glabrous, only partly concealed by the appendages. Appendages triangular, brown or blackish brown, decurrent, ciliate, cilia 6-8(-10) on each side, 1.5-2.5 mm long, ending in a slender mucro 2-4(-5) mm long. Flowers rose-purple, the marginal moderately radiant. Achenes 1.8-2.5 mm long. Pappus 2-3 mm long.

Hab.: On calcareous-gypsiferous soil; alt. 200-700 m; fl. & fr. Mar.-Apr.

Distrib.: Occasional in the western lower steppe region of Iraq. MAM: Sardariyia, 15 km S.W. of Agra, Memerian 10793 (K). - FUJ: between Jabals Makbul and Khanaqa, Hand.-Mazz. 1053 (W, WU); between Wadi Safa and Hadhr, Hand.-Mazz. 1107 (W); Qaiyara, Bayliss 72 (K); Qal’a Sharqa, Maresch 108 in Hand.-Mazz. (W, WU); 53 km W. of Balad Sindjar, Eig & Zohary s.n. (HUJ).

Syria, Turkey.

*C. laxa* is closely related to *C. ammoncyamus*. It is mainly distinguished from this species by the well-developed main-axis and the slightly smaller achenes and shorter pappus. The distribution is more northern than in *C. ammoncyamus*. 

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**Sect. Phalolepis (Cass.) DC.**


Perennials with a woody base and several stems, 35-55 cm high. Stems nearly glabrous, branched in the upper part with several branches with 1-3 heads. Leaves nearly glabrous, punctate with sessile glands, very slightly arachnoïd-pilose on the upper side; basal and lower leaves withered at flowering time, petiolate, lyrate-pinnatifid, c. 5 cm long, with 1-2 pairs of linear lateral segments and a lanceolate larger terminal segment; median leaves lanceolate to linear-lanceolate, mostly with 1-2 pairs of linear lobes; upper leaves linear, 1-2 mm long. Involute ovoid, 12-14 mm long, 8-10 mm broad. Phyllaries in several series, indistinctly nerved in the upper part, totally concealed by their appendages. Appendages nearly orbicular, not decurrent, c. 4 mm broad, the triangular central part firm, brownish, the margins hyaline, whitish, irregularly denticulate to ciliolate and more or less lacerate, appendage ending in a mucro 1.5-3.5 mm long. Flowers rose-purple, the marginal very inconspicuous (or radiant flowers lacking?). Achenes 2.5-3 mm long. Pappus 3.5-5 mm long, the inner row short (sometimes as long as the others?).

Hab: In the mountains, alt. 1000-1500 m; fl. & fr. July-August.

Distrib.: At the western end of the mountain region. MAM: between Dohuk and Amadiya, c. 1000 m, Rech. f. 11627 (= Guest, Rawi et al., E, K, US, W); near Amadiya, by a millstream at Sulaf, Guest 3769 (GOET, K); in cracks in cliff in Guli Mazurka, above Sulaf, Guest 3769 A (K); ibid. Agnew & Haines s.n. (E): Amadiya: in Mazurka Gorge above Sulaf, 2. VIII. 1933, Guest s.n. (K, type).

Endemic.

**Sect. Rhizocalathium Tzvelev.**


*C. sessilis* auct. non Willd.: Boiss., Fl. Orient. 3: 676 (1875).


Perennial with a creeping and branched woody rhizome. A single head sessile or nearly sessile in a rosette of leaves, rarely a stem a few centimetres long present below the head. Leaves laxly hirsute with long articulate hairs, variable in form, often lyrate with a large triangular or lanceolate terminal segment and 1-3(-5) pairs of linear-lanceolate lateral segments, occasionally some or even all of the leaves undivided; in Iraq the leaves sublyrate or pinnatifid with the terminal segment scarcely larger than the lateral. Involucrre ovoid, 15-20 mm long, 10-20 mm broad. Phyllaries in several series, coriaceous, glabrous. Appendages small, straw-coloured or light brown, erect or reflexed, narrowly triangular, only in small part concealing the base of the phyllaries, with 1-5 cilia 1-3 mm long on each side, the terminal spinule of about the same length. Flowers yellow, the marginal inconspicuous, not radiant. Achene 5-6 mm long. Pappus 1-2 mm long.

Hab. & distrib.: On the highest mountain in Iraq near the summit, adjacent to the Iranian frontier; alt. 2200-3000-3700 m; fl. & fr. July-August.
MRO: Algurd Dagh (Helgord), on a rocky plateau, Guest & Ludlow-Hewitt 2881 (K); Algurd Dagh, Gillett 9597 (K); Algurd (Helgord), on a western slope nr. the summit of the mountain, Rech. f. 11419 (E, W); Algurd, E. site of Mt. slope, Rawi & Serhun 24739 (K); S. part of "Kavukh Mountain" [= Karokh ?], 2200 m, Kass & Serhun 27478 (K).

This mountain is the southernmost station for the species. These populations differ from most others by the pinnatifid, not distinctly lyrate leaves.
Turkey, Iran.


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Perennial herb with branched woody rhizome and a very short erect or decumbent-ascending stem up to 10 cm length, stem shorter than or about as long as the basal leaves, simple or with few branches. Leaves +/- densely floccose-tomentose, glabrescent; the basal leaves petiolate, very variable, often partly undivided and partly lyrate or even pinnatisect; the few cauline leaves usually undivided, lanceolate or oblong. Involucre ovoid, c. 25-30 mm long and 18-25 mm broad. Phyllaries in several series, their lower part coriaceous, glabrous and smooth, only partly concealed by the appendages. Appendages triangular or nearly orbicular, light brown or straw-coloured with a brighter margin, rather irregularly ciliate in the upper part, with dentate, slightly decurrent anicles towards the base and ending in a spine 2-5 mm long. Flowers yellow with a purple anther-tube, the marginal ones inconspicuous with thread-like lobes. Achenes 6-8 mm long, brown, tetragonal in cross-section with a denticulate upper margin. Pappus c. 15-20 mm long, brown, scabrous, the innermost row longest.

Hab.: Only found in one locality near the Iranian frontier; alt. 1700-2000 m; fl. & fr. June-July. MRO: Kud, near Haji Umrân, Rawi 9177 (K); Haji Umrân, on dry slopes by the roadside, Wiltshire s.n. (in Herb. Haines) (E); Haji Umrân, on dry slopes, Rech. f. 11295 (W).

Distrib.: E. Turkey, N. & W. Iran, Transcaucasia.
Only subsp. auchenii described above, occurs in Iraq. It is distributed throughout most of the range of the species.


Perennial, c. 20-30 cm, high, simple or often with one or two simple branches in the lower part. Stem and leaves +/− densely greyish floccose-tomentose. Basal and lower leaves petiolate, ovate-oblong in outline, pinnatisect with 3-6 pairs of lanceolate segments (the upper decurrent along the rachis), rarely part of the lower leaves undivided and lanceolate; median and upper leaves strongly decurrent, the median often pinnatisect in their terminal part, undivided in the lower half, sometimes undivided, resembling the upper ones, which surpass the head. Involucre nearly orbicular with a truncate base, 25-30 mm broad. Phyllaries in several series, coriaceous, glabrous and smooth. Appendages not totally concealing the basal part of the phyllaries, broadly triangular, not decurrent, brown, with 3-7 cilia 2-4 mm long on each side, ending in a spine scarcely longer or stronger than the cilia. Flowers purple, the marginal inconspicuous. Mature achenes unknown. Pappus 14-19 mm long, whitish or brown, bristles scabrous, the innermost not differing from the others.

**Hab.** In the mountains, on limestone slopes, serpentine rocks etc.; alt. (600-)1400-1800 m; fl. & fr. (Apr.-) May-Aug.

**Distrib.** Local in the mountain region of Iraq. **MJS:** Tschil Miran on Jabal Sinjar, Hand.-Mazz. 1512 (W, WU); Rashidi on Jabal Sinjar, Anders 2682 (W); Jabal Sinjar: near the foot of the mountain, Haussknecht 595 (type: BM, G, JE, K, W); Qusi & Hamud 49142 (K); Jabal Sinjar, Omar, Khayat & Qusi 52563 (K); Jabal Sinjar, Theiger 538 (BM), 540 (BM). - **MSU:** Penjwin, Rawi 12234 (K), Rech. f. 12255 (W); Kajjan mountains, nr. Penjwin, Rawi 22667 (K).
A revision of Centaurea (Compositae-Caucasia) in the flora of Iraq.

**Sect. Cynaroides** Boiss. ex Walp. [Sect. Cynaropsis Wagenitz; Sect. Acrocentron (Cass.) DC. § Cynaroidae Boiss.]


Biennial with erect robust stem, c. 40-110 cm high, sparsely pilose, branched in the upper part. Leaves stiff, papery when dry, scabrous with short hairs; basal leaves with a long petiole, ovate to subcordate, or more rarely lyrate, very large, with a petiole c. 25 cm long; lower cauline leaves broadly lanceolate, narrowed into a broad petiole, entire or lobed in the basal part; median cauline leaves broadly lanceolate or obovate, sessile and decurrent, up to 20 cm long and 7 cm broad; upper leaves lanceolate, much smaller, shortly decurrent. Heads several in a raceme with peduncles 10-15 cm long, sometimes additional longer branches present near the middle of the stem. Involucre nearly globose, 40-50 mm in diameter. Phyllaries in many series, coriaceous, totally concealed by their appendages. Appendages large, ovate or broadly triangular, not decurrent, whitish, straw-coloured or brown, ciliate with numerous cilia (3-)4-5 mm long and ending a spine of variable length (see subspecies). Flowers rose-purple, the marginal scarcely radiant. Achenes 6-7.5 mm long. Pappus 10-15 mm long, the inner row 2.5 mm, of narrow scales.

Distrib.: Syria, Turkey, Iran.

A magnificent plant with the largest heads known in the genus. It really justifies the name given by Boissier.

**Subsp. regia**

Icon: Fl. Iran. 139 b: tab. 334 (1980).

Spines of the median phyllaries (8)9-14 mm long. Appendages of median phyllaries usually whitish or straw-coloured (rarely brown).

Hab. & distrib. (of subsp.): Occasional on the lower slope of the mountains and in drier hills of the steppe. Alt. 350-700 m; fl. & fr. May-July. - MJS, MAM, FKI. - Syria, W. Iran.
**Subsp. cynaroccephala (Wagenitz)**


Spines of the median phyllotaxis (3-)4-8 mm long, these appendages brownish.

Hab. (of subsp.): Quite common in the eastern sector of the mountain region of Iraq, rare in the central sector. MRO, MRU, MSU. - S.E. Turkey

One specimen, Field & Lazar 623(F), collected at Jabal Khatchra (FUJ, nr. Balad Sinjar on the way to Tal Afar) is intermediate between the two subspecies.

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Icon: Fl. Iran. 139 b: tab. 335 (1980).

Biennial plant with a thick tunic-like root, erect, 50-125 cm high, hirsute with long hairs especially in the lower part, branched only in the upper part. Leaves densely hirsute to nearly tomentose; the rarely collected basal leaves petiolar, ovate-subcordate, large (c. 22 cm long); the lower cauline leaves often withered at flowering time, broadly lanceolate, gradually narrowed at base or constricted into a broad petiole; median and upper leaves lanceolate, decurrent. Heads 5-12, sessile or nearly so and forming a spike, or on short peduncles, involucre nearly globose, 30-40 mm in diameter; phyllaries in many series, their basal part totally concealed by the appendages. Appendages nearly orbicular or broadly ovate, straw-coloured or whitish, 10-12 mm broad without the cilia, cilia c. 10-15 on each side, 1-4 mm long, the terminal spine 1-3 mm long. Flowers rose-coloured or purple, the marginal scarcely radiant, shorter than the central ones. Achenes 5-6.5 mm long, Pappus 5-9 mm long, the inner row much shorter.
A revision of Centauria (Compositae-Cactaeae) in the flora of Iraq.

Hab. & distib.: Rare in Iraq: MRO: Haji Urran, Guest & Husham (Alizzi) 15904 (K), Rawi & Serhang 24933 (K). N.E. of Rayat, subalpine plains, 1480 m, Zohary s.n. (HUJ), Iran.


Biennial plant with a thick turnip-like root. Stem erect, (30-)60-180 cm high, hispitate with long hairs especially in the lower part, branched only in the upper part. Leaves hisporate ™ tormentose, with long appressed hairs especially conspicuous along the whitish midrib. Basal leaves cordate or oblanceolate with a long petiole; lower cauline leaves broadly lanceolate or lanceolate, with a short petiole; median and upper leaves lanceolate, decurrent. Heads in a raceme, peduncles short in the upper part, gradually longer towards the base of the raceme, the lowest sometimes with 2-4 heads. Involucres subglobose to inversely cone-shaped, with a truncate base, gradually narrowed towards the apex, 30-35 mm long, (20-)25-30 mm broad. Phyllaries in several series, firm, finely tormentose, + glabrescent. Appendages only partly concealing the basal part of the phyllaries, firm, coriaceous, straw-coloured or brownish, ™ patent, with a narrow triangular base 2.5-4 mm broad without the cilia, gradually narrowed into the 8-12 mm long terminal spine, with 4-8 distant cilia (2-)3-5 mm long on each side. Flowers pale purplish, whitish when dry, the marginal scarcely radiant. Achenes 5.5-6.5(-8) mm long. Pappus 0.6-8-10 mm long. The inner row much shorter.

Hab.: Dry and grassy places on lower hillsides, locally frequent in open oak forest, on limestone soils; alt. 750-1500 m; fl. & fr. Jun.-Aug.

Distrib.: Quite common on the lower mountains in Iraq. MAM, MRO, MSU. - S.E. Turkey.

Icon: Fl. Iran. 139 b: tab. 338 (1980).

Perennial, c. 25-50 cm, with a woody base, branched nearly from the base or from the middle, branches with several heads, forming a lax panicle. Stem and branches whitish, subglaucous or with sparse, long, articulate hairs. Leaves rather rigid when dry, scabrous with short hairs (only visible with the hand-lens); basal and lower cauline leaves petiolate, lanceolate in outline, c. 30 cm long, pinnatifid to subulate with 3-5 pairs of linear-lanceolate lateral segments (sometimes a few additional smaller ones in the intervals), segments entire or with a single coarse tooth; median and upper leaves oblong-lanceolate to linear-lanceolate, entire, decurrent. Inflorescences 15-20 mm long, 10-15 mm broad, cup-shaped. Phyllaries in several series, coriaceous, smooth, nearly glabrous. Appendages not totally concealing the basal part of the phyllaries, straw-coloured, triangular, not decurrent, 8-13 mm long and c. 2 mm broad excluding the cilia, gradually narrowed into a spine 4-6 mm long, on each side with 3-4 distant cilia 2-3 mm long. Appendages of innermost phyllaries rounded with a denticulate margin. Flowers yellow. Achene 4.5-5.5 mm long, Pappus 4-6 mm long, inner row as long as or even slightly longer than the others.

Hab. & Distrib.: Occasional in the neighbourhood of Sulaimanya district in Iraq. MSU: Pira Magrun ("Pir Omar Gudrun"), in grassy places, alt. c. 1200 m, Hausskn., s.n. (lectotype: G; isotypes: G, JE, K, W); Bida (? misprint of Pira) Magrun, Anon. 5208 (K); Sulaimanya, dry waste at foothills of mountain near city (of Sulaimanya), Haines 1313 (E, K); between Surdash and Shadala, Quercetum persicae, c. 1000 m, Zohary & Feinbrun s.n. (HUI).

A rare narrow endemic so far only known from four gatherings in the area of Sulaimanya.
A revision of *Centauria* (Compositae-Caucasae) in the flora of Iraq.


Basionym: *Amberboa decurrens* DC., Prodr. 6: 560 (1838); Type: Iran, Prov. Hamadan; Amadan [Hamadan], Acher 3196 (holotype: G-DC).

Syn.: *Phaeopappus decurrens* (DC.) Boiss., Fl. Orient. 3: 600 (1875);


*Phaeopappus gymnocladus* Jaub. et Spach, III. Pl. Or. 3: 15 (1847).


Icon.: Jaub. et Spach, III. Pl. Or. 3: tab. 211 (1847); Fl. Iran. 139 b: tab. 340/341 (1980).

Biennial plant with a thick turnip-like root. Stem stout, erect, 50-100-180 cm high, branched only above, hisute in the basal part, in the upper part lanate when young, later glabrescent. Leaves papyry when dry, sparsely pilose, with whitish elevated nerves; basal and lower caudine leaves with a long petiole, undivided, broadly ovate to nearly triangular to truncate with 1-2 pairs of lateral segments and a very large terminal segment, 12-15 cm broad; median leaves oblong-spatulate to broadly lanceolate, decurrent with broad wings; upper leaves lanceolate or linear, short or scarcely decurrent. Capitula (2-)5-15, arranged in a raceme, the upper nearly sessile or with short peduncles, the lower with a peduncle to 5 cm (nearly even to 20 cm long), involucre ovoid or obconical, 25-35 mm long, 22-30 mm broad. Phyllaries in several series, acute, coriaceous, tormentose (later glabrescent), terminated by a spine 5-20 mm long ("var. amadanensis") or ending in a macro only 0.6-2 mm long ("var. gymnoclada"). Flowers yellowish-white, the
G. Wagesita

Anther-tube rose-coloured. Marginal flowers few, shorter than the central ones, very inconspicuous. Achene 6-8 mm long. Pappus 10-15 mm long, the bristles of the innermost row slightly longer than the others.

Hab. & Distrib.: Only found twice in the S.E. mountains of Iraq. MSU: Avroman above Darimar, 1630 m, Gillett 11844 (K); calcareous hill slope above Kormal, Hadda 5057 (PR) W. Iran.

The following specimens from MRO seem to represent a new species allied to C. amadinensis and the Iranian C. nemecii Niblik but are inadequate for description:

MRO: Bursonini Gorge, c. 730 m, Emberger, Guest et al. 15485 (K); Gali Warta c. 30 km N.W. by N. of Rania, 950 m, Rawi, Nuri & Kass 28857 (K); Kurek, N. of Shahidan Project, c. 100 m, Rawi & Serhang 23816 (K).

The involucre in this material is c. 4-5 cm in diameter, the appendage a spine 10-22 mm long and broadened at base, the pappus (only known from Rawi & Serhang 23816) 10 mm long with short inner row. The plant needs re-collecting with flowers and mature fruits.

Sect. Microlophus (Cass.) DC.


Icon: Fl. Iran. 139 b: tab. 343 (1980).

Biennial or perennial plant with thickened taproot. Stem 25-75 cm high, hirsute with articulate hairs, profusely branched from about the middle, the branches often with several heads forming a lax corymb. Leaves firm, with elevated nerves, especially the lower sparsely hirsute, the others glabrescent; basal and lower leaves petiolate, basal pinnatifid with 8-8(-10) pairs of linear-lanceolate or narrowly triangular acute segments, sometimes lobed near base; lower leaves pinnatifolius; median ovate-oblong, broadly decurrent; upper leaves ovate to lanceolate, shortly decurrent or sessile, sometimes distinctly enveloping the involucre. Involucre 16-20 mm long, 8-12 mm broad, nearly obconical (contracted towards apex). Phyllaries in
several series, coriaceous. Appendage very small, a macro 0.5-1(-2) mm long, deciduous. Flowers sulphur-yellow, the marginal inconspicuous, not radiant. Achene 4-5 mm long. Pappus c. 4(-8) mm long, inner row very short.

Hab. & Distrib.: Rare, only three collections known. MRO: in open oak forest at Kounak, near Shahidan, c. 1000 m, Rawi & Serhang 18247 (K); in oak forest between Shahidan and Pushtashan, c. 1000 m, Rech. f. 11010 (E, K, W). - FNM: on the riverside of Tigris, nr. Bawšt (Bauer), S. of Zakho, Kotschi 172/266 (W).

E. Turkey, N.W. Iran, Transcaucasia.

The synonymy and the description given above refer to the typical var. *polypodiifolia* which is the only form of the species represented in Iraq, although the broad upper leaves of the few Iraqi specimens seen are not quite typical.


*Serratula behen* (L.) Lam., Tab. Encycl. 3: 242 (1823), excl. descript.


*Centaurium behen* (L.) C. Koch in Linnaea 24; 418 (1851).


*C. alata* Lam., Encycl. 1: 665 (1785).

Icon.: Fl. Palaest. 3, pl. 666 (1977); Fl. Iran. 139 b; tab. 344, 411, fig. 2, 423 (1980); Fl. Armen. 9: 418 (1995).

Perennial, stem erect, glabrous, c. 60-150 cm high, branched in the upper part, branches overtopping the main axis. Leaves firm, with elevated nerves, appearing glabrous (very short hairs usually present). Basal and lower cauline leaves petiolate, very large (up to 18 cm broad and 55 cm long), usually lyrate with 1-3 pairs of retrose, lanceolate or narrowly triangular segments and a much larger broadly lanceolate or obovate-triangular terminal segment with a truncate base, or basal leaves rarely entire, broadly lanceolate; median cauline leaves oblong or broadly lanceolate, sometimes pinnatifid, decurrent; upper leaves much smaller, lanceolate to nearly ovate, decurrent or scarcely stem-embracing. Heads solitary at the end of long branches. Involucre ovoid, strongly narrowed towards the top, 18-26 mm long, 10-18 mm broad. Phyllaries in many series, imbricate, coriaceous, glabrous, acute, ending in a very short deciduous macro 0.2-0.8 mm long. Flowers
yellow, numerous, the marginal inconspicuous with threadlike segments. Achenes 4.5-6 mm long. Pappus 5-7(-8) mm long; inner row short (1.6-2 mm).
Distrib.: Quite common in Iraq on the western and central mountains, occasional on lower hills. MIS, MAM, MRO, MSU, FUI. - Palestine, Lebanon, Syria, Turkey, Iran, Transcaucasia.


Perennial, up to 150 cm high, nearly glabrous in all parts. Stem pale green with whitish streaks, branching from the middle with divaricate branches. Leaves firm, coriaceous, pale green, becoming reddish or purple when withering, glabrous but with minute sessile glands, nerves elevated. Lower leaves withered at flowering time, very variable, large (up to 30 cm long), ovate-elliptic and undivided or lyrate with a large terminal segment and up to four pairs of small oblong lateral segments, segments crenate-dentate at the margins; median leaves cordate with a semiamplexical base; uppermost small, linear, acute, sessile, not deciduous. Heads solitary, on long peduncles. Involucre ovoid, rounded at base, 24-28 mm long, 14-16 mm broad. Phyllaries in several series, coriaceous, glabrous or thinly tomentose, terminated by a yellowish or reddish spine 6-17 mm long (in the median phyllaries), inner phyllaries with a scarious unarmed appendage. Spine simple or with a pair of short lateral spinules. Flowers pale yellow, the marginal shorter than the central ones, with threadlike segments. Achenes c. 4 mm long. Pappus 8-9 mm long, brownish, inner row 3-4 mm.
Hab.: On steppic hills, sometimes gravelly or even a little rocky; alt. 100-300 m; fl. & fr. Apr.-May (-June).
Distrib.: Occasional, mostly along the frontier of Iran from Khanaqin to Badra. FPF: Kani Mazi 20 km S. of Khanaqin, Hadač, Haines & Walid al Hashim 4645 (PR); Naft Khana, 35 km S.E. of Khanqaqin, Hadač, Haines & Walid Al Hashim 2054 (E, K); between Mandalay and Badra, Rech. f. 9681 (W, type, K, isotype); 35 km N.E. of Mandalay, 250-270 m, Qasii & Khayat 50805 (K); 28 km N. of Mandalay, 260 m, Qasii & Yashya 45230 (K); 55 km S.E. of Mandalay, c. 110 m, Rawi 20743 (K). - LEA: Jabal Hamrin nr. Shahraban (Muqladiya), Haines 1397 (E, K).

Endemic (but likely to occur also in W. Iran).


C. russeliana Bucht., Index ad DC., Prodr. 2: VI (1840), nom. illeg. (based on C. rigida Banks & Sol.).


C. rigida Banks et Sol. var. erythracantha (Bormm.) Blakelock in Kew Bull. 4: 48 (1949).


Perennial (sometimes behaving as perennial ?) nearly glabrous plant with a stout thickened root with several stems, with fibrous remains of withered petioles at base. Stem 30-90 cm divaricately and repeatedly branched from near the base, forming sometimes nearly globose bushes. Leaves rigid, coriaceous; basal and lower cauline leaves petiolate, very large (up to 50 cm long), usually lyrate with a large
oblong to triangular terminal segment (not rarely hastate at base) and 1-4 (or more) pairs of lanceolate much smaller lateral segments or (in "var. schizophylla") basal leaves pinnatifid with 8-10 pairs of linear-lanceolate segments, segments irregularly dentate; median leaves pinnatifid or undivided, dentate, shortly decurrent; upper leaves entire, gradually narrowed from a broad half-clasping base to nearly linear. Involucre ovoid, 13-18 mm long, 6-9 mm broad. Phyllaries in several series, coriaceous, floccose-tomentose, glabrescent, the median ending in an erect or patent spine 5-15 mm long, usually yellow (reddish in "var. erythracantha"), the spines sometimes with minute lateral spinules. Flowers sulphur-yellow, the marginal inconspicuous, not radiant. Achene 4-5 mm long. Pappus 4-5 mm long, scabrous, the inner row short.

Hab.: On rocky limestone soil, steppic clay, as a weed in corn and barley field, etc.; up to alt. c. 900 (-1600) m; fl. & fr. May-Aug.(-Sept.).
Distrib.: Occasional in the foothills and steppe region of Iraq and on the alluvial plain. - MAM, MRO, MSU, FUJ, FNI, FAR, FKI, FPF, DGA, L - Palestine, Jordan, Syria, Turkey


Icon: Fl. Iran. 139 b: tab. 348 (1980).

Perennial herb with woody basal parts, c. 25-50 cm high, base of stem with fibrous remnants of petioles. Stems erect, sparsely anachnoid, branching repeatedly from near the base. Leaves firm, especially beneath with nerves elevated and scabrous with very short hairs, glabrescent; basal and lower leaves petiolate, to 30 cm long, pinnatifid, oblong-lanceolate in outline, with several pairs of linear or narrowly triangular segments, segments dentate or lobate, the terminal one much larger, triangular; median stem-leaves sessile, half-clasping and ± decurrent, undivided, irregularly dentate or entire, gradually narrowed from the base, 10-12 cm
long and c. 1.5–2 cm broad (in the basal part); the upper one smaller, linear-lanceolate, entire, shortly decurrent. Capitula numerous, in a lax corymb. Involucre 15–18 mm long, 5–8(–10) mm broad, narrowed towards the top; phyllaries in few series, coriaceous, smooth, nearly glabrous, ending in a minute mucro usually only 0.2–0.4 mm long (rarely up to 1.5 mm). Flowers sulphur-yellow, only a few outer sterile ones with threadlike segments. Achenes 5–6 mm long. Pappus 4–6 mm long, the inner series as long as the intermediate bristles.

Hab. & Distrib.: Occasional on stony hillsides in the S.E. mountain region of Iraq at 1300–1400 m. - MSU: Nalparaiz, Hadač et al. 4844 (PR): Mt. Avroman, at Tawila near the Iranian border, 1400 m, Rech. f. 10293 (B, E, K, LD, W), Rawi 21965 (K); 10 km W. of Tawila, Rawi 22142 (K); Zalerm Mt., 1300 m, Rawi, Hosham & Nuri 29393 (K); 12 km E. of Chemchemical, Rawi & Gillett 1618 (K) Iran.

Allied to C. rigida, but distinguished by the very short mucro of the phyllaries (only 0.2–0.4 mm, 1–1.5 mm in the specimen collected by Hadač et al. 4844) and the long inner pappus.

_Sect. Mesocentron (Cass.) DC. (Mesocentron Cass._)


*Calceolaria* _solstitialis_ (L.) Lam., Fl. Franç., 2: 34 (1778).


Icon.: Fl. Reipubl. Pop. Roman. 9: tab. 163, fig. 1 (1964); Fl. Iran. 139 b: tab. 349 + 411, fig. 3 (1980); Fl. Armen. 9: 428 (1995).

Annual, 15–80 cm, branched from near the base or the middle part, the branches simple in smaller plants, partly branched with several heads in more robust ones. Stems and leaves appressed-tomentose. Basal and lower leaves (mostly
withered at flowering time) lyrate to pinnatifid, with 3-4 pairs of lanceolate lateral segments and a usually larger lanceolate to triangular terminal segment; median and upper stem-leaves lanceolate to linear-lanceolate, lobed or toothed to entire, widely decurrent into narrow entire wings; uppermost leaves linear. Heads solitary at the ends of long to moderately short branches. Involucr um ovoid-ovoid, 13-16 mm long and 8-12 mm broad. Phyllaries in several series, arachnoid-tomentose. Appendages in the outer phyllaries 3-5 short spinules of nearly equal length, in the median a straw-colored patent spine c. 15-25 mm long, with 2-3 short spinules (2-4 mm) on each side near the base. Flowers yellow, the marginal not radiant, with threadlike segments. Achenes 2-3 mm long, dimorphic: the marginal dull, blackish, without pappus, the central glossy, greyish to brown with white pappus 3-4(5) mm long, the innermost row short.

Hab. & Distrib.: Occasional on the lower mountain slopes and in the steppe region. MAM: 5 km S. of Zakho, 700 m, Rawi 23093 (K); Sersang ("Sursinëk"). 920 m, Eig & Feinbrun s.n. (HUL). FNI: Gerworni, nr. Ain Sifni, Field & Lazar 723 (F). MSU: Tashluja, Hadač 1946 (PR).

W. S. & S.E. Europe, Syria, Lebanon, Turkey, Iraq, S. Russia, Caucasus, C. Asia (Turkmenia to W. Pamir-Alai). Introduced as a weed in N. America and elsewhere.

Only subsp. solstitialis, described above, occurs in Iraq. It is found nearly throughout the range of the species.


Annual. Primary stem usually very short, branching as in *C. pseudosinaica*. Stem and branches villous with long articulate hairs (conspicuously glistening if viewed under a strong lens). Leaves sparsely hirsute, slightly arachnoid especially when young. Basal leaves petiolate, lanceolate in outline, dentate, pinnatifid or
pinnatisect (sometimes with lobate lateral segments); median and upper leaves lanceolate, dentate, decurrent with dentate wings. Involucre oblong, 11-14 mm long, 9-11 mm broad, slightly arachnoid when young. Phyllaries in several series, coriaceous, outer and median ending in a yellow spine in the median 12-20(-30) mm long; with (2-)3-4 pairs of lateral spines 2.5-5 mm long in the lower part. Flowers yellow or flesh-coloured, the marginal inconspicuous, shorter than the central ones. Achene 2.2-3 mm long, the lateral hilm c. 1/3 the length of the achene. Pappus (2-)3-3.5 (-4) mm long, inner row short.

Hab.: Sandy, clay and gravelly soil in subdesert, rocky low hills, rarely as a weed; alt. (150-)300-700 m; fl. & fr. (Mar.-)Apr.-May (-Jun.)

Distrib.: Quite common in the western desert of Iraq. DWD. - Egypt (Sinai), Jordan, Palestine, Syria, Arabia (N. Sardiyah).


Icon: Fl. Iran. 130 h: tab. 350 + 411, fig. 4 (1980).

Annual. Primary stem usually very short (the terminal head on a peduncle 1-5 cm long, rarely longer), branched from the base with several procumbent or ascending branches up to 25 cm long or longer with several heads. Stem, branches and leaves +/- densely hairy with short stiff hairs, not arachnoid. Basal leaves petiolate, lanceolate in outline, dentate, lyrate or pinnatilobed with 2-5 pairs of lateral segments; median and upper leaves decurrent with denticulate wings, lanceolate or linear-lanceolate, median coarsely dentate or denticulate and similar to the upper ones. Involucre oblong, 12-15 mm long, 6-10 mm broad, slightly arachnoid when young, glabrescent. Phyllaries in several series, coriaceous, outer and median ending in a yellow spine (10-)15-20 mm long in the median with 1-2 (rarely 3) pairs of lateral spines 3-5 mm long. Flowers yellow, the marginal inconspicuous, shorter than the central ones. Achene 3-3.5 mm long with a lateral hilm 1/3-1/4 of the length of the achene. Pappus 3-4 mm long, scabrous, inner row short.
G. Wagesius

Hab.: In the desert on silty and sandy or clay depressions or plains, or gravelly soil
by a ravine, and as a weed; alt. up to c. 250 m; fl. & fr. Apr.-May.
Distrib.: Quite common in the desert region of Iraq. DGA, DLJ, DWD, DSD. -
Anbahia (Kuwait, Saudiya, Dubai, Qatar, Muscat, N. Yemen), S. Iran.
Only subsp. pseudeosinatae, described above, is present in Iraq.

25. *C. mesopotamica* Bornm. in Beih. Bot. Centralbl. 20, II: 170 (1906);
- Type: Syria: inter Hith et Anah et Deir-Palmira, 1. V. 1894, Th. Strauss
(holotype?, JE).
Icon: Fl. Iran. 139 b: tab. 351 (1980).

Annual with a very short main axis (terminal head sessile or with a peduncle
to 4 cm high) and several prostrate to ascending basal branches. Branches 5-30(-35)
cm long, simple or branched with 2-4 (rarely more) heads. Leaves thinly tomentose;
basal leaves petiolate, lanceolate, mostly dentate, more rarely lyrate or pinnatifid
median and upper leaves sessile, +/- lanceolate, dentate or entire. Involucre ovoid,
(11-)12-14(-15) mm long, 8-10(-12) mm broad; phyllaries in several series, with a
fine mealy tomentum, later glabrescent. Appendages of median phyllaries a spine
(6-)10-20(-25) mm long with 2-3(-4) pairs of lateral spinules 2-4 mm long in the
lower part. Flowers yellow, the marginal shorter than the central. Branches of the
style spreading. Achenes 2-2.5 mm long, with a small lateral hilum scarcely 1/4 of
the length of the achene. Pappus 2.5-4 mm, the inner row very short.
Jordan, Syria, Arabia.

Easily to be distinguished from similar species (e.g., *C. microcaulis*) by the
type of indumentum on the phyllaries, which is a fine mealy tomentum easily
wiped off.
Hab.: Generally in sandy places; alt. up to 650 m; fl. & fr. Apr.-May(-Jun.).
Distrib.: Quite common in the Desert Region of Iraq, occasional in the alluvial plain.
FUJ, DLJ, DGA, DWD, DSD, LEA, L - Jordan, Syria, Arabia (Kuwait, Saudiya,
Oman, Muscat).

Annual with very short main axis (terminal head nearly sessile) and several prostrate to ascending basal branches. Branches 5-25(-35) cm long, simple or branched. Leaves with sessile glands and sparse long hairs. Basal leaves petiolate, oblong-lanceolate and dentate, lobate or even interruptedly pinnatifid; median and upper leaves sessile, sometimes slightly auriculate, lanceolate and dentate (or the median pinnatifid). Heads solitary at the ends of the branches. Involucre 13-14 mm long, 6-8 mm broad. Phyllaries in several series, sparsely arachnoid. Appendage of median phyllaries a spine 7-15(-20) mm long, in the lower part with 2-4 pairs of lateral spinules 2-3.5 mm long. Flowers yellowish, drying bluish-green; marginal flowers shorter than the central, scarcely radiant. Branches of the style not spreading. Achenes 2.8-3.2 mm long, lateral hilum large, c. 1/3 the length of the achene. Pappus 1.5-3 mm long, the inner row very short.

Hab.: In a sandy clay depression, on a stony hillside; alt. 300-450 m (only recorded on the label of Rawi's gatherings); fl. & fr. Mar.-May.

Distrib.: Occasional in the steppe and desert regions of Iraq. FUJ: 5 km S. of Hadhr, Alizzi & Husain 33857 (K), DJJ: 10 km S. of Manaf, Omar & H. Hamid 36587 (K); 48 km N.W. of the Baiji-Haditha track, Chakravarty, Rawi, Khatib & Alizzi 31851 (K), 74 km N.W. of the Baiji-Haditha track, Chakravarty, Rawi, Khatib & Alizzi 31884 (K); DWD: 95 km N.E. of Rutba, Rawi & Khatib 32339 (K), Wadi Haaran, Chakravarty, Rawi, Khatib & Alizzi 31628 (K).

Syria.

**Sect. Corethropsis** DC.


Perennial suffrutescent plant with several erect stems, 25-35 cm high. Stems appressed-tomentose, grey, usually with a few divaricate branches with one head each. Leaves floccose-tomentose; basal leaves usually withered at flowering time, lanceolate and entire or pinnatifid with two pairs of linear-lanceolate segments;
median cauline leaves sessile, narrowly lanceolate, entire or with few teeth; upper leaves very small, linear. Involucres oblong, 18-19 mm long, 10-12 mm broad. Phyllaries in several series, thinly appressed-tomentose, the inner glabrescent, purple-suffused; phyllaries (except the innermost) ending in a yellowish spine up to 9-11 mm long, mostly with 1-2 pairs of short spines 2-3 mm long at the base. Flowers yellow, the marginal shorter than the central flowers, with threadlike segments. Achenes unknown. Pappus 7-8 mm long, the inner row not shorter.

Hab.: On a sandy clay hillside, on a rocky limestone hill; alt. 500-600 m; fl. & Fr. June.

Distrib.: Very rare in Iraq. DWD: 260 km W. of Ramadi, Rawi 20977 (K), Rech. f. 9846 (B, E, K); 40 km E. of Rutba, Omar, Quasi & K. Iramad 43964 (K); 45 km S. of Rutba, Rawi 21260 (K).

Syria.

A very rare species, only known from the type gathering in Northern Syria (Halabja) and three in Iraq. Arenes attributed the species to Sect. Seridia, but the typical species of this section are very different. He further on speculated about a hybrid origin from Centaurea cheiracanthia and Jurinea stoechelina DC., although admitting that, this hypothesis seems rather improbable due to the fact that the first named species is not known from the area. Of course the idea of a hybrid between two genera rather far from another is quite absurd. Perhaps C. delhesiana can best be allocated to the section Corethropsis DC., including C. scoparia Sieb. ex Spr. and C. schimperi DC.

Sect. Calcitrapa DC.


Calcitrapa iberica (Spreng.) Schur, Enum. Pl. Transs.: 409 (1866).


A revision of Centaurea (Compositae-Caesalpiniaceae) in the flora of Iraq.


Annual or biennial, 20-80 cm high, strongly and dichotomously branched in the upper part with distinct overtopping of the relative main axis by two or three branches arising a short distance below the terminal head. Leaves sparsely hisrate; lower leaves petiolate, pinnatifid, pinnatifid or lyrate with up to 6 pairs of lanceolate, dentate (or rarely pinnatifid) segments; stem-leaves sessile, with fewer segments but in other respects similar; upper leaves pinnatifid with 1-2 pairs of segments or undivided, dentate. Involucre ovoid, 13-18 mm long and 9-12(15) mm broad. Phyllaries in several series, glabrous, coriaceous, the outer and medium with a narrow whitish hyaline margin and ending in a spine. Spine in the medium phyllaries rigid, stramineous or brownish, 10-30 mm long, at the base on each side with (1-)2-3 spinules 2-4 mm long. Inner phyllaries with a rounded nearly entire scarious brownish appendage. Flowers rose-violet or whitish, the marginal moderately radiant. Achenes 3-4 mm long. Pappus 1-2.5(3) mm long, the inner row short.

Hab.: Along the margins of fields and dry water channels; generally below 150 m (exceptionally up to alt. c. 2000 m); fl. & fr. Apr.-May (Jun.-Aug.).

Distrib.: Widespread except in the desert regions. MAM, MRO, FKI, FPF, LEA, LCA, LSM, LBA. - S.E. Europe, Jordan, Palestine, Syria, Lebanon, Turkey, Iran, Transcaucasia, Afghanistan, Pakistan, Kashmir, C. Asia.

29. _C. hyalelepis_ Boiss., Diagn. Ser. I, 6: 133 (1845). - Syntypes: Syria, Auche 3136 (G-DC); Iraq/Syria: de Bagdad à Alep, 1822, Olivier (G-DC), Alep et Mossoul, Kotsch (n.v.).

_C. patlescens_ Delile var. _hyalelepis_ (Boiss.) Boiss., Fl.Orient. 3: 69 (1875).
Icon: Fl. Palaest. 3, pl. 674 (1977); Fl. Iran. 139 b: tab. 353 (1980).
Annual to biennial, 30-80(-100) cm high. Stem repeatedly and divaricately branched from near the base with overtopping of the relative main axis as described above for C. iberi Branches whitish with sparse crisp hairs. Basal leaves withered at flowering-time, pinnatifid to lyrate with several pairs of lanceolate toothed or basally lobed segments; median cauline leaves similar or undivided, toothed; upper leaves lanceolate to nearly triangular, sessile with a semiaxillary base, with few coarse teeth, subtending the capitula. Involucre ovoid to nearly globular, 11-13 mm long, 8-10 mm broad. Phyllaries in several rows, glabrous, with a hyaline margin forming broad auricles at the base of the spines. Spines in the median phyllaries 15-25(-30) mm long, with 1-2 pairs of very short (1-1.5 mm) spinules at base, sometimes lateral spinules altogether wanting. Flowers yellow. Achenes 2.2-2.5(-3) mm long. Pappus 2.5-3 mm long.

Hab.: Sandy clay plains and wadis, riverain thicket, waste, fallow and cultivated land, especially along irrigation channels; alt. c. 30-450 m; fl. & fr. (Mar.-)Apr.-Jun.

Distrib.: Quite common in the upper plains and foothills region of Iraq; also in the desert and lower Mesopotamian plain. FUJ, FNI, FAR, FKI, FFP, DLJ, LCA, LEA, LSM. -Cyprus, Palestine, Jordan, Lebanon, Syria, Turkey, S. Iran.


Perennial, sometimes densely tufted with numerous sterile rosettes and ascending or prostate stems 5-50 cm long with several capitula. The main stem usually overtopped by one or two lateral branches. Stem and leaves with +/− thick, appressed, greyish-white tomentum. Basal to median leaves pinnatifid with 4-6 pairs of linear segments ending in a short firm muero, upper leaves linear-lanceolate with 1-3 teeth on each side. Involucre ovate, tomentose, 13-15 mm long, 8-9 mm broad. Appendage of median phyllaries a firm yellowish spine 15-25 mm long, simple or with 1-2 pairs of spinules near base. Flowers white with a creamy anther-tube (or sometimes rose-coloured?). Achenes 4-4.5 mm long with large lateral hilum with a prominent tooth-like elaiosome, without pappus.

Distrib.: Syria, Lebanon, Jordan. - No material from Iraq has been seen. Zohary (1939: 251) mentions a specimen from "Harrat el Rajil, between Azrak and Rutba"
but it has not been located in HUJ and it is not clear if the locality is in Iraq. An occurrence in the area of the flora seems not to be beyond the realm of possibility.

Boissier placed this species, known to him only from the type collection, in the sect. Mesocentron and describes the flowers as pink. The material seen by us has yellow flowers when dry, but according to field-notes by Townsend on material from eastern Jordan they are white with a creamy anther-tube. Both colours may occur (as in C. sinaica) or Boissier may have been in error. C. poxilii with non-decurrent leaves and achenes without pappus is certainly better at home in sect. Calcitrata, but the perennial habit is unusual here too.

Sect. Tetramophaea (DC.) Boiss. (Tetramorphaea DC.)

Baseonym: Tetramorphaea bruguieriana DC., Prodr. 6: 609 (1838). - Type: Iraq: de Bagdad a Mossul, Olivier (G-DC).

Annual, c. 10-50 cm high, in larger plants profusely branched from near the base with divericate and intricate branches often overtopping their relative main axis, the whole plant often forming a nearly globose bush; small plants with few branches near the middle. Stem and branches ivory-white, hirsute with articulate hairs. Leaves sparsely hirsute, white-ciliate at the margins; lower leaves petiolate, lyrate-pinnatifid or undivided, lanceolate; median oblong, sessile and half-clasping; upper smaller, oblong-cordate, often several crowded at base of the involucre. Involucre (excluding the appendages) 10–11 mm long and 5–6 mm broad. Phyllaries in several series, greenish, glabrous, the outer with large foliaceous appendages very similar to the uppermost leaves, ciliate at the margin; median phyllaries with a simple spire 15–20 mm long; inner with small scarious appendages. Flowers pale purplish, the marginal slightly radiant. Achenes c. 2 mm long. Pappus 2.5–3 mm.

Distrib. (of species): Syria, Turkey, Iran, Transcaucasia, Afghanistan, Pakistan, C. Asia (Turkmenia to Syr Darya).
**Subsp. bruguieriana**


Icon: Fl. Iran. 139 b: tab. 354, fig. 1 (1980).

Foliaceous appendages subcordate, 5.6 mm broad, with cilia 1-3 mm long at the margin.

Hab. (of subsp.): On stony gravelly or sandy soil, sometimes rather saline, also as a weed of irrigated cultivation or roadsides; alt. 40-320 m; fl. May-Jul., fr. Jun.-Aug.

Distrib. (of subsp.): Very common in the steppe region of Iraq, also occasionally found in the desert region. MJS, MSU, FUJ, FNI, FAR, FKI, FPF, DLJ, DSD, LCA, LEA - Turkey, Syria, Iran.

A few gatherings are conspicuous by their apparently yellow flowers - in one case noted by the collector [FUJ: Qayyarah, Mosul, Baytiss 138 (K)]. It is not impossible that this is due to a hybridization with the yellow-flowered *C. hyalolepis*.

Further observations are necessary.


*C. phyllocephala* Boiss. *var. persica* Boiss., Diagn. Ser. 1, 6: 134 (1845).

Icon.: Fl. URSS 28: 461 (1963); Fl. Armen. 9: 432 (1995); Icon.: Fl. Iran. 139 b: tab. 354, fig. 2+412, fig. 1 (1980).

Foliaceous appendages oblong, c. 4 mm broad, with very short cilia (0.3-0.8 mm). No really typical specimen of this subspecies has been found in Iraq. A few specimens are intermediate between the subspecies, with cilia 0.5-1.5 mm long: MRO; Erbil to Salalhuddin, Haines s.n. (E); DSD: 60 km S.W. by S. of Zubair, Guest & Rawi 14312 (K).

Iran, Transcaucasia, Afghanistan, Pakistan, C. Asia.
A revision of *Centauria* (Compositae-Capitatae) in the flora of Iraq.

**Sect. Acrocentron** (Cass.) DC. (Colymbata Hill).

**32. C. urvillei** DC., Prodr. 6: 592 (1838).


Biennial or short-lived perennial herb with thickened main root. Stem 5-35 cm, often shorter than the basal leaves, simple or branched from near the base. Leaves slightly arachnoid to distinctly tomentose; lower and median leaves lyrate with a triangular, rhombic or oblong-ovate terminal segment and few to numerous lanceolate, oblong or lyrate lateral segments, often interspersed with small lobes. Involucres 20-40 mm long, 15-40 mm broad, ovoid to globose. Phyllaries in several series. Appendages +/− concealing the basal part of the phyllaries, very variable in the form and colour of the basal part. Length of cilia and of the terminal spine (10-40 mm long). Flowers rose-purple or whitish, the marginal slightly radiant. Achenes 4-7 mm long; pappus (5)-8-14 mm. Bristles of the receptacle 15-20 mm.

Distrib. (of species): Turkey, Iran, Iraq.

A very variable species, especially in Turkey, with several subspecies which are not easy to delimit. Subsp. *urvillei*, which occurs mainly in Outer Anatolia, is lacking in Iraq, where the species is represented by:

**Subsp. deinacantha** (Boiss. et Hausskn.) Wagenitz in Fl. Iran. 139 b: 388 (1980).


Stem stout, sulcate in the lower part, c. 20-35 cm high, branched from near the base with several one-headed branches about as long as the main stem. Lower leaves pinnate, lyrate with 2-4 pairs of lanceolate or oblong lateral segments (often additional small segments between the larger ones). Involucres 30-40 mm long, 30-35 mm broad. Appendages from a broad triangular straw-coloured or brown base gradually narrowed into a spine, with the spine in the median phyllaries 20-30(−40) mm long, 6-9 mm broad at the base excluding the cilia, cilia 5-7 mm long. Achene 6-7 mm long; pappus 8-14 mm long, inner row short.
G. Wagener

Hab. (of subsp.): In the mountains, often in crevts in limestone rock; alt. 700-1200 m; fl. & fr. Jun-Jul. (-Aug.).

Distrib. (of subsp.): In the central section of the mountain region, MRO: Navanda, Hadač 2506 (PR); Kānī Māzi Shirin, Agnew, Hadač & Haines s.n. (E); Rowanduz, Agnew, Hadač & Haines 5776 (PR); Rowanduz, "Naphtian", Hadač & Kader 5320 (PR); between Rowanduz and Bersorini, Borrn. 1487 (B); Rech. f. 11264 (W); Kewa Rash, Rawi & Serhang 23786 (K). - MSU: Piri Magrun ("Pir Omar Gudrun"), Hausskn.584 and s.n., (G-BOISS, lectotypes, BM, JE, K, isotypes); Haines s.n. (E). Iran.


Colymbada elegantissima (Borrn.) Holub in Folia Geobot. Phyto. 7: 315 (1972).

Biennial (or perennial ?), 30-50 cm high (or more ?). Stem erect, + hirsute at the base, glabrous above, simple or with 1-2 branches in the upper part. Leaves thin, sparsely to moderately densely hirsute with articulate hairs or subglabrous; basal and lower leaves with a short petiole, interruptedly pinnatisect to sublyrate, with 4-5 pairs of larger and several smaller segments, segments very variable, oblong to obovate (rounded at apex) in outline, with several coarse teeth or lobes, the terminal segment often somewhat larger; median leaves similar, but smaller and sessile, sometimes more distinctly lunate; upper leaves pinnatifid or entire with few teeth or lobes near base. Involucre nearly globose, c. 30 mm long and 30-35 mm broad. Phyllaries in numerous series, conic, glabrous. Appendages concealing a large part of the basal part of the phyllaries, triangular, brown or blackish brown, decurrent, rather abruptly narrowed into a 6-15 mm long spine, regularly ciliate, cilia 5-6 mm long, innermost appendages nearly circular, unarmed, cuculate, regularly ciliate. Flowers rose-purple (according to the collectors). Mature achenes unknown. Pappus 7-9 mm long, inner row 2.5 mm long.


Distrib.: Only found in the central sector of the mountain region, mostly near the Persian border. MRO: Sakri Sakran, nr. Rowanduz, 1500 m, Borrn. 1489
A revision of Centaurea (Compositae-Cichorieae) in the flora of Iraq.

(B, holotype); Razanuk, Cuckney (in Guest) 3838 (K); Saran, nr. Kani Kawan spring, Karokh, Nuri & Alkas 21316 (K); between Saran and Kikil, Alkas, Nuri & Serhay 27328 (K); Berd Agha Gin, 18 km N.W. of Ramia, 1115 m, Rawi, Nuri & Alkas 28718 (K); Warta, 30 km N.W. by N. of Ramia, Rawi, Nuri & Alkas 28868 (K); nr. Dargala, c. 35 km N.W. by N. of Ramia, Rawi, Nuri & Alkas 28888 (K).

Endemic.

Most collections are incomplete and better material is urgently needed to give a clear picture of the variability of this species. As far as our knowledge goes the large interruptedly pinnatisect basal leaves with rounded segments and the large heads with regularly ciliate appendages and moderately long spine are characteristic.


Icon: Fl. Iran. 139 b: tab. 357 (1980).

Perennial. Stem 30-65 cm high, sparsely hirsute in the lower part, nearly glabrous above, with few long one-headed branches near the middle or in the upper part. Leaves with sparse articulate hairs especially on the lower surface, nearly glabrous above, the upper leaves +/- glabrous, lower leaves often withered at flowering time, pectiolate, pinnatisect or lyrate, with 3-4 pairs of entire or denticulate, lanceolate or oblong lateral segments; median leaves lyrate, sessile with a large lanceolate terminal segment and 3-4 pairs of linear-lanceolate segments or lobes; upper leaves undivided, dentate or with small lobes at the base. Involucre nearly globose, 20-22-25 mm long, 20-25-30 mm broad. Phyllaries in many series, basal part totally or nearly totally concealed by their appendages. Appendages straw-coloured, coriaceous, in the median phyllaries narrowly triangular, shortly decurrent, very gradually narrowed in the spine, c. 20-30(-35) mm long, regularly ciliate in the lower part, 5-7 mm broad at base excluding the 6-9 mm cilia. Appendages of the innermost phyllaries rounded, ciliate, without a spine. Flowers rose-purple. Achene 6-6.5 mm long. Pappus 7-9 mm long, inner row 2-3 mm.

Hab.: In the mountains on limestone; alt. 1550-1800 m; fl. & fr. Jun.-July.
G. Wagener


Perennial. Stem c. 80-90 cm high, glabrous, with few long one- or few headed branches in the upper part. Leaves glabrous or nearly glabrous; basal and lower leaves petiolate, large (basal with petiole 40-50 cm long), lyrate or pinnatifid, terminal segment (if leaves are lyrate) broadly lanceolate, up to 7 cm broad, repand-dentate; lateral segments 3-4 (in pinnatisect leaves up to 7) on each side, oblong-lanceolate, indistinctly dentate, 10-20 (-25) cm broad, the upper ones in particular distinctly decurrent along the rhachis; median cauline leaves similar to the lower, but sessile and smaller with only 1-3 pairs of segments; uppermost leaves undivided, margin entire or dentate. Involucre oblong, 22-25 mm long and 14-18 mm broad; phyllaries in many series, greenish, their lower part for the most part concealed by the appendages. Appendages straw-coloured, triangular, decurrent, ending in a short spine 3-4 mm long, ciliate, the cilia 3-6 mm long, often undulate. Flowers rose-purple. Achenes 5.5 mm long; pappus 7 mm long.

Hab.: In fissures in calcareous rock in oak forest; alt. 1000-1400 m; fl. & fr. Jul.-Aug.

Distirib.: Rare in Iraq - only found in two localities in the N.W. corner of the forest zone not far from the Turkish frontier. MAM: Dairka, 35 km N.E. of Zakho, Omar & Dabbagh 45385 (K); Gara village, nr. Sersang, Kotschy, Pl. Alepp. Kurd. Moss. 374 (GOET, H, isotypes): Sersang, Haines s.n. (E); above Sersang (Sissungh), between Dohuk and Amadiya, Rech. f. 11663 (GOET, W).

Endemic.

Closely allied to C. persica and mainly differing by the very short terminal spine.

*Colymbada persica* (Boiss.) Holub in Folia Geobot. Phyto-tax. 7: 316 (1972).

**Icon**: Fl. Iran. 139 b: tab. 363 (1980).

Perennial. Stem (25-)30-50(-90) cm high, at base often with firm remains of the petioles, basal part sometimes with long hairs, remaining part or the whole stem glabrous, simple or with a few one-headed branches above the middle. Leaves firm, subglabrous (seabrid on margin and sometimes with sparse long hairs especially on the nerves of the lower surface); basal and lower leaves petiolate, lyrate, terminal segment thornic or lanceolate, entire or remotely dentate, lateral segments 2-4(-7) on each side, lanceolate or linear-lanceolate; median leaves similar but sessile and with only 1-2 pairs of lateral segments, sometimes only lobate; cauline leaves few, the uppermost undivided. Involucre oblong or subglobose, 20-25(-27) mm long and 16-23 mm broad; phyllaries in many series, not much of the lower part covered by the appendages. Appendages straw-coloured (scarcey differing in colour from the phyllaries), central triangular part 4-5 mm broad at base, extending into narrow decurrent margins and rather abruptly constricted into the spreading spine, appendages in the median phyllaries 10-20(-25) mm long including the spine, ciliata, ciliata (3-4-5-6) mm long; appendages of inner phyllaries nearly orbicular, without a spine, ciliata or lacerate. Flowers rose-purple, the marginal not radiant. Achenes 5-7 mm long. Pappus (5-)7-9 mm long, the inner row c. 2 mm.

**Distrib.** (of species): E. Turkey, W. Iran.

**Var. persica**

Nearly always at least with some hairs at the base of the stem or at the margins and nerves of the leaves, plant scarcely more than 60 cm high. Basal leaves up to 20 cm long with 2-5 segments on each side. Appendages very variable in length, spines straight.

**Hab.**: On mountainsides, sometimes by streams; alt. 800-2000 m; fl. & fr. Jun.-Aug.

**Distrib.**: Occasional in the central mountain region of Iraq. MRO: Algurd, Guest 2849 (K), Gillett 9532 (K), Gillett 12465 (K, US); between Karokh Mt. and Dargala,
Rawi, Kass & Nuri 27732 (K); Siewaka, at the foot of Karkh, Kass & Nuri 27562 (K).


Totally glabrous, up to 90 cm tall. Basal leaves large (up to 35 cm with petiole) with 3-7 segments on each side. Appendage (12-)15-20 mm long, spines slightly curved.

Hab. & Distrib.: In the high mountains on rocky places and in ravines; alt. 1300-2600 m; fl. & fr. Jun.-Aug.

MRO: Handren, Bornm., ier Pers.-Ture. 1486 (JE, K), 1492 (B, type); above Nawanda, Rech. f. 11392 (W); Qandil range, above Pushtashan, Rech. f. 11812 (W). An endemic variety.


Biennial or perennial plant with a tap-root. Stem erect, c. 45-60 cm high, subglabrous, with few short or long one-headed branches in the upper part. Leaves firm, appearing glabrous but with sparse short hairs near and at the margins and along the nerves; basal (and lower ?) leaves lyrate, large, up to 30 cm long including the long petiole, the terminal segment distinctly larger, lanceolate, lateral segments 3-5 on each side, oblong-lanceolate (the lower much smaller), all remotely dentate; medium leaves lyrate-prinmatiolobed, sessile; the upper much smaller, lanceolate, with 1-2 lobes on each side at the base. Involucere nearly glabrous, 22-25 mm long and 26-26 mm broad. Phyllaries in many series, their lower part totally covered by the appendages. Appendages coriaceous, straw-coloured or light brown, broadly triangular (excluding the cilia 6-7 mm, including the cilia up to 15 mm broad), shortly decurrent, with 14-16 cilia 4-7 mm long on each side, ending in a scarcely 1 mm long, often very indistinct mucro. Flowers rose-purple, the marginal not radiant. Achenes 5-6 mm long. Pappus 6-7 mm long, scabrous, the inner row 2-3 mm long.
A revision of *Centaurea* (Compositae-Cacaceae) in the flora of Iraq.

Hab.: In the thorn-cushion zone of the Mountain Forest Region; alt. 2140 m; fl. & fr. Jun-Aug.

Distrib.: Very rare on igneous rocks and limestone slopes. On the village of Zerz in the Rowanduz district, Agnew, Hadjić & Haines 5945 (PR, type); above Art on Ser Kurawa, Gillett 9713 (K).

Endemic.

This species is remarkably similar to *C. persica* in vegetative characters, but differs strikingly in the totally unarmed long appendages which completely cover the basal part of the phyllaries.


Perennial, 20-50 cm high, simple or with few branches, +/- hirsute at least in the lower part. Leaves sparsely hirsute to subglabrous; basal leaves pinnatisect or pinnate, with 4-8 pairs of oblong to obovate, mostly irregularly dentate lateral segments, smaller segments sometimes present between the larger ones, the terminal segment lanceolate to nearly obvate; median and upper leaves lyrate to pinnatilobed with 1-3 pairs of segments or lobes. Involucre oblong to cup-shaped, rounded at the base, 25-33 mm long, 18-30 mm broad. Appendages with a triangular brown base, gradually narrowed into a slender spine of variable length, margins whitish, ciliate, decurrent. Appendage with the spine 10-35 mm long, the cilia 4-5-(8) mm long; innermost phyllaries with very broad rounded appendages, 8-15 mm broad, rather regularly ciliate. Flowers rose-purple, the marginal not radiant. Achenes 5.5-6.5 mm, densely hairy when young. Pappus 10-15 mm long, the inner row much shorter.

Hab.: On steep limestone slopes; alt. 1100-1400 m; fl. & fr. Apr.-May.

Distrib.: Very rare in the mountain region of Iraq. MSU: on the Avroman range, above Darimar, Gillett 11834 (K); above Khural (on the same range of mountains), Hadjić 5070 (PR). Iran.

It is only with some hesitation that I have included in *C. luristanica* these two collections from Avroman, which differ in some respects from each other and the
type. *C. luristanica* is only known from few collections. Characteristic features seem to be the triangular brown basal part of the appendages, the very broad ciliate appendages of the inner phyllaries and the long pappus.


Icon: Fl. Iran. 139 b: tab. 361 (1980).

Very probably perennial, but underground parts still unknown. Stem 50 cm high or more, ascending, stout, nearly glabrous, with 1-2 short branches each with one head in the upper part. Leaves glabrous or nearly glabrous, the basal and lower petiolate, long (up to 30 cm including the petiole), interruptedly pinnatisect with 8-10 pairs of larger, lanceolate, coarsely dentate or pinnatifid segments and several smaller leaflets; median and upper leaves gradually smaller, sessile, pinnatisect or pinnatifid with few segments, involucre oblong-ovoid, truncate at the base, 25-30 mm long, 20-22 mm broad. Phyllaries in several series, floccose-tomentose, greenish, the inner ones with purple tinge. Appendages only partly concealing the basal portion of the phyllaries, spreading or slightly recurved, brown, gradually narrowed into the spine from a triangular decurrent base, 15-20 mm long including the spine, 3-5 mm broad at base excluding the 4-5 mm cilia. Flowers rose-purple, the marginal scarcely radiant. Achenes 5-5.5 mm long. Pappus 8-10 mm, inner row short, elements scale-like.

Hab.: Among rocks with a silty substratum; alt. 1500 m; fl. & fr. July.

Distrb.: Very rare in Iraq - only found by the Turkish frontier, N.E. of Zakho.

MAM: Zawita Mt., nr. Sharanish, Rawi 23651 (K), Rech. f. 10902 a (GOET, W), S.E. Turkey.


Icon: Fl. Iran. 139 b: tab. 358 (1980).
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Perennial, sometimes with several stems from the base, 20-40(60) cm high. Stem hirsute with articulate hairs in the basal part and with white wool in the axils of the leaves, glabrous in the upper part; a few long, simple branches present in the lower half. Leaves with sparse to dense, long, articulate hairs especially on the lower side. Basal leaves mostly withered at flowering time, petiolate, interrupted pinnatifid with distant, lanceolate, dentate segments of unequal size; medium leaves similar but sessile or subulate; only a few distant very small leaves in the upper half of the stem and in the branches. Involucre oblong, 20-25 mm long, 15-18 mm broad. Phyllaries in several series, slightly tomentose, often with a purple tinge, their lower part not totally concealed by the appendages. Appendages straw-coloured to brownish, triangular, decurrent, gradually narrowed into a spine, with the spine (in the median phyllaries) 15-25 mm long, 3-5 mm broad at base excluding the 3-4(-5) mm cilia. Appendages of innermost phyllaries scarious, ciliolate, irregularly ciliate, unarmed. Flowers rose-purple, the marginal scarcely radiant. Achene c. 5 mm long (only known from one gathering). Pappus 8-11 mm long, inner row 2.5-3 mm.

Hab.: In oak forest on a steep slope, in crevices in limestone; alt. 1300-1400 m; fl. & fr. Apr.-Jun.

Distr.: Rare in the mountain region of Iraq, and only found on or near one mountain. MSU: Amoret, m. Qaradagh, Haines 1155 (E, K); Qara Dugh, Poore 436 (K), Hadač 5235 (PR), Iran.

*Cyanus* Mill.

*Centauraea* sect. *Cyanus* (Mill.) DC.

Perennials with a simple stem or few branches or more copiously branched annuals. Capitula medium-seized to large. Leaves +/- densely tomentose, rarely glutinoscent, entire or pinnatifid to pinnatilobed, the upper often decurrent. Involucre ovoid to subglobose. Phyllaries less rigid than in most other sections, appendages triangular, strongly decurrent with a dentate or ciliate brown or blackish border (cilia often silvery), never ending in a firm spine or spine. All flowers violet- or rose-purple or pale yellow or (mostly) the central violet-purple, the marginal cornflower-blue; marginal flowers usually strongly radiant with more than 5 segments, without
staminodes. Achenes medium-sized, conspicuously barbate at the margin of the large hilum; pappus scabrous, often shorter than the achene, sometimes absent.

*Centaurea variegata* Lam., Encycl. 1: 668 (1785), nom. illeg.
*Centaurea cana* auct. vix Sm. in Sibth. et Sm., Prodr. Fl. Graec. 2: 198 (1813).
Icon.: Fl. Reipubl. Pop. Roman. 9: tab. 165, fig. 2-5 (1964); Fl. Iran. 139 b: tab. 380/381 (1980).

Perennial, with a slender long creeping rhizome. Stem erect, 10-40(-50) cm high, arising from the centre of a rosette (leaves of rosette often withered at flowering time) unbranched or with few simple branches in the upper part. Stem and leaves +/- densely floccose-tomentose; leaves lanceolate to linear-lanceolate, the lower narrowed into a petiole, the median and upper sessile and often shortly decurrent. Heads solitary at the ends of the branches. Involucre cup-shaped, 15-22 mm long, 9-18 mm broad. Phyllaries in several series, greenish with decurrent scarious appendage. Appendage light brown to blackish brown, ciliolate, the cilia 1.5-3.5 mm long, brown at base, silvery in the upper part. Marginal flowers strongly radiant, blue or more rarely rose-purple, the central purple-violet, anther-tube slightly curved. Achene 4-6 mm long. Pappus 1-2.5 mm long.

Hab.: Rocky and grassy mountain slopes, open oak forest and scrub, also on a wall and in a vineyard; alt. 600-3000 m; fl. & fr. (Mar.-) May-July.

All attempts to subdivide this very polymorphic species have so far been unsatisfactory. In Iraq the species is confined to the mountainous area but shows a considerable variation even there. Some plants described by me (in Flora Iranica) as "Group D" from Iraq are rather conspicuous but there are transitional forms and I doubt whether formal taxonomic recognition is advisable at this stage of our knowledge. The situation is made more difficult by the fact that a considerable part
of the material seen has been collected without the basal and underground parts, which may be of importance.


   Syn.: **Centaurea depressa** M. Bieb., Fl. Taur.-Cauc. 2: 346 (1808). Type: Republic of Georgia: in colibus siccis Iberiae, circa Tiflis [Tbilisi], Steven (LE, n.v.).

   **Centaurea anatolica** Grisch., Spic. Fl. Rumel. 2: 234 (1844)

   C. **depressa** M. Bieb. var. **amosiana** Bornm. in Magyar Bot. Lapok 4: 260 (1905). Icon: Fl. Iran. 139 b: tab. 382+413, fig. 5 (1980).

   Annual, 10-60 cm., main stem erect, often with several ascending branches from near the base, with one to several heads. Branches and leaves greyish floccose-tomentose. Lower leaves oblong or oblong-spathulate, basally narrowed into a broad petiole, entire or lyrate with a large terminal segment and 2-3 pairs of lateral lobes; median and upper leaves sessile, gradually smaller, oblong to linear-lanceolate. Involucre (13-)14-18 mm long, 8-12(-13) mm broad, ovoid to cup-shaped. Phyllaries in several series, glabrous, greenish (the innermost often violet-tinted), with a triangular appendage widely decurrent along the margin. Appendage brown or blackish with silvery teeth 1.5-2(-3) mm long. Marginal flowers blue (cornflower-blue), sterile, distinctly radiant with 6-8 unequal, rather broad lobes; central flowers violet with a steel-blue, strongly curved anther-tube. Achene 4.5-5.5(-6) mm long with large bearded hilum. Pappus 5-8(-9) mm long, inner row short.

   **Hab.** On a silty plain; alt. 550 m; fl. & fl. April. Only one established record in the desert region. DWD: 32 km W. of Rutba, Rawi 31142 (K).

   **Distrib.** S.E. Europe (Bulgaria, Greece), Crimea, Lebanon, Syria, Turkey, Iran, Transcaucasia, W. Pakistan, C. Asia, Nepal, W. Tibet (introduced to Spain).

   This species, widespread in most countries of the Nearer East, is remarkably rare in Iraq. Only one collection from this area has been seen by the author and one other (from Jabal Harrarin) is recorded by Antony, whose determinations are not very reliable. As the species is a common weed in some adjacent countries a casual introduction seems possible.
3. *Cyanus segetum* Hill, Herb. Brit. 1: 82. 1769. - Based on *Centaurea cyanus* L. 
Syn.: *Centaurea cyanus* L., Sp. Pl. ed. 1: 911 (1753). Type: ?

Annual, 20-60 cm or more high, sparingly or profusely branched from near the base with 1-several- headed ascending branches. Stem and leaves thinly floccose-tomentose, the leaves glabrescent below. Lower leaves usually withered at flowering-time, lyrate or lanceolate; median and upper leaves linear-lanceolate to nearly filiform, the median usually with 1-3 long subulate teeth in the basal part, the upper entire. Involucre 10-16 mm long, 5-10 mm broad, oblong, funnel-shaped when fruiting. Phyllaries in several series, greenish, the innermost often violet-tinged. Appendage a narrow light brown to blackish brown border divided into teeth 0.5-1 mm long. Flowers similar to those of *C. depressa* but the marginal flowers with narrower lobes. Achenes 3-4 mm long. Pappus 2-3 mm long.

Hab. & Distrib.: Only found once in Iraq: MRO, Mergasur, damp ground near stream overflow, Agnew, Hadzê & Haines s.n. (E).

Quite commonly cultivated in gardens as an ornamental in Iraq - e.g. LCA: Baghdad, Guest 186 (K). No doubt the Mergasur plant was adventive.

As a weed in most of Europe, Siberia, C. Asia, N. America and elsewhere, in natural habitats in Italy, Greece, W. Turkey.

*Sizolophus* Cass.


Annuals with few to numerous medium-sized capitula. Leaves undivided or the lower lyrate. Involucre ovoid, appendages triangular, scarcely decurrent, with numerous regular cilia and ending in a slender spine. Flowers yellow, the marginal scarcely radiant, with staminodes. Achenes medium-sized. Pappus scabrous, the inner row short.


Stizolophus balsamitaefolian Cass., Cuvier. Dict. Sci. Nat. 51: 50 (1827); nom. illegit., based on C. balsamitae Lam.

Icon.: Fl. Iran. 139 b: tub. 305 + 408, fig. 2 (1980); Fl. Armen. 9: 365 (1995).

Annual with an erect stem 30-80(-120) cm high, with several long simple branches in the upper half, rarely simple. Stem and branches straw-coloured, glabrescent. Leaves scabrous with very short hairs, entire or denticulate (rarely the lower with few coarse teeth at base); lower leaves oblong, withered at flowering time; median and upper leaves gradually smaller and narrower, ending in a yellow macro 1-3 mm long. Involucre ovoid with truncate base. 15-25 mm long, 12-24 mm broad. Phyllaries in several series, their lower part nearly concealed by the appendages. Appendages cartilaginous, appressed, yellowish to light brown, triangular, 2.5-3.5 mm long and broad excluding the cilia, scarcely decurrent, with 7-12 cilia 2-3 mm long on each side, gradually narrowed into a spine-like 2-4 mm long. Innermost phyllaries narrowed into a slender often reddish tip. Flowers yellow, the marginal scarcely radiant, with staminodes. Achene 4-5.5 mm long. Pappus 2-5 mm, scabrous to barbellate, inner row short.

In the area of the flora only represented by: subsp. balsamitae.

Involucre 18-25 mm long, (15-)17-24 mm broad. Appendages (without the cilia) 2.5-3.5 mm long and broad with 8-12 cilia in each side and a terminal spine-like 3-4 mm long. Achene 4.5-5.5 mm long. Pappus (3.5-)4-5 mm long.

Hab.: Among oak forest and scrub; alt. 1600-1700 m; fl. & fr. Jul.-Aug.

Distrib.: In the eastern section of the forest zone of Iraq (and also in the irrigated tree plantation near Mosul): MSU: Qopi Qaradagh, Haines 2051 (E, K); Qara Dagh, Bathaina Makki 497 (W). - FKE: Nineveh plantation, N. of Mosul, Anders 1581 (W).

Distrib. (of species): Syria, Turkey, Iran, Afghanistan, Transcaucasia, C. Asia (Turkmenia to Tur Shum). This subspecies throughout the range of the species. A second subspecies occurs in eastern Iran.

Syn.: *Centarea balsamitoides* Post, Pl. Post. 2: 15 (1891). - Type: Syria: in agris inter Palmyram et Marbat-'Antar in desertō syriaco, 28. VII. 1890, G. E. Post 70 (G, BM; s.n.),


Annual, stem erect, 20-60 cm high, branched from near the base or in the middle part, the branches simple or with several heads. Stem and branches ivory-white, shining, nearly glabrous. Leaves firm, puberulent and covered with sessile glands; lower leaves withered at flowering-time, lyrate (or sometimes undivided ?); medium leaves lanceolate to linear-lanceolate, 3-5 mm broad, the upper ones only 1-2 mm broad, very small. Heads solitary at the ends of the branches. Involucr ovoid, 13-17 mm long, 6-9 mm broad. Phyllaries in many series, imbricate, with slightly elevated longitudinal ribs, finely tomentose. Appendages small, narrowly triangular (c. 1 mm broad at base excluding the cilia), straw-coloured, with 4-6 pairs of distinct cilia 1.5-2 mm long and a terminal macro 2-3.5 mm long. Flowers sulphur-yellow, the marginal not radiant, with stamnodes. Achenes 3-3.5 mm long, greyish, at the base with a cartilaginous yellowish swelling at the hilum. Pappus (3.5-)4-5 mm long, the inner row short.

Hab.: On gravelly hilltops, stony hillsides and clay slopes; alt. 100-300 m; fl. & fr. Mar.-May.

Distrib.: In the dry steppe region of Iraq? FUJ: between Luke Khatanya (in Syria) and Jabal Sinjar, Hand.-Mazz. 1590 (W.).-FKI/FPF: between Tikrit and Mándali, Sutherland s.n. (K). - FPF: Jabal Hamrin, nr. Muğdadya (Shahabab), Haines 1396 (E, K); Jabal Hamrin on the Khanaqin road, Agnew 1301 (K), Hadadé 1709 (PR); Jabal Hararin, Sutherland 51 (BM, K s.n.); Quraiṭu, nr. Khanaqin, Rawi 5697; Kani Mari, nr. Khanaqin, Hadadé, Haines & Wallūd al Hashimi 4648 (PR). DLJ: Umm at matin, 74 km N.W. of Baiji-Haditha road, Chakravarty, Rawi, Khosb in Alizzi 32040 (K).

Syria

*S. balsamitoides* is closely allied to *S. coronepiſiōlis* (Lam.) Cass. from Turkey and Transcaucasia, in which it was included later by POST himself. The
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capitula are however smaller in *C. balcanica*, the pappus is longer and present in all achenes, while in *C. coronopifolia* there is a distinct heterocarpy with outer achenes lacking a pappus. Further investigations will show if the last named character is a really constant one.

**References**


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THE FIRST IDEA FOR RECHINGER’S
"FLORA IRANICA"*

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Introduction

Major Floras are long term projects. Flora Brasiliensis and Flora SR, may act as examples: the first was started in 1840 by Carl Friedrich Philipp von Martius in Munich together with Stephan Endlicher in Vienna and completed in 1906 by Ignatz Urban in Berlin. The latter was started by Vladimir Leontjevich Komarov in 1934 and completed by Evgenij Grigorjevich Bobrov and Nikolai Nikolaievich Tsvetlev in 1964, all three based in Saint Petersburg. Flora Iranica, is no exception to this. It was started by Karl Heinz Rechinger in Vienna in 1963 and now, 44 four years later, the project is approaching its completion with the last volumes edited by his widow Wilhelmina Rechinger. Only the treatments of ferns, Antirrhineae and a proportion of the albeit extreme large genus Astragalus are outstanding.

However, there are also differences: Flora Brasiliensis was published under the auspices of the Emperor of Austria, the Emperor of Brazil and the King of Bavaria with ample funds coming from various sources, e.g. from the parliament in Rio; Flora SR was financed by the well-funded Soviet Academy of Sciences. By contrast, Flora Iranica, could only rely on the infrastructure of the Natural History Museum in Vienna, but funds had to be found otherwise with Rechinger often not being very successful in these endeavours - not surprisingly since it was

* Note: This manuscript due to its "delayed submission", is included here as the last article of this issue - Editorial Board.
clearly not a project of an institution but rather a private undertaking (for a list of institutions providing grants, see RECHINGER 1989: 346). And there is one more substantial difference: Karl Heinz Rechinger was not only the editor of Flora Iranica for fascicles 1-171 but he also wrote very many accounts, often of large and complex families or genera (listed in LACK 2000). In short, his input was much more substantial than that of any of the key persons of Flora Brasiliensis or Flora SSSR mentioned above. No doubt, it was Rechinger’s “immense drive and determination” (HEIDGE 2006) which kept the project praised by many (e.g. PODLECH 1996) moving steadily for decades.

This contribution does not give an outline of the still untold Flora Iranica Story but deals only with the very beginning of the project or rather how the first idea for it was born.

The first idea

Karl Heinz Rechinger accompanied by his first wife Frida had travelled to Iran for the first time in 1937 arriving in Pahlavi on 13th May and leaving the country on 17th August. Since both an itinerary (RECHINGER 1939) and a travelogue (RECHINGER 1989) of this tour undertaken together with Erwin Gauba have been published, no further details need to be presented here.

Back in Vienna, Karl Heinz Rechinger asked his father Karl Rechinger, then 70 years old and living like the son and his wife in the family’s block of flats in Friedrichstraße 6 (LACK 2000), to abstract the meagre and widely scattered data published on the flora of Iran “in the form of a card index” (RECHINGER 1989). This was a sensible choice since the father was a retired Custos 1. Klasse at the Department of Botany of the K.K. Naturhistorisches Hofmuseum in Vienna and had published a brief paper of J.A. Knapp’s collection from Iran (RECHINGER, K. 1894) 43 years earlier. The hand-written card index with rubber-stamps giving the references seems to have been prepared in order to facilitate the determination of the specimens brought back by the son from the expedition. These were subsequently published in a series of papers in the “Annalen des Naturhistorischen Museum Wien” and “Reperitoarium Specierum Novarum Regni Vegetabilis” appearing in Vienna and Berlin respectively.
The first idea for Rechinger’s “Flora Iranica”

Karl Heinz Rechinger, could not resist travelling to Weimar in Nov. 1937 with some of his Iranian trophies to meet Joseph Bornmüller, then 74 years old and regarded as the highest authority on the flora of Iran (LACK 2000). This was a stimulating experience, lead to a life-long mutual respect in botanical matters and resulted in at least one more visit to Weimar in early 1939 (RECHINGER 1955, LACK 2000).

The occupation of Austria by the Deutsche Wehrmacht, the infamous “Anschluß”, declared by the Deutsches Reich, the outbreak of the World War II which saw Rechinger as a soldier in German uniform made plans for a second expedition to Iran if they then had existed totally futile. However, during the intervals of his military service work on the collections from Iran continued as did the botanical correspondence with Bornmüller.

In early Nov. 1944, when the Soviet front in Hungary was reaching Budapest from the east, Rechinger was called up to do service in the “Arbeitsdienst” [labour service] near Oberwart in Burgenland, then Styria. He was one of the many to build the famous “Ostwall” [eastern rampart] intended to stop the victorious Soviet Army from entering occupied Austria. At a moment of great despair, Rechinger wrote a most interesting and rather personal letter to Bornmüller published here in full and translated into English (Fig. 1, see Appendix).

The letter from Schwadorf

The key sentence reads “It is and remains one of my favourite ideas to write a Flora of Persia at some later date”. When writing this, Rechinger had stiff fingers because of the cold, was sitting on a heap of straw with poor light with his prospects very uncertain. Clearly, he had at that moment no plan for a Flora Iranica but rather a very vague idea of what he would like to do once peace was restored. This may have helped him to forget his miserable situation.

On the other hand, this letter was written not without critical undertone and considering the political realities of Nov. 1944, could have brought Rechinger into substantial trouble - in particular since Bornmüller was quite in conformity with Nazi politics. This fact is best illustrated by the latter’s undated manuscript note in the copy of the Bornmüller Festschrift (SCHWARZ 1938a) kept in the library of the
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Botanisches Museum in Berlin. The last sentence of the eulogy (SCHWARZ 1938b) ended with a plea to enable Bornmüller, a private scholar who had lost his private property during the inflation (1), to continue his scientific work. To the last sentence he added in pencil that through "unseren Gauleiter Saukel" [our Gauleiter Saukel] this has meanwhile been achieved. The note probably referred to an "Ehrensold von einer füntlichen Höhe" [honorary emolument of regal dimensions] (2) which Bornmüller received since mid-1940 from the Nazi authorities. The note may also refer to the Goethe Medal for Art and Science awarded to him by the Führer on 6th Dec. 1942 (CASPAR 1997). A particular brutal member of the innermost Nazi circle, Josef Saukel, Gauleiter and later Reichsstatthalter of Thuringia, since 1942 also Plenipotentiary General for the Utilisation of Labour, was involved in the "deportation for slave labour [from occupied territories to Nazi Germany] of more than five million human beings, many of them under terrible conditions of cruelty and suffering" (ANON, 1946). He was tried at the International Military Tribunal in Nuremberg in 1946, convicted of crimes against humanity and hanged.

It seems that, friendship between Bornmüller and Rechinger, the two specialists for the flora of Iran, had prevailed in 1944 over politics.

Epilogue

It took more than 19 years until the first three, albeit unnumbered fascicles of Flora Iranica appeared, bearing the note "Dec. 1963" on the title page. Distribution may not have been very quick: the copies kept in the library of the Botanic Garden and Botanical Museum Berlin-Dahlem have the rubber stamp "20 Mai 1964", which indicates some delay. Unfortunately, there was no introduction to the Flora Iranica, and the profile of the project was only explained six years later in a journal announcing various news from the publisher (RECHINGER 1969, English translation in RECHINGER 1989).

Araceae (fascicle 1), Convulvulaceae (fascicle 2) and Ephedraceae (fascicle 3) have been treated first; keys, synonyms, specimens studied, distribution data, miscellaneous notes and line drawings were provided, but no descriptions. Rechinger dealt with Convulvulaceae, the other two families were treated by Harald
Riedl, the first of several specialists to contribute to the undertaking. In any case, a vague idea had become reality and a great project started.

Acknowledgements

The Herbarium Haussknecht, University of Jena kindly agreed to the reproduction of a letter kept in its archive. Thanks are due to H. Manitz, Jena for making various manuscript sources of Herbarium Haussknecht available to the author.

Unpublished sources

(2) LETTER O. RENNER to J. BORNMÜLLER, Jena, 4th June 1941. - Archives, Herbarium Haussknecht, University of Jena.

References


Appendix

Lieber Freund Bommlüle!


Für den Fall, dass man sich überdienen sollte, nehme ich Ihr Anliegen herzlich der Korrekturhelfer möglichst aller Ihrer Arbeiten betreffenden Arbeiten mit freundlicher Dankbarkeit an und bitte, die Sendung eingeschrieben an das Museum zu richten. Es ist und bleibt eine meiner Lieblingsdichten, später einmal eine Flora von Persien zu schreiben und die Vorarbeiten hierfür würden durch Ihr Anliegen ungenügend erleichtert.

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Entschuldigen Sie das Geschmiere, ich sitze auf einem Sohlhaken bei schlechtem Licht neben einem räuchernden Ofen und habe vor Frist und ungewohnter Arbeit steife Finger.
Herzlichst Ihr K.H. Rechinger.

Entrenching Schandorf, 6 Nov. 1944, Kreis Oberwart, Styría
Dear friend Bornmüller,

I have received your very recognizing and friendly letter when I was about to leave Vienna for some weeks. According to the principle “the right man in the right place”, I have been detached to entrenched, maybe assuming that, digging up plants is a special qualification for this work. The living conditions to which you are condemned here are as primitive as even an oriental traveller would only encounter under exceptional circumstances. The only alteration being the enemy bombers which fly above our heads every day to Vienna, Graz, etc.

In case that I should survive, I accept with heartfelt gratitude your offer concerning the proofs of all your papers referring to Persia and ask you to send them with registered mail to the museum [i.e. the Natural History Museum in Vienna]. It is and remains one of my favourite ideas to write a Flora of Persia at some later date and the preparatory work for this would be immensely facilitated by your offer.

Until my departure on 2nd Nov., neither our museum nor the herbaria and books evacuated out-of-town nor the Botanical Institute of Vienna University have been damaged. In contrast, the bank building where our books lay in strong-rooms was hit without the bomb penetrating completely. The printing house Gistel was burnt down completely including the last volume of our Annals [i.e. Annalen des Naturhistorischen Museums Wien 54 (2)] together with the composition and the manuscripts. This is indeed a blow for us but not the worse. I am not personally affected since having suspected evil in advance had made arrangements to have reprints made of my work (4th part of my Iranian collections) [i.e. Ergebnisse einer botanischen Sammelreise nach dem Iran, IV. Teil, republished in Ann. Naturhist, Mos. Wien 55: 265-295 (1946)]. However, what has happened during the last days I do not know.
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Excuse my scrawl. I am sitting on a heap of straw in poor light next to a smoky stove with fingers stiff from frost and unaccustomed work.

Very cordially Yours,
K.H. Rechinger


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