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. Esfandiari 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 Kurdestan, 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 year 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 (Touran 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".

Editorial Board

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TYPE SPECIMENS COLLECTED BY K.H. RECHINGER IN "FLORA IRANICA" AREA

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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 holoptera* H. Riedl, Iran: Rech. 5351

Angiospermae-Monocotyledonae
Gramineae
2) *Agropyron podperae* Nab., var. *velutinum* Melderis, Iraq: Rech. 10915.
3) *Agropyron stenostachyum* Melderis, Afghanistan: Rech. 32251.
4) *Elymus paboanus* Claus, var. *saxatilis* Melderis, Afghanistan: Rech. 18244-a.
5) *Orysopsis microcarpa* Pilger var. *pubescens* Bor, Afghanistan: Rech. 31363.
6) *Orysopsis rechingeri* Bor, Afghanistan, Rech. 37277.

Juncaceae
7) *Eleocharis palustris* (L.) Roemer & Schultes, subsp. *iranica* Kukkonen, Pakistan: Rech. 30668.
8) *Juncus heldreichianus* Marsson, subsp. *orientalis* Snog. Iran: Rech. 32735.
9) *Juncus rechingeri* Snog. Afghanistan: Rech. 37174-b.
10) *Schoenoplectus rechingeri* Kukkonen, Pakistan: Rech. 30675.

Liliaceae

11) *Allium caroli-henrici* Wendelbo, Afghanistan: Rech. 35053.
12) *Allium choriotepalum* Wendelbo, Afghanistan: Rech. 35864.
13) *Allium farctum* Wendelbo, Pakistan: Rech. 30991.
14) *Allium ionandrum* Wendelbo, Afghanistan: Rech. 35915.
15) *Allium longicollum* Wendelbo, Afghanistan: Rech. 34761.
16) *Allium oreophiloides* Regel, subsp. *Salangense* Wendelbo, Afghanistan: Rech. 37501.
17) *Allium trachycoleum* Wendelbo, Iraq: Rech. 11901.
18) *Eremurus rechingeri* Wendelbo, Iraq: Rech. 15436.
19) *Gagea anonyma* Rech. f., Iran: Rech. 27133 (isotypus).
20) *Gagea chloroneura* Rech. f. Afghanistan: Rech. 37535.

Typhaceae

21) *Typha albida* H. Riedl, Afghanistan: Rech. 35322.

Angiospermae-Dicotyledonae

Apocynaceae

22) *Nerium oleander* L., subsp. *kurdicum* Rech. f., Iraq: Rech. 12141.

Asclepiadaceae

23) *Cynanchum cardiostephanum* Rech. f., Afghanistan: Rech. 35614.
24) *Vincetoxicum cardiostephanum* (Rech. f.) Rech. f., Afghanistan: Rech. 35614.

Berberidaceae

25) *Berberis khorasanica* Browicz & J. Zielinski, Iran: Rech. 3253.

Boraginaceae

26) *Heliotropium gypsaceum* Rech. f. & H. Riedl, Iran: Rech. 14951.
27) *Heliotropium khyberianum* Rech. f. & H. Riedl, Pakistan: Rech. 19368.
28) *Heliotropium multiflorum* Rech. f., Aell. & Esfand., Iran: Rech. 4006.
29) *Heliotropium nodulosum* Rech. f., Aell. & Esfand., Iran: Rech. 3999.
30) *Heliotropium oliganthum* Rech.f., Aell. & Esfand., Iran: Rech. 3910.
31) *Heliotropium rechingeri* H. Riedl, Pakistan: Rech. 29591.
32) *Heliotropium remotiflorum* Rech. f. & H. Riedl, Pakistan: Rech. 27990.
33) *Heliotropium serpentinicum* Rech. f., Iran: Rech. 1318.
34) *Heliotropium serpentinicum* Rech. f. var. *brachystylum* Rech. f., Iran: Rech. 1586.
35) *Heliotropium tuftanicum* Rech. f., Aell. & Esfand., Iran: Rech. 4058.
36) *Heliotropium ulophyllum* Rech. f. & H. Riedl, Pakistan: Rech. 29487.
37) *Lindelofia micrantha* Rech. f. & H. Riedl, Afghanistan: Rech. 17378.
38) *Mattiastrum crista-galli* Rech. f. & H. Riedl, Iran: Rech. 4502.
39) *Mattiastrum cynoglossoides* Rech. f. & H. Riedl, Afghanistan: Rech. 17688-b
40) *Mattiastrum densum* Rech. f. & H. Riedl, Iraq: Rech. 12800.
41) *Mattiastrum flaviflorum* Rech. f. & H. Riedl, Afghanistan: Rech. 18446.
42) *Mattiastrum formosum* Rech. f. & H. Riedl, Afghanistan: Rech. 31422.
43) *Mattiastrum polyanthum* Rech. f. & H. Riedl, Afghanistan: Rech. 17688.
44) *Mattiastrum pygmaeum* Rech. f., Iran: Rech. 6022.
45) *Mattiastrum sessiliflorum* Rech. f. & H. Riedl, Afghanistan: Rech. 17385.
46) *Mattiastrum subscaposum* Rech. f. & H. Riedl, Afghanistan: Rech. 16926.
47) *Moltkia gypsacea* Rech. f., Iran: Rech. 2795.
48) *Myosotis albicans* H. Riedl, Pakistan: Rech. 30826.

49) *Myosotis kurdica* H. Riedl, Iraq: Rech. 11750.
50) *Omphalodes heterophylla* Rech. f. & H. Riedl, Pakistan: Rech. 19442.
51) *Onosma qandilicum* Rech. f. & H. Riedl, Iraq: Rech. 11205.
52) *Paracaryum serpentinicum* Rech. f. & H. Riedl, Afghanistan: Rech. 31459.
53) *Paracaryum stellatum* H. Riedl, Pakistan: Rech. 28434.
54) *Trichodesma bamianicum* Rech. f. & H. Riedl, Afghanistan: Rech. 18392
55) *Trichodesma longipedicellatum* Rech. f. & H. Riedl, Pakistan: Rech. 27760.
56) *Trichodesma macrocarpum* Rech. f., Aell. & Esfand., Iran: Rech. 3321.

Campanulaceae

57) *Asyneuma mazanderanicum* Rech. f., Iran: Rech. 6533.
58) *Campanula Hermanii* Rech. f. Iran: Rech. 47405.
59) *Campanula kermanica* (Rech. f., Aell. & Esfand.) Rech. f., Iran: Rech. 3730.
60) *Campanula khorasanica* (Rech. f. & Aell.) Rech. f., Iran: Rech. 4485.
61) *Campanula polyclada* Rech. f. & Schiman-Czeika, Afghanistan: Rech. 18756.
62) *Campanula schimaniana* Rech. f, Afghanistan: Rech. 35698.

Caryophyllaceae

63) *Acanthophyllum chloroleucum* Rech. f. & Aell., Iran: Rech. & Aell. 4979.
64) *Acanthophyllum kabulicum* Schiman-Czeika, Afghanistan: Rech. 31069.
65) *Acanthophyllum laxiusculum* Schiman-Czeika, Iran: Rech. 42342.
66) *Ankyropetalum gypsophiloides* Fenzl, var. *viscosum* Barkoudah, Iraq: Rech. 11268.
67) *Arenaria globuliflora* Rech. f., Afghanistan: Rech. 32318.
68) *Arenaria serpyllifolia* L., var. *macrosepala* Rech. f., Iran: Rech. 901.
69) *Dianthus binaludensis* Rech. f., Iran: Rech. 56272.
70) *Dianthus crinitus* SM., subsp. *kermanensis* Rech. f., Iran: Rech. 3827.
71) *Dianthus longivaginatus* Rech. f., Iran: Rech. 42769-a.
72) *Dianthus nangarharicus* Rech. f., Afghanistan: Rech. 32455.
73) *Dianthus orientalis* Adams in Weber & Mohr, subsp. *gorganicus* Rech. f., Iran: Rech. 52444.
74) *Diaphanoptera khorasanica* Rech. f., Iran: Rech. 1515.
75) *Diaphanoptera stenocalycina* Rech. f. & Schiman-Czeika, Iran: Rech. 52881.
76) *Gypsophila bazorganica* Rech. f., Iran: W. Rechinger in Rech. 43961.
77) *Gypsophila leioclada* Rech. f., Iran: Rech. 47263.
78) *Gypsophila myaiantha* Rech. f., Afghanistan: Rech. 36812.
79) *Gypsophila mucronifolia* Rech. f., Iran: Rech. 1239.
80) *Gypsophila pseudomelampoda* Gauba & Rech. f. in Rech. f., Iran: Rech. 1055.
81) *Gypsophila wilhelminae* Rech. f., Iran: W. Rechinger in Rech. 43962.
82) *Gypsophila xanthochlora* Rech. f., Iran: Rech. 5836.
83) *Mesostemma kotschyanum* (Fenzl in Boiss.) Vved., subsp. *acrotonum* Rech. f., Afghanistan: Rech. 16831.
84) *Mesostemma kotschyanum* (Fenzl in Boiss.) Vved., subsp. afghanicum Rech. f., Afghanistan: Rech. 17751-a.
85) *Mesostemma kotschyanum* (Fenzl in Boiss.) Vved., subsp. *macrocladum* Rech. f., Afghanistan: Rech. 32009.
86) *Mesostemma perfoliatum* (Rech. f.) Rech. f., Afghanistan: Rech. 36547.
87) *Minuartia chlorosciada* Rech. f., Afghanistan: Rech. 37451.

88) *Pentastemonodiscus monochlamydeus* Rech. f., Afghanistan: Rech. 17834.
89) *Saponaria makranica* Rech. f., Pakistan: Rech. 28265.
90) *Saponaria polyphylla* Rech. f., Afghanistan: Rech. 17427.
91) *Saponaria stenopetala* Rech. f., Afghanistan: Rech. 35882.
92) *Saponaria subrosularis* Rech. f., Pakistan: Rech. 29886.
93) *Silene austro-iranica* Rech. f., Aell. & Esfand., Iran: Rech., Aell. & Esfand. 3386.
94) *Silene caroli-henrici* Meltz., Iran: Rech. 47518.
95) *Silene commelinifolia* Boiss., var. *ovatifolia* Meltz., Iran: Rech. 48535.
96) *Silene guntensis* B. Fedtsch., subsp. *pistillaris* Rech. f. & Meltz., Afghanistan: Rech. 31874.
97) *Silene salangensis* Meltz. Afghanistan: Rech. 37486.
98) *Sphaerocoma aucheri* Boiss., var. *rechingeri* Chaudhri, Pakistan: Rech. 27904.

Cheopodiaceae

99) *Anabasis lachnantha* Aell. & Rech. f., Iraq: Rech. 8159.
100) *Anthochlamys multinervis* Rech. f., Iran: Rech. 1960.
101) *Chenopodium foliosum* Aschers., subsp.*montanum* Uotila, Iran: Rech. 6046.

Compositae

102) *Achillea biebersteinii* Afan. x *A. nobilis* L. subsp. *neilreichii* (Kerner) Formanek; *A.* x *huber-morathii* Rech. f., Iran: Rech. 57025.
103) *Anthemis altissima* L.,var. *discoidea* Iranshahr, Iran: Rech. 52356.
104) *Anthemis atropatana* Iranshahr, Iran: Rech. 41648.
105) *Anthemis austro-iranica* Rech. f., Iran: Rech. 3179.
106) *Anthemis gracilis* Iranshahr, Iran: Rech. 47304.
107) *Anthemis hamrinensis* Iranshahr, Iraq: Rech. 9580.
108) *Anthemis kandaharica* Iranshahr, Afghanistan: Rech. 35302.
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. *khorassanica* (Rech. f.) Iranshahr, Iran: Rech. 1802.
113) *Atractylis arabica* Rech. f., Iraq: Rech. 9414.
114) *Carthamus curdicus* Hanelt, Iraq: Rech. 10731.
115) *Centaurea alveicola* Rech. f., Iraq: Rech. 9681.
116) *Centaurea aucheri* (DC.) Wagenitz, subsp. *indistincta* Wagenitz, Iran: Rech. 48045.
117) *Centaurea aziziana* Rech. f., Iran: Rech. 6576.
118) *Centaurea galactochroa* 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.
124) *Centaurea pterocaula* Trautv., subsp. *Iranica* Wagenitz, Iran: Rech. 14746.
125) *Cephalorrhynchus rechingerianus* Tuisl, Iraq: Rech. 10386-a.

126) *Cirsium carduchorum* Petrak, Iraq: Rech. 11330.
127) *Cirsium hygrophilum* x *obvallatum*; *C.* x *mazanderanicum* Petrak, Iran: Rech. 6294-c,
128) *Cirsium iranicum* Petrak, Iran: Rech. 14885.
129) *Cirsium iraqense* Petrak, Iraq: Rech. 11080.
130) *Cirsium swaticum* Petrak, Pakistan: Rech. 19417.
131) *Cousinia acanthophysa* Rech. f., Iraq: Rech. 10922.
132) *Cousinia actinia* Boiss., subsp *brachyphylla* Rech. f., Afghanistan: Rech. 19343.
133) *Cousinia algurdina* Rech. f., Iraq: Rech. 11465.
134) *Cousinia ammophila* Rech. f., Afghanistan: Rech. 37300.
135) *Cousinia araneotexta* Rech. f., Afghanistan: Rech. 18862.
136) *Cousinia bijarensis* Rech. f., Iran: Rech. 42478.
137) *Cousinia chaetolepis* Rech. f., Afghanistan: Rech. 19096.
138) *Cousinia crispa* x *gmelini*; *C.kamarbandensis* Rech. f., Iran: Rech. 6435.
139) *Cousinia crispa* x *sphaerocephala*; *C. hybrida* Rech. f., Iran: Rech. 6457.
140) *Cousinia decumbens* Rech. f., Iran: Rech. 6003.
141) *Cousinia esfandiarii* Rech. f. & Aell., Iran: Rech. 5426.
142) *Cousinia euchlora* Bornm. & Rech. f., Iran: Rech. 1454.
143) *Cousinia fabrorum* Rech. f., Iran: Rech. 56129.
144) *Cousinia ghorana* Rech. f., Afghanistan: Rech. 18905.
145) *Cousinia glaucopsis* Bornm. & Rech. f., Iran: Rech. 1969-a.
146) *Cousinia greuteri* Rech. f., Afghanistan: Rech. 16443.
147) *Cousinia hedgei* Rech. f., Afghanistan: Rech. 16354.
148) *Cousinia heteroloba* Rech. f., Afghanistan: Rech. 16516.
149) *Cousinia infundibularis* Rech. f., Afghanistan: Rech. 18997.
150) *Cousinia insignis* Rech. f., Afghanistan: Rech. 36810.
151) *Cousinia immitans* Rech. f., Afghanistan: Rech. 31719.
152) *Cousinia irritans* Rech. f., Iran: Rech. 5955.
153) *Cousinia kataghanica* Rech. f., Afghanistan: Rech. 37515.
154) *Cousinia kirrindica* Bornm. & Rech. f., Iran: Rech. 2136.
155) *Cousinia leptomera* Rech. f., Afghanistan: Rech. 19068.
156) *Cousinia lignosissima* Rch.f., Iran: Rech. 55857.
157) *Cousinia malacophylla* Rech. f., Afghanistan: Rech. 18794.
158) *Cousinia meshhedensis* Bornm. & Rech. f., Iran: Rech. 1567.
159) *Cousinia millefontana* Rech. f., Iran: Rech. 43052.
160) *Cousinia miserabilis* Rech. f., Afghanistan: Rech. 19009.
161) *Cousinia mutehensis* Rech. f., Iran: Rech. 46787.
162) *Cousinia nekarmanica* Rech. f., Iran: Rech. 5820.
163) *Cousinia parjumanensis* Rech. f., Afghanistan: Rech. 19027.
164) *Cousinia porphyrostephana* Rech. f., Afghanistan: Rech. 31311.
165) *Cousinia qandilica* Rech. f., Iraq: Rech. 11003.
166) *Cousinia qarehbilensis* Rech. f., Iran: Rech. 52908.
167) *Cousinia malacophylla* Rech. f., Afghanistan: Rech. 18794.
168) *Cousinia meshhedensis* Bornm. & Rech. f., Iran: Rech. 1567.
169) *Cousinia millefontana* Rech. f., Iran: Rech. 43052.
170) *Cousinia miserabilis* Rech. f., Afghanistan: Rech. 19009.
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172) *Cousinia nekarmanica* Rech. f., Iran: Rech. 5820.
173) *Cousinia parjumanensis* Rech. f., Afghanistan: Rech. 19027.
174) *Cousinia porphyrostephana* Rech. f., Afghanistan: Rech. 31311.
175) *Cousinia qandilica* Rech. f., Iraq: Rech. 11003.
176) *Cousinia qarehbilensis* Rech. f., Iran: Rech. 52908.
177) *Cousinia quettensis* Rech. f., Pakistan: Rech. 29056.
178) *Cousinia raphiostegia* Rech. f., Iran: Rech. 51741.
179) *Cousinia rechingerae* Bornm., Iran: Rech. 1927.
180) *Cousinia rhabdodes* Bornm. & Rech. f., Iran: Rech. 1951.
181) *Cousinia rudis* Rech. f., Afghanistan: Rech. 16234-b.
182) *Cousinia sabzevarensis* Rech. f., Iran: Rech. 53669.
183) *Cousinia salangensis* Rech. f., Afghanistan: Rech. 31300.
184) *Cousinia sardashtensis* Rech. f., Iran: Rech. 49113.
185) *Cousinia shahrestanica* Rech. f., Afghanistan: Rech. 36730.
186) *Cousinia shahvarica* Rech. f., Iran: Rech. 5996.
187) *Cousinia shorlughensis* Rech. f., Afghanistan: Rech. 55734, G.
188) *Cousinia singularis* Rech. f., Afghanistan: Rech. 17781.
189) *Cousinia stroterolepis* Rech. f., Iran: Rech. 43086-b.
190) *Cousinia tenuiramula* Rech. f., Iran: Rech. 47144.
191) *Cousinia trachyphyllaria* Bornm. & Rech. f., Iran: Rech. 1520.
192) *Cousinia tricolor* Rech. f., Afghanistan: Rech. 18904.
193) *Cousinia trinensis* Rech. f., Afghanistan: Rech. 35080.
194) *Cousinia wilhelminae* Rech. f., Iran: W. Rechinger in Rech. 41757.
195) *Crepis kurdica* Rech. f., Iraq: Rech. 11128.
196) *Crepis sancta* (L.) Babcock, subsp. *azerbaijanica* Rech. f., Iran: Rech. 39958.
197) *Crepis sancta* (L.) Babcock, subsp. *iranica* Rech. f., Iran: Rech. 31248.
198) *Echinops amoenus* Rech. f., Iraq: Rech. 10732.
199) *Echinops arachniolepis* Rech. f., Iran: Rech. 1420.
200) *Echinops armatus* Boiss. & Hausskn., var. *cryptadenus* Rech. f., Iraq: Rech. 9638.
201) *Echinops armatus* Boiss. & Hausskn., var. *pappilosus* Rech. f., Iraq: Rech. 9968.
202) *Echinops elbursensis* Rech. f., Iran: Rech. 6724.
203) *Echinops faucicolus* Rech. f., Iraq: Rech. 11267.
204) *Echinops ghoranus* Rech. f., Afghanistan: Rech. 19165.
205) *Echinops hololeucus* Rech. f., Afghanistan: Rech. 18833.
206) *Echinops keredjensis* Rech. f., Iran: Rech. 6686.
207) *Echinops mosulensis* Rech. f., Iraq: Rech. 11978.
208) *Echinops pachyphyllus* Rech. f., Iran: Rech. 14582.
209) *Echinops rectangularis* Rech. f., Iraq: 11276.
210) *Echinops registanicus* Rech. f., Afghanistan: Rech. 35266.
211) *Echinops sulaimani* Rech. f., Pakistan: Rech. 29994.
212) *Echinops tenuisectus* Rech. f., Iraq: Rech. 9714.
213) *Erigeron acer* L., subsp. *arctophilus* (Rech. f.) Rech. f., Iran: Rech. 6137.
214) *Erigeron acer* L., subsp. *phaeocephalus* Rech. f., Afghanistan: Rech. 18389.
215) *Erigeron anisophyllus* Rech. f., Pakistan: Rech. 19433.
216) *Erigeron cedretorum* Rech. f., Pakistan: Rech. 30653.
217) *Erigeron plesiogeron* Rech. f., Afghanistan: Rech. 32316.

218) *Heteroderis pusilla* (Boiss.) Boiss., var. *gymnocephala* Rech. f., Pakistan: Rech. 28925 pp.
219) *Hieracium kandawanicum* (Rech. f. & Zahn) Rech. f., Iran: Rech. 954-b.
220) *Jurinea kopetensis* Rech. f., Iran: Rech. 1653.
221) *Jurinea shahrestanica* Rech. f., Afghanistan: Rech. 36553.
222) *Karvandarina aphylla* Rech. f., Iran: Rech. 3964.
223) *Koelpinia chrysoglochis* Rech. f., Iraq: Rech. 8728.
224) *Launaea platyphylla* Rech. f., Afghanistan: Rech. 35281.
225) *Leontodon hispidus* L. *mazanderanicus* Rech. f., Iran: Rech., 2030.
226) *Leontodon stenocalathius* Rech. f., Iran: Rech. 6162.
227) *Pentanema nematolepis* Rech. f., Afghanistan: Rech. 34991.
228) *Pentanema prasinurum* Rech. f., Afghanistan: Rech. 17586.
229) *Phagnalon pycnophyllon* Rech. f., Pakistan: Rech. 29452.
230) *Psychrogeton aellenii* (Rech. f.) Grierson, Iran: Rech. & Aell. 5133.
231) *Psychrogeton shahrestanicus* Rech. f., Afghanistan: Rech. 36736.
232) *Picris strigosa* M.B., subsp. *kurdica* Lack, Iraq: Rech. 11280.
233) *Picris strigosa* M.B., subsp. *macrotricha* Lack, Iran: Rech. 49503.
234) *Scariola leucoclada* (Rech. f. & Tuisl) Tuisl, Afghanistan: Rech. 19074.
235) *Scleroraphis polysphaera* Rech. f., Afghanistan: Rech. 36811.
236) *Scleroraphis leptoclada* Rech. f., Iran: Rech. 56215.
237) *Scorzonera helodes* Rech. f., Iran: Rech. 47666.
238) *Scorzonera kandavanica* Rech. f., Iran: Rech. 48310.
239) *Scorzonera koelpinioides* Rech. f., Pakistan: Rech. 29829.
240) *Scorzonera longipapposa* Rech. f., Afghanistan: Rech. 35489.
241) *Scorzonera meshhedensis* (Rech. f.) Rech. f., Iran: Rech. 1504.
242) *Scorzonera microcalathia* (Rech. f.) Rech. f., Iran: Rech. 1535.
243) *Scorzonera mucida* Rech. f., Aell. & Esfand., Iran: Rech. 3052-b.
244) *Scorzonera tenax* Rech. f., Iraq: Rech. 11572.
245) *Senecio paulsenii* O. Hoffm., subsp. *khorassanicus* (Rech. f. & Aell.) B. Nord., Iran: Rech. 4439.
246) *Steptorrhamphus pumilus* (Rech. f. & Tuisl) Tuisl, Afghanistan: Rech. 17862.
247) *Tanacetum budjnurdense* (Rech. f.) Tsvel., Iran: Rech. 1880.
248) *Tanacetum salsugineum* Podl., Iran: Rech. 40536.
249) *Taraxacum azerbaijanicum* v.S. Iran: Rech. 39977.
250) *Taraxacum behzudicum* v.S., Afghanistan: Rech. 36101-a.
251) *Taraxacum hydrophilum* v.S., Iran: Rech. 51245.
252) *Taraxacum iranicum* v.S., Iran: Rech. 5061.
253) *Taraxacum kabulense* v.S., Afghanistan: Rech. 33646-a.
254) *Taraxacum kalchainum* v.S., Iran: Rech. 39227.
255) *Taraxacum neo-spurium* v.S., Iraq: Rech. 11891.
256) *Taraxacum pallidipapposum* v.S. Afghanistan: Rech. 18342.
257) *Taraxacum pseudo-calocephalum* v.S., Iran: Rech. 4811.
258) *Taraxacum pseudo-dissimile* v.S., Iran: Rech. 4328.
259) *Taraxacum pseudo-wallichii* v.S., Afghanistan: Rech. 35441.
260) *Taraxacum purpurei-petiolatum* v.S., Iran: Rech. 5086 p.p.
261) *Taraxacum rechingeri* v.S., Iran: Rech.
262) *Taraxacum ruberuliforme* v.S. Iran: Rech. 39976-a.
263) *Taraxacum spinulosum* v.S., Iran: Rech. 957-b.

264) *Tragopogon bakhtiaricus* Rech. f., Iran: Rech. 47225.
265) *Tragopogon rechingeri* Ownbey, Iraq: Rech. 11844.
266) *Tragopogon vaginatus* Ownbey & Rech. f., Iraq: Rech. 10571.

Convolvulaceae

267) *Convolvulus argyracanthus* Rech. f., Aell. & Esfand., Iran: Rech. 3228.
268) *Convolvulus oxyphyllus* Boiss., subsp. *cateniflorus* Rech. f., Iraq: Rech., 9639.

Crassulaceae

269) *Pseudosedum acutisepalum* Jansson, Afghanistan: Rech. 18874.
270) *Rosularia adenotricha* (Wall. ex Edgew.) Jansson, subsp. *linearifolia* Jansson, Afghanistan: Rech. 18551.
271) *Rosularia rechingeri* Jansson, Iraq: Rech. 11883.

Cruciferae

272) *Aethionema trinervium* (DC.) Boiss. var. *apterocarpum* (Rech. f. & Aell.) Hedge, Iran: Rech. 5063.
273) *Alyssum penjwinense* Dudley, Iraq: Rech. 10446.
274) *Alyssum polycladum* Rech. f., Iran: Rech. 6519.
275) *Arabis rimarum* Rech. f., Iran: Rech. 6469-c.
276) *Cithareloma registanicum* Rech. f., Afghanistan: Rech. 34636.
277) *Erysimum acrotonum* Polatschek & Rech.f., Afghanistan: Rech. 35199.
278) *Erysimum ghaznicum* Cullen & Rech. f., Afghanistan: Rech. 17765.
279) *Erysimum macrospermum* Cullen & Rech. f., Afghanistan: Rech. 231.
280) *Erysimum nuristanicum* Polatschek & Rech. f., Afghanistan: Rech. 32452.
281) *Erysimum salangense* Polatschek & Rech. f., Afghanistan: Rech. 31733.
282) *Fibigia compacta* Rech. f., Afghanistan: Rech. 37400.
283) *Graellsia integrifolia* (Rech. f.) Rech. f., Iran: Rech. 1710.
284) *Isatis pachycarpa* Rech. f., Aell. & Esfand., Iran: Rech. 3789-a.
285) *Koeiea altimurana* Rech. f. Afghanistan: Rech. 31845.
286) *Koeiea flexuosa* Rech. f., Afghanistan: Rech. 18027.
287) *Koeiea ghorana* Rech. f., Afghanistan: Rech. 18866.
288) *Matthiola ghorana* Rech. f., Afghanistan: Rech. 19054.
289) *Matthiola graminea* Rech. f., Afghanistan: Rech. 17518.
290) *Matthiola macranica* Rech. f., Pakistan: Rech. 30111.
291) *Matthiola tenera* Rech. f., Afghanistan: Rech. 31972.
292) *Sisymbrium gaubae* Rech. f. & Bornm., Iran: Rech. (syntypi) 304, 1176.
293) *Sisymbrium integerrimum* Rech. f. & Aell., Iran: Rech. 4521.
294) *Sterigmostemum rhodanthum* Rech. f., Aell. & Esfand., Iran: Rech. 3140.

Dipsacaceae

295) *Pterocephalus gedrosiacus* Rech. f., Aell. & Esfand., Iran: Rech. 4225.
296) *Scabiosa deserticola* Rech. f., Iraq: Rech. 12806.
297) *Scabiosa leucactis* Patzak, Iraq: Rech. 9691.

Euphorbiaceae

298) Andrachne merxmülleri Rech. f., Iran: Rech. 47405.
299) *Euphorbia aellenii* Rech. f., Iran: Rech. 4759.
300) *Euphorbia gedrosiaca* Rech. f., Iran: Rech. 4074.
301) *Euphorbia gypsicola* Rech. f. & Aell., Iran: Rech. 2791.
302) *Euphorbia megalocarpa* Rech. f., Afghanistan: Rech. 19069.
303) *Euphorbia multifurcata* Rech. f., Aell. & Esfand. Iran: Rech. 4220.

Frankeniaceae

304) *Frankenia bucharica* Basil., subsp. *kabulensis* Chrtek, Afghanistan: Rech. 16888.

Fumariaceae

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

306) *Cryotocapnos chasmophyticus* Rech. f., Afghanistan: Rech. 35122.

Geraniaceae

307) *Geranium swatense* Schönbeck-Temesy, Pakistan: Rech. 19566.

Hippocastanaceae

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

Labiatae

309) *Ajuga zachoënsis* Rech. f., Iraq: Rech. 10747.

310) *Cyclotrichium longiflorum* Leblebici, Iraq: Rech. 10764.

311) *Ballota platyloma* Rech. f., Iran: Rech. 6634.

312) *Dracocephalum surmandicum* Rech. f., Iran: Rech. 47516.

313) *Eremostachys azerbaijanica* Rech. f., Iran: Rech. 40785.

314) *Eremostachys ghorana* Rech. f., Afghanistan: Rech. 19079.

315) *Hymenocrater platystegius* Rech. f., Iran: Rech. 1412.

316) *Hymenocrater altimuranus* Rech. f., Afghanistan: Rech. 31839.

317) *Mentha longifolia* (L.) Hudson, var. *austro-afghanica* Rech. f. Afghanistan: Rech. 19158.

318) *Mentha longifolia* (L.) Hudson, var. *chlorodictya* Rech. f., Iran: Rech. 5586.

319) *Nepeta eremokosmos* Rech. f., Iran: Rech. 1233.

320) *Nepeta griffithii* Hedge, Afghanistan: Rech. 30467.

321) *Nepeta juncea* Benth. in DC., subsp. *ghorana* Rech. f., Afghanistan: Rech. 19162.

322) *Nepeta nawarica* Rech. f., Afghanistan: Rech. 37385.

323) *Nepeta polyodonta* Rech. f., Afghanistan: Rech. 37145.

324) *Nepeta praetervisa* Rech. f., Afghanistan: Rech. 16922.

325) *Nepeta rechingeri* Hedge, Afghanistan: Rech. 16636

326) *Nepeta subincisa* Benth. in DC., var. *salangensis* Rech. f., Afghanistan: Rech. 37084.

327) *Nepeta uberrima* Rech. f., Afghanistan: Rech. 31563.

328) *Phlomis polioxantha* Rech. f., Iraq: Rech. 9649.

329) *Salvia chloroleuca* Rech. f. & Aell., Iran: Rech. & Aell. 4771.

330) *Salvia rechingeri* Hedge, Afghanistan: Rech. 18915.

331) *Satureja metastasiantha* Rech. f., Iraq: Rech. 11142.

332) *Scutellaria bornmuelleri* Hausskn. ex Bornm. subsp. *mianensis* Rech. f., Iran: Rech. 42258.

333) *Scutellaria edelbergii* Rech. f., subsp. *squarrosissima* Rech. f., Afghanistan: Rech. 19308.

334) *Scutellaria ghorana* Hedge, Afghanistan: Rech. 19022.

335) *Scutellaria kotkaiensis* Rech. f., Afghanistan: Rech. 32265.

336) *Scutellaria porphyrantha* Rech. f., Iraq: Rech. 12105.

337) *Scutellaria theobromina* Rech. f., Iran: Rech. 42000.
338) *Stachys inflata* x *turcomanica*; x *St. paraplesia* Rech. f., Iran: Rech. 5456-b.
339) *Stachys nephrophylla* Rech. f., Iraq: Rech. 11250.
340) *Stachys setifera* C.A. May., subsp. *iranica* (Rech. f.) Rech. f., Iran: Rech. 6262.
341) *Teucrium chasmophyticum* Rech. f., Iraq: Rech. 12083.
342) *Teucrium stocksianum* Boiss., subsp. *patulum* (Hedge & Lamond) Rech. f., Pakistan: Rech. 29476.
343) *Thymbra neurophylla* Rech. f., Iraq: Rech. 10017.
344) *Thymus linearis* Benth., subsp. *hedgei* Jalas, Pakistan: Rech. 29370.
345) *Ziziphora clinopodioides* Lam., subsp. *elbursensis* (Rech. f.) Rech. f., Iran: Rech. 6525-b.
346) *Ziziphora clinopodioides* Lam., subsp. *filicaulis* (Rech. f.) Rech. f., Iran: Rech. 6014.
347) *Ziziphora clinopodioides* Lam., subsp. *pseudodasyantha* (Rech. f.) Rech. f., Iran: Rech. 1425.

Malvaceae

348) *Alcea afghanica* I. Riedl, Afghanistan: Rech. 31457.
349) *Alcea crassicaulis* I. Riedl, Iran: Rech. 42352.
350) *Alcea gorganica* (Rech. f., Aell. & Esfand.) Zohary, Iran: Rech. 5547.
351) *Alcea laxiflora* I. Riedl, Iran: Rech. 32616.
352) *Alcea lineariloba* I. Riedl, Iran: Rech. 32585.
353) *Alcea macrocarpa* I. Riedl, Iraq: Rech. 11051.
354) *Alcea mosulensis* I. Riedl, Iraq: Rech. 10620.
355) *Alcea rechingeri* (Zohary) I. Riedl, Iraq: Rech. 12334.
356) *Alcea scabridula* I. Riedl, Iran: Rech. 42215.
357) *Alcea wilhelminae* I. Riedl, Iran: Rech. 41764.
358) *Alcea xanthochlora* I. Riedl, Iran: Rech. 43659.
359) *Sida quettensis* I. Riedl, Pakistan: Rech. 29481.

Onagraceae

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

Papaveraceae:

361) *Papaver gaubae* Cullen & Rech. f., Iran: Rech. 712-a.

Papilionaceae

362) *Argyrolobium pulvinatum* Rech. f., Pakistan: Rech. 27934-a.
363) *Astragalus alienus* Podlech, Iran: Rech. 47846.
364) *Astragalus altimurensis* I. Deml, Afghanistan: Rech. 31888.
365) *Astragalus antheliophorus* I. Deml, Afghanistan: Rech. 37288-a.
366) *Astragalus aspreticola* Podlech, Iran: Rech. 51096.
367) *Astragalus baba-allüar* Parsa, subsp. *nudicarpus* (Širj. & Rech. f.) Tietz, Iran: Rech. 5669.
368) *Astragalus caroli-henrici* I. Deml, Afghanistan: Rech. 18890.
369) *Astragalus chehreganii* Zarre & Podlech, Iran: Rech. 41877.
370) *Astragalus coronilla* Bunge, subsp. *semnanicus* Gazer & Podlech, Iran: Rech. 50981.
371) *Astragalus cystosus* Zarre & Podlech, Iran: Rech. 53642.
372) *Astragalus discernendus* Širj. & Rech. f., subsp. *polyneurus* (I. Deml) Podlech, Afghanistan: Rech. 35622.

373) *Astragalus endytanthus* Podlech & I. Deml, Afghanistan: Rech. 36947.
374) *Astragalus eremophilus* Boiss., subsp. *makranicus* Podlech, Pakistan: Rech. 28000.
375) *Astragalus franziskae* I. Deml, Afghanistan: Rech. 17588.
376) *Astragalus ghashghaicus* Tietz & Zarre, Iran: Rech. 47424.
377) *Astragalus khoshjailensis* Širj. & Rech. f., Iran: Rech. f., Aell. & Esfand. 5434.
378) *Astragalus kukkonenii* Podlech, Afghanistan: Rech. 18279.
379) *Astragalus leotus* Boiss., subsp. *ghazniensis* I. Deml, Afghanistan: Rech. 17336.
380) *Astragalus naftabensis* Širj. & Rech. f., Iran: Rech. 6465.
381) *Astragalus orthocarpoides* Širj. & Rech. f., Iran: Rech. f. & Aell. 4731.
382) *Astragalus parwanicus* Podlech & I. Deml, Afghanistan: Rech. 31336.
383) *Astragalus perdurans* Podlech, Iran: Rech. 6042.
384) *Astragalus pseudobrachystachys* Širj. & Rech. f., Iran: Rech. f., Aell. & Esfand. 3138.
385) *Astragalus pseudoindurascens* Širj. & Rech. f., Iran: Rech. f. & Aell. 4610.
386) *Astragalus pseudokurramensis* Širj. & Rech. f., Iran: Rech. f. & Aell. 5094-c.
387) *Astragalus pseudomultijugus* Podlech, Iran: Rech. 41956.
388) *Astragalus psilacanthus* Boiss., subsp. *pseudopsilocentros* I. Deml, Pakistan: Rech. 29764.
389) *Astragalus qoturensis* Podlech, Iran: W. Rechinger & Renz in Rech. f. 49644.
390) *Astragalus registanicus* Rech. F., Afghanistan: Rech. 35343.
391) *Astragalus rubrolineatus* Širj. & Rech. f., Iran: Rech. 6004.
392) *Astragalus saetiger* Becht, Iran: Rech. 48421.
393) *Astragalus semnanensis* Bornm. & Rech. f., Iran: Rech. 1249.
394) *Astragalus sharestanicus* Podlech & I. Delm, Afghanistan: Rech. 36764.
395) *Astragalus shatuensis* Podlech, Afghanistan: Rech. 36282.
396) *Astragalus subrosulariformis* Širj. & Rech. f., Iran: Rech. f. & Aell., 5096.
397) *Astragalus tawilicus* C.C. Townsend, Iraq: Rech. 12369, W (isotypus)
398) *Astragalus wilhelminae* I. Deml, Afghanistan: W. Rechinger in Rech. 37332.
399) *Hedysarum damghanicum* Rech. f., Iran: Rech. 55375 (fl.) et 56498 (fruct.).
400) *Lotus compactus* Chrtková-Žertová, Pakistan: Rech. 27975.
401) *Lotus corniculatus* L., subsp. *fruticosus* Chrtková-Žertová, Afghanistan: Rech. 19047.
402) *Lotus gebelia* Vent., var.*lanatus* Chrtková-Žertová, Iraq: Rech. 12342.
403) *Lotus laricus* Rech. f., Aell. & Esfand. Iran: Rech. 3327.
404) *Lotus michauxianus* Sér. in DC., var. *glabratus* Chrtková-Žertová, Iran: Rech. 110.
405) *Medicago makranica* C.C. Heyn, Pakistan: Rech. 27934-b.
406) *Onobrychis afghanica* Širj. & Rech. f., subsp. *brachycalyx* Rech. f. Afghanistan: Rech. 37190.
407) *Onobrychis amoena* M. Pop. & Vved., subsp. *meshhedensis* Širj. & Rech. f., Iran: Rech. 1575.
408) *Onobrychis cornuta* (L.) Desv. subsp. *leptacantha* Rech. f., Afghanistan: Rech. 32365 (fl.); 32331 (fruct.).
409) *Onobrychis kermanensis* (Širj. & Rech. f.) Rech. f., Iran: Rech. 3180.

410) *Onobrychis laxiflora* Baker, subsp. *kabulica* Rech. f., Afghanistan: Rech. 31132.
411) *Onobrychis laxiflora* Baker, subsp. *macrodonta* Rech. f., Pakistan: Rech. 28988.
412) *Onobrychis laxiflora* Baker, subsp. *shahrestanica* Rech. f., Afghanistan: Rech. 36784.
413) *Onobrychis luristanica* Rech. f., Iran: Rech. 48136.
414) *Onobrychis mazanderanica* Rech. f., Iran: Rech. 52383.
415) *Onobrychis ptychophylla* Širj. & Rech. f., Iran: Rech. 1717.
416) *Onobrychis samanganica* Rech. f., Afghanistan: Rech. 16484.
417) *Oxytropis admiranda* Vassilcz., Afghanistan: Rech. 35492.
418) *Oxytropis bicornis* Vassilcz., Iran: Rech. 53020.
419) *Oxytropis saperlebulensis* Vassilcz., Afghanistan: W. Rechinger in Rech. f. 37323-b.
420) *Oxytropis sata-kandaonensis* Vassilcz., Afghanistan: Rech. 32127a.
421) *Oxytropis vavilovii* Vassilcz., Afghanistan: Rech. 32225.
422) *Tephrosia rechingeri* Ali, Pakistan: Rech. 29465.
423) *Trifolium mazanderanicum* Rech. f., Iran: Rech. 2031.
424) *Trigonella ionantha* Rech. f., Afghanistan: Rech. 37376.
425) *Trigonella pycnotricha* Rech. f., Afghanistan: Rech. 17425.
426) *Trigonella subenervis* Rech. f., Iran: Rech. 53660.
427) *Vicia rechingeri* Chrtková-Žertová, Iran: Rech. 41710.

Parnassiaceae

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

Plumbaginaceae

429) *Acantholimon acanthobryum* Rech. f. & Schiman-Czeika, Afghanistan: Rech. 37398.
430) *Acantholimon ahangarense* Rech. f. & Schiman-Czeika, Afghanistan: Rech. 18884.
431) *Acantholimon austro-iranicum* Rech. f. & Schiman-Czeika, Iran: Rech. 3502.
432) *Acantholimon carinatum* Rech. f. & Schiman-Czeika, Afghanistan: Rech. 19063.
433) *Acantholimon catenatum* Rech. f. & Schiman-Czeika, Afghanistan: Rech. 18910.
434) *Acantholimon cephalotoides* Rech. f. & Schiman-Czeika, Iran: Rech. 1952.
435) *Acantholimon chlorostegium* Rech. f., Iran: Rech. 3877.
436) *Acantholimon ghoranum* Rech. f. & Schiman-Czeika, Afghanistan: Rech. 18886.
437) *Acantholimon homophyllum* Rech. f. & Schiman-Czeika, Afghanistan: Rech. 37330.
438) *Acantholimon kutschanense* Rech. f., Iran: Rech. 1646.
439) *Acantholimon leucochlorum* Rech. f. & Schiman-Czeika, Afghanistan: Rech. 17689.
440) *Acantholimon nawaricum* Rech. f. & Schiman-Czeika, Afghanistan: Rech. 37405.
441) *Acantholimon ophiocladum* Rech. f., Iran: Rech. 6736.

442) *Acantholimon poliochlorum* Rech. f. & Schiman-Czeika, Afghanistan: Rech. 18240.
443) *Acantholimon schizostegium* Rech. f. & Schiman-Czeika, Afghanistan: Rech. 19028.
444) *Acantholimon sorchense* Rech. f., Iran: Rech. 1971.
445) *Acantholimon spinicalyx* Koeie & Rech. f., Iran: Rech. 4370.
446) *Acantholimon stereophyllum* Rech. f. & Schiman-Czeika, Afghanistan: Rech. 18909.
447) *Acantholimon subsimile* Rech. f. & Schiman-Czeika, Afghanistan: Rech. 18453.
448) *Acantholimon wilhelminae* Rech. f. & Schiman-Czeika, Iran: W. Rech. in Rech. 44000.
449) *Cephalorrhizum pachycormum* Rech. f., Afghanistan: Rech. 16640.

Polygonaceae

450) *Calligonum laristanicum* Rech. f. & Schiman-Czeika, Iran: Rech. 3423.
451) *Calligonum schizopterum* Rech. f. & Schiman-Czeika, Iran: Rech. 3918.
452) *Polygonum breviarticulatum* Rech. f., Afghanistan: Rech. 34831.
453) *Polygonum hyrcanicum* Rech. f., Iran: Rech. 1892.
454) *Polygonum olivascens* Rech. f. & Schiman-Czeika, Iran: Rech. 3159.
455) *Polygonum sarobiense* Rech. f., Afghanistan: Rech. 34474.
456) *Rheum platylobum* Rech. f., Afghanistan: Rech. 33877.
457) *Rumex acetosa* L. subsp. *turcomanica* (Rech. f.) Rech. f., Iran: Rech. 1733.
458) *Rumex kandavanicus* (Rech. f.) Rech. f., Iran: Rech. 2099.

Primulaceae

459) *Dionysia balsamea* Wendelbo & Rech. f., Afghanistan: Rech. 19094.
460) *Dionysia saponacea* Wendelbo & Rech. f., Afghanistan: Rech. 19092.

Ranunculaceae

461) *Aquilegia gracillima* Rech. f., Afghanistan: Rech. 17579.
462) *Aquilegia microcentra* Rech. f., Afghanistan: Rech. 36677.
463) *Consolida kandaharica* Iranshahr, Afghanistan: Rech. 34869.
464) *Delphinium bulbilliferum* Rech. f., Afghanistan: Rech. 36670.
465) *Delphinium elbursense* Rech. f., var. *elbursense*, Iran: Rech. 6093-a.
466) *Delphinium elbursense* Rech. f., var. *gymnobotrys* Rech. f., Iran: Rech. 6093-b.
467) *Delphinium ursinum* Rech. f., Iran: Rech. 6083.
468) *Delphinium wilhelminae* Iranshahr, Pakistan: Rech. 30576.
469) *Paraquilegia altimurana* Rech. f., Afghanistan: Rech. 31857.
470) *Ranunculus orozganicus* Iranshahr & Rech. f., Afghanistan: Rech. 35238.
471) *Ranunculus papyrocarpus* Rech. f., Iran: Rech. 3759.
472) *Ranunculus renzii* Iranshahr & Rech. f., Iran: W. Rechinger & J. Renz in Rech. f.

Resedaceae

473) *Reseda aucheri* Boiss. subsp. *afghanica* Rech. f., Afghanistan: Rech. 31705.
474) *Reseda aucheri* Boiss. subsp. *rechingeri* (Abdallah & De Wit) Rech. f. Afghanistan: Rech. 35524.

Rhamnaceae

475) *Rhamnus pallasii* Fisch. & C.A. Mey., subsp. *sintenisii* (Rech. f.) Browicz & Zielinski, Iran: Rech. 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 jugata* Browicz, Afghanistan: Rech. 19081.
481) *Amygdalus x keredjensis* Browicz, Iran: Rech. 803.
482) *Cerasus rechingeri* Browicz, Pakistan: Rech. 29365.
483) *Cotoneaster rechingeri* Klotz, Pakistan: Rech. 29879.
484) *Crataegus melanocarpa* M.B., subsp. *elbursensis* (Rech. f.) H. Riedl, Iran: Rech. 2007.
485) *Potentilla iranica* (Rech. f.) Schiman-Czeica, Iran: Rech. 1135.
486) *Rosa freitagii* J. Zielinski, Afghanistan: Rech. 35035.
487) *Rubus anatolicus* x *ochthodes*; *R. lahidjanensis* Rech. f., Iran: Rech. 59.
488) *Sorbus orientalis* Schönbeck-Temesy, Iran: Rech. 6647.

Rubiaceae

489) *Asperula comosa* Schönb.-Tem., Iraq: Rech. 10890.
490) *Asperula glomerata* (M.B.) Griseb., subsp. *afghanica* Ehrend. & Schönb.-Tem., Afghanistan: Rech. 18235.
491) *Asperula inopinata* Schönb.-Tem., Iraq: Rech. 10981.
492) *Asperula mazanderanica* Ehrend., Iran: Rech. 1973.
493) *Asperula rechingeri* Ehrend. & Schönb.-Tem., Iran: Rech. 47337.
494) *Crucianella demavendensis* Ehrend. & Schönb.-Tem., subsp. *damghanensis* Ehrend. & Schönb.-Tem., Iran: Rech. 1185.
495) *Galium anguineum* Ehrend. & Schönb.-Tem., Iran: Rech. 5699.
496) *Galium azerbayjanicum* Ehrend. & Schönb.-Tem., Iran: Rech. 41858.
497) *Galium decumbens* (Ehrend.) Ehrend. & Schönb.-Tem., Iran: Rech. 5983.
498) *Galium problematicum* (Ehrend.) Ehrend. & Schönb.-Tem., Iran: Rech. 583.
499) *Rubia rechingeri* Ehrend., Iran: Rech. 1711.

Saxifragaceae

500) *Saxifraga mazanderanica* Rech. f., Iran: Rech6323.

Scrophulariaceae

501) *Pedicularis rechingeri* Wendelbo, Iran: Rech. 1702.
502) *Scrophularia azerbaijanica* Grau, Iran: Rech. 41450.
503) *Scrophularia elegantissima* Rech. f. & Wendelbo, Afghanistan: Rech. 17424.
504) *Scrophularia flava* Grau, Iran: Rech. 47605.
505) *Scrophularia gorganica* Rech. f., Iran: Rech. 6133.
506) *Scrophularia horizontalis* Rech. f., Afghanistan: Rech. 36781.
507) *Scrophularia kurdica* Eig, subsp. *glabra* Grau, Iran: Rech. 48719.
508) *Scrophularia rechingeri* Grau, Iran: Rech. 42238.
509) *Scrophularia singularis* Rech. f., Afghanistan: Rech. 33936.
510) *Scrophularia valida* Grau, Iran: Rech. 51216.
511) *Veronica rubrifolia* Boiss., subsp. *respectatissima* M.A. Fischer, Iran: Rech. 47340.
512) *Veronica avromanica* M.A. Fischer, Iraq: Rech. 10334.
513) *Veronica anagalloides* Guss., subsp*heureka* M.A. Fischer, Iraq: Rech. 10290.

Solanaceae

514) *Hyoscyamus nutans* Schönbeck-Temesy, Iran: Rech. 27200.
515) *Lycium makranicum* Schönbeck-Temesy, Pakistan: Rech. 27792.
516) *Solanum carmanicum* Schönbeck-Temesy, Iran: Rech. 3630.

Umelliferae

517) *Bupleurum kabulicum* Rech. f., Afghanistan: Rech. 31100.
518) *Calyptrosciadium polycladum* Rech. f. & Kuber, subsp. *bamianicum* Leute, Afghanistan: Rech. 37000.
519) *Calyptrosciadium polycladum* Rech. f. & Kuber, subsp. *polycladum*, Afghanistan: Rech. 19253.
520) *Daucus littoralis* Smith in Sibth. & Smith, subsp *hyrcanicus* Rech. f., Iran: Rech. 2090.
521) *Eryngium rechingeri* Tamamsch. & Pimen., Afghanistan: Rech. 36816.
522) *Ferula dictyocarpa* Rech. f., Afghanistan: Rech. 16366.
523) *Ferula flabelliloba* Rech. f. & Aell., Iran: Rech. f. & Aell. 4661.
524) *Ferula ghorana* Rech. f., Afghanistan: Rech. 19040.
525) *Ferula kashanica* Rech. f., Iran: Rech. 46849.
526) *Ferula latisecta* Rech. f. & Aell., Iran: Rech. 4988.
527) *Ferula pachycaulos* Rech. f., Afghanistan: Rech. 16490.
528) *Ferula rechingeri* Chamberlain, Afghanistan: Rech. 33946.
529) *Ferula serpentinica* Rech. f., Iran: Rech. 5894.
530) *Ferula trachelocarpa* Rech. f., Afghanistan: Rech. 18891.
531) *Ferula xanthocarpa* Rech. f., Afghanistan: Rech. 19107.
532) *Ferula xylorhachis* Rech. f., Iran: Rech. 1529.
533) *Ferulago phialocarpa* Rech. f. & H. Riedl, Iran: Rech. 14758.
534) *Ferulago subvelutina* Rech. f., Iran: Rech. 1919.
535) *Heracleum gorganicum* Rech. f., Iran: Rech. 6142.
536) *Heracleum rechingeri* Manden., Iran: Rech. 43416.
537) *Johreniopsis oligactis* (Rech. f. & H. Riedl) M. Pimen., Iran: Rech. 14692.
538) *Johreniopsis stricticaulis* (Rech. f.) M. Pimen., Iran: Rech. 1749.
539) *Kandaharia rechingerorum* Alava, Afghanistan: Rech. 34803.
540) *Leutea nematoloba* (Rech. f.) M. Pimen., Iran: Rech. 6668.
541) *Leutea rechingeri* (Leute) M. Pimen., Iraq: Rech. 11345.
542) *Lomatopodium staurophyllum* (Rech. f.) Rech. f., Iran: Rech. 1510.
543) *Malabaila isfahanica* Alava, Iran: Rech. 46721.
544) *Mastigosciadium hysteranthum* Rech. f. & Kuber, Afghanistan: Rech. 19051.
545) *Pimpinella anisactis* Rech. f., Iran: Rech. 1714.
546) *Pimpinella brachyclada* Rech. f. & H. Riedl, Iraq: Rech. 11247.
547) *Prangos calligonoides* Rech. f., Iran: Rech. 5758.
548) *Pimpinella kurdica* Rech. f. & H. Riedl, Iraq: Rech. 12100.
549) *Pimpinella nephrophylla* Rech. f. & H. Riedl, Iraq: Rech. 10737-a.
550) *Pimpinella ternata* Rech. f., Afghanistan: Rech. 35258.
551) *Prangos serpentinica* (Rech. f., Aell. & Esfand.) Herrnstadt & Heyn, Iran: Rech. f., Aell. & Esfand. 4396.
552) *Psammogeton registanicus* Rech. f., Afghanistan: Rech. 34663-b.
553) *Psammogeton ternatus* (Rech. f.) Engstrand, Afghanistan: Rech. 35258.
554) *Pycnocycla acanthorhipsis* Rech. f., Aell. & Esfand., Iran: Rech. f., Aell. & Esfand., 4038, W, E, IRAN.

555) *Pycnocycla aucheriana* Decne. ex Boiss., var. *mesomorpha* (Rech. f., Aell. & Esfand.) Hedge & Lamond, Iran: Rech. f., Aell. & Esfand., 3921.
556) *Peucedanum translucens* Rech. f., Iran: Rech. 6154-c.
557) *Registaniella hapaxlegomena* Rech. f. Afghanistan: Rech. 35329.
558) *Scaligeria gongylotaxis* Rech. f., Afghanistan: Rech. 18799.
559) *Semenovia subscaposa* (Rech. f.) Alava, Iran: Rech. 6060.
560) *Trachydium vesiculoso-alatum* Rech. f., Iran: Rech. 1495.

Urticaceae

561) *Parietaria rechingeri* Chrtek, Iraq: Rech. 12091.
562) *Urtica dioica* L. subsp. *kurdistanica* Chrtek, Iran: Rech. 43026.

Vitaceae

563) *Vitis hissarica* Vassilcz., subsp. *rechingeri* Vassilcz. Iraq: Rech. 11893.

Zygophyllaceae

564) *Fagonia bruguieri* DC., var. *Rechingeri* Hadidi, Iran: Rech. 3387.
565) *Fagonia olivieri* DC., var. *glandulosa* Hadidi, Iraq: Rech. 8806.
566) *Fagonia ovalifolia* Hadidi, Afghanistan: Rech. 34638 (holotypus)=Rech. 34659 (isotypus).

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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.

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

Introduction

The University Prof. Dr. Karl Heinz Rechinger wan born a century ago on

Oct. 16th, 1906 and died on Dec. 30th, 1998 (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 1989) 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; EISELT 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 Festschrifts 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.

contributions 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 & FÖRTHER 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. Zarre (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

(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.

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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 tabulae 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.= Number of endemic species; End. Ir.= Number of endemic species in Iran; Page= Number of text pages; BWT= Number of black and white tabulae (line drawing tables in the text are also added); COT= Number of colour tabulae (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. The number of subspecific taxa is not included in this table

Family	Gen.	Gen. Ir.	Spec.	Spec. Ir.	End.	End. Ir.	Page	BWT	COT	Year
1.*Araceae	6	4	21	11	2	2	8	2	-	1963
2.*Convolvulaceae	5	3	62	44	26	15	24	4	-	1963
3.*Ephedraceae	1	1	10	8	5	1	8	-	-	1963
4.*Tamaricaceae	3	3	48	38	21	7	17	8	-	1964
5.*Orobanchaceae	3	3	55	45	10	4	25	8	-	1964
6.*Euphorbiaceae	6	5	115	79	41	20	48	20	-	1964
7.Onagraceae	4	4	33	22	2	-	19	8	-	1964
8. Cuscutaceae	1	1	24	16	5	1	16	4	-	1964
9. Primulaceae	9	8	63	36	35	17	37	8	4(6)	1965
10. Caprifoliaceae	4	3	26	8	2	-	16	4	-	1965
11. Ericaceae	2	1	3	1	2	-	2	-	-	1965

Table 1 (contd.)

12. Taxaceae	1	1	2	2	-	-	2	-	-	1965
13. Campanulaceae	8	6	82	56	28	16	51	12	-	1965
14. Pinaceae	4	1	11	2	-	-	9	4	-	1965
15. Plantaginaceae	1	1	28	22	5	1	23	4	-	1965
16. Elatinaceae	1	1	4	1	-	-	2	-	-	1966
17. Globulariaceae	1	1	2	1	-	-	2	-	-	1966
18. Haloragaceae	1	1	2	2	-	-	1	-	-	1966
19. Hydrangeaceae	2	-	2	-	-	-	2	-	-	1966
20. Parnassiaceae	1	1	3	2	1	-	4	-	-	1966
21. Platanaceae	1	1	1	1	-	-	2	-	-	1966
22. Punicaceae	1	1	1	1	-	-	2	-	-	1966
23. Vahliaceae	1	-	2	-	-	-	2	-	-	1966
24. Acanthaceae	11	2	15	2	-	-	9	-	-	1966
25. Aquifoliaceae	1	1	1	1	1	1	1	-	-	1966
26. Aristolochiaceae	1	1	4	3	2	2	3	-	-	1966
27. Buxaceae	1	1	3	1	-	-	2	-	-	1966
28. Ceratophyllaceae	1	1	1	1	-	-	1	-	-	1966
29. Datiscaceae	1	1	1	1	-	-	1	-	-	1966

Table 1 (contd.)

30. Ebenaceae	1	1	1	1	-	-	1	-	-	1966
31. Hippuridaceae	1	1	1	1	-	-	1	-	-	1966
32. Myrtaceae	1	1	1	1	-	-	1	-	-	1966
33. Nymphaeaceae	3	3	3	3	-	-	2	-	-	1966
34. Papaveraceae	7	5	48	40	13	4	27	8	-	1966
35. Phytolaccaceae	1	1	1	1	-	-	1	-	-	1966
36. Rutaceae	2	2	27	20	11	8	21	8	-	1966
37. Salvadoraceae	1	1	1	1	-	-	2	-	-	1966
38. Sapindaceae	1	1	1	1	-	-	2	-	-	1966
39. Theligonaceae	1	1	1	1	-	-	1	-	-	1966
40. Oxalidaceae	1	1	2	1	-	-	2	-	-	1967
41. Gentianaceae	9	4	44	20	6	-	28	4	-	1967
42. Saxifragaceae	2	1	24	11	4	4	17	4	-	1967
43. Verbenaceae	7	3	12	5	-	-	8	-	-	1967
44. Bignoniaceae	2	1	3	1	-	-	3	-	-	1967
45. Loganiaceae	1	-	1	-	-	-	1	-	-	1967
46. Cistaceae	3	3	9	8	-	-	8	-	-	1967
47. Grossulariaceae	1	1	10	4	1	1	9	-	-	1967

Table 1 (contd.)

48. Boraginaceae	47	37	368	223	166	79	281	44	4(8)	1967
49. Guttiferae	1	1	21	16	2	1	20	-	-	1968
50. Cupressaceae	3	3	10	7	-	-	20	-	-	1968
51. Lythraceae	5	4	17	13	1	-	9	-	-	1968
52. Oleaceae	5	5	17	9	1	-	11	-	-	1968
53. Hamamelidaceae	2	1	2	1	1	1	3	-	-	1968
54. Cornaceae	1	1	4	3	-	-	3	-	-	1968
55. Elaeagnaceae	2	2	3	2	-	-	3	-	-	1968
56. Polygonaceae	9	8	119	78	34	16	88	8	-	1968
57. Cruciferae	126	103	472	315	121	68	372	50	-	1968
58. Lentibulariaceae	1	1	4	1	-	-	3	-	-	1969
59. Sparganiaceae	1	1	3	2	-	-	4	-	-	1969
60. Paeoniaceae	1	1	3	1	-	-	6	-	-	1969
61. Aceraceae	1	1	10	6	-	-	11	8	-	1969
62. Valerianaceae	3	2	32	29	-	-	23	10	-	1969
63. Anacardiaceae	3	3	7	5	-	-	9	8	-	1969
64. Celasteraceae	3	2	7	4	-	-	5	-	-	1969
65. Salicaceae	2	2	39	17	1	-	45	-	-	1969

Table 1 (contd.)

66. Rosaceae	31	26	244	145	54	35	217	60	-	1969
67. Amaryllidaceae	6	6	10	8	1	1	8	-	-	1970
68. Capparidaceae	5	3	31	19	4	1	32	4	-	1970
69. Geraniaceae	5	5	55	39	3	1	67	8	-	1970
70.*Gramineae	151	108	764	367	47	11	573	72	-	1970
71. Typhaceae	1	1	11	7	1	-	8	4	-	1970
72. Crassulaceae	6	6	46	29	11	6	32	8	-	1970
73. Asclepiadaceae	13	10	26	16	3	-	21	8	-	1970
74. Vitaceae	2	2	6	2	1	-	5	4	-	1970
75. Juncaceae	2	2	31	22	1	-	35	4	-	1971
76. Alliaceae	2	2	141	75	67	27	100	24	4(16)	1971
77. Fagaceae	2	2	11	8	1	-	20	12	-	1971
78. Alismataceae	3	3	6	5	-	-	5	4	-	1971
79. Butomaceae	1	1	1	1	-	-	1	-	-	1971
80. Hydrocharitaceae	5	4	5	4	-	-	4	-	-	1971
81. Zosteraceae	5	4	5	4	-	-	4	-	-	1971
82. Juncaginaceae	1	1	2	2	-	-	3	-	-	1971
83. Potamogetonaceae	2	2	13	10	-	-	9	4	-	1971

Table 1 (contd.)

84. Ruppiaceae	1	1	1	1	-	-	1	-	-	1971
85. Zannichelliaceae	4	4	4	4	-	-	4	-	-	1971
86. Najadaceae	1	1	3	3	-	-	2	-	-	1971
87. Staphyleaceae	1	-	1	-	-	-	2	-	-	1971
88. Sphenocleaceae	1	1	1	1	-	-	1	-	-	1971
89. Eriocaulaceae	1	-	1	-	-	-	1	-	-	1971
90.*Compositae-Cynareae I *Cousinia*	1	1	374	208	325	169	329	176	8(16)	1972
91. Amaranthaceae	7	4	17	12	-	-	19	8	-	1972
92. Hippocastanaceae	1	-	1	-	-	-	2	-	-	1972
93. Pyrolaceae	1	-	2	-	-	-	3	2	-	1972
94. Monotropaceae	1	1	1	1	-	-	2	-	-	1972
95. Thymelaeaceae	6	5	13	11	3	2	17	4	-	1972
96. Betulaceae	2	2	9	3	3	-	9	8	-	1972
97. Corylaceae	2	2	5	4	-	-	6	4	-	1972
98. Zygophyllaceae	8	7	31	24	1	-	32	32	-	1972
99. Frankeniaceae	2	2	4	3	1	1	6	-	-	1972
100. Solanaceae	10	9	62	44	11	8	82	20	-	1972

Table 1 (contd.)

101. Podophyllaceae	5	3	7	4	1	-	11	4	-	1973
102. Araliaceae	2	1	4	2	-	-	5	4	-	1973
103. Apocynaceae	4	4	6	5	-	-	11	8	-	1974
104. Dioscoreaceae	2	1	2	1	-	-	2	-	-	1973
105. Urticaceae	5	3	13	9	2	-	16	8	-	1974
106. Linaceae	2	1	22	16	5	3	19	8	-	1974
107. Burseraceae	1	-	1	-	1	-	2	-	-	1974
108. Plumbaginaceae	8	4	192	97	151	65	158	96	8(16)	1974
109. Moringaceae	1	-	2	-	-	-	2	-	-	1974
110. Fumariaceae	3	2	36	15	11	1	32	14	8	1974
111. Berberidaceae	1	1	13	5	2	1	16	8	-	1975
112.*Iridaceae	4	4	61	34	25	4	79	8	16(52)	1975
113. Aizoaceae	5	4	7	5	-	-	8	-	-	1975
114. Molluginaceae	5	5	7	5	-	-	8	-	-	1975
115. Nyctaginaceae	2	2	5	3	-	-	6	7	-	1965
116. Loranthaceae	4	3	8	4	2	-	6	-	-	1976
117. Portulacaceae	1	1	5	1	-	-	5	-	-	1976
118. Callitrichaceae	1	1	2	2	-	-	6	4	-	1976

Table 1 (contd.)

119. Lemnaceae	3	3	9	5	-	-	8	-	-	1976
120. Malvaceae	15	12	108	76	39	17	86	53	-	1976
121. Juglandaceae	2	2	2	2	-	-	5	-	-	1976
122. Compositae II Lactuceae	38	32	363	247	131	56	352	208	-	1977
123. Cucurbitaceae	7	5	11	8	-	-	14	4	-	1977
124. Polygalaceae	1	1	14	7	2	1	11	8	-	1977
125. Rhamnaceae	6	5	20	13	2	1	28	16	-	1977
126.*Orchidaceae	24	17	64	46	4	3	148	16	56(117)	1978
127. Trapaceae	1	1	2	1	-	-	2	-	-	1978
128. Pedaliaceae	2	1	2	1	-	-	3	-	-	1978
129. Cynomoriaceae	1	1	1	1	-	-	1	1	-	1978
130. Myrsinaceae	2	-	2	-	-	-	2	-	-	1978
131. Avicenniaceae	1		1	1	1	-	-	2	- -	1978
132. Commelinaceae	1	-	3	-	-	-	3	-	-	1978
133. Meliaceae	3	2	3	2	-	-	3	-	-	1978
134. Goodeniaceae	1	-	1	-	-	-	1	-	-	1978
135. Moringaceae	1	1	3	1	-	-	4	4	-	1978

Table 1 (contd.)

136. Rafflesiaceae	1	1	1	1	-	-	2	-	-	1978
137. Menispermaceae	2	1	3	1	-	-	4	-	-	1978
138. Cannabaceae	2	2	2	2	-	-	5	-	-	1978
139. Compositae III a,b Cynareae	49	41	371	264	186	92	468	416	8(10)	1980
140. Papilionaceae I Vicieae	6	6	104	83	18	8	89	60	-	1979
141. Lauraceae	2	-	2	-	-	-	3	-	-	1979
142. Ulmaceae	3	3	14	8	1	1	16	8	-	1979
143. Balsaminaceae	1	1	12	1	2	-	13	3	-	1979
144. Caryophyllaceae I Paronychioideae	14	13	32	28	5	3	38	12	-	1980
145. Compositae IV Inuleae	36	30	145	91	41	18	140	128	-	1980
146. Palmae	2	2	2	2	-	-	6	-	8(14)	1980
147. Scrophulariaceae I	29	20	243	170	80	44	298	248	16	1981
148. Tiliaceae	4	3	15	7	-	-	15	8	-	1981
149. Resedaceae	3	3	16	14	4	2	23	36	-	1982

Table 1 (contd.)

150.*Labiatae	60	46	541	346	251	105	597	560	32(59)	1982
151. Liliaceae I	3	3	28	10	6	-	31	16	8(18)	1982
152. Rosaceae II *Rosa*	1	1	20	12	1	-	32	24	-	1982
153. Moraceae	4	3	12	8	-	-	15	8	-	1982
154. Compositae V Astereae	16	15	65	34	24	5	70	76	-	1982
155. Santalaceae	1	1	10	6	-	-	11	12	-	1982
156. Sterculiaceae	3	-	5	-	-	-	5	-	-	1982
157.*Papilionaceae II	64	48	534	295	189	71	499	424	-	1984
158. Compositae VI Anthemideae	18	12	214	127	93	37	234	224	-	1986
159. Sapotaceae	1	-	1	-	-	-	2	-	-	1986
160. Caesalpinaceae	6	6	14	6	-	-	11	8	-	1986
161. Mimosaceae	4	3	17	10	-	-	15	16	-	1986
162.*Umbelliferae	140	112	518	316	190	75	556	509	-	1987
163.*Caryophyllaceae I	I 31	25	460	310	195	55	528	505	-	1988
164.*Compositae VII	20	17	72	50	15	10	125	83	-	1989
165.*Liliaceae II	23	21	211	132	68	30	194	172	8(30)	1990

Table 1 (contd.)

166. Rhizophoraceae	2	1	2	1	-	-	3	-	-	1990
167. Pontederiaceae	2	-	2	-	-	-	2	-	-	1990
168. Dipsacaceae	5	5	50	40	12	7	67	60	-	1991
169. Violaceae	1	1	23	14	3	1	29	24	-	1992
170.*Liliaceae III	1	1	17	15	2	2	40	6	8(19)	1992
171. Ranunculaceae	25	21	273	149	81	31	249	268	8(16)	1992
172.*Chenopodiaceae	44	38	229	178	31	14	371	212	-	1997
173.*Cyperaceae	20	15	189	106	4	1	307	42	-	1998
174. Papilionaceae III *Astragalus*	(1)	(1)	311	188	192	95	351	227	-	1999
175. Papilionaceae IV *Astragalus* II	(1)	(1)	152	105	119	77	197	134	-	2001
176.*Rubiaceae	20	16	152	103	39	25	287	157	-	2005
Total	1471	1156	9977	6193	3318	1490	10065	5873	204(397)	

Notes: 1-6: Without description. 70: All tables line-drawing. 90: The complementary data of the genus *Cousinia* in No. 139a are also included. 112: In Latin and English. 126: Identification keys and species descriptions in Latin and English; colour pictures are given for all taxa. 150, 157: Tabulae in separate volume. 162: Identification key of the genera only in English; tabulae in separate volume. 163: Tabulae in separate volume. 164: English abstract and English determination key are given for the tribes. 165: Identification key to the genera of English and Latin; the genus *Tulipa* without identification key. 170: In English only; colour photos are given for all taxa. 172, 173: In English only; 176: Edited by Wilhelmina Rechinger.

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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Israel	3
Nederland	6
Pakistan	2
Poland	2
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Sweden	9
Switzerland	4
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USA	5
Total	97

List of publications by K.H. Rechinger on Iran and adjacent areas

In order to avoid repetition, the publisher (s) of Flora Iranica is (are) given only for the first reference and the whole series:

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

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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.

Key words: *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).

Bulbus 2-2.5 cm longus et 1-1.5 cm in diametro, oblongo-ovoideus, tunicis externis coriaceis pallide griseo-brunneis. Bulbilli ut videtur nulli. Scapus 30-50 cm altus. Folia in numero 3-4, quam scapus breviora, 1-2 mm lata, semicylindrica, canaliculata, fistulosa, laevia. Spatha umbellam subaequans, acuminata. Umbella subglobosa, multiflora. Pedicelli subaequilongi 10-20 mm longi, basibus longo bracteolatis. Perigonium cupulatum. Tepala 3-3.5 mm longa, ovata, cymbiformia, rugosa, acuta, subroseo-infuscata. Filamenta triangularia, simplicia perigonio duplo longiora. Stylus exsertus. Capsula subglobosa perigonium superanta.

Ab A. confragoso perigonii phyllis pallide coloratis differt.

Habitat in gypsaceis montium Koppet-Dagh orientalis (Persia).

Species in honorem M.R. Joharchi Mashhadensis 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, channeled, 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 Shurab 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

sect. *Eremoprasum* 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 gypsaceous slopes in Pamir-Alaj, Tien-Shan and Koppet-Dagh mountain ranges.

Fig. 1. Holotype of *Allium joharchii*.

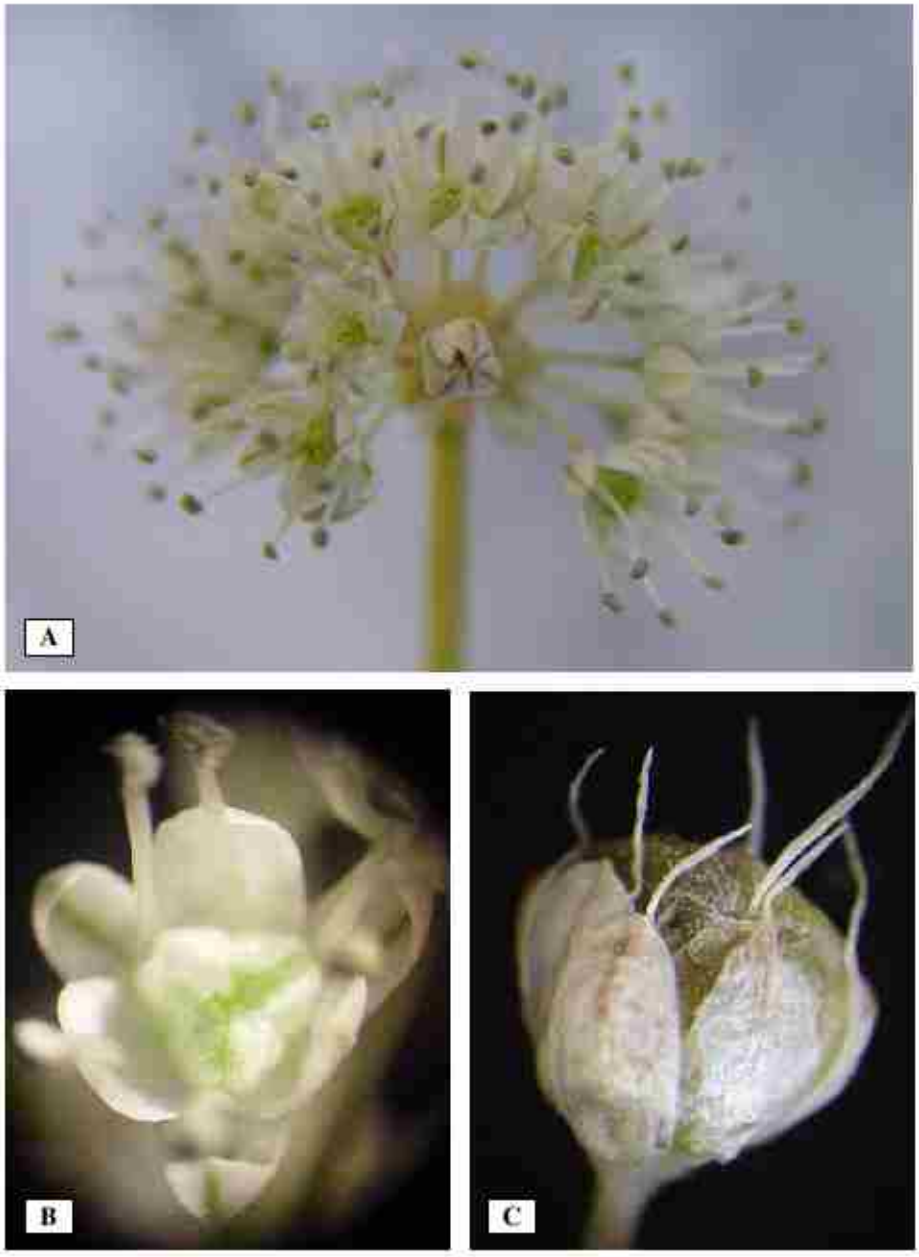

Fig. 2. *Allium joharchii*: A. Inflorescence, B. Flower and C. Capsule.

Fig. 3. Distribution map of *Allium* sect. *Eremoprasum* in C. Asia. *Allium sabulosum* (black circle), *A. incrustatum* (black square), *A. scrobiculatum* (grey circle), *A. transvestiens* (white square), *A. popovii* (dark-grey square), *A. jaxarcticum* (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	2
	Tepals smooth	5
2.	Tepals obtuse, the inner ones emarginate	3
	Tepals acute, the inner ones not emarginate	4
3.	Tepals greenish. Outer tunics and bulblets with crests	*A. incrustatum* Vved.
	Tepals brownish. Outer tunics and bulblets without crests	*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. joharchii* F.O. Khass. et Memariani
5.	Outer tunics without crests, scape thickish	*A. scrobiculatum* Vved.
	Outer tunics with crests, scape not thickish	6
6.	Filaments shorter than tepals	*A. jaxarcticum* Vved.
	Filaments longer than tepals	7
7.	Tepals obtuse, lilacky	*A. transvestiens* Vved.
	Tepals acute, whitish with purple vein	*A. popovii* Vved.

Acknowledgement

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

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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

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varieties of Tulips distributed in two subgenera of *Eriostemones* Boiss. and *Tulipa* (*Leiostemones* 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:

I. sect. *Clusianae* Baker: 1. *T. clusiana* DC., 2. T. *harazensis* Rech. F., 3. *T. montana* Lindl. var. *montana*, 4. *T. montana* Lindl. var. *chrysantha* (Boiss.), and 5. *T. linifolia* Regel. (specimens collected from Afghanistan were also included).

II. sect. *Tulipanum* DE Reboul: 6. *T. hoogiana* B. Fedtsch., 7. *T. systola* Stapf., and 8. *T. kuschkensis* B. Fedtsch.

III. sect. *Eichleres* (Hall) Raamsdonk & De Varies: 9. *T. micheliana* Hoog., 10. *T. ulophylla* Wendelbo, and 11. *T. wendelbo* Matin & Iranshahr.

IV. sect. *Kolpakovskianae* (Hall) Raamsdonk & De Varies: 12. *T. lehmaniana* Merckl.

V. sect. *Tulipa* Baker: 13. *T. scherenkii* Regel.

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 VARIES (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 inter-relationships, 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 VARIES 1995).

Table 1. Morphological characters and their coding

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

Table 1. (contd.)

27	Inner tepal blotch	1. absent, 2. black/dark purple, 3. purple, 4. brown/violet, 5. yellow
28	Tip of outer tepal pubescent	Presence (1)/absence (0)
29	Margin of outer tepal pubescent	Presence (1)/absence (0)
30	Midrib of outer tepal pubescent	Presence (1)/absence (0)
31	Tip of inner tepal pubescent	Presence (1)/absence (0)
32	Margin of inner tepal pubescent	Presence (1)/absence (0)
33	Midrib of inner tepal pubescent	Presence (1)/absence (0)
34	Occurrence of yellow/white margin around blotch	Presence (1)/absence (0)
35	Tip of outer tepal form	1. acuminate, 2. mucronate, 3. obtuse
36	Filament length	Cm
37	Anther length	Cm
38	Anther color	1. yellow, 2. violet, 3. green/purple
39	Pollen color	1. yellow, 2. violet/purple, 3. green
40	Filament color contrasting with flower color	0. similar, 1. deviating
41	Ovary length	Cm
42	Stigma color	1. yellow, 2. brown
43	Width of bulb	Cm
44	Tunic type	1. coriaceous, 2. papery, 3. sub-coriaceous
45	Color of bulb tunic	1. brown, 2. dark brown
46	Occurrence of hairs at upper part of bulb tunic	Presence (1)/absence (0)
47	Occurrence of hairs at middle part of bulb tunic	Presence (1)/absence (0)
48	Occurrence of hairs at base of bulb tunic	Presence (1)/absence (0)
49	Bulb tufted at top	Presence (1)/absence (0)
50	Type/form of tunic hairs	1. tometose, 2. sericeous at tunic base and strigose at summit, 3. short hair, 4. long hair
51	Occurrence of carpophore at the base of capsule	Presence (1)/absence (0)
52	Capsule length	Cm
53	Capsule width	Cm

In order to check the position of *T. ulophylla*, 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. Discriptive statistics (mean and standard error) of quantitative morphological characters in *Tulipa* species studied. (species code: C = *clusiana*, CH = *chrysantha*, H = *harazensis*, LEH = *lehmaniana*, LIN = *linifolia*, M = micheliana, MONT = *montana* var. *montana*, O = *montana* var. *montana* with orange flowers, SCH = *scherinkii*, LAF = *linifolia* from Afghanestan, U = *ulophylla*, W = *wendelboi*, HOO = *hoogiana*, K = *kutchkensis*, S = *systola*)

Character	Species														
	C	CH	H	LEH	LIN	M	MONT	O	SCH	LAF	U	W	HOO	K	S
Stem length	23.11	9.78	6.38	9.86	16.28	13.00	9.61	8.35	18.52	6.30	5.87	8.50	16.14	15.40	8.47
	±2.95	±0.79	±1.88	±2.41	±1.07	±2.14	±0.82	±1.02	±1.81	±1.07	±1.05	----	±4.75	±3.00	±1.74
First leaf length	21.13	11.91	12.50	12.62	15.38	10.72	13.02	12.00	16.55	7.75	10.98	10.50	18.84	6.96	12.76
	±2.57	±0.46	±0.01	±1.57	±0.80	±0.51	±0.56	±0.55	±1.88	±0.80	±0.86	----	±1.74	±0.51	±1.80
Second leaf length	18.59	11.61	11.75	10.41	16.57	9.82	12.93	12.17	16.06	8.00	11.04	11.00	18.61	6.31	11.83
	±1.27	±0.50	±0.25	±0.40	±0.59	±0.60	±0.55	±0.70	±3.24	±0.59	±0.99	----	±1.53	±0.47	±2.71
First leaf width	0.85	0.67	1.15	2.00	0.87	2.41	0.72	0.62	2.71	0.81	1.40	0.70	1.60	1.54	2.86
	±0.14	±0.03	±0.20	±0.06	±0.06	±0.21	±0.04	±0.04	±0.46	±0.06	±0.12	----	±0.10	±2.50	±0.74
Second leaf width	0.58	0.48	0.58	1.28	0.56	1.70	0.53	0.44	1.76	0.60	1.12	0.55	1.05	0.94	1.59
	±0.14	±0.01	±0.12	±0.07	±0.08	±0.07	±0.03	±0.03	±0.54	±0.08	±0.18	----	±0.12	±1.14	±0.54
Outer leaf length	3.86	3.06	3.20	4.09	3.17	4.37	3.31	3.01	5.60	3.97	3.78	3.27	4.19	1.91	4.26
	±0.37	±0.10	±0.40	±0.45	±0.29	±0.07	±0.13	±0.06	±0.46	±0.29	±0.62	----	±0.36	±1.00	±0.84
Outer leaf width	1.25	1.36	1.43	2.04	1.25	3.42	1.40	1.40	1.97	1.88	1.40	1.63	1.68	1.60	1.92
	±0.06	±0.06	±0.03	±0.33	±0.07	±0.02	±0.04	±0.05	±0.24	±0.07	±0.25	----	±0.25	±2.10	±0.31
Inner leaf length	3.28	2.82	2.75	4.23	3.17	4.37	3.09	2.83	4.83	3.99	3.34	3.35	3.74	2.00	4.26
	±0.16	±0.09	±0.25	±0.44	±0.25	±0.02	±0.12	±0.07	±0.50	±0.25	±0.48	----	±0.24	±1.40	±0.74
Inner leaf width	1.15	1.25	1.45	2.06	1.15	2.15	1.32	1.20	1.95	1.88	1.79	1.60	2.18	1.91	2.17
	±0.04	±0.02	±0.25	±0.37	±0.17	±0.03	±0.05	±0.04	±0.33	±0.17	±0.41	----	±0.28	±2.40	±0.31
Filament length	0.71	0.61	0.73	0.86	0.59	0.80	0.63	0.54	0.95	0.57	0.90	1.00	0.96	0.62	0.73
	±0.05	±0.02	±0.13	±0.01	±0.02	±0.04	±0.02	±0.03	±0.08	±0.02	±0.08	----	±0.10	±0.50	±0.54
Anther length	0.71	0.51	0.70	0.45	0.48	0.91	0.57	0.57	0.92	0.58	0.79	0.60	0.85	0.40	0.88
	0.05	±0.02	±0.10	±0.01	±0.02	±0.03	±0.03	±0.05	±0.01	±0.02	±0.12	----	0.08	±0.01	±0.17
Ovary length	0.88	0.69	0.70	0.97	0.78	0.96	0.75	0.66	1.30	0.92	1.07	0.80	1.04	0.64	1.38
	±0.05	±0.03	±0.01	±0.01	±0.03	±0.04	±0.02	±0.03	±0.01	±0.03	±0.22	----	±0.15	±0.51	±0.24
Bulb width	1.32	1.94	2.13	3.05	2.07	2.66	1.88	2.01	2.47	2.14	2.16	1.70	2.63	2.44	3.18
	±0.00	±0.08	±0.08	±0.01	±0.13	±0.22	±0.09	±0.08	±0.01	±0.13	±0.33	----	±0.46	±1.70	±0.47

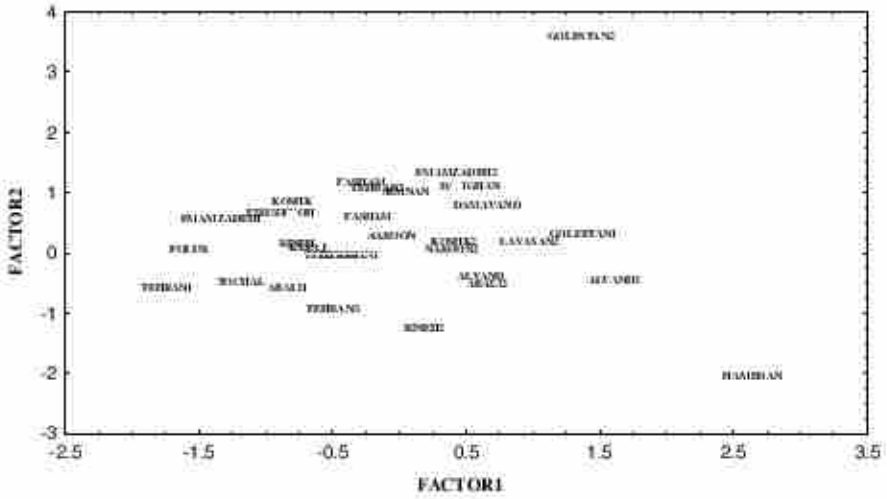


Fig. 1. PCA ordination of *T. montana* var. *montana* populations.

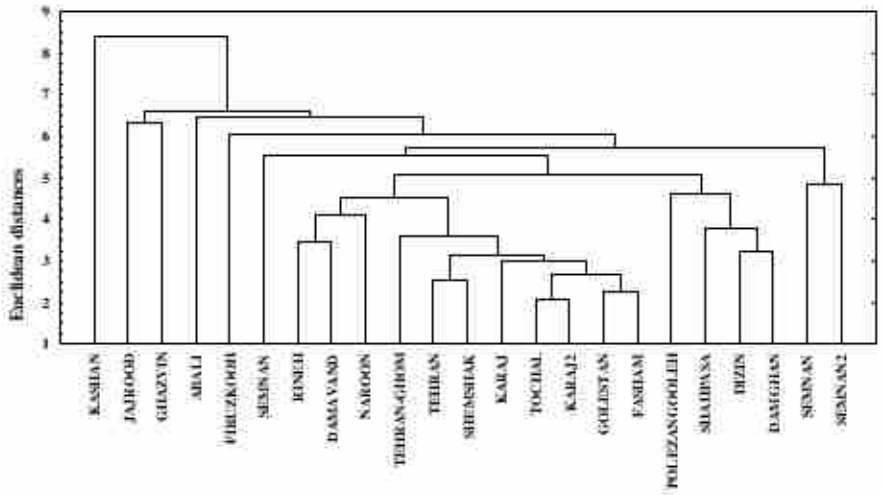


Fig. 2. UPGMA clustering of *T. montana* var. *chrysantha* populations studied.

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. harazensis*, two populations of *T. micheliana*, four populations of *T. ulophylla*, three populations of *T. lehmaniana*, and four populations of *T. scherenkii* 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. *chrysantha* and *T. linifolia* show phenetic similarity and are placed close to each other while *T. clusiana* and *T. harazensis* stand little far from the other species.

The species belonging to the sect. *Tulipanum* i.e. *T. hoogiana*, *T. systola* and *T. kuschkensis* 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.

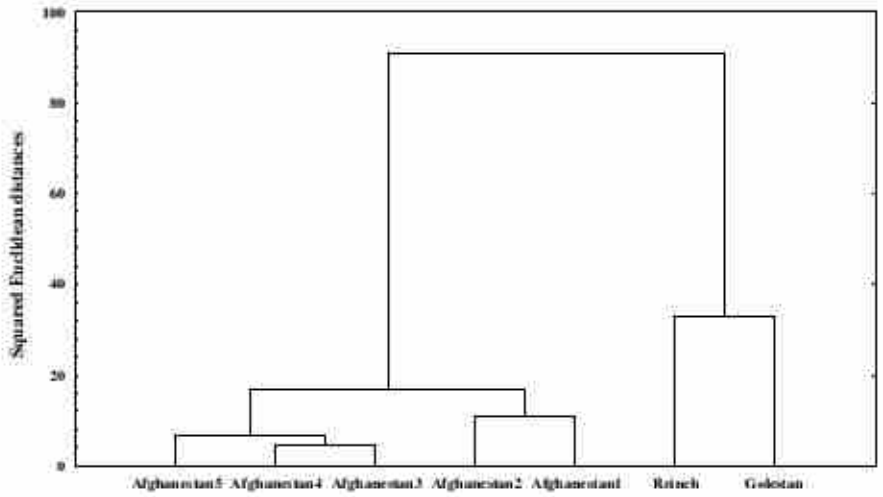


Fig. 3. WARD clustering of *T. linifolia* populations.

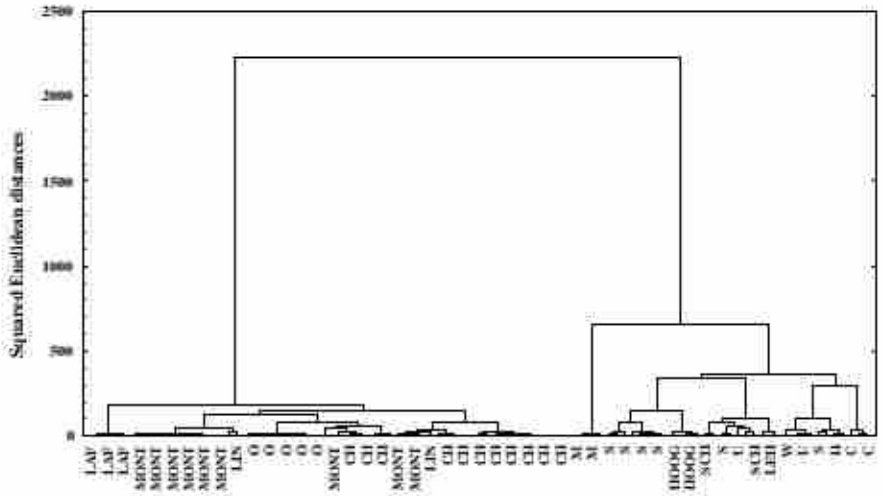


Fig. 4. WARD clustering of *Tulipa* species studied (species code: C = *clusiana*, CH = *chrysantha*, H = *harazensis*, LEH = *lehmaniana*, LIN = *linifolia*, M = *micheliana*, MONT = *montana* var. *montana*, O = *montana* var. *montana* with orange flowers, SCH = *scherinkii*, LAF = *linifolia* from Afghanistan, U = *ulophylla*, W = *wendelboi*, HOOG = *hoogiana*, K = *kutchkensis*, and S = *systola*).

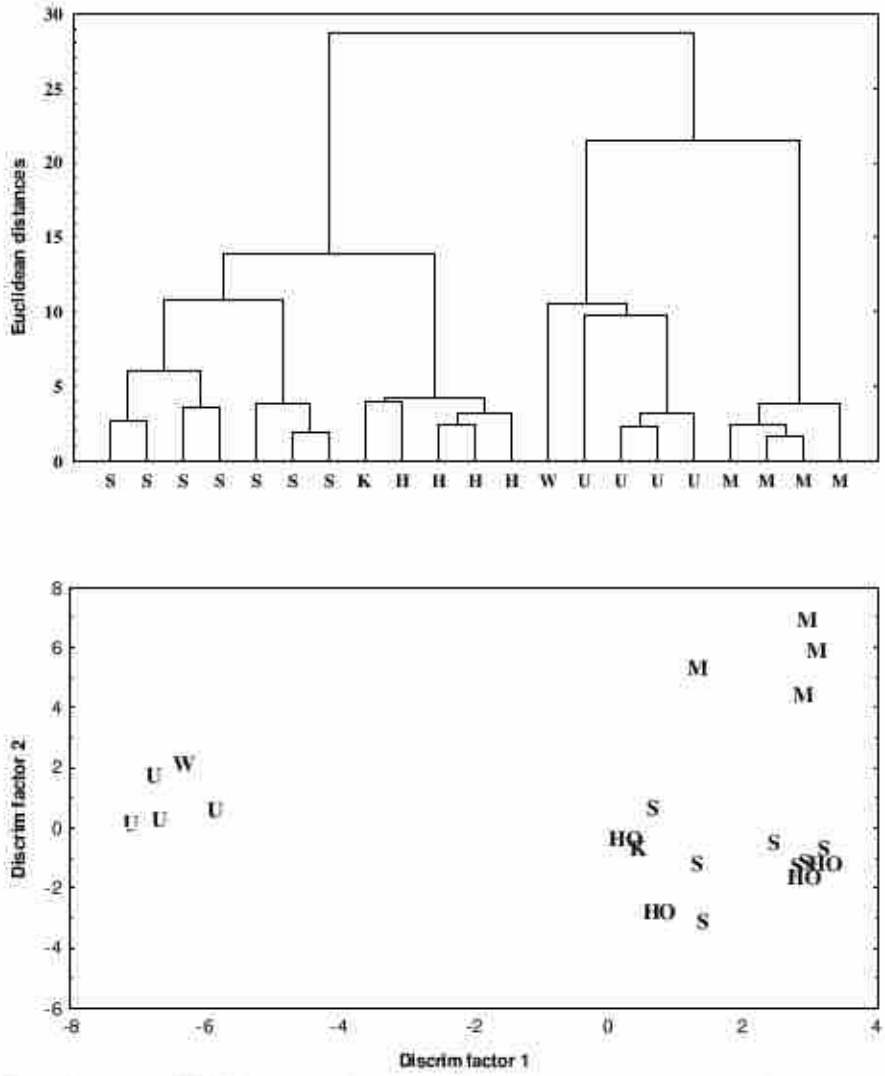
Two species of *T. lehmaniana* (from the sect. *Kolpakovskianae*) and *T. scherenkii* (from the sect. *Tulipa*) also show similarity to each other and are placed close together. In general the phenetic results support MATIN (1998) taxonomic treatment of the subgenus *Tulipa*.

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).

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LEAF ANATOMY IN THE FAMILY MORACEAE

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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 striation 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.

Key words: Cystoliths, Laticifers, Trichomes, Anatomy, Moraceae

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Introduction

The Moraceae is a family comprising 38-50 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 Artocarpeae in Moreae. Later, BERG (1989) investigated the systematics and phylogeny of the Urticales and proposed five tribes within Moraceae, i.e. Moreae, Artocarpeae, Castilleae, Dorstenieae and Ficeae. The delimitation of tribes was based on various characters such as inflorescences, type of flower and friut. For example Ficeae characterized by woody habit, inflorescence (syconia) basically bisexual and cymose/castilleae group is woody but inflorescence capitate and involucrate, unisexual (racemose), while Dorstenieae exhibit woody and herbaceous habit with complex inflorescence, often with reduced flowers. Atrocarpeae characterized by woody habit, inflorescence usually unisexual racemose and Moreae mainly woody and (in *Fatoua*) herbaceous, 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 1989 (Table 1).

Table 1. Taxonomic treatment of the family Moraceae

Author	Tribe	Genera
BERG 1989	Ficeae	*Ficus*
	Castilleae	*Antiaris, Castilla, Neotropies, Helicostylis, Maqwira, Mesogyne, Noucleopsis, Prebea, Pseudodolmedia*
	Dorstenieae	*Bosqwicopsis, Brosimum, Dorstenia, Helianthostylis, Scyphosyce, Trilepisium, Trymatococcus, Utsetela*
	Antocarpeae	*Antiaropsis, Artocarpus, Bagassa, Batocarpus, Huffetia, Paratocarpus, Prainea, Soroca, Sparattocyce, Treculia*
	Moreae	*Blukrodia, Broussonetia, Fatua, Maclura, Milicia, Morus, Streblus, Trophis*
HUMPHRIES & BLACKMORE 1989	Ficeae	
	Dorstenieae	
	Castilleae	
	Sparattosyeae	
	Moreae	
	Artocarpeae	
TAKHTAJAN 1997	Moreae	*Morus, Brossonetia, Milicia, Maclura, Trophis, Streblus, Blukrodea, Fataua*
	Artocarpeae	*Artocarpus, Paratocarpus, Treculia, Prainea, Hullellia, Antiaropsis, Sparathosyce, Batocarpus, Bagassa, Sorocea, Clarisia, Paulsenia*
	Castilleae	*Antiaris, Castilla, Perebea, Helicostylis, Maqwira, Mesogyne, Noucleopsis, Pseudodolmedia*
	Dorstenieae	*Bosqwiciopsis, Brosimum, Dorstenia, Helianthostylis, Scyphosyce, Trilepisium, Trymatococcus, Utsetela*
	Ficeae	*Ficus*

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, BAIJNATH & NAIDOO 1979, HARDIN 1981, BISHT *et al.* 1989, VAN VEENENDAAL & 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 parozone, 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 Strereo Scan 240 SEM at the Jodrell Laboratory, Kew (UK).

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 *Brosimopsis* 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*, *Parartocarpus venenosus*, *Perebea xanthochyma*, *Pseudolmedia laevigata*, *Sorocea saveocarpa* and *Trymatococcus aligandrus*, 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), *Castilla ulei* (Fig. 14), *C. tunea*, *Ficus* species (Figs 15-17) and *Trymatococcus paraensis;* (ii) prickle hairs with swollen base sunken in mesophyll, always containing a cystolith, in *Morus* spp., *Ficus* spp., *Poulsenia 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*, *Bosqueiopsis gilletii*, *Morus nigra*, *M. alba*, *Brosimum costaricanum*, *Maclura*

pomifera, Castilla ulei, Helicostylis tomentosa, H. scabra, Dorstenia elata, Sorocea saveocarpa, Trymatococcus 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 dioica* 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. benghalensis, 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 *Cadrania* species (Figs 24-28); cells very short in *Antiaropsis decipiens, Clarisia ilicifolia, Ficus pretoridea* (Fig. 29), *F. deltoidea* (Fig. 30), *Prainea papuana* and *Scyphosyce 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 ulei* (Figs 33, 34), *Antiaris toxicaria* ssp. *Welwitschii* (Fig. 35) and *Sorocea 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 *Antiaropsis decipiens, Artocarpus rigidus, Bosqueiopsis gilletii, Brosimum costaricanum, Ficus lutea, Maclura pomifera, Mesogyne insignis, Naucleopsis glabra* (Fig. 27), *Parartocarpus venenosus, Pseudolmedia laevigata* and *Treculia madagascarica*.

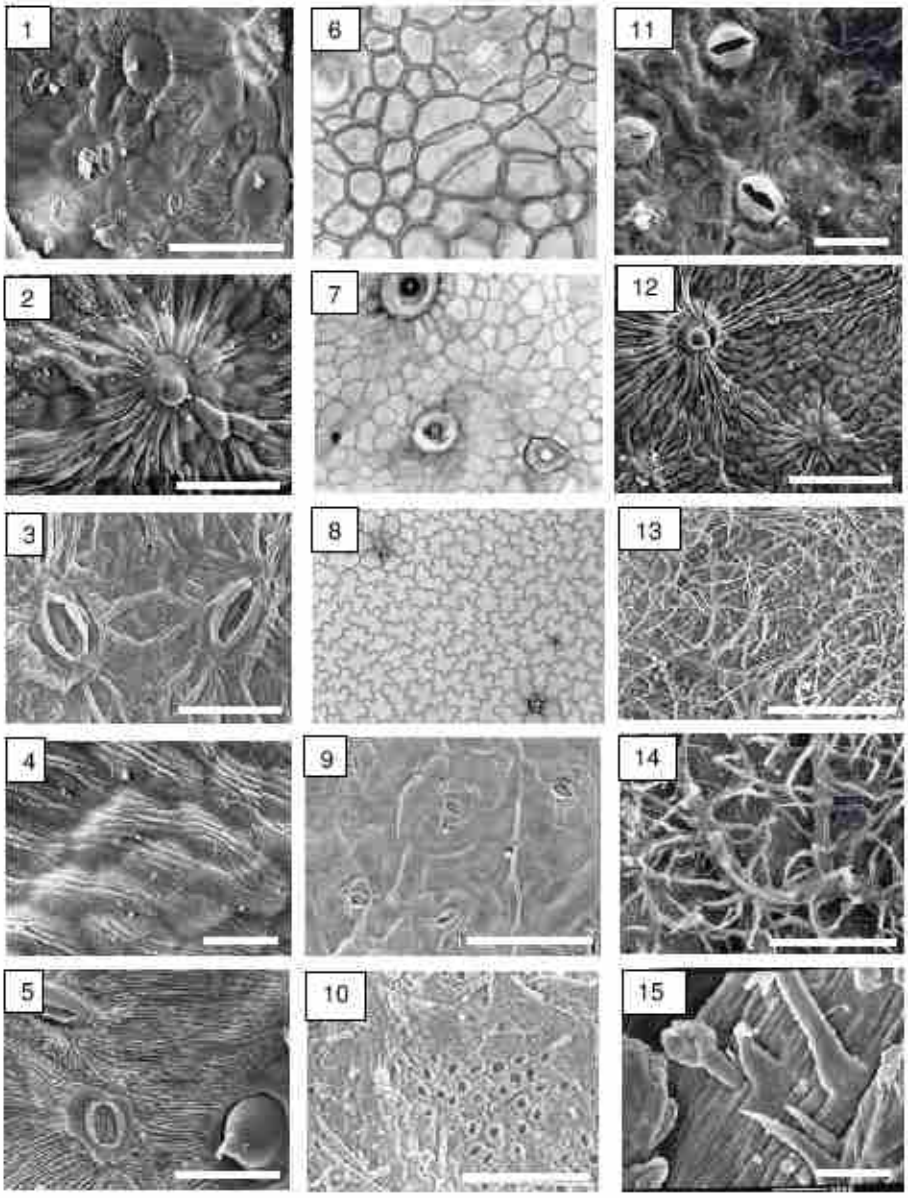
Midrib: Usually with prominent arc of several bundles abaxially and small bundles in ground tissue adaxially. Vascular bundles collateral, in one row in lamina. Bundle sheath of major bundles composed of several layers of collenchyma; bundle sheath extensions collenchymatous, usually both ad- and abaxially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

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

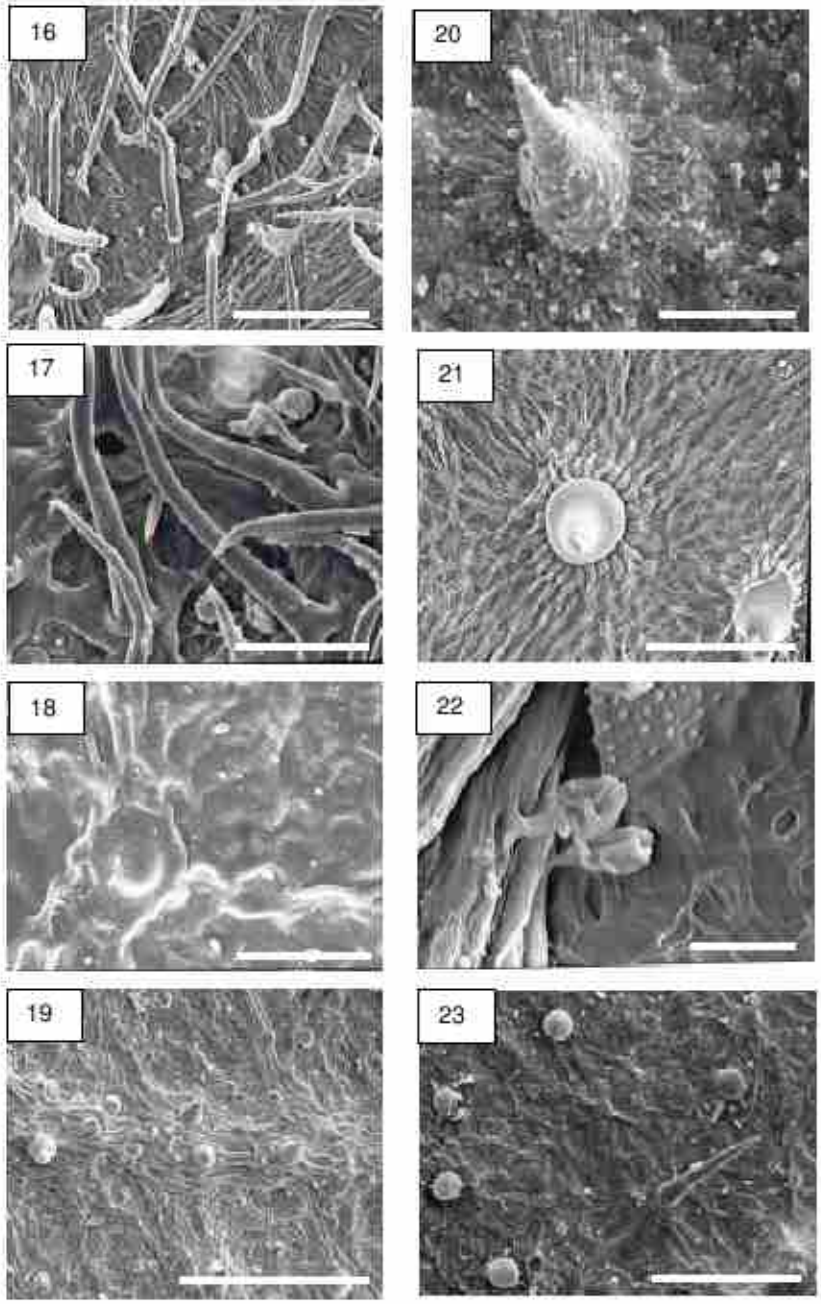
Laticifers: unbranched, present mainly in mesophyll and around veins in lamina, sometimes extending to hypodermis or even epidermis in species examined of *Antiaris, Artocarpus, Castilla, Dorstenia, Ficus, Maclura, Trecullea* and *Morus* (Fig. 37). Crystals: in addition to those in cystoliths, druses 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, Poulsenia, Sparattosyce* and *Streblus*, but absent from *Fatoua, Mesogyne, Prainea* and *Sorocea* (Figs 39-42).

Discussion

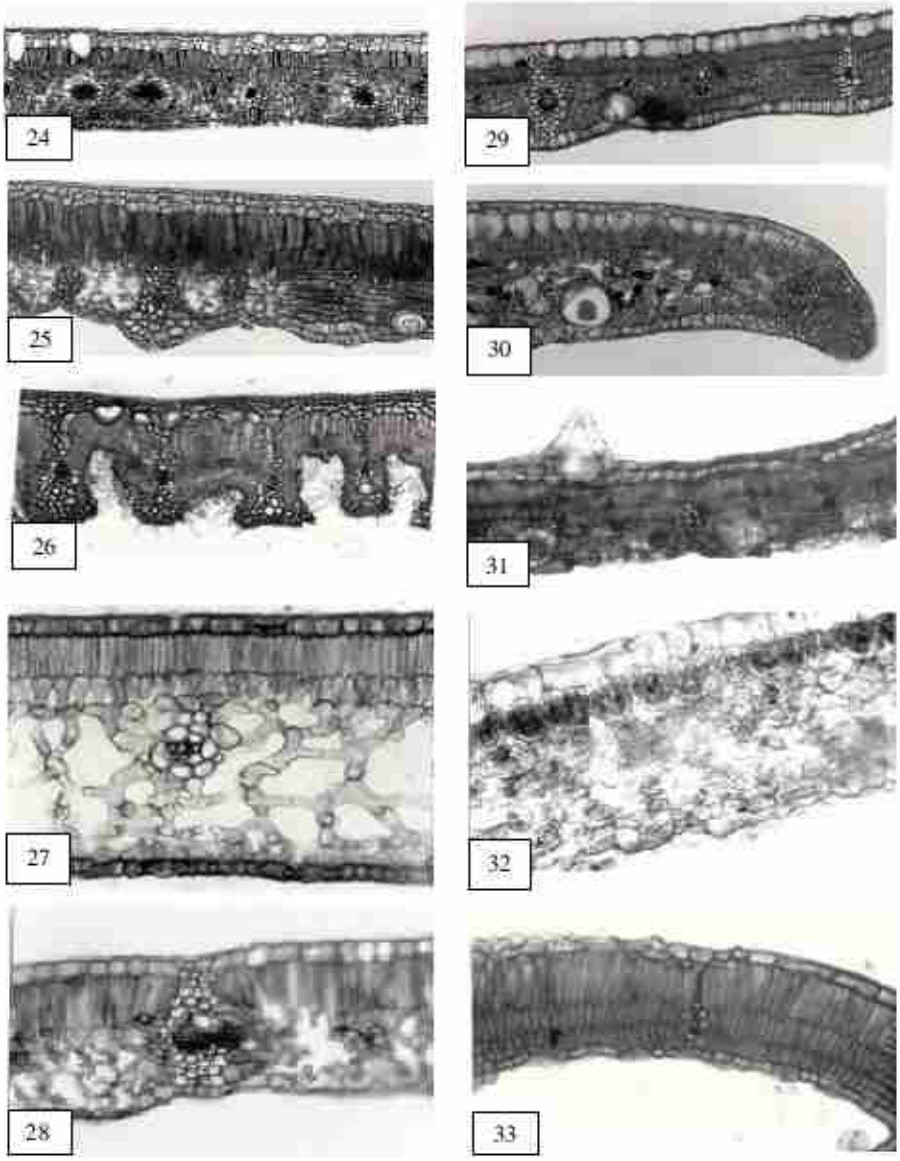
Except for *Ficus*, our survey of the Moraceae is based on only a few species of each genus. The results exhibit several notable features within the family which are quite compatible with the information summarized by METCALFE & CHALK (1950). Most species have regularly-shaped epidermal cells in one 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 anomocytic stomata, except *Dorstenia* where they are mainly anisocytic and some anomocytic. GANGADHARA & INAMDAR (1977) recorded other forms in the family, such as actinocytic in *Artocarous communis* and anisocytic and partly also helicocytic 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).



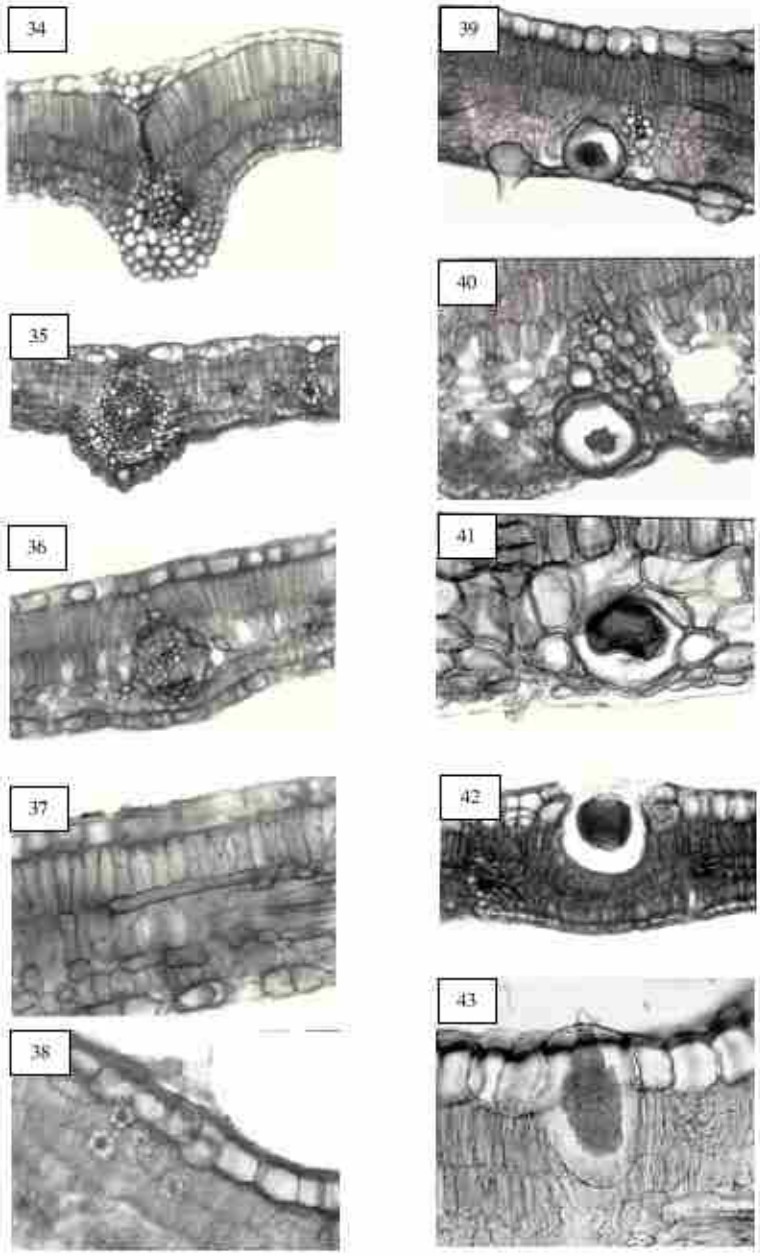
Figs 1-15. Leaf surfaces, SEM & LM. 1. *Ficus carica* 2. *Broussonetia kazinoki* 3. *Morus nigra* 4. *Maclura pomifera* 5. *Ficus rupestris* 6. *F. deltoids* (×40), 7. *Morus alba* (×25), 8. *Dorsetenia elata* (×4), 9. *D. psilurus* 10. *Ficus bengalensis* 11. *Schyphosce pondurata* 12. *Broussonetia kazinoki* 13. *B. papyrifera* 14. *Castilla uleii* 15. *Ficus carica*. (Scale bars: 1-3, 5=50 µm, 4, 11, 15=20 µm, 9, 10, 12=100 µm, 13, 14=500 µm).



Figs 16-23. Leaf surfaces, SEM. 16. *Ficus carica* 17. *F. carica* 18. *Morus alba* 19. *Ficus rupesteris* 20. *F. palmata* 21. *Broussonetia papyrifera* 22. *Castilla ulei* 23. *Dorstenia elata*. (Scale bars: 16, 21, 23=100 µm, 17-18 µm, 20=50 µm, 19=200 µm).



Figs 24-33. Leaves in transverse sections, showing abaxial and adaxial epidermis, mesophyll of variable patterns, vascular bundles and presence of cystolites. 24. *Ficus benghalensis* (×4), 25. *F. villosa* (×10), 26. *Chlorophora excelsa* (×10), 27. *Naucleopsis glabra* (×25), 28. *Cadrania tricuspidata* (×10), 29. *Ficus pretorides* (×10), 30. *F. deltoides* (×10), 31. *F. palmata* (×10), 32. *Dorstenia psilurus* (×25), 33. *Castilla ulei* (×25).



Figs 34-43. Leaves in transverse sections. 34. *Castilla ulei* (×25). 35. *Antiaris toxicaria* ssp. *welwitschii* (×10). 36. *Sorocea guilleminiana* (×25). 37. *Trecullea madagascaria* (×10). 38. *Ficus johannis*. (×25). 39. *F. carica* (×25). 40. *F. villosa* (×40). 41. *F. benghalensis* (×40). 42. *Morus alba* (×25). 43. *F. rupestris* (×40).

Glandular trichomes are present in all genera and are uniformly unbranched, either with a spherical 1-2-celled head, as in *Morus*, 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 (Figs 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 sunken 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 VEENENDAAL & DEN OUTER (1990), BRUMMITT (1992) and TAKHTAJAN (1997).

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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* Lam. 1986-2200.
2 *Broussonetia kazinoki* Siebold. 1986-8199.
3 *Broussonetia kazinok* Siebold. 1986-8213.
4 *Broussonetia papyrifera* Vent. 1985-8415.
5 *Broussonetia papyrifera* Vent. 1985-8198.

6 *Broussonetia papyrifera* Vent. 1952-60101.

7 *Dorstenia bahiensis* Klotzsch ex Fisch. & C.A. Mey. 1977-2803.

8 *Dorstenia drakena* L. 1984-1399.

9 *Dorstenia elata* Gardn. 1980-961.

10 *Dorstenia psilurus* Welw. 1969-17745.

11 *Ficus binnendijkii* Miq. 1992-883.

12 *Ficus carica* L. 433-794628.

13 *Ficus carica* L. 453-7904828.

14 *Ficus deltoidea* Jack. 1973-12472.

15 *Ficus lutea* Vahl. 1973-20447.

16 *Ficus pretoriae* Burtt-Davy. 1964-2802.

17 *Ficus pumila* L. 1986-1808.

18 *Ficus villosa* Blume 1984-2930.

19 *Maclura pomifera* C.K. Schneid. 1910-66603.

20 *Morus nigra* L. 1986-49201.

21 *Morus rubra* L. 1993-223.

Herbarium materials:

22 *Antiaropsis decipins* K. Sch. New Guinea. J.S. Womersley, NCF 19147.

23 *Antiaris toxicaria* Lesch. ssp. *Welwitschii* (Engl.) C.C. Berg, Ethiopia. I. Friis, M.G. Gilbert & K. Vollesen 4012 (K).

24 *Antiaris toxicaria* ssp. *welwitschii* var. *welwitschii*. Northern Rhodesia. J.M. Mutimushi 1167 (K).

25 *Artocarpus rigidus* Bl. ssp. *rigidus*. Indonesia. K. Siditasa 442.

26 *Bosqueiopsis gilletii* De Wild. & Th. Dur., Tanzania, Lindi Distr. S. Bidgood, R. Abdallah & K. Vollesen 1537 (K).

27 *Brosimum alicastrum* ssp. *alicastrum*. Mexico, Junan Ramirez Is. Edward Palmer 471 (K).

28 *Brosimum costaricanum* Liebm. Costa Rica, Aguabuena. Karsten Thomsen 535, dupl. 8 (K).

29 *Castilla tunu* Hemsl. Ecuador, C.C. Berg. P.J.M. Maas & B.J.H. ter Welle 424 (K).

30 *Castilla ulei* Warb. Brazil, Para. Caucha 288 (K).

31 *Chlorophora excelsa* (Welw.) Benth. & Hook. Nairobi, Kenya. Semsei 1024 (K).

32 *Clarisia ilicifolia* (Sprengel) Banjauw & Rossb. Bolivia, dept Beni, Cauchuela Esperanta. G. Meyer 105 (K).

33 *Cudrania tricuspidata* (Carr.) Bur. China. Chow 150 (K).

34 *Dorstenia foetida* (Forssk.) Schweinf. & Engl. Oman, Dhofar Province. A. Radcliffe-Smith (K).

35 *Dorstenia turbinata* Engl. Ghana. Hall & Abbiw GC 44686 (K).

36 *Fatoua Pilosa* Gaudich. Australia, C.R. Dunlop 7897 (K).

37 *Fatoua villosa* Hawaii (cult.). Joel Lau 2403 (K).

38 *Ficus benghalensis* L. Iran Hormozyan, Bandarabbas, Assadi & Mozaffarian (TARI) 47150.

39 *Ficus benghalensis* L. Arabia, Dhahran. J.S. Ingham 304 (K).

40 *Ficus carica* L. Turkey, Erzrum. Davis 47643 (K).

41 *Ficus carica* ssp. *Afghanistanica*. Iran, Khuzistan. Assadi & Nikcherhreh 76365 (TARI).

42 *Ficus carica* ssp. *carica*. C. Iran, Kashan. Batouli 76576 (TARI).

43 *Ficus carica* ssp. *carica*. C. Iran, Kashan. Batouli 76575 (TARI).

44 *Ficus carica* ssp. *rupestris* (Hausskn. ex Boiss.). Browicz. Iran, Esfahan. M. Usofi 1236 (TARI).

45 *Ficus carica* ssp. *Rupestris* (Hausskn. ex Boiss.). Browicz Iran, Esfahan. M. Usofi 882 (TARI).

46 *Ficus carica* ssp. *rupestris*. Iran, Chaharmahal-o Bakhtiari, V. Mozaffarian 57605 (TARI).

47 *Ficus carica* ssp. *rupestris*. Iran, 21 km N. of Tehran, Kan, Amin & Bazargan 18538 (TARI).

48 *Ficus* aff. *carica* ssp. *rupestris*. Iran, Kashan, Batouli 76577 (TARI).

49 *Ficus carica* var. *rupestris* Hausskn. Iran, Dorud-Sefiddashat, Z. Rowshan 9741 (TARI).

50 *Ficus carica* var. *rupestris*. N. Iran, Rezaiyeh, Sabeti 7601.

51 *Ficus carica* var. *rupestris*. Iraq, Penjwin, Al Kaisi & K. Hamad 43519 (K).

52 *Ficus johannis* Boiss. ssp. *afghanistanica* (Warb.) Browicz. S. Iran, Kerman, Sonboli 1001 (TARI).

53 *Ficus johannis* Boiss. ssp. *afghanistanica*. S. Iran, Fars, Assadi & Abuhamzeh 46582 (TARI).

54 *Ficus johannis* ssp. *johannis*. Iran, Kazeroon, Davis & Bokhari 55862. Syn.: *Ficus geranifolia* Miq. (K).

55 *Ficus palmata* Forsk. Iran & Afghanistan. Grey-Wilson & T.F. Hewer 1032 (K).

56 *Helicostylis scabra* (Macbr.) C.C. Berg. Brazil, Manaus-Porto Velho Rd. G.T., Prance, T.D. Pennington, M. Leppard, O.P., Monteiro & J.F. Ramos 22824 (K).

57 *Helicostylis scabra*. Brazil. G.T. Prance, B.S. Pena, J.F. Ramos & O.P. Monteiro 3803 (K).

58 *Helicostylis scabra*. Brazil, Amazons. C.A. Cid *et al*. 8463 (K).

59 *Helicostylis tomentosa* (P. & E.) Rugby. Brazil, Amazonas, T. Plowman, E.W. Davis, C.A. Cid & I.L. Amaral, Lima & J. Guedes 12451 (K).

60 *Helicostylis tovarensis* (Klotzsch & Karsten) C.C. Berg. Ecuador, NAPO, Archidona. Walter Palacias & E. Freire 5092 (K).

61 *Maclura cochinchinensis* (Lour). Corner. New S. Wales, Australia. R. Coveny 9793. Syn. *Cudrania cochinchinensis* (Lour.) Kudo & Masamune (K).

62 *Maquira coriacea* (Karst.) C.C. Berg. Brazil, Humaitã to Porto Velho Rd. Prance, Pena & Ramos 3514 (K).

63 *Maquira guianensis* Aublet. Brazil, near Rio Itacaunas. DC. Daly, R. Callejas, M.G. da Silva, E.L. Taylor, C. Rosario & M.R. dos Santos 1636 (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 *Nauclepsis glabra* Baill. Brazil, Aripuana, near Humboldt Center. Prance, Berg, Bisby *et al.* 18241 (K).

68 *Parartocarpus venenosus* Becc. Indonesia, N. Sulawesi. J.S. Burley, Tukirin *et al.* 3686 (K).

69 *Perebea xanthochyma*. Karsten, Costa Rica, Aguabuena. Karsten Thomsen 191 dupl. 4 (K).

70 *Poulsenia armata* (Miq.) Standl. British Honduras. W.A. Schipp 1154 (K).

71 *Prainea papuana* Becc. Papua New Guinea. J.R. Croft *et al.* 68819 (K).

72 *Pseudolmedia laevigata* Trécul. Venezuela, Merida. J. de Bruijn 1504 (K).

73 *Pseudolmedia laevis* (R. & P.) Macbr. Bolivia, state of Pando. G.T. Prance, E. Forero, B.L. Wrigley, J.F. Ramos & L.G. Farias 6219 (K).

74 *Scyphosyce pondurata* Hutch. Cameroun, Korup National Park. D.W. Thomas 4288 (K).

75 *Sorocea guilleminiana* Gaud. Brazil, State of Pará. Daly, Taylor, Rosario & Dos Santos 1677 (K).

76 *Sorocea saveocarpa* Lanj. & Boer, Ecuador, Esmoraldas. T.D. Pennington, L. Veloz *et al.* 14150 (K).

77 *Sparattosyce dioica* Bur., New Caledonia. H.U. Stauffer 5774 (K).

78 *Strebls asper* Lour. China Hainan H.Y. Liang 64142 (K).

79 *Streblus glaber* (Merr.) Corner. Sarawak. Carlo Hansen 545 (K).

80 *Streblus taxoides*. Malaya. Kochummen 32521 (K).

81 *Taxotrophis macrophylla* (Bl.). China, Hainan. F.C. How 70663 (K).

82 *Treculia madagascarica* N.E. Brown, Madagascar. L.J. Dorr 3560 (K).

83 *Trilepisium madagascariense* DC. Nigeria. Chapman 3837 (K).

84 *Trymatococcus aligandrus* (R. Ben.) Lanj. Surinam. S. Mori & A. Bolten 8457 (K).

85 *Trymatococcus amazonicus*. P. & E. Brazil, Rio Vaupes. M.L. Kawasaki 180 (K).

86 *Trymatococcus paraensis* Ducke. S. America, Nassau. J. Lanjouw & J.C. Lindeman (K).

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DIFFERENT TYPES OF FOLIAR TRICHOMES IN THE FAMILY BORAGINACEAE

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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 *silvatica*, *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 layeres 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 (HLLGER *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

(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 Boraginaceae 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, naufy, 1514.

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

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

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

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

Myosotis silvatica Ehrh. ex Hoffm.- Azerbaijan, Aghdash, Mazegar, 2300 m, 81338.

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

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

Symphytum asperum Lepech. - Azerbaijan, Doghroon 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).

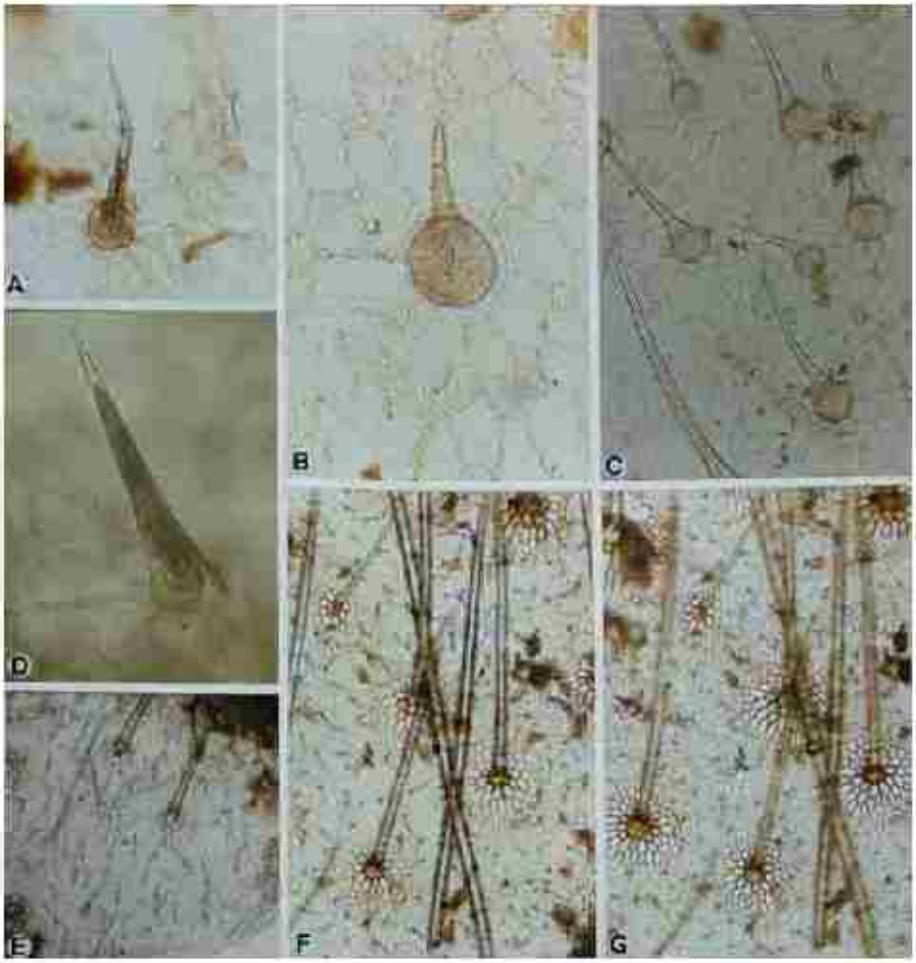

Fig. 1. A-G: Surface view of adaxial epidermis showing trichomes of the Boraginaceae. A-B. *H. ellipticum*, C. *Asperugo procumbens*, D. Cystolith-like structures in the hairs of *Anchusa ovata*, E-G. *O. microcarpum*. A-C (×75), B (×150), D (×300), E-G (×30).

Both leaf surfaces in *Asperugo procumbens*, *Heliotropium ellipticum* and *Myosotis silvatica* are more or less densely covered with different types of multicellular, uniseriate, simple trichome forming an indumentums 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).

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 variously 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).

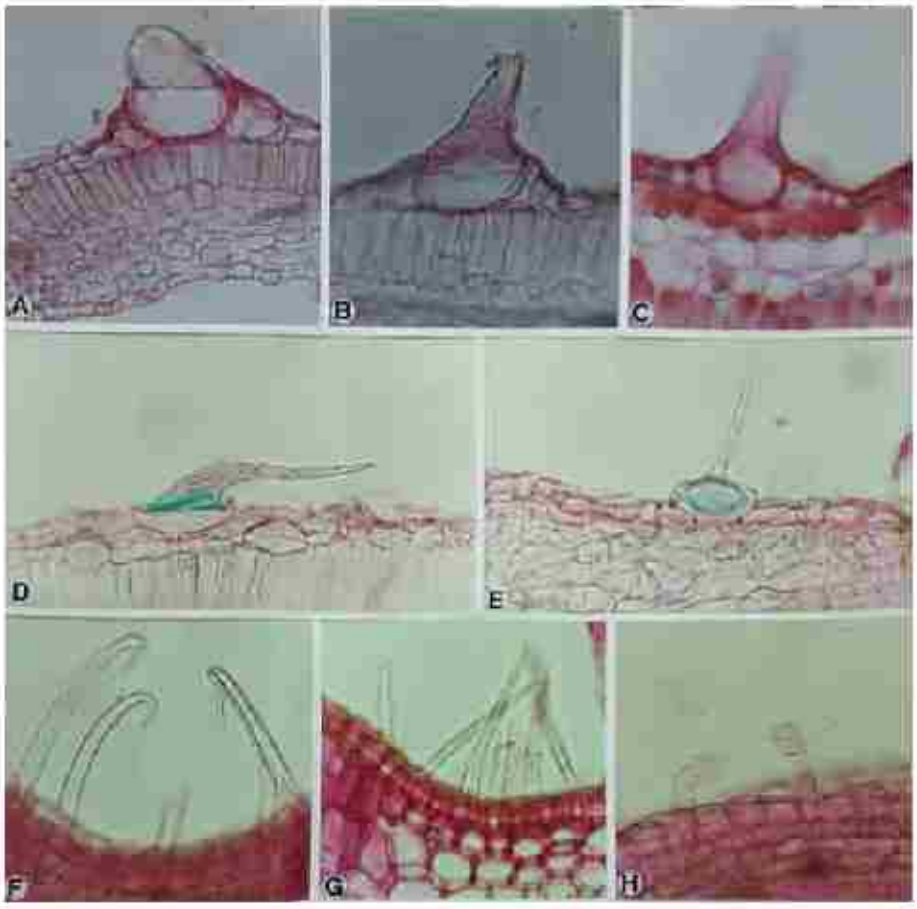

Fig. 2. A-H: Leaf of the Boraginaceae in transversal section. A-E. A cystolith-like trichome, A. *S. asperum*, B. *Asperugo procumbens*, C. *M. silvatica*, D-E. *H. ellipticum*, F-H. Glandular and non-glandular trichomes, F & H. *S. asperum*, G. *O. dichroanthum*, A-H (×150).

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 above-mentioned 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 (EHLERINGER 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.

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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.

Key words: *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, KHATAMSAZ 2002). *Onosma* is divided in two large groups based on the bristles with tubercle at the bast 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. khorassanicum* is *Onosma azure*um 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 & Joharchi, Sp. Nov.** (Fig. 1)

Perenne, multicaule, usque ad 30 cm altum, basi lignosa, caules numerosi, lasi reliquis sicc is foliorum emarcidorum, setis erectibus tuberculatis et pubibus brevibus tubeculatis 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. Basi cuneata vel leviter rotundata; folia omina margine recurvata. Inflorescentia scropioidea, terminalis, primo subcapitata, demum paunlo elongate. Bracteae lanceolatae vel triangulares, acutae, 12 mm longae et 4 mm latae, Pedicelli floriferi 4 mm longi, fructiferi usgua 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 sterili 0.5 mm longo bedentato. Annulus nectarifer glaber, lobatus. Filamento basin versus paulo dilatata. Stylus corollom longior. Nuculae usque ad 6 mm longae.

Perennial, multistemmed, up to 30 cm high, woody at base. Stem, numerous, coverd by erect dense tubercled bristles, with short small erect tubercled hairs, with dried reminde of primary leaves at base. Basal leaves, spathulate, 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, infindibular, 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.

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

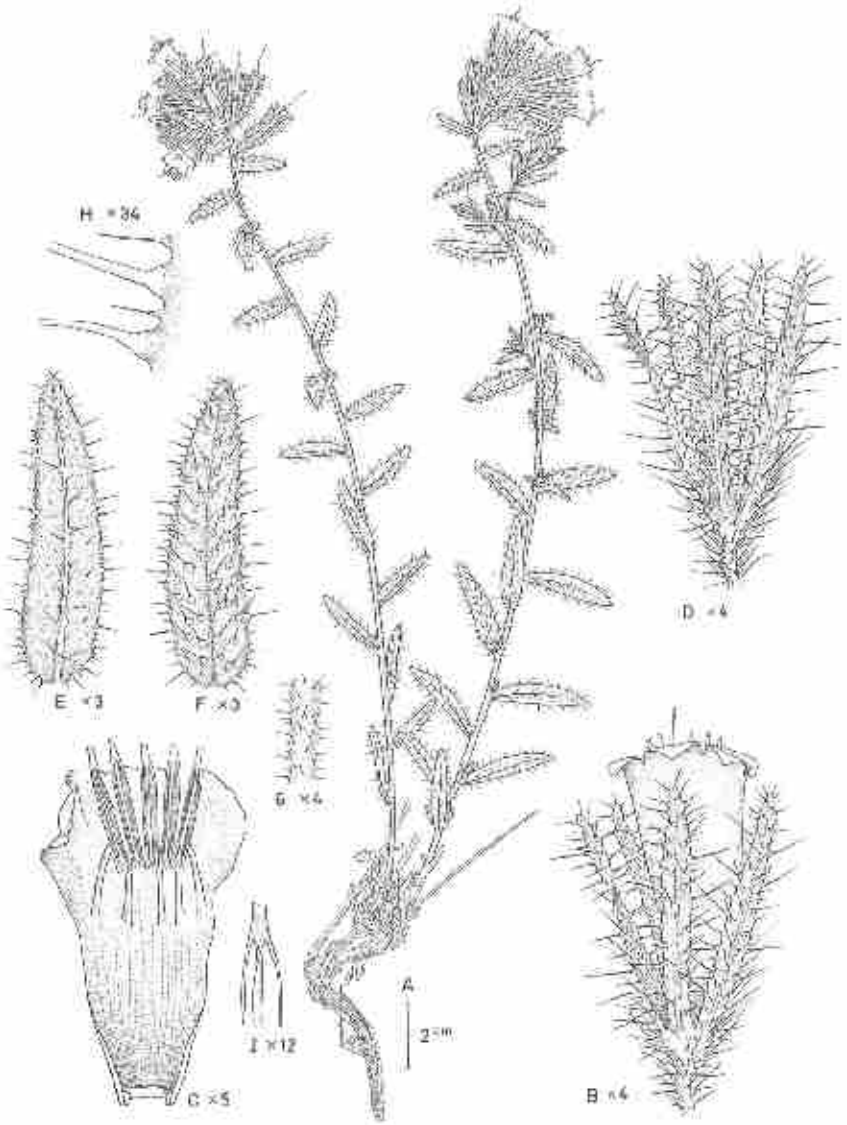

Fig. 1. *Onosma khorassanica*: A. Habit, B. Calyx and corolla, C. Stamens, D. Calyx, E. Lower surface of leaf, F. Upper surface of leaf, G. A part of stamen with bristles, H. Tubercled bristles and hairs, I. Sterile part of anther.

Affinities: *Onosma khorassanica* is very closed to *O. azureum* 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).

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

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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 quarzite sand and fixed in ethanol-acetic acid (3:1). The chromosomes have been stained with carmine acetic acid.

Results and Discussion

Erysimum sisymbrioides 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. sisymbrioides* 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. sisymbrioides	
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, Rakhui-Tal, an der Mündung des Siau-Tales, 3750 m, 16.9.1965, D. Podlech 12782 (W 1966-24419) - (Fig. 1b). POLATSCHEK 1968	2n=18
E. griffithianum	
Iran: Kerman, Rafsandjan-Khenamon, 60 km von Rafsandjan entfernt, Glou-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

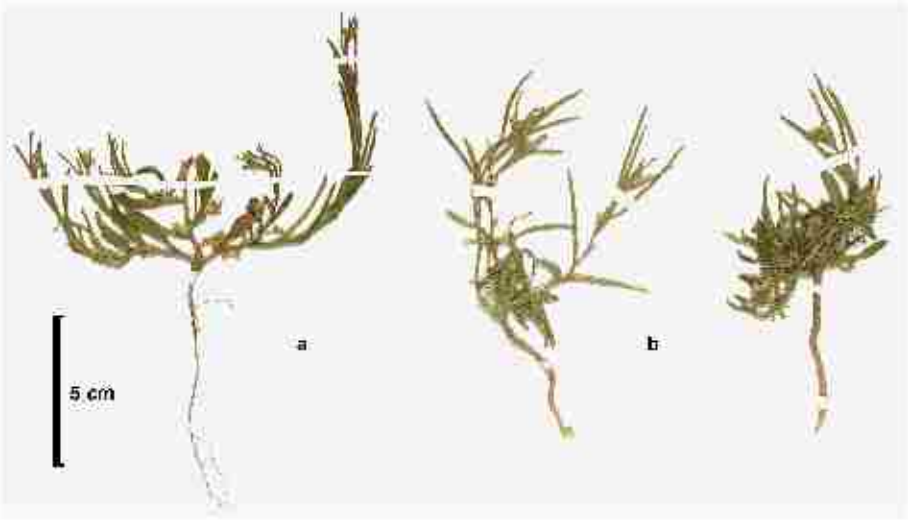

Fig. 1. Specimens of *Erysimum sisymbrioides*: a. Termé & Izadyar 34358 E, b. Podlech 12782.

An earlier count for *E. sisymbrioides* (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. sisymbrioides* 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. sisymbrioides*.

The new chromosome count for *Erysimum sisymbrioides* 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. Titz (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. sisymbrioides* are correlated with the distribution area.

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

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Abstract

Allium autumniflorum F.O. Khass. & Akhani and *A. tuchalense* 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 subnival meadows of the Tuchal mountains in N. Tehran. It belongs to subgen. *Allium*, sect. *Pallasia* (Tzag.) 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.

Key words: New records, *Allium*, Alliaceae, Iran

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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 center 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 (FRITSCH 1996, FRITSCH & KHASSANOV 2002, FRITSCH *et al.* 2001, MATIN 1989, 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*)**

Holotypus: Golestan: 6 km SE Maraveh Tappeh towards Yeke-Chenar, 37°52' 3''N, 55°59'47''E, 413 m. 11.10.2004. H. Akhani 18086 (IRAN; isotypus TASH, Hb. Akhani).

Bulbus 1-1.5 cm in diametro, ovoideus, tunicis externis coriaceis pallide griseis. Bulbilli ut videtur nulli. Scapus 20-30 cm altus, usque ad apicem glaber vaginis foliorum involutis. Folia 4, quam scapus breviora, quartum 2 mm latum, 3-4 cm longum, cylindricum, fistulosum. Spatha circa 5 mm longa, bivalvis, persistentia. Umbella hemisphaerica, 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 obcordatis.

Species affinitate incerta.

Habitat in Persia boreali.

Bulbs ovate, 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, nectarines 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. *kiabii* Akhani and *Johrenia golestanica* Rech. f. (Akhani 1998).

***Allium tuchalense* F.O. Khass. & Noroozi sp. nov. (subgen. *Allium*, sect. *Pallasia* (Tzag.) F.O. Khass., R.M. Fritsch et N. Friesen).**

Holotypus: Tehran: Tuchal mountains in N. Tehran, 35°53'34"N, 51°24'27"E, 3705 m, 14.7.2006. J. Noroozi 1181 (Holotypus IRAN, isotypus Hb. Akhani).

Other specimens examined: Tehran, Tuchal mountains, Istgah-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 diametro, tunicis exterioribus papyraceis, atrocinereis. Bulbilli nulli. Scapus 10-20 cm altus. Folia 2-3, scapo plerumque breviora, canaliculata, filiformia. Spatha 0.5 cm longa, bivalvis, persistentia. Umbella

sphaerica, multiflora, densa. Pedicelli circa 1 cm longi, basi bracteolati. Perigonium campanulatum. Tepala 2-2.5 mm longa, lucide-rosea, nervis violascentibus percursis, late lanceolata, obtusa. Filamenta 3-3.5 mm longa, lucide-rosea, basi connata et tepalis adnata, triangulari subulata. Antherae purpureae. Stylus exsertus. Capsula valvis circa 2.5 mm longis, obcordatis. Ab Allio capitellato tepalis brevioribus et floribus lucide-roseis differt.

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

Bulbs 1-1.5 cm in diameter, with dark greyish papery outer tunics. 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. tuchalense* are the most western representatives of this group, growing on the high altitude alpine meadows.

According to present knowledge, *A. tuchalense* is known from alpine area of Tuchal 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 *Oxytropidetea persicae* Klein (KLEIN 1994). It was found in some alpine communities such as *Jurinelletum frigidae* association, *Acantholimon-Onobrychis cornuta* community (*Acantolimo-Onobrychidetum cornutae* unpublished) and *Crepis heterotricha* community (*Crepietum heterotrichae* unpublished). In Table 1, a selection of 14 phytosociological relevés are given in the *Oxytropidetea persicae*

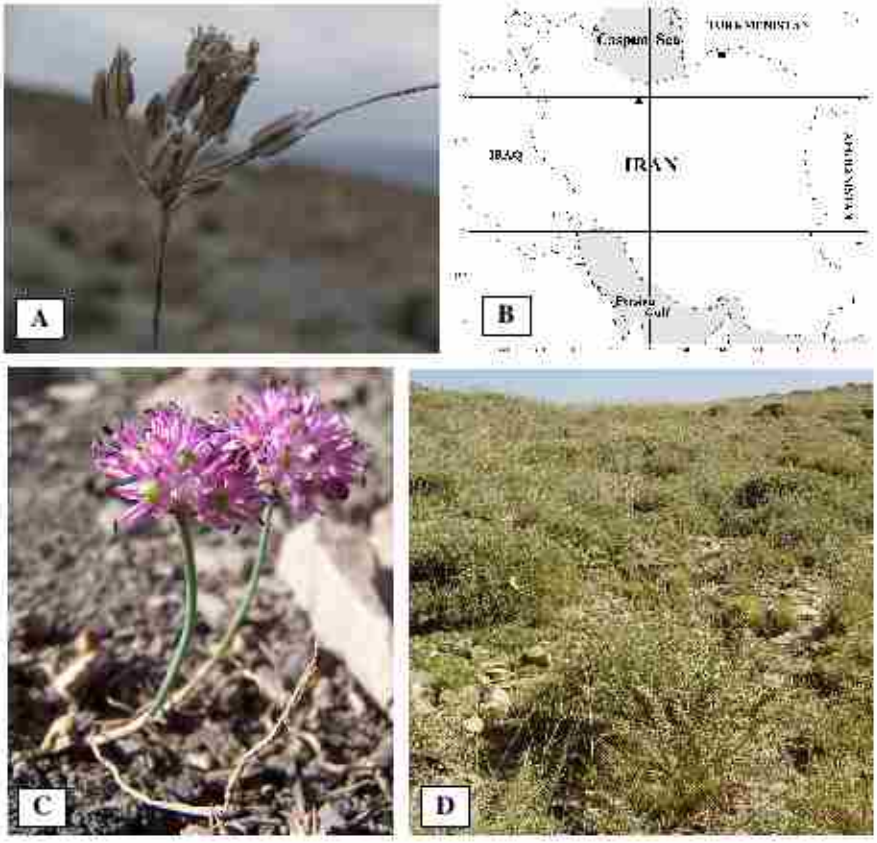

Fig. 1. A. *Allium autumniflorum*, B. distribution map of *A. autumniflorum* (dot) and *A. tuchalense* (triangle), C. *A. tuchalense*, D. The view of *Acantholimon-Onobrychis cornuta* community, habitat of *A. tuchalense*.

where *A. tuchalense* occurs. This Table provides raw data without syntaxonomical evaluation. The most characteristic species associate with the new species are *Trachydium depressum* (Boiss.) Boiss., *Astragalus macrosemius* Boiss. & Hohen., *Arenaria insignis* Litw., *Asperula glomerata* (M. Bieb.) Griseb., *Acantholimon cf. brachystachyum* Boiss., *Alopecurus textilis* Boiss., *Physoptychis gnaphalodes* (DC.) Boiss., *Oxytropis persica* Boiss., *Scorzonera meyeri* (C. Koch.) Lipsch., *Draba pulchella* Willd., *Poa araratica* Trautv., *Campanula ruprechtii* Boiss., *Ziziphora clinopodioides* Lam., *Bromus tomentosus* Tris., *Piptatherum laterale* (Regel) Roshev. and *Elymus transhyrcanus* (Nevski) Tzvelev.

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

The flowering time of *A. tuchalense* is usually from mid July to early August with the earliest in *Jurinelletum frigidae* and the latest in *Astragalo-Cousinion crispae* 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 *Oxytropidetea persicae* communities in which *Allium tuchalense* is associated

Relevé No.	**704**	**700**	**702**	**595**	**600**	**655**	**840**	**670**	**667**	**669**	**590**	**591**	**592**	**813**
Altitude (m) 3000 +	**550**	**550**	**550**	**792**	**773**	**685**	**710**	**557**	**730**	**782**	**778**	**784**	**710**	**714**
Aspect (degree)	**270**	**270**	**270**	**360**	**45**	**45**	**248**	**32**	**203**	**360**	**360**	**360**	**180**	**248**
Slope (degree)	**5**	**5**	**5**	**5**	**10**	**5**	**5**	**15**	**25**	**5**	**5**	**5**	**4**	**4**
Total cover %	**85**	**95**	**90**	**75**	**70**	**70**	**75**	**45**	**50**	**55**	**60**	**45**	**50**	**50**
Richness	**8**	**10**	**9**	**18**	**19**	**20**	**14**	**13**	**14**	**15**	**17**	**13**	**13**	**17**
Shannon diversity index	**1.6**	**1.6**	**1.5**	**2.3**	**2.3**	**2.4**	**1.8**	**2.3**	**2.3**	**2.4**	**2.5**	**2.2**	**2.3**	**2.5**
Relevé area (m^2)	**12**	**12**	**12**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**
Allium tuchalense	+	+	1	+	1	+	+	1	+	+	+	+	+	+
Hordetum violacei														
Hordeum violaceum	3	3	2	.	.	.	.	.	.	.	.	.	.	.
Polygonum serpyllaceum	1	2	2	1	1	.	.	.	.	.	.	.	.	.
Trifolium radicosum	3	3	3	.	.	.	.	.	.	.	.	.	.	.
Helichrysetum psycrophilum														
Helichrysum psychrophilum	.	.	.	2	1	1	.	.	.	.	.	+	.	.
Silene aucheriana	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Cousinion multilobae														
Cousinia multiloba	3	4	4	3	3	3	.	.	.	.	.	.	.	.
***Catabrosetalia parviflorae* Klein**														
Catabrosella parviflora	2	1	1	2	2	2	+	.	.				.	.
Cousinia crispa	1	1	1	+	.	1	.	.	.	.	.	.	.	.
Astragalus iodotropis	.	.	.	1	+	.	.	.	.	.	.	.	.	.
Acantolimo-Onobrychidetum cornutae														
Onobrychis cornuta	.	.	.	.	.	+	3	1	2	.	.	.	.	1

Table 1. (contd.)

Crepietum heterotrichae															
Crepis heterotricha	.	.	.	.	.	.	.	.	.	1	+	+	.	.	
Jurinelletum frigidae															
Jurinella frigida	.	.	.	.	.	.	.	.	.	.	1	.	2	2	
Astragalus capito	.	.	.	.	.	.	.	.	.	.	.	.	2	2	
***Trachydetalia depressae* Klein**															
Trachydium depressum	.	.	.	.	.	1	.	.	+	+	+	.	.	1	
Astragalus macrosemius	.	.	.	.	.	+	1	.	2	1	2	1	2	+	
Arenaria insignis	.	.	.	1	1	1	1	2	+	1	2	1	1	1	
Asperula glomerata	.	.	.	+	1	.	1	1	+	1	+	.	1	+	
Acantholimon cf. brachystachyum	.	.	.	.	+	1	1	1	2	.	2	.	2	2	
Alopecurus textiles	.	.	.	.	1	1	.	.	1	+	1	.	1	1	
Physoptychis gnaphalodes	.	.	.	.	.	.	.	1	.	.	.	.	2	2	
***Oxytropidetea persicae* Klein**															
Oxytropis persicus	.	.	.	+	.	1	+	.	.	.	.	.	.	.	
Scorzonera meyeri	.	.	.	1	1	1	1	.	.	+	+	1	.	.	
Draba pulchella	.	.	.	+	+	+	.	1	.	.	+	.	.	1	
Poa araratica	.	.	.	2	1	1	3	2	2	2	3	3	1	1	
Campanula ruprechtii	.	.	.	.	+	1	1	1	1	+	1	1	.	.	
Ziziphora clinopodioides	.	.	.	.	1	1	1	.	1	+	1	1	.	.	
Common in different habitats															
Bromus tomentosus	.	.	.	+	1	.	1	1	1	2	1	2	1	1	
Elmyas transhyrcanus	.	.	.	+	.	.	.	1	.	.	+	.	1	1	
Piptatherum laterale	1	1	1	1	1	2	.	.	1	+	.	.	.	.	

Species with low frequency: *Erigeron uniflorus* (595: +); *Gagea confusa* (600: +, 669: 1); *Ranunculus crymophylus* (595: +); *Herniaria incana* (600: +); *Tragopogon kotschyi* (700: +, 702: +, 813: 1); *Gagea* sp. (655: 1); *Minuartia mesogitana* (670: 1); *Polygonum molliaeforme* (840: 1, 670: 1, 592: 1); *Gagea alexeenkoana* (591: +).

Table 2. Associated species and plant communities of *Allium tuchalense* based on 14 selected relevés of the alliance *Astragalo-Cousinion crispae* belonging to the order *Catabrosetalia parviflorae*

Relevé No.	**648**	**629**	**645**	**635**	**636**	**642**	**632**	**757**	**758**	**640**	**644**	**633**	**786**	**788**
Altitude (m) 3000 +	**680**	**766**	**700**	**745**	**750**	**740**	**730**	**740**	**740**	**750**	**700**	**735**	**665**	**703**
Aspect (degree)	**270**	**90**	**270**	**270**	**270**	**270**	**270**	**270**	**270**	**270**	**293**	**270**	**45**	**270**
Slope (degree)	**10**	**5**	**15**	**15**	**15**	**15**	**15**	**10**	**10**	**15**	**15**	**15**	**20**	**10**
Total cover %	**80**	**75**	**70**	**75**	**65**	**55**	**75**	**80**	**75**	**70**	**70**	**80**	**80**	**85**
Richness	**9**	**14**	**10**	**11**	**12**	**12**	**12**	**13**	**12**	**13**	**10**	**11**	**14**	**16**
Shannon diversity index	**1.6**	**2.1**	**1.8**	**1.9**	**1.8**	**1.8**	**2.1**	**1.8**	**1.7**	**2**	**1.3**	**1.8**	**2.1**	**2.1**
Relevé area (m2)	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**
Allio-Trigopogetum kotschyi														
Allium tuchalense	+	+	1	2	+	+	+	+	1	1	1	1	+	1
Trigopogon kotschyi	1	2	2	+	.	1	+	1	1	1	1	.	.	1
Astragalo-Cousinion crispae														
Astragalus iodotropis	3	3	3	3	3	3	2	3	3	2	4	2	2	1
Cousinia crispa	.	.	.	2	2	2	2	1	1	3	.	3	3	3
Helichrysum psychrophilum	.	1	+	1	1	+	1	2	1	2	1	+	2	1
Catabrosetalia parviflorae														
Taraxacum brevirostre	+	+	+	2	1	+	1	1	1	1	1	+	.	1
Catabrosella parviflora	2	2	2	2	1	1	2	3	3	2	2	2	3	3
Polygonum serpyllaceon	3	2	+	1	1	.	.	1	1	+	.	.	.	1
Draba pulchalla	.	.	+	1	+	1	+	1	1	+	1	1	1	1
Scorzonera meyeri	.	1	.	.	.	.	+	.	.	1	+	.	.	.
Piptatherum laterale	2	2	2	1	1	1	1	.	1	1	1	1	2	2
Bromus tomentosus	.	+	.	1	+	2	2	.	.	.	.	1	1	1
Silene aucheriana	.	.	.	.	.	.	.	+	.	1	+	1	.	.

Table 2. (contd.)

Species with low frequency: *Gagea alexeenkoana* (757: 1, 786: 1: 788: 1); *Poa araratica* (788: 1); *Veronica kurdica* (786: 1); *Silene marschallii* (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); *Ziziphora clinopodioides* (629: 1); *Erysimum caespitosum* (636: +; 642: +); *Erysimum nanum* (757: +; 758: 1; 766: 1) *Gagea* sp. (648: 1); *Potentilla argyroloma* (757: 1).

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NOTES ON THE FLORA OF IRAN 6: EIGHT NEW PLANT RECORDS FROM IRAN COLLECTED FROM KHORASAN AND GOLESTAN PROVINCES (N.E. IRAN)*

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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 tschernjaewii* Regel, *Cephalorrhynchus picridiformis* (Boiss.) Tuisl., *Elatine hydropiper* L., *Gaillonia dubia* Aitch. & Hemsl., *Pseudosedum longidentatum* Boriss., and *Scrophularia nikitinii* Gorschk. 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 nikitinii*.

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

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* Continued from GHOBADNEJHAD *et al.* 2004, AKHANI 2003

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Introduction

The Khorasan 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 Hyrcanian 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

***Cephalorrhyncus picridiformis* (Boiss.) Tuisl, Ann. Nat. Mus. Wien 72: 619 (1968)** (Fig. 1)

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

Material examined:

Khorasan: S.E. Torbat-e Heydarieh, Pir Yahoo, 25.6.2003, 1600 m, Joharchi 34858 (FMUH).

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.

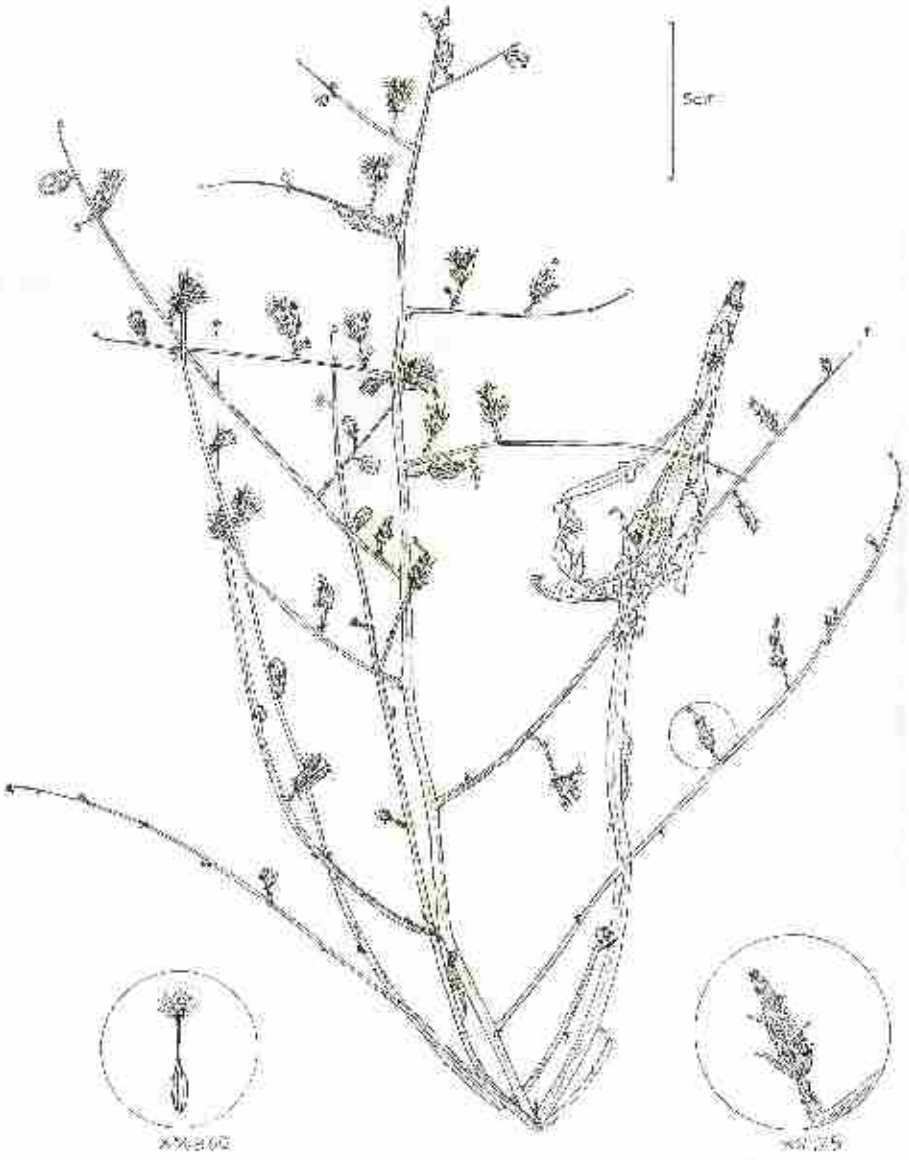

Fig. 1. The line drawing illustration of *Cephalorrhyncus picridiformis* (Boiss.) Tuisl.

Brassicaceae

***Leptaleum hamatum* Hemsl. & Lace, Journ. Linn. Bot. 28: 321, tab. 38 (1891)**

Type: Pakistan: Quetta, Sheila Bagh, 1800 m, Lace 3325 (K!).

Material examined:

Khorasan: S. Gonabad, Kakhk, mountains between Kalat-e-no and Pagodar, 2000 m, 24.4.1990. Faghihnia & Zangooei 18374 (FMUH, Hb. H. Akhani).

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 Shahreza, 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 glandulose hairs and hooked siliquae. The hairs in *L. linifolium* are branched and the fruits are not hooked at apex. In accordance with MEHRNIA (l.c.), the distinction of both species is well justified by constant characters.

Caryophyllaceae

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

Material examined:

Khorasan: Nehbandan, Shosf, between Afzal-abad and Murghzar, 31°55'9"N, 60°15'18"E, 1711 m, 18.5.2005, Joharchi & Zangooei 36242 (FMUH, Hb. H. Akhani).

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).

***Acanthophyllum stenostegium* Freyn, Bull. Herb. Boissier Sér. 2, 3: 866 (1903)**

Material examined:

Khorasan: Kelat-e Naderi, at the beginning of Geroo road, 16.5.2005. Izadi 36220 (FUMH, Hb. H. Akhani).

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).

Crassulaceae

***Pseudosedum longidentatum* Boriss. Acta Inst. Bot. Acad. Sci. URSS. 1: 109 (1933)**

Materials examined:

Khorasan: S.E. Ghaen, between Dozg and Ahangaran, 1500 m, 15.5.1989. Joharchi & Zangooei 17363 (FMUH); Between Ghaen and Gonabad, near Khezri, Pir-mardan Shah, 19.5.1986, Ayatollahi & Zangooi 14385 (FMUH); S Birjand, Omar Shah dam (Band-e Omar Shah), 18.5.1986, Ayatollahi & Zangoei 14301 (FMUH).

A first record from Iran; *Pseudosedum longidentatum* is distinguished from the widespread *P. multicuale* 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, Pamir-Alaj) and Afghanistan (JANSSON & RECHINGER 1970).

Elatinaceae

***Elatine hydropiper* L. Sp. Pl. 367 (1753)**

Material examined:

Golestan: Northwestern parts of Golestan National Park, Sulukli Lake, 37°29'41"N, 55°46'20"E, 1349 m, 12.7.2003. H. Akhani 17053.

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

already known from recently discovered and isolated Sulukli lake. The previous records are *Alopecurus aequalis* Sobol., *Carex pseudocyperus* L., *Ceratophyllum submersum* L., *Potamogeton filiformis* Pers., *P. natans* L. and *Salix cf. caprea* L. (AKHANI & SCHOLZ 1998, AKHANI 1999, 2005).

Ranunculaceae

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

Khorasan: Sarakhs, between Gonbadli and Shurijeh, 500 m, 8.4.1987, Ayatollahi & Zangooei 15076 (FMUH); S.W. Mashhad, Najafi montains, 1200 m, 21.4.1985, Joharchi & Safavi 12117 (FMUH).

The finding of *A. tschernjaewii* 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 Tadjikistan, 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 segements 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:

Khorasan: Ghaen, Zirkuh, West of Darej-e Olia, near water storage tank, 1233 m, 33°24'18"N, 60°10'10"E, 19.5.2005, Joharchi & Zangooei 36260 (FMUH, Hb. H. Akhani).

This species was recorded as endemic from various localities in N.W. and West Afghanistan by EHRENDORFER & SCHÖNBECK-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-na leaves, which are 17-23 mm long and 1-2 mm broad and pedicellate basal flowers.

Scrophulariaceae

***Scrophularia nikitinii* Gorschk., Not. Syst. Leningrad 16: 333 (1954)** (Fig. 3)

Material examined:

Khorasan: Torbat-e Jam, N. Saleh-abad, Kuh-e Zaloo, 2.6.2003, 1250-1300 m, Joharchi & Zangooei 34609 (FMUH, Hb. H. Akhani).

Scrophularia nikitinii Gorschk. is easily distinguishable by broad ovate and petiolate leaves which are slightly denticulate 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, Badhys, Jugum Gjas-Gjadyk, in Rachmatar mount. (GRAU 1981). It is known from several localities in the lower mountain zone in N.W. of Afghanistan (Fig. 4).

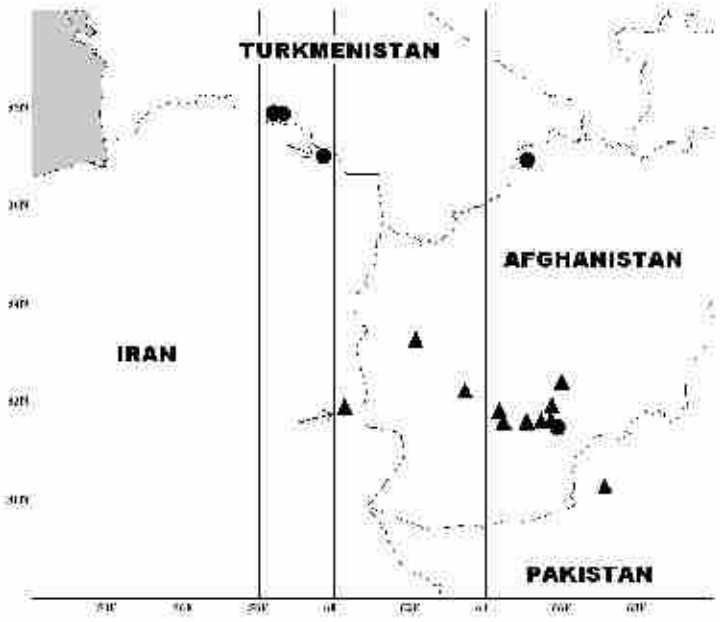

Fig. 2. Distribution map of *Acanthophyllum kandaharicum* (triangle) and *A. stenostegium* (dot) and. The new records in Iran are indicated by arrows.

Fig. 3. Line drawing illustration of *Scrophularia nikitinii* Gorschk.

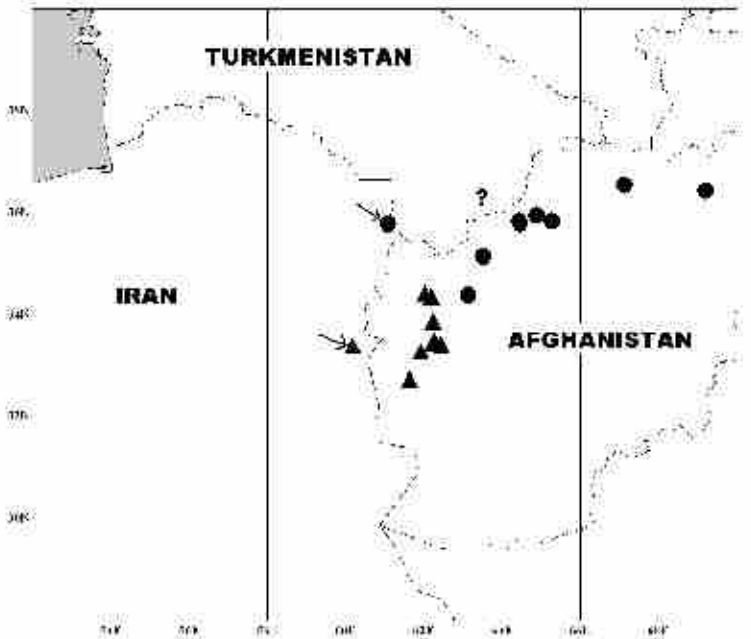

Fig. 4. Distribution map of *Gaillonia dubia* (triangle) and *Scrophularia nikitinii* (dot). The new records in Iran are indicated with arrows. The type location of *S. nikitinii* is indicated by a question mark.

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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 Papilinaceae as the two large families among the 91 families. During my work gething acquinted 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-Zagrosina Province. Each of the above two parts is further divided into four subdivisions. The determinated 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 determinating 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 Kermanshah 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 mountainy 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 mountainy parts of province which continued from North West to South East with the altitude of 2790 m from Sea level, Gachan, 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, Lumar, Badre, Darreshahr, 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.

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 Poshtkuh 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. Behboudii, 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 beginned 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 nummularia, Hammada salicornica, Capparis spinosa, Silybum marianum, Tamarix ramosissima,*

Pteropyrum naufelum, Satureja khuzstanica, Salsola lachnantha, Centaurea intricata, Astragalus fasciculifoliu and *Astragalus kentrophyllus*, are well spread and make the physignomial features of the province in lowlands, and *Quercus brantii, Astragalus brachycalyx, Daphne mucronata, Pistacia atlantica* and *Astragalus microcephalus* in mountainy area of the province.

Based on physiognomical, ecological and floristic criteria, Ilam 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 vegetion

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:

Alhagi mannifera
Annual grasses
Capparis spinosa
Hammada salicornica
Prosopis farcta
Silybum marianum
Vitex pseudonegundo
Ziziphus nummularia

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

Anabasis setifera
Astragalus fasciculifolius
Atriplex leucoclada
Centaurea bruguierana
Centaurea hyalolepis
Cornulaca monacantha
Echinops kermanshahanicus
Erucaria hispanica
Gypsophila obconica
Gypsophila linearifolia
Halocharis sulphurea
Haplophyllum tuberculatum
Heliotropium denticulatum
Heteranthelium piliferum
Notobasis syriaca
Pycnocycla flabellifolia
Salsola jordanicola
Salsola lachnantha
Salsola nitraria
Salsola orientalis
Salsola tomentosa
Seidlitzia rosmarinus
Stipa capensis
Verbascum assurgens

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

Acacia farnesiana
Acacia salicina
Acacia saligna
Albizzia lebbeck
Bougainvillea glabra
Bougainvillea spectabilis
Buhinia purpurea
Callistemom viminalis
Citrus sinensis
Clerodendron inermis
Calotropis procera
Dodonea 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 bracteatum
Alhagi mannifera
Astragalus fasciculifolius
Calligonum intextextum
Capparis spinosa
Carthamus oxyacantha
Centaurea bruguierana
Centaurea hyaloleis
Citrullus colocynthis
Convolvulus oxyphyllus
Cornulaca aucheri
Cyperus eremicus
Diplotaxis harra
Echinops psammophilus
Erucaria hispanica
Haplophyllum tuberculatum
Heliotropium ramosissimum
Hyparrhenia hirta
Launaea mucronata
Moltkiopsis ciliate
Olivieriana decumbens
Onopordon leptolepis
Pimpinella barbata
Plantago Boissieri
Stipagrostis plumose

1.3. Permanent riverbed dominated by:

Alhagi mannifera
Arundo donax
Capparis spinosa
Lycium shawii
Mentha longifolia
Phragmites australis
Popolus euphratica
Prosopis farcta
Salsola foetida (imbricata)
Tamarix ramosissima
Vitex pseudonegundo

1.4. Mostly shrublands and calcareous badland and hilly parts covered by:

Acantholimon blackelokki
Acanthophyllum bracteatum
Achillea oligocephala
Alcea aucheri
Alhagi mannifera
Amygdalus arabicus
Amygdalus lycioides
Anchusa strigosa
Aristida adscensionis
Aristida caerulescens
Artemisia sieberi
Arundo donax
Astragalus fasciculifolius
Astragalus gossypinus
Astragalus kentrophyllus
Astragalus meridionalis
Astragalus trifoliolatus
Capparis spinosa
Carthamus oxyacantha
Centaurea intericata
Chesneya rhytidosperma
Cleome oxypetala
Convolvulus reticulates
Cornulaca monacantha
Cousinia stenocephala
Diplotaxis harra
Echinops kermanshahanicus
Echinops pachyphyllus
Echinops tenerrimus
Enneapogon persicus
Ephedra foliata
Ephedra transitoria
Erodium oxyrrhynchum
Ferula behboudiana
Ferulago macrocarpa
Ficus rupestris
Gaillonia bruguieri
Glaucium oxylobum
Gundelia tournefortii
Halothamnus iranicus
Haplophyllum tuberculatum
Helianthemum lippii
Heliotropium denticulatum
Hyparrhenia hirta
Mozaffariania insignis
Noaea mucronata
Onosma dasytrichum
Onosma longirostris
Periploca aphylla
Phlomis olivieri
Pistacia khinjuk
Popolus euphratica
Prosopis farcta
Pteropyrum naufelum
Pycnocycla flabellifolia
Reseda aucheri
Rumex ephedroides
Saccharum ravennae
Salsola jordanicola
Salsola orientalis
Salvia palaestina
Satereja khuzistanica
Scrophularia striata
Scutellaria pinnatitida
Stipagrostis plumosa
Taverniera nummularifolia
Teucrium olivierianum
Teucrium polium
Thymbra spicata
Thymus daenensis
Trachomitum venetum
Verbascum alceoides
Vitex pseudonegundo
Ziziphus nummularia
Zoegea 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, Popolus euphratica, Pycnocycla flabellifolia, Artemisia* sp., *Ducrosia flabellifolia, Hyoscyamus orthocarpus, Ferula behboudiana, Albraunia fugax* and *Trachomitum venetum*. *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, Acer monspessulanum* and *Crataegus azarulus* as dominant species together with loose and spreading species of trees and shrubs like:

Amygdalus elaeagnifolia
Amygdalus haussknechtii
Amygdalus lycioides
Astragalus fasciculifolius
Celtis caucasica
Cerasus mahaleb
Cerasus microcarpa
Cercis griffithii
Contoneaster luristanica
Crataegus sp.
Cupressus tempervirens var. *horizontalis*
Daphne mucronata
Daphne oleoides
Ficus carica
Ficus rupestris
Fraxinus rotundifolia
Hedera helix
Lonicera nummulariifolia
Myrtus communis
Olea europaea
Paliurus spina-christii
Pistacia khinjuk
Popolus euphratica
Pterocarya fraxinifolia
Pyrus glabra
Pyrus syriaca
Rhamnus pallasii
Rosa canina
Rosa elymaitica
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
Carthamus oxyacantha
Centaurea solstitialis
Cephalaria dichaetophora
Euphorbia azerbaiejanica
Euphorbia macroclada
Euphorbia macrostegia
Heteranthelium piliferum
Picnomon acarna
Trachynia distachya

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:

Alhagi persarum
Amygdalus lycioides
Artedia squamata
Astragalus adscendens
Astragalus compactus
Astragalus ecbatanus
Astragalus fasciculifolius
Astragalus gossypinus
Astragalus microcephalus
Astragalus neo-mozaffariani
Astragalus piptocephalus
Astragalus rhodosemius
Capparis parviflora
Capparis spinosa
Carthamnus oxyacantha
Centaurea elymaitica
Centaurea elymaitica
Centaurea irritans
Centaurea koeiana
Centaurea paradoxa
Chaerophyllum macropodum
Cirsium congestum
Cirsium spectabile
Codonocephalum
Convolvulus chondrilloides
Cousinia cylindracea
Cousinia jacobsi
Daphne mucronata
Dianthus orientalis
Dionysia gaubae
Dionysia lurorum
Dionysia zagrica
Dorema aucheri
Echinops kermanshahanicus
Echinops mosulensis
Echinops pachyphyllus
Echinops tenerrimus
Eryngium creticum
Eryngium glomeratum
Eryngium noeanum
Euphorbia denticulata
Euphorbia macroclada
Ferula haussknechtii
Ferula oopoda
Ferulago angulata
Ferulago contracta
Ferulago macrocarpa
Ferulago stellata
Glycyrrhiza glabra
Gundelia tournefortii
Gypsophila pallida
Heptaptera anisoptera
Hordeum bulbosum
Hypericum helianthemoides
Hypericum scabrum
Linaria fastigiata
Marrubium vulgare
Marsdenia erecta
Nepeta kotschyiana
Nepeta persica
Onopordon carduchorum
Onosma dasytrichum
Onosma sericeum
Phagnalon rupestris
Phlomis bruguieri
Phlomis olivieri
Phlomis pungens
Picris trigosa
pimpinella olivieriana
Prangos ferulacea
Prangos uloptera
Pterocephalus canus

Rubus anatolicus
Rumex ephedroides
Salvia bracteosa
Salvia multicaulis
Salvia palaestina
Scariola orientalis
Serratula cerinthifolia
Smyrniopsis aucheri
Smyrnium cordifolium
Stachys benthamiana
Stachys inflate
Stipa spp.
Trigonella elliptica

2.3. Shrubby parts upper than *Quercus* growing line

Mostly have plants species like:

Acer monspessulanum
Alkanna orientalis
Amygdalus elaeagnifolia
Amygdalus haussknechtii

and other herbaceous plants like:

Acantholimon erinaceum
Acanthophyllum microcephalum
Artemisia haussknechtii
Asperula glomerata
Astragalus abnormis
Astragalus brachycalyx
Astragalus lagonix
Astragalus microcephalus
Astragalus myriacanthus
Astragalus neo-mozaffariani
Astragalus sanandajensis
Asyneuma multicaulis
Atraphaxis spinosa
Aubrietia parviflora
Bunium luristanicum
Bupleurum falcatum
Celtis caucasica
Centaurea irritans
Cerasus mahaleb
Cerasus microcarpa
Cerasus pseudoprostratus
Cicer spiroceras
Cotoneaster luristanica
Cousinia cylindracea
Cousinia haussknechtii
Crataegus azarulus
Daphne mucronata
Dianthus orientalis
Dionysia zagrica
Ferula haussknechtii
Fibigia macrocarpa
Galium mite
Glycyrrhiza glabra
Gundelia tournefortii
Hesperis leucoclada
Hyoscyamus senecionis
Linaria fastigiata
Lonicer nummulariifolia
Marrubium astracanicum
Mindium laevigatum
Minuartia linearis
Nectaroscordum tripedale
Nepeta persica
Noaea mucronata
Onobrychis cornuta
Onosma haussknechtii
Pentanema pulicariforme
Phlomis olivieri
Pimpinella deverroides
Pimpinella tragium
Pistacia atlantica
Pistacia khinjuk
Prangos uloptera
Pterocephalus kurdicus
Rhamnus pallasii
Salsola canescens
Salvia bracteata
Satureja bachtiarica
Scrophularia frigida
Solenanthus circinnatus
Stachys acerosa
Symrnium cordifolium
Tanacetum polycephalum
Tulipa stylosa
Ziziphora clinopodioides

2.4. High mountains and cushion-shaped plants area

Acantholimon erinaceum
Aethionema grandiflora
Agropyrum spp.
Artemisia haussknechtii
Astragalus adscendens
Astragalus microcephalus
Astragalus myriacanthus
Bupleurum falcatum
Euphorbia macrostegia
Ferulago angulata
Festuca ovina
Fibigia macrocarpa
Johreniopsis scoparia
Lamium album
Marrubium astracanicum
Onobrychis cornuta
Parietaria judaica
Parlatoria cakiloides
Pterocephalus kurdicus
Rosularia elymaitica
Tanacetum polycephalum

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

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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.

Key words: *Astragalus*, *Ornithopodium*, Ilam, Iran

Introduction

Ilam Province with a surface approximately 1,908871 hectars 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 associatrion 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 branti 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 qoueted a known floristic area as Posht kuh in the west of the country.

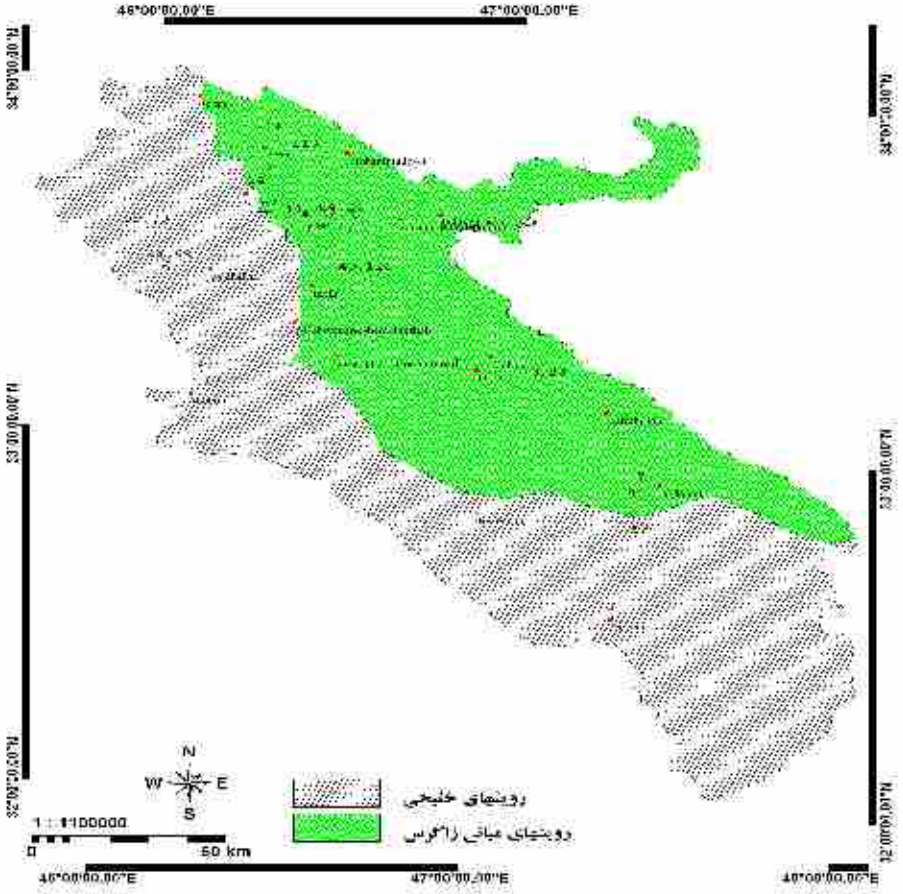

Fig.1. Ilam Province map showing crossing of two phytogeographical regions in which the localities number for *Astragalus* spp. has been collected.

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

No.	Locality	Altitude (m)
1	Ilam, Michkhas, margin of fields	1320
2	Dehloran, Andimeshk, close to Chame-Hendi	180
6	Salehabad, Rika, Hills S. of Rika	760
7	Abdanan, Dinar kuh	-
8, 10, 27	Ilam, Kuh-e Ghalarang, Ghalandar pass	2160
9, 79	Ilam, Meime to Malekshahi, Chesmeh Pahn	1550
12	Ilam to Chavar	1090
14, 93, 114	Ilam, Chavar, Tang-e Dalab	1370-1900
15, 39, 67	N. slope of Reno tunnel	1730
26	Ilam, Arghavan valley	1600
29	slope of Kabir-kuh from Meime	1900-2200
30	Ilam, Gachan mountain	2200-2400
31	Ilam, Ghalarang, Malegavan	2200
37	Mehran, c. 5 km from Gonbad-e Pirmohammad to Malekshahi	-
40, 87	Chenar Bashi	1060
68	Salehabad, Kulek	700
69	Salehabad, Sarnei to Meimak	400
70	Close to diviation Meimak-Sumar-Eivan	450
74	Salehabad, S. of Salehabad, Kurek Surkh	540
77	Ilam, around Ilam Dam	1070
81	Abdanan, Anjire to Ananan	-
82	Abdanan to Murmury	805
86	Badre, Tang-e Kafari	700
118	Eivan, Bankul	1880-2000
120	Eivan, Charmale	1450
123	c. 4 km from Meime to Zarrinabad	-
126	Ilam, Mishkhas, Kuh-e Seivan	2400

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. zarreianus* where only two species described from Ilam Province such as *A. ferruminatus* and *A. zarreianus*.

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. *Incani*. Distribution pattern of this species is nearly broad but in the same region, Bakhtaran and Lorestan Provinces.

A. adulterianus 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. brachycalyx 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. caryolobus* (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. mardabadensis*" 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. ecbatanus Parsa **(12, 7)**

It is 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. ferruminatus Maassoumi **(118)**

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

A. flexilipes 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. glumaceus Bunge

Within the sect. *Hymenostegis*, 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 Ilam Province, this species as a canopy in the woodland of *Quercus branti* 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. hamosus L. **(1)**

Annual species growing on the great part of the country.

Astragalus 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 differt leguminibus linearis (nec anguste ellipticum), inflorescentiae remotiusculae, laxe (nec dense subcapitatae).

Plants 60-70 cm tall, densely covered with symmetrically to assymetrically mediflxed, appressed hairs. Caudex 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 basifixed 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. Leaflets in 1 pair, in upper leaves unifoliate, 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. Peduncles 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-ventraly 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 iland 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 boundry.

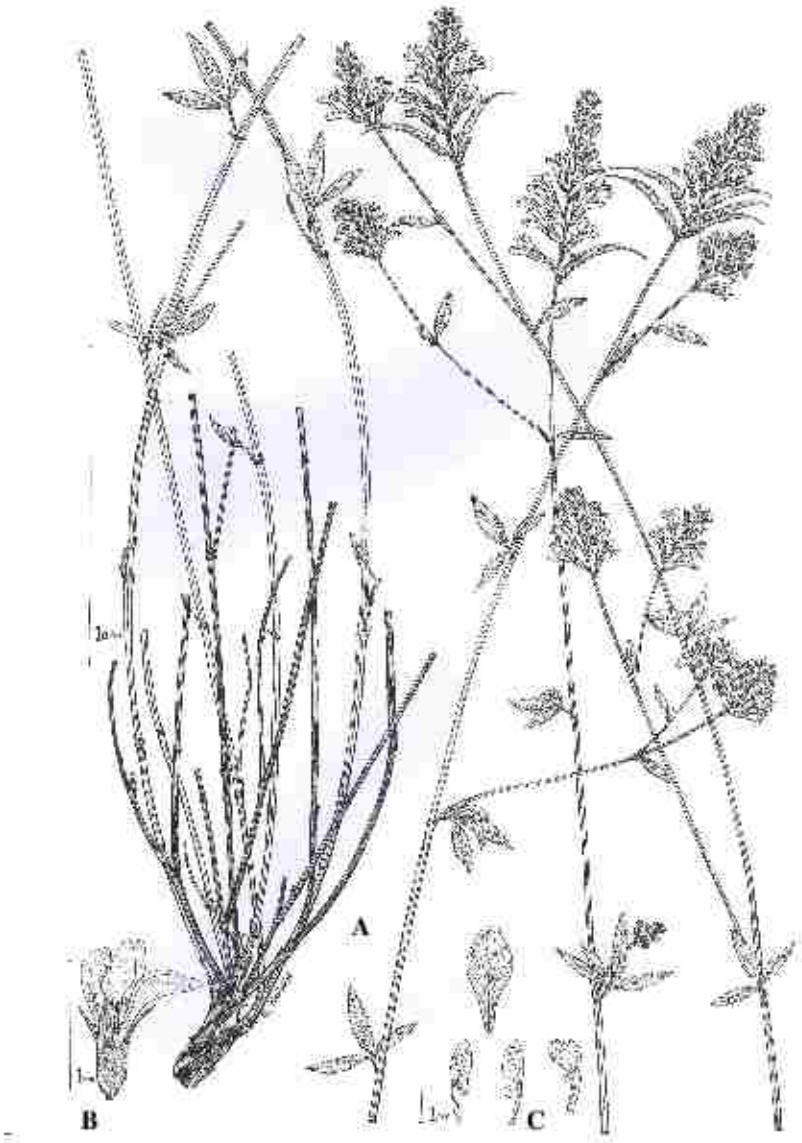

Fig. 2. *Astragalus heinzianus*: A. Habit, B. Flowers, C. Flower dissection.

A. kirrindicus Bunge **(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 Bunge **(82)**

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

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

***A. myriacanthus* (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 Maassoumi **(27)**

This is a distinct tragacantic species which grows in the fissure of the calcareous rocks like *A. zoharyi*. Within tragacantic 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 rupesterial 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. oleaefolius* (6)**

Based on previous collection, this species is widely distributed at high altitude in several localities of central and westhern 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, Yassuj, 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. rhodosemius* (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. sevangensis* (18)**

A common foddery species in high altitude.

***A. sieberi* (3)**

Based on a single speciemen, 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 Saharo-Arabian 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. trifoliolatus Boiss **(69, 70)**

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

A. verus 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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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. *leiocaules* Bunge due to its morpholofical characters discussed in the paper.

Key word: *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).

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The genus *Cousinia* Cass. belongs to the Arctium group tribe Cardueae subtribe Carduinae (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).

In Iran, *Cousinia* is represented by more than 240 species, grouped into 50 sections (RECHINGER 1972, 1979, GHAHREMAN, IRANSHAHR and ATTAR 1999, ATTAR & GHAHREMAN 2000, ATTAR & GHAHREMAN 2002, ATTAR, GHAHREMAN & ASSADI 2000, 2001, MEHREGAN, ASSADI & ATTAR 2003 DJAVADI & ATTAR 2005), so, after genus *Asteragalus* L., *Cousinia* is the largest genus in Iran.

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; Koptedagh (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 Kopetdagh (RECHINGER 1972, 1979). Here, the number of species decreases sharply towards the west, Turanian lowlands and central deserts of Iran.

This paper is on the basis of a field trip to the poorly investigated areas of Khorasan 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 (boundray area between Iran and Afghanistan) and north (boundary area between Iran and Turkmanestan) of Khorasan 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.

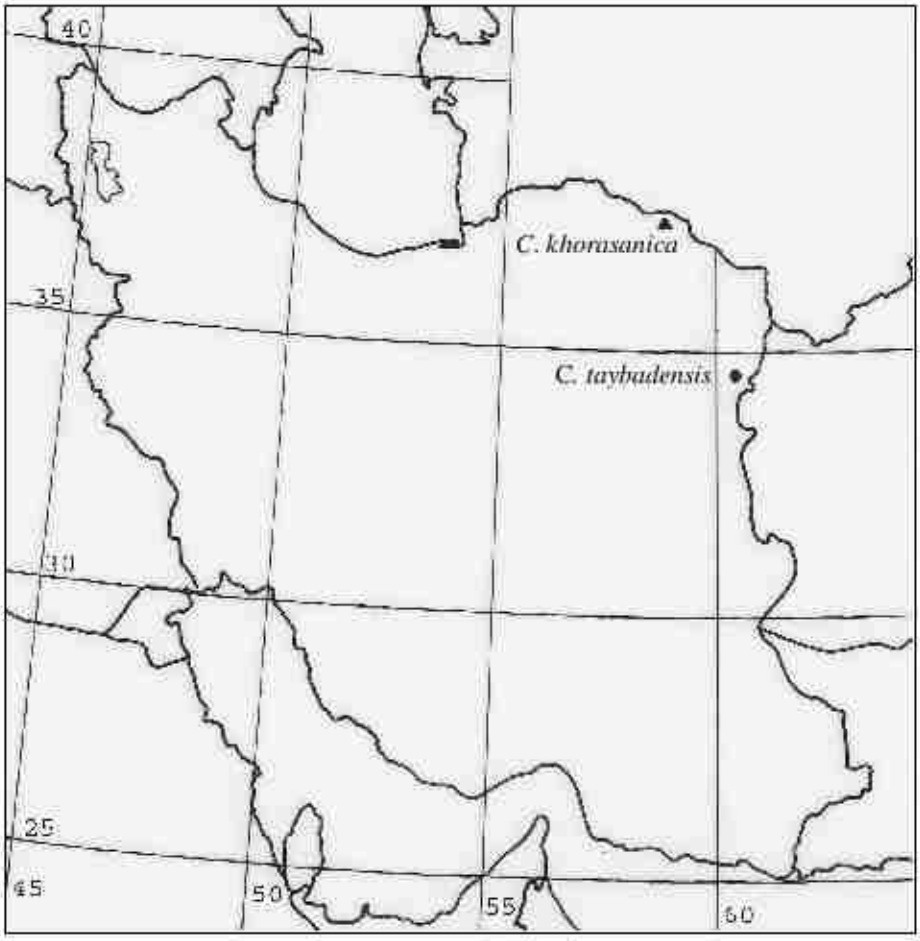

Fig. 1. Distribution of the two new species of *Cousinia*.

***Cousinia taybadensis* Djavadi & Attar, sp. nova** (Figs 2-4)

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

Suffruticoso-caespitosa, perennis. Caulis 8-18 cm altus, breviter ramosus, foliatus, albo-eburneus, glaber. Folia coriacea, omnino spinosa, sinuato-lobata, glabra, virida; folia basalia et caulina inferiora elliptica 2-4 x 1.5-2 cm, petiolata, petiolo usque 2 cm longo suffulta, basi truncata; folia caulina triangularia 2-2.5 x 1.5-2 cm, sessilia, non decurrentia, basi subcordata, ± auriculata; nervatura centralia alba, prominens. Capitula plus minusve 35 flora, 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 araneosum vel glabrum; phylla plus minusve 40, 8- seriata; phylla exteriora et intermedia linearia, basi appressa, superne in spinam patulam, raro apice reflexo-hamatam abeuntia; phylla intima recta, purpurea, araneosa, acuminata, margine scariosa, quam intermedia longiora. Receptaculi setae laeves. Corolla purpurea, 15mm longa, tubo 6mm, limbo 9 mm, laciniis 3mm longis. Antherarum tubus purpurascens, glaber. Achaenia matura ignota, verisimiliter atrobrunnea, pyramidata, basi attenuata.

Perennial, suffruticose, caespitose. Stem 8-18cm tall, shortly branched, leafy, ivory white, glabrous.Leaves coriaceous, triangular or oblong, all spiny, sinuate-lobed, 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, inclusing spines 1.5-2 x 1.5 cm in diam.,

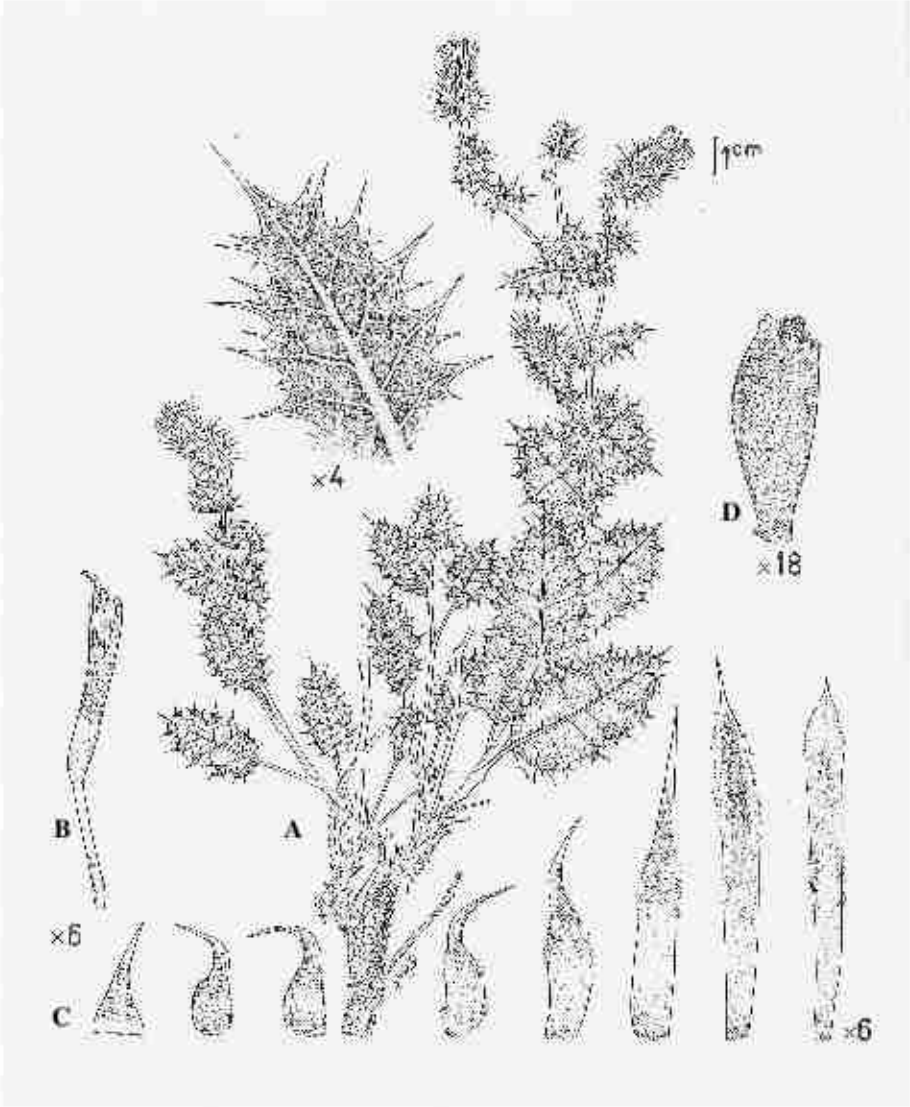

Fig. 2. *Cousinia taybadensis*: (A) Habit, (B) Flower, (C) Involucral bracts, (D) Achene.

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, attenuate 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 achens not seen, but apparently deep brown, pyramidate, attenuate towards base.

Cousinia taybadensis can not be exactly assigned to any of the known sections. Although,it seems to be 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 cacitule 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 Emam-Gholi, Rahman-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 furcato-ramosus, polycephalus. Folia omnia tenuiter coriacea, discoloria, supra viridian, valde glabrescentia vel omnia glabra, lucida, subtus appresse albo-araneosa-tomentosa, nervatura pennato-reticulata, utrinque prominens, nervis in spinas marginales alteratim breviores et longiores excurrentibus, apice longius spinosa; folia basalia 7-8 x 3.5 cm, sessilia, non decurentia, sinuato-lobata, lobo terminali apice rotundata, margine spinoso-dentata,

lateralibus quinquelobatis, ovato-late lanceolata, lobis in spinam terminalem fere longam excurrentibus, margine spinoso-dentata; folia caulina inferiora c. 5 x 3 cm, sessilia, ± oblonga, spinoso-dentata; folia caulina superiora sessilia, basi rotundata-cordata, acuminata, margine spinoso-dentata; folia summa decrescentia, a capitulis remota. Capitula singular, terminalia, spinis inclusis c. 2.5 cm diametro, multiflora; involucrum absque spinis c. 1.5 cm, ovatum, basi rotundatum, superne constrictum, araneosum; Involucri phylla numerosus, multiseriata, coriacea, lanceolata, e basi appresse sensim in spinam terminalem vulnerantem 5 mm longam attenuata, recurvata, exima virescentia, lateraliter utrinque spinis 2 brevioribus praedita; phylla intermedia lanceolata ± 5 mm lata sensim in apicem acutam; phylla intima prominentia, scariosa, lineari-lanceolata, sinsim acuminata, superne purpureo-violacea, araneosa. Receptaculi setae leaves. Corolla pallide rosea, c. 22 mm longa, tubo 9.5 mm, lacinis ± 3 mm longis. Antherarum tubus roseus, glaber. Achaenia matura ignota.

Perennial. Stem 20-22 cm high, upright, slightly arachnoid, glabrecens, leafy, divaricate-furcate-branched almost in upper half, branches one-headed. Leaves leather-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 cauline leaves c.5 cm long, 3 cm wide, sessile, ± oblong; middle caulin leaves sessile, cordate at the base, dentate-spinose at margin, extended in prickle 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 numerous, leather-like, close-appressed at base, sickle-shaped-curved, spine-sharp-pointed, ± 5 mm long; external ones terminated in 5 mm spine, with 1-2 spinules 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. Crollas pale pink.

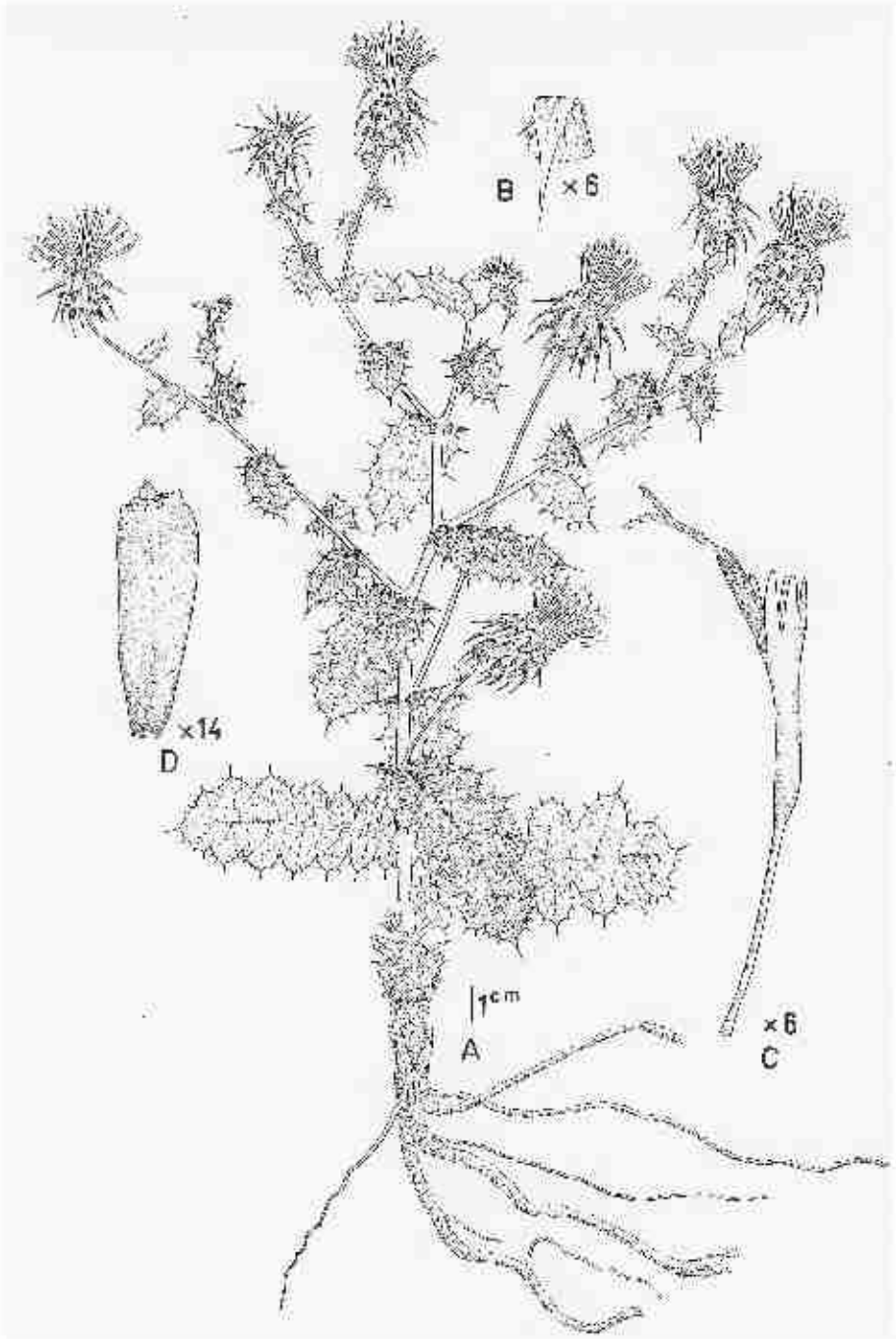

Fig 5. *Cousinia khorasanica*: (A) Habit, (B) External involucral bract, (C) Flower, (D) Achene.

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 leiocaules Bunge. The most important morphological characters of this section are as follow:

Perennial with woody polycephalous rootstocks or undershrubs. Stem short or long, glabr or later glabrescent, branched in upperpart, 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 1. Differences between *Cousinia khorasanica*, *C. antonowii* and *C. affinis*

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

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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 *trn*L intron and *trn*L-*trn*F intergenic spacer sequences (cpDNA *trn*L-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 *trn*L/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 Colutoid 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*.

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Key words: Fabaceae, nrDNA-ITS, *Oreophysa*, phylogeny, cpDNA *trn*L-F

Introduction

BROWICZ (1963) in a short article, reviewed the taxonomic history of the enigmatic monotypic genus *Oreophysa* (Bunge ex Boiss.) Bornm. Based on a herbarium specimen (Aucher-Eloy s.n.), *Oreophysa 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 suffruticose 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. *Oreophysa* Bunge ex Boiss for this species (BOISSIER 1872). BORNMULLER (1905) elevated this taxon from the sectional to generic rank as *Oreophysa triphylla* (Bunge ex Boiss.) Bornm. 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 *Oreophysa 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 suffruticose 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 *Oreophysa* 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 *trn*L intron and *trn*L-*trn*F intergenic spacer (here abbreviated as cpDNA *trn*L-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 *trn*L-F region was amplified using primers *trn*L-c and *trn*L-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 *trn*L-F.

nrDNA ITS and cpDNA *trn*L-F sequences for *Oreophysa microphylla*, nrDNA ITS for *Biserrula pelecinus* L. and cpDNA *trn*L-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 *trn*L-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 MulTrees 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*trn*L-F phylogenetic analyses

Species	DNA source (location, voucher)[a]	GenBank Accession No. nrDNA ITS	GenBank Accession No. cpDNA *trn*L-F
Astragalus adsurgens Pallas	China: USDA 462310, W & S 267	AF121674	AF126980
A.asterias Hohen.	Iran: Runemark & Mozaf. 30957 (TARI)	AB051917	-
A.asterias Hohen.	Morocco:USDA 514691, W & S 169	-	AF126989
A. echinatus Murray	Morocco: Podlech 46718 (TARI)	AB051938	AB287411[c]
A. arizonicus A. Gray	USA: Sanderson 968	AF121690	AF126973
A. boeticus L.	Iran: Maass. & Abou. 51949 (TARI)	AB051937	AF126982
A. canadensis L.	W & S 302	U50496-7	AF126981
A. umbellatus Bunge	USA: Parker 88-78 (COLO)	AF121683	AF126988
Biserrula pelecinus L. (syn. *Astragalus pelecinus* (L.) Barneby	Australia (adventive): USDA 186284, W & S 294	-	AF126995
Biserrula pelecinus L.	Morocco: Podlech 44780	AB287409[b]	-
Caragana arborescens Lam.	Former USSR: USDA 310390	L10798-9	AF127002
Caragana grandiflora (M.B.) DC.	Iran: Assadi & Shahsavari 65834 (TARI)	AB051905	AB287412[c]
Chesneya astragalina Jaub. & Spach.	Iran: Assadi & Maass. 55503 (TARI)	AB051906	AB287413[c]
Charmichaelia williamsii Kirk	New Zealand: Sanderson 1550	U50520-1	AF127000
Clianthus puniceus (G. Don) Lindley	New Zealand: T & M 7140 (Liston, 960, OSC)	L10800-1	AF126998
Colutea arborescens L.	Former USSR: USDA 369222 W & S 406	U56009-10	AF126993
Colutea istria Miller	DELEP 890385	U69544 -5	-
Colutea persica Bioss.	Iran: Foroughi 17434 (TARI)	AB051907	AB287414[c]
Lessertia herbacea DC.	S. Africa: W & S 299	AF121752	AF126997
Oreophysa microphylla (Jaub. & Spach) Browicz	Iran: Foroughi *et al.* 12312 (TARI)	AB287410[b]	AB287415[c]

Table 1. (contd.)

Oxytropis aucheri Bioss.	Iran: Maass. 55104 (TARI)	AB051908	AB287416[c]
Oxytropis lambertii Pursh	AZ, Coconino Co: Wojciechowski 155	AF121753	AF126991
Podlechiella vogelii subsp. *fatimensis* (Chiov.) Maassoumi & Kazempur Osaloo [= *Astragalus vogelii* subsp *fatimensis* (Chiov.) Maire]	Iran: Mozaf. *et al.* 39103 (TARI)	AB051911	AB287417[c]
Sphaerophysa salsula (Pallas) DC.	Asia (adnetive): Yoder-Williams 78-120A-1 (RENO)	U56011-2	AF126996
Smirnowia turkestana Bge.	Former USSR: anonymous (A)	U51218-9	-
Sutherlandia frutescens L.	Mexico: W & S 266	U50516-7	AF126994
Swainsona pterostylis (DC.) Bakh. f.	Ausralia: DLEG 900185, W & S 296	U56007-8	AF126999

[a] Abbreviations used in DNA source: A, Arnold Arboretum/ Gray Herbarium, Harvard University, Cambridge; Abou., Abouhamzeh; ARIZ, University of Arizona Herbarium, Tucson; COLO, University of Colorado Herbarium, Boulder; DELEP/ DLEG, Desert Legume Program (University of Arizona), Tucson, AZ; Maass., Maassoumi; Mozaf., Mozaffarian; 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.

[b] Full length nrDNA ITS1-5.8S-ITS2 region for these taxa were sequenced at the present work.

[c] Full length cpDNA *trn*L intron, *trn*L exon 3, and *trn*L-*trn*F 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 salsula* (Pallas) DC. (without having 5.8S gene) to 613 bp in *Chesneya astragalina* Jaub. & Spach, and in *Oreophysa 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 astragalina* is sister to a polytomic assemblage, the so-called "Astragalean 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 *Smirnowia turkestanica* Bunge through *Colutea persica* Boiss. Within this clade, *Oreophysa microphylla* is nested among three sampled *Colutea* species as moderately (74 %) united with *C. persica*.

The length of cpDNA *trn*L intron varied from 428 bp in *Swainsona pterostylis* (DC.) Bakh. f. to 551 bp in *Astragalus adsurgens* Pallas, and the length of *trn*L-*trn*F 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 *Oreophysa microphylla*, the length of *trn*L intron and the intergenic spacer were 509 bp and 107 bp, respectively. The aligned cpDNA *trn*L-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 astragalina* is sister to "Astragalean clade" composed of three smaller clades including a monophyletic *Oxytropis*, 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)].

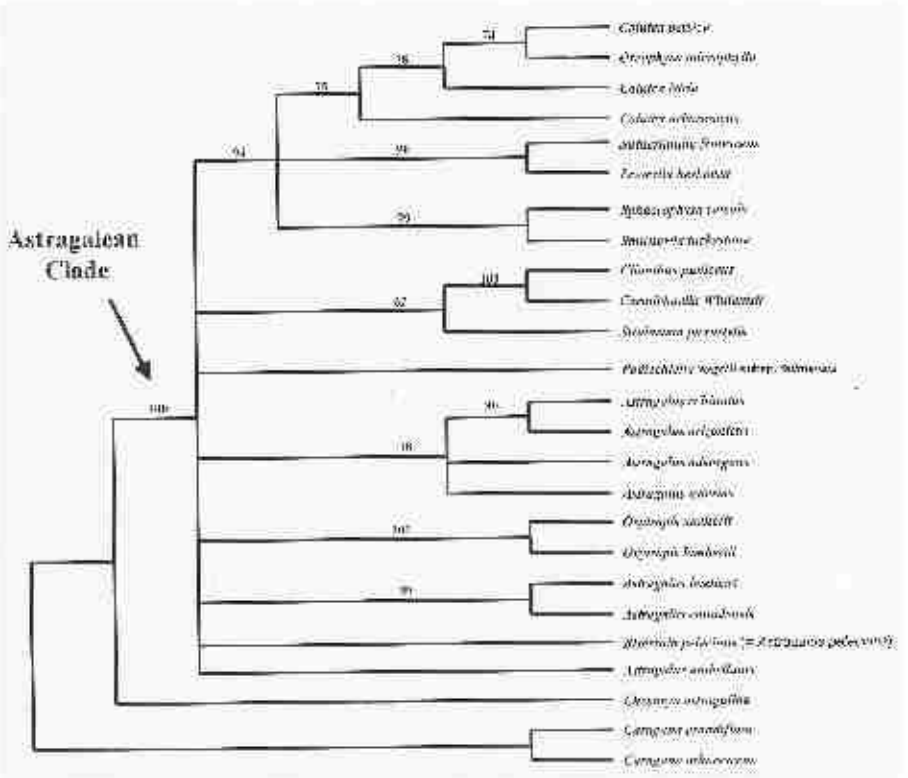

Fig. 1. Strict consensus tree of 41 most parsimonious trees resulting from phylogenetic analysis of 25 nrDNA ITS sequences (Length=324 steps, CI=0.605., RI=0.721). Numbers above branches are bootstrap values for 100 replicate analyses; values < 50% are not indicated.

Within this "Coluteoid clade", *Oreophysa* forms a trichotomy with *C. persica* and *C. arborescens* L., as supported moderately (74%). In *trn*L intron sequences, *O. microphylla* is characterized by a single nuclotide site and a 5 base pair indel, as autapomorphic character states. The combined nrDNA ITS- cpDNA *trn*L-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 *trn*L-F data show that, *Chesneya astragalina* is again sister to "Astragalean clade".

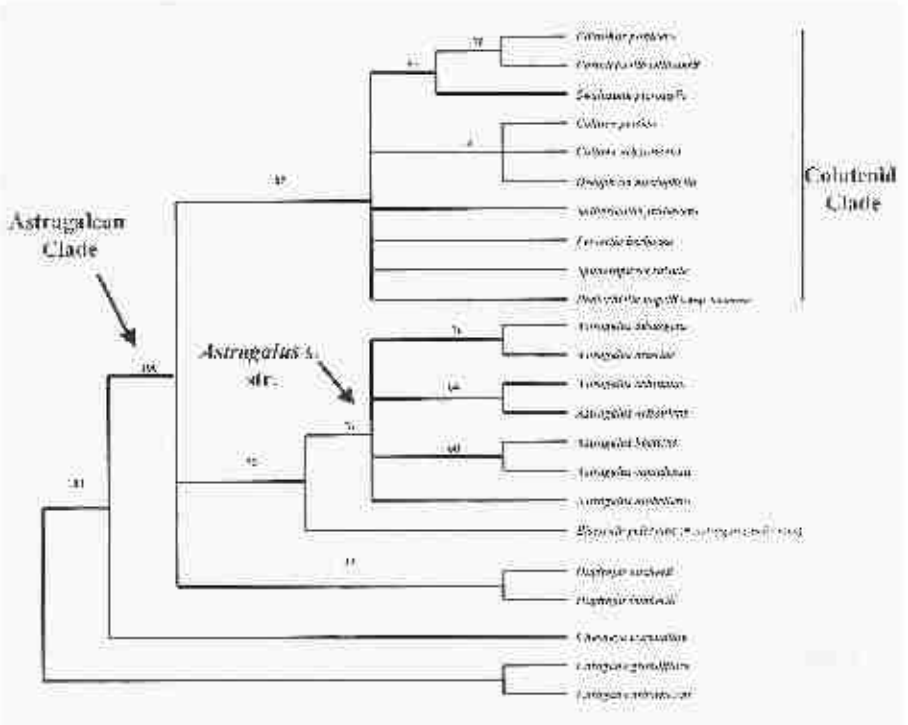

Fig. 2. Strict consensus tree of 8466 most parsimonious trees resulting from phylogenetic analysis of 23 *trn*L-F sequences (Length=97 steps, CI=0.773, RI=0.845). Numbers above branches are bootstrap values for 100 replicate analyses; values < 50% are not indicated.

This clade is composed of two weakly supported subclades including *Oxytropis- Biserrula-Astragalus* s. str. assemblage and "Coluteoid clade". However, *Oreophysa* 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, *Oreophysa 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). *Oreophysa 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, GHAHREMAN 1995).

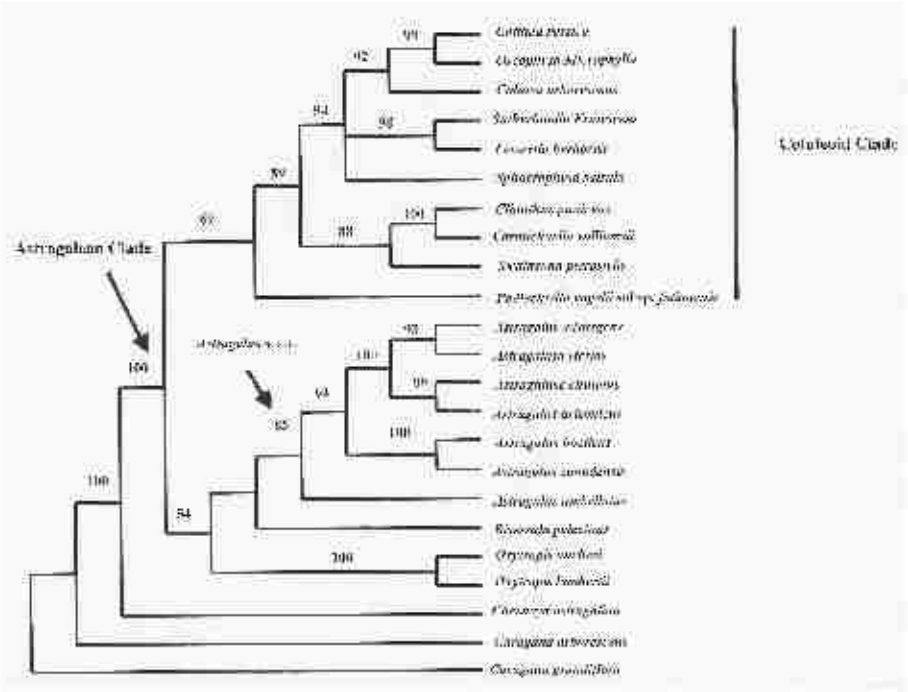

Fig. 3. Strict consensus of three most parsimonious trees resulting from phylogenetic analysis of 23 combined nrDNA ITS-cpDNA *trn*L-F sequences for *Oreophysa* and related genera (Length=408 steps, CI=0.645, RI=0.745). Numbers above branches are bootstrap values for 100 replicate analyses; values < 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, *Oreophysa* is allied with the genera *Colutea*, *Smirnowia*, *Eremosparton* and *Sphaerophysa* -without exact relationship- within "Coluteoid clade" of "Astragalean clade". Our molecular data clearly revealed that *Oreophysa 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 *Oreophysa* is no longer tenable, and thus we synonymized it with *Colutea triphylla*.

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

Syn.: *Sphaerophysa microphylla* Jaub. & Spach, Ill. Pl. Orient., 1: 126, tab. 64 (1843).

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USEFUL WILD *ALLIUM* SPECIES IN NORTHERN IRAN

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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), *Nectaroscordum* (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

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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 Kermanshah.

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

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

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".

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 subvineale 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. subvineale* 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 Khorasan 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* (Salisb.) 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).

3. subg. *Cepa* (Mill.) Radić sect. *Cepa* (Mill.) Prokh.

Allium asarense 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. Fedt.

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. asarense*, 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.

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 oschaninii* plants growing on a rocky slope of Akhlamad valley.

4. subg. *Nectaroscordum* (Lindl.) Asch. et Graebn.

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 Sanadaj (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 Kordestan 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. Fritsch 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. *Megaloprason* 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. rosenorum* 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.

5.3 Sect. *Melanocrommyum* Webb et Berth.

Allium kharputense Freyn et Sint. s. lat.

In Iran, this species is only reported to grow in Saral region in Kordestan near Saradaj 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 koelzii (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 1. Wild *Allium* species used by the local population in northern Iran

Accession	Local name	[Preliminary] Definite scientific name	Use	Manner of application or indication	Province and location	Remarks
1007	Tareh kuhi	*A. paradoxum* (M. Bieb.) G. Don var. *normale* Stearn	food	especially leaves and bulbs used as fresh vegetable	Mazandaran, Golestan National Park, Golzar valley	widely collected and sold at markets in many towns, price 100 Tuman per bundle
1023		*A. oschaninii* O. Fedt.	food	used as vegetable like common onion	Khorasan, Binalud massif, slopes of the valley above vill. Akhlamad, close to waterfall	but said by others to cause cancer
1032	Malil kuhi	[*A. iranicum* (Wendelbo) Wendelbo]	food	whole plant is eaten as vegetable	Khorasan, Binalud massif, valley N.E. of vill. Kharv-e Olya	
1034		*A. kuhsorkhense* R.M. Fritsch et Joharchi ined.	food	leaves are used as vegetable	Khorasan, Binalud massif, valley N.E. of vill. Kharv-e Olya	used only by some people, other do not
1036	Malil kuhi	*A. fibrosum* Regel	food	whole plant is eaten as vegetable like *A. iranicum*	Khorasan, Binalud massif, valley N.E. of vill. Kharv-e Olya	
1038	Piyaze kuhi	*A. asarense* R.M. Fritsch et Matin	food	whole plants and especially the bulbs are used for soups and other dishes like common onion	Tehran, Alborz range, Karaj valley ca. 1 km above vill. Asara	
1073	Gelaugh	[*Allium* sp. sect. *Allium*]	food	leaves and young stems, sometimes also bulbs are made into a traditional soup-like dish "Aash"	Hamadan, Alvand massif, N. slopes near vill. Ganjname	

Table 1. (contd.)

1074	Kul	[*A. breviscapum* Stapf]	food	leaves and young stems, sometimes also bulbs are used for a traditional soup-like dish "Aash"	Hamadan, Alvand massif, N. slopes near vill. Ganjnameh	
1075	Sir-ghorateh	[*A. iranicum* (Wendelbo) Wendelbo]	food	leaves and young stems, sometimes also bulbs are used for a traditional soup-like dish "Aash"	Hamadan, Alvand massif, N. slopes near vill. Ganjname	
1076	Mu-sir	[*A. stipitatum* Regel]	Medicine, Food (spice)	fresh (and possibly dried) bulbs used against pains of backbone, legs, and feet, bulbs are eaten pickle-cured in vinegar or chopped and mixed with yoghurt	Hamadan, sold at the market in Hamadan	said to have been brought from Assadabad, not consumed by the local population south of Hamadan near Ekbatan Dam
1081		[*A. atroviolaceum* Boiss.]	food	used for the traditional dish "Aash"	Hamadan, S. side of Alvand massif, village Oshtoran, Hamzeh Khan castel	
1087	Alaf	[*A. subvineale* Wendelbo]	food	whole plant is eaten in dishes	Hamadan, Alvand massif, valley above village Emam Zadeh Kuh c. 15 km N.W. Hamadan	
1088	Talme	[*A. iranicum* (Wendelbo) Wendelbo]	food	whole plant is eaten like vegetable or for soup	Hamadan, Alvand massif, valley above village Emam Zadeh Kuh c. 15 km N.W. Hamadan	
1089	Kul, Mu-sir	[*A. haemantholdes* Boiss. et Reuter]	food	bulbs and leaves are sliced and added to yoghurt	Hamadan, Alvand massif, slopes near the road along Ekbatan Dam c. 15 km S.E. Hamadan	

Table 1. (contd.)

----	Mu-sir	[*A. stipitatum* Regel]	spice	bulbs are sliced and dried, later chopped and mixed into yoghurt	Kermanshah, sold at the market in Kermanshah	
----	Suroneh, Sorkhe	[*Allium* sp. aff. *A. jesdianum* Boiss. et Buhse]	medicine, food	fresh leaves are used as general tonic, fresh salad and mixed with yoghurt	Kermanshah, sold at the market in Kermanshah	leaf bases and wounded parts with red colour, "sur" means "red",
----	Pichak	[*A. tripedale* Trautv.]	food, medicine	leaves cut in small pieces, added to ordinary dough which is deep-fried in oil, or as fresh salad, said to improve digestion and act against stomach problems	Kermanshah, sold at the market in Kermanshah	
1102	Sorkhe	[*Allium* sp. aff. *A. jesdianum* Boiss. et Buhse]	medicinal plant	as a general tonic and against rheumatism	Kermanshah, sold at the market in Kerend	
1103	Sorkhe	[*Allium* sp. aff. *A. jesdianum* Boiss. et Buhse]	medicinal plant	as a general tonic and against rheumatism	Kermanshah, sold at the market in Eslam Abad	
1104	Pichak	[*A. tripedale* Trautv.]	medicinal plant	leaves are cut and added to a ordinary dough which is fried in oil	Kermanshah, sold at the market in Eslam Abad	
1110		*A. koelzii* (Wendelbo) K. Persson et Wendelbo	medicine	the bulb is cooked and used against skin diseases	Kermanshah, limestone massif c. 5 km N.W. Nojivaran 30 km N.E. Kermanshah	people in the village Nojivaran did not know this plant
1115	Gilakheh	[*A. kharputense* Freyn et Sint.]	food	whole young plants (without scape) are eaten as vegetable	Kordestan, territory of the Saral Agricultural Station c. 30 km N. Sanadaj to Divandarreh	said to be also sold at the local markets

Table 1. (contd.)

1135	Valak	[*A. derderianum* Regel]	food	fresh leaves are eaten as vegetable (cooked with rice) or as salad	Tehran, Alborz range, Dizin pass between Gajereh and Shemshak	information given by a man from Shemshak
1136	Tareh kuhi	[*A. iranicum* (Wendelbo) Wendelbo]	food and medicine	fresh leaves are eaten as vegetable (cooked with rice) or as salad; use of this plant increases the iron level of blood	Tehran, Alborz range, c. 3 km below Dizin pass to Shemshak	information given by a man from Shemshak
1138	Valak	[*A. akaka* Gmel. ex Schult. et Schult. f. *s.l.*]	food and medicine	young to flowering plants are eaten as vegetable and are applied against rheumatism and other pains	Tehran, sold at the "Tajrish" market in Tehran Shemiran, said to have been brought from Zanjan area	inflorescences are pickled in vinegar to make special spice "Torshi"

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

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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. Morphological 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 & EHRENDORFER 2005), this genus includes 15 species in Iranian plateau. Eight species of *Asperula* thrive in Iran, five of which are endemic (SCHÖNBECK-TEMESY & EHRENDORFER l.c.).

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

I this study, a new subspecies of *Asperula oppositifolia* is described from Khorasan Province (N.E. Iran). The species belongs to the sect. *Oppositifoliae* Shishk. ex Schönb.-Tem. This section mainly characterized by its subfruticose to chamaephytic, polycormic growth form with strong tap root (but never with rhizomic stolons), opposite leaves (only rarely with stipules), 4-lobed corollas, the glabrouse stigmata and the ± truncate ovaries and mericarps. This section belongs to the Oriental-Turanian and W. Himalayan floristic element (SCHÖNBECK-TEMESY & EHRENDORFER 2005).

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

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

Planta perennis, ± glandulosa-papilosa, 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. *pseudocyanchia* Ehrend. pedicellis longioribus; mericarpis rugosis glandulosis.

Plants perennial, ± glandular-papillose to nearly glabrous, stems 13-30 cm long. Leaves usually linear, 5-20 mm long, 0.5-1.5 mm wide. Inflorescence cylindric 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

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. *rechingeri* (from the holotype: M. Joharchi & M. Aydani 35596, FUMH).

Fig. 2. *Asperula oppositifolia* ssp. *rechingeri*.

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 Aydani 35497 (FUMH, FAR); 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. *chitralensis* Schönb.-Tem. & Ehrend; endemic to Pakistan (Chitral)
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., Joharchi, & Aydani; endemic to Iran
6. ssp. *sikaramensis* Schönb.-Tem. & Ehrend; endemic to E. Afghanistan
7. ssp. *swatensis* Schönb.-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 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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BIOGEOGRAPHICAL PATTERNS IN THE RUBIACEAE OF "FLORA IRANICA"

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Abstract

A biogeographical analysis of the Angiosperm family Rubiaceae in S.W. Aisa 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 Paleotropic 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 "Rostaniha" 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, NATALI *et al.* 1996 etc.). In vol. 176 of "Flora Iranica" (EHRENDORFER *et al.* 2005) 20 genera and 152 species of Rubiaceae were accepted, ranging from shrubs and basally woody chamaephytes to perennial herbs (hemicryptophytes) 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 Dagh 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, Armeniya, 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 Hyrcanian Province, regional but also wider distributed submeridinal 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, cleary centered in the plaeotropics, have reached the "Flora Iranica" area. *Wendlandia* with about 70 species in (sub) tropical Asia is represented in S.W. Asia by *W. arabica* Deffler in Yemen (and Somalia) and the shrubby *W. ligustroides* (Boiss. & Hohen.) Blakelock, an isolated relic species, growing in limestone gorges of Iraq Kurdistan, possibly related to *W. longidens* (Hance) Hutch. in S.W. China. In contrast, paleotropical members of *Kohautia* and *Oldenlandia* 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 *Himalrandia tetrasperma* (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) Ehend. & Schönb.-Tem. (mostly in in the Himalayas) or *G. subtrinervium* Ehrend. & Schönb.-Tem. (from the C. Asiatic group of *G. hirtiflorum* Req.). 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. & Lace.

Old and recent links with the Mediterranean

The new and DNA-supported circumscription of the Rubiaceae-Rubioideae tribe Putorieae (BACKLUND *et al.* In Press) includes the closely related (but better not fused) genera *Gaillonia, Crocyllis, Aitchisonia, Pseudogaillonia, Pterogaillonia, Jaubertia, 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 Medditerranean *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 Putorieae 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'Urv. 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 apomophic taxa expand from there into the Mediterranean, as the coastal perennials of sect. *Maritimae* and many small-flowered annuals of sect. *Crucianella*. Among the latter, *C. angustifolia* L. is wide-spread 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 segetal habitats in Europe etc. Examples are: *Asperula* sect. *Asperula*, *Galium* sect. *Kolgyda* with *G. spurium* L., *G. ceratopodum* Boiss. (diploid) + *G. tricornutum* Dandy (tetraploid), *G. verticillatum* Danth. and *G. supercreatum* M. Pop. + *G. murale* (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 *Galium spurium* L. subsp. *ibicinum* (Boiss. & Haussk.) Ehrend. The small therophyte genus *Callipeltis* has one species endemic to the Levante (+ Iraq), another endemic to SW Iran and Iraq, and the third, *C. cucullaria* (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. *Thliphthisa* (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* Schönb.-Tem & 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* Schönb.-Tem., endemic to the Kurdic mountains of N. Iraq. Within *Galium* sect. *Kolgyda*, the *G. adhaerens* 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 & Schmalh. (6 subsp.), and *Cruciata 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. *Campylanthera*, *Crucianella* sect. *Roseae* and sect. *Crucianella*, *Asperula* sect. *Cruciana*, sect. *Oppositifoliae*, sect. Thliphthisa, sect. *Trichodes* and sect. *Asperula*, *Galium* sect. *Hylaea*, sect. *Galium*, sect. *Orientigalium* and sect. *Kolgyda*, in *Callipeltis* and in *Cruciata*. 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 & EHRENDORFER 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-Tem. (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.

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. platy-phylla*, could have grown in rocky openings of the later Tertiary humid and warm and deciduous Hyrcanian 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. *Glauca* (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 Euboea, Crimea, the Kuban and Caucasus areas, the Levante, N. Iraq, W. and N. Iran, and S.W. Turkmenyia. 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. asterocephala* Bornm. and *A. comosa* Schönb.-Tem., vicarious limestone chasmophytes from the Kurdic mountains of N. Iraq (+ adjacent S.E. Anatolia) and *A. szovitsii* Ehrend. & Schönb.-Tem from N.W. Iran, all rare and of local distribution, constitute the evidently ancient basis of this section. *A. prostrata* (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. mollu-ginoides* (M.B.) Reichenb., 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.) Grisseb. 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 Iranica" area and 11 in the Caucasus area. Not less than 11 species are endemic within the "Flora Iranica" 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 has 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-temesyae* 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 unsufficently understood.

A contrasting example for Oriental-Turanian diversification and subsequent reduction are the related *Asperula* sectt. *Trichodes* (1), *Crucianelloides* (2) and *Tricostella* (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. sherardioides* (Boiss.) Jaub. & Spach (2) and *A. insignis* (Vatke) Ehrend. (3) are local or regional endemics, limited to Fars (1), Gilan (2) and Kurdistan 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. chitralensis* Ehrend. to the mountains of S. Kazakhstan. *Asperula* sect. *Oppositifoliae* 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. *Kolgyda* 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. tenuissimum* 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 remakable amount of floristc diversification within the extensive Oriental-Turanian region makes it possible to characterize different subregions by

typical endemic taxa. In addition, the examples already cited in the paragraphs above, one can list a number of (sub)endemic "Flora Iranica" Rubiaceae taxa for the following six subregions: 1) N. Iraq (Kurdistan): *Asperula friabilis* Schönb.-Tem., *Galium hainesii* Schönb.-Tem., *G. qaradaghense* Schönb.-Tem. 2) N.E. Iran (Azerbaijan): *Gaillonia szovitsii* DC., *Rubia rigidifolia* Pojark., *Asperula rezaiyensis* Schönb.-Tem., *Galium azerbayjanicum* Ehrend. & Schönb.-Tem. 3) N. Iran (Elburz): *Galium diploprion* Boiss. & Hohen., *G. aucheri* Boiss., *G. problematicum* (Ehrend.) Ehrend. & Schönb.-Tem., *G. delicatulum* Boiss.& Hohen., *G. decumbens* (Ehrend.) Ehrend. & Schönb.-Tem., *G. wendelboi* Ehrend. & Schönb.-Tem., *G. elbursense* Bornm. & Gauba. 4) N.E. Iran (N. Khorasan + Kopet Dagh): *Rubia rechingeri* Ehrend., *Galium pojarkovae* Pobed. 5) S.W. Iran (Zagros Mts.): *Rubia albicaulis* Boiss., *R. pauciflora* Boiss., *R. caramanica* Bornm., *Asperula* fragillima Boiss.& Hausskn., *A. brachyantha* Boiss., *A. rechingeri* Ehrend. & Schönb.-Tem., *Galium iranicum* Hausskn., *G. sojakii* Ehrend. & Schönb.-Tem., and 6) Afghanistan: *Gaillonia dubia* Aitch. & Hemsl., *G. afghanica* Ehrend., *G. kandaharensis* Ehrend. & Qarar, *Rubia oppositifolia* Griff., *R. maymanensis* Ehrend. & Schönb.-Tem., *Asperula podlechii* Schönb.-Tem., *A. pulchella* (Podlech) Ehrend. & Schönb.-Tem., *Galium baghlanense* Ehrend. & Schönb.-Tem.

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 submeridinal 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 *Phuopsis* 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

A. taurina L., *Galium* sect. *Platygalium* with *G. rotundifolium* L., the uniform diploid *Cruciata laevipes* Opiz (closely related to the polymorphic and polyploidy Oriental-Turanian *C. taurica* (Pall.) Ehrend. and the wide-spread *C. pedemontana* (Bell.) Ehrend. Clades with extensive Eurasian or even N. Hemisphere (*) areas not rarely have split off more local derivatives (#) in the northern parts of the "Flora Iranica" area, as exemplified by *Galium* sect. *Aparinoides*: *G. elongatum* C. Presl, *G. karakulense* Pobed. (#); *G.* sect. *Platygalium*: *G. boreale* L. (*); *G.* sect. *Hylaea*: *G. odoratum* (L.) Scop.; *G.* sect. *Trachygalium*, *G. rivale* agg.: *G. vassilczenkoi* Pobed. (#), *G. pseudorivale* Tzvel. (#); *G.* sect. *Galium*: *G. verum* L., *G. consanguineum* Boiss. (#), *G. baghlanense* Ehrend.-Schönb.-Tem. (#), *G. kuetzingii* Boiss. & Buhse (#) and G. sect. *Kolgyda*, *G. parisiense* agg.: *G. ghilanicum* Stapf (#).

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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 !

Astragalus sect. ***Microthrix*** Širj., Repert. Spec. Nov. Regni Veg. 47: 197. 1939. Lectotype (ined.): *Astragalus microcephalus* Willd.

A. sect. ***Macrothrix*** Širj., Repert. Spec. Nov. Regni Veg. 47: 225. 1939. Lectotype (ined.): *Astragalus barba-jovis* DC.

A. acmophyllus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 93. 1868 in clave [et l.c. 15(1): 166. 1869]. Syntypes: in monte Argaeo Cappadociae, B. Balansa 938 (sub *A. fenzlii*); et in monte Argaeo Cappadociae [région alpine du mont Argeé, Cappadoce] 22.8.1856, *B.* Balansa 194 (sub *A. eriocephalus*) (G-BOIS!, K, MSB!). - (designated here): [Turkey] in monte Argaeo Cappadociae, B. Balansa 938 (P!).

- var. ***bracteolatus*** Širj., Repert. Spec. Nov. Regni Veg. 47: 228. 1939. Syntypes: Cappadocia, m. Argaeus, reg. alpina, 2200–2500 m, 18.6.1890, J.F.N. Bornmüller 2133 (Bornmüller 2134 = 2137, B!); ibid., Erdschias-dagh: Auf Abhängen oberhalb Hadschidar, 2200 m, vi. 1902, E. Zederbauer; ibid., auf steinigen Abhängen des Lifos, 2300 m, vii. 1902, E. Zederbauer (WU!). - Lectotype (designated here): [Turkey] M. Argaeus, Erdschias-dagh: auf Abhängen oberhalb Hadschidar, 2200 m, vi.1902, E. Zederbauer (WU!: the sheet marked as lectotypus; iso: WU!).

A. adustus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 80. 1868 in clave [et l.c. 15(1): 134. 1869]. - Lectotype (designated here): [Turkey] in Kurdistaniae Prov. Musch, distr. Warto., mont. Bimgöll prope Gumgum, in valle ad alveum Goschkar, 5600', 24.8.1859, Th. Kotschy 404 (sub *A. arnacantha*) (P!; iso: G!, G-BOIS!, JE!, K!; LE!, PR!, PRC!, W!, Z!).

A. akscheherensis Freyn & Bomm., Mém. Herb. Boiss. 13: 12. 1900. - Lectotype (designated here): [Turkey] Phrygia interior, mt. Sultandagh, supra urbem

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

A. albifolius Freyn & Sint., Österr. Bot. Z. 43: 417. 1893. - Lectotype (designated here): [Turkey] Paphlagonia ad Tossia, Giaurdagh, 29.7.1892, P.E.E. Sintenis 4843 (BRNM!; iso: B!, BP!, G!, JE!, LD!, P!, WU!).

A. alexeenkoanus B. Fedtsch. & N.A. Ivanova, Trudy Tadzh. Bazy 2: 147. 1936. - Lectotype (designated here): [Tadzhikistan] Darwas, inter pagos Dscharf et Kewron in valle fl. Pändsh, 1300-2000 m, 15.8.1901. M.A. Alexeenko 3850 (LE!: the sheet marked as lectotypus; iso: LE!)

A. alopecias Pall., Sp. Astragal.: 12, t. 9. 1899. - Lectotype (designated here): ad fl. Uldshar, in lacum vastum Alagul, deserti Kirgiso-Songarici, Sievers (LE!; BM!: sine indicatione loci).

A. alpinus L. f. ***arcticus*** Sondén, Svensk Bot. Tidskr. 1 (1907): 288. 1908. - Syntypes: Ab. Bj. Nuoljas sluttningar, 16.7.1908, M. Sondén; Peskan Jarka; Snuor; Ort; Pesisjokk. Lectotype (designated here): Ab. Bj. Nuoljas sluttningar, 16.7.1908, M. Sondén (S!).

A. ambiguus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 86. 1868 in clave [et l.c. 15(1): 150. 1869]. - Lectotype (designated here): [Turkey] Syria bor., jug. Amanus prope Beilan in subalpinis Daos-dagh, 3800', v. 1862, Th. Kotschy 301 (P!; iso: G-BOIS!, MSB!, W!).

A. andalanicus Boiss. & Hausskn. var. ***ovatus*** Širj. & Bomm., Repert. Spec. Nov. Regni Veg. 52: 10. 1943. - Lectotype (designated here): [Iran] Prov. Luristan, Bordsh, 2100 m, 16.6.1937, M.E. Køie 1267 (B!; iso: W!).

A. antiochianus Post, Fl. Syria, Palest. Sinai: 11. 1896 [et in Bull. Herb. Boiss. 5: 756. 1897]. - Lectotype (designated here): [Syria] prope Antiochiam, 20.8.1886, G.E. Post 9 (K!; iso: BM).

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): l.c., tabula et fig.).

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

A. argenteus nobis, Dalmatia, Visiani (M!); iso: HAL!: as, *A. argenteus* nobis: scirpsit et misit Visiani, G!: ex Dalmatia 1827, misit Visiani).

A. atropatanus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 82. 1868 in clave [et l.c. 15(1): 138. 1869]. - Lectotype (designated here): [Iran] inter Teheran et Tabris, vi.1859, A. von Bunge & T. Bienert (P!; iso: G-BOIS!, GOET!, K!, MSB!, P!).

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

A. baalbekensis Bornm., Mitth. Thür. Bot. Vereins, n.s. 28: 54. 1911. - Lectotype (designated here): [Lebanon] Antilibanon, oberhalb Baalbek, 1500-1600 m, J.F.N. Bornmüller 11593 (B!; iso: BP!, G!!, JE!, W!).

A. bethlehemiticus Boiss., Diagn. pl. orient., ser. 1, 9: 85. 1849, Syntypes: in Judaea ad Herodiam, Thecuam Bethlehem, 1817, Sieber (E!, JE!, K, M!, PR!, WU!); in monte Francorum prope Bethlehem, P.M.R. Aucher-Eloy 1261 (FI!, G-BOIS!, G!, K!); in collibus Damasci, E. Boissier (LE!, WU!); et in Libano supra Deir el Kammar, E. Boissier. - Lectotype (designated here): Syria: in Libano, supra Deir el Kamar, v.-vii. 1846, E. Boissier (G-BOIS!: upper plant; the lower plant is a syntype "in collibus Damasci").

- var. ***brachycalyx*** Eig, Syst. Stud. Astrag. Near East: 100. 1955. Syntypes: Syria, Antilebanon, env. of Saddad, 24.6.1932, A. Eig & M. Zohary (HUJ); between Saddad and Breige, 23.6.1932, A. Eig & M. Zohary (HUJ). - Lectotype (designated here): Syria, Antilebanon, environs of Saddad, 24.6.1932, A. Eig & M. Zohary (HUJ!).

- var. ***transitans*** Eig, Syst. Stud. Astrag. Near East: 99. 1055. Syntypes: S. Syria, Jebel Druze, envir. of El-Kefr, 21.6.1932, A. Eig & M. Zohary (HUJ); near Saube, between Damascus and Jebel Druze, 9.6.1932, A. Eig & M. Zohary (HUJ!); Tel Chinane, near Chaab, 21.6.1932, A. Eig & M. Zohary. - Lectotype (designated here): Tel Chinane, near Chaab, 21.6.1932, A. Eig & M. Zohary (HUJ!: lower plant, mixed with the syntype).

A. bienertii Bunge, Mém. Acad. Imp. Sci. Saint Pétersburg 11(16): 80. 1868 in clave [et l.c. 15(1): 133. 1869]. - Lectotype (designated here): [Iran] Persiae Prov.

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

A. brachycentros Fisch. var. ***koieanus*** Širj. & Bornm., Repert. Spec. Nov. Regni Veg. 52: 5. 1943. - Lectotype (designated here): [Iran] Bordsch, 2100 m, 16.6.1937, M.E. Køie 776. (B!: with description; iso: W!).

A. brachycephalus Franch. var. ***minor*** Pamp., Nuovo Giorn. Bot. Ital. n.s. 17: 5. 1910. Syntypes: [China] Yunnan-sen, 2.4.1905, Ducloux 390; dto., iv.1904, Maire 123. - Lectotype (designated here): Yunnan-sen, 2.4.1905, Ducloux 390 (FI!).

A. calavrytensis Beauverd & Topali, Candollea 7: 257. 1937. Syntypes: in monte Chelmos supra Calavryta Achaiae, 29.6.1935, S. Topali & G. Beauverd 610 (G-BOIS); Mte. Kastro prope Kalavryta Achaiae, 1.6.1926, J.F.N. Bornmüller 529. - Lectotype (designated here): Mte. Kastro prope Kalavryta Achaiae, 1.6.1926, J.F.N. Bornmüller 529 (G!: with diagnose; iso: B!, JE!).

A. canus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11 (16): 102. 1868 in clave [et l.c. 15(1): 180. 1869]. Type: Habitat in Persia, P.M.R. Aucher-Eloy 1369, v.s. sp. in herb. Mus. Paris. et Boiss. – Lectotype designated here): in Persia, P.M.R. Aucher-Eloy 1369 (P!; iso: FI!, FI-W!, G-BOIS!).

A. catacamptus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 110. 1868 in clave [et l.c. 15(1): 191. 1869]. - Lectotype (designated here): inter Sof et Kohrud Persiae, v.1859, A. von Bunge & T. Bienert (P!: the four plants on upper left side of the sheet; iso: G-BOIS!). The lectotypification of PODLECH 1998 on a collection from Shahrud is not valid, because the choosen collection is not mentioned in the original diagnosis.

A. caucasicus Pall. var. ***boissieri*** Širj. 1939, Repert. Spec. Nov. Regni Veg. 47: 198 - Syntypes: Prov. Terek et Cernomorsk, Grossheim; ad Tiflis; Prov. Eliabethpol; Prov. Baku [Syntypes: Caucasus, from herb. Bieberstein (PR!); Iberia, C.A. Meyer: both named by the author as var. *boissieri*]. - Lectotype (designated here): Iberia, C.A. Meyer (PR!).

A. chlorocyaneus Boiss. & Reut., in Boissier, Diagn. pl. orient., ser. 1, 9: 56. 1849. Syntypes: circa Barcinonem, G.F. Reuter; in regno Granatensi, E. Boissier; circa Aranjuez, iv.1841, G.F. Reuter (GOET!, K!, P!); in Mauritania prope Algeriam,

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

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

A. commixtus Bunge, Arbeiten Naturf. Vereins Riga 1: 246. 1847. Syntypes: Agatme, 13.4.1842, A. Lehmann (LE!); zwischen Agatme und Karagata, 14.4.1842, A. Lehmann. Lectotype (PODLECH, 1994: only the collection but not the herbarium selected): [Uzbekistan] zwischen Agatme und Karagata, 14.4.1842, A. Lehmann. - Lectotype (herbarium selected here): (LE!; iso: G-BOIS!. Syntypes were distributed as Al. Lehmannii Rel. Botan. No. 374 (K!).

A. consimilis Bornm., Mitth. Thür. Bot. Ver. N.F. 23: 26. 1908. - Lectotype: cacumine montis Mesogis [Aydin Da.] (supra Tire), 900-1200 m, 14.6.1906, J.F.N. Bornmüller 9414 (B!: the sheet marked as lectotypus; iso: B!: foto MSB!, JE!, K, PR!).

A. cruentiflorus Boiss. f. ***major*** Bornm., Mitth. Thür. Bot. Ver., N.F. 28: 52. 1911. - Lectotype (designated here): Libani in regione alpina jugi Sanin, 2200-2300 m, 20.7.1897, J.F.N. Bornmüller 572 (B!: the sheet marked as lectotypus; iso: B!, JE!).

A. cylleneus Fisch., Bull. Imp. Soc. Naturalistes Moscou 26(2): 355. 1853. - Lectotype (designated here): [Greece] in M. Kyllene, 5000-7122', T.H.H. von Heldreich (LE!: the 2 upper and the lower plant on the right side; iso: G-BOIS!, L!, WU!).

A. dainellii Pamp., Lav. Ist. Bot. Reale Univ. Cagliari (Sped. Ital. De Filippi Himal. & c. 1913-1914, Ser. II, 11 [Agg. Fl. Carac.]) 22: 167. 1934. - Lectotype (designated here): Valle de Nubra, alte valle Sassir, 4850 m, 31.8.1930, G. Dainelli & E. Kalau von Hoff (FI!: sheet marked as lectotypus; iso: FI!).

A. diphterites Fenzl, Flora 26(1): 396. 1843. - Lectotype (designated here): [in monte Karadjadagh Mesopotamiae] trans Tigrim, inter Bauerd et Zacho, Kotschy [146] (W!: the sheet marked as lectotypus; iso: BM, MSB!, P!, W!).

- subsp. ***brachyanthus*** Eig, Syst. Stud. Astrag. Near East: 104. 1955. Syntypes: Iraq, near Ain Sifni (W of Mosul), 12.7.1933, E. Guest; Atrush, 13.7.1933, E. Guest (HUJ). - Lectotype (designated here): Iraq, near Ain Sifni (W. Mosul), 12.7.1933, E. Guest (HUJ!).

A. dipsaceus Bunge var. ***germanicopolitanus*** Bornm., Repert. Spec. Nov. Regni Veg. Beih. 89: 179. 1940. Syntypes: Türkei, Paphlagonia austr., ad oppidum Cankri (Germanicopolis), 800 m, 3.7.1929, J.F.N. Bornmüller [14098]; et ad Koc-hisar (Ilkas), 1000 m, 18.6.1929, J.F.N. Bornmüller 14084; Tossia, in lapidosis Cinonbaba, 30.6.1892, P.E.E. Sintenis 4483. - Lectotype (designated here): [Turkey] Tossia, in lapidosis Cinonbaba, 30.6.1892, P.E.E. Sintenis 4483 (M!; iso: G!, PRC!, STU!, W!, WU!, Z!).

A. dissectus B.Fedtsch. & N.A. Ivanova, Trudy Tadzhiksk. Bazy 2: 148. 1936. - Syntypes: inter Ob-i-garm et Faisabad, Russanow; Darwas, inter pagos Dsharf et Kevron, M.A. Alexeenko; dito, A. Regel; ad fl. Pandsh prope pag. Dshan, 1916, B.A. & A. Fedtschenko, O.E. Knorring & Czerniakovskaja (LE); jugum Sarajak ad fl. Dagana, N.F. Gontscharov, J.S. Grigorjev & A.A. Nikitin (LE); inter fl. Schurak et Chasret-sultan, montes Karimonak, ad fl. Daras-pitau, N.F. Gontscharov, J.S. Grigorjev & A.A. Nikitin (LE: = type of *Tragacantha tenuispina* Boriss.); montes Gasimailik pr. pagum Dagana, N.F. Gontscharov & Matveev (LE: type of *Tragacantha proxima* Boriss.); jugum Ak-tau, montes Chadsha-mamat, N.F. Gontscharov & Matveev; Uzbekistan, Baissun, versus Derbent, [8.8.]1913. B. Fedtschenko [749] (LE!, MSB!); dto., 1000 m, 21.8.1913, J.F.N. Bornmüller 1120 (B!); Montes Kuhitang supra pagum Wandob, 1916, B.A. & A. Fedtschenko, O.E. Knorring & Czerniakovskaja (LE). - Lectotype (designated here): Uzbekistan, Baissun, versus Derbent, 1000 m, 21.8.1913. Bornmüller 1120 (LE!; iso: B!).

A. dolius Boiss. & Haussk. in Boissier, Fl. Or. 2: 340. 1872. - Lectotype (designated here): in monte Avroman Kurdistaniae Persiae, 7000', H.C. Haussknecht 349 (G-BOISS!; iso: JE!, LE!, W!).

A. dumetorum Hand.-Mazz., Symb. Sin. Pt. 7: 555. 18933. Syntypes: China, [Szechuan] N'Seite des von Muli gegen Dschungdien führenden Rückens, 3900 m, 4.8.1915, H. von Handel-Mazzetti 7426; und in der Jakmatte auf dem

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

A. ecbatanus Bunge 1868, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 71 in clave [et l.c. 15(1): 118. 1869] - *Campylanthus* - Type: inter Bagdad et Kermanschah, G.A. Olivier & J.G. Bruguière (fl., specimen unicum in herb. Kunthiano nunc regio Berolinensi [destroyed]), et specimina dua sine fl. et fr. in herb. Mus. Paris [P: these specimens are most probably *A. spinosus*). - Lectotype (TIETZ 1988): Foto of the original flower dissection in Illustr. Collect. Astr. (K!) in connection with the original description). - Epitype (designated here): Iran, Prov. Lorestan: between Nojan and Keshwar, 33°17' N, 48°29' E, 1900 m, 18.6.2001, Sytin & al. (MSB!).

A. echidnaeformis Širj., Repert. Spec. Nov. Regni Veg. 47: 198. 1939. Syntypes: M. Kuh Saebs Buschom prope Schiras, 30.6.1885, O. Stapf (K!, W!) (sub nom. *A. kuhistanus*); et Kuh Karabagh, O. Stapf. - Lectotype (designated here): Kuh Karabagh S of Schiras, O. Stapf (sub nom. *A. kuhistanus*) (WU!; iso: B!).

A. eginensis Freyn & Sint., Österr. Bot. Z. 42: 10. 1892. - Lectotype (designated here): Armenia turcica, Egin [= Kemaliye] ad Salachlü, 25.6.1890, P.E.E. Sintenis 3490 (BRNM!; iso: BP!, G!, JE!, LD!, W!, WU!).

A. ellipsoideus Ledeb. var. ***kuldshensis*** Basil., Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 3: 111. 1922. Syntypes: Kuldsha, untere Taldy, 4000', v.1879, A. Regel; oberer Taldy, 5000', 17.5.1879, A. Regel (LE!); Irenkhabirga, 8000', 24.5.1879, A. Regel (LE!); Turlagan, 9000', 3.8.1879, Kunges. - Lectotype (designated here): [China] Kuldsha, unterer Taldy, Irenkhabirga, 4000', 15.5.1879, A. Regel (LE!; iso: MSB!).

A. elymaiticus Boiss. & Hausskn. in Boissier, Fl. Or. 2: 346. 1872. - Lectotype (ZARRE in ZARRE, MAASSOUMI & PODLECH, ined.): in montibus Sawers et Eschker Persiae austro-occ., 8000-9000', vii.1867, H.C. Haussknecht 24 (G-BOIS!; iso: BM!, G-BOIS!, JE!, K!, LE!, W!).

- var. ***validior*** Bornm., Beih. Bot. Centralbl. 19(2): 231. 1905. Syntypes: Sultanabad, 22.7.1883, Th. Strauss (K!, WU!) et 2.5.7.1890, Th. Strauss (WU!); Schuturunkuh, 25.7.1889, Th. Strauss (WU!); Sultanabad, 22.6.1890, Th. Strauss

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

A. erinaceus Fisch. subsp. ***sefidrudensis*** Širj. & Bornm., Repert. Spec. Nov. Regni Veg. 52: 6. 1943. Syntypes: Persia bor., in valle Sefidrud prope Rudbar, 300-400 m, 6.-7.5.1902. J.F.N. Bornmüller 6900; ibid., inter Rustamabad et Rudbar, 200-300 m, 3.5.1902. J.F.N. Bornmüller 6899 (B!); inter Rescht et Teheran prope Mendschil, 400 m, 10.5.1902. J.F.N. Bornmüller 6901 (B!). - Lectotype (designated here): Persia bor., in valle Sefidrud prope Rudbar, 300-400 m, 6-7.5.1902. J.F.N. Bornmüller 6900 (B!).

A. eriocalyx Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 86. 1868 in clave [et l.c. 15(1): 150. 1869]. Syntypes: [Turkey B8 Van] Argerosch-dagh inter lacum Van et provinciam Mökösch [Mukus], 3370 m, 1859, Th. Kotschy 805; & 867 pp. (cum *A. hirticalyx* mixtus). - Lectotype (designated here): [Turkey B8 Van] Argerosch-dagh inter lacum Van et provinciam Mökösch [Mukus], 3370 m, Th. Kotschy 805 (P; iso: G-BOIS!, W!)

A. erythrocephalus Freyn & Sint., Österr. Bot. Z. 42: 10. 1892. - Lectotype (designated here): Armenia turcica, Karput, in monte Karatasch, 13.5.1889, P.E.E. Sintenis 335 (BRNM!; iso: B!, BP!, BR!, G!, JE!, LD!, PR!, W!, WU!)

A. eschkerensis Boiss. & Hausskn. in Boissier, Fl. Or. 2: 328. 1872. - Lectotype (designated here): in montibus Sawers et Eschker Persiae austro-occ., 8000', vii.1868, H.C. Haussknecht 9 (G-BOIS!; iso: JE!).

A. eustrophacanthus Rech.f. & Edelb., Biol. Skr. 9(3): 87. 1958. Type: Afghanistan, Deh Kundi, Khidir Kotal, 2900 m, 11.6.1949, L. Edelberg 1924 (C, W, both untraceable). - Neotype (designated here): Afghanistan, Prov. Ghazni, Khawaja Abdal, W Ghazni an der Straße nach Dasht-i-Nawar, 2900 m, 11.6.1970, O. Anders 3908 (MSB!).

A. exiguus Post, Plantae Postianae 3: 7. 1892 - Lectotype (designated here): in cacumine Sudr-esh-Sheikh-ali (Antilibani), 28.7.1891, G.E. Post (K!; iso: BM).

A. exscapus L. f. ***caulifer*** Borbás 1885, Erdész. Lapok 24: 304 [et Österr. Bot. Z. 35: 233. 1885 (as variety)] - Type: not indicated. Because no specimen of this

taxon collected before the publication is found, a neotypification is necessary. Neotype (the only existant specimen of Borbás, designated here): in arenosis campi Rákos ad Budapestinum, 11.7.1888, V. de Borbás (BP!).

A. exsul Maire, Mém. Soc. Sc. Nat. Maroc 15: 26. 1924 [et in schedis impr. ad Jahandiez, Pl. Maroc. anno 1924 distrib.]. - Lectotype (designated here): [Morocco] Moyen Atlas, entre Aghbalou Larbi et l'Aguelman Sidi Ali ou Mohand, 2100-2200 m, 30.6.1923, E. Jahandiez (MPU!; iso: P!, RAB!).

A. fenzlii Boiss., Diagn. pl. orient., ser. 2, 5: 89. 1856. Syntypes: in regione meridionali alpina Tauri Cilicici, 5300-6000', 1836, Th. Kostchy 131; in Tauri alpes "Bulgar Dagh", 5300-6000', 5.8.1853, Th. Kotschy 170 (BP!, G!, G-BOIS!, MSB!, P!, PR!, W!). Lectotype: in regione meridionali alpina Tauri Cilicici, 5300-6000', 1836, Th. Kostchy 131 (G-BOIS!; iso: BM!, BP!, E!, FI!, FI-W!, G!, GOET!, K!, M!, PR!, TUB!, W!, WU!, Z!).

- subsp. ***armadshek*** Eig, Syst. Stud. Astrag. Near East: 81. 1955. Syntypes: S. Turkey, Taurus Mountains, Bulgardagh, at the foot of Mt. Armadshek 1500-1600 m, 21.8.1931, A. Eig & M. Zohary (HUJ); between El-Malla and Biredjik, 1650 m, 21.8.1931, A. Eig & M. Zohary (HUJ!, W!); descent from Jam Shansha towards Shansha, 1600-1800 m, 21.8.1931, A. Eig & M. Zohary (HUJ!); ascent to Armadshek, 1900-2000 m, 21.8.1931, A. Eig & M. Zohary. - Lectotype (designated here): ascent to Armadshek, 1900-2000 m, 21.8.1931, A. Eig & M. Zohary (HUJ!; iso: E!).

- var. ***ellenbergii*** Širj. & Bornm., Repert. Spec. Nov. Regni Veg. 50: 136. 1941. Syntypes: [Türkei] Ala Dag, 1938, Ellenberg 783 (B!) n. Bereketli, 1700 m, 27.8.1938, Ellenberg 417 (B!); Ala Dag [in der Schlucht Emli-Boasi, 2100 m, 7.9.1938, Ellenberg [s.n.] (B!). - Lectotype (designated here): [Türkei] Ala Dag, 1938, Ellenberg 783 (B!).

A. filagineus Boiss., Diagn. pl. orient., ser. 1, 9: 89. 1849. Syntypes: in Persia, P.M.B. Aucher-Eloy 1267 (FI-W!, G!, K!: foto MSB!); et in monte Elburs prope pag. Dareke, Th. Kotschy 561 (as *A. compactus*). - Lectotype (designated here): in monte Elburs prope pag. Dareke, Th. Kotschy 561 (as *A. compactus*) (G-BOIS!; iso: BM!, FI-W!, G!, K: pp.!, LE!, TUB!, W!).

A. fragilidens Freyn & Sint., Bull. Herb. Boiss., ser. 2, 4: 1111. 1904. Syntypes: Aschabad prope Nephton, 13.4.1900, P.E.E. Sintenis 2090; dto., 16.5.1900, P.E.E. Sintenis 396 (M!). - Lectotype (designated here): [Turkmenistan] Aschabad prope Nephton, 16.5. 1900, P.E.E. Sintenis 2090 (BRNM!; iso: B!, BP!, JE!, LD!, LE!, M!, MSB!, STU!, W!, WU!, Z!).

A. geminanus Boiss. & Hausskn. in Boissier, Fl. Or. 2: 330. 1872. - Lectotype (designated here): mte. Geminan inter Sihna [Sanandaj] et Kermanschah Persiae occ., 7000', ix.1867 H.C. Haussknecht [22 = 352i] (G- BOIS!: the sheet marked as lectotypus; iso: G-BOIS!, BM!, JE!, K!, LE!, W pp.!).

- var. ***minor*** Boiss. & Hausskn., in Boiss., Fl. Or. 2: 330. 1872. - Lectotype (designated here): in monte Ataschke inter Awiheng et Sihna [Sanandaj] Persiae occid., 9000', viii.1867, H.C. Haussknecht 23 (G-BOIS! iso: JE!, W pp.!).

A. gillii Širj., Repert. Spec. Nov. Regni Veg. 50: 269. 1941. Syntypes: [Iran, Elburs] Kendevan, 2970 m, 5. july, A. Gilli; Kendevan I, 2800 m, 3 July, A. Gilli W!). - Lectotype (designated here): Elburs] Kendevan, 2970 m, 5 July, A. Gilli (W!).

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!).

A. glaucopsoides Bornm., Mitth. Thür. Bot. Vereins, N.S. 23: 10. 1908. - Lectotype (designated here): Persia occ., inter Kermanschah et Nehawend Luristaniae ad Dscham-Tuéh, 14.5.1904, Th. Strauss (B!: with description; iso: JE!, W!).

A. gossypinoides Hand.-Mazz. & Bornm., Ann. Naturhist. Mus. Wien 27: 75. 1913. Syntypes: im Dschebel Sindschar zwischen Dscheddale und Chattunije im Wadi Schilu, 600-700 m, 11.6.1910, H. von Handel-Mazzetti 1555 (W!: foto K, WU!); im Dschebel Abd el Asis bei Gharra, 500-600 m, 22.6.1910, H. von Handel-Mazzetti 1748; Mardin, Senar, 1888, P.E.E. Sintenis 1316 (as *A. filagineus*) (E!, WU!). - Lectotype (designated here): im Dschebel Abd el Asis el Gharra, 500-600 m, 22.6.1910, H. von Handel-Mazzetti 1748 (WU!; iso: B!, TARI!, W!).

- var. ***sindscharensis*** Širj., Repert. Spec. Nov. Regni Veg. 47: 230. 1939. -Lectotype (designated here): Mesopotamia, in mont. Dschebel Sindschar, H. von Handel-Mazzetti 1555 (WU!; iso: W!).

A. gossypinus Fisch. var. ***nervulosus*** Boiss., Fl. Or. 2: 350. 1872. - Lectotype (designated here): in mont. Avroman [et Schahu], 4000' [5000'], vii.1867. H.C. Haussknecht (G-BOIS!: No. 341; iso: BM!, G-BOIS!, LE!, MSB!, W!).

A. griffithii Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 15(1): 192. 1869. Syntypes: in regno Cabulico, Kalu Pass, W. Griffith journ. 1079 (= distr. 1511) (G-BOIS!, K!); distr. 1513 (K!, P!: without flowers and fruits); 1542. - Lectotype (designated hereined.): Kalu Pass, Griffith distr. 1513 (K!).

A. guestii Eig, Syst. Stud. Astrag. Near East: 80. 1955. Syntypes: Iraq, Zawita, 3750 ft., 28.7.1933, E. Guest 3764 (K!); envir. of Suwara-Tuka, between Dohuk and Amadia, 1000–1200 m, 28.9.1933, M. Zohary & Amdursky. - Lectotype (designated here): envir. of Suwara-Tuka, between Dohuk and Amadia, 1000-1200 m, 28.9.1933, M. Zohary & Amdursky (HUJ!).

A. heratensis Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 83. 1868 in clave [et l.c. 15(1): 145. 1869]. - Lectotype (designated here): [Afghanistan] N. Herat [prope Herat], ix.1858, A. von Bunge (P!; iso: FI!, G-BOIS!, GOET!, K!, L!, LE!, MSB!, W!).

A. hirtus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 54. 1868 in clave [et l.c. 15(1): 87. 1869]. - Holotype: Persia media inter Gäs et Murtschehar, N Isfahan, Bunge & Bienert (P!: in juvenile state, without flowers and fruits); therefore an epitype is choosen which shows all essential characters of the species. Epitype (choosen here): Iran, Prov. Esfahan, at the beginning of road from Golpeyegan to Muteh, 1850 m, 20.7.1998, Maassoumi & Mozaffarian 76711 (MSB!; iso: TARI!).

A. hypsogeton Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 82. 1868 in clave [et l.c. 15(1): 140. 1869]. – Lectotype (designated here): Persia or., inter Nischapur et Meschhed, 8000', vi.-vii.1858, A. von Bunge & Th. Bienert (LE!: the sheet marked as lectotypus; iso: G-BOIS!, GOET!, K!, L!, LE!, MSB!, W!).

A. karataschensis Širj., Repert. Spec. Nov. Regni Veg. 47: 234. 1939. - Lectotype: Armenia turcica, [B7 Elazig] in m. Karatsch prope Karput [supra Pekenik], 12.6.1889, P.E.E. Sintenis 769 (as A. lamarckii) (K!: iso: LD).

A. karsianus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 15 (1): 115. 1869. - Lectotype (designated here): [Turkey] Armenia prope Kars, G.F.R.J. von Radde 280 (LE!; iso: P!).

A. kashmirensis Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 30. 1868 in clave [et l.c. 15(1): 34. 1869]. Syntypes: In alpibus caschmirensibus, Jacquemont 778; Falconer 420 (sub nom. *A. pyrrhotricho*) (K). - Lectotype (designated here): In alpibuis caschmirensibus, Jacquemont 778 (P!).

A. keyserlingii Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 82. 1868 in clave [et l.c. 15(1): 139. 1869]. - Lectotype (designated here): inter Murtschehar et Sof, N Isfahan, v.1859, A. von Bunge & Th. Bienert (LE!: the sheet marked as lectotypus; iso: G-BOIS!, GOET!, K!: inter Jesd et Isfahan, LE!, MSB!, W!).

A. kifonsanicus Ulbr., Bot. Jahrb. Syst. 36, Beibl. 82: 64. 1905. Syntypes: Ki fon shan, in der Nähe von Pao ki scen, Distr. Ki shan, Lu tun, v.1895, G. Giraldi 706; dto. 29.4.1891, G. Giraldi 4243 (FI!); dto., 1898, G. Giraldi 4240: fr. (FI!). - Lectotype (designated here): [China, Shanxi] Ki fon shan, in der Nähe von Pao ki scen, Distr. Ki shan, Lu tun, v. 1895, G. Giraldi 706 (FI!; the type material at B is distroyed: good drawing at K!).

A. krugeanus Freyn & Bornm. Österr. Bot. Z. 40: 443. 1890. - Lectotype (designated here): Amasia, mt. Akdagh, 1600–2000 m, 19.6.1889, J.F.N. Bornmüller 92 (BRNM!; iso: B!, BM!, BP!, BR!, BRNM!, FI!, GOET!, JE!, K!, LD!, LE!, OXF!, PR!, PRC!, STU!)

- var. ***commagenicus*** Hand.-Mazz., Ann. Naturhist. Mus. Wien 27: 77. 1913. - Lectotype (designated here): Tschirik Jailassi auf dem Nemrud Dagh bei Kjachta, 1950 m, 12.7.1910, H. von Handel-Mazzetti No. 2141 (WU!; iso: B!, BRNM!, W!). Note: The statement in Fl. of Turkey vol. 3 of a holotype in W. is wrong.

- var. ***hareftae*** Náběl̆ek, Spisy Prir. Fak. Masarykovy Univ. 35: 81. 1923. - Lectotype (designated here): [Turkey] Taurus Armenus, mons Harefta inter Wan (Baskala) et Kocanes, 2600 m, 31.8.1910, F. Náběl̆ek 3100 (SAV!; iso: BRNU).

- var. ***karadaghensis*** Širj. & Bornm., Repert. Spec. Nov. Regni Veg. 52: 11. 1943. Syntypes: Lycaonia, m. Karadagh supra Suleiman-Hadji-Jujla, 17.6.1911, Andrasovszky 456; in m. Karadagh supra p. Karadagh, 25.7.1911, Andrasovszky

450 (B!). - Lectotype (designated here): Lycaonia, m. Karadagh supra Suleiman-Hadji-Jajla, 17.6.1911, Andrasovszky 456 (B!).

- var. ***karagoeldaghensis*** Širj., Repert. Spec. Nov. Regni Veg. 47: 247. 1939. - Lectotype (designated here): Armenia turc., in alpinis mt. Karagoeldagh, Giamdagh Maden, 1894, P.E.E. Sintenis 7143 (LD!; iso: BR!, E!, L!, M!, STU!).

- var. ***kurdomerensis*** Širj., Repert. Spec. Nov. Regni Veg. 47: 247. 1939. -Lectotype (designated here): Armenia turcica, in m. Kurdomer, distr. Gümüschkhane, 1894, P.E.E. Sintenis 6208 (PRC!; iso: B!, JE!, LD!, PR!, STU!, Z!).

- var. ***nitens*** Freyn & Sint., Bull. Herb. Boiss. 3: 180. 1895. Syntypes: Armenia turcica, Gümüschkhane, prope Taltaban, 16.7., P.E.E. Sintenis 6265; Armenia turcica, Szandschak, Gümüshkhane, ad Aimeme-bogas, 16.8.1894, P.E.E. Sintenis 7419 (B!, LD!). - Lectotype (designated here): Armenia turcica, Gümüschkhane, prope Taltaban, 16.7., P.E.E. Sintenis 6265 (BRNM!; iso: BP!, JE!, K!, LD!, PRC!, W!, WU!, Z!).

- var. ***sipikordaghensis*** Širj., Repert. Spec. Nov. Regni Veg. 47: 247. 1939. - Type: Armenia turc., Sipikordagh, 1890, P.E.E. Sintenis 3021 (W!; iso: LD).

A. kuhistanus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 82. 1868 in clave [et l.c. 15(1): 141. 1869]. - Lectotype (designated here): Persiae prope Kuhistan, inter Isferar et Derre-mian, A. von Bunge & Th. Bienert (P!; iso: G-BOIS!, K!, MSB!).

A. kurdicus Boiss. var. ***achyrdaghensis*** Širj., Repert. Spec. Nov. Regni Veg. 47: 231. 1939. - Lectotype (designated here): Syria bor., in m. Achyrdagh supra Marasch, H.C. Haussknecht (JE!; iso: G-BOIS!).

A. kutepovii Širj., Repert. Spec. Nov. Regni Veg. 47: 239. 1939. Lectotype (here designated): [Turkey] Cappadocia, prope Maaden, vi.1898, Siehe (W!; iso: G!, WU!).

A. lamarckii Boiss., Diagn. pl. orient., ser. 1, 9: 82. 1849. Syntypes: 'Tragacantha orientalis humillima incana flore purpurascente', Armenia, J.P. de Tournefort; *A. compactus* var. ? (B-W, G-BOIS!); A. humilis Willd. non M.Bieb. (B-W.); in Armenia, Gundelsheimer (G-BOIS!); in Cappadocia, P.M.B. Aucher-Eloy. - Lectotype (designated here): in Cappadocia, P.M.B. Aucher-Eloy 1261 (G-BOIS!; iso: FI!).

A. lasiocaulos Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 83. 1868 in clave [et l.c. 15(1): 144. 1869]. - Lectotype (designated here): ad fines orientales Persiae in montibus Kuh-i-Kerat , inter Gurian et Chaf, A. von Bunge & Th. Bienert (P!; iso: FI!, G-BOIS!, GOET!, K!, LE!, W!).

A. lasioglottis M.Bieb., Fl. Taur.-Cauc. 3: 486. 1819. - Lectotype (designated here): in apricis Caucasi cabardinici ad rivum Podkumek circa acidulam Nartsana [Narzan], 1809, C. Steven (LE!; iso: H!, K!, LE!).

A. lateritians Freyn & Bornm., Bull. Herb. Boiss. 5: 599. 1897. Syntypes: Persiae austr. Prov. Kerman, Kuh-i-Nasr, 3800 m, 4.7.1892, J.F.N. Bornmüller 3788; [Schah-Kuh] mt. Kuh-i-Diwassi districtu Rahbur (inter Kerman et Bender-Abbas), 3100 m, 2.8.1892, J.F.N. Bornmüller 3789 (B!, BRNM!). - Lectotype (designated here): Persiae austr. Prov. Kerman, Kuh-i-Nasr, 3800 m, 4.7.1892, J.F.N. Bornmüller 3788 (B!: with description; iso: BM!, BRNM!, G!, HBG!, JE!, K!, LD!, LE!, OXF!, PRC!, W!, Z!).

A. lepidanthus Boiss., Diagn. pl. orient., ser. 1, 9: 85. 1849. - Lectotype (designated here): inter Edlip et Aleppum, vi.1846. Boissier (G-BOIS!: sheet marked as lectotypus; iso: G-BOIS!, WU!).

A. leucomallus Bornm. & Širj., Repert. Spec. Nov. Regni Veg. 52: 11. 1942. Syntypes: [Turkey B7 Erzincan] Egin (Kemaliye), Salachlü, 29.6.1890, P.E.E. Sintenis 2779 (MSB!, W!; Egin ad Euphratem, Kainartschar, [ad Paschtasch], 26.6.1889, Sintenis 936. - Lectotype (designated here: Egin ad Euphratem, Kainartschar,

[ad Paschtasch], 26.6.1889, Sintenis 936 (B!: with description; iso: BR!, BRNM, K).

A. levieri Sommier & Levier, Boll. Soc. Bot. Ital. 1893: 527. 1883 [et Österr. Bot. Z. 44: 28. 1894]. Syntypes: jugo Tieberdinski inter flum. Tscherda et Do-ut ditionis Kuban, 3000 m, 2.9.1890, C.P.S. Sommier & E. Levier 353; mt. Elbrus in monte supra flumen Kükürtli, 2800–3000 m, 9.9.1890, C.P.S. Sommier & E. Levier (FI!). - Lectotype (designated here): jugo Tieberdinski inter flum. Tscherda et Do-ut ditionis Kuban, 3000 m, 2.9.1890, C.P.S. Sommier & E. Levier 353 (FI!: cum diagnosi; iso: FI!, G!, LE!).

A. litostachyus Boiss. & Hausskn. in Boissier, Fl. Or. 2: 350. 1872. - Lectotype (designated here: [Iran] in monte Schahu Kurdestaniae Persiae supra Rowansir, 5000', H.C. Haussknecht (G-BOIS; iso: BM!, JE!, K!, M!).

A. longispicatus Ulbr., Bot. Jahrb. Syst. 36, Beibl. 82: 61. 1905. - Lectotype (designated here): [China] Shensi sept., Lio y shan in der Schlucht des Fon y huo, 20.8.1898, G. Giraldi 4256 (FI!; the type material at B is destroyed: drawing at K!).

A. macrolacis Boiss. & Buhse, Nouv. Mém. Soc. Imp. Naturalistes Moscou 12: 63. 1860. - Lectotype (designated here): im Gebirge bei Bibersin, 31.5.1848, Buhse 1004/4 (LE!: with description by Buhse; no material in G-BOIS).

A. malacotrichus Fischer, in schedis impr. ad Th.Kotschy, Pl. alepp. kurd. moss., ed. Hohenacker No. 224. 1843. - Lectotype (designated here): In collibus pr. Aleppum, 13.5.1841. Kotschy Pl. alepp. kurd. moss. 224 (LE!; iso: BM!, G!, GOET!, HOH!, K!, LE!, M!, MSB!, PR!, REG!, TUB!, W!, WU!).

A. marschallianus Fisch., Bull. Soc. Imp. Naturalistes Moscou 26(2): 328. 1853. Syntypes: ad portas Caucasicas, F.A. Marschall von Bieberstein [LE!: pp.]; prope Lars, Fritzsche (foto: K); in m. Balkan Turcomaniae, G.S. Karelin (LE). - Lectotype (designated here): prope Lars, Fritzsche (LE!).

A. medorum Bornm., Mitth. Thür. Bot. Vereins, n.s. 23: 11. 1908. - Lectotype (designated here): Persia occ., in monte Elwend, vi.1902, Th. Strauss (B!; iso: JE!).

A. meschhedensis Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 82. 1868 in clave [et l.c. 15(1): 140. 1869]. - Lectotype (designated here): prope Turuk, Kuh-Sangi, haud procul ab urbe Meschhed, vii.1858, A. von Bunge & Th. Bienert (P!; iso: FI!, G-BOIS!, GOET!, K!, LE!, MSB!, W!).

A. microcephalus Willd. var. ***argaeus*** Širj., Repert. Spec. Nov. Regni Veg. 47: 204. 1939. Syntypes: Cappadocia, m. Argaeus, 1400 m, 1856 B. Balansa 939 (G-BOIS!: sub num. 199, GOET!); ibid., 1600 m, E. Zederbauer; ibid., Kysil-depe, 2000 m, [7.7.1898], Siehe 190 (B!: fragm., K, LE!, WU!. - Lectotype (designated here): [Turkey] Cappadocia, m. Argaeus, 1600 m, E. Zederbauer (WU!: sheet marked as lectotypus; iso: WU!).

A. micropterus Fisch., Bull. Soc. Imp. Naturalistes Moscou 26(2): 396. 1853. - Lectotype: inter Amasia et Toptscham in ditione Tokatensi, E. Wiedemann (LE!: sheet marked as lectotypus; iso: LE!: mixed with *A. tokatensis*).

- var. ***robustior*** Širj., Repert. Spec. Nov. Regni Veg. 47: 246. 1939. - Lectotype (designated here): Pontus, m. Kirklar supra Amasia, 500-600 m, 1890, Bornmüller 2867 (BRNM!; iso: B!, BR!, LE!).

A. monspessulanus L. subsp. ***illyricus*** (Bernh.) Chater in Feddes Repert. 79: 51. 1968 = *A. illyricus* Bernh., Select. Sem. Hort. Erfurt. 1836 [et reimpr. in Linnaea 12: Litt. 74. 1838]. No type is given. - Neotype (designated here): Miramare prope Tergestem, Marchesetti in Fl. Exsicc. Austro-Hungarica nr. 7 (MSB!; iso: M!, W!).

A. morgani Freyn, Bull. Herb. Boiss. 5: 601. 1897. - Lectotype (designated here): [Iran] Persiae occ. Prov. Luristan, in monte Haschtad-pahlu-Kuh, (ad meridiem opp. Korremabad), Jul.1891. M. et M^{me} De Morgan (BRNM!; iso: P!).

A. mouterdeianus Eig, Syst. Stud. Astrag. Near East: 107. 1855 - Lectotype (designated here): Lebanon, Zachleh, 31.5.1936, P. Mouterde (sub *A. zachlensis*) (G!: the plant on the right side)

A. multispinus Freyn & Bornm., Bull. Herb. Boiss. 5: 597. 1897. Syntypes: Persiae austr. Prov. Kerman, prope Rahbur (inter Kerman et Bender-Abbas), 31.7.1892, J.F.N. Bornmüller 3781 (B); dto., 2700 m, J.F.N. Bornmüller 3785; in monte Kuh-i-Lalesar, 3200 m, 23.7.1892, J.F.N. Bornmüller 3783 (B!, BM!, BP!, BRNM!, STU!, WU!, Z!). - Lectotype (designated here): Persiae austr. Prov. Kerman, prope Rahbur (inter Kerman et Bender-Abbas), 2700 m, 31.7.1892, J.F.N. Bornmüller 3785 (BRNM!; iso: B!, G!, JE!, K!, TARI!, W!, WU!).

- var. ***parviflorus*** Freyn & Bornm., Bull. Herb. Boiss. 5: 598. 1897. - Lectotype (designated here): Persia austr., Prov. Kerman, mt. Kuh-i-Dschupar, 3000 m, 11.6.1892, J.F.N. Bornmüller 3712 (BRNM!; iso: B!, BP!, G!, JE!, K!, MSB!, P!, WU!).

A. myrianthus Beck, Denkschr. Akad. Wiss. Wien, math.-naturwiss. Cl., 2. Abt. 51: 336. 1886. - Lectotype (designated here): in desertis prope Hamadan, 26.7.1882, Th. Pichler 58 (WU!; iso: B!, JE!, MSB!, W!).

A. nimrudensis Širj., Repert. Spec. Nov. Regni Veg. 47: 233. 1939. - Lectotype (designated here): Kurdistania occ., Taurus Cataonicus, in m. Nimrud-dagh pr. v. Kjachta, distr. Mamuret-ül-Asis, 1600–2250 m, 12.7.1910., H. von Handel-Mazzetti (as *A. erythrocephalus*) (WU!: sheet marked as lectotypus; iso: W, WU!).

A. noemiae Eig, Syst. Stud. Astrag. Near East: 74. 1955. - Lectotype (designated here): Iraq, Ser Amadia, 3.8.1933, E. Guest 4974 (K!: sheet marked as lectotypus; iso: K!).

A. naftolskii Eig, Syst. Stud. Astrag. Near East: 87. 1955. Syntypes: S. Syria, Hermon, Wadi Shib'a, 21.7.1924, A. Eig; ibid., 18.6.1924, Naftolski (HUJ!). Lectotype (designated here): S. Syria, Hermon, Wadi Shib'a, [c. 1200 m] 21.7.1924, A. Eig (HUJ!; iso: E!, K, W!).

A. norvegicus **Grauer**, Pl. minus cogn. decuria: 13. 1784 [et reimpr. in J. Bot. (London) 60: 271. 1922]. Type: Norvegia, prope Roeraas versus praedium Engan, ad Glomen fluvium, Weber (not to find elsewhere). Neotype (designated here): Norway, Alp. Dovrensis, Kongsvold, 20.7.1870, Zetterstedt & Wickbom (MSB!; iso: M!).

A. nudatus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 85. 1868 in clave [et l.c. 15(1): 147. 1869]. - Lectotype (designated here): in Tauri cilicici alpe Achür-dagh supra Marasch, H.C. Haussknecht 7 (LE!; iso: E!, JE!).

A. ochrobius Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 82. 1868 in clave [et l.c. 15(1): 141. 1869]. - Lectotype (designated here): prope Kehris-deneh versus fines Persiae orientalis inter Meschhed et Herat, viii.1858, A. von Bunge & Th. Bienert (LE!; iso: BR!, FI!, G-BOIS!, GOET!, K!, MSB!, P!).

A. oleaefolius DC. subvar. *alexandri* Širj., Repert. Spec. Nov. Regni Veg. 47: 254. 1939. Syntypes: [Turkey, B6 Kayseri] Cappadocia, Ylan-dagh ad Caesaream, 1400 m, 12.8.1856; B. Balansa 942 [erronnee 922]; Armenia rossica, ad p. Alagez, I.I. Karjagin & Safiev. Lectotype (designated here): Cappadocia, Ylan-dagh ad Caesaream, 1400 m, 12.8.1956, B. Balansa 942 (W!; iso: G-BOIS

A. pachyacanthus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 82. 1868 in clave [et l.c. 15(1): 143. 1869]. - Lectotype (designated here): [Iran] prope

Kelat Prov. Chorassan, distr. Gunabadensis, A. von Bunge & Th. Bienert (LE!; iso: BR!, G-BOIS!, GOET!, K!, P!, W!).

A. pannosus Fenzl var. ***albotomentosus*** Fenzl in Tschichatscheff, Asie Min. Bot. 1: 3. 1860. - Lectotype (designated here): pl. d'Orient, 1855, B. Balansa 480 (G!; iso: FI-W!, JE!, MSB!, P!).

A. paraglycyphyllos Boissieu in Lecomte, Not. Syst. 1: 225. 1910. Syntypes: à Vladimirof, 1.8.1908, Faurie 517 (E!, MSB!, P!, W!); Sakhalin, près Brizine, 1.7.1908, Faurie 516. Lectotype (designated here): Sakhalin, près Brizine, 1.7.1908, Faurie 516 (P!; iso: E!, MSB!, W!).

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

- var. ***intermedius*** Širj. & Bornm., Repert. Spec. Nov. Regni Veg. 52: 4. 1943. Syntypes: Persia, in m. Kuh Domine, Fereidun, vii.1908, Th. Strauss; ad Dschekab, 1903, Th. Strauss (B). - Lectotype (designated here): Persia, in m. Kuh Domine, Fereidun, vii.1908, Th. Strauss (B!).

A. pennatus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 85. 1868 in clave [et l.c. 15(1): 148. 1869]. - Lectotype (designated here): in Tauri cilicici alpe Berys-dagh, 2450-2750 m, 4.7.1865, H.C. Haussknecht 14 (P!; iso: G-BOIS!, W!).

A. peristereus Boiss. & Hausskn. in Boissier, Fl. Or. 2: 351. 1872. - Lectotype (designated here): [Iraq] mt. Pir Omar Gudrun Kurduchiae Persiae conterminae, 5000', H.C. Haussknecht 28 (G-BOIS!; iso: JE!, W!).

A. pichleri Beck var. ***glabrescens*** Širj., Repert. Spec. Nov. Regni Veg. 47: 203. 1939. - Lectotype (designated here): Persia, Tschintschian, leg. Th. Pichler (W!; iso: B!, PR!: in agro ecbatanensis (sub *A. floccosus*), det. Širjaev himself, WU!).

A. piletocladus Freyn & Sint., Bull. Herb. Boiss., sér. 2, 4: 1108. 1904. Syntypes: Sülüklü, 20.7.1900, P.E.E. Sintenis 735b (BRNM!); ibid., 7.8.1900, P.E.E. Sintenis 1061; ibid., in fauce Persergraben, 17.8.1900, P.E.E. Sintenis 1103 (BP!, BREM!, BRNM!, JE!, LD!, PR!, PRC!, ZT!); Kisil-Arwat, 5.5.1901, P.E.E. Sintenis 1682a (BRNM!, E!, G!); Karakala, in monte Sundsodagh,

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

A. prusianus Boiss. var. ***bozantinus*** Eig, Syst. Stud. Astrag. Near East: 84. 1955. Syntypes: S. Turkey, Cilicia, Taurus Mountains, envir. of Bozanti, 800 m, 20.8.1931, Eig & Zohary (HUJ; W!); Bulgardagh Mountains, Armadshek, above Ak-Keupri, 1200 m, 21.8.1931, Eig & Zohary (HUJ: foto K!); env. of Goezne, NW of Mersina, 1000–1100 m, 16.8.1931, Eig & Zohary. - Lectotype (designated here): env. of Goezne, NW of Mersina, 1000–1100 m, 16.8.1931, Eig & Zohary (HUJ!).

A. pseudosquarrosus Širj. & Rech.f., Anz. Österr. Akad. Wiss., Math.-Naturwiss. Kl. **91**: 164. 1954. - Lectotype (designated here): [Iran] Baluchistan, inter Zahedan et Khash ditionis Sarhadd, 1300-1600 m, 15.5.1948, K.H. Rechinger & al. 4280 (W!: sheet marked as lectotype; iso: B!, E!, G!, K!, IRAN!, W!).

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

A. pterocephalus Bunge, Izv. Imp. Obsheh. Ljubit. Estestv. Moskovsk. Univ. 26(2): 252. 1880. Syntypes: Kokand, nahe Borukha, 31.7.1892 (LE!); Turkestan, nahe Makschevata, zwischen Ura-tjube und Jangy-aryk, O.A. Fedtschenko; und bei Suratag, O.A. Fedtschenko (LE!). - Lectotype (designated here): Turkestan, nahe Makschevata, zwischen Ura-tjube und Jangy-aryk, O.A. Fedtschenko (LE!).

A. pulvinatus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 82. 1868 in clave [et l.c. 15(1): 142. 1869]. - Lectotype (designated here): [Iran] Prov. Chorassan, distr. Meschhedensis supra pagum Dshegar, vi.–vii.1858, A. von Bunge & Th. Bienert (LE!; iso: FI!, G-BOIS!, GOET!, K!, L!, MSB!, W!).

A. pycnocephalus Fisch. var. ***nabelekii*** Širj., Repert. Spec. Nov. Regni Veg. 47: 232. 1939. - Lectotype (designated here): [Turkey] Kurdistania turc., inter Hashita et Amadia, F. Näbëlek (SAV!: sheet marked as lectotypus; iso. SAV!).

A. quinquejugus Širj. & Rech.f., Biol. Skr. 9(3): 171. 1958. - Lectotype (designated here): [Afghanistan] Deh Kundi, 2800 m, 11.6.1949, L. Edelberg 1869 (W!; iso: C!).

A. rahensis Širj. & Rech.f., Ann. Naturhist. Mus. Wien 58: 66. 1951. - Lectotype (designated here): Persia Prov. Shahrud-Bustam, mt. Shahvar supra Nekarman, Rahé, 2700 m, 20.-26.7.1948, K.H. Rechinger 6000 (W!: the upper plant; iso: E!, G!, K, M!).

A. rascheyaensis Freyn & Bornm., Bull. Herb. Boiss. 6: 982. 1898. Syntypes: Syria, Antilibani inter Zebedani et Rascheya, 24.6.1897, J.F.N. Bornmüller 568; Libani, in regione alpina jugi Sanin, 2200-2300 m, J.F.N. Bornmüller 272 (B!: = *A. cruentiflorus* Boiss.). - Lectotype (designated here): Syria, Antilibani inter Zebedani et Rascheya, 24.6.1897, J.F.N. Bornmüller 568 (BRNM!; iso: B!).

A. rubens B. Fedtsch. & N.A. Ivanova, Trudy Tadzhiksk. Bazy 2: 146. 1936. - Lectotype (designated here): [Tadzhikistan] Darwas occidentalis in jugo montium inter fluvia Jachsu et Ob-niou, prope pagum Art, 2.10.1932. N.F. Gontscharov, J.S. Grigoriew & A.A. Nikitin 998 (LE!: sheet marked as lectotypus; iso: LE!).

A. rumelicus Bunge var. ***euboicus*** Širj., Repert. Spec. Nov. Regni Veg. 47: 200. 1939. Lectotype (designated here): Graecia, in ins. Euboea [in reg supr. m. Delphi Euboea, 5000', 8.1858], T.H.H. von Heldreich (B!; iso: MSB!, P!).

- var. ***tayegeticus*** Sirj., Repert. Spec. Nov. Regni Veg. 47: 199. 1939. - Lectotype (designated here): Graecia, in m. Tayegetus, T.H.H. von Heldreich 1423 (WU!; iso: B!, M!, MA!, MSB!).

A. sangonensis Širj. & Rech.f., Anz. Österr. Akad. Wiss., Math.-Naturwiss. Kl. 91: 164. 1954. - Lectotype (designated here): [Iran] Baluchistan, Mt. Taftan, prope Sangon, 1600 m, 19.5.1948, K.H. Rechinger & al. 4075 (W: Acqu. No. 7364!; iso: B!, E!, G!, IRAN, K!, LD!, M!, W: Acqu. No. 7341!).

A. schottianus Boiss., Diagn. pl. orient., ser. 2, 5: 89. 1856. - Lectotype (designated here): [Turkey] circa castellum Güleck Tauri Cilicici, 4800', viii.1853, Th. Kotschy 283b.321e (G-BOIS!: sheet marked as lectotypus; iso: G-BOIS!, GOET!, LE!, W!).

A. semipellitus Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 83. 1868 in clave [et l.c. 15(1): 144. 1869]. - Lectotype (designated here): Persia, prope Ischredabbad inter Jesd et Isfahan, v. 1858, A. von Bunge & Th. Bienert (LE!; iso: G-BOIS!, GOET!, K!, L!, W!).

A. senganensis Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 82. 1868 in clave [et l.c. 15(1):142]. - Lectotype (designated here): [Iran] inter Teheran et Tabris, prope Sengan et Bagh, A. von Bunge & T. Bienert (P!; iso: G-BOIS!).

A. sieversianus Pall., Sp. Astragal.: 15, t. 12. 1800. - Lectotype (designated here): circa fluv. Uldshaar deserti Kirgiso-Songarici, Sievers (LE!; iso: BM).

A. somcheticus K.Koch, Linnaea 15: 720. 1841. - Lectotype (designated here): in Somchetia, C. Koch (LE!: in Prov. Schunagel, 1837, leg. Dr. Koch No. 554; the type material at B is destroyed.

A. spicaeformis Eig, Syst. Stud. Astrag. Near East: 103. 1955. Syntypes: Syria, between Qaryatein and Hawarin, 24.6.1932, A. Eig & M. Zohary (E!, HUJ: foto K, W!); between Homs and Palmyra, near Forkhlos, 7.7.1934, P. Mouterde (as *A. bethlehemiticus*). - Lectotype (designated here): between Homsand Palmyra, near Forkhlos, 7.7.1934, P. Mouterde (HUJ!).

A. squalidus Boiss. & Noë var. ***chloroxanthinus*** Freyn & Bornm., Österr. Bot. Z. 42: 48. 1892. - Lectotype (designated here): [Turkey] Pontus galaticus, in monte Abadschi-Dagh, 1200–1500 m, 11.5.1890, J.F.N. Bornmüller 2099 (B!; iso: G!, LD!).

A. stapfii Širj., Repert. Spec. Nov. Regni Veg. 47: 206. 1939. - Lectotype (designated here): Persia, Kuh Banu, 8.8.1885, O. Stapf 2573 (as *A. brachycentros*) (WU!; iso: K!, TARI!, W!).

A. stenonychioides Freyn & Bornm., Mém. Herb. Boiss. 13: 11. 1900. - Lectotype (designated here): Phrygia interior, Sultandagh, prope Akscheher, 1100 m, 19.6.1899, J.F.N. Bornmüller 4419 (BRNM!; iso: B!).

A. strictifolius Boiss. f. ***grandifolius*** Širj., Repert. Spec. Nov. Regni Veg. 47: 236. 1939. Syntypes: Persia borealis, jugi Elbursensis in reg. subalpina, in valle Lur ad pagum Getschesär, 2200 m, 4.7.1902. J.F.N. & A. Bornmüller 6897 (B: pp.!, BM!, K!, MSB!, W!); quoque in collibus aridis m. Elburs pr. Derbend, vii.1843. Th. Kotschy 658 (BM: pp.!, FI-W!, K: pp.!, M!, PRC!, W!); quoque in valle

Talagon montis Elburs prope Gattade, 14.7.1843, Th. Kotschy 521 (pp.). - Lectotype (designated here): [Iran] in valle Talagon montis Elburs prope Gattade, 14.7.1843, Th. Kotschy 521 (W!: on same sheet with Kotschy 658; iso: FI-W!).

- f. ***intermedius*** Širj., Repert. Spec. Nov. Regni Veg. 47: 236. 1939. Syntypes: Persia, ad latera montium in valle Koschadara distr. Nakitschiwan, A.J. Szovits 451 (FI!, K!, M!, PRC!, W!); quoque in locis lapidopsis Sterilisimis circa Seidchodschi, distr. Khoi, Prov. Aderbeidschan, A.J. Szovits 488. - Lectotype (designated here): [Iran] in locis lapidosis sterilissimis circa Seidchodschi, distr. Khoi, Prov. Aderbeidschan, A.J. Szovits 488 (W!; iso: E!, FI! G-BOIS!, K!, LE!, M!, MSB!, PRC!, W!, ZT!).
- subsp. ***zoharyi*** Ponert, Feddes Repert. 83: 623. 1973. - Lectotype (designated here): Ankara, Keciören, 6.7.1953, Zohary (HUJ!: sheet marked as lectotypus; iso: HUJ!).
- var. ***kutepovii*** Širj., Repert. Spec. Nov. Regni Veg. 47: 237. 1939. - Lectotype (designated here): Transcaucasia, distr. Nachitschewan, A.J. Szovits 451 (W!; iso: B!, E!, G-BOIS!, JE!, K!, LE!, M!, MSB!, PRC!, W!, WU!).

A. strictipes Bornm., Bull. Herb. Boiss., sér. 2, 5: 840. 1905. Syntypes: Elburs occ., vall. Serd-derre supra Gerab, 2600 m, 26.6.1902, J.F.N. Bornmüller 6842 (B!); et in valle Talkan supra Dschoistan, 2100 m, 27.6.1902, J.F.N. Bornmüller 6841. - Lectotype (designated here): [Iran, Prov. Tehran] in valle Talkan supra Dschoistan, 2100 m, 27.6.1902, J.F.N. Bornmüller 6841 (B!).

A. stromatodes Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 85. 1868 in clave [et l.c. 15(1): 148. 1869]. Syntypes: in Tauri cilicici alpe Achür-dagh [Acker-dagh], 5000', supra Marasch, 19.7.1865, H.C. Haussknecht 8a (G-BOIS!); dto. nr. 10 (B!, JE!, LE!); dto. nr. 8 (G-BOIS!). - Lectotype (designated here): in Tauri cilicici alpe Achür-dagh [Acker-dagh], 5000', supra Marasch, 19.7.1865, H.C. Haussknecht 10 (LE!; iso: B!, G-BOIS!, JE!).

A. supranubius Bornm., Mitth. Thür. Bot. Vereins, n.s. 28: 53. 1911. Syntypes: Antilibanon, Hermon ('Djebel Cheikh'), 18.7.1878, Ch. Gaillardot (JE!); Antilibanon, oberhalb Rascheya, 7000-9000', Th. Kotschy 170; Northern Libanon, Makmelgebirge above Ehden, 1855, C.J. Blanche 3109bis (JE). -

Lectotype (designated here): Antilibanon, oberhalb Rascheya, 7000-9000', Th. Kotschy 170 (B!; iso: MSB!, W!).

- var. ***brevidens*** Eig, Syst. Stud. Astrag. Near East: 89. 1955. Syntypes: Syria, Mt. Hermon, above Ain Jineh, 1500-1600 m, 23.7.1924, A. Eig; between Ain Zhib and Kasr–Antar, 11.8.1929, Gavrielith (HUJ). - Lectotype (designated here): Syria, Mt. Hermon, above Ain Jineh, 1500-1600 m, 23.7.1924, A. Eig (HUJ!; iso: E!, W!).

A. teresianus Sennen & Elias, in schedis ad Sennen, Pl. d'Espagne n° 4640. 1922 [et in Bol. Soc. Ibér. Ci. Nat. 26: 119. 1928]. - Lectotype (designated here): [Spain] Logrono, Treviana, 18.5.1922, Frère Elías in Sennen 4640 (MA! No. 67447; iso: G!, L!, MA!; W!).

A. tinctus Freyn & Sint., Österr. Bot. Z. 42: 11. 1892. - Lectotype (designated here): Armenia turcica, Egin, ad Salachlü, 25.6.1890, P.E.E. Sintenis 2778 (BRNM!; iso: B!, G!, JE!, LD!, LE!, MSB!, PR!).

A. tokatensis Fisch., Bull. Soc. Imp. Naturalistes Moscou 26(2): 370. 1853. - Lectotype (designated here): [Turkey] prope Tokat Natoliae, E. Wiedemann (LE!: sheet marked as lectotypus; iso: G-BOIS!, LE!).

A. tossiensis Freyn & Sint., Österr. Bot. Z. 43: 416. 1893. - Lectotype (designated here): [Turkey] Paphlagonia, Tossia, ad Tschinonbaba, 20.7.1892, P.E.E. Sintenis 4712 (BRNM!; iso: B!, BM!, BP!, FI!, G!, GOET!, JE!, K!, LD!, LE!, MSB!, PR!, PRC!, STU!, WU!, Z!).

- var. ***armeniacus*** Širj., Repert. Spec. Nov. Regni Veg. 47: 246. 1939. - Lectotype (designated here): Armenia turc., distr. Gümüschkhane, Taltaban, 1894, P.E.E. Sintenis 6267b (PRC!; iso: BRNM!, LD!, M!, WU!).

PRC!; iso: BRNM!, LD!, M!, WU!).

A. totschalensis Bornm., Bull. Herb. Boiss., sér. 2, 5: 763. 1905. - Lectotype (designated here): [Iran] Elburs occ., ad basin septentrionalem alpium Totschal in valle Scheheristanek, 2250 m, 7.6.1902, leg. J.F.N. Bornmüller 6898 (B!: sheet marked as lectotypus; iso: B!, BM!, E!, G!, JE!, K!, STU!, W!, WU!, Z!).

A. transjordanicus Eig, Syst. Stud. Astrag. Near East: 12. 1955. Syntypes: Southern Syria, Hauran, inter Gabagueb et Sanamein, ca. 660 m, 7.5.1933, G. Samuelsson; Bosra, 7.5.1886, Post (B!, K!). - Lectotype (designated here): Southern Syria,

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

A. trapezunticus Širj. & Bornm., Repert. Spec. Nov. Regni Veg. 52: 12. 1943. - Lectotype (designated here): [Turkey] Anatolia Prov. Trapezunt prope p. Dzevizlik, 27.6.1917, B.K. Schischkin; et B.K. Schisch*kin* in Grossheim & Schischkin, Pl. orient. exs. 139 (sub *A. ovatus*) (B!; iso: BRNM, K!, PR!).

A. tricholobus DC. var. ***minor*** Hohen., Bull. Soc. Imp. Naturalistes Moscou 6: 345. 1838. Lectotype (designated here: [Azerbaijan] in traj. Suwant, 5000-6000 ft., v.-vi.1836, R.F. Hohenacker (LE!, iso: G!, G-BOIS!, MSB!, P!, W!).

A. wallianus Bornm. & Reese, Repert. Spec. Nov. Regni Veg. 43: 151. 1938. - Lectotype (designated here): [Turkey] Phrygia, Uschak, 30 km E der Stadt, 5 km S Banias, 7.6.1935, H. Reese & E. Wall (B!; iso: JE!).

A. wartoensis Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 87. 1868 in clave [et l.c. **15**(1): 153. 1869]. - Lectotype (designated here): in Kurdistaniae provincia Musch copiosus per districtum Warto, 4600'-5000', 26.8.1859, Th. Kotschy 411 (erron. in descr. 416) (P!: sheet marked as lectotypus; iso: BM!, CGE!, E!, G!, G-BOIS!, JE!, K!, L!, LE!, MSB!, P!, PR!, W!, ZT!).

A. wrangelii Širj., Repert. Spec. Nov. Regni Veg. 47: 201. 1939. Syntypes: Aschabad, Sülüklü (Saratowka), 4.7.1900, P.E.E. Sintenis 735; Kisil Arvat, Karakala in monte Sundsodagh, 31.5.1901, P.E.E. Sintenis 1682c (BRNM!); Kisil Arvat, in m. Kopet dagh, 5.5.1901, P.E.E. Sintenis 1682a (BRNM!); ibid., 18.5.1901, P.E.E. Sintenis 1682b (BRNM!). Lectotype: Aschabad, Sülüklü (Saratowka), 4.7.1900, P.E.E. Sintenis 735 (as *A. verus*) (W!; iso: B!, BRNM!, G!, M!, LE!, MSB!, P!, STU!, WU!, Univ. Lausanne).

A. xanthogossypinus Hand.-Mazz., Ann. Naturhist. Mus. Wien 27: 76. 1913. Syntypes: bei Sert am Abstieg in die Schlucht des Bohtan, 17.8.1910, H. von Handel-Mazzetti 2979; unter Fündük am Tigris NW Dschesiret ibm Omar, H. von Handel-Mazzetti (WU); bei Mar Jakub N Mossul, 550–900 m, H. von Handel-Mazzetti (WU). - Lectotype (designated here): Bei Sert am Abstieg in die Schlucht des Bohtan, 17.8.1910, H. von Handel-Mazzetti 2979 (WU!; iso: B!, W!).

A. zachlensis Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 88. 1868 in clave [et l.c. 15(1): 154. 1869]. Syntypes: Syria in Libano supra Zahle, J.J.H. de Labillardière (FI-W!, G); ibid., v.-vii.1846, E. Boissier. - Lectotype (designated here): Syria in Libano supra Zahle, vi.1846, E. Boissier (G-BOIS!; iso: K!, LE!, MSB!, WU!).

- var. ***parvibracteatus*** Širj., Repert. Spec. Nov. Regni Veg. 47: 235. 1939. - Lectotype (designated here): Syria, Libanon, Bhamdun, 1200-1300 m, 1910, J.F.N. Bornmüller 11582 (B!; iso: E!, G!, JE!, MSB!, WU!).

A. zahlbruckneri Hand.-Mazz., Ann. Naturhist. Mus. Wien 27: 74. 1912. - Lectotype (designated here): [Turkey B7 Elazığ] Hasarbaba Dagh am Göldschik (Quellsee des westlichen Tigris) unweit Kharput, 1800-2450 m, 29.7.1910, H. von Handel-Mazzetti 2580 (WU!: with description; iso: B!, W!).

A. zebedaniensis Freyn & Bornm., Bull. Herb. Boiss. 6: 981. 1898. - Lectotype (designated here): [Lebanon] Syria, Antilibani, inter Zebedani et Rascheya, 24.6.1897, J.F.N. Bornmüller 270 (B!; iso: BRNM!, G!).

Phaca glabra Clarion, Bull. Soc. Philom. 3: 99 (No. 61). 1811. - Lectotype (designated here): "Phaca glabra: caule ramoso, prostrato, foliolis subovatis, florum alis integris, Messidor", scripsit Clarion (P!). other probably type material: e Clarion (G-DC!: fl. blanchatre tache purpre-violeo).

Tragacantha flexilispina Boriss., Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 10: 74. 1947. - Lectotype (ZARRE, ined.): Fergana, distr. Namangna, in montibus ad ripam sinistram fl. Itokar, 15.7.1915. R. Roshevitz 65 (LE!: sheet marked as lectotypus; iso: LE!).

Tragacantha hilariae Boriss. in Fl. Tadzhik. 5: 683. 1937. - Lectotype (designated here): Darwaz, prope pagum Dzhap ad fl. Pjandzh, 11.7.1916, B. Fedtschenko, O.E. Knorring & E.G. Czernjakovskaja 1071 (LE!: sheet marked as lectotypus; iso: LE!).

Tragacantha intermixta Boriss., Trudy Bot. Inst. Akad. Nauk SSSR, Ser. 1, Fl. Sist. Vyssh. Rast **3**: 221. 1936. - Lectotype (designated here): in montibus pr. Aschabad, 28.6.1897, D.I. Litwinow (LE!: with description and drawings; iso: LE!, W!).

Tragacantha kuhitangi Nevski, Trudy Bot. Inst. Akad. Nauk SSSR, Ser. 1, Fl. Sist. Vyssh. Rast. 4: 258. 1937. - Lectotype (designated here): in monte Kuhitang supra pagum Kuhitang, 19.6.1931, S.A. Nevski 337 (LE!: sheet marked as lectotypus; iso: LE!).

Tragacantha macrantha Boriss. in Fl. Tadzhik. 5: 680. 1937. - Lectotype (designated here): [Uzbekistan] Hissar, prope pagum Chovak, distr. Schachrisjabs, 15.6.1897, V.I. Lipsky 146 (LE!: sheet marked as lectotypus; iso: LE!).

Tragacantha meraca Boriss., Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 10: 59. 1947. - Lectotype (designated here): Turcomania, jugum Kopet-Dagh, prope Pul-i-Chatum, in jugo Gjas-gjadyk, Rachnatur, 31.8.1930, I.A. & O. Linczevski 1016 (LE!: sheet marked as lectotypus; iso: LE!).

Tragacantha multifoliolata Boriss., Trudy Bot. Inst. Akad. Nauk SSSR, Ser. 1, Fl. Sist. Vyssh. Rast. 3: 219. 1936. - Lectotype (designated here): Montes Kopet-dagh, supra pagum Tjasi-taplan in jugo Koozly-dagh, 1500 m, 6.7.1931, A.G. Borissova (LE!: sheet marked as lectotypus; iso: LE!).

Tragacantha pycnantha Boriss., in Fl. Tadzhik. 5: 681. 1937. - Lectotype (designated here): prope Mumynabad, 21.5.1910, Divnogorskaja [460] (LE!: sheet marked as lectotypus; iso: LE!).

Tragacantha stipulosa Boriss., Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 10: 75. 1947. - Lectotype (designated here): Asia media, prope Samarkand, in trajectu Tachta-Karaginsky, 10. (23.) 7.1901. D.I. Litwinow 1415 [as *A. asaphes*] (LE!: sheet marked as lectotypus; iso: G!, LE!, PRC!, WU!!).

Tragacantha transcaucasica Boriss., Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 10: 67. 1947. - Lectotype (designated here): [Turkey] distr. Artvin, Gurdzany, 10.6.1914, Turkevitch 785 (LE!: sheet marked as lectotypus; iso: LE!).

Tragacantha unguiculata Boriss., Bot. mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 10: 57. 1947. - Lectotype (designated here): Jugum Kopet-dagh, prope Firjusa, 23.6.1921, M. Popov 696 (LE!: sheet marked as lectotypus; iso: LE!).

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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. kuhsorkhense* 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 (FRITSCH & 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. *Megaloprason*, FRITSCH 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, FRITSCH *et al.* 2001, FRITSCH *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 (FRITSCH *et al.* 2002). Scientific progress led to nomenclatorial alterations of names used by WENDELBO (1971): *Allium bodeanum* Regel became a *nomen rejicendum* (BRUMMITT 2001) and was sunken into synonymy of *A. cristophii*; *A. hirtifolium* Boiss. is con-specific with the somewhat earlier described *A. stipitatum* Regel (FRITSCH 1996), and the Iranian specimens of *A. brachyscapum* Vved. turned out to represent a new species *A. assadii* Seisums (SEISUMS 2000). Because strong evidence accumulated that, *Nectaroscordum* 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

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. *Scorodon* 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 *Polyprason* Radić (FRIESEN *et al.* 2005; see below). The other 11 Iranian species which WENDELBO (1971) included under sect. *Scorodon* remained in subg. *Allium* but were transferred by KHASSANOV (2000) and FRIESEN *et al.* (2005) to other sections:

- *A. fibrosum* Regel, *A. rubellum* M. Bieb., *A. syntamanthum* C. Koch, *A. lamondiae* Wendelbo, and *A. umbilicatum* Boiss. to **sect. *Avulsea*** F.O. Khass.
- *A. callidictyon* C.A. Mey. to **sect. *Brevispatha*** Valsecchi
- *A. bungei* Boiss. and *A. sabulosum* Stev. ex Bunge in GOEB. to **sect. *Eremoprasum*** (Kamelin) F.O. Khass., R.M. Fritsch & Friesen
- *A. kirindicum* Bornm. and *A. kopetdagense* Vved. to **sect. *Kopetdagia*** F.O. Khass.
- *A. longivaginatum* Wendelbo to **sect. *Longivaginata*** (Kamelin) F.O. Khass., R.M. Fritsch & Friesen

- *A. capitellatum* Boiss. to **sect. *Caerulea*** (Omelcz.) 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 unrecognised or new taxa for Iran belong to subg. *Allium* than to other subgenera.

1.1 *Allium longipapillatum* R.M. Fritsch & Matin, sp. nova (sect. *Allium*)

Holotype: Iran: Prov. Lorestan, Khorramabad: Cham-Divan, 1400 m, 25.05.1999 leg. Veiskarami, 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, plana in statu vivendi convoluta, manifeste papillata, 8-16(20) cm longa et 3-4(5) mm lata, margine (sub-)ciliatis, vivide usque glauce viridis. Scapus flexuosus subcylindricus levis, basi decima partis vaginis foliorum involuti, glauce viridis basi atrorubro 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; interiora 1.2-1.5 mm lata, exteriora sublatiora; luteo-rosea fuscato-nervosa. Filamenta tepalis aequantia vel sublongiora, interiora tricuspidata tepalis latiora, cuspide antherifera minus dimidio longitudinis ovatae baseos filamenti attingente, cuspide lateralia longissima; filamenta exteriora indivisa triangularia. Stylus exsertus 2-2.5 mm longus. Ovarium subsphaericum ca. 2 mm longum leve. Capsula et semina ignota.

Differt ab *Allio qaradaghense*, *A. notabile* et *A. subnotabile* foliis brevissimis asperi-papillosis, vaginis foliorum brevissimis et coloris tepalorum luteo-roseis. Simile *A. notabile* characteriis tepalorum filamentorumque et coloris tunicis bulborum sed color tunici et magnitudo magniis bulbillis similis *A. subnotabile*.

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, vivid 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, 2-2.5 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 Bakhtiari 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. qaradaghense* Feinbr. than to *A. notabile* Feinbr. 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.

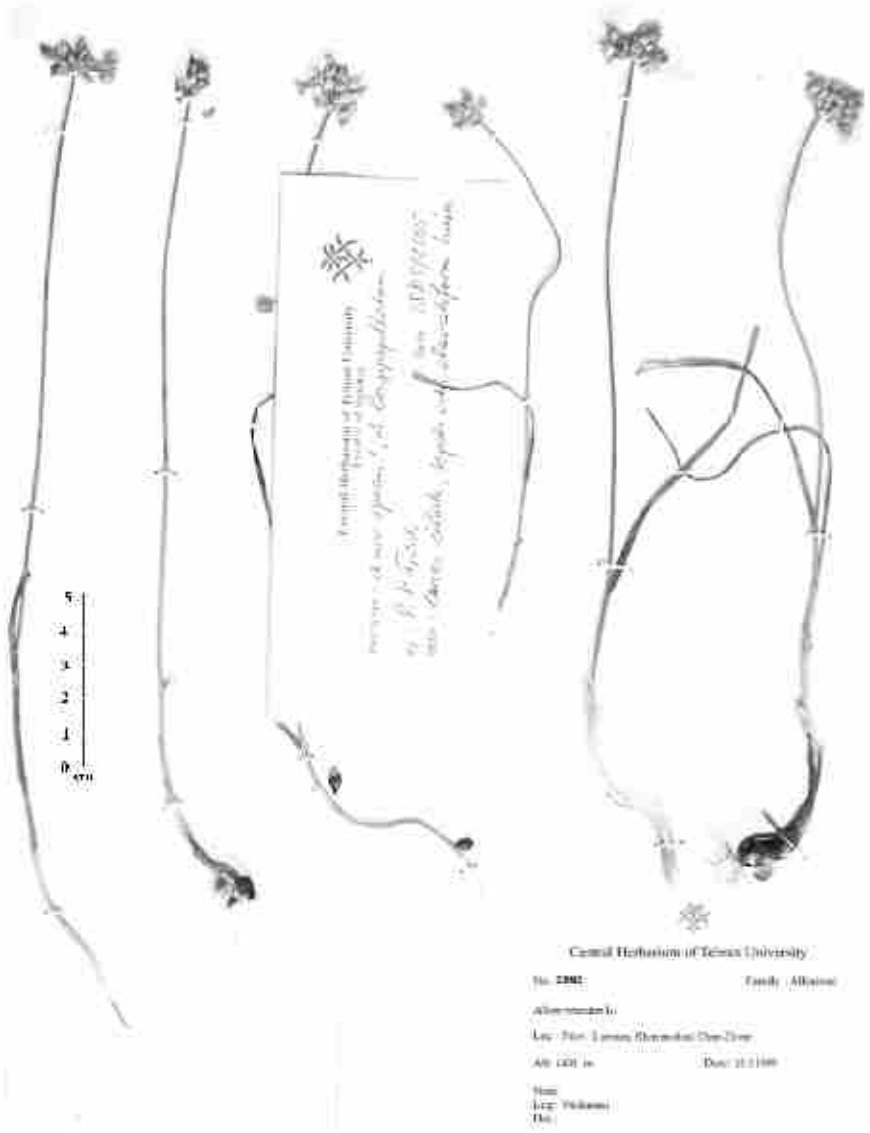

Fig. 1. Holotype of *Allium longipapillatum*.

Additional specimens examined:

This new species species was collected by R.M.F. in the Bakhtiar 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 transplanting to the *Allium* collection in Gatersleben, and a Type specimen could not be selected.

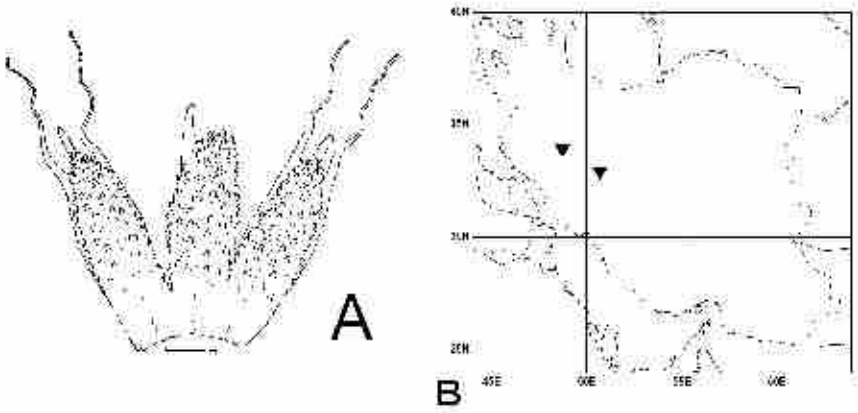

Fig. 2. *Allium longipapillatum*: A. Tepals and filaments (scale bar = 1 mm), B. Distribution map.

1.2. *Allium montelburzense* R.M. FritscH, 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° 19' 49", E 36° 12' 11", 2780 m, 17.07.2005 leg. SH. Zarre & H. Moazzeni 36583 (TUH!; isotypes: B!, M!, TARI!) (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, circinnata, 10-13 cm longa ca. 2 mm in diametro, glabra. Spatha membranacea, bivalva, ovato-lanceolata, rosea usque purpurea, ca. 5 mm longa. Inflorescentia semi-globosa, 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 longitudinis connata et

tepala adnata. Antherae 2.5 mm longae, purpureae. Ovarium obovato-globosum, minute tuberculatum, sessile. Stylus filiformis, ca. 4.5 mm longus. Capsula obovata, 3-5 mm in diametro. Semina nigra, convexa, elliptica, ca. 4 mm longa et 2-2.5 mm lata.

Affinis *Allio capitellato* sed differt filamentis staminum duplo (nec paulo) longioris, antheris purpurescentibus (nec flavis), tepalis lanceolatis-oblongis (nec ovatis) et foliis fistulosis (nec semiteretibus-canaliculatis); differt ab *A. lalesarico* bulbi tunicis exterioreis denigricantibus papyraceis (nec cinerascentibus brunneis et reticulato-fibrosis) et filamentis staminum duplo longioris (nec aequilongis).

Bulb single, ovate, ca. 1.5 cm diam. and ca. 2 cm long, outer tunics grayish brown to black, inner tunics papery to hyaline, white, collum 2-2.5 cm long. Scape filamentous, erect, ca. 15-20 cm long, ca. 2 mm diam., greyish green, glabrous. Leaves 1-2, fistulous, circinnate, 10-13 cm long and ca. 2 mm wide, glabrous or on the nerves finely covered with short scabrid hairs. Spathe ± membranous, divided into two ovate-lanceolate acuminate parts, pink to purplish with darker veins, ca. 5 mm long. Inflorescence semi-globose, 15-30-flowered. Pedicels unequal in length, pink, thin, 5-10 mm long. Tepals narrowly lanceolate-oblong, obtuse at tip, 3-3.2 mm long and 1.2-1.5 mm wide, basally 1-2 mm united, slightly deflexed and involute, pink to purple with darker veins. Filaments 7-8 mm long, about two times longer than tepals, basally for 1.5-2 mm connate to each other and for the same length adnate to tepals, lanceolate-linear, pink to purple. Anthers 2.5 mm long, purplish. Ovary obovate to globose, finely tuberculate, sessile. Style filiform, ca. 4.5 mm. Capsules obovate, 3-5 mm diam. Seeds black, convex, elliptic in outline, ca. 4 mm long and 2-2.5 mm wide.

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.

Relationship: Only few species of sect. *Scorodon* sensu WENDELBO (1971) distributed in Iran possess stamens longer than tepals. *Allium capitellatum*,

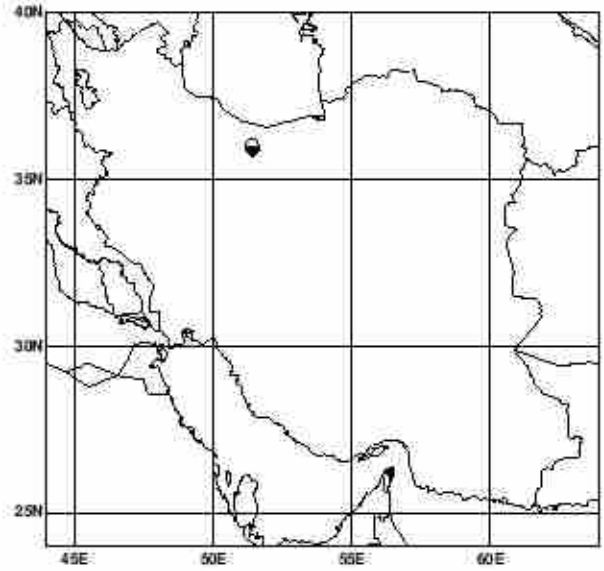

Fig. 3. Distribution map of *Allium montelburzense*.

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. Zarre & H. Moazzeni 36584 (TUH, TARI).

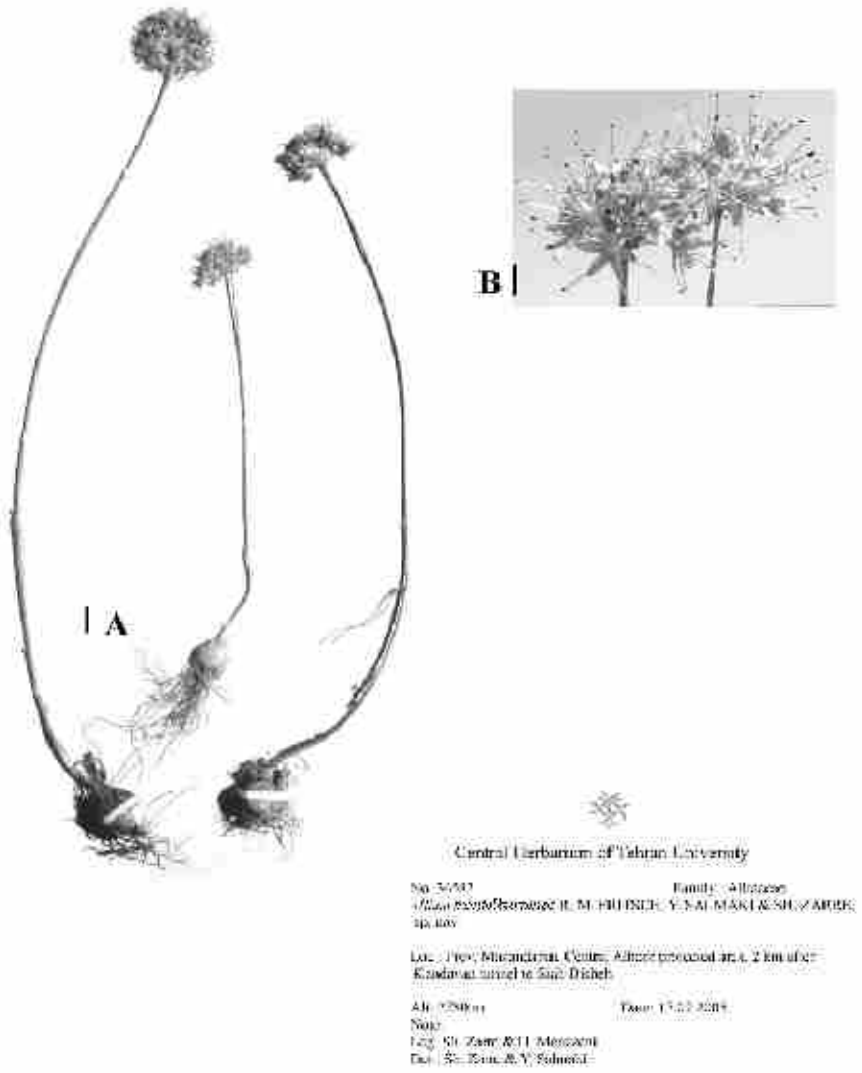

Fig. 4. *Allium montelburzense*: A. Holotype (TARI), B. Inflorescence in natural condition (scale bar: A = 1 cm, B = 5 mm).

Diagnostic key to Iranian species of *Allium* sect. *Scorodon* sensu Wendelbo (1971, pp.: with stamens as long as or longer than tepals, inner filaments simple or with wide teeth near the base, and deciduous spathe; or if spathe persistent then much shorter than inflorescence).

1. Bulb tunics reticulate-fibrous in texture, collum at least 3 cm long ..... *A. talesaricum*

- Bulb tunics papery in texture, collum not longer than 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. montelburzense*

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

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

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

Description: Bulbus subglobosus 2-3 cm in diametro; tunicae cinereae-badiae paulo longitudinaliter fissae. Folia singuli vel bini, elliptica usque oblanceolata, crassa carnosa, basin versus stipitato-acutata basi amplexicaulia, superne plana, supra subsulcata impolita, inferne levia nitida; margine dentata atque sublevia usque subtiliter acuminata, rubra; 15-25 cm longa 5-8 cm lata, glaucissima, basi inferne rubro-badia suffusa. Scapus cylindricus erectus levis, pars supraterranea 5-8 cm longa, ca. 6 mm in diametro, glauco-viridis basi atroruber suffusus. Spatha membrancea 2-4-partita partibus breve acuminatis, pallide fulva nervis inconspicuis. Inflorescentia initio semiglobosa deinde subglobosa densa multiflora, 4-6 cm in diameter. Pedicelli erecti stricti paullus incrassati initio 6-8 mm longi deinde usque 25 mm longi, viride-fusci. Flores stellati. Tepala longe-triangularia convoluta acuta, 7-9 mm longa basi 1.5-2 mm lata, rosea usque badia interdum alba fuscato-nervosa, post anthesin valide convoluta ultimus anguste-conica nec rigida. Filamenta subulata tepalis subequantia, alba apice kermesina vel violacea, basi breve connata et tepalis

adnata. Antherae elongatae flavae usque subviolaceae. Ovarium depresse-globosum intense trisulcatum, asperrimum, 3-4 mm longum 4-5 mm in diameter, viride rubro-suffusum. Stylus conicus 5-4 mm longus stigmate 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 crassa, impolita nigra.

Affinitas incerta, fortasse distans affinis *Allio brachyscapo*. Quamquam statura similis ab *A. akaka* et speciebus affinibus 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 tapals, 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:

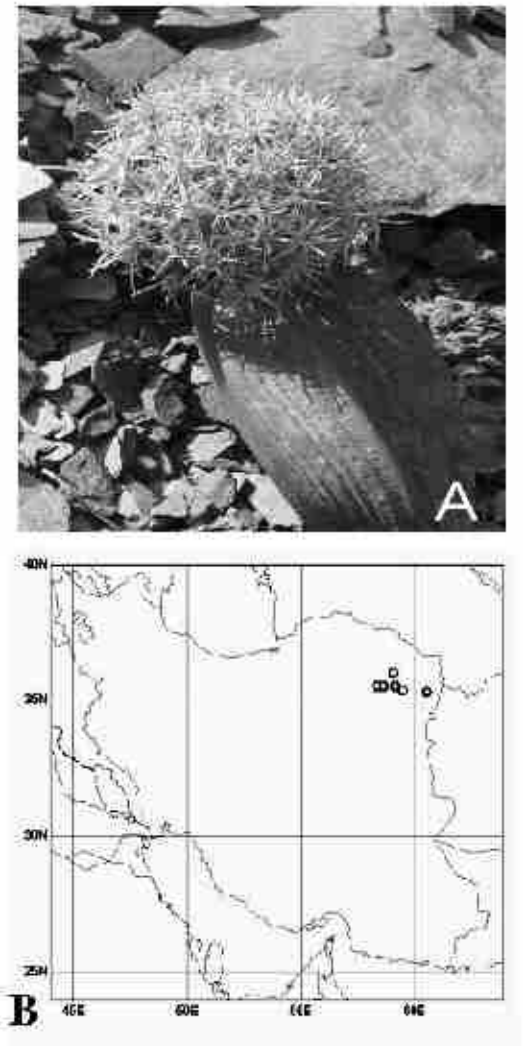

Fig. 5. *Allium kuhsorkhense*: A. Plant from type locality, B. Distribution map.

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. vasilevskajae* 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 kuhsorkense* 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*

Character	*A. akaka* s. str.	*A. kuhsorkhense*
Inflorescence	± semi-globose	(sub-) globose
Tepals	ovate	triangular
Dry tepals	With thickened midvein, stinging stiff	without thickened midvein, soft, not stinging
Filament length	1/2 of tepals	slightly shorter than tepals
Inner filaments	Basally triangular widened	throughout subulate
Ovary	ovate with flat tip, shining,surface finely sub-tuberculate	depressed-globose, dull, surface coarsely tuberculate
Capsules	about as long as wide	wider than long
Distribution	N.W. Iran, E. Anatolia	N.E. Iran (Hamadan Prov.)

Additional specimens examined:

Iran: Prov. Khorasan: Binalud massif, valley with river N.E. of vill. Kharv-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, Safiabad, Ghanbarbaghi, 1700 m, 14.5.1991, Faghihnia & Zangoui 20156 (FUMH); Kashmar, Rivash, Kuhsorkkh, between Targh and Kalateh Teymour, 1800 m, 4.5.1994, Faghihnia & Zangoui 23861 (FUMH); North of

Torbat-e Jam, between Timanak-Bala and Dosange, 1200 m, 11.5.1994, Faghihnia & Zangoui No. 23873 (FUMH); Kashmar, S.W. Rivash (Sorkhkuh), Band-e Ghara, 1800 m, 8.5.1995, Faghihnia & Zangoui 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 interiora non distincte unguiculata." 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 spathes. 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 median 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

malformed 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* Nàb. 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, fading 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 attingenti percursa" 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 sheathes 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:

Iran: Prov. Kermanshah: Limestone massif ca. 5 km N.W. vill. Nojivaran 30 km NE Kermanshah, 1680 m, N 34°25'43", E 47°23'02", 16.05. 2006, M. Abbasi, R.M. Fritsch & M. Keusgen (*Allium* reference collection: IRAN-1110); Prov. Kordestan: Southern slope of a stony hill c. 25 km N.W. of Divandarreh, 2300 m, N 36°03'36", E 46°51'48", 18.05. 2006, M. Abbasi, R.M. Fritsch & M. Keusgen (*Allium* reference collection: IRAN-1118); Prov. Kordestan: Loamy-stony slope in the valley Banajar above vill. Noshur Olia, near Mt. Avalan, 1850 m, N 35°00'50", E 46°54'21", 19.05. 2006, M. Abbasi, R.M. Fritsch & M. Keusgen (*Allium* reference collection: IRAN-1122); Prov. Bakhtiari: Fast senkrechte Kalkfelswand der Karstquelle Pirghar am Rand von Deh-Cheshmeh, ca. 5 km südl. Farsan, ca. 2000 m, N 32°12', E 50°32', 17.05.1994, R. Fritsch No. 1070 (TAX 5805, GAT).

Tepals with several nerves are rarely found in the genus *Allium*. They are characteristic only for subg. *Nectaroscordum* (Lindl.) Asch. & Graebn. and sect. *Pseudoprason*, but are sometimes also present in *A. oreophilum* C.A. Mey., the only species of subg. *Porphyroprason* (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:

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. oreophilum*
- 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 hearth-shaped lamina .....subg. *Nectaroscordum*
- Leaves flat, elliptic to broadly lanceolate, all tepals 4-5 mm long, white, elliptic, strongly concave, initially three (and later all ones) reflexed and inside curled ..... *A. koelzii*

New records of *Allium* for the Flora of Iran

1. subg. *Allium* sect. *Avulsea* F.O. Khass.

***Allium lamondiae* Wendelbo**, Nytt Mag. Bot. 14: 102 (1968).

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 Rask to Chahbahar, ca. 300 m, 8.3.1977, Runemark, Assadi & Sardabi 22383 (TARI) ; Bam 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 Irandegan (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. lamondiae* in Iran is given in Fig. 7.

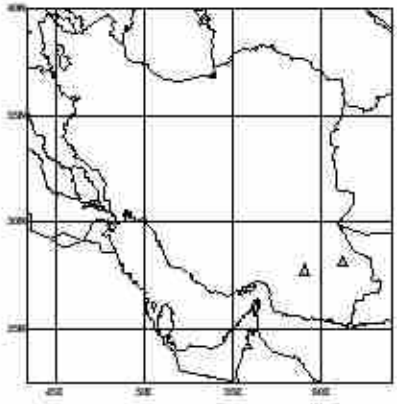

Fig. 7. Distribution map of *Allium lamondiae* in Iran.

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, fistulous, 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*

***Allium fuscoviolaceum* Fomin**, Monit. Jard. Bot. Tiflis 14: 50 (1909).
Holotype: Turkey, Prov. Kars, in monte Askjar-dagh prope Sarykamyseh, leg. Michailowsky (TBI)

Specimens examined from Iran:

Iran: Prov. Azarbaijan: Mt. Misho, E. village Payam, S. of Marand, 2040 m, N 38°19' 38", E 45°48', 05.06.2005, R.M. Fritsch, SH. Zarre & H. Moazzeni (*Allium* reference collection: IRAN-1061); slope near the main road from Tabriz to Mianeh ca. 35 km to Mianeh, 1500 m, N 37°30'49", E 47°23'26", 06.06.2005 R.M. Fritsch, SH. Zarre & 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.

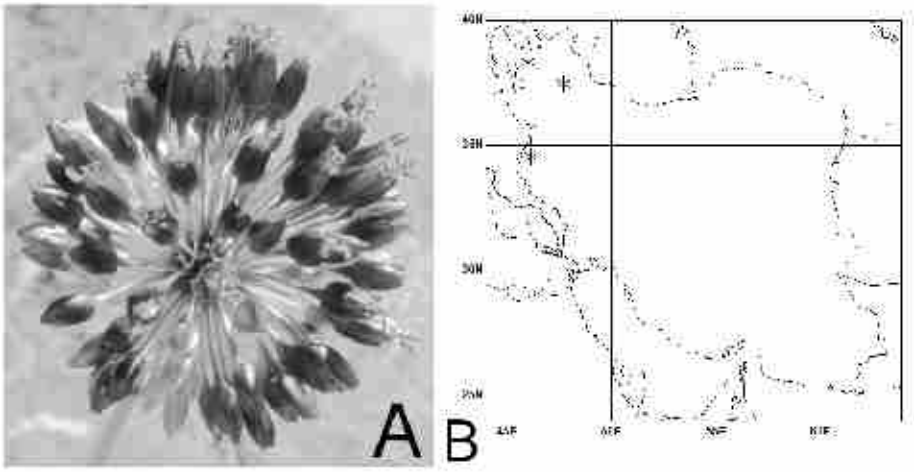

Fig. 8. *Allium fuscoviolaceum*: A. Inflorescence during anthesis, B. Distribution map in Iran.

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 tunics papyraceous, grey. Scape 30-70 (100) cm long, cylindrical, smooth. Leaves 3-4, fistulose, semicylindrical, canaliculate, usually subscabrid at the margin of channel, (2)3-4 mm wide, shorter

than scape. Spathe splitted in two shortly beaked parts, half as long as the (hemi-) sphaerical, 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 und half as long as narrowly linear basal lamina. Style purple, exserted. Capsule broadly elliptic, c. 4 mm.

Flowering and fruiting time: June till August.

3. subg. *Polyprason* Radić sect. *Scorodon* W.D.J. Koch s. strictiss.

Sect. *Scorodon* in the narrow sense is a small section. KHASSANOV (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: Hashtpan, 18 km to Nouleh Boulagh, N 37°49', E 48°45', 500 m, 05.09.1982, Termeh, Matin & Zargani (IRAN!); Prov. E. Azarbaijan, Arasbaran protected area, Tazekandi-Anza, 1500 m, A. Ghahreman & 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.

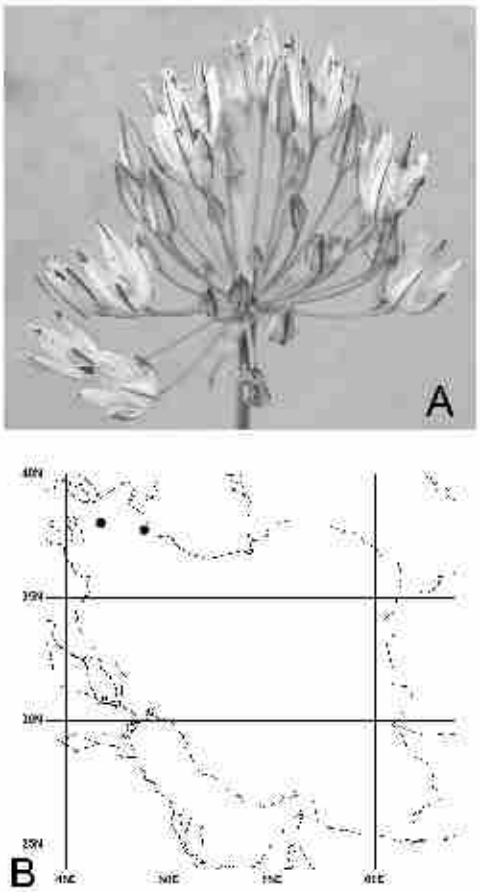

Fig. 9. *Allium moschatum*: A. Inflorescence during anthesis, B. Distribution map in Iran.

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 collum. 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-oblong 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 fastigiate, 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. kuhsorkense*) 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.

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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 spherioidal (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 bireticulate 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 bireticulate, lumen with equal size perforations. Type II includes species with sterile dolabriform lower thecae usually connected to each other. Pollen exine of this type is bireticulate, 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 majdae* pollen is hexacolpate with two larger mesocolpia, exine is bireticulate, lumen with equal size perforations. Pollen shape and exine ornamentation in *Zhumeria* is similar to *Salvia* Type I.

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Key words: Pollen morphology, Staminal structure, *Salvia*, *Zhumeria*, 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*, *Zhumeria*, *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: *Calosphace* 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 (Eusphace, Hymenosphace, Drymosphace, Horminum, Aethiopis and Plethiosphace). 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 Lamioideae with tricolpate pollen. The pollen grain of Lamioideae 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 polyphyletic

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-RAFII 1983, HARLEY 1992, JAMZAD *et al.* 2000). The comprehensive work of AFZAL-RAFII (*l.c.*) on *Salvia* provided palynological and cytological data. She suggested the evolutionary trends in the genus based on these characters.

Zhumeria is a monotypic genus of Lamiaceae endemic to Southern Iran. It has the following characteristic features which gives an isolated position to it within the family: Four exserted 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 Meriandreae Briq. Other isolated genera of this tribe are *Meriandra* with two species (N.E. India, N.E. Africa and S.W. Arabia); *Dorystoechas* 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 *Zhumeria majdae* is examined and compared with those of *Salvia*, *Meriandra* and *Dorystoechas* to find its affinity to the above mentioned genera.

Materials and methods

Pollen of 23 species of *Salvia* and *Zhumeria* 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 spheroidal (P/E=0.88-0.99 µm), suboblate (P/E=0.75-0.87 µm) or prolate spherioidal (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. aristata*, *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 bireticulate. 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 stenophylous 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 bireticulate, with more or less equal size perforations. This group includes *S. aristata*, *S. bracteata*, *S. suffruticosa*,

S. aegyptiaca, *S. santolinifolia*, *S. baznanica*, *S. jamzadii*, *S. hydrangea*, *S. lerifolia*, *S. syriaca* and *S. hypochionaea* (Figs 3 & 7).

Type II: Lumen rounded, ± elliptic or polygonal, exine bireticulate, 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. sclarea* 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. verticillata* (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 bireticulate 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).

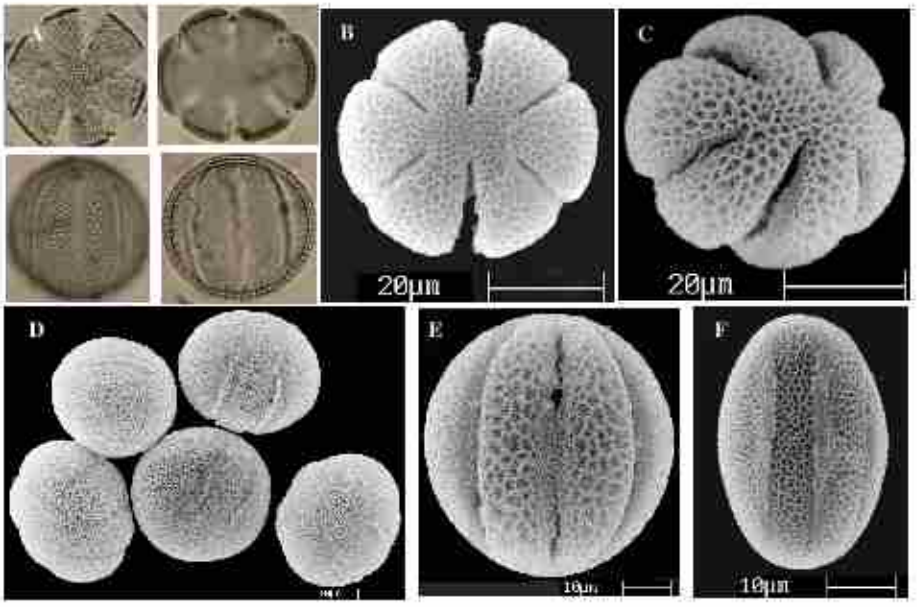

Fig. 1. Pollen grains of *Salvia* spp. A. *S. compressa* (light microscopy, polar and equatorial view, high and low focus), B. *S. lerifolia*, C. *S. limbata* (pollar view), D. *S. aristata* (pollen group), E. *S. mirzayanii*, F. *S. jamzadii* (equatorial view).

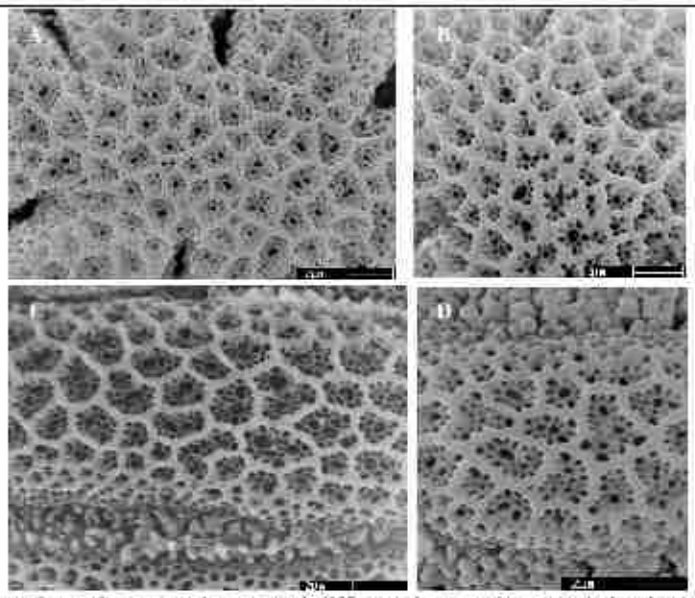

Fig. 2. Granular colpus membrane and different lumen shape and size in apocolpium and mesocolpium. A & D. *S. aethiopis*, B. & C. *S. sahendica* (A & B apocolpium, C. & D. mesocolpium).

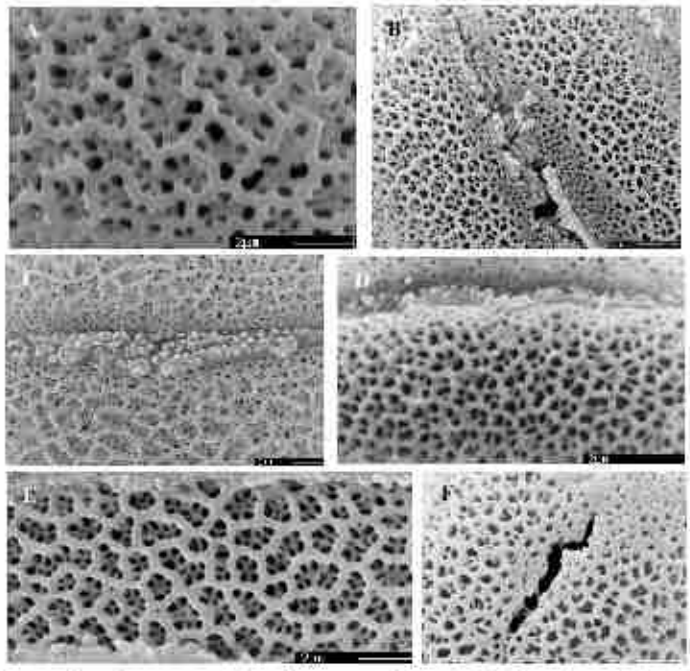

Fig. 3. Pollen exine in mesocolpium in group I. A. & B. *S. aristata*, C. *S. bracteata*, D. *S. bazmanica*, E. *S. jamzadii*, F. *S. santolinifolia*.

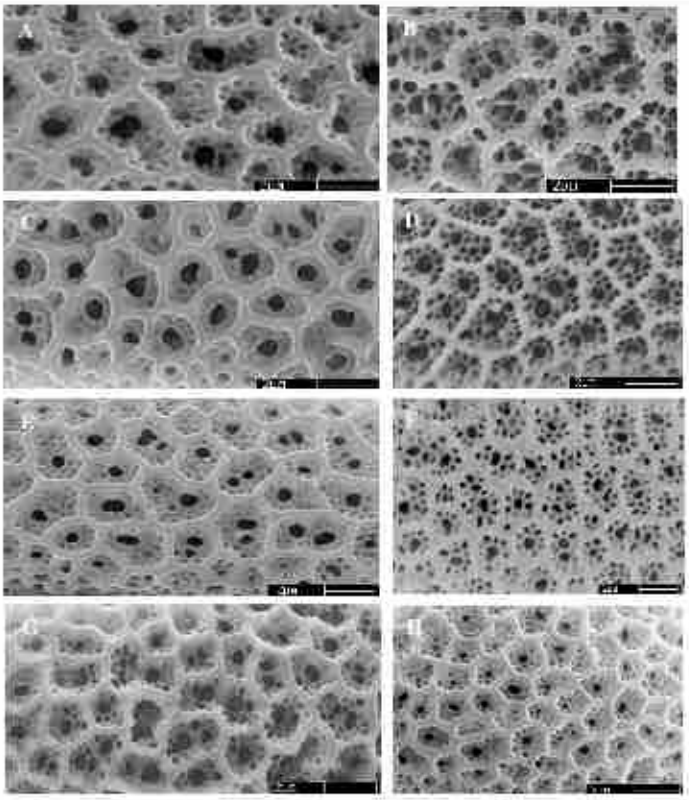

Fig. 4. Pollen type II. Exine in mesocolpium. A. *S. atropatana*, B. *S. microstegia*, C. *S. lachnocalyx*, D. *S. limbata*, E. *S. sclarea*, F. *S. mirzayanii*, G. *S. macrosiphon*, H. *S. compressa*.

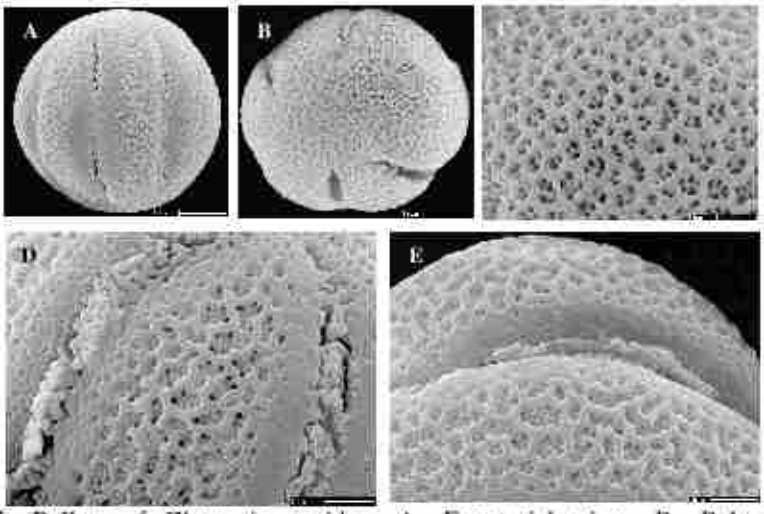

Fig. 5. Pollen of *Zhumeria majdae*. A. Equatorial view, B. Polar view, C. Apocolpium, D. & E. Mesocolpium and colpus membrane.

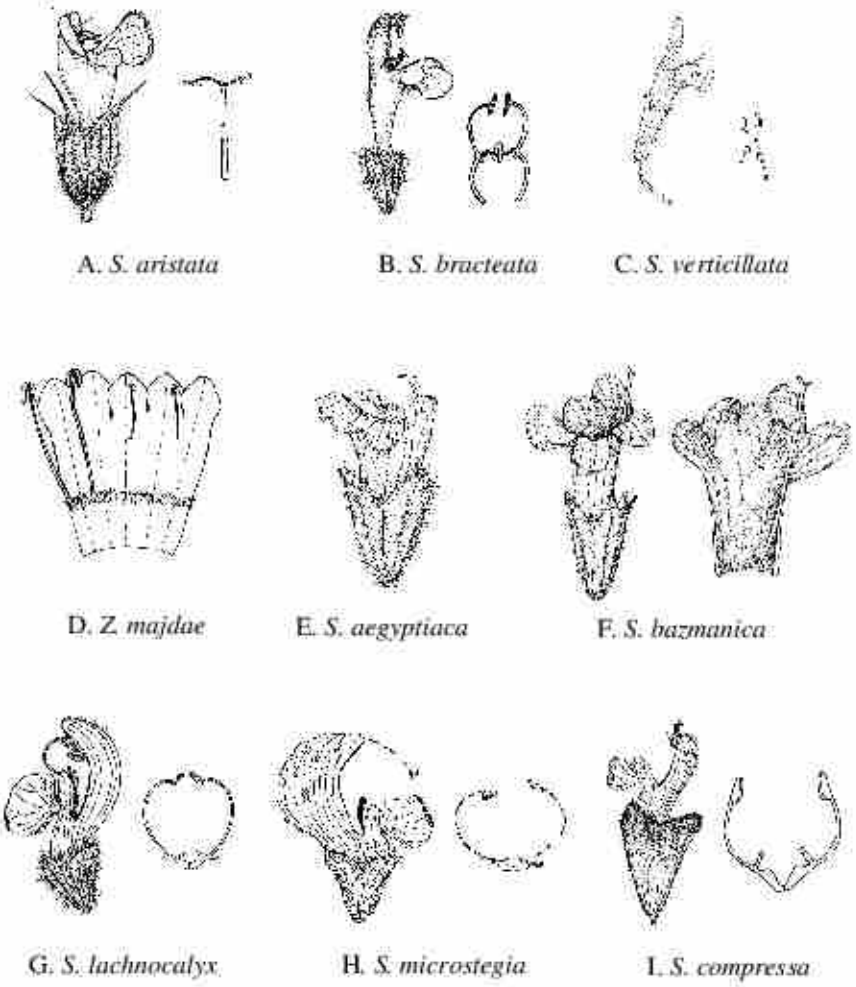

Fig. 6. Flowers and stamen shapes in different groups of *Salvia* spp. and *Zhumeria*.

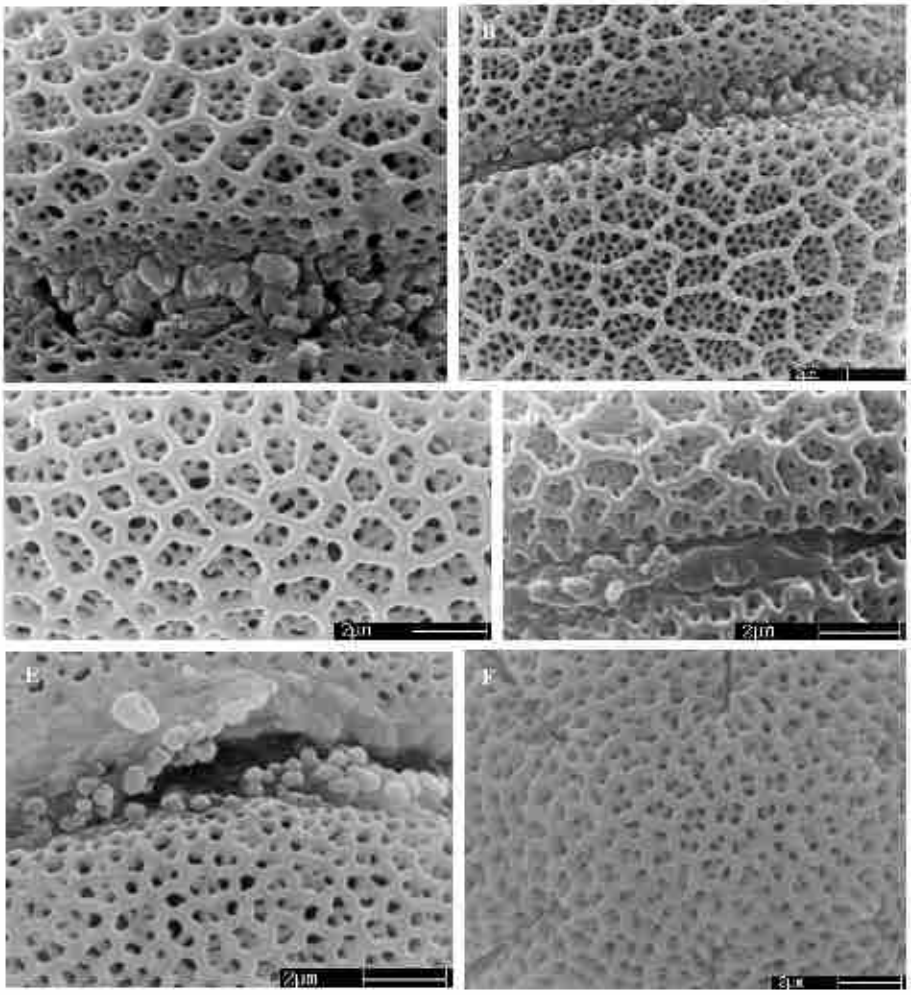

Fig. 7. Exine in mesocolpium: A. *S. hypochionaea*, B. *S. lerifolia*, C. *S. syriaca*, D. *S. virgata*, E. & F. *S. verticillata* (F. apocolpium, E. mesocolpium).

Stamen

The staminal structure in *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. limbata, S. reuterana, S. mirzayanii, S. lachnocalyx, S. atropatana, S. lerifolia, S. compressa* etc.) and entirely aborted in *S. verticillata* group but partly fertile and slightly smaller than upper thecae in others

(*S. aristata*, *S. bracteata*, *S. aegyptiaca*, *S. santolinifolia*, *S. hydrangea* etc., Fig. 6). 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 suprareticulate (including bireticulate) (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 suprareticulate pollen is a synapomorphy of a large clade composed of gynobasic-styled Lamiaceae, tribe Scutellariae, 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,

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

Based on floral and stamen morphology and palynoloical 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. bracteata*, *S. jamzadii*, *S. santolinifolia* and *S. suffruticosa*.

Group II: The upper lip of corolla falcate, lower thecae infertile, dolabriform. 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. macrosiphon*, *S. microstegia*, *S. mirzayanii*, *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. lerifolia* 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 measurments. P. polar length, E. equatorial width, P/E. shape, WT. wall thickness

Species	Collecting data	P	E	P/E	WT
Salvia aegyptiaca L.	Bokhari & Wendelbo 146 (TARI)	(34-) 38.33 (-42)	(40-) 45.50 (-51)	0.84	2-3
Salvia aegyptiaca L.	Runemark & Mozaffarian 27171 (TARI)	(35-) 38.42 (-43)	(37-) 42.50 (-50)	0.90	2-3
Salvia aethiopis L.	Froughi & Assadi 13954 (TARI)	(41-) 44.00 (-50)	(42-) 50.75 (-54)	0.87	2-3
Salvia aethiopis L.	Wendelbo & Ann Ala 18267AC	(35-) 41.10 (-50)	(39-) 50.20 (-60)	0.82	2-3
Salvia aristata Auch. ex Benth.	Mozaffarian & Nowroozi 34149 (TARI)	(54-) 60.80 (-65)	(64-) 68.73 (-78)	0.88	3-4
Salvia aristata Auch. ex Benth.	Fattahi & Khaledian 72 (TARI-duplicte)	(52-) 56.00 (-60)	(56-) 64.60 (-72)	0.87	2.5-3.5
Salvia atropatana Bunge	Jamzad *et al.* 70251 A	(43-) 55.50 (-64)	(48-) 62.67 (-70)	0.89	3-4
Salvia bracteata Banks & Soland	Runemark & Mozaffarian 29245 (TARI)	(41-) 51.86 (-64)	(44-) 53.11 (-59)	0.98	2-3
Salvia bracteata Banks & Soland	Runemark & Mozaffarian 29224 (TARI)	(48-) 54.53 (-61)	(46-) 54.24 (-69)	1.01	2-3.5
Salvia hazmanica Rech. f. & Esfand.	Mozaffarian 70164 (TARI).	(36-) 43.36 (-51)	(38-) 44.83 (-52)	0.97	2-3
Salvia compressa Vent	Runemark & Mozaffarian 30997 (TARI)	(44-) 47.00 (-50)	(40-) 47.20 (-59)	0.99	2-3
Salvia compressa Vent	Mozaffarian 62727 (TARI)	(42-) 47.00 (-53)	(38-) 47.96 (-66)	0.98	2-3

Table 1. (contd.)

Salvia hypochionaea Boiss.	Assadi & Mozaffarian 30437 (TARI)	(53-) 60.69 (-69)	(57-) 67.36 (-78)	(53-) 60.69 (-69)	(57-) 67.36 (-78)
Salvia jamzadii Mozaffarian	Mozaffarian 71257 (TARI)	(52-) 59.21 (-66)	(54-) 63.30 (-76)	0.94	3-3.5
Salvia lachnocalyx Hedge	Assadi & Ranjbar 83023 (TARI)	(48-) 54.85 (-63)	(44-) 54.42 (-60)	1.01	3-4
Salvia lerifolia Benth.	Paryab 5006 (TARI-duplicate)	(50-) 54.13 (-59)	(50-) 59.79 (-69)	0.91	2-3
Salvia lerifolia Benth.	Maddah 1901 (TARI-dplicate)	(40-) 59.33 (-75)	(50-) 60.52 (-72)	0.98	2.5-3
Salvia limbata C.A. Mey.	Assadi & Mozaffarian 30127 (TARI)	(50-) 56.10 (-60)	(50-) 61.19 (-69)	0.92	3-4
Salvia limbata C.A. Mey.	Assadi & Mozaffarian 29970 (TARI)	(50-) 54.10 (-58)	(46-) 54.79 (-61)	0.99	3-4
Salvia macrosiphon Boiss.	Froughi 5428 (TARI)	(53-) 62.44 (-84)	(55-) 62.38 (-71)	1.00	2.5-4
Salvia microstegia Boiss. & Balansa	Jamzad *et al.* 70251 B (TARI)	(45-) 57.83 (-65)	(53-) 58.68 (-66	0.99	2.5-3.5
Salvia mirzayanii Rech. f. & Esfand.	Runemark *et al.* 22619 (TARI)	(53-) 57.00 (-62)	(62-) 65.10 (-68)	0.88	2.5-3.5
Salvia mirzayanii Rech. f. & Esfand.	Froughi 1154 (TARI)	(47-) 55.90 (-65)	(52-) 60.80 (-67)	0.92	3-4
Salvia sahendica Boiss. & Buhse	Ghahremani & Imani 6676 (TARI-duplicate)	(46-) 56.07 (-65)	(49-) 57.98 (-76)	0.97	3-4
Salvia santolinifolia Boiss.	Wendelbo & Froughi 15754 (TARI)	(36-) 43.00 (-60)	(44-) 52.15 (-72)	0.82	2-3
Salvia santolinifolia Boiss.	Riazi 5430 (TARI)	(38-) 42.33 (-45)	(42-) 47.79 (-54)	0.89	2-3

Table 1. (contd.)

Salvia sclarea L.	M. Nowroozi 2928 (TARI-duplicate)	(45-) 55.10 (-65)	(58-) 73.00 (-87)	0.75	3-4
Salvia sclarea L.	J.R.Edmondson & A.G. Miller 1647 (TARI)	(45-) 53.40 (-59)	(40-) 59.60 (-75)	0.84	3-4
Salvia suffruticosa Montbr. & Auch. ex Benth.	Runemark & Froughi 19835 (TARI)	(44-) 55.10 (-61)	(40-) 59.60 (-75)	0.92	2.5-4
Salvia suffruticosa Montbr. & Auch. ex Benth.	Raizi 9691 (TARI)	(47-) 56.00 (-60)	(57-) 61.88 (-67)	0.90	2.5-3.5
Salvia syriaca L.	Diai 13305 (TARI)	(45-) 48.00 (-52)	(51-) 51.50 (-52)	0.93	3-3.5
Salvia syriaca L.	Mozaffarian 45752 (TARI)	(45-) 49.70 (-54)	(45-) 49.00 (-51)	1.01	3-4
Salvia verticillata L.	Assadi & Shahsavari 65744 (TARI)	(29-) 32.70 (-34)	(28-) 35.72 (-40)	1.02	2.5-3
Salvia verticillata L.	Assadi & Nikchehreh 76909 (TARI)	(33-) 35.55 (-39)	(39-) 41.90 (-46)	0.92	2-3.5
Salvia virgata Jacq.	Zare & Mashayeli 6458 (TARI-duplicate)	(42-) 47.50 (-54)	(44-) 51.58 (-80)	0.85	2-3
Salvia virgata Jacq.	Amini & Zare 6503 (TARI-duplicate)	(36-) 44.50 (-49)	(39-) 44.33 (-51)	0.92	2-3
Zhumeria majdae Rech. f & Wendelbo	Zaefi 1952 (TARI-duplicate)	(49-) 53.92 (-60)	(60-) 66.57 (-72)	1.00	2-3

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

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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. dryadanthoides* Juz. replacing *P. phyllocalyx* (Juz. Schiman-Czeika. *Potentilla* sect. *Bifurcae* (Th. Wolf) Grossh. becomes *Schistophyllidium* (Juz. ex Fed.) Ikonn., with the single species *S. bifurcum* (L.) Ikonn. replacing *P. bifurca* L. *Potentilla* sect. *Xylorhizae* (Th. Wolf) Schiman-Czeika becomes *Tylosperma* Botsch. encompassing *P. lignosa* Willd. (as *T. lignosa* [Willd.] Botsch.) and *P. sericophylla* Parker (combination in *Tylosperma* ined.). *Potentilla* sect. *Rupestres* (Th. Wolf) Grossh. becomes *Drymocallis* Fourr. ex Rydb., with *D. poteriifolia* (Boiss) Soják replacing *P. poteriifolia* Boiss. Two other species of *Drymocallis* 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, *Comarum salesovianum* (Stephan) Bunge is replaced by *Farinopsis salesoviana* (Stephan) Chrtek & Soják. Additions to

Potentilla s.s. include *P. discipulorum* Davis, *P. virgata* Lehm., *P. alexeenkoi* Lipsky, *P. agrimonioides* M.-Bieb., *P. bactriana* Soják, *P. parmirica* Th. Wolf, *P. pamiroalaica* Juz., *P. gorganica* Soják, *P. laciniosa* Waldst. & Kit. ex Nestl., *P. botschantzeviana* T.A. Adylov, *P. ghazniensis* Soják, *P. porphyrantha* Juz., *P. algida* Soják, *P. doubjonneana* Cambess., *P. crantzii* (Crantz) Beck ex Fritsch, and *P. adenophylla* Boiss. & Hohenack. Among other changes are the inclusion of *P. straussii* Bornm. within *P. speciosa* Willd., *P. canescens* Besser within *P. inclinata* Villars., *P. gilanica* Th. Wolf and *P. adsharica* Sommier & Levier within *P. divaricata* DC., and *P. cryptophila* Bornm. within *P. petraea* Willd. The inclusion of *P. argyrophylla* Wall. ex Lehm., *P. hirta* L., and *P. tephroleuca* Th. Wolf in Flora Iranica is probably erroneous and based on other species.

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

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 apomictic 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 *Potentilleae* 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 "Zweifelhafte Angaben".

As previously indicated, the norm for any published floristic work is that changes begin to accumulate almost immediately, and the treatment of *Potentilleae* 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* Juz. from Azarbayejan Province, Iran, along with a recent collection of *P. petraea* Willd. ex Schldl., 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 schiraziana* 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 Jiˇrí Soják, who collected in Iran in 1977 and whose conclusions on Eurasian *Potentilla* were published in a series of papers beginning in the 1960'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*, *Dasiphora* (or *Pentaphylloides* Duhamel, a superfluous name), *Drymocallis*, *Farinopsis* Chrtek & Soják, *Schistophyllidium* (Juz. ex Fed.) Ikonn., *Sibbaldia*, and *Sibbaldiopsis* Rydb. The second evolutionary line, comprised of *Potentilla* s.s., *Duchesnea*, and the North American genera *Ivesia* Torr. & A. Gray, *Horkelia* Cham. & Schltdl., and *Horkeliella* 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. anserina* L.) and the Asian genus *Tylosperma* 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 *Dasiphora* (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 fragarioid 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 fragarioid 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 fragarioid clade cannot be retained in *Potentilla* without that genus being widely polyphyletic, unless *Fragaria*, *Chamaerhodos*, *Alchemilla* L., *Aphanes* L., and *Lachemilla* Rydb. are also included. The alternative is to remove all taxa in the fragarioid clade from *Potentilla*, and it is this option that is currently being implemented in Europe (KURTTO & ERIKSSON 2003) and N. America (ERTTER *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 schiraziana* 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 floristicians 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 *Potentilleae* (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.* (ined.)

DUCHESNEA Smith.

1. *Duchesnea indica* (Andrews) Focke - alternatively *Potentilla indica* (Andrews) Th. Wolf in or near *Potentilla* sect. *Potentilla* (e.g. KURTTO & ERIKSSON 2003).

DASIPHORA Raf. – replaces *Potentilla* sect. *Fruticosae* (Th. Wolf) Grossh. and *Pentaphylloides* 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.) Schiman-Czeika, that occurs in the territory of Flora Iranica.

SCHISTOPHYLLIDIUM (Juz. ex Fed.) Ikonn. - replaces *Potentilla* sect. *Bifurcae* (Th. Wolf) Grossh. (SOJÁK 1989, 2004); alternatively, KURTTO & ERIKSSON (2003) include this genus within *Sibbaldianthe* Juz.

2. ***Schistophyllidium bifurcum*** (L.) Ikonn. ≡ *Potentilla bifurca* L., *Sibbaldanthe bifurca* (L.) Kurto & Eriksson. SOJÁK (1970, 1988) recognizes *Potentilla*

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

TYLOSPERMA Botsch. – replaces *Potentilla* sect. *Xylorhizae* (Th. Wolf) Schiman-Czeika, fide SOJÁK (2004, mss. ined.)

3. ***Tylosperma lignosa*** (Willd.) Botsch. = *Potentilla lignosa* Willd.

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

DRYMOCALLIS Fourr. ex. Rydb. -- replaces *Potentilla* sect. *Rupestres* (Th. Wolf) Grossh. (SOJÁK 1989, 2004)

9. ***Drymocallis poteriifolia*** (Boiss.) Soják = *Potentilla poteriifolia* Boiss, fide SOJÁK (1989)

• ***Drymocallis schiraziana*** (Khat.) Ertter & Attar., comb. nov. Basionym: *Potentilla schiraziana* Khat., Iranian J. Bot. 3 (2): 93. 1987.

• ***Drymocallis rupestris*** (L.) Soják = *Potentilla rupestris* L., reported from Iran by KHATAMSAZ (1987)

POTENTILLA **L.**

Potentilla sect. ***Eriocarpae*** (Th. Wolf) Juz. - encompasses *P.* sect. *Biflorae* (Th. Wolf) Schima-Czeika, fide SOJÁK (1987c)

5. *Potentilla biflora* Willd.

Potentilla sect. *Speciosae* (Th. Wolf) Juz.

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 discipulorum*** Davis -- reported from Iran, Prov. Azarbayejan (KHATAMSAZ 1987)

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

7. *Potentilla curviseta* Hook. f. var. *collecttiana* (Aitch. & Hemsl.) Soják

Potentilla sect. ***Micranthae*** Soják - established by SOJÁK (1987c) and containing the sole Flora Iranica species placed in *P.* sect. *Campestres* (Poeverl.) Juz. by SCHIMAN-CZEIKA (1969a).

8. *Potentilla micrantha* Ramond ex DC.

Potentilla sect. ***Pensylvanicae*** Poeverl. -- replaces sect. *Multifidae* (Rydb.) Juz. (SOJÁK 1987c, 1994)

10. *Potentilla multifida* L.

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

11. *Potentilla soongarica* 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 alexeenkoi*** Lipsky -- reported from Iran, Prov. Azerbayejan (KHATAMSAZ 1987) but considered to be a synonym of *P. sericea* by SOJÁK (1987d)

13. *Potentilla polyschista* Boiss.

14. *Potentilla hololeuca* Boiss. ex Lehm.

- ***Potentilla agrimonioides*** M. - Bieb. var. ***intercedens*** Soják - the species was reported from Iran, Prov. Azarbayejan (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*** Soják -- newly described species occurring in Afghanistan and adjacent parts of Tajikistan and Pakistan (SOJÁK 1992)

- ***Potentilla bactriana*** var. ***bamianica*** 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. *Haematochri* (Rydb.) B.C. Johnst.]

15. *Potentilla argyrophylla* Wall. ex Lehm. var. *argyrophylla* - After examining specimens annotated by SCHIMAN-CZEIKA & SOJÁK (pers. comm. 2006) strongly doubts the occurrence of this species in Afghanistan and Pakistan].

Potentilla sect. ***Terminales*** (Döll) Gren. & Godr. - encompasses *P.* sect. *Argenteae* (Rydb.) Juz., fide SOJÁK (1987c)

16. *Potentilla argentea* L.
17. ***Potentilla inclinata*** **Villars.** – encompasses *P. canescens* Besser, fide SOJÁK (2004)
18. *Potentilla meyeri* Boiss.
19. *Potentilla gerardiana* Lindl. ex Lehm.

Potentilla sect. *Rectae* (Th. Wolf) Juz.

20. *Potentilla recta* L.
21. *Potentilla pedata* Nestler
22. *Potentilla nurensis* Boiss & Hausskn. ex. Boiss.

[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-Czeika - SOJÁK (pers. comm. 2006; In Press) considers this to be intermediate between *P. divaricata* and *P. recta*.
25. ***Potentilla divaricata*** **DC**. - according to SOJÁK (1994, 2004, In Press), encompasses ***P. gilanica*** Th. Wolf and ***P. adsharica*** Sommier & Levier (the latter in Flora Iranica, No. 44 in *P.* sect. *Chrysanthae*)

- ***Potentilla gorganica*** Soják -- newly described species occurring in Iran, Prov. Golestan, and Turkmenistan (SOJÁK 1991)
- ***Potentilla laciniosa*** Waldst. & Kit. ex Nestl. -- collected in NE Iran in 1977 by SOJÁK (pers. comm. 2006)
- ***Potentilla*** *assalemica* Soják - newly described species from Iran, Prov. Gilan (SOJÁK 2006)

Potentilla sect. *Rivales* Poeverl.

26. *Potentilla supina* L. - moved here from *P.* sect. *Rectae*; SOJÁK (1987b, 1993) recognizes multiple subspecies, with at least subsp. ***caspica*** Soják and perhaps subsp. ***paradoxa*** (Nutt. ex Torr. & Gray) Soják occurring in Flora Iranica (SOJÁK, pers. comm. 2006)
27. *Potentilla desertorum* Bunge

Potentilla sect. *Persicae* (Th. Wolf) Juz.

28. *Potentilla bungei* Boiss.
29. *Potentilla elvendensis* Boiss.
30. *Potentilla argaea* Boiss. & Balansa
31. *Potentilla coelestis* Gilli.
32. *Potentilla flabellata* Regel & Schmalh.
33. *Potentilla argyroloma* Boiss. & Hohen.
34. *Potentilla persica* Boiss. & Haussk.
35. *Potentilla kurdica* Boiss. & Hohen.
36. *Potentilla pannosa* Boiss. & Haussk.
37. *Potentilla mollota* Boiss.

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

39. *Potentilla nuda* Boiss.

40. *Potentilla flaccida* Th. Wolf

41. *Potentilla aucheriana* Th. Wolf

42/43. *Potentilla petraea* Willd. - encompasses ***P. cryptophila*** Bornm., fide SOJÁK (2004)

• ***Potentilla botschantzeviana*** T.A. Adylov - described in 1976 (Opred. rast. sred. Azii 5: 247) and reported from N.E. Iran by SOJÁK (pers. comm. 2006, 2007, In Press).

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

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

Potentilla sect. *Chrysanthae* (Th. Wolf) Juz.

[44. *P. adsharica* Sommier & Levier -- included within 25. *P. divaricata* in *P.* sect. *Rectae*, fide SOJÁK (2004)]

[45. *Potentilla szovitsii* Th. Wolf - based on a mixture of *P. divaricata* (No. 25 in *P.* sect. *Rectae*) 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, non Greene 1887

Potentilla sect. *Aureae* (Rydb.) 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, Caucusus and Transcaususus, 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 kurramensis* Th. Wolf - SOJÁK (pers. comm., 2006) considers this to be no more than a subspecies or variety of ***P. turczaninowiana*** Stschegl.

49. *Potentilla geranioides* Willd.

- ***Potentilla doubjonneana*** Cambess. - mentioned as occurring in northern Afghanistan, where confused with *P. gelida* (SOJÁK 1988)
- ***Potentilla crantzii*** (Crantz) 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. Mazandaran (KHATAMSAZ 1988)

Potentilla sect. ***Potentilla*** - replaces *P.* sect. *Tormentillae* (Rydb.) 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. ***Pentaphylloides*** 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.) Rydb. (e.g. SOJÁK 2004)

Potentilla: "Species incertae et incomplete notae" in Flora Iranica

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

2. *Potentilla gaubeana* Bornem.

3. *Potentilla kandavanensis* Bornem. & Gauba

4. *Potentilla nivea* L. var. *himalaica* Kitam.

5. *Potentilla pimpinelloides* L. f. *nana* Parsa - form is not distinct from typical *P. pimpinelloides*, fide SOJÁK (pers. comm. 2006)
6. *Potentilla radiata* Lehm.
7. *Potentilla umbrosa* Steven ex M. Bieb.

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

1. ***Farinopsis salesoviana*** (Stephan) Chrtek & Soják -- replaces *Comarum salesovianum* (Stephan) Bunge (CHRTEK & SOJÁK 1984, SOJÁK 2004)

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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. *Cynaroideae* Bunge is corrected to sect. *Cynaroides* Bunge. *Cousinia caroli-henrici* is described and illustrated as a new species from sect. *Cynaroides* Bunge. The following species are synonymed: *C. albicaulis* Boiss. & Bhuse and *C. sabzevarensis* Rech. f. with *C. onopordioides* Ledeb., *C. pichleriana* Bornm. ex Rech. f. with *C. ecbatanensis* Bornm. and *C. fursei* Rech. f. with *C. pergamacea* Boiss. & Hausskn. A complete description of sect. *Cynaroides* is given. Distribution patterns, diversity centers and distribution map of sect. *Cynaroides* are presnted 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* Jaub. & Spach (sect. *Cynaroides*), *C. cylindracea* Bioss., (sect. *Stenocephalae*), *C. congesta* Bunge (sect. *Congestae*) and *C. belangeri* 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; basals sometimes rosette, usually dried at flowering time; caulines shortly or longly decurrent; uppermosts 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 sagittate. Receptalce 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 pergamacea similis sed cinerascenti-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-canescent. Stem solitary, densely leafy, broadly interruptedly or continuously winged, densely floccose-tomentose, branched from base, with corymbiform branches above; branches monocephalous. 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 winges on the stem; upper and upper most 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 sagittate, 9 x 5 mm, with 1-2 spines on each side, gradually acuminate; inner bracts longer than the outers and medians, appendage smaller, sagittate, 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: Kurdestan: Baneh, Attar & Ghahreman, 22455-TUH.

The related species to *Cousinia caroli-henrici* is *C. pergamacea* Boiss. & Haussk. in Boiss. that distributed in Baneh and Sardasht in Kurdestan Province. *Cousinia caroli-henrici* 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-henrici 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. albicualis, *C. sabzevarensis*, *C. pichleriana*, and *C. fursei* are synonymed with *C. onopordioides*, *C. echaunensis*, and *C. pergamacea*, respectively.

The name of sect. *Cynaroideae* 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 achene 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. onopordioides* 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, Turkmanistan 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, Jebal-e Barez and Hezar in Kerman Province. A few number of species such as *C. onopordioides*, *C. grandiceps*, *C. verbascifolia*, *C. lyrata* and *C. monocephala* can be found in N.E. Iran. Sarakhs area is the farthest distribution limit in the E. Iran. *Cousina lyrata* and *C. verbascifolia* have been found in small patches in Sarakhs area. *Cousinia 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. Semnan to Ahuvan pass. Other species such as *C. calocephala*, *C. behboudiana* and *C. keredjensis* grow in the Demavand 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), Oshtoran-Kuh (in Lorestan Province) and in western parts of Iran such as Oramanat mt and Shahu (Kermanshah and Kurdestan Proviences). Therefore, Azarbayejan with 13 species has the high species diversity in Iran than other areas. There are eight species in Hamadan Province, the endemic species "*C. elwendensis*" is only placed in Alvand mt. On the other hand, Kurdestan 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* occurres in Shahbazan area in 60 km N. Dezful where have been only collected a single species, namely, *C. disfulensis*. 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 Jebal Barez and Joupar 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 Turkmanistan" 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), Kurdestan (11 species) Kermanshah (10 species), Hamadan (9 speceis) and Bakhtiari (7 species) Provinces (Table 3).

The check list of sect. *Cynaroides* Bunge including of synonym names:

1. *Cousinia algurdina* Rech. f., Anz. Math.-Nat. Kl. Osterr. Akad. Wiss. 101: 344 (1964).

Type: Iraq: Nowanda, 2600-3000 m, 11465. Specimens studied: 30533-TARI. Rare. Map 16

2. *C. aligudarzensis* Attar & Ghahreman, (new species, In Press).

Type: Iran: Lorestan: near Aligudarz. Endemic. Specimens studied: Iran. Lurestan: 10 km on road to Khomeyn from 3-way intersection at Aligudarz, ca. 1500 m, 21 July 2001, F. Attar & A. Ghareman 27613 (holotype, TUH). Map 31

3. *C. anoplophylla* Rech. f., Fl. Iranica, Compositae III, *Cousinia* in Cynareae: vol. 139A: 140 (1979).

Type: Iran: Kermanshah: Chalan to Dalahu. Endemic. Specimens studied: 29256-TARI. Rare. Map. 32

4. *C. araneosa* DC., Prodr. 6: 556 (1838).

Type: Iran: Fars: mt. Dinar. Endemic. Rare. Any specimens not found. Map 8

5. *C. barbeyi* C. Winkl., Acta Horti Petrop. 12: 274 (1893).

Type: Iran: Boyer-Ahmad: mt. Gilouyeh. Endemic. Specimens studied: 46457-IRAN; 26304-TUH (Locus classicus). Rare. Map 25

6. *C. behboudiana* Rech. f. & Esfand., Ann. Nat. Mus. Wien 57: 81 (1950).

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;

4144-TARI; 9827-TARI; 4188-TARI; 4156-TARI; 33880-IRAN; 8857-IRAN; 169-IRAN (Type); 40826-IRAN; 50930-IRAN. Map 19

7. *C. bobeckii* Rech. f., Fl. Iranica, Compositae I, Cynareae: *Cousinia*, vol. 90: 238 (1972).

Type: Iran: Azerbaijan: Urumieh, W. Urumieh Lake. Endemic. Specimens studied: 22500-TUH (Locus classicus). Map 30

8. *C. bornmulleri* C. Winkl., Acta Horti Petrop. 14: 235 (1897).

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

9. *C. calocephala* Jaub. & Spach, Ill. Pl. Or. 2: 96 (1846).

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; 33790-IRAN; 33880-IRAN; 33909-IRAN; 33910-IRAN; 8851-IRAN; 33890-IRAN; 40350-TARI; 33998-IRAN. Map 17

10. *C. Carduchorum* C. Winkl. & Bornm., Bull. Herb. Boissier 3: 568 (1895).

Type: Iraq: Kurdestan: Arbil and Sakri Sakran. Specimens studied: 27592-TUH. Map 31

11. *C. caroli-henrici* Attar & Ghahreman. Sp. nova.

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

12. *C. chlorsphaera* Bornm., Beih. Bot. Centrbl. 28, 2: 253 (1911) et 32, 2: 405 (1914).

Type: Iran: Lorestan: mt. Oshtoran-kuh. Endemic. Specimens studied: 57427-TARI. Rare. Map 7

13. *C. concinna* Boiss. & Hausskn. *In*: Boiss., Fl. Or. 3: 513 (1875).

Type: Iran: between Mazibon and Avihang. Endemic. Specimens studied: 20562-TUH; 14296-TUH; 9003/1-IRAN; 9004/1-IRAN; 71607-TARI; 74767-TARI; 60654-TARI; 1160-TARI; 75191-TARI; 71596-TARI. Map. 1

14. *C. cymbolepis* Boiss., Diagn. Pl. Or. Nov. ser. 1, 6: 119 (1846).

Syn.: *Cousinia schultziana* Jaub. & Spach

Type: Iraq: 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

15. *C. cynaroides* (M.B.) C.A. Mey., Verz. Pfl. Cauc. 230 (1831).

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

16. *C. dalahuensis* Attar & Ghahreman, Iran. Journ. Bot. 8 (2): 264 (2000).

Type: Iran: Kermanshah, Gahvareh, Tang-e Khamush. Endemic. Specimens studied: 19918-TUH (Holotype). Rare. Map 3

17. *C. disfulensis* Bornm. in Koelz, Danish Scient. Invest. Iran 4, Beitr. S.W. Iran 1: 23 (1954). Iran. Journ. Bot. 9 (1): 55-62 (2001). Descr. compl.

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

18. *C. ecbatanensis* Bornm., Osterr. Bot. Zeitschr. 62: 474 (1912).

Type: Iran: Hamadan. Endemic. Specimens studied: 22368-TUH (Locus classicus)

Syn.: *Cousinia pichlerian* Bornm. ex Rech. f. Map 9

19. *C. elwendensis* Bornm., Beih. Bot. Centrbl. 28, 2: 255 (1911); Iran. Journ. Bot. 8 (1): 21 (1999). Descr. compl.

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

20. *C. eriocephala* Boiss. & Hausskn. in Boiss., Fl. Or. 3: 504 (1875).

Type: Turkey. Specimens studied: 68887-TUH. Map 5

21. *C. farsistanica* Bornm., Osterr. Bot. Zeitschr. 62: 185 (1912).

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

22. *C. gigantolepis* Rech. f., Fl. Iranica, Compositae I, Cynareae: *Cousinia*, vol. 90: 257 (1972).

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

23. *C. gilliatt* Rech. f., Fl. Iranica, Compositae, Cynareae I: *Cousinia*, vol. 90: 244 (1972).

Type: Iran: Azerbaijan: near Tabriz. Endemic. Specimens studied: 21967-TUH (Locus classicus). Rare. Map 13

24. *C. grandiceps* Bunge, Mem. Acad. Science. Petersbg. 7. ser., 9, 2: 54 (1865)

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

26. *C. grantii* Rech. f., Fl. Iranica, Compositae, Cynareae I: *Cousinia*, vol. 90: 245 (1972).

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

27. *C. hakkarica* Hub.-Mor., in Notes R.B.G. Edinb. 32: 54 (1972).

Type: Turkey: mt. Hakkary. Specimens studied: 45467-TUH; 70031-TARI. Rare. Map 13

28. *C. hamadanensis* Rech. f., Fl. Iranica, Compositae III, Cynareae: *Cousinia*, vol. 139A: 142 (1979).

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

29. *C. inflata* Boiss. & Hausskn. in Boiss., Fl. Or. 3: 512 (1875).

Type: Iran: Kermanshah: mt. Shahu. Specimens studied: 20573-TUH; 20561-TUH; 17829-TUH; 22375-TUH; 1221-TARI; 23465-TUH; 20575-TUH; 74816-TARI; 74698-TARI; 46727-TARI. Map. 4

30. *C. iranica* C.Winkl. & Strauss, Acta Horti Petrop. 14: 233 (1897).

Type: Iran: Arak: mt. Rasvand, near Chehel Khatun. Endemic. Specimens studied: 75038-TARI (Locus classicus); 21881-TUH (Locus classicus). Map 28

31. *C. jaccobsii* Rech. f., Fl. Iranica, Compositae, Cynareae I: *Cousinia*, vol. 90: 237 (1972).

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

32. *C. keredjensis* Bornm. & Gauba, Feddes Repert. 36: 328 (1934).

Type: Iran: near 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

33. *C. kermanshahensis* Attar, Ghahreman & Assadi, Iran. Journ. Bot. 9 (1): 55-62 (2001).

Type: Kermanshah, Eslamabad-Gharb, Mahidasht region, Bujan pass. Endemic. Specimens studied: 19180-TUH (HoloType); 2525-TARI (Paratype). Rare. Map 11

34. *C. khansaricus* Attar & Ghahreman, Nordic J. Bot. 23: 589-592.

Type: Iran: Esfahan: Khansar. Endemic. Specimen seen: 20037-TUH (Holotype). Map 33

35. *C. khorramabadensis* Bornm. *In*: Koeie, Danish Scient. Invest. Iran 4, Beitr. S.W. Iran 1: 25 (1945).

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

36. *C. khorramabadensis* Bornm. var. ***Purpurea*** Attar & Ghahreman, Iran. Journ. Bot. 9(20): 161-169 (2002).

Type: Iran: Lorestan: Shulabad. Endemic. Specimens studied: 27591-(TUH) (Holotype). Map 34

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

Syn.: *Cousinia lurorum* Bornm. var. *recurvata* Bornm.; *C. lurorum* Bornm. var. *lancigera* Bornm.

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

38. *C. kopi-karadaghensis* Rech. f., Fl. Iranica, Compositae, Cynareae I: *Cousinia*, vol. 90: 249 (1972).

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

39. *C. kornhuberi* Heimerl, Denkschr. Akad. Wiss. Wien Math.-Nat. Kl. 50: 62 (1885).

Syn.: *Cousinia medorum* Bornm. & Gauba

Type: Iran: Hamadan, mt. Alvand. Endemic. Specimens studied: 22369-TUH; 20553-TIH; 20550-TUH; 33916-IRAN. Map 25

40. *C. kotschyi* Boiss., Diagn. Pl. Or. Nov. ser. 1, 6: 120 (1846).

Syn.: *Cousinia silyboides* Jaub. & Spach

Type: Iran: Boyer-Ahmad, mt. Dena. Endemic. Specimens studied: 20552-TUH; 20558-TUH; 33993-IRAN; 33897-IRAN; 13136-IRAN; 489-IRAN. Map 15

41. *C. lactiflora* Rech. f., Fl. Iranica, Compositae III, *Cousinia* in Cynareae, vol. 139A: 143 (1979)

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

42. *C. lurorum* Bornm., Feddes Repert. 40: 346 (19d36).

Syn.: *Cousinia cymbolepis* Boiss. var. *subintegriloba* Bornm.

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

43. *C. lyrata* Bunge, Mem. Acad. Scienc. Petersbg. 7. ser., 9, 2: 53 (1865).

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

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

44. *C. macrocephala* C.A. Mey., Verz. Pfl. Cauc. 231 (1831).

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.

45. *C. millefontana* Rech. f., Fl. Iranica, Compositae, Cynareae I: *Cousinia*, vol. 90: 248 (1972)

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

46. *C. mobayenii* Ghahreman & Attar, Iran. Journ. Bot. 8(2): 260 (2000).

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

47. *C. monocephala* Bunge, Mem. Acad. Scienc. Petersbl. 7. ser., 9, 2: 52 (1865).

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

48. *C. mozaffarianii* Attar, Assadi & Ghahreman, Pak. J. Bot., 32 (2): 293-294. (2000).

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

49. *C. nana* Attar, Ghahreman & Assadi, Nordic J. Bot. 20 (5).

Type: Iran: Arak: Kaveir-e Mighan. Endemic. Specimens studied: 64185-TARI (Holotpe). Map 29

50. *C. noeana* Boiss., Diagn. Pl. Or. Nov. ser. 2, 3: 57 (1856).

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

51. *C. onopordioides* Ledeb. in Eichw., Pl. Nov. It. Casp. Cauc. 40 (1831-33).

Syn.: *Cousinia albicaulis* Boiss. & Buhse; *C. sabzevarensis* 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-

TARI; 21534-TARI; 40320-TARI; 40395-TARI; 54253-TARI; 53885-TARI; 16046-TARI; 4386-TARI; 53184-TARI; 21345-TUH; 40485-TUH; 21233-TARI; 21510-TARI. Map 27

52. *C. parsana* Ghahreman, Attar & Iranshahr, Iran. Journ. Bot. 8 (1): 16 (1999).

Type: Iran: Hamadan: Road of Malayer, 20 km Hamadan, above Ekbatan 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 farsei* Rech. f.

Type: Iraq: Penjvein. Specimens studied: 22481-TUH (Locus classicus); 18314-TUH; 12219-IRAN; 33913-IRAN; 42653-TARI; 22571-TUH; 5504-TARI; 12198-IRAN; 25936-TARI. Map. 2

54. *C. perspolitanus* Attar & Ghahreman, Nordic J. Bot. 23: 589-592 (2005).

Type: Iran: Fars: Abadeh. Endemic. Specimen seen: 22509 (TUH). Map 34

55. *C. phyllocephala* Bornm. & Gauba, 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: Azerbaijan: between Khoy and Nakhdjovan. Specimens studied: not seen. Rare.

57. *C. qandilica* Rech. f., Fl. Iranica, Compositae, Cynareae I: *Cousinia*, vol. 90: 223 (1972).

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

58. *C. qaradaghensis* Rech. f., Fl. Iranica, Compositae, Cynareae I: *Cousinia*, vol. 90: 258 (1972).

Type: Iran: Azerbaijan: near Daran, mt. Kiamaki-dagh. Endemic. Specimens studied: 43662-IRAN. Rare

59. *C. rhombiformis* C. Winkl. & Strauss, Acta Horti Petrop. 14: 232 (1897).

Type: Iran: Lorestan: between mt. Oshtoran-kuh and mt. Sas, Sefidab. Endemic. Specimens studied: 21884-TUH (Locus classicus); 57635-TARI; 10276-TARI. Rare. Map 5

60. *C. sabalanica* Attar & Ghahreman, Nordic J. Bot. 20: (2000).

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

61. *C. sagittata* C. Winkl. & Strauss, Acta Horti Petrop. 14: 233 (1897).

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

62. *C. sanandadjensis* Rech. f., Fl. Iranica, Compositae, Cynareae I: *Cousinia*, vol. 90: 235 (1972)

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

63. *C. sardashtensis* Rech. f., Fl. Iranica, Compositae III, *Cousinia* in Cynareae, vol. 139A: 139 (1979)

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

64. *C. sarzehensis* Attar, Ghahreman & Assadi, Nordic J. Bot. 20: 5 (2000).

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

65. *C. sefidiana* (Pau) Rech. f., Anales Jardin Botanico de Madrid, 47 (2): 371 (1990); Iran. Journ. 9 (1): 55-62 (2001). Descr. compl.

Syn.: *Cousinia cymbolepis* Boiss. var. *sefidiana* Pau

Type: Iran: Bakhtiari, near Karun River, mt. Sefid. Endemic. Specimens studied: 54903-TARI; 74482-TARI. Rare. Map 20

66. *C. shebliensis* Ghahreman, Iranshahr & Attar, Iran. Journ. Bot. 8 (1): 15-22 (1999).

Type: Iran: Mianeh to Tabriz, Shebli pass. Endemic. Specimens studied: 20580-TUH (Holotype). Rare. Map 29

67. *C. shulabadensis* Attar & Ghahreman, Iran. Journ. Bot. 9 (2): 161-169 (2002).

Type: Iran: Lorestan: Khorramabad, Shulabad. Endemic. Specimens studied: 21874-TUH (Holotype); 27593-TUH (Paratype). Rare. Map 35

68. C. stroterolepis Rech. f., Fl. Iranica, Compositae, Cynareae I: *Cousinia*, vol. 90: 250 (1972).

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

69. *C. straussii* Hausskn. & Winkl., Acta Horti Petrop. 14: 235 (1897).

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

70. *C. subinflata* Bornm., Osterr. Bot. Zeitschr. 63: 291 (1913).

Type: Hamadan: Nahavand, mt. Garrin. Endemic. Specimens studied: 33912-IRAN. Rare. Map. 1

71. *C. verbascifolia* Bunge, Mem. Acad. Scienc. Petersbg. 7. ser., 9, 2: 52 (1865)

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

72. *C. wettestiniana* Bornm., Verh. Zool.-Bot. Ges. Wien 60: 137 (1910).

Type: Iran: Azerbaijan: Tabriz. Specimens studied: 21343-TUH; 18038-TUH; 9776-TUH; 69907-TARI; 65432-TARI; 30532-TARI; 8558-TARI; 64324-TARI; 74886-TARI. Map. 6

73. *C. zagrica* Attar, Ghahreman & Assadi, Sendtnera, 8: 5-71 (2002)

Type: Iran: Azerbaijan: W Urumieh. Endemic. Specimen seen: 74871-TARI (Holotype). Map 36

74. *C. zardkuhensis* Attar & Ghahreman, Iran. Journ. Bot. 9 (2): 161-169 (2002)

Type: Iran: Bakhtiari, between Gandoman and Borujen. Endemic. Specimens studied: 21887-TUH (Holotype); 20038-TUH (Paratype). Map 36

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

Species	Ir	Tk	Iq	Af	Pk	Tu	RA
1. *C. acanthophysa* Rech. f.			•				
2. *C. aintabensis* Boiss. & Hausskn. *In*: Boiss.		•					
3. *C. algurdina* Rech. f.	•		•				
4. *C. aligudarzensis* Attar & Ghahreman	•						
5. *C. anoplophylla* Rech. f.	•						
6. *C. araneosa* DC.	•						
7. *C. arbelensis* C. Winkler & Bornm.		•	•				
8. *C. barbeyi* C. Winkler	•						
9. *C. beckeri* Trautv.						•	
10. *C. behboudiana* Rech. f. & Esfand.	•						
11. *C. birecikensis* Hub.-Mor.		•					
12. *C. bobeckii* Rech. f.	•						
13. *C. bornmulleri* C. Winkler.	•						
14. *C. calocephala* Jaub. & Spach	•						
15. *C. canescens* DC.		•					
16. *C. carduchorum* C. Winkler & Bornm.	•		•				
17. *C. caroli-henrici* Attar & Ghahreman	•						
18. *C. chlorosphera* Bornm.	•						
19. *C. concinna* Boiss. & Hausskn.	•						
20. *C. cymbolepis* Boiss.	•		•				
21. *C. cynaroides* (M.B.) C.A. Mey.	•		•				•
22. *C. dalahuensis* Attar & Ghahreman	•						
23. *C. disfulensis* Bornm. *In*: Koeie	•						
24. *C. ecbatanensis* Bornm.	•						
25. *C. elwendesis* Bornm.	•						
26. *C. eriocephala* Boiss.	•	•					
27. *C. farsistanica* Bornm.	•						
28. *C. gabrielae* Bornm.							•

Table 1. (contd.)

29. *C. gigantolepis* Rech. f.	•					
30. *C. gigantosphaera* Rech. f.			•			
31. *C. gilliatti* Rech. f.	•					
32. *C. grandiceps* Bunge	•					
33. *C. grandis* C.A. Mey.	•	•				
34. *C. Grantii* Rech. f.	•					
35. *C. hakkarica* Hub. - Mor.	•	•				
36. *C. hamadanensis* Rech. f.	•					
37. *C. inflate* Boiss. & Hausskn.	•		•			
38. *C. Iranica* C.Winkl. & Str.	•					
39. *C. jaccobsii* Rech. f.	•					
40. *C. keredjensis* Bornm. & Gauba	•					
28. *C. gabrielae* Bornm.						•
41. *C. kermanshahensis* Attar & Ghah.	•					
42. *C. khorramabadensis* Bornm.	•					
43. *C. khansaricus* Attar & Ghahreman	•					
44. *C. khorramabadensis* Bornm. var. *purpurea* Attar & Ghah.	•					
45. *C. kirrindica* Bornm. & Rech. f.	•					
46. *C. kopi-karadaghensis* Rech. f.	•		•			
47. *C. kornhuberi* Heimerl	•					
48. *C. kotschyi* Boiss.	•					
49. *C. kurdica* C. Winkler & Bornm.			•			
50. *C. lactiflora* Rech. f.	•					
51. *C. leatherdalei* Rech. f.			•			
52. *C. lurorum* Bornm.	•					
53. *C. lyrata* Bunge	•			•	•	
54. *C. macrocephala* C.A. Mey.	•					•
55. *C. macrolepis* Boiss. & Hausskn.			•			

Table 1. (contd.)

56. *C. mazu-shirinensis* Rech. f.		•				
57. *C. millefontana* Rech. f.	•					
58. *C. mobayenii* Ghahreman & Attar	•					
59. *C. monocephala* Bunge	•					
60. *C. mozaffarian* Attar, Assadi & Ghahreman	•					
61. *C. nana* Attar, Ghahreman & Assadi	•					
62. *C. noeana* Boiss.	•					
63. *C. odontolepis* DC.		•				
64. *C. onopordioides* Ledeb. *In*: Eichw.	•		•	•	•	
65. *C. parsana* Ghah., Iranshahr & Attar	•					
66. *C. pergamaceae* Boiss. & Hausskn.	•	•				
67. *C. perspolitanus* Attar& Ghahreman	•					
68. *C. phyllocephala* Bornm. & Gauba	•					
69. *C. purpurea* C.A. Mey.	•					
70. *C. qandilica* Rech. f.	•	•				
71. *C. qaradaghensis* Rech. f.	•					
72. *C. rhombiformis* C. Winkl. & Strauss	•					
73. *C. sabalanica* Attar, Ghah. & Assadi	•					
74. *C. sagittata* C. Winkl. & Strauss	•					
75. *C. sanandadjensis* Rech. f.	•					
76. *C. sardashtensis* Rech. f.	•					
77. *C. sarzehensis* Attar, Ghah. & Assadi	•					
78. *C. sefidiana* Pau	•					
79. *C. shebliensis* Ghah., Iransh. & Attar	•					
80. *C. shulabadensis* Attar & Ghahreman	•					
81. *C. stroterolepis* Rech. f.	•					
82. *C. straussii* Hausskn. & C. Winkl.	•					
83. *C. subinflata* Bornm.	•					

Table 1. (contd.)

84. *C. vanensis* Hub.-Mor.					•		
85. *C. verbascifolia* Bunge			•				
86. *C. wettestiniana* Bomm.			•				
87. *C. wheeler* hainsii Rech. f.						•	
88. *C. zagrica* Attar, Ghahreman & Assadi			•				
89. *C. zardkuhensis* Attar & Ghahreman			•				

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

Country	Taxa	Endemics
Iran	74	59
Iraq	17	9
Turkey	8	5
Turkmenistan	3	1
Republic of Azarbaijan	3	1
Pakistan	3	-
Afghanistan	2	-

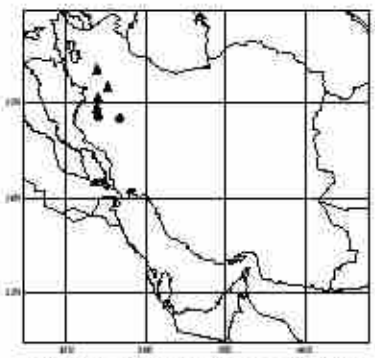
Table 3. List of *Cousinia* spp. in different provinces

Province	Species
Azerbaijan (W & E) (15 spp.)	*algurdina, bobeckii, calocephala, cymbolepis, eriocephala, grandis, grantii, hakkarica, macrocephala, purpurea, qandilica, qaradaghensis, shebliensis, wettesteiniana, zagrica*
Kordestan (13 spp.)	*anoplophylla, calocephala, caroli-henrici, concinna, gigantolepis, inflata, kopi-karadaghensis, kotschyi, millefontana, pergamacea, sagittata, sanandajensis, stroterolepis*

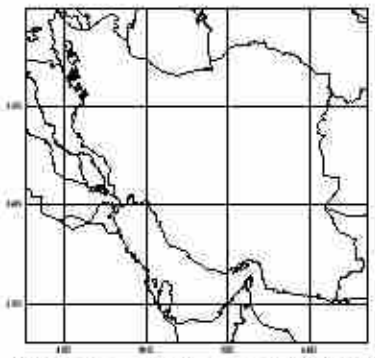
Table 3. (contd.)

Kermanshah (10 spp.)	*calocephala, dalahuensis, inflata, subinflata, jaccobsii, kermanshahensis, kirrindica, lurorum, mobayenii, noeana*
Hamadan (10 spp.)	*celocephala, ecbatanensis, elwendensis, hamadanensis, kornhuberi, kotschyi, parsana, sagittata, sanandajensis, subinflata*
Bakhtiari (8 spp.)	*aligudarzensis, calocephala, chlorosphaera, kornhuberi, noeana, rhombiformis, sefidiana, zardkunehsis*
Lorestan (6 spp.)	*calocephala, carduchorum, khorramabadensis, phyllocephala, sagittata, shulabadensis*
Khorasan (5 spp.)	*grandiceps, lyrata, monocephala,onopordioides, verbascifolia*
Ardebil (5 spp.)	*calocephala, cynaroides, gilliatii, grandis, sabalanica*
Fars (4 spp.)	*bornmulleri, farsistanica, mozaffariani, perspolitanus*
Arak (4 spp.)	*iranica, nana, sagittata, straussii*
Tehran (4 spp.)	*calocephala, behboudiana, Keredjensis, onopordioides*
Esfahan (4 spp.)	*bornmulleri, calocephala, khansaricus, lactiflora*
Semnan (4 spp.)	*behboudiana, calocephala, grandiceps,onopordioides*
Kerman (3 spp.)	*grandiceps, onopordioides, sarzehensis*
Boyer-Ahmad (2 spp.)	*araneosa, barbeyi*
Markazi (2 spp.)	*calocephala, cymbolepis*
Khuzestan (2 spp.)	*disfulensis, kotschyi*
Qazvin (2 spp.)	*behboudiana, calocephala*
Zanjan (2 spp.)	*calocephala, kotschyi*
Baluchestan (1 sp.)	*onopordioides*
Gorgan (1 sp.)	*onopordioides*

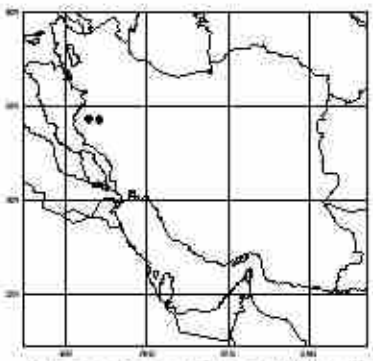
Distribution map of *Cousinia* spp. (sect. *Cynaroides*) in Iran



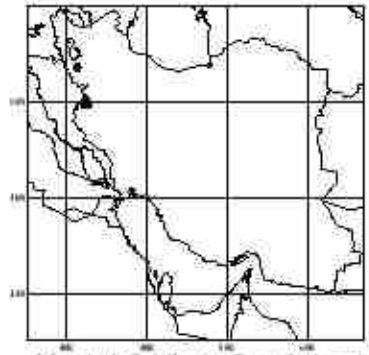
Map 1. ▲*C. concinna*; ●*C. subinflata*



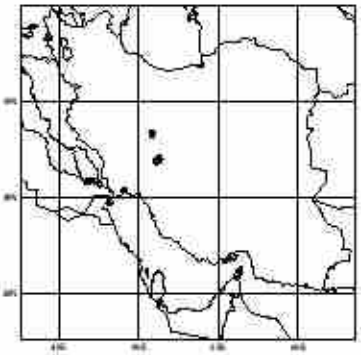
Map 2. ●*C. pergamacea*; ▲*C. millefontana*



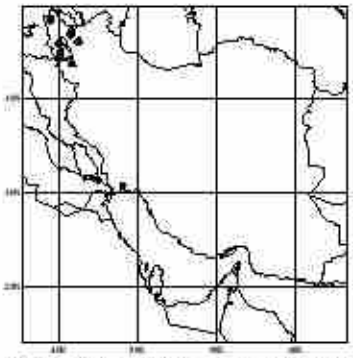
Map 3. ▲*C. gandilica*; ●*C. dalahuensis*



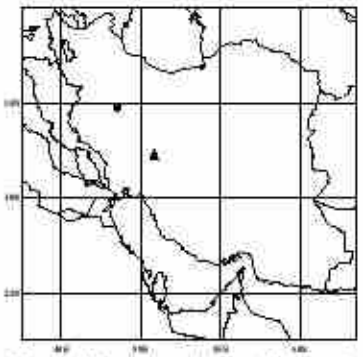
Map 4. ▲*C. inflata*; ●*C. sardashtensis*



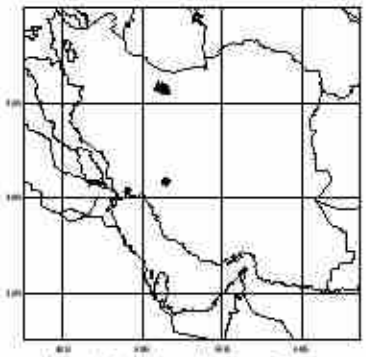
Map 5. ▲*C. eriocephala*; ●*C. rhombiformis*



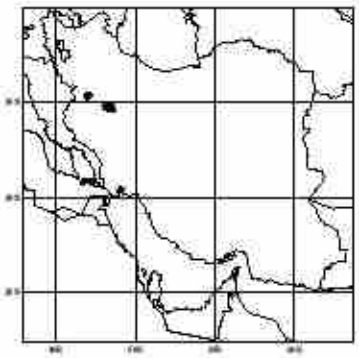
Map 6. ▲*C. grandis*; ●*C. wettesteiniana*



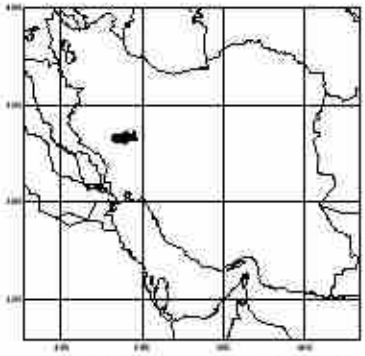
Map 7. ▲*C. chlorosphera*; ●*C. elwendensis*



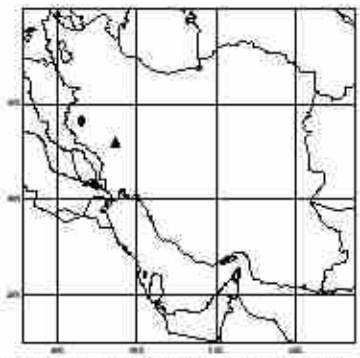
Map 8. ▲*C. keredjensis*; ●*C. anneeana*



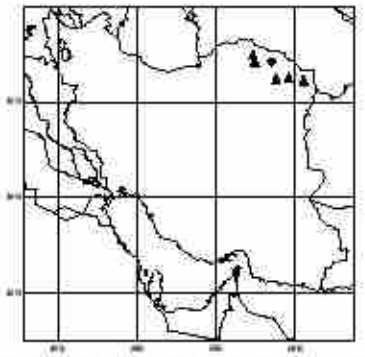
Map 9. ▲*C. ecbatanensis*; ●*C. sanandajensis*



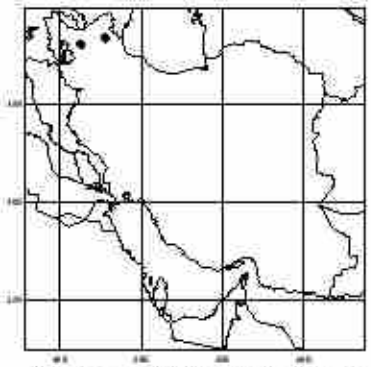
Map 10. ▲*C. khorramabadensis*; ●*C. phyllocepha*



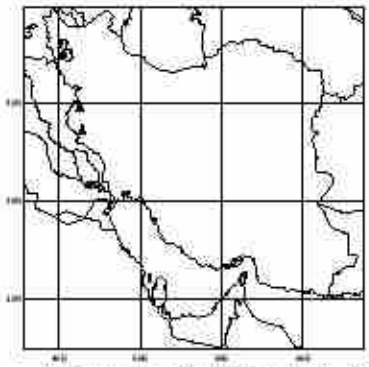
Map 11. ▲*C. disfulensis*; ●*C. kermanshahensis*



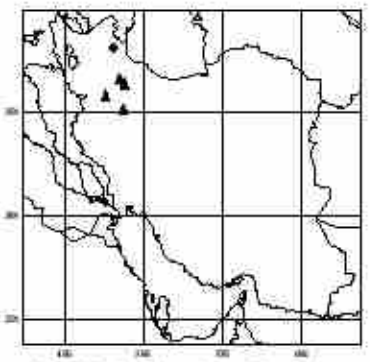
Map 12. ▲*C. verbascifolia*; ●*C. monocephala*



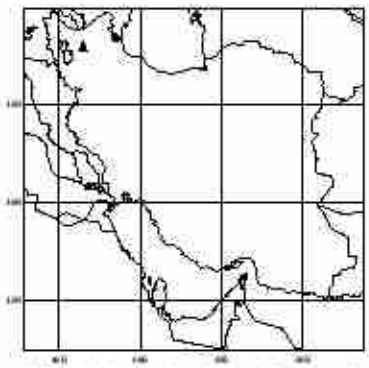
Map 13. ▲*C. hakkarica*; ●*C. gilliatii*



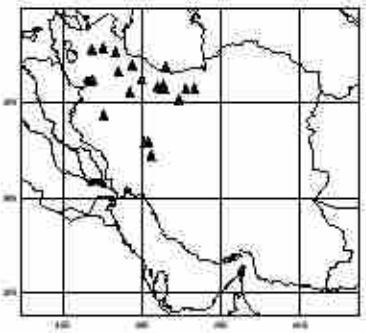
Map 14. ▲*C. jacobsii*; ●*C. bobeckii*



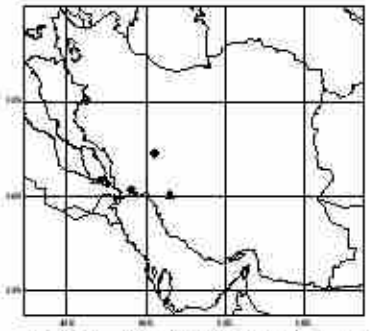
Map 15. ▲*C. kotschyi*; ●*C. sabalanica*



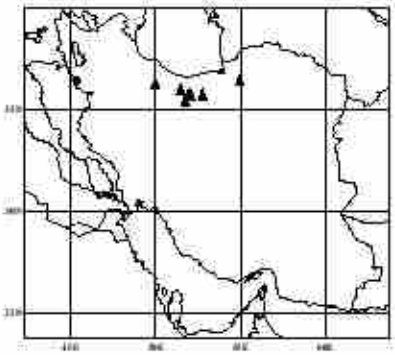
Map 16. ▲*C. aigurdina*; ●*C. cynaroides*



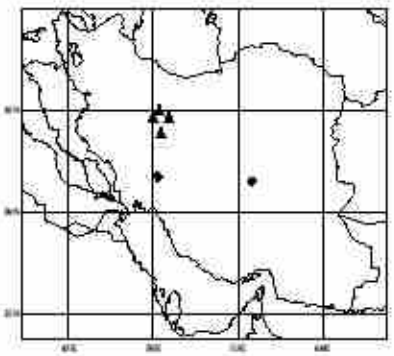
Map 17. ▲*C. calocephala*; ●*C. kopi-karadaghensis*



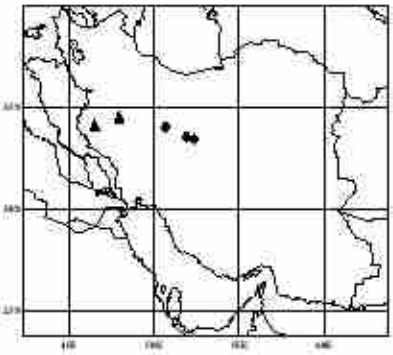
Map 18. ▲*C. mozaffarianii*; ●*C. noena*



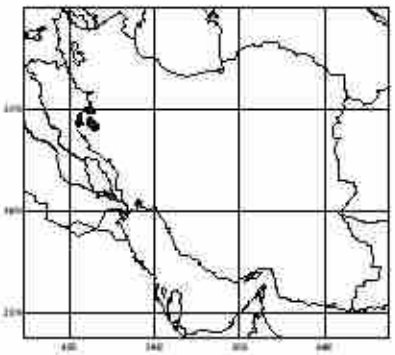
Map 19. ▲*C. behboudiana*; ●*C. stroterolepis*



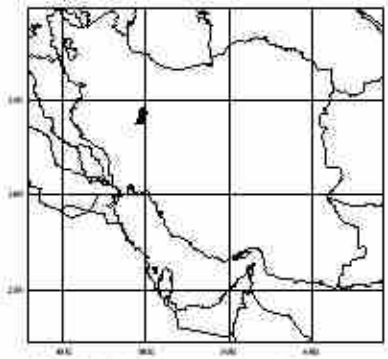
Map 20. ▲*C. symbolepis*; ●*C. sefidiana*



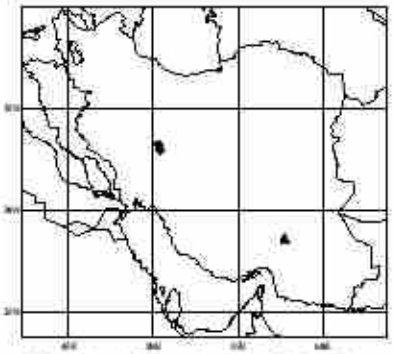
Map 21. ▲*C. luronum*; ●*C. bornmulleri*



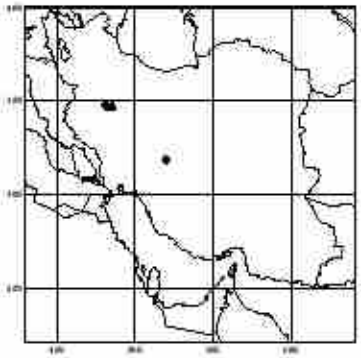
Map 22. ▲*C. kirrindicus*; ●*C. mobayenii*



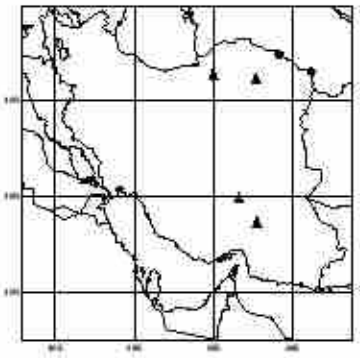
Map 23. ▲*C. gigantolepis*; ●*C. sagittata*



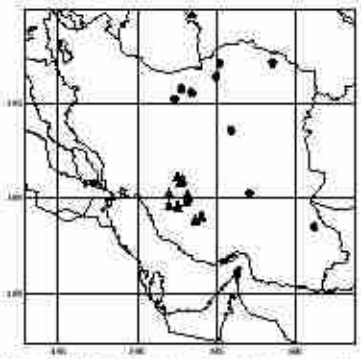
Map 24. ▲*C. sarzehensis*; ●*C. lactiflora*



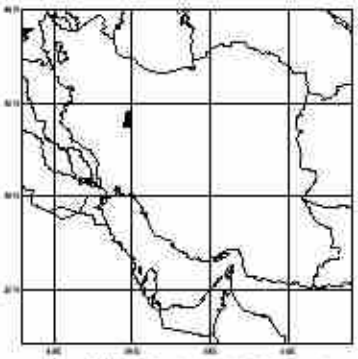
Map 25. ▲*C. parsiana*; ●*C. kermluberi*



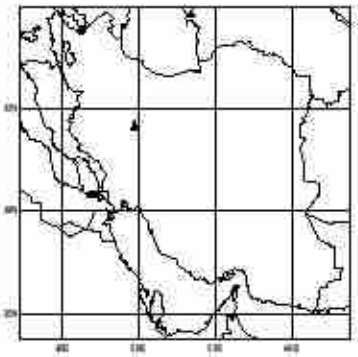
Map 26. ▲*C. grandiceps*; ●*C. lyrata*



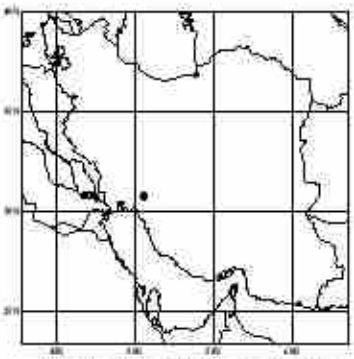
Map 27. ▲*C. farsistanica*; ●*C. onoporditoides*



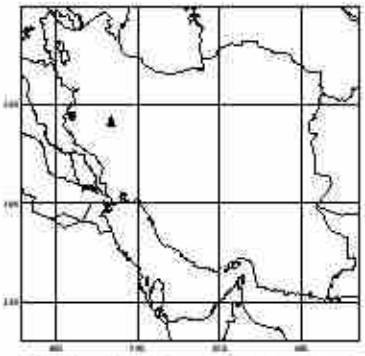
Map 28. ▲*C. straussii*; ●*C. iranica*



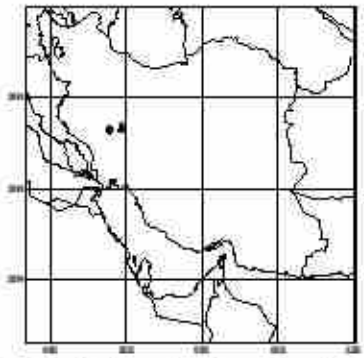
Map 29. ▲*C. nana*; ●*C. shebliensis*



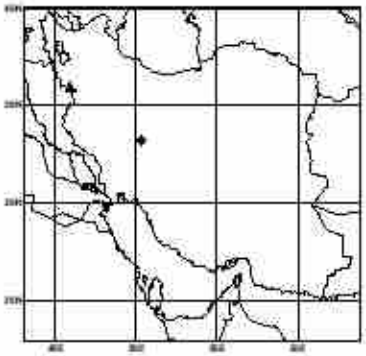
Map 30. ▲*C. gruntii*; ●*C. harbeyi*



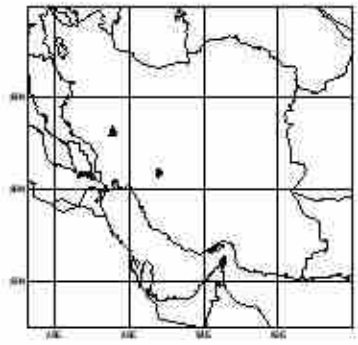
Map 31. ▲*C. aligudarzensis*; ●*C. carduchorum*



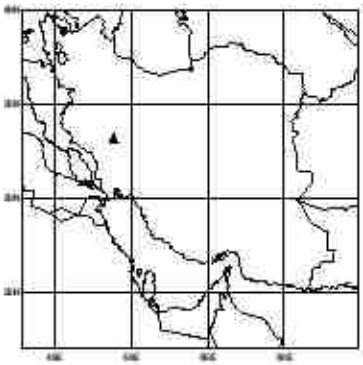
Map 32. ▲*C. hamadanensis*; ●*C. anoplophylla*



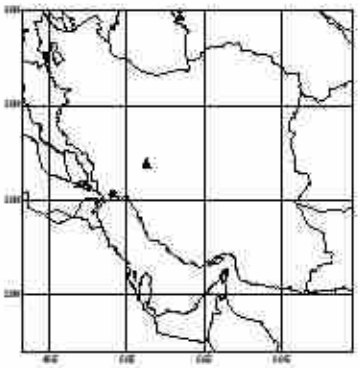
Map 33. ▲*C. caroli-henrici*; ●*C. khansaricus*



Map 34. ▲*C. khorramabadensis* var. *purpurea*; ●*perspolitanus*



Map 35. ▲*C. shulabadensis*; ●*C. qaradaghensis*



Map 36. ▲*C. zarikahensis*; ●*C. zagrica*

Acknowledgments

The authors are grateful to Dr. M. Iranshahr for advisering and editing of the Latin diagnoses during this study, Dr. M. Assadi for advisering 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. Aghabeigi, Mr. M.R. Joharchi and Mr. T. Maassoumi for preparing facilities to use specimens of "IRAN", "FUHM" and Karaj Herbaria, respectively.

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A REVISION OF *CENTAUREA* (COMPOSITAE-CARDUEAE) IN THE FLORA OF IRAQ

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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 Iraqian 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, HUJ, 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 Iraqian 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 (cornflower) blue (in garden forms also white or red); phyllaries with a black or brown border widely decurrent	Group A
- Flowers never blue; phyllaries not with a widely decurrent black or brown border	2
2. Median (and upper) leaves distinctly decurrent	3
- Leaves not decurrent	4
3. Plants annual, with small heads, involucre up to 12 mm broad	Group B
- Plants perennial or biennial, if biennial then with much larger heads	Group C
4. Plants annual or sometimes biennial	Group D
- Plants perennial	Group E

Key to species

Group A (*Cyanus*)

1. Annual plants; anther-tube of central flowers strongly curved		2
- 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	2. *Cyanus depressus*	
- Upper leaves linear, 1-2 mm broad; cilia of appendage 0.5-1 mm; pappus 2-3.5 mm long	3. *Cyanus segetum*	

Group B

1. Decurrent wings of the leaves entire	22. *C. solstitialis*	
- Decurrent wings dentate		2
2. Stems and leaves +/- cobwebby with long glossy hairs; achene 2.2-2.8 mm long, the hilum nearly 1/3 of its length	22. *C. solstitialis*	
- Stems and leaves with very short stiff hairs; achene 3-3.5 mm long, the hilum only about ¼ of its length	24. *C. pseudosinaica*	

Group C

1. Phyllaries without an appendage, or with a minute mucro up to 1.5 mm long		2
- Phyllaries with a distinct appendage		4
2. Stem and leaves nearly glabrous		3
- Stem and leaves with crisped hairs	17. *C. polypodiifolia*	
3. Basal leaves lyrate with very large terminal segment and few lateral segments; involucre 10-18 mm broad; inner row of pappus distinctly shorter than the preceding	18. *C. behen*	
- 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	21. *C. koeiana*	
4. Appendage a simple spine (sometimes with a pair of minute lateral spinules)		5
- Appendage not a simple spine		7
5. Involucre 6-9 mm broad	20. *C. rigida*	
- Involucre more than 14 mm broad		6
6. Capitula on short peduncles forming a raceme; pappus 10-15 mm, the inner row long	16. *C. amadenenis*	
- Capitula on long divaricate branches; pappus 8-9 mm long, the inner row shorter	19. *C. alveicola*	
7. Basal part of phyllaries totally covered by the appendages		8

- Basal part of phyllaries not totally covered by the appendages		9
8. Capitula 4-5 cm in diameter, on peduncles 10-15 cm long; terminal spine 4-15 mm long	12. *C. regia*	
- Capitula 3-4 cm in diameter, on very short peduncles; terminal spine only 1-3 (-4) mm long	13. *C. imperialis*	
9. Flowers yellow	15. *C. gudrunensis*	
- Flowers rose-purple or whitish		10
10. Biennial plant with several capitula in a raceme; terminal spine of appendages distinct, longer than cilia	14. *C. gigantea*	
- 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	31. *C. bruguieriana*	
- Phyllaries not with green foliaceous appendage		2
2. Flowers yellow		3
- Flowers rose-purple or whitish		7
3. Appendages triangular with several pairs of cilia, ending in a stiff spinule, c. 2-4 mm long		4
- Appendages consisting of a much longer rigid spine, +/- dilated at the base		5
4. Appendages cartilaginous, c. 3 mm broad at base excluding the cilia, with 8-12 cilia on each side; achenes 5-6 mm long	1. *Stizolophus balsamita*	
- Appendages not cartilaginous, only 1 mm broad at base, with 4-6 cilia on each side; achenes 3-3.5 mm long	2. *Stizolophus balsamitoides*	
5. Phyllaries with a broad hyaline border; spines without lateral spinules or with one pair near the base	29. *C. hyalolepis*	
- Phyllaries without a hyaline border; spines with 2-4 pairs of lateral spinules often going up to the middle of the spine		6
6. Phyllaries with a fine, appressed, mealy tomentum; achene 2.3-2.5 mm long; flowers remaining yellow when dry	25. *C. mesopotamica*	
- Phyllaries sparsely arachnoid (cobwebby); achene 2.8-3.2 mm long; flowers drying bluish	26. *C. microcnicus*	
7. Appendage a rigid spine with 1-3 pairs of lateral spinules near base	28. *C. iberica*	
- Appendage triangular with 5-10 pairs of cilia and ending in a slender spinule		8
8. Main stem very short, central capitulum nearly sessile; achene 2.5 mm long, pappus 3-4 mm long	6. *C. ammocyanus*	
- Main stem elongated ; achene 1.8-2.3 mm long, pappus 2-3 mm long	7. *C. laxa*	

Group E

1. Appendage a firm spine, simple or with 1-2 pairs of short spinules at or near the base		2
- Appendage spiny or not, but always with several pairs of lateral cilia or teeth		3
2. Stem erect, median leaves entire or with few teeth; pappus 7-8 mm long	25. *C. delbesiana*	
- Stem ascending or prostrate, median leaves pinnatisect or pinnatilobed; pappus absent	30. *C. postii*	
3. Flowers yellow		4
- Flowers purplish or whitish		5
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. aucheri*	
5. Plant copiously branched with numerous small capitula; involucre 3-10 mm broad		6
- Plant with few branches with one large head; involucre more than 15 mm broad		11
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
7. Appendage ending in a very short mucro shorter as or as long as the lateral cilia		8
- Appendage ending in a spinule slightly to distinctly longer than the lateral cilia		9
8. Capitula crowded in fascicles at the end of the branches; upper leaves lanceolate or oblong	1. *C. aggregata*	
- Capitula solitary at the end of the branches; upper leaves linear	2. *C. fusiformis*	
9. Involucre 4-6 mm broad; capitula with c. 10-20 hermaphrodite flowers	5. *C. singarensis*	
- Involucre 3-4 mm broad; capitula with 5-8 hermaphrodite flowers		10
10. Terminal spinule of appendage stout; appendage usually with a purple-brown spot; often two heads close together	3. *C. virgata*	
- Terminal spinule slender, awn-like; appendage light brown; heads solitary	4. *C. intricata*	
11. Appendage with short spine or mucro, this only up to 8 mm long in the median phyllaries		12
- Appendage with a distinctly longer spine		13
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	14
-	Appendages not concealing the basal part of the phyllaries	16
14.	Plants branched from near the base	32. *C. urvillei*
-	Plants unbranched or with few branches in the upper part	15
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
17.	Stem branched from near the base	40. *C. irritans*
-	Stem simple or branched in or above the middle (branching from the base may occur in damaged plants)	18
18.	Involucre tomentose	39. *C. davisii*
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.

1. *C. aggregata* Fisch. et Mey. ex DC., Prodr. 6: 585 (1838). - Type: Iran: in glareosis ad torrentem Avrin, prov. Aderbeischan Persico-Rossicae, 27. VII. 1828, Szovitz s.n. (holo: G-DC, Iso: H, K).

C. virgata Lam. subsp. *aggregata* (DC.) Gugler, Cent. Ungar. Nationalmus.: 248 (1907) = Ann. Hist. Nat. Mus. Hung. 6: 248 (1908).

C. pauciflora C. Koch in Linnaea 24: 433 (1851)

C. chrysolopha Boiss. et Kotschy in Boiss., Diagn. Ser. 2, 3: 75 (1856).

C. amani Post in Bull. Herb. Boiss. 1: 23 (1893).

C. aggregata DC. var. *argyrea* Bornm. in Beih. Bot. Centralbl. 60 B: 210 (1939).

Acosta aggregata (DC.) Soják in Čas. Nár. Muz., Odd. Přír. 140: 133 (1972).

Icon.: Fl. Iran. 139 b: tab. 308 (1980); Fl. Armen. 9: 403 (1995).

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 mucro 0.5 mm long. Flowers rose-purple, the marginal scarcely radiant, 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.

2. *C. fusiformis* Blakelock in Kew Bull 4: 47 (1949). - Type: Kurdistan: Dohuk, 1500 fr., 10.X.1931, Guest 1589 (K).

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 indistinctyl 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 par 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: Dohuk, Guest 1589 (K); Sarsang, 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. 11534 (E, W); Bikhair (Jabal Bekher), Rawi 23061 (K).

Distrib.: Endemic, only known from a limited area near the Turkish frontier.

3. *C. virgata* Lam., Encycl. 1: 670 (1785). - Type: cult. hort. Paris, seeds collected by Michaux "dans l'Arménie" (P-LAM n.v., vidi photo).

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, pinnatipartite or partly bi-pinnatipartite with linear segments, rarely lyrate, often withered at flowering time; median leaves pinnatipartite 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 spinule ± 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:

subsp. *squarrosa* Gugler, Cent. Ungar. Nationalmus.: 248 (1907) = Ann. Hist. Nat. Mus. Hung 6: 248 (1908).

C. squarrosa Willd., Sp. Pl. ed. 4, 3(3): 2319 (1803), nom. illegit. (non *C. squarrosa* Roth 1800). - Type: "Habitat in Oriente", Gundelsheimer (holotype: B-WILLD 16635).

C. squarrosa Willd. var. *rubella* Sch. Bip. in Pl. Alepp. Kurd. Moss. 303 (1843).

C. squarrosa Willd. var. *colensis* C. Koch in Linnaea 24: 434 (1851).

Acosta squarrosa (Willd.) Soják in Čas. Nár. Muz., Odd. Přír. 140: 134 (1972).

C. virgata L. var. *squarrosa* (Willd.) Boiss., Fl. Orient. 3: 651 (1875).

C. virgata Lam. Variant A, Wagenitz in Willdenowia 6: 483 (1972).

Icon: 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 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.).

Distrib.: 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 remarkabyl 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.

4. *C. intricata* Boiss., Diagn. Ser. I, 6: 130 (1845). - Type: Aucher-Eloy 4853 (G, K).

Icon: Fl. Iran. 139 b: tab. 311, subsp. *kermanshahensis* Wagenitz (1980).

Perennial suffrutescent plant, (10-)20-40 cm high. Stems woody, the old dead ones subspinescent, 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 pinnatilobed 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 ofthe branches, often easily deciduous. Involucre 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(-4) mm long. Flowers pale purplish (whitish when dry), only 5-8 flowers hermaphrodite 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 Mahmur, Gillett 11218 (K) - FPF: Koma 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. Singarae, 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, lyrate, 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. Involucre 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 spinule 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. & distrib.: In rocky clefts in limestone mountains; alt. 250-1450 m. - MJS: Jabal Sinjar, Haussk n. s.n. (G, K, type), Gillett 11084 (K); Anders 1989 (W). - FUJ: Jabal Khatchra, between Balad Sinjar and Tal Afar, Field & Lazar 637 (E, K, W).

A rare local endemic, allied to *C. intricata* but with distinctly larger heads.

Sect. *Ammocyanus* Boiss.

6. *C. ammocyanus* Boiss., Diagn. Ser. 1, 10: 109 (1849). - Type: Egypt (?): in arenosis Arabiae petreae Palaestinae conterminae ad meridiem Gaza, IV. 1846 (G-Boiss).

Ammocyanus arabicus Dostál in Acta Bot. Acad. Sci. Hung. 19: 78 (1973). - based on *C. ammocyanus*.

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 spathulate to lanceolate in outline, undivided, pinnatilobed or sublyrate; median leaves lanceolate, entire or with few lobes or teeth; uppermost leaves linear-lanceolate, inserted directly below the capitulum and usually longer than the involucre. Involucre 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 mucro 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. 200-650m.

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.

7. *C. laxa* Boiss. et Hausskn. in Fl. Orient. 3: 640 (1875). - Syntypes: Turkey: In agris et desertis Mesopotamiae inter Orfa [Urfa] et Kharran, 10. V. 1865, Haussknecht (G-BOISS, JE, W); Syria: af fluv. Chabur, V. 1867, Haussknecht (BM, G-BOISS, JE, K, W); in monte Gebel Belas deserti ad Palmyran, 19. V. 1857, Blanche 3409 (JE).

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 pinnatipartite; 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. Involucre 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: Sardariyria, 15 km S.W. of Aqra, Memerian 10793 (K). - FUJ: between Jabals Makhul and Khanuqa, Hand.-Mazz. 1053 (W,WU); between Wadi Safa and Hadhr, Hand.-Mazz. 1107 (W); Qaiyara, Bayliss 72 (K); Qal'a Sharqat, 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. ammocyanus*. 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. ammocyanus*.

Sect. *Phalolepis* (Cass.) DC.

8. *C. foveolata* Blakelock in Kew Bull. 4: 46 (1949). - Type: Iraq: Amadia, Kurdistan, c. 5000 ft., in Mazurka Gorge above Sulaf, 2. VIII. 1933, Guest s.n. (K: holo- and isotype).

Icon: Fl. Iran. 139 b: tab. 314 (1980).

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 arachnoid-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. Involucre 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 ciliate 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 Amadya, 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); Amadya: in Mazurka Gorge above Sulaf, 2. VIII. 1933, Guest s.n. (K, type).

Endemic.

Sect. *Rhizocalathium* Tzvelev.

9. *C. rhizantha* C.A. Mey., Verz. Pfl. Cauc.: 64 (1831). - Type: Talysh: in campis altiorium montium Talüsch, alt. 1829-2011 m, C.A. Meyer (LE, G).

C. sessilis auct. non Willd.: Boiss., Fl. Orient. 3: 676 (1875).

C. glaucescens Fisch. et Mey. in Ann. Sci. Nat., Bot. Ser. 4, 1: 31 (1854).

C. grossheimii Sosn. in Bot. Zhurn. 34: 288 (1949).

C. sessilis Willd. var. *pinnatiloba* Rech. f. in Symb. Bot. Upsel. 11 (5): 33 (1952).

C. rhizanthoides Tzvelev in Fl. URSS 28: 620 (1963).

Icon.: Fl. URSS 28: 577 (1963); Fl. Iran. 139 b: tab. 320 + 418 (1980); Fl. Armen. 9: 426 (1985).

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 segmet 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 pinnatipartite with the terminal segment scarcely larger than the lateral. Involucre 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, Gillett9597 (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 & Serhang 24739 (K); S. part of "Karvukh Mountain" [= Karokh ?], 2200 m, Kass & Serhang 27478 (K).

This mountain is the southernmost station for the species. These populations differ from most others by the pinnatipartite, not distinctly lyrate leaves.

Turkey, Iran.

Sect. *Phaeopappus* (DC.) O. Hoffm. (*Amberboa* Less. sect. *Phaeopappus* DC.; *Phaeopappus* (DC.) Boiss. p.p.; *Tomanthea* DC.).

10. *C. aucheri* (DC.) Wagenitz in Bot. Jahrb. Syst. 82: 180 (1963).

Tomanthea aucheri DC., Prodr. 6: 564 (1838). - Type: Iran: Persia occid., Aucher 3195 (holotype: G-DC).

Phaeopappus aucheri (DC.) Heimerl in Stapf in Denkschr. Akad. Wiss. Wien, Math.-Nat. Kl. 50(2): 65 (1885).

Phaeopappus leuzeoides Boiss., Diagn. Ser. I, 6: 124 (1845). nom. illeg. (based on *Tomanthea aucheri* DC.).

Phaeopappus depressus Boiss., Fl. Orient. Suppl.: 311 (1888).

Tomanthea depressa (Boiss.) Czerep. in Notul. Syst. Herb. Inst. Bot. Acad. Sci. URSS 20: 480 (1960).

Icon.: Publ. Fac. Sci. Univ. Masaryk 52: tab. VII, fig. 2 (1925); Fl. Iran. 139 b: tab. 327 (1980); Fl. Armen. 9: 361 (1995).

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 auricles towards the base and ending in a spinule 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, tetragonous 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: Kudu, near Haji Umran, Rawi 9177 (K); Haji Umran, on dry slopes by the roadside, Wiltshire s.n. (in Herb. Haines) (E); Haji Umran, on dry slopes, Rech. f. 11295 (W).

Distrib.: E. Turkey, N. & W. Iran, Transcaucasia.

Only subsp. *aucheri*, described above, occurs in Iraq. It is distributed throughout most of the range of the species.

11. *C. handelii* Wagenitz in Bot. Jahrb. Syst. 82: 184 (1963).

Basionym: *Phaeoappus haussknechtii* Boiss., Fl. Orient. 3: 599 (1875). - Type: Iraq: In deserto ad pedem montis Singarae, 6. V. 1867, Haussknecht (595) (lectotype: G, isotypes: BM, JE, K, W).

Tomanthea haussknechtii (Boiss.)Takht., Trudy Molod. Naučn. Rabotn. Armen. Fil. AN SSSR 1939: 243 (1939).

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 rhachis), 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 spinule 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); Rashid on Jabal Sinjar, Anders 2682 (W); Jabal Sinjar: near the foot of the mountain, Haussk. 595 (type: BM, G, JE, K, W); Qaisi & Hamad 49142 (K); Jabal Sinjar, Omar, Khayat & Qaisi 52563 (K), Jabal Sinjar, Thesiger 538 (BM), 540 (BM). - MSU: Penjwin, Rawi 12234 (K), Rech. f. 12255 (W); Kajan mountains, nr. Penjwin, Rawi 22667 (K).

Sect. *Cynaroides* Boiss. ex Walp. [Sect. *Cynaropsis* Wagenitz; Sect. *Acrocentron* (Cass.) DC. § Cynaroideae Boiss.].

12. *C. regia* Boiss., Diagn. Ser. I, 6: 135 (1845). - Type: Syria: in Assyria in deserto ad Tigrim, Kotschy 371 [= Pl. Mesopot. 234, in graminosis collinis ad pagum Mustafavi in viciniis Dschesirah (Čizre)] (holotype: G-BOISS, isotypes: BM, K, W). *Cynaroides regia* (Boiss.) Dostál in Acta Bot. Acad. Sci. Hung. 19: 77 (1973).

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 oblong, 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. *cynarocephala* (Wagenitz)Wagenitz, Fl. Iran 139 b: 365 (1980):

C. cynarocephala Wagenitz in Willdenowia 2: 477 (1960). - Type: as for *C. carduncului* Boiss.

C. carduncului Boiss., Diagn. Ser. I, 6: 135 (1845), nom. illeg. (non *C. carduncului* Pallas 1771). - Type: Turkey: in Assyria inter Merdin [Mardin] et Assuaner, 12. VI. 1841, Kotschy 349 = Pl. Mesop. 184 in collinis inter Diarbekir et vallem Ouina (lectotype: G-BOISS, isotypes: G, K, W).

Spines of the median phyllaries (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.

13. *C. imperialis* Hausskn. ex Bornm. in Beih. Bot. Centralbl. 20, II: 168 (1906). - Type: Iran, Prov. Kermanshah: ad Kengover [Kangavar] in monte Rasbend, 15. VII. 1896, Strauss s.n. (lectotype: B, isotypes: G, JE, W).

Icon: Fl. Iran. 139 b: tab. 335 (1980).

Biennial plant with a thick turnip-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 petiolate, 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 spinule 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.

Hab. & distrib.: Rare in Iraq: MRO: Haji Umran, Guest & Husham (Alizzi) 15904 (K), Rawi & Serhang 24933 (K); N.E. of Rayat, subalpine plains, 1480 m, Zohary s.n. (HUJ). Iran.

14. *C. gigantea* Sch. Bip. ex Boiss., Fl. Orient. 3: 672 (1875). - Type: Iraq: in locis apricis lapidosis ad pagum Gara Kurdistaniae prope Mossul, 1. VIII. 1841, Kotschy 349 (lectotype: G-BOISS, isotypes: G, GOET, K, LAU, W).

C. chaldaeorum Näbělek in Publ. Fac. Sci. Univ. Masaryk 52: 40 (1925). Icon.: Publ. Fac. Sci. Univ. Masaryk 52: tab. VIII (1925); Fl. Iran. 139 b: tab. 336 + 410, fig. 2 (1980).

Biennial plant with a thick turnip-like root. Stem erect, (30-)60-180 cm high, hirsute with long hairs especially in the lower part, branched only in the upper part. Leaves hirsute to +/- tomentose, with long appressed hairs especially conspicuous along the whitish midrib. Basal leaves cordate or oblong-cordate 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. Involucre 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 tomentose, +/- 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(-8) mm long. Pappus (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.

15. *C. gudrunensis* Boiss. et Hausskn. in Boiss., Fl. Orient. 3: 673 (1875). - Type: Iraq: Kurdistan, in graminosis Pir Omar Gudrun [Pira Magrun], 4000', Haussknecht 585 (lectotype: G-BOISS, isotypes: G, JE, K, W).

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, subglabrous 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, pinnatipartite tosublyrate 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. Involucre 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); Sulaimaniya, dry waste at foothills of mountain near city (of Sulaimaniya), Haines 1313 (E, K); between Surdash and Shadala, Quercetum persicae, c. 1000 m, Zohary & Feinbrun s.n. (HUJ).

A rare narrow endemic so far only known from four gatherings in the area of Sulaimaniyah.

Sect. *Paraphysis* (DC.) Wagenitz (*Amberboa* Less. sect. *Paraphysis* DC.).

16. *C. amadanensis* Sch. Bip. in Linnaea 19: 326 (1847).

Basionym: *Amberboa decurrens* DC., Prodr. 6: 560 (1838). Type: Iran, Prov. Hamadan: Amadan [Hamadan], Aucher 3196 (holotype: G-DC).

Syn.: *Phaeopappus decurrens* (DC.) Boiss., Fl. Orient. 3: 600 (1875).

Tomanthea decurrens (DC.) Takht. in Trudy Molod. Naučn. Rabotn. Armen. Fil. AN SSSR 1939: 243 (1939).

Paraphysis decurrens (DC.) Dostál in Acta Bot. Acad. Sci. Hungar. 19: 76 (1973).

Phaeopappus gymnocladus Jaub. et Spach, Ill. Pl. Or. 3: 15 (1847).

Phaeopappus decurrens (DC.) Boiss. var. *gymnocladus* (Jaub. & Spach) Bornm. in Beih. Bot. Centralbl. 32 II: 413 (1914).

Tomanthea gymnoclada (Jaub. et Spach) Takht. in Trudy Molod. Naučn. Rabotn. Armen. Fil. AN SSSR 1939: 243 (1939).

Centaurea amadanensis Sch. Bip. var. *gymnoclada* (Jaub. et Spach)Wagenitz in Bot. Jahrb. Syst. 82: 191 (1963).

Phaeopappus decurrens (DC.) Boiss. var. *anoplos* Bornm. in Koeie, Beitr. Fl. S.W. Irans 1: 30 (1945).

Icon.: Jaub. et Spach, Ill. 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, hirsute in the basal part, in the upper part lanate when young, later glabrescent. Leaves papery when dry, sparsely pilose, with whitish elevated nerves; basal and lower cauline leaves with a long petiole, undivided, broadly ovate to nearly triangular to lyrate with 1-2 pairs of lateral segments and a very large terminal segment, 12-15 cm broad; median leaves oblong-spathulate 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 (rarely even to 20 cm long). Involucre ovoid or obconical, 25-35 mm long, 22-30 mm broad. Phyllaries in several series, acute, coriaceous, tomentose (later glabrescent), terminated by a spine 5-20 mm long ("var. *amadanensis*") or ending in a mucro only 0.6-2 mm long ("var. *gymnoclada*"). Flowers yellowish-white, the

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 Khormal, Hadač 5057 (PR). W. Iran.

The following specimens from MRO seem to represent a new species allied to *C. amadanensis* and the Iranian *C. nemecii* Náběl ek but are inadequate for description:

MRO: Bursorini 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.

17. *C. polypodiifolia* Boiss., Diagn. Ser. I. 6: 126 (1845). - Type: Turkey: inter Diarbekir et Mardin, 1843, Kotschy 282 (lectotype: G-BOISS).

Microlophus polypodiifolius (Boiss.) Agadshanov, Fl. Azerb. 8: 443 (1961).

Centaurea euphratica Boiss., Diagn. Ser. I, 6: 125 (1845).

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 pinnatilobed; 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 mucro 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 Kourak, 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). - FNI: on the riverside of Tigris, nr. Bawart (Bauerd), S. of Zakho, Kotschy 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.

18. *C. behen* L., Sp. Pl. ed. 1: 914 (1753). - Type: Described from Asia Minor and Lebanon.

Serratula behen (L.) Lam. Tab. Encycl. 3: 242 (1823), excl. descript.

Piptoceras behen (L.) Cass., Dict. Sci. Nat. 54: 482 (1829).

Centaurium behen (L.) C.Koch in Linnaea 24: 418 (1851).

Microlophus behen (L.) Takht. in Takht. et Fedorov, Fl. Erevana: 326 (1946).

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 retrorse, lanceolate or narrowly triangular segments and a much larger broadly lanceolate or oblong-triangular terminal segment with a truncate base, or basal leaves rarely entire, broadly lanceolate; median cauline leaves oblong or broadly lanceolate, sometimes pinnatilobed, 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 mucro 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).

Hab.: On lower mountain slopes and foothills; alt. (250-)400-1700 m; fl. & fr. (Apr.-May) Jun.-Aug.

Distrib.: Quite common in Iraq on the western and central mountains, occasional on lower hills. MJS, MAM, MRO, MSU, FUJ. - Palestine, Lebanon, Syria, Turkey, Iran, Transcaucasia.

19. *C. alveicola* Rech. f. in Ber. Deutsch. Bot. Ges. 72: 283 (1959) & Fl. Lowland Iraq: 655 (1964). - Type: Iraq, Distr. Diyala: ad confines Persiae, inter oppida Mandali et Badra, in alveo quodam lapidoso, 3. VI. 1957, Rechinger 9681 (Holotype: W, isotype K).

Icon: Ber. Deutsch. Bot. Ges. 72, tab. XIII, fig. d (1959); Fl. Iran. 139 b: tab. 346 (1980).

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 semiamplexicaul base; uppermost small, linear, acute, sessile, not decurrent. 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, somtimes 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 Khanaqin, Hadač, Haines & Walid al Hashim 2054 (E, K); between Mandali and Badra, Rech. f. 9681 (W, type, K, isotype); 35 km N.E. of Mandali, 250-270 m, Qaisi & Khayat 50805 (K); 28 km N. of Mandali, 260 m, Qaisi & Yaahya 45230 (K); 55 km S.E. of Mandali, c. 110 m, Rawi 20743 (K). - LEA: Jabal Hamrin nr. Shahraban (Muqdadiya), Haines 1397 (E, K).

Endemic (but likely to occur also in W. Iran).

20. *C. rigida* Banks & Sol., in Russell, Nat. Hist. Aleppo ed. 2, 2: 263 (1794). - Type: Syria: pr. Aleppo, P. Russell (BM).

C. russeliana Buek, Index ad DC., Prodr. 2: VI (1840), nom. illeg. (based on *C. rigida* Banks & Sol.).

C. myriocephala Sch. Bip. ex Boiss., Fl. Orient. 3: 682 (1875).

C. schizophylla Nábělek in Publ. Fac. Sci. Univ. Masaryk 52: 42 (1925).

C. myriocephala Sch. Bip. ex Boiss. var. *schizophylla* (Nábelek) Nábelek in Publ. Fac. Sci. Univ. Masaryk 105: 47 (1929).

C. rigida Banks et Sol. f. *schizophylla* (Nábělek) Blakelock in Kew Bull. 4: 48 (1949).

C. rigida Banks et Sol. var. *schizophylla* (Nábělek) Wagenitz in Fl. Iran. 139 b: 377 (1980).

C. myriocephala Sch. Bip. ex Boiss. var. *erythracantha* Bomm. in Repert. Spec. Nov. 24: 372 (1928).

C. rigida Banks et Sol. var. *erythracantha* (Bornm.) Blakelock in Kew Bull. 4: 48 (1949).

Icon.: Publ. Fac. Sci. Univ. Masaryk 52: tab. IX (1925). Fl. Palaest. 3, pl. 667 (1977).

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 pinnatipartite with 8-10 pairs of linear-lanceolate segments, segments irregularly dentate; median leaves pinnatipartite 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

Centaurea rigida is rather variable especially concerning the length of the spines and the form of the basal leaves. According to HANDEL-MAZZETTI (Ann. Naturh. Mus. Wien 25: 65. 1914), *C. rigida* can behave as a tumbleweed.

21. *C. koeieana* Bornm. ex Koeie, Beitr. Fl. Südwest Irans 1: 31 (1945). - Type: Iran: Luristan, Khorramabad, 50 km östl. beim Dorfe Bicheh, 1200 m, 21. V. 1937, Koeie 652 (B).

Icon: Fl. Iran. 139 b: tab. 348 (1980).

Perennial herb with woody basal parts, c. 25-50cm high, base of stem with fibrous remnants of petioles. Stems erect, sparsely arachnoid, 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, pinnatipartite, 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.: Ocasional 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); Zalem Mt., 1300 m, Rawi, Hosham & Nuri 29393 (K); 12 km E. of Chemchemal, Rawi & Gillett 11618 (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.).

22. *C. solstitialis* L., Sp. Pl. ed. 1: 917 (1753). - Type: ?

Calcitrapa solstitialis (L.) Lam., Fl. Franç. 2: 34 (1778).

Cyanus solstitialis (L.) J. et C. Presl, Fl. Cechica: 179 (1819).

Triplocentron solstitialis (L.) Fourr., Ann. Soc. Linn. Lyon N.S. 17: 97 (1869).

Leucantha solstitialis (L.) Löve et Löve, Bot. Notis. 114: 44 (1961).

Centaurea adami Willd., Sp. Pl. ed. 4, 3: 2310 (1803).

Centaurea solstitialis L. var. *adami* (Willd.) Heuff. in Verh. Zool.-Bot. Ges. Wien 8: 144 (1858).

Centaurea solstitialis L. subsp. *adami* (Willd.) Nyman in Consp. Fl. Eur.: 430 (1879).

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 pinnatipartite, 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. Involucre oblong-ovoid, 13-16 mm long and 8-12 mm broad. Phyllaries in several series, arachnoid-tomentose. Appendage in the outer phyllaries 3-5 short spinules of nearly equal length, in the median a straw-coloured 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 ["Sursink"], 920 m, Eig & Feinbrun s.n. (HUJ). - FNI: Gerwona, nr. Ain Sifni, Field & Lazar 723 (F). - MSU: Tasluja, Hadač 1946 (PR).

W., S. & S.E. Europe, Syria, Lebanon, Turkey, Iran, S. Russia, Caucasia, 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.

23. *C. sinaica* DC., Prodr. 6: 592 (1838). - Type: Egypt, Sinai, 1837, Aucher 3139 (holotype: G-DC, isotypes: G, K)

C. arabica Velen., Sitz.-Ber. Böhm. Ges. Wiss., Math.-Nat. Kl.1911, XI: ?(1912). - Arabia media: distr. el-Marsad, 1910 (?), Musil (PRC).

C. pseudosinaica Mouterde, Saussurea 3: 19 (1973), nom. illeg. (non *C. pseudosinaica* Czerep. 1960).

Icon: Fl. Palaest. 3, pl. 670 (1977).

Annual. Primary stem usually very short, branching as in *C. pseudosinai* 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, pinnatilobed 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 spinules 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 hilum 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. Saudiya).

24. *C. pseudosinaica* Czerepanov in Notul. Syst. Herb. Inst. Bot. Acad. Sci. U.R.S.S. 20: 392 (1960). - Type: Iran: Irania austro-orientalis, Bempur, Gadd 182 (holotype: LE).

Icon: Fl. Iran. 139 b: 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 spinules 3-5 mm long. Flowers yellow, the marginal inconspicuous, shorter than the central ones. Achene 3-3.5 mm long with a lateral hilum 1/3-1/4 of the length of the achene. Pappus 3-4 mm long, scabrous, inner row short.

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. - Arabia (Kuwait, Saudiya, Dubai, Qatar, Muscat, N. Yemen), S. Iran.

Only subsp. *pseudosinaica*, 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 Deïr-Palmyra, 1. V. 1894, Th. Strauss (holotype?, JE).

C. musilii Velen., Sitz.-Ber. Böhm. Ges. Wiss., Math.-Nat. Kl.1911, XI: 9 (1912).

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 pinnatilobed: 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. microcnicus*) 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).

26. *C. microcnicus* Reese et Samuelsson in Rech. f., Ark. Bot. Ser. 2, 1(5): 459 (1959). - Type: Syria: Desertum syriacum (palmyrense); c. 20 km ad sept. pagi Karyatein [El Qaryatein], in lapidosis, 10. V. 1933, Reese s.n. (S).

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 pinnatipartite; median and upper leaves sessile, sometimes slightly auriculate, lanceolate and dentate (or the median pinnatilobed). 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. Achene 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). DIJ: 10 km S. of Manaif, 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 Hauran, Chakravarty, Rawi, Khatib & Alizzi 31628 (K).

Syria.

Sect. *Corethropsis* DC.

27. *C. delbesiana* Arènes in Notul. Syst. (Paris) 14: 187 (1951). - Type: Syria: Syrie du Nord, Halabié (Haute Djezireh), Delbès (holotype: P, n.v.).

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 pinnatipartite with two pairs of linear-lanceolate segments;

median cauline leaves sessile, narrowly lanceolate, entire or with few teeth; upper leaves very small, linear. Involucre 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 spinules 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, Qaisi & K. Hamad 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. Arènes 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 cheiracantha* and *Jurinea staehelina* 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. delbesiana* can best be allocated to the section *Corethropsis* DC. including *C. scoparia* Sieb. ex Spr. and *C. schimperi* DC.

Sect. *Calcitrapa* DC.

28. *C. iberica* Trev. ex Spreng., Syst. Veg. ed. 16, 3: 406 (1826). - Type: "Armenia, Caucas." (P ?, n.v.).

Calcitrapa iberica (Spreng.) Schur, Enum. Pl. Transs.: 409 (1866).

Centaurea pallescens Delile var. *iberica* (Spreng.) Gugl. et Thell. in Cent. Ungar. Nationalmus.: 209 (1907) = Ann. Hist.-Nat. Mus. Hung. 6: 209 (1908).

Leucantha iberica (Spreng.) Löve et Löve in Bot. Notis. 114: 44 (1961).

C. iberica Spreng. var. *brevispina* Freyn et Sint. in Österr. Bot. Z. 44: 259 (1894). - Icon.: Fl.Reipubl. Pop. Roman. 9: tab. 163, fig. 3 (1964); Fl. Palaest. 3, pl. 673 (1977); Fl. Iran. 139 b: tab. 352 + 411, fig. 5 (1980); Fl. Armen. 9: 429 (1995).

Annual or biennial, 20-80 cm high, strongly and divaricately 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 hirsute; lower leaves petiolate, pinnatifid, pinnatipartite or lyrate with up to 6 pairs of lanceolate, denticulate (or rarely pinnatilobed) segments; stem-leaves sessile, with fewer segments but in other respects similar; upper leaves pinnatipartite with 1-2 pairs of segments or undivided, denticulate. Involuvre ovoid, 13-18 mm long and 9-12(-15) mm broad. Phyllaries in several series, glabrous, coriaceous, the outer and median with a narrow whitish hyaline margin and ending in a spine. Spine in the median 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. hyalolepis* Boiss., Diagn. Ser. I, 6: 133 (1845). - Syntypes: Syria, Aucher 3136 (G-DC); Iraq/Syria: de Bagdad a Alep, 1822, Olivier (G-DC), Alep et Mossoul, Kotschy (n.v.).

C. pallescens Delile var. *hyalolepis* (Boiss.)Boiss., Fl.Orient. 3: 69 (1875).

C. pallescens Delile f. *hyalolepis* (Boiss.) Gugler, Cent. Ungar. Nationalmus.: 208 (1907) = Ann. Hist. Nat. Mus. Hung 6: 209 (1908).

Calcitrapa hyalolepis (Boiss.) Holub in Preslia 46: 227 (1974).

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, pinnatisect 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 semiamplexicaul 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. 50-450 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, FPF, DLJ, LCA, LEA, LSM. -Cyprus, Palestine, Jordan, Lebanon, Syria, Turkey, S. Iran.

30. *C. postii* Boiss., Fl. Orient. 3: 688 (1875). - Type: Libanon: in Libano orientali prope El Hurmul, 22. VI. 1866, Post 324 (holotype: G-BOISS).

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 pinnatipartite with 4-6 pairs of linear segments ending in a short firm mucro, 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. postii* with non-decurrent leaves and achenes without pappus is certainly better at home in sect. *Calcitrapa*, but the perennial habit is unusual here too.

Sect. *Tetramophaea* (DC.) Boiss. (*Tetramorphaea* DC.).

31. *C. bruguieriana* (DC.) Hand.-Mazz. in Ann. Naturh. Mus. Wien 27: 451 (1913).

Basionym: *Tetramorphaea bruguieriana* DC., Prodr. 6: 609 (1838). - Type: Iraq: de Bagdad a Mossul, Olivier (G-DC).

Centaurea phyllocephala Boiss., Diagn. ser. I. 6: 134 (1845); Fl. Orient. 3: 684 (1875), nom. illeg.

Annual, c. 10-50 cm high, in larger plants profusely branched from near the base with divaricate 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-pinnatilobed 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 spine 15-20 mm long; inner with small scarious appendages. Flowers pale purplish, the marginal slightly radiant. Achene 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*

C. brugieriana (DC.) Hand.-Mazz. var. *spinosissima* Bornm. in Beih. Bot. Centralbl. 60 B: 214 (1939).

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: Qaiyarah, Mosul, Bayliss 138 (K)]. It is not impossible that this is due to a hybridization with the yellow-flowered *C. hyalolepis*. Further observations are necessary.

Subsp. *belangeriana* (DC.) Bornm. in Beih. Bot. Centralbl. 60 B: 214 (1939).

Basionym: *Tetramophaea belangeriana* DC., Prodr. 6: 609 (1838). - Type: Iran: "Perse", Belanger 535 (holotype: G-DC).

Centaurea belangeriana (DC.) Heimerl in Denkschr. Akad. Wiss. Wien, Math.-Nat. Kl. 50: 66 (1995).

C. phyllocephala Boiss. var. *persica* Boiss., Diagn. Ser. I, 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 Salahuddin, Haines s.n. (E); DSD: 60 km S.W. by S. of Zubair, Guest & Rawi 14312 (K).

Iran, Transcaucasia, Afghanistan, Pakistan, C. Asia.

Sect. *Acrocentron* (Cass.) DC. (Colymbada Hill).

32. *C. urvillei* DC., Prodr. 6: 592 (1838).

Colymbada urvillei (DC.) Holub in Preslia 45: 144 (1973).

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 dictinctly 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. Involucre 20-40 mm long, 15-40 mmm broad, ovoid to globose. Phyllaries in several series. Appendages +/- concealing the basal part of the phyllaries, very variable in the form and colour ofthe 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).

Basionym: *C. deinacantha* Boiss. et Hausskn. in Boiss., Fl. Orient. 3: 665 (1875).

Type: Iraq: In fissuris rupium aren. Pir Omar Gudrun, 3000-4000', VI. 1867, Haussknecht 584 (lectotype: G-BOISS, isotypes: BM, JE, K).

? *C. urvillei* DC. var. *longicaulis* Parsa in Kew Bull. 1948: 201 (1948).

Icon: Fl. Iran. 139 b: tab. 356 (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 petiolate, lyrate with 2-4 pairs of lanceolate or oblong lateral segments (often additional small segments between the larger ones). Involucre 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.

Hab. (of subsp.): In the mountains, often in clefts 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); Kani Mazi Shirin, Agnew, Hadač & Haines s.n. (E); Rowanduz, Agnew, Hadač & Haines 5776 (PR); Rowanduz, "Naprdan", Hadač & Kader 5320 (PR); between Rowanduz and Bersorini, Bornm. 1487 (B), Rech. f. 11264 (W); Kewa Rash, Rawi & Serhang 23786 (K). - MSU: Pira Magrun ("Pir Omar Gudrun"), Haussk.n.584 and s.n. (G-BOISS, lectotypes, BM, JE, K, isotypes); Haines s.n. (E). Iran.

33. *C. elegantissima* Bornm. in Repert. Spec. Nov. 24: 369 (1928). - Type: Kurdistan: Riwandous (ad fines Pers.) in monte Sakri-Sakran, 1500 m, 23. VI. 1893, Bornmüller, Iter Pers.-Turc. 1489 (holotype: B).

Colymbada elegantissima (Bornm.) Holub in Folia Geobot. Phytotax. 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 lyrate; upper leaves pinnatilobed 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, coriaceous, 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, cucullate, regularly ciliate. Flowers rose-purple (according to the collectors). Mature achenes unknown. Pappus 7-9 mm long, inner row 2.5 mm long.

Hab.: On stony and rocky mountain slopes; alt. 900-1650 m; fl. & fr. May-Jun.

Distrib.: Only found in the central sector of the mountain region, mostly near the Persian border. MRO: Sakri Sakran, nr. Rowanduz, 1500 m, Bornm. 1489

(B, holotype); Razanuk, Cuckney (in Guest) 3838 (K); Saran, nr. Kani Kawan spring, Karokh, Nuri & Alkas 21316 (K); between Saran and Kilkil, Alkas, Nuri & Serhang 27328 (K); Berd Agha Gin, 18 km N.W. of Rania,1115 m, Rawi, Nuri & Alkas 28718 (K); Warta, 30 km N.W. by N. of Rania, Rawi, Nuri & Alkas 28868 (K); nr. Dargala, c. 35 km N.W. by N. of Rania, 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.

34. *C. ochrocephala* Wagenitz in Fl. Iran. 139 b: 389 (1980). - Type: Iran, Azerbaijan orientalis: Chalil Kuh, in faucibus N.W. Selwana, 1750-2000 m, in rupium fissuris, 4. VII. 1974, Rechinger 48965 (holotype: W, isotypes: C, GOET)
Icon: Fl. Iran. 139 b: tab. 357 (1980).

Perennial. Stem 30-65 cm high, sparsely hirsute in the lower part, nearyl 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, petiolate, pinnatisect or lyrate, with 3-4 pairs of entire or denticulate, lanceolate or oblong lateral segments; median leaves lyrate, sessile with ar 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.

Distrib.:Very rare. MAM: nr. Sharanish, Rech. f. 10935 (W). - MSU: Zalim, Rawi, Husham & Nuri 29379 (K, differing from the type by the brownish appendages). Iran.

35. *C. longipedunculata* Sch. Bip. ex Boiss., Fl. Orient. 3: 668 (1875). - Type: Iraq: In proclivibus orientem versus sitis pr. pagum Gara Kurdist., 5. VIII. 1841, Kotschy, Pl. Alepp. Kurd. Moss. 374 (isotypes: GOET, H, K, KIEL).

Colymbada longipedunculata (Boiss.)Holub, Folia Geobot. Phytotax. 7: 316 (1972).

Icon: Fl. Iran. 139 b: tab. 362 (1980).

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 pinnatisect, 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.

Distrib.: Rare in Iraq - only found in two localities in the N.W. corner of the forest zone not far from the Turkish frontier.MAM: Daimka, 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 (Sissanh), between Dohuk and Amadiya, Rech. f. 11663 (GOET, W).

Endemic.

Closely allied to *C. persica* and mainly differing by the very short terminal spine.

36. *C. persica* Boiss., Diagn. ser. I. 6: 132 (1845). - Type: Iran: in faucibus alpis Kuh-Daëna (Kuh-e Dinar) Persiae australis, 16. VII. 1842, Kotschy 664 (lectotype: G-BOISS, isotypes: BM, GOET, W).

Colymbada persica (Boiss.) Holub in Folia Geobot. Phytotax. 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 (scabrid on margin and sometimes with sparse long hairs especially on the nerves of the lower surface); basal and lower leaves petiolate, lyrate, terminal segment rhombic 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 (scarcely 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, ciliate, cilia (3-)4-5(-6) mm long; appendages of inner phyllaries nearly orbicular, without a spine, ciliate 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 Karokh, Kass & Nuri 27562 (K).

Var. *multijuga* Bornm. In Beih. Bot. Centralbl. 60 B: 211 (1939). - Type: Iraq: Kurdistan (Assyrien): Riwandus, am Berge Händarin, 1300 m, 28. VIII. 1893, Bornm. (B).

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., Iter Pers.-Turc. 1486 (JE, K), 1492 (B, type); above Nawanda, Rech. f. 11392 (W); Qandil range, above Pushtashan, Rech. f. 11812 (W).

An endemic variety.

37. *C. hadacii* Wagenitz in Kew Bull. 40: 793 (1985).

Type: Iraq: Distr. Rowanduz, in declivibus calcareis supra vicum Zeita, 19. VI. 1961, Agnev, Hadač & Haines 5945 (holo- and isotype: PR).

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; median leaves lyrate-pinnatilobed, sessile; the upper much smaller, lanceolate, with 1-2 lobes on each side at the base. Involucre 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 14-16cilia 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.

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. MRO: above the village of Zeita in the Rowanduz district, Agnew, Hadač & Haines 5945 (PR, type); above Ari 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 large appendages which completely cover the basal part of the phyllaries.

38. *C. luristanica* Rech. f. in Anz. Math.-Nat. Kl. Oesterr. Akad. Wiss. 88: 265 (1961).- Type: Iran, Prov. Luristan; Paris Mt. [M. Pariz], on rock face, 7000 ft. [c. 2100 m], 28. V. 1940, Koelz (holotype: W).

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 lyrate, 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 obovate; 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 Khurmal (on the same range of mountains), Hadač 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.

39. *C. davisii* Wagenitz in Willdenowia 6: 497 (1972). - Type: Turkey, Vilayet Mardin: Hessana at S. foot of Cudi Da., 900 m, limestone cliffs at foot of gorge, M. Karakol, Davis 42779 (holotype: E, isotype: GOET).

Colymbada davisii (Wagenitz) Holub in Preslia 45: 144 (1973).

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 pinnatilobate segments and several smaller leaflets; median and upper leaves gradually smaller, sessile, pinnatisect or pinnatifid with fewer 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. Achene 5-5.5 mm long. Pappus 8-10 mm, inner row short, elements scale-like.

Hab.: Among rocks with a slaty substratum; alt. 1500 m; fl. & fr. July.

Distrib.: 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.

40. *C. irritans* Wagenitz in Fl. Iran. 139 b: 390 (1980). - Type: Iran: Prov. Kermanschah: Bisitun, 34° 23' N, 47° 25' E, rocky slopes of limestone, 3. VI. 1963, Jacobs 6760 (holotype: W, isotype: E).

Icon: Fl. Iran. 139 b: tab. 358 (1980).

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, interruptedly pinnatipartite with distant, lanceolate, dentate segments of unequal size; median leaves similar but sessile or sublyrate; 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, cucullate, 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.

Distrib.: Rare in the mountain region of Iraq, and only found on or near one mountain. MSU: Amoret, nr. Qaradagh, Haines 1155 (E, K); Qara Dagh, Poore 436 (K), Hadač 5235 (PR). Iran.

***Cyanus* Mill.**

***Centaurea* 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 glabrescent, entire or pinnatilobed to pinnatifid, 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 spinule 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.

1. *Cyanus triumfettii* (All.) Löve & D. Löve in Bot. Not. 114: 44 (1961).

Centaurea triumfettii All., Auct. Syn. Hort. Taur.: 16 (1773) & Fl. Pedem. 1: 158 (1785). - Type: ?

Centaurea variegata Lam., Encycl. 1: 668 (1785), nom. illeg.

Centaurea axillaris Willd., Sp. Pl. ed. 4, 3(3): 2290 (1803), 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, ciliate, 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.

Distrib.: On the mountains. MJS, MAM, MRO, MSU.- C. & S. Europe, Crimea, (mountains of) N. Africa, Lebanon, Turkey, N. & W. Iran, Caucasia.

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.

2. *Cyanus depressus* (M. Bieb.) Soják in Čas. Nár. Muz., Odd. Přír. 140: 131 (1972)

Syn.: *Centaurea depressa* M. Bieb., Fl. Taur.-Cauc. 2: 346 (1808). Type: Republic of Georgia: in collibus siccis Iberiae, circa Tiflis [Tbilisi], Steven (LE, n.v.).

Centaurea anatolica Griseb., Spic. Fl. Rumel. 2: 234 (1844)

C. depressa M. Bieb. var. *amasiana* 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-tinged), 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. & fr. 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 Hamrin) 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: ?
Icon: Fl. Reipubl. Pop. Roman. 9: tab. 164, fig. 2 (1964).

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, Hadač & 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.

***Stizolophus* Cass.**
Syn.: *Centaurea* sect. *Stizolophus* (Cass.) DC., *Centaurea* sect. *Balsamitophyllum* Boiss.

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 spinule. Flowers yellow, the marginal scarcely radiant, with staminodes. Achenes medium-sized. Pappus scabrous, the inner row short.

1. *S. balsamita* (Lam.) K. Koch in Linnaea 24: 423. 1851.
Syn.: *Centaurea balsamita* Lam., Encycl. 1: 667 (1785). - Type: cult. hort. Paris, (P-LAM, n.v., vidi photo).

Stizolophus balsamitaefolium Cass., Cuvier, Dict. Sci. Nat. 51: 50 (1827); nom. illegit., based on *C. balsamita* Lam.

Icon.: Fl. Iran. 139 b: tab. 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 mucro 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, 2-3.5 mm long and broad excluding the cilia, scarcely decurrent, with 7-12 cilia 2-3 mm long on each side, gradually narrowed into a spinule 2-4 mm long. Innermost phyllaries narrowed into a s 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. *balsamita***.

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 spinule 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, Buthaina Makki 497 (W). - FKI: Nineveh plantation, N. of Mosul, Anders 1581 (W).

Distrib. (of species): Syria, Turkey, Iran, Afghanistan, Transcaucasia, C. Asia (Turkmenia to Tian Shan). This subspecies throughout the range of the species. A second subspecies occurs in eastern Iran.

2. *S. balsamitoides* (Post) Soják in Novit. Bot. Delect. Seminum Hort. Bot. Univ. Carol. Prag. 1962: 48. 1962

Syn.: *Centaurea balsamitoides* Post, Pl. Post. 2: 15 (1891). - Type: Syria: in agris inter Palmyram et Marbat-'Antar in deserto syriaco, 28. VII. 1890, G. E. Post 70 (G, BM; s.n.).

C. stramenticia Hand.-Mazz. in Ann. Naturh. Mus. Wien 27: 448 (1913).

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 ?); median 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. Involucre 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 mucro 2-3.5 mm long. Flowers sulphur-yellow, the marginal not radiant, with staminodes. Achene 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 Lake Khatanya (in Syria) and Jabal Sinjar, Hand.-Mazz. 1590 (W).-FKI/FPF: between Tikrit and Mandali, Sutherland s.n. (K). - FPF: Jabal Hamrin, nr. Muqdadya (Shahraban), Haines 1396 (E, K); Jabal Hamrin on the Khanaqin road, Agnew 1301 (K), Hadač 1709 (PR); Jabal Hamrin, Sutherland 51 (BM, K s.n.); Qaraitu, nr. Khanaqin, Rawi 5697; Kani Mari, nr. Khanaqin, Hadač, Haines & Walûd al Hashimi 4648 (PR). DLJ: Umm at matin, 74 km N.W. of Baiji-Haditha road, Chakravarty, Rawi, Khatib in Alizzi 32040 (K).

Syria

S. balsamitoides is closely allied to *S. coronopifolius* (Lam.) Cass. from Turkey and Transcaucasia, in which it was included later by POST himself. The

capitula are however smaller in *C. balsamitoides*, 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.

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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 v. Martius in Munich together with Stephan Endlicher in Vienna and completed in 1906 by Ignatz Urban in Berlin. The latter was started by Vladimir Leontjevic Komarov in 1934 and completed by Evgenij Grigorievicz Bobrov and Nikolai Nikolaievich Tsvelev 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

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* 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" (HEDGE 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 "Repertorium Specierum Novarum Regni Vegetabilis" appearing in Vienna and Berlin respectively.

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

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 fürstlichen 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 form the publisher (RECHINGER 1969, English translation in RECHINGER 1989).

Araceae (fascicle 1), Convolvulaceae (fascicle 2) and Ephedraceae (fascicle 3) have been treated first; keys, synonymies, specimens studied, distribution data, miscellaneous notes and line drawings were provided, but no descriptions. Rechinger dealt with Convolvulaceae, 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.

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Appendix

Stellungsbau Schandorf, 6. Nov. [19] 44 Kreis Oberwart, Steiermark

Lieber Freund Bornmüller!

Ihren so überaus anerkennenden und freundschaftlichen Brief erhielt ich, als ich eben im Begriff stand, Wien auf einige Wochen zu verlassen. Nach dem Prinzip "der richtige Mann am richtigen Ort" wurde auch ich zum Schanzgraben abkommandiert, vielleicht in der Annahme, dass das Ausgraben von Pflanzen hiezu eine besondere Eignung bilde. Die Lebensumstände, zu denen man hier verdammt ist, sind so primitiv, wie sie selbst einem Orientreisenden nur in seltenen Ausnahmefällen unterkommen können. Die einzige Abwechslung bilden die feindlichen Bomberflugzeuge, die tagtäglich über unsere Köpfe hinweg nach Wien, Graz etc. fliegen.- Eine ungemein trostlose Zeit.

Für den Fall, dass man sie überleben sollte, nehme ich Ihr Anerbieten bezügl. der Korrekturfahnen möglich aller Ihrer Persien betreffenden Arbeiten mit freudiger Dankbarkeit an und bitte, die Sendung eingeschrieben an das Museum zu richten. Es ist und bleibt eine meiner Lieblingsideen, später einmal eine Flora von Persien zu schreiben und die Vorarbeiten hiezu würden durch Ihr Anbieten ungemein erleichtert.

Bis zu meiner Abreise am 2. Nov. hat weder unser Museum, noch unsere auswärts geborgenen Herbarien und Bücher noch das Bot. Inst. der Univ. Wien Schaden gelitten. Getroffen wurde hingegen das Bankgebäude, in dessen Tresors unsere Bücher liegen, ohne dass die Bombe durchgeschlagen hätte und ganz ausgebrannt ist die Druckerei Gistel mitsamt dem letzten Band unserer Annalen [i.e. Annalen des Naturhistorischen Museum Wien 54 (2)] samt Satz und Manuskripten. Dies ist wohl ein Schlag für uns, aber nicht der Schlimmste. Persönlich bin nicht betroffen, da ich von meiner Arbeit (4. teil der pers. Ausbeute) [i.e. Ergebnisse einer botanischen Sammelreise nach dem Iran, IV. Teil, erneut veröffentlicht

in Annalen des Naturhistorischen Museums Wien 55: 265 - 295 (1946)] mir im Voraus Böses ahnend Separate machen ließ. - Was die letzten Tage gebracht haben, weiß ich allerdings nicht.

Entschuldigen Sie das Geschmiere, ich sitze auf einem Stuhlhaufen bei schlechtem Licht neben einem rauchenden Ofen und habe vor Frost und ungewohnter Arbeit steife Finger.
Herzlichst Ihr K.H. Rechinger

Entrenching Schandorf, 6 Nov. 1944, Kreis Oberwart, Styria
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 entrench, 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 alternation being the enemy bombers which fly above our heads every day to Vienna, Graz, etc.

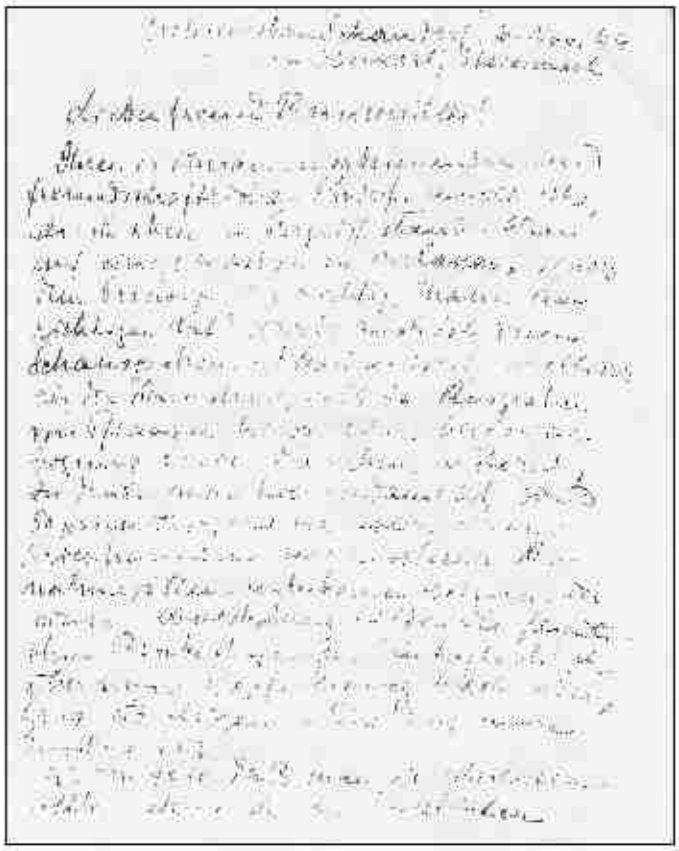
In case that I should survive, I accept with heartfelt gratitude your offer concerning the proofs of all your papers referring to Persia and ask you to send them with registered mail to the museum [i.e. the Natural History Museum in Vienna]. It is and remains one of my favourite ideas to write a Flora 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. Mus. Wien 55: 265-295 (1946)]. However, what has happened during the last days I do not know.

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



Letter by K.H. Rechinger to J. Bornmüller, Nov. 1944, pencil on paper, photocopy. - Archiv, Herbarium Haussknecht, University of Jena.

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