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Critical taxonomic analysis of *Dichoropetalum, Johrenia, Zeravschania* and related genera of *Umbelliferae-Apioideae-Peucedaneae*

Abstract

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During critical investigation of the *Umbelliferae* in the Near East, N Africa and Europe some additional species were found to be putative relatives of *Johrenia* and the *Peucedanum* segregate *Johreniopsis.* A comparative multivariate analysis of 41 species, based on 32 morphological diagnostic characters, revealed a revised taxonomic grouping of the species. The forgotten generic name *Dichoropetalum,* typified by *D. alpinum,* is restored to accommodate a group of 26 SW Asian and Mediterranean species, including species of the former genera *Johreniopsis* and *Holandrea* (now regarded as sections), as well as some *Peucedanum* and *Johrenia* species. We recognize six sections in *Dichoropetalum,* of which three are described as new. Two species of *Johreniopsis,* poorly known before, are transferred to *Zeravschania*. *Johrenia*, on the contrary, is regarded as a genus with five species only. *Johrenia westii,* which requires further investigation, belongs most probably to the genus *Ferulago*. 28 new nomenclatural combinations are validated and lectotypes are designated for several names.

Key words: *Apiaceae, Holandrea, Johreniopsis, Peucedanum,* Mediterranean region, SW Asia, taxonomy, morphology, carpology, multivariate analysis.

Introduction

The critical revision of *Peucedanum* L. s. ampl. and related genera (tribe *Peucedaneae*) remains one of the most complicated taxonomic problems in the subfamily *Apioideae* of the family *Umbelliferae*. Despite many new data on *Peucedaneae* accumulated during the last decades, both morphological and molecular, the delimitation of the genera and other supraspecific taxa is yet urgently to be revised. The current inappropriate supraspecific classification of the *Peucedaneae* is partly the result of gradual (clinal) character variation (like in the *Ligusticum* alliance), partly of the incomplete knowledge of its members, some of which are very rare and therefore poorly investigated.

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The revision of the entire *Peucedaneae* is a project of the more distant future since it calls for a complete comparative study of the numerous species spread across Europe, Asia, Africa and even Oceania. However, we believe that there is an alternative way, and that *Peucedanum* s. ampl. can be divided into natural groups by successive splitting of the most divergent taxa.

In the present contribution the traditional *Peucedanum* sect. *Palimbioidea* Boiss. is critically revised in comparison with, on the one hand, putatively related taxa mainly from the Near East, and, on the other hand, *Peucedanum* s.str. (i.e. *P.* sect. *Peucedanum*). Among the former are the genera *Holandrea* Reduron & al. and *Johreniopsis* Pimenov, described on the basis of species earlier included in this section.

Research history

Some *Peucedanum* segregates were separated by the first author in "Flora Iranica" (Pimenov 1987). One of them is *Johreniopsis,* the species of which were formerly placed in *P.* sect. *Palimbioidea*. The name *Johreniopsis* was chosen due to habitual similarity with *Johrenia.* During our further investigation of the *Umbelliferae* from Iran, Turkey and adjacent countries of the Near East, the close affinity of some Turkish species to *Johreniopsis* became more and more evident. Later, the new genus *Holandrea* (Reduron & al. 1997) was segregated with three European and Caucasian species also formerly included in *P.* sect. *Palimbioidea*. The earlier generic names *Chabraea* Raf. and *Schlosseria* Vuk., used for some species of *Holandrea,* were shown to be illegitimate. Carpological descriptions of two European *Holandrea* species (under their traditional names in *Peucedanum*) were given by Kowal & Wojterska (1973). When describing recently a new species from Anatolia, *P. isauricum,* Parolly & Nordt (2004) made a comparative analysis of related Turkish species, also including some fruit characters. Fruits of other closely related species, however, were described rather scantily.

Evidently there are some major differences between the two species groups traditionally treated as *Peucedanum* sect. *Peucedanum* and sect. *Palimbioidea,* in morphology, anatomy, chemical constituents, chromosome numbers and DNA sequences. In the published molecular cladograms the species of *Peucedanum* s.str. *(P. officinale, P. morisonii, P. coriaceum, P. gallicum)* form a clade separate from the *Holandrea* clade containing *H. carvifolia, H. pschavica, H. schottii* and *P. achaicum* (Downie & al. 2000, Spalik & al. 2004). According to Valiejo-Roman & al. (2006) *Johreniopsis scoparia* also belongs to the *Holandrea* clade, just as *Zeravschania* Korovin is rather distant, being more similar to *Demavendia* Pimenov and *Haussknechtia* Boiss., and the genus *Leutea* Pimenov, separated from *Peucedanum* (Pimenov 1987), is closer to *Ferula* L. than to *Peucedanum* s.str.

Chromosome numbers in many *Peucedaneae* are uniform, with prevalence of x = 11. All species of *Peucedanum* sect. *Palimbioidea, Johrenia, Zeravschania* and *Johreniopsis* studied up to now are diploid with $2n = 22$ (Pimenov & al. 2002). This number was found in *P.* sect. *Peucedanum* too, but in this section most species are hexaploids or tetraploids (*P. officinale, P. ruthenicum, P. morisonii, P. longifolium;* the last taxon, however, being variable in chromosome numbers).

Peucedanum sect. *Palimbioidea* and sect. *Peucedanum* differ also in their secondary metabolites. All species of *P.* sect. *Peucedanum* contain linear furocoumarins, their specific component is peucedanin (3-methoxy-2-isopropyl-7H-furobenzopyran-7-on). These compounds are not isolated from species of *P.* sect. *Palimbioidea* (Carbonnier & al. 1978, Hadaček 1989). On the contrary, in *P. carvifolia* and *P. schottii* polyacetylene compounds were found (Hadaček 1989) that are absent in the species of *P.* sect. *Peucedanum*.

Fruits of all *Peucedanum* s.l. species, as well as of some related taxa, are similar in their morphology, adopted for wind dispersal. They have more or less developed winged marginal ribs and subindivisible dorsal ribs. This similarity was a basis for a broad concept of *Peucedanum,* but we believe that this fruit morphological similarly is homoplasic, a view that is supported by some minor but essential differences in the inner mericarp structure (Kowal & Wojterska 1973).

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Among other morphological characters, the degree of development of the calyx teeth is diagnostic: they are present in *Peucedanum* s.str. and absent in all other taxa regarded.

Difference in leaf morphology is considerable. Leaf laminas in *Johrenia, Johreniopsis* and *Peucedanum* sect. *Palimbioidea* are pinnate, but in *Peucedanum* s.str. they are ternate-multisect with geniculate rhachis and segments, which are not situated in one plane. Basal leaf segments have long petiolules in *P.* sect. *Peucedanum,* but are sessile or subsessile in *P.* sect. *Palimbioidea*. Petioles are in cross section usually round with central vascular bundles in sect. *Peucedanum,* but are falcate with a groove on the adaxial side without central vascular bundles in sect. *Palimbioidea*. All these differences, minor and sometimes overlapping as they may be, indicate considerable divergence of the two groups, sufficient to exclude *P.* sect. *Palimbioidea* from *Peucedanum.*

The species included in *Peucedanum* sect. *Palimbioidea* have changed since its description by Boissier (1872). Originally the section included the "oriental" species *P. chabraei, P. pshawicum* (both currently placed in *Holandrea,* Reduron &. al. 1997), *P. alpinum* (currently placed in the restored genus *Ormosolenia,* Pimenov 1992) and *P. palimbioides,* whereas *P. chrysanthum, P. vittijugum, P. meyeri, P. depauperatum* and *P. scoparia* (plus *P. spreitzenhoferi,* Boissier 1888) were attributed to the yellow-flowered group of section *"Eupeucedana"* (= *P.* sect. *Peucedanum*). Thellung (1926) adopted *P.* sect. *Palimbioidea* within subg. *Peucedanum,* comprising the species *P. carvifolia* and *P. schottii,* Shishkin (1951) adopted it with the species *P. schottii, P. podolicum, P. pschawicum* and *P. palimbioides*. Frey (1989) followed mainly Thellung, whose classification he regarded as the most practical; in Frey's partial revision of *P.* sect. *Peucedanum* and *Palimbioidea* the latter includes eight species *(P. oligophyllum, P. aequiradium, P. carvifolia, P. schottii, P. graminifolium, P. paucifolium, P. stridii, P. lavrentiadis).*

Johrenia was described by Candolle (1829) based on *J. dichotoma* DC. Later *Dichoropetalum* Fenzl, based on *D. alpinum* Fenzl, was described (Fenzl 1842) but soon after sunk by its author into the synonymy of *Johrenia* (Fenzl 1843) and then forgotten. The basis for the modern *Johrenia* taxonomy was laid by Boissier (1844, 1872), who placed 10 species (one of them in question) in *Johrenia,* and divided them into two informal groups. The first ("vittae jugales exteriores intra marginem spongiosum occultatae") contains six species *(J. selinoides, J. dichotoma, J. fungosa, J. graeca, J. alpina* and *J. berytea).* The second group was again subdivided into two subgroups, each monotypic, with the species *J. candollei* and *J. platycarpa,* respectively. Drude (1897-98) maintained Boissier's classification of the genus, while erroneously adding the Siberian *Phlojodicarpus* Turcz. to it. Bornmüller (1930) compiled a synopsis of the *Johrenia* species and included descriptions of some new species, among which *J. polyscias* is adopted in today's floras. Tamamschjan (1951) demonstrated that Boissier's main groups differ in fruit anatomical features and recognized these groups in the rank of sections. She also showed that some species were mistaken for *Johrenia* and actually belong to *Ledebouriella* H. Wolff, the present *Saposhnikovia* Schischk. Currently, in *Johrenia* 36 validly published names or combinations are known (Mozaffarian 2003, IPNI 2006).

Material and methods

43 species of *Johrenia, Johreniopsis* and *Peucedanum* from SW Asia, the S European and N African Mediterranean and adjacent parts of Europe, as well as of the related genus *Zeravschania* were included in our comparative morphological study (Table 1). Besides the species previously included in *P.* sect. *Palimbioidea* (cf. Thellung 1926, Shishkin 1951, Frey 1988) we added to our set (1) the N African *P. munbyi* Boiss., which is similar in habit to *P. carvifolia* and was described (Boissier 1854) as closely related to *P. chabraei,* and (2) the Greek endemic *P. achaicum* Halacsy, implicitly regarded as a *P. carvifolia* relative (Tutin 1968). The names of species, initially adopted in the present study, are presented in the left column of Table 1, their essential synonyms, as used in literature, in the second column. The plant material, including types for most species, was studied in ANK, B, BEI, BM, E, G, JE, K, L, LE, LIV, MANCH, MW, P, TARI, W and WU (herbarium abbreviations according to Holmgren & Holmgren 1998-).

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Table 1. A priori and a posteriori accepted names of the *Umbelliferae* species included in the present study.

a priori accepted name	basionym and essential synonyms	a posteriori accepted name
1. ***Holandrea*** *carvifolia* (Vill.) Reduron & al.	*Peucedanum carvifolia* Vill.	*Dichoropetalum carvifolia* (Vill.) Pimenov & Kljuykov
2. *H. pschawica* (Rupr.) Reduron & al.	*Peucedanum pschawicum* Rupr.	*Dichoropetalum pschawicum* (Rupr.) Pimenov & Kljuykov
3. *H. schottii* (DC.) Reduron & al.	*Peucedanum schottii* DC., *P. petraeum* W. D. J. Koch	*Dichoropetalum schottii* (DC.) Pimenov & Kljuykov
4. ***Johrenia*** *alpina* (Fenzl) Fenzl	*Dichoropetalum alpinum* Fenzl	*Dichoropetalum alpinum* Fenzl
5. *J. aromatica* Rech.f.		*Dichoropetalum aromaticum* (Rech. f.) Pimenov & Kljuykov
6. *J. aurea* Boiss.		*Dichoropetalum aureum* (Boiss.) Pimenov & Kjuykov
7. *J. berytea* Boiss.		*Dichoropetalum depauperatum* (Boiss.) Pimenov & Kljuykov
8. *J. dichotoma* DC.	*Peucedanum haradjianii* Rech. f.	*Johrenia dichotoma* DC.
9. *J. distans* (Griseb.) Halacsy	*Caroselinum distans* Griseb., *Johrenia graeca* Boiss.	*Johrenia distans* (Griseb.) Halacsy
10. *J. golestanica* Rech. f.		*Dichoropetalum golestanicum* (Rech. f.) Pimenov & Kljuykov
11. *J. paucijuga* (DC.) Bornm.	*Ferula paucijuga* DC.	*Dichoropetalum paucijugum* (DC.) Pimenov & Kljuykov
12. *J. platycarpa* Boiss.		*Dichoropetalum platycarpum* (Boiss.) Pimenov & Kljuykov
13. *J. polyscias* Bornm.		*Johrenia polyscias* Bornm.
14. *J. porteri* Boiss.		?
15. *J. ramosissima* Mozaff.		*Dichoropetalum ramosissimum* (Mozaff.) Pimenov & Kljuykov
16. *J. selinoides* Boiss.		*Johrenia selinoides* Boiss.
17. *J. tortuosa* (Fisch. & C. A. Mey.) D. F. Chamb.	*Eriosynaphe tortuosa* Fisch. & C. A. Mey., *Johrenia fungosa* Boiss.	*Johrenia tortuosa* (Fisch. & C. A. Mey.) D. F. Chamb.
18. *J. westii* Post		*Ferulago westii* (Post) Pimenov & Kljuykov
19. ***Johreniopsis*** *oligactis* (Rech. f. & Riedl) Pimenov	*Peucedanum oligactis* Rech. f. & Riedl	*Zeravschania pauciradiata* (Boiss.) Pimenov
20. *J. scoparia* (Boiss.) Pimenov	*Johrenia scoparia* Boiss., *Peucedanum scoparium* (Boiss.) Boiss.	*Dichoropetalum scoparium* (Boiss.) Pimenov & Kljuykov
21. *J. seseloides* (C. A. Mey.) Pimenov	*Ferula seseloides* C. A. Mey., *Peucedanum paucifolium* Ledeb., *P. meyeri* (Boiss.) Boiss.	*Dichoropetalum seseloides* (C. A. Mey.) Pimenov & Kljuykov
22. *J. stricticaulis* (Rech. f.) Pimenov	*Peucedanum stricticaule* Rech. f.	*Zeravschania stricticaulis* (Rech. f.) Pimenov & Kljuykov
23. ***Peucedanum*** *achaicum* Halacsy		*Dichoropetalum achaicum* (Halacsy) Pimenov & Kljuykov
24. *P. alpigenum* Boiss.		*Dichoropetalum alpigenum* (Boiss.) Pimenov & Kljuykov

25. *P. chryseum* (Boiss.) D. F. Chamb.	*Anethum chryseum* Boiss., *Peucedanum chrysanthum* Boiss.	*Dichoropetalum chryseum* (Boiss.) Pimenov & Kljuykov
26. *P. depauperatum* Boiss.		*Dichoropetalum depauperatum* (Boiss.) Pimenov & Kljuykov
27. *P. graminifolium* Boiss.		*Dichoropetalum graminifolium* (Boiss.) Pimenov & Kljuykov
28. *P. isauricum* Parolly & Nordt		*Dichoropetalum isauricum* (Parolly & Nordt) Pimenov & Kljuykov
29. *P. junceum* (Boiss.) Mouterde	*Johrenia juncea* Boiss., *Peucedanum spreitzenhoferi* Dingler	*Dichoropetalum junceum* (Boiss.) Pimenov & Kljuykov
30. *P. knappii* Bornm.	*Peucedanum chenur* Mozaff.	*Zeravschania knappii* (Bornm.) Pimenov & Kljuykov
31. *P. lavrentiadis* Strid & Papan.		*Dichoropetalum lavrentiadis* (Strid & Papan.) Pimenov & Kljuykov
32. *P. minutifolium* (Janka) Velen.	*Peucedanum vittijugum* subsp. *minutifolium* (Janka) Kuzmanov & Andrejev	*Dichoropetalum minutifolium* (Janka) Pimenov & Kljuykov
33. *P. munbyi* Boiss.		*Dichoropetalum munbyi* (Boiss.) Pimenov & Kljuykov
34. *P. oligophyllum* (Griseb.) Vandas	*Seseli oligophyllum* Griseb.	*Dichoropetalum oligophyllum* (Griseb.) Pimenov & Kljuykov
35. *P. palimbioides* Boiss.	*Malabaila carvifolia* Boiss.	*Dichoropetalum palimbioides* (Boiss.) Pimenov & Kljuykov
36. *P. stridii* Hartvig		*Dichoropetalum stridii* (Hartvig) Pimenov & Kljuykov
37. *P. vittijugum* Boiss.		*Dichoropetalum vittijugum* (Boiss.) Pimenov & Kljuykov
38. ***Zeravschania*** *aucheri* (Boiss.) Pimenov	*Peucedanum aucheri* Boiss.	*Zeravschania aucheri* (Boiss.) Pimenov
39. *Z. ferulifolia* (Gilli) Pimenov	*Peucedanum ferulifolium* Gilli	*Zeravschania ferulifolia* (Gilli) Pimenov
40. *Z. membranacea* (Boiss.) Pimenov	*Peucedanum membranaceum* Boiss.	*Zeravschania membranacea* (Boiss.) Pimenov
41. *Z. pauciradiata* (Boiss.) Pimenov	*Peucedanum pauciradiatum* Boiss.	*Zeravschania pauciradiata* (Boiss.) Pimenov
42. *Z. regeliana* Korovin		*Zeravschania regeliana* Korovin
43. *Z. scabrifolia* Pimenov		*Zeravschania scabrifolia* Pimenov

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The phenetic analyses include cluster analysis (UPGMA) and principal components analysis (PCA) conducted by means of the NTSYSpc package for Windows (Rohlf 1994). The resulted rectangular data matrix is shown in Table 2. Some data are missing, mainly for a few species poorly represented in the available collections. For a principal components analysis (of characters and species) these missing character states were replaced by means for each character.

Characters. – The species were investigated in 33 selected morphological characters. The selection includes previously known diagnostic characters, additional carpological and other characters used in our previous revisions of complex taxonomic groups in the *Umbelliferae* (Kljuykov & al. 2004). Among the characters 11 are vegetative and 22 reproductive, including 12 fruit characters. The fruit structure of the species included in the present investigation is illustrated in Fig. 5-10.

The following characters and character states (with their coding) were recognized:

1. Life-form: monocarpics with unbranching rootstock = 0; polycarpics with branching rootstock = 1.
2. Stem base: densely covered by remains of leaf petioles = 0; without remains of leaf petioles = 1.
3. Stem height (in cm): 7-40 = 0; 41-100 = 0.5; more than 100 = 1.
4. Stem ribs: stems rounded, without prominent ribs, or finely striate = 0; with slightly developed ribs = 0.5; with well developed ribs = 1.
5. Stem indumentum: none, glabrous = 0; pubescent = 1.
6. Leaf shape (in outline): leaves linear to lanceolate = 0; ovate to triangular = 1.
7. Leaf sheaths: long, linear = 0; short, linear = 0.5; short, triangular = 1.
8. Basal primary segments (attachment): sessile = 0; with short petiolules (up to 5 mm) = 0.5; with long petiolules (more than 5 mm) = 1.
9. Terminal leaf lobes: filiform = 0; linear = 0.25; lanceolate = 0.5; ovate, toothed at the margin = 1.
10. Terminal leaf lobes: numerous, densely clustered = 0; not clustered = 1.
11. Upper cauline leaves: long = 0; short = 1.
12. Bracts: present = 0; absent = 1.
13. Min. number of rays per umbel: less than 5 = 0; more than 5 = 1.
14. Max. number of rays per umbel: less than 10 = 0; more than 10 = 1.
15. Umbel rays: very unequal = 0; slightly unequal = 0.5; almost equal = 1.
16. Bractlets (texture): completely herbaceous = 0; with narrow white margins = 1.
17. Bractlets (form in outline): subulate to linear = 0; linear-lanceolate = 0.5; lanceolate to broadly lanceolate = 1.
18. Bractlets (relative to umbellules): longer than umbellule = 0; shorter than umbellule = 1.
19. Calyx teeth: well developed = 0; very short = 0.5; absent = 1.
20. Petals (colour): white = 0; whitish or yellowish = 0.5; yellow = 1.
21. Stylopodia: flat = 0; short-conical = 0.5; conical = 1.
22. Mericarps (in cross section): dorsally convex = 0; dorsally compressed = 1.
23. Dorsal mericarp ribs: indistinguishable (submerged into spongy pericarp tissue) = 0; filiform = 0.5; keeled or slightly inflated = 0.75; strongly spongily inflated = 1.
24. Marginal mericarp ribs: not developed = 0; shortly winged, swollen/inflated = 0.5; shortly winged, triangular = 0.75; winged, thin = 1.
25. Mericarps (on commissural side): with destroyed parenchyma near carpophore = 0; commissural parenchyma not destroyed = 1.
26. Parenchyma cells with lignified pitted walls on dorsal mericarp side: developed = 0; absent or sometimes only under vascular bundles = 1.
27. Marginal ribs inflated, composed of large mesocarp cells with lignified pitted walls: yes = 0; no = 1.
28. Hypendocarp (inner lignified layer of mesocarp): absent = 0; feebly marked (fragmentary) = 0.5; strongly expressed, consisting of prosenchyma lignified cells = 1.

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Table 2. Data matrix for the 33 selected morphological characters of the 43 investigated species. For details see text.

	1.Hol.carvifolia	2.Hol.pshawica	3.Hol.schottii	4.Ja.alpina	5.Ja.aromatica	6.Ja.aurea	7.Ja.berytea	8.Ja.dichotoma	9.Ja.distans	10.Ja.golestanica	11.Ja.paucijuga	12.Ja.platycarpa	13.Ja.polyscias	15.Ja.ramosissima	16.Ja.selinoides	17Ja.tortuosa	18.Ja.westii	19.Js.oligactis	20.Js.scoparia	21.Js.seseloides	22.Js.stricticaulis	23. Peu. achaicum	25.Peu.chrysoeum	26.Peu.depauperatum	27.Peu.graminifolium	28.Peu.isauricum	29.Peu.juncoeum	30.Peu.knappii	31. Peu. lavrentiadis	32.Peu.minutifolium	33. Peu. munbyi	34.Peu.oligophyllum	35.Peu.palmbioides	36. Peu. stridii	37.Peu.vittijugum	38.Zer. aucheri	39.Zer. ferulifolia	40.Zer. membranacea	41.Zer.paucicradiata	42.Zer. regeliana	43.Zer. scabrifolia
r1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
r2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
r3	0.5	0.5	0.5	0	0.5	0	0.5	0	0.5	0	0	0.5	0.5	0	0	0	0.5	0	0	0	0.5	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
r4	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
r5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
r6	1	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
r7	0.5	0.5	0.5	0.75	1	0.75	0.75	0	0	0.75	0.5	0.75	0	0.75	0.5	0	0	0	0	0	0	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
r8	0	0	0	0	0	0	0.5	1	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
r9	0.25	0.25	0.25	0.5	0.5	0.25	0.5	0.5	0.25	0.5	0.25	0.25	0.25	1	0.5	0.5	0.25	0.5	0.25	0.25	0	1	0.25	0.5	0.5	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.5
r10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
r11	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
r12	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
r13	1	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
r14	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
r15	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
r16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
r17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
r18	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
r19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
r20	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
r21	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0	0	0	0	0.5	0	0.5	1	0.5	1	1	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1
r22	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
r23	0.5	0.5	0.5	0.75	0.5	0.75	0.75	0	0	0.5	1	1	0	0.5	0	0	0.5	0.5	0.5	0	0.5	0.5	0.75	0.75	0.75	0.75	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
r24	1	1	1	0.75	0.5	0.75	0	0	0	0.5	0.5	0.5	0	0.5	0	0	0	0.75	1	1	0.75	1	1	1	1	1	1	0.75	1	1	0.75	0.75	0.5	0.5	0.5	0.5	0.75	0.75	0.75	0.75	0.75
r25	1	1	1	1	1	1	1	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
r26	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
r27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
r28	1	1	1	1	0.5	1	1	1	1	1	0.5	0	0	1	1	1	0	1	1	1	1	0.5	1	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	1	1	1
r29	1	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
r30	0.75	0.75	0.75	0	0	0	0	0.75	0	0	0	0	0	0	0	0	1	0	0.75	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0
r31	1	1	1	1	1	0.5	0.5	1	0.5	0	0	0	0	0	0	0	0	0.5	0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
r32	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	1	0.5	1	1	0.5	0	0.5	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	0.5	0.5	1	1	0	0	0	0	0	0
r33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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29. Secretory ducts (vittae) in mericarp furrows (presence/absence): absent or inconstant, not visible in each furrow = 0; always developed, more or less broad = 1.
30. Secretory ducts (vittae) in mericarp furrows (number): solitary = 0; several in each furrow = 0.75; cyclic, small = 1.
31. Commissural secretory ducts (vittae): absent = 0; two in each mericarp = 0.5; more than two = 1.
32. Rib secretory ducts: absent = 0; small = 0.5; large, exceeding vallecular vittae if present = 1.
33. Mericarp vascular bundles: compact = 0; consisting of several groups of vascular elements = 1.

Results

Characters. – Principal components analysis represents in plot form correlations between the distribution of character states within the set of taxa. Projection of character points onto a plot of 1 and 2 principal components (Fig. 1) shows different similarity among characters; the majority of them are low-correlated, although there are a few groups of highly correlated characters (13 and 30; 26 and 29; 15, 16 and 27; 6 and 28). Overall information from characters within each such group is lower than the sum of information from independent characters. This character correlation influences the species coordinates in the components analysis, and is not taken into consideration in the cluster analysis.

Taxa excluded. – Two species are to be excluded from further discussion of the *Johrenia-Johreniopsis-Zeravschania* taxonomic complex. These are *Johrenia porteri* Boiss. and *J. westii* Post.

Johrenia porteri is a poorly known species. We have studied two sheets in G, including one to be treated most probably as the holotype (an isotype is kept in BEI). This type material does not allow to include the species in the comparative analysis. The collection at G is represented by a part of the inflorescence with compact umbels and immature fruits. A picture of radical pinnate leaves is attached to the type sheet, but its origin is unclear. In B we found an additional sheet ("Kurd Dagh, 11.4.1893"), collected and determined by G. Post, with a rosette of radical leaves,

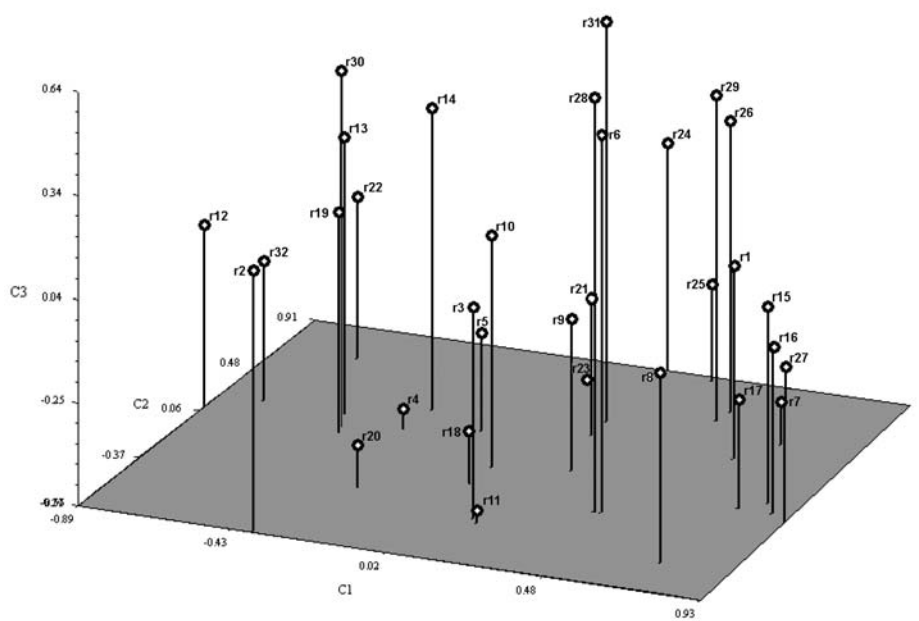


Fig. 1. Character loadings in three-factor space showing character correlation (PCA).

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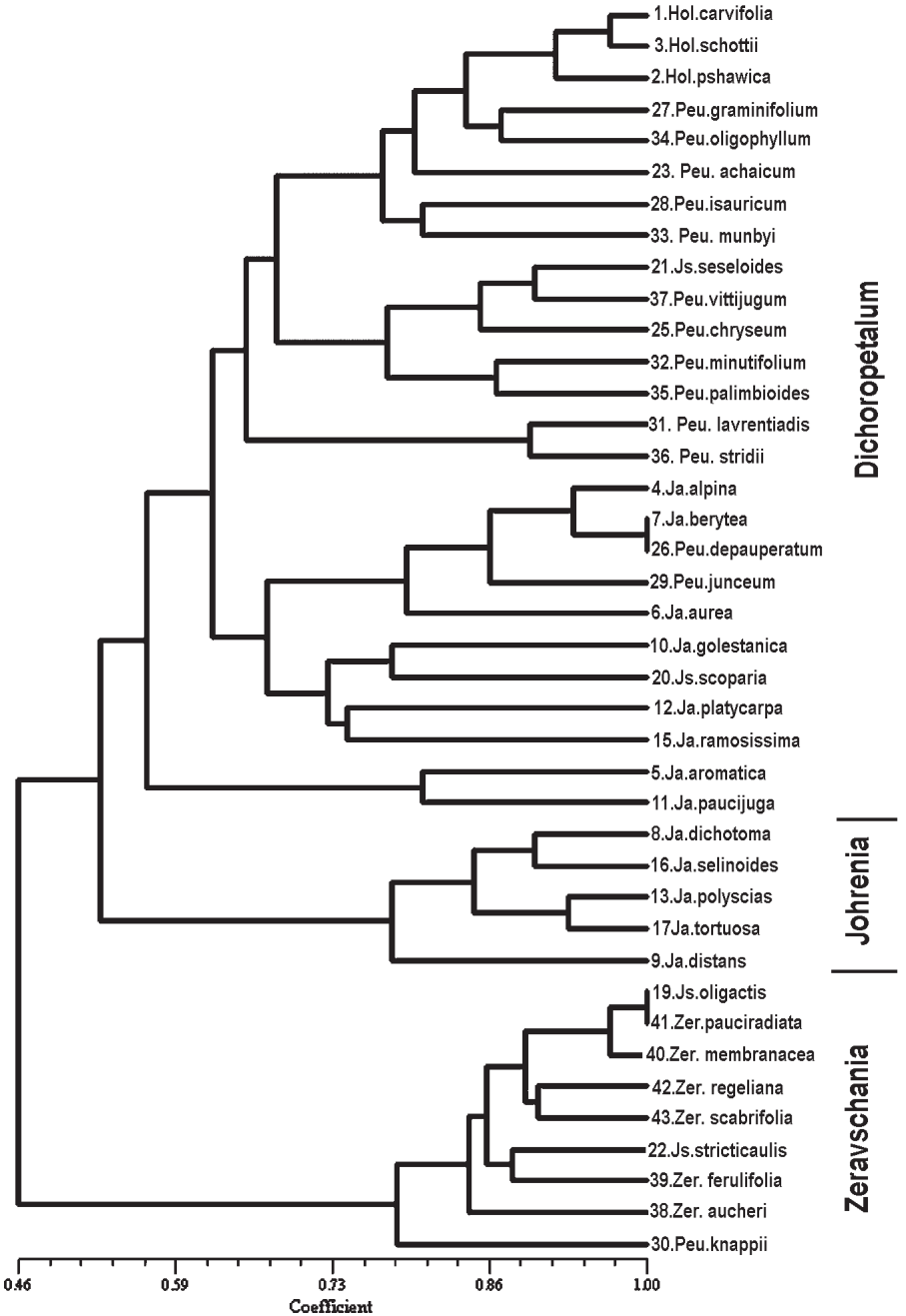


Fig. 2. UPGMA phenogram of relationships among species investigated.

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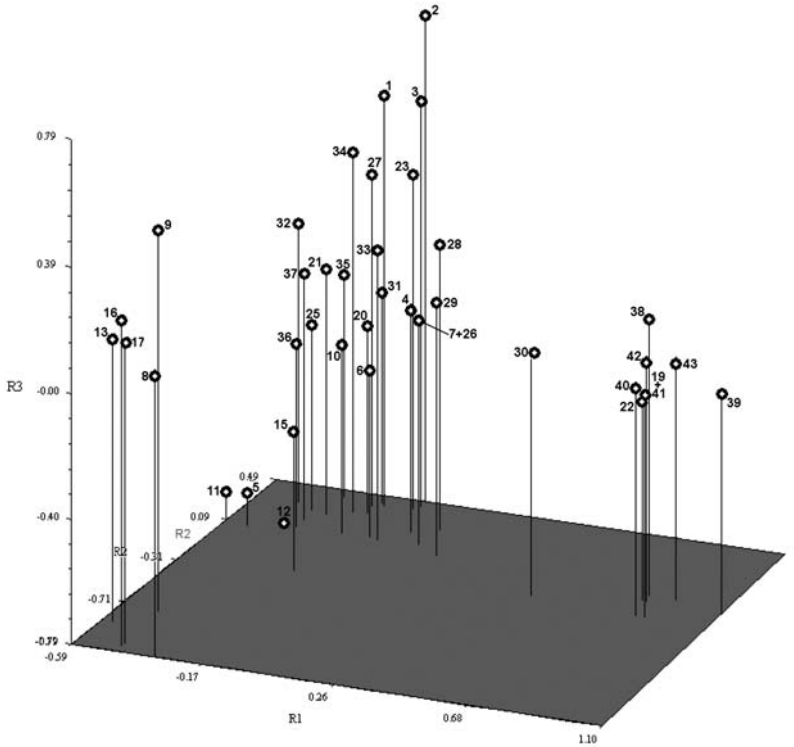


Fig. 3. OTUs loadings in three-factor space (PCA).

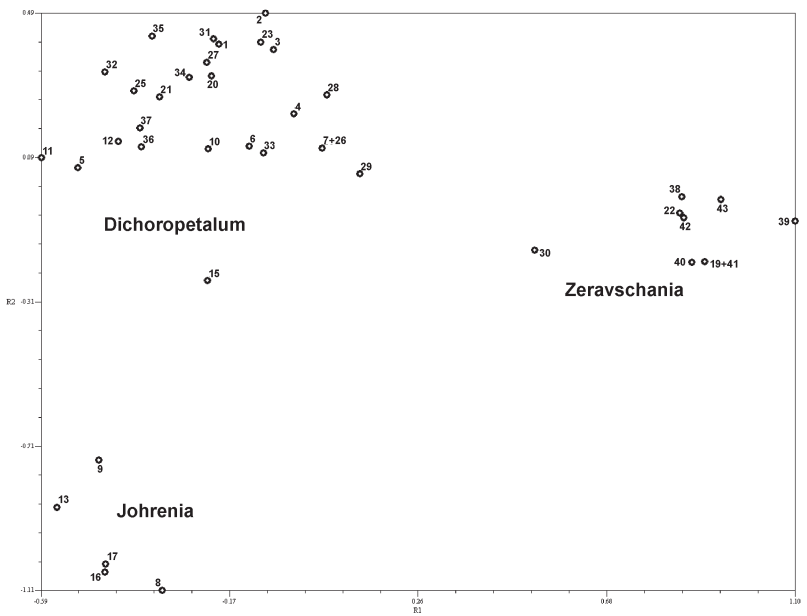


Fig. 4. Two-factor plot (components 1 and 2) showing OTUs relationships in reduced character space.

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similar to the above mentioned picture. Similar and more complete material of this gathering exists in BEI. Collected after the publication of the species, this material is not relevant for typification and may even represent another species. Bornmüller (1930) proposed to attribute this gathering to *Pimpinella saxifraga,* an attribution we doubt, but another *Pimpinella* species, *P. corymbosa,* may be a good match. In G is another sheet ("Ravine frais de Froulok- Bassit (Alneto-Platanetum). 23.7.1955, *Pabot*"), which is in some characters similar to and was treated by Mouterde (1970) as *J. porteri*. It has almost mature fruits, with slightly inflated marginal ribs, one of the diagnostic characters of *Johrenia*. A more careful investigation of Pabot's gatherings showed, however, some differences from the type material of *J. porteri*. For instance, they have well developed filiform deflexed bractlets exceeding the umbellule and the umbellules are not compact but have considerably longer rays and peduncles. The radical leaves, although pinnate, differ in outline and have longer teeth. It seems possible that this collection is identical or very close to the newly described *Peucedanum longibracteolatum* Parolly & Nordt (2005). Therefore, at present we cannot attribute *J. porteri* to *Johrenia* or to any other genus regarded in this analysis. One possible solutions is an attribution of the generative shoots, kept in BEI and G, to *Peucedanum junceum* (see below under *Dichoropetalum junceum*), and the vegetative rosettes collected later (B and BEI), to *Pimpinella corymbosa,* both species being distributed in the locus classicus of *J. porteri*. If so, it would be no surprise that there are no more collections of the species. Nevertheless, search for similar plants and collecting of more complete material at the type and nearby localities is desirable.

Johrenia westii clearly differs from all investigated species in its fruit secretory system, consisting of numerous comparatively small vittae, arranged cyclically. Among platyspermous *Umbelliferae* of the region a similar fruit structure is observed only in the species of *Ferulago*. Well developed bracts of *J. westii* are another character, unusual in the present set of species, and peculiar for *Ferulago*. The vascular system of the mericarps of *J. westii* is rather unusual for *Apioideae,* consisting of several separate groups of vessels; a similar structure has been observed in *Ferulago*. The species has, however, umbels with 2-3 rays, whereas all local *Ferulago* species have more umbel rays.

In Table 2 some species completely match other species *(Johrenia berytea* is apparently conspecific with *Peucedanum depauperatum* and *Johreniopsis oligactis* with *Zeravschania pauciradiata)*. After the exclusion of *Johrenia porteri, J. westii, J. berytea* and *Johreniopsis oligactis,* the final matrix of 41 species and 33 characters was processed.

Main groups of taxa. – Cluster analysis of the data matrix made in the UPGMA modification (Fig. 2) allows to outline some main groups in our material. The relationships were further elucidated by PCA. The first three factors were excluded on the basis of the character correlation matrix. The character factor loadings were used to produce projections of OTUs in the three-factor (Fig. 3) and two-factor space. All in all, three two-factor plots were obtained, including the one reproduced in Fig. 4.

In both analyses, three distinct main groups were revealed, one consisting of several subgroups:

1.1. *Holandrea carvifolia, H. schottii, H. pshawica, Peucedanum alpigenum, P. oligophyllum, P. achaicum, P. graminifolium, P. isauricum, P. munbyi;*
1.2. *P. lavrentiadis, P. stridii;*
1.3. *Johrenia alpina, J. berytea, Peucedanum depauperatum, P. junceum, Johrenia aurea;*
1.4. *Johrenia golestanica, Johreniopsis scoparia, Johrenia platycarpa, J. ramosissima;*
1.5. *Johrenia aromatica, J. paucijuga;*
1.6. *Johreniopsis seseloides, Peucedanum vittijugum, P. chryseum, P. minutifolium, P. palimbioides;*
2. *Johrenia dichotoma, J. selinoides, J. polyscias, J. tortuosa, J. distans;*
3. *Johreniopsis oligactis, Zeravschania pauciradiata, Z. membranacea, Z. regeliana, Johreniopsis stricticaulis, Zeravschania ferulifolia, Z. scabrifolia, Z. aucheri, Peucedanum knappii.*

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Discussion

In the plot of the first three principal components (Fig. 3) and in the biplot of components 1 and 2 (Fig. 4) three groups are clearly distinguished.

Group 2, corresponding to *Johrenia* s.str., is clearly separated also in the biplot of components 2 and 3 (not shown).

Group 3, containing the type of *Zeravschania, Z. regeliana,* should be interpreted as slightly enlarged *Zeravschania*. It is clearly separated from the remaining species also in the biplot of components 1 and 3 (not shown).

Group 1 (with subgroups 1.1-1.6) is a polymorphic taxon of the same rank as groups 2 and 3, for which generic rank seems most appropriate. It contains the species that provide the types of five generic names: (1) *Chabraea* Raf. 1840 (type: *C. carvifolia* (Vill.) Raf. ≡ *Peucedanum carvifolia* Vill. ≡ *Holandrea carvifolia* (Vill.) Reduron & al.), non Adans. 1763, (2) *Dichoropetalum* Fenzl 1842 (type: *D. alpinum* Fenzl ≡ *Johrenia alpina* (Fenzl) Fenzl), (3) *Schlosseria* Vuk. 1857 (type: *S. chabraei* Schloss. & Vuk. ≡ *Peucedanum carvifolia* ≡ *Holandrea carvifolia*), non Steud. 1841, (4) *Johreniopsis* Pimenov 1987 (type: *J. seseloides* (C. A. Mey.) Pimenov), and (5) *Holandrea* Reduron & al. 1997 (type: *H. carvifolia* (Vill.) Reduron & al.). Among these names, *Chabraea* Raf. and *Schlosseria* Vuk. are illegitimate as later homonyms (Reduron & al. 1997). Priority has *Dichoropetalum* Fenzl, based on *D. alpinum,* which in our classification belongs to group 1.3. The generic names *Johreniopsis* and *Holandrea* provide later synonyms. *Dichoropetalum* can be clearly divided into six subgroups, which we treat here as sections.

Taxonomy

Key to the genera *Ormosolenia, Leutea, Peucedanum* s.str., *Zeravschania, Johrenia* and *Dichoropetalum*

1. Plants dwarf with low (up to 20 cm tall), creeping, leafless stems; blades of basal leaves entire, round in outline, 3-lobed or deeply dissected (more rarely pinnate with 1-2 pairs of leaflet); bracteoles 1-3; mericarps with numerous cyclic vittae . . . . . *Ormosolenia*
– Plants not dwarf, with erect, taller and leafy stems (if stems are low and leafless, basal leaves bipinnate or biternate); leaf blades 2-4-dissected; bracteoles more than 3, usually numerous; mericarp with 1-3 (rare up to 5) vallecular vittate 2
2. Ultimate leaf segments cylindric, rigid, petiole-like; leaves almost all radical, stem leaves size-reduced; umbel rays thickened in fruits; marginal mericarp ribs narrow . . *Leutea*
– Ultimate leaf segments flat, clearly differing from petioles; umbel rays not thickened; marginal mericarp ribs broader; if ribs narrow *(Zeravschania),* leaf segments flat, dentate . . 3
3. Calyx teeth present; petioles round, often with central vascular bundles; leaf lamina ternate-multisect with segments not situated in one plane; primary segments long-petiolulate; ultimate segments long (2-9 cm), linear, entire . . . . . *Peucedanu*m
– Calyx teeth inconspicuous or (in *Zeravschania ferulifolia* and *Z. stricticaulis*) very short; petioles falcate in transection with a groove on the adaxial side, always without central bundles; leaf lamina pinnate, plane; primary segments sessile or petiolulate; ultimate segments short (<1 cm), dentate or lobate (in *Z. knappii* linear, entire, 1-2 cm long) 4
4. Bracts 3 or more; basal primary segments with long petiolules (more than 5 mm); mericarps (in cross section) dorsally convex . . . . . *Zeravschania*
– Bracts absent or, more rarely, 1-2; basal primary segments sessile or with short petiolules (up to 5 mm); mericarps (in cross section) dorsally compressed 5
5. Leaf sheaths long, linear; dorsal mericarp ribs indistinguishable (submerged into spongy pericarp tissue); pericarp on commissural side thick, with two portions of non-lignified or destroyed parenchyma near carpophore. . . . . *Johrenia*
– Leaf sheaths short, linear or triangular; dorsal mericarp ribs filiform, keeled, slightly or strongly inflated; pericarp on commissural side thin, without destroyed parenchyma . . . . . *Dichoropetalum*

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1. *Dichoropetalum* Fenzl, Pugill. Pl. Nov. Syr.: 17. 1842.
Typus: *Dichoropetalum alpinum* Fenzl

Plantae polycarpicae vel monocarpicae, caulibus basi plerumque residuis foliorum emortuorum dense tectis, glabris, rarius pubescentibus. *Folia* vaginis brevibus, linearibus vel triangulatibus, laminis ambitu triangularibus vel lanceolatis, segmentis primariis basalibus sessilibus vel brevepetiolulatis, lobis terminalibus linearibus, lanceolatis vel ovatis; folia caulina superiora integra, longa vel brevia. *Umbellae* plerumque radiis valde inaequelongis, bracteis nullis. *Bracteolae* herbaceae, subulatae, lineares vel lanceolatae, vulgo radiolis breviorae. *Dentes calycini* obsoleti. *Petala* alba vel flava. *Stylopodia* plana vel conica. *Mericarpia* dorso compressa, jugis dorsalibus filiformibus, carinatis vel inflatis, marginalibus brevealatis, vix inflatis vel tenuibus alatis, cellulis parenchymaticis e latere commissurali non destructis, e latere dorsali elignescentibus vel membranis lignescentibus, porosis, hypendicarpiis evolutis, rarius obsoletis, vittis vallecularibus nullis vel paucis, commissuralibus nullis, binis vel paucis, canaliculis jugalibus nullis, vel solitariis. *Endospermium* ventre planum.

Key to the sections of *Dichoropetalum*

1. Stems simple; petals white . . . . . 1.2. *D.* sect. *Stridia*
– Stems branching or leafy; petals white, pinkish or yellow 2
2. Leaf blades (in outline) linear to lanceolate 3
– Leaf blades ovate to triangular 5
3. Numbers of rays per umbel less than 5 . . . . . 1.4. *D.* sect. *Scoparia*
– Number of rays per umbel more than 6 4
4. Dorsal mericarp ribs filiform or keeled; marginal mericarp ribs winged, thin; parenchyma cells with lignified pitted walls on dorsal mericarp side absent; furrow and commissural ducts present . . . . . 1.6. *D.* sect. *Johreniopsis*
– Dorsal and marginal mericarp ribs inflated; all mesocarp of parenchyma cells with lignified pitted walls; furrow and commissural ducts absent . . . . . 1.5. *D.* sect. *Parajohrenia*
5. Upper cauline leaves with long entire blade; petals white or pinkish (but yellow in *D. achaicum*) . . . . . 1.1. *D.* sect. *Holandrea*
– Upper cauline leaves with short entire blade; petals yellow . 1.3. *D.* sect. *Dichoropetalum*

1.1. *Dichoropetalum* sect. ***Holandrea*** (Reduron & al.) Pimenov & Kjuykov, **comb. & stat. nov.**
≡ *Holandrea* Reduron & al. in J. Bot. Soc. Bot. France 1: 93. 1997.
Type: *Dichoropetalum carvifolia* (Vill.) Pimenov & Kljuykov

Plantae polycarpicae vel monocarpicae, caulibus foliosis, vulgo ramificantibus; *laminis foliorum* ambitu oblongis, ovatis vel triangulatis, superioribus integris, longis. *Petala* alba, rarius flava vel purpurea. *Umbellae* 3-15-radiatae. *Cellulae mesocarpii* parenchymaticae e latere dorsali elignescentes. *Vittae valleculares* solitariae vel paucae.

1. Bractlets longer than umbellule rays . . . . . (3) *D. pshawicum*
– Bractlets shorter than umbellule rays 2
2. Umbel rays 3-5 3
– Umbel rays more than 6 4
3. Terminal lobes of lower cauline leaves linear . . . . . (9) *D. munbyi*
– Terminal lobes of lower cauline leaves ovate, dentate at the margins . . (8) *D. isauricum*
4. Mericarps with solitary vallecular vittae 5
– Mericarp with 2-3 vallecular vittae 6
5. Styles 2-2.5 mm long, 2-3 times longer than stylopods . . . . . (2) *D. schotii*
– Styles up to 1 mm long, equal to or shorter than stylopods . . . . (7) *D. graminifolium*
6. Terminal lobes of stem leaves very narrow, up to 1 mm wide and up to 8 cm long . . . . . (5) *D. oligophyllum*

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– Terminal lobes of stem leaves 2-4 mm wide, up to 4 cm long 7
7. Umbel rays scabrid . . . . . (1) *D. carvifolia*
– Umbel rays glabrous . . . . . (6) *D. achaicum*

(**1**) ***Dichoropetalum carvifolia*** (Vill.) Pimenov & Kljuykov, **comb. nov.** ≡ *Selinum carvifolia* Chabraei ex Crantz, Inst. Rei Herb. 2: 126. 1766 [& Strip. Austr. Fasc. 3: 62, t. 3, fig. 2. 1767], nom. illeg., non L. (1762) ≡ *Peucedanum carvifolia* Vill., Prosp. Hist. Pl. Dauphiné: 25. 1779 [& Hist. Pl. Dauphiné 2: 638. 1787] ≡ *Selinum chabraei* Jacq., Fl. Austriac. 5: 72.1778 [& in Murray, Syst. Veg., ed. 14: 279. 1784] ≡ *Imperatoria chabraei* (Jacq.) Spreng., Pl. Umb. Prodr.: 17. 1813 ≡ *Oreoselinum chabraei* (Jacq.) Bess., Cat. Hort. Cremen: 94. 1818 ≡ *Peucedanum chabraei* (Jacq.) Rchb. in Moessler, Handb. Gewächse, ed. 2, 1: 448. 1827 ≡ *Palimbia chabraei* (Jacq.) DC., Prodr. 4: 176. 1830 ≡ *Pteroselinum chabraei* (Jacq.) Rchb., Fl. Germ. Exc. 2: 453. 1832 ≡ *Caroselinum chabraei* (Jacq.) Griseb., Spic. Fl. Rumel. Bithyn. 1: 374. 1843 ≡ *Schlosseria chabraei* (Jacq.) Schloss. & Vuk., Fl. Croat.: 474. 1869 ≡ *Holandrea carvifolia* (Vill.) Reduron & al. in J. Bot. Soc. Bot. France 1: 93. 1997. – Lectotype (designated by Frey 1989: 280): [icon] *Selinum carvifolia* Chabraei ex Crantz, Stirp. Austr. Fasc. 3, t. 3, fig. 2. 1767.
= *Ligusticum decussatum* Moench, Method. Pl.: 81. 1794, p.p.
= *Selinum podolicum* Bess., Prim. Fl. Galic. 2: 392. 1809 ≡ *Oreoselinum podolicum* (Bess.) M. Bieb., Fl. Taur.-Cauc. 3: 210. 1819 ≡ *Peucedanum podolicum* (Bess.) Eichw., Naturhist. Skizze: 155. 1830 ≡ *Peucedanum chabraei* var. *podolicum* (Bess.) DC., Prodr. 4: 176. 1830.
= *Selinum chabraei* var. *aestivale* Holandre, Fl. Moselle, ed. 1: 146. 1829 ≡ *Peucedanum chabraei* var. *aestivale* (Holandre) Rouy & Camus, Fl. France 7: 386. 1901.
= *Selinum chabraei* var. *autumnale* Holandre, Fl. Moselle, ed. 1: 146. 1829 ≡ *Peucedanum chabraei* var. *autumnale* (Holandre) Rouy & Camus, Fl. France 7: 386. 1901.
= *Pastinaca selinoides* Vis. in Flora 12 (Ergänzungsbl. 1): 10. 1829 ≡ *Peucedanum chabraei* var. *selinoides* (Vis.) Vis., Fl. Dalmat.: 51.1850 ≡ *Peucedanum selinoides* (Vis.) Fritsch., Excurs. Fl. Oesterr.: 379. 1922, non DC. 1830.
= *Peucedanum heterophyllum* Vis. in Cat. Sem. Horti Patavini 3: 4. 1836 ≡ *Schlosseria heterophylla* (Vis.) Vuk. in Oesterr. Bot. Z. 7: 350. 1857 ≡ *Palimbia chabraei* var. *heterophylla* (Vis.) Schur, Enum. Pl. Transsilv.: 265. 1866.
= *Palimbia decussata* Schur, Sert. Fl. Transsilv.: 30. 1853.
= *Peucedanum euphimiae* Kotov in Bot. Zhurn. (Kiev) 1(2): 278. 1940.

Fruit structure. – See Fig. 5A.

Distribution. – Austria, Belgium, Bosnia & Herzegovina, Bulgaria, Czech Rep., Croatia, France, Germany, Hungary, Italy, Luxembourg, Moldavia, the Netherlands, Romania, Russia, Serbia, Slovakia, Spain, Switzerland, Ukraine.

Ref. – Under *Peucedanum carvifolia:* Lange (1880: 44), Calestani (1905: 232), Burnat (1906: 208, in nota), Thellung (1926: 1375, fig. 2518), Hayek (1927: 1034), Beck-Mannagetta (1927: 470), Degen (1937: 506), Rohlena (1942: 225), Stojanov & Stefanov (1948: 856), Dostal (1950: 1059), Janchen (1956: 432), Chrtek & Hendrich (1962: 137), Soó (1966: 481), Tutin (1968: 362), Holub (1972: 40), Rompaey & Devlosalle (1972: map 644), Nikolić (1973: 282), Guinochet & Vilmorin (1975: 475), Kuzmanov & Andreev (1982: 228, t. 46), Pignatti (1982: 233), Molero & Rovira (1985: 537), Frey (1989: 280, fig. 37), Bruck (1988: 69), Fabri (1993: 312), Grulich (1997: 469, t. 94, fig. 2), Lukač & Regula-Revilacqua (1997: 112), Lauber & Wagner (1998: 772), Wisskirchen & Haeupler (1998: 360), Guillen & Lainz (2003: 351, fig. 113). – Under *Imperatoria chabraei:* Sprengel (1818: 64). – Under *Oreoselinum chabraei:* Marchall von Bieberstein (1819: 209), Besser (1822: 12). – Under *Peucedanum chabraei:* Gaudin (1828: 330, comb. superfl.), Ledebour (1844: 308, comb. superfl.), Visiani (1850: 51), Todor (1958: 604), Fournier (1961: 688). – Under *Palimbia chabraei:* Schur (1866: 265). – Under *Selinum podolicum:* Hoffmann (1816: 155). – Under *Peucedanum podolicum:* Shishkin (1951: 195). – Under *Peucedanum chabraei* var. *podolicum:*

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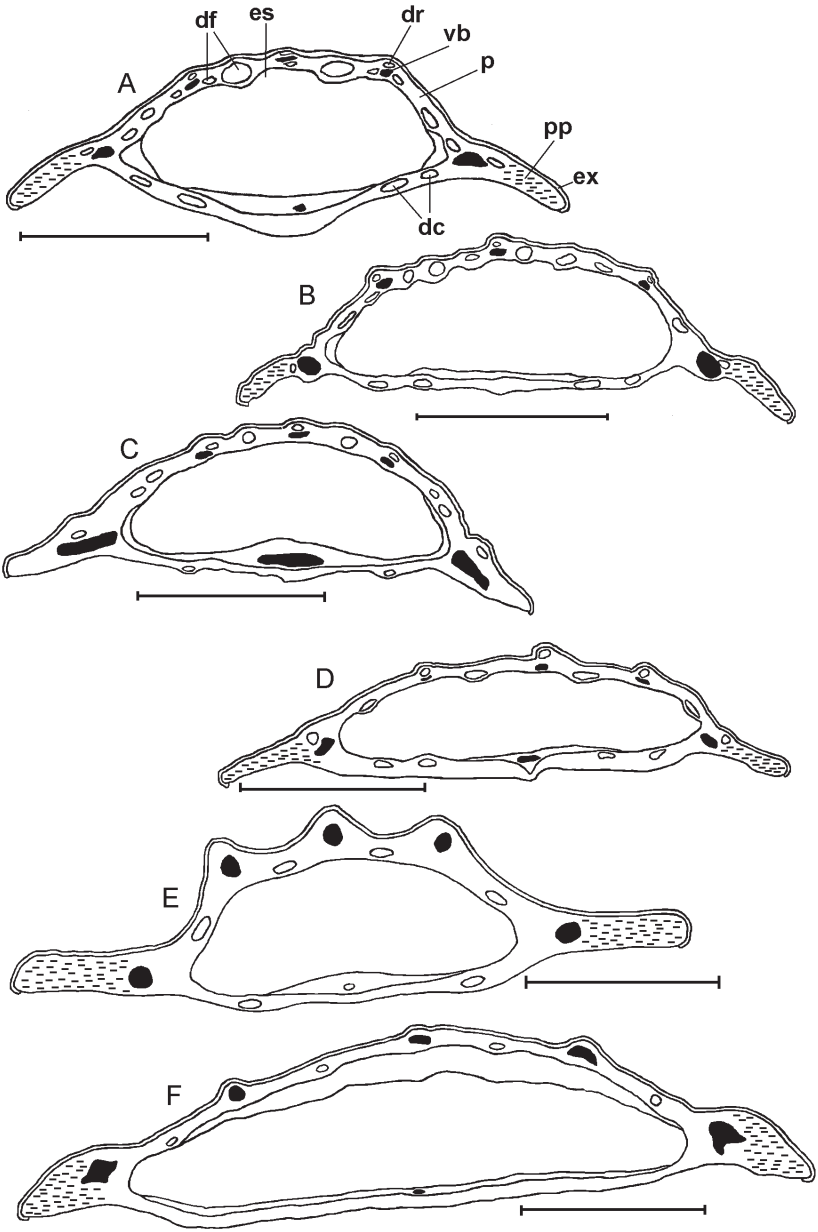


Fig. 5. Schematic transects of mericarps – A: *Dichoropetalum carvifolia;* origin: Moravia orient.-merid., Un Brod, Nivnice, 1933, *Podpera 1246* (LE); B: *D. pschawicum;* origin: Russia, N Ossetia, valley of Bad river, 1.6.1977, *Pimenov & al. 168* (MW); C: *D. oligophyllum;* origin: Greece, Makedonia orient., prov. Senres, 23.7.1979, *Greuter* (E); D: *D. achaicum;* origin: Bouraïkos, au-dessous de village de Zachloron (Achaïe, Gréce), 8.7.1896, *Saint Lager* (G); E: *D. graminifolium;* origin: Turkey, A4 Kastamonu, 20.9.1996, *Vural 7059* (GAZI); F: *D. munbyi;* origin: Algerie, dep. d'Alger, terrains argieux humices pres de l'Oued Smar, 15.10.1953, *Dubois* (W). – Abbreviations: dc = commissural secretory ducts, df = secretory ducts in furrows, dr = secretory duct in distal part of rib, es = endosperm, ex = exocarp, p = parenchyma cells without pits, pp = parenchyma cells with lignified pitted walls, vb = vascular bundles. – Scale bars = 1 mm.

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Todor (1958: 606), Fabri (1993: 313, in nota). – Under *Peucedanum chabraei* var. *aestivale:* Todor (1958: 606). – Under *Peucedanum chabraei* var. *autumnale:* Todor (1958: 606), Fabri (1993: in nota). – Under *Peucedanum carvifolia* var. *selinoides:* Degen (1937: 506).

(2) *Dichoropetalum schottii* (Bess.) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum schottii* Bess. in Candolle, Prodr. 4: 178. 1830 ≡ *Holandrea schottii* (Bess.) Reduron & al. in J. Bot. Soc. Bot. France 1: 93. 1997. – Lectotype (designated by Hartvig 1986): "Cult. Crem. *Besser*" (G-DC!; isotype (Vinogradova 2003): LE!).
= *Peucedanum petraeum* W. D. J. Koch, Syn. Fl. Germ., ed. 1: 304. 1837 ≡ *Peucedanum schottii* var. *petraeum* W. D. J. Koch, Syn. Fl. Germ., ed. 2: 334. 1843 ≡ *Peucedanum schottii* subvar. *petraeum* (W. D. J. Koch) Burnat, Fl. Alp. Marit. 4: 206. 1906. – Holotype: Italia "In rupibus et locis asperis saxosis (zwischen Triest u. Fiume an Felsen der neuen Straße), *Noe*" (W; isotype: G).

Distribution. – Albania, Bosnia & Herzegovina, Croatia, France, Greece, Italy, Serbia.

Ref. – Under *Peucedanum schottii:* Hy (1901:105), Calestani (1905: 231), Burnat (1906: 205), Thellung (1926: 1377: fig. 2519), Hayek (1927: 1034), Beck-Managetta (1927: 462), Degen (1937: 507), Fournier (1961: 689), Tutin (1968: 362), Nikolić (1973: 284, t. 54, fig. 2), Guinochet & Vilmorin (1975: 474), Pignatti (1982: 233), Demiri (1983: 348), Molero & Rovira (1985: 537), Hartvig (1986: 718), Frey (1989: 281, fig. 37), Bolòs & Vigo (1990: 472), Qosja (1992: 402, fig. 749), Lukač & Regula-Revilacqua (1997: 112), Guillen & Lainz (2003: 353). – Under *Peucedanum schottii* var. *petraeum:* Rohlena (1942: 225).

Note. – Burnat (1906) and Thellung (1926) gave *Oenanthe karsthia* Hacq. as a synonym of this species. Reduron & al. (1997) noted, however, that the fruit description of *O. karsthia* does not corresponds to the *Peucedanum* fruit type. J.-P. Reduron kindly informed us that herbarium material of this species is probably lost. The species description by Besser of *Peucedanum schottii* was published in Candolle's "Prodromus" and the origin "In Vohlynia & Podolia" apparently refers to a plant cultivated in the botanical garden at Kiew, because *P. schottii* is not distributed in the Ukraine and adjacent countries, where only *P. carvifolia* occurs.

(3) *Dichoropetalum pschawicum* (Boiss.) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum pschawicum* Boiss., Fl. Orient. 2: 1020. 1872 ≡ *Holandrea pschawica* (Boiss.) Reduron & al. in J. Bot. Soc. Bot. France 1: 93. 1997. – Holotype: Georgia "Caucasus, Pschawia supra lacum Tana inter 1580-1200 hec, 23.9.1860, *Ruprecht*" (G-BOIS!; isotype: LE!)
– *P. chabraei* auct. non Rchb. : Boissier, Fl. Orient. 2: 1020.1872.
– *P. carvifolia* auct. non Vill. : Grossheim, Fl. Kavkaza 3: 182. 1932.

Fruit structure. – See Fig. 5B.

Distribution. – Russia (N Caucasus: Krasnodar Terr., Adygea, Stavropol Terr., Kabardino-Balkaria, N Ossetia), Georgia.

Ref. – Under *Peucedanum pschawicum:* Lipsky (1899: 326), Grossheim (1932: 180), Shishkin (1951: 196), Tamamschjan (1967: 116, fig. 125), Mandenova (1984: 268), Menitsky (1991: 1761), Ivanov (2001: 101).

(4) *Dichoropetalum alpigenum* (Boiss.) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum alpigenum* Boiss., Fl. Orient. 2: 1020. 1872. – Holotype: Turkey "In alpibus Ponti Lazici loco non indicato, *K. Koch*" (G-BOIS!).

Distribution. – Turkey: N (Pontic) Anatolia. Known only from the type gathering.

Note. – This species was regarded by Chamberlain (1972) and Frey (1989) as a synonym of *Peucedanum carvifolia*. The large disjunction between Lazistan and the European area of *Dichoropetalum carvifolia* casts doubt on their conspecifity, especially as Boissier (1872) showed at

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least three differences between these species. Although the type material is scanty, some of these differences can be confirmed. As no similar species are known in adjacent territories (the nearest is *D. pshawicum* from the Main Caucasian Ridge), specific distinction of *D. alpigenum* is very probable. Further search for the species seems to be necessary.

(5) ***Dichoropetalum oligophyllum*** (Griseb.) Pimenov & Kljuykov, **comb. nov.** ≡ *Seseli oligophyllum* Griseb., Spic. Fl. Rumel. Bithyn. 1: 359. 1843 ≡ *Peucedanum oligophyllum* (Griseb.) Vandas in Magyar Bot. Lapok 4: 110.1905. – Holotype: Makedonia "In pratis prope Mandani, Mt Kobelitza in Scardi Macedoniae, 4000', *Grisebach 936*" (GOET).
= *Peucedanum aequiradium* Velen. in Sitzungsber. Königl. Böhm. Ges. Wiss., Math. Naturwiss. Cl. 1889: 36. 1890 ≡ *Peucedanum oligophyllum* subsp. *aequiradium* (Velen.) Achtarov in Izv. Bulg. Bot. Druz. 9: 65. 1943 ≡ *Peucedanum carvifolia* subsp. *aequiradium* (Vel.) Stoj. & Steph., Fl. Bulg.: 835. 1925. – Type: Bulgaria "In graminosis alpinis siccis praesertim inter Vaccinia in cacumine montis Rujen montium Osogovska Planina, 1887, *Velenovsky*" (PRM).

Fruit structure. – See Fig. 5C.

Distribution. – Albania, Bulgaria, Greece, F.Y.R. Macedonia, Serbia.

Ref. – Under *Seseli oligophyllum:* Boissier (1872: 965), Demiri (1983: 3480). – Under *Peucedanum oligophyllum:* Hayek (1927: 1033), Stojanov & Stefanov (1948: 856), Tutin (1968: 362), Strid & Papanicolaou (1981: 74), Kuzmanov & Andreev (1982: 229), Hartvig (1986: 717), Frey (1989: 279, fig. 37), Qosja (1992 : 401, fig. 748). – Under *Peucedanum aequiradium:* Hayek (1927: 1033), Nikolić (1973: 282), Hartvig (1986: 717). – Under *Peucedanum oligophyllum* subsp. *aequiradium:* Tutin (1968: 362, comb. superfl.), Strid & Papanicolaou (1981: 74)

(6) ***Dichoropetalum achaicum*** (Halacsy) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum achaicum* Halacsy, Consp. Fl. Graec. Suppl. 1: 42. 1908. – Type: Greece "In rupibus vallis fluminis Voreikos infra Zachloru Achaiae [Bouraïkos, au-dessous de village de Zachloron (Achaïe, Gréce)], 8.7.1896, *Saint Lager*" (G!).

Fruit structure. – See Fig. 5D.

Distibution. – Greece.

Ref. – Under *Peucedanum achaicum:* Hayek (1927: 1033), Tutin (1968: 362).

(7) ***Dichoropetalum graminifolium*** (Boiss.) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum graminifolium* Boiss. in Ann. Sci. Nat., Bot., ser. 3, 1: 314. 1844. – Holotype: Turkey "Olympe de Bithynie, Brousse [Bursa], 8.1830, *Aucher-Eloy 3758*" (G!; isotypes: K!, P!).

Fruit structure. – See Fig. 5E.

Distribution. – Turkey: N (Pontic) Anatolia: Bursa, Kastamonu, Samsun; Central Anatolia: Sivas.

Ref. – Under *Peucedanum graminifolium:* Tchihachev (1860: 435), Boissier (1872: 1017), Chamberlain (1972: 475), Frey (1989: 282, map 37), Heller & Heyn (1993: 41), Vural & Adigüzel (1996: 60, fig. 1), Parolly & Nordt (2004: 141).

(8) ***Dichoropetalum isauricum*** (Parolly & Nordt) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum isauricum* Parolly & Nordt in Willdenowia 34: 135. 2004. – Holotype: [Turkey], C4 Antalya, NE Demirtas (Richtung Pass) [towards pass], 840 m, lichter Waldhang, Waldsaum [open forest slope, forest fringe], Exp. W., 7.9.2001, *Ulrich 1/12* (STU).

Fruit structure. – See Parolly & Nordt (2004).

Distribution. – Turkey (S Anatolia: Antalya).

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(9) *Dichoropetalum munbyi* (Boiss.) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum munbyi* Boiss., Diagn. Pl. Orient., ser. 2, 2: 89. 1854. – Lectotype (designated here): Algeria "Ad vias circa pagum la Senia prov. Oran, *Balansa 598*" (G!; isotype: K!); paralectotype: Oran, La Senia, in humidis salinis, 5.8.1850, *Munby* (K!).

Fruit structure. – See Fig. 5F.

Distribution. – Algeria, Morocco.

Ref. – Under *Peucedanum munbyi:* Quézel & Santa (1963: 671).

1.2. *Dichoropetalum* sect. ***Stridia*** Pimenov & Kljuykov, **sect. nov.**
Type: *Dichoropetalum lavrentiadis* (Strid & Papan.) Pimenov & Kljuykov

Plantae polycarpicae, caulibus eramosis, aphyllis. *Folia* radicalia ambitu ovata vel triangulata. *Umbellae* 6-13-radiatae. *Petala* alba. *Cellulae mesocarpii* paranchymaticae e latere dorsali elignescentes. *Vittae valleculares* paucae vel nullae.

1. Stems densely covered at the base by a fibrous collar of leaf remains; mericarps with solitary vallecular vittae . . . . . (10) *D. lavrentiadis*
– Stems at the base without a collar of leaf remains; mature mericarps without vallecular vittae . . . . . (11) *D. stridii*

(10) *Dichoropetalum lavrentiadis* (Strid & Papan.) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum lavrentiadis* Strid & Papan. in Bot. Not. 133: 524. 1980. – Holotype: "Greece, Nom. Florinis/Pellis, Mt Kajmakcalan (Voras Oros), summit area, 2450-2520 m, a few hundred metres from the Jugoslavian border, 17.8.1979, *Strid & Papanicolaou 16599*" (C; isotypes: ATH, B, G!, LD).

Distribution. – Greece, Serbia, Albania.

Ref. – Under *Peucedanum lavrentiadis:* Hartvig (1986: 720, fig. 45, A-E), Frey (1989: 284, fig. 27).

(11) *Dichoropetalum stridii* (Hartvig) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum stridii* Hartvig in Strid, Mt. Fl. Greece 1: 720, fig. 45 F. ≡ *Peucedanum lavrentiadis* subsp. *multicaulis* Strid & Papan. in Bot. Not. 133: 524. 1980. – Holotype: "Greece, Nomos Ioannina, Ep. Konitsa, Mt. Smolikas, SE side, place named Gangarantza, 2200-2400 m, on peridotite and serpentine, 25.7.1971, *Stamatiadou 13511 bis*" (ATH; isotypes: C, G!).

Fruit structure. – See Fig. 6A.

Distribution. – Greece.

Ref. – Under *Peucedanum stridii:* Frey (1989: 283, fig. 26).

1.3. *Dichoropetalum* sect. ***Dichoropetalum***

Plantae polycarpicae, caulibus eramosis vel ramosis. *Laminae foliorum* ambitu ovatae vel triangulatae, superiores integrae, breves. *Umbellae* 3-9-radiatae. *Petala* flava. *Cellulae mesocarpii* parenchymaticae e latere dorsali elignescentes. *Vittae valleculares* solitariae.

1. Stems low, up to 20 cm high; basal primary leaf segments sessile 2
– Stems 25-100 cm high; basal primary leaf segments with short petiolules 3
2. Terminal leaf lobes lanceolate, dentate, not crowded; stems erect or spreading, commissural vittae in mericarps present . . . . . (12) *D. alpinum*
– Terminal leaf lobes linear, crowded; stems prostrate; commissural vittae in mericarps absent . . . . . (15) *D. aureum*

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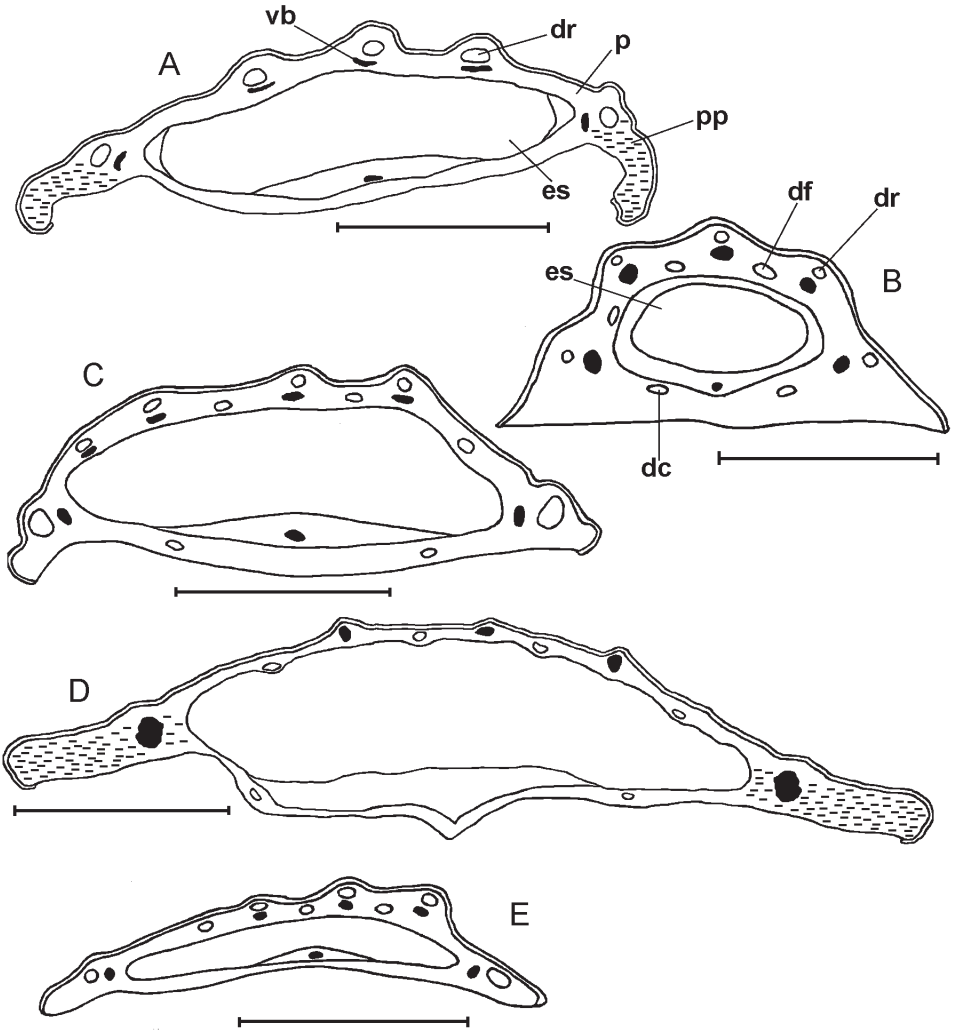


Fig. 6. Schematic transects of mericarps – A: *Dichoropetalum stridii;* origin: Greece, Nomos Ioannina, Ep. Konitsa, Mt Smolikas, SE side, place named Gangarantza, 2200-2400 m, on peridotite and serpentine, 25.7.1971, *Stamatiadou 13511bis* (G); B: *D. alpinum;* Turkey, C6 Maras, 1600-2000 m, step, 10.8.1991, *Aytaç & Duman 4145* (GAZI); C: *D. depauperatum;* origin: Syria, Akher Dagh, 6000, *Haradjan 1572* (LE); D: *D. junceum;* origin: Israel, Jerusalem, 12.10.1951, *Grizi* (W); E: *D. aureum;* origin: Turkey, Anti-Taurus, à 12 lieux à l'ESE de Cesarée (Cappadoce), 6.8.1856, *Balansa 1007* (P). – Scale bars = 1 mm; for the abbreviations see caption of Fig. 5.

3. Leaves long-persistent; stems up to 100 cm high; fruits elliptic in outline; dorsal mericarp ribs shortly keeled, marginal ribs shortly winged, triangular in cross section . . . . . (13) *D. depauperatum*
– Leaves withered at flowering; stems 120-200 cm high; fruits obovate in outline; dorsal mericarp ribs filiform, marginal ribs narrowly winged . . . . . (14) *D. junceum*

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(12) *Dichoropetalum alpinum* Fenzl, Pug. Pl. Nov. Syr.: 57. 1842 ≡ *Johrenia alpina* (Fenzl) Fenzl in Russeger, Reisen 1: 961, t. 17. 1843 . – Holotype: Turkey "in alpibus Tauri occidentalis [In monte Tauro], 8.1836, *Kotschy 213*" (G-BOIS!; isotypes: BM, E!, G!, K!, L!, LE!, M!, P!, US, W!, WAG).
= ? *Peucedanum depauperatum* var. *alpinum* Boiss., Fl. Orient. 2: 1019. 1872. – Lectotype (designated here): Israel/Lebanon/Syria "In summo Hermone [Hermon, regio alpino], 5.7.1846, *Boissier*" (G-BOIS!); paralectotypes: Lebanon "locis super nivalibus derelictis in jugo versus Baalbeck, 7500', 30.7.1855, *Kotschy 357*" (G-BOIS!, W!); Lebanon "in cacuminibus inter Yamouny & Dimam,18.7.1864, *Blanche 3221*" (G-BOIS!).

Fruit structure. – See Fig. 6B. Type sheets of the species contain a packet with fruits, but these fruits do not belong to the type plants, which are at anthesis. These fruits are the most probably from *Johrenia tortuosa,* growing in the same region. True *D. alpinum* fruits were investigated on the basis of another gatherings of the species.

Distribution. – Turkey (S Anatolia: İçel, Kahramanmaraş), Lebanon.

Ref. – Under *Johrenia alpina:* Tchihachev (1860: 440), Bornmüller (1930: 47), Hiroe (1958: 186; 1979: 232, p.p.), Heller & Heyn (1993: 32).

(13) *Dichoropetalum depauperatum* (Boiss. & Balansa ex Boiss.) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum depauperatum* Boiss. & Balansa ex Boiss., Diagn. Pl. Orient., ser. 2, 5: 98. 1856. – Holotype: Turkey "Région montagneux superieure de Taurus, au-dessus de Boulgarmaden, 15.9.1855, *Balansa 617*" (G-BOIS!; isotypes: G, GH, K!, P!, W!).
= *Johrenia berytea* Boiss. & Hausskn. ex Boiss., Fl. Orient. 2: 1012. 1872. – Holotype: Turkey "In rupestribus montis Berytdagh Cataoniae 7000'-9000' [In rupestr. Berytdagh 7-9000'], 16.8.1865, *Haussknecht 1158*" (G-BOIS!; isotype: JE!).

Fruit structure. – See Fig. 6C.

Distribution. – Lebanon, Syria, Turkey (Central Anatolia: Afyon, İsparta, Kayseri, Nidğe; S Anatolia: Antalya, İçel, Adana, Kahramanmaraş, Hatay; E Anatolia: Malatya).

Ref. – Under *Peucedanum depauperatum:* Tchihachev (1860: 435), Post (1896: 363, fig. 190), Handel-Mazzetti (1913: 52), Post (1932: 554, fig. 350), Thiébaut (1936: 167), Rechinger (1957: 315), Hiroe (1958: 179; 1979: 1562, p.p), Mouterde (1970: 648, t. 311, fig. 1), Chamberlain (1972: 436), Heller & Heyn (1993: 41), Fragman & al. (1999: 44). – Under *Johrenia berytea:* Bornmüller (1930: 48), Chamberlain (1972: 437), Heller & Heyn (1993: 33).

(14) *Dichoropetalum junceum* (Boiss.) Pimenov & Kljuykov, **comb. nov.** ≡ *Johrenia juncea* Boiss., Diagn. Pl. Orient., ser. 1, 10: 33. 1849 ≡ *Peucedanum junceum* (Boiss.) Mouterde in Fl. Djebel Druze: 161. 1953, non Spreng. 1820 ≡ *Peucedanum mouterdei* M. Hiroe in Umbell. World: 1574. 1979. – Holotype: Lebanon "Ad margines agrorum sterilium in Antilibano inter Rascheya et radices Hermonis [circa Rascheya], 7.1846, *Boissier*" (G-BOIS!; isotype: G!).
= *Peucedanum spreitzenhoferi* Dingler in Flora 66: 210. 1883. – Syntypes: Lebanon "In campis aridis lapidosis Antilibani in Wadi Faluj supra Jubb Jenin Coelosyriae, 3000', *Dingler*" (B, destroyed); Israel "Loco Nikephori dicto Palestinae, *Spreitzenhofer*" (B, destroyed).
= ? *Johrenia porteri* Post ex Boiss., Fl. Orient., Suppl.: 266. 1888, quoad typum. – Holotype: Turkey "In Syriae borealis collibus siccis ad Kapukham ditionis Marasch [Kapu bham dagh], 17.9.1887, *Post*" (G!; isotypes: BEI! G-BOIS!).

Fruit structure. – See Fig. 6D.

Distribution. – Israel, Jordan, Lebanon, Syria, Turkey (SW Anatolia: Hatay, Kahramanmaraş).

Ref. – Under *Johrenia juncea:* Boissier (1872: 1013), Post (1896: 363; 1932: 553), Bornmüller (1930: 46), Thiébaut (1936: 166). – Under *Peucedanum junceum:* Mouterde (1970: 648, t. 311, fig. 2), Chamberlain (1972: 480), Heller & Heyn (1993: 41), Fragman & al. (1999: 44). – Under *Peucedanum*

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spreitzenhoferi: Post (1932: 554), Thiébaut (1936: 167), Grünberg-Fertig & Zohary (1970: 303), Zohary (1972: 440, t. 639), Boulos (1977: 99), Al-Eisawi (1982: 178), Parolly & Nordt (2004: 141).

(15) ***Dichoropetalum aureum*** (Boiss. & Balansa ex Boiss.) Pimenov & Kljuykov, **comb. nov.** ≡ *Johrenia aurea* Boiss. & Balansa ex Boiss., Diagn. Pl. Orient., ser. 2, 6: 81. 1859. – Holotype: Turkey "In parte superiori monto Aslan dach Antitauri in Cappadocia [Région alpine superieure de l'Aslan-Dach l'un pas pies de l'Anti-Taurus a 12 lieux à l'ESE de Cesarée (Cappadoce)], 6.8.1856, *Balansa 1007*" (G-BOIS!; isotypes: G!, MANCH! P!, W!).

Fruit structure. – See Fig. 6E.

Distribution. – Turkey (Central Anatolia: Kayseri; S Anatolia: İçel), Lebanon, Israel.

Ref. – Under *Johrenia aurea:* Tchihachev (1860: 441), Boissier (1872: 1013), Post (1896: 363), Bornmüller (1930: 48), Post (1932: 553), Thiébaut (1936: 165), Mouterde (1970: 651, t. 314, fig. 1), Chamberlain (1972: 437), Heller & Heyn (1993: 32).

1.4. ***Dichoropetalum*** sect. ***Scoparia*** Pimenov & Kljuykov, **sect. nov.**
Type: *Dichoropetalum scoparium* (Boiss.) Pimenov & Kljuykov

Plantae monocarpicae vel polycarpicae, caulibus ramosis, foliosis. *Laminae foliorum* ambitu lanceolatae, superiores longae vel breves. *Umbellae* 3-9-radiatae. *Petala* flava. *Cellulae mesocarpii* omnes parenchymaticae lignescentes vel e latere dorsali elignescentes. *Vittae valleculares* nullae, solitariae vel paucae.

1. Monocarpic plants; stems glabrous; terminal leaf lobes lanceolate to ovate 2
– Polycarpic plants; stems pubescent; terminal leaf lobes linear 3
2. Terminal leaf lobes lanceolate, without teeth or lobes or notches; stylopods conical; marginal mericarp ribs narrow, winged, vallecular vittae distinct, solitary; stems branched from the middle part . . . . . (16) *D. golestanicum*
– Terminal leaf lobes ovate, dentate; stylopods short-conical; marginal mericarp ribs shortly winged, slightly swollen, vallecular vittae absent; stems strongly branched from the base . . . . . (19) *D. ramossimum*
3. Petioles and leaf blades soft; stems virgate, thin, slightly branched; upper cauline leaves with long blades; dorsal mericarp ribs thin, filiform, marginal ribs narrow, winged, mericarp with distinct vallecular vittae, secretory ducts in ribs thin or absent . . . . (17) *D. scoparium*
– Petioles and leaf blades rigid; stems multi-branched dichotomously; upper cauline leaves with short blades; all mericarp ribs inflated, mericarp usually with inconspicuous vallecular vittae, secretory ducts in ribs large . . . . . (18) *D. platycarpum*

(16) ***Dichoropetalum golestanicum*** (Rech. f.) Pimenov & Kljuykov, **comb. nov.** ≡ *Johrenia golestanica* Rech. f., Fl. Iran. 162: 376, t. 304. 1987. – Holotype: Iran "Persia, Gorgan: Jangal-e Golestan prope Tang-e Rah, 420-500 m, 13.-14.10.1976, *Terme & Matine 35109-E*" (W!).

Fruit structure. – See Fig. 7A.

Distribution. – Turkmenistan, Iran (N: Golestan).

Ref. – Under *Johrenia golestanica:* Heller & Heyn (1993: 33), Jalili & Jamzad (1999: 677).

(17) ***Dichoropetalum scoparium*** (Boiss.) Pimenov & Kljuykov, **comb. nov.** ≡ *Johrenia scoparia* Boiss., Diagn. Pl. Orient., ser. 1, 6: 61. 1846 ≡ *Peucedanum scoparium* (Boiss.) Boiss., Diagn. Pl. Orient., ser. 2, 2: 90. 1856 ≡ *Johreniopsis scoparia* (Boiss.) Pimenov in Rechinger, Fl. Iran. 162: 455, t. 411. 1987 – Holotype: Iran "[Fars] In argillosis acidis alpis Kuh-Daena [Kuh-e-Dinar], 17.7.1842, *Kotschy 676*" (G-BOIS!; isotypes; BM!, C, E!, K!, LE!, M!, P!, US, W!).

Fruit structure. – See Fig. 7B.

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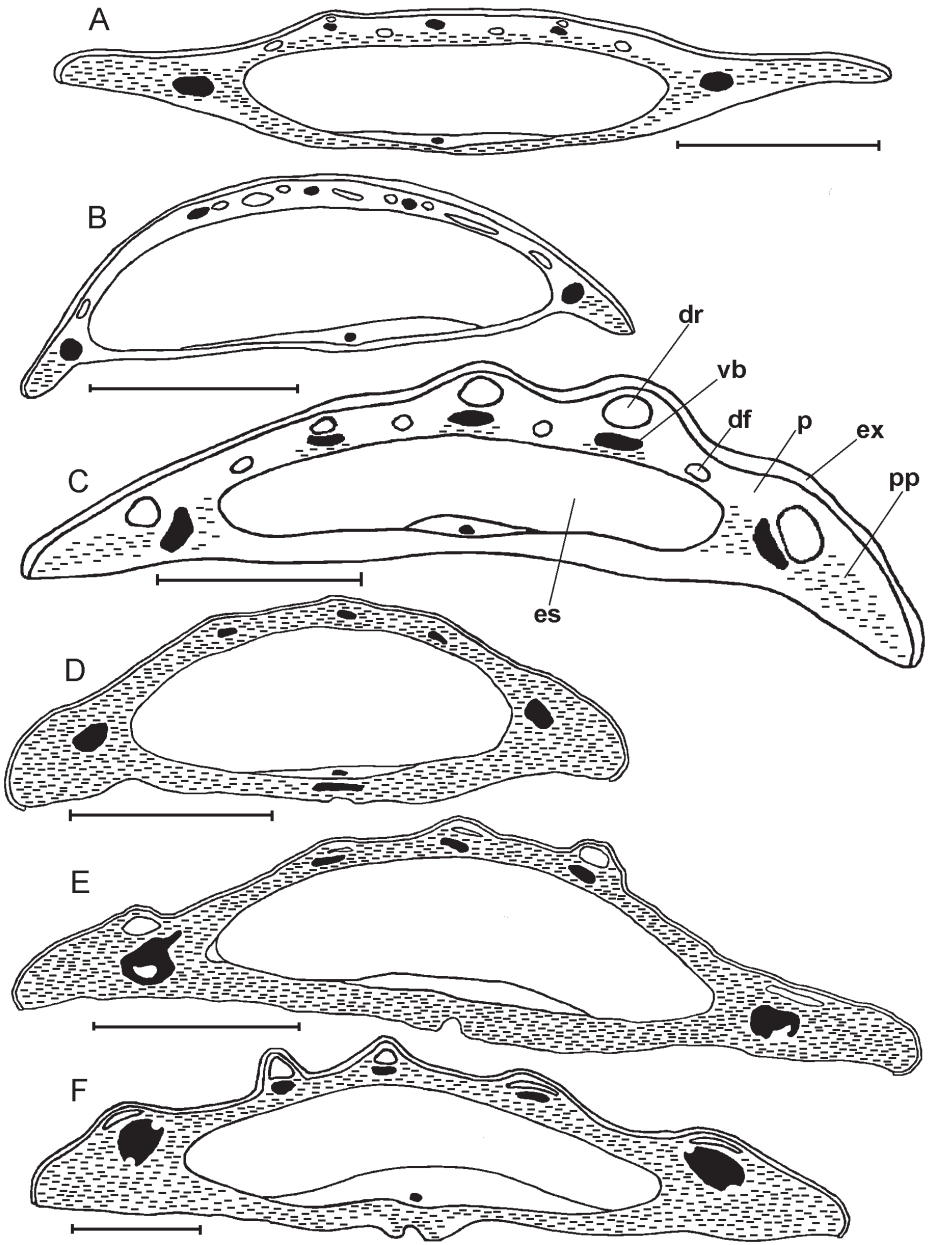


Fig. 7. Schematic transects of mericarps – A: *Dichoropetalum golestanicum;* origin: Iran, Golestan, Gorgan, Jangal-e, Tang-e Gol, 600-700 m, 13.-14.10.1976, *Termé & Matiné 35110* (E); B: *D. scoparium;* origin: Iran, prov. Chaharmahal-e Bakhtiari, Sabz Kuh, Kuh-e Darreh, 2300-2750 m, *19.8.1986, Mozaffarian 58181* (TARI); C: *D. platycarpum;* origin: Iran, Khorassan, N Nishapour, Mirabadriva, 1750 m, 10.7.1995, *Faghihaia & al. 26066* (MD); D: *D. ramosissimum;* origin: Iran, Mazandaran, Kelardascht, Rudbarak, 1700 m, *Mozaffarian 72066* (TARI); E: *D. aromaticum;* origin: Turkey, Van, Çatak, 25.7.1954, *Davis & Polunin 23240* (ANK); F: *D. paucijugum;* origin: Azerbaidzhan, Nakhichevan, Shakhbuz distr., Karababa, Kjukjuchai river, 12.6.1977, *Pimenov & al. 488* (MW). – Scale bars = 1 mm; for the abbreviations see caption of Fig. 5.

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Distribution. – Iran (W: Azarbayjan, Kordestan, Kermanshah, Hamadan, Lorestan; Central: Arak, Chaharmahal va Bakhteyari; S: Boyerahmad va Kohgiluye, Fars), Iraq.

Ref. – Under *Johrenia scoparia:* Boissier (1872: 1019). – Under *Johreniopsis scoparia:* Townsend (1964: 74), Heller & Heyn (1993: 43), Jalili & Jamzad (1999: 678).

(18) ***Dichoropetalum platycarpum*** (Boiss.) Pimenov & Kljuykov, **comb. nov.** ≡ *Johrenia platycarpa* Boiss. in Ann. Sci. Nat., Bot., ser. 3, 1: 308. 1844. – Holotype: Iran "In monte Elbourz, *Aucher-Eloy 4582*" (G-BOIS!; isotypes: G!, P!, K!).

Fruit structure. – See Fig. 7C.

Distribution. – Turkmenistan, Afghanistan, Iran (Central: Semnan, Tehran; E: Khorassan; S: Fars, Kerman).

Ref. – Under *Johrenia platycarpa:* Boissier (1844: 80; 1872: 1012), Bornmüller (1930: 49), Mozaffarian (1983: 317), Rechinger (1987: 377), Pimenov & Kljuykov (1992: 112, fig. 1), Heller & Heyn (1993: 33).

(19) ***Dichoropetalum ramosissimum*** (Mozaff.) Pimenov & Kljuykov, **comb. nov.** ≡ *Johrenia ramosissima* Mozaff. in Bot. Zhurn. (St. Petersburg) 88(4): 104, fig. 1. 2003. – Holotype: Iran "Mazandaran: Kelardascht, Rudbarak, 1700 m, *Mozaffarian 72066*" (TARI!).

Fruit structure. – See Fig. 7D.

Distribution. – Iran (N: Mazandaran).

1.5. ***Dichoropetalum*** sect. ***Parajohrenia*** Pimenov & Kljuykov, **sect. nov.**
Type: *Dichoropetalum paucijugum* (DC.) Pimenov & Kljuykov

Plantae monocarpicae, caulibus ramosis. *Laminae foliorum* ambitu lanceolatae, superiores integrae, breves. *Umbellae* 7-13-radiatae. *Petala* flava. *Cellulae mesocarpii* parenchymaticae omnes membranis lignescentibus. *Vittae valleculares* commissuralesque obsoletae.

1. Plants with strong smell; stems almost round in cross section; bractlets linear; stylopods short-conical; lateral umbels not overtopping the central one . . . (20) *D. aromaticum*
– Plants without strong smell; stems considerably ribbed; bractlets lanceolate; stylopods flat; lateral umbels clearly overtopping the central one . . . . . (21) *D. paucijugum*

The position of this group of two species in *Dichoropetalum* remains unstable. Some small changes in the coding of the character states can produce a grouping, in which sect. *Parajohrenia* is joined with *Johrenia,* as its most distant fragment. Such treatment might be nearer to traditional taxonomy of the two species, but contradicts their character set.

(20) ***Dichoropetalum aromaticum*** (Rech. f.) Pimenov & Kljuykov, **comb. nov.** ≡ *Johrenia aromatica* Rech. f., Fl. Iran. 162: 376, t. 303. 1987. – Holotype: Iran "Kurdistan, Sanandaj, 35º03'N, 46º57'E, 1200-1400 m, low rolling mountains of dark slaty rock with open herbaceous vegetation, 21.6.1963, *Jacobs 6973*" (W!).

Fruit structure. – See Fig. 7E.

Distribution. – Iran (W: W Azarbayjan, Kordestan, Kermanshah), Turkey (E Anatolia: Van), Iraq.

(21) ***Dichoropetalum paucijugum*** (DC.) Pimenov & Kljuykov, **comb. nov.** ≡ *Ferula paucijuga* DC., Prodr. 4: 171. 1830 ≡ *Johrenia candollei* Boiss. in Ann. Sci. Nat., Bot., ser. 3, 1: 306. 1844 ≡ *Johrenia paucijuga* (DC.) Bornm. in Russk. Bot. Zhurn. 1-2: 9. 1910. – Holotype: Iran "in radices montium prope Badalan prope Khvoy, 7.6.1828, *Szovits*" (G-DC!).

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= *Johrenia persica* Boiss. in Ann. Sci. Nat., Bot., ser. 3, 1: 306. 1844. – Holotype: [Iran], *Aucher-Eloy 3664* (G!; isotype: P!)
= *Seseli leucocoleum* Stapf & Wettst. in Denkschr. Kaiserl. Akad. Wiss., Math.-Nat. Kl. 51, 2: 318. 1886. – Holotype: Iran "In locis rupestribus et vinetis prope Jalpan, 25.5.1882, *Pichler*" (WU!).

Fruit structure. – See Fig. 7F.

Distribution. – Iran (W: W Azarbayjan, E Azarbayjan, Zanjan, Kordestan, Hamadan, Lorestan; Central: Arak, Chaharmahal va Bakhteyari; S: Fars), Azerbaidzhan, Armenia.

Ref. – Under *Johrenia paucijuga:* Bornmüller (1911: 238), Grossheim (1927: 20, comb. superfl.), Bornmüller (1930: 50), Grossheim (1932: 175), Shishkin (1951: 49, t. 5, fig.3), Karjagin (1955: 476), Tamamschjan (1967:104, map 115), Takhtajan & Fedorov (1972: 193), Mandenova (1973: 385, t. 175), Mozaffarian (1983: 122, 316), Rechinger (1987: 375, t. 302), Heller & Heyn (1993: 33).

1.6. *Dichoropetalum* sect. ***Johreniopsis*** (Pimenov) Pimenov & Kljuykov, **comb. & stat. nov.** ≡ *Johreniopsis* Pimenov in Rechinger, Fl. Iran. 162: 454. 1987.
Type: *Dichoropetalum seseloides* (C. A. Mey.) Pimenov & Kljuykov

Plantae monocarpicae, caulibus ramosis foliosisque. *Laminae foliorum* ambitu lanceolatae, superiores breves. *Umbellae* 6-14-radiatae. *Petala* flava. *Cellulae mesocarpii* parenchymaticae e latere dorsali elignescentibus. *Vittae valleculares* solitariae vel paucae.

1. Stems covered by short hairs; mericarps with several vallecular vittae 2
– Stems glabrous, mericarps with solitary vallecular vittae 3
2. Umbel rays strongly unequal; bractlets subulate to linear; stylopods flat; dorsal mericarp ribs filiform . . . . . (25) *D. minutifolium*
– Umbel rays ± equal; bractlets linear-lanceolate; stylopods short-conical; dorsal mericarp ribs shortly keeled . . . . . (26) *D. palimbioides*
3. Stems clearly ribbed . . . . . (24) *D. chryseum*
– Stems round in cross section 4
4. Bractlets 2-3; terminal leaf lobes lanceolate; stylopods flat . . . . . (23) *D. viittijugum*
– Bractlets 3-7; terminal leaf lobes linear; stylopods conical . . . . . (22) *D. seseloides*

(22) *Dichoropetalum seseloides* (C. A. Mey.) Pimenov & Kljuykov, **comb. nov.** ≡ *Ferula seseloides* C. A. Mey., Verz. Pfl. Casp. Meer.: 126. 1831 ≡ *Johrenia meyeri* Boiss. in Ann. Sci. Nat., Bot., ser. 3, 1: 307. 1844 ≡ *Peucedanum meyeri* (Boiss.) Boiss., Fl. Orient. 2: 1018. 1872 ≡ *Johreniopsis seseloides* (C. A. Mey.) Pimenov in Rechinger, Fl. Iran. 162: 455, t. 412. 1987. – Holotype: Azerbaidzhan "in monte Beschbarmak, 21.7.1830, *C. A. Meyer*" (LE!, photo: W).
= *Peucedanum conrathii* Freyn in Bull. Herb. Boissier 3: 305. 1895. – Type: Georgia "Somchetia: in collibus apricis circa Achtala, 7.1888, *Conrath*".

Fruit structure. – See Fig. 8A.

Distribution. – Russia (N Caucasus: Daghestan), Iran (W: Kordestan; N: Golestan; Central: Semnan, Chaharmahal va Bakhteyari), Azerbaidzhan, Georgia, Armenia, Turkey (N (Pontic) Anatolia: Coruh; E Anatolia: Kars, Bitlis).

Ref. – Under *Peucedanum paucifolium:* Shishkin (1951: 199), Karjagin (1955: 489), Tamamschjan (1967: 115, map 124), Mandenova (1984: 267), Frey (1989: 282, map 37). – Under *Peucedanum meyeri:* Lipsky (1899: 326), Grossheim (1932: 193), Chamberlain (1972: 476), Mandenova (1973: 405), Mozaffarian (1983: 124, t. 322). – Under *Peucedanum conrathii:* Grossheim (1932: 181). – Under *Johreniopsis seseloides:* Heller & Heyn (1993: 43).

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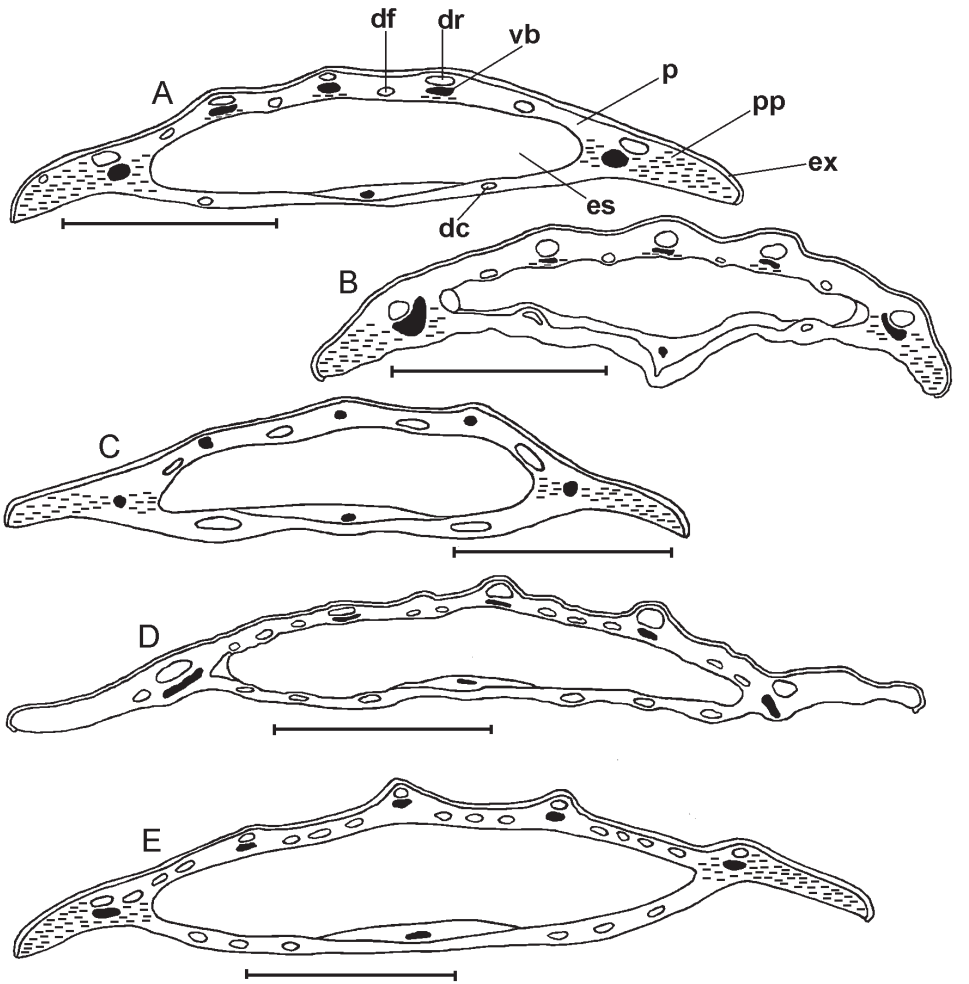


Fig. 8. Schematic transects of mericarps – A: *Dichoropetalum seseloides;* origin: N Azerbaidzhan, Beschbarmak Mt, 10.8.1978, *Pimenov & al. 953* (MW); B: *D. vittijugum;* origin: Greece, Makedonia, Kastoria, 18.8.1988, *Gardner & Gardner 4354* (E); C: *D. chryseum;* origin: Turkey, Antalya, between Kargi chai & Belioter, 1000 m, *26.8.1947, Davis 14233* (E); D: *D. minutifolium;* origin: Bulgaria, 8.1902, *Stribrny* (E); E: *D. palimbioides;* origin: Turkey, A7, Gümüshane, 10.8.1968, *Baytop 14315* (E). – Scale bars = 1 mm; for the abbreviations see caption of Fig. 5.

(23) ***Dichoropetalum vittijugum*** (Boiss.) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum vittijugum* Boiss., Fl. Orient. 2: 1018. 1872. – Lectotype (designated here): Greece "In regione inferiori montis Dirphyis Delphi Eubeae supra pagum Steni, 31.7.1858, *Heldreich 1844*" (G-BOIS!). – Paralectotypes: Greece "In dumosis, radices Taygeti prope Gola inter frutices, 8.6.1846, *Sartori 1844*" (G-BOIS!); "In monte Malevo Laconiae prope Hajos-Joannis, *Orphanides 3194*" (G-BOIS!) "in mt. Chelmos prope Chalkinika, 18.-30.6.1852, *Orphanides 2074*" (G-BOIS!, W[photo]); "prope Carpenisi Eurytaeniae ad rad. m. Veluchi, 9.8.1847, *Samaritani*".

Fruit structure. – See Fig. 8B.

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Distribution. – Albania, Bulgaria, Greece, Serbia, F.Y.R. Macedonia.

Ref. – Under *Peucedanum vittijugum:* Halacsy (1901: 640), Calestani (1905: 230), Hayek (1927: 1034), Rechinger (1943: 413), Stojanov & Stefanov (1948: 858), Tutin (1968: 362), Kuzmanov & Andreev (1982: 226, t. 47), Demiri (1983: 348), Hartvig (1986: 718), Qosja (1992: 403, fig. 750).

(24) ***Dichoropetalum chryseum*** (Boiss. & Heldr. ex Boiss.) Pimenov & Kljuykov, **comb. nov.** ≡ *Anethum chryseum* Boiss. & Heldr. ex Boiss., Diagn. Pl. Orient., ser. 1, 10: 32. 1849 ≡ *Peucedanum chryseum* (Boiss. & Heldr. ex Boiss.) D. F. Chamb. in Davis, Fl. Turkey 4: 475. 1972. – Holotype: Turkey "In humilioribus Tauri Pamphylici [Pamphylia ad radices Tauri] inter Marla & Adalia alt. 1000', 7.1845, *Heldreich*" (G-BOIS!; isotype: K!)
= *Peucedanum chrysanthum* Boiss., Diagn. Pl. Orient., ser. 2, 6: 86. 1859. – Lectotype (designated here): Turkey "In vineis prope Ouchak Phrygiae [Ouchak (Phrygie), vers 910 m d'alt., vignes], 8.1857, *Balansa 1245*" (G-BOIS!; isolectotypes: BM!, GH, JE!, K!, LE!, P!, US, W-photo).

Fruit structure. – See Fig. 8C.

Distribution. – Turkey (N (Pontic) Anatolia: Samsun; Central Anatolia: Kırıkkale, Amasya, Kütahya, Uşak, Denizli, Burdur, İsparta, Konya, Kırşehir; W Anatolia: Manisa, Aydın, Muğla; S Anatolia: Antalya, İçel).

Ref. – Under *Anethum chryseum:* Tchihachev (1860: 436), Boissier (1872: 1026), Zohary (1972: 434). – Under *Peucedanum chryseum:* Heller & Heyn (1993: 41). – Under *Peucedanum chrysanthum:* Tchihachev (1860: 435), Boissier (1872: 1018), Tamamschjan (1967: 115, map 124).

(25) ***Dichoropetalum minutifolium*** (Janka) Pimenov & Kljuykov, **comb. nov.** ≡ *Bunium minutifolium* Janka in Oesterr. Bot. Z. 22: 177. 1872 ≡ *Peucedanum minutifolium* (Janka) Velen., Fl. Bulg. Suppl.: 122. 1898 ≡ *Peucedanum vittijugum* var. *minutifolium* (Janka) Kuzmanov & Andrejev, Fl. Nar. Rep. Bălgarija 8: 228. 1982. – Type: Bulgaria "In steppis collinis mari nigro vicinis inter Aitos & Burgas Thraciae orientalis, 2.7.1871, *Janka*" (BP).
= *Peucedanum thracicum* Velen. in Sitzungsber. Boehm. Ges. Wiss., Math. Naturwiss. Cl. 1892 : 379. 1893. – Type: "In collibus graminosis supra Stanimaka, 7.1892, *Janka, Velenovsky & Stribrny*".

Fruit structure. – See Fig. 8D.

Distribution. – Serbia, Croatia, Bulgaria.

Ref. – Under *Peucedanum minutifolium:* Hayek (1927: 1035), Nikolić (1973: 285), Lukač & Regula-Revilacqua (1997: 112).

(26) ***Dichoropetalum palimbioides*** (Boiss.) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum palimbioides* Boiss., Fl. Orient. 2: 1021. 1872. – Holotype: Turkey "In Ponto Lazico ad Ardanutsch, *K. Koch*" (G-BOIS!).
= *Malabaila carvifolia* Boiss. & Balansa ex Boiss., Diagn. Pl. Orient., ser. 2, 6: 85. 1859 ≡ *Pastinaca carvifolia* (Boiss. & Balansa ex Boiss.) Koso-Pol. in Bull. Soc. Imp. Naturalistes Moscou, ser. 2, 29: 112. 1916 ≡ *Peucedanum acuminatum* M. Hiroe, Umbell. World: 1570. 1979. – Holotype: Turkey "In vineis partis inferioris montis Alidagh prope Caesaream [Kayseri] Cappadociae, 1300', 7.8.1866, *Balansa 1016*" (G!; isotypes: BM!, JE!, K!, US, W!).
= *Peucedanum tomentellum* Freyn & Sint. in Oesterr. Bot. Z. 44: 101. 1894. – Lectotype (designated here): Turkey "Paphlagonia, wilayet Kastamonu, Tossia: in collibus ad Karvak-Tschesme, 4.8.1892, *Sintenis 4880*" (B!; isolectotypes: BM!, G!, JE!, K!, LE!, P!, W!).
= *Peucedanum fallax* Freyn & Sint. in Oesterr. Bot. Z. 44: 102. 1894. – Lectotype (designated here): Turkey "Paphlagonia, Tossia, in vineis montis Giaurdagh, 7.8.1892, *Sintenis 4945*" (B!; isolectotypes: G!, JE!,K!, LE!, P!, W!).

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Fruit structure. – See Fig. 8E.

Distribution. – Turkey (N (Pontic) Anatolia: Kastamonu, Sinop, Çoruh; Central Anatolia: Ankara, Kırıkkale, Çankırı, Amasya, Tokat, Sivas, Konya, Nevşehir, Kayseri; S Anatolia: Adana, Kahramanmaraş; E Anatolia: Gümüşhane, Bayburt, Erzurum, Malatya, Tunceli).

Ref. – Under *Peucedanum palimbioides:* Lipsky (1899: 326), Grossheim (1932: 182), Tamamschjan (1967: 116, map 125), Chamberlain (1972: 478), Heller & Heyn (1993: 42). – Under *Malabaila carvifolia:* Tchihachev (1860: 460, *"curvifolia"*).

2. *Johrenia* DC. in Coll. Mém. 5 (Mém. Fam. Ombellifères): 54. 1829 [& Prodr. 4: 196. 1830]
Type: *Johrenia dichotoma* DC.
= *Caroselinum* Griseb., Spic. Fl. Rumel. Bithyn. 1: 374. 1843. – Type: *Caroselinum distans* Griseb.

Plantae monocarpicae, caulibus basi residuis foliorum emortuorum obsoletis, glabris. *Folia* vaginis longis, laminis ambitu ovatis vel triangulatibus, segmentis primariis basalibus sessilibus vel brevepetiolulatis vel longepetiolulatis, lobis terminalibus linearibus vel lanceolatis; folia caulina superiora integra, brevia. *Umbellae* plerumque radiis valde inaequelongis, bracteis nullis. *Bracteolae* herbaceae, subulatae, lineares vel lanceolatae, radiolis breviora. *Dentes calycini* obsoleti. *Petala* flava. *Stylopodia* plana vel breveconica. *Mericarpia* dorso compressa, jugis inconspicuis, in textum mesocarpii immersis, cellulis mesocarpii parenchymaticis lignescentibus, porosis, e latere commissurali destructis circa carpophorum, hypendocarpiis evolutis, vittis vallecularibus nullis vel paucis, maxime minutis, commissuralibus nullis, canaliculis jugalibus solitariis, frequenter magnis. *Endospermium* ventre planum.

1. Basal primary leaf segments sessile; vallecular mericarp vittae distinct, several; umbels 3-5-rayed . . . . . (5) *J. distans*
– Basal primary leaf segments petiolulate; vallecular mericarp vittae absent or very thin; umbels 5-20-rayed 2
2. Umbels 15-20-rayed; stylopods flat . . . . . (2) *J. selinoides*
– Umbels 5-13-rayed; stylopods short-conical 3
3. Central part of dorsal mericarp surface in mature fruits green, clearly differing from white spongy marginal part . . . . . (1) *J. dichotoma*
– Central part of dorsal mericarp surface in mature fruits white, not differing in colour from spongy marginal part 4
4. Stems branching almost from the base; mericarps slightly compressed dorsally . . . . . (3) *J. polyscias*
– Stems branching from the middle part; mericarp convex on dorsal surface . (4) *J. tortuosa*

(1) *Johrenia dichotoma* DC., Prodr. 4: 196. 1830. – Holotype: Lebanon "In Oriente ad Libanum, *de Labillardiere*" (G-DC!).
= *Peucedanum haradjianii* Rech. f. in Ark. Bot., ser. 2, 5(1): 315, fig. 35. 1957. – Holotype: Turkey "Cassius: in monte Cassio, 4-5000', 6.1909, *Haradjian 3924*" (G; isotype: W!).

Distribution. – Turkey (Central Anatolia: Aksaray, Ankara, İsparta, Kayseri, Konya, Yozgat; W Anatolia: Muğla; S Anatolia: Adana, Antalya, Gaziantep, Hatay, İçel; E Anatolia: Erzincan, Elazig), Greece (E Aegean Isls.), Iraq, Israel, Lebanon, Syria.

subsp. ***sintenisii*** Bornm. in Repert. Spec. Nov. Regni Veg. 28: 43. 1930.
Holotype: Turkey "Mardin, Balekri, 16.7.1888, *Sintenis 1330*" (JE!; isotypes: E! K! LD).

Distribution. – Turkey (S Anatolia: İçel, Kahramanmaraş).

Fruit structure. – See Fig. 9A.

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Ref. – Tchihachev (1860: 440), Boissier (1872: 1010), Post (1896: 551, fig. 188), Handel-Mazzetti (1913: 51), Bornmüller (1930: 43, 1938: 285), Post (1932: 551, fig. 348), Mouterde (1970: 650, t. 313, fig. 1), Chamberlain (1972: 435), Heller & Heyn (1993: 33), Fragman & al. (1999: 35), Snogerup & al. (2001: 149). – Under *Johrenia dichotoma* subsp. *sintenisii:* Chamberlain (1972: 435).

(2) *Johrenia selinoides* Boiss. & Balansa ex Boiss., Diagn. Pl. Orient., ser. 2, 5: 99. 1856. – Holotype: Turkey "In faucibus Pylarum Ciliciarum (Gulek Bogasi) [Défile des Portus Ciliciennes, à 10 lieux au nord de Parscus], 9.1855, *Balansa 616*" (G-BOIS!; isotype: P!).
= *Eriosynaphe kotschyana* Fenzl ex Tchih., As. Min., Bot. 1: 433. 1860. – Lectotype (designated here): Turkey "Tauro Cilicico, in Tauri alpes 'Bulgar Dagh', ad inclytas 'Gullek Boghas' in regione montana 3800 ped., 1853, *Kotschy*" (W!).

Fruit structure. – See Fig. 9B.

Distribution. – Turkey (Central Anatolia: Konya; S Anatolia: Adana, Antalya, Hatay, İçel).

Ref. – Tchihachev (1860: 441), Boissier (1872: 1010), Post (1896: 362), Bornmüller (1930: 46), Post (1932: 551), Thiébaut (1936: 166), Chamberlain (1972: 434, map 57, *"silenoides"*), Heller & Heyn (1993: 33).

(3) *Johrenia polyscias* Bornm. in Repert. Spec. Nov. Regni Veg. 28: 44. 1930. – Holotype: Turkey "Agri Ancyritani ad meridiem versus oppidi, prope Cankai, in valle Kavakli-dere, c. 800 m, 16.7.1929" ["Galatia: ditionis oppidi Angora (Ancyra), in valle Kawakli-dere, c. 900 m, 16.7. 1929, *Bornmüller 14139*]" (B!; isotypes: E!, G!, K!, P!, W!).

Fruit structure. – See Fig. 9C.

Distribution. – Turkey (Central Anatolia: Ankara, Amasya, Tokat).

Ref. – Krause (1937: 114), Chamberlain (1972: 436, fig. 8), Heller & Heyn (1993: 33).

(4) *Johrenia tortuosa* (Fisch. & C. A. Mey.) D. F. Chamb. in Davis, Fl. Turkey 4: 436. 1972 ≡ *Eriosynaphe tortuosa* Fisch. & C. A. Mey., Ind. Sem. Horti Petrop. 5: 35. 1838. – Holotype: Turkey "In Anatolia [in Natolia] [? circa Amasya & Tokat], *Wiedemann 35*" (LE!; isotypes: BM, P!)
= *Johrenia fungosa* Boiss., Diagn. Pl. Orient., ser. 1, 10: 33. 1849. – Holotype: Turkey "In montibus Lydiae [Tmolus supra Philadilphiam], 6.1842, *Boissier*" (G-BOIS!; isotypes: JE!, LIV!).
= *Johrenia engleri* Dingler in Flora 66: 212. 1883. – Holotype: Turkey "In lapidosis et rupestribus montanis inter virgulta ad oppidum Biledschik Bithyniae, 7.1873, *Dingler*" (B).
– *Johrenia dichotoma* auct. non DC.: Boissier in Ann. Sci. Nat., Bot., ser. 3, 1: 304. 1844.

Fruit structure. – See Fig. 9D.

Distribution. – Turkey (N (Pontic) Anatolia: Bursa, Samsun; Central Anatolia: Ankara, Çorum, Amasya, Tokat, Eskişehir, Afyon, Burdur, İsparta, Konya, Niğde, Yozgat, Kayseri; W Anatolia: İzmir, Manisa; S Anatolia: Antalya, İçel, Adana), Syria.

Ref. – Heller & Heyn (1993: 33). – Under *Johrenia fungosa:* Tchihachev (1860: 441), Boissier (1872: 1011), Post (1896: 362), Bornmüller (1930: 41), Post (1932: 552), Thiébaut (1936: 166), Mouterde (1970: 650, t. 313, fig. 2). – Under *Johrenia engleri:* Boissier (1888: 266), Bornmüller (1930: 45).

(5) *Johrenia distans* (Griseb.) Halacsy, Consp. Fl. Graec. 1: 634. 1901 ≡ *Caroselinum distans* Griseb., Spic. Fl. Rumel. Bithyn. 1: 374. 1843. – Type: Macedonia "In peninsula Hajion-Oros; raro inter frutices sempervirentes pr. Hajianna in litore (substr. marmor)".
= *Johrenia graeca* Boiss. & Spruner ex Boiss. in Ann. Sci. Nat., Bot., ser. 3, 1: 305. 1844. – Holotype: Greece "In parte orientali montis Hymetti Atticae versus prom. Sunium [im östlichen Hymettus in Griechenland], *Spruner*" (G-BOIS!; isotypes: G!, W!).

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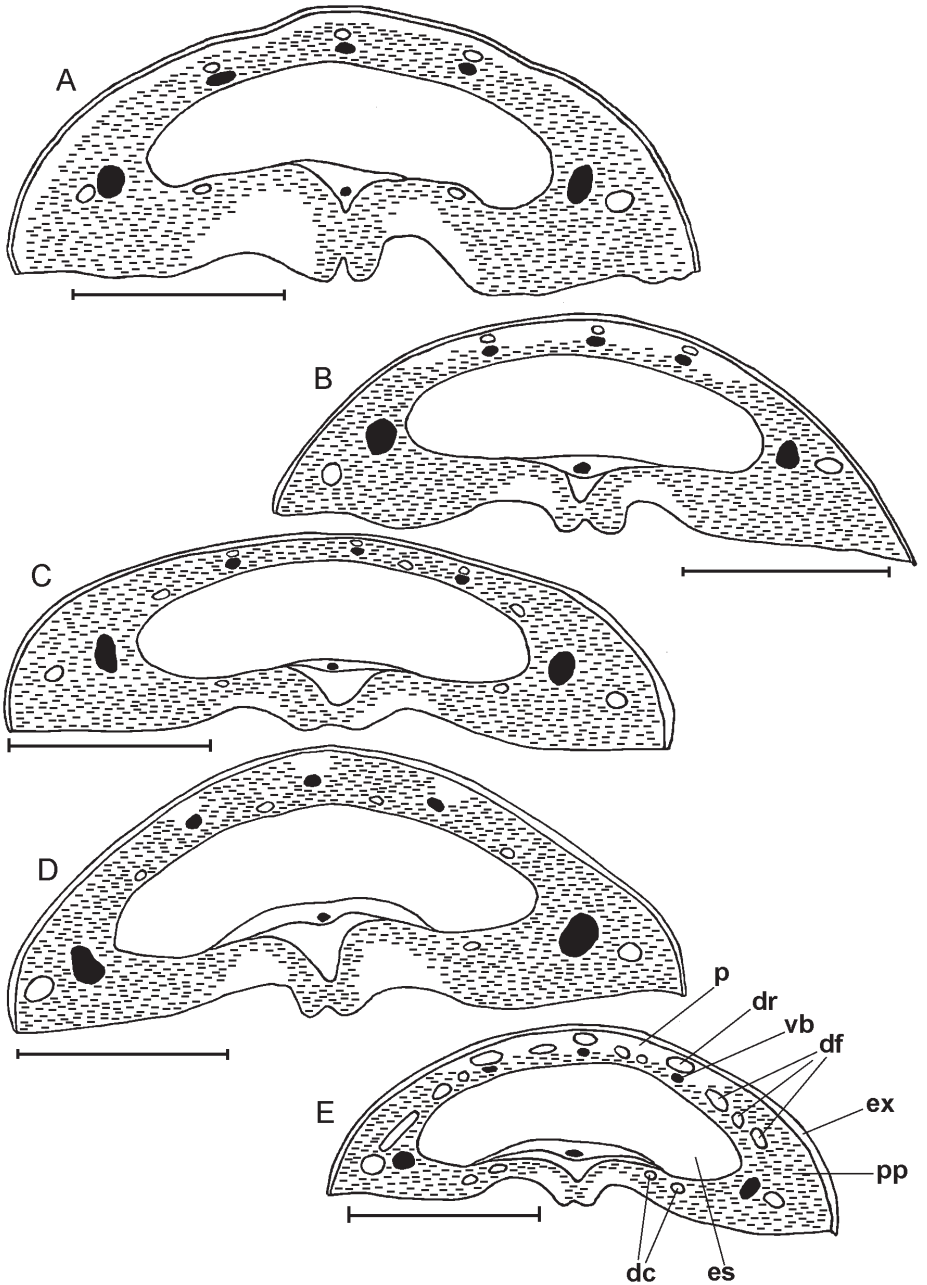


Fig. 9. Schematic transects of mericarps – A: *Johrenia dichotoma;* origin: Turkey, C5 İçel, Toros Dağlari, near Çamliyayla, 37°09'N, 34°36'N, 18.8.96, *Pimenov & al. T96-72* (MW); B: *J. selinoides;* origin: Turkey, Antalya, distr. Alanya, Han Boğazi forest, near Geyik Da., 1600 m, 30.8.1947, *Davis 14713* (E); C: *J. polyscias;* origin: Turkey, Portus Galaticus, 26.6.1890, *Bornmüller 905* (K); D: *J. tortuosa;* origin: Turkey, Tmolus & Sypulus, 8.1842, *Boissier 908* (K); E: *J. distans;* origin: Greece, Mt Hymetus, *Heldreich 910* (E). – Scale bars = 1 mm; for the abbreviations see caption of Fig. 5.

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= *Johrenia thessala* Bornm. in Repert. Spec. Nov. Regni Veg. 28: 37. 1930. – Holotype: Greece "Thessala, Kabampaka, Hagios Stephanos, in fauce Karawa, 27.5.1896, *Bornmüller 528*" (LD).

Fruit structure. – See Fig. 9E.

Distribution. – Greece, F.Y.R. Macedonia.

Ref. – Calestani (1905: 224), Hayek (1927: 1026), Rechinger (1943: 410), Tutin (1968: 358).

3. *Zeravschania* Korovin in Bot. Mater. Gerb. Inst. Bot. Zool. Akad. Nauk Uzbeksk. SSR 12: 28. Typus: *Zeravschania regeliana* Korovin

Plantae polycarpicae, caulibus rotundis, basi plerumque residuis foliorum emortuorum dense tectis, glabris, rarius pubescentibus. *Folia* vaginis brevibus, laminis ambitu ovatis vel triangularibus, segmentis primariis basalibus longepetiolulatis, lobis terminalibus linearibus, lanceolatis vel ovatis, margine dentatis; folia caulina superiora integra, brevia. *Umbellae* radiis 3-15, plerumque subaequelongis, bracteis evolutis, integris. *Bracteolae* lanceolatae vel latelanceolatae, albomarginatae, vulgo radiolis breviorae. *Dentes calycini* obsoleti rarius breves. *Petala* alba vel flava. *Stylopodia* breveconica, rarius conica. *Mericarpia* dorso convexa, jugis dorsalibus filiformibus, marginatis brevetriangulatis, cellulis mesocarpii parenchymaticis a latere dorsali elignescentibus, a latere commissurali non destructis, hypendocarpiis evolutis, vittis vallecularibus solitariis, commissuralibus binis. Endospermium ventre planum.

1. Lower part of stem covered by short hairs . . . . . (5) *Z. stricticaulis*
– Stems completely glabrous in lower part 2
2. Petals white 3
– Petals yellow or greenish yellow 7
3. Terminal leaves lobes lanceolate 4
– Terminal leaf lobes ovate, dentate 5
4. Stems hollow; leaves long-persistent, glabrous; mericarps ribs with secretory ducts . . . . . (3) *Z. regeliana*
– Stems solid; leaves quickly withering, covered by short rigid hairs; mericarp ribs without secretory ducts . . . . . (4) *Z. scabrifolia*
5. Calyx teeth broadly triangular, obtuse; stylopods conical . . . . . (6) *Z. ferulifolia*
– Calyx teeth inconspicuous; stylopods short-conical or dish-shaped 6
6. High montane plants with thick branched caudex; stylopods dish-shaped . . . . . (7) *Z. minjanensis*
– Plants of low altitudes with taproots; stylopods short-conical . . . . . (8) *Z. aucheri*
7. Terminal leaf lobes lanceolate, short . . . . . (1) *Z. pauciradiata*
– Terminal leaf lobes long, narrowly linear to filiform 8
8. Leaves rigid; bracteoles white-membraneous at the margins, lanceolate to ovate . . . . . (2) *Z. membranacea*
– Leaves soft; bracteoles herbaceous, linear . . . . . (9) *Z. knappii*

(1) *Zeravschania pauciradiata* (Tamamsch.) Pimenov in Rechinger, Fl. Iran. 162: 459, t. 417. 1987 ≡ *Peucedanum pauciradiatum* Tamamsch. in Trudy Bot. Inst. Akad. Nauk SSSR, Ser. 1 Fl. Sist. Vyssh. Rast. 3: 225. 1936. – Holotype: Azerbaidzhan "prov. Nakhiczevan, c. Ordubad, M. Schagal, 24.6.1920, *Schelkovnikov & Kara-Murza*" (ERE!).
= *Peucedanum albostriatum* Karjagin in Izv. Azerbaidzhansk. Fil. Akad. Nauk SSSR 5: 39. 1940. – Holotype: Armenia "distr. Megri, pr. custodiam Karschevan, ad fl. Arax, in schistosis lapidosis siccis, 22.6.1934, *Karjagin*" (BAK).
= *Peucedanum oligactis* Rech. f. & Riedl in Anz. Oesterr. Akad. Wiss., Math-Naturwiss. Kl. 98: 251. 1961 ≡ *Johreniopsis oligactis* (Rech. f. & Riedl) Pimenov in Rechinger, Fl. Iran. 162: 456, t. 413. 1987. – Holotype: Iran "prov. Kermanshah, inter Kermanshah & Sanandaj 94 km NNW Taq-i Bustan, substr. Tonschiefer, 28.8.1957, *Rechinger 14692*" (W!)

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Fruit structure. – See Fig. 10A.

Distribution. – Iran (W: E Azarbayjan, Kordestan, Kermanshah), Azerbaidzhan, Armenia.

Ref. – Pimenov (1988: 79), Heller & Heyn (1993: 43). – Under *Peucedanum pauciradiatum:* Shishkin (1951: 200), Karjagin (1955: 489), Tamamschjan (1967: 115, fig. 125), Mandenova (1973: 405, t. 183). – Under *Johreniopsis oligactis:* Heller & Heyn (1993: 43), Jalili & Jamzad (1999: 678).

(**2**) ***Zeravschania membranacea*** (Boiss.) Pimenov in Rechinger, Fl. Iran. 162: 458, t. 415. 1987 ≡ *Peucedanum membranaceum* Boiss. in Ann. Sci. Nat., Bot., ser. 3, 1: 315. 1844. – Holotype: Iran "prope Elamout [Persia, Alamut], *Aucher-Eloy 4566*" (P!; isotypes: G-BOIS!, K!, LE!, W!, US).
= *Cachrys leptorhabdos* Bornm. in Repert. Spec. Nov. Regni Veg. 51: 103. 1942. – Holotype: Iran "Dschekab inter Sultanabad & Kaschan, 7.1903, *Strauss*" (B!).

Fruit structure. – See Fig. 10B.

Distribution. – Iran (W: W Azarbayjan, E: Azarbayjan, Zanjan, Hamadan; N: Mazandaran; Central: Arak, Esfahan; S: Fars).

Ref. – Pimenov (1988: 79), Heller & Heyn (1993: 43), Jalili & Jamzad (1999: 696). – Under *Peucedanum membranaceum:* Mozaffarian (1983: 124). – Under *Cachrys leptorhabdos:* Leute (1987: 211, in nota).

(**3**) ***Zeravschania regeliana*** Korovin in Bot. Mater. Gerb. Inst. Bot. Zool. Akad. Nauk Uzbeksk. SSR 12: 28. 1948. – Holotype: Tadzhikistan "Vall. fl. Zeravschan, inter pag. Kschtut & [lacum] Kuli-Kalon, 1882, *Regel*" (LE!).

Fruit structure. – See Pimenov (1988)

Distribution. – Tadzhikistan, Uzbekistan.

Ref. – Shishkin (1950: 412), Korovin (1959: 351), Pimenov (1983: 273; 1988: 78), Korovin & al. (1984: 152, t. 10, fig.3-5).

(4) ***Zeravschania scabrifolia*** Pimenov in Vvedensky, Consp. Fl. As. Med. 7: 375, 274. 1983. – Holotype: Tadzhikistan "jugum Petri Primi, pars occidentalis, declivum septentrionale prope trajectum Kamchirak, 2700 m, 18.8.1975, *Pimenov 1127*" (MW!; isotype: LE!).

Distribution. – Tadzhikistan.

Ref. – Korovin & al. (1984: 152), Pimenov (1988: 78).

(**5**) ***Zeravschania stricticaulis*** (Rech. f.) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum stricticaule* Rech. f. in Repert. Spec. Nov. Regni Veg. 50: 258. 1941 ≡ *Johreniopsis stricticaulis* (Rech. f.) Pimenov in Rechinger, Fl. Iran. 162: 456, t. 414. 1987. – Holotype: Iran "Prov. Khorassan, Montes Kopet-Dagh inter Quchan & Loftabad, in jugo Allah Akbar, 1800 m, 15.7.1937, *Rechinger 1749*" (W!; isotypes: BM!, US).

Fruit structure. – See Fig. 10C.

Distribution. – Iran (E: Khorassan).

Ref. – Heller & Heyn (1993: 43), Jalili & Jamzad (1999: 678).

Note. – Akhani (in shed. herb. W) came to the same conclusion about the taxonomic attribution of *Peucedanum stricticaule* to *Zeravschania,* instead of *Johreniopsis*.

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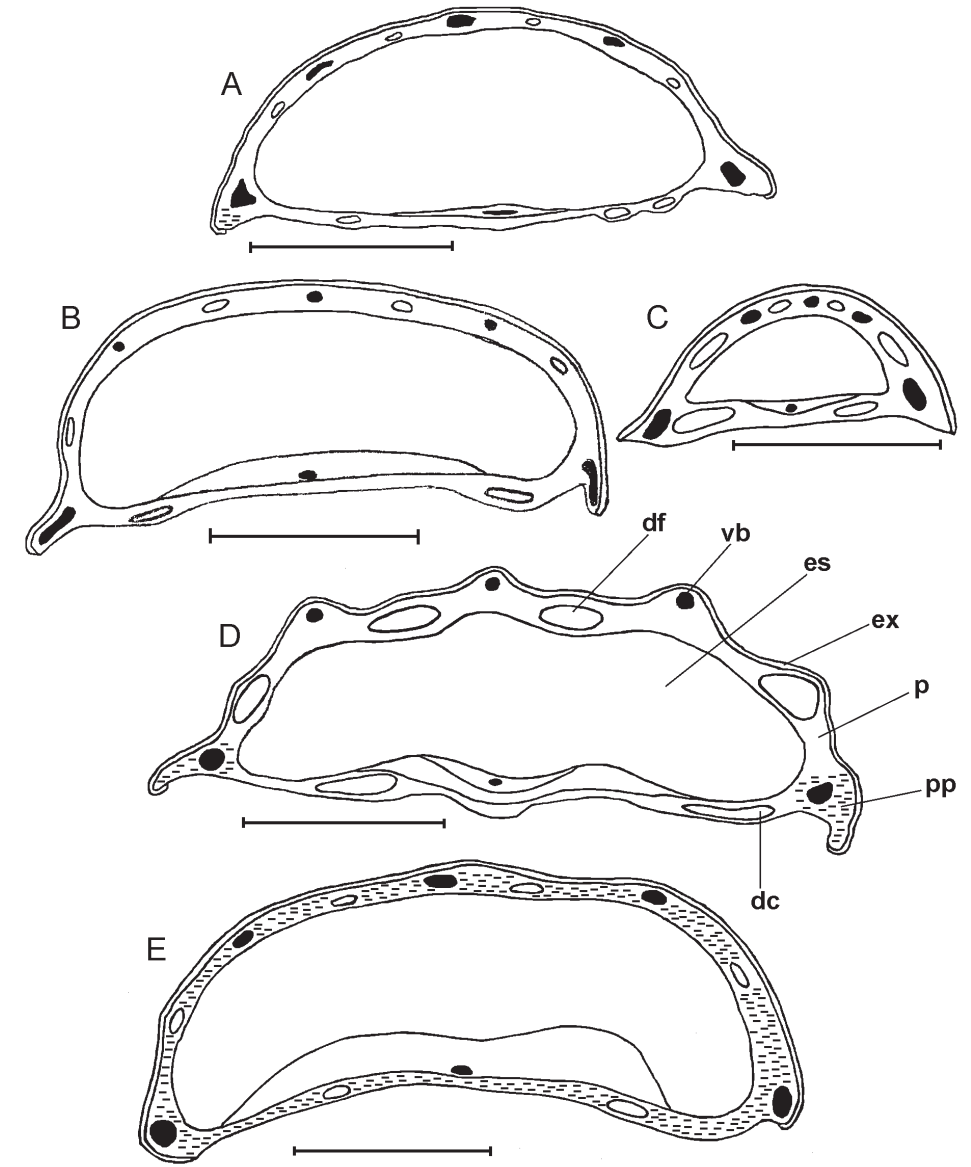


Fig. 10. Schematic transects of mericarps – A: *Zeravschania pauciradiata;* origin: Iran, Arak, Toureh Besri, Kuh-e Aladagh, 25.8.1985, *Mozaffarian 64194* (TARI); B: *Z. membranacea;* origin: Iran, E Azerbaijan, c. 34 km S Mianeh, 1 km after Kahriz village, 1293 m, 37°13'N, 47°43'E, 2.9.2000, *Akhani & Salimian 14214* (herb. Akhani); C: *Z. stricticaulis;* origin: Iran, Khorassan, Hazar Masdjid, inter Ardak et Tolgor, 1200-1600 m, 7.-10.6.1948, *Rechinger 4986 b* (E); D: *Z. ferulifolia;* origin: Afghanistan, Kabul: Sher Darwasa, 1900 m, 19.6.1962, *Hedge & Wendelbo 4312* (E); E: *Z. aucheri;* origin: Iran, Esfahan, Semirom Koh-e, 9.8.1978, *Assadi & Mozaffarian 31662* (TARI). – Scale bars = 1 mm; for abbreviations see caption of Fig. 5.

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(**6**) ***Zeravschania ferulifolia*** (Gilli) Pimenov in Rechinger, Fl. Iran. 162: 460, t. 418, 419. 1987 ≡ *Peucedanum ferulifolium* Gilli in Repert. Spec. Nov. Regni Veg. 61, 3: 204. 1959. – Holotype: Afghanistan "bei Kabul, nach N exponierte Schlucht am Nordhang eines Berges am rechten Kabulusur in den Tangi Ghari unweit des Wasserfalls Maipar, 1070 m, 22.6.1951, *Gilli 2037*" (W!).
= *Scaligeria paniculata* Nasir in Biologia (Lahore) 9: 39. 1963. – Holotype: Pakistan "Baluchistan, Koshkai, *Dick Peddie 22*".
= *Ferula kandaharica* Rech. f., Fl. Iran. 162: 424, t. 383. 1987. – Holotype: Afghanistan "Kandahar, in monte 15 km SW Kandahar, 1100 m, 22.5.1967, *Freitag 811*" (W; isotype: E!).

Fruit structure. – See Fig. 10D.

Distribution. – Afghanistan, Iran (E: Khorassan), Pakistan.

Ref. – Pimenov (1988: 78, p.p.). – Under *Peucedanum ferulifolium:* Nasir (1972: 137, fig. 41A-C). – Under *Scaligeria paniculata:* Rechinger (1987: 233, in nota).

(**7**) ***Zeravschania minjanensis*** (Rech. f.) Rech. f., Fl. Iran. 162: 461, t. 420. 1987 ≡ *Eleutherospermum minjanense* Rech. f. in Kongel. Danske Vidensk. Selsk. Skr. 13(4) [Symb. Afghan. 5]: 88. 1963. – Holotype: Afghanistan "Minjan, in jugo Minjan, 3600 m, 26.7.1937, *Koelz 12718*" (US).

Distribution. – Afghanistan.

(8) ***Zeravschania aucheri*** (Boiss.) Pimenov in Rechinger, Fl. Iran. 162: 459, t. 416. 1987 ≡ *Peucedanum aucheri* Boiss. in Ann. Sci. Nat., Bot., ser. 3, 1: 315. 1844. – Lectotype (designated by Pimenov 1987): Iran "In Persiae borealis monte Dalmkou, *Aucher-Eloy 4630*" (G-BOIS!; isolectotypes: K!, W!).
= *Peucedanum kotschyi* Boiss., Diagn. Pl. Orient., ser. 1, 6: 63. 1846. – Holotype: Iran "Persia australis, *Kotschy 888*" (G-BOIS!).

Fruit structure. – See Fig. 10E.

Distribution. – Iran (W: W Azarbayjan, E Azarbayjan, Hamadan, Lorestan; N: Mazandaran; Central: Semnan, Tehran, Arak, Ghom, Esfahan, Chaharmahal va Bakhteyari; S: Boyerahmad va Kohgiluye, Hormozgan).

Ref. – Pimenov (1988: 79), Heller & Heyn (1993: 43), Jalili & Jamzad (1999: 695). – Under *Peucedanum aucheri:* Boissier (1872: 1022), Burkill (1909: 36), Nasir (1972: 139), Mozaffarian (1983: 123, t. 319).

(9) ***Zeravschania knappii*** (Bornm.) Pimenov & Kljuykov, **comb. nov.** ≡ *Peucedanum knappii* Bornm. in Verh. Zool.-Bot. Ges. Wien 60: 121. 1910. – Holotype: Iran "Azerbeidjan, Qotursu [Kotursu], distr. Afshar, Takht-i Soleiman, in pascuis montanis, 18.8.1884, *Knapp*" (B!).
= *Peucedanum chenur* Mozaff. in Bot. Zhurn. (St. Petersburg) 88(4): 116, fig. 5. 2003. – Holotype: Iran "Kurdistan: Sanandaj, kuhhalye Chehelcheshme, Saral region, 2000-2350 m, *Mozaffarian 74795*" (TARI!).

Fruit structure. – See Mozaffarian (2003, sub *Peucedanum chenur*).

Distribution. – Iran (W: W Azarbayjan, Kordestan).

Ref. – Under *Peucedanum knappii:* Rechinger (1987: 444), Heller & Heyn (1993: 41), Jalili & Jamzad (1999: 684).

Species excludendae

Johrenia longifolia (Fisch. ex Spreng.) Calest. ≡ ***Eriosynaphe longifolia*** (Fisch. ex Spreng.) DC.
Johrenia lycaonica Bornm. = ***Onopordon hispidum*** (Friv.) Griseb.

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Johrenia nudiuscula (Turcz.) Palib. = ***Ferulopsis hystrix*** (Bunge ex Ledeb.) Pimenov
Johrenia pichleri Boiss. = ***Xanthoselinum alsaticum*** (L.) Schur
Johrenia platypoda Aitch. & Hemsl. ≡ ***Galagania platypoda*** (Aitch. & Hemsl.) M. G. Vassilieva & Pimenov
Johrenia popovii (Korovin) Korovin = ***Ferula nuratavica*** Pimenov
Johrenia racemoso-umbellata Gilli ≡ ***Ferula racemoso-umbellata*** (Gilli) Rech. f.
Johrenia seseloides (Hoffm.) Koso-Pol. ≡ ***Ledebouriella seseloides*** (Hoffm.) H. Wolff
Johrenia sieversii Koso-Pol. = ***Ledebouriella seseloides*** (Hoffm.) H. Wolff
Johrenia tordylium Fenzl ≡ ***Coriandrum tordylium*** (Fenzl) Post
Johrenia villosa (Turcz. ex Fisch. & C. A. Mey.) Kudo ≡ ***Phlojodicarpus villosus*** (Turcz. ex Fisch. & C. A. Mey.) Ledeb.
Johrenia westii Post, Pl. Post. 3: 9. 1892 ≡ ***Ferulago westii*** (Post) Pimenov & Kljuykov, **comb. nov.** – Lectotype (designated here): Syria "In planitiae ad radices montis Halimat-Jabu (Antilibani) in Wadi Kenniyyeh-er-Ras [plain at head of Wadi Kenuyyat-er-Vas], 27.7.1891, *Post 121*" (BEI!; isolectotypes: B!, G!, K!)
Zeravschania pastinacifolia (Boiss. & Hausskn. ex Boiss.) Salimian & Akhani ≡ ***Demavendia pastinacifolia*** (Boiss. & Hausskn. ex Boiss.) Pimenov

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