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Taxonomic studies on the genus *Zosima* HOFFM. (Umbelliferae)

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Abstract

A taxonomic study of the genus *Zosima* HOFFM. was carried out. The genus is recognised as having four species, *Z. absinthifolia* (VENT.) LINK, *Z. gilliana* RECH.f. & H.RIEDL, *Z. korovinii* G.M. PIMENOV and *Z. radians* BOISS. & HOHEN. *Z. gilliana* is confined to Afghanistan and north-west of Pakistan, *Z. korovinii* to Kirghisia and *Z. radians* to Iran. *Z. absinthifolia* is widespread in south-west and central Asia. A distribution map is provided for each species. Mericarp micro-morphology, mericarp anatomy and pollen grains were studied using Scanning Electron Microscopy and Light Microscopy. The mericarp surface between the two ribs and on the margin is striate except for *Z. radians,* which is smooth only on the margin. The hairs are ribbon shaped, except for *Z. korovinii*, where they are long triangular. The number of dorsal vittae in the genus is four and commisural vittae two; the dorsal vittae completely occupy the vallecular regions. The genus has oval pollen grains in *Z. absinthifolia* and *Z. radians*, subrhomboidal in *Z. gilliana* and subrectangular in *Z. korovinii.* The tectum is striate-rugulate in all species, except for *Z. absinthifolia,* where it is cerebroid.

Key Words: Taxonomy; Umbelliferae, *Zosima;* plant anatomy, palynology.

Introduction

The genus *Zosima* was first introduced by HOFFMANN (1814), who described *Z. orientalis* HOFFM. based on *Sphondylium orientale,* a name on an herbarium label. HOFFMANN recognised *Heracleum absinthifolium* VENT. and *Tordylium absinthifolium* as synonyms of *Z. orientalis*. *Zosima* was differentiated from the genus *Heracleum* on the basis of the fruits having hyaline wings, around which the lateral ridges form a thickened rim. HOFFMANN'S species name, *Z. orientalis,* was replaced by LINK (1821) with *Z. absinthifolia,* which was an earlier epithet, validly published as *Heracleum absinthifolium* (VENTENAT 1807). The genus was then studied by DE CANDOLLE (1830), BENTHAM (1867) and BOISSIER (1872). Many of Boissier's species were later transferred to the genus *Semenovia* REGEL & HERDER, which had been recognised as belonging to the genus *Platytaenia* NEVSKI & VVED by MANDENOVA (1959). ALAVA (1987) adopted MANDENOVA's treatment of the genera, *Zosima* and *Semenovia* (1959). He also made new combinations in the genus *Semenovia.* ALAVA (1987) recognised three species of *Zosima* from Iran. HELLER & HEYN (1993) only reported two species in *Zosima* in their annotated catalogue of the flora of the Middle East (see table 1).

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Table 1: Taxonomic treatment of the genus *Zosima* HOFFM. by some earlier authors

Author	Tribe & Subtribe	Taxa
HOFFMANN (1814)		*Z. orientalis*
LINK (1821)		*Z. absinthifolia*
DE CANDOLLE (1830)	Peucedaneae	*Z. anethifolia* *Z. absinthifolia*
BENTHAM (1867)	Peucedaneae	*Z. absinthifolia* var. *radians*
BOISSIER (1872)	Peucedaneae - Eupeucedaneae	*Z. absinthifolia* *Z. radians* *Z. tragioides* *Z. frigida* *Z. lasiocarpa* *Z. dichatoma*
DRUDE (1898)	Peucedaneae - Tordyliinae	*Z. absinthifolia* *Z. radians* *Z. tragioides* *Z. frigida* *Z. lasiocarpa* *Z. dichotoma*
SCHISCHKIN (1951)	Peucedaneae	*Z. tordylioides* *Z. absinthifolia*
HIROE (1979)		*Z. absinthifolia* *Z. tragioides* *Z. pimpinellioides* *Z. bucharica* *Z. depauperata* *Z. heterodonta* *Z. komarovii* *Z. rubtzovii*
MOZAFFARIAN (1983)		*Z. radians* *Z. absinthifolia* *Z. frigida* *Z. dichotoma*
ALAVA (1987)		*Z. absinthifolia* *Z. radians* *Z. gilliana*
HELLER & HEYN (1993)		*Z. absinthifolia* *Z. radians*

Material and methods

Around 150 specimens were obtained on loan from herbaria in England and around Europe. Also, some specimens were examined in the field. The specimens were studied and measurements made using a microscope and micrometer or ruler. Some characters (plant height and flowering time) were also taken from the literature or from the labels on herbarium sheets, whenever it was not possible to observe them directly from the specimens.

The pollen material was obtained from herbarium specimens (see table 2). Several unopened buds (to make sure alien pollen grains not present) were placed in a watch-

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Table 2: Voucher specimens for palynological studies.

Taxa	Herbaria	Country	Collector Number
Zosima absinthifolia (VENT.) LINK	RNG	Turkey	Nydegger 44393
	RNG	Turkey	Southam s.n.
Z. gilliana RECH.f. & H.RIEDL	E	Afghanistan	Hedge & Wendelbo 3758
Z. korovinii PIMENOV	GB	Kirghisia	Pimenov et al. 1043
Z. radians BOISS. & HOHEN.	E	Iran	Forughian-Hariri 21923

glass and squashed. A few drops of wetting agent were added. Then the floral fragments were removed using a dissecting microscope, leaving only the pollen grains. Acetolysis mixture was made by mixing 9 parts of acetic anhydride with 1 of conc. sulphuric acid. This was added with a bulb pipette to the dry pollen in the watchglass on a heating block. When the pollen grains darkened, they were allowed to cool for a few minutes. Methylated spirit was then added drop by drop to the centre of the remaining acetolysis mixture and formed a ring around the rim of the watchglass that was wiped away. For SEM study, the pollen grains were mounted on to double-sided adhesive tape on SEM stubs. For light microscopy, the remaining pollen grains were transferred to slides on a small block of glycerine jelly containing safranine. The glycerine jelly was melted and cover slips added. For the SEM study, stubs were coated with gold for 5 - 6 minutes. Measurements were carried out using light microscopy. Photographs were taken on a JEOL T20 SEM and by using a Zeiss light microscope.

The following institutions have been visited or material obtained on loan (acronyms according to Index Herbariorum, HOLMGREN et al. 1990): B, BM, C, E, G, GB, H, ISTE, K, L, RNG, SUNIV, W, and additionally Gazi Üniversitesi, Fen-Edebiyat Fakültesi Herbaryumu, Ankara, Turkey.

Morphology

Longevity and Seasonality: *Z. absinthifolia*, *Z. gilliana* and *Z. radians* are biennial. *Z. korovinii* is perennial. All species have taproots. The flowering period starts in April and continues throughout July.

Stem and indumentum: The height of the plants varies from 30 to 100 cm in *Z. absinthifolia*, 50 to 85 cm in *Z. gilliana*, 35 to 50 cm in *Z. korovinii* and 30 to 50 cm in *Z. radians*. The stem is straight or deeply sulcate. All species produce a strong fibrous collar, which is the remnant of the basal leaves just above the root. The stem is hairy in all species.

Leaves: The leaves are alternate and differentiated into a pinnate lamina and a distinct petiole. The leaves are generally 2 - 3-pinnate but *Z. korovinii* is 1-pinnate. The radical leaf sizes are 150 - 400 × 40 - 60 mm in *Z. absinthifolia*, 160 - 300 × 65 - 100 mm in *Z. gilliana*, 80 - 120 × 20 - 30 mm *Z. korovinii* and 100 - 200 × 20 - 60 mm in *Z. radians*. There are 3 - 4 primary leaf segments, except for *Z. gilliana* which has 4 - 7. The indumentum of the leaves is very similar to that of the stem. They are hairy on both sides.

Umbels: The umbels are compound in all species, but if two or three lateral umbels branch from the same node at top of the plant, it is called here a complex compound

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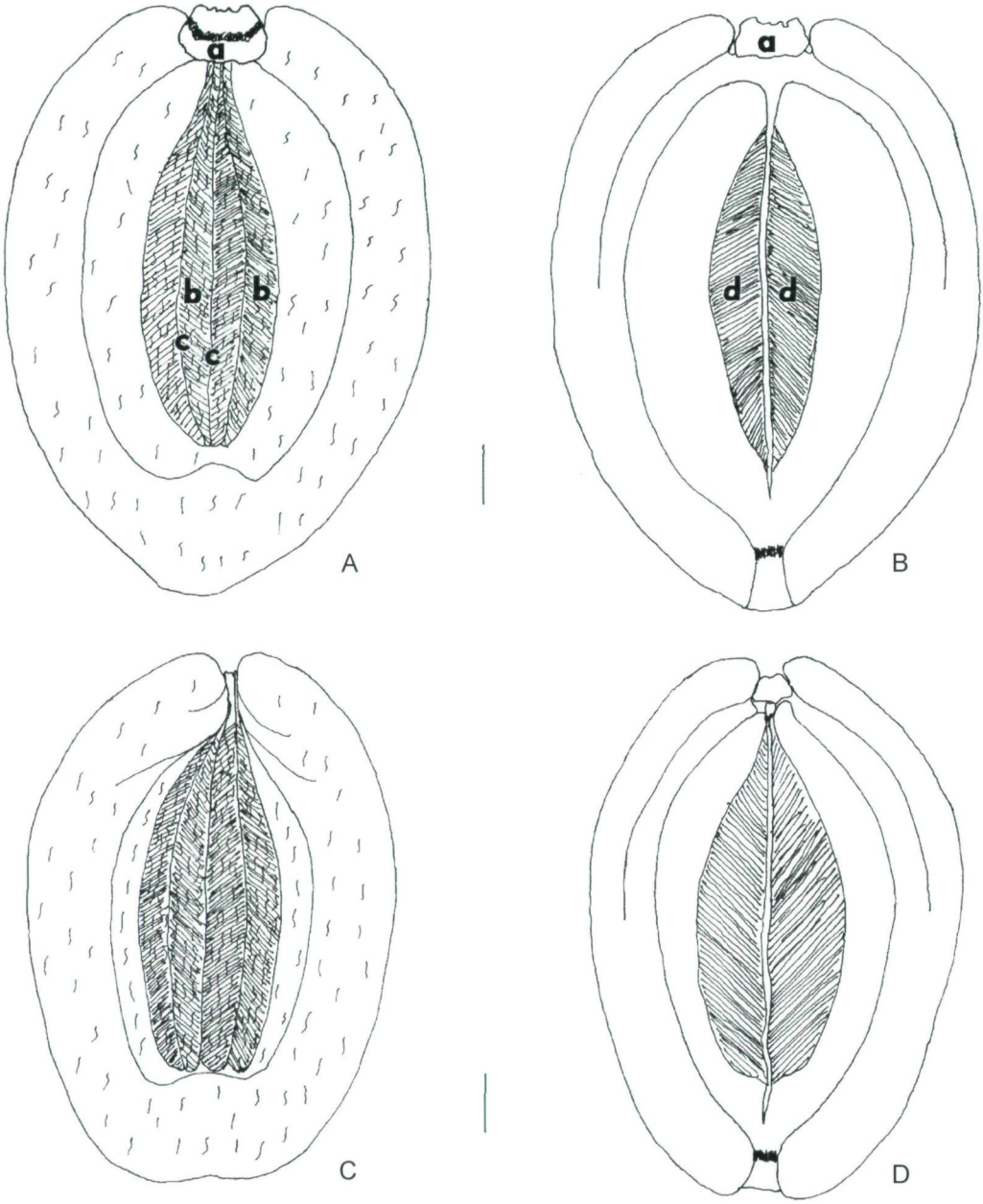

Fig. 1: Mericarps of *Zosima* species. A) dorsal surface of *Z. absinthifolia*; B) commisural surface of *Z. absinthifolia;* C) dorsal surface of *Z. radians;* D) commisural surface of *Z. radians* (a - stylopodium, b - dorsal vitta, c - dorsal rib, d - commisural vitta). Scale 1 mm.

umbel, whereas if the lateral umbels branch alternately, then it is a simple compound umbel. The general tendency is to form a simple compound umbel, except for *Z. radians*, which has a complex compound umbel. The diameter of the umbels ranges from 35 to 140 mm

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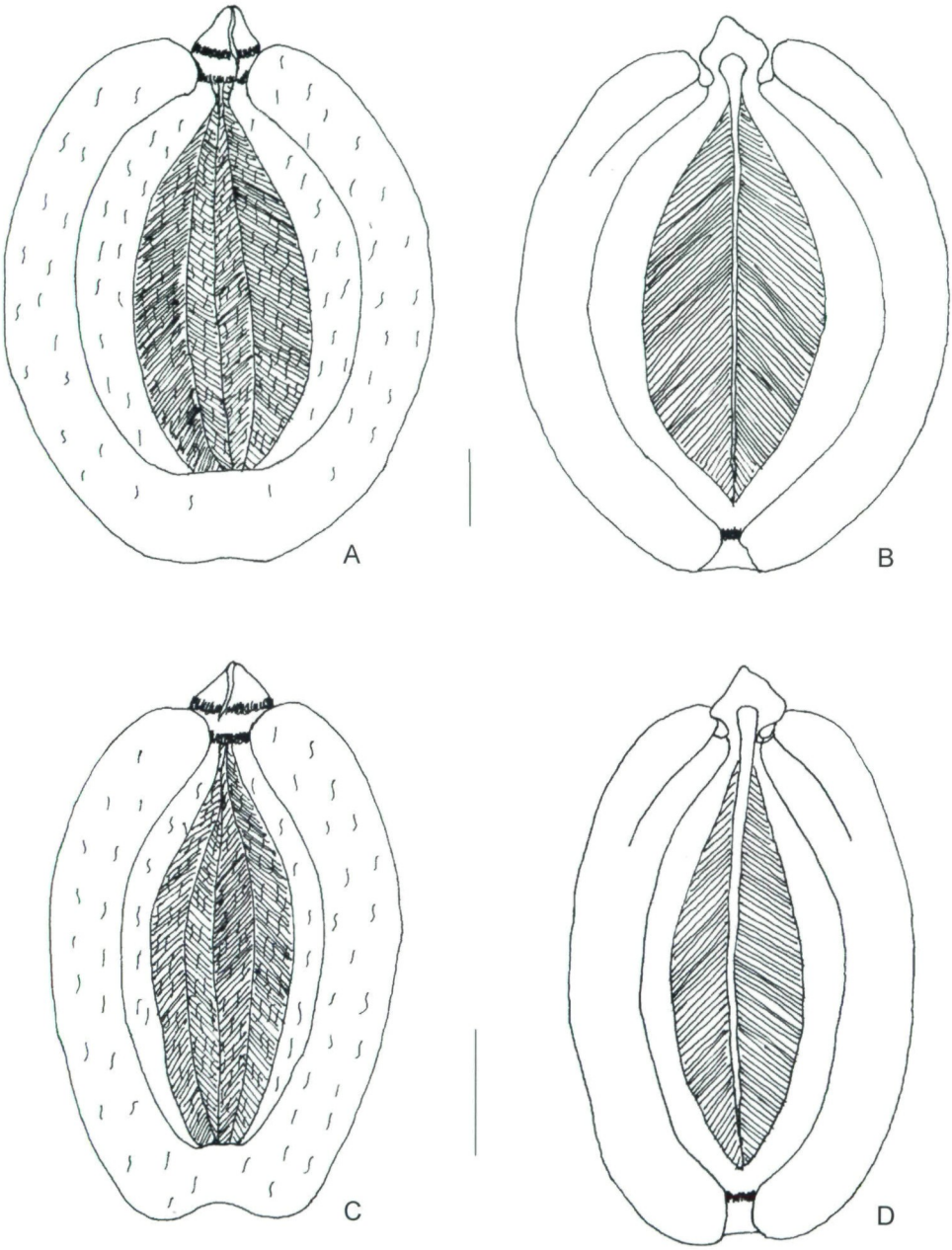

Fig. 2: Mericarps of *Zosima* species. A) dorsal surface of *Z. gilliana*; B) commisural surface of *Z. gilliana;* C) dorsal surface of *Z. korovinii*; D) commisural surface of *Z. korovinii.* Scale 1 mm.

in *Z. absinthifolia,* 45 to 90 mm in *Z. gilliana*, 20 to 55 mm in *Z. korovinii* and 40 to 130 mm in *Z. radians,* and are equal or subequal. The number of the rays varies from 15 to 40 in *Z. absinthifolia,* 18 to 30 in *Z. gilliana*, 5 to 9 in *Z. korovinii* and 13 to 40 in *Z. radians*.

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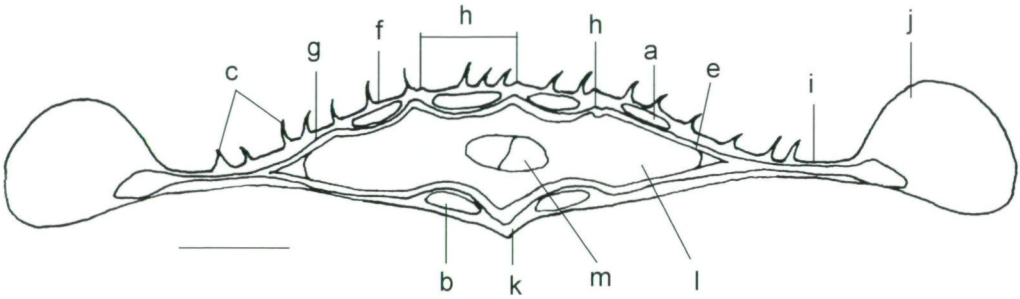

Fig. 3: Transverse section of a mericarp of *Z.radians* (a - dorsal vitta, b - commisural vitta, c - hairs, d - vallecular region (the distance between two ribs), e - endocarp, f - exocarp, g - mesocarp, h - dorsal vascular bundle, i - mericarp wing neck, j - mericarp wing margin, k - carpophore, l - endosperm, m - cotyledon). Scale 1 mm.

Bracts: Bracts are present in all species. They range from 5 to 8 in *Z. absinthifolia,* 8 to 12 in *Z. gilliana*, 3 to 5 in *Z. korovinii* and 2 to 6 in *Z. radians*. The shape is linear or linear-lanceolate, hairy with a ciliate margin in all species.

Bracteoles: Bracteoles are present in all species. They range from 5 to 7 in *Z. absinthifolia,* 8 to 12 in *Z. gilliana*, 4 to 6 in *Z. korovinii* and 5 to 13 in *Z. radians*.

Sepals: The sepal teeth are absent or minute in all species.

Petals: The petals are white, hairy on their dorsal surfaces and range from 1 to 7 mm in length.

Fruit Macromorphology: The fruits are dorsally compressed in all species and the mericarps elliptic in *Z. absinthifolia* and *Z. gilliana* and range from elliptic to suborbicular or cordate-obovate in *Z. korovinii* and *Z. radians* (see figs. 1, 2 and 3). The fruits are between 7.5 and 12 mm long in *Z. absinthifolia,* 7 and 8.5 mm in *Z. gilliana*, 3.5 and 4.5 in *Z. korovinii,* 9 and 12 mm in *Z. radians*. The style is curved in all species. The apex of the mericarps is slightly or deeply emarginate in *Z. absinthifolia* and *Z. korovinii* and makes a sinus in *Z. gilliana* and *Z. radians*.

Fruit Micromorphology: The cells on the dorsal surface form a reticulate pattern. The surface between the two ribs in the species is striate (see figs. 4). The margin of the mericarp surface is very similar to that of the surface between the two ribs except for *Z. radians,* which is smooth. Hairs are present on the dorsal surface in all species and are ribbon shaped except for *Z. korovinii,* which are long triangular. The hair surface is vertically corrugated in *Z. absinthifolia* and *Z. gilliana*, papillose in *Z. korovinii* and smooth in *Z. radians* (see figs. 4). The commisural surface in *Z. radians* is waxy, and the remaining species are glabrous or subglabrous.

Anatomy of mericarp

The number of dorsal vittae in the genus is four. There is only one vitta between the two dorsal ribs, which completely fills it and its width ranges from 0.16 to 0.55 mm (see fig. 3). The number of commisural vittae is 2 and the width varies between 0.40 and 1.19 mm.

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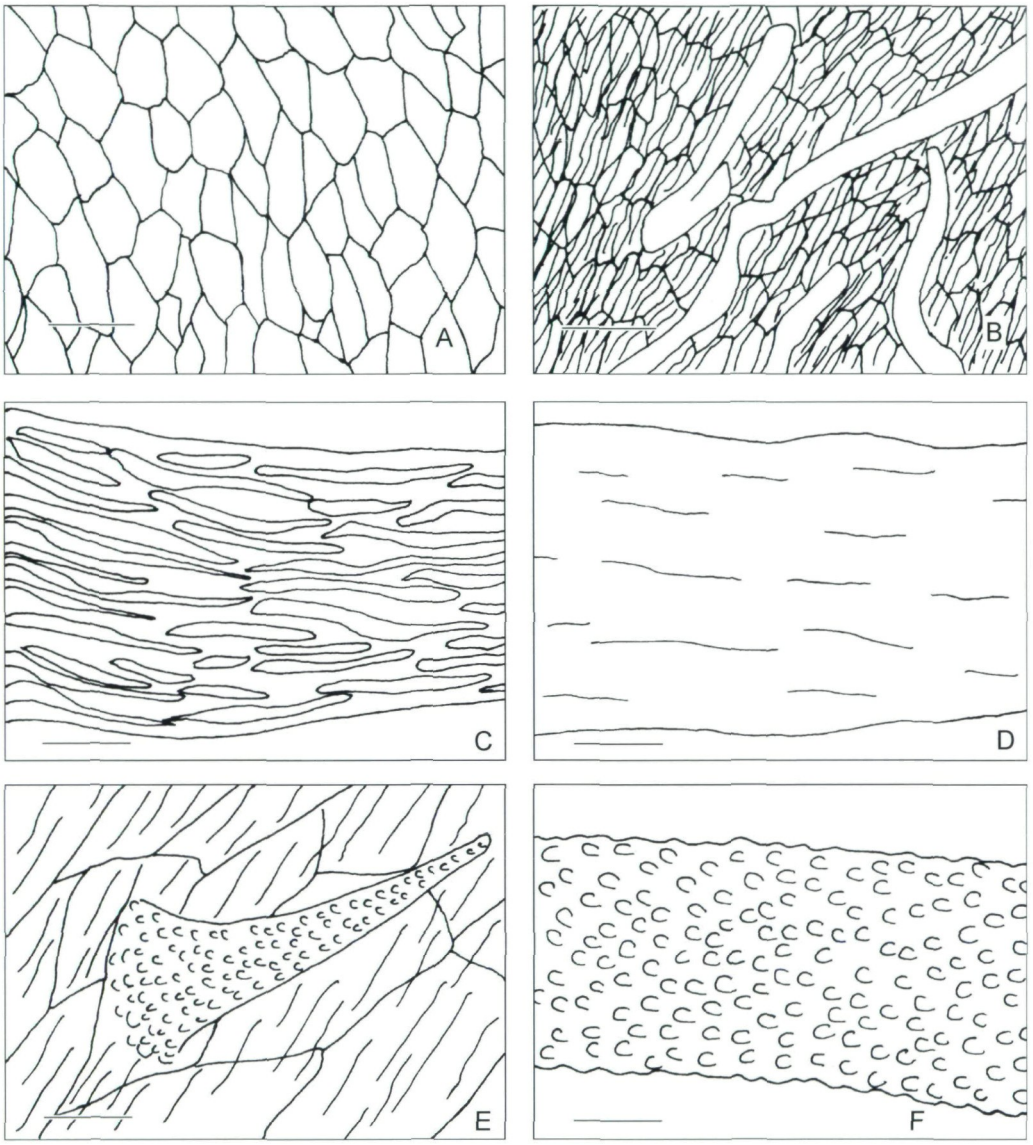

Fig. 4: A) *Z. radians,* reticulate and smooth surface on mericarp margin; B) *Z. absinthifolia,* reticulate and striate surface with ribbon shaped hairs between two ridges; C) *Z. absinthifolia,* vertically corrugated hair surface; D) *Z.radians,* smooth hair surface; E) *Z. korovinii,* hair with papillose surface; F) *Z. gilliana,* papillose hair surface. Scale bars of A = 50 µm; B = 30 µm; C, D, E = 30 µm; F = 5 µm.

All taxa have a lateral wing with a hyaline neck and thickened margin. Exocarp layers range from one to four. The number of the exocarp and mesocarp parenchyma cell layers varies from one to four. The genus has a very distinctive woody lignified endocarp

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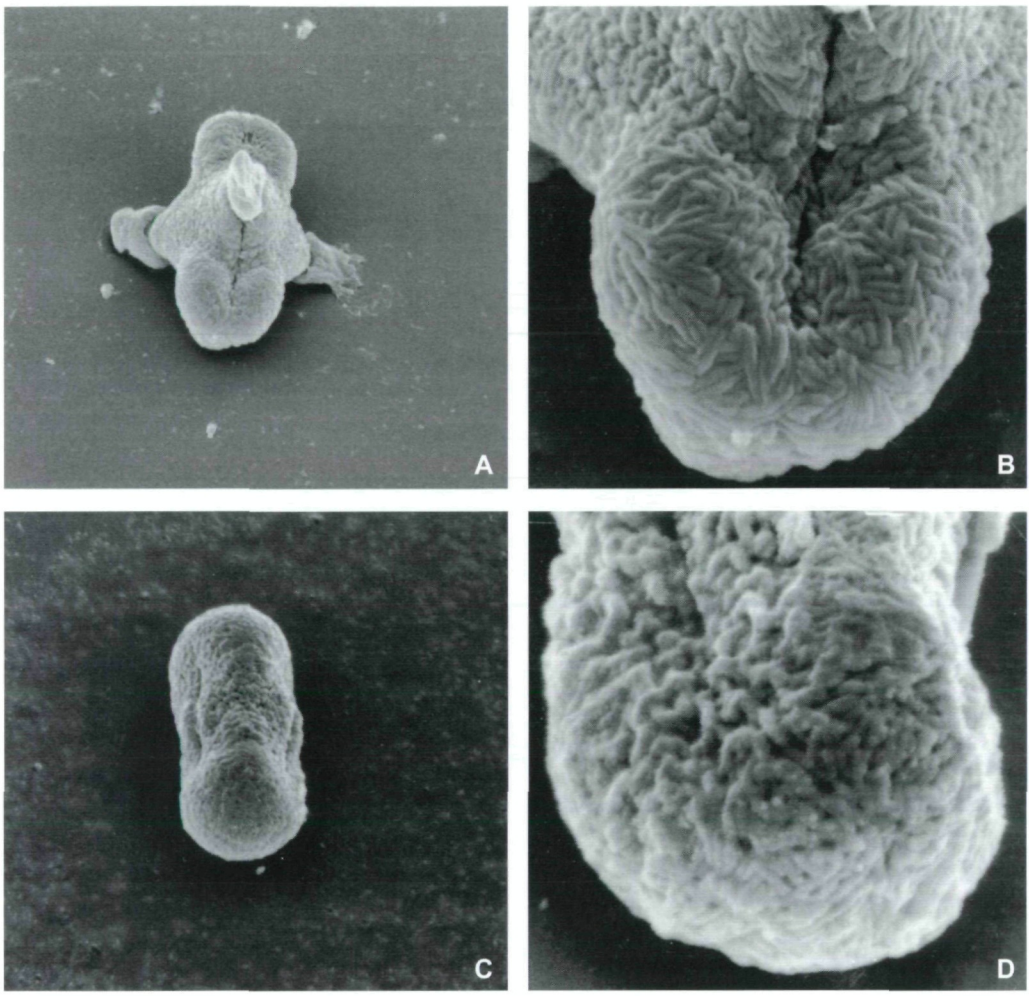

Fig. 5: SEM pictures of pollen grains in *Zosima* species. A, B) three-colporate pollen grain with striate-rugulate surface in *Zosima gilliana;* C, D) three-colporate pollen grain with cerebroid surface in *Z. absinthifolia.*

layer which holds the red colour of safranin when stained. This layer extends through the wings where it connects with the lateral rib bundles. There are between one and three lignified endocarp layers.

Palynology

Oval pollen grains are found in *Z. absinthifolia* and *Z. radians*, subrhomboid in *Z. gilliana* and subrectangular in *Z. korovinii*. The outer contour is generally straight, except for *Z. gilliana*, where it is slightly angled or curved (see figs. 5 and 6). The polar ends are rounded in all species. The tectum is striate-rugulate in all species, except for *Z. absinthifolia,* which is cerebroid (see fig. 5).

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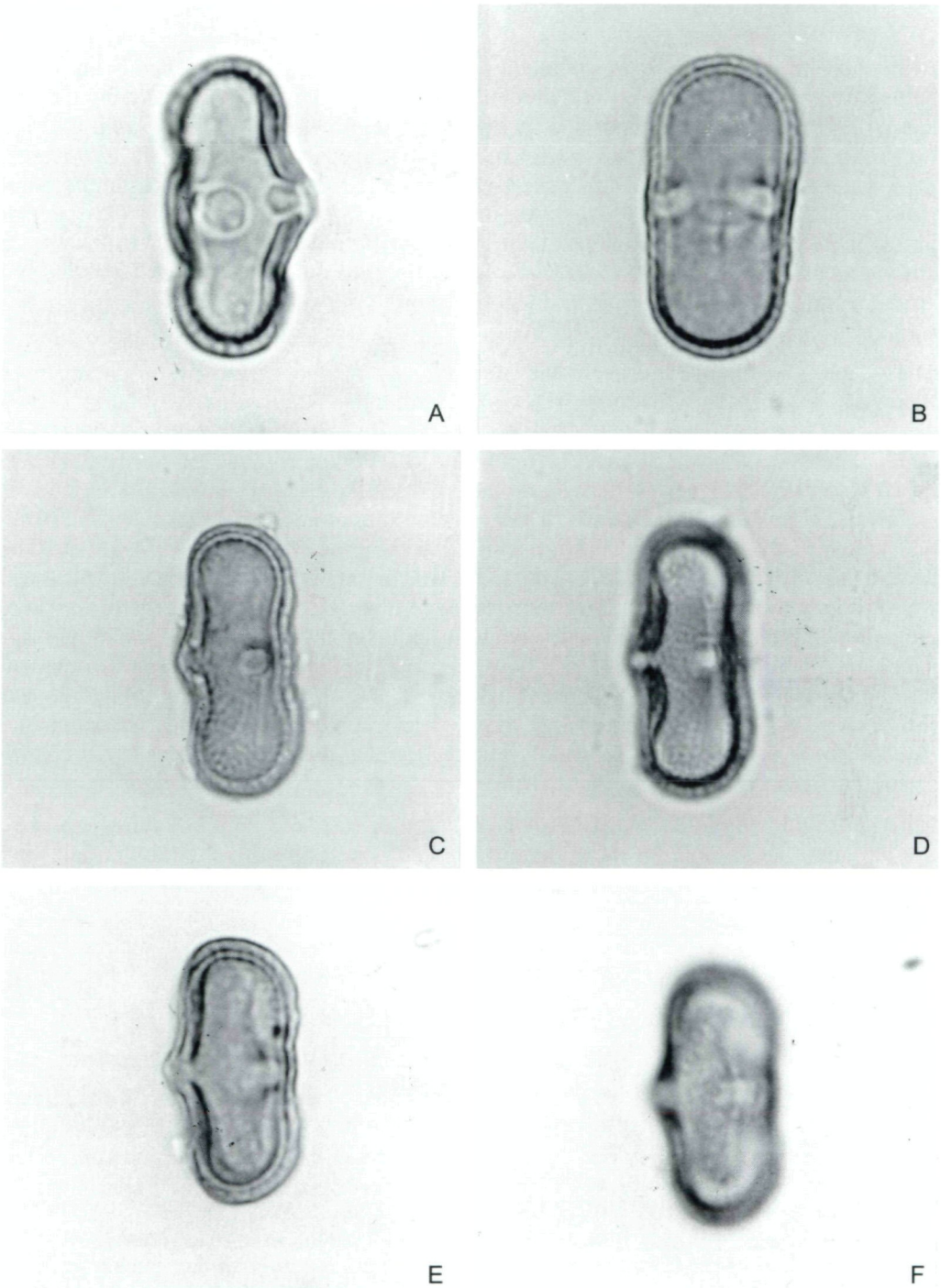

Fig. 6: Light microscopy pictures of pollen grains in *Zosima* species. A) *Z. gilliana,* B) *Z. absinthifolia;* C, D) *Z. korovinii*; E, F) *Z. radians*.

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Discussion and conclusions

Although previous taxonomists included many species in *Zosima*, most of them do not belong to the genus. The genus is characterised by having large vittae occupying the vallecular region, a character supported by linear leaf segments, except *Z. gilliana*. *Zosima* is recognised having only four species at the moment, *Z. absinthifolia*, *Z. gilliana*, *Z. korovinii* and *Z. radians*. *Zosima absinthifolia* has a very large area of distribution compared to the other species and is common in central and south-west Asia. This species of *Zosima* is extremely variable throughout its distribution and possibly hybridises with closely related species. *Zosima gilliana* is confined to an area between Pakistan and Afghanistan. *Zosima korovinii* is known only from Kirghisia. The other species, *Zosima radians,* is endemic to Iran (see fig. 7).

The genus is also separated from the other closely related genera by producing both flavonols and flavones (MENEMEN et al. 1998). The other closely related genera *Malabaila* HOFFM., *Pastinaca* L., *Heracleum* L., *Trigonosciadium* BOISS. and *Stenotaenia* BOISS. produce only flavonols and *Opopanax* W.D.J. KOCH only flavones. HARBORNE (1967) suggested that the replacement of flavonol by flavone compounds is an advanced position in the angiosperms. In fact, this opinion supports FROEBE (1971) who stated that umbels were evolved from a raceme-type inflorescence. In some of the taxa, as in the genus *Malabaila,* lateral umbels branched much more like racemes, whereas in some *Zosima* taxa they are reduced to a whorled branching structure, where the lateral umbels arise from the same node. A chemical investigation of *Semenovia suffruticosa* showed that it contains a flavone compound, chrysoeriol, that is also evident in the genus *Zosima* and that is absent in many species of other closely related genera (MENEMEN et al. 1998). This shows a very clear relationship between *Zosima* and *Semenovia*. However, morphologically and anatomically (mericarp), *Zosima* is clearly separated from *Semenovia*

Micromorphology studies by SEM showed that mericarp and pollen features could be used at some taxonomic levels to delimit the taxa studied such as the pollen and hair shape and pollen and mericarp surface.

Taxonomic treatment

Zosima **HOFFM.**, Gen. Umbell. ed. 1: 145. t. 4 (1814); ed. 2: 145 (1816).

Biennial or perennial, 30 - 100 cm; tap rooted; strong fibrous collar present. Stem tomentose, pubescent, villose, striate or slightly to deeply sulcate, terete or angled. Leaves 1- to 3-pinnate, 80 - 400 × 20 - 100 mm, oblong, elliptic, ovate or triangular, hairy on both sides. Primary leaf segments 3 - 7, ovate or triangular. Secondary leaf segments, if present, opposite or opposite and alternate, ovate or triangular. Umbels simple or complex compound, 20 - 140 mm, rays 5 - 40, equal or subequal, hairy. Bracts present, 2 - 12, 3 - 15 × 0.5 - 2 mm, linear or linear-lanceolate, margins ciliate. Bracteoles present 4 - 13, 3 - 11 × 0.5 - 1.5 mm, linear-lanceolate, margins ciliate. Sepals not conspicuous. Outer flowers regular or irregular. Petals white, hairy on dorsal surface, 1 - 7 mm. Mericarps elliptic, suborbicular or cordate-obovate, 3.5 - 12 × 3 - 9 mm, retuse, slightly cordate at base, margins entire. Hairs present. Styles not erect, glabrous. Apex

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Table 3: Current names of species excluded from *Zosima*:

Name in *Zosima*	current name
Z. anethifolia DC.	*Ducrosia anethifolia* (DC.) BOISS.
Z. bucharica B. FEDTSCH.	*Semenovia bucharica* (B. FEDTSCH.) MANDEN.
Z. depauperata SCHISCHK.	*Semenovia depaupertata* (SCHISCHK.) MANDEN.
Z. dichotoma BOISS.	*Semenovia dichotoma* (BOISS.) MANDEN.
Z. frigida BOISS. & HAUSSKN.	*Semenovia frigida* (BOISS. & HAUSSKN.) MANDEN.
Z. heterodonta KOROVIN	*Semenovia heterodonta* (KOROVIN) MANDEN.
Z. humilis FENZL	*Pastinaca zozimoides* FENZL (FENZL)
Z. komarovii (MANDEN.) M. HIROE	*Semenovia dasycarpa* (REGEL & SCHMALH.) KOROVIN
Z. lasiocarpa (BOISS.) BOISS.	*Semenovia lasiocarpa* (BOISS.) MANDEN.
Z. leiophylla HAUSSKN.	*Semenovia* sp.
Z. nuttalii (DC.) D. DIETR.	*Polytaenia nuttalii* DC.
Z. pamirica LIPSKY	*Semenovia pamirica* (LIPSKY) MANDEN.
Z. pimpinellioides NEVSKI	*Semenovia pimpinellioides* (NEVSKI) MANDEN.
Z. rubtzovii SCHISCHK.	*Semenovia rubtzovii* (SCHISCHK.) MANDEN.
Z. subscobosa RECH.f.	*Semenovia* subscobosa (RECH.f.) ALAVA
Z. tordyloides KOROVIN	*Semenovia* sp.
Z. tragioides BOISS.	*Semenovia tragioides* (BOISS.) MANDEN.

of mericarp slightly or deeply emarginate, sometimes making a sinus at top of mericarp. Dorsal vittae 4, completely occupying the vallecular region. Dorsal and dorso-lateral vittae equal and both reaching the base of mericarp. Commisural surface waxy or not; commisural vittae 2, reaching the base of mericarp.

Type species: *Z. absinthifolia* (VENT.) LINK

1 Leaves 1-pinnate; rays less than 10; mericarp less than 5 mm ..... **3. *Z. korovinii***

1* Leaves 2- or 3-pinnate; rays more than 12; mericarp more than 6 mm 2

2 Number of the primary segments generally more than 5; all flowers regular ..... **2. *Z. gilliana***

2* Number of the primary segments generally less than 5; outer flowers irregular 3

3 Leaf elliptic; mericarp commisural surface without wax; mericarp apex slightly to deeply emarginate, not making a sinus ..... **1. *Z. absinthifolia***

3* Leaf ovate or triangular; mericarp commisural surface waxy; mericarp apex deeply emarginate, making a sinus ..... **4. *Z. radians***

1. ***Z. absinthifolia*** (VENT.) LINK, Enum. Hort. Berol. 1: 274 (1821).
≡ *Heracleum absinthifolium* VENT., Choix Pl.: 7 (1803).
Type (lectotype cited by ALAVA 1987): Iran, Sur la route de Bagdad à Kermanshah, Bruguière & Oliver [G].

= *Zosima orientalis* HOFFM. Gen. Umbel. ed. 1: 148. t. 4 (1814).
Type: "Habitat in Oriente, Persia. Occurrit in regionibus caucasicis, circa montem Beschtau et in Iberia, circa Tiflin" [syntypes MW, n.v.].

= *Zosima iranica* MANDEN., Trudy Tbilissk. Bot. Inst. 15: 161 (1953)
Type: Persia inter Schahrud et Nischapur, vi 1858, Bunge [Holotype LE, n.v.].

= *Z. transcaspica* GANDOGER, Bull. Soc. Bot. France 65: 32 (1918).
Type: Regio transcaspica, Krosnowodsk in steppis arenosis ad Urfa, 21 iv 1901 Sintenis 1530 [L].

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Biennial, 30 - (70) - 100 cm. Stem pubescent, striate or slightly sulcate, terete and angled, mostly branched at base. Leaves 3-pinnate, 150 - (312) - 400 × 40 - (51) - 60 mm, elliptic. Primary leaf segments 3 - (3.7) - 4, ovate or triangular. Secondary leaf segments opposite and alternate, ovate or triangular. Umbels simple or compound, 35 - (85) - 140 mm, rays 15 - (19.8) - 20, equal or subequal sometimes unequal. Bracts 5 - 8, 3 - 15 × 0.5 - 2 mm. Bracteoles 5 - 7, 3 - 10 × 0.5 - 1.5 mm. Outer flowers irregular; petals 1 - 3 mm. Mericarps elliptic, 7.5 - (9.3) - 12 × 7 - (7.3) - 9 mm. Mericarp slightly to deeply emarginate at apex. Commisural surface without wax.

Representative specimens examined: AFGHANISTAN: N.W. of Obeh, 5400', 26 iv 1971, R. B. & L. Gibsons 151 [K]. – ARMENIA: c. Xaruk, 2100-2400 m, 12 vii 1972, Mahakir & Tamahsu [BM]. – CYPRUS: Larnaca, between Mazotos and Alaminos, 17 iv 1991, Alziar et al. 522 [RNG]. – JORDAN: Petra, 1000 m, iv 1937, Dinsmore 11754 [K]. – GEORGIA: In saxosis sapidosis prope Schuscha, 1838, Hohenacker [K]. – IRAN: Desert north of Kermanshah, Kerman-Yezd Rd., 11 iv 1934, Biggs 13103 [BM]. Aschabad, 4 v 1900, Sintenis 235 [K]. Regio transcaspica, Aschabad, 4 v 1900, Sintenis [L]. – IRAQ: Kurdistan, E. of Ruwunduz, 4000-6000', 27 v 1951, Thesiger [BM]. Khantur Mt., 1360 m, 6 vii 1957, Rawi 23369 [K] – PAKISTAN: Pir Killae, Surat, 3500' 30 iv 1954, Rahman 25883 [BM]. – SAUDI ARABIA: N of Hijaz, 7700 ft, 22 iii 1978, Collenette 461 [K]. – SYRIA: Khumeifis, 4 v 1902, Post [K]. – TURKEY: Icel, N. side of the "Cilician Gate", Mountain slopes W. of the road Ankara-Adana, 1800 m, 19 v 1959, Hennipman et al. 1284 [L]. Regio transcaspica, Kasandschik, in steppis ad Usun-su, 28 iv 1901, Sintenis 1631 [L]. Regio transcaspica, Krosnowodsk in steppis arenosis ad Urfa, 21 iv 1901 Sintenis 1530 [L]. C10 Hakkari, Zap Gorge, 9 km from Hakkari to Van, 1200 m, 14 vi 1966, Davis 44941 [E]. B9 Van, 26 km from Baskale to Hosap, 2400 m, 3 vii 1966, Davis 45884 [E].

2. ***Z. gilliana*** RECH.f. & H.RIEDL, K. Danske Vid. Selsk. Biol. Skrift. 13. 5: 134 (1963). Holotype: Afghanitan, Berghang südöstlich von Surobi unter der Kammhöhe, 1500 m, 29 V 1951, Gilli 2041 [W].

Biennial, 50 - (71) - 85 cm. Stem tomentose, striate or slightly sulcate and terete. Leaf 2- to 3-pinnate, 160 - (230) - 300 × 65 - (79) -100 mm, oblong, ovate or triangular. Leaf primary segments 4 - (4.7) - 7, ovate or triangular. Leaf secondary segments opposite, ovate or triangular with lobed margins. Umbels simple compound, 45 - (63) - 90 mm, rays 18 - (22.8) - 30, equal or subequal. Bracts 8 - 12, 5 - 10 × 0.8 - 1.2 mm. Bracteoles 8 - 12, 5 - 8 × 0.5 - 1.2 mm. All flowers regular; petals 1.5 - 3 mm. Mericarp elliptic, 7 - (7.5) - 8.5 × 4 - (5.7) - 7 mm. Apex of mericarp with a sinus. Commisural surface without even a little wax.

Representative specimens examined: AFGHANISTAN: Prov. Kabul, Tang-e Gharu, Mahi Par Mountain slope, 31 v 1968, Jorgensen 553 [GB]. Prov. Kabul, in faucibus Tang-e Hharru inter Kabul et Sarobi, ca. 34°32'N, 69°25'E, ca 1400-1500 m, 17 vi 1962, K.H. Rechinger 16935 [W]. Kabul, Mittlere Tang-e Gharu, 1 km oberhalb Mahipar, 1350, 19 v 1970, Anders 3695 [W]. Sarobi, 28 v 1951, Volk 1594 [W]. Bei Kabul, Tangi Gharu, Schutthalde, 1740 m, 12 v 1950, Gilli 2042 [W]. Kabul-Umgebung, Tal des Kabul-Flusses bei Tangi-Gharu, weisse Bluten, 1600-1700 m, 21 v 1935, Kerstan 545 [W]. Gerolle im Kabulfluss sudostlich von Surobi, 1050, 28 v 1951, A. Gilli 2040 [W]. Prov. Maymana, Darrah Zang near Bolceragh, steep rocky slopes, 1400 m, 29 v 1962, Hedge & Wendelbo W. 3758 [E]. – PAKISTAN: Inter Mingora, 33°47'N, 72°22'E, et Khawazakhiela, 850-950 m, 2 vi 1965 K. H. Rechinger 30514 [W].

3. ***Z. korovinii*** G.M. PIMENOV, Byull. Glavn. Bot. Sada (Moscow) 101: 45 (1976). Lectotype (hic designatus): Kirghisia, Montes Tianschan-Centralis, invall. fluvii Dzhumgol, 30 VI 1971, Pimenov, Borjaev, Baranova & Sdobnina 1043 [B, isotype GB].

Perennial, 35 - (43) - 50 cm. Stem villose, deeply sulcate, terete and branched at base. Leaves 1-pinnate, 80 - (103) - 120 × 20 - (27) - 30 mm, elliptic. Leaf segments 3 - (3.3) - 4, ovate or triangular, serrate and lobed, apex acute or obtuse. Umbels simple compound,

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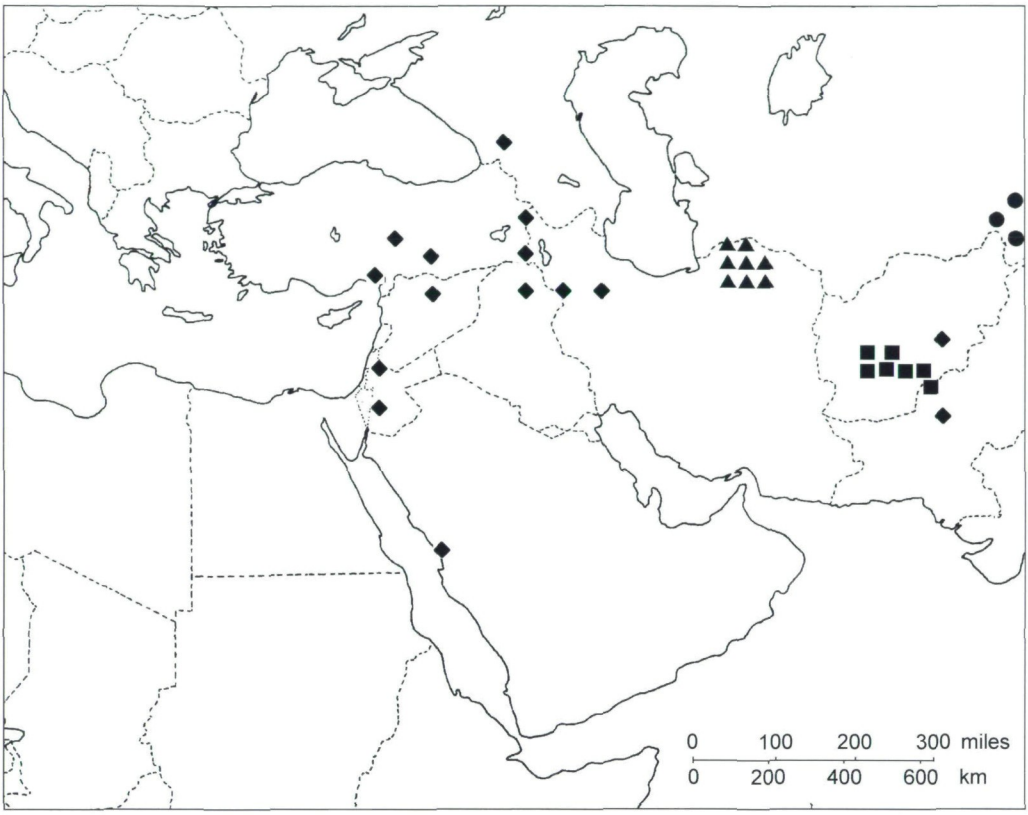

Fig. 7: Distribution map of *Zosima absinthifolia* (◆), *Z. gilliana* (■), *Z. korovinii* (●), *Z. radians* (▲).

rays 5 - (6.7) - 9, 20 - (40) - 55 mm, equal or subequal. Bracts present, 3 - 5, 3 - 7 × 0.8 - 1.5 mm. Bracteoles 4 - 6, 4 - 6 × 0.8 - 1.3 mm. All flowers regular; petals 1.5 - 3.5 mm. Mericarps elliptic to orbicular or suborbicular, 3.5 - (4) - 4.5 × 3 - (3.2) - 4 mm. Apex of mericarp slightly to deeply emarginate at top of mericarp. Commisural surface without wax.

Specimens examined: KIRGHISIA: Montes Tianschan-Centralis, invall. Fluvii Dzhumgol, 30 vi 1971, Pimenov, Borjaev, Baranova & Sdobnina 1043 [B, GB]. Asia Media, prov. Osch, in systemate fluminis Gultscha, supra pag. Sufi-Kurgah, inter pag. Kolduk et lacum Chonkol in gypsaceis, 25 vii 1981, Baranova 714 [G].

4. ***Z. radians*** BOISS. & HOHEN., Diagn. Ser. 1, 10: 43 (1849).

≡ *Zosima absinthifolia* DC. var. *radians* (BOISS. & HOHEN.) BENTH. & HOOK.f., Gen. Plant. 1: 924 (1862).

≡ *Zosima absinthifolia* DC. var. *tereticaulis* O. KUNTZE f. *radians* (BOISS. & HOHEN.) O.KUNTZE, Acta Horti Petrop. 7: 193 (1877).

Lectotype (hic designatus): Iran, hab. in Schistosis montis Elbrus Persia borealis prope Passgala, Kotschy 246 [W, isotypes G, SUNIV].

Biennial, 30 - (39) - 50 cm. Stem pubescent, deeply sulcate, angled and branched at base. Leaves 3-pinnate, 100 - (160) - 200 × 20 - (50) - 60 mm, ovate or triangular.

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Primary leaf segments 3 - (3.6) - 4, ovate or triangular. Secondary leaf segments opposite, ovate or triangular. Umbels complex compound, 40 - (83) - 130 mm, rays 13 - (19.6) - 40, equal or subequal. Bracts 2 - 6, 5 - 13 × 0.8 - 1.5 mm. Bracteoles 5 - 13, 5 - 11 × 0.9 - 1.3 mm. Outer flowers irregular; petals 3.5 - 7 mm. Mericarp elliptic or cordate-obovate, 9 - (10.3) - 12 × 7 - (7.8) - 9 mm. Apex of mericarps with a sinus. Commisural surface waxy.

Representative specimens examined: IRAN: Persia borealis, jugi Elbursensis in subalpinis ad basin septentr. Alpium Totschal, prope Scheheristanek, 2200 m, 1 vi 1902, J. & A. Bornmuller 7231 [B, W]. Persia borealis, Elburs, 1600 m, 19 vi 1935, Gauba 419 [B]. Persia borealis, 2000', 24 v 1935, Gauba 350 [B]. Montes Elburs centr, in ditione oppidi Keredj, in monte Pic Kuh, 1600-2200 m, 30 v 1937, K. H. Rechinger 587 [SUNIV]. Montes Elburs centr, in ditione oppidi Keredj, in monte Pic Kuh, 1600-2200 m, 30 v 1937, K.H. Rechinger 581 [W]. Montes Elburs centr, in ditione oppidi Keredj, in montibus Kuh-e Dasht, 1800 m, 21 v 1937, K.H. Rechinger 282 [W]. Zentral-Elburs, am Sudabhang des Totschal im Tal Hafthous nordwestlich von Teheran, Bergsteppe, 1300-1500 m, 4 vii 1948, Allen 1386 [W]. Montes Elburs centr., in declivibus australibus montis Tocal ad pagum Posgaleh prope Darband, 1500-2000 m, 25 vi 1937, K.H. Rechinger 1118 [W]. Ostan 2, entre Kardj et Gach-i-Sar, 1200-2500 m, 16 v 1956, Schmid 5728 [G]. Ostan 2, environs de Ab-Ali, 2000 m, 9-10 v 1956 Schmid 5558 [G]. W. Karaj Baragan, 1760 m, 21 vi 1972, Farughian-Hariri 21923 [E].

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