

Bilacunaria aksekiensis (Apiaceae), a new species from south Anatolia, Turkey

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A new species, *Bilacunaria aksekiensis* A. Duran & B. Doğan (Apiaceae), is described and illustrated from Anatolia, Turkey. It grows in open *Pinus brutia* forests and on calcareous stony slopes of the Taurus Mountains in the district of Akseki (C3 Antalya province). *Bilacunaria aksekiensis* is morphologically close to *B. microcarpa*. The diagnostic morphological characters of *B. aksekiensis* are discussed. In addition, the pollen characteristics and mericarp surface of *B. aksekiensis* and *B. microcarpa* are examined by SEM. The geographical distribution of the new species and the morphologically related species is mapped. *Bilacunaria aksekiensis* is diploid with the chromosome number of 22.

The family Apiaceae includes approximately 450 genera and 3700 species (Pimenov & Leonov 1993). The largest genera in Asia are *Ferula*, *Bupleurum*, *Pimpinella*, *Heracleum*, *Seseli*, *Angelica*, *Bunium* and *Prangos*. The Asian countries with the greatest Apiaceae diversity are China, Turkey, Iran, Russia and Kazakhstan. Among these countries, Turkey has the highest diversity in Asia and probably in the world, with 151 species in 42 genera (Pimenov & Leonov 2004, Duran *et al.* 2005, Duman & Sağıroğlu 2005, Parolly & Nordt 2005, Pimenov *et al.* 2005, Özhatay & Kültür 2006, Sağıroğlu & Duman 2007, Kandemir & Hedge 2007, Dirmenci 2008).

The genus *Hippomarathrum* was previously revised by Chamberlain (1972) for the *Flora of Turkey*. Traditionally *Hippomarathrum* is divided into two genera according to carpologi-

cal differences (Pimenov & Tikhomirov 1983): *Bilacunaria* and *Cachrys*. *Bilacunaria* has four species, mainly distributed in Anatolia, Armenia, Cyprus, Iran, Israel, Transcaucasia and Syria (Davis 1972, Meikle 1977, Rechinger 1987, Shishkin 1950, Zohary 1987). Two of them, *B. microcarpa* and *B. scabra*, are distributed in the southeast and east Anatolia. The Mediterranean species of *Hippomarathrum* are placed in *Cachrys* (Pimenov & Tikhomirov 1983). That genus has two species in Turkey, *C. crassiloba* and *C. cristata*, which mainly grow in southwest and west Anatolia.

Bilacunaria differs from *Cachrys* primarily in its fruit characters. *Bilacunaria* species have almost round fruits with indistinct ridges and projections on the surface. In anatomical studies of the fruits of *Bilacunaria*, the cross-section appears round with two lacunae in the funiculus.

There are five ridges on each mericarp and five vascular bundles beneath the ribs. *Cachrys* species have oblong or ovate and relatively large fruits with conspicuous ridges and projections on the surface. *Cachrys* species do not have lacunae in the funiculus; however, there is sclerification throughout the mesocarp layer. Therefore, it is possible to distinguish *Bilacunaria* from *Cachrys* according to fruit characteristics (Pimenov & Tikhomirov 1983).

Turkey has two native *Bilacunaria* species: *B. microcarpa* and *B. scabra*, distributed in Anatolia. In this paper, a new species is added to the genus.

The *Bilacunaria* specimen did not have fruits when it was collected in 2005. Specimens with fruits were collected from the same locality in 2008. The specimens were not referable to any known *Bilacunaria* or *Cachrys* species. The study of the specific descriptions of *Hippomarathrum* given in Chamberlain (1972), Herrstadt and Heyn (1972, 1977), Tutin (1968), Zohary (1987), Shishkin (1950), Rechinger (1987), Pimenov and Tikhomirov (1983), Pimenov and Leonov (1993), Meikle (1977) and Gruenberg-Fertig *et al.* (1973) as well as the comparison with specimens in the herbaria KNYA, ANK, GAZI, HUB, ISTE and K showed that the specimens represented a species new to science.

Each provided numerical value is the average of ten measurements from different specimens. The specimens of *Bilacunaria aksekiensis* were examined and compared with specimens of the morphologically similar *B. microcarpa* and *B. scabra*.

Pollen grains were prepared for examination by light microscopy according to Wodehouse (1935), and the measurements were made with an Olympus BX-50 microscope. The pollen diameter measurements are based on ca. 50 samples and the other characters on approximately ten. For SEM study, the pollen grains and mericarp surfaces were coated with gold, and the micrographs were obtained using an Oxford Leo-440 microscope. The descriptive terminology of Erdtman (1969) was followed.

For the study of somatic chromosomes, root tips were obtained from germinated seeds, which were pre-treated in *a*-monobromonaphthalene overnight and then fixed in alcohol:acetic acid

(3:1). Roots were hydrolyzed in 1 N HCl at 60 °C for 16 minutes and stained in Feulgen; in addition, squashes were made in 1% lactopropionic orcein. Permanent slides were made in Depex. Chromosome measurements were based on at least five metaphase plates.

***Bilacunaria aksekiensis* A. Duran & B. Doğan, *sp. nova* (Figs. 1–3)**

Species plantis perennibus; caulibus glabris; foliis segmentatis 25–60 × 0.4–0.7 mm, glabris, apiculatis; radiis 7–22 mm longis, asperis; bracteis 4–5; petalis puberulis; stylis 4–6 mm longis; fructibus 5–6 × 6–6.5 mm, distincte aculeatis diversa.

TYPE: Turkey. Antalya: Akseki, Çukurköy, Alçaktepe, Kocaöz vicinity, 920 m, 7.VIII.2005 A. Duran 7087 (holotype KNYA; isotypes GAZI, ANK, HUB, and Selçuk University, Herbarium of Education Faculty).

Perennial, monocarpic, 70–130 cm tall, thickened rootstock cylindrical-oblong, vertical, 3–6 cm in diameter. Stem stout, glabrous, sparsely or densely resinous at surface, distinctly sulcate, angular or ± terete, entirely much branched, with a weakly developed fibrous collar 3–6 cm long, 4–8 cm diameter at base, lower and middle stem sometimes slightly purplish. Basal leaves broadly oblong to obovate in outline, 50–75 × 40–60 cm (including petiole), petiole with weakly developed sheath, lamina 5–7 pinnate, primary segments 3 and remote, ultimate segments linear, filiform, 25–60 × 0.4–0.7 mm, apiculate, glabrous. Petioles ± flattened, 12–17 cm long. Lower cauline leaves partly reduced, semiamplexicaule, broadly obovate in outline, middle and upper cauline leaves gradually reduced to flowering parts, especially upper cauline leaves much reduced, sessile, sometimes slightly asperulous, 1–2 pinnate or few segments, or lobed to entire. Inflorescence much branched, the branches ascending to erect, alternate, opposite or in whorls 3 or more, upper flowering branches very dense, leaves at base of lateral branches reduced to oblong sheath. Flowers hermaphrodite. Umbels 5–8 rayed, rays 7–22 mm long, equal, asperulous; bracts 4–5, (3–)5–10(–15) × 0.8–1.2 mm, linear-lanceo-



Fig. 1. Holotype of *Bilacunaria aksekiensis*.

late, acuminate, slightly asperulous, persistent. Umbellules 9–11-flowered, when ripe 2–9, 4–6 mm long, asperulous. Bracteoles 5–8, 2–5 × 0.7–1 mm, linear-subulate, slightly asperulous. Sepals nearly obsolete, ca. 0.5 mm, ± rounded, yellow, minutely puberulous. Petals yellow, 0.7–1.0 × 0.8–1.0 mm, oblong, strongly incurved, puberulous externally. Stylopodium flattened, with an undulate margin, not embedded in corky pericarp; style clearly long, slightly curved at the upper part, graceful conical, minutely scabridu-

ous especially lower part, 4–6 mm long; stigma capitate. Mericarps mostly well-developed, didymous or slightly unequal. Mature fruits 5–6 × 6–6.5 mm, broadly oblong, aculeate. Chromosome number: $2n = 22$ (in holotype). Flowering June–July, fruiting July–August.

Bilacunaria aksekiensis appears to be endemic to south Anatolia and thus belongs to the East Mediterranean floristic element. The specimens were collected in Akseki (Antalya province), where the species appears to be rare

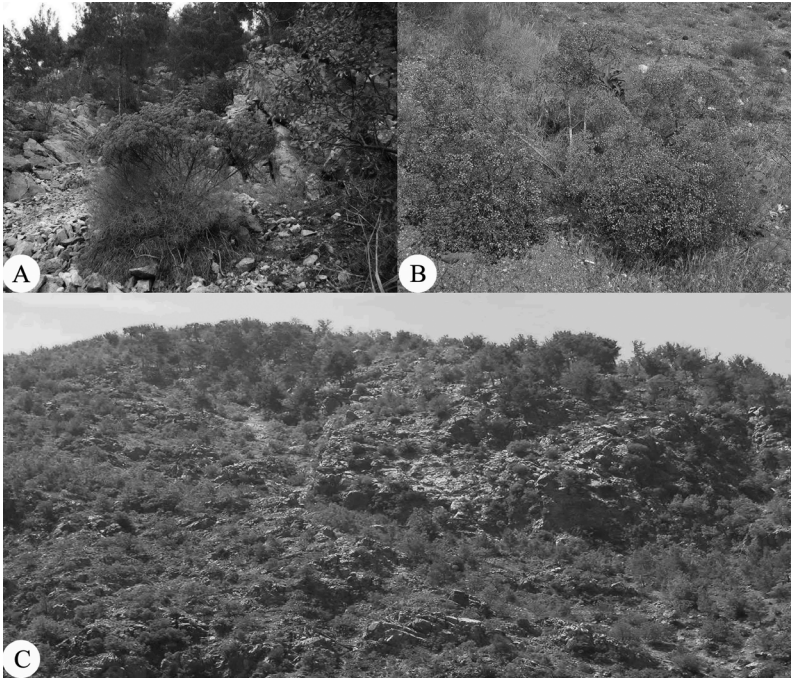


Fig. 2. — A: Habitat of *Bilacunaria aksekiensis*. — B: Habitat of *B. microcarpa*. — C: General view of the type locality of *B. aksekiensis*.

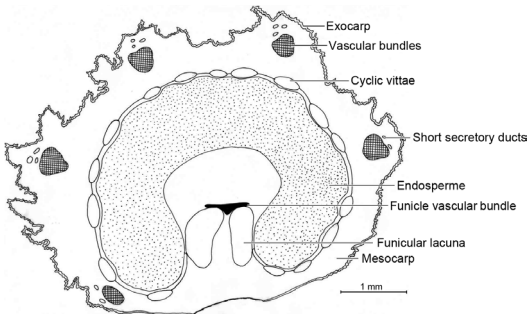


Fig. 3. Cross-section of mericarp of *Bilacunaria aksekiensis*.

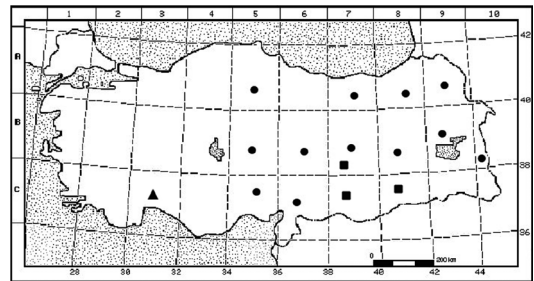


Fig. 4. Distribution map of *Bilacunaria aksekiensis* (▲), *B. microcarpa* (●) and *B. scabra* (■) in Turkey.

and local (Fig. 4). *Bilacunaria aksekiensis* grows on calcareous stony slopes in open *Pinus* forest and scrubs of *Conringia grandiflora*, *Rhamnus nitidus*, *Cotinus coggygria*, *Rhus coriaria*, *Pistacia terebinthus* subsp. *terebinthus*, *Cercis siliquastrum* subsp. *hebecarpa*, *Colutea cilicica*, *Astragalus lusitanicus* subsp. *orientalis*, *Ononis viscosa* subsp. *breviflora*, *Crataegus monogyna* subsp. *monogyna*, *Ferulago cassia*, *Valeriana dioscoridis*, *Xeranthemum annuum*, *Helichrysum pamphylicum*, *Styrax officinalis*, *Fraxinus ornus* subsp. *cilicica*, *Phlomis grandiflora* var. *grandiflora*, *Micromeria myrtifolia*, *Quercus*

infectoria subsp. *boissieri*, *Q. coccifera*, *Ostrya carpinifolia* and *Piptatherum coeruleescens*.

Mericarp surfaces and pollen grains of *B. aksekiensis* and *B. microcarpa* were studied by SEM. The mericarp surface of *B. aksekiensis* is aculeate whereas in *B. microcarpa* it is verrucose (Fig. 5). The pollen grain characteristics of *B. aksekiensis* and *B. microcarpa* are compared in Table 1 and Fig. 6.

Bilacunaria aksekiensis is clearly related to *B. microcarpa*, which is endemic in south Anatolia. The former differs from *B. microcarpa* mainly by the characters given in Table 2.

Bilacunaria aksekiensis also resembles *B.*

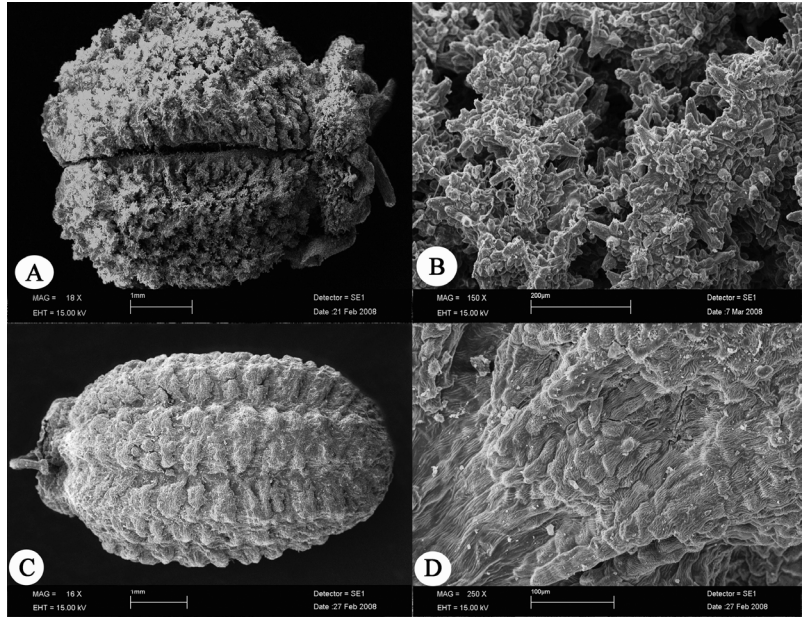


Fig. 5. SEMs of fruits. — **A** and **B**: *Bilacunaria aksekiensis*. **A**: General shape. **B**: Details of surface. — **C** and **D**: *B. microcarpa*. **C**: General shape. **D**: Details of surface.

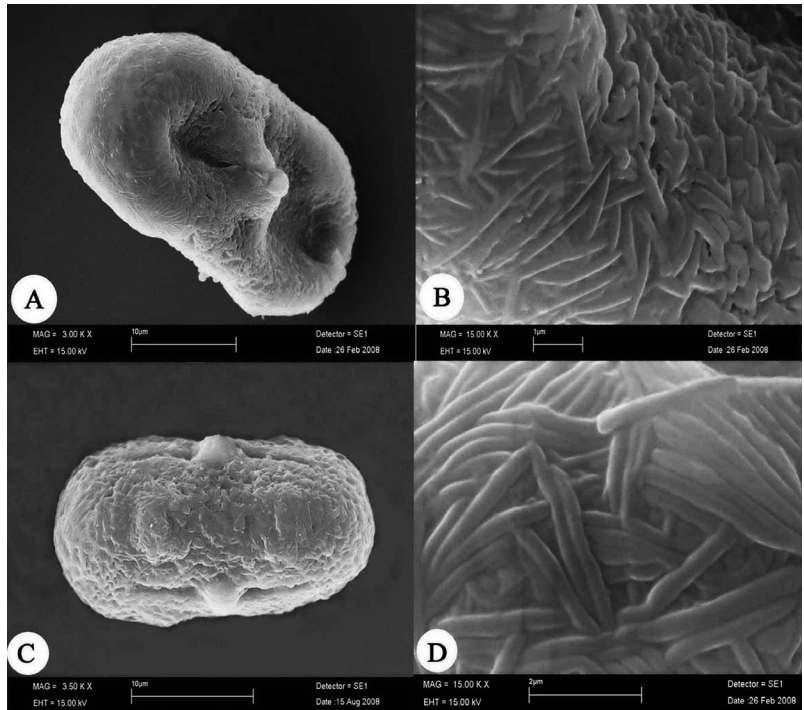


Fig. 6. SEMs of pollen grains. — **A** and **B**: *Bilacunaria aksekiensis*. **A**: General shape. **B**: Details of surface. — **C** and **D**: *B. microcarpa*. **C**: General shape. **D**: Details of surface.

scabra, which grows in southeast Anatolia, Cyprus and Syria. The former differs from *B. scabra* by its glabrous (vs. hairy) stems; not swollen nodes (vs. swollen); oblong–obovate, 5–7 pinnate basal leaves (vs. broadly oblong–

obovate, 4–5 pinnate); umbels with 5–8 rays, 7–22 mm long, slightly asperous (vs. 4–5 rays, 10–20 mm long, ± unequal, scabridulous); slightly puberulous sepals (vs. papillose–puberulous); 4–6 mm long styles (vs. 1–3 mm long) and

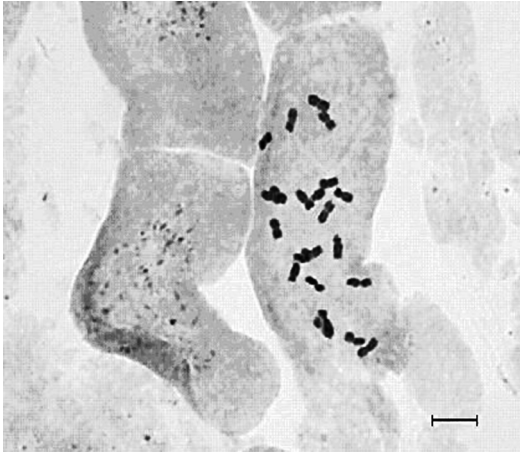


Fig. 7. Somatic metaphase chromosomes of *Bilacunaria aksekiensis*. Scale bar 5 μ m.

oblong, 5–6 \times 6–6.5 mm fruits (vs. globose, 4–5 \times 4–5 mm).

Bilacunaria aksekiensis has $2n = 22$, which is the basic number in the genus *Bilacunaria* (Fig. 7). Also *B. boissieri*, *B. microcarpa* and

B. scabra have $2n = 22$ (Pimenov & Vassilieva 1983).

Palaeopalynological data show that Anatolia had a dense vegetation cover in the last interglacial period. The topography of Turkey has changed many times since then, which resulted in different microclimates in the tectonic valleys (Gemici 1993). The Taurus Mountains are a botanically interesting area located in the Mediterranean phytogeographical region and very rich in local endemic plants (Duran et al. 2005). *Bilacunaria aksekiensis* grows in the Taurus Mountains, which are affected by the Mediterranean Sea (Fig. 2C). Recently several new species have been described from this region, including *Linaria dumanii*, *Arabis davisii*, *Centaurea antalyensis* (Özhatay & Kültür 2006), *Chaerophyllum aksekiense* (Duran & Duman 1999), *Tordylium ketenoglui* (Duman 2000), *Peucedanum isauricum* (Parolly & Nordt 2004), and *Astragalus antalyensis* and *A. cedreticola* (Duran & Podlech 1999).

ADDITIONAL SPECIMENS EXAMINED. — *Bilacunaria aksekiensis* (paratypes): **Turkey**. C3 Antalya: Akseki, Çukurköy, Alçaktepe, Fireklidünek vicinity, 1000 m, 2005 A. Duran 7074 (KNYA, GAZI); *ibid.*, 2005 A. Duran 7087 (KNYA); *ibid.*, 2007 A. Duran and M. Öztürk 7498 (MR); Antalya: Akseki, Çukurköy, north of Kavzan Dağı, Saytaş vicinity, ca. 1150 m, 2008 A. Duran 8134 (MR). — *Bilacunaria microcarpa*: **Turkey**. A5 Amasya: Direkli, S. Peker 1545 (GAZI); A7 Gümüşhane: 1968, T. Baytop s.n. (ISTE); Erzurum: Aşkale-Bayburt road, A. Duran 6012 (MR); A9 Kars: between Karaurgan-Sarıkaş, A. Duran 6825 (MR); B5 Yozgat: Akdağmadeni, T. Ekim & A. Değerli 4098 (ANK); B6 Kahramanmaraş: Göksun-Sarız road, A. Duran 6867 (MR); B7 Erzincan: Erzincan-Sivas road, M. Dinç 2841 and

Table 1. Pollen morphology of *Bilacunaria aksekiensis* and *B. microcarpa*.

Pollen morphology	<i>B. aksekiensis</i>	<i>B. microcarpa</i>
Polar axis (μ m)	29.43 \pm 1.2	29.24 \pm 1.2
Equatorial axis (μ m)	15.35 \pm 1.1	13.99 \pm 1.1
P/E	1.91	2.09
Exine thickness (μ m)	1.43 \pm 0.7	1.75 \pm 0.7
Intine thickness (μ m)	0.75 \pm 0.2	0.81 \pm 0.2
Shape	subprolate	perprolate

Table 2. A comparison of the diagnostic characters and fruit anatomy of *Bilacunaria aksekiensis* and *B. microcarpa*.

Character	<i>B. aksekiensis</i>	<i>B. microcarpa</i>
Stem	glabrous	glabrous to \pm slightly asperous
Basal leaves	oblong-obovate	obconical
Terminal segments	25–60 \times 0.4–0.7 mm, glabrous, apiculate	10–30 \times 0.5–2 mm, \pm hispidulous, acuminate
Umbels	5–8 rays, 7–22 mm long, slightly asperous	7–10 rays, 20–40 mm long, \pm glabrous
Bracts	4–5	5–8
Petals	outer surface puberulous	glabrous
Style length (mm)	4–6	1.5–2
Fruit shape	broadly oblong, 5–6 \times 6–6.5 mm	oblong-globose, 3–5 \times 4–6 mm
Fruit surface ornamentation	distinctly aculeate	obtuse-verrucose
Endosperms	horseshoe-shaped	horseshoe-shaped, tips of endosperm slightly curved

A. Duran (MR); B8 Bingöl: between Göymük-Kanlıova, *T. Baytop 18267* (ISTE); B9 Ağrı: Tutak-Ağrı road, A. Duran 7531 (MR); C5 Niğde: Ulukışla, A. Duran 7645 (MR). — *Bilacunaria scabra*: **Turkey**. C7/8 Diyarbakır/Mardin: in Mesopotamia inter Diyarbakır et Mardin, *Kotschy 322* (isotype K, photo!); Şanlıurfa: Ceylanpınar, *H. Ay 1001* (MR); C8 Mardin: Dargeçit-Midyat road, A. Duran 7958 (MR).

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References

- Chamberlain, D. F. 1972: *Hippomarathrum* Link. — In: Davis, P. H. (ed.), *Flora of Turkey and the East Aegean Islands*, vol. 4: 390–393. Edinburgh University Press, Edinburgh.
- Davis, P. H. 1972: Umbelliferae. — In: Davis, P. H. (ed.), *Flora of Turkey and the East Aegean Islands*, vol. 4: 265–288. Edinburgh University Press, Edinburgh.
- Dirmenci, T. 2008: A new species of *Pastinaca* L. (Apiaceae) from Turkey. — *Botanical Journal of the Linnean Society* 158: 296–300.
- Duman, H. 2000: *Tordylium* L. — In: Güner, A., Özhatay, N., Ekim, T. & Başer, K. H. C. (eds.), *Flora of Turkey and the East Aegean Islands*, vol. 11, suppl. 2: 145. Edinburgh University Press, Edinburgh.
- Duman, H. & Sağıroğlu, H. 2005: A new species of *Ferula* (Apiaceae) from south Anatolia, Turkey. — *Botanical Journal of the Linnean Society* 147: 357–361.
- Duran, A. & Duman, H. 1999: Two new species of Umbelliferae from southern Turkey. — *Edinburgh Journal of Botany* 56: 47–53.
- Duran, A. & Podlech, D. 1999: *Astragalus antalyensis* A. Duran & Podlech, *Astragalus cedreticola* A. Duran & Podlech. — *Sendtnera* 6: 135–174.
- Duran, A., Sağıroğlu, M. & Duman, H. 2005: *Prangos turcica* (Apiaceae), a new species from south Anatolia, Turkey. — *Annales Botanici Fennici* 42: 67–72.
- Erdtman, G., 1969: *Handbook of palynology*. — Hafner Publishing, New York.
- Gemici, Y. 1993: Tersiyerden günümüze Türkiye'nin flora ve vejetasyonu. — *Turkish Journal of Botany* 17: 221–226.
- Gruenberg-Fertig, I., Heyn, C. C. & Herrnstadt, I. 1973: Typification of *Cachrys libanotis* L. (Umbelliferae). — *Taxon* 22: 425–434.
- Herrnstadt, I. & Heyn, C. C. 1972: *Prangos* Lindl. — In: Davis, P. H. (ed.), *Flora of Turkey and the East Aegean Islands*, vol. 4: 382–388. Edinburgh University Press, Edinburgh.
- Herrnstadt, I. & Heyn, C. C. 1977: A monographic study of the genus *Prangos* (Umbelliferae). — *Boissiera* 26: 1–91.
- Kandemir, A. & Hedge, I. 2007: An anomalous new *Ferulago* (Apiaceae) from eastern Turkey. — *Willdenowia* 37: 273–276.
- Meikle, R. D. 1977: *Cachrys* L. — In: Meikle, R. D. (ed.), *Flora of Cyprus*, vol. 1: 726–729. Royal Botanic Gardens, Kew.
- Özhatay, N. & Kültür, Ş. 2006: Check-list of additional taxa to the supplement Flora of Turkey, III. — *Turkish Journal of Botany* 30: 281–316.
- Parolly, G. & Nordt, B. 2004: *Peucedanum isauricum* (Apiaceae), a striking new species from south Anatolia, with notes on the related *P. graminifolium* and *P. spreitzenhoferi*. — *Willdenowia* 34: 135–144.
- Pimenov, M. G. & Tikhomirov, V. N. 1983: The taxonomic problems in the genera *Prangos* Lindl., *Cachrys* L., *Cryptodiscus* Schrenk and *Hippomarathrum* Hoffm. et Link (Umbelliferae–Apioidae). — *Feddes Repertorium* 94: 145–164.
- Pimenov, M. G. & Vassilieva, M. G. 1983: In IOPB chromosome number reports LXXXI. — *Taxon* 32: 663–664.
- Pimenov, M. G. & Leonov, M. V. 1993: *The genera of the Umbelliferae. A nomenclature*. — Royal Botanic Gardens, Kew.
- Pimenov, M. G. & Leonov, M. V. 2004: The Asian Umbelliferae biodiversity database (ASIUM) with particular reference to south-west Asian taxa. — *Turkish Journal of Botany* 28: 139–145.
- Pimenov, M. G., Akalın, E. & Kljuykov, E. 2005: *Prangos ilanae* (Umbelliferae), a new species from western Turkey. — *Candollea* 60: 379–386.
- Rechinger, K. H. 1987: Umbelliferae. — In: Rechinger, K. H. (ed.), *Flora Iranica*, vol. 162: 190–210. Akademische Druck- und Verlagsanstalt, Graz.
- Sağıroğlu, M. & Duman, H. 2007: *Ferula mervynii* (Apiaceae), a distinct new species from north-east Anatolia, Turkey. — *Botanical Journal of the Linnean Society* 153: 357–362.
- Shishkin, B. K. 1950: Umbelliferae. — In: Shishkin, B. K. (ed.), *Flora of the U.S.S.R.*, 16: 179–195. Izdatel'stvo Akademii Nauk SSSR, Moskva–Leningrad.
- Tutin, T. G. 1968: *Cachrys* L. — In: Tutin, T. G., Heywood, V. H., Burges, N. A., Moore, D. M., Valentine, D. H. & Walters, S. M. (eds.), *Flora Europaea*, vol. 2: 343–344. Cambridge University Press, Cambridge.
- Zohary, M. 1987: *Hippomarathrum* Link. — In: Zohary, M. (ed.), *Flora Palaestina*, 2: 407–409. The Israel Academy of Sciences and Humanities, Jerusalem.
- Wodehouse, R. P. 1935: *Pollen grains*. — McGraw–Hill, New York.