

THREE NEW RECORDS OF TRIPLEUROSPERMUM (ASTERACEAE) FOR THE FLORA OF IRAN

M. Ramezanali Aliakbar, M. Pakravan, A. Sonboli & M. Khayati

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Three species of *Tripleurospermum* Sch. Bip., are reported for the first time for the flora of Iran, including *T. conoclinium* (Boiss. & Balansa) Hayek from Ardabil province in North West Iran, *T. rosellum* var. *album* (Boiss. & Orph.) Hayek and *T. callosum* (Boiss. & Heldr.) E. Hossain from West Azarbayejan province. The micromorphology of fruit of these species have also been investigated by SEM. Furthermore, geographical distribution of the new records is discussed.

Mino Ramezanali Aliakbar, Maneezheh Pakravan (Correspondence <pakravan@alzahra.ac.ir>) & Maryam Khayati, Faculty of Biological Science, Alzahra University, Tehran, Iran.- Ali Sonboli, Department of Biology, Medicinal Plants & Drugs Research Institute, Shahid Beheshti University, Tehran, Iran.

Key words: Asteraceae; *Tripleurospermum*; micromorphology; achene; Iran

گزارش جدید سه گونه از جنس *Tripleurospermum* (ASTERACEAE) برای فلور ایران

مینو رمضانعلی علی اکبر: دانشجوی کاشناسی ارشد سیستماتیک گیاهی، دانشکده علوم زیستی، دانشگاه الزهراء، تهران، ایران

منیژه پاکروان: دانشیار دانشکده علوم زیستی، دانشگاه الزهراء، تهران، ایران

علی سنبلی: دانشیار پژوهشکده گیاهان دارویی، دانشگاه شهید بهشتی، تهران، ایران

مریم خیاطی: دانشجوی کاشناسی ارشد سیستماتیک گیاهی، دانشکده علوم زیستی، دانشگاه الزهراء، تهران، ایران

گونه *T. rosellum* var. *album* (Boiss. & Balansa) Hayek از استان اردبیل و دو گونه *T. conoclinium* (Boiss. & Balansa) Hayek از استان آذربایجان غربی برای اولین بار از ایران گزارش می‌شوند. در این مطالعه میکرومورفولوژی فندقه با استفاده از میکروسکوپ الکترونی نگاره مورد بررسی قرار گرفته و با گونه‌های نزدیکش مقایسه شده است. پراکنش جغرافیایی این گونه‌ها نیز مورد بحث قرار گرفته است.

INTRODUCTION

The cosmopolitan Asteraceae is regarded as one of the largest and highly evolved plant families with 43 tribes, 1600-1700 genera (Funk & al. 2009) and 25000-35000 species (Mandel & al. 2019) in the world. The Anthemideae is the seventh largest tribe in this family (Valles & al. 2005), that *Tripleurospermum* Sch. Bip with 38 species is a small genus of this tribe. This medicinal plant is a Mediterranean genus. Its distribution area is mainly in Europe and temperate Asia, with a few species also in

North America and North Africa (Bremer & Humphries, 1993). *Tripleurospermum* is represented in Iran with 7 species (Mozaffarian 2008; Khayati & al. 2016).

The morphological and micromorphological features of the cypsela in Asteraceae have high systematic value and have been used extensively to elucidate taxonomic relationships across the family (Stebbins 1953; Corner & Corner 1976; Roth 1977; Kallersjo 1985; Bean 2001; Pak & al. 2001; Hood and Semple 2003; Marzinek & al. 2010; Franca & al.,

2015; Ghimire & al., 2016; Silva & al., 2018). Inceer & al. (2012) have studied fruit micromorphology of Turkish *Tripleurospermum* and could interpret interspecific relationships.

In the course of the study on the genus *Tripleurospermum* in a project for M.S. degree by the first author, our attention was caught by some specimens collected from western and north western provinces of Iran, that morphologically did not match to any of the Iranian species. The micromorphological characters of achene were also studied to help in defining the species. Furthermore, they were compared with two close species including *T. transcaucasicum* (Manden.) Pobed. and *T. sevanense* (Manden.) Pobed. The results revealed that these specimens are new records for the flora of Iran. Here we report them and discuss their geographical distribution.

MATERIALS AND METHODS

The plant materials were collected from Azerbaijan and Ardabil Provinces. The specimens were identified using determination keys in Flora of Turkey, Flora of USSR and Flora of Iran (Hossain 1975; Pobedimova 1985; Mozaffarian 2008). Fruits of 5 taxa of *Tripleurospermum* species were used for SEM analysis. Mature fruits belonging to 5-7 capitula of each taxon were collected from natural Iranian populations. Plant vouchers are deposited in the MPH (Medicinal Plants, Institute, Shahid Beheshti University) and ALUH (Alzahra University) herbaria. The list of taxa and their localities are presented in table 1.

The achene surface was analysed on the SEM. Dry and mature achenes were put in alcohol 70% for one week then mounted directly on the stubs using double-sided adhesive tape, coated with gold and then observed in TESCAN VEGA3 LMU scanning electron microscope.

Table 1. List of *Tripleurospermum* species and voucher information used in the present study.

Taxa	Locality	Voucher specimen
<i>Tripleurospermum conoclinium</i> (Boiss. & Balansa) Hayek	Iran, Ardabil, Baghru Mountain, Neor lake	Khayati 2758 MPH
<i>T. rosellum</i> var. <i>album</i> (Boiss. & Orph.) Hayek	Iran, West Azarbaijan, Chaldoran, Avajigh village	Khayati 2761 MPH
<i>T. callosum</i> (Boiss. & Heldr.) E. Hossain	Iran, West Azarbaijan, Chaldoran, Avajigh village;	Khayati 2759 ALUH
	Iran, West Azarbaijan, Uromie, Chaldoran;	Kayati 2760 ALUH
	Turkey, Cifteler, Yazilikaya	Pakravan 2917 ALUH
<i>T. transcaucasicum</i> (Manden.) Pobed.	Iran, West Azarbaijan, Chaldoran, Avajigh village	Olanj N 1907 MPH
	Iran, West Azarbaijan, Khoy, Chaldoran, Pirahmad	Olanj N 1880 MPH
<i>T. sevanense</i> (Manden.) Pobed.	Iran, West Azarbaijan, Khoy, Chaldoran	Khayati 2764 ALUH

RESULTS & DISCUSSION

Achene micromorphology

SEM micrographs of the studied achenes are presented in fig.1. In this study the qualitative and quantitative characters such as shape of achene, length, color and ornamentation type, shape of corona, length and color were examined. Our results showed that the presence of corona and different sculpturing on achene are useful characters to separate species from each other. It is known that surface ornamentation of achene in *T. conoclinium* is reticulate and there is no corona on the tip of the achene (fig. 1 A-C).

Surface of achene in *T. rosellum* var. *album* is similar to *T. conoclinium* (reticulate) but it has white corona that is large and lobulated (fig. 1 D-F).

The achene surface ornamentation types in these species are similar and reticulate with 3 thin ribs, but in *T. callosum* and *T. sevanense*, the achenes are obpyramid, while *T. transcaucasicum* has linear-oblong achene. Moreover, corona in *T. transcaucasicum* is shorter than the other two species. It is lobulated white with pale brown margin but *T. callosum* has crenulate white corona and *T. sevanense* has lobulated white corona (fig. 1 G-O, fig. 2 A-J).

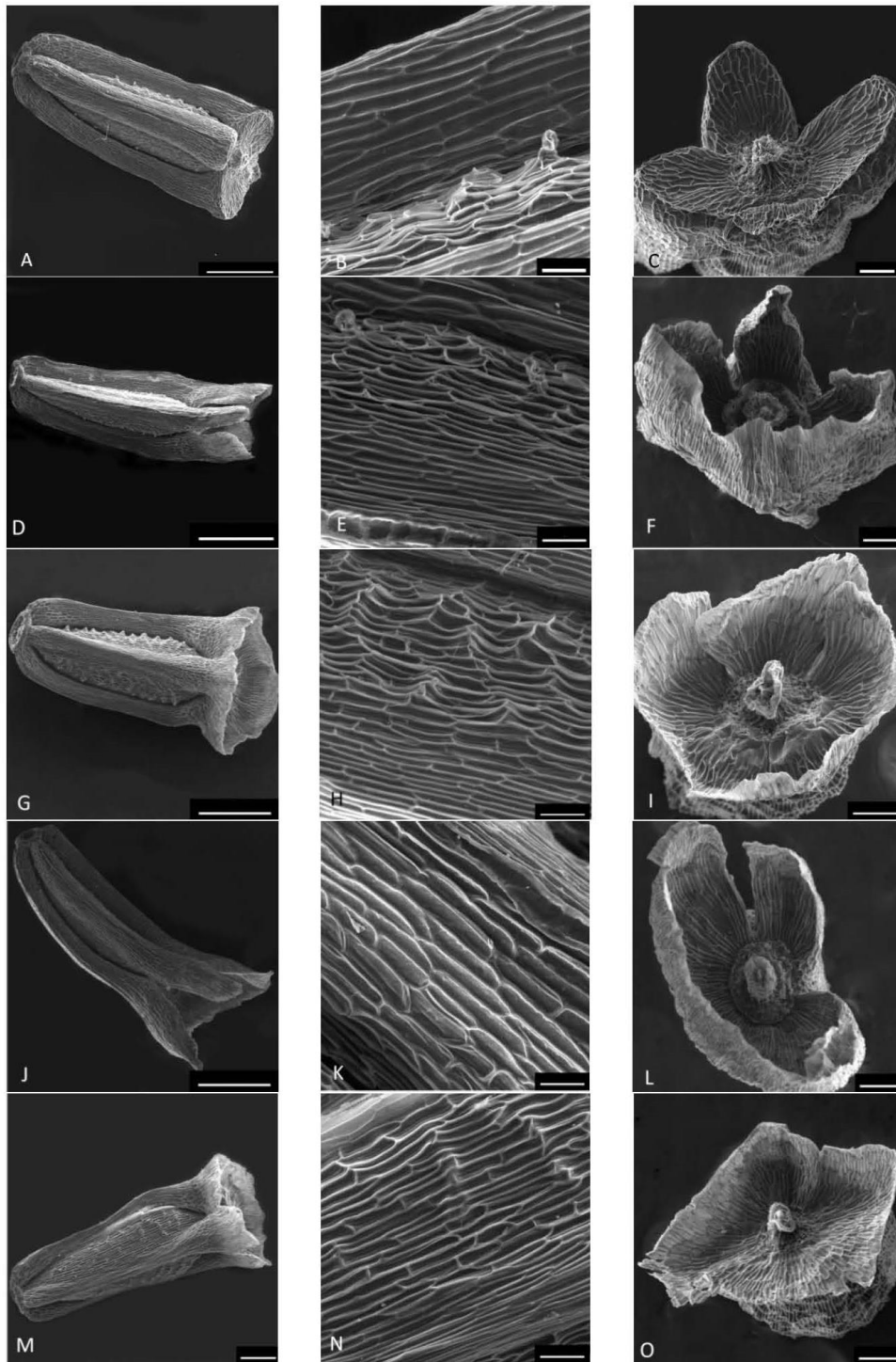


Fig. 1. SEM micrographs of the achenes. A & C, *Tripleurospermum conoclinium*; D & F, *T. rosellum* var. *album*; G & I, *T. callosum*; J & L, *T. transcaucasicum*; M & O, *T. sevanense*; A, D, G, J, M, ventral side; B, E, H, K, N, surface ornamentation; C, Corona Absence; F, I, L, O, Corona. Scale bars: A, D, G, J = 500µm; B, E, H, K, N = 50µm; C, F, L, O = 200 µm; I = 100µm.



Fig. 2. General view of the achenes. A & B, *Tripleurospermum conoclinium*; C & D, *T. rosellum* var. *album*; E & F, *T. callosum*, G & H, *T. transcaucasicum*; I & J, *T. sevanense*; A, C, E, G, I, Posterior surface; B, D, F, H, J, Anterior surface; Scale bars: 0.4 mm.

New records

Tripleurospermum conoclinium (Boiss. & Bal.) Hayek, Repert. Spec. Nov. Regni Veg. Beih. 30 (2): 655 (1931).

Biennial or perennial herbs. Stem 25-65 cm, 1 to many, branched from the base or unbranched above. Leaves 2-3 pinnatisect, lacinate linear-lanceolate, mucronate. Inflorescence corymbose, capitule radiate, 2-4 or rarely many, 0.9-1.5 cm broad; peduncles long, unequal. Phyllaries ovate-oblong, obtuse or sub obtuse, pubescent or glabrescent, margins brownish-membranous. Receptacle elongate, broadly conical-oblong; ligule 9-13 mm; corolla lobes of disc flowers prominently glandular at tips. Achenes obovate or obovate-oblong, black at maturity, 1-2×0.6-1.2 mm, profusely mucilaginous, anteriorly smooth or finely lineolate, posteriorly 3-ribbed, ribs thick, white; corona absent; glands tend to coalesce at tip of achene.

Phenology: It blooms between May and July.

Specimen seen: Iran, Ardabil Province, Baghru Mountain, Neor Lake, 1888m, 5 July 2012, Khayati 2758 (MPH) (fig. 3).

Geographical distribution: *Tripleurospermum conoclinium* was reported from Turkey, from very few scattered localities in Anatolia and a single locality in European portion of Turkey. It has also been identified in Greece.

T. rosellum* var. *album (Boiss. & Oroph.) Hayek in Feddes Rep. Beih. 30 (2):654 (1931).

Perennial herbs. Stem 10-30 cm high, solitary or many, erect or ascending, usually unbranched, rarely divided at apex. Leaves 1-3 pinnatisect, lacinate, lax or dense, leaflets lanceolate or linear-filiform, acute. Inflorescence corymbose, capitula radiate, 0.9-1.5 cm broad (excl. ligules), solitary, terminal, rarely 2 on each stem, borne on long naked, glabrous or pubescent peduncles. Outer phyllaries broadly oblong-subacute, glabrous or minutely puberulent, inner oblong-obtuse, all with wide (rarely narrow) undulate, pale brown, pale brown, membranous margins. Receptacle ovoid, ovoid-conical or hemispherical. Ligules 7-13 mm, white; lobes of disc flowers glandular at tips. Achenes 1.5-2×0.6-1.3 mm, compressed, ± incurved, base truncate, slightly mucilaginous, anteriorly smooth, lineolate, posteriorly 3-ribbed, ribs thickened, white, fissures broad; corona white, campanulate, 1/3 as long as achene.

Phenology: It blooms from April to June.

Specimen seen: Iran, West Azarbaijan, Chaldoran, Avajigh Village, 28 May 2011, Khayati 2761 (MPH), (fig 4).

Geographical distribution: *Tripleurospermum rosellum* var. *album* was known from Turkey, "GülGödesi" in Turkish, and is distributed in North

Anatolia and Greece. This species grows in limestone rocks and bare ground at an altitude of 400-2150 m.

The distinguishing morphological characters of this variety are lanceolate leaves, tripinnatisect, with linear, acute lobes and white ligules. The collected specimen of *T. rosellum* var. *album*, from Iran, were also compared with the type specimen in Kew Herbarium Catalogue, collected by Coquebert de Montbret, A.F.E.

from Turkey

Tripleurospermum callosum (Boiss. & Heldr.) E. Hossain, Notes, Roy. Bot. Gard. Edinburgh 33 (3): 435 (1975).

Syn.: *Chamaemelum callosum* Boiss. & Heldr. (1849). Diagn. Pl. Orient. Nov. Ser. 1, 11: 22; *Chamaemelum heterocarpum* (K. Koch) Boiss. (1875). Fl. Orient. 3: 329. *Matricaria heterocarpa* K. Koch (1851). Linnaea 24 (3): 333.

Perennial herbs. Stem 14-55 cm high, solitary or many arising from rhizome, always laxly and profusely branched from below upwards. Leaves 2-3 pinnatisect; lacinae linear-filiform or linear lanceolate, acute, mucronate or sometimes thickly mucronate with white ends. Capitula numerous, laxly corymbose, radiate 0.6-1 cm broad (excl. ligule), borne on long or short peduncles. Outer phyllaries triangular acute, glabrous or pubescent, inner oblong, sub-obtuse, all with white membranous margins, rarely pale brown. Receptacle ovoid-conical. Ligules 6-9 mm; corolla lobes of disc flowers glandular at tips. Achenes ob-pyramidal, 1.5-1.8×0.4-0.6 mm, anteriorly tuberculate-rugulose, dark brown or blackish at maturity, non-mucilaginous, posteriorly 3-ribbed, ribs white, thin, acute, fissures broad, rugulose or tuberculate; margin of corona, white, crenulate, 1/5 to 1/6, rarely 1/5 as long as achene.

Phenology: It blooms from May to June.

Specimen seen: Iran, West Azarbaijan, Uromie, Chaldoran, 20 Jun 2012, Khayati 2760 (ALUH), (fig. 5).

Turkey, Cifteler, Yazilikaya, 27 June 2007, Pakravan 2917 (ALUH), (fig. 6).

Geographical distribution: *Tripleurospermum callosum* is distributed from Turkey to Iran and Transcaucasia.

T. callosum is most closely related to *T. transcaucasicum* (Manden.) Pobed. and *T. sevanense* (Manden.) Pobed. It differs from the former in having a characteristic branching stem, very laxly corymbose inflorescence and ovoid-conical receptacle; from the latter it is distinguished by having phyllaries with white membranous margins, branching stem, and glandular disc flowers.



Fig. 3. Herbarium specimen of *Tripleurospermum conoclinium*.



Fig. 4. Herbarium specimen of *Tripleurospermum rosellum* var. *album*.



Fig. 5. Herbarium specimen of *Tripleurospermum callosum*.

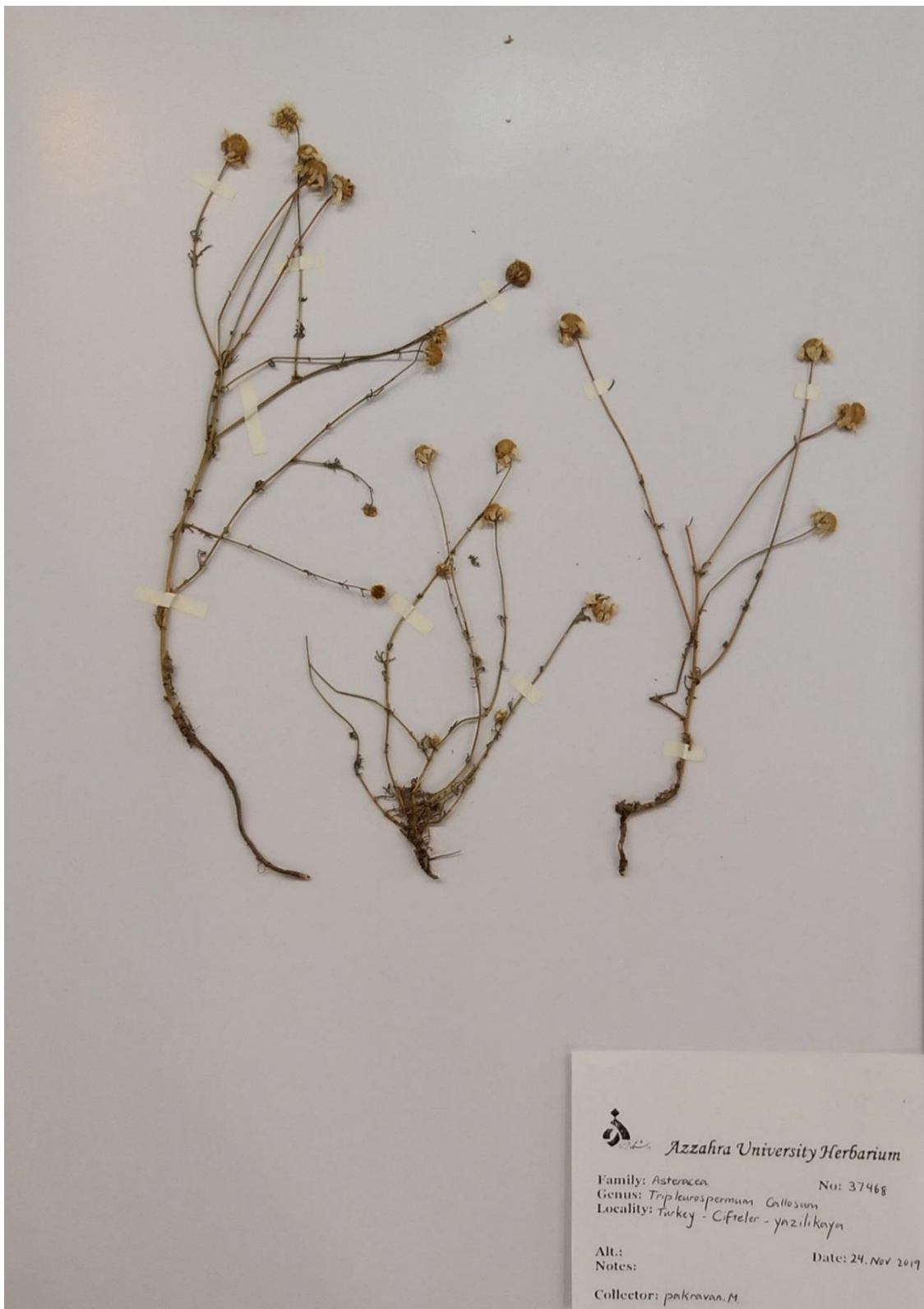


Fig. 6. Herbarium specimen *Tripleurospermum callosum*.

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