Turkish Journal of Biodiversity

Turk J Biod, September 2022, 5(2): 86-97
https://doi.org/10.38059/biodiversity. 1165445
Journal homepage: http://turkbiod.artvin.edu.tr/
http://dergipark.org.tr/biodiversity

e-ISSN:2667-4386

RESEARCH ARTICLE **Open Access**

The determination of the taxonomic position of *Peucedanum arenarium* subsp. *neumayeri* and subsp. *urbani* in Turkey

Peucedanum arenarium subsp. *neumayeri* ve subsp. *urbani'nin* Türkiye'deki taksonomik konumunun belirlenmesi

Hüseyin Aşkın AKPULAT[a], Emine AKALIN[b*]

[a] Department of Biology, Faculty of Sciences, Sivas Cumhuriyet University, 58140, Sivas, Turkey
[b] Department of Basic Pharmacy Sciences, Faculty of Pharmacy, İstanbul University, 34116, İstanbul, Turkey

Article Info

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**Corresponding author*:
e-mail: aakpulat99@yahoo.com
ORCID: 0000-0001-8394-2746

Article history
Received: *August 22, 2022*
Received in revised form: *September 30, 2022*
Accepted: *September 30, 2022*
Available online: *September 30, 2022*

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Keywords: Apiaceae, ITS nrDNA, molecular systematics, morphology, *Peucedanum*, *Taeniopetalum*

Anahtar Kelimeler: Apiaceae, ITS nrDNA, moleküler sistematik, morfoloji, *Peucedanum*, *Taeniopetalum*

ABSTRACT

In this study, the taxonomic status of two subspecies of *Peucedanum arenarium* grown in Turkey, subsp *urbani* and subsp. *neumayeri* were investigated. There are no ripe fruits of this subspecies in the flora of Turkey. In fact, *P. arenarium* subsp. *neumayeri* has been misdiagnosed in the flora of Turkey because it is not a ripe fruit. When we looked at the ripe fruit of the plant we collected from the type locality, it was determined that this species was actually *Johneria tortusa. P. arenarium* subsp. *urbani* plant samples were collected by us for the first time and morphological, anatomical, DNA sequence analysis and SEM studies were carried out. Molecular (ITS nrDNA sequences), morphological and especially microcarpological data were determined. As a result, in Turkey, *P. arenarium* subsp. *neumayeri* is absent. It is true that the *P. arenarium* subsp *urbani* species is transferred as *Taeniopetalum urbani.*

ÖZ

Bu çalışmada *Peucedanum arenarium*'un Türkiye'de yetiştirilen iki alt türü subsp *urbani* ve subsp. *neumayeri* araştırıldı. Bu alt türün Türkiye florasında olgunlaşmış meyveleri bulunmamaktadır. Aslında, *P. arenarium* subsp. *neumayeri* olgun bir meyve olmadığı için Türkiye florasında yanlış teşhis edilmiştir. Tip lokalitesinden topladığımız bitkinin olgun meyvesine baktığımızda bu türün aslında *Johneria tortusa* olduğu belirlendi. *P. arenarium* subsp. *urbani* bitki örnekleri tarafımızca ilk kez toplanmış ve morfolojik, anatomik, DNA dizi analizi ve SEM çalışmaları yapılmıştır. Moleküler (ITS nrDNA dizileri), morfolojik ve özellikle mikrokarpolojik veriler belirlendi. Sonuç olarak, Türkiye'de *P. arenarium* subsp. *neumayeri* bulunmamaktadır. *P. arenarium* subsp *urbani* türünün *Taeniopetalum urbani* olarak aktarılması da doğrudur.

Citation:

To cite this article: Akpulat HA, Akalın E (2022). The determination of the taxonomic position of *Peucedanum arenarium* subsp. *neumayeri* and subsp. *urbani* in Turkey. *Turk J Biod* 5(2): 86-97. https://doi.org/10.38059/biodiversity.1165445

1. INTRODUCTION

It is stated by researchers that the genus *Peucedanum* L. is a taxonomically problematic genus (Pimenov and Leonov, 1993, 2004; Spalik et al., 2004; Akpulat, 2011). In addition, some species belonging to the genus *Peucedanum* were transferred to Cervaria and Johreniopsis genera by Pimenov (Pimenov, 1987a, 1987b, 1987c). It is a polymorphic genus that shows great diversity, especially in leaf forms (Chamberlein, 1972; Pimenov and Leonov, 1993; Tutin, 1968). The revision of the genus *Peucedanum* abroad was made by Frey (1989), and the revision of this genus in our country

was made by Akpulat (2011). There are a total of 16 species of the genus *Peucedanum*, 14 species (15 taxa) + 2 suspicious species, under 4 sections registered in the flora of Turkey. Four of them are endemic and the endemism rate is 28.5% (Chamberlein, 1972; Davis et al., 1988; Güner et al., 2000). In recent years, new species belonging to the genus *Peucedanum* have been found and this number has reached 21 species and 22 taxa (Parolly and North, 2004, 2005; Akpulat and Akalın, 2010; Yildirim and Duman, 2017). One of the endemic species *P. arenarium* subsp. *urbani* was given in the Endangered (EN) category in the Red Data Book of Plants of Turkey (Ekim et al. 2000). Non-endemic but rare *P. arenarium* subsp. *neumayeri* is in the VU category (Ekim et al. 2000). In the revision study carried out by Akpulat, these taxa were not found in the field. *P. arenarium* subsp. *urbani* and *P. arenarium* subsp. *neumayeri* taxa do not have herbarium records in Turkey. *Peucedanum arenarium* Waldst. et Kit. is a perennial monocarpic species belonging to the Apiaceae family. According to the flora of Turkey, this species is represented by 2 subspecies in our country, *P. arenarium* subsp. *neumayeri* and *P. arenarium* subsp. *urbani*. *P. arenarium* subsp. *neumayeri* grows only locality between Datça and Marmaris. *P. arenarium* subsp. *urbani* is an endemic subspecies that grows only in Kaz Mountains. The samples in the Turkish flora written by Chamberlain, may have been misdiagnosed because there were no mature fruits (Figure 1). Fruit plant samples belonging to these subspecies are not sufficient. Although these subspecies are in the flora of Turkey, they have not been collected in recent years and are not recorded in herbariums. According to the flora of Turkey, these two subspecies are very similar to each other and are separated according to the length of the rays. Detailed taxonomic studies were carried out by recollecting these subspecies. Chamberlain (1972) defined the species as follow in the flora of Turkey;

P. arenarium Waldst. & Kit., Pl. Rar. hung. 1:18 (1800). The plant is erect, glabrous perennial with thick rhizomes; trunk 30-100 cm high, striped. Basal leaves 3-pinnate, petiole length 10-30 cm, last segments straight 10-20 mm. Umbels with 2-6 rays; rays, uneven but irregular, glabrous when fruiting, 1-7 cm long; no braces; bracteoles 8-10, lanceolate. The flowers are yellow in color. There are 15-30 in each umbel. Young fruit elliptical, glabrous; petiole 2-4 mm. in length

1. Umbellar rays 2-6 cm (when fruiting).....subsp. ***neumayeri***

1. Umbellar rays 9-23 cm (when fruiting) .....subsp. ***urbani***

subsp. ***neumayeri*** (Vis.) Stoj. & Stef., Fl. Cont. ed. 3:857 (1948). Synonym: *Taeniopetalum neumayeri* Vis., Fl. dam. 3:49 (1850); *Peucedanum neumayeri* (Vis.) Reichb., Ic. FL. germ. 21:63, t. 116 (1867). Serpentine cliffs. 100-150 m.

Flowering: June-July, Habitat: mixed forest, Altitude: 700 m., Hazard category: VU IUCN criteria (2016).

subsp. ***urbani*** (Freyn & Sint. ex Wolff) Chamberlain, comb. et stat. nov. Endemic. Synonym: *P. urbani* Freyn & Sint. ex Wolff in Feddes Rep. 20:68 (1924).

Type: [Turkey B1 Balıkesir] Troas: Kaz Mountain, circa fontes Scamandri, 29 vii 1883, Sintenis 494 (iso. BM! E! K! LD!). get in accordance with IUCN criteria (2016).

Flowering: June-July, Habitat: steppe cavities, Altitute:1500 m., Hazard category: E



Figure 1. Herbarium specimens of *Peucedanum arenarium* collected from Turkey **A)** *P. arenarium* subsp. *neumeyeri* **B)** *P. arenarium* subsp. *urbani*

In our country, *P. arenarium* subsp. *neumayeri* and *P. arenarium* subsp. there is no study done with urbani. Although there are records of these taxa in the flora of Turkey, these taxa were not collected later. There is no fruit information in the flora of Turkey. Fruit is a very important character of the Apiaceae family. By collecting

fruit samples, the missing parts of the flora will be completed and their descriptions will be expanded.

P. arenarium subsp. *neumayeri*, changed to *T. arenarium* subsp. *neumayeri* (Vis.) (Pimenov & Ostr.). In addition, *P. arenarium* subsp. *urbani* changed to Taeniopetalum urbani (Freyn & Sint. ex H.Wolff) Pimenov (Ostroumova et al., 2016)

As a result of our research, the taxonomic status of the *P. arenarium* subspecies in our country has been clarified.

P. arenarium subsp. *urbani*, which is endemic in Turkey, The missing ripe fruit information in the flora of Turkey has been completed.

2. MATERIALS AND METHODS

2.1. Plant materials

P. arenarium subsp. *urbani* were collected from natural habitats in Datça (Muğla) and Kaz Mountains (Balıkesir/Çanakkale) during field studies conducted in 2021 (Figure 2). Collected samples are kept in Sivas Cumhuriyet University Faculty of Arts and Sciences Herbarium (CUFH).

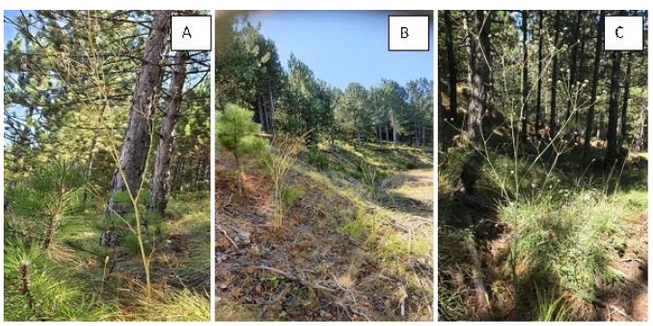


Figure 2. *Peucedanum arenarium* subsp. *urbanii* collected from Kaz Mountains

2.2. Morphological methods

Samples of fruiting and flowering plants were collected to determine the limits of variation in each species. Habitat characteristics and some distinctive features of the species were noted during the field studies. Photographs of the species were taken in their natural habitats. Table 1 was prepared by determining the morphological characters of *P. arenarium* taxa and comparing them. The fruit criteria of the species are given in Table 1.

2.3. Anatomical methods

The fruits were preserved in 70% ethanol. In this study at least 10 mature fruits were analyzed. All transverse sections were cut by hand from the middle of the mericarps using a razor blade. Samples were examined in Sartur reagent (a compound reagent of Sudan III, lactic acid, aniline, iodine, potassium iodide, water, and alcohol) (Çelebioğlu & Baytop, 1949). Photographs were taken with iPhone X. Measurements of mericarps were made by the program ImageJ©. The fruit morphology and anatomy were described by using the terms of Botanical Latin (Stearn 2005), and Kızılarslan Hançer and Akalın (2017).

2.4. Micromorphology and scanning electron microscopy (sem) methods

The structure of green synthesized AgNPs was identified by spectroscopic techniques. The maximum absorption of i-AgNPs and antioxidant activity tests were determined by an Ultraviolet-visible (UV-2600) spectrophotometer. Fourier Transform Infra-red (FTIR 4700) spectrometer was employed to determine the functional groups of compounds in the plant extract and stabilized the i-AgNPs. X-ray Diffraction Analysis was executed by a diffractometer (Malvern Panalytical). The morphology of i-AgNPs was established by Scanning Electron Microscope, elemental analysis was presented by an EDAX detector.

2.5. Molecular method

2.5.1. DNA isolation processes

DNA isolations were performed using the DNeasy Plant Mini Kit (QIAGEN, Germany) following the manufacturer's instructions with some modifications. *P. arenarium* subsp. *urbani* and subsp. *neumeyeri* were used for DNA isolation.

2.5.2. Polymerase chain reaction processes

During this project work, three different DNA regions were amplified using *P. arenarium* subsp. *urbani* and subsp. *neumayeri* individuals: nuclear genome (nrITS) and chloroplast genome trnA (Leu)-trnA (Phe) (trnL-F) and rpl32-trnL regions. PCR amplification of ITS nrDNA, ITS5a (5'-CCT TAT CAT TTA GAG GAA GGA G-3') (Stanford

et al., 2000) and ITS4 (5'-TCC TCC GCT TAT TGA TAT GC-3') (White et al., 1990) primers. For trnL-F region amplification processes, trnL-c (5'-CGA AAT CGG TAG ACG CTA CG3') (Taberlet et al. 1991) and trnL-f (5'-ATT TGA ACT GGT GAC ACG AG-3 ') (Taberlet et al., 1991) primers and rpl32-F (5'-CAG TTC CAA AAA AAC GTA CTT C-3') (Shaw et al., 2007) and trnL (UAG) (5'-CTG CTTCCT) for rpl32-trnL region amplification. Amplification was performed using primers AAG AGC AGC GT-3') (Shaw et al., 2007).

2.5.3. DNA data analysis

PCR products, which were successfully amplified as a result of polymerase chain reaction processes and controlled on agarose gel, were sent to Genoks (Gene Research and Biotechnology Company, Turkey) for sequencing. Raw sequenced DNA data files are given by Sequencher ver. Edited via 5.4 (Gene Codes Corporation, Ann Arbor, MI, USA), and the edited sequences were aligned using Bioedit 7.2.5. By examining the DNA structures of different *Peucedanum arenarium* subsp. *urbani* and subsp. *neumeyeri* individuals, polymorphic sequence regions, and heterozygous structures were identified. Phylogenetic cladograms were constructed using PAUP * 4.0a165 (Swofford 2003). A Neighbor-Net graph was obtained using SplitsTree 4.14. A data matrix was created according to the distinctive characters of the rpl32 DNA data.

2.5.4. Obtaining phylogenetic trees

After sequence alignment, phylogenetic trees were constructed using the PAUP* program (Swofford, 2003) with aligned sequences. Consensus trees were created using the maximum consistency (MP) method in tree generation. For maximum consistency trees, the characters are all unordered and equally weighted. The maximum likelihood tree was created (Figure 13).

3. RESULTS

3.1. Micromorphological findings

There is no information about *P. arenarium* subsp *urbani* fruit in the flora of Turkey. For the Apiaceae family, the fruit is very important for diagnosis. In this study, ripe fruit was collected for the first time (Figure 3).



Figure 3. Fruit of *Peucedanum arenarium* subsp. *urbani*

In addition, features not found in the flora of Turkey for *P. arenarium* subsp *urbani* are given in Table 1.

In the flora of Turkey, the height of the plant is given as 100 cm. As a result of our field studies, it has been determined that this plant grows up to 200 cm in length. It has been determined from the samples in the field that the plant is monocarpic.



Figure 4. Comparison of *Peucedanum arenarium* subsp. *neumayeri* Turkey samples

Table 1. Comparison of *Peucedanum arenarium* species

Characters	*Peucadanum arenarium*	
	subsp. *neumayeri*	**subsp. *urbani***
Plant Height, cm	20–150(200)	30–100(200)
General Leaf Outline	2–5-pinnate	3–4-pinnate
1st-Order Petiolule Length, cm	3–8	4–8
2nd-Order Petiolule Length, cm	(0.5)2–4	1–4
Ultimate Segment Morphology	Entire, bifid, (trifid), linear; acute, mucronulate	Linear, acute, mucronulate
Ultimate Segment/Lobe Width, mm	0.8–2	1–1.2
Ultimate Entire Segment/Lobe Length, mm	10–18	9–20
Central-Umbel Peduncle Length, cm	6–13	12
Number of Rays in Central Umbel	4–12	2–4(6)
Maximal Ray Length in Central Umbel, cm	4–9(13)	7–25
Pedicel Length, mm	1–3(4)	1–3(4)
Petal Colour	Yellow	Yellow
Mature Schizocarp Shape	Obovoid (ellipsoid)	Obovoid, ellipsoid
Schizocarp Length, mm	7–8	6-9
Schizocarp Width, mm	4–5	4-5

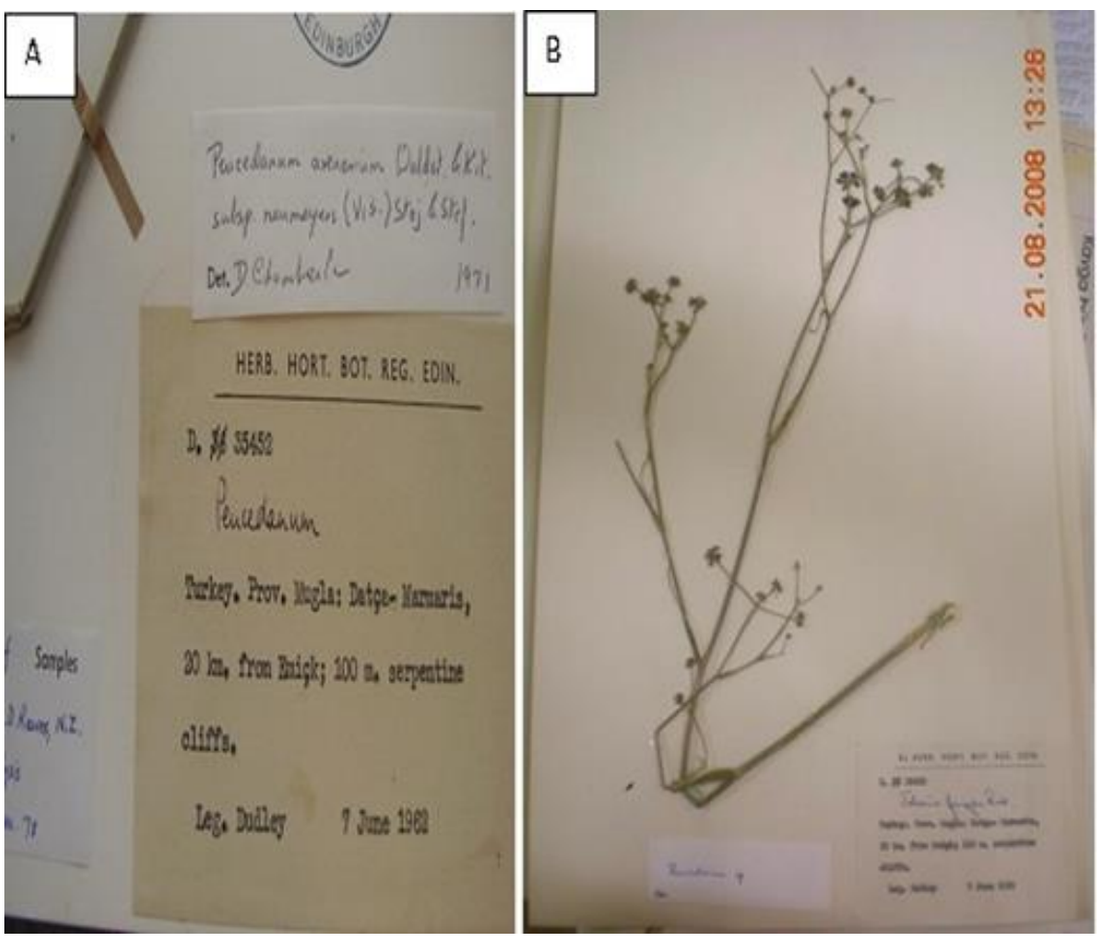


Figure 5. Turkey sample of *Peucedanum arenarium* subsp. *neumayeri*

When the samples numbered 35420 and 35452 collected by Davis (Figure 4) are examined; it looks like he's been diagnosed with *Johrenia fungosa*. These specimens were defined by Chamberlain, (1972) as *P. arenarium* subsp. *neumayeri* to the flora of Turkey. Diagnosis is inaccurate as there are no basal leaves and no mature fruit. This difference is clearly seen when *P. arenarium* subsp. *neumayeri* samples are examined. According to the flora of Turkey, this specimen collected only between Datça and Marmaris is *J. fungosa*. Now, it is the synonym of *Johrenia tortuosa* (Fisch. & C.A.Mey.) D.F.Chamb (Figure 5,6).

By collecting fruit samples of this species, it was determined that this species actually belongs to the genus *Johrenia.*



Figure 6. Ripe fruit of *Peucedanum arenarium* subsp. *neumayeri* (*Johneria tortusa*)

3.2. Anatomical findings

Sections of the fruit of *P. arenarium* subsp. *urbani* are given in Figures 7 and 8. The cross-section of the fruit was taken and anatomical differences were determined. Four dorsal vittas and 2 commissural vittas were detected in the fruit. These glandular vittas in mature fruit are typical of the genus *Peucedanum*. Without fruit, it was actually crucial to the confirmation of the *P. urbani* strain. In this study, the fruit section was examined and this species was thought to be the definitive *Peucedanum* genus.

When the fruit sections of *P. arenarium* subsp. *urbani* are examined in detail;

Although the fact that the fruit has wings is a feature belonging to the genus *Peucedanum*, it differs from the fact that the upper surface of the epidermis is convex (wavy). As seen in Figure 7, the convex (wavy) epidermis indicates that it belongs to the genus *Taneopetalum.*



Figure 7. Convex epidermis of the fruit of *Peucedanum arenarium* subsp. *urbani*

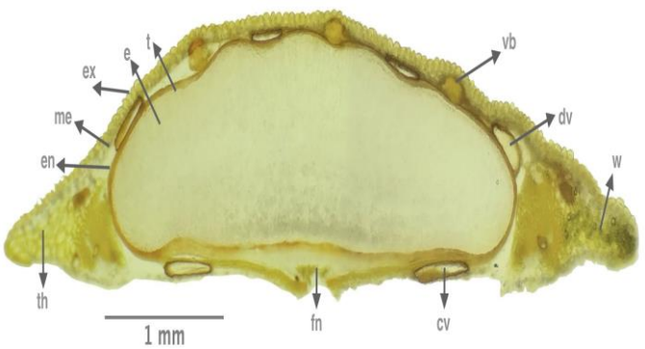


Figure 8. Cross-sections of the fruit of *Peucedanum arenarium* subsp. *urbani* **cv:** commissural vittae, **dv:** dorsal vittae, **e:** endosperm, and endocarp, **ex:** exocarp, **fn:** funicle, **me:** mesocarp, **t:** testa, the thin-walled and non lignified parenchymatic tissue, **vs:** vascular bundle, **w:** wing

3.3. SEM findings

In this study, SEM was used to determine the fruit morphology and distribution of *P. arenarium* subsp. *urbani* for the first time. Stems, leaves, calyces, and corollas were examined and photographed using the NeoScope JCM brand electron microscope.

Many photographs of the fruit were taken from the front, back, top, and back (Figure 9). The palm, tip, and edges of the leaf have been studied in detail. Stomata on the leaf were detected and photographed (Figure 10). In addition, scanning electron microscopy SEM photographs of the pollen of *P. arenarium* subsp. *urbani* were taken for the first time and the pollen shape was determined (Figure 11). Pollen grains are tricolpate, radially symmetrical, and isopolar. The exine statue is

irregular in meridian and polar optic sections, and the mericarp surface is striated (Figure 11).

Fruit is very important for the Apiaceae family. With the SEM results, the data related to this fruit have been reached.

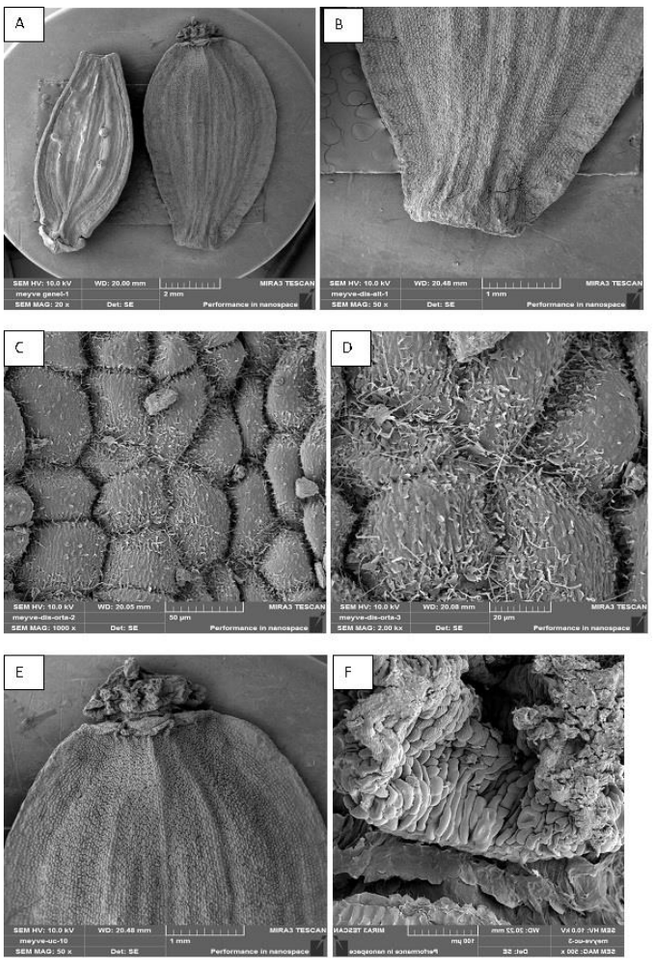


Figure 9. SEM images of the fruit of *Peucedanum arenarium* subsp. *urbani*- **A, B, E:** mericarps; **B, D, F:** details of exocarp Scale bars: 1 µm (B, E); 2 µm (A); 20 µm (D); 50 µm (C); 100 µm (F).

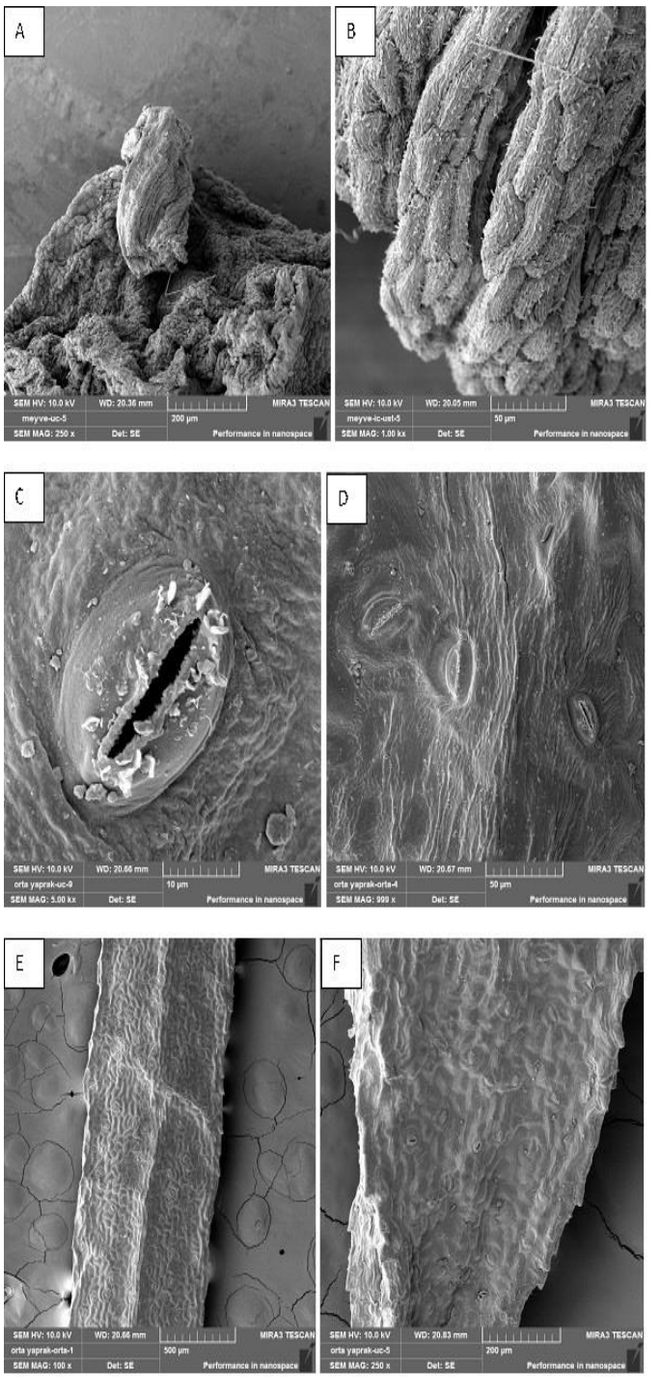


Figure 10. SEM images of the leaf of *Peucedanum arenarium* subsp. *urbanii*- **A, B:** mericarps; **C, D:** stomata; **E, F:** leaves. Scale bars: 200 µm (A, E, F); 50 µm (B, D); 10 µm (C)

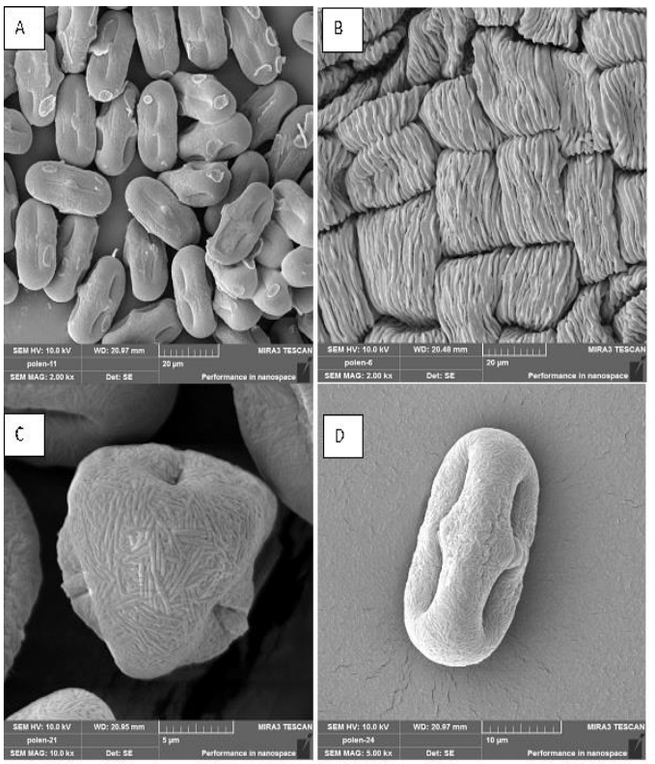


Figure 11. SEM images of pollen from *Peucedanum arenarium* subsp. *urbanii*- **A:** general shape of pollen; **B:** surface details of pollen; **C:** polar aspect, **D:** ekvotoral aspect. Scale bars: 20 µm (A, B); 10 µm (D); 5 µm (C)

3.4. Molecular findings

3.4.1. ITS Results

In this study, the subject of our project, *P. urbanii* Freyn & Sint. ex H.Wolff, that is, *T. urbani* (Freyn & Sint. ex H.Wolff) Pimenov, whose name has changed after the changes made in recent years, and *Taeniopetalum arenarium* (Waldst. & Kit.) Tikhom has been transferred to the genus *Taeniopetalum* with the latest studies. (former name= *Peucedanum arenarium*) and *Taeniopetalum obtusifolium* (Sibth. & Sm.) Pimenov (former name= *Peucedanum obtusifolium*) species and var *Peucedanum* belonging to the genus *P. chryseum* (Boiss. Et Heldr.) Chamberlain and *P. ozhatayiorum* Akpulat & E. Akalın (Akpulat and Akalın, 2010) species were investigated molecularly using nrITS data. As seen in Figure 13, polymorphism was observed in some regions among the studied species. Accordingly, a total of 647 nucleotide sequences were obtained for the 6 taxa studied. 598 out of 647 characters are fixed characters for all taxa. Although 6 characters are variable, they are not informative in terms of parsimony, and 43 characters are among the characters that are informative in terms of parsimony. Six characters (see Fig. 12-nucleotide sequences 26, 144, 489, 559, 604, and 645) that vary in only one taxon are not parsimonically sufficient, but notably 605-610 with 3-nucleotide changes at nucleotide positions 59 and 203. The insertion/deletion regions between nucleotides are quite remarkable. Among the parsimonically important regions in the obtained data, 55., 86., 88., 134., 136., 155., 186., 206., 208., 226., 412., 425., 430., 447., 470. *T. obtusifolium* and *T. urbanii* have the same nucleotide sequences at., 474., 495., 496., 539., 540., 557., 566., 601., 613., 619., and 629. nucleotide positions however, the fact that *T. arenarium* (at least the subspecies *T. arenarium* subsp. *neumayeri,* which is a subspecies widespread in our country) which was later transferred to the genus *Taeniopetalum*, is far from having the same nucleotide as these two species, in fact, takes into account the possibility that this taxon may be very close to the *Peucedanum* members of the *Taeniopetalum* genus. it causes us. Of course, more precise decisions about this will be possible in future studies by using more individuals and obtaining more data.

When Figure 13 is examined, as seen in the phylogenetic tree obtained according to the DNA sequences, *T. obtusifolium* and *T. urbani* coexist with a bootstrap value of 100. On the other hand, according to these data, *P. ozhatayorum* seems to be the closest to these two taxa. *Taeniopetalum arenarium* subsp. *neumayeri* is the closest group to the mentioned three taxa. Therefore, with this study, the status of the *P. ozhatayorum* species is controversial, and this is a point that should be emphasized in future studies.

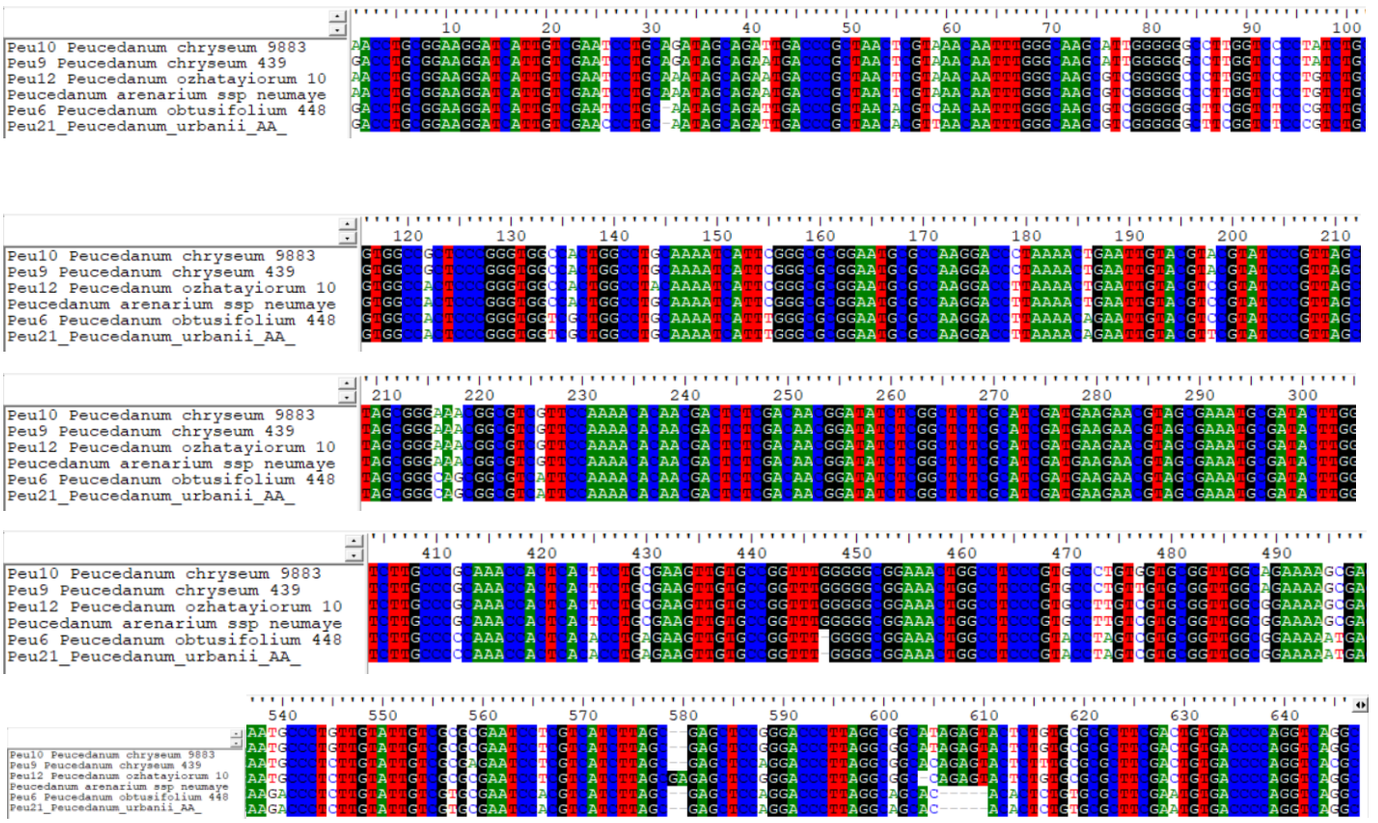


Figure 12. Comparison of sequences obtained against nrITS data

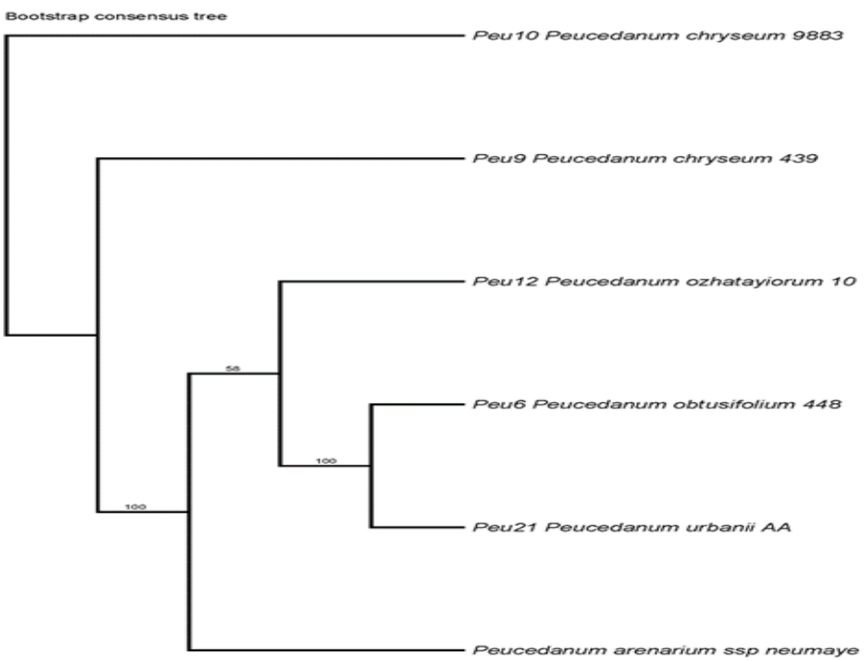


Figure 13. Maximum likelihood tree based on nrITS data

3.3.2. trnL-F Results

The trnL-F sequences with positive results in this study were the only sequences belonging to *T. urbanii*. When the data in the gene bank were examined, informative trnL-F sequences belonging to the genus *Taeniopetalum* or *Peucedanum* were not seen. Therefore, the DNA sequences obtained from this study will form the basis for future studies. The data of *T. urbanii* taxon is presented below. Accordingly, 929 nucleotide data of this species were obtained as the trnL-F sequence.

Sequence *Taeniopetalum urbanii* trnL-F:

CCTTGGATGGAACCTACTAAGTGAGAACTTTCAATTCAGAGAAACCCCG
GAATTAATAAAAATGGGCAATCCTGAGCCAAATCCTATTTTCCAAAAACA
AACAAAGGCCCAGAAGGTGAAAAAAGCGTAGGTGCAGAGACTCAATGG
AAGCTGTTCTAACAAATGGAATTGACTGTGTTGCATTGGTAGAGGAATCC
TTCCATTGAAACTTCCGAAAAGATGAAGGATATACGTATATACATACGTA
TACGTACTGAAATACTCTATCAAATGATTAATGACGACCTTAATCTGTATT
TTTCTATGAAAAAGGGAAAAATTGTTGTGAATCGATTCCGTATTGAAGAA
AGAATCGAATATTCATTGATCAAAGCATTCACCACACAGTCTGATAGTTC
TTTTGCAGAACTAATTAATCGGACGAGAATAAAGATAGAGTCCCATTCTA
CATGTCAATACCGGCAACAATGAAATTTATAGTAAGAGGAAAATCCGTT
GACTTTAAAAATCGTGAGGGTTCAAGTCCCTCTATCCCCAAAAAGCCCAT
TTGGCTCCTTAACTATTAACTATTTATCTTATCTTTTTTTTCGTTAGTAGTTC
AAATTCGTTATCTTTCTTATTCACCCTACTCTTTTACAAACGGATCCGAGA
GAAAGATTTGTATCTTATGACAAGTCTTGTGATATATGATACATGTACAA
ATGACCGTCTTTGACCAAAGACTCCCCATTTGAACGAGTCATGGTCGATA
TCATTATTCATACTGAAGCTGACAAAGTCTTCCTTTTTTGAAGATCCAAGA
AATTCTAGCACCTGGATAAGACTTTGTAATACCCTTTGAATTGACATAGA
CCTAAGTTATCTAGTAAAATGAGGATGCGGTATCGGGAATGGGAATGGT
CGGGATAGCTCAGCTGGTAGAGCAGAGG

4. DISCUSSION AND CONCLUSION

Known from a single locality in the flora of Turkey, *P. arenarium* subsp. *urbani* and *P. arenarium* subsp. *neumayeri* species have examples in herbariums abroad. It is not found in any herbarium in our country. Since there are no mature fruits in these samples abroad, the fact that these species were never collected later made us doubt the existence of these species.

During the field trips carried out during this study, the type specimen of *Peucedanum urbanii* taxon, which is distributed only in the Kaz Mountains in our country and in the world, was collected in 1883 (29 July 1883) by a researcher named P. Sintenis. This example numbered 494, is also the only example that is the source of the definition in the work named “Flora of Turkey”. It was published as a new species by researchers named Ascherson and Sintenis.

Endemic in the Flora of Turkey, *P. arenarium* subsp. *urbani* has no ripe fruit information. These plant samples collected from Kaz Mountains and a single region are not found in any herbarium in our country. These plant samples collected from our country are also found in overseas herbariums such as Geneva, Edinburgh and Kew. This plant was never collected after 1883.

In our study, this endemic plant was collected again for the first time after 138 years. The plant sample was examined, photographed, and the fruity sample was identified for the first time and necessary notes were taken. The detailed anatomical examination was done by taking fruit sections and microscope images were taken and recorded. Fruit measurements were made in detail.

Thanks to the information we have gathered, we have expanded the description of *Peucedanum urbanii.* According to Ostroumova (2016), *Taeniopetalum* differs from all the members of *Peucedanum* s.l. by large convex exocarp cells. A distinctive morphological character, such as large epicarp cells, is therefore critical in the discussion on the taxonomic placement of the genus *Taeniopetalum.* The following characters were used for delimitation of *Taeniopetalum* taxa: leaf segment shape, umbel ray number and length, and pedicel length.

As a result of the study, the species given as *P. arenarium* subsp. *urbanii* was misdiagnosed as it was not a mature fruit. This species was determined to be *Taeniopetalum urbani*.

P. arenarium subsp. *neumayeri*, on the other hand, is the only known endemic species in Datça (Muğla) in the flora of Turkey. This species has never been collected since. It is not found in any herbarium in Turkey. The fruit specimens of this species were collected and studied in detail. Fruit is very important for the Apiaceae family. When the samples numbered 35420 and 35452 collected by Davis in the flora of Turkey are examined; (Figure 14). This specimen was originally identified as *Johrenia fungosa*. This specimen is the synonym of *Johrenia tortuosa* (Fisch. & C.A.Mey.) D.F.Chamb. The fruits may look alike when young, but when fully ripe they differ

greatly. As a result of our research, it was determined that this species actually belongs to the genus *Johrenia.*

As a result; *P. arenarium* subsp. *urbani*, *Taeniopetalum urbani* (Freyn & Sint. ex H.Wolff) Pimenov. is correct to transfer. *P. arenarium* subsp. *neumayeri* was misdiagnosed as it was not a ripe fruit, and we determined that it was *Johrenia turtuosa.* According to these results, there are no 2 subspecies of *P.* arenarium in our country. The number of species belonging to the genus *Peucedanum* in our country has been updated to 13 species.

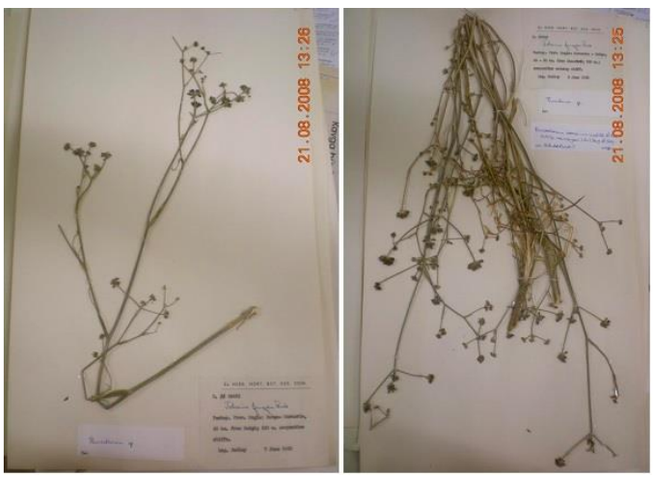


Figure 14. The samples numbered 35420 and 35452 collected by Davis

Taeniopetalum urbani (Freyn & Sint. ex H.Wolff) Pimenov, Akpulat & Akalın sensu lato

Taeniopetalum urbani (Freyn & Sint. ex H.Wolff) Pimenov, Pl. Biosystems 148(5-6): 1108. 2014.

≡ *Peucedanum urbani* Freyn & Sint. ex H.Wolff, Repert. Spec. Nov.Regni Veg. 20: 68. 1924; Rech.f., 1943, Fl. Aegaea: 413. 1943.

≡ *Peucedanum arenarium* Waldst. & Kit. subsp. urbani (Freyn & Sint. ex H.Wolff) Chamberlain, 1972, Fl. Turkey (P.H.Davis, ed.) 4: 478.

Type: Turkey: 'Troas: in monte Ida [Kaz Da.] in decliv. montosis circa fontis Scamandri', 29.VII.1883. Sintenis 494 (lectotype G!, designated by Pimenov and Sutorý, 2014: 1108; isolectotypes BM!, BR, CUFH!, E!, GOET, K!, LD, LE, P!, US, W!).

Perennial, monocarpic herb, completely glabrous. Rootstock thick with fibrous collar, up to 5-7 cm in diameter. Stem 80–200 cm high, straight, branched only in the upper part, round, full, only slightly grooved, gray-green. Leaves dark green, long petiolate in the ground rosette, triangular in outline, 3-4 × pinnate, up to 35 cm long and 20 cm wide, ultimate segment linear, acute mucronulate 10 mm, stem leaves sessile, Umbels up to 10 cm in diameter. Rays 3-6(-7), 7-25 cm long. Bracts absent, or 1-3 (4). Bracteoles 8-13, linear- lanceolate, 3-5 mm long. Umbellules with 7-10(-12) flowers. All flowers hermaphroditic; the calyx leaves distinct, triangular, corolla leaves yellow, approx. 1 mm long sepal inconspicuous; petal yellow, 1-1.5 mm deflexed.

Fruiting pedicel 3-4 mm long, ± equal. The fruit is light brown to gray ellipsoid bipeds, with three low dorsal ribs, on the edges with narrow wings 0.5-1 mm wide. Mericarps elliptic, 7-9×3-4 mm, glaucous when ripe; dorsal ridges conspicuously filiform, lateral wings stylopodium short conical, 1 mm long; styles c. 1 mm long reflexed; stigma capitate; dorsal vittae per vallecula 1, commissural 2. Fl. 6-7, Fr. 8-9. (Figure 15).

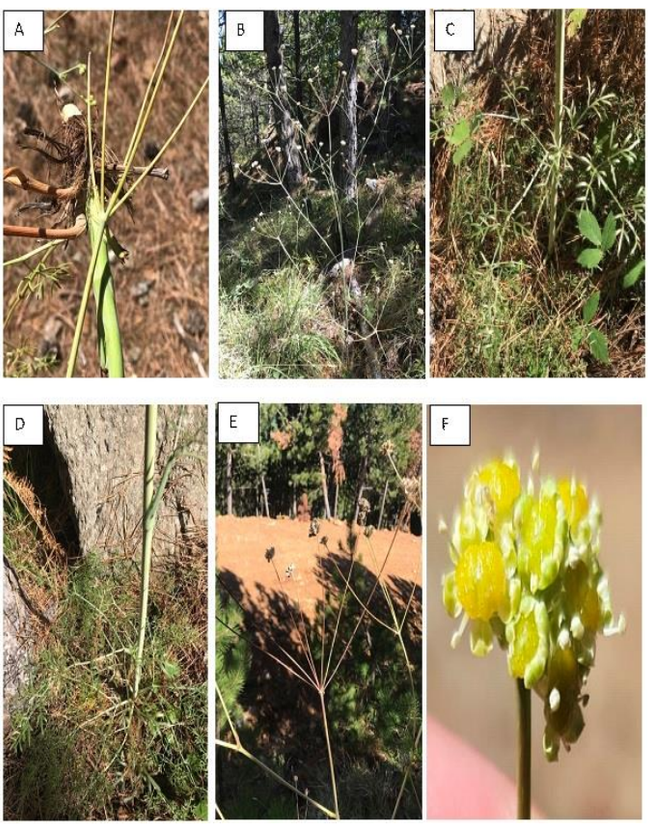


Figure 15. *Taeniopetalum urbani* (Freyn & Sint. ex H.Wolff) Pimenov, Akpulat & Akalın - **A:** Fibrous collar; **B:** habitus; **C, D:** leaves; **E:** umbel and rays; **F:** flowers

ACKNOWLEDGMENTS

This study was supported by Sivas Cumhuriyet University Scientific Research Projects Coordination Unit (BAP, Project Number: EĞT-093). We would like to thank Tuncay Dirmenci for his help during fieldwork, Taner Özcan for moleculer data and H. Onur Tuncay for the anatomical section.

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