

## A new species of *Teucrium* sect. *Stachyobotrys* (Lamiaceae) from the south of Turkey

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**Abstract:** A new species of *Teucrium* L., *Teucrium aladagense* Vural & H.Duman, is described from Aladağ mountain, located in Adana, Kayseri, and Niğde provinces in Turkey. The species belongs to *Teucrium* L. sect. *Stachyobotrys* Benth. A description, distribution map, habitat, information on trichome morphology, and the threatened category of the species are provided. The differences between the new species and its allies *T. lamiifolium* d'Urv s.l. and *T. hircanicum* L. are discussed, and an identification key is provided for the identification of similar taxa.

**Key words:** Adana, Aladağ, endemic, Kayseri, Niğde, *Teucrium*, Turkey

### 1. Introduction

*Teucrium* L. is a large genus of Lamiaceae: Ajugoideae with more than 260 species. The genus is distributed mainly in the Mediterranean region, which is a major speciation center of the genus (Tutin and Wood, 1972; Cantino et al., 1992; Navarro and El Oualidi, 2000; Harley et al., 2004; Govaerts et al., 2010). *Teucrium* and *Ajuga* L. are distinguished from other members of the Lamiaceae with the upper lip of corolla reduced or lacking and style not fully gynobasic (Ekim, 1982; Navarro and El Oualidi, 2000; De Martino et al., 2010).

A total of 46 taxa of *Teucrium* naturally occur in Turkey, and 16 are endemic to Turkey (Ekim, 1982; Duman, 2000; Dönmez, 2006; Dönmez et al., 2010; Dinç and Doğu, 2012; Dirmenci, 2012). *Teucrium* has been divided into 8 sections based on the general habit, leaf type, calyx shape, and inflorescence structure in the *Flora of Turkey* (Ekim, 1982). Most of the species (endemic and nonendemic) are distributed mainly in the Mediterranean phytogeographical region of Turkey.

During a 2007 field trip to Aladağ, a large mountain in Adana, Kayseri, and Niğde provinces (Figure 1), interesting specimens of *Teucrium* were collected by the first 2 authors. After a careful examination of the morphological features of the specimens, it was determined that the specimens are new to science and belong to the genus *Teucrium* sect. *Stachyobotrys* Benth. (Lamiaceae, Ajugoideae), with similarities to *T. hircanicum* L. and *T. lamiifolium* d'Urv s.l.

The aim of this paper is to provide a detailed morphologic description, trichome morphology, information on habitat and conservation status, and a distribution map of the new species.

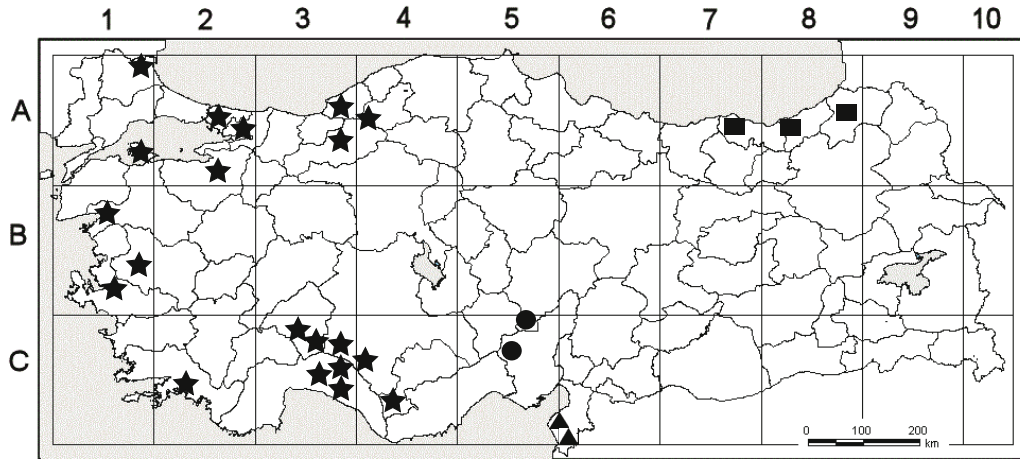
### 2. Materials and methods

#### 2.1. Morphological and micromorphological studies

The specimens were collected in 2007 and 2013 from the foothills of Aladağ, a major mountain of the Eastern Taurus mountain chain located at the intersection of Adana, Kayseri, and Niğde provinces (Figure 1). The specimens were dried using standard herbarium techniques and deposited in GAZI (Gazi University), NGBB (Nezahat Gökyiğit Botanical Garden), and the herbarium of Necatibey Education Faculty, Balıkesir University. The specimens were examined and compared with herbarium specimens (Appendix; on the journal's website) in ANK, B, BCN, E, EGE, GAZI, HUB, INONU, ISTE, ISTE, K, KNYA, LE, MA, MARE, RO, TO, VANF, W, and WU, together with the definitions in the relevant literature (Bentham, 1834, 1848; Boissier, 1879; Briquet, 1895; Ekim, 1982; Rechinger, 1982; Dirmenci, 2012). The morphological characteristics of the species were determined by visual observations with a binocular microscope and a ruler.

Research on trichome morphology of *Teucrium aladagense* and related species *T. lamiifolium* subsp. *lamiifolium* and *T. hircanicum* was carried out using tabletop scanning electron microscopy (SEM). Stems

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**Figure 1.** Distribution of *Teucrium aladagense* (●), *T. lamiifolium* subsp. *lamiifolium* (★), *T. lamiifolium* subsp. *stachyophyllum* (▲), *T. hircanicum* (■).

and leaves were investigated and photographed using a NeoScope JCM. SEM studies took place in the Basic Sciences Research and Applied Center of Balıkesir University.

### 3. Results

**3.1. *Teucrium aladagense* Vural & H.Duman sp. nov.**  
(Figures 2–3)  
(*T.* sect. *Stachyobotrys* Benth.)

**Type:** Turkey, Adana: Aladağ/Pozantı: Kamışlı, between Hamidiye (Pozantı district) and Büyüksöfulü (Aladağ district) villages, 1200 m, *Pinus brutia* Ten. forest, serpentine, rocky slopes, 23.06.2007. *Vural* (10030) & *H.Duman* (holotype: GAZI, isotype: ANK, HUB, ISTE, EGE, NGBB).

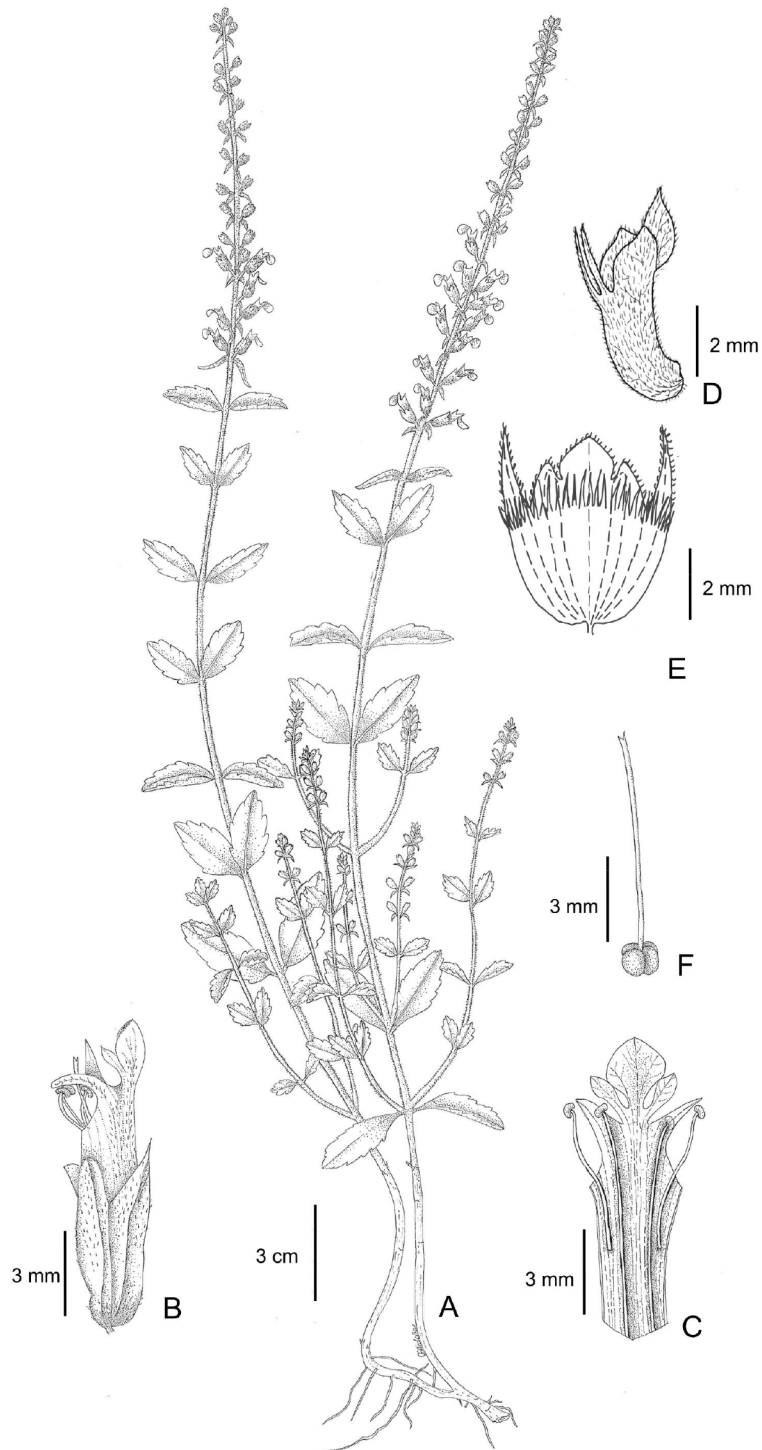
**Diagnosis:** *Teucrium aladagense* similar to *T. lamiifolium* s.l. and *T. hircanicum* in morphology, but it can be easily distinguished from *T. lamiifolium* s.l. by its subshrub habit (not perennial or biennial herbs) (Figure 2–3), cuneate leaves at base (not truncate or subcordate), inflorescence lax-raceme, 5–25 cm in length (not dense spike-like raceme, 3–8 cm in length), bracts linear-subulate, 2–7.5 mm, longer than pedicel and shorter than calyx tube (not equal to or overtopping calyx), calyx 5–6.5 mm (not 6–9 mm); corolla purplish (not white or greenish white). It differs from *T. hircanicum* by its few- to many-branched ascending stems from the woody rootstock (not single or few-branched erect stem from base), leaves 1.6–4.5 × 0.5–2.3 cm, ±concolorous, cuneate at base (not 3–7 × 1–4.5 cm, ±discolorous, truncate or cordate), inflorescence lax raceme (not dense spike-like raceme), calyx 5–6.5 mm (not 4–5 mm).

**Description:** Subshrubs; few to many stems from the woody rootstock. Stems 50–90 cm and branched from the base, ascending, lower part puberulous with sessile glands, densely villous with glandular papillate and sessile glands

at inflorescence. Leaves petiolate, petiole 2–10 mm; leaves diminishing in size from base to inflorescence, 16–45 × 5–23 mm, ovate to lanceolate, serrate, cuneate at base, acute to obtuse at apex, bright green and puberulous with sessile glands above, pale green and denser puberulous with sessile glands beneath; veins visible. Inflorescence a narrow lax raceme, 5–25 cm, many flowered, flowers solitary in axils of bracts. Bracts linear subulate, 2–7.5 mm, longer than pedicel and shorter than calyx tube, puberulous to villous with densely sessile glands. Pedicel 2–3 mm. Calyx 5–6.5 mm, gibbous, densely villous with sessile glands, with glandular papillae; upper tooth broadly ovate, obtuse, ±reflexed; 2 lateral teeth shorter than the upper tooth, obtuse; 2 lower teeth linear-lanceolate, 2.5–3 mm, shorter or longer than the upper tooth. Corolla purplish, 6–8 mm, longer than calyx, densely villous with densely sessile glands and glandular papillae; middle lobe of lower lip bearded inside; style and filaments exserted from corolla, sparsely villous with sparsely sessile glands, style equally bilobed. Nutlets oblong-rounded, 1–1.5 mm, glandular, tuberculate, brown.

**Paratypes:** C5 Kayseri: Yahyalı, Kapuzbaşı, above Ulupınar village, 37°51'20.5"N, 035°22'35.7"E, 1185 m, *P. brutia*, serpentine, 27.07.2008 *A.Güner* 15225, *M.Koyuncu*, *M.Vural*, *H.Duman*, *Z.Aytaç*, *S.Kanoğlu*, *M.Akbalık*, *N.Gökyiğit*, *T.Gökyiğit*, *G.Taniş* (NGBB); 5 km north of Kapuzbaşı village, dry stream beds under *P. brutia* forest, 25.07.2013, *Dirmenci* 4021, *Akçiçek* & *Ö.Güner* (GAZI, Herb. Dirmenci, NGBB).

**Etymology:** The species epithet is derived from the name of the Aladağ mountain, which is the type locality of the species (Figure 1). Aladağ, located in one of the major mountain chains (Taurus mountains), is positioned at the intersection of the Middle Taurus and Anti-Taurus mountain chains, housing more than 400 endemic plant species (Tüfekçi et al., 2002).



**Figure 2.** *Teucrium aladagense* (Vural 10030). A- habit, B- flower, C- inner of corolla, D- calyx, E- inner of calyx, F- gynoecium.

**Habitat and ecology:** *Teucrium aladagense* occurs in rocky slopes of serpentine habitats, dry stream beds under the *Pinus brutia* Ten. forest ca. 1200 m above sea level (a.s.l.). It occurs together with species such as *Achillea*

*monocephala* Boiss. & Balansa, *Allium* sp., *Dianthus* sp., *Lysimachia dubia* Willd., *Onosma* sp., *Silene* sp., and *Teucrium chamaedrys* L. (Figure 4).



Figure 3. A- habit, B- flowers, C- a part of inflorescence of *Teucrium aladagense*.



Figure 4. Habitat of *Teucrium aladagense*.

**Distribution and conservation status:** The species is confined to Aladağ mountain, which is one of the highest mountains of Turkey with the highest peak at 3767 m a.s.l. The species is known to be endemic to this area and

a Mediterranean element. The species was observed in 3 different localities on the mountain, apparently less than 100 km<sup>2</sup>. The total number of observed individuals is ca. 500–1000. Based on the distribution range and population size (B1bi-v) criteria of the International Union for Conservation of Nature (IUCN), it should be regarded as a Critically Endangered species (CR) (IUCN, 2001).

### 3.2. SEM results

#### 3.2.1. Stem

*T. aladagense* has simple glandular and eglandular trichomes. Capitate glandular trichomes are short and have 1 or 2 stalk cells. There are also peltate trichomes. Eglandular trichomes are denser than the glandular ones (Figure 5A). *Teucrium lamiifolium* subsp. *lamiifolium* has capitate and peltate glandular trichomes as well (Figure 5B). *Teucrium hircanicum* has eglandular trichomes that are denser than glandular trichomes. There are rarely peltate trichomes. In addition, there are no capitate trichomes, or they are very rare (Figure 5C).



**Figure 5.** Stem indumentums of *Teucrium aladagense* and related species. A–D: *Teucrium aladagense*, B–E: *T. lamiifolium* subsp. *lamiifolium*, C–F: *T. hircanicum*.

Eglandular trichomes of *T. aladagense* are 2–3-celled trichomes densely covered by micro-papillae. The apical cell is conspicuously elongated and generally crumpled (Figure 5D). Contrary to *T. aladagense*, capitate trichomes are elongated and have 2–3 stalk cells on *T. lamiifolium* subsp. *lamiifolium*. Eglandular trichomes are very elongated and flexuose. They are 3–10-celled trichomes sparsely covered by micro-papillae. Internodes are distinct, and apical cell is acute (Figure 5E). *Teucrium hircanicum* has elongated and flexuose eglandular trichomes as well. Eglandular trichomes are 3–10-celled and cover the stem (Figure 5F).

### 3.2.2. Leaf

*Teucrium aladagense* has peltate glandular and eglandular trichomes on both sides of the leaves. The capitate trichomes are rare, and the eglandular trichomes are 1–2-celled and have micro-papillae (Figure 6A).

*Teucrium lamiifolium* subsp. *lamiifolium* has capitate and peltate glandular and eglandular trichomes on both sides. Capitate trichomes have 1–2 stalk cells and are elongated. Eglandular trichomes are generally 3–8-celled and distinctly with internodes (Figure 6B).

*Teucrium hircanicum* has short capitate trichomes on both sides. Eglandular trichomes are generally 3–7(–8)-celled, and apical cells are acute (Figure 6C).

Indumenta are generally similar on the adaxial and abaxial sides. However, peltate trichomes are denser on the abaxial sides of *T. aladagense*, *T. lamiifolium* subsp.

*lamiifolium*, and *T. hircanicum* (Figures 6D–6F).

## 4. Discussion

*Teucrium aladagense* belongs to sect. *Stachyobotrys* with affinities to *T. lamiifolium* d’Urv s.l. and *T. hircanicum* L. The characteristics of sect. *Stachyobotrys* are: perennial or biennial herbs. Stems are hirsute or villous. Leaves are dentate-crenate. Flowers are borne in dense spike-like racemes. Calyx is gibbous at base, bilabiate, upper tooth broadly ovate, wider than the others, 2 lateral teeth short and obtuse, 2 lower teeth lanceolate. Nutlets are 1.5 mm (Ekim, 1982).

*Teucrium lamiifolium* subsp. *lamiifolium*, *T. hircanicum*, and the new species have some degree of similarities or differences in stem indumentum (Figure 5). *Teucrium aladagense* has short and sparsely eglandular trichomes, mostly 1–2-celled, but *T. lamiifolium* subsp. *lamiifolium* and *T. hircanicum* are villous with multicellular and longer eglandular trichomes (Figures 5A–5C). *T. hircanicum* has short capitate trichomes that have 1–2 stalk cells (Eshratifar et al., 2011); *T. aladagense* has this type of trichome, but capitate trichomes of *T. lamiifolium* subsp. *lamiifolium* are more elongated (Figures 5D–5F).

Adaxial and abaxial sides of leaves of the taxa are quite different (Figure 6). *Teucrium aladagense* has the shortest eglandular trichomes on the adaxial side. Eglandular trichomes are denser on *T. lamiifolium* subsp. *lamiifolium* and *T. hircanicum* than on the new species (Figures 6A–6C).



**Figure 6.** Leaf indumentums of *Teucrium aladagense* and related species. A–C: adaxial side, D–F: abaxial side. A, D: *Teucrium aladagense*; B, E: *T. lamiifolium* subsp. *lamiifolium*; C, F: *T. hircanicum*.

*Teucrium aladagense*, *T. lamiifolium* subsp. *lamiifolium*, and *T. hircanicum* have capitate trichomes with 1–2 stalk cells; the trichomes of *T. aladagense* are the shortest ones (Figures 6A–6C). On the adaxial side of the leaves, density of peltate trichomes on *T. aladagense* is greater than on *T. hircanicum* (Figures 6A, 6C).

Abaxial sides of *T. lamiifolium* subsp. *lamiifolium* and *T. hircanicum* are softly villous, and the new species is pubescent with densely peltate trichomes (Figures 6D–6F). *Teucrium lamiifolium* subsp. *lamiifolium* and *T. hircanicum* have multicellular eglandular trichomes, but *T. aladagense* has short 1–2-celled eglandular trichomes. Apical cells of the eglandular trichomes of *T. aladagense* are crumpled, but eglandular trichomes of the other taxa are not. These trichomes are denser on *T. lamiifolium* subsp. *lamiifolium* and *T. hircanicum* (Figures 6D–6F). Density of peltate trichomes of *T. aladagense* is greater than that of the others (Figure 6D). Capitate trichomes of *T. lamiifolium* subsp. *lamiifolium* are denser and longer than those of *T. aladagense*; they are 1–2 stalk cells and 1 head cell (Figures 6D, 6E).

#### Key to the new species and its allies

1. Calyx with the upper tooth large, much broader than the other 4 teeth,
  2. Spinescent annual; flowers in axils of upper leaves (sect. *Spinularia*) ..... **spinosum**
  2. Unarmed perennials or biennials; flowers in racemes

3. Raceme lax; pedicels conspicuous; upper tooth larger and much broader than the other 4 equal teeth (sect. *Scorodonia*) ..... **kotschyanum**
3. Racemes dense, spike-like or lax; pedicels conspicuous or hidden by flowers; upper teeth larger and broader than the others, 2 lateral teeth very short and obtuse, 2 lower teeth lanceolate (sect. *Stachyobotrys*)
4. Flowers whitish; bracts as long as calyces or overtopping them ..... **lamiifolium**
4. Flowers purple; bracts not reaching top of calyces
  5. Leaves cuneate at base, ±concolorous; inflorescence lax raceme; calyx 5–6.5 mm (South Anatolia) ..... **aladagense**
  5. Leaves truncate or cordate, discolorous; inflorescence dense spike-like raceme; calyx 4–5 mm (Northeast Anatolia) ..... **hircanicum**

1. Calyx with the upper tooth equal to or shorter than the others

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BCN, E, EGE, G, GAZI, HUB, INONU, ISTE, ISTF, ISTO, K, KNYA, L, LE, MA, MARE, RO, TO, VANE, W, WIR, and WU. Thanks to Didem Çakaroğulları for proofreading and correcting the English, Esma Akdoğan for drawing, Bahar Kaptaner for drawing the calyx (Figure 2D), and Adil Güner for providing photographs (Figures 3B, 3C).

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## Appendix

**Examined specimens.** – *Teucrium lamiifolium* subsp. *lamiifolium*: A1 Kırklareli: between Demirköy and Dereköy 8 km from Balaban village to Dereköy, 27.06.1975, N.&E. Özhatay (ISTE 32183); Kırklareli: near Demirköy, Poyralı, 26.06.1968, A.Baytop (ISTE 13925, E); Kırklareli: near Dereköy, on the hills. 24.07.1968, A.Baytop (ISTE 14173, E); A1 Balıkesir: Marmara island, between Saraylar and Asmalı villages, near Asmalı village, 50 m, 13.07.1987, E.Tuzlacı (ISTE 40374); A2 İstanbul: Çınarcık, Üçreisler, 10.07.1982, E.Tuzlacı (ISTE 49928); İstanbul: Çınarcık, Üçreisler, 10.08.1986, E.Tuzlacı (MARE 641); İstanbul: Beykoz, Beykoz Konakları, macchie, 09.06.1999, 100 m, H.Şağban (HUB 3348); İstanbul: Beykoz, Polenezköy, 09.1944, M.Başarman & A.Mete (ISTF 5007); Kocaeli: Yuvacık dam, 104 m, 12.07.2007, A.Efe, N.Aksoy & D.Oral (ISTO 34418); A2 Bursa: Uludağ, between Teferrüç and Bakacıkaltı, 28.06.1994, M.Başarman (ISTF 3411); Bursa: Uludağ, Bakacık road, 1948, M.Başarman (ISTF 8544); Bursa: 8 km to Uludağ National Park, slopes, *Pinus* forest, 810 m, 19.07.1994, G.Kaynak, M.Göçmen & Ş.Güvenç (BULU 8656); Bursa: Uludağ Şosesi, 29.07.1945, M.Başarman (ISTF 5562); Bursa: near Merinos, fallow fields, 150 m, 02.08.1998, R.Günay (BULU 10714); A3 Bolu: Bolu mountains, Belengölcük, ca. 780 m, 04.07.1979, Y.Akman & E.Yurdakul (ANK 10122); Bolu: Bolu mountain, Devrek road (Dirgine), ca. 220–260 m, 05.07.1979, Y.Akman & E.Yurdakul (ANK 10123); Zonguldak: Devrek, Davulga, *Fagus orientalis*, ca. 500 m, 20.07.1983, M.Demirörs (ANK 1547); A4 Zonguldak: Dorukhan pass, north side, *Fagus-Quercus-Pinus nigra*, 800 m, 08.08.1982, T.Raus 6966 (B); Zonguldak: Dirgine to Karadere, 220 m, P.H.Davis 37681 & Coode (E); B1 Balıkesir: Mount Ida, Sarıkız road, 1050 m, 30.07.1971, A.Baytop (ISTE 20780); Balıkesir: Savaştepe, Yeşilhisar, Meşederesi, 28.07.1982, G.Çakırer (ISTE 49605); Balıkesir: Edremit, Mount Ida, 25.07.1968, A.Pamukçuoğlu & P.Quezel (HUB 21435); Balıkesir: Mount Ida, above Zeytinli, 450 m, 30.07.1971, A.Baytop (ISTE 20747); B1 Balıkesir: Mount Ida, 1050 m. 30.08.1971, A.Baytop (ISTE 20780, E); Balıkesir: Mount Ida, 1968, P.Quezel et al. (ANK); Balıkesir: Susurluk, Seyitler village, Keltepe, 800 m, 28.07.1994, Y.Altan 5815 (GAZİ); Manisa: Turgutlu, above Koyrak village, 620 m, 26.06.2010, E.Tuzlacı & G.Bulut (MARE 12976); İzmir: Çıplakdağ, 700–1200 m, 11.07.1933, O.Schwarz 915 (B); Muğla: 32 km from Muğla to Fethiye, under *P. brutia* Ten., 16.05.2012, T.Özcan 222, T.Dirmenci & E.Akçiçek; C3 Antalya: Termessus, 800 m, 29.05.1990, K.H.C.Başer (ISTE 61453); around Side, 05.06.1970, A.Pamukçuoğlu & P.Quezel (HUB 21436); Antalya:

Manavgat to Akseki, 40 miles from main road junction; 880 m, weathered limestone cliffs and scree, *Dudley* 35798 (E); C3 Antalya: Akseki, Erenkaya village, Sokmak, 1500 m, 29.08.1994, H.Özçelik 6900 (GAZİ); Antalya: Akseki, Çukurköy plateau, Tekeğnazı, 1840–1950 m, 18.07.1995, A.Duran 2915 (GAZİ); C3 Isparta: Eğridir, Aksu, Anamas Dağı, Melikler cemetery, around Pınargözü, 1600 m, 25.06.1980, N. & E.Özhatay, E.Tuzlacı (ISTE 45081); Isparta: Şarkikaraağaç, Yenişarbademli, about Anar lake north cliffs, 1600–1700 m, 30.05.1974, H.Peşmen & A.Güner (HUB 21437); Isparta: Dedegöl mount., Felsblockhalde, 1600 m, 18.07.1968, Sorger (W); Isparta: between Kovada thermal reactor and Kovada lake, 850 m, screes, 28.08.1993, H.Duman 5421, Z.Aytaç & A.Dönmez (GAZİ); Isparta: Çandır, Yazılıkanyon, *Q. coccifera*, *Q. ilex*, *P. brutia*, *P. latifolia*, *C. sliqua*, *C. sliquastrum*, screes, 10.05.2007, G.Kaynak & A.Bilişik (BULU 29468); Konya: Beyşehir, Yeşildağ, Cemaller, Gökkaya mountain, 1450 m, 26.06.1981, M.Serin (KON 418); C3/C4 Antalya/Konya: Akseki to Seydişehir, 38 km northeast Akseki: Yıldız Dağı, Alacabeli, limestone cliffs, 1700–1750 m, 09.07.2000, Ö.Eren & G.Parolly 7834 (B-Parolly); C4 Antalya: Alanya, Alanya-Hadim road 15 km, east of Cebelreis mountain, screes, 950–1150 m, 27.06.1993, H.Duman 4954 & F.Karavelioğulları (GAZİ); Antalya: Alanya, north of Şih village, 1000 m, macchie, 09.10.1992, H.Duman 4675 & F.Karavelioğulları (GAZİ); Antalya: between Alanya and Gündoğmuş, Güzelbağ, 750 m, 05.07.1980, E.Tuzlacı, B.Çubukçu & A.Meriçli (ISTE 45670). Konya: Seydişehir, Kuyucak mountain, 1750 m, 28.06.1982, H.Ocakverdi 1515 (ANK, KON); Konya: Bozkır, Ham Boğazı, 1500 m, P.H.Davis 14719 & K.Karamanoğlu (ANK); Karaman: Kazancı, Hamitseydi boğazı, Sarvadi, 12.07.2013, T.Dirmenci 3976-b, E.Akçiçek & Ö.Güner;

– *T. lamiifolium* subsp. *stachyophyllum*: Type: Lebanon: au bord du ravin qui traverse les jardins et forme le lit dutorrent appelé El Kamlé, pres de Saïda, 08.06.1855 Gaillardot (isotype B, E); C5 Hatay: Musa mountain, above Teknepinar, macchie, 450 m, 17.06.1979, E.Tuzlacı & M.Saraçoğlu (ISTE 42304); C6 Hatay: Samandağ, Musa mountain, Tekepınarı village, rocky slopes, 650 m, 08.07.2010, M.Dinç 3319 & S.Doğu; C6 Hatay: Yayladağ, Yayıkdamlar village, rocky slopes, 800 m, 07.07.2010 M.Dinç 3313 & S.Doğu; Hatay: Yaylaağ, Keldağ, 970–1280 m, 27.06.1993, Z.Aytaç 5993, A.Dönmez & H.Şağban (HUB, GAZİ); Hatay: Yayladağ, Keldağ, Denizgören village, 820 m, 16.07.2013, T.Dirmenci 4007, E.Akçiçek, & Ö.Güner– *T. hircanicum*: (lectotype: Hb. Linn.722/20 photo!); A8 Artvin: Murgul, Sülüklü, 550 m, 30.07.1959 (ANK); Artvin: Hatıla gorge, 500 m, 26.08.2013, T.Dirmenci 3941 & B.Yıldız.