

## The synopsis of the genus *Trigonella* L. (Fabaceae) in Turkey

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**Abstract:** In this study, the synopsis of the taxa of the genus *Trigonella* in Turkey is presented. It is represented with 34 taxa in Turkey. The name of *Trigonella coelesyriaca* was misspelled to Flora of Turkey and the correct name of this species, *Trigonella caelesyriaca*, was given in this study. The endemic *Trigonella raphanina* has been reduced to synonym of *T. cassia* and *T. balansae* is reduced to synonym of *T. corniculata*. In addition, *T. spruneriana* var. *sibthorpii* is reevaluated as a distinct species. Lectotypification was designated for *T. capitata*, *T. spruneriana* and *T. velutina*. Neotypification was decided for *T. cylindracea* and *T. cretica* species. *Trigonella* taxa used to be represented by 52 taxa in the Flora of Turkey. However, they have later been evaluated by different studies under 32 species (34 taxa) in Turkey. In this study, taxonomic notes, diagnostic keys are provided and general distribution as well as their conservation status of each species within the genus in Turkey is given.

**Key words:** Anatolia, lectotype, Leguminosae, neotype, systematic

### 1. Introduction

The genus *Trigonella* L. (Linnaeus, 1753) belongs to the tribe *Trifolieae*, subtribe *Trigonellinae* in the Fabaceae family (Lock and Simpson, 1991; Mabberley, 2017). It includes about 135 species widely distributed in dry regions around the east Mediterranean, west Asia, south Europe, north and south Africa, with only one species growing in south Australia<sup>1</sup> (Townsend and Guest, 1974; Kawashty et al., 1998; Akan, 2008, 2012; Çeter et al., 2012; Ranjbar et al., 2012a, 2012b; Pinar et al., 2014). According to Vavilov (1926), the Near East region, extending from Israel through Syria and southern Turkey into Iran and Iraq, and the Mediterranean center including Spain, Morocco, and Turkey are the centers of origin of *Trigonella*, *Trifolium*, and *Medicago* species (Vavilov, 1926; Dangi et al., 2004, 2016; Fazlıoğlu et al., 2018; Basu et al., 2019; Uslu and Babaç, 2019).

All the members of the genus in Turkey are annual, hairy or glabrous, with pinnately trifoliolate leaves, often exhaling an odour of Coumarin (Huber-Morath, 1970; Dangi et al., 2004). In Turkey, it is grown in Thrace, Marmara, Central, South and Southeastern Anatolia regions. Some taxa are important in food and medicine, particularly of the cultivated species *Trigonella foenum-*

*graecum* L. (Fenugreek) were known and used for different purposes in ancient times, especially in Greece and Egypt (Beyzi et al., 2010; Petropoulos, 2017). Seeds of Fenugreek are used for various purposes in the domestic market, as well as exporting.

Vernacular names of the genus of *Trigonella* in Turkey are Çemen otu, Boyotu, Poy otu, Pıtlan, Pıltan or Hulbe otu. It is called Andeko in south east Anatolia (Akan, 2008; Güner et al., 2012).

Several researchers have attempted to employ the taxonomy of the genus *Trigonella*. Sirjaev (1928, 1934), Vasilchenko (1953), Hutchinson (1964) and Ivimey-Cook (1968) gave detailed descriptions of its taxonomic characters.

*Trigonella* genus is presented in Flora of Turkey in volume 3, as 49 species (51 taxa) by Huber-Morath (1970). Then, *Trigonella pseudocapitata* Contandr. & Quézel, was published in 1976 (Contandriopoulos and Quezel, 1976), and added in the 10th additional volume (Davis et al., 1988). Thus, along with the additional volume in Flora of Turkey, *Trigonella* taxa number is increased to 52 taxa. Later, a new subspecies for Flora of Turkey, *Trigonella monantha* C.A. Meyer subsp. *incisa* (Benth.) Ali has been published (Ertekin and Kaya, 2004). In these years, the

<sup>1</sup> Akan H, Ekici M, Aytac Z, Pinar MN (2006). The Taxonomic revision of *Trigonella* L. in Turkey. The project of the Scientific and Technological Research Council of Turkey (TÜBİTAK). Project No: TBAG-2099 101T142. Ankara, Turkey (unpublished data).

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revision of the genus of *Trigonella* in Turkey was studied by Akan et al.<sup>1</sup> (Akan et al., 2005; Akan, 2008; Akan et al., 2009), as a result of this research, the genus members were evaluated under 50 taxa. After that, by Göktürk (2009), *Trigonella coerulescens* (Bieb.) Hal. subsp. *kemerensis* R.S. Göktürk has been published. In the checklist by Özhatay et al. (2009), it was stated that the *Trigonella velutinoides* Hub.-Mor. was published by Huber-Morath (1971). In the years when this revision of genus was made by us, Small and his team transferred many *Trigonella* taxa to *Medicago* genus (Small 1987, 1988, 1989; Small et al., 1981; Small and Brookes, 1983, 1986; Small and Jomphe, 1989; Small et al., 1990; Bena, 2001; Small, 2011). Then, a book named “A checklist of the Flora of Turkey” is prepared, this transfer and novalties are taken into account. Small (2011) in his book named “Alfalfa and relatives: Evolution and classification of *Medicago*” reviews the reasons and evidence for many transfer of species from *Trigonella* to *Medicago*. In summary, these species share morphological (floral), chemical, and DNA features which clearly warrant their combining with *Medicago* and separation from *Trigonella*. Thus, the *Trigonella* genus in our country was evaluated as 32 species (33 taxa) by Akan (2012). In addition, a new taxon, *Trigonella coerulescens* (M. Bieb.) Halácsy subsp. *ayvalikensis* Erdoğan, Selvi & Tümen, from western Anatolia, was published by Erdoğan et al. (2017). As a result, the current status of *Trigonella* in our country is 32 species and two subspecies (34 taxa). 11 of them are endemic and endemism rate is 32.4% in Turkey. The *Trigonella* genus represent with 10 sections in in Tukey.

During the revision of the genus of *Trigonella* in Turkey studied by Akan et al.<sup>1</sup>, the morphology of the genus members, pollen morphology, seed surface morphology and karyology studies have been carried out to contribute the taxonomy of the genus (Martin et al., 2006, 2008, 2010, 2011a, 2011b; Yılmaz et al., 2009; Çeter et al., 2012; Pinar et al., 2014). Turkey's wild fenugreek book was also released by us (Akan et al., 2009). However, generic circumscription has long been a problematic question in the tribe *Trifolieae* subtribe *Trigonellinae*. In particular, many studies have been undertaken on ascertaining the proper relationships between the genera *Medicago* and *Trigonella* (Small et al., 1981; Small and Brookes, 1986; Small, 1987, 1988, 1989; Small and Jomphe, 1989; Small et al., 1990; Bena, 2001; Small, 2011). Several studies on the taxonomical relationship among these genera have been carried out (Small, 1987, 2011). However, no strict delimitation could be proposed.

In this study, the taxonomic notes for each species, the distribution and threatened category of endemic taxa, especially the positions of narrowly distributed is exposed. New observations and collections are given as well.

## 2. Materials and methods

During the months of March to July during 2002–2006, belonging to the genus *Trigonella* members in which grows in different regions in Turkey, has been collected in flower and fruit. The specimens have been identified by the Flora of Turkey (Hub.-Mor. 1970; Davis et al., 1988; Tan and Panista, 2000).

In addition, the specimens kept in the specimens of ADA, AEF, ANK, ATA, BULU, CUM, DUF, EGE, FUH, GAZI, HUB, INONU, ISTE, ISTF, OMU, SUH and VANF herbaria were examined. Type specimens kept in abroad herbaria, such as E, K, B, G, BM, BRA, MSB, OXF, UPS and W herbaria were also examined (Thiers, 2019).

Herbarium specimens in Turkey and from abroad were examined, but only some of them could be given here.

The relevant literature was used for typification (Ali, 1972; Turland and Jarvis, 1997; Seregin et al., 2018).

Red list categories of endemic taxa were revised according to IUCN Red List Categories (IUCN, 2016; Ekim et al., 2000; Akan et al., 2005). These categories are stated with their abbreviations: CR: critical endangered, EN: endangered, VU: vulnerable, NT: near threatened, LC: least concern.

In this study, authors of plant species are given according to the database named The Plant List<sup>2</sup>, and were checked from the work Authors of Plant Names (Brummitt and Powell, 1992).

Turkish names of plants belonging to the taxa were given according to Güner et al. (2012).

Alphabetical order of sections was followed in the submission of the plant list. The location, altitude, date, habitat, collector number and endemism status of the plant were given.

The grid system proposed by Davis (1965) was used to for the distribution of the each species.

In the findings part, some of our own collections and herbaria records of Turkey and abroad are included. Specimens collected during this study were kept in GAZI, HARRAN and KSU herbaria.

## 3. Results

**TRIGONELLA** L. Sp. Pl. 776 (1753) /Çemenotu

**Lectotype:** *Trigonella foenum-graecum* L., Prop. Brit. Bot. 177 (1929).

In the Index Kewensis, the following thirteen synonyms are given for the genus *Trigonella*: *Tellis* Linn. Syst. Ed I (1735), *Foenum-graecum* (Tourn) Rupp. (1745), *Kentia* Adans (1763), *Buceras* Hall (1785), *Melisitus* Medic (1787), *Trifolium* Moench (1794), *Falcatula* Brot (1801), *Pocockia* Ser (1825), *Botryolotus* Jaub. (1842), *Nephromedia* Kostel (1844), *Grammocarpus* Schur. (1853), *Aporathus* Broamf. (1856) and *Follicullicera* Pasq. (1867).

<sup>2</sup> The Plant List (2013). Version 1.1. [online]. Website <http://www.theplantlist.org/> [accessed 00 Month Year].

**Description of the genus**

Hairy or glabrous annual herbs (in Turkey) with pinnately trifoliolate leaves, often exhaling an odour of Coumarin. Leaflets usually toothed, emarginate, pinnatifid; leafy stipules adnate to petiole, 1–5–9 × 0.5–4 mm; ovate, lanceolate, cuneate, obovate, oblong, obcordate, orbicular, rhomboid. Flowers axillary, solitary or mainly in heads, spikes or short racemes. Calyx 5-toothed, campanulate or sometimes tubular, regular or 2-lipped, 1.5–12 mm length. Corolla yellow, violet, pinkish, pale-lilac, blue, orange or rarely white. Standard oblong or obovate, 2.5–20 × 1–8 mm. Keel obtuse, linear-obovate, shorter than oblong wings; keel and wings tightly joined or free, elliptic. Stamens free from petals, diadelphous, the upper one entirely free, filaments not dilated at apex, whitish, glabrous; anthers dorsifixed; stigma capitate. Fruits mainly exserted from calyx, straight or curved (never coiled), linear to oblong or ovate, sometimes subovate or semilunar, terete or compressed, rarely torulose, with or without a beak, with distinct or indistinct mainly entire sometimes denticulate sutures, not winged, 1-to many seeded, dehiscent or rarely indehiscent. Seeds mainly tubercled or wrinkled, rarely smooth. Cotyledons (in seedling) swollen at base. Well-developed fruiting material is indispensable for determination. The genus has its centre in the Mediterranean area.

**Identification key of Turkish Trigonella species:**

- 1. Peduncle absent to 5 mm long; flowers always erect
- 2. Flowers always yellow; flowers more than (1–)2 ..... Group B
- 2. Flowers never yellow; flowers up to 2 ..... Group A
- 1. Peduncle 5–70 mm long; flowers erect to recurved
- 3. Flowers white; fruits not torulose ..... Group C
- 3. Flowers yellow, blue, lila-blue, purple; fruits rarely torulose
- 4. Flowers blue or lila to blue ..... Group D
- 4. Flowers yellow or pinkish
- 5. Legumes flat, often parchment-like, sessile, sutures denticulate or if unarmed then fruits orbicular to half-ovate or semilunar ..... Group E
- 5. Legumes terete or compressed, linear to oblong-ovate, sutures unarmed
- 6. Fruits torulose ..... Group F
- 6. Fruits not torulose
- 7. Fruits ovate-oblong; seeds 1–2 ..... Group G
- 7. Fruits linear, linear-oblong; seeds more than 1
- 8. Fruits glabrous, unbeaked ..... Group H
- 8. Fruits usually hairy, beaked ..... Group I
- Group A**
- 1. Legumes with prominent midrib, 40–100 mm long ..... *T. macrorrhynca*
- 1. Legumes without a prominent midrib, 15–110 mm long

- 2. Legumes distinctly compressed; style 5–6 mm long; filaments 9–11 mm ..... *T. cariensis*
- 2. Legumes compressed or not; style 1–3.5 mm long; filaments 4.5–8 mm long
- 3. Legumes compressed, 25–50 mm long; beak 10–25 mm long ..... *T. gladiata*
- 3. Legumes not compressed, 20–110 mm long, with beak 15–40 mm long
- 4. Stipules 3–4 mm long; pedicels glabrous; calyx theet up to 1.5 mm long; style 3–3.5 mm long; seeds 2–8 ..... *T. cassia*
- 4. Stipules 5–6 mm long; pedicels hairy; calyx theet up to 3 mm long; style 1–1.5 mm long, seeds 6–20 ..... *T. foenum-graecum*

**Group B**

- 1. Legumes glabrous, circular or semicircular curved, beak 0.25–0.5 mm long; flowers 2–5 ..... *T. spinosa*
- 1. Legumes pubescent, erect to semierect, sometimes semi circular, beak 0.5–4 mm long; flowers 1–25
- 2. Stipules 2–2.5 mm long; inflorescence 2–8 flowered; calyx 3.5–4.5 mm long ..... *T. arcuata*
- 2. Stipules 3–3.5 mm long; inflorescence 4–18 flowered; calyx 2.5–3.5 mm long ..... *T. monspeliaca*

**Group C**

- 1. Stipules 3–5 mm long; corolla 5–9 mm long; legumes 7–25 mm long; with beak 3–5 mm long ..... *T. kotschyi*
- 1. Stipules 2–3 mm long; corolla 3.5–4.5 mm long; legumes 4–7 mm long; with beak 0.5–1 mm long ..... *T. cilicica*

**Group D**

- 1. Legumes 7–15 mm long, hirsute adpressed hairy; seeds 4–7
- 2. Plant densely villose; corolla 6–15 mm long; fruits with beak 3–4 mm long ..... *T. coerulescens*
- 2. Plant setose hairy; corolla 4–7 mm long; fruits with beak 1–1.5 mm long ..... *T. pseudocapitata*
- 1. Legumes 2–6 mm long, glabrous; seeds 1–3
- 3. Inflorescence globose-ovate; corolla 4–5.5 mm long; legumes 3–5 mm, with beak 1.5–2 mm long ..... *T. capitata*
- 3. Inflorescence oblong rasemose; corolla 5.5–7.5 mm; legumes 2–6 mm long; with beak 3–4 mm long ..... *T. procumbens*

**Group E**

- 1. Calyx theet 0.5–1 mm long, legume glabrous, beak absent ..... *T. cretica*
- 1. Calyx theet 1.5–3 mm long; legume hairy, with beak 0.5–1.5 mm long ..... *T. plicata*

**Group F**

- 1. Stipules entire, 2–4.5 mm long; leaflets glabrous above; calyx teeth 0.5–1.5 mm; flowers pendulose
- 2. Stipules 2–2.5 mm long; petiole 5–23 mm long; peduncle with 0.–1.5 mm awn; legumes adpressed hairy ..... *T. smyrnea*

2. Stipules 4–5 mm long; petiole 70–120 mm long; peduncle with 7–12 mm awn;

legumes villose ..... *T. strangulata*

1. Stipules dentate or bilobed, 4–5 mm long; leaflets hairy; calyx teeth 1.5–3 mm long; flowers erect .....

..... *T. isthmocarpa*

**Group G**

1. Stipules 6–7 mm long, lanceolate–subulate; legumes ovate–oblong to cylindrical heads; corolla 5–7 mm long; filaments 5–6 mm long; ovaries 3–3.5 mm long; stilus 2.5–3 mm long; fruits with 3–4.5 mm long beaked ..... *T. spicata*

1. Stipules 2.5–3 mm long; linear–subulate; legumes orbicular to adpressed heads; corolla 3–4 mm long; filament 3–3.25 mm long; ovaries 2 mm long; stilus 1–1.5 mm long; with 2–2.5 mm long beaked ..... *T. cephalotes*

**Group H**

1. Leaflets glabrous; legumes striate lengthwise .....  
..... *T. caelesyriaca*

1. Leaflets hairy; legumes transversed nerved

2. Stipules 5–6 mm long; leaflets glabrous above; inflorescence 7–20 flowered; pedicels 3–4 mm long .....

..... *T. corniculata*

2. Stipules 2–4 mm long; leaflets hairy on both surfaces, rarely glabrous above; inflorescence 2–9 flowered; pedicels up to 3 mm long ..... *T. lycica*

**Group I**

1. Stipules entire; flowers pendulose; stylus hairy below

2. Pants densely villose or pubescent, not adpressed; legume transversely nerved

3. Petiole 2–12 mm long; corolla 6–6.5 mm long; calyx theeth 0.5–1.25 long; seeds oblong–ovoid, 2–5 mm .....  
..... *T. sibthorpii*

3. Petiole 20–100 mm; corolla 5–6 mm long; calyx theeth 3–4 mm long; seeds oblong–cylindrical, 1–2 mm

4. Peduncles 5–30 mm densely villous, calyx 3.5–6 mm long, teeth 3–4 mm long ..... *T. velutina*

4. Peduncle 8–20 mm long, spreading densely hairy, calyx; 4–4.5 mm long, teeth 1–2.5

mm long ..... *T. velutinoides*

2. Plant sparsely or apressed hairy; legume reticulate, rarely transversely nerved

5. Leaves 6–15 mm long; corolla 3–4 mm long; legume with subulate and 4–10 mm long beaked ..... *T. filipes*

5. Leaves 8–70 mm long; corolla 4–8 mm long; legumes with linear–acuminate and 0.5–8 mm long beak

6. Corolla 7–8 mm long; legume beaked 0.5–0.75 mm long; seeds 4–5 ..... *T. mesopotamica*

6. Corolla 4–7 mm long; legume beaked 3–8 mm long; seeds 2–5

7. Indumentum spreading; petiole 5–30 mm long; leaves 15–70 mm long; peduncle 5–50 mm long; legumes transversely nerved ..... *T. spruneriana*

7. Indumentum densely adpressed; petiole 3–6 mm long; leaves 8–15 mm long; peduncle 5–20 mm long; legumes reticulate nerved .....

..... *T. cylindracea*

1. Stipules dentate bilobe to entire; flowers erect; stylus glabrous .....

..... *T. cancellata*

Sect. **Biebersteinianae** (Širj.) Grossh.

In Turkey, sect. *Biebersteinianae* is represented with *T. coerulescens* and three subspecies.

1. **Trigonella coerulescens** (Bieb.) Hal., Consp. Fl. graec 1:351 (1901) / Hintkokası

It has three subspecies in Turkey.

Key to the three subspecies of *Trigonella coerulescens* in Turkey (Erdoğan et al., 2017)

1. Bracts 2.0–2.5 mm long; calyx 5 mm long, teeth linear; leaflets obovate and densely tomentose .....

..... subsp. *kemerensis*

1. Bracts 3–6 mm long; calyx 6–9 mm long, teeth subulate; leaflets obovate–cuneate and densely villous

2. Bracts 4–6 mm long; calyx 7–9 mm long; inflorescence 6–15 flowered; stipules 6–7 mm long .....

..... subsp. *coerulescens*

2. Bracts 3–5 mm long; calyx 6–7 mm long; inflorescence 15–25 flowered; stipules 3–6 mm long .....

..... subsp. *ayvalikensis*

subsp. **ayvalikensis** Erdoğan, Selvi & Tümen, in Phytotaxa 319 (2): 167–174 (2017)/ Ayvalıkçemenotu

**Holotype:** Turkey: B1 Balıkesir, Ayvalık, Küçükköy, west of Badavut beach, sandy coast, 1 m, 12.03.2016,

39°16'23" N, 26°37'43" E, *Selami Selvi 1616* (holo. The herbarium of Balıkesir University, Altınoluk Vocational School, Programme of Medicinal and Aromatic Plants, photo!, iso. ANK!, ISTE).

*Flowering time:* March–April

*Habitat:* sandy coast, shore of salt lake, 1–3 m.

*Distribution:* W Anatolia, endemic to Turkey. Medit. element. IUCN: VU B2ab(iii).

*Note:* It is endemic to Turkey, known only from the two localities; near the Badavut beach–Sarımsaklı beach and shore of St. Tuka Salt Lake in Ayvalık, Balıkesir, Turkey (Erdoğan et al., 2017). It grows only on sandy coast and shore of Salt Lake. The epithet comes from Ayvalık district, where holotype specimen was collected. In the original paper (Erdoğan et al., 2017), no local name was given for the plant in the original publication, for this reason, the vernacular name of the plant is suggested here as “Ayvalıkçemeni”.

subsp. **coerulescens** / Hintkokası

**Holotype:** [Caucasus] in deserto Anketeri fluviis Terek et Kumae interjacente, *Steven #s.n.* (holo. LE!).

≡ *Trifolium coerulescens* Bieb., Fl. Taur.–Cauc. 3:509 (1819).

= *Trigonella azurea* C.A. Meyer, Verz.Pfl. Cauc. 136 (1831).

= *Trigonella fasciculata* Bertol., Misc. Bot. 2:19 (1843).

*Flowering time:* April–June

*Habitat:* Liming slopes, pine forests, steppe, fallow fields, roadside, 300–1300 m. *Distribution:* Turkey, Greece, Crimea, Caucasus, Transkaspiya, Syria, Iraq, Iran; Ir.–Tur. element. *IUCN:* LC.

*Examined specimens:* **A4 Ankara:** Kalecik–Irmak 10 km, 650 m, 24.05.87, fields, *Koyuncu 2558* (AEF 16290!); **Kırıkkale:** 2 km north of Delice, 800 m, steppe, 29.04.1989, *Dönmez 1142* (E!); **B1 Çanakkale:** Bozcaada, 10 m, 06/05/1975, sandy area, *Seçmen & Leblebici 459/g* (EGE!); **B5 Niğde:** 5 km from Ulukışla to Pozantı, 1300 m, 01.06.2002, steppe, *Akan 3595 & Ekici* (GAZI!, HARRAN!); **C1 Aydın:** Geyra to Kale, 950 m, 28.05.2002, meadows, *Akan 3439, Aytaç & Ekici* (GAZI!, HARRAN!); **B7 Erzincan:** Bağıştaş, near Karasu river, 870 m, 17.05.1980, *Yıldırım 2772* (HUB!); **C3 Burdur:** Burdur, 970 m, *Alpay* (ANKO 2251!); **C4 Konya** Sarayköy, Tokkalı hill, 1400 m, 30.05.79, *Dural-393* (KNYA!); **C5 Niğde:** Pozantı, 900 m, stony places, 08.05.1990, *Gemici 5069 & Ellici* (EGE!); **C8 Mardin:** Midyat to Savur 17 km, 20.04.1986, 1120 m, *Nydegger* (HUB!).

*Note:* It is one of the most common takson in Turkey. It can be mixed with members of the genus *Trifolium* due to the similarity of its flowers during the flowering period. However, it has the characteristic of the the genus *Trigonella* with the signficiant feature and linear fruit. According to the Flora of Turkey, peduncle length up to 50 mm in description, but in our specimens it is found to be 65 mm.

subsp. **kemerensis** R. S. Göktürk, in *Annales Botanici Fennici*, 46 (1): 62–64 (2009) / Kumçemenotu

**Holotype:** Turkey. C3 Antalya: Kemer, Çıralı, 3 m, 02.04.2007, 36°23'895' 'N, 30°28'537' 'E, sandy seashores, R.S. Göktürk 6013 (Holotype: AKDU!; isotypes ANK, GAZI!, HUB).

*Flowering time:* March–April

*Habitat:* On sandy seashores.

*Distribution:* Olimpos Beydağları National park, Antalya. Endemic to Turkey. *Medit. element. IUCN:* CR B1ab(i).

*Note:* It is endemic to Turkey, known only from two localities in Kemer and Kumluca districts of Antalya province. It grows only on sandy sea shores (Göktürk, 2009).

Sect. **Bucerates** Boiss. In Turkey, it is represented by three species.

**2. Trigonella arcuata** C. A. Meyer, *Verz. Pfl. Cauc.* 136 (1831) / Eğriçemenotu

**Type:** (USSR, Azerbaijan) Talysch, in collbus lapidosia prope pagum Svant, 20.06.1831, C. A. Meyer (Holo. LE photo!, iso. E00175377 photo!).

=*Trigonella cancellata* Desf. var. *arcuata* (C.A.Mey.) Širj., *Fac. Sci. univ. Masaryk Brno* 128:17 (1930).

=*Medicago arcuata* (C.A. Mey.) Trautv. in *Bull. Acad. Petersb.* 8, n.17 (1841).

*Flowering time:* May–July

*Habitat:* Steppe, riverside, 900–1950 m. *Distribution:* Caucasus, Iran, S Russia, Turkey, Central Asia; Ir.–Tur. element. *IUCN:* NT

*Examined specimens:* **A9 Kars:** 41 km from Kars to Kağızman, 1400 m, 13.07.2002, stony places, *Akan 3719, Aytaç & Ekici* (GAZI!, HARRAN!); **B9 Kars:** Iğdır to Aralık 11 km, 18.05.1990, 900 m, *Levostrom 45455* (GAZI!); **B10 Ağrı:** 20 km from Doğubeyazıt to Çaldıran, 1950 m, 14.07.2002, roadside, *Akan 3760, Aytaç & Ekici* (GAZI!, HARRAN!).

*Note:* It is widely distributed in the Eastern Anatolia of Turkey. In the Flora of Turkey, stipule is given as dentate for species, however, some of our specimens have entire stipules and the number of flowers is 2–8 (not 4–8).

**3. Trigonella cancellata** Desf., *Tab. Êcole Bot. Ed.* 3:218 (1829) / Karsçemenotu

**Lectotype** (designated by Lassen, 1975): Described from an unknown locality, *Retzius, A.J., #s.n.* (lecto. LD, LD1750907 photo!)

=*Medicago connivens* Trautv., *Acta Horti Petrop.* 4: 125 (1876).

*Flowering time:* June–July.

*Habitat:* Stony places, steppe, 1250–2250 m. *Distribution:* Turkey, S Russia, the Caucasus, N Iran, Trankaspiya, Turkestan; Ir.–Tur element. *IUCN:* CR B1c(iii).

*Examined specimens:* **A9 Kars:** Kars–Kağızman 23 km, 13.07.2002, 1800 m, stony places, *Akan 3711 & Ekici* (GAZI!, HARRAN!); Posof, Doğrular village, 1450–2200 m, 30.05.96, *Demirkuş 3440* (HUB!); **B10 Ağrı:** Doğubeyazıt–Çaldıran 20. km, 14.07.2002, 1350 m, steppe, *Akan et al. 3757* (GAZI!, HARRAN!); Ağrı–Doğubeyazıt 17 km, 1720 m, 12.07.1979, steppe, *A. Baytop*, (ISTE 42764!).

*Note:* This species has natural distribution only in Eastern Anatolia. It is close to *T. spinosa* but the peduncle length is 0–3 mm in *T. spinosa* while it is 1–3 cm in *T. cancellata*.

**4. Trigonella monspeliaca** L., *Sp. Pl. ed.* 1:777 (1753)/ Somçemenotu

**Lectotype** (designated by Lassen, 1975 in Turland & Jarvis (1997): Described from S. France, *Herb. Linn. No.* 932.13, right-hand plant (LINN photo!)

*Flowering time:* March–June

*Habitat:* Rocky slopes, oak groves, open lands in the forest, empty plains, 0–1500 m. *Distribution:* Turkey, Mediterranean countries, Syrian desert, N Iraq, Iran, S Russia, Caucasus, *Medit. element. IUCN category:* LC.

*Examined specimens:* **A1 Çanakkale:** Gökçeada, the north east of Değirmendere hill, 19.05.1975, *Seçmen & Leblebici 647* (EGE!); **A7 Trabzon:** Dağbaşı–Bayburt 20 km, 11.07.2002, 1400 m, steppe hills, *Akan 3690 & Ekici* (GAZI!, HARRAN!). **B1 İzmir:** Kuru mountain,

27.05.2002, 615 m, *Akan 3418 & Ekici* (GAZI!, HARRAN!); **B3 Konya:** Sultan mountain, Doğanhisar district, 1375 m, 30.03.1975, *Quercus* forest, *Ocakverdi 29* (KNYA!); **B7 Elazığ:** Fırat University Campus, 1100 m, 26.05.1997, *Akgül 1376* (INONU!); **C2 Muğla:** Köyceğiz, Döğüşbekir village, 30 m, 18.03.1991, roadside, *Güner et al.* (HUB!); **C3 Antalya:** Antalya–Korkuteli 11 km, 17.04.2002, 200 m, *Akan 2818/b* (GAZI!, HARRAN!); **C4 Mersin:** Anamur–Gilindre 20 km, 14.04.1956, *Davis & Polunin* (ANK!); **C6 Hatay:** Hatay–Belen, 14.04.2002, 450 m, *Akan 2774 & Ekici* (GAZI!, HARRAN!); **C7 Şanlıurfa:** Şanlıurfa–Birecik 36 km, 05.05.2002, 500 m, *Akan 3127 & Ekici* (GAZI!, HARRAN!); **C8 Mardin:** Nusaybin, 750 m, 22.05.1957, *Davis & Hedge 28469* (ANK!);

*Note:* It is a widespread in all Anatolia. According to the Flora of Turkey, this species has not peduncle but in this study, it is determined that it has at least 1 mm peduncle. Although the maximum number of flowers has been determined as 18, from C1 Muğla, collected by Davis & Polunin (E00337063, E!), the flower number was observed up to 28. It has been reorganized as “*Medicago monspeliaca* (L.) Trautv.” recently by Small (1987). It has been recorded that the designation for lectotype is restricted to just the right-hand specimen on the sheet, although we believe this may have just been for technical reasons rather than taxonomic ones.

Sect. **Capitatae** Boiss. In Turkey, it is represented by three species.

**5-Trigonella capitata** Boiss. Diagn. ser. 1(2): 17 (1843) / Topçemenotu (Figures 1 and 2).

**Lectotype (designated here):** Turkey C2 Denizli ad aquas et rivulos prope Pamboukkalesi (Pamukkale), Hierapolin veteris, vi 1842, *Boissier #s.n.* (lecto. G00360087 photo!). **Isolectotypes:** BM000901110 photo!, C10012410 photo!, G00330237 photo!, G00360062 photo!, G00360086 photo!, HBG519002 photo!, JE00007608 photo!, JE00007609 photo!, JE00007610 photo!, K000118148!, K000998718!, M0239491 photo!, S12-8361 photo!, S-G-9360 photo!, US01050161 photo!.

*Flowering time:* May–June

*Habitat:* Humid areas, cultural areas, 800–1100 m. *Distribution:* Turkey, Transcaucasia, Iran; Ir.–Tur. element. *IUCN:* NT.

*Examined specimens:* **A5 Amasya:** West of Boğazköy village, 18.06.1955, *Çetik 422* (KNYA!); **B3 Eskişehir:** Çifteler, 02.07.1953, *Birand & Zohary 3265* (ANK!); **Afyon:** 10 miles from Çay to Afyon, 1000 m, in *Juncus* clumps, 13.05.1965, *Coode & Jones 2374* (ISTF 20702!); **B4 Kırşehir:** Kervansaray mountain, Gümüşkümbet village, 1200 m, 21.06.1995, steppe, *Hamzaoğlu 2226* (GAZI!); **B7 Elazığ:** Elazığ–Bingöl 8 km, 1200 m, 06.06.1997, wetlands, *Akgül 1439* (INONU!); **C2 Denizli:** Pamukkale, 29.05.2002, 270 m, meadows, *Akan 3461 et al.* (GAZI!,

HARRAN!); **C3 Antalya:** Akseki, 700 m, 08/04/1956, *Davis & Polunin 25775* (ANK!).

*Nomenclatural notes:* According to the Flora of Turkey (Huber-Morath, 1970), the syntypes were given from Denizli and Malatya. Since no lectotype specimen was encountered until this study, one of the specimen of Boissier collected from Denizli in 1842 was proposed as a lectotype here (G00360087). The most beautiful natural distribution was found in Pamukkale, Denizli (Figure 2). However, it is adversely affected by fluctuations in tourism. The legume length of the species in Flora of Turkey was given as 3 mm, however, it was measured to 5 mm in our specimens. It was determined that the peduncle length was up to 9 cm.

**6. Trigonella procumbens** (Besser) Reichenb., Ic. Pl. Crit. 4:35 (1826) / Yatıkboyotu

**Holotype:** Described from S. Russia (Podolia), *Besser* (holo. KW photo!)

≡ *Melilotus procumbens* Besser, Enum. Pl. Volhyn. 30 (1822).

= *Trigonella besseriana* Ser. in Dc., Prodr. 2:181(1825).

*Flowering time:* May–July

*Habitat:* Humid areas, cultural areas, empty plains, gardens, steppe, 0–1500 m *Distribution:* Turkey, the Balkans, S Russia, the Caucasus. *IUCN:* NT.

*Examined specimens:* **B1 İzmir:** Şaraphane, nearby of Melez river, 24/05/1983, *Gemici & Ellikçi* (EGE!); **B3 Konya:** Akşehir–Gelendost 3 km, 29.05.2003, 1070 m, roadside, *Akan 4650 & Ekici* (GAZI!, HARRAN!); **B3 Konya:** Akşehir–Gelendost 3 km, 29.05.2003, 1070 m, cultivated area, *Akan 4650 & Ekici* (GAZI!, HARRAN!).

*Note:* In Turkey, it is one of the blue-flowered among *Trigonella* members. It is generally distributed in South Anatolia. The most beautiful natural populations, were found around Akşehir, Konya. It usually spreads on the edges of fields and this situation is a risk for natural population of species. According to the Flora of Turkey, it is stated that the stipules are usually toothed in some specimens, but our observations show that the stipules are entire for species.

**7. Trigonella pseudocapitata** Contandr. & Quézel. Bull. Soc. Bot. Fr. 123: 421 (1976) / Kavrukboyotu

**Holotype:** [Turkey C2 Muğla/Denizli] paturages rocaillieux calcaires sur le revers occidental du Göz Tepe inter Fethiye [sic] et Cameli, 1600 m, 21 vi 1973, *P. Quézel & Contandr.*, 73–435 (holo. MARS!).

*Flowering time:* June–July

*Habitat:* Open lands in the forest, limestone slopes, 1500–1900 m. *Distribution:* Endemic to Turkey. *Medit.* element. *IUCN:* CR B1ab (iii).

*Examined specimens:* **C2 Muğla:** Elmalyurt–Fethiye 7 km, 29.06.2005, 1500 m, open lands in the forest, *Akan 5751 & Ekici* (GAZI!, HARRAN!); Fethiye, Yeşilgöl mountain,



Figure 1. Lectotype of *Trigonella capitata* Boiss. (G00360087).

1700–1900 m, 07.06.1992, *Gemici* 681 (EGE!); **Denizli**: Kelekçi–Olukbaşı village, 22.06.2003, 1550 m, open lands in the forest, *Akan* 4766 & *Ekici* (GAZI!, HARRAN!).

*Note*: It is endemic to west part of Turkey. It was defined to science in 1971 by Huber.-Morath after publication of Flora of Turkey, volume 3, in 1970s. Thus, in this study, it is added to the identification key. In Turkey, it is one of the blue-flowered species of *Trigonella*. Generally, it has been localized to regions of Burdur, Denizli and Muğla, west part of Turkey, but the populations were found to be inadequate. Therefore, it is included in the category of CR. It is very close to *T. capitata* however, its stipules and length of fruit is longer than *T. capitata*. The peduncle length of the species in the Flora of Turkey is given as 5–15 mm, in our study, it is measured as 7–22 mm. Flowers and fruits of this species can be evaluate a as an ornamental plant.

Sect. **Cylindricae** Boiss. In Turkey, it is represented by eleven species.

**8. *Trigonella cilicica*** Hub.-Mor., *Bauhinia* 2(3):300, t. 5 (1965) / Torosboyotu

**Holotype**: Turkey C5 İçel: distr. Tarsus, *Pinus brutia*–Wald bei Gülek bogazi, 820 m, 29.5.1956, *Huber–Morath* 16504 (holo. G!).

*Flowering time*: May–June

*Habitat*: Pine forests, stony hills, 800–1800 m.

*Distribution*: Endemic to Turkey. *Medit. element.*  
*IUCN*: CR B1ab(i).

*Examined specimens*: **C5 Mersin**: Pozantı–Gülek pass 26 km, 01.06.2002, 830 m, *Pinus brutia* forest, *Akan* 360 & *Ekici* (GAZI!, HARRAN!); **Adana**: Pozantı–Çiftelhan 8 km, 08.06.2003, 850 m, stony places, *Akan* 4682 & *Ekici* (GAZI!, HARRAN!); **Niğde**: Ulukışla, Alihoca village, 1800 m, 30.5.1978, *Pinus brutia* forest, *Erik* 2853 (HUB!).



**Figure 2.** The general view of *Trigonella capitata* Boiss. from field (by H. Akan).

*Note:* In Turkey, it is a rare endemic, localized to Gülek pass in Mersin province. Up to this study, it was known only from the type specimen. According to the Red Data Book (Ekim et al., 2000), it was known in the DD (data deficient) category. Natural population of this species was discovered around Gülek pass during our intensive field studies. It is close to the *T. filipes* however it can be easily distinguished from *T. filipes* by the white flowers and by short fruits. In the Flora of Turkey, the length of leaflets of the species is given as 4–8 mm long, and the length of peduncle is given as 5–15 mm long, however, in our collections, leaflets are measured as 2–18

mm long and the peduncle is measured as 15–30 mm long.

**9. *Trigonella cylindracea*** Desv., J. Bot. Appl. 3:77 (1814) /Boruboyotu (Figures 3 and 4).

**Neotype (Designated here):** Mersina (Cilicie). Sables maritimes, Turkey, *B. Balansa* 470 (Neotype:BM000901093 photo!) (Isotype of *Trigonella plagineura* Boiss.).

=*Trigonella plagineura* Boiss., Diag. Ser. 1(9): 16 (1849).

*Flowering time:* April–May

*Habitat:* Sandy places, 0–50 m. *Distribution:* Turkey, W Syria, N Egypt. *Medit. element.* IUCN: NT.





**Figure 3.** The neotype of *Trigonella cylindracea* (BM 000901093) (designated here).

**Examined specimens:** **C3 Antalya:** Antalya–Akseki 10 km, 19.04.2002, 450 m, roadside, *Akan 2843 & Ekici* (GAZI!, HARRAN!); **C5 Mersin:** Viranşehir, 20.04.2002, 0–10 m, beaches, *Akan 2843 & Ekici* (GAZI!, HARRAN!); Pompeiopolis to Mersin, sands, *Balls 470* (ANK!); Egemen, nr. Tarsus, dunes, *Karamanoglu 5335* (ANK!); Tarsus, Egemen village, 26.04.1955, *R. Çetlik 5336* (KNYA!, AEF!).

**Nomenclatural Notes:** There is not enough data for the type example specified for this taxon. In the original publication of this species introduced to the science by Desvaux (1814), no information about typification was found. The revision of the genus of *Trigonella* has been prepared by Širjaev (1928, 1934), there is no information here either. In the Flora of Turkey, “in Oriente, Desvaux” specified only as type is insufficient data (Huber-Morath, 1970). For this reason, the sample belonging to *T. plagioneura* Boiss., which was defined as a type and is in a synonym state, was determined as the neotype (Figure 3) for this taxon. According to International Code of Nomenclature, item 9.7, a neotype is a specimen

or illustration selected to serve as nomenclatural type if no original material is extant, or as long as it is missing (Menemen and Dönmez, 2006). The same specimen is available at MNHN herbarium (Paris, France) with specimen number of MNHN-P-P0295616. In the Flora of Turkey, the length of peduncle of this species, is given up to 2 cm, however the length of peduncle of our specimens from field trips, measured at most to 1 cm. It only grows on salty and sandy areas. In the Flora of Turkey, the number of flowers is given as 5–15, in our specimens, the number of flowers is determined as 5–10.

**10. *Trigonella filipes* Boiss.** Diagn. Ser. 1(9):16 (1849) / İnceboyotu

**Holotype:** [Syria] in collibus siccis dumosis circa Rascheya Antilibani, 1846, *Boissier* (holo. G photo!).

**Flowering time:** April–June

**Habitat:** Rocky slopes, limestone steppe, empty spaces, road edges, 400–1200 m. **Distribution:** Turkey, W Syria, N Iraq, W Iran, Ir.–Tur. element. **IUCN:** LC.

**Examined specimens:** **B4 Ankara:** Balgat, wheat fields, 30/5/1958 *R. Çetik 20813* (ANK!); Keçiören, 06.06.1958 *Çetik & Davis 20810* (ANK!); **B7 Erzincan:** Kemaliye, around Sandıkbağı, 900 m, 18.05.1980, *Yıldırım 2816-2956* (HUB!); **C6 Hatay:** Yayladağ, Şenköy village, 14.04.2002, 430 m, under shrubs, *Akan 2750, Akan 2759 & Ekici* (GAZI!, HARRAN!); **Antakya:** Şenköy (between Antakya & Yayladağ), 800 m, 28.04.1957, rocky limestone slopes in maquis, *Davis 27216* (E 00175597!); **Gaziantep:** 29.04.1935, *Balls 2197* (E!, ANK!); **C7 Şanlıurfa:** Şanlıurfa–Suruç 20 km, 18.05.2002, 600 m, roadside, *Akan 3200 & Ekici* (GAZI!, HARRAN!); **C8 Mardin:** Derik–Mazıdağı 1 km, 23.04.2005, 925 m, under *Quercus* forest, *Akan 5585 & Ekici* (GAZI!, HARRAN!); **Mardin:** 10–12 km W of Savur, 900 m, 05.05.1966, rocky limestone slopes, *Davis 42450* (E 00175599!); Mardin–Diyarbakır, 1000 m, 27.05.1957 *Davis & Hedge 28834* (ANK!).

**Note:** The length of the peduncle in herbarium specimens and from our field collections, it is found to be no more than 3 cm. However, the peduncle length of specimens collected from Hatay by Davis (27216, E!), can extend up to 6 cm.

**11. *Trigonella kotschy* Fenzl** Diagn ser. 1 (19):15 (1849) / Akboyotu

**Type:** [Turkey C5 in monte Tauro, 1836, *Kotschy* 163 (holo. G photo!, iso. W!, K!).

= *Trigonella boissieri* Bornm., Bull. Herb. Boiss. 2(5):647(1905).

**Flowering time:** April–June

**Habitat:** Stony hills, fallow fields, roadsides, *Quercus* forest, 0–2000 m. **Distribution:** Endemic to Turkey. Ir.–Tur. element. **IUCN:** LC.

**Examined specimens:** **B5 Aksaray:** Hasan mountain, 21.06.2003, 900 m, roadside, *Akan 4749 & Ekici* (GAZI!,



Figure 4. The general view of *Trigonella cylindracea* from field (by H. Akan).

HARRAN!); **B7 Elazığ:** Kale, about 25 miles from Elazığ, 1100 m, igneous slopes, 04.06.1957, *Davis 28961* (E 00175609!); **Erzincan:** İliç, Yakupluk surroundings, Handeresi location, the foothills of the Munzur mountains, 1200 m, 31.05.1979, *Ş.Yıldırım 1877* (HUB!); **Malatya:** Kömürhan, 800 m, 14.07.1997, steppe, *Akgül 1434* (INONU!); **C4 Konya:** Konya to Karaman, district Kızılyaka, 1700 m, 30.08.1983, under *Juniperus excelsa*, *M. Serin 1709* (KNYA!); **C5 Mersin:** Arslanköy to Çamlıyayla, W of Çamlıyayla, 13.05.87, 550 m, Leg. *Nydegger* Det: H. Morath (HUB!); **C5 Mersin:** Tarsus, Egemen, 24.04.2002, 50 m, sandy hills, *Akan 2855 & Ekici* (GAZI!, HARRAN!); **C6 Adana:** Çukurova: Tarsus, 29.04.1967, (E 00175605!); **Hatay:** Belen, below Belen, 400 m, 23.04.1957, *Davis 27015* (E 00175604!); **C7 Şanlıurfa:** Şanlıurfa–Hilvan 32 km, 12.04.2002, 650 m, roadside, *Akan 2693 & Ekici* (GAZI!, HARRAN!).

*Note:* It is one of the white-flowered species of *Trigonella* in Turkey. The description of the species in the Flora of Turkey, the feature for leaflets is given as “glabrescent”, however, the specimens collected from the field, generally, were found to be sparsely hairy. In the Flora of Turkey, the length of peduncle for species is given as 2.5–6 cm, in our study, the length of peduncle measured as 1–4 cm long. Moreover, the flower numbers can be 13 (not 10) for this species. There are not many examples of white-flowered taxa of *Trigonella* genus in the world, but in Turkey, *Trigonella kotschyi* and *T. cilica* carry white flowers. However, it is stated that yellow-flowered species in samples from other countries, belong to *T. hierosolymytiana* Boiss.

**12. Trigonella mesopotamica** Hub.–Mor., Notes R.B.G. Edinb. 29:322 (1969) / Dicleboyotu

**Holotype:** Turkey C8 Mardin: 11 km from Midyat to Gercüş, 1100 m, limestone steppe, 13.5.1966, *Davis 42899* (holo. G!).

= *Trigonella hierosolymytana* auct., quod. plantam anaticam et syriacam, non-Boiss. (1849);

= *Trigonella kotschyi* Fenzl var. *hierosolymytana* (Boiss.) Širj. In Publ. Fac.Sci. Univ. Masseryk Brno 1(2):27 (1929), pro parte, excl. typ.: *T. kotschyi* Fenzl subsp. *hierosolymytana* (Boiss.) Thiéb. Fl. Lib. Syr. 2: 19 (1940), excl. typ.

*Flowering time:* April–May

*Habitat:* Stony hills, fallow fields, roadsides, *Quercus* forests., 300–1500 m. *Distribution:* Turkey, Lebanon, Syria; Ir.–Tur. element. *IUCN:* LC.

*Examined specimens:* **B7 Elazığ:** Haroğlu to Kömürhan, 1200 m, 07.06.1981, stony places, *Evren 557* (ANK!); **B8 Siirt:** 37 km from Siirt to Baykan, 900 m, 18.05.1966, open lands in the oak forest, *Davis 43172* (E 00175600!); **C5 Mersin:** Tarsus, 750 m, 23.04.1973 *Akman 7859* (ANK!); **C6 Adıyaman:** Gerger to Adıyaman 4 km, 12.05.2002, 570 m, open lands in the oak forest, *Akan 3196 & Vural*; Gaziantep: Gaziantep–Şanlıurfa 1 km, 18.05.2002, 950 m, roadside, *Akan 3218/b & Ekici* (GAZI!, HARRAN!); **C7 Şanlıurfa:** Suruç; Onbirnisan village, 05.05.2002, 500 m, meadows, *Akan 3126 & Ekici* (GAZI!, HARRAN!); **C8 Mardin:** 11 km from Midyat to Gercüş, 1100 m, 13.05.1966, steppe, *Davis 42899* (E!, ANK!).

*Note:* In Turkey, the species more widely distributed in eastern and southeastern Anatolia. The holotype of this species has been examined (E!), by the number of flowers

to be noted that no more than 10, however, the number of flowers counted as 17 on some specimens collected from the field. In the Flora of Turkey, the peduncle length for species is given as 20–60 mm and legume length is given as 20–25 mm, however the peduncle length in our specimens is measured as 5–40 mm and the length of legume is 8–25 mm.

**13. *Trigonella sibthorpii* Boiss., Diagn. Ser. 1 (9): 14 (1849) /Dervisboyotu**

**Lectotype (designated here):** In Asia Minore, 1842/06, Boissier # s.n. (Lecto. G 00782054 photo!)

≡ *Trigonella torulosa* Gris. var. *sibthorpii* (Boiss.) Vass., Acta Inst. Bot. Acad. Sci. URSS. 1 (10):205 (1953).

≡ *Trigonella spruneriana* Boiss. var. *sibthorpii* (Boiss.) Hub.-Mor., Flora of Turkey, vol. 3: 462 (1970).

**Flowering time:** April–May

**Habitat:** Sandy areas, sea shore, rocky slopes, 0–50 m.

**Distribution:** Turkey, Cyprus, Lebanon, Syria and Israel. Medit. element. IUCN: NT.

**Examined specimens: C3 Antalya:** Serik, Kumköy, 22.05.2002, 5 m, sandy beach, *H. Akan 3305 et al.* (GAZI, HRU); Antalya: Akseki, Otluk mountain, Serebil district, open lands in the forest, 1050 m, 27.05.1996, *Duran 3729* (GAZI!); Antalya: between Antalya and Serik, 2 m, sandy area., 06.04.1956, Det.: *H. Morath* (E 00175558!).

**Nomenclatural notes:** In the Flora of Turkey, it is provided as a variety of *T. spruneriana*. In the 1970s, this taxon was given by Huber-Morath as a variety of *T. spruneriana*. However, in our literature searches, it was found that this taxon was portrayed as a separate species by Danin and Small (1989). Thus, in our study, var. *sibthorpii* is reevaluated as a distinct species. In addition, it has been observed that this taxon differs from other variety by habitat differences because *T. sibthorpii* grows completely in coastal-dunes.

According to the Flora of Turkey (Huber-Morath, 1970), the syntypes were given from Asia Minore and Cyprus. Since no lectotype specimen were encountered until this study, one of the specimen of Boissier collected from Asia Minore, in 1842 was proposed as a lectotype here, deposited at G (00782054 photo!).

**14. *Trigonella smyrnea* Boiss., Diagn. Ser. 1 (2):19 (1843) /Efeboyotu**

**Holotype:** [Turkey B1 İzmir] in umbrosis mentis Taktali supra Smyrnam, v 1842, Boissier (holo. G photo!).

**Flowering time:** May–June

**Habitat:** Rocky slopes, limestone steppe, oak groves, empty spaces, road edges, 50–1350 m. **Distribution:** Turkey, Samos, E. Medit. element. IUCN: VU B2ab(i).

**Examined specimens: B1 İzmir:** Seferihisar, 22.03.1979, *Seçmen & Leblebici 1779* (EGE!); **C3 Antalya:** Elmalı; Gömbe, 28.05.2003, 1300–1350 m, stony hills, *Akan 4630 & Ekici* (GAZI!, HARRAN!).

**Note:** It is a species with a narrow spread in Western and S. Western Anatolia. The peduncle length for species is given as 20 mm long at most in the Flora of Turkey, but it has been determined that the peduncle length can extend up to 35 mm long in our collections. In addition, the number of flowers is indicated as 8 at most. It has been observed that this number can be up to 15 in our specimens. It is closed to *T. strangulata* with a distinct node between the seeds. It has been suggested to be in the VU category since it has a narrow spread and a sparse population. The most beautiful natural spread is found in Gömbe, district of Kaş, Antalya.

**15. *Trigonella spruneriana* Boiss. Diagn. Pl. Orient. ser. 1, 2: 17 (1843) /Koçboyotu (Figure 5).**

**Lectotype (designated here):** Turquie, Cadmus ad. or. Denislili in dumosis, 06.1842, (Figure 3). Boissier, #s.n. (lecto. G00330244 photo!), isolectotypes: (Boiss. 1842/06 Fl 009216 photo!), (Boiss.1842/6 G00330241 photo!).

= *Trigonella torulosa* Gris., Spic. 1:40 (1843).

**Flowering time:** April–June

**Habitat:** Stony hills, shrubs, open lands in the forest, steppe, fallow fields, 0–2000 m. **Distribution:** Turkey, Greece, W. Syria, NW Iraq, W Iran, Transcaucasia, Transkaspiya, Ir.–Tur. element. IUCN: LC

**Examined specimens: A4 Ankara:** Ayaş, 1000 m, 04.05.1986, roadside, *M. Vural 4093* (GAZI!); Kalecik to Irmak 10 km, 650 m, 24.05.1987, fields, *Koyuncu 75619* (AEF!); Ankara: 15 km N of Ankara on Çankırı road, 08.06.1965, stony chalky slopes, *Coode & Jones 2143* (E 00175554!); **A5 Samsun:** Samsun, 12.06.2003, 550 m, steppe, *Akan 4713 & Ekici* (GAZI!, HARRAN!); **B1 İzmir:** Bornova, N of Bornova, 16.04.1969, *K. Fitz* (EGE!); **B2 Uşak:** Uşak–Kayagöl village 4 km, 24.05.2003, 900 m, meadows, *Akan 4608 & Ekici* (GAZI!, HARRAN!); **B3 Afyon:** Boyat to Afyon 5 km, 24.05.2003, 1200 m, meadows, *Akan 4596 & Ekici* (GAZI!, HARRAN!); **B4 Ankara:** Elmadağ, Kılınçlar village, 18.06.1971, serpentine, *Kılınç 106* (ANK!); **B5 Kayseri:** Erciyes mountain, 08.07.2002, 1800 m, 1550 m, steppe, *Akan 3662 et al.* (GAZI!, HARRAN!); **B7 Adıyaman:** Gerger to Abacık, 1600 m, 28.05.1981, limestone area, *A. Güner 3737 & Yıldız* (HUB!); **C2 Aydın:** Below Karacasu, 500 m, halky hills in maqius, 23.04.1965, *Davis 41661* (E 00175555!); **C3 Antalya:** 500 m, 13.05.1956, *H. Birand 15* (ANK!); Antalya: south of Akseki, 450 m, 06.05.1972, *R. Çetik 3569* (KNYA!); **C4 Konya:** Hadim to Konya 10 km, 17.07.02, 1400 m, roadside, *Akan 3788 & Ekici* (GAZI!, HARRAN!); **C5 Adana:** Kurttepe, 11.04.1935, *Balls 2110* (ANK!); **C6 Adana:** Adana to Kozan 3 km, 20.05.2002, 120 m, fouts, *H. Akan 3276 & M. Ekici* (GAZI!, HARRAN!); **C7 Şanlıurfa:** Birecik to Halfeti; Teketaş village, 05.05.02, 480 m, meadows, *H. Akan 3113/b & M. Ekici* (GAZI!, HARRAN!); **C8 Mardin :** 11 km from Midyat to Gercüş,



**Figure 5.** The lectotype of *Trigonella spruneriana* Boiss. (G00330244).

1100 m, limestone steppe, 13 May 1966, *Davis 42931* (E!).

**Taxonomical notes:** It is one of the most common *Trigonella* species in Turkey. In the Flora of Turkey, it was represented by two varieties. However, the idea of separation of var. *sibthorpii* from *T. spruneriana* has been reached. In one of our previously study, var. *sibthorpii* was evaluated as a separate species (Akan, 2012).

Boissier collected three plant specimens, which was belong to *Trigonella spruneriana* Boiss., from Turkey,

deposited in G herbarium as G00330244, G00330241 and G00330242. In Flora of Turkey, these specimens were given as syntype (Huber-Morath, 1970). According to International Code of Nomenclature, item 9.2 (Menemen & Dönmez, 2006), the sample registered with G00330244, which is in the best formation, was selected as the lectotype, in this study. G00370099 (*Aucher 1172*), G00370121 (*Kotschy 163*) and G00330243 (*Spruner #s.n.*) samples belonging to the same taxon should also be evaluated as

lectoparatype since they are collected at different times and from different regions.

**16. *Trigonella strangulata*** Boiss., Diagn. Ser. 1(9): 17 (1849) / Düğmeliboyotu

**Holotype:** [Syria] in collibus siccis Antilibani circa Rascheya, Boissier (holo. G photo!).

**Flowering time:** April–June

**Habitat:** Rocky slopes, limestone steppe, oak groves, empty fields, roadsides, wet meadows, 300–2200 m. **Distribution:** Turkey, Syrian desert, Anti-Lebanon, N Iraq, Transcaucasian. Ir.–Tur. element. IUCN: LC.

**Examined specimens:** **B2 Denizli:** Çivril, 800–850 m, 06.06.1983, fallow fields, *Y. Gemici* 2005 & *Ark.* (EGE!); **B3 Isparta:** Şarkikaraağaç, 1250 m, 26.05.1994, *B. Mutlu* 461 (HUB!); **B6 Maraş:** Göksun to Kınıkkoz village, 3 km, 1400–1700 m, 16.07.1981, mixed forest, *Yıldız* 2873 (HUB!); **C2 Muğla:** Muğla–Kale 1 km, 25.05.2002, 1000 m, stony hills, *Akan* 3380 & *Ekici* (GAZI!, HARRAN!); **C3 Antalya:** Konyaaltı, 17.04.02, 10 m, stony places, *Akan* 2826 & *Ekici* (GAZI!, HARRAN!); **C4 İçel:** Mut, Magras mountain, limestone slopes and rocks, 1300 m, 11.05.1965, *Coode & Jones* 789 (E 00175565!); **C6 Hatay:** Akra mountain, 19.05.2002, 1185 m, *Quercus* forest, *Akan* 3234 & *Ekici* (GAZI!, HARRAN!); **C8 Mardin:** Derik–Mazıdağı 1 km, 23.04.2005, 925 m, *Quercus* forest, *Akan* 5577 & *Ekici* (GAZI!, HARRAN!); Mardin: 10–12 km W of Savur, 900 m, 05.09.1966, rocky limestone slopes in *Quercus* forest, *Davis* 42440 (E 00175568!); Derik Mazıdağı 1. km, 23.04.2005, 925 m, meşelik, *H.Akan* 5577 & *Ekici* (GAZI!, HARRAN!).

**Note:** The most striking feature of the fruit is the node among the seeds, known as strangulate, and the name of the epithet comes from this feature. The peduncle length is given between 20–50 mm long in Flora of Turkey, but it has been determined that peduncle length is at most 32 mm in our collections. In the Flora of Turkey, the length of the leaflets for species is given as 7–13 mm long, however in our specimens, the leaflets are measured as 6–20 mm long. It is closed to *T. smyrnea* but the fruit of *T. smyrnea* (up to 10 mm) is shorter than *T. strangulata* (up to 25 mm).

**17. *Trigonella velutina*** Boiss., Diagn. Ser. 1(2): 18 (1843) / İpekboyotu

**Lectotype (designated here):** [Turkey C2 Denizli] in dumosis umbrosis Cariae in monte Cadmo supra Denisleh (lecto. GH00063418 photo!).

**Flowering time:** May–June

**Habitat:** Rocky slopes, limestone steppe, in gardens, road edges, 500–2000 m. **Distribution:** Turkey, Anti-Lebanon. Ir.–Tur. element. IUCN: LC.

**Examined specimens:** **A4 Ankara:** Ayaş beli, 1100 m, 06.06.1975, meadows, *Y. Akman* 6672 (ANK!); **A9 Kars:** Kağızman–Cumaçay 26 km, 14.07.2002, 1800 m, meadows, *Akan* 3743, *Aytaç & Ekici* (GAZI!, HARRAN!);

**B3 Eskişehir:** 29 km from Polatlı to Sivrihisar, 800 m, *Coode & Jones* 2886 (E!) **B4 Ankara:** Polatlı–Afyon 107 km, 24.05.2003, 1000 m, fieldside, *Akan* 4601 & *Ekici* (GAZI!, HARRAN!); **B4 Konya:** Obruk, Maymarlı hill, 1150 m, 15.06.1982, *H. Dural* 1016 (KNYA!); Selçuklu: Karaömerler village, 1100 m, 30.06.1987, *B. Eyce & A. Ünal* 819 (KNYA!); **B7 Malatya:** Malatya to Kayseri 40 km, 15.06.1986, roadside, *Ö. Seçmen* 3399 (EGE!); **C2 Muğla:** Kale to Muğla 1 km, 25.05.2002, 1000 m, stony hills, *Akan* 3381, 3442 & *Ekici* (GAZI!, HARRAN!); **C3 Antalya:** Elmalı, 30.05.2002, 1000 m, steppe, *Akan* 3519, 3524 & *Ekici* (GAZI!, HARRAN!); **Isparta:** Sütçüler, Belence to İbişler, 1100 m, 27.05.1974, serpentine area, *Peşmen & Güner* 1198 (HUB); **C4 Karaman:** Ayrancı; Kayaönü village, 01.06.2002, 1600 m, steppe, *Akan* 3581 & *Ekici* (GAZI!, HARRAN!); **C5 Niğde:** Ulukışla to Pozantı 5 km, 01.06.2002, 1300 m, meadows, *Akan* 3591 & *Ekici* (GAZI!, HARRAN!); **C6 Malatya:** Erkenek, Deveyatağı district, 1400 m, 28.05.1989, limestone area, *E. Altoklu* 1617 & *B. Yıldız* (EGE!).

**Taxonomical Notes:** It is one of the *Trigonella* species with a dense population in our country. It can be easily distinguished with the occurrence of intense villose hairs among the other members of the genus. In Flora of Turkey, it is stated that leaflets are linear and oblanceolate, but in our observations, it is determined that leaflets are mostly oblong-obovate. In addition, although the peduncle length was given up to 30 mm long, it was observed that the measurements we made were at most 16 mm long.

In Flora of Turkey, samples collected from Denizli in 1842 by Boissier is provided as syntypes (Huber-Morath, 1970). It has been stated that these samples, given as syntypes, are deposited in the W and K herbaria. However, *Trigonella sibthorpii* Boiss. var. *velutina* Boiss. (GH 00063418) is verified by Şirjaev as *Trigonella velutina* Boiss. Şirjaev (1928, 1934) and on this sheet it was mentioned as a isotype. Here, we designated the specimen as lectotype which was confirmed as isotype by Şirjaev (1928, 1934). The other specimens that are given as syntypes in Flora of Turkey, is suggested to be isolectotype. These specimens are deposited at K000118152!, BM000901092! and FI009212!.

**18. *Trigonella velutinoides*** Hub.-Mor. in Bauhinia 4: 197 (1971) / Karamanboyotu

**Type:** (Turkey) C4 Konya: Steppe 15 km nördlich von Karaman, an der Strasse nach Konya, 1030 m, 7.vi.1969, *Ch. Simon* 69-983 (holo. Hb. Simon photo!; iso. Hb. Hub.-Mor. Photo!, iso. G photo!).

**Flowering time:** June

**Habitat:** Steppe. **Distribution:** Endemic to Turkey. Ir.–Tur. element. IUCN: VU B2ab(i).

**Note:** It is endemic to central Anatolia. It was defined to science by Huber-Morath in 1971, after the publication of Flora of Turkey. During the revision of the the genus, it

couldn't be gathered. The type specimen has been examined and decided that it is similar to *T. velutina*, however it is distinguished by somewhat larger corollas, which always clearly protrude above the calyx, and longer pedicels. The fruiting position is hardly elongated, it remains spherical and does not become elongated like in *T. velutina*. It is habitually similar to the *T. cylindracea*, *T. spruneriana* and *T. mesopotamica*, but can be distinguished from these three species by the narrower folioles and the larger, long and narrow-sided calyx.

Sect. **Foenum-graecum** Ser.

In Turkey, sect. *Foenum-graecum* is represented by five species.

**19. *Trigonella cariensis*** Boiss. Diagn. ser. 1(2): 21 (1843) /Kokuluboncuk

**Type:** (Turkey C2 Muğla) in Caria prope Moglah (Muğla), *Aucher-Eloy 1160* (holo. G photo!, W!, iso. K photo!, iso. BM photo!, iso. P photo!).

**Flowering time:** March–April

**Habitat:** Rocky slopes, pine forests, 0–1150 m.

**Distribution:** Turkey, Greece, E. Medit. element. *IUCN:* LC.

**Examined specimens:** **B1** Aydın: Samsun dağı, 07.04.2005, 50 m, shrubs, *Akan 5550 & Ekici* (GAZI!, HARRAN!); **İzmir:** Bornova, Yamanlar mountain, 400 m, 31.05.1980 *Y. Gemici 601* (EGE!); **C1 Muğla:** Kale, 25.05.2002, 480 m, stony places, *Akan 3379 & Aytaç* (GAZI!, HARRAN!); **Muğla:** Bodrum, Farilya village, 22.03.1969 *K. Fitz & F. Spitzenberger* (EGE!); **C3 Antalya:** Antalya–Bucak 20 km, 23.05.2002, 220–250 m, *Akan 3318 & Ekici* (GAZI!, HARRAN!); **Antalya:** Kemer to Kumluca, Ulupınar district, 500 m, 2.5.1979, dried meadows, *Peşmen 4534 & 4254* (HUB!); Manavgat to Akseki, above Fersinuluni, 700 m, 8.04.1956, edge of *Pinus brutia* forest, *Davis 25775*, (E 00175415!);

**Note:** It is common in Turkey, especially in western Anatolia. It has a wide distribution in natural population. The closest species is *T. gladiata*. It can be easily distinguished from it by a long fruit beak, and taking a sudden “curve” apparent of the fruit. In the Flora of Turkey, the fruit length is given as 30 mm at most for species, but it has been observed that this length can be extended up to 60 mm in our collection. It can be an important ornamental plant with flashy flowers and fruits.

**20. *Trigonella cassia*** Boiss. Diagn. Ser. 1 (9): 13 (1849) /Halbet (Figures 6 and 7).

**Holotype:** [Turkey C6 Hatay] Bois du Cassius (Akra Dağı), regione moyenne, v–vii. 1846, *Boissier* (holo. G photo!).

= *Trigonella raphanina* Boiss., Fl. Or. 2: 71 (1872).

**Flowering time:** April–May

**Habitat:** Stony hills, shrubs, open lands in the forest, cultivated fields, 100–1200 m. **Distribution:** Endemic to Turkey. Medit. Element. *IUCN:* CR B1b(iii).

**Examined specimens:** **C5** Mersin: Çopurlu, 20.04.02, 160 m, open lands in the forest, *Akan 2848 & 2850* (GAZI!, HARRAN!); **C6** Hatay: Akçadağ (Keldağ), Çandır village, 09.05.2002, 1100 m, stony hills, *Akan 3248* (HARRAN!).

**Note:** It is one of the narrow-spread endemic species localized only to South Anatolia in Turkey. It was known only from the type specimen (Figure 1) up to this study. No other distribution has been found other than Akra Mountain, Hatay, which has a very narrow spread. It is suggested to be included in the CR category since its population is very insufficient. It received its epithet from the “Cassius”, the historical name of the Akra mountain. In the Flora of Turkey, *T. raphanina* issued as a separate species and was given as a small variety of *T. cassia*, but due to of the insufficient material, not determined as an exact species. In this study, intensive fieldwork was carried out in the type locality of *T. raphanina*, around Mersin. It is observed that the samples from type locality belongs to *T. cassia*. The type specimens of both species are examined and are determined to be similar properties. Therefore, it was decided that *T. raphanina* is a synonym of *T. cassia* (Akan, 2012). In the Flora of Turkey, legume length is given as 15–25 mm, in our study, legume length is 30–85 mm. In the Flora of Turkey, for *T. cassia*, calyx 6–7 mm long, legume length 1.5–2.5 cm, for *T. raphanina*, calyx 8–10 mm long, legume length 1.5–3 cm. All of the characters except for calyx and fruit characteristics were overlapping to each other. In our new measurements, the length of calyx was identified for *T. raphanina* as 6–8 mm. The beak length of *T. cassia* and *T. raphanina* is 1.5–2.5 mm in Flora of Turkey and overlapping each other. Therefore, in this study, *T. raphanina*, priorite by rule, is given as a synonym of *T. cassia* (Figures 2 and 3).

**21. *Trigonella foenum-graecum*** L. Sp. Pl. 777 (1753) /Çemenotu

**Lectotype** (designated by Westphal, 1974): Described from France (Montpellier), *Anon. #s.n.* (Hb. LINN-HL932-16, photo!).

**Flowering time:** March–May

**Habitat:** Stony places, fallow fields, cultivated places, 0–1100 m. **Distribution:** Turkey, Syria, Caucasia, N Iraq, NW Iran, Saudi Arabia; Medit. area. *IUCN:* LC.

**Examined specimens:** **A2 İstanbul:** Yeşilköy, Edge of railway, 22.04.1953, damp meadow, *Demiriz 1384* (ISTF 12288!); **A4 Kırıkkale:** Delice, Büyükavşar town, 1150 m, 06.07.1991, under oak forest, *Yaman 1106* (GAZI!); **Ankara:** Kalecik to Irmak 10 km, 650 m, 21.06.1989, *Koyuncu 16287* (AEF!); **B1 İzmir:** Bornova; Doğanlar village, 40 m, 14.06.1963, *Karamanoğlu* (AEF!); **B7 Erzincan:** Geçit village, 05.07.1940, *H. Bağda 272* (ANK!); **C3 Isparta:** Gelendost, Yakaköy village, 1100 m, 19.09.1992, shrubs area, *Kuddusi 969* (KNYA!); **C5 Mersin** Kuyuluk, Azalık, 07.04.1957, *Davis & Hedge 26529* (ANK!); **C6 Hatay:** İskenderun, Belen, 400 m, 10.06.1968, *Y. Akman 7856*

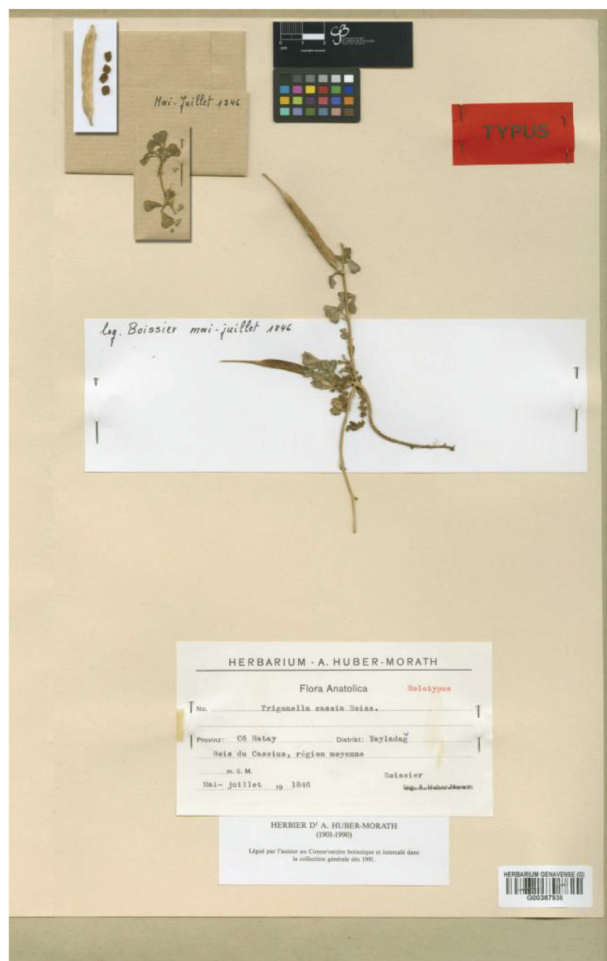


Figure 6. The holotype of *T. cassia* Boiss. (G).

(ANK!); **C7 Şanlıurfa:** Gaziantep to Şanlıurfa, 14.05.2005, 700 m, *H. Akan 5700 & Ekici* (GAZI!, HARRAN!); **C8 Mardin:** cereal field, 10.05.1971, *M. Zel 1126* (ANK!).

*Note:* *T. foenum-graceum* has economic value. It is cultivated for fodder or as a spice plant in large parts of the world. Its seeds carry oil and mucilage, is put into the fenugreek. The Turkish names are “Çemenotu”, “buyotu” or “Poy” in Turkey, the most common name is “Çemen”. It is an aromatic plant that the seeds of this species are sold in all markets. Large numbers of countries have been reported to cultivate fenugreek, but India, Ethiopia, Egypt, and Turkey are the major countries for seed production. Although it is argued that this species may be a cultivar, it was determined that its natural spread is very common in our intensive field studies.

**22. *Trigonella gladiata*** Stev. Fischer, Cat. Jard. Gorenki Ed. 1:112 (1808) /Hülbe

**Lectotype** (designated by N. Fedoronchuk & L. Krytzka, 2001): Described from Crimea / (Lectotype: LE 01071946 photo!).

=*Trigonella prostrata* DC. in Lam., Fl. Fr. 5, Suppl. 571 (1815).

= *Trigonella foenum-graecum* L. var. *sylvestris* L. 1759, Syst. Nat., ed. 10, 2: 1180.–

*Flowering time:* April–June

*Habitat:* Shrubs, cultivated fields, gardens, 0–800 m.

*Distribution:* Turkey, Mediterranean countries, Bulgaria, Romania, Crimea, Caucasus, Medit. element. IUCN: LC.

*Examined specimens:* **A2 (A) İstanbul:** Soğanlı to Kartal, 02.07.1893, *Azn. 595* (E!); **B1 İzmir:** Bornova, Hills of Bornova, 30.04.1969, *K. Fitz & F. Spitzenberger* (EGE!); **C1 Aydın:** Didyma, sea level, 09.04.1965, *Davis 40769* (E!); **C4 Karaman,** Akarköy, 30.05.2003, 1150 m, open lands in the forest, *Akan 4670 & Ekici* (GAZI!, HARRAN!).

*Note:* The closest species is *T. cariensis*, however, it can be easily separated from other species by short beak of fruit beak (1–2 cm) and short flower length (17–20 mm). It has low population in its natural habitat. However, there is no danger for now as it is spread in different parts of Turkey. In the Flora of Turkey, fruit length has been given as 40 mm, but it has been determined that it can extend up to 50 mm in our collection.

*Note:* The closest species is *T. cariensis*, however, it can be easily separated from other species by short beak of fruit beak (1–2 cm) and short flower length (17–20). It has low population in its natural habitat. However, there is no danger for now as it is spread in different parts of Turkey. In the Flora of Turkey, fruit length for species has been given as 40 mm, but it has been determined that it can extend up to 50 mm in our collection.

**23. *Trigonella macrorrhyncha*** Boiss. Diang. Ser. 1 (2):21 (1843) /Boyotu

**Type:** [Turkey C5 Icel/Adana] in argillosis Ciliciae, Aucher 1158 (holo. G photo!, iso. K! K000118147, iso. W!).

=*Trigonella amana* Post, Fl. Syria 9 (1890).

*Flowering time:* March–May

*Habitat:* Stony hills, steppe, 400–1500 m. *Distribution:* Endemic to Turkey. Medit. element. IUCN: LC.

*Examined specimens:* **C4 Konya:** Karaman, Ağaçyurdu village, forest of *Pinus nigra*, 1400 m, *M. Vural, 1428* (ANK!); **C5 Mersin:** Namrun (Çamlıyayla), 21.05.2002, 870 m, shrubs, *Akan 3293 & Ekici* (GAZI!, HARRAN!); **C8 Mardin:** Derik to Mazıdağı 1 km, 23.04.2005, 925 m, open lands in the forest, *Akan 5579 & Ekici* (GAZI!, HARRAN!); **C6 Kahramanmaraş:** Zeytun, Solak mountain, 1060 m, 11.05.1934, *Balls* (ANK!); **C8 Mardin:** Derik to Mazıdağı 1 km, 23.04.2005, 925 m, open lands in the oak forest, *H. Akan 5579 & Ekici* (GAZI!, HARRAN!).

*Note:* It has abundant and widespread population in its natural habitat. It is an endemic species which is spread to different areas of Turkey. It is proposed to be included in the IUCN category LC. In the Flora of Turkey, the fruit up to 60 mm in length in species. However, in our new measurements up to 100 mm. The closest species is *T.*



**Figure 7a.** The fruit of *T. cassia* in field.



**Figure 7b.** The general view of *Trigonella cassia* with flowers from field (by H. Akan).



*cassia* but it can be distinguished by lying pilose hairs of fruit and is very obvious to have a central vein. In addition, the fruit of *T. cassia* is glabrous or very rare hairy. Moreover, a significant rachis is not known for *T. cassia*.

Sect. **Isthmocarpae** Boiss. In Turkey, sect. *Isthmocarpae* is represented by three species.

**24. *Trigonella cephalotes*** Boiss. & Bal., Boiss. Diagn. Ser. 2 (5): 77 (1856) / Oyaotu

**Type:** [Turkey C5 İçel] in herbidis ad fluviam Guzel Déré supra Sedichig in Cilicia littorali [NE of Mersina], 20.05.1855, *Balansa* 468 (holo. G photo!, iso. G00367937 photo!, G00367942 photo!, G00367951 photo!, iso. BM000793314 photo!, iso. K000998717 photo!, iso. JE00007607 photo!, iso. CAS0005334 photo!, iso. FI009205 photo!, iso. WAG0004609 photo!, iso. GOET005330 photo!, C10012411 photo!, iso. MO-277445 photo!, iso. MPU023170).

**Flowering time:** April–May

**Habitat:** Calcareous field, river-side, 0–300 m.

**Distribution:** Greece to Turkey. E. Medit. element. **IUCN:** VU B2ab(iii).

**Examined specimens:** **C2** Muğla: Marmaris, above İnişdibi village, 17.4.2002, 300 m, open lands in the forest, *Akan* 2830 & *Ekici* (GAZI!, HARRAN!); Antalya–Bucak 20 km, 23.05.2002, 250 m, screen of *Quercus coccifera*, *Akan* 3319 & *Ekici* (GAZI!, HARRAN!); **C5 İçel:** Tarsus, Egemen to Eksibeler, 06.04.1955, damp places, *K. Bilger* 5337 (KNYA!).

**Note:** It is one of the endemic species with narrow spreading and inadequate population. It is therefore recommended to be included in the VU category. It is closed to *T. spicata*. However, inflorescence is in the form of a more orbital or semi-umbillate head, and by this way, it can be easily distinguished from *T. spicata*. In the Flora of Turkey, it is stated that the peduncle length can extend up to 50 mm, it has been determined as maximum 35 mm in our collections.

**25. *Trigonella isthmocarpa*** Boiss. & Bal. Diagn.ser. 2(6): 44 (1859) / Dilboyotu

**Holotype:** [Turkey B5 Kayseri] prope Caesaream (Kayseri), 1100 m, vii 1856, *Balansa* 115 (holo. G photo!).

**Flowering time:** May–July

**Habitat:** Fallow fields, steppe, 1000–1600 m.

**Distribution:** Endemic to Turkey, Ir.–Tur. element. **IUCN:** VU B2ab(iii).

**Examined specimens:** **B5** Aksaray: 28 km S of Aksaray, 08.06.2003, 1145 m, fallow fields, *Akan* 4695 & *Ekici* (GAZI!, HARRAN!); Hasan mountain, 21.06.2003, 900 m, roadside, *Akan* 4751 & *Ekici* (GAZI!, HARRAN!); **C4 Konya:** Karapınar, 1100 m, 13.06.90 *Aytaç* & *Duman* 3121 (GAZI!); **C5** Niğde: Taşpınar, 28.06.2005, 1200 m, fallow fields, *Akan* 5728 & *Ekici* (GAZI!, HARRAN!);

**Note:** It is one of the narrow endemic species, localized in central Anatolia in Turkey. Since the known natural

population is not very common, it is recommended to be in the VU category. It is noteworthy that there is a distinct node among the seeds. In the Flora of Turkey, the number of flowers of species is 2–6, in our specimens, the number of flowers is 5–9.

**26. *Trigonella spicata*** Sibth. & Sm., Prodr. Fl. Graec. 2:108 (1813) /Başakboyotu

**Holotype:** (Greece) Cycladuni insula Seriphos, *Sibthorp.* (holo. Herb. OXF, photo!)

=*Trifolium hamosum* Bieb., Fl. Taur.–Cauc. 2: 207 (1808). ≡*Trigonella hamosa* (Bieb.) Besser, Cat. Pl. Horto Cremen. 155 (1816), non L. (1758). =*T. uncinata* Ser. in DC., Prodr. 2:181(1824). ≡ *Melilotus uncinatus* (Ser.) Besser ex Lebed., Fl. Ross. 1:555 (1843).

**Flowering time:** April–June

**Habitat:** Pine forests, oak groves, limestone hills, empty plains, 0–1250 m. **Distribution:** Turkey, the Balkans, the Crimea, Transcaucasia, W Syria, N Iraq. E. Medit. element. **IUCN category:** LC.

**Examined specimens:** **A5 Samsun:** 12.06.2003, 550 m, steppe, *Akan* 4715 & *Ekici* (GAZI!, HARRAN!); **B1 İzmir:** Ayrancılar to İzmir 6 km, 25.05.2003, 100 m, shrubs, *Akan* 4617 & *Ekici* (GAZI!, HARRAN!); **İzmir:** Karaburun, above Akdağ, 900 m, 25.05.1991, *Bekat* 354 & *Gemici* (EGE!); **B7 Elazığ:** Fırat University Campus, 1250 m, 16.07.1997, *Akgül* 1371 (INONU!); **C4 Konya:** Karaman, Sartavul pass, 1600 m, 27.05.1974, limestone steppe, *R. Çetik* 3784 (KNYA!); **C5 Mersin:** Güzelyayla to Değirmendere 5 km, 18.05.2003, 810 m, open lands in the forest, *Akan* 4542 *Ekici* (GAZI!, HARRAN!); **C6 Gaziantep:** Gaziantep to Nizip 10 km, 28.05.1961, *R. Çetik* 427 (KNYA!); **C7 Şanlıurfa:** Şanlıurfa to Hilvan 8 km, 20.05.2003, 750 m, steppe, *Akan* 4582 & *Ekici* (GAZI!, HARRAN!).

**Note:** It is one of the widespraed species in Turkey. It is closed to *T. cephalotes*. However, since the inflorescence is in cylindrical, ovate or oblong position, this situation can be distinguished by *T. cephalotes*, especially since this situation becomes even more pronounced in fruit. In the Flora of Turkey, the length of the fruit of species can be up to 50 mm, it has been determined as 30 mm at most in our collections.

Sect. **Lunatae** Boiss. In Turkey, sect. *Lunatae* is represented by three species.

**27. *Trigonella corniculata*** (L.) L., Systema ed. 10: 1180 (1759) /Gazalçemenotu (Figures 8 and 9).

**Type:** Described from Monte Gargano, in SE Italy (LINN-HL932-8 photo!).

**Lectotype** (Designated by Greuter in Greuter & Rechinger in Boissiera 13: 78. 1967): Herb. Linn. No. 932.8 (LINN photo!).

In: Jarvis, Charlie (2007): Chapter 7: Linnaean Plant Names and their Types (part T). In: Order out of Chaos.



**Figure 8.** a) The general view of *Trigonella corniculata* L. from field a) with flowers, b) with fruits (by H. Akan).

Linnaean Plant Types and their Types. London: Linnaean Society of London in association with the Natural History Museum: 878-905.

=*Trifolium corniculatum* L. (1753), Species Plantarum 2: 766. 1753

=*Trigonella corniculata* sensu Sibth. & Sm., Prodr. Fl. Graec. 8: 44 (1833). =*Trigonella esculenta* Willd., Enum. Pl. Hort. Berol. 799 (1809).

=*Trigonella elatior* Sibth. & Sm., Prodr. Fl. Graec. 2:108 (1813).

=*Trigonella uralensis* Ledeb., Fl. Ross. 2:534 (1842).

=*Trigonella balansae* Boiss. & Reuter in Boiss., Diagn. ser. 2(5):79 (1856).

=*Trigonelle balansae* Boiss. & Reuter in Boiss., Diagn. Ser. 2(5):79 (1856). **Syn. Nova**

=*Trigonella corniculata* L. var. *balansae* (Boiss. & Reuter) Fiori, Nuovo Gior. Bot. Ital. 45:134 (1913).

=*Trigonella corniculata* L. subsp. *occidentalis* Greuter, Boissiera 13: 78 (1967). ≡*Trigonella corniculata* sensu Greuter subsp. *corniculata*, Boissiera 13:77 (1967).

≡*Medicago corniculata* (L.)Trautv., Bull. Acad. Petersb. 8:271 (1841)

≡*Trifolium corniculatum* L. (1753), Species Plantarum 2: 766. 1753.

*Flowering time:* March–May

*Habitat:* Roadsides, stony places, cultivated area, shrubs, 0–800 m. *Distribution:* Turkey, W. Medit. Area, Greece, Cyprus, N Africa, Syria, Lebanon, Medit. element. IUCN: NT.

*Examined specimens:* **A2 Kocaeli:** Gebze, Çayırova, 2100 m, 07.06.1970, steppe, Çel 24973 (ISTF!); **A4 Zonguldak:** Kozlu to Zonguldak, 80 m, 05.05.1951, roadside, Demiriz 10970 (ISTF!); **A5 Sinop:** Sinop, 4 m, open slopes, 01.05.1967, Tobey 1695 (E 00175545!); **B1 İzmir:** Bornova, Ege University campus, 27.05.2002, 20 m, Akan 3422-*b* & Ekici (GAZI!, HARRAN!); **C1 Muğla:** Bodrum, 10 m, ruins, 11.04.1965, Davis 40893 (E!); **C2 Muğla:** Bodrum castle, 18.04.2002, 10 m, Akan

2827 & Ekici (GAZI!, HARRAN!); Marmaris to Emecik, 08.04.2005, 75 m, fieldside, Akan 5553 & Ekici (GAZI!, HARRAN!); **C3 Isparta:** Yandağ mountain, 1850 m, 16.06.1991, stony area, Kuddusi 532 (KNYA!).

*Note:* An important issue pointed out that *T. balansae* and *T. corniculata* draws attention to its proximity to each other. The characters are interwoven. The identification of these two species led by a very remarkable difficulty. It is observed that they are mixed, or too close together all the time. As a result of the new measurements and observations, *T. balansae* species has been reduced to synonym of *T. corniculata* (Akan, 2012). In the Flora of Turkey, the leaflets of species, is given as 10–40 × 8–30 mm, in our specimens, the leaflets is measured as 5–22 × 1.5–15 mm and calyx is 5 mm (not 3 mm) in length. The other overlapping characters for *T. corniculata* and *T. balansae* in Flora of Turkey; peduncle length length 1.5–6 cm, corolla 6–7 mm, legume length 10–20 mm for *T. corniculata* whereas peduncle length 1–5 cm, corolla 6–8 mm and legume length 10–20 mm for *T. balansae*.

**28. Trigonella lycica** Hub.–Mor., Bauhinia 2(3): 300, t.6 (1965) /Yiğitboyotu

**Holotype:** Turkey C3 Antalya: Finike–Elmalı, Schlucht ob dem Aykirca Kahve 36 km N oberhalb Finike, am Südfuss' des Bey Da., 700 m, 28.5.1950. Huber–Morath 9870 (holo. G!, iso. E!).

*Flowering time:* May–June

*Habitat:* Stony places, open lands in the forest. *Distribution:* Endemic to Turkey. E. Medit. element. IUCN: NT.

*Examined specimens:* **C2 Muğla:** Köyceğiz, Sultaniye village, meadows, 17.03.91, 10 m, Güner 8223 (GAZI!); **C3 Antalya:** Finike to Elmalı 35 km, Arif village, 24.05.2002, 670 m, stony hills, Akan 3350 & Ekici (GAZI!, HARRAN!); **Antalya:** Finike to Elmalı, 28.05.2003, 650 m, steppe, Akan 4637 & Ekici (GAZI!, HARRAN!); Kemer, 1700 m, 6.6.1979, alpinic area, H. Peşmen 4288 (HUB!); Finike to Aykirca, 28.05.1950, Heilbron & A. Atilla (ISTF!).



Figure 9. Lectotype of *Trigonella corniculata* L. (LINN-HL932-8).

*Note:* It is endemic to Turkey, has been found to be insufficient population. The known population of species is not abundant and may be threatened in the near future. In the Flora of Turkey, the peduncle length of species is given as maximum 3 cm, but with new findings, it is observed that peduncle lengths up to 5 cm.

**29. *Trigonella spinosa* L., Sp. Pl. 777 (1753) / Dişlekboyotu**

**Lectotype** (designated by Lassen, 1997): Described from Crete (Hb. LINN, 932.7 photo!).

*Flowering time:* April–May

*Habitat:* Maquis places, 0–400 m. *Distribution:* Turkey, Crete, Cyprus, W Syria. *Medit. element. IUCN:* VU B2ab(iii).

*Examined specimens:* **B2 Denizli:** Çivril to Işıklı, 850 m. 06.06.1983, roadside, *Y. Gemici 2043 et al.* (EGE!); **C2 Muğla:** Marmaris–Datça 50 km, 08.04.2005, 20–50 m, maquis places, *Akan 5554 & Ekici* (GAZI!, HARRAN!); Muğla: Marmaris, Emecik, 20 m, *Davis 41312* (E!).

*Note:* The natural distribution of this species is narrow and insufficient. In the Flora of Turkey, the measurement of stipule was not given. In our study, stipule was measured as 1.5–3 × 0.5–1.5 mm. The specimens collected by Davis (*D.41312!*) from Marmaris (E!), it is seen that the stipule length reaches to 5–6 mm long. Although it is remarkable that it resembles to *T. monspeliaca*, it can be easily distinguished by its semicircular or rounded fruit shape.

Sect. **Pectinatae** Boiss. Represent with one species in Turkey.

**30. *Trigonella plicata*** (Boiss. & Bal.) Boiss., Fl. Or. 2:90 (1872) /Kocaboyotu, (Figure 10).

**Holotype:** [Turkey C5 İçel] in arenosis fluvii Guzel Dere prope Mersina, *Balansa* (herb. G00782228photo!).

≡*Pocockia plicata* Boiss. & Bal. in Boiss., Diagn. ser. 2(5):76 (1856).

≡*Medicago plicata* (Boiss. & Bal.) Sirj., Publ. Fac. Sci. Univ. Masaryk Brno 102:33 (1928).

*Flowering time:* May–June

*Habitat:* Stony places, open lands in the forest, under *Quercus* sp, 600–1300 m.

*Distribution:* It is endemic to Turkey. E. Medit element. IUCN: LC.

*Examined specimens:* **C4 Konya:** Hadim–Konya 10 km, 17.7.2002, 1350 m, roadside, *Akan 3789 & Ekici*; Karaman: Kızılyaka–Pınarbaşı 2 km, 28.06.2005, 1200 m, *Akan 5741 & Ekici*.

*Examined specimens:* **B5 Niğde:** near Aksaray, May 1981, *Polinin 15922* (E 00175526!); **B7 Malatya:** İnönü University Campus, 900 m, 03.05.1997, *Akgül 1007* (INONU!); **C4 Konya:** Beyşehir, 1150 m, 20.06.1986, under oak forest, *Küçüködük 623* (KNYA!); **C5 Adana:** Adana to Gülek 95 km, 29/5/1956, *H. Birand 121* (ANK!); **C6 Kahramanmaraş:** Süleymanlı, Ilıca, Kertmen village, 1000 m, 14.06.1981, *B. Yıldız 2698* (HUB!).

*Note:* It is endemic to Turkey and has narrow distribution. In recent years, *T. plicata* is rearranged as *Medicago plicata* by Small (1987). Since the distinctive feature of fruit, *T. plicata* status should be considered in the genus of *Trigonella*. In the Flora of Turkey, the leaflets of the species are given as 5–9 × 3–9 mm, in our findings, leaflets are 4–5 × 3–4 mm. The flower numbers in our finding is 1–3 (not 2–6).

Sect. **Samaroideae** Boiss. In Turkey, represented by only one species.

**31-*Trigonella cretica*** (L.) Boiss., Fl. Or. 2:91 (1872) / Adanaefeli

**Neotype (designated here):** LUGD-BAT, No: 908-125 400 L 2000531, photo!.

≡*Melilotus creticus* L., Sp. Pl. ed. 2, 1078 (1763).

≡*Trifolium creticum* (L.) Willd., Sp. 1. 3:1356 (1800).

≡*Pocockia cretica* (L.) Ser. in DC., Prod. 2:185 (1825).

*Flowering time:* April–June

*Habitat:* Ruderal places, open lands, roadside; 100–1000 m. *Distribution:* It is endemic for Flora of Turkey (Turkey, Lesvos, Samos). Medit. element. IUCN: LC.

*Examined specimens:* **A3 Bilecik:** Osmaneli to Bilecik 1000 m, eroded south banks, 22.04.1966, *Davis 42050* (E 00175536!); **A4 Ankara:** Beypazarı, Aladağ valley, rocky places, 700 m, 874 27/5/1971, *Y. Akman* (ANK!); **B1**

**Manisa:** Soma, 400 m, 12.05.1977, *Seçmen 994* (EGE!); **B2 Manisa:** Salihli to Kula, Sandal village, 26.05.2003, 770 m, open lands, *Akan 4626 & Ekici* (GAZI!, HARRAN!); **C2 Burdur:** Gölhisar to Dirmil 4 km, 30.05.2002, 950 m, *Akan 3480 & Ekici* (GAZI!, HARRAN!).

*Nomenclatural notes:* The taxon that was first defined as *Trifolium Melilotus cretica* L. by Linne (1753: 765), this is a basionim, was later changed to *Melilotus creticus* by him (1763) and finally it was evaluated as *Trigonella cretica* (L.) Boiss. in 1872 by Boissier. Although the first sample of the species could not be found, LUGD-BAT, No: 908-125 400 L 2000531 and the registered sample was deemed appropriate to function as a type since it is both one of the oldest samples in terms of existing samples and is an ideal example and it has been given as a new neotype. According to International Code of Nomenclature, item 9.7, a neotype is a specimen or illustration selected to serve as nomenclatural type if no original material is extant, or as long as it is missing (Menemen and Dönmez, 2006).

It is mostly spreading in Central and Western Anatolia in Turkey. Although peduncle length was given as 1–3 cm for the species, in the Flora of Turkey, it was found that the specimens we collected from the field were generally around 2–5 cm. In the Flora of Turkey, the stipule feature is mostly a toothed or slotted in species, but there are also examples with flat features in our findings, also, the fruit length is 6–18 mm in our specimens, not 10–13 mm. According to Flora of Turkey, this taxon, whose place of identification is unknown and thought to have been collected from the Crete region by mistake, takes its scientific name from here, and is also endemic. However, this taxon is known to spread in the regions of the Mediterranean.

Sect. **Verae** Sirj. In Turkey, it is represented by only one species.

**32. *Trigonella caelesyriaca*** Boiss., Diagn. ser. 1(9): 19 (1849) / Handekok, sphalm.

**Type:** [Lebanon] ad margines agrorum Coelesyriacae inter Zebdani et Zachle, *Boissier* (holo. G photo!).

=*Trigonella gaillardotii* Boiss., Diagn. ser. 2(5): 78 (1856). =*Trigonella aleppica* Boiss. & Hausskn. in Boiss., Fl. Or. 2: 79 (1872).

*Flowering time:* April–June

*Habitat:* Field edges, empty plains, cultural areas, lowland steppe, 300–1150 m. *Distribution:* Turkey, Syria, N Iraq, Ir.–Tur. element. IUCN: LC.

*Examined specimens:* **B7 Malatya:** Malatya to Erzurum, 16.04.1962, *J. M. Winter 419* (E 00175562!); **C6 Gaziantep:** Dülük village, 21.04.2002, 860 m, fields, *Akan 2877 & Ekici* (GAZI!, HARRAN!); **C7 Şanlıurfa:** Şanlıurfa to Birecik 36 km, 05.05.2002, 500 m, fields, *Akan 3121* (GAZI!, HARRAN!); Nizip: Nizip to Birecik 11 km, 07.04.2002, 350 m, roadside, *Akan 2631 & Ekici* (GAZI!, HARRAN!).

*Note:* The correct name of this species is *T. caelesyriaca* (Dianga. Pl. Orient. ser.1.9:19 (1849)). The name of this

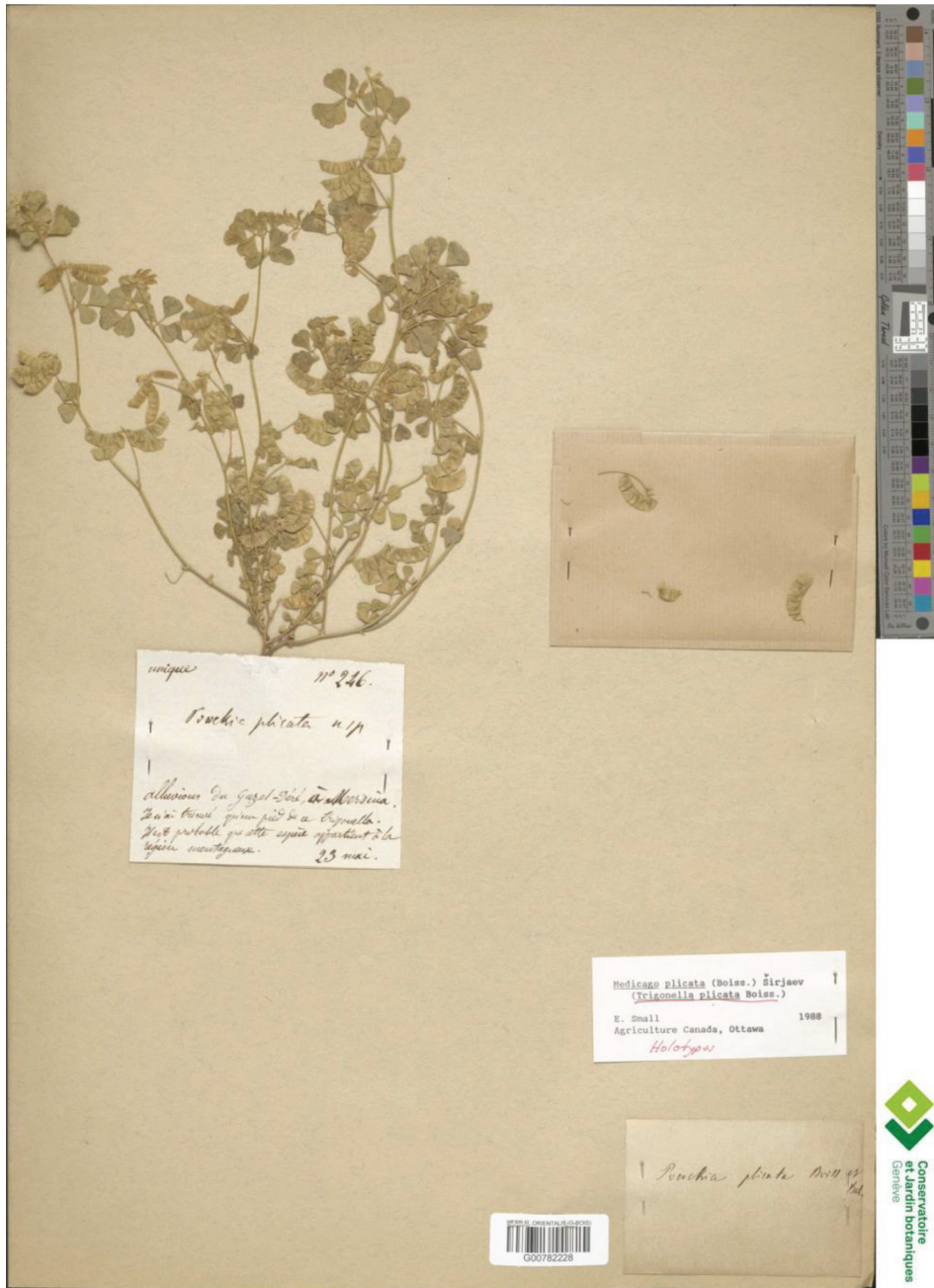


Figure 10. The holotype of *Trigonella plicata* type (G00782228).

species was misspelled to Flora of Turkey. It is one of the local species, distributed in the eastern and southeastern Anatolia. It is collected as animal feed in the Şanlıurfa region and is cultivated in some villages of Harran. Even, in the Flora of Turkey, it is stated that some of the specimens around Ankara (Uresin 246) mentioned as a good example of cultivation. It is known with the names such as “Andeko, “Nefel”, Üçgül” in the southeastern Anatolia. It can be considered as an ornamental plant with its beautiful and showy flowers.

#### 4. Discussion

The morphological, palynological and cytological features of the species belong to the *Trigonella* genus in Turkey, the identification key, species descriptions and the geographical distributions form the basis of this study.

As a result of pallinological studies, it is determined that the pollens are radial symmetrical, isopolar, prolate-spheroid, subprolate, suboblate, spheroid, prolate and oblate-spheroid (Pinar et al., 2014).

Seed morphology of *Trigonella* members were examined from various regions of Turkey. Based on seed features scabrated, verrucated, rugulated, regulate-granulated, aculeated, ridged-tuberculated-verrucated and tuberculated seed surface were recognized (Çeter et al., 2012).

The chromosome numbers vary from  $2n = 14$  to  $2n = 46$  in the genus (Martin et al., 2008; Yılmaz et al., 2009; Martin et al., 2010, 2011a, 2011b).

In this study, both population of endemic species was determined and samples that can be known only from the type were collected and taken to herbaria. The diagnostic keys have been rearranged.

*T. pseudocapitata* and *T. velutinoides* were defined in 1970s, were not included to key in the Flora of Turkey, with this study, and were added to the identification key. The endemic *T. raphanina* have been determined to be synonym of *T. cassia* (see discussion under the *T. cassia*) and *T. balansae* is reduced to synonym of *T. corniculata*. In addition, *T. spruneriana* var. *sibthorpii* is reevaluated as a distinct species (Akan, 2012).

*Trigonella* members used to be represented by 52 taxa in the Flora of Turkey. However, they have later been evaluated by different studies under 32 species (34 taxa) in Turkey. The majority of the *Trigonella* taxa have been transferred to *Medicago* genus based on morphological (floral), chemical, and DNA features (Small, 1987; Small et al., 1987; Bena, 2001; Small, 2011). But, it has been clear since the 1980s that the genus *Medicago* L. is easily and unambiguously separable from *Trigonella* and from other potentially closely related genera (Small, 2011). According to all sources we know of (regional floras, revisions of *Medicago* by Small, molecular phylogenetic and genomic data papers), there is no longer any question about the delimitation of the two genera, *Trigonella* and *Medicago* (including all of the 23 former “medicagoid” *Trigonella* species considered by Urban (1873) and Şirjaev (1928), which were transferred back to *Medicago* by Small (1987) based on floral characters, especially the explosive pollination syndrome. It is important to note that analyses

of all multiple molecular markers (nuclear and plastid sequences) support this transfer and indicate that each genus is a very well-supported monophyletic group. On the other hand, scholars such as Bentham (1865), Urban (1873) and Small (2011) have discussed morphological characters and their taxonomic significance. While no single morphological character distinguishes these two genera, Small, in many of his papers, makes a compelling case for a suite of characters which separate *Medicago* from *Trigonella*, noting those species that appear to be exceptions to this separation between these genera. In addition, there is also chemical evidence that distinguishes *Medicago* from both *Melilotus* Mill. and *Trigonella*. For instance, *Medicago* accumulates the phytoalexins vesitol and sativan after fungal infection, but these substances are absent from *Trigonella* and *Melilotus*. Similarly, species of *Medicago* contain hemolytic saponins, which are not found in *Trigonella* or *Melilotus* (Ingham and Harborne, 1976; Jurzysta et al., 1988). As for the relationship of these two genera to *Melilotus*, there is both molecular and morphological evidence that *Melilotus* is nested within a paraphyletic *Trigonella*. On the other hand, *Trigonella* has nomenclatural priority (published in Species Plantarum in 1753 by Linnaeus) while *Melilotus* was published by Miller in 1754. The study of Steele et al. (2010) sheds more light on this topic. There is also a paper by Dangi et al. (2016) on the systematics of *Trigonella* and *Melilotus*. In conclusion, it can be argued that scientists in Europe and elsewhere believe that *Medicago* and *Trigonella* are clearly distinct genera based on a considerable amount of data from a variety of molecular, morphological and taxonomic sources.

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