



A new species of *Trigonella* sect. *Ellipticae* (Leguminosae-Papilionoideae) from Iran, including cytogenetic and anatomical notes

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Abstract

A new species, *Trigonella bakhtiarica*, from the Iranian province Chahar Mahal Va Bakhtiari is described, illustrated and compared to its most closely related species, *T. aphanoneura*. *Trigonella bakhtiarica* has a longer corolla and differs in the shape, surface and size of its pods, which are taxonomically informative characters in *Trigonella* sect. *Ellipticae*. Chromosome counts and meiosis assays show that both species are diploid, and that their euploid plants possess a somatic chromosome number of $2n = 2x = 16$, which is consistent with the predicted base number of $x = 8$.

Keywords: Fabaceae, morphology, taxonomy, Trifolieae

Introduction

The genus *Trigonella* (Linnaeus 1753) is a member of tribe Trifolieae, in the family Leguminosae (Dangi *et al.* 2004). This genus consists of about 100 species in 18 sections. A high proportion of both the species and sections are reported from the Irano-Turanian phytogeographical region (Lock & Simpson 1991, Mabberley 1997). *Trigonella* is known to occur in a wide range of habitats at altitudes varying from 60 to approximately 4000 m and appearing in cold and humid to drought and semi-drought areas, the majority of which are found in the Irano-Turanian region. In Flora Iranica (Rechinger 1984) the genus is represented by 63 annual and perennial species in 12 sections. There are 27 annual species belonging to 11 sections of the genus *Trigonella* in Iran (Rechinger 1984, Hamzeh'ee 2000, Janighorban 2004, Badrzadeh *et al.* 2009, Ranjbar *et al.* 2012a, 2012b, 2012c). About 14 perennial species endemic to Iran belong to *T.* sect. *Ellipticae* (Boissier 1872: 67, Sirjaeve 1928). This section is characterized by having glabrous leaves, stems and pods, and yellow or occasionally violet flowers (Boissier 1872, Huber-Morath 1969).

In recent years the relationships among *Trigonella* species have been explored in various studies, including: Small *et al.* 1981, Brookes & Small 1988, Small *et al.* 1990, Al-habori *et al.* 1998, Pandita *et al.* 1999, Hamzeh'ee 2000, Murakami *et al.* 2000, Kabilan *et al.* 2002, Janighorban 2004, Martin *et al.* 2008, 2011a, 2011b, Ranjbar *et al.* 2009). However, there has been very little study of anatomical properties. Those studies involving anatomy have focused on the perennial species, for instance Ranjbar *et al.* (2012b), which used anatomical characters for reporting new species and intraspecific variation (Ranjbar *et al.* 2010). Here we report the somatic chromosome numbers, and anatomical and morphological characters that allow *T. bakhtiarica* to be delineated as a new species distinct from, but closely related to *T. aphanoneura* Rech. f. (Rechinger 1984), in sect. *Ellipticae*.

Material and methods

Morphology

This study is based on herbarium material and on field observations conducted in western, southwestern and central Iran. The materials collected in the field were in vegetative or fruiting phase (with a few flowers) and were deposited in the Herbarium of Bu-Ali Sina University (BASU) Hamedan, Iran and TARI. Several herbarium specimens have been examined of both taxa from the following herbaria: FUMH, PR, TARI, W and WU (acronyms follow Index Herbariorum online at <http://sweetgum.nybg.org/ih/>), including the type material of *T. aphanoneura* (Fig. 3).

Type:—IRAN. Prov. Chahar Mahal Va Bakhtiar, between Naghan and Boroujen, Sabz-kuh protected area, Chahartagh, 31.70°N, 50.80°E, 2200 m, 5 June 2012, *Ranjbar 33055*, (holotype BASU, photo W).

Perennial, 38–58 cm tall. Stem branched, glabrous or occasionally sparsely covered with appressed white hairs 0.2–0.5 mm long. Stipules herbaceous, 2–5 × 0.6–1 mm, adnate to the petiole for up to 0.5 mm, lanceolate, glabrous. Leaves 3-foliolate, 8–17 mm long; petiole 2–5 mm long, glabrous to sparsely appressed hairy, similar to the stem. Leaflets obdeltoid to obcordate, 4–10 × 3–7 mm, truncate or emarginate, glabrous above, glabrous or sparsely appressed white hairy beneath, the hairs 0.2–0.5 mm long. Inflorescence an erect raceme, laxly 3–6-flowered, apex aristate; peduncles 1.3–5.2 cm long. Pedicels 3–5 mm long. Bracts hyaline-membranous, 0.3–0.4 × ca. 0.2 mm, triangular, glabrous. Calyx ca. 5 mm long, tubular, glabrous or rarely with sparse appressed hairs 0.2–0.5 mm long; teeth filiform to subulate, ca. 2 mm long. Corolla yellow. Standard 9–10 × 5–6 mm, obovate, tapering abruptly into the short cuneate claw, apex rounded. Wings ca. 10 mm long; blades oblong, apex rounded, 6–7 × ca. 1.5 mm, claw linear, 0.6–0.7 mm long. Keel 8–9 mm long; blades 5 × 2.5 mm; claw linear, 3–4 mm long. Stamens diadelphous (9 fused + 1 free), 8–9 mm long. Ovary 5–6 mm with stipe ca. 1 mm long, glabrous. Pods 7–12 × 3–4 mm, ovate to lanceolate, widely rounded at the lateral side, with a slender stipe 1 mm long, at the apex obtuse to rounded, beaked; valves straw-colored to pale brown to cream, rugose with shallow ridges and furrows, glabrous. Seeds 1–2, oblong, ca. 3 × ca. 2 mm, greenish to brown.

Phenology:—Collected in flower and fruit in May and June.

Etymology:—The species is named after the type locality, Bakhtiari, Iran.

Distribution and habitat:—*T. bakhtiarica* is a narrowly distributed endemic species, known only from the type locality (fig. 2). It was collected from a stony area in the mountainous region of the Sabz-kuh protected area. *T. aphanoneura*, the closest relative of *T. bakhtiarica*, is common in the dry-steppe of Boroujen protected area and a few localities in the Esfahan Province.

Discussion

Results from the present study support the status of *T. bakhtiarica* as a new species distinct from *T. aphanoneura*. *T. bakhtiarica* differs from *T. aphanoneura* in the macromorphological characters of a longer stem, and shorter, inflated pods. Anatomically it differs in the shape of the transverse section, and in having more vascular bundles and only spongy tissue in the stems. Also the stomata index and sizes of stomata are different between the two species. The results of our cytogenetic study showed that the basic chromosome number of $x = 8$ for the new species is equal to that of all species of *T. sect. Ellipticae* (Hesamzadeh & Ziaei-Nasab 2009; Ranjbar *et al.* 2011a, 2012b). Hence, the diploid state has been retained during speciation within this perennial section. Nearly all members of this section are diploid ($2n = 2x = 16$), whereas annuals can be diploid, tetraploid or hexaploid with $2n = 2x = 16$, $2n = 4x = 32$ and $2n = 6x = 48$ chromosome numbers (Aykut *et al.* 2009; Martin *et al.* 2008, 2011a, 2011b; Ranjbar *et al.* 2011b). Results from the present study improve understanding of morphology, chromosome number and anatomy in *T. sect. Ellipticae*, demonstrating relationships between these different characters, and their utility for taxonomic delimitation.

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References

- Al-habori, M., Al-aghbari, A.M. & Al-mamary, M. (1998) Effects of fenugreek seeds and its extracts on plasma lipid profile: A study on rabbits. *Phytotherapy Research* 12: 572–575.
- Aykut, Y., Martin, E., Ünal, F. & Akan H. (2009) Karyological study on six *Trigonella* L. species (Leguminosae) in Turkey. *Caryologia* 62: 89–94.
<http://dx.doi.org/10.1080/00087114.2004.10589673>
- Badrzadeh, M. & Ghafarzadeh-namazi, L. (2009) *Trigonella caerulea* (Fabaceae), an aromatic plant from Ardabil province, Iran *Iranian*

- Boissier, P.E. (1872) *Trigonella*. In: Boissier, P.E. (Ed.) *Flora Orientalis* 2. Geneva, pp. 526–553.
- Brookes, B. & Small, E. (1988) Enhanced floral analysis by low temperature scanning electron microscopy. *Scanning Microscopy* 2: 247–256.
- Dangi, R.S., Lagu, M.D., Choudhary, L.B., Ranjekar, P.K. & Gupta, V.S. (2004) Assessment of genetic diversity in *Trigonella foenum-graecum* and *Trigonella caerulea* using ISSR and RAPD markers. *BMC Plant Biology* 4: 13–18.
<http://dx.doi.org/10.1186/1471-2229-4-13>
- Fahn, A. (1990) *Plant anatomy*. Pergamon Press, New York, 185 pp.
- Fukui, K. & Nakayama, S. (1996) *Plant chromosomes*. CRC Press, Boca Raton, Florida, USA. 152 pp.
- Hamzeh'ee, B. (2000) Some new and noteworthy plant records from Iran. *Iranian Journal of Botany* 8: 271–277.
- Hesamzadeh, S.M. & Ziaei-Nasab, M. (2009) *Color chromosome atlas of legumes collected in the natural resources gene bank of Iran*. Tehran, Iran, 103 pp.
- Huber-Morath, A. (1969) *Trigonella*. In: Davis, P.H. (Ed.) *Flora of Turkey*. Edinburgh University Press, Edinburgh, UK. pp. 452–482.
- Janighorban, M. (2004) A new record of the genus *Trigonella* (Fabaceae) for the flora of Iran. *Iranian Journal of Botany* 10: 177–179.
- Kabilan, S., Kayalvizhia, R., Balasubramanian, S. & Ramalingan, C. (2002) Mass spectral analysis of solvent extracts of Fenugreek seeds. *Asian Journal of Chemistry* 14: 844–849.
- Linnaeus, C. (1753) *Species plantarum*. Laurentius Salvius, Stockholm, 1200 pp.
- Lock, J.M. & Simpson, K. (1991) *Legumes of West Asia, a check-list*. Royal Botanic Gardens, Kew.
- Mabberley D.J. (1997) *The Plant Book*. A portable dictionary of the vascular plants, 2nd ed. Cambridge University.
- Martin, E., Akan, H., Ekici, M. & Aytac, Z. (2008) Karyomorphological studies on section *Bucerates* Boiss. of *Trigonella* L. (Leguminosae) from Turkey. *Caryologia* 61: 225–236.
<http://dx.doi.org/10.1080/00087114.2008.10589634>
- Martin, E., Akan, H., Ekici, M. & Aytac, Z. (2011a) New chromosome numbers in the genus *Trigonella* L. (Fabaceae) from Turkey. *African Journal of Biotechnology* 10: 116–125.
- Martin, E., Akan, H., Ekici, M. & Aytac, Z. (2011b) Karyotype analyses of ten sections of *Trigonella* (Fabaceae). *Comparative Cytogenetics* 5: 105–121.
<http://dx.doi.org/10.3897/compcytogen.v5i2.969>
- Murakami, T., Kishi, A., Matsuda, H. & Yoshikawa, M. (2000) Medicinal foodstuffs. 17. Fenugreek seed. (3): Structures of new furostanol-type steroid saponins, trigoneosides 10a, 10b, 11b, 12a, 12 band 13a from the seeds of Egyptian *Trigonella foenum-graeceum* L. *Chemical & Pharmaceutical Bulletin* 48: 994–1000.
<http://dx.doi.org/10.1248/cpb.48.994>
- Pandita, V.K., Nagarajan, S. & Sharma, D. (1999) Reducing hard seededness in fenugreek by scarification technique. *Seed Science & Technology* 27: 627–637.
- Ranjbar, M. & Hajmoradi, Z. (2012a) Notes on *Medicago* sect. *Lunatae* Boiss. and *Trigonella* sect. *Bucerates* Boiss. of the tribe Trifolieae (Fabaceae), with two new records from Iran. *Iranian Journal of Botany* 18: 235–238.
- Ranjbar, M., Hajmoradi, Z. & Karamian, R. (2010) The taxonomic importance of leaf epidermis morphology and peduncle anatomy in *Trigonella disperma* Bornm. ex Vassilcz. *Taxonomy & Biosystematic Journal* 1: 15–26.
- Ranjbar, M., Hajmoradi, Z. & Karamian, R. (2011a) Cytomorphological study of *Trigonella disperma* (Fabaceae) in Iran. *Cytologia* 76: 1–15.
<http://dx.doi.org/10.1508/cytologia.76.279>
- Ranjbar, M., Hajmoradi, Z. & Karamian, R. (2011b) Cytogenetic study and pollen viability of four populations of *Trigonella spruneriana* Boiss. (Fabaceae) in Iran. *Journal of Cell & Molecular Research* 3: 19–24.
- Ranjbar, M., Karamian, R. & Hajmoradi, Z. (2009) Composition of the essential oil of *Trigonella disperma* from Iran. *Chemical of Natural Compound* 45: 116–117.
<http://dx.doi.org/10.1007/s10600-009-9234-0>
- Ranjbar, M., Karamian, R. & Hajmoradi, Z. (2012b) A new species and taxonomy studies in *Trigonella* sect. *Ellipticae* (Fabaceae) in Iran. *Annales Botanici Fennici* 49: 279–287.
<http://dx.doi.org/10.5735/085.049.0411>
- Ranjbar, M., Karamian, R., Hajmoradi, Z. & Joharchi M.R. (2012c) A revision of *Trigonella* sect. *Ellipticae* (Fabaceae) in Iran. *Nordic Journal of Botany* 30: 17–35.
<http://dx.doi.org/10.1111/j.1756-1051.2009.00171.x>
- Rechinger, K.H. (1984) *Trigonella*. In: Rechinger, K.H. (Ed.) *Flora Iranica* 157. Akademische Druck-Verlagsanstalt, Graz, pp. 207–253.
- Schols, P., Dessein, S., D'hondt, C., Huysmans, S. & Smets, E. (2002) Carnoy: a new digital measurement tool for palynology. *Grana* 41:

124–126.

<http://dx.doi.org/10.1080/001731302760156936>

Sirjaeve, G. (1928) *Generis Trigonella revisio critica*. Faculty of science of university of Masaryk, Brno, 16 pp.

Small, E., Bassett, I.J. & Crompton, C.W. (1981) Pollen variation in tribe Trigonelleae (Leguminosae) with special reference to *Medicago*. *Pollen et Spores* 23: 295–319.

Small, E., Brookes, B. & Lassen, P. (1990) Circumscription of the genus *Medicago* (Leguminosae) by seed characters. *Canadian Journal of Botany* 68: 613–629.

<http://dx.doi.org/10.1139/b90-081>