

## NOTES ON THE GENUS *CISTANCHE* (OROBANCHACEAE) IN IRAN

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The genus *Cistanche* Hofm. & Link. has seven species in Iran of which one taxon is endemic to area of "Flora Iranica". During reconsidering of *Orobanchaceae* for the Farsi version of Flora of Iran we found a new subspecies of *Cistanche* which is described as *C. flava* (C. A. Mey.) Korsh. subsp. *bicolor* Saeidi & Shahi. Moreover, *C. eremodoxa* Bornm., previously reported from Khorassan province, is proposed as a synonym of *C. ambigua* (Bunge) G. Beck. A diagnostic key to all species of *Cistanche* distributed in Iran is also provided. For each species, ecology and some taxonomic remarks are presented.

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مطالعاتی بر روی جنس *Cistanche* (Orobanchaceae) در ایران

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جنس *Cistanche* در ایران دارای ۷ گونه است که یک گونه آن انحصاری ناحیه "فلورا ایرانیکا" است. در راستای تدوین تیره *Orobanchaceae* برای فلور ایران به زبان فارسی یک زیر گونه جدید بنام *C. flava* subsp. *bicolor* برای اولین بار از ایران گزارش می‌گردد. همچنین *C. eremodoxa* که قبلاً از استان خراسان گزارش گردیده بود مترادف با *C. ambigua* پیشنهاد می‌شود. کلید شناسایی، ویژگیهای اکولوژی و تاکسونومی گونه‌های این جنس بیان می‌شود.

### Introduction

*Cistanche* with about 18 species is distributed in the arid and semi-arid regions of the world (Blatter 1921; Agrawal 1984; Musselman 1984). In Iran, this genus contains seven species including: *C. ambigua* (Bunge) Beck, *C. fissa* (C. A. Mey.) Beck, *C. flava* (C. A. Mey.) Korsh., *C. laxiflora* Aitch. & Hemsl., *C. ridgewayana* Aitch. & Hemsl., *C. salsa* (C. A. Mey.) Beck and *C. tubulosa* (Schrenk) Wight. *Cistanche* comprises holoparasite and perennial herbs, with alternative leaves and flowers arranged in spike or racemes. Its corolla is subactinomorphic and calyx lobes are rounded at the margin. The chromosome number  $2n=40$  has been recorded for *Cistanche* by Schneeweiss et al. (2004). Recently molecular phylogenetical studies of some species of *Cistanche* including *C. tubulosa* and *C. salsa* have revealed that they were not closely related to each other (Moriya et al., 1995; Tomari et al., 2002; Tomari et al., 2003). There is no detailed taxonomic

study on *Cistanche* in Iran except for that presented in Flora Iranica (Rechinger, 1964), which lacks taxonomic description of the species, but encompasses a diagnostic key and notes on the distribution of the species.

Gilli (1976) who considered 6 species of this genus in Iran also presented notes on geographical distribution of the species and an identification key to them.

The present paper contributes to the ongoing taxonomic revision of *Cistanche* in Iran.

A short Latin diagnosis, description of the new subspecies of *Cistanche flava* and its differences with the typical subspecies are presented.

### Material and methods

This work is mainly based on the study of herbarium materials deposited in main Iranian herbaria, i.e.,

Table 1. The comparison of *Cistanche flava* subsp. *flava* and *C. flava* subsp. *bicolor*

Characters	<i>C. flava</i> subsp. <i>flava</i>	<i>C. flava</i> subsp. <i>bicolor</i>
Corolla color	pale yellow	yellow with violet limb
Shape of the calyx lobe	equal or unequal, when unequal dorsal lobe shorter than the other lobes	unequal, one of the lateral lobes shorter than the other lobes
Pubescence of calyx lobes	hairy along the margin	absent
Anther apex	obtuse	mucronate

FUHM, IRAN, TARI, TUH and author's own collection from wild populations which are deposited in the herbarium of Guilan University (GUH). In addition, the studied species were compared with type specimens and authentic materials in the herbaria: K, B, LE and Gazi University in Ankara. Characters were selected from color and density of hairs on the stem and leaf; length bracts and presence of pubescence, presence or absence of bractlets, length of bractlets and their pubescence; number, shape, size and pubescence of the calyx lobes; color of flowers and anthers; capsule shape and the number of its valves. Selected localities representing the distribution of seven species of *Cistanche* distributed in Iran are given in the appendix.

### Results and Discussion

The main result of this paper is recognizing a new subspecies of *C. flava*. The new subspecies is easily distinguishable from the typical subspecies by the color of corolla, absence of hairs on lobes of calyx and the apex of anthers. The comparison of the material of the new subspecies with the type specimen in LE (Azerbaijan, between Baku and Salijanami, 1947.11.7, Novopokrosky 899) also confirmed that the differences are considerable enough to represent a new taxon. The differences between two subspecies are shown in Table 1.

#### ***Cistanche flava* (C. A. Mey.) Korsh. subsp. *bicolor* Saeidi & Shahi, subsp. nov.**

Type: Iran, Semnan, Touran protected area, 3 km from Chah-jam to Toroud, 1100 m, 1978.4.23, Freitag & Mozaffarian 28437 (holo. TARI). (Fig. 1).

Calyx lobis lateralibus quam ceteris brevioribus (nec lobis dorsalibus quam ceteris brevioribus), margine glabris (nec pubescentibus). Corolla flava, limbo violaceo (nec pallide flavo). Anthera apice mucronata (nec obtusa).

*Flowering and fruiting time.* Apr.-Jun.

*Notes on the ecology, distribution and affinities of Cistanche in Iran.*

*Cistanche tubulosa* is a highly polymorphic species which is adapted to different ecological conditions such as dry habitats, sea coasts and sand dunes with

sufficient water supply and prefers clay, gypsum and salty soils. For various reasons, this species has a wide distribution and many hosts in Iran. It is the most frequent species of *Cistanche* in Iran and in the world. *Cistanche tubulosa* is closest to *C. flava* by having flower color, calyx shape and some other characters similar to that, but there are distinct differences between them. The bracts of *C. tubulosa* are oblate or ovate-lanceolate, while the bracts of *C. flava* are oblate or lanceolate-linear. Also the bractlets in *C. tubulosa* are smaller than the calyx, whereas they are as long as calyx or longer than the calyx in *C. flava*. *Cistanche flava* has a restricted distribution in center of Iran.

*Cistanche laxiflora* is adapted to different ecological conditions. This species lives on non-saline conditions, it also thrives under saline soil and is widely distributed through the central region of Iran. Its type specimen is collected from Harirud river in Afghanistan. This species is very similar to *C. tubulosa*, but *C. laxiflora* has lax inflorescence, while *C. tubulosa* has dense inflorescence. Furthermore, *C. laxiflora* differs from *C. tubulosa* in length and width of inflorescence and its proportion to plant height. This species is endemic to the area of Flora Iranica (Rechinger 1964).

*Cistanche salsa* is adapted to sandy and salty soils and coast of salty rivers. It is a halophyte plant and *Anabasis* is known as its only host. This species differs from *C. ambigua* in corolla color, presence or absence of woolly-hairs on the dorsal surface of bract and its size.

The species *C. ambigua* and *C. eremodoxa* were recorded as separate species in the Flora Iranica, but the occurrence of *C. ambigua* was considered as doubtful in Iran (Rechinger 1964). These species are said to differ in presence or absence of hairs at the margin of corolla lobes. *Cistanche eremodoxa* was reported by Bornmüller (1936) from Khorassan province in Iran; while Gilli (1976) and Schischkin (2000) considered it as a synonym of *C. ambigua*. Based on the examined herbarium specimens and observation of the type specimen in Berlin (B), it is reasonable to propose *C. eremodoxa* as a synonym of *C. ambigua*. A list of host plants of different species of *Cistanche* in Iran is given in Table 2.

Table 2. The host plants of different species of *Cistanche* in Iran.

Species	Host plants
<i>C. tubulosa</i>	<i>Zygophyllum, Haloxylon, Calligonum, Prosopis, Pteropyrum, Tamarix</i>
<i>C. flava</i>	<i>Calligonum, Suaeda, Alhagi</i>
<i>C. laxiflora</i>	<i>Petropyrum, Seidlitzia</i>
<i>C. ambigua</i>	<i>Calligonum</i>
<i>C. salsa</i>	<i>Anabasis</i>
<i>C. ridgewayana</i>	<i>Tamarix</i>
<i>C. fissa</i>	<i>Artemisia</i>

### Identification key to *Cistanche* species distributed in Iran

- 1- Flowers with no or only one bractlet *C. ridgewayana*
- Flowers with two bractlets 2
2. Calyx with 4-5 heteromorphic lobes, deeply excised on the side of rachis and back lobe in form of small sharp tooth or the lobe absolutely absent *C. fissa*
- Calyx with 5 isomorphic lobes 3
3. Bracts woolly along the edges. Anthers attenuate at base and aristate at apex 4
- Bracts glabrous or rarely hairy along the edges. Anthers roundish at base and obtuse, mucronate, or rarely acuminate at apex 5
4. Corolla yellow, with yellowish-violet limbs. Bracts woolly on dorsal surface, more than two times as long as calyx. Bractlets lanceolate-linear *C. salsa*
- Corolla cream or white, with bluish-violet limbs. Bracts glabrous on dorsal surface; equal to or 1.5 times as long as calyx. Bractlets oblong-linear *C. ambigua*
5. Flowers lax. Inflorescence 1.5-3.5 times as long as width. Plants at least three times taller than the inflorescence *C. laxiflora*
- Flowers dense. Inflorescence 3.5-6 times as long as width. Plants 2-3 times as tall as the inflorescence 6
6. Bracts ovate or oblong-lanceolate, slightly longer to slightly shorter than the calyx *C. tubulosa*
- Bracts lanceolate or oblong-linear, much longer than the calyx, as long as or longer than the corolla (*C. flava*) 7
7. Corolla pale yellow. Calyx lobes equal or unequal, when unequal the abaxial lobe shorter than the others, hairy along edges. Anthers obtuse at apex *C. flava* subsp. *flava*
- Corolla yellow with violet limb. Calyx lobes unequal, one of the lateral lobes shorter than others, glabrous. Anthers mucronate at apex *C. flava* subsp. *bicolor*

### Appendix:

#### *C. tubulosa*:

**Esfahan:** 23 km NE Kashan, 750 m, Babakhanloo, Amin & Bazarghan 17821. **Yazd:** 54 km Bafgh to Sheitoor, near Gazestan, 2200 m, Assadi & Bazghosha 56076; Ardakan, Toot and Anjirvand, 1800m,

Mozaffarian 77411; Near Yazd, 1000m, Rechinger 2704. **Fars:** 43 km from Lar to Bastak, 400m, Assadi & Sardabi 41846; Lar, 800m, Iranshahr 32311 (IRAN); Bandare Lenghe, Tonbe koochak Island, 10 m, Mozaffarian 63586; Shatvar Island, Aminirad 33505 (IRAN); Bostan, Banifarur Island, Terme & Karavar 26565 (IRAN); Bandar Abbas, Bandare Khamir, Shahi & Saeidi 13229. **Bushehr:** Farsi Island, Tehrani & Sangari 26566 (IRAN); Dayyer, Morghi Island, Tehrani & Sangari 26567 (IRAN). **Khuzestan:** Near Ahvaz, Mobayen 8831 (IRAN); Mahshahr, Boune Island, Tehrani & Eskandari 33506/1 (IRAN); NE Susangerd, Farhe region, 40 m, Mozaffarian 53474 (IRAN); NE Bostan, around Misho Dagh mountain, 50-200 m, Mozaffarian 53740 (IRAN). **Kerman:** Ahmad Abad, Iranshahr 32314 (IRAN); Jiroft, Maraz, 18 km SE Pimjan, 750-900 m, Tehrani & Mousavi 32304 (IRAN); Jiroft, Ghaleye Ghanj to Shams Abad, Shah Abad, 450 m, Mousavi & Tehrani s. n. (IRAN); Bemani, Shah Mardi, Mousavi & Iranshahr 32321 (IRAN); 53 km NE Sirjan, 1730 m, with no name of collector 6839. **Balouchestan:** Zahedan to Khash, Hakimi 32303 (IRAN); Khash, ca. 1500 m, Assadi 22958; Moksoukhteh, 25 km Gasht road, 480 m, Foroughi 10825; 17 km Iranshahr, Bam road, 550 m, Foroughi 10652; 2 km SE Iranshahr, 580 m, Runemark, Assadi & Sardabi 22291; 64 km Bazman, 640 m, Runemark, Assadi & Sardabi 22593; 34 km MirJave road to Khash, Runemark, Assadi & Sardabi 22644; Iranshar to Sarbaz, around main road, Ghahreman & Mozaffarian 14056; Iranshahr to Bazman, 30 km WN Bazman, Govanz, 1500 m, Mousavi & Tehrani s. n. (IRAN); Saravan, Iranshahr 32320 (IRAN). **Khorassan:** SW Tabas, new road, Tabas to Yazd, 1000 m, Raafi & Zanghooei 26346 (FUHM); Dashte Lut, South of Tabas, 590 m, Leonard 32302 (IRAN). **Semnan:** 21 km SW Raze, 880 m, Freitag & Mozaffarian 28655; 82 km Sabzevar to Mayamey, Befor Abbas Abad, 930 m, Assadi & Maassoumi 55902; Shahrud, 8 km Ahmad Abad, near Zaman Abad, 950 m, Iranshahr s. n. (IRAN); West of Dashte Lut, 750 m, Leonard 32319 (IRAN).

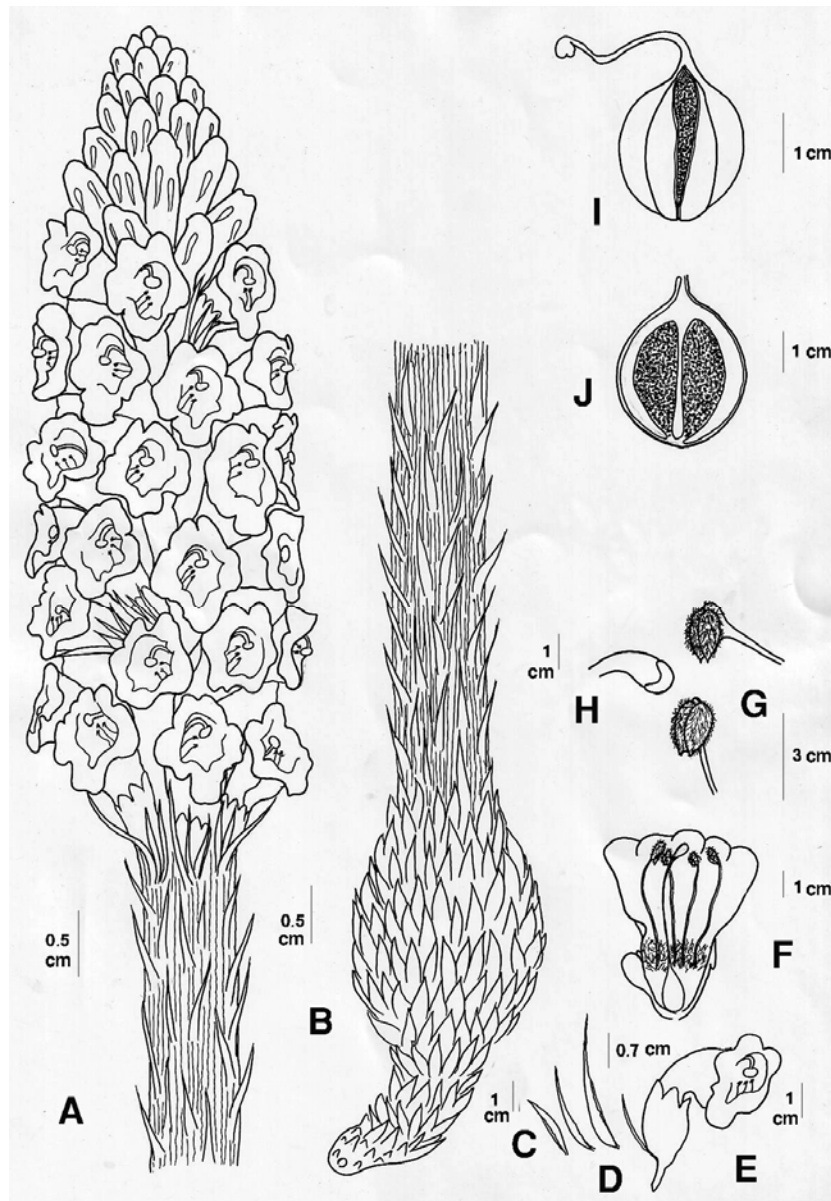


Fig. 1. *Cistanche flava* subsp. *bicolor*. A) Inflorescence (scale bar = 0.5 cm); B) stem with scale leaves (scale bar = 0.5 cm); C) bractlets (scale bar = 1 cm); D) bract (scale bar = 0.7 cm); E) one flower with calyx (arrow indicate the lateral lobe; scale bar = 1 cm); F) Stamens and ovary (scale bar = 1 cm); G) Anthers (scale bar = 3 cm); H) Stigma (scale bar = 1 cm); I) Fruit (scale bar = 1 cm); J) longitudinal section of fruit (scale bar = 1 cm).

**Tehran:** Ghom lake, 800 m, Jadidi 25598 a; Kavir protected region, 7 km SE Karvansaraye Shah Abbas, Wendelbo, Alla & Cobham 10905; to Ghom, around of Ghom lake, 800 m, Sangari, Tehrani, Terme & Karavar s. n. (IRAN); Kavir protected region, in Ghom lake, 750-800 m, Runemark, Foroughi & Assadi 19548; Hoze Soltan lake, Shahi & Saeidi 13242.

***C. flava* subsp. *flava*:**

**Semnan:** Shahrud, to Ahmad abad, Iranshahr s. n.; Sharud, Kalat Hizomi, Shahi & Saeidi 13230. Azerbaijan, between Baku and Salijanami, Novopokrosky 899 (LE !, Type).

***C. flava* subsp. *bicolor*:**

**Semnan:** protected region of Turan, 3 km Chahjam to Turud, 1100 m, Freitag & Mozaffarian 28437.

***C. laxiflora*:**

**Fars:** Lar, 500 m, Foroughi 1142. **Khuzestan:** Mahshahr, Bune Island, Tehrani & Eskandari 33506 (IRAN). **Baluchestan:** near coast, Tehrani & Mousavi s. n. (IRAN); Iranshahr, to Bazman, Sharif 32307/2 (IRAN). **Khorassan:** 70 km Neishabour to Kashmar, Assadi & Mozaffarian 35494. **Tehran:** Kavir protected region, Kuhsiah, Shah Abbas karvansaraye, 1100-1300 m, Rechinger 50123; Hoze Soltan lake, Shahi & Saeidi 13243; Siah kuh: Karvan-Sarai Shah Abbas, 34° 44' N, 52° 10', 1100-1300 m, Rechinger, 50123 (B.!). Afghanistan, Harirud Valley, Aitchinson (K. !, Type).

***C. salsa*:**

**Azerbaijan:** Jolfa-Aras, 790 m, Foroughi 5701. **Esfahan:** between Faridan & Esfahan, Ghahreman, Sheikholeslmi & Aghustin 8825 (TUH). **Semnan:** Shahr, Ahmad Abad, to Darb Ahangh, Iranshahr 32300 (IRAN). **Tehran:** Kvir region, 80 km NW Shah Abbasi Karvansaraye, 900 m, Wendelbo, Alla & Cobham 10847; Kavir protected regions in Ghom lake, 750-800 m, Runemark, Foroughi & Assadi 19548. Turkey, B5 Kayseri: Sultan Marshes, Oztekin 1491. Novopokrosky (LE.!, Type).

***C. ambigua*:**

**Semnan:** Chahjam, 1100 m, Freitag & Mozaffarian 28414. **Esfahan:** 60 km North of Naein, 1800 m, Iranshahr 32313 (IRAN). **Tehran:** protected region of Kavir, Talhe, 900-1000 m, Runemark, Assadi & Foroughi 19539. Gabriel 193b (B. !, Lectotype).

***C. fissa*:**

**Semnan:** Shahrud, Ahmad Abad, Rechinger 50654.

***C. ridgewayana*:**

**Guilan:** 43 km Rudbar to Gilvan, 550 m, Assadi & Shah Mohammadi 60176. **Kerman:** Bahram Abad, near Kabutar Khan, Rechinger, Esfandiari & Aellen 32301 (IRAN). Kerman, Inter desert, near Kushkuh, Bornmuller 3907 (K. !). **Baluchestan:** 80 km Zahedan to Bam road, 1350 m, Assadi 22721. **Semnan:** Damghan, 1300-1400 m, Rechinger 52162. **Tehran:** Absard, Zand 13241. Afghanistan, Harirud Valley, Aitchinson (K. !, Type).

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