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Caraganeae, a new tribe with notes on the genus *Chesneya* LINDL. ex ENDEL. (Fabaceae) from Flora of Iran

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ABSTRACT: The four species of the genus *Chesneya* LINDL. ex ENDEL. recorded from Iran are described and a key to them presented. Each is compared to its closest ally and its geographical distribution given. *Chesneya gaubaeana* BORNM. is treated as synonym of *C. parviflora* JAUB. & SPACH. Seed testa morphology as seen under the scanning electron microscope is discussed and photomicrographs are provided. *Chesneya* and closely related genera such as *Caragana* FABR., *Halimodendron* FISCH. ex DC., *Calophaca* FISCH., and *Gueldenstaedtia* FISCH., are placed in the new tribe Caraganeae. The morphological data offer a novel hypothesis of tribal relationship for Galegeae group and suggest that tribe Caraganeae could well be treated as a distinct taxon.

KEYWORDS: *Chesneya*, Iran, micromorphology, new tribe.

Introduction

Chesneya belongs to the tribe Galegeae, the largest tribe in Fabaceae. BOISSIER (1872) recognised two species of *Chesneya*, *C. astragalina* JAUB. & SPACH. and C. *parviflora* JAUB. & SPACH. According to the most recent morphological classification of the papilionoid tribe Galegeae (POLHILL 1981), *Chesneya* LINDL. ex ENDL. is a member of the subtribe Astragalinae, which includes, among other genera, *Astragalus* L., *Caragana* FABR., and *Oxytropis* DC. *Chesneya* is one of the most complex genera in Fabaceae. Nearly all species in *Chesneya* are, at first sight, similar to one another and also variable. Most workers, such as LOCK & SIMPSON (1991), agree that the two genera

Chesneya and *Astragalus* are particularly closely related. However, this revision has shown that the morphological resemblance of the genera was due to parallelism. *Chesneya* may have been derived from *Caragana* or *Calophaca* in Eurasia and the former Soviet Union, and it is most closely related to *Gueldenstaedtia*. However, morphological evidence from flowers and pods indicate that *Caragana* FABR., *Halimodendron* FISCH. ex DC., *Calophaca* FISCH., *Chesneya* LINDL. ex ENDL., and *Gueldenstaedtia* FISCH should be considere as a natural group.

Methods

This paper is based on an examination of the *Chesneya* collections in the herbarium at Research Institute of Forests and Rangelands (TARI), as indicated in the text. The seed morphology of all four Iranian species (except *C. kotschyi*) was examined in a Cambridge 360 scanning electron microscope. Most seeds were mounted as they came from the herbarium specimens. Some were soaked in a drop of water to try to remove the adherent outermost layer, but this treatment made very little difference to the appearance of the seed under the SEM. The seeds were mounted on stubs using sticky tabs and sputter-coated with platinum.

Treatment

Chesneya LINDL. ex ENDL., Gen. Plant. 1275, 1840

Perennial herbs, branched and woody from the base. Stem diffuse, densely pubescent or villose. Stipules large, herbaceous. Leaves imparipinnate, leaflets entire. Inflorescence axillary, 1-3 flowered, yellow, red or bluish. Calyx tubular or tubular-campanulate, gibbous at the base or strongly asymmetrically pedicellate, subbilabiate, the two upper teeth considerably fused. Standard obcordate to elliptic, pilose dorsally, a little longer than the obtuse keel and wings. Stamens diadelphous (9+1), anthers uniform. Pod sessile, oblong, dehiscent. Seeds irregular reniform.

Key to the species

1a Stem, peduncle and rachis densely villose; pods more than 12 mm broad ..... ***C. kotschyi***

1b Stem, peduncle and rachis densely pubescent; pods less than 12 mm broad **2**

2a Standard 15-18 mm long; peduncle 0-5 mm long ..... ***C. parviflora***

2b Standard 20-24 mm long; peduncle 5-20 mm long **3**

3a Pods narrowly oblong, 4-5 mm broad; calyx teeth 3-4 mm long ..... ***C. kopetdaghensis***

3b Pods broadly oblong, 6-7 mm broad; calyx teeth 4-6 mm long ..... ***C. astragalina***

1. *C. astragalina* JAUB. & SPACH, I 11. Pl. Or. 1: 94, 1842

Perennial herbs, with a long woody taproot, stem 5-20 cm long, more or less densely pubescent. Stipules 3-5 mm long and 2-3 mm broad, herbaceous, ovate, acute, more or less densely pubescent. Leaves 5-8 cm long, petioles 2-3 cm long, leaflets 4-6 pairs, 7-10 mm long and 4-6 mm broad, obovate to oblong, upper surface covered with scattered hairs, lower surface densely pubescent, round or truncate to slightly emarginate, round to cuneate at the base. Inflorescence axillary, 1-3 flowered, peduncle short, 0.5-2 cm long, 1-1.5 mm in diameter, densely pubescent. Bracts 1-2 mm long, linear, pilose. Calyx 13-17 mm long, tubular-campanulate, gibbous at the base, submembranaceous, densely pubescent, the teeth triangular-lanceolate, 3-6 mm long. Corolla yellowish, violet to reddish. Standard 20-24 mm long, the limb ovate-elliptic, round, softly pubescent outside. Wing petals 20-23 mm long, the limb 10-12 mm long and 4-5 mm broad, obliquely oblong to triangular, apex rounded, base auriculate, triangular, limb longer than the calyx. Keel subequalling the wing. Ovary hairy, 8-10 ovuled. Pod broadly oblong, 40-60 mm long and 5-6 mm broad, bilocular, beak 2-3 mm long, covered with villous. Seeds 3-4 × 2.5 mm, reniform.

Specimen seen: Esfahan. Ca. 22 km from Kashan to Natanz, 1200 m; 28.5.1986, Assadi & Bazgosha; 55946. - 85 km SW of Kashan, 1410 m; 10.4.1969, Babakhanlou; 9431. - **Markazi.** 8 km N of Garmsar, 1500 m; 1.5.1973, Bazargan & Arazm; 15400. - **Semnan.** 60 km Garmsar to Semnan, 950 m; 28.4.1974, Babakhanlou & Amin; 17662. - Semnan, Touran protected area, desert mountain about 50 km SE of Torud, 800-850 m; 28.4.1978, Freitag & Mozaffarian; 2866. - Semnan to Firuzkuh ca. 18 km W of Semnan, 1300-1350 m; 24.6.1977, Wendelbo & Foroughi; 13007 - Touran protected area, 4 km E of Razeh, Chah Plange, near Andarkuh, 1280 m; 25.4.1978, Freitag & Mozaffarian; 28516 - Semnan to Shahrud, S and top of Razeh Mts, 1400-1600 m; 27.4.1978, Freitag & Mozaffarian; 28600. - Kavir, Siahkuh, Karavanserai Shah-Abbas, 8 km meridiem versus, 900 m; Rechinger; 963 - Kavir, Chashme-ye Safid-Ab, 1000 m; 46420. - **Tehran.** 37 km from Garmsar on road to Semnan, near Sorkhe-Now, 940 m; 20.4.1978, Freitag & Mozaffarian; 28259. - Kavir protected area, 2 km on the road NW of gate to Shah-Abbas Karavanserai, 850 m; 5.5.1976, Runemark et al.; 19440. - Cyahkuh 100 km Kavir-e Varamin, 820 m; 2.5.74, Babakhanlou et al.; 17834. - Kavir Protected Region, Siahkuh, pass S of Einor Rashid, 1150 m; 3.12.1974; 15215. - Kavir protected area, ca. 30 km from Shah-Abbas Karavanserai to NW of gate, 1000-1200 m; 5.5.1976, Runemark et al.; 19444. - Ca. 12 km from Evianaky to Garmsar, 1000 m; 23.4.1987, Mozaffarian; 59116.

Note: This species is widespread in Iran and extremely variable in relation to ecological condition. Growing in saline deserts or semideserts, steppes, and dry stony or gravelly slopes in the lower middle mountain zone. Its forms, based on herbarium materials, are distinguished by being densely pubescent, by the standard 20-24 mm long and by the calyx teeth 4-6 mm long.

The seed testa of this species is typical of the genus and similar in form to that of *C. parviflora* (Fig. 1a, c). The seed testa of *C. astragalina* is papillose-reticulate with secondary reticulation.

2. *C. kopetdaghensis* BORISS., Fl. URSS. 11: 302, 1945

Perennial herbs, with a long woody taproot, stem 4-8 cm long, densely silvery-pubescent. Stipules 3-4 mm long and 3-4 mm broad, herbaceous, ovate, round at the apex, densely pubescent. Leaves 5-7 cm long, petioles 1-2 cm long, leaflets 4-5 pairs, 5-9 mm long and 4-6 mm broad, obovate to obcordate, both sides, more or less densely pubescent above and below, obtuse to truncate or retuse, round to cuneate at the base. Inflorescence axillary, 1-flowered, peduncle 0.5-2 cm long, 1-1.5 mm in diameter, densely pubescent. Bract ca. 1 mm long, narrowly linear, pubescent, bracteolate. Calyx 14-17 mm long, tubular-campanulate, strongly asymmetrically pedicellate, densely pubescent, the teeth linear-triangular, 3-4 mm long. Corolla yellow or red to violet. Standard 21-24 mm long, the limb orbicular, round, softly pubescent outside. Wing-petals 21-23 mm long, the limb 4-6 mm long and 3-4 mm broad, oblong to triangular, apex rounded, base auriculate, auricle triangular, limb longer than the calyx. Keel 18-20 mm long, slightly shorter than the wing. Ovary linear, pilose. Pod narrowly oblong, 30-55 mm long and 4-5 mm broad, bilocular, beak 2-3 mm long, covered with villous hairs. Seed 4-5 × 2-3, reniform.

Specimen seen: Gorgan. 15 km E of Maravetappeh, on the road to Ghazanghayeh, 300 m; 22.4.1986, Assadi & Maassoumi; 55503. - E of Maravetappeh, near Ghazanghayeh, 300 m; 22.4.1986, Assadi & Maassoumi; 55253. - **Khorasan.** 74 km to Mashhad, from Kalat-e Naderi, 950 m; 27.4.1986, Assadi & Maassoumi; 55860. - 7 km W of Kalat-e Naderi, 1250 m; 27.4.1986, Assadi & Maassoumi; 55030. - 50 km from Kashmar to Neyshabour, after Rivash, 1850 m; 12.6.1981, Assadi & Mozaffarian; 35641. - 38 km E of Torbat-e Jam, 700 m; 11.10.1988, Assadi & Amirabadi; 66784. - Ca. 25 km SW of Darreh-Gaz, Tandooreh National Park, Chehel-Mehr, 1200 m; 29.5.1984, Assadi & Maassoumi; 50821. - 5 km from Mozdouran to Sarakhs, 940 m; 26.4.1989, Mozaffarian; 67607. - 70 km from Neyshabur to Kashmar, 1550-1950 m; 11.6.1981, Assadi & Mozaffarian; 35454.

Note: Occurs in the mountains of NE Iran. Closely related to *C. astragalina* JAUB & SPACH, but differs in the silvery-gray pubescence, breadth of pod and number of flowers.

The seed testa (Fig. 1b) is distinctive among the Iranian species; micrograph shape will confirm the identification.

3. *C. kotschyi* BOISS., Diagn. Pl. Or. Nov. Ser. 1, 6: 34, 1846

Perennial herbs, branched from the base, 5-15 cm long, densely villose. Stipules 4-6 mm long and 2-3 mm broad, herbaceous, ovate, acute, more or less densely villose. Leaves 5-8 cm long, petioles 2-3 cm long, leaflets 4-6 pairs, 5-12 mm long and 5-7 mm broad, obovate to oblong, both sides densely pubescent, round or trunicate to slightly emarginate, round to cuneate at the base. Inflorescence axillary, 1-2 flowered, peduncle 0.5-2 cm long, 1.5-2 mm in diameter, densely villose. Bract 1-2 mm long, linear, softly pubescent. Calyx 15-20 mm long, broadly tubular, gibbous at the base, densely villose, the teeth 3-5 mm long, lanceolate. Corolla yellow to violet. Standard 24-27 mm long, the limb

ovate-elliptic, round, softly pubescent outside. Wing-petals 22-24 mm long, the limb 8-11 mm and 4-5 mm broad, oblong to triangular, apex rounded, base auriculate, triangular, limb longer than the calyx. Keel subequalling the wing. Ovary linear, hairy, 7-9-ovuled. Pod broadly oblong, 50-60 mm long and 12-14 mm broad, bilocular, beak 2-4 mm long, villous. Seeds 3.5-4 × 3 mm.

Specimen seen: Bushehr. Borazjan, Dalaki to Bushkan, between Tange Eram and Faryab, 350 m; 25.4.1995, Mozaffarian; 74147.

Note: This small species occupies a limited area in the Southern Iran. We have seen only one specimen that corresponds to BOISSIER's description. This species is close to *C. astragalina*.

4. *C. parviflora* JAUB.& SPACH, I 11. Pl. Or. 1: 95, 1842

Syn.: *C. macranica* RECH. f. & ESFAND., Englers Bot. Jahrb. 75: 335, 1951
Syn.: *C. gaubaena* BORNM., Feddes Repert. 50: 283, 1941, **syn. nov.**

A dwarf acaulescent, perennial herb, with a long woody taproot, stem 1-5 cm long, densely pubescent. Stipules 3-5 mm long and 2-3 mm broad, herbaceous, ovate-triangular, acute to acuminate, densely pubescent. Leaves 5-8 cm long, petioles 1-2 cm long, leaflets 4-8 pairs, 7-10 mm long and 3-5 mm broad, obovate to oblong, both surfaces densely pubescent, round to truncate, round at the base, 1-2-flowered, 1-1.5 mm in diameter, shortly pedunculate or sessile, densely pubescent. Bract and bracteole linear, minute, pilose. Calyx 8-12 mm long, tubular-campanulate, gibbous at the base, densely pubescent, the teeth triangular-lanceolate, 2-4 mm long. Corolla yellowish, violet to reddish. Standard 15-18 mm long, the limb ovate-elliptic, round, densely appressed-hairy on the outside. Wing-petals 14-17 mm long, the limb 6-9 mm long and 4-5 mm broad, oblong, round-tipped, auriculate at the base, triangular, limb longer than the calyx. Keel equalling or slightly shorter than the wing, the limb 7-9 mm long, auricle round. Ovary linear, 8-10 ovuled, pilose. Pod oblong 30-45 mm long and 4-6 mm broad, bilocular, beak 2-3 mm long, covered with patent soft silky white hairs. Seed 4 × 3 mm, reniform.

Specimen seen: Baluchestan. 50 km from Chahbahar to Iranshar, 90 m; 17.4.1983, Mozaffarian; 43843. - 45-40 km on road from Iranshahr to Khash, 900-1000 m; 6.3.1977, Runemark, Assadi & Sardabi; 22254. - 30 km to Zahedan from Zabol, 1200 m; 25.4.1985, Valizadeh & Maassoumi; 1099. - Khash to Iranshahr road, Karvandar, 1250 m; 13.4.1983, Mozaffarian; 42923. - 25 km on road from Bazman to Bam, 1200-1400 m; 10.3.1977, Runemark et al.; 22601. - 130 km from Khash to Iranshahr after Dame, 700 m; 13.4.1983, Mozaffarian; 42969. - Chah-Bahar, Gardanehe Hoder, Rashk roach, 350 m; 7.3.1974, Foroughi; 10736. - Sarbaz, 74 km Zabol, 1280 m; 11.3.1974, Foroughi; 10794. - **Hormozgan.** 15 km from Bandar-Abbas to Sirjan, 100 m; 25.2.1982, Mozaffarian et al.; 37900. - B. Lengeh, ca. 10 m; 29.3.1986, Mozaffarian; 63594. - 111 km from Bandar-Abbas to Sirjan, after the tunnel, 1000 m; 21.4.1983, Assadi & Sardabi; 42093. - Bandar-Abbas, Siahu area, 1200 m; 8.5.1982, Mozaffarian et al.; 39697.

Note: This species closely resembles *C. kotschyi* and *C. astragalina* and is not always readily distinguishable from them. It differs in the smaller flowers and width of pod.

The separate specific status of *C. parviflora* is confirmed by details of the seed testa morphology as seen under the electron microscope (Fig. 1c). The seed testa is without an obvious rugose layer and thus differs from *C. astragalina*.

Seed morphology

The basic pattern of the seed testa in Iranian *Chesneya* is remarkably heterogeneous. Variation arises from differences in both size and shape of the whole seed. In the majority of studied species, the seeds are slightly longer than in other Galegeae. Studies of several genera of Fabaceae, especially genera of Galegeae, have demonstrated a variety of different structures: reticulate, papillose, tuberculate and granular (RANJBAR, unpublished SEM examination data).

Results and Discussion

The molecular data obtained in the last few years, however, are unequivocal in demonstrating the paraphyly of Galegeae. In the phylogenetic analyses were performed by WOJCIECHOWSKI et al. (2000), *Caragana* presented from a monophyletic group that is sister to the Hedysaroid clade. Both ITS and *rpo*C (SANDERSON & LISTON 1995) studies agree on an "Astragalean" clade within Galegeae consisting of part of Astragalinae, including *Astragalus* (*Astracantha*), *Oxytropis* and *Biserrula*, and all of Coluteinae. Excluded from this clade are the rest of Astragalinae and the monotypic subtribes (containing *Glycyrrhiza*) and *Galega*. The group of *Caragana*, *Halimodendron*, and *Calophaca* is the sister group of this assemblage in the *rpo*C data and in some ITS analyses depending on choices made in the alignment of the sequences (SANDERSON & LISTON 1995). In any case the analyses agree that Astragalinae must be paraphyletic, with parts of it, *Astragalus* and *Oxytropis*, more closely related to the subtribe Coluteinae than to *Caragana* and then it is not possible that *Caragana* belongs to "Astragalean" clade (SANDERSON & LISTON 1995). However, the morphological data are presented have support the introduction of a natural group inculedes *Caragana* FABR., *Halimodendron* FISCH. ex DC., *Calophaca* FISCH., *Chesneya* LINDL. ex ENDL., and *Gueldenstaedtia* FISCH.

It is encouraged that so strongly supported that *Chesneya* belong to a new tribe. New taxon well supported with morphological evidence as pedicel asymmetrically attached to slightly gibbous ± tubular calyx (except *Halimodendron*), the valves of pod generally twisting on dehiscence (except *Halimodendron*), remotely flower and opening calyx in fruiting time. Genus *Halimodendron* has little affinity with new tribe. However, we suggest the name "Caraganeae" for genera as *Caragana* FABR., *Halimodendron* FISCH. ex DC., *Calophaca* FISCH., *Chesneya* LINDL. ex ENDL., and *Gueldenstaedtia* FISCH.

Caraganeae RANJBAR trib. nov.

Herbae perennes basi vel suffrutices vel frutices; folia paripinnata vel im paripinnata; foliola 1-7 juga, integra; stipulae herbaceae; pedunculi axillares, ± elongati, 1-3-flori; calyx tubulosus, basi gibbosus, subbilabiatus; corolla majuscula, flava vel rubescens vel violascens; stamina diadelpha; ovarium sessile, multiovulatum; legumen sessile, lineare vel oblongum, uniloculare; valvae maturitate tortae.

Genus typicum: *Caragana* FABR., Enum., ed. 2: 421, 1763.

Other genera (citation according to POLHILL 1981): *Caragana* FABR., *Halimodendron* FISCH. ex DC., *Calophaca* FISCH., *Chesneya* LINDL. ex ENDL., and *Gueldenstaedtia* FISCH.

Distribution: E Europe, SW to C Asia, Sino-Himalayan region to Siberia.

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Fig. 1. on the next page.

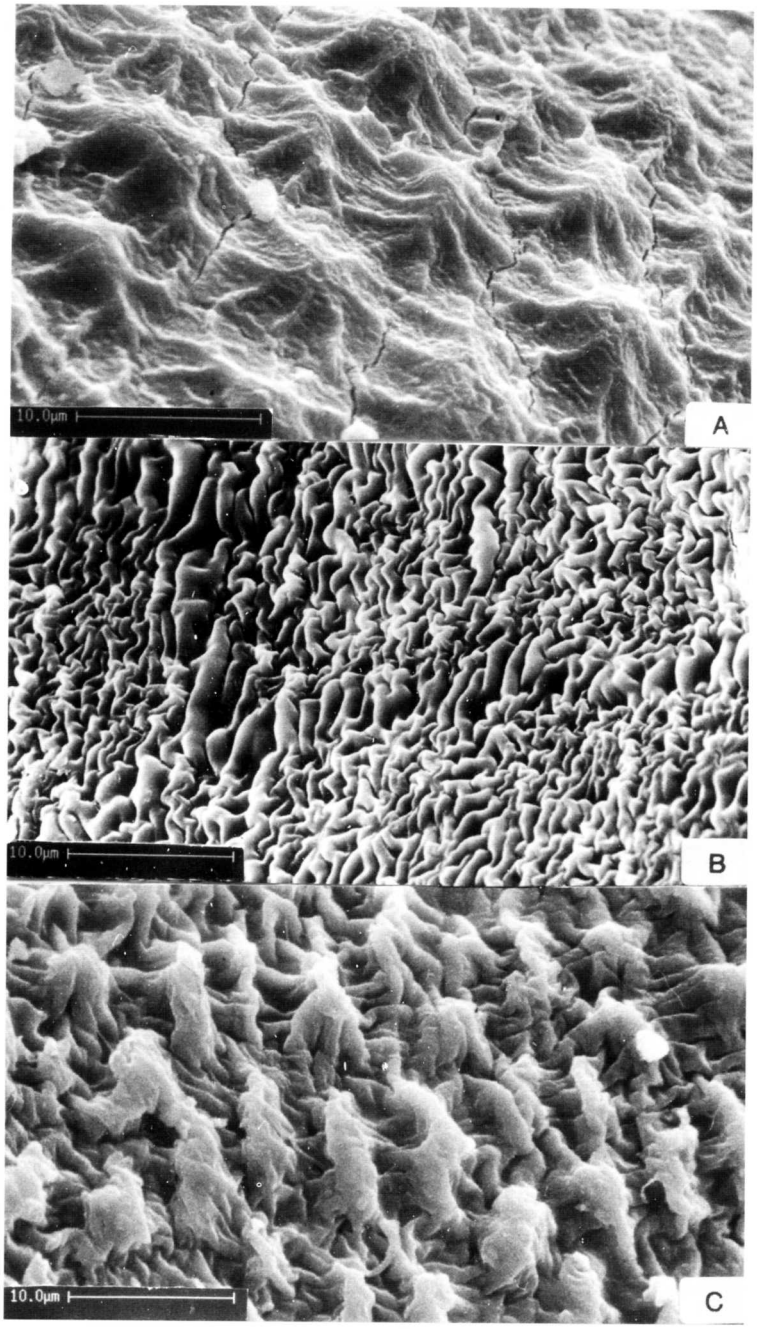

Fig. 1. SEM micrographs of *Chesneya* seed coat. – (a) *C. astragalina* (ASSADI & BAZGOSHA; 55946). – (b) *C. kopetdaghensis* (ASSADI & MOZAFFARIAN; 35641). – (c) *C. parviflora* (MOZAFFARIAN; 42969). – (bar = 10µm).