A new species of *Astragalus* L. sect. *Sesamei* DC. (Leguminosae) from the southeast of Spain: *Astragalus castroviejoi*

by

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Abstract


We describe a new species of *Astragalus* section *Sesamei* from the semiarid zone of SE Spain: *Astragalus castroviejoi*. Morphologically the new species resembles *A. sesameus* L. and *A. stella* L. and we provide a key to distinguish the three species. *A. castroviejoi* is a diploid species with 2n = 16, the same chromosome number as *A. sesameus* and *A. stella*. We provide an image of the karyotype, together with an illustration of the new species and a map of its distribution. Since the existing populations are restricted in area, we also provide an estimate of the conservation status of this species according to the criteria of the IUCN.

Keywords: *Astragalus castroviejoi*, *Leguminosae*, sect. *Sesamei*, karyology, morphology, conservation.

Resumen


En este trabajo se describe una especie nueva de la zona semiarida del SE de España perteneciente a la sección *Sesamei* del género *Astragalus*: *Astragalus castroviejoi*. En lo morfológico, esta especie se parece a *A. sesameus* L. y *A. stella* L., por lo que se aporta una clave para la identificación de estas tres especies. *A. castroviejoi* es una especie diploide con 2n = 16, el mismo número cromosómico de *A. sesameus* y *A. stella*. Se da la descripción del cariotipo y se aporta la iconografía de la especie y un mapa de distribución. Como los núcleos poblacionales son pequeños se hace también una valoración, siguiendo los criterios de la IUCN, del estado de conservación de la especie.


Introduction

*Astragalus* is the most diverse genus of all Angiosperms, with more than 2,500 species. The genus is mainly distributed through arid and temperate regions of the Northern Hemisphere and South America. It is especially abundant in SW and SC Asia, where 1500 species are found, western North America (around 500 species) and in South America, especially in the Andean region (150 species) (Sanderson & Wojciechowski, 2000). Europe is host to 120 species (Podlech, 2008), although N Africa is also a centre of considerable diversity. Molecular studies (Sanderson & Wojciechowski, 2000; Wojciechowski & al., 1999) have indicated that the species from North and South America, the so-called “Neo-Astragalus”, show little genetic diversity and are closely related to the annual species *A. echinatus* Murray, the only species of the sect. Pentaglottis Bunge endemic to the Mediterranean Region. Most species are perennial herbs or spiny bushes, but c. 70 species are strictly annual, all of them living in the Irano-Turanian and Mediter-
ranean Regions. All annual species of *Astragalus* belong to the subgenus *Trimeniaeus* Bunge and can be divided into 13 sections, six of which are monospecific (Podlech, 1994), with sect. Sesamei DC. being the most diverse with 22 recognised species (Gazer, 1993).

In the marl-gypsum pastures of SE Spain, populations of taxon evidently belonging to *Astragalus* sect. Sesamei that are very similar in morphology to *A. sesameus*, have been found. All the members of sect. Sesamei are characterised by having mostly white basified hairs; stipules adnate to the petiole; dense inflorescences, that are axillary, and sessile or long-pedunculate; tubular calyx, with lanceolate teeth usually slightly shorter than the tube, rarely longer; flowers with the standard longer than the wings and keel; androecium diadelphous, 10 stamens, the vexillar stamen free; ovary pilose, with a longitudinal septum, bilocular, with (3)4-8 ovules per locule; style short, fat, curved, glabrous, ending in a semispherical humid stigma with no surrounding hairs; legume sessile, with a keel on the ventral face, and a groove in the dorsal one, ± pilose, bilocular, with (2)3 or more seeds per locule; seeds tetragonal, with a sunken hilum, ± flat, with smooth or rugulose surface, brownish-gray or greenish. Most species of this section live in SW Asia, although seven species are found in Algeria and six in Morocco (Gazer, 1993). Currently only three species of sect. Sesamei occur in Spain: *A. scorpioides* Willd., *A. sesameus* L. and *A. stella* L. (Podlech, 1999).

In this study we focused on a morphology and karyology of these populations that live in the marl-gypsum pastures of SE Spain so as to compare them with *A. sesameus* and *A. stella*, the two species with similar morphology in *Astragalus* sect. Sesamei (the *A. stella* group hereafter).

**Materials and methods**

The material used for karyological studies came from plants cultivated in the greenhouses at the University of Seville, originally from a population from Murcia in the marl-gypsum pasture of the *A. stella* group.

Chromosomes were observed in root tip meristem cells that were pre-treated with 0.002 M 8-hydroxiquinoline for three hours at 4 °C and subsequently fixed in Carnoy solution (3 : 1, 96% ethanol: glacial acetic acid) for at least 24 hours. Chromosomes were stained with hydrochloric acid-carmine according to Snow (1963). Images were taken with a Leica DC 300 inserted in an Axioshot Zeiss with Plan-Apochromatic 63/1.4 objective at 2.5 magnification.

For the terminology referring to chromosomes, we have followed Levan & al. (1964) and for size, Stebbins (1938).

Both vegetative and reproductive characters were quantified, based on the material of the *A. stella* group only, at the herbaria of the universities of Seville (SEV) and Murcia (MUB) (see Appendix 1).

**Results and discussion**

*Astragalus stella* group species have similar floral characters, with the standard oblong-campanulate, emarginate or retuse apex, and undifferentiated stamens; wings with narrow-elliptic limb, obliquely bilobate, auriculate at the base, and a narrow claw nearly as long as the limb; keel smaller than both standard and wings, with nonauriculate, galate and a broad claw, as long as or even longer than limb. All the flowers of these species encountered at anthesis had the anthers open at the end of the keel, and closely associated with the stigma, giving the impression that they had not been visited by bees. This leads us to think that the whole group is self-fertilising, as is the case with other annual species of *Astragalus* of the sections *Bucerates* DC. and *Epiglo- tlus* Bunge (Gallardo & al., 1994).

Although petal morphology and disposition of the androecium and gynoecium are similar in the *A. stella* group, nevertheless, a series of characters serve to distinguish three taxa: the pedunculate or subsessile infrutescence, specially the morphology of the calyx, the number of ovules/locule in the ovary, the disposition of the legumes in the infrutescence, the dorsal and dorso-ventral width of the legumes, and also the length of the hairs on the legumes. These three taxa comprise *A. stella* and *A. sesameus*, and a new species to which we give the name *A. castroviejoi*, in honour of the distinguished taxonomist Dr. Santiago Castroviejo Bolívar.

Following the description, we provide a key to identify these three species.

**Astragalus castroviejoi** Talavera & Sánchez-Gómez, sp. nov. (Fig. 1)

*Species similis ac Astragalus stella habitu, foliis et inflorescentia. Huibus disimilis: 1) calice cum inaequalibus dentibus (in A. stella sunt ± aequales), 2) ovario cum (3)4 ovulis per loculi [in A. stella (5)6(7)] atque 3) legamine erecto vel erecto-patenti (patent in A. stella), latitudine dorsali 3-4.5 mm (in A. stella 2-2.5 mm), cum pilis –longissimis– 1.7-3 mm (in A. stella 1-1.2 mm).

*Species in memoriam et honorem Doctoris Santiago Castroviejo Bolívar.*
A new species of Astragalus

Fig. 1. Astragalus castroviejoi, Alcoluche, Lorca, Murcia (SEV 250016): a, habit; b, stem node at the base of a leaf showing stipules; c, inflorescence; d, bract; e, calyx; f, standard; g, wing; h, keel; i, androecium; j, gynoecium; k, stigma; l, legume; m, transverse section of legume in median zone; n, seed.


Annual herb 13-30 cm, branched from the base, with ascending or procumbent villous stems, striated, with dense erect or erect-patent hairs up to 1.5 mm, with exception of legume, which also has short appressed, basifixed white hairs, rarely with black hairs on stipules, which sometimes are also present at the base of flowers, at the apex of the sepals, and on the stems. Leaves 50-85(90) mm long, petiolate, imparipinnate, with 7-11 pair of leaflets; stipules 5-7 × 2-2.3 mm, triangular, greenish, shortly adnate at base to petiole, densely hairy; petiole 10-13 mm; leaflets 6.5-11 × 3.5-5.2 mm, petiolulate, elliptic, truncate or rounded at the apex, villous, more glabrous in the upper side, with petiolule c. 0.5 mm. Inflorescences axillary, pedunculate, ± spiciform, with (3)-7-8(13) flowers; peduncle 18-65(78) mm, densely hairy, shorter than its leaves in flowering, as long as its leaves in fruiting. Flowers sessile, bracteate; bract 3.5-5 × 0.3 mm, linear or lanceolate, densely villous. Calyx 7-8.2 mm, tubular, densely villous; teeth 1.7-3.5 × 0.5 mm, the three abaxial longer than the two vexillar teeth. Corolla with bluish standard, white wings and white pink-suffused keel; standard 8.5-10 × 2.4-3.5 mm, oblanceolate, emarginate, with a wide undifferentiated claw; wings 7-8.2 mm, smaller than standard, with limb 4.4-7 × 1.5-1.6 mm elliptic, obliquely bilobed, auriculate (ca. 1 mm) at the base, with a narrow claw 3-3.5 mm; keel 5.6-6.5 mm, smaller than wings, with limb 2.25 × 1.4-1.5 mm, galeate, obtuse at the apex, attenuated in a wide claw of 3-4 mm. Androecium with 10 stamens, the vexillar free, the other 9 stamens forming a tube up to the middle of the fila-

![Fig. 2. Karyotype of Astragalus castroviejoi, Alcoluche, Lorca, Murcia (from seeds of SEV 250017): A, somatic metaphase, 2n = 16; B, karyogram.](image-url)
ments. Anthers ca. 0.4 mm, ovoid. Ovary bilocular, sessile, hairy, with (3)4 ovules per locule; style 1.5-2 mm glabrous, arched; stigma elliptic, extrorse, humid, glabrous. Legume 10-17(19) × 3.2-5 mm, 3-4.5 mm wide on the dorsal face, erect-patent, widely lanceolate longitudinally, bilobate on the back, almost didymous, with rounded lobes, keeled ventrally, with an almost completely closed septum, and a short hooked prickly beak 1-2 mm, valves coriaceous, with (2)3-4 seeds per locule, covered with two kinds of hairs (heterotrichous indumentum), with dense short apressed hairs ca. 0.5 mm, and more sparsely with long, markedly tuberculate-based hairs 1.7-3 mm; septum 1.4-2 mm. Seeds 1.7-3 × 1.3-2 mm, reniform, flat, rugulose, somewhat cerebriform, dark-green, with reddish spots.

**Phenology.** April-May.

**Karyology.** Chromosome number in *Astragalus castroviejoi* is 2n = 16 (Fig. 2A), as in *A. sesames* and *A. stella* (Pretel Martínez, 1974). Chromosomes are small (1.6-1.79 µm; pairs VI to VIII of the karyotype) and medium-small (2.15-3.28 µm; pairs I to V of the karyotype). Three pairs of chromosomes present centromere in median region (m; pairs IV, VI and VIII of the karyotype; Fig. 2B), three in the submedian region (sm; pairs II, III and V of the karyotype) and two in subterminal region (st; pair I and VII of the karyotype). The karyotype asymetry, sensu Stebbins (1971), is 3B.

**Distribution and habitat.** *Astragalus castroviejoi* is endemic to SE Spain, only known from the area bordering the provinces of Almería (Vélez Blanco) and Murcia (Lorca), in enclaves known as Cañada Caballero and Rambla de La Pinos (Almería) and Alcoluche (Murcia) (Fig. 3). From a biogeographical point of view, the localities where the species is found belong to the Castilian-Maestracense-Manchegan chorological province, Manchean sector, Manchean-Espunense subsector (Sánchez-Gómez & Guerra, 2007), characterised by a steppe-like environment with a certain degree of continentality, and where marl-gypsum substrates predominate. *Astragalus castroviejoi* only grows on lower Cretacic dark-green marls with secondary gypsum. It forms part of annual and pastureland communities on nitrified soils among shrublands dominated by *Ononis tridentata* L. and *Lygeum spartum* L., accompanied by species such as *Cleonia lusitanica* L., *Onobrychis stenorhiza* DC., *Linum strictum* L., *Bombycilaena discolor* (Pers.) Lainz, *Moricandia moricandioides* (Boiss.) Heywood, *Convolvulus siculus* L., *Astragalus alopecuroides* subsp. *grosii* (Pau) Rivas Goday & Rivas Mart., *Plantago albicans* L., *Guiraoa arvensis* Coss. and *Scorpiurus sulcatus* L., within the meso-Mediterranean bioclimatic belt at altitudes between 780 and 850 m, with semi-arid-dry ombrotypes (Sánchez-Gómez & Guerra, 2007).

**Conservation.** Only six small subpopulations are known, and these form a single population which is included in two 1×1 km² UTM squares. In 2009, two subpopulations are located in the province of Murcia, with 512 reproductive individuals, while the other four subpopulations are located in the province of Almería, with 1186 reproductive individuals. The known area of distribution is about 15 ha in a total area of around 60 ha.

The natural habitat of *Astragalus castroviejoi* is open to many threats, mostly anthropic in origin, mainly related with agriculture and animal husbandry. A good part of the potential habitat of the species is at present occupied by extensive cereal crops, and recent ploughing, for example, has seriously affected one of the subpopulations found in Murcia. Given the absence of any steep slopes in the area where *A. castroviejoi* is found and the proximity to cultivated zones, there is a strong risk that the remaining enclaves will suffer a similar fate. As regards grazing, the Murcian subpopulations in particular are exposed to strong pressure, and *A. castroviejoi* plants have not only been eaten, but are also exposed to the harmful effect of substrate compaction. Given the annual character of the species and the irregular nature of rainfall in the area, extreme inter-annual fluctuations in plant numbers are to be expected, although this remains to be confirmed. According to the data available, and applying IUCN (2001) criteria, *A. castroviejoi* should be considered as a threatened species within the category CR B1ab(i,ii,iii,iv,v) + 2ab(i,ii,iii,iv,v), and it is highly probable that sub-criterion...
“c” could be applied once the populations have been monitored for several years. In accordance with the above, we recommend the inclusion of A. castroviejoi in Red lists and Catalogues of legally protected species at regional, national and European levels, a measure that should help the short-term stabilisation and recovery of known populations.

**Identification Key**

1. Inflorescences sessile, rarely pedunculate (and then up to 5 mm length); legume 1.5-2 mm wide on the dorsal-ventral face ......................................................... A. sesametus
   - Inflorescences pedunculate (2)12-90 mm; legume 2.5-5 mm wide on the dorsal-ventral face .............................................. 2
2. Calyx 5-7.5 mm; teeth subequal; ovary with (5)7 ovules per locule; legume patent when mature, 2-2.5 mm wide on the dorsal face, with hairs up to 1-1.4 mm ............ A. stella
   - Calyx 7-8.2 mm; teeth unequal, the two vexillar teeth smaller than the other three; ovary with (3)4 ovules per locule; legume erect or erect-patent when mature, 3-4.5 mm wide on the dorsal face, with hairs up to 1.7-3 mm .......... A. castroviejoi

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**References**


**Appendix 1**

**Selectec herbarium material studied**

*Astragalus sesametus* L.


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Astragalus stella L.


Rif: Chelchaouen, de Chelchaouen a Oued Laou, calizas, 345 m, 1-V-1996, M.A. Mateos, F.J. Pina & S. Silvestre s.n. (SEV 159784); Chelchaouen, Jebel Tas-saat, 1500-1600 m, 21-VI-1994, S. Talavera & al. s.n. (SEV 149438); Chelchaouen, entre Bou Ahmed y Tarhia, 210 m, serpentinas, 3-V-1996, M.A. Mateos, F.J. Pina & S. Silvestre s.n. (SEV 155971).

SPAIN. Albacete: entre Albacete y Balazote, 8 km de Albacete, 3-VI-1978, J.A. Devesa, J. Pastor & B. Valdés s.n. (SEV 133447); Tamayo, Villamalea, 20-V-1990, M.D. Sánchez-López s.n. (MUB 36763); Hellín, estación de Agramón, 380 m, 30SXH1952, 17-V-1980, F. Alcaraz s.n. (MUB 4744); Algibe, Socovos, 490 m, 30SXH0245, 28-V-1988, F. Sánchez-Gómez & F. Alcaraz s.n. (MUB 27333).


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