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Morphology, Pollen, Seed Structure and Karyological Study on *Astragalus ovalis* Boiss. & Balansa (Sect. *Ammodendron*) in Turkey

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Abstract: *Astragalus ovalis* Boiss. and Balansa, is only one representative of *Ammodendron* Bunge section in Turkey. In this study, morphology, pollen morphology, seed surface and chromosome morphology of this species were analysed.

Key words: *Ammodendron*, *Astragalus*, Turkey

INTRODUCTION

Astragalus L., is the largest genus of Fabaceae in the world, with approximately 3000 species. The regions rich in species of this genus are in Asia, particularly western and central Asia, eastern Europe and Africa. They are generally accepted as important representatives of steppe vegetation. In these regions, they are found particularly widespread in the countries having extensive steppes. The distribution of the species of this genus were given in Table 1^[1].

As it is seen in this Table 1, Turkey is the third richest country with respect to the number of this species. This rank also indicates the dominant vegetation type of Turkey.

Table 1: Distribution of species of genus *Astragalus* over countries and their endemism rates

Region	Country	Total species	End species	End rate (%)
W. Asia	Iran	678	381	56.19
	Saudi Arabia	21	1	4.76
	Iraq	145	9	6.20
	Afghanistan	293	144	49.14
Former Soviet	Russia	1005	562	55.92
Europe	Europe	142	50	35.21
	Turkey	455	210	47.08
M. East	Syria-Lebanon	59	15	25.42
	Jordan	35	2	5.71
	Palestine	52	4	7.69
S. Asia	India	54	4	7.40
	Pakistan	135	26	19.25
E. Asia	China	278	22	7.91
	Aegypt	34	2	5.88
Africa	Algeria	39	2	5.12
	Morocco	45	9	20.00
	Libya	89	24	26.96

Table 2: Distribution of taxa of section *Ammodendron*

Country	Total species	End rate (%)
Russia	32	54.2
Afghanistan	12	20.3
Iran	10	16.9
Lübanon	1	1.7
Egypt	1	1.7
India	1	1.7
Palestina	1	1.7
Pakistan	1	1.7
Saudi Arabia	1	1.7
Turkey	1	1.7

The section *Ammodendron* is widespread in Asia. It has approximately 59 species all over the world, 32 of which are distributed in Russia whereas Turkey has only one, namely *Astragalus ovalis* Boiss. and Balansa^[1-3]. The number of species distributed over different countries and also their endemism rates are given in Table 2.

Astragalus ovalis is known from Kayseri and Konya (Tuz Gölü) provinces. This region constitutes the western limit of this section distribution in Asia.

The members of this section found in other countries are distributed especially in sandy and salty habitats. *A. ovalis* is also distributed in sandy and salty habitats around Tuz Gölü (Salt Lake).

MATERIALS AND METHODS

The specimens were collected around Tuz Gölü (Konya-Ankara) 2001 and deposited at GAZI. The specimens were also examined in ANK and GAZI.

Polliniferous material was taken from GAZI collected by the authors. For LM study, the pollen slides were prepared according to the technique developed by

Wodehouse^[4]. An Olympus B2-2 microscope was used for examination. For SEM study, dry pollen grains were transferred to stubs and coated with gold. A Jeol 100 x CXII scanning electron microscope was used for the examination. The terminology used is mainly that of Faegri and Iversen^[5].

For karyotype analysis the seeds were placed into petri dishes with filter paper. Chromosome preparations were obtained from root tips pretreated with α -monobromonaphthalene (16 h) at 4°C and then fixed in 3:1 absolute alcohol: glacial acetic acid. Roots were hydrolysed in 1N HCl at 25°C for 12 min and stained in 2% aceto orcein for 2 h. Squashes were made in 45% acetic acid. Permanent slides were made in Depex. Measurements were based on 5 metaphase plates. Chromosomes were classified using the nomenclature of Levan *et al.*^[6]. Idiogram was arranged in order of decreasing lengths.

All the authors' names of plants mentioned in this study were checked from and compared with the Authors of Plant Names^[7].

RESULTS AND DISCUSSION

Astragalus ovalis Boiss. and Balansa

Type: [Turkey B5 Kayseri] Cappadocia in collibus lapidosis supra Karahisar, 1250 m, 18. 6. 1856, *Balansa* (G-BOISS foto!)

Plants ascending suffruticose, caulescent, up to 50 cm, covered with equally to unequally bifurcate hairs. Caudex strongly branched. Stems up to 40 cm, sulcate, densely covered with adpressed white hairs. Stipules greenish, 3-7 mm, broadly ovate, acute to shortly acuminate, free from the petiole, shortly connate behind the stem, with ciliate margins, otherwise glabrous to glabrescent. Leaves 3-9 cm; petiole 0.5-1 cm, like the rachis densely covered with adpressed white hairs. Leaflets 4-8 paired, 8-20(-25) x 3-8 mm, elliptic to oblong-

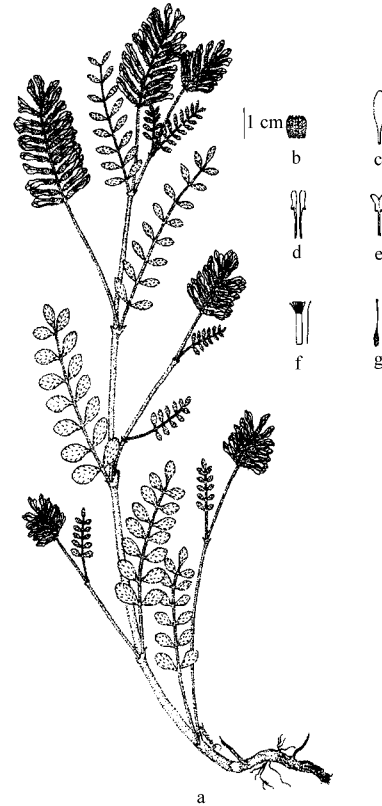


Fig. 1: *Astragalus ovalis*. a: habit, b: calyx, c: standard, d: wing, e: keel, f: stamens, g: ovary (M. Ekici 2194)

elliptic, loosely to densely covered on both surface with adpressed white hairs. Peduncle 2-7 cm, hairy like the stem. Racemes cylindric, lax at anthesis. Bracts 1-3 mm, narrowly lanceolate, sparsely white hairs. Pedicels c. 1 mm, white hairy. Calyx 6-10 mm, purplish-suffused, tubular at the beginning of anthesis, soon inflated and $\pm$ ovoid in fruit, generally adpressed to $\pm$ spreading bifurcate white hairs or sometimes with a few short adpressed black bifurcate hairs; teeth 0.5-1.5 mm, narrowly triangular, white

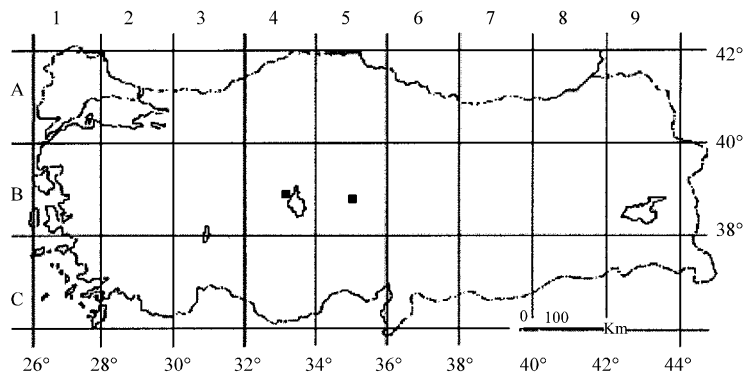


Fig. 2: The distribution map (■) of *Astragalus ovalis* in Turkey

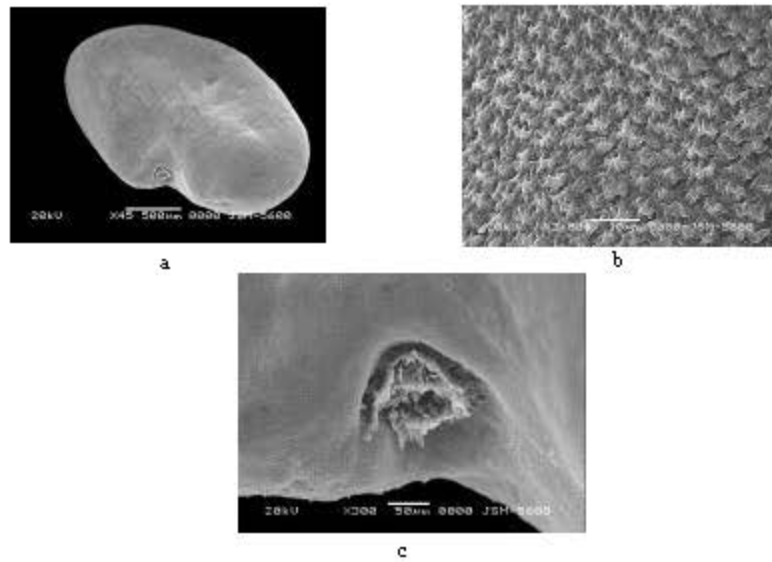


Fig. 3: Scanning electron micrographs of seed grains. a: general view of seed grain; b: close up of seed grain; c: micropyl

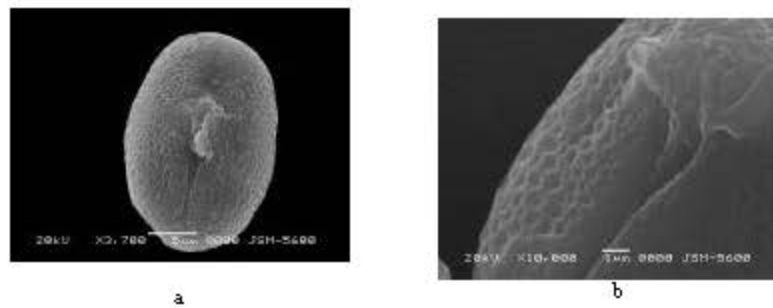


Fig. 4: Scanning electron micrographs of pollen grains. a: general view of pollen grain; b: close up of pollen grain



Fig. 5: Somatic chromosomes in *Astragalus ovalis*. Bar = 10 μ m

Table 3: Measurements of somatic metaphase chromosomes of *Astragalus ovalis* (*m = median)

Chromosome pair No.	Chromosome arms (µm)		Total length (µm)	Arm ratio (r = L/S)	Relative length (%)	Centromeric position*
	Long arm (L)	Short arm (S)				
1	0.83	0.80	1.63	1.04	15.11	m
2	0.77	0.71	1.48	1.08	13.72	m
3	0.76	0.68	1.44	1.12	13.34	m
4	0.72	0.65	1.37	1.11	12.70	m
5	0.74	0.57	1.31	1.30	12.14	m
6	0.68	0.57	1.25	1.19	11.58	m
7	0.62	0.58	1.20	1.07	11.12	m
8	0.63	0.48	1.11	1.31	10.29	m

Total length of haploid complement : 10.79 µm

hairy. Petals pink to purple. Standard 14-18 x 4-6 mm, elliptic rounded or slightly retuse at the apex, gradually narrowed at base. Wings 14-16 mm, narrowly oblong, obtuse at the apex. Keel 12-15 mm. Stamens 11-13 mm. Ovary 2-3 mm with stipate, densely white villous; style hairy only at the base (Fig. 1). Fruits 7-9 x 3-4 mm, ovate to elliptic, densely long spreading white simple-pilose; beak 2-3 mm±straight. Seeds 2-2.2 x 1-1.3 mm, oblong-reniform, brownish, surface of seeds rugulate-granulate pitted.

Flowering time: 5-6.

Examined specimens

B4 Ankara: 15 km from Şereflikoçhisar to Ankara, lake side, 970 m, 1.vi.1998, *M. Aydoğdu* (GAZI); ibid., 17. v. 2001, N 39° 00' 17", E 33° 27' 61", *M. Ekici* 2194, *Z. Aytac* (GAZI); ibid., 4. vii. 2001, *M. Ekici* 2540, *Z. Aytac* (GAZI); ibid. 22. vii. 1952, *H. Birand* 710 and *Kasaplıgil* (ANK); Yavşan Tuzlası, 900 m, 25. v. 1953 *H. Birand* 1462, 1463 (ANK) (Fig. 2, 3).

Pollen structure: Pollen grains are prolate, tricolporate, P/E: 1.38. Polar axis 26.48 µm, equatorial axis 19.07 µm. Amb. Shabe triangular, obtuse, convex. Equatorial shape elliptic. Colpi narrow and long, Clg/Clt= 7.92 µm, pore shabe prolate, Plg/Plt= 1.53 µm, exine 1.11 µm, intine 0.43 µm. Structure tectate and sculpture reticulate (Fig. 4).

Karyotype analysis: Analysis of somatic metaphases showed that the chromosome number of *A. ovalis* is 2n=16 (Fig. 5). For this species the chromosome morphology has been examined for the first time. Karyotypic data are presented in Table 3. The set consisted of eight metacentric chromosome pairs. The length of chromosomes in this taxon varied from 1.11 to 1.63 µm. Chromosome 8 had the highest L/S arm ratio. Total haploid length of *A. ovalis* was 10.79 µm. Idiogram is shown in Fig. 6.

The karyotype of *A. ovalis* shows 8 pairs of metacentric (m) chromosomes. The members of the

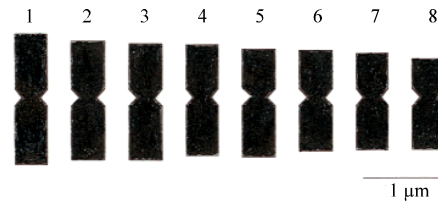


Fig. 6: Idiograms of somatic chromosomes in *Astragalus ovalis*

Dasyphyllium Bunge section have submedian and submedian+median chromosomes. Total lengths of chromosomes vary between 6.95-3.03 µm in these species^[8]. Ashraf and Gohil^[9] reported that the karyotype of *Astragalus grahamianus* Benth. and *A. zanscarensis* Bunge are comprised of submedian and subterminal chromosomes and the karyotype of *A. leucocephalus* Benth. is comprised of median, submedian and subterminal chromosomes. Total lengths of chromosomes vary between 4.44-1.55 µm in these species. Ashraf and Gohil^[10] reported that the karyotype of *A. melanostachys* Benth. ex Bunge is comprised of 3 pairs of large subterminal chromosomes, a medium sized pair of secondarily constricted submedian chromosomes and two pairs of small submedian chromosomes (2n=12). Total length of chromosomes of *A. melanostachys* range between 4.43-1.43 µm.

In this study, it is observed that the total length of chromosomes varies between 1.63-1.11 µm in *A. ovalis*. The chromosome number of *A. ovalis*, 2n=16, is the same as *Dasyphyllium* section and *A. grahamianus*, *A. zanscarensis*, *A. leucocephalus* species except *A. melanostachys*. However the karyotypic data show that *A. ovalis* must be considered karyotypically very different from other *Astragalus* species as mentioned above.

Distribution and suggested conservational status: The species is endemic to Central Anatolia and known from more than one locality, namely the Erciyes mountain (type locality) and around Tuz Gölü. But the known populations in these localities exist in low densities due to

uncontrolled grazing and the effects of agricultural activities. Therefore the species could be regarded as EN (*endangered*) category^[11].

Ecology: It is a member of halophytic vegetations on sandy places, between 800-1400 m altitude. It grows with *Lepidium caespitosum* Desv., *Lycium anatolicum* A. Baytop and R. R. Mill, *Astragalus lycius* Boiss., *Ranunculus repens* L., *Limonium globuliferum* (Boiss. and Heldr.) O. Kuntze, *Allium macrochaetum* Boiss. and Hausskn subsp. *macrochaetum*, etc.

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