

CROSSING EXPERIMENTS IN ELYMUS TRANSHYRCANUS GROUP, A NEW SUBSPECIES AND A NEW SPECIES

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Elymus transhyrcanus is a variable species in Iran. Tufted and not tufted populations of this species occur in Alborz mountain chains. A disjunct locality of the species was found in W. Iran. Crossing experiments were made between different morphological and geographical variants. In spite of habit difference between the accessions from N. Iran, tufted or not tufted, they gave hybrids with high pollen fertility and high chiasmata frequency in meiotic metaphase I. Hybrids between the accessions from N. and W. Iran, showed low pollen fertility and relatively low chiasmata frequency. Based on morphological differences and crossing experiments data, *E. transhyrcanus* subsp. *lorestanicus* is described as a new subspecies for W. Iranian material. *Elymus zagricus* is described as a new species from W. Iran. The new species is related to *E. transhyrcanus* and *E. libanoticus*. It differs from both of them by having ciliate glumes and lemma.

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دورگه گیری درون گونه‌ای در گونه *Elymus transhyrcanus* ، یک زیر گونه و یک

گونه جدید

مصطفی اسدی

گونه *Elymus transhyrcanus* گونه‌ای متنوع در ایران است. جمعیت های بالشتکی و ریزوم دار این گونه در سلسله جبال البرز یافت می‌گردد. رویشگاهی منفک از گسترشگاه شناخته شده این گونه در غرب ایران تشخیص داده می‌شود. آزمون‌های دورگه گیری بین اشکال مختلف از نقطه نظر ریختی و جغرافیایی به عمل آمد. علیرغم وجود اختلاف در ریخت ظاهری جمعیت‌های شمال شامل بالشتکی و یاغیر بالشتکی ، دورگه‌های بین آنها دارای دانه‌های گرده با باروری در حد بالا و فراوانی بالای کیاسما در مرحله متافاز تقسیم میوز بودند. دورگه های حاصل بین جمعیت‌های شمال و غرب ایران دارای دانه گرده با باروری کم و فراوانی نسبتاً پایین کیاسما بودند. براساس اختلافات ریختی و آزمونهای دورگه گیری زیرگونه *Elymus transhyrcanus* subsp. *lorestanicus* به عنوان زیرگونه جدیدی از غرب ایران شرح داده می‌شود. گونه *E. zagricus* به عنوان گونه جدیدی از غرب ایران معرفی می‌گردد. این گونه با گونه های *E. transhyrcanus*، *E. libanoticus*، *E. gentryi* مقایسه می‌گردد و با داشتن پوشینه (گلوب) و پوشینک (لما) مژه دار، از آنها تشخیص داده می‌شود.

Table 1. List of *Elymus transhyrcanus* seeds used in crossing experiments.

Habit	Accession	2n	Origin of material
Tufted	3786 & 3788	42	Mazandaran: 45 Km from Baladeh towards Kandavan pass, 2900 m, Assadi 70893 & Aghabeigi s.n.
Tufted	3776	42	Tehran: Gachsar, mountains W. of Azadbar on the road to Taleghan, 2800 m, Assadi s.n.
Not tufted	3763	43	Tehran: Between Dizin and Shemshak, 1930 m, Assadi 70882.
Tufted	3756	42	Tehran: Between Gachsar and Dizin, near Velayatrud, 2270 m, Assadi 70874.
Not tufted	3774	42	Lorestan: Doroud, Oshtorankuh, 2400 m, Assadi 70738 b.

INTRODUCTION

Elymus transhyrcanus (Nevski) Tzvelev has been known from Middle Asia, Caucasus, Turkey and N. Iran (Bor 1970, Tzvelev 1976, Melderis 1985). This species varies morphologically in Alborz mountains, N. Iran. Plants from higher altitudes form dense tufts, while in lower altitudes less dense plants with no tufts were observed. Also, a collection from W. Iran in a locality outside the distribution of the species were collected. This collection was morphologically distinct from the normal *Elymus transhyrcanus* of N. Iran. Crossing experiments were performed between

different accessions. On the base of morphological characters, hybrid fertility and chromosome behaviour at meiotic metaphase I, two subspecies are recognized in *E. transhyrcanus*.

MATERIAL AND METHODS

Herbarium specimens were studied. Seeds were collected in the field and germinated in Lund and Svalöv, Sweden. Crossing experiments, mitotic studies, meiotic analysis and pollen fertility were done according to Assadi & Renemark 1994. Table 1 shows list of seeds used in crossing experiments.

RESULTS

Crossing programme, number of crossed florets, number of hybrid seeds and number of hybrid plants are shown in table 2.

Table 2. Crossing programme between different populations of *Elymus transhyrcanus*.

Combination	hybrid	no. of florets	seed set	no. of plants
3776×3768	8562	14	3	2
3774×3778	8550	-	1	1
3774×3756	8570	20	7	4
3768×3774	8565	20	6	6
3786×3763	8756	17	7	4
3756×3786	8575	30	2	1

Table 3 shows mean and range of chromosome association, chiasmata per cell and pollen fertility of the hybrid plants between different populations of *Elymus transhyrcanus* (Fig. 1). In the hybrid accessions 8550, 8565 and 8570 lagging univalents 2-6 and a bridge were observed.

DISCUSSION

Low seed set and plant production is due to the unfavourable condition of experiments. *Elymus* species are often easily crossed (Lu & Bothmer 1993, Assadi

& Runemark 1994), therefore, the results of crossing programme do not show relationship of the populations.

Parents of hybrid accessions 8562, 8550, 8570 and 8565 are from disjunct localities in N. and W. Iran. They show relatively irregular chromosome configuration and low pollen fertility. Means of chromosome association in these combinations varies from 1.00-2.04 I, 19.62-19.96 II, 0.00-0.10 III, 0.08-0.24 IV and 0.00-0.02 V. Means of chiasmata frequencies are comparatively low and varies between 35.22-37.06.

There are certain morphological differences between the accessions from W. Iran comparing to the accessions from N. Iran. Comparing to the parents (Assadi 1994), irregular chromosome association, low chiasmata frequency, and low pollen fertility of the hybrid plants indicate that the populations from N. and W. Iran have to a considerable extent differentiated. However, as hybrids between different *Elymus* species are totally sterile or with pollen fertility less than %5 (Salomon & Lu 1992, Assadi & Runemark 1994), range of pollen fertility between 26 and 47 indicate that differentiation is not in specific level.

The hybrid accession 8756 with the parents tufted and not tufted shows mean

Table 3. Meiotic metaphase I configuration of the hybrids between different populations of *Elymus transhyrcanus*.

Hybrid accession	No. of cells	Mean and range of chromosome association and chiasmata/cell					Pollen fertility %		
		I	II	III	IV	V			
8562*	50	1	Total 19.78	Rods 3.74	Rings 10.04	0.28	37.06	45	
		(0-4)	(17-21)	(0-10)	(10-20)	(0-1)	(30-41)		
8550	50	1.5	19.96	3.50	16.46	0.10	0.08	36.88	26
		(0-4)	(17-21)	(1-7)	(13-19)	(0-1)	(0-1)	(33-40)	
8570	50	2.04	19.62	4.60	15.02	0.10	0.08	35.22	47
		(0-6)	(18-21)	(2-8)	(12-18)	(0-1)	(0-1)	(0-1)	
8565	50	1.52	19.70	4.10	15.60	0.04	0.24	36.22	44
		(0-5)	(17-21)	(1-8)	(10-19)	(0-1)	(0-1)	(29-30)	
8756	50	0.70	20.10	2.18	17.92	0.70		39.42	68
		(0-2)	(18-21)	(0-5)	(5-21)	(0-2)		(37-42)	
8575	50		21	1.10	19.90			40.90	89
			(21)	(0-6)	(15-21)			(37-40)	

* - In accession 8562 one hexavalent and one octavalent were observed.

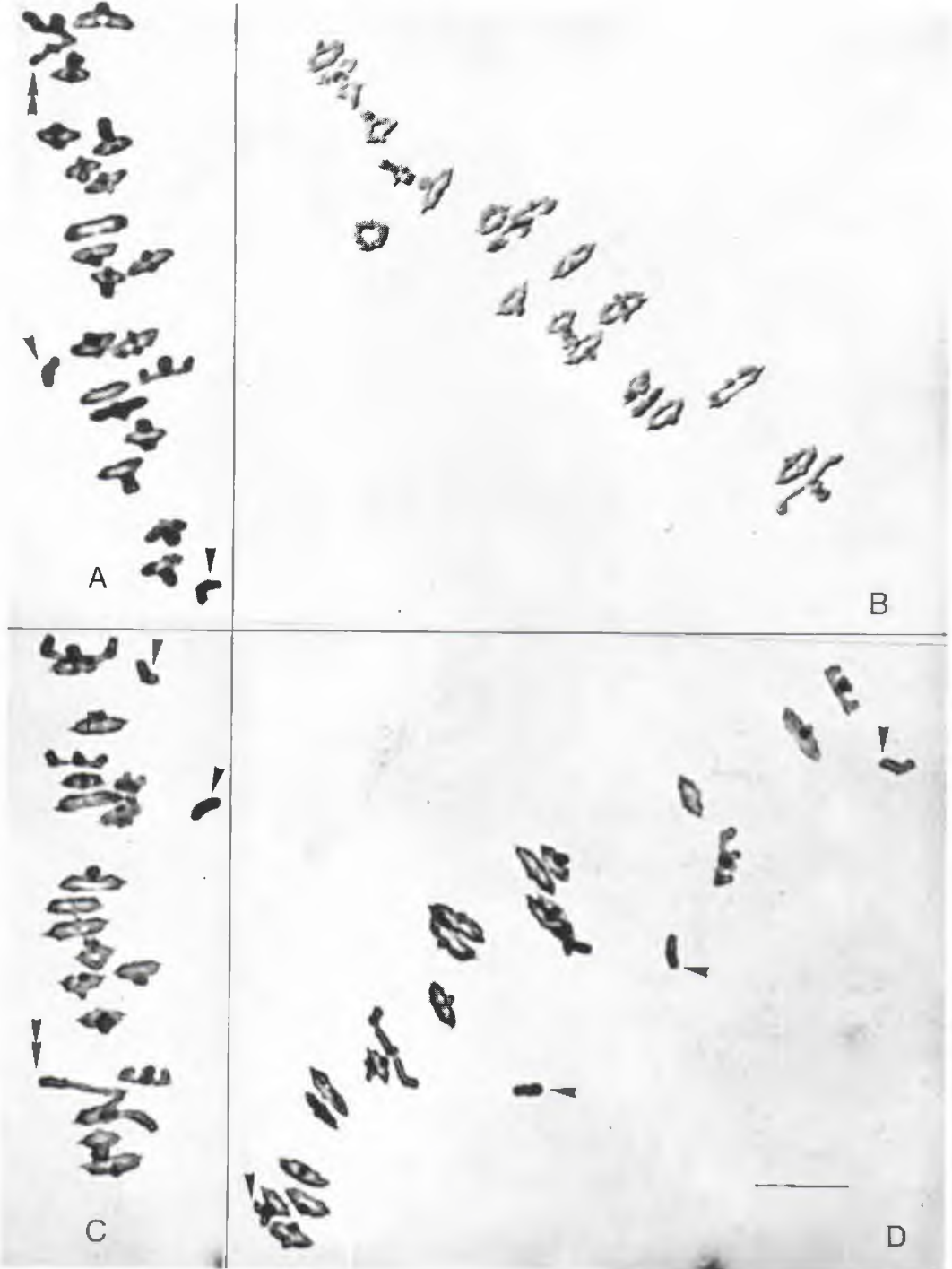


Fig. 1. Meiotic metaphase I configuration of the hybrids between different morphological variations (A), populations (B) and subspecies (C-D) of *Elymus transhyrcanus*. -A: tufted x not tufted with 2 univalents indicated by arrow, one rod bivalent, 18 ring bivalents and one trivalent indicated by double arrow ($2n=43$). -B: tufted x tufted with 1 rod bivalent and 20 ring bivalents. -C-D: subsp. *transhyrcanus* x subsp. *lorestanicus* with 2 univalents indicated by arrow, 3 rod bivalents, 15 ring bivalents, one tetravalent indicated by double arrow in C and four univalents indicated by arrows, three rod bivalents, 16 ring bivalents in D. Bar=10 μm .

chiasmata frequency 39.42 and relatively high pollen fertility, %68, indicating both parents are conspecific.

Univalents and chromatid bridges in anaphase I indicate chromosome rearrangements in different populations.

TAXONOMIC CONCLUSION

Population of *Elymus transhyrcanus* from W. Iran is recognized as a new subspecies different from N. Iranian populations. Two subspecies are geographically isolated.

During the studies of herbarium specimens, a new species from W. Iran was recognized. The new species is morphologically similar to *E. transhyrcanus*. A key to the taxa and nomenclature of *E. transhyrcanus* is given and the new taxa are described.

1. Glumes and lemma distinctly ciliate, leaf sheath ciliate

1. *E. zagricus* Assadi, sp. nov.

1. Glumes and lemma eciliate, leaf sheath never ciliate (***E. transhyrcanus***) **2.**

2. Stems glabrous, spike rachis glabrate, peduncles, glumes, and lemma glabrous

2a. subsp. ***transhyrcanus***

2. Spike rachis and spikelet base covered with dense hairs, glumes and lemma sparsely hairy

2b. subsp. ***lorestanicus* Assadi, subsp. nov.**

1. *Elymus zagricus* Assadi, sp. nov. (Fig. 2).

Gramen perenne, dense caespitosum. Culmi 50-80 cm alti, viridi-flavi glabri. Foliorum vaginæ glabrae, margine parte ciliatae, ligulae minimae, ca. 0.2 mm

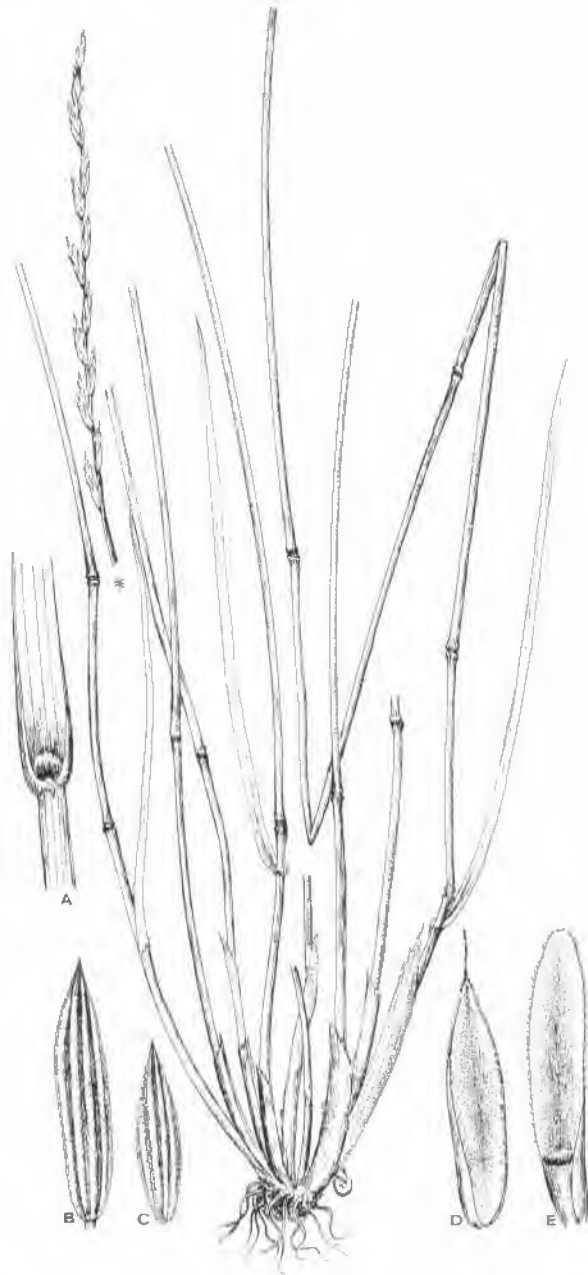


Fig. 2. *Elymus zagricus* (x0.6). - A. Leaf (x3). - B. Upper glume (x3.5). - C. Lower glume (x3.6). - D. Lemma (x4.6). - E. Palea (x6).

longae, membranaceae, ad margine ciliatae; laminae 10 mm longae et usque ad 3 mm latae, planae vel involutae, subtus glabrae, supra pilosae. Spicae 5-15 cm longae, angustae; rachidibus planis, marginibus scabris; spiculae 6-12, sessiles, 2-3 florum; glumae inaequales, inferior 6-9 mm superior 7-10.5 mm longae, obliquae, acutae vel obtusae, mucronatae, margine membranaceae et ciliatae, lemma 9-10 mm longum, dorso glabrum, marginibus distincte ciliatum, superne obscure 5-nervis, apice in aristam usque ad 3 mm longam productum; palea lemmate vix breviora, cariniis ciliatis. Antherae ca. 4 mm longae.

Typus. Kohgilouye-Boirahamad (Fars on lable): Kuh-e Dena, Gardaneh Bijan, 2400-2600 m, 4.8.1978, rocky stony scrub forest of *Juniperus*, Assadi & Mozaffarian 31286 (holotypus TARI); *Paratypus.* Kohgilouyeh-Boirahamad: Sisakht, Gardaneh Bijan, 2600 m, 8.8.1994, Assadi 72437 & Assadi 72448; Chaharmahale Bakhtiari: Darreh Bazoft, Chebed, N. slope of Kuh-e Taraz, 1700-2300 m, 12.7.1986, Mozaffarian 57817.

Perennial, densely caespitose with short rhizomes, ca. 50-80 cm high, greenish yellow. Culms thin, ca. 1-2 mm indiameter, glabrous. Leaf sheath glabrous, partly

ciliate at the margin; ligules very short, ca. 0.2 mm long, membranous, ciliate at the margin; leaf lamina flat or convolute, up to 10 mm long and 3 mm broad, lower side glabrous, upper side hairy, distinctly auriculate at the base. Spike narrow, 5-15 cm long; rachis broadened, scabrous along the angles; spikelets sessile, 6-12, 2-3 flowered, ca. twice as long as rachis internodes. Lower glumes oblique (middle vein in one side), 6-9 mm long, 3-5 veined, acute or obtuse with a short mucron at the apex, membranous and ciliate at the margin; upper glumes 7-10.5 mm long, similar to the lower glume. Rachilla glabrous or minutely puberulent; lemma 9-10 mm long, glabrous but distinctly ciliate at the margin, obscurely 5-veined near the tip, awned; awn up to 3 mm long; palae somewhat shorter than lemma, 7-8 mm long, rounded at the apex, totally ciliate on the keels. Anthers ca. 4 mm long.

The new species is characterized by having caespitose habit and ciliate glumes and lemma. It is related to *E. transhyrcanus* (Nevski) Tzvelev. Main differences of the new species from *E. transhyrcanus* lies in the presence of cilia along the margine of glumes and lemma. In appearance *E. zagricus* is similar to *E. libanoticus* but differs from it in ciliate glumes and lemma.

Moreover anther length in the new species is 4 mm long (most probably inbred) and leaf sheath ciliate. In *E. libaanoticus* glumes and lemma eciliate, anthers longer (outcross), leaf sheath smooth and lemma not awned. *E. zagricus* differs from *E. gentryi* (Melderis) Melderis by having ciliate glumes, lemma and leaf sheath.

2. *E. transhyrcanus* (Nevski) Tzvelv, Nov. Syst. Pl. Vas. (Leningrad) 9: 61 (1972).

2a. *E. transhyrcanus* s u b s p . *transhyrcanus*

Syn.: *Roegneria transhyrcana* Nevski, Acta Univ. Asiae Med. ser. 8b (Bot.) 17: 70 (1934); *R. leptora* Nevski in Fl. USSR 2: 623 (1934); *Agropyron leptorum* (Nevski) Grossh., Fl. Kavk. 1: 331 (1939). -Typus: Turkmenia, Ashkabad region, stony areas, 1000 m, Chapadag mountain, Borrissova 725 (LE!).

2b. *E. transhyrcanus* subsp. *lorestanicus* Assadi, **subsp. nov.**

Differt a subsp. *transhyrcanus* vagina, rachidi, glumis et lemmate dissimilibus pilosis.

Typus. Lorestan, Doroud, Oshtorankuh, 2400 m, 8.8.1991, Assadi 70738 b (holotypus TARI; isotypus LD);

Kordestan, 15 km NE of Baneh, Gardaneh Khan, 2450 m, Fattahi, Tavakoli and Hatami 2435.

Perennial, not caespitose, Culms 100 cm., puberulent or hairy. Leaf sheath puberulent, eciliate; ligule ca. 0.5 mm long, lacerate; leaf lamina ca. 20 cm long and 4 mm broad, flat, densely covered with long hairs on the upper surface, puberulent beneath. Spikes up to 12 cm long; rachis densely hairy; spikelets 9-11, 15 mm long, 3-5 flowered, hairy at the base; glumes unequal, lower 11 mm and the upper 13 mm long, 5-7 veined, scabrous on the veins, acute to shortly mucronate at the tip; lemma ca. 14 mm long, veined at the tip, finely hairy, awned; awn ca. 3 mm long; palae somewhat shorter than lemma, distinctly ciliate on the keels. Anthers 5 mm long.

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