

Ana Petrova, Stefan Kožuharov & Friedrich Ehrendorfer

Karyosystematic notes on *Bromus* (*Gramineae*), and a new species of the *B. riparius* polyploid complex from Bulgaria

Abstract

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A new diploid species, *Bromus parilicus*, is recognized within the *B. riparius* aggregate and compared to *B. cappadocicus* (6x), *B. lacmonicus* (8x), and *B. riparius* (10x). The decaploid *B. fibrosus* var. *orbelicus* is raised to specific rank. *B. transsilvanicus* probably also belongs to the *B. riparius* aggregate. $2n = 14$ and $2n = 70$, counted on plants from N.E. Anatolia, are new chromosome numbers for *B. tomentellus* subsp. *tomentellus* and subsp. *woronovii*, respectively. The first $2x$ count ($2n = 14$) for a member of the *B. erectus* aggregate is reported for *B. moellendorffianus*, which is newly recorded for Slovenia.

Introduction

Elaborating on our previous, preliminary work on Balkan brome-grasses (Kožuharov & al. 1981), we have continued our study of some plants we had the opportunity to collect, not only in the Balkan countries but also in N.W. Anatolia (Mt. Ulu dağ). The following note relates new data and conclusions concerning the karyology and taxonomy of several interesting perennial taxa of the *Bromus riparius* and, in one case (*B. moellendorffianus*), the *B. erectus* complex.

Live plants collected in the field were nursed in the greenhouse, and seeds from wild populations were germinated in Petri dishes. Cytological data were obtained from the study of squash preparations of meristematic tissue from root tips dyed with Gomori's chromic haematoxylin after fixation in Carnoy's Fluid I.

Results

Bromus parilicus Petrova, Kožuharov & Ehrend., **spec. nova** – Typus: Bulgaria australis, Mt Slavjanka (Alibotuš), in declivibus et convallibus lapidosis siccis supra pagum Paril, loco dicto "Parilski dol", 27 Jul 1977, S. Kožuharov (SOM N° 149258). – Fig. 1-8.

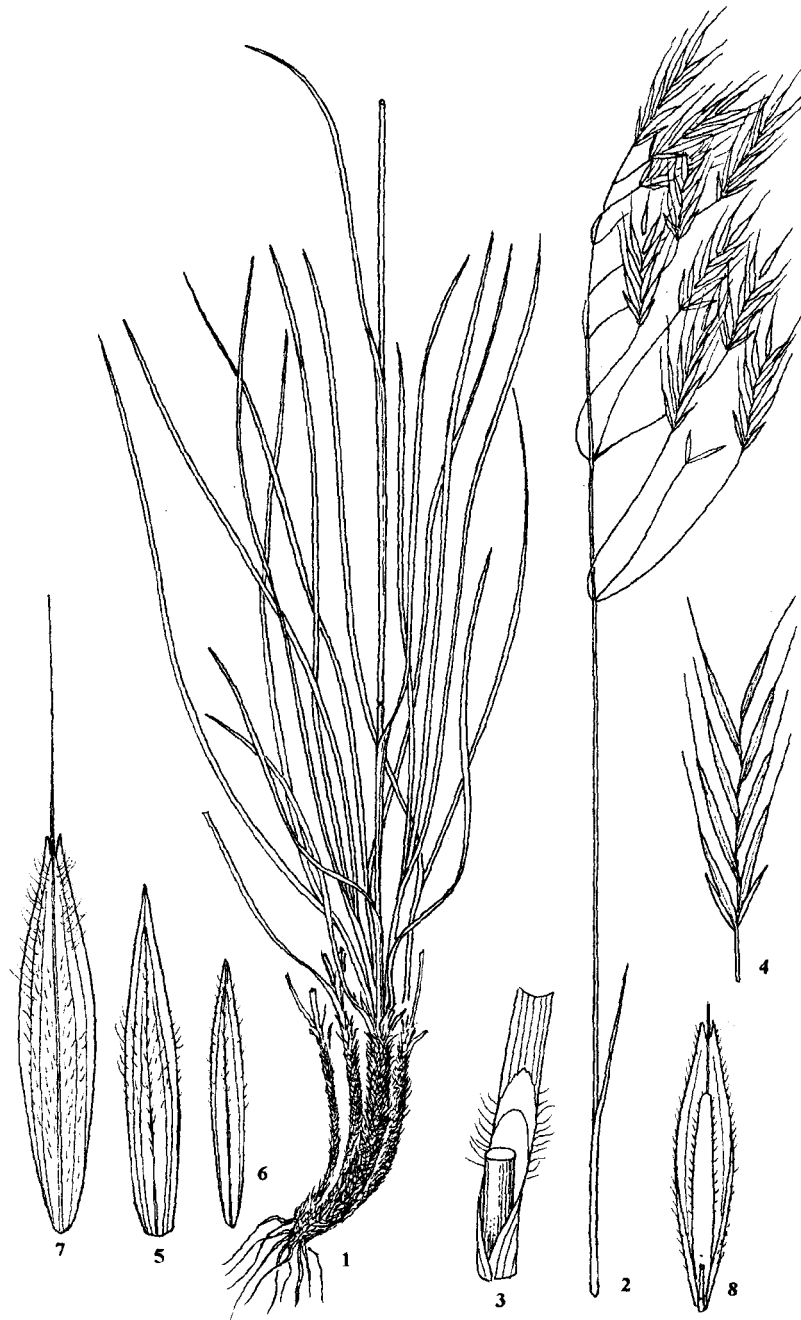


Fig. 1-8. *Bromus parilicus*, as drawn from the type collection. – 1-2, basal and upper part of the plant; 3, joint of a culm leaf, with ligula; 4, spikelet; 5-6, lower and upper glume; 7, lemma in dorsal view; 8, lemma in ventral view, with palea. – Magnification: 1-2: 1×; 5-6 & 8: 4×; 4 & 7: 5×; 3: 10×.

Table 1. A comparison of *Bromus parilicus* and related species of the *B. riparius* aggregate: somatic chromosome numbers ($2n$) and morphological features.

| | <i>B. parilicus</i> | <i>B. cappadocicus</i> | <i>B. lacmonicus</i> | <i>B. riparius</i> |
|---------------------|---------------------|------------------------|----------------------|--------------------|
| $2n$ | 14 | 42 | 56 | 70 |
| Rhizome | thickened | thickened | not thickened | hardly thickened |
| Lower leaf blade | convolute | convolute | convolute | flat, keeled |
| length (mm) | 150-300 | 100 | 150-200 | 100-200 |
| diam. or width (mm) | 0.5-1 | 0.2-0.5 | 0.5-1 | 2-3 |
| Leaf sheaths | ciliate | ciliate | ciliate | hairy |
| Ligula length (mm) | ≤ 0.5 | ≤ 0.5 | 0.5-1 | 0.5-1.5 |
| Panicle length (cm) | 6-12 | 4-8 | 8-14 | 6-14 |
| branch length (cm) | 2-4 | 1-2 | (1) 2-5 | 2-4 |
| Spikelet number | 5-8(-9) | 2-5 | 4-7 | 6-9(-15) |
| Flower number | (6) 7-9 | 5-10 | 4-5 | 7-10 |
| Glumes | subequal | unequal | unequal | subequal |
| Lemma to palea | very unequal | unequal | subequal | subequal |
| Awn position | erect | patent | patent | erect |
| Awn : lemma ratio | ½ | ½ | 1 | ½ |

Gramen perenne, dense caespitosum; rhizoma multiceps, non stoloniferum, subincrassatum, vaginis foliorum annorum praecedentium 6-7 cm longis in fibras flexuosas subreticulatim connexas dissolutis arcte tectum. Culmi principales 40-70 cm alti, basi incrassati, nigricantes, rigidi, erecti vel basi arcuati nec autem geniculati. Foliorum vaginae glabrae sed infimae longe, sparse et patule ciliatae, ligulis abbreviatis 0.2-0.5 mm longis; laminae ima basi ad articulationem longe ciliatae caeterum glabrae vel pilis patentibus parce obsitae, infimae setaceo-convolutae rigidae, 0.5-1.0 mm diam., (10-)15-30 cm longae, apice acutae, erectae vel curvatae, eae foliorum caulinarum 3-5 cm longae, 0.5 mm latae, glabrae. Panicula 6-12 cm longa, ramis patentibus inaequalibus, inferioribus 2-4 cm longis, superioribus saepe spiculas aequantibus vel parum superantibus. Spiculae 7-11, elongatae, floribus (5-)6-8(-9), 2-2.5 cm longae, superne parum dilatatae, glumis acutissimis, subaequalibus. Gluma inferior uninervia 9-10 mm longa, superior trinervia 10-11 mm longa, margine hyalina. Lemma 10-12 mm longum, lanceolatum, quinquenervium, subhirsutum, margine hyalinum, apice breviter bidentatum; infra apicem aristatum, arista 6-8 mm longa, erecta. Palea dorso carinata, ciliata, acuta, 6-8 mm longa, margine ciliata. – Numerus chromosomatum: $2n = 2x = 14$.

Bromus lacmonicus Hausskn. differt habitu stolonifero laxo, ligulis 0.5-1.0 mm longis, spiculis (4-)5-floribus, glumis inaequalibus, aristas lemmata aequantibus, patentibus; *B. cappadocicus* Boiss. & Balansa foliis basalibus brevioribus (lamina ad 10 mm longa), setaceis, paniculis paucispiculatis, spiculis 2-3 cm longis, glumis inaequalibus, aristas lemmate dimidio nec subduplo brevioribus patentibus discrepat.

Within the aggregate of *Bromus riparius* Rehmman, characterized by basal leaf sheaths decaying into reticulate fibres, the sclerophyllous *B. lacmonicus* line has been found to consist of a polyploid series ranging from $2x$ to $10x$ (Kožuharov & al. 1981). The diploid

cytodeme is represented by a population from Mt Slavjanka (Alibotuš), on the border between Bulgaria and Greece. It can be regarded as close to the hypothetical ancestor of the line, and had been provisionally named "*Bromus parilicus*" (a nomen nudum in Kožuharov & al. 1981). Further studies have since confirmed this population to be well differentiated from all other known taxa of the aggregate, *B. lacmonicus* in particular. Therefore, we here formally recognize it as a new species.

Bromus parilicus is close to *B. cappadocicus* and *B. lacmonicus*, but is well differentiated from both, as well as from *B. riparius* s.str., by the characters shown in Table 1. Few authors have noted the difference between *B. cappadocicus* and *B. lacmonicus* relative to leaf length: *B. lacmonicus*, being loosely caespitose and stoloniferous, has much longer and thicker basal leaves than has *B. cappadocicus*, which is densely caespitose and lacks stolons.

Bromus orbelicus (Velen.) Petrova, Kožuharov & Ehrend., **stat. nov.** \equiv *B. fibrosus* var. *orbelicus* Velen. in Sitzungsber. Königl. Böhm. Ges. Wiss. Prag, Math.-Naturwiss. Cl. 1902(29): 18. 1902 \equiv *B. transsilvanicus* var. *orbelicus* (Velen.) Stoj. et Stef., Fl. Bulg. 1: 83. 1924. – Typus: "In m. Rilo passim copiose in regione supra zonam silvaticam" (cf. Velenovský, l.c.; et Fl. Bulg.: 616. 1891) (PRC, not seen).
– "*B. macedonicus*", ined. (Kožuharov & al. 1981: 382) [non *Bromus fibrosus* subsp. *macedonicus* Degen & Dörfl. in Denkschr. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl. 64: 41. 1897].

Gramen perenne, laxe caespitosum; rhizoma stoloniferum, subincrassatum, vaginis foliorum annorum praecedentium 3-4 cm longis in fibras flexuosas subreticulatim connexas dissolutis arcte tectum. Culmi elati, rigidi, erecti, basi non geniculati. Foliorum vaginae ciliatae, ligulis 1.5-2.0 mm longis; laminae pilis patentibus obsitae, eae foliorum caulinarum planae, plicatae, 5-10 cm longae, 2-3(-4) mm latae, infimae autem setaceo-convolutae, rigidae, 20-30 cm longae, 0.5-1.0 mm diam. Panicula erecta, ovata vel elliptica, laxa, 10-14 cm longa, ramis erectis vel subpatentibus inaequalibus, ad nodos 3-5-nis, inferioribus 5-8 cm longis, superioribus spiculas subaequantibus vel superantibus. Spiculae 8-15, elongatae, floribus 7-10(-11), 2-3(-4) cm longae, glabrae, glumis acutissimis, subaequalibus. Gluma infera uninervia 10-11 mm longa, superior trinervia 11-13 mm longa, margine hyalina. Lemma 13-15 mm longum, lanceolatum, 3-4(-5)-nervium, ciliato-puberulum, margine hyalinum, infra apicem aristatum; arista ad 7-9 mm longa, erecta. Palea acuta, 10-13 mm longa, ciliata.

Numerus chromosomatum: $2n = 10x = 70$. – Bulgaria, Central Rila mountains, 5-10 km E of the Rila monastery, locality "Vodnija čal", along the road to "Ribni ezera", on calcareous slopes, S exposition, 2000-2300 m, 5 Aug 1979, S. Kožuharov & A. Petrova (SOM, W).

The species also occurs in the western part of the Rodopi mountains and on the mountains along the Western borderline of Bulgaria.

Bromus orbelicus differs from *B. tomentellus* Boiss. by its loosely tufted habit, taller culms, narrower leaves, panicle branches longer than the spikelets, and shorter lemmata and awns; from *B. moesiacus* Velen. by its much taller culms, panicle branches exceeding

the spikelets in length, larger spikelets with more numerous flowers, and awns shorter than the lemmata; both other species are more hairy (even velvety) than *B. orbelicus*.

When writing our previous paper (Kožuharov & al. 1981) we were of the opinion that the 10x cytodeme described above, found on Mt Rila, was the same taxon as *Bromus fibrosus* subsp. *macedonicus*, and we therefore provisionally and invalidly named it "*B. macedonicus*". We have since been able to study an isotype of the former name ("Macedon. Centr., in petrosis prope Allchar", 19 Jun 1893, I. Dörfler, W No. 9652) and have found that it differs considerably from our Bulgarian taxon: its spikelets are larger and have a larger number of flowers, the glumes are markedly unequal, the awns are less than half as long as the lemmas, the panicle is much broader, with almost drooping, glabrous spikelets (the diagnosis erroneously has "paleae hirtae"), and the leaves are velvety pubescent. *B. orbelicus* resembles *B. barcensis* Simonk. and *B. transsilvanicus* Steud. in appearance, but has hairy spikelets, subequal glumes, longer awns, and longer ligulae.

In our opinion, *Bromus transsilvanicus* is a member of the *B. riparius* aggregate, although some authors (Ascherson & Graebner 1898-1902, Hayek 1932-1933, Smith 1980) include it in the *B. erectus* aggregate. Significantly, Steudel (1853-1854) in his diagnosis mentions "radice valide fibrosa". The misplacement by later authors probably has its roots in Beck (1890) and Ascherson & Graebner (1901), who ignored this particular trait in Steudel's original description but probably relied on the later description by Simonkai (1887) instead, in which the fibrous rhizome is not mentioned. Since Steudel's original specimens are not presently available for study, the question of the correct application of the name *B. transsilvanicus*, and of the correct taxonomic placement of that species and of "*B. transsilvanicus* auct.", will require further attention.

B. tomentellus* Boiss. & Balansa subsp. *tomentellus

Chromosome number: $2n = 2x = 14$. – N.W. Anatolia (Turkey), Mt Ulu dağ, on dry calcareous slopes, S.W. exposition, 8 Jul 1978, S. Kožuharov (SOM).

This is a new chromosome number for the nominotypical subspecies of *Bromus tomentellus*, another member of *B. riparius* aggregate. The species in its wide sense was known to be tetraploid (Barnett 1955, Schulz-Schaeffer 1960). The diploid cytodeme apparently represents a starting point of this polyploid lineage, in parallel to the SE. European *B. moesiacus*.

***B. tomentellus* subsp. *woronovii* (Tzvelev) Tzvelev**

Chromosome number: $2n = 10x = 70$. – N.W. Anatolia (Turkey), Mt Ulu dağ, on dry siliceous slopes, S.E. exposition, 8 Jul 1978, S. Kožuharov (SOM).

Bromus tomentellus forms a polyploid series of its own, centred in S.W. Asia. *B. sclerophyllus* Boiss. probably also belongs to this lineage. All these taxa have broad, sclerophyllous leaves, mostly densely hairy and with sparse, long patent cilia. The 10x *B. tomentellus* subsp. *woronovii*, with its broad, hard, greyish and acute leaves sparsely covered by long patent cilia only, is morphologically intermediate between the typical members of the *B. tomentellus* lineage and *B. cappadocicus*. Further investigations on the other members of this group are needed.

B. moellendorffianus (Asch. & Graebn.) Hayek

Chromosome number: $2n = 2x = 14$. – Slovenia, Julian Alps, foothills of Mt Triglav, 800-900 m, on calcareous slopes, S.E. exposition, 2 Jul 1975, S. Kožuharov (SOM).

This apparently is not only a new count but also a new record for the species, so far unknown from Slovenia. Further localities are likely to be found in the area between Mt Triglav and the locus classicus of the species, near Sarajevo in Bosnia. The chromosome number we found is the first diploid number for a member of the *Bromus erectus* aggregate, which is characterized by having basal leaf sheaths that decay into parallel rather than reticulate fibres.

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Addresses of the authors:

Dr Ana Petrova & Prof. Dr Stefan Kožuharov, Institute of Botany, Bulgarian Academy of Sciences, Akad. G. Bončev Str. 23, BG-1113 Sofija, Bulgaria.
Prof. Dr Friedrich Ehrendorfer, Institute of Botany, University of Vienna, Rennweg 14, A-1030 Vienna, Austria.