

CARMEN ACEDO &amp; FELIX LLAMAS

**Two new brome-grasses (*Bromus*, *Poaceae*) from the Iberian Peninsula****Abstract**

Acedo, C. & Llamas, F.: Two new brome-grasses (*Bromus*, *Poaceae*) from the Iberian Peninsula. – Willdenowia 27: 47–55. 1997. – ISSN 0511–9618.

*Bromus cabrerensis* and *B. nervosus* (*B.* subg. *Bromus*) from the Iberian Peninsula are described as species new to science and illustrated. The tetraploid *B. cabrerensis* ( $2n = 28$ ) is closely related to the *B. hordeaceus* complex, whereas *B. nervosus* holds a rather isolated position.

**Introduction**

The genus *Bromus* L. is distributed world-wide, but mainly in temperate regions of the northern hemisphere. In the Mediterranean flora this genus is represented by some forty species, most of them belonging to *Bromus* subg. *Bromus*.

The annual brome-grasses in general provide considerable problems with respect to the status and delimitation of the taxa. In the last thirty years this group has been studied in some detail (Tournay 1961, Smith 1968b, 1970, 1972, Scholz 1971a, 1972b, 1987, Sales 1993, Smith & Sales 1993, Acedo & Llamas 1994, Acedo 1995) and several new taxa have been described (Smith 1968a, 1985, Scholz 1971b, 1972a, 1989a, 1995, Sales & Smith 1990).

In the course of our research about the Iberian brome-grasses (Acedo 1995), several taxonomically interesting *Bromus* populations were collected and examined. In this contribution, *Bromus cabrerensis* and *B. nervosus*, two species of *B.* subg. *Bromus* that differ from all other Mediterranean species of this subgenus in inflorescence features, spikelet size, spikelet shape, and leaf blade anatomy, are described as new to science.

**Material and methods**

The plant material studied includes living plants collected by the authors as well as herbarium specimens from LEB, LISI, and MA (herbarium abbreviations following Holmgren & al. 1990).

Transverse sections of leaf blades and culms were cut with a microtome from fresh material and rehydrated herbarium specimens fixed in F.A.A. (formalin acetic acid), embedded in water, cleared with sodium hypochlorite, and stained in safranin and fast green.

For palynological studies, fresh pollen grains were acetolized following the standard method described by Erdtman (1960).

The chromosome number of *Bromus cabrerensis* was counted in root tip mitoses pretreated in 0.002 M 8-hydroxyquinoline, fixed in acetic acid ethanol mixture, and stained in acid carmine.

***Bromus cabrerensis* Acedo & Llamas, sp. nova** – Fig. 1.

Holotypus: Spain, León, La Cabrera, Truchas, 29TQG18, beside an irrigation channel, with *Holcus lanatus*, *Poa trivialis*, ... on nitrophilous soil, 9.7.1992, F. Llamas & C. Acedo (LEB 52595).

Gramen annum, 85–120 cm altum. Caules erecti, solitarii, sub inflorescentiam puberuli pilis sericeis brevibus basi bulbosis. Foliorum vaginæ 9–15 cm longae, pubescentes, iunctae 3/4 partibus inferioribus. Lamina 150–300 × 4.5–10 mm, pilis longis sparsis in facie adaxiali et pilis brevioribus in facie abaxiali. Ligula membranacea triangularis, 2–3 mm longa, pilis sericeis in facie abaxiali. Inflorescentia composita, 10–20 cm longa, densa et contracta etiam per anthesin, 20–40-ramosa, ramis 3–4 per nodum; internodia puberula longitudine variantia sed internodium infimum longitudine ca. 1/2 inflorescentiae aequans. Spiculae 1–6 per ramum (rami longissimi aliquando spiculis 25), ovatae 12–13 × 3–3.5 mm (praeter aristae), floribus 8–10 (flos summus aliquando sterilis). Glumae latae, subaequales, pilosae, margine late scarioso et piloso, gluma inferior ovata, 5.5–7 × 1.5–3 mm, apice acuto, 3-nervia, gluma superior elliptica, 6–7 × 3–4 mm, apice obtuso, 7-nervia. Lemma herbaceum, ellipticum, glumae superiori simile sed 6–7.5 mm (praeter aristae) longum, 5-nervium, apice obtuso (in maturitate aliquando ≤ 0.1 mm emarginato), aristatum 0.5–0.75 mm infra apicem; arista 5–8 mm longa, tenuis, recta, basaliter plana. Palea oblonga, 6–7 × c. 1.5 mm, apice breviter emarginato, alis tenuibus, carinis heterotrichis sparse ciliatis et inter ciliis scabris. Lodiculae 1 mm longae, triangulares, glabrae. Antherae 2–2.5 mm longae. Caryopsis ellipsoidea, tenuis, plana, 6–7 × 2 mm.

Annual, culms solitary, erect, 85–120 cm long, with 5–8 nodes. Culm apex puberulous of short and silky trichomes with bulbous base. Leaf sheaths 9–15 cm long, pubescent of soft, long trichomes. Leaf blade 150–300 × 4.5–10 mm, sparsely hirsute of longer trichomes on the abaxial than on the adaxial face; ligule triangular, 2–3 mm long. Panicle 10–20 cm long, with 5–10 nodes, dense, contracted during and after anthesis; scale of the lowermost node long, with acute apex and ciliate margin; internodes puberulous, varying in length, the lowermost as long as half of the panicle length; panicle branches 20–40, 3–4 per node, at least one longer than the internode. Spikelets ovate 12–13 × 3–3.5 mm (without awns), with 8–10 florets (Fig. 1A). Glumes subequal with wide scarios margins; lower glume ovate, 5.5–7 × 1.5–3 mm, with acute apex, 3–5 veined (Fig. 1B); upper glume elliptical, 6–7 × 3–4 mm, with obtuse apex, 7-veined (Fig. 1C). Lemma herbaceous, 6–7.5 mm long (without awns), similar to the upper glume but slightly longer, with obtuse, slightly notched (≤ 0.1 mm) apex at maturity (Fig. 1D) and rounded edges, with a 5–8 mm long awn less than 1 mm below the apex. Palea 6–7 × 1.5 mm, with emarginate apex and keels heterotrichous, sparsely ciliate and scabrous between cilia. Lodicules 1 mm, triangular and glabrous. Anthers 2–2.5 mm. Caryopsis 6–7 × 2 mm, ellipsoid, flattened.

Pollen sphaeroidal, of medium size, with polar diameter 39.4–44.6 µm and equatorial diameter 39.4–42.9 µm. Pore 3.4–4.3 µm in diameter, rounded by a ring of 2.6–3.4 µm width.

Chromosome number: The counts in ten plants raised from caryopses of the type population of *B. cabrerensis* (voucher: LEB 52594) revealed the tetraploid number of  $2n = 28$ , which is also the common number in the *B. hordeaceus* group.

Transverse section of the leaf blade (Fig. 1E): open V-shaped, longitudinally slightly ribbed (less than a quarter of the leaf thickness) over the vascular bundles on the adaxial face. Central structure: with a keel on the abaxial face over the median vascular bundle, which is associated with colourless parenchyma and an abaxial sclerenchyma girder (Fig. 1F). Thickness: 375–500 µm in the middle of the leaf blade and 175–225 µm at the edges. Bulliform cells: as fan-shape groups of 2–5 little cells in the furrows. Mesophyll: chlorenchyma not radiate. Vascular bundles: 23–45, 5–9 of first order (or basic type). Bundle sheaths double, the inner complete, the outer interrupted adaxially and abaxially; some small vascular bundles not accompanied by sclerenchyma with complete outer sheath. Sclerenchyma associated only with first order vascular bundles interrupting the vascular sheath, and also present at the leaf margins.

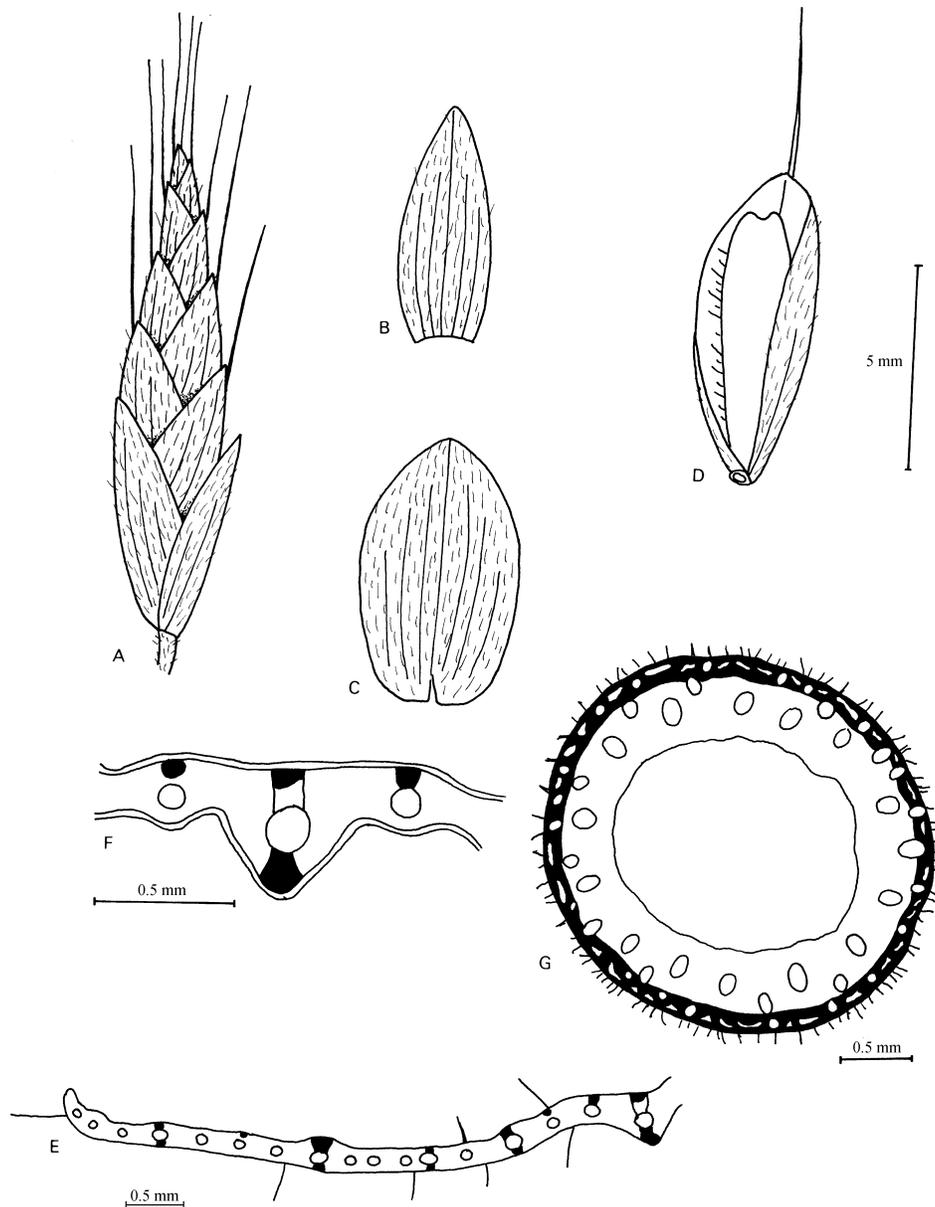


Fig. 1. *Bromus cabrerensis* – A: spikelet, B: lower glume, C: upper glume, D: lemma, E: transverse section of the leaf blade, F: detail of the keel, G: transverse section of the culm. – Drawings after LEB 52624.

Transverse section of the culm (Fig. 1G): rounded, without ribs, 1500–3000  $\mu\text{m}$  in diameter, culm wall 500–1000  $\mu\text{m}$  thick. Vascular bundles 30–60, in 3–4 concentric irregular circles embedded in the sclerenchyma. Ground tissue 30–150  $\mu\text{m}$  thick. Sclerenchyma: a thin subepidermic ring of 40–50  $\mu\text{m}$  associated with the subepidermic girders. Medullary parenchyma 300–



Fig. 2. Distribution of *Bromus cabrerensis* ● and *B. nervosus* ★.

800  $\mu\text{m}$  thick, interrupted by a central cavity of 200–1700  $\mu\text{m}$  in diameter. Epidermis with some prickles and macrohairs.

Phenology: flowering during July and fruiting from mid July to the end of August.

Distribution and ecology: *B. cabrerensis* is known only from NW Spain (Fig. 2). It occurs in grassy moist ruderal places on rich soils.

Etymology: *Bromus cabrerensis* is named according to the provenance of the holotype from the Spanish region “La Cabrera” in the León province.

**Additional specimens examined**

SPAIN: ASTURIAS: Catavio, 29TPJ8022, Prado, 2.5.1992, *F. Llamas, R. M<sup>a</sup> Valencia & C. Acedo* (LEB 52568). — LEÓN: León, Campus de Vegazana, zona nitrificada y húmeda, 24.7.1994, *C. Acedo* (LEB 51652); Truchas (La Cabrera), 29TQG18 borde de regato, con *Holcus lanatus*, *Poa trivialis*, sobre suelo nitrificado, 9.7.1992, *F. Llamas & C. Acedo* (LEB 52578, 52579); *ibid.*, zona nitrificada en borde de regato, 30.7.1992, *F. Llamas & C. Acedo* (LEB 52594); *ibid.*, 14.7.1993, *F. Llamas, E. Puente, M. J. López Pacheco & C. Acedo* (LEB 52624). — LUGO: Fazouro, 29TPJ32, Prado de siega, 15 m, 2.5.1992, *F. Llamas, R. M<sup>a</sup> Valencia & C. Acedo* (LEB 52570).

***Bromus nervosus* Acedo & Llamas, sp. nova – Fig. 3.**

Holotypus: Portugal, Estremadura, Regengos de Monsaraz, Herdade de Esperas, “Malhadas”, 29SPC25, 18.4.1949, *Joaquim Tapum* (LISI). – Paratypus: Portugal, Estremadura, Vilafranca de Xira, Povoá de Santa Iria, 29SMD90, Taludes do valado, 5.5.1943, *F. Fonte* (MA 167396).

Gramen annuum, 20–40 cm altum. Caules striati, internodiis glabris, nodis 5 inaequaliter pilosis praesertim in valleculis. Foliorum vaginæ 6–11 cm longae, pubescentes, dense pilosae pilis

sericeis longis tenuibus attingentibus orem. Lamina 80–170 × 2.5–5 mm, hirsuta pilis longioribus in facie adaxiali. Ligula membranacea triangularis, c. 1.5 mm longa. Inflorescentia laxa aut densa, semper composita et interrupta, 6–11 × 2–3 cm, ramis 3–4 per nodum; internodia 25–45 mm longa, internodium infimum quam reliqua longius. Spiculae 1–3 per ramum, pedunculis quam spiculis brevioribus, < 2 mm longis, ellipticae vel romboideae, (10)15–20 × 7–8 mm (praeter aristae), floribus valde imbricatis etiam in maturitate; flores superiores 3–4 saepe steriles. Glumae magnae subaequales, tenuiter lanceolatae, nerviis valde prominentibus, gluma inferior triangularis, 8–9 × c. 3 mm, 3-nervia, gluma superior tenuiter elliptica ad obrhomboidea, 9.5–10.5 × 2.5–3 mm, 5-nervia. Lemma herbaceum, rhombicum, 11–13 × 3–4 mm (praeter aristae), 9-nervium, apice truncato vel paulo emarginato, marginibus anguste scariosis, in media regione longitudinis angulosis, aristatum c. 1 mm infra apicem; arista quam lemma minor, 2–6.5 mm longa, tenuis, recta etiam in maturitate, basaliter plana. Rachilla floris secundi c. 1.5 mm longa, pilosa pilis erectis. Callus et cicatrix rotundatus. Palea quam lemma valde minor, 7–9 × 1–1.5 mm, lanceolata, glabra, carinis sparse et aequaliter ciliatis. Lodiculae 1 mm longae, pyriformes, apice aliquando irregulariter 2–3-lobulato. Antherae c. 1.5 mm longae.

Annual, 20–40 cm. Culms striate and glabrous with 4–5 hairy nodes, mainly in the vallecules. Leaf sheath 6–11 cm long with a dense indumentum of fine, silky, long hairs reaching the mouth. Leaf blade 80–170 × 2.5–5 mm, hirsute of sparse, ± erect trichomes, often reaching 2000 µm on adaxial face and up to 1000 µm on the abaxial face; ligule triangular, c. 1.5 mm long. Panicle 6–11 × 2–3 cm, lax or dense, composed and always interrupted; internodes 25–45 mm long, glabrous or with short and rigid hairs; nodes with a short scale, often with scaberulous edge; branches 3–4 per node and each with 1–5 spikelets on peduncles of varying length, but not longer than the spikelets and most of them less than 1–2 mm; branches and peduncles barbate, with stiff hairs sometimes longer than the diameter of branches and peduncles. Spikelets (Fig. 3A) elliptical to rhomboid (10)15–20 × 7–8 mm (excluding awns), with strongly imbricate florets, the uppermost 3–4 often sterile. Glumes large, overlapping half of the spikelet, subequal, narrowly lanceolate, keeled and hirsute, with very prominent veins, the lower one triangular, 8–9 × c. 3 mm, the upper one narrowly elliptical to obrhomboid, 9.5–10.5 × 2.5–3 mm, 5-veined. Lemma herbaceous, hairy, rhombic, 11–13 × 2.5–4 mm (excluding awns), 9-veined, with truncate to slightly emarginate apex at maturity, and narrowly scarious margins, angled in the middle and often folded (Fig. 3B). Awn shorter than lemma, straight even when ripe. Rachilla of the second floret c. 1.5 mm, with rigid hairs. Callus rounded, glabrous. Palea 7–9 × 1–1.5 mm, up to 6/10 of the lemma length (Fig. 3C); keels sparsely ciliate, apex emarginate and with very narrow wings. Lodicules 1 mm. Anthers up to 1.5 mm. Caryopsis similar in length to the palea.

Transverse section of the leaf blade (Fig. 3D): open V-shaped, slightly ribbed on both the adaxial and abaxial face. Central structure: with a midrib where the sclerenchyma associated with the median vascular bundle presents adaxial and abaxial projections. Thickness: 125–170 µm in the middle of the leaf blade and 80–125 µm at the edges. Bulliform cells: groups of 2–4 little cells in the furrows. Mesophyll: chlorenchyma not radiate. Vascular bundles: 15–30, 7–11 of first order. Bundle sheath double, the inner complete, the outer abaxially always interrupted, and adaxially associated with the sclerenchyma, if present. Sclerenchyma girders associated only with first order vascular bundles interrupting the vascular sheath, and also present at the leaf margins. Epidermis with macrohairs of 100–2000 µm length, most of them over the ribs.

Transverse section of the culm (Fig. 3E): rounded, 1400–1700 µm in diameter, culm wall 325–415 µm thick, with ribs in front of the sclerenchyma associated with the outer vascular bundles. Vascular bundles 15–30, in 2–3 concentric irregular circles. Ground tissue 30–150 µm thick, interrupted by the subepidermic sclerenchyma girders. Sclerenchyma: a subepidermic ring of 40–60 µm associated with the subepidermic girders. Medullar parenchyma 250–500 µm

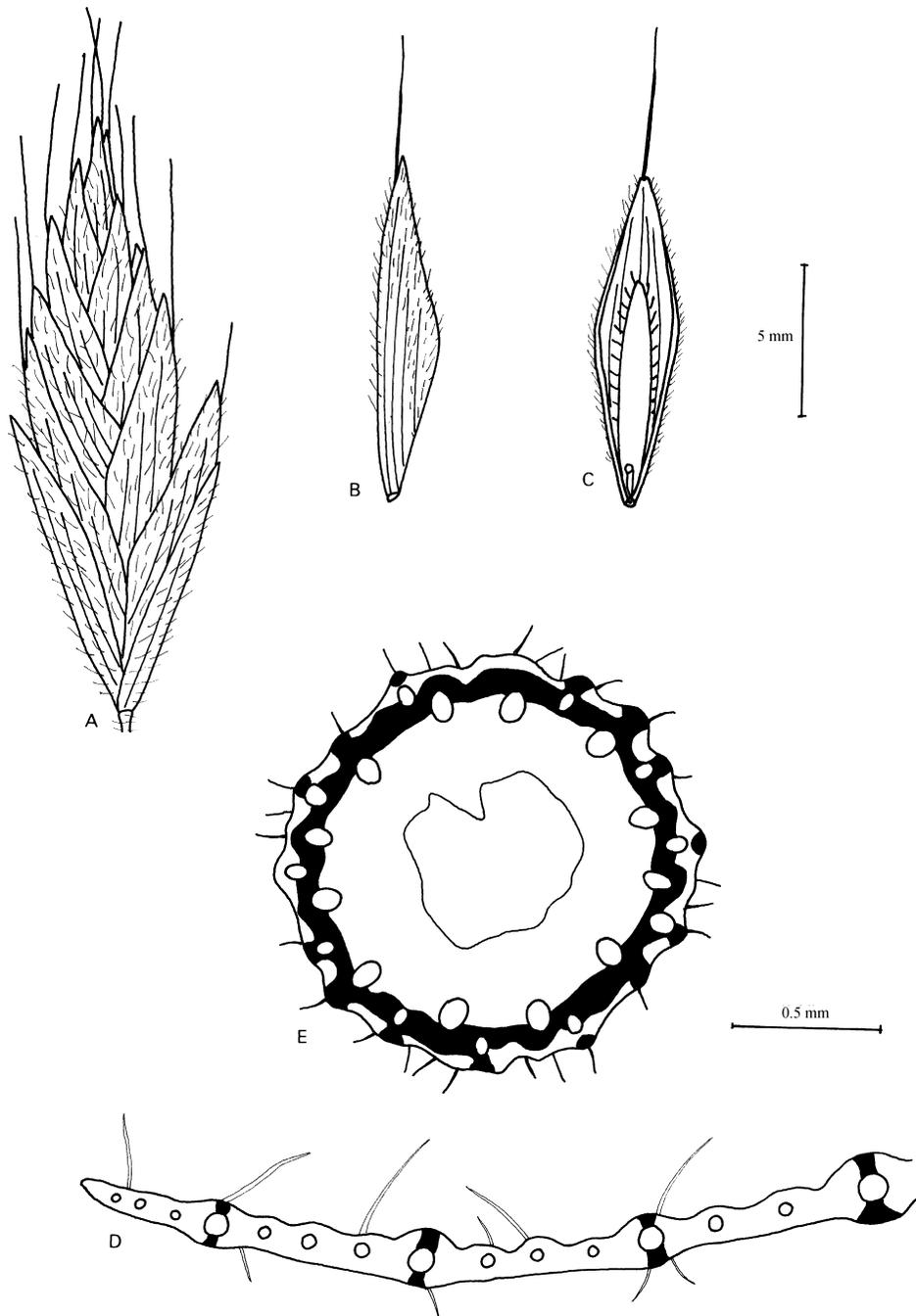


Fig. 3. *Bromus nervosus* – A: spikelet, B: lemma in costal view, C: lemma and palea, D: transverse section of leaf blade, E: central, G: transverse section of the culm. – Drawings after MAF 169376.

thick, interrupted by a central cavity of 500–700 µm in diameter. Epidermis with macrohairs up to 200 µm length.

Phenology: flowering during April and May and fruiting from the end of April to the end of May, but probably extending this period.

Distribution and ecology: *Bromus nervosus* is known only from the Estremadura, Portugal (Fig. 2), and seems to be a ruderal plant of dry habitats.

Etymology: The epithet “nervosus” refers to the strong nervature of the glumes, lemmas and culm in this species.

## Discussion

*Bromus nervosus* and *B. cabrerensis* clearly belong to *B.* subg. *Bromus* due to their annual life form, the slightly compressed spikelets, 3-veined lower glumes, and dorsally rounded lemmas with a single, very fine, straight and erect awn.

*Bromus cabrerensis* shows great morphological resemblance to the *B. hordeaceus* complex: it has pubescent leaf sheaths, dense panicles with hairy spikelets, and herbaceous, veined lemmas. *B. cabrerensis* clearly differs, however, by the large panicles with numerous spikelets. Although there is some variation in the panicle size of *B. hordeaceus*, it never reaches the dimensions found in *B. cabrerensis*. Moreover, in *B. cabrerensis*, some branches of the lower panicle node are clearly longer than the spikelets (and almost equalling the internode length), whilst in *B. hordeaceus* the panicle branches are shorter than the spikelets. Other important diagnostic features are the spikelet size as well as the size of the spikelet components, and the anther length. The spikelet size was shown by Smith & Sales (1993) to be an important differential character, especially in this group of annual brome-grasses, and is clearly larger in *B. hordeaceus* than in *B. cabrerensis*. With respect to the length of the mature anthers, which is, accor-

Tab. 1. Main differential features of *Bromus cabrerensis*, *B. hordeaceus* and *B. nervosus*.

	<i>B. cabrerensis</i>	<i>B. hordeaceus</i>	<i>B. nervosus</i>
Morphological features			
Height of plant [cm]	85–120	15–100	20–40
Panicle	dense	dense	spikelike
Panicle branches	longer than spikelets	shorter than spikelets	shorter than spikelets
Spikelet size [mm]	12–13 × 3–3.5	15–20 × 5–8	(10)15–20 × 7–8
Spikelet shape	ovoid	elongate-ovoid to oblong	ellipsoidal to rhomboid
Lemma length [mm]	6–7.5	7–10	11–13
Lemma shape	elliptical	lanceolate to obrhombic	rhombic
Lemma nerves	shallow	shallow	prominent
Awn length [mm]	6–8	4–5.8	6–8
Palea length [mm]	6–7	6–8	7–9
Anther length [mm]	2–2.5	0.5–2.5	c. 1.5
Caryopsis length [mm]	6–7	4.5–7	7–9
Anatomical features			
Stem ribs	absent	absent	present
Central leaf structure	with a keel	without a keel	without a keel
Epidermal spines	big	absent	small
Macrohairs [µm]	400–600	300–2000	100–2000

ding to Smith & Sales (1993), generally a useful and conservative character, we found in *B. cabrerensis* a value of 2–2.5 mm compared to 0.5–1.5(2) mm in *B. hordeaceus*.

Finally, according to Ellis (1976) particularly the central leaf blade structure is a diagnostically important and, in most cases, easily distinguishable feature. *B. cabrerensis*, with a well-developed keel due to the abaxial sclerenchyma girder of the median vascular bundle being accompanied by parenchyma, shows in this respect striking differences to all other species of the subgenus. In contrast to *B. cabrerensis*, *B. hordeaceus* presents a centrally positioned midrib, where the central vascular bundle is associated with sclerenchyma girders without parenchyma, resulting in some weaker abaxial thickening of the leaf.

*Bromus nervosus* holds a rather isolated position within *Bromus* subg. *Bromus*. It differs from all other species by its generally narrow and interrupted inflorescence with most of the branches being very short and the spikelets being sessile. Palynological and caryological features have not been studied in *B. nervosus*, because it is, so far, only known from two herbarium specimens. In this material pollen grains could not be analyzed, and the fully developed caryopses did not germinate.

### Acknowledgements

Financial support from the “Comisión mixta Diputación-Universidad de León” is gratefully acknowledged. We thank the directors and curators of the consulted herbaria for the loan of specimens, and particularly the curator of LISI, who provided the specimen that we designated as holotype of *Bromus nervosus*.

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Address of the authors:

Carmen Acedo & Félix Llamas, Department of Plant Biology, University of León, Campus de Vegazana s/n, E-24071 León, Spain; e-mail: dbvcac@unileon.es (C. Acedo), dbvflg@unileon.es (F. Llamas).