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On the identity of *Brachypodium firmifolium* (Poaceae) from Cyprus

Abstract

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Brachypodium glaucovirens is the correct name for *B. firmifolium* formerly regarded either as a Cyprus endemic or as a synonym of *B. sylvaticum*. The most important diagnostic features against *B. sylvaticum* are the erect racemes and finely prickled to shortly hairy longitudinal ribs on the adaxial leaf blade surface. Constancy of these characters was proven by cultivation in experimental plots (source plants from Cyprus and the S Aegean region). A key to the species and its relatives is provided. The names *B. glaucovirens* and *B. firmifolium* are lectotypified.

Key words: Gramineae, taxonomy, *Brachypodium glaucovirens*, *Brachypodium sylvaticum*, E Mediterranean region.

Introduction

In 1946 the Finnish botanist H. Lindberg (1871-1963) described the new species *Brachypodium firmifolium* from high altitudes of the E Mediterranean island of Cyprus. Since that time this species has been generally regarded (e.g., by Bor 1985) as an endemic of Cyprus. However, the recent revision of the genus in Europe, the Canary Islands and the Levant (Schippmann 1991) questioned this taxonomy, citing *B. firmifolium* in the synonymy of the widespread *B. sylvaticum* (Huds.) P. Beauv., interpreting the type specimens, labelled “M Troodos, Mesopotamos, in siccis juxta cataractam”, as members of a population of *B. sylvaticum* adapted to a dry habitat (“trockener Standort”; Schippmann 1991: 173). Schippmann likewise placed in the synonymy of *B. sylvaticum* the Mediterranean *B. glaucovirens* (Murb.) Sagorski, which was originally described by the Swedish botanist S. S. Murbeck (1859-1946) from the Balkans (Bosnia-Herzegovina) in 1891. According to Schippmann it does not merit infraspecific recognition because of many supposed transitions (“Übergangsformen”) and the lack of a clear-cut geographic distribution pattern (Schippmann 1991: 76). Although sympatric populations of the latter two species occur as was stated by Murbeck (1891), other authors disagree and accept *B. glaucovirens* as a species distinct from *B. sylvaticum* (Khan 1992, dealing with seed proteins; Khan & Stace 1999; both articles do not mention *B. firmifolium*), thus confirming the traditional *Brachypodium* taxonomy (see Hayek 1932-33, Saint-Yves 1934).

Based on macro- and micromorphological data, the present paper demonstrates that *Brachypodium glaucovirens* and *B. firmifolium* are conspecific. Specimens from the type locality of *B. glaucovirens*, leg. Sagorski (B), have been checked and compared with the type of *B. firmifolium* (H). In addition, several specimens of *Brachypodium* from Cyprus, Greece and the Aegean area have been examined, a few of them grown from seeds and cultivated in the Botanic Garden Berlin-Dahlem and the author’s private garden.

Results

For the flora of Cyprus the name *Brachypodium firmifolium* must be deleted from the list of Cyprus endemics (Tsintides & Kourtellarides 1997) and replaced by the earlier *B. glaucovirens*, a name missing in the treatment by Bor (1985). The essential diagnostic characters of *B. glaucovirens* and *B. firmifolium* are the same: (1) erect racemes, (2) awn of lemma as long as or shorter than the lemma body, (3) leaves more or less glaucous and rather firm (Table 1). In contrast, *B. sylvaticum* (1) has nodding racemes, (2) the awn of the lemma is mostly considerably longer than the lemma body, and (3) the leaves are darker green and softer. These differences are apparently genetically fixed since the progeny of populations from Cyprus and the S Aegean region cultivated in Berlin (for vouchers see specimen list, below) invariably has kept these diagnostic features.

Table 1. Comparison of the diagnostic characters of *Brachypodium glaucovirens* and *B. firmifolium* according to their protologues.

	<i>B. glaucovirens</i> , Murb. (1891)	<i>B. firmifolium</i> , Lindberg (1946)
Racemes (“spike”)	“erecta, rarius subnutans”	“spiculis ... in spicam ... erectam ... dispositis”
Awns	“aristae vel paleam aequantes vel paullo breviores”	“glumella ... 7-8 mm longa, arista in flosculis superioribus 5 mm longa”
Plant / leaves, resp.	“glaucula vel glauco-virens” “folia subrigida”	“foliis pallide glaucoviridibus, firmis, non flaccidulis”

The firm and more glaucous leaf blades of *Brachypodium glaucovirens*, in comparison to *B. sylvaticum*, are due to bigger, broader and scabrous to shortly hairy veins (costal zones) on the adaxial side, here SEM-illustrated for the first time (Fig. 1A-F). If there is a dense covering of long hairs on the leaves of either species, then this subtle specific difference is obscured.

Brachypodium glaucovirens (Murb.) Sagorski in Mitth. Thüring. Bot. Vereins, ser. 2, 16: 34. 1901 ≡ *Brachypodium sylvaticum* subsp. *glaucovirens* Murb. in Acta Univ. Lund. 27: 22. 1891 ≡ *Brachypodium pinnatum* var. *glaucovirens* (Murb.) Brand in Hallier & Brand, Syn. Deut. Schweiz. Fl., ed. 3, 3: 2780. 1907 ≡ *B. sylvaticum* var. *glaucovirens* (Murb.) Stojanoff & Stefanoff, Fl. Bulg. 1: 161. 1924. – Lectotype (designated here): Bosnia-Herzegovina, “in Waldungen beim Kloster Zitomisljic”, 7.7.1889, Murb. (LD).
= *Brachypodium firmifolium* H. Lindb., Iter Cypr.: 7. 1946. – Lectotype (designated here): Cyprus, “M. Troodos, in siccis, juxta cataractam”, 21.6.1939, Lindberg (H!).
– *Brachypodium rupestre* subsp. *cespitosum* auct., non (Host) Roem. & Schult. (1817): Scholz in Willdenowia 5: 116. 1968.
– *Brachypodium sylvaticum* auct. nonnulli p.p., non (Huds.) P. Beauv. (1812): Schippmann in Boissiera 45: 165. 1991.

Compactly or laxly caespitose perennial, up to 2 m high. Culms erect, slender to moderately stout, smooth and glabrous or hairy, shortly bearded at the nodes. Leaves sometimes loosely long-hairy; ligule short, truncate; leaf blades glaucous green, linear-acuminate, 6-35 × 2-11 mm, ± firm, adaxially ribbed, the ribs very scabrous to minutely hairy, with or without long, soft

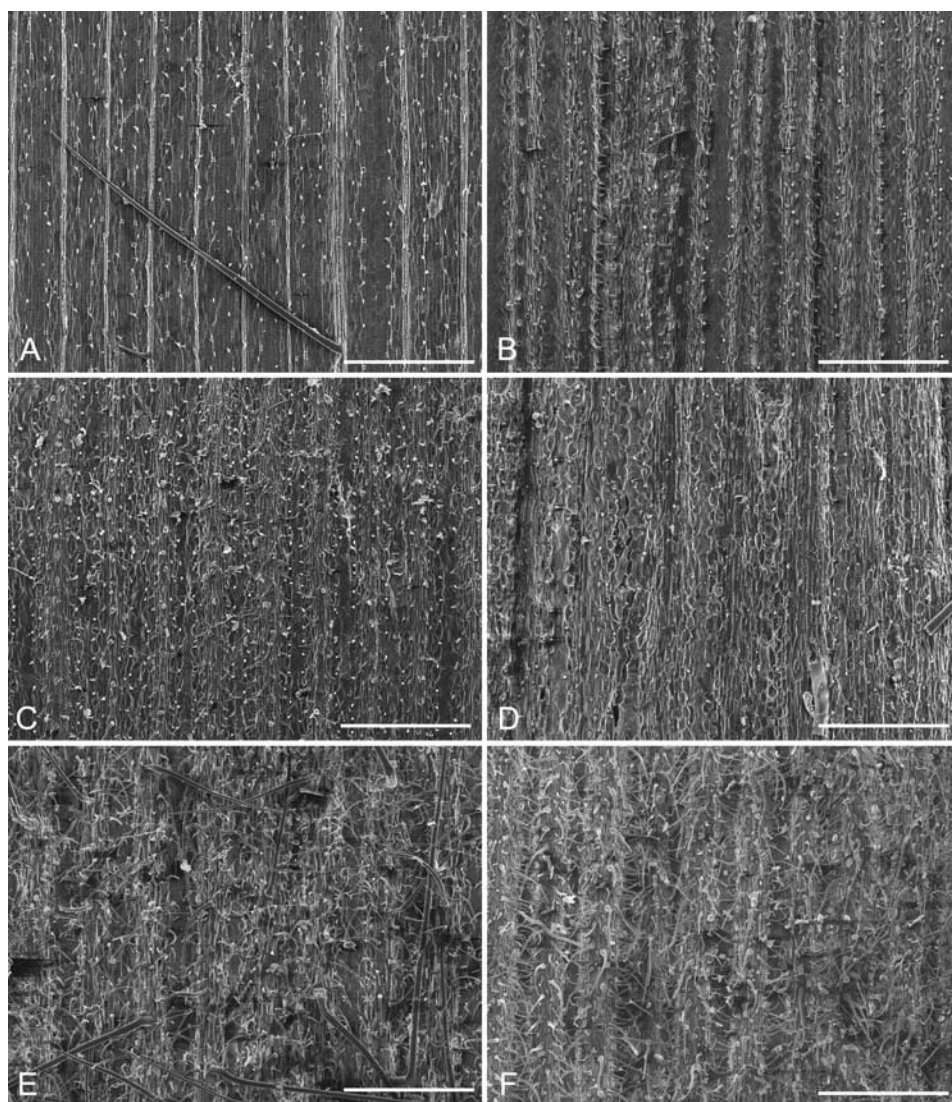


Fig. 1. *Brachypodium*, SEM micrographs of the adaxial side of the leaf blades – A: *B. sylvaticum* (Germany, Bavaria, 1902, Harz, B); B-F: *B. glaucovirens* showing longitudinal finely prickled (B-D) to short-hairy (E-F) ribs (B: Bosnia-Herzegovina, 1901, Sagorski, B; C: Cyprus, Hadjikyriakou 5708, B; D: Cyprus, Hand 3641, herb. Hand; E: Cyprus, Hand 3743, herb. Hand; F: Crete, Böhling 9203a, B). – Scale bars: 400 µm.

hairs. *Racemes* spike-like, usually erect, 10-30 cm long, with 3-15 spikelets. *Spikelets* 4-20-flowered, 1.5-6 cm long, straight, rarely falcate; *glumes* 3-7-nerved; *lemmas* 7-nerved, rounded on the back, glabrous or hairy (esp. on margins), (5-)7-11(-12) mm long, tipped with a fine awn 3-10 mm long and as long as or shorter than the lemma body. *Anthers* 1.5-5 mm long. *Caryopses* c. 1.5 × 6 mm.

Variation. – *Brachypodium glaucovirens* ($x = 8$, $2n = 16$) is a variable species as to the dimensions of leaves, culms, spikelets and the degree of hairiness. It is similar to *B. sylvaticum*, *B. pinnatum* (L.) P. Beauv. and *B. rupestre* (Host) Roem. & Schult., the latter two being strongly

rhizomatous plants. All three vary widely in their chromosome numbers (mostly $x = 7, 9$; several polyploidy levels; Schippmann 1991, Khan & Stace 1999). The type specimens of *B. glaucovirens* and *B. firmifolium* represent the phenetic extremes of a single species. A division into infraspecific taxa does not seem possible.

Illustrations. – Lindberg 1946: fig. 1 [*“B. firmifolium”*]; Bor 1985: t. 102, fig. 1, 2 [*“B. firmifolium”*]; Tsintides & Kourtellarides 1997: photo [*“B. firmifolium”*].

Distribution. – The distribution of *Brachypodium glaucovirens* is imperfectly known because of much confusion with other *Brachypodium* species, especially *B. rupestre*. Probably *B. glaucovirens* is a mainly E Mediterranean species extending to the Near East. All the records of *B. rupestre* from the S Aegean area may belong to *B. glaucovirens*, because among more recent collections from Crete not a single specimen of *B. rupestre* could be traced. Unfortunately, some previous records of *B. glaucovirens* (under *B. sylvaticum* subsp. *glaucovirens*) from this area (Greuter 1973, Greuter & al. 1983) were later doubted.

Habitats. – Rocky mountain slopes, open forests or meadows, moist places, river beds, roadsides and field margins. Altitude: sea level to 1700 m.

Selected specimens. – BOSNIA-HERZEGOVINA: In silvis ad monasterium Zitomislic, 7.1901, *Sagorski* (B); Mostar, an der Narenta bei Buna, *Sagorski* (B). — GREECE: Nomos & Eparchia Kerkira, Insel Kerkiyra (Corfu), oberhalb Acharavi, Straße nach Strogili, Gebüsch, 23. & 25.8.2002, *Scholz* (B); *ibid.*, bei Arillas, schattige Stellen, 1.9.2002, *Scholz* (B); Nomos Ioannina, Eparchia Dodona, SE Despotiko, krautreicher Eichenwald, 210 m, 12.7.1998, *Eisenblätter & Willing* 66442 (B, *“Brachypodium pinnatum”*); *ibid.*, Eparchia Pogoniou, NW Limni, Straßenrand, 13.7.1998, *Eisenblätter & Willing* 66780 (B, *“Brachypodium pinnatum”*); Nomos Florina, Dimos Prespa, Mt Dikorfo, National Park “Lake Mikri Prespa” above Oxia, deciduous shrub, on limestone, 1120 m, 18.7.2001, *Schuler* 1501 (B); Nomos Kavala, Dimos Chrisupolis, Nestos delta E of Chrisupolis, banks of river Nestos, riparian forest with *Alnus glutinosa*, 10 m, 28.6.2000, *Schuler* 00/248 (B, *“Brachypodium sylvaticum* subsp. *sylvaticum”*); Nomos Fthiotis, Eparchia Domokos, c. 1 km S of Echara village along road to Ano Agoriani, stony places by a small stream, ophiolithic substrate, c. 200 m, 26.6.1997, *Constantinidis* 7021 (B); Nomos Attika, Eparchia Megaris, c. 0.5-1 km ENE of Inoi, by a small, nearly dry rivulet with cultivated fields all around, c. 150 m, *Constantinidis* 3965 (B); Nomos Ilia, Elis, in humidis maritimis, 3.6.1891, *Heldreich* (B); Peloponnisos, Nomos Achaia, Eparchia Diakofto, Ag. Andreas-Schlucht SW Diakofto, quelliger Hang mit *Vitex*, an kleinem Kanal, 250 m, 13.6.2006, *Böhling* 13638 (Herb. Böhling); Nomos Chania, Eparchia Apokorono, Georgiopolis, Wegrund in Strandnähe, 14.6.1996, *Scholz* (B); *ibid.*, Dramia, *Böhling* 10305 (B); Nomos Rethimno, Eparchia Amari, Platania, am Rande eines Flussbettes, 11.8.1984, *Scholz* (B); *ibid.*, Eparchia Vasiliou, Spili, diesjährig ungenutztes Gartenfeld, toniger Lehm, 15.8.1998, *Böhling* 8446 (B); Nomos Iraklio, Eparchia Pirgiotissi, Kalamaki, kultivierte Schwemmebene am Unterlauf des Geropotamos, 5 m, 3.11.1999, *Böhling & Raus* 10536 (B, *“Brachypodium cf. sylvaticum* subsp. *sylvaticum”*); Nomos Dodekanisos, Eparchia Karpathos, Insel Karpathos, W-exponiertes Bachtal 2 km nördlich Mesochori, südl. des Kaps Prionas, sickernasses Bachbett mit größeren wassergefüllten Kolken, 40-100 m, 30.5.1983, *Raus* 8503 (B, *“Brachypodium sylvaticum* subsp. *glaucovirens”*); *ibid.*, Arkassa, feuchtes Bachtal mit einzelnen wassergefüllten Kolken östl. des Ortes, 60-100 m, 13.6.1983, *Raus* 8751 (B, *“Brachypodium sylvaticum* subsp. *glaucovirens”*); *ibid.*, Eparchia Rodou, Apollonia, grasige Stelle im *Rubus*-Gebüsch in *Myrtus-Pinus brutia*-Wald bei Quelle, 200-250 m, 16.8.1998, *Böhling* 8858 (B). — TURKEY: NW Antalya, *Quercus coccifera*-Gebüsch, 270 m, 7.7.1979, *Kehl* 19/?-A (B, *“Brachypodium pinnatum?”*). — CYPRUS: M. Troodos, in siccis juxta cataractam, 21.6.1939, *Lindberg* (H, lectotype of *Brachypodium firmifolium* H. Lindb.); *ibid.*, Prodromos village, along stream, igneous rocks, 1400 m, 8.7.1997, *Hadjikyriakou* 2758 (B, *“Brachypodium sylvaticum”*); *ibid.*, 500 m from Troodos square on the road to Platnes, moist places by the road, 1650 m, 23.7.2003, *Hadjikyriakou* 5720 (B, *“Brachypodium sylvaticum”*); *ibid.*, Almirolivado, margins of a seasonal small lagoon, 1600 m, 28.6.2003, *Hadjikyriakou* 5708 (B, *“Brachypodium*

firmifolium"); ibid., Loumatatou Tous Aetous, moist places along road, igneous rocks, 1500 m, 17.7.1998, *Hadjikyriakou 3616* (B, "*Brachypodium firmifolium*"); Tala, above Adonis Baths waterfall in Mavrokolympos valley, wet sites along brook, c. 300 m, 26.10.2002, *Hand 3641* (herb. Hand, "*Brachypodium pinnatum*"); Prodomos, NNW, below West Shoulder of Chionistra at track crossing brook SSE Trikoukkia, wet ground, c. 1500 m, 4.11.2002, *Hand 3743* (herb. Hand, "*Brachypodium sylvaticum*"); Prodomos, at road S of Trikoukkia, brook in distinctive bend, wet ground, c. 1340 m, 4.11.2002, *Hand 3744* (herb. Hand, "*Brachypodium sylvaticum*"); Foini, picnic site ENE Moni Panagias Trooditissas, along brook Argaki tou Xerokolymbou above road, partly humid ground along brook, c. 1350 m, 4.11.2002, *Hand 3735* (herb. Hand, "*Brachypodium sylvaticum*"). — CULTIVATED IN BERLIN FROM WILD SOURCE: Greece, Nomos Pella, Eparchia Almopia, Straße von Flestani nach Aetochori, 530-570 m, 17.8.1990, *Pirker & al. 62* (B, cult. Bot. Garten Berlin-Dahlem); Crete, sine loc., 1998, *Böhling* (B, cult. Bot. Garten Berlin-Dahlem 1999); Cyprus, M. Troodos, c. 1.5 km SSE Prodomos, E der Straße nach Trooditissa, 16.11.1998, *Showler* (B; cult. Privatgarten H. Scholz, Berlin, in 2002-05).

Short identification key to the *Brachypodium pinnatum-sylvaticum* complex

1. Plants with obvious creeping rhizomes; awn of lemma 2.5-5 mm long, not more than half as long as lemma body *B. pinnatum* group
- Plants caespitose or very shortly rhizomatous; awn of lemma more than half as long as lemma body 2
2. Leaf blades dark or light green, soft and thin, adaxially with narrow and low ribs; racemes nodding; awn of lemma up to 12(-15) mm long, usually distinctly longer than lemma body *B. sylvaticum*
- Leaf blades glaucous green, rather firm, adaxially with rather broad and more prominent ribs; racemes erect; awn of lemma up to 10 mm long, as long as or shorter than lemma body *B. glaucovirens*

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