Acta Bot. Croat. 74 (1), 173-179, 2015

CODEN: ABCRA 25
ISSN 0365-0588
eISSN 1847-8476

**Short communication**

# Re-evaluation of the *Panicum capillare* complex (Poaceae) in Croatia

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**Abstract** – The *Panicum capillare* complex includes several taxa, among them *P. capillare* L., which is usually considered to be an established alien throughout Europe, whereas other species are recorded only as casuals. A new representative of the complex, *P. riparium* H. Scholz was described from Germany in 2002, and shortly after its description was recorded in several countries on the continent. In the course of herbarium revisions and recent field studies the authors documented several localities of the species in Croatia as well. The paper presents a new key for the determination of Croatian species of the complex and anticipates the invasion of *P. riparium* in the sub-Mediterranean regions of the Balkan Peninsula.

**Keywords:** Balkan Peninsula, determination key, invasive alien, neophyte, *Panicum capillare* agg.

## Introduction

The genus *Panicum* L. is one of the largest genera of grasses with about 300 species worldwide. The majority of species are of tropical or subtropical origin (Zuloaga and Soderstrom 1985, Freckmann and Lelong 2003, 2007, Shouliang and Renvoize 2006). Recently, the number of species in the genus has been considerably reduced through segregation of many species into smaller genera (Aliscioni et al. 2003). Several species play an important role as feed and forage in different ecosystems of the world, and, under anthropogenic influences many species have significantly expanded their distribution as agricultural weeds or ruderals (Ryves et al. 1996, Van De Wouw et al. 2008, Moravcová et al. 2010). The majority of *Panicum* species recognized in central and southern Europe belong to sect.

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*Panicum* L. (leaf sheaths rounded and hairy, lower glumes acute to attenuate) and sect. *Dichotomiflora* (Hitch.) Honda (leaf sheaths compressed, glabrous, lower glumes truncate to subacute) (Conert 1979, Clayton 1980, Freckmann and Lelong 2003).

The *Panicum capillare* complex (sect. *Panicum*, »witchgrasses« native to North America) includes taxa, which were taxonomically evaluated in different ways. Employing a typical central European »disaggregate approach«, Scholz (2002) distinguished several taxa at species rank, whereas Anglo-Saxon taxonomists (»aggregate approach«) tend to reduce the number of species through assessment of taxa at the rank of subspecies or variety (Clements el al. 2004, Freckmann and Lelong 2003, 2007). These contractions do not signify that these taxa are conspecific, but some authors consider the differences to be too small and the degree of variety too great to accept them as »good species«. It should be noted that the American determination keys to the discussed complex usually focus only on the length of mature spikelets and ignore other features (e.g. form of lemmas, form of panicle).

Among the representatives of the complex, *Panicum capillare* L. is described as a naturalized alien throughout Europe (Clayton et al. 1980), whereas other species were recorded in certain countries (e.g. *P. gattingeri* Nash and *P. hillmannii* Chase in Austria and Slovenia; Jogan 2007, Fischer 2008) as rare casuals only. From Croatia only *P. capillare* has been reported (Domac 1994, Euro+Med 2006, Nikolić 2014).

*Panicum riparium* H. Scholz (2002: 275) was recently described as a new species from the Elbe Valley in Germany. Whereas Scholz (2002) emphasized that *P. riparium* and *P. barbipulvinatum* Nash are not conspecific, the exhaustive study of Amarell (2013a, b) showed that the names are probably synonymous. Although some authors (Hohla 2013, Verloove 2014) have already adopted the name *P. barbipulvinatum* for some newer records, widespread use of this name in the case of central European plants should be discouraged until type material of all related North American taxa has been investigated. Herbarium revisions of the *P. capillare* complex have shown that *P. riparium* is not a new invader but an overlooked, long-established taxon in central Europe, and, in some parts of the synanthropic European range, is more abundant than *P. capillare* s. str. (Wilhalm 2011, Nagy et al. 2012, Amarell 2013b). According to these findings, its occurrence in Croatia was to be expected, which has necessitated a re-evaluation of the complex in the area.

## Material and methods

Specimens in the following herbaria (acronyms given according to Thiers 2014) were searched for records of the *Panicum capillare* complex: BP, BPU, DE, GJO, JPU, LJU, PECS, W, ZA, ZAHO, and the private herbarium of the first author. Not only were the historical collections revised, but a new voucher specimen of *P. riparium* was placed in ZA. Characterization of *P. capillare* s. str. and *P. riparium* was based on the revision of 20 specimens for each as a reference derived from the herbaria listed above, the keys of Scholz (2002), Fischer et al. (2008), Király et al. (2009) and Amarell (2013b) were also applied.

Field studies in northern Croatia were conducted in 2012 and 2013. For the new locality of *Panicum riparium*, geo-coordinates were determined using a Trimble Nomad GPS handheld device in WGS 84 projection. Quadrant numbers (»MTB«) of the central-European Flora Mapping System are presented after Nikolić et al. (1998).

## Results and discussion

*Panicum riparium* is readily distinguished from *P. capillare* s. str. using macroscopic characters by the structure of the panicle and the form of spikelets. For further confirmation of the determination some measurements of spikelets and fruits are useful (see the key below and Fig. 1).


**Fig. 1.** *Panicum capillare* L.: (a) panicle; (b) detail of panicle; (c) mature spikelets; *Panicum riparium* H. Scholz: (d) panicle; (e) detail of panicle; (f) mature spikelets. Del. J. Táborská.

Determination key for Croatian species of *Panicum capillare* complex:

**1a.** Pedicel of subterminal spikelet longer than 5 mm, patent (angle between subterminal and terminal pedicels 20–60°). Mature spikelet 2.2–2.7× as long as broad, acute, short pointed; lemma (7–)9 veined. Caryopsis 1.5–1.7× as long as broad . . . . . ***P. capillare* s. str.**

**1b.** Pedicel of subterminal spikelet shorter than 3 mm, appressed to the branch (angle between subterminal and terminal pedicels < 10°). Mature spikelet 2.7–3.4× as long as broad, acuminate with a long tapering apex; lemma 5(–7) veined. Caryopsis 1.8–2.2× as long as broad . . . . . ***P. riparium***

In the course of systematic revision of herbarium material of the *P. capillare* complex, several overlooked specimens of *P. riparium*, a new species for the Croatian flora, were found in BP and ZA. The earliest collection is dated to the second half of the 1800s, however, its exact location and date are not given. The first precisely dated specimen was collected in the early 1900s in the present-day Rijeka. From the 1950s *P. riparium* was repeatedly collected in the vicinity of Zagreb, and further findings are known from the

sub-continental (Slavonski Brod), sub-Mediterranean (Knin, Rijeka) and Mediterranean (Vodice) parts of Croatia. In the course of the floristic investigation of the Ivanščica Mountain, a recent occurrence of *P. riparium* was documented in 2013 (see Appendix 1 and Fig. 2). During the revision we recorded only five Croatian collections of *P. capillare* s. str. (see Appendix 2), thus we consider that it is distinctly rare in the country.

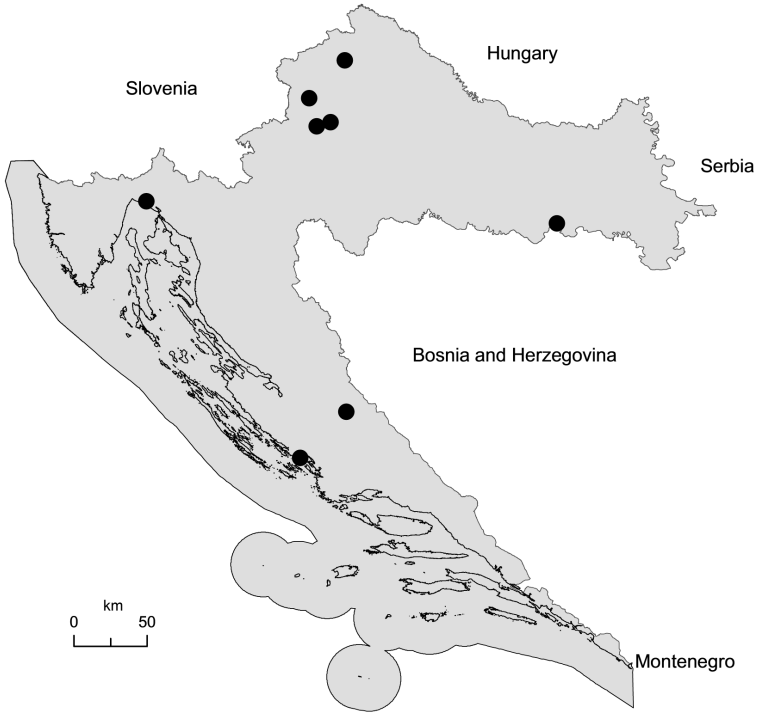


**Fig. 2.** Distribution of *Panicum riparium* H. Scholz in Croatia.

Shortly after its description in Germany (Scholz 2002), *P. riparium* was reported from several countries in central Europe: Austria (Hohla 2006), Hungary (Király et al. 2009), Germany (Amarell 2010), Switzerland (Ciardo et al. 2011), Italy (Wilhalm 2011), France and Great Britain (Amarell 2013b), and Belgium (Verloove 2014), due to actual floristic research in the field and herbarium revisions. Accompanying *P. capillare* s. str., *P. riparium* was often recorded as well, thus showing that both species coexist on the continent. The relative abundance of these taxa is not yet known in the individual countries. Nevertheless, *P. riparium* seems to have a slight sub-Atlantic character with the (hitherto known) European distribution centre north of the Alps.

Representatives of the *P. capillare* complex grow usually in ruderal habitats (roadsides, building sites) in Europe; their occurrences in agricultural habitats are much less frequent, whereas they are serious weeds in North America, infesting predominantly corn, soybean and winter wheat cultures (Darbyshire and Cayouette 1995, Clements et al. 2004). *P. riparium* was reported from Hungary exceptionally as an abundant agricultural weed on acidic sandy soils (Nagy et al. 2012).

In Croatia *P. capillare* has been described as an invasive alien (Boršić et al. 2008), and as a particularly noxious agricultural weed (Hulina 2010). However, several former reports without voucher may refer to *P. riparium*, newly published records of which are a clear indication of a presumable invasion in the sub-Mediterranean and Mediterranean regions. The Croatian records from Knin and Vodice represent the southernmost reported localities of the latter species in Europe. Exhaustive field studies and herbarium revisions are needed to assess the actual distribution and role of *P. riparium* in the northern part of the Balkan Peninsula because of the prospect of rapid invasion in secondary habitats.

## Acknowledgements

Thanks are due to Uwe Amarell (Offenburg, Germany) for discussions on the origin and distribution of *Panicum riparium* in Europe. Richard Lansdown (Stroud, Great Britain) kindly improved our English. The study of Gergely Király was supported by project Agrárklíma.2 VKSZ-12-1-2013-0034.

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**Appendix 1.** Recorded localities of *Panicum riparium* H. Scholz in Croatia.

»*in agris*«; C. J. Schlosser (as »*P. capillare*«), n. d., ZA16220; Fiume (today Rijeka), »*in ruderatis viae ferrae*« (probably MTB 0652.4), G. Lengyel (as »*P. capillare*«), VIII. 1908, BP356966; Kamena Gorica, N of the settlement, N46.162662°; E16.256507° (MTB 9863.2), G. Király & D. Schmidt, 07. IX. 2013, ZA; Knin, railway station (MTB 1963.3), M. Milović (as »*P. capillare*«), 12. XI. 2000, ZA16208; Slavonski Brod, Poloj, bank of Drava river (MTB 0874.3), L. Marković (as »*P. capillare*«), 08. IX. 1969, ZA16214; Stubičke Toplice (MTB 0061.2), N. Fiket (as »*P. capillare*«), 29. VIII. 1955, ZA16218; Vodice (MTB 2260.2), M. Milović (as »*P. dichotomiflorum*«), 10. VIII. 1999, ZA16210; Zagreb, »garden« (MTB?), I. Horvat (as »*P. capillare*«), 18. IX. 1948, ZAHO; Zagreb, Borovje (MTB 0161.4), L. Marković, L. Gospodarić (as »*P. capillare*«), 09. IX. 1954, ZA16211; Zagreb, Lanište (MTB 0261.2), A. Kumbarić (as »*P. capillare*«), 25. VIII. 1992, ZA16216; Zagreb, Savski most (MTB 0261.2), L. Marković (as »*P. capillare*«), 26. VIII. 1959, ZA16217; Zagreb, W of »Savski most« (MTB 0261.2), L. Marković (as »*P. capillare*«), 03. X. 1969, ZA16215; Zagreb, Sesvete (MTB 0162.4), B. Hundozi (as »*P. capillare*«), 04. IX. 1964, ZA16214.

**Appendix 2.** Herbarium specimens of *Panicum capillare* L. found in Croatian herbaria.

Gunja, near the railway bride on Sava (MTB 1179.1), L. Marković, 10. IX. 1969, ZA16213; Medvednica, Adolfovac, forest cutting (MTB 0161.2), L. Marković, 08. IX. 1974, ZA11846; Negoslavci, on row crops (probably MTB 0779.2), M. Jakovlević, 15. VIII. 1956, ZA16219; Ozalj, on row crops SW of railway station (MTB 0358.4), L. Ilijanić (as »*P. dichotomiflorum*« but fragments of the collection belong to *P. capillare*), 12. XI. 1986, ZA; Trakošćan, on row crops (MTB 9761.2), S. Kečkeš (as »*P. miliaceum*«), 13. VIII. 1956, ZA16207.