

Invasion of *Sporobolus vaginiflorus* (Poaceae) in Bosnia and Herzegovina

Semir Maslo¹ & Šemso Šarić²

¹ Primary School, Lundåkerskolan, Gislaved, Sweden; E-mail: semmas@edu.gislaved.se (corresponding author)

² Jelaške, Olovo, Bosnia and Herzegovina E.mail: semsosumar@gmail.com

Received: September 12, 2021 ▷ Accepted: October 08, 2021

Abstract. *Sporobolus vaginiflorus* is native to North America but it has been introduced in some areas beyond its natural range and has been recently recorded in Bosnia and Herzegovina. In the period of 2018–2019, it was recorded in 43 new localities in South Herzegovina and Central Bosnia. On the basis of the number of populations and the number of individuals within populations, the authors assume that this species is now invasive in Bosnia and Herzegovina.

Key words: alien plants, Bosnia and Herzegovina, invasive species, morphology, *Sporobolus*

Introduction

The genus *Sporobolus* R.Br. (Poaceae) is a cosmopolitan genus belonging to subfamily Chloridoideae (Peterson & al. 2007). It is one of the largest genera within the subfamily, comprising about 160 species predominantly distributed in the tropical and subtropical areas of the world (Peterson & al. 2007). In the European vascular flora, six species have been recorded (Valdés & Scholz 2009), including four present in the Balkans: native *S. pungens* (Schreb.) Kunth. and three alien species, *S. indicus* (L.) R. Br., *S. neglectus* Nash. and *S. vaginiflorus* (A. Gray) A. W. Wood. Within the genus, only *S. vaginiflorus* was recorded in the area of Bosnia and Herzegovina.

Sporobolus vaginiflorus (A. Gray) A. W. Wood, in Class-Book Bot., ed.: 775. 1861. (synonyms: *Vilfa vaginiflora* A. Gray; *Muhlenbergia vaginiflora* (Torr. ex A.Gray) Jogan), also known as Poverty Dropseed, originates from North America, and is a locally naturalized alien in some parts of Europe. The first record from Europe was from NE Italy in 1951 (Melzer 2003), and SW

Slovenia, in the region adjacent to Italy in 1953 (Jogan 2017). Subsequently, the plant began to spread rapidly across the Southeast and Central European countries. The furthestmost points of its European range are now in South Germany and Hungary (Fürnrohr 2015, Király & Hohla 2015). In some regions of Europe, it is classified as an invasive species (Melzer 2003, Tinner 2013). About history of the spread of *S. vaginiflorus* in Europe referencing goes to Hohla & al. (2015), Hohla (2016) and Jogan (2017).

So far, *S. vaginiflorus* has been reported in Europe as introduced in Austria (Melzer 2003, Hohla & al. 2015, Gilli & Pachschröll 2018, Reich & al. 2018), Bosnia and Herzegovina (Nobis & al. 2016, Jogan 2017), France (Choler & Dutartre 1996, Dentant & al. 2012), Germany (Fürnrohr 2015, Dickoré & Springer 2016, Hohla 2016), Hungary (Király & Hohla 2015), Italy (Pignatti 1982, Wilhalm 2000), Croatia (Horvatić & Gospodarić 1959–60), Montenegro (Stešević & Jogan 2006), Serbia (Jogan 2017), Slovenia (Jogan 2017), and Switzerland (Ciardo & Delarze 2005, Tinner 2013).

Material and methods

A field study was conducted in the autumn of 2018 and 2019. Identification of the specimens was done according to Hitchcock & Chase (1951), Peterson & al. (2003) and Jogan (2017). The nomenclature follows Valdés & Scholz (2009). Distribution of the species in Bosnia and Herzegovina is shown on the map, using a standard UTM grid 10×10 km (Fig. 2). Its invasiveness status was determined by employing the terminology according to Blackburn & al. (2011). Data on the abundance of *S. vaginiflorus*, size of its populations and characteristics of the habitats where it grows in Bosnia and Herzegovina were obtained in the course of fieldwork.

Results and discussion

S. vaginiflorus (Fig. 1) is a small annual grass. Culms are 15–60 cm tall, erect or decumbent, wiry, with a narrow simple chasmogamous panicle developed terminally (Fig. 1c) and protruding from the leaf sheath only partially under suitable environmental conditions (in warm autumns). *S. vaginiflorus* resembles the other N American annual grass species with cleistogamous spikelets, and specifically *S. neglectus*. Both grass species have quite similar ecology limited to dry ruderal sites in their European secondary area, especially along roads. The main differences between *S. vaginiflorus* and *S. neglectus* are in the length of spikelets (4–7 mm vs. 2–3 mm), palea often longer than lem-

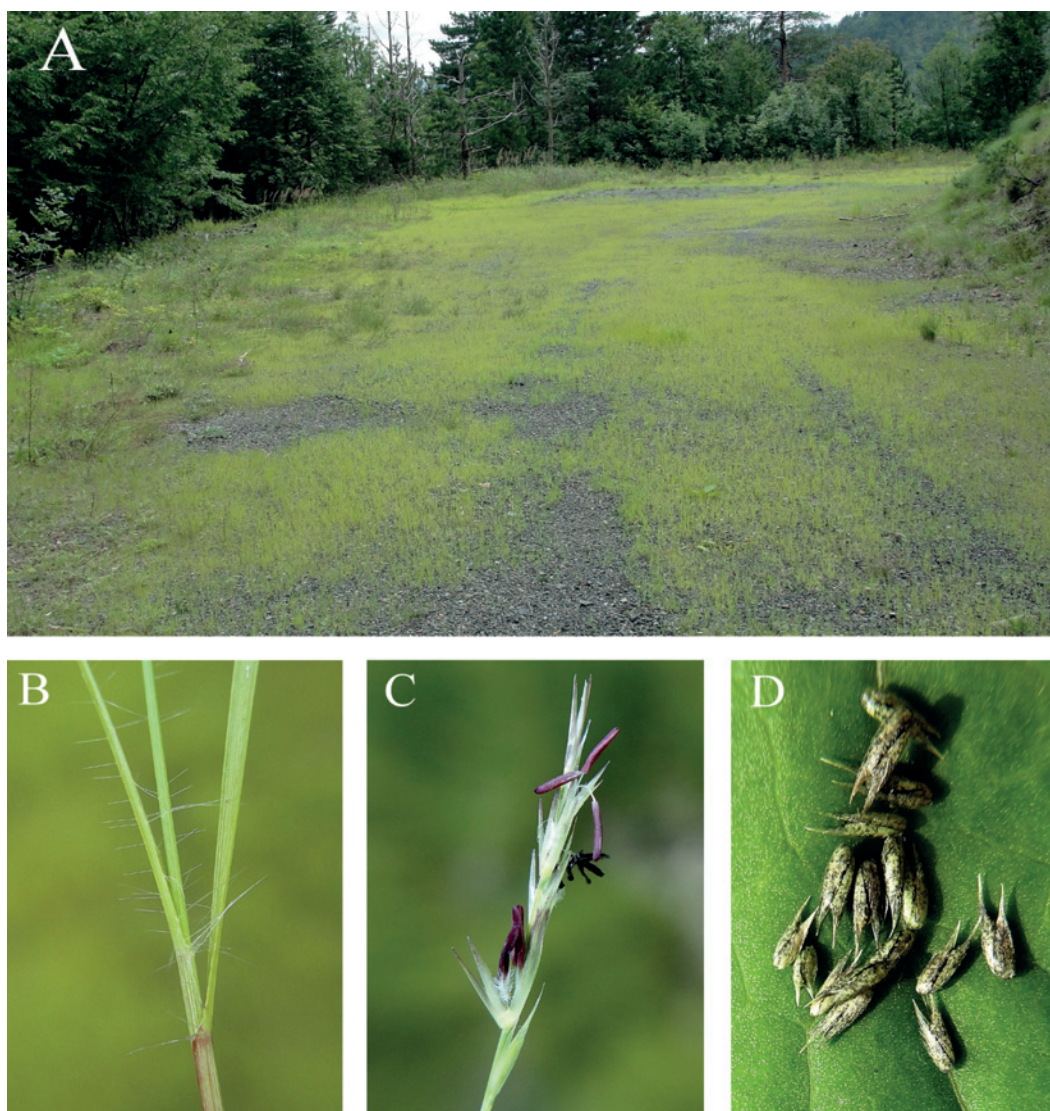


Fig. 1. *Sporobolus vaginiflorus* in the vicinity of Dištica near Zavidovići. **a.** habitat, **b.** leaves (× 2), **c.** chasmogamous panicle (× 2), **d.** mature anthercia fallen from spikelets (× 2) (Photo Šemso Šarić).

ma (in *S. neglectus*, palea is as long as lemma), lemma and palea with tightly appressed hairs, gradually tapering into a narrow peak resembling an awn, (in *S. neglectus*: glabrous, abruptly pointed to a short beak) (adapted from Jogan 2017). A detailed description of the genus and of the species can be found in Peterson & al. (2003).

The first record of *S. vaginiflorus* in Bosnia and Herzegovina dates back to 2016, when it was discovered near the town of Bosanski Petrovac in Northwest Bosnia (Nobis & al. 2016). Soon after that, the species was recorded in Herzegovina, along the main road M-6.1 Mostar-Široki Brijeg (Jogan 2017).

New data on the distribution of *S. vaginiflorus* in Bosnia and Herzegovina indicate that the invasive character of this species is becoming more manifest. Although it has been so far found only in one locality in South Herzegovina and in another one in Northwest Bosnia, the new data also indicate its presence in Central Bosnia. The species reaches high abundance of individuals in all new localities in Bosnia and Herzegovina.

The currently known distribution of *S. vaginiflorus* in Bosnia and Herzegovina extends to 45 localities (Table 1, Fig. 2), with some populations amounting to

several thousand individuals (Fig. 1a). On the territory of Bosnia and Herzegovina, *S. vaginiflorus* occurs mostly on trampled ground with scanty plant cover, especially along the main roads, and in more natural habitat types, mainly in pioneer communities on serpentine soil in Central Bosnia, as well as on sandy and gravelly dry river banks in South Herzegovina. Its elevational range in Bosnia and Herzegovina varies between 6 m -1080 m. It usually grows along roads and in disturbed spots, but has also started to colonize natural and isolated areas of the serpentine soil in Central Bosnia above 1000 m.

In Central Bosnia, the species has been recorded in 37 new localities (Table 1, Fig. 2). Most localities are found on the edge of regional roads, where the species forms approximately 1 m wide homogeneous stands. The most numerous populations have been observed on the serpentine soils in Central Bosnia, where the species forms dense stands and completely covers some stretches of the macadam roads, with populations of thousands of individuals on several hundred square meters. The largest populations were observed near Careva Ćuprija, on 1000 square meters, and Dištica, on 600 square meters (Table 1, Fig. 2).

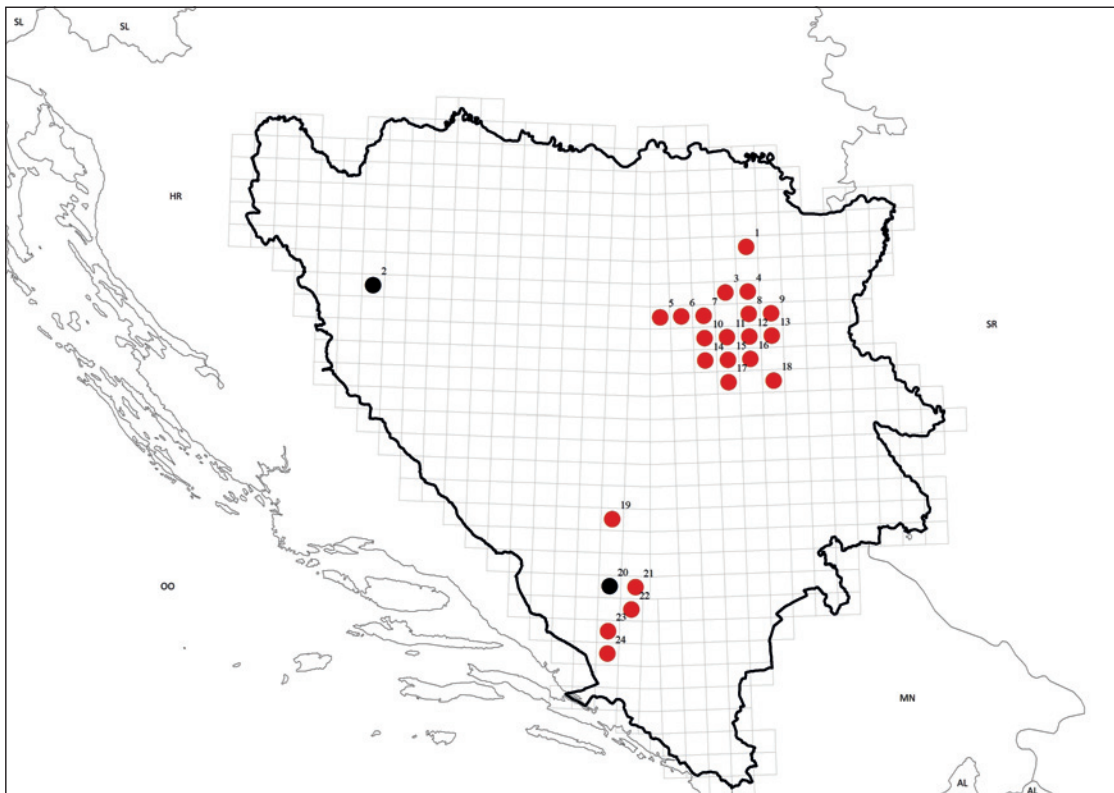


Fig. 2. Current distribution of *Sporobolus vaginiflorus* in Bosnia and Herzegovina (New records are indicated by red).

Table 1. Georeferenced data of the currently known distribution of *Sporobolus vaginiflorus* in Bosnia and Herzegovina (Data from literature are marked in bold).

No. of quadrant	Number and name of the locality, habitat, observers and dates of observation	WGS coordinates	Altitude	UTM quadrant
1	1 Srebrenik, Behrami, along the main road M-1.8, Šarić, Š. 28.09.2018	44°41'08" N, 18°29'45" E	301 m	CQ05
4	2 Tuzla, Šićki Brod, dry ruderal places in industrial zone of the city, Šarić, Š. 28.09.2018	44°31'18" N, 18°35'15" E	203 m	CQ03
3	3 Lukavac, Modrac, along the regional road R-471, Šarić, Š. 13.09.2019	44°30'27" N, 18°27'17" E	199 m	BQ93
8	4 Živinice, Višća, along the regional road R-469, Šarić, Š. 29.09.2018	44°24'53" N, 18°36'20" E	263 m	CQ02
13	5 Živinice, Kupjerusi, dry ruderal places, Šarić, Š. 12.09.2019	44°24'05" N, 18°36'40" E	327 m	CQ11
9	6 Živinice, Rizvići, dry ruderal places, Šarić, Š. 12.09.2019	44°25'23" N, 18°36'51" E	318 m	CQ12
10	7 Zavidovići, Stošnica Potok, country macadam road on serpentine, Šarić, Š. 22.09.2019	44°23'07" N, 18°19'05" E	328 m	BQ81
15	8 Zavidovići, Dištica, country macadam road on serpentine, Šarić, Š. 28.09.2018	44°17'52" N, 18°22'11" E	850 m	BQ90
7	9 Zavidovići, Podvolujak, along the regional road R-467, Šarić, Š. 22.09.2018	44°25'46" N, 18°15'56" E	252 m	BQ82
11	10 Zavidovići, Ribnica, along the regional road R-467, Šarić, Š. 13.09.2018	44°20'10" N, 18°24'16" E	292 m	BQ91
11	11 Zavidovići, Ribnica, along the regional road R-467, Šarić, Š. 13.09.2018	44°20'59" N, 18°24'01" E	295 m	BQ91
11	12 Zavidovići, Ribnica, at crossroads between the road R-469 and R-467, Šarić, Š. 13.09.2018	44°20'14" N, 18°24'18" E	310 m	BQ91
11	13 Zavidovići, Ribnica selo, country macadam road on serpentine, Šarić, Š. 09.09.2018	44°20'40" N, 18°23'47" E	305 m	BQ91
6	14 Žepče, Ljeskovića, along the regional road R-465, Šarić, Š. 22.09.2018	44°25'09" N, 18°06'49" E	260 m	BQ72
5	15 Žepče, Papratnica, along the main road M-17, Šarić, Š. 22.09.2018	44°25'21" N, 18°00'15" E	237 m	BQ62
12	16 Banovići, dry ruderal places, east part of the town, Šarić, Š. 23.09.2018	44°24'21" N, 18°31'40" E	337 m	CQ01
8	17 Banovići, dry ruderal places, central part of the town, Šarić, Š. 23.09.2018	44°24'30" N, 18°31'33" E	332 m	CQ02
12	18 Banovići, Breštica, along the regional road R-469, Šarić, Š. 23.09.2018	44°23'08" N, 18°30'49" E	421 m	CQ01
12	19 Banovići, Marino Brdo, along the regional road R-469, Šarić, Š. 23.09.2018	44°22'40" N, 18°22'42" E	477 m	CQ01
12	20 Banovići, Marino Brdo, along the regional road R-469, Šarić, Š. 23.09.2018	44°22'33" N, 18°28'49" E	533 m	CQ01
11	21 Banovići, Marino Brdo, along the regional road R-469, Šarić, Š. 23.09.2018	44°22'24" N, 18°28'56" E	529 m	BQ91
8	22 Banovići, Omazići, along a dirt road, Šarić, Š. 13.10.2018	44°25'03" N, 18°32'43" E	350 m	CQ02
8	23 Banovići, Oskova, along the regional road R-469, Šarić, Š. 13.10.2018	44°24'55" N, 18°35'38" E	256 m	CQ02
8	24 Banovići, Oskova, along the rail tracks, Šarić, Š. 13.10.2018	44°24'46" N, 18°33'24" E	292 m	CQ02
12	25 Banovići, Podgorje, along the regional road R-469, Šarić, Š. 13.10.2018	44°23'36" N, 18°30'38" E	401 m	CQ01
11	26 Banovići, Velike Ribnice, along the regional road R-469, Šarić, Š. 13.10.2018	44°21'15" N, 18°26'20" E	409 m	BQ91
11	27 Banovići, Velike Ribnice along the regional road R-469, Šarić, Š. 13.10.2018	44°21'13" N, 18°27'29" E	390 m	BQ91
11	28 Banovići, Željova along the regional road R-469, Šarić, Š. 13.10.2018	44°22'04" N, 18°27'13" E	473 m	BQ91
11	29 Banovići, Željova along the regional road R-469, Šarić, Š. 13.10.2018	44°22'08" N, 18°27'41" E	455 m	BQ91
15	30 Olovo, Duboštica, country macadam road on serpentine, Šarić, Š. 10.09.2019	44°14'31" N, 18°23'22" E	579 m	BQ90
15	31 Olovo, Careva Čuprija, along the regional road R-467, Šarić, Š. 03.09.2018	44°16'45" N, 18°25'48" E	387 m	BQ90

No. of quadrant	Number and name of the locality, habitat, observers and dates of observation	WGS coordinates	Altitude	UTM quadrant
15	32 Olovo, Vojnica, along the regional road R-467, Šarić, Š. 03.09.2018	44°15'54" N, 18°24'24" E	475 m	BQ90
18	33 Olovo, Petrovići, along the regional road R-467, Šarić, Š. 11.10.2019	44°08'35" N, 18°42'03" E	759 m	CQ19
14	34 Vareš, Duboštica, along a field road, Šarić, Š. 03.09.2018	44°14'17" N, 18°20'33" E	660 m	BQ80
17	35 Vareš, Ivančevo, , along the regional road R-444, Šarić, Š. 03.10.2019	44°12'11" N, 18°24'56" E	880 m	BP99
12	36 Konjuh, Stožerac, country macadam road on serpentine, Šarić, Š. 13.09.2018	44°20'26" N, 18°29'58" E	1008 m	CQ01
16	37 Kladanj, Drinjača, country macadam road on serpentine, Šarić, Š. 13.09.2018	44°13'46" N, 18°36'43" E	737 m	CQ00
19	38 Donja Jablanica, along the main road M-17, Šarić, Š. 13.10.2019	43°37'48" N, 17°45'24" E	148 m	YJ23
21	39 Mostar, Vrapčići, along the main road M-17, Maslo, S. 30.10.2019	43°22'25" N, 17°50'49" E	78 m	YJ30
22	40 Buna, along the main road M-17, Maslo, S. 02.11.2018	43°14'54" N, 17°50'13" E	36 m	YH39
23	41 Žitomisljići, along the main road M-17, Maslo, S.02.11.2018	43°12'23" N, 17°47'36" E	24 m	YH28
23	42 Počitelj, along main road M-17, Maslo, S. 02.11.2018	43°09'28" N, 17°45'38" E	45 m	YH28
24	43 Čapljina, Mogorjelo, Struge, Neretva river, riverbank, Maslo, S. 02.11.2018	43°04'48" N, 17°41'53" E	6 m	YH27
2	44 Bosanski Petrovac, along the regional road R-5, Király, G. 29.09.2013	44°33'29" N, 16°30'14" E	785 m	XK13
20	45 Mostar, Žovnica, along the road M-6.1, Mostar – Široki Brijeg, Jogan, N. 2017	43°20'25" N, 17°47' 09"E	152 m	YJ20

In South Herzegovina, the species has been recorded in six localities along the M-17 road, from the southern border with Croatia towards Jablanica, where it forms a several meters long monodominant patch with several thousands of individuals (Table 1, Fig. 2). The largest populations were observed there near Počitelj and Buna, where the species forms a population on a stretch of hundreds of meters. The species was recorded in a more natural habitat on the right bank of the Neretva River in Struge near Čapljina. The current population growing on a gravel bank of the river consists of barely 50 individuals.

Following the framework proposed by Blackburn & al. 2011, *S. vaginiflorus* could be considered an invasive alien species on the territory of Bosnia and Herzegovina, already in the E category (fully invasive species, with individuals dispersing, surviving and reproducing at multiple sites across a greater or lesser range of habitats and extent of occurrence).

Acknowledgements. The authors would like to thank Aldin Boškailo for mapping the distribution of the species in Bosnia and Herzegovina. Credit also goes to Lanna Maslo for improving the English language of this paper.

References

- Blackburn, T. M., Pyšek, P., Bacher, S., Carlton, J. T., Duncan, R. P., Jarošík, V., Wilson, J. R. & Richardson, D. M. 2011. A proposed unified framework for biological invasions. – Trends Ecol. Evol., **26**(7): 333-339.
- Choler, P. & Dutartre, G. 1996. Une nouvelle espèce de *Sporobolus* pour la région Rhône-Alpes: *Sporobolus vaginiflorus* (Torr.) Wood. – Monde Pl., **455**: 8-9.
- Dentant, C., Le Driant, F., Van Es, J., Ferrus, L., Garraud, L., Abdujhak, S. & Douzet, R. 2012. Actualisation de la flore du territoire des Hautes-Alpes. – Monde Pl., **508**: 3-26.
- Dickoré, W. B. & Springer, S. 2016. Weitere Notizen zur Flora von München Berichte der Bayerischen Botanischen Gesellschaft zur Erforschung der Heimischen Flora, **86**: 262-276.
- Fürnrohr, F. (ed.) 2015. Bemerkenswerte Pflanzenfunde im Regnitzgebiet seit 2002. RegnitzFlora 7: 72–76.
- Gilli, C. & Pachschröll, C. 2018. (295) *Sporobolus vaginiflorus*. – In: Gilli C. & Niklfeld H. (Eds.): Floristische Neufunde (236–304). – Neulreichia, **9**: 345–346.
- Hitchcock, A. S. & Chase, A. 1951. Manual of the Grasses of the United States. Dover, New York.
- Hohla, M., Diewald, W. & Király, G. 2015: *Limonium gmelinii* – eine Steppenpflanze an österreichischen Autobahnen sowie weitere Neuigkeiten zur Flora Österreichs. – Stapfia, **103**: 127-150.
- Hohla, M. 2016. Wiederfund der Kanten-Wolfsmilch (*Euphorbia angulata*) in Oberösterreich, sowie weitere Beiträge zur Flora von

- Oberösterreich, Niederösterreich, Steiermark und Vorarlberg. – Stapfia, **105**: 109–118.
- Horvatić, S & Gospodarić, L.** 1960. *Sporobolus vaginiflorus* (Torr.) Wood u biljnom pokrovu Hrvatske. – Acta Bot. Croat., **18-19**: 79-103.
- Jogan, N.** 2017. Spread of *Sporobolus neglectus* and *S. vaginiflorus* (Poaceae) in Slovenia and neighbouring countries. – Botanica Serbica, **41**(2): 249-256.
- Király, G & Hohla, M.** 2015. New stage of the invasion: *Sporobolus vaginiflorus* (Poaceae) reached Hungary. – Stud. Bot. Hung., **46** (2): 149-155.
- Melzer, H.** 2003. *Sporobolus vaginiflorus* (Poaceae), ein Neubürger aus Nordamerika, lange übersehen in Österreich- und anderes Neue zur Flora von Kärnten – Neireichia, **2-3**: 131-142.
- Nobis, M., Nowak, A., Piwowarczyk, R., Ebel, A .L., Király, G., Kushunina, M., Sukhorukov, A. P., Chernova, O. D., Kipriyanova, L. M., Paszko, B., Seregin, A. P., Zelewska-Galosz, J., Denysenko, M., Nejfeld, P., Stebel, A. & Gudkova, P. D.** 2016: Contribution to the flora of Asian and European countries: new national and regional vascular plant records, 5. – Botany Letters, **163**(2): 159-174.
- Peterson P. M., Hatch S. L. & Weakley, A. S.** 2003. *Sporobolus* R. Br. – In: **Flora of North America Editorial Committee (eds.)**, Flora of North America, 25, pp. 115-139, New York and Oxford.
- Peterson P. M., Columbus J. T. & Pennington S. J.** 2007. Classification and biogeography of New World grasses: Chloridoideae. – Aliso, **23**: 580–594.
- Pignatti, S.** 1982. Flora d'Italia 3. Edagricole, Bologna.
- Prosser, F.** 1993. Segnalazioni floristiche tridentine. II. – Annali del Museo Civico di Rovereto: Sezione: Archeologia, Storia, Scienze Naturali, **8** (1992): 169-238.
- Reich, D., Kaiser, R. & Hofbauer, M.** 2018. (295) *Sporobolus vaginiflorus*. – In: **Gilli, C. & Niklfeld, H. (Eds.)**: Floristische Neufunde (236–304). – Neireichia, **9**: 345.
- Stešević, D & Jogan, N.** 2006. Two new neophytes in the flora of Montenegro: *Artemisia verlotiorum* and *Sporobolus vaginiflorus*. – Natura Montenegrina, **5**: 173-175.
- Tinner, U.** 2013. Zwei neue Grasarten im St. Galler Rheintal: *Sporobolus vaginiflorus* und *Sporobolus neglectus*. – Bauhinia **24**: 53–56.
- Valdés, B. & Scholz, H.** 2009. *Poaceae* (pro parte majore). - In: Euro+Med PlantBase - the information resource for Euro-Mediterranean plant diversity. Retrieved September 2020 from <http://ww2.bgbm.org/euroPlusMed/>
- Wilhelm, T.** 2000. Nuove segnalazioni di Gramineae dall'Alto Adige (Provincia di Bolzano). – Annali del Museo Civico di Rovereto: Sezione: Archeologia, Storia, Scienze Naturali **14** (1998): 175-187.
-