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Studies in the genus *Paspalum* (*Paniceae*, *Poaceae*) in Europe: 3. *Paspalum thunbergii*, a new naturalized neophyte in W Europe

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Abstract: *Paspalum thunbergii*, a weedy species native to E Asia, is reported for the first time from W Europe. In Italy a naturalized population was detected in 2014 in a heathland in Boscaccio (Lentate sul Seveso; Monza and Brianza province, Lombardia region). A subsequent revision of local herbaria revealed the existence of a second population, also in Lombardia, discovered in Mortara (Pavia province) in 2011 and now confirmed. The taxonomy and nomenclature of this species are briefly discussed, as are its ecology and habitat preferences. An original line drawing and photographs of the species and its habitat are provided. An updated identification key for the species of *Paspalum* in Europe is also presented.

Key words: alien species, naturalized species, neophyte, identification key, taxonomy, Europe, Italy, *Poaceae*, *Gramineae*, *Paniceae*, *Paspalum*, *Paspalum thunbergii*

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Introduction

The genus *Paspalum* L. (*Paniceae*, *Poaceae*) includes nearly 350 species (Scataglini & al. 2014) and is mainly distributed in tropical and subtropical regions of the New World. It is most diverse in South America, with the greatest species diversity in C Brazil (Zuloaga & Morrone 2005). Relatively few species are originally native to the Old World (Africa, Asia, Oceania; e.g. Webster 1987; Clayton & Renvoize 1982; Chen & Phillips 2006). The only monograph of the genus dates back to Flüggé (1810). Several species are of economic importance for forage, turf and ornamental purposes, while others are reputed agricultural or environmental weeds. Some of these now occur more or less widely in warm-temperate and (sub-)tropical regions of the world.

In Europe no species of *Paspalum* are native but several of the weedy species have been naturalized since the 19th century. According to Clayton (1980), *P. dilatatum* Poir., *P. distichum* L. [as *P. paspalodes* (Michx.) Scribner], *P. urvillei* Steud. and *P. vaginatum* Swartz are naturalized in Europe. Of these, *P. urvillei* has a restricted distribution and is only known from the Iberian Peninsula and Macaronesia (Pinto da Silva 1940; Litzler 1979; Hansen & Sunding 1993). The others are more or less widely spread, especially in S Europe (for their actual distributions see Euro+Med 2006+). Some additional species have become naturalized in Europe in recent decades: *P. exaltatum* J. Presl and *P. quadrifarium* Lam. in Italy (Garbari 1966; Verloove & Reynders 2007b), *P. paucispicatum* Vasey [syn.: *P. distichum* subsp. *paucispicatum* (Vasey) Verloove & Reynders] in France and Italy (Verloove & Reynders 2007a, Soldano & Verloove 2015) and *P. notatum* Flüggé [incl. *P. saurae* (Parodi) Parodi] in Spain (incl. Canary Islands), Greece, France (Corsica) and doubtlessly else-

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where in the Mediterranean area (e.g. Carretero 1987; Scholz 2002; Verloove 2003; Böhling & Scholz 2004; Verloove 2005; Verloove & Reyes-Betancort 2011; Tison 2012; Siverio Núñez & al. 2013; Vázquez Pardo 2014). Two additional species, *P. setaceum* Michx. and *P. thunbergii* Kunth, have been recorded only from the easternmost parts of Europe (former USSR; Tsvelev 1984).

In October 2014 the second author found a species of *Paspalum* in a heathland in the locality Boscaccio (Lentate sul Seveso, province of Monza and Brianza, region Lombardia, Italy) that did not correspond with any of the known species from that genus in Italy. It was identified by the first author as *P. thunbergii*, a Far Eastern weed. A subsequent revision of specimens in some local herbaria brought to light the existence of a second population that was initially discovered by the third author (as *P. dilatatum*; see Ardenghi 2013) in Mortara in 2011. Both localities were revisited in 2015 and the species was found to be firmly established at both. It may have been overlooked elsewhere in NW Italy (or elsewhere in Europe) since, in general appearance, it closely resembles *P. dilatatum*. In this paper, the distinguishing features are presented and the taxonomy, nomenclature, ecology and habitat preferences of the species are briefly discussed. Original line drawings, photographs and an updated identification key for the species of *Paspalum* in Europe are also provided.

Results and Discussion

Taxonomy and nomenclature

Paspalum thunbergii Kunth, Révis. Gramin.: 25. 1829 ≡ *Paspalum scrobiculatum* var. *thunbergii* (Kunth) Makino in Bot. Mag. (Tokyo) 10: 60. 1896. – Fig. 1 & 2.
= *Paspalum dissectum* Murray, Syst. Veg., ed. 14: 104. May–Jun 1784, nom. illeg. [non *Paspalum dissectum* (L.) L., Sp. Pl., ed. 2, 1: 81. 1762].
– *Paspalum dissectum* sensu Thunb., Fl. Jap.: 45. Aug 1784 [misapplication of *P. dissectum* (L.) L. 1762].

Description (adapted from Chen & Phillips 2006) — *Perennial* from short, knotty rootstock. *Culms* tufted, erect, 50–100 cm tall; nodes glabrous (or pilose). *Leaf sheath* keeled, hirsute; *leaf blade* linear, 10–25 × 0.5–0.8 cm, hirsute on both surfaces, rarely glabrous, apex acuminate; *ligule* membranous, 0.5–1.5 mm long, apex truncate. *Inflorescence axis* 1–9(–12) cm long; *racemes* (2 or)3–6, laxly ascending or spreading, 3–9 cm long, axils pilose; rachis 1–1.5 mm wide, margins scaberulous; spikelets commonly paired, at least in central part of raceme (or a vestigial 2nd spikelet present); pedicels minutely puberulous. *Spikelets* elliptic to orbicular-elliptic, plumply planoconvex, 2.5–3 × 2–2.3 mm, apex rounded or subacute; *lower glume* absent, rarely vestigial; *upper glume* membranous, sparsely pubescent especially along margins, 3-veined with lateral veins marginal; *lower lemma* similar to upper glume but glabrous; *upper lemma* pallid, as long as spikelet, coriaceous, punctulate-striate, apex obtuse.

Remarks — Linnaeus (1762) recombined *Panicum dissectum* L. as *Paspalum dissectum* (L.) L., giving the provenance as "in America calidiore". Murray (May–Jun 1784) gave no provenance for *Paspalum dissectum* Murray and made no reference to Linnaeus or Thunberg (as he did, e.g., under the preceding species, *Phalaris hispida* Thunb.); he therefore published an illegitimate later homonym. Thunberg (Aug 1784) misapplied the name *P. dissectum* (L.) L. to a Japanese plant, citing Linnaeus (1762) and using exactly the same diagnostic phrase name as did Murray. Kunth (1829) adopted the name *P. thunbergii* Kunth for the species to which Thunberg misapplied *P. dissectum*, citing "*P. dissectum* Thunb. Jap." (i.e. Thunberg 1784) in synonymy, not mentioning *P. dissectum* Murray, and giving the provenance as "Japonia, Java"; he clearly excluded the correctly applied *P. dissectum* (L.) L. because he accepted that species separately (l.c., as "*P. dissectum* Linn. Sp." from "America calid., Brasilia"). Kunth included no description or diagnosis in the protologue of *P. thunbergii*, but the name was validly published by the reference he provided to the diagnosis in Thunberg (1784). Steudel (1853: 28) published *P. thunbergii*, ascribing the name to Kunth and providing a diagnosis, citing "*P. dissectum* Thunb. Jap. 45. non Lin." This is clearly a subsequent use of the already validly published *P. thunbergii* Kunth, not a new name attributable to "Kunth ex Steud."

The systematic position of *Paspalum thunbergii* is uncertain and, to our knowledge, this species has not been included in molecular phylogenetic studies. It is similar to *P. scrobiculatum* L. and has been combined under that species, as *P. scrobiculatum* var. *thunbergii* (Kunth) Makino (Makino 1896). This and related species have been accommodated in the informal Plicatula Group, which is characterized by usually dark brown upper lemmas (e.g. Rua & al. 2009), which are pale in *P. thunbergii*. Cidade & al. (2013) referred to this group as a highly complex assemblage.

From its putative relatives, *Paspalum plicatulum* Michx. and *P. scrobiculatum*, both with a more or less pantropical distribution, *P. thunbergii* is distinguished by upper lemmas that are pale at maturity. With the similar *P. longifolium* Roxb. – also widespread and weedy – it shares the pale upper lemmas, but this species has more numerous racemes (up to 20), smaller spikelets (2–2.5 mm long), and a broader rachis up to 4 mm wide.

Compared with the species of *Paspalum* hitherto known to occur in Italy, *P. thunbergii* is most similar to *P. dilatatum*. Both are tufted, fairly robust perennials with racemose inflorescences with 2–6 spreading branches and paired spikelets. However, in *P. thunbergii* the leaf blades and sheaths are densely hirsute hairy, spikelets are slightly smaller (2.5–3 mm long, vs 2.8–4 mm long), rounded to subacute at the apex and only sparsely and very shortly

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Fig. 1. *Paspalum thunbergii* in Italy. – A: forest path in Boscaccio: B: roadside ditch in Mortara; C: rhizome; D: inflorescence; E: spikelets. – A: Boscaccio, photographed in August 2015 by Guido Brusa; B–E: Mortara, photographed in August 2015 by Nicola Ardenghi.

pubescent, especially along the margins (vs acuminate at the apex, with long-ciliate margins). Moreover, *P. thunbergii* typically has upper glumes that are 3-veined with a very prominent central vein and marginal lateral veins (vs 5–7-veined upper glumes in *P. dilatatum*). Also, both species are ecologically rather different (see below). *Paspalum thunbergii* and *P. dilatatum* locally have likely been confused in Italy or elsewhere in Europe. However, a revision of herbarium specimens of the latter in some herbaria (BER, BR, HBBS, GENT, MSNM, PAV and TO; acronyms according to Thiers [continuously updated]) only yielded one supplementary record of *P. thunbergii* (see specimens examined).

Identification key for the species of *Paspalum* in Europe:

1. Stoloniferous and/or rhizomatous perennial, rooting at lower nodes. Inflorescence conjugate, i.e. composed of a terminal pair of branches, sometimes with 1–5 additional branches. Spikelets usually solitary (rarely paired) **2**
– Caespitose or shortly rhizomatous perennial, not rooting at nodes. Inflorescence with 1 to numerous racemosely arranged branches. Spikelets paired **4**
2. Upper glume sparsely shortly pubescent on back . . . . . ***P. distichum*** (incl. subsp. *paucispicatum*)

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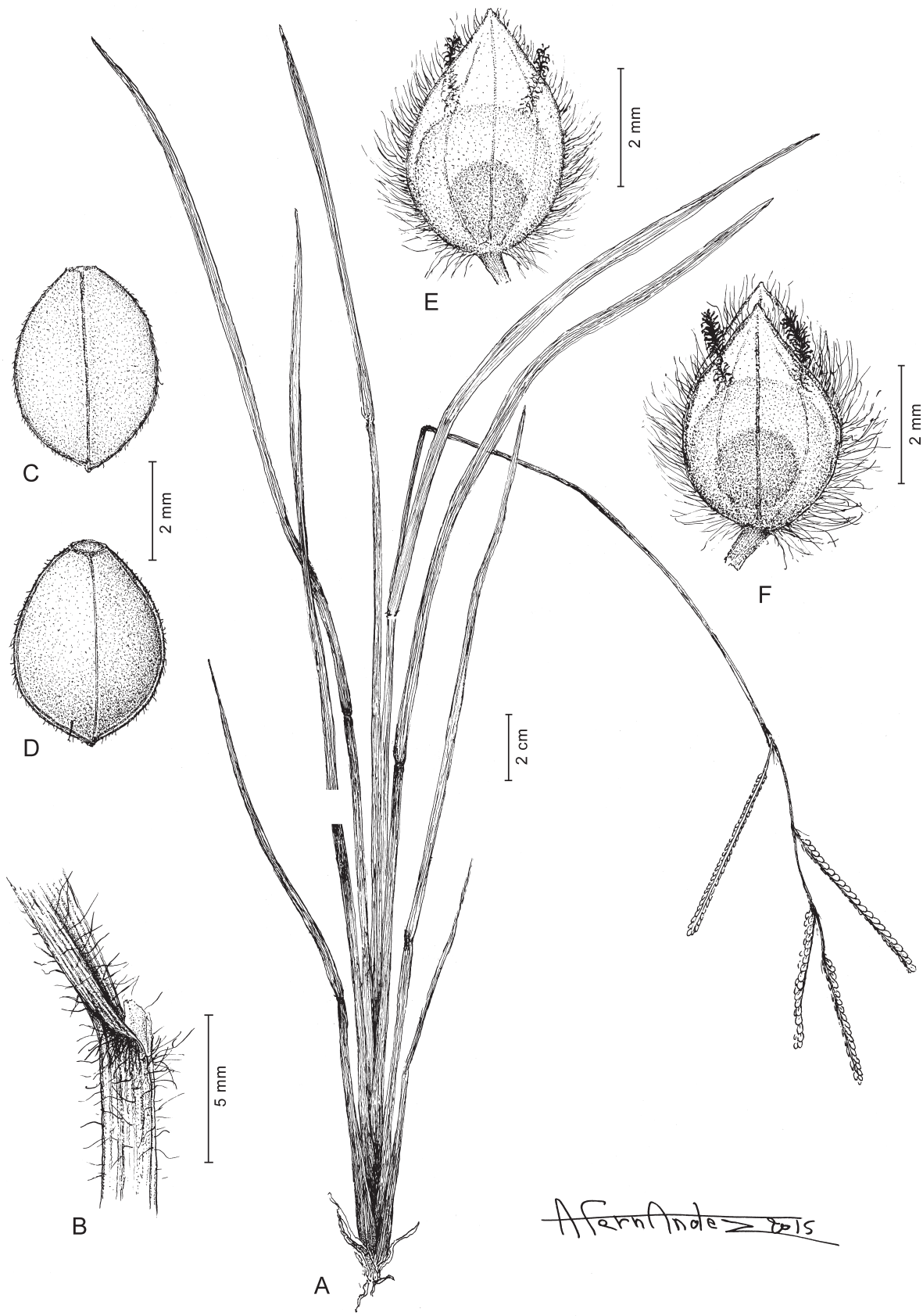


Fig. 2. *Paspalum thunbergii*: A: general habit; B: leaf sheath; C: spikelet abaxial surface; D: spikelet adaxial surface. – *Paspalum dilatatum*: E: spikelet abaxial surface; F: spikelet adaxial surface. – Drawn by Antonio Fernandez; A-D from [see selected specimens examined] *G. Brusa s.n.* (BR); E, F from France, Landes, Ondres, N of Bayonne, alongside Etang d'Irieu, 19 Jul 1979, *J. E. De Langhe 424/79* (BR).

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– Upper glume glabrous on back **3**
3. Spikelets lanceolate, acute to acuminate at apex. Ligule 1–2 mm long . . . . . ***P. vaginatum***
– Spikelets ovate, obtuse at apex. Ligule 0.2–0.4 mm long . . . . . ***P. notatum*** (incl. *P. saurae*)
4. Upper glumes and lower lemmas long-ciliate at margins with silky hairs 1–2 mm long **5**
– Upper glumes and lower lemmas glabrous to minutely pubescent, hairs much shorter and not silky . . . **6**
5. Panicle branches (2 or)3–5(–7). Spikelets 2.8–4 mm long. Leaf sheath usually glabrous (in Europe) . . . . . ***P. dilatatum***
– Panicle branches (7–)10–30. Spikelets 1.8–2.8 mm long. Leaf sheath usually pubescent (in Europe) . . . . . ***P. urvillei***
6. Panicle branches 2–6, rarely more. Culms 50–110 cm tall. Leaf blades and sheaths hirsute hairy. Spikelets orbicular-elliptic, rounded at apex **7**
– Panicle branches 10–40. Culms up to 180 cm tall. Leaf blades and sheaths glabrous or shortly hairy. Spikelets elliptic, (sub)acute at apex **8**
7. Spikelets 2.5–3 mm long. Panicle branches 2–6, rarely more, on relatively short and thick peduncles . . . . . ***P. thunbergii***
– Spikelets 1.4–1.9 mm long. Panicle branches usually fewer (often solitary), on long and thin peduncles . . . . . ***P. setaceum***
8. Spikelets 3–3.5 mm long, (sub)acute, lower lemma and upper glume slightly longer than upper floret. Upper glume slightly pubescent to subglabrous without bulbous-based hairs . . . . . ***P. exaltatum***
– Spikelets 2–2.5 mm long, (sub)obtuse, lower lemma and upper glume equal to upper floret. Upper glume densely pubescent with bulbous-based hairs . . . . . ***P. quadrifarium***

Ecology and habitat preferences

In its area of origin (see below) *Paspalum thunbergii* occurs in fields and waste places, usually on moist soils (Chen & Phillips 2006). In Boscaccio, *P. thunbergii* grows alongside a forest path over a distance of c. 180 m. The species mostly occurs on the edges of the path, not in the centre where trampling seems to prevent its development. As a consequence, the plants of *P. thunbergii* grow in interrupted linear stands 50–100 cm wide; a total area of about 70 square meters is currently occupied by the species at this site. The flowering period starts in the middle of August and continues until the first frost (mostly at the end of October or later). Seedlings were not recorded in the surroundings of the flowering plants; spreading seems to be mostly (or entirely?) vegetative, i.e. by means of the short rhizomes. However, new stands are likely to establish from seed. The soil is mainly loamy and water stagnation occurs after abundant rainfall. At the end of summer, hygrophilous species grow together with *P. thunbergii*, such as *Carex sylvatica* Huds., *Lycopus europaeus* L., *Lythrum salicaria* L. and *Persicaria hydropiper* (L.) Spach; the protected *Eleocharis carniolica* W. D. J. Koch (Annex II, Habitats Directive 92/43 of the European Union) was also recorded in a small pool nearby. However, weedy species are most frequent: *Echinochloa crus-galli* (L.) P. Beauv., *Plantago major* L., *Poa annua* L., etc., especially short-lived alien species such as *Bidens frondosa* L., *Digitaria violascens* Link, *Erigeron annuus* (L.) Desf. and *Panicum dichotomiflorum* Michx. and perennial aliens such as *Juncus tenuis* Willd., *Muhlenbergia schreberi* J. F. Gmel., *Oxalis stricta* L., *Potentilla indica* (Jacks.) Th. Wolf and *Solidago gigantea* Aiton. *Paspalum thunbergii* does not exhibit the ability to invade the nearby heathland, where a monospecific stand of *Molinia arundinacea* Schrank covers the understory.

The population of *Paspalum thunbergii* in Mortara occupies a linear area of about 260 × 1 m between an unsurfaced road and a rice field channel with a cover ranging from about 80 % (at the border of the population) to 95 % (most of the area); other species have a <1% cover [e.g. *Convolvulus arvensis* L., *Linaria vulgaris* Mill., *Potentilla reptans* L., *Ranunculus acris* L., *Setaria pumila* (Poir.) Roem. & Schult., *Sorghum halepense* (L.) Pers., *Trifolium repens* L., *Urtica dioica* L., *Vicia cracca* L.]. *Paspalum thunbergii* usually avoids the channel bank, which is occupied by a well-developed *Magnocaricion elatae* community (*Carex acutiformis* Ehrh., *Convolvulus sepium* L., *Lotus pedunculatus* Cav., *Lythrum salicaria* L., *Solanum dulcamara* L., *Sparganium erectum* L., *Symphytum officinale* L., *Urtica dioica* L.). With its greenish-bluish erect leaf blades, the plants are visible from a distance. In Mortara, the species surely spreads both by seed and vegetatively.

Distribution and weed status in the world and in Italy

Paspalum thunbergii is originally native in E Asia. It is widely distributed in India (Darjeeling, Sikkim), Bhutan, China (provinces of Anhui, Fujian, Guangdong, Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Shandong, Sichuan, Yunnan and Zhejiang), Taiwan, Korea and Japan (Chen & Phillips 2006). It is known as an introduction further to the west. Tsvelev (1984) reported it from the former Soviet Union in Georgia and Azerbaijan and, more recently, it was discovered in NE Turkey (e.g. Terzioğlu & Anşin 2001; Korkmaz & al. 2008). It is probably also present in Hawai‘i, where it has been confused with *P. scrobiculatum* (Snow 2010).

Paspalum thunbergii has some economic importance, since it is sometimes planted for erosion and desertification control or for afforestation purposes (Quattrocchi 2006). However, it is also a reputed weed species (e.g. Holm & al. 1979; Häfliger & Scholz 1980; Watson & Dallwitz 1992), mostly in paddy fields (e.g. Moody 1989), but also in sugar cane, for instance in Taiwan (Peng 1984).

It is not clear how *Paspalum thunbergii* arrived in Italy. Although it has some economic importance, in Italy

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an accidental introduction seems more likely. In Boscaccio the forest path leads to a fish pond where the Chinese pond mussel (*Sinanodonta woodiana* Lea) was recently introduced. This species is known to have entered Europe with, among others, Chinese fish such as silver carp, *Hypophthalmichthys molitrix* Valenciennes (Cappelletti & al. 2009). It is remarkable that apparently in the same period a grass species native to China emerged in the same area. Alternatively, forestry work in the nearby heathland may also have been responsible for the inadvertent introduction of *P. thunbergii* in Boscaccio (by propagules adhered to the forestry machines). In the latter case, it should occur elsewhere in the area as well. The vector of introduction in the Mortara locality is not clear, but it is probable that it arrived along with rice seeds (this species is recorded from wet soils, including paddy fields, in China). The species was surely not introduced for revegetation of the channel embankment, since rice growers in the Lombardia and Piemonte regions prefer bare embankments and rice field margins that are devoid of any kind of vegetation, weedy or not.

According to the criteria defined by Richardson & al. (2000), in Italy *Paspalum thunbergii* is regarded as a naturalized species on the basis of current data.

Selected specimens examined

Italy: Lombardia: Pavia province, Mortara, strada Cascina Gianolo all'altezza dell'omonima cascina (CFCE 0718-1:Mortara), UTM ED50: 32T 0477413.5012041, 109 m, sponda di fossato, copioso, 20 Jul 2011, *N. Ardenghi 43241*, *43242* (MSNM [sub *P. dilatatum*]); ibid., 45°15'32.3"N, 08°42'49.0"E, 110 m, between an unsurfaced road and a rice field channel embankment, wet compacted sandy soil, 12 Aug 2015, *N. Ardenghi & S. Mossini s.n.* (BR); Monza and Brianza province, Boscaccio, municipality of Lentate sul Seveso, 45°41'33.1"N, 09°08'38.9"E, 280 m, along a path in a woodland of *Quercus robur* and *Pinus sylvestris*, near a road, acid (heathland ecosystem), 2 Oct 2014, *G. Brusa s.n.* (BR). — China: Guizhou: Jiangkou Xian, Heiwan River at Tongkuangchang, SE side of the Fanjing Shan mountain range, river flood plain and adjacent mixed-deciduous broad-leaved evergreen forest on steep slopes, c. 900 m, growing in weedy area along trailside with *Plantago*, 27 Aug 1986, *Sino-American Guizhou Botanical Expedition 551* (BR). — Japan: Hondo, Noda in Shimosa, 28 Aug 1950, *J. Ohwi 64* (BR); Yokoska, *Savatier 1866-74* (BR, [dupl. P n.v.]); Yokohama, 1862, *Maximowicz Iter secundum* (BR, [dupl. LE n.v.]).

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References

Ardenghi N. M. G. 2013: Notulae 143–161. – Pp. 19–27 in: Galasso G. & Banfi E. (ed.), Notulae ad plantas advenas Longobardiae spectantes: 3 (141–208). – Pagine Botaniche **36:** 18–59.

Böhling N. & Scholz H. 2004: *Paspalum notatum* Flüggé. – P. 79 in: Greuter W. & Raus Th. (ed.), Med-Checklist Notulae, 22. – Willdenowia **34:** 71–80.

Cappelletti C., Cianfanelli S., Beltrami M. E. & Ciutti F. 2009: *Sinanodonta woodiana* (Lea, 1834) (*Bivalvia: Unionidae*): a new non-indigenous species in Lake Garda (Italy). – Aquatic Invasions **4:** 685–688.

Carretero J. L. 1987: *Paspalum saurae* (Parodi) Parodi, una gramínea nueva para Europa. – Anales Jard. Bot. Madrid **44:** 175–176.

Chen S.-L. & Phillips S. M. 2006: *Paspalum*. – Pp. 526–530 in: Wu Z.-Y., Raven P. H. & Hong D.-Y. (ed.), Flora of China **22.** *Poaceae*. – Beijing: Science Press; St. Louis: Missouri Botanical Garden Press.

Cidade F. W., Vigna B. B. Z., de Souza F. H. D., Valls J. F. M., Dall'Agnol M., Zucchi M. I., de Souza-Chies T. T. & Souza A. P. 2013: Genetic variation in polyploid forage grass: Assessing the molecular genetic variability in the *Paspalum* genus. – BMC Genetics **14:** 50.

Clayton W. D. 1980: *Paspalum*. – P. 263 in: Tutin T. G., Heywood V. H., Burges N. A., Moore D. M., Valentine D. H., Walters S. M. & Webb D. A. (ed.), Flora europaea **5.** – Cambridge: Cambridge University Press.

Clayton W. D. & Renvoize S. A. 1982: *Gramineae* (part 3). – Pp. 451–98 in: Polhill R. M. (ed.), Flora of tropical East Africa. – Rotterdam: A. A. Balkema.

Euro+Med 2006+ [continuously updated]: Euro+Med PlantBase – the information resource for Euro-Mediterranean plant diversity. – Published at http://ww2.bgbm.org/EuroPlusMed/ [last accessed 22 Mar 2016].

Flüggé D. J. 1810: Graminum monographiae. Pars **I.** *Paspalus*. *Reimaria*. – Hamburgi: F. Perthes et J. H. Besser.

Garbari F. 1966: *Paspalum quadrifarium* Lam. nella campagna pisana. – Giorn. Bot. Ital. **73:** 326.

Häfliger E. & Scholz H. 1980: Grass weeds **I.** – Basle: Documenta Ciba-Geigy.

Hansen A. & Sunding P. 1993: Flora of Macaronesia. Checklist of vascular plants. 4th revised edition. – Sommerfeltia **17:** 1–167.

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Holm L., Pancho J. V., Herberger J. P. & Plucknett D. L. 1979: A geographical atlas of world weeds. – New York: J. Wiley & sons.

Korkmaz H., Yalcin E. & Berk E. 2008: An investigation on the floristic characteristics of the Boztepe Protected Forest Area (Unye-Ordu). – EurAsian J. BioSci. **2:** 1–17.

Kunth K. S. 1829: Révision des Graminées **1.** – Paris: Gide.

Linnaeus C. 1762: Species plantarum, ed. 2, **1.** – Holmiae: Laurentii Salvii.

Litzler P. 1979: *Paspalum urvillei* Steudel en Espagne. – Bull. Soc. Bot. France, Lettr. Bot., **126:** 95–102.

Makino T. 1896: Mr. Hisashi Kuroiwa's collections of Liukiu plants. – Bot. Mag. (Tokyo) **10:** 55–60.

Moody K. 1989: Weeds reported in rice in south and southeast Asia. – Los Baños: International Rice Research Institute.

Murray J. A. 1784: Systema vegetabilium secundum classes ordines genera species cum characteribus et differentiis, ed. 14. – Gottingae: Jo. Christ. Dieterich.

Peng S. Y. 1984: The biology and control of weeds in sugarcane. – Amsterdam: Elsevier.

Pinto da Silva A. R. 1940: O género *Paspalum* em Portugal. – Agron. Lusit. **2:** 5–23.

Quattrocchi U. 2006: CRC World dictionary of grasses: names, scientific names, eponyms, synonyms, and etymology. – Boca Raton: CRC Taylor & Francis.

Richardson D. M., Pyšek P., Rejmánek M., Barbour M. G., Panetta F. D. & West C. J. 2000: Naturalization and invasion of alien plants: concepts and definitions. – Diversity & Distrib. **6:** 93–107.

Rua G., Valls J. F. M., Graciano Ribeiro D. & Oliviera R. C. 2009: Four new species of *Paspalum* (*Poaceae*, *Paniceae*) from central Brazil, and resurrection of an old one. – Syst. Bot. **33:** 267–276.

Scataglini A., Zuloaga F. O., Giussani L. M., Denham S. S. & Morrone O. 2014: Phylogeny of *Paspalum* (*Poaceae*, *Panicoideae*, *Paspaleae*) based on plastid and nuclear markers. – Pl. Syst. Evol. **300:** 1051–1070.

Scholz H. 2002: *Paspalum notatum* Flüggé. – P. 206 in: Greuter W. & Raus Th. (ed.), Med-Checklist notulae, 21. – Willdenowia **32:** 195–208.

Siverio Núñez A., Sobrino Vesperinas E, Rodríguez De la Torre H. A., Reyes-Betancort J. A. & Santos Guerra A. 2013: Nuevos xenófitos de elevada capacidad invasora para la flora canaria. – Bot. Macaronés. **28:** 165–173.

Snow N. 2010: Notes on grasses (*Poaceae*) in Hawai'i: 2. – Bishop Mus. Occas. Pap. **107:** 46–60.

Soldano A. & Verloove F. 2015: 676. *Paspalum paucispicatum* Vasey. – Pp. 315–316 in: Selvaggi A., Soldano A., Pascale M. & Dellavedova R. (ed.), Note floristiche piemontesi n. 604–705. – Rivista Piemont. Storia Nat. **36:** 275–340.

Steudel E. G. 1853–1854 ["1855"]: Synopsis plantarum glumacearum **1.** – Stuttgartiae: J. B. Metzler.

Terzioğlu S. & Anşin R. 2001: A chorological study on the taxa naturalized in the eastern Black Sea region. – Turk. J. Agric. Forest. **25:** 305–309.

Thiers B. [continuously updated]: Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. http://sweetgum.nybg.org/science/ih/ [last accessed 22 Mar 2016].

Thunberg C. P. 1784: Flora japonica. – Lipsiae: I. G. Mülleriano.

Tison J.-M. 2012: *Paspalum notatum*. – P. 302 in: Jeanmonod D. & Schlüssel A. (ed.), Notes et contributions à la flore de Corse, XXIV. – Candollea **67:** 293–321.

Tsvelev N. N. 1984: Grasses of the Soviet Union. – Rotterdam: A. A. Balkema.

Vázquez Pardo F. M. 2014: 083. – *Paspalum notatum* Flüggé. – Folia Bot. Extremadur. **8:** 84–85.

Verloove F. 2003: *Physalis ixocarpa* Brot. ex Hornem. and *Verbena litoralis* Kunth, new Spanish xenophytes and records of other interesting alien vascular plants in Catalonia (Spain). – Lazaroa **24:** 7–11.

Verloove F. 2005: New records of interesting xenophytes in Spain. – Lazaroa **26:** 141–148.

Verloove F. & Reyes-Betancort J. A. 2011: Additions to the flora of Tenerife (Canary Islands, Spain). – Collect. Bot. (Barcelona) **30:** 63–78.

Verloove F. & Reynders M. 2007a: Studies in the genus *Paspalum* (*Paniceae*, *Poaceae*) in Europe: 1. *Paspalum distichum* subsp. *paucispicatum*, an overlooked taxon in France. – Willdenowia **37:** 199–204.

Verloove F. & Reynders M. 2007b: Studies in the genus *Paspalum* (*Paniceae*, *Poaceae*) in Europe: 2. The *Quadrifaria* group. – Willdenowia **37:** 423–430.

Watson L. & Dallwitz M. J. 1992: Grass genera of the world. – Wallingford: CAB International.

Webster R. D. 1987: The Australian *Paniceae*. – Berlin & Stuttgart: J. Cramer.

Zuloaga F. O. & Morrone O. 2005: Revisión de las especies de *Paspalum* para América del Sur Austral (Argentina, Bolivia, Sur del Brasil, Chile, Paraguay y Uruguay). – Monogr. Syst. Bot. Missouri Bot. Gard. **102:** 1–297.

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