Università degli Studi di Pavia
Dipartimento di Scienze della Terra e dell'Ambiente

SCUOLA DI ALTA FORMAZIONE DOTTORALE
MACRO-AREA SCIENZE E TECNOLOGIE

DOTTORATO DI RICERCA IN SCIENZE DELLA TERRA E DELL'AMBIENTE

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The genus *Festuca* s.l. (Poaceae): taxonomic and distributional studies, with special reference to the *F. circummediterranea* group

Anno Accademico 2015−2016
Ciclo XXIX

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Abstract

Festuca L. (Poaceae, Loliinae) and allied genera represent one of the most problematic taxonomic critical groups of worldwide interest, for combination of intrinsic high phenotypic variability and nomenclatural complexity, produced by two centuries of heterogeneous and, to some extent, conflicting taxonomic interpretations. The present PhD thesis, through the examination of three main ISI papers and further "satellite" contributions (both ISI and non-ISI) published during the PhD course, fills some relevant gaps in the knowledge of *Festuca* s.l., with special regards to three research topics:

1. Nomenclature: the name *Festuca apennina* De Not., still lacking a formally designated type, is lectotypified and a new combination, shifting this taxon from *Festuca* to *Lolium* L. at species rank, is proposed: *L. apenninum* (De Not.) Ardenghi & Foggi;
2. Taxonomy: the first comprehensive karyological overview of the group of *Festuca circummediterranea* Patzke, comprising 10 Euro-Mediterranean taxa, is provided. The first chromosome counts for *F. jeanpertii* (St.-Yves) Markgr. subsp. *jeanpertii*, subsp. *achaica* Markgr.-Dann., and subsp. *gracilis* (Hack.) Raus are reported. All the taxa were found to be diploid ($2n=14$) and have a similar karyotype. These data clarify the relationships between each taxon and represent a valuable support to a future multidisciplinar systematic revision of the whole aggregate;
3. Applied Plant Taxonomy: the application of the current taxonomic knowledge in *Festuca* s.l. improved scientific fields more or less connected with taxonomy, such as:
    - (a) Phytogeography: the new treatment of *Festuca* s.l. within the new edition of Sandro Pignatti's *Flora d'Italia* (in press) has been fulfilled; along with floristic novelties at regional scale, the distributional scenario of this critical group has been enhanced in both southern Europe and Italy;
    - (b) Crop wild relatives (CWR): taking into account the commercial value of fescues as cultivated grasses, the first taxonomically based priority list of Italian CWRs of *Festuca* s.l. has been compiled.

Contents

1. INTRODUCTION

1.1. “Fescues”, a multiform critical group

“*PYRGOPOLINICES: Quid ea? Ingenuan an festuca facta e serva liberast?*”
(Plautus, *Miles gloriosus*, v. 961)

Within the verse 961 of the comedic play *Miles gloriosus* (“Braggart Warrior”), the Roman playwright Titus Maccius Plautus (c. 251−184 BC), through the words of the soldier Pyrgopolynices, unveils a peculiar meaning of the Latin term *festūca*, *-ae*. In ancient Rome, “*festuca*” meant “straw”, “stem”, “stalk”, and was used by Pliny the Elder to name a group of grasses “*quae vocatur aegilops*” (Castiglioni & Mariotti, 2005). Yet, the significance adopted by Plautus belongs to the Roman civil law context (Hammond *et al.*, 1997), where the word acquired a broader significance: it indicated the rod (known also as “*vindicta*”) laid by the lictor of the magistratus on the head of a slave in the act of releasing him from slavery (“*Manumissio vindicta*”) (Smith, 1842).

By contrast with the ancient Roman connotation of freedom, the term “*festuca*”, intended as a complex of distinct grass genera (“*Festuca* s.l.”), is traditionally regarded by most botanists, both professional and amateur, as one of the most intricate critical groups, at least in the Euro-Mediterranean flora, along with genera like *Hieracium* L., *Pilosella* Hill, *Rosa* L., *Rubus* L., and *Alchemilla* L. A combination of intrinsic high phenotypic variability (due to its open reproductive system), nomenclatural complexity, lack of universally accepted diagnostic features, and low aesthetic appeal, forced botanists to submit to a continuously mutable scenario, made of heterogeneous and sometimes cryptic taxonomic interpretations, making a unequivocal and quick identification of the specimens extremely difficult (Foggi *et al.*, 2007).

The genus *Festuca* L. (Poaceae, Pooideae, Poeae, Loliinae) was described by Linnaeus in 1753 (Linnaeus, 1753), but his original concept was much broader than today, as it included species currently belonging to other subfamilies, tribes, and genera, such as *Danthonia decumbens* (L.) DC. (≡ *Festuca decumbens* L.), *Glyceria fluitans* (L.) R.Br. (≡ *Festuca fluitans* L.), and *Rostraria cristata* (L.) Tzvelev (≡

Festuca cristata L.). In the course of the centuries, the limits of *Festuca* became better circumscribed and new genera emerged. One of the first agrostologists to recognize a scarse homogeneity in Linnaeus' treatment was Palisot de Beauvois (1812), who described the new genus *Schedonorus* P.Beauv., to accommodate some of the species characterized by broad leaf blades. This choice marked the traditionally accepted distiction between "broad-leaved fescues" and "fine-leaved fescues" (characterized by conduplicate leaf blades on the tillers), the latter group commonly regarded as the "authentic" fescues [not by chance, the type of the genus *Festuca* is *F. ovina* L., a fine-leaved species; see Nash (1913), and Jarvis *et al.* (1987), and Jarvis (2007)]. In subsequent years, similar alternatives were proposed by Grisebach (1852) and Janka (1860), who introduced two further genera, *Leucopoa* Griseb. and the monotypic *Amphigenes* Janka respectively (see also Müller & Catalán, 2006). In the same period, Willkomm (1861) proposed, within *Festuca*, the sect. *Eskia* Willk., encompassing species characterized by prominent ligules, and lemmas and paleas with scarious margins.

Towards the end of the 19th century, Eduard Hackel published *Monographia Festucarum Europaearum* (Hackel, 1882), a monumental work on the genus *Festuca* s.l., despite focused only on the taxa native to Europe and nearby countries. In his monograph, Hackel considerably changed the systematics of *Festuca* s.l. and introduced remarkable methodological innovations, still followed today (such as transversal leaf sections as diagnostic character), which improved the classification and eased the identification processes. He did not accept the previuously segregated genera and adopted a genus circumscription more similar to that of Linnaeus. Yet, like his precursors, he was deeply conscious of the high variability of the genus and preserved the post-Linnaean taxonomic subdivisions by introducing an infrageneric classification system articulated in six sections (Hackel, 1881, 1882), whose basic organization is still used nowadays (at least in part). Hackel grouped most of the fine-leaved taxa within sect. *Ovinae* (Fr. ex Andersson) Hack., nom. inval., while he distributed the broad-leaved taxa among the remaining sections: *Bovinae* (Fr. ex Andersson) Hack. (= *Schedonorus*), *Montanae* Hack., *Scariosae* Hack. (= sect. *Eskia* p.p.), *Subbulbosae* Nyman ex Hack. and *Variae* Hack. (= *Amphigenes* = sect. *Eskia* p.p.).

In the second half of the 20th century, Alexeev (1977) proposed a new infrageneric subdivision of *Festuca* at the rank of subgenus, recognizing four different subgenera: *Festuca*, *Drymanthele* Krecz. & Bobrov (= sect. *Montanae*), *Leucopoa* (Griseb.) Hack., and *Schedonorus* (P.Beauv.) Peterm., with *Festuca* comprising the fine-leaved taxa. Holub (1984, 1998) subsequently elevated *Drymanthele* to genus rank, adopting the new name *Drymochloa* Holub, and Darbyshire (1993), in opposition to the splitting tendency, transferred the *Schedonorus* taxa to the genus *Lolium* L., mainly on the basis of biological affinities (i.e., high hybridization rate between *Schedonorus* and *Lolium*).

The recent studies on the phylogeny of *Festuca* s.l. (Gaut *et al.*, 2000; Torrecilla & Catalán, 2002; Torrecilla *et al.*, 2003, 2004; Catalán *et al.*, 2004, 2007; Catalán, 2006; Inda *et al.*, 2008; Soreng *et al.*, 2015) evidenced the separation of two main clades:

(1) the highly supported "fine-leaved" fescues, with two lineages made up by:
    (a) *Festuca* s.s. and several annual [*Ctenopsis* De Not., *Micropyrum* (Gaudin) Link, *Narduroides* Rouy, *Psilurus* Trin., *Vulpia* C.C.Gmel., and *Wangenheimia* F.Dietr.] and a couple of perennial (*Dielsiochloa* Pilg. and *Hellerochloa* Rauschert) taxa traditionally attributed to other genera;
    (b) *Festuca* sects. *Eskia*, *Pseudatropis* Krivot. (separated from *Eskia* by Krivotulenko, 1960), and *Dimorphae* Catalán & Joch.Müll.;
(2) the poorly supported "broad-leaved" fescues, comprising several lineages of unclear relationships, formed by:
    (a) *Schedonorus*, *Lolium*, and the monotypic genus *Micropyropsis* Romero Zarco & Cabezudo;
    (b) *Festuca* sect. *Subbulbosae*;
    (c) *Leucopoa* p.p.;
    (d) *Drymochloa*, *Festuca* sects. *Scariosae* and *Pseudoscariosae* Krivot. (the latter segregated from sect. *Eskia* by Krivotulenko, 1960);
    (e) *Festuca* sect. *Lojaconoa* Catalán & Joch.Müll. (= *Subbulbosae* p.p.);
    (f) *Leucopoa* p.p. (= *Amphigenes*) and *Festuca* sect. *Subulatae* Tzvelev.

Since the 2010's, new contributions have been published in order to transpose the phylogenetic scenario into a taxonomic and nomenclatural treatment fully representative of the relationships between the various groups of taxa. All the genera falling within the "fine-leaved fescues" clade (1a + 1b) have been grouped under the genus *Festuca* (Kellogg, 2015; Soreng *et al.*, 2015), with the exception of sect.

Dimorphae (*Festuca carpatica* F.Dietr., *F. dimorpha* Guss., *F. laxa* Host), regarded by some authors (Foggi *et al.*, 2005, 2010; Foggi & Müller, 2009b) as part of the genus *Leucopoa*, in disagreement with the molecular results. Most of the lineages comprised within the "broad-leaved fescues" clade have been treated as independent genera, although some discrepancies between the phylogenetic data and taxonomy are still obvious: *Lolium* (2a), *Patzkea* G.H.Loos (2b + 2e), *Leucopoa* (2c + 2f), and *Drymochloa* (2d) (see, e.g., Darbyshire, 1993; Foggi *et al.*, 2005, 2010; Foggi & Müller, 2009b; Loos, 2010; Soreng *et al.*, 2015).

1.2. The genus *Festuca* s.s.

The genus *Festuca*, as circumscribed here, includes more than 500 species, mainly distributed in the temperate and cool areas of the Northern and Southern Hemispheres, with a numerical prevalence in the Euro-Mediterranean region (Watson & Dallwitz, 1992+; Clayton *et al.*, 2006+; Euro+Med, 2006+; Barkworth *et al.*, 2007; Inda *et al.*, 2008; Foggi & Tison, 2014; Kellogg, 2015; Soreng *et al.*, 2015; Simon *et al.*, 2016). Despite the group is clearly monophyletic, it lacks any obvious morphological synapomorphies (Kellogg, 2015). Darbyshire & Pavlick (2007) described patterns of transverse leaf-sectional anatomy of putative diagnostic value for the whole genus, however comparable data are still not available for the other merged genera (Kellogg, 2015).

The perennial species traditionally referred to as "fine-leaved fescues" represent the main component of this genus, amounting to about 450 units (Foggi & Tison, 2014; Kellogg, 2015). They are conventionally arranged in four main sections, distinguished on the the basis of macro-morphological (emergence of new tillers, growth habit, ligule length) and anatomical (pattern of schlerenchyma in transverse tiller leaf section) characters: *Festuca* (incl. *F. ovina*, *F. stricta* Host, and *F. circummediterranea* Patzke groups), *Aulaxyper* Dumort. [incl. *F. rubra* L., *F. trichophylla* (Ducros ex Gaudin) K.Richt., and *F. violacea* Schleich. ex Gaudin groups], *Eskia* Willk., *Dimorphae* Catalán & Joch.Müll. This scheme partially corresponds to the classification system originally introduced by Hackel (1881, 1882) and is still employed today, with special regards to the Euro-Mediterranean representatives of the genus (see, e.g., Foggi & Rossi, 1996; Torrecilla *et al.*, 2004; Devesa *et al.*, 2013; Foggi & Tison, 2014). Sometimes, each section is additionally subdivided in groups (or aggregates) of small species, sharing similar morphological, anatomical, karyological, and ecological features.

1.3. State of the art in systematics, taxonomy, and nomenclature of *Festuca* s.l. in the Euro-Mediterranean area

Since Hackel's *Monographia Festucarum Europaearum* (Hackel, 1882), the systematics and taxonomy of *Festuca* s.l. across the Euro-Mediterranean region have advanced as a result of the efforts of many investigators. Among these, Saint-Yves (1913, 1927) and many other festucologists belonging to the French biosystematic school, such as Bidault (1968, 1969), Auquier (1977), and Kerguélen (1975), have provided valuable regional information and methodological contributions. All of these outcomes were condensed by Markgraf-Dannenberg (1980) in her monumental treatment of this genus for *Flora Europaea*, allowing to expose many taxonomic problems, with a consequent new drive in fescue research.

Since the late 1980's, the studies on *Festuca* and allied genera focused mainly on the systematics and taxonomy of single sections and groups of species, taking into account innovative methodological approaches, such as the investigation of karyology, ploidy level, and genetics. Yet, nomenclature kept its traditional basic role to correctly interpret two centuries of heterogeneous contributions on this critical group.

Besides the aforementioned papers on the phylogeny of *Festuca* and allied genera, which had a great impact on the taxonomic scenario of this group also in the Euro-Mediterranean area (see paragraph 1.1), the current treatment of *Festuca* s.s. in this region has been improved thanks to contributions on different species and infrageneric taxa, among these: sects. *Festuca* (Fuente & Ortuñez, 1998) and *Eskia* (Foggi *et al.*, 2007; Torrecilla *et al.*, 2013), *F. inops* De Not. (Foggi *et al.*, 2006), *F. pallens* (Šmarda & Kočí, 2003; Šmarda *et al.*, 2007), *F. robustifolia* Markgr.-Dann. (Foggi & Signorini, 2001), and the aggregates of *F. trichophylla* (Al-Bermani *et al.*, 1992), *F. violacea* (Foggi *et al.*, 1999), *F. valesiaca* (Arndt, 2008), and *F. alpina* (Foggi *et al.*, 2012a). In addition, comprehensive monographs and checklists have been published for France (Kerguélen & Plonka, 1989; Portal, 1999; Foggi & Tison, 2014), the Iberian Peninsula (Cebolla Lozano & Rivas Ponce, 2003; Devesa *et al.*, 2013), Italy (Foggi & Rossi, 1996), and the whole Euro-Mediterranean area (Foggi & Müller, 2009a), enhancing the local floristic knowledge.

In this context, a precious aid to better understand the variability of *Festuca* s.s. is provided by karyology, in particular chromosome counts, karyomorphology, and ploidy level estimation. Since speciation within this genus has been evidenced to be a consequence of hybridization and polyploidization processes (Malik & Thomas 1966), chromosome counts and ploidy level investigation proved to be key elements in clarifying the relationships between problematic taxa (Auquier & Kerguélen, 1978; Kerguélen & Plonka, 1989; Šmarda, 2006), especially those chracterized by a low morphological variability. Specifically, in the course of the last three decades, a generally accepted interpretation of karyological data gave origin to two main systematic approaches towards fescues: broad species containing miscellaneous polyploid complexes are splitted into distinct species or subspecies (see, e.g., Fuente García *et al*. 1997; Foggi *et al*., 1999; Arndt, 2008), while taxa featuring the same ploidy level are merged into a single systematic unit (see, e.g., Foggi *et al*., 2006); however, in the case of karyological homogeneity accompanied by clear differences on morphological, ecological and/or geographical grounds, the employment of infraspecific ranks (particularly, the subspecies rank) is recommended in order to preserve valuable information on the local variability (see, e.g., Foggi *et al*., 2012a). Following a tradition started in France by Litardière (1949, 1950), in recent times different contributions have been published, providing the first chromosome counts and karyomorphological data for a number of karyologically unknown taxa (see, e.g., Fuente *et al*., 2001; Šmarda & Kočí, 2003; Fiorini *et al*., 2008). However, the karyological information on *Festuca* s.l. is far from complete: for example, the chromosome number and ploidy level of about 16% of the taxa occurring in Italy are still unknown (pers. obs.), and extensive karyological overviews taking into account more populations from a single taxon are very few.

Despite the methodological innovations which improved the systematics of *Festuca* s.l. during the last decades, nomenclatural investigation still plays a primary role in the study of this critical group. Particularly, typification (i.e., the permanent attachment of a herbarium specimen or an illustration, known as "nomenclatural type", to a name; see Art. 7.2 of the *ICN*: McNeill *et al*., 2012) represents a basic tool for understanding and formally establishing the connection between a nomenclatural combination and a systematic unit, with respect to the original concept of its descriptor(s). This operation, which allows to clear centuries of ambiguities in the use of names, is universally accepted as the first and mandatory step for a thourough systematic research (Ardenghi *et al.*, 2013). Additionally, the study of protologues within the typification context (i.e., every element associated with a name at its valid publication, e.g., description, diagnosis, illustrations, etc.; see Art. 8A.4 of the *ICN*) often provides an amount of extra information useful not only for the typification purpose but also for the subsequent and more advanced stages in the systematic study. Specifically, the geographical provenance (known as "*locus classicus*") of the material employed by an author to describe a taxon, is of basic relevance to unequivocally associate further information of systematic significance (e.g., karyological and molecular data) with a specific taxon, in line with the concept of "*typification biosystématique*" introduced by Auquier & Kerguélen (1978). Aware of the scientific value connected with typification, festucologists, since the second half of the 20th century, published a high number of contributions in this field (e.g., Fuente & Sanchez-Mata, 1986; Jarvis *et al.*, 1987; Reveal *et al.*, 1991; Foggi & Signorini, 1997; Signorini & Foggi, 1997; Foggi *et al.*, 2004, 2006, 2012b; Ardenghi *et al.*, 2013), yet without covering the historical nomenclatural pulverization distinctive of *Festuca* s.l.

One of the tasks of modern nomenclature is to "translate" the systematic relationships between taxa evidenced by phylogeny into formally correct names fully representative of the biological information. For this purpose, different tools, strictly regulated by the *International Code of Nomenclature for algae, fungi, and plants* (*ICN*) (McNeill *et al.*, 2012), are available to researchers in this field, such as the possibility to publish new combinations (see, e.g., Art. 41 of the *ICN*) and reject or conserve older names (see, e.g., Arts. 14 and 56 of the *ICN*). Despite the fact that many contributions have recently been published on this topic (see, e.g., Darbyshire, 1993; Soreng *et al.*, 2001; Foggi *et al.*, 2005; Danihelka *et al.*, 2009; Foggi *et al.*, 2010; Loos, 2010), the current nomenclatural treatment of different sections of *Festuca* s.s. and allied genera (such as the "broad-leaved fescues") need to be improved and refined, mainly to solve many discrepancies with phylogeny (see, e.g., the cases of *Schedonorus* and *Micropyropsis* vs. *Lolium*, *Festuca* sect. *Dimorphae* vs. *Leucopoa* p.p., *Lojaconoa* and *Festuca* sect. *Subbulbosae* vs. *Patzkea*, and *Vulpia* vs. *Festuca* exposed in paragraph 1.1).

1.4. The group of *Festuca circummediterranea*

Along with the aggregates of *Festuca ovina* and *F. rubra*, the group of *F. circummediterranea* is one of the least known in the Euro-Mediterranean area. According to the current systematic treatment of *Festuca* in this region (Foggi & Müller, 2009a), the group includes ten closely related taxa [*F. circummediterranea*, *F. humifusa* Brullo & Guarino, *F. jeanpertii* (St.-Yves) Markgr. subsp. *jeanpertii*, subsp. *achaica* Markgr.-Dann., subsp. *campana* (N.Terracc.) Markgr.-Dann, and subsp. *gracilis* (Hack.) Raus, *F. lambinonii* Kerguélen, *F. marginata* (Hack.) K.Richt. subsp. *marginata*, subsp. *andres-molinae* Fuente & Ortúñez, and subsp. *gallica* (Hack. ex Charrel) Breistr.], distributed on a vast geographical area spanning from the Iberian Peninsula eastwards to the Aegean Islands and Turkey, in the Alps and north-western Africa. They grow in xerophilous grasslands and pastures from the sea level to the subalpine belt, and are characterized by schlerenchyma arranged in three well-defined strands at the margins and the keel of the transversal leaf section. Their relatedness was already recognized by Hackel (1882), who placed most of these taxa within *Festuca ovina* subsp. *laevis* Hack., a choice subsequently followed also by Markgraf-Dannenberg (1976) and Foggi *et al.* (2009, 2012b).

Preliminary morphometrical, karyological, and molecular analyses carried out by Foggi *et al.* (2009) on the taxa occurring across the Italian peninsula raised doubts about the currently accepted taxonomic limits between species and subspecies. None of the investigated parameters allowed a separation of well-defined groups of variability; thus, the possibility of treating the taxa occurring in Italy as a single species was assumed. Accordingly, Foggi & Tison (2014) simplified the treatment of the *F. circummediterranea* group in France by merging *F. circummediterranea* s.s., *F. lambinonii*, and *F. marginata* subsp. *gallica* into a single species with two subspecies, *F. marginata* subsp. *marginata* (incl. subsp. *gallica*) and *F. marginata* subsp. *alopecuroides* (Hack.) K.Richt. (= *F. lambinonii*; incl. *F. circummediterranea* sensu auct. Fl. Gall.).

In order to start a multidisciplinary systematic revision of the whole aggregate across its distributional range, further preliminary data need to be acquired and analyzed. While the nomenclatural aspects have been already investigated in-depth by Foggi *et al.* (2012b), other elements, such as chromosome counts and ploidy level estimation, are currently not available for all the taxa constituting the *F. circummediterranea* group. This sort of information, which proved to be relevant in the revision of other aggregates belonging to the sect. *Festuca* (e.g., *F. alpina* group, see Foggi *et al.*, 2012a), will be of fundamental aid to a future revision of the *F. circummediterranea* group, especially if integrated with data coming from the analysis of morphological and biomolecular parameters.

1.5. Aim of the research

Aim of this study is to fill some major gaps in the knowledge of *Festuca* and allied genera, with special regards to the following three research topics:

(1) *Nomenclature*: typify names in *Festuca* s.l. still lacking a formally designated type; provide new nomenclatural combinations for relocating species and subspecies into the correct genus at the most appropriate taxonomic rank, in accordance with the recent phylogenetic treatments;

(2) *Taxonomy*: provide supporting data of taxonomic relevance as a pre-requisite for multidisciplinary systematic revisions of critical aggregates of species; special attention will be paid to the controversial group of *Festuca circummediterranea* and its karyological aspects;

(3) *Applied Plant Taxonomy*: application of the current taxonomic knowledge in *Festuca* s.l. for improving scientific fields more or less connected with taxonomy, such as:

    (a) phytogeography;

    (b) crop wild relatives (CWR).

2. MATERIAL AND METHODS

The present thesis is based on the collection of three main original publications on *Festuca* L. and allied genera published in three different ISI journals during the PhD course. All the papers are enclosed within the thesis. Each publication, associated with one of the three research topics presented in paragraph 1.5, is preceded by a short introduction. Below each enclosed paper, a list of additional ISI publications on the same topic and non-ISI publications on *Festuca* s.l. is reported; they are numbered and mentioned in the text by means of the associated number (the three main articles are cited in chapter 4, "Conclusions", through the related Roman numbers).

The material and methods of each paper are summarized below; more detailed information is available in the text of each article.

(1) Article I (*Nomenclature*): investigation of the life, works and herbarium specimens of Giuseppe De Notaris, author of the name *Festuca apennina* De Not.; study of the protologue of *Festuca apennina* and subsequent literature regarding this taxon; search of herbarium specimens of interest for the typification purpose; study of the works on the phylogeny of the "broad-leaved fescues";

(2) Article II (*Taxonomy*): location of the *loci classici* of each species and subspecies (tot. 10 taxa) constituting the aggregate of *Festuca circummediterranea*; sampling of one-two live specimens from more than 100 populations across the distributional range of the aggregate, with special regards to the populations from the *loci classici*; cultivation of the sampled specimens; karyological analyses (chromosome counts and measurements) on cells undergoing somatic mitoses taken from developing root-tips in spring or autumn; idiograms and karyological formula of each sampled population;

(3) Article III (*Applied Plant Taxonomy*): consultation of taxonomic and floristic literature on *Festuca* s.l. in the Euro-Mediterranean area and Italy; application of the Taxon Group (TG) method to define the crop wild relatives of *Festuca* s.l. in Italy.

Papers on *Festuca* s.l. published in non-ISI journals during the PhD course or submitted to ISI journals and with the writer of this thesis not listed as the first author are enclosed in Appendix I (papers n. 4, 11, 13−14, 16−21, 23, 26); additional papers published in ISI journals regarding taxonomic groups different from *Festuca* s.l. are included in Appendix II (papers n. 1−3, 5−10, 12, 15, 22, 24−25, 27−29).

3. PUBLICATIONS

3.1. Article I (*Nomenclature*)

Ardenghi N.M.G. & Foggi B., 2015 − Lectotypification and combination of *Festuca apennina* (Poaceae). *Taxon*, 64(5): 1038−1041. DOI: 10.12705/645.14

The name *Festuca apennina* De Not., lacking a formally designated type, is lectotypified using a specimen preserved at the herbarium of the Natural History Museum of Florence (FI). The specimen was chosen after searching Giuseppe De Notaris' original material in different institutional Italian and European herbaria, such as GDOR (Museo Civico di Storia Naturale Giacomo Doria of Genoa), GE (University of Genoa), P (Muséum National d'Histoire Naturelle of Paris), PAD (University of Padova), and TO (University of Turin). The study of the specimen designated as lectotype and the analysis of the protologue allowed the authors to better understand the diagnostic morphological traits of this taxon (leaf sheaths, spikelets, lemmas), not clearly presented in the traditional literature on *Festuca* s.l. (see, e.g., Hackel, 1882; Markgraf-Dannenberg, 1980). Additionally, thanks to a field trip conducted in the *locus classicus* area (June 2015), located between north-western Emilia-Romanga and eastern Liguria (northern Italy), the ecological requirements of this taxon were investigated. Morphology and ecology, along with karyological data acquired from literature, enabled the authors to draw considerations on the taxonomy of *F. apennina*, that was treated as an independent species rather than a subspecies of *F. pratensis* Huds., as conventionally reported by most festucologists (see, e.g., Hackel, 1882; Saint-Yves, 1913; Markgraf-Dannenberg, 1980; Kerguélen & Plonka, 1989; Foggi *et al.*, 2005). Moreover, in accordance with the latest results on Loliinae phylogeny (see paragraph 1.1), a new combination is proposed, to transfer *F. apennina* into the genus *Lolium* L. at the species rank: *Lolium apenninum* (De Not.) Ardenghi & Foggi.

Lectotypification and combination of *Festuca apennina* (Poaceae)

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DOI http://dx.doi.org/10.12705/645.14

Abstract The name *Festuca apennina* is discussed and lectotypified using a specimen held at FI. A new combination, *Lolium apenninum*, is proposed.

Keywords *Festuca apennina*; *Festuca pratensis*; *Lolium*; *Schedonorus*; taxonomy; typification

■ INTRODUCTION

"Broad-leaved fescues" have originally been included within *Festuca* L. (Poaceae) by Linnaeus (1753) and the historical specialists of the genus (Hackel, 1882; Saint-Yves, 1927; Markgraf-Dannenberg, 1980). Since Alexeev (1977), however, this conception was gradually abandoned and two main taxonomic approaches emerged, principally in consequence of divergent interpretations of recent molecular data supporting a closer relationship of the "broad-leaved fescues" with *Lolium* L. rather than *Festuca* (Gaut & al., 2000; Catalán & al., 2004): while some authors, strictly on phylogenetic and biological grounds, include "broad-leaved fescues" within *Lolium* (e.g., Darbyshire, 1993; Banfi & al., 2005; Soreng & al., 2015), others have recognized them as a macro-morphologically separate genus, *Schedonorus* P.Beauv. (e.g., Holub, 1998; Soreng & Terrell, 1998; Foggi & al., 2005).

The species formerly included within *Schedonorus* approximately amount to 10–12, all of Eurasian origin (Foggi & Tison, 2014), among them *Festuca arundinacea* Schreb. (≡ *S. arundinaceus* (Schreb.) Dumort.) and *F. pratensis* Huds. (≡ *S. pratensis* (Huds.) P.Beauv.), two of the most important forage crops in temperate regions. Further related taxa are acquiring an increasingly relevant role in the crop breeding field, such as tetraploid *F. apennina* De Not. (≡ *S. apenninus* (De Not.) Tzvelev) (Lewis, 1977; Jauhar, 1993; Yamada, 2011; Rao & Rognli, 2014). This species described from the Ligurian Apennines (De Notaris, 1844) and reportedly distributed in the Apennines and from the Alps eastwards to the Carpathians (Markgraf-Dannenberg, 1980; Foggi & Müller, 2009), has recently been investigated in depth on genetic, cytological, and physiological grounds (see, e.g., Borrill & al., 1976; Lewis, 1977; Tyler & al., 1978; Jauhar, 1993), mostly for agronomical purposes. On the other hand, its nomenclature has been quite neglected: the name *Festuca apennina* still lacks a formally designated type (see Kerguélen & Plonka, 1989: 247), and only two botanists in the past had the opportunity to examine De Notaris's original material, namely Parlatore (1850), and Saint-Yves (1913). Moreover, most of the morphological descriptions available in literature are based on specimens collected outside the locus classicus, mainly in the Alps (see Saint-Yves, 1913; Markgraf-Dannenberg, 1950).

The aim of this paper is to typify the name *Festuca apennina* De Not., a fundamental step for further systematic studies in "broad-leaved fescues" and related taxa, in line with previous studies carried by the authors (see Ardenghi & al., 2013).

■ TYPIFICATION OF THE NAME *FESTUCA APENNINA*

Festuca apennina De Not. was described by Giuseppe De Notaris (1805–1877) within his *Repertorium florae ligusticae* (De Notaris, 1844: 468), while holding the position of professor of botany and director of the botanical garden at the University of Genoa (Saccardo, 1895; Traverso, 1931; Stafleau & Cowan, 1976; Garbari, 1990; Peccenini, 2008). The protologue consists of a detailed description of the species and a short diagnosis, preceded by a concise quotation of the localities of provenance: "In sylvis montanis opacis Liguriae orientalis, *Monte Gottro, S. Stefano d'Aveto,* Traverso" (the shady mountain forests of eastern Liguria), in mount Gottero (WGS84: 44°21′46″N, 09°40′43″E), and S. Stefano d'Aveto (WGS84: 44°32′44″N, 09°27′03″E), Ligurian Apennines, north-western Italy. Description and geographical distribution were almost certainly based on specimens collected for De Notaris by Carlo Traverso (1809–1857), naturalist and head gardener at the Genoa botanical garden until 1845 (Burnat, 1883: CXXII; Saccardo, 1895: 165–166, 183; Peccenini, 2008: 156), who used to provide his director with exsiccata for his *Repertorium* (Burnat, 1883: CXXII; Saccardo, 1895: 165–166, 183; Peccenini, 2008: 156), similarly to other naturalists acknowledged in the work's preface (De Notaris, 1844: 3–4).

Searches conducted at FI, GDOR, GE, P, PAD, and TO resulted in the following De Notaris specimens that are original

Received: 16 Mar 2015 | returned for (first) revision: 30 May 2015 | (last) revision received: 15 Jun 2015 | accepted: 15 Jun 2015 || publication date(s): online fast track, n/a; in print and online issues, 28 Oct 2015 ||

material for the name *Festuca apennina* (each line is separated by means of the symbol "/"):

(1) "*Festuca apennina* DNtrs. / Parl. fl. ital. / Mt. Gottro Lig. orient. / Da De Notaris in Agosto 1847", *G. De Notaris s.n.* (FI barcode FI002995!);

(2) "*Festuca apennina* DNtrs. / Mt.e Gottro Lig. orient. / VII/843. [= August 1843]", *G. De Notaris s.n.* (GDOR [digital image!]);

(3) "*Festuca apennina* DNtrs / montis Liguriae orientalis / herb. DNtrs / (De Notaris)", *G. De Notaris s.n.* (P barcode P00653931!).

De Notaris's signature ("DNtrs") is present only on the specimen at FI, however, the handwriting on all the examined material is undoubtedly his, it matching the calligraphy of a postcard signed by De Notaris available from Biblioteca dell'Orto Botanico di Padova (2015). The label of the FI exsiccatum features some additional handwritten annotations by Filippo Parlatore ("Parl. fl. ital." and "Da De Notaris in Agosto 1847"; Parlatore's handwriting was confirmed by comparison with Burdet, 1977: 203–204), who received the specimen from De Notaris in August 1847 ("Da De Notaris in Agosto 1847" [from De Notaris in August 1847]) for the treatment of *Festuca apennina* within his *Flora italiana* (Parlatore, 1850: 452); "Agosto 1847", therefore, does not represent the time of collection, but only the date when Parlatore received De Notaris's specimen. The label of the P specimen is entirely handwritten by De Notaris, with the exception of the last line, "(De Notaris)", probably added afterwards by a Paris herbarium technician. In later years, both the exsiccata at FI and GDOR were attempted to be designated as type: a label with the red-printed word "Typus" was stuck on the FI specimen, while a handwritten and printed one, bearing the word "Lecto-TYPUS", was authored in 1990 by Mauro G. Mariotti and pinned on the GDOR exsiccatum. However, these typification statements cannot be taken as effective lectotypifications, since they were not published (*ICN* Art. 7.9; McNeill & al., 2012).

The discovered specimens were collected in eastern Liguria ("Liguria orientalis"), however only those kept at FI and GDOR feature one of the localities mentioned in the protologue (De Notaris, 1844), namely "Mt. Gottro". Between the two specimens, we select the one at FI as lectotype, its morphology better matching the diagnosis provided by De Notaris (1844), in which the upper glume ("valvula superiore haud acuminata") and the ligule ("ligula magis producta") are regarded as useful to distinguish the species from *Festuca decolorans* (Rchb.) Mert. & W.D.J.Koch ex Kunth (= *F. arundinacea*). De Notaris's conception of ligule was probably broader than today, it referring not only to the membranous part at the junction of leaf blade and leaf sheath, but also to the surrounding "auricles", which are very long ("magis producta", in De Notaris's words) in the FI specimen. The exsiccatum at GDOR, although bearing well-developed spikelets, is incomplete, lacking the basal part of the culms, thus most of the leaf sheaths, ligules and auricles, the latter a character of primary relevance for the study of "broad-leaved fescues" morphology (see, e.g., Hackel, 1882; Kerguélen & Plonka, 1989). The specimen at GDOR could be the specimen from De Notaris's herbarium in Genoa investigated by Saint-Yves and reported by the latter to be incomplete ("cet échantillon est fort médiocre, les innovations manquent totalement"; Saint-Yves, 1913: 145), but the locality of provenance, mentioned in his work as "Santo Stefano d'Aveto", does not correspond. No specimens from S. Stefano d'Aveto were located neither at GE nor at GDOR, therefore either the specimen cited by Saint-Yves has been lost or the author wrongly transcribed the specimen's label.

Pending further investigation of northern Apennines populations, the taxon described by De Notaris is here considered an independent species, thus neither a subspecies nor a variety of *Festuca pratensis* as usually reported in literature (see, e.g., Hackel, 1882; Saint-Yves, 1913; Markgraf-Dannenberg, 1950, 1980; Kerguélen & Plonka, 1989; Foggi & al., 2005). The examined specimens, in fact, are morphologically distinct from *F. pratensis*. Even tough they feature dark brown leaf sheaths and prolonged acuminate auricles (with the exception of the one at GDOR, where the basal part of the culms is lacking), both traits typical to *F. pratensis*, spikelets are different, much more resembling those of *F. arundinacea* (not incidentally, De Notaris's diagnosis compared *F. apennina* with *F. decolorans*, synonym of *F. arundinacea*): they are ovate-elliptical, with lemmas, besides bearing well-developed awns (ranging from about 25% to 70% the length of the second-lowest lemma), that are ovate-lanceolate in shape, usually concealing the rachilla (see, e.g., Hackel, 1882; Markgraf-Dannenberg, 1980; Kerguélen & Plonka, 1989; Portal, 1999). Further cytological and ecological evidence support our choice: individuals of *F. apennina* sampled by Tyler & al. (1978) in S. Stefano d'Aveto proved to be tetraploid (instead of diploid as *F. pratensis* or hexaploid as *F. arundinacea*); additionally, according to our recent field observations in the locus classicus area (June 2015), *F. apennina* occurs in tall forbs communities along edges and in clearings of *Fagus sylvatica* L. forests above 1100 m a.s.l. (rather than lowland and mountain grasslands, where *F. pratensis* typically grows), confirming the original habitat information provided in the protologue (De Notaris, 1844).

In accordance with recent molecular data evidencing the inclusion of *Schedonorus* within *Lolium* (Soreng & al., 2015), we here propose a new combination for relocating *Festuca apennina* at specific rank into *Lolium*.

Lolium apenninum (De Not.) Ardenghi & Foggi, **comb. nov.** ≡ *Festuca apennina* De Not., Repert. Fl. Ligust.: 468. 1844 ≡ *Festuca elatior* subsp. *pratensis* var. *apennina* (De Not.) Hack. in Bot. Centralbl. 8(12): 407. 1881 ≡ *Festuca pratensis* subsp. *apennina* (De Not.) Hegi, Ill. Fl. Mitt.-Eur. 1: 343. 1908 ≡ *Schedonorus apenninus* (De Not.) Tzvelev in Novosti Sist. Vyssh. Rast. 31: 259. 1998 ≡ *Lolium pratense* subsp. *apenninum* (De Not.) Banfi, Bracchi & Galasso in Mem. Soc. Ital. Sci. Nat. Mus. Civico Storia Milano 33(2): 8. 2005 ≡ *Schedonorus pratensis* subsp. *apenninus* (De Not.) H.Scholz & Valdés in Willdenowia 35: 243. 2005 – **Lectotype (designated here):** [Italy, on the regional border between Emilia-Romagna (Albareto municipality) and Liguria (Sesta Godano municipality), mount Gottero]

"*Festuca apennina* DNtrs. Parl. fl. ital. Mt. Gottro Lig. orient. Da De Notaris in Agosto 1847", *G. De Notaris s.n.* (FI barcode FI002995!). — Image of lectotype available at http://parlatore.msn.unifi.it/img72/FI002995.jpg

ACKNOWLEDGEMENTS

The authors are grateful to Graziano Rossi (University of Pavia, Italy) for his strategic suggestions and support to our research, and Giulio Ferretti (University of Florence, Italy), for his help in locating the specimen at GDOR. We express our gratitude also to Chiara Nepi (FI), Maria Tavano (GDOR), Simonetta Peccenini (GE), Rossella Marcucci (PAD), and Laura Guglielmone (TO), for kindly searching material of our interest in their collections.

LITERATURE CITED

Alexeev, E.B. 1977. K sistematike aziatskix ovsyanicz (*Festuca*). I. Podrodỳ *Drymanthele*, *Subulatae*, *Schedonorus*, *Leucopoa* [To the systematics of Asian fescues (*Festuca*): I. Subgenera *Drymanthele*, *Subulatae*, *Schedonorus*, *Leucopoa*]. *Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol.* 82: 95–102.

Ardenghi, N.M.G., Signorini, M.A., Parolo, G., Rossi, G., Pignotti, L., Vitek, E. & Foggi, B. 2013. Typification of names of taxa belonging to *Festuca arundinacea* (≡ *Schedonorus arundinaceus*) aggregate (Poaceae) in Hackel's herbarium (W). *Phytotaxa* 84: 55–59. http://dx.doi.org/10.11646/phytotaxa.84.2.2

Banfi, E., Bracchi, G., Galasso, G. & Romani, E. 2005. Agrostologia placentina. *Mem. Soc. Ital. Sci. Nat. Mus. Civico Storia Milano* 33: 1–80.

Biblioteca dell'Orto Botanico di Padova 2015. Iconoteca dei Botanici. Biblioteca dell'Orto Botanico, Università degli Studi di Padova. http://www.bibliorto.cab.unipd.it/in- biblioteca/iconoteca-botanici (accessed 26 Feb 2015)

Borrill, M., Tyler, B.F. & Morgan, W.G. 1976. Studies in *Festuca* 7. Chromosome atlas (Part 2). An appraisal of chromosome race distribution and ecology, including *F. pratensis* var. *apennina* (De Not.) Hack.–tetraploid. *Cytologia* 41: 219–236.

Burdet, H.M. 1977. Cartulae ad botanicorum graphicem. X. *Candollea* 29: 165–206.

Burnat, M.E. 1883. Botanistes qui ont contribué a faire connaitre la flore des Alpes-Maritimes, bibliographie er collections botaniques. *Bull. Soc. Bot. France*, sér. 2, 30: CVII–CXXXIII.

Catalán, P., Torrecilla, P., Rodríguez, J.Á.L. & Olmstead, R.G. 2004. Phylogeny of the festucoid grasses of subtribe Loliinae and allies (Poeae, Pooideae) inferred from ITS and *trnL–F* sequences. *Molec. Phylogen. Evol.* 31: 517–541. http://dx.doi.org/10.1016/j.ympev.2003.08.025

Darbyshire, S.J. 1993. Realignment of *Festuca* subgenus *Schedonorus* with the genus *Lolium* (Poaceae). *Novon* 3: 239–243.

De Notaris, G. 1844. *Repertorium florae ligusticae*. Taurini [Turin]: ex Regio Typographeo. http://dx.doi.org/10.5962/bhl.title.6657

Foggi, B. & Müller, J. 2009. *Schedonorus*. In: Valdés, B. & Scholz, H. (eds.), with contributions from Raab-Straube, E. von & Parolly, G.: Poaceae. Euro+Med Plantbase – The information resource for Euro-Mediterranean plant diversity. http://ww2.bgbm.org/EuroPlusMed/PTaxonDetail.asp?NameId=7712070&PTRefFk=7100000 (accessed 3 Mar 2015).

Foggi, B. & Tison, J.-M. 2014. *Schedonorus* P.Beauv. Pp. 278–279 in: Tison, J.-M. & Foucault, B. de (eds.), *Flora Gallica: Flore de France*. Mèze: Biotope Éditions.

Foggi, B., Scholz, H. & Valdés, B. 2005. The Euro+Med treatment of *Festuca* (Gramineae) – New names and new combinations in *Festuca* and allied genera. *Willdenowia* 35: 241–244. http://dx.doi.org/10.3372/wi.35.35202

Garbari, F. 1990. DE NOTARIS, Giuseppe. In: *Dizionario biografico degli italiani*, vol. 38. Rome: Istituto della Enciclopedia italiana. Available online on http://www.treccani.it/enciclopedia/giuseppe-de-notaris_(Dizionario-Biografico)/ (accessed 26 Feb 2015)

Gaut, B.S., Tredway, L.P., Kubik, C., Gaut, R.L. & Meyer, W. 2000. Phylogenetic relationships and genetic diversity among members of the *Festuca-Lolium* complex (Poaceae) based on ITS sequence data. *Pl. Syst. Evol.* 224: 33–53. http://dx.doi.org/10.1007/BF00985265

Hackel, E. 1882. *Monographia Festucarum europaearum*. Kassel and Berlin: Verlag von Theodor Fischer. http://dx.doi.org/10.5962/bhl.title.15610

Holub, J. 1998. Reclassifications and new names in vascular plants 1. *Preslia* 70: 97–122.

Jauhar, P.P. 1993. Cytogenetics of the *Festuca-Lolium* complex. *Monogr. Theor. Appl. Genet.* 18: 1–255. http://dx.doi.org/10.1007/978-3-642-84086-9

Kerguélen, M. & Plonka, F. 1989. Les *Festuca* de la flore de France (Corse comprise). *Bull. Soc. Bot. Centre-Ouest*, n.s., numéro spécial 10: 1–368.

Lewis, E.J. 1977. Studies in *Festuca*. IV. A phyletic study of *Festuca pratensis* var. *apennina* (De Not.) Hack., hybridization with synthetic tetraploid *F. pratensis* Huds. *Genetica* 47: 59–64. http://dx.doi.org/10.1007/BF00122440

Linnaeus, C. 1753. *Species plantarum*, vol. 1. Holmiae [Stockholm]: impensis Laurentii Salvii. http://dx.doi.org/10.5962/bhl.title.669

Markgraf-Dannenberg, I. ["J."] 1950. Die Gattung *Festuca* in den Bayerischen Alpen. *Ber. Bayer. Bot. Ges.* 28: 195–211.

Markgraf-Dannenberg, I. 1980. 4. *Festuca* L. Pp. 125–153 in: Tutin, T.G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A. (eds.), *Flora Europaea*, vol. 5. Cambridge: Cambridge University Press.

McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Prud'homme Van Reine, W.F., Smith, G.F., Wiersema, J.H. & Turland, N.J. (eds.) 2012. *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code).* Regnum Vegetabile 154. Königstein: Koeltz Scientific Books. [online ed., http://www.iapt-taxon.org/nomen/main.php]

Parlatore, F. 1850. *Flora italiana*, vol. 1(2). Firenze: Tipografia Le Monnier. http://dx.doi.org/10.5962/bhl.title.6341

Peccenini, S. 2008. Le collezioni botaniche dell'Università di Genova: Storia del Museo e dell'Orto Botanico. *Museol. Sci.* 2008(2): 156–160.

Portal, R. 1999. *Festuca de France*. Vals-près-Le Puy: Portal.

Rao, K.M. & Rognli, O.A. 2014. 5. Meadow Fescue. Pp. 91–108 in: Cai, H., Yamada, T. & Kole, C. (eds.), *Genetics, genomics and breeding of forage crops*. Boca Raton: CRC Press.

Saccardo, P.A. 1895. *La botanica in Italia*. Venezia: Tipografia Carlo Ferrari.

Saint-Yves, A. 1913. *Les Festuca de la Section Eu-Festuca et leurs variations*. Geneva, etc.: Georg. http://dx.doi.org/10.5962/bhl.title.15432

Saint-Yves, A. 1927 *Tentamen. Claves analyticae Festucarum …* Rennes: Oberthur.

Soreng, R.J. & Terrell, E.E. 1998. Taxonomic notes on *Schedonorus*, a segregate genus from *Festuca* or *Lolium*, with a new nothogenus, ×*Schedololium*, and new combinations. *Phytologia* 83(1997): 85–88.

Soreng, R.J., Peterson, P.M., Romaschenko, K., Davidse, G., Zuloaga, F.O., Judziewicz, E.J., Filgueiras, T.S., Davis, J.I. & Morrone, O. 2015. A worldwide phylogenetic classification of the Poaceae (Gramineae). *J. Syst. Evol.* 53: 117–137. http://dx.doi.org/10.1111/jse.12150

Stafleau, F.A. & Cowan, R.S. 1976. *Taxonomic literature*, ed. 2, vol. 1, *A−G*. Utrecht: Bohn, Scheltema & Holkema http://dx.doi.org/10.5962/bhl.title.48631

Traverso, G.B. 1931. DE NOTARIS, Giuseppe. In: *Enciclopedia Italiana*. [Rome]: Istituto Giovanni Treccani. Available online on http://www.treccani.it/enciclopedia/giuseppe-de-notaris_(Enciclopedia-Italiana)/ (accessed 26 Feb 2015)

Tyler, B., Borrill, M. & Chorlton, K. 1978. Studies in *Festuca*. X. Observations on germination and seedling cold tolreance in diploid *Festuca pratensis* and tetraploid *F. pratensis* var. *apennina* in relation to their altitudinal distribution. *J. Appl. Ecol*. 15: 219–226.

Yamada, T. 2011. *Festuca*. Pp. 153–164 in: Kole, C. (ed.), *Wild crop relatives: Genomic and breeding resources; Millet and grasses*. Berlin, Heidelberg: Springer. http://dx.doi.org/10.1007/978-3-642-14255-0_9

3.1.1. Additional ISI publications on the same topic

(1) Ardenghi N.M.G., 2015 – Lectotypification of *Leonurus quinquelobatus* (Lamiaceae). *Taxon*, 64(1): 160−162. DOI: 10.12705/641.27

(2) Ardenghi N.M.G. & Galasso G., 2015 − Lectotypification of the name *Alnus brembana* (Betulaceae), a controversial Alpine endemic species. *Phytotaxa*, 233(1): 98−100. DOI: 10.11646/phytotaxa.233.1.10

(3) Ardenghi N.M.G., Galasso G. & Banfi E., 2015 − Discovered outdoors: typification of names of taxa described from Italy outside their native range. *Phytotaxa*, 212(2): 133−140. DOI: 10.11646/phytotaxa.212.2.2

(4) Banfi E., Galasso G., Foggi B., Kopecký D. & Ardenghi N.M.G., submitted − From *Schedonorus* and *Micropyropsis* to *Lolium* (Loliinae, Poaceae): new combinations and typifications. *Taxon*.

(5) Iamonico D., Banfi E., Galasso G., Lohmann L.G., Lombardi J.A. & Ardenghi N.M.G., 2015 – Typification of the Linnaean name *Bignonia peruviana* (Vitaceae). *Phytotaxa*, 236(3): 283−286. DOI: 10.11646/phytotaxa.236.3.10

(6) Iamonico D., Galasso G., Banfi E. & Ardenghi N.M.G., 2015 – Typification of Linnaean names in the genus *Vitis* (Vitaceae). *Taxon*, 64(5): 1048−1050. DOI: 10.12705/645.17

In line with the aforementioned contribution, within publication (4), still under review, twenty-two new combinations are proposed in order to fully relocate, at world-scale, all the taxa (described from north-western Africa eastwards to Formosa) previously placed within the genera *Schedonorus* P.Beauv. and *Micropyropsis* Romero Zarco & Cabezudo into *Lolium*. Moreover, six names in *Festuca* are lectotypified.

Further typifications of names belonging to different families (Betulaceae, Cyperaceae, Lamiaceae, Vitaceae) and grass genera (*Panicum* L.) have been proposed within other papers (1−3, 5−6); three of the lectotypified names were originally published by Linnaeus (5−6). Most of these names (2−3, 5−6) are currently treated as synonyms, however their correct synonymization was practicable only by means of the identification needed for the type designation.

3.2. Article II (*Taxonomy*)

Ardenghi N.M.G., Fiorini G., Rossi G. & Foggi B., 2016 − Chromosome numbers and karyomorphology of *Festuca circummediterranea* Patzke group (Poaceae, Loliinae). *Phytotaxa*, 263(3): 255−269. DOI: 10.11646/phytotaxa.263.3.6

The first comprehensive karyological overview of the group of *Festuca circummediterranea* Patzke, which comprises 10 Euro-Mediterranean taxa (5 species and 7 subspecies, including autonyms; see paragraph 1.4) is given. Thirty populations were sampled from across almost the whole distributional range of the aggregate, including the *loci classici* of each taxon. The first chromosome counts for *F. jeanpertii* (St.-Yves) Markgr. subsp. *jeanpertii*, subsp. *achaica* Markgr.-Dann., and subsp. *gracilis* (Hack.) Raus are reported. All the taxa were found to be diploid (2n=14) and strongly similar on karyomorphological grounds, with a predominace of metacentric and submetacentric chromosomes. The only remarkable difference is represented by the occurrence of B-chromosomes, recorded from a single taxon, *F. marginata* subsp. *gallica* (Hack. ex Charrel) Breistr.; their taxonomic significance is however regarded as irrelevant (Stace, 1991).

The karyological results, besides filling a gap in the knowledge of *F. circummediterranea* group, provide a relevant tool for a future systematic revision of the aggregate, which should take into account also data from the analysis of further morphological and molecular parameters.

Phytotaxa 263 (3): 255–269
http://www.mapress.com/j/pt/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

http://dx.doi.org/10.11646/phytotaxa.263.3.6

Chromosome numbers and karyomorphology of *Festuca circummediterranea* Patzke group (Poaceae, Loliinae)

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Abstract

The first comprehensive karyological overview of the group of *Festuca circummediterranea*, comprising 10 Euro-Mediterranean taxa (5 species and 7 subspecies, including autonyms), is provided. Thirty populations were sampled from across almost the whole distributional range of the aggregate, including the *loci classici* of each taxon. The first chromosome counts for *F. jeanpertii* subsp. *jeanpertii*, subsp. *achaica*, and subsp. *gracilis* are reported. All the taxa were found to be diploid (2n = 14) and have a similar karyotype, characterized by the predominace of metacentric and submetacentric chromosomes; the occurrence of B-chromosomes was recorded from a single taxon, *F. marginata* subsp. *gallica*.

Key words: Euro-Mediterranean flora, *Festuca humifusa*, *Festuca jeanpertii*, *Festuca lambinonii*, *Festuca marginata*, taxonomy

Introduction

Along with the aggregates of *Festuca ovina* Linnaeus (1753: 73) and *F. rubra* Linnaeus (1753: 74), the group of *F. circummediterranea* Patzke in Gutermann *et al.* (1974: 261) is one of the least known in the Euro-Mediterranean area. According to the current systematic treatment of *Festuca* Linnaeus (1753: 73) in this region (Foggi & Müller 2009, Raus 2013), the group includes 10 closely related taxa [*F. circummediterranea*, *F. humifusa* Brullo & Guarino (2001: 409), *F. jeanpertii* (Saint-Yves 1924: 42) Markgraf in Hayek (1933: 276) subsp. *jeanpertii*, subsp. *achaica* (Markgraf-Dannenberg 1976: 128) Markgraf-Dannenberg in Heywood (1978: 325), subsp. *campana* (Terracciano 1872: 195) Markgraf-Dannenberg in Heywood (1978: 325), and subsp. *gracilis* (Hackel 1882: 109) Raus in Raab-Straube & Raus (2013: 246), *F. lambinonii* Kerguélen (1983: 59), *F. marginata* (Hackel 1882: 108) Richter (1890: 96) subsp. *marginata*, subsp. *andres-molinae* Fuente García & Ortúñez Rubio (1993: 107), and subsp. *gallica* (Hackel ex Charrel 1920: 5) Breistroffer (1966: 79)], distributed in a vast geographical area spanning the Iberian Peninsula eastwards to the Aegean Islands, the Alps and north-western Africa. They grow in xerophilous grasslands and pastures from sea level to the subalpine belt, and are characterized by sclerenchyma arranged in three well-defined strands at the margins and the keel of the transversal leaf section. Their relatedness was recognized by Hackel (1882), who placed most of these taxa within *Festuca ovina* subsp. *laevis* Hackel (1882: 107), a choice followed by Markgraf-Dannenberg (1976) and Foggi *et al.* (2009, 2012).

Preliminary morphometrical, karyological, and molecular analyses carried out by Foggi *et al.* (2009) on the taxa occurring across the Italian peninsula raised doubts about the currently accepted taxonomic limits between species and subspecies. None of the investigated parameters allowed a separation of well-defined groups of variability; thus, the possibility of treating the taxa occurring in Italy as a single species was assumed. Accordingly, Foggi & Tison (2014) simplified the treatment of the *F. circummediterranea* group in France by merging *F. circummediterranea* s.s., *F. lambinonii*, and *F. marginata* subsp. *gallica* into a single species with two subspecies, *F. marginata* subsp. *marginata* (incl. subsp. *gallica*) and *F. marginata* subsp. *alopecuroides* (Hackel 1882: 108) Richter (1890: 96) (= *F. lambinonii*; incl. *F. circummediterranea*). A comprehensive understanding of the variability of the whole aggregate across its entire distributional range is still lacking.

Chromosome counts and ploidy level estimations within the *F. circummediterranea* group are currently available for seven taxa: *F. circummediterranea* (Bidault 1966a, Parreaux 1972, Fiorini *et al.* 2008, Šmarda *et al.* 2008), *F. humifusa* (Brullo & Guarino 2001, Šmarda *et al.* 2008), *F. jeanpertii* subsp. *campana* (Fiorini *et al.* 2008, under

Accepted by Jeffery Saarela: 18 May 2016; published: 3 Jun. 2016

F. circummediterranea), *F. lambinonii* (Huon 1970), *F. marginata* subsp. *marginata* (Litardière 1950, Huon 1970), subsp. *andres-molinae* (Fuente García & Ortúñez Rubio 1993, Ortúñez Rubio & Fuente García 1995, Fuente *et al*. 2001), and subsp. *gallica* (Litardière 1950, Bidault 1963, 1964, 1966a, 1966b, 1968, Parreaux 1971, 1972). Only the populations from the *loci classici* of *F. circummediterranea*, *F. humifusa*, *F. lambinonii*, and *F. marginata* subsp. *andres-molinae* have been karyologically investigated. In the literature, data on karyotype morphology are available only for *F. circummediterranea*, *F. jeanpertii* subsp. *campana*, *F. marginata* subsp. *andres-molinae*, and subsp. *gallica* (Bidault 1968, Ortúñez Rubio & Fuente García 1995, Fiorini *et al*. 2008).

The aim of this paper is to provide the first updated and complete karyological overview of the whole *Festuca circummediterranea* aggregate across its distributional range, with special regard to the populations from the *loci classici* according to the concept of the "*typification biosystématique*" by Auquier & Kerguélen (1978): the sampling of these populations, on which the description of a species or subspecies is based, allows unequivocal association of a chromosome count with a specific taxon. This work represents a basic step to fulfill a modern systematic revision of this critical group, still under study by the authors.

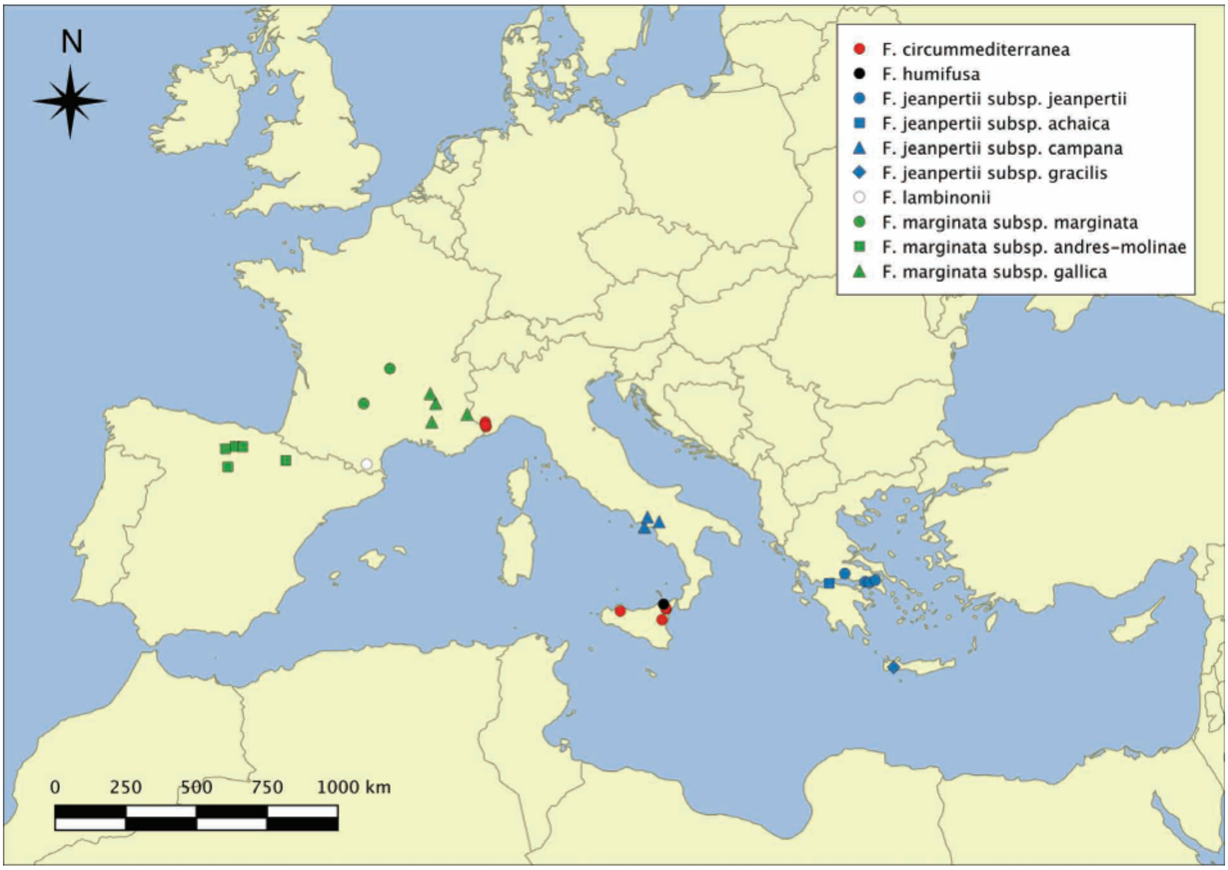

FIGURE 1. Geographic distributions of the sampled populations of *Festuca circummediterranea* group.

Material and Methods

Between 2009 and 2014, more than 100 populations belonging to the 10 taxa constituting the *Festuca circummediterranea* group were sampled from across almost the whole European distributional range of the aggregate (Fig. 1). One or two living plants from each population were collected and cultivated in 184 pots at the Botanical Garden of the University of Florence "Giardino dei Semplici." Plants from 30 pots, corresponding to 30 populations, including those from the *loci classici* of each taxon, produced satisfying and useful mitotic plates. The *locus classicus* of *F. ovina* subsp. *laevis* subvar. *heldreichii* Hackel (1882: 109), currently regarded by Foggi & Müller (2009) as a synonym of *F. jeanpertii* subsp. *jeanpertii*, was additionally sampled. In Table 1, the investigated populations, including provenance and coordinates, ploidy level, chromosome number, and karyotype formula, are reported, along with information acquired from Fiorini *et al.* (2008). The location of each sampled population is presented in Fig. 1. Herbarium voucher specimens for each population from which we obtained a chromosome count are preserved at FI (herbarium acronym follows Thiers 2016).

TABLE 1. List of the investigated populations and related locality of provenance and elevation, number of pot (“N. Pot”), ploidy level (“Ploidy”), chromosome number (“2n”), and karyotype formula (“Formula”). FC = *Festuca circummediterranea*, FH = *F. humifusa*, FJJ = *F. jeanpertii* subsp. *jeanpertii*, FJA = *F. jeanpertii* subsp. *achaica*, FJC = *F. jeanpertii* subsp. *campana*, FJG = *F. jeanpertii* subsp. *gracilis*, FL = *F. lambinonii*, FMM = *F. marginata* subsp. *marginata*, FMA = *F. marginata* subsp. *andres-molinae*, FMG = *F. marginata* subsp. *gallica*. Data regarding the populations FC1, FC2, FC4, FJC1, and FJC2 were acquired from Fiorini *et al*. (2008). A voucher specimen for each investigated population is preserved at FI; each herbarium voucher is identified by the number of pot reported in this table.

Code	Locus classicus	Latitude	Longitude	Country	Locality, elevation	N. Pot	Ploidy	2n	Formula
FC1	LC	37° 59.55′N	13° 15.73′E	ITALY	Sicily: Bosco della Pizzuta, 1315 m	10155	2×	14	10m + 3sm + 1sm sat
FC2	-	37° 58.39′N	15° 08.39′E	ITALY	Sicily: Peloritani Mountains, 1129 m	10195	2×	14	10m + 1sm +1sm sat + 2st
FC3	-	37° 38.16′N	14° 56.87′E	ITALY	Sicily: Mount Etna, Grande Albergo, 1725 m	10201	2×	14	2M + 6 m + 6sm
FC4	-	38° 00.32′N	15° 07.72′E	ITALY	Sicily: Novara di Sicilia, 899 m	10204	2×	14	4m + 4sm + 2sm sat + 4st
FC5	-	44° 03.79′N	07° 36.83′E	FRANCE	Alpes-Maritimes: La Brigue, 765 m	10920	2×	14	6m + 2m sat + 6sm
FC6	-	44° 08.25′N	07° 34.00′E	FRANCE	Alpes-Maritimes: Col de Tende, 1281 m	10921	2×	14	2M + 8m + 4sm
FC7	-	44° 12.60′N	07° 34.34′E	ITALY	Piedmont: Limone Piemonte, 962 m	10923	2×	14	6m + 2m sat + 4sm + 2sm sat
FC8	-	44° 06.93′N	07° 34.22′E	FRANCE	Alpes-Maritimes: between Tende and Col de Tende, 1162 m	11612	2×	14	10m + 2m sat + 2sm
FH	LC	38° 08.19′N	15° 03.22′E	ITALY	Sicily: Capo Tindari, 3 m	10194	2×	14	10m + 4sm
FJJ1	LC	38° 07.95′N	23° 18.61′E	GREECE	Corfu: Mount Pateras, N slope, 562 m	11518	2×	14	10m + 4sm
FJJ2	-	38° 05.69′N	23° 28.21′E	GREECE	West Attica: between Mandra and Agios Sotiras, 206 m	11516	2×	14	8m + 5sm + 1sm sat
FJJ3	LC	38° 08.08′N	23° 44.60′E	GREECE	East Attica: Mount Parnitha, 990 m	11525	2×	14	2M + 6m + 4sm + 2st
FJJ4	-	38° 29.75′N	22° 33.39′E	GREECE	Boeotia: Mount Parnassus, 1128 m	11575	2×	14	10m + 2sm +2st
FJA	LC	38° 15.45′N	21° 52.34′E	GREECE	Achaea: Mount Panachaiko, N slope, 606 m	11545	2×	14	10m + 2sm + 2sm sat

...Continued on next page

TABLE 1. (Continued)

Code	**Locus classicus**	**Latitude**	**Longitude**	**Country**	**Locality, elevation**	**N. Pot**	**Ploidy**	**2n**	**Formula**
FJC1	-	40° 40.10′N	14° 27.55′E	ITALY	Campania: Mount Faito, 720 m	10152	2×	14	8m + 2sm +3st + 1st sat
FJC2	-	40° 48.56′N	15° 05.90′E	ITALY	Campania: Lago Laceno, 1079 m	10158	2×	14	12m + 2sm
FJC3	LC	40° 59.06′N	14° 36.99′E	ITALY	Campania: Avella, Mount Tuppo Tuotolo, 523 m	12159	2×	14	10m + 3sm + 1sm sat
FJG	LC	35° 18.41′N	23° 54.83′E	GREECE	Crete: Mount Gingilos, 1432 m	12113	2×	14	8m + 6sm
FL	LC	42° 39.06′N	02° 23.28′E	FRANCE	Pyrénées-Orientales: Moligt-les-Bains, 599 m	11621	2×	14	8m + 6sm
FMM1	LC	45° 48.19′N	03° 06.10′E	FRANCE	Puy-de-Dôme: Clermont-Ferrand, 389 m	11615	2×	14	6m + 6sm + 2st
FMM2	-	44° 36.50′N	02° 01.97′E	FRANCE	Lot: South of Figeac, 239 m	11616	2×	14	10m + 4sm
FMA1	-	42° 44.10′N	03° 24.63′W	SPAIN	Burgos: Oña, 596 m	11640	2×	14	10m + 4sm
FMA2	-	42° 37.00′N	03° 49.03′W	SPAIN	Burgos: Quintana-Martín Galíndez, 555m	11643	2×	14	2M + 6m + 4sm + 2st
FMA3	-	42° 45.74′N	03° 04.95′W	SPAIN	Álava: Sobrón, near the nuclear power plant, 513 m	11645	2×	14	9m +1m sat + 4sm
FMA4	-	42° 30.76′N	01° 08.80′W	SPAIN	Zaragoza: Navardún, 476 m	11672	2×	14	6m + 6sm + 2sm sat
FMA5	LC	42° 03.30′N	03° 35.90′W	SPAIN	Burgos: Covarrubias, 955 m	11639	2×	14	10m + 4sm
FMG1	-	44° 45.81′N	05° 17.99′E	FRANCE	Drôme: Drôme river, 358m	10944	2×	14	10m + 4sm +1B
FMG2	LC	45° 04.72′N	05° 01.59′E	FRANCE	Drôme: Romans-sur-Isère, 243 m	10964	2×	14	8m + 6sm
FMG3	-	44° 09.75′N	05° 09.49′E	FRANCE	Vaucluse: between Malaucène and Mont Ventoux, 430 m	10968	2×	14	8m + 5sm +1sm sat
FMG4	-	44° 27.21′N	06° 44.60′E	FRANCE	Alpes-de-Haute-Provence: NE of Barcelonette, 1305 m	11613	2×	14	10m + 4sm + 3B

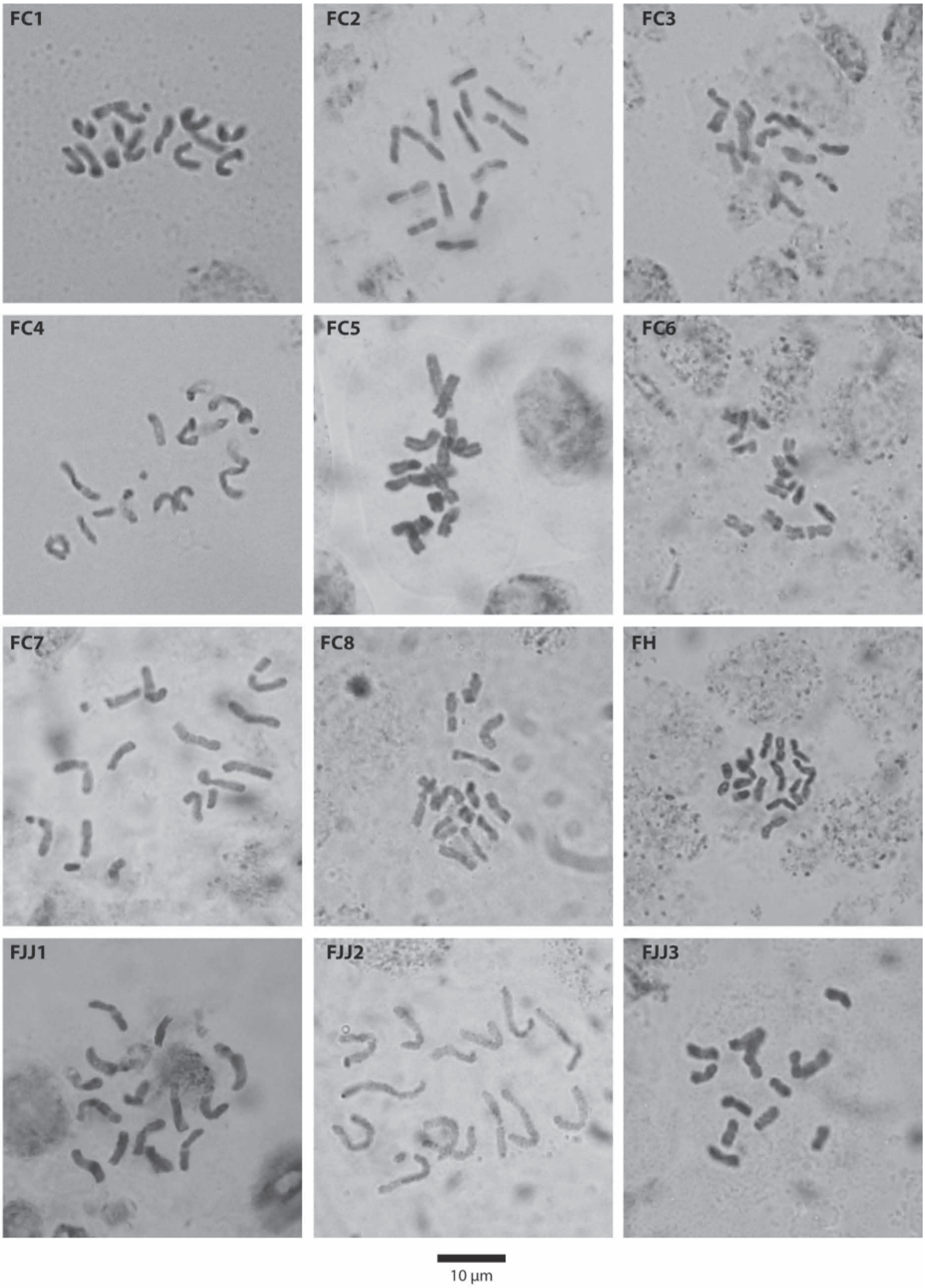

FIGURE 2. Mitotic metaphase plates of *Festuca circummediterranea* (populations FC1−FC8), *F. humifusa* (FH), and *F. jeanpertii* subsp. *jeanpertii* (FJJ1−FJJ3) (all 2n = 14).

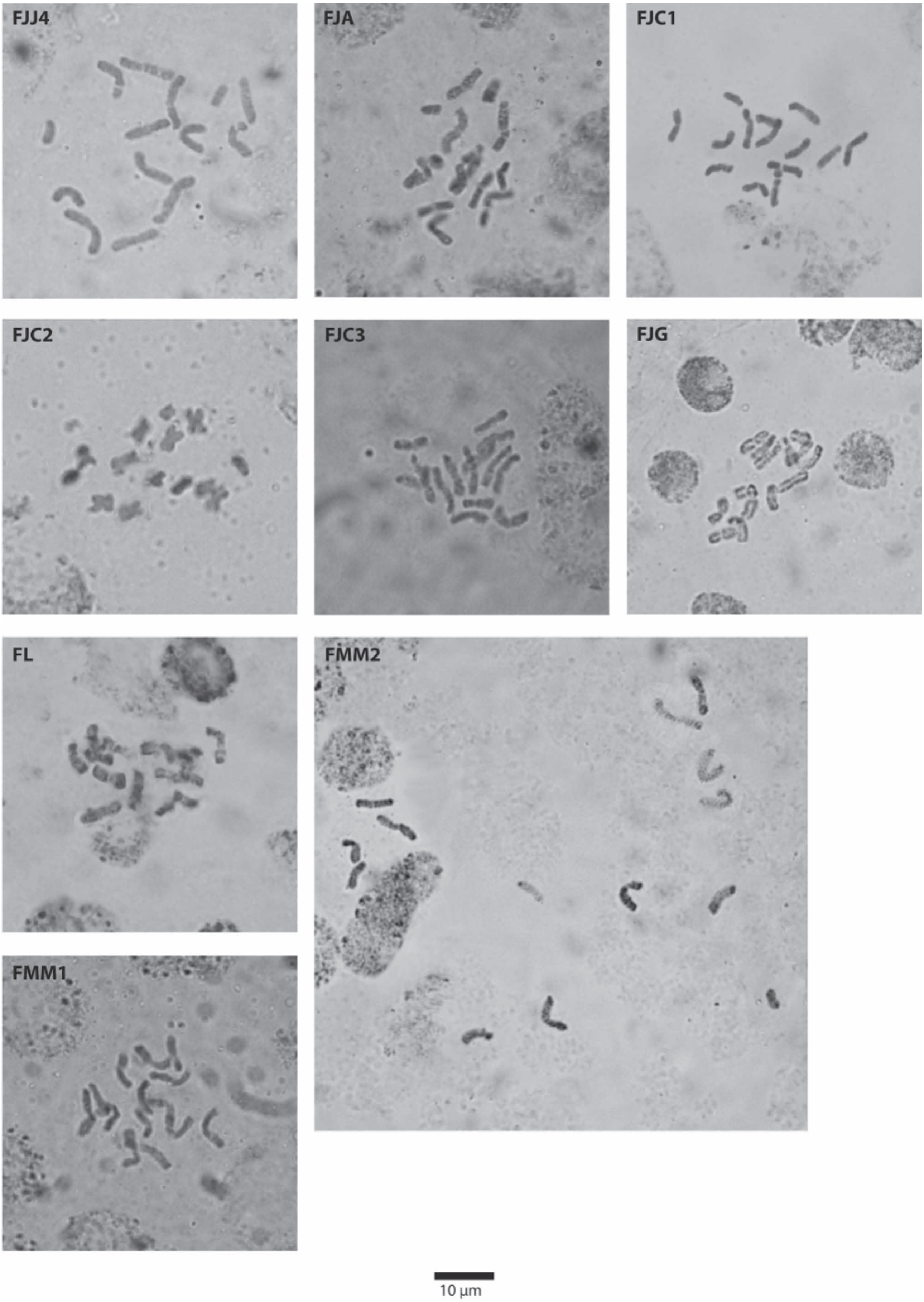

FIGURE 3. Mitotic metaphase plates of *Festuca jeanpertii* subsp. *jeanpertii* (population FJJ4), subsp. *achaica* (FJA), subsp. *campana* (FJC1−FJC3), subsp. *gracilis* (FJG), *F. lambinonii* (FL), and *F. marginata* subsp. *marginata* (FMM1−FMM2) (all 2n = 14).

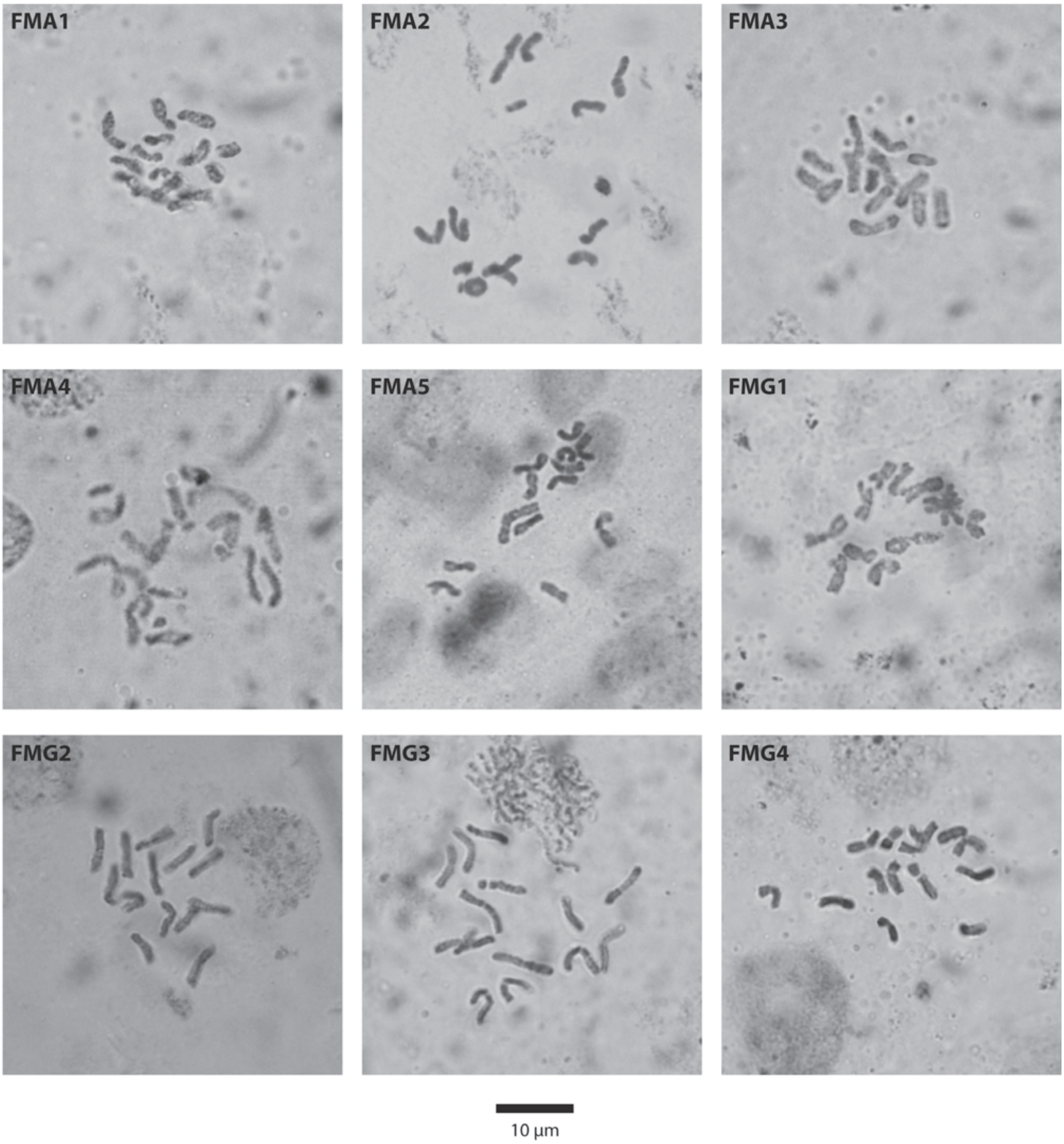

FIGURE 4. Mitotic metaphase plates of *Festuca marginata* subsp. *andres-molinae* (populations FMA1−FMA5) and subsp. *gallica* (FMG1−FMG4) (all 2n = 14).

Karyological analyses were performed on cells undergoing somatic mitoses taken directly from developing root-tips in spring or autumn. After a pre-treatment for three hours in 8-hydroxichinoline saturated solution at room temperature, the material was fixed in Carnoy's solution (3:1 ethanol and acetic acid) (Johansen 1940) and preserved at 5°C until preparation. After hydrolysis in 1 N HCl for 5 min at 60°C, they were stained with 40% water solution of lacto-propionic orcein (Dyer 1979) for 18−48 hours at room temperature, dissected and squashed on clean glass slides with one drop of 45% acetic acid, before examination under a Zeiss Axiophot light microscope (1000×). Pictures were taken with a Canon G5 digital camera.

Measurements and values were processed to obtain chromosome ordering and homologue recognition, idiogram, karyotype formula, described according to chromosome nomenclature proposed by Levan *et al*. (1964).

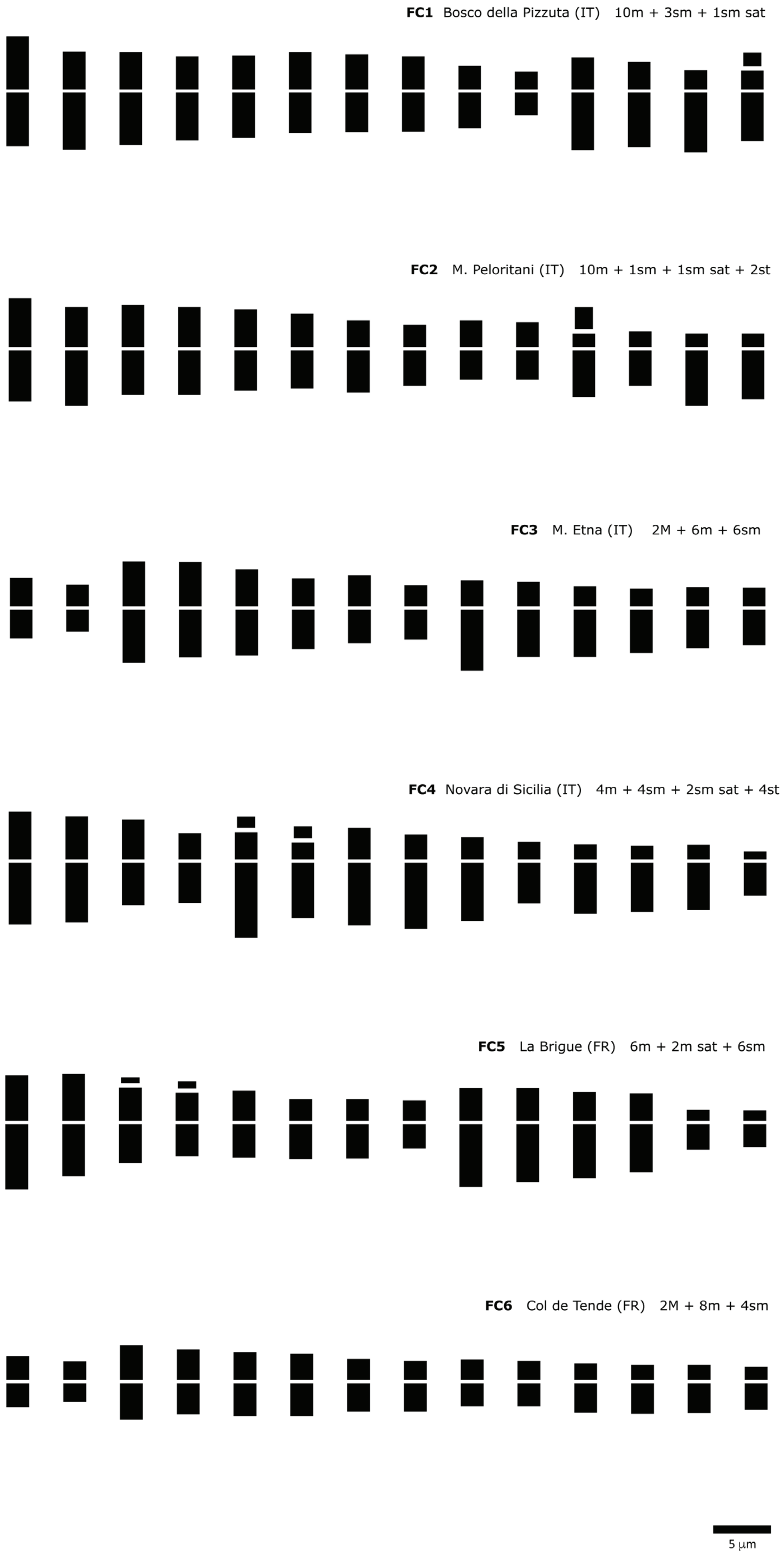

FIGURE 5. Idiograms of *Festuca circummediterranea* (populations FC1−FC6) (2n = 14).

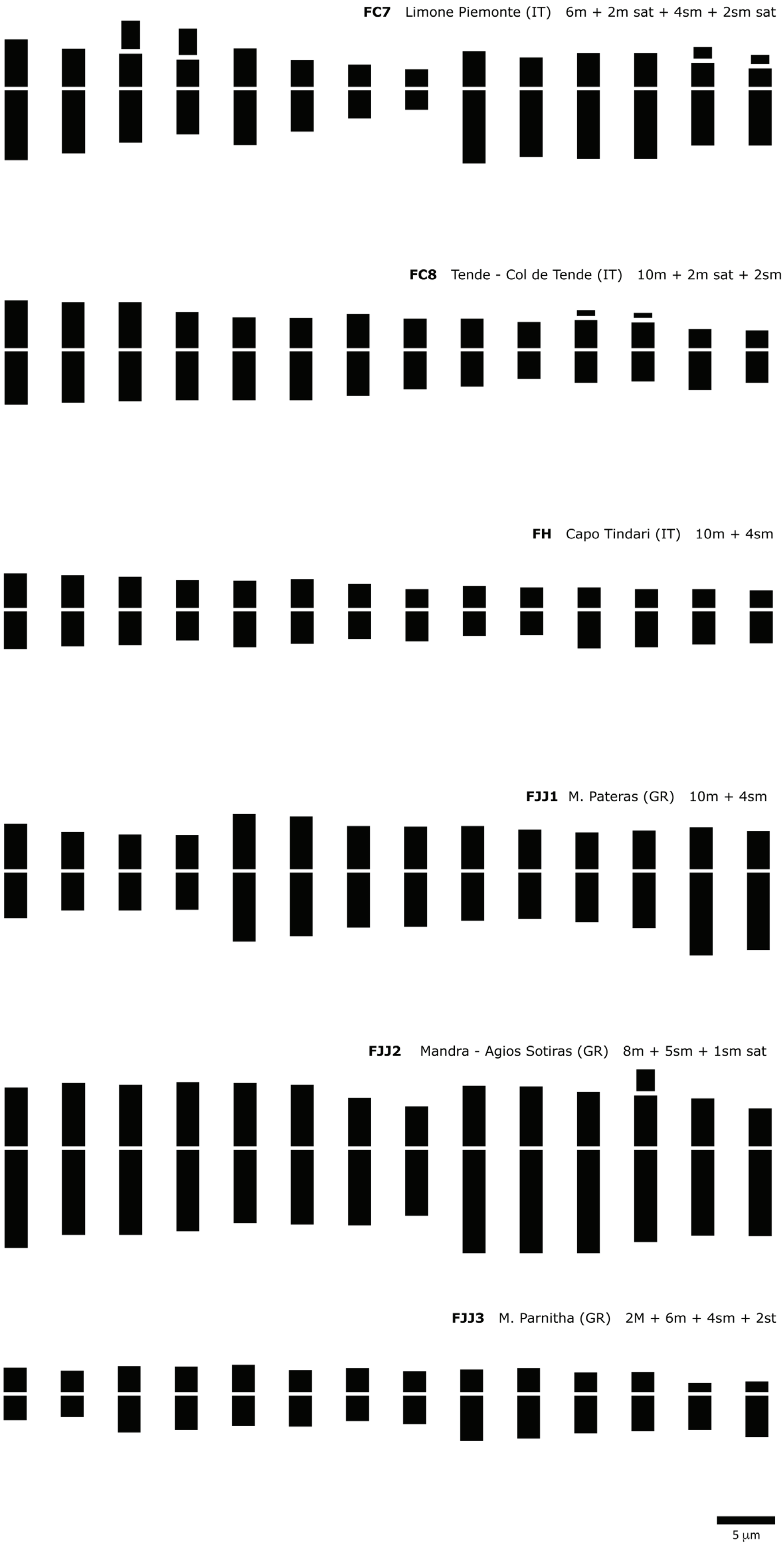

FIGURE 6. Idiograms of *Festuca circummediterranea* (populations FC7−FC8), *F. humifusa* (FH), and *F. jeanpertii* subsp. *jeanpertii* (FJJ1−FJJ3) (all 2n = 14).

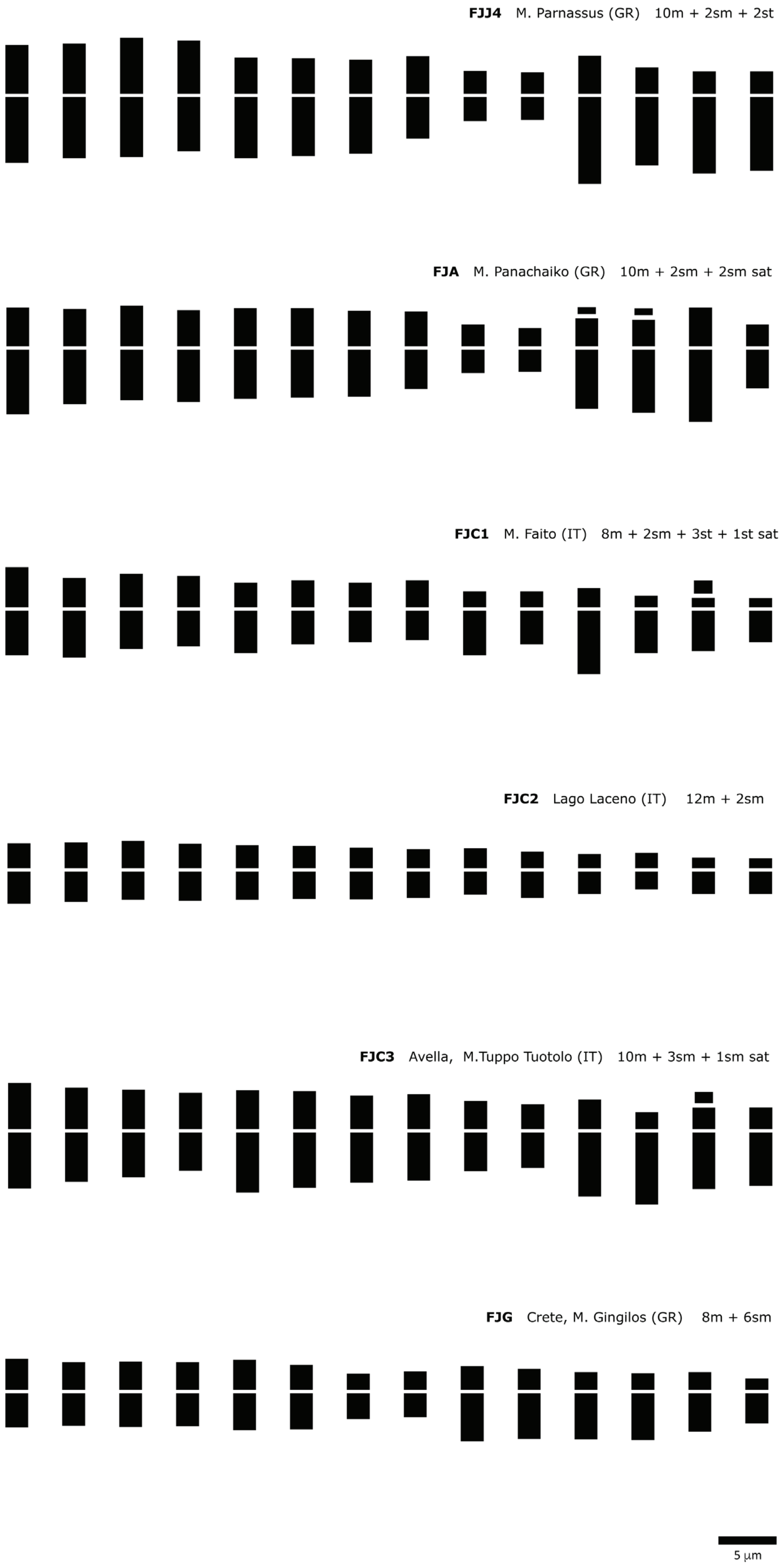

FIGURE 7. Idiograms of *Festuca jeanpertii* subsp. *jeanpertii* (population FJJ4), *F. jeanpertii* subsp. *achaica* (FJA), subsp. *campana* (FJC1−FJC3), and subsp. *gracilis* (FJG) (all 2n = 14).

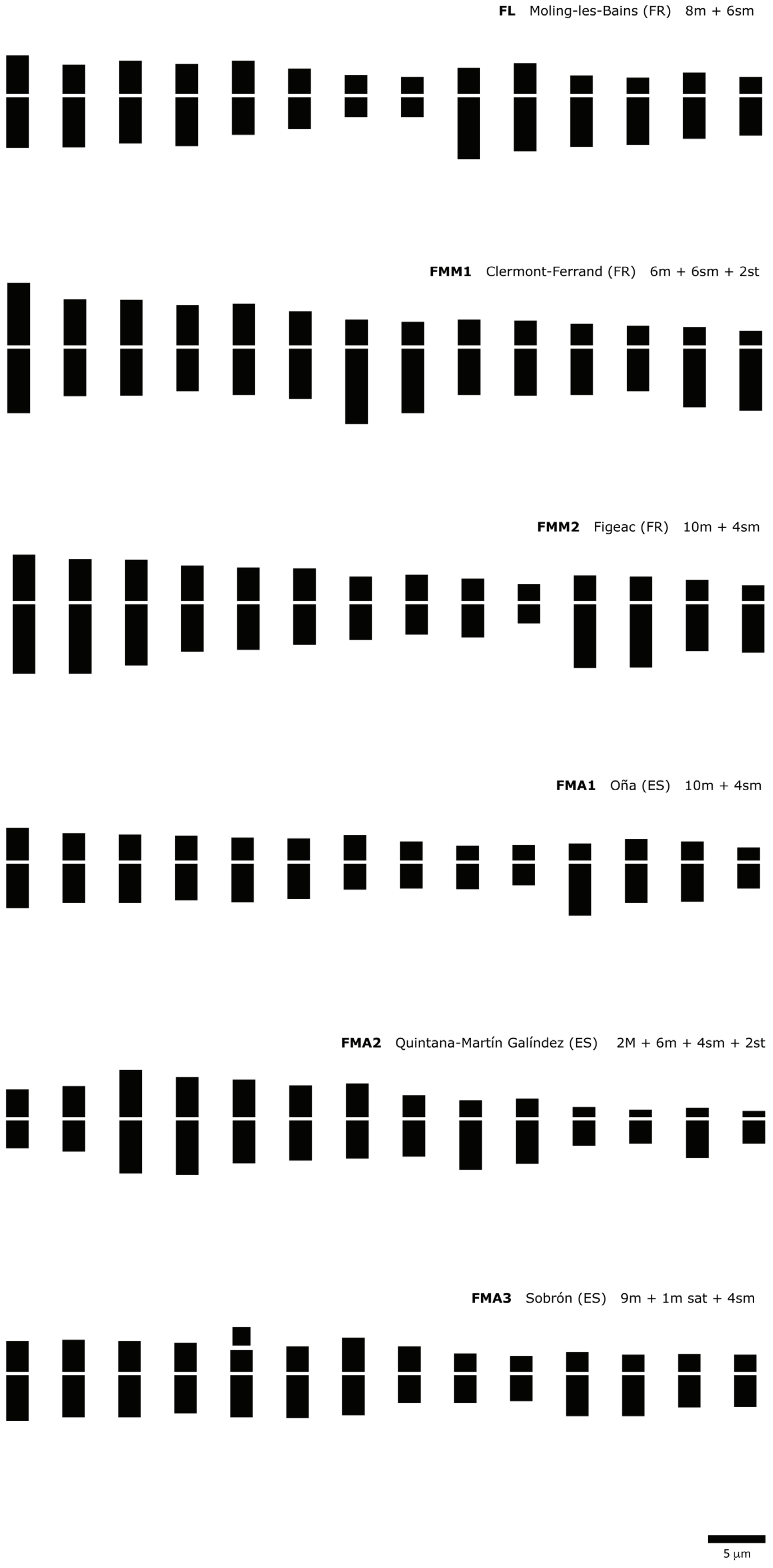

FIGURE 8. Idiograms of *Festuca lambinonii* (population FL), *F. marginata* subsp. *marginata* (FMM1−FMM2), subsp. *andres-molinae* (FMA1−FMA3) (all 2n = 14).

FIGURE 9. Idiograms of *Festuca marginata* subsp. *andres-molinae* (populations FMA4−FMA5) and subsp. *gallica* (FMG1−FMG4) (all 2n = 14).

Results

Festuca circummediterranea, *F. humifusa*, *F. jeanpertii* subsp. *jeanpertii,* subsp. *achaica,* subsp. *campana*, and subsp. *gracilis, F. lambinonii*, *F. marginata* subsp. *marginata*, subsp. *andres-molinae*, and subsp. *gallica* are diploid, having 2n = 14 (Table 1, Figs. 2−4).

The karyotypes of the investigated taxa are characterized by a predominance of metacentric (mostly m rather than M) chromosomes, usually in number of 8 or 10; these are constantly accompained by 4 or 6 (occasionally 2 or 8) submetacentric chromosomes. The presence of subacrocentric chromosomes (in number of 2 or 4) is sporadic. Less than half of the examined samples showed the presence of satellites, which were recorded from six different taxa; their occurrence was noticed also by Bidault (1968) in *F. marginata* subsp. *gallica* and can be detected in the mitotic metaphase drawing of *F. humifusa* published by Brullo & Guarino (2001). B-chromosomes were found only in two samples of *F. marginata* subsp. *gallica*, a feature noticed for this taxon by Bidault (1964, 1966a) (Table 1, Figs. 5−9).

Discussion

All the taxa belonging to the *Festuca circummediterranea* aggregate appear to have identical chromosome numbers. Our counts of 2n = 14 for *Festuca circummediterranea*, *F. humifusa*, *F. jeanpertii* subsp. *campana*, *F. lambinonii*, *F. marginata* subsp. *marginata*, subsp. *andres-molinae*, and subsp. *gallica* confirm the previous diploid counts for these taxa reported in literature (Litardière 1950, Bidault 1963, 1964, 1966a, 1966b, 1968, Huon 1970, Parreaux, 1971, 1972, Fuente García & Ortúñez Rubio 1993, Ortúñez Rubio & Fuente García 1995, Brullo & Guarino 2001, Fuente *et al.* 2001, Fiorini *et al*. 2008, Šmarda *et al*. 2008). Šmarda *et al*. (2008) listed a tetraploid "*F. circummediterranea* Patzke s.l." from Italy; however, the identity of the population from which the tetraploid count was reported was originally uncertain and the abbreviation "cfr." was wrongly changed into "s.l." prior to publication of that study (B. Foggi, pers. obs.). The identity of this tetraploid taxon remains uncertain. We did not find any tetraploid counts.

No substantial variation in gross karyomorphology has been recorded between the species and subspecies, and within the populations. The only remarkable difference is represented by the presence of B-chromosomes in *F. marginata* subsp. *gallica* (Table 1, Fig. 9; see also Bidault 1964, 1966a), whose role in taxonomy, however, is commonly regarded as irrelevant (Stace 1991) and their contribution to the genome size is still unclear (Šmarda & Bureš 2006).

The low variability in karyomorphology adds a further obstacle to discriminating the currently accepted taxa, whose separation on morphological grounds has recently been regarded as questionable (Foggi *et al.* 2009, Foggi & Tison 2014). All the taxa are characterized by the same leaf sclerenchyma arrangement (three well-defined strands at the margins and the keel of the transversal leaf section) and the features traditionally employed to distinguish the various species and subspecies (length of panicles, glumes, lemmas, and awns, closure degree of basal leaf sheaths; see e.g. Markgraf-Dannenberg 1976, 1980) show a highly fluctuating pattern of variability across the distributional area of each taxon (Foggi & Tison 2014).

The aggregate of *F. circummediterranea* is placed by Šmarda *et al*. (2008) among the "derived fine-leaved fescues", a recent group associated with a rapid reduction of the genome size. However, while the evolutionary relationships of the aggregate with other sections and species groups of *Festuca* have been clarified, currently no evolutionary trends can be traced within the group of *F. circummediterranea*: no polyploid counts resulted from our surveys and the values of DNA content, monoploid genome size, average chromosome size, and cytosine and guanine content reported by Šmarda *et al*. (2008) are very similar between the two representatives of the group they examined (*F. circummediterranea* and *F. humifusa*).

Despite the preliminary results here presented, conclusions of a taxonomic and evolutionary nature are premature at this stage of the research, since they need to be integrated with data from the analysis of further karyological, morphological, and biomolecular parameters.

Acknowledgements

The authors are indebted to Leonardo Cartei (Florence), Paolo Cauzzi (University of Milan), Jacopo Foggi (Florence), Matilde Gennai (University of Florence), Claudia Quercioli (Florence), Annalisa Santangelo (University of Naples

“Federico II”), and Sandro Strumia (Second University of Naples) for their precious help in the field. We are deeply grateful also to editor Jeffery M. Saarela (Canadian Museum of Nature, Ottawa) and two anonymous reviewers for their valuable suggestions and edits.

References

Auquier, P. & Kerguélen, M. (1978) Un groupe embrouillé de *Festuca* (Poaceae): les taxons désignés par l’épithète “*glauca*” en Europe occidentale et dans les regions voisines. *Lejeunia, Ser. Nova* 89: 1−82.

Bidault, M. (1963) Eìtude expeìrimentale de quelques populations de Festuca du groupe ovina et ses conseìquences taxinomiques. *Bulletin de la Société Botanique de France* 110 (9): 372−380.
http://dx.doi.org/10.1080/00378941.1963.10835408

Bidault, M. (1964) Sur la preìsence de chromosomes surnumeìraires dans divers taxa du *Festuca* gr. *ovina* L. *Comptes rendus hebdomadaires des séances de l’Académie des Sciences* 259: 4779−4782.

Bidault, M. (1966a) Observations caryologiques sur le *Festuca ovina* L. ssp. *laevis* Hack. *Bulletin de la Société Botanique de France* 113 (1–2): 12−14.
http://dx.doi.org/10.1080/00378941.1966.10838301

Bidault, M. (1966b) Remarques sur quelques *Festuca* gr. *ovina* L. s.l. du Briançonnais. *Bulletin de la Société Botanique de France* 113(1−2): 46−60.
http://dx.doi.org/10.1080/00378941.1966.10838307

Bidault, M. (1968) Essai de taxonomie expérimentale et numérique sur *Festuca ovina* L. s. l. dans le sud-est de la France. *Revue de cytologie et de biologie végétales* 31: 217−356.

Breistroffer, M. (1966) Flore abrégée du Diois (Drôme). *Bulletin de la Société Botanique de France* 110 (suppl. 2): 42−143.
http://dx.doi.org/10.1080/00378941.1963.10835446

Brullo, S. & Guarino, R. (2001) *Festuca humifusa* (Gramineae), a new species from Sicily. *Bocconea* 13: 409−412. Available from: http://147.163.105.223/bocconea/13-409.pdf (accessed 9 May 2016)

Charrel, L. (1920) Le *Festuca ovina*. Clef dichotomique, synonymie. *Bulletin trimestriel de la Société Botanique et Géologique du Var et de la Corse* 18: 4−7.

Dyer, A.F. (1979) *Investigating chromosomes.* Edward Arnold, London, 138 pp.

Fiorini, G., Quercioli, C. & Foggi, B. (2008) Reports (1679−1680). *In*: Kamari, G., Blanché, C. & Siljak-Yakovlev, S. (Eds.) Mediterranean chromosome number reports − 18. *Flora Mediterranea* 18: 595−599. Available from: http://147.163.105.223/flora/18-563.pdf (accessed 9 May 2016)

Foggi, B. & Müller, J. (2009) *Festuca*. *In*: Valdés, B. & Scholz, H. (Eds.) *Poaceae. Euro+Med Plantbase - the information resource for Euro-Mediterranean plant diversity*. Available from: http://ww2.bgbm.org/EuroPlusMed/PTaxonDetail.asp?NameCache=Festuca&PTRefFk=7100000 (accessed: 28 October 2015).

Foggi, B. & Tison, J.-M. (2014) *Festuca* L. *In*: Tison, J.-M. & de Foucault, B. (Eds.) *Flora Gallica. Flore de France*. Biotope, Mèze, pp. 238−248.

Foggi, B., Quercioli, C., Bruschi, P., Signorini, M.A. & Guidi, T. (2009) Il gruppo *Festuca* “*circummediterranea*” (Poaceae) in Italia. *In*: Peccenini, S. & Domina, G. (Eds.) *Gruppi critici della Flora d’Italia, Comunicazioni*. SocietaÌ Botanica Italiana, Gruppo per la Floristica, Roma, 30−31 October 2009, pp. 11−12. Available from: http://www.societabotanicaitaliana.it/uploaded/831.pdf (accessed 9 May 2016)

Foggi, B., Quercioli, C., Gennai, M., Nardi, E. & Signorini, M.A. (2012) Lectotypification of taxa belonging to the “*Festuca circummediterranea*” group. *Candollea* 67(2): 221−228. Available from: http://www.ville-ge.ch/cjb/publications/cando672/C672_221-228.pdf (accessed 9 May 2016)

Fuente García, V. & Ortúñez Rubio, E. (1993) *Festuca marginata* subsp. *andresmolinae*, subsp. nov. para la Península Ibérica. *Botanica Complutensis* 18: 105−112. Available from: https://revistas.ucm.es/index.php/BOCM/article/view/BOCM9393110105A/6499 (accessed 9 May 2016)

Fuente, V., Ferrero, L.M. & Ortúñez, E. (2001) Chromosome counts in the genus *Festuca* L. section *Festuca* (Poaceae) in the Iberian Peninsula. *Botanical Journal of the Linnean Society* 137 (4): 385−398.
http://dx.doi.org/10.1006/bojl.2001.0493

Gutermann, W., Ehrendorfer, F. & Fischer, M. (1974) Neue Namen und kritische Bemerkungen zur Gefäßpflanzenflora Mitteleuropas. *Österreichische botanische Zeitschrift* 122 (4): 259−273.
http://dx.doi.org/10.1007/BF01441577

Hackel, E. (1882) *Monographia Festucarum Europaearum*. Kassel, Berlin, 216 pp.
http://dx.doi.org/10.5962/bhl.title.15610

Hayek, A. (1933) Prodromus Florae peninsulae Balcanicae 3. *Repertorium specierum novarum regni vegetabilis, Beihefte* 30 (3): 1−472.

Heywood, V.H. (1978) Flora Europaea Notulae Systematicae ad Floram Europaeam spectantes. No. 20. *Botanical Journal of the Linnaean Society* 76(4): 297−384.
http://dx.doi.org/10.1111/j.1095-8339.1978.tb01817.x

Huon, M.A. (1970) Les fetuques de l'Ouest de la France. Recherches de biosystematique et de biogeographie. *Botanica Rhedonica, Sér. A* 9: 1−298.

Johansen, D.A. (1940) *Plant Microtechnique*. McGraw-Hill Book Company, Inc., New York & London, 523 pp.

Kerguélen, M. (1983) Les graminées de France au travers de «Flora Europaea» et de la «Flore» du C.N.R.S. *Lejeunia*, n. sér., 110: 1−79.

Levan, A., Fredga, K. & Sandberg, A.A. (1964) Nomenclature for centromeric position on chromosomes. *Hereditas* 52 (2): 201−220.
http://dx.doi.org/10.1111/j.1601-5223.1964.tb01953.x

Linnaeus, C. (1753) *Species Plantarum*. L. Savius, Stockholm, 1200 pp.
http://dx.doi.org/10.5962/bhl.title.669

Litardière, R. (1950) Nombres chromosomiques de diverses gramineìes. *Boletim da Sociedade Broteriana*, 2ª Sér. 24: 79−87.

Markgraf-Dannenberg, I. (1976) Die Gattung *Festuca* in Griechenland. *In:* Dafis, S. & Landolt, E. (Eds.) *Zur Vegetation und Flora von Griechenland.* Veröffentlichungen des Geobotanischen Institutes der Eidg. Techn. Hochschule, Stiftung Rübel, in Zürich 58: 92−182.
http://dx.doi.org/10.5169/seals-308448

Markgraf-Dannenberg, I. (1980) *Festuca* L. *In:* Tutin, T.G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A. (Eds.) *Flora Europaea* 5. Cambridge University Press, Cambridge, pp. 125−153.

Ortúñez Rubio, E. & Fuente García, V. de la (1995) Reports (394−400). *In*: Kamari, G., Felber, F. & Garbari, F. (Eds.) Mediterranean chromosome number reports − 5. *Flora Mediterranea* 5: 261−265. Available from: http://147.163.105.223/flora/5-261.pdf (accessed 9 May 2016)

Parreaux, M.-J. (1971) Étude du nombre chromosomique de quelques espèces xérophiles du Jura. Actes du Colloque sur la Flore et la Végétation des Chaînes Alpine et Jurassienne. *Annales littéraires de l'Université de Besaçon* 125: 113−126.

Parreaux, M.-J. (1972) Recherches biosystématiques sur quelques *Festuca* du groupe *laevis* Hack. du sud-est de la France. *Annales Scientifiques de l'Université de Besançon, sér. 3* 13: 69−155.

Raab-Straube, E. von & Raus, T. (2013) Euro+Med-Checklist Notulae, 2 [Notulae ad floram euro-mediterraneam pertinentes 31]. *Willdenowia* 43 (2): 239−249.
http://dx.doi.org/10.3372/wi.43.43202

Raus, T. (2013) *Festuca jeanpertii* subsp. *gracilis* (Hack.) Raus, comb. nov. *In*: Raab-Straube, E. von & Raus, T. (Eds.) Euro+Med-Checklist Notulae, 2 [Notulae ad floram euro-mediterraneam pertinentes 31]. Willdenowia 43 (2): 246.
http://dx.doi.org/10.3372/wi.43.43202

Richter, K. (1890) *Plantæ Europeæ* 1. Verlag von Wilhelm Engelma*nn*, Leipzig, 378 pp.
http://dx.doi.org/10.5962/bhl.title.10116

Saint-Yves, A. (1924) Festucarum varietates novæ (Subg. *Eu-Festuca*). *Bulletin de la Société Botanique de France* 71 (1): 28−43.
http://dx.doi.org/10.1080/00378941.1924.10833526

Šmarda, P. & Bureš, P. (2006) Intraspecific DNA content variability in *Festuca pallens* on different geographical scales and ploidy levels. *Annals of Botany* 98(3): 665–678.
http://dx.doi.org/10.1093/aob/mcl150

Šmarda, P., Bureš, P., Horová, L., Foggi, B. & Rossi, G. (2008) Genome size and GC content evolution of *Festuca*: ancestral expansion and subsequent reduction. *Annals of Botany* 101 (3): 421–433.
http://dx.doi.org/10.1093/aob/mcm307

Stace, C.A. (1991) Plant taxonomy and biosystematics. Second edition. Cambridge University Press, Cambridge, 264 pp.

Terracciano, N. (1872) *Relazione intorno alle peregrinazioni botaniche fatte per disposizione della Deputazione Provinciale di Terra di Lavoro in certi luoghi della provincia.* Nobile e C., Caserta, 240 pp.

Thiers, B. (2016) *Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. The New York Botanical Garden*. Available from: http://sweetgum.nybg.org/ih/ (accessed 9 May 2016)

3.2.1. Additional ISI publications on the same topic

(7) Ardenghi N.M.G., Galasso G., Banfi E., Zoccola A., Foggi B. & Lastrucci L., 2014 – A taxonomic survey of the genus *Vitis* (Vitaceae) in Italy, with special reference to Elba Island (Tuscan Archipelago). *Phytotaxa*, 166(3): 163−198. DOI: 10.11646/phytotaxa.166.3.1

(8) Ardenghi N.M.G., Banfi E. & Galasso G., 2015 − A taxonomic survey of the genus *Vitis* L. (Vitaceae) in Italy, part II: the 'Euro-American' hybrids. *Phytotaxa*, 224(3): 232−246. DOI: 10.11646/phytotaxa.224.3.2

(9) Ardenghi N.M.G., Galasso G., Banfi E. & Cauzzi P., 2015 − *Vitis* ×*novae-angliae* (Vitaceae): systematics, distribution and history of an "illegal" alien grape in Europe. *Willdenowia*, 45(2): 197−207. DOI: 10.3372/wi.45.45206

Papers (7−9) resulted from the investigation of the taxonomy of the genus *Vitis* L. (Vitaceae) in Italy and Europe. In recent years, *Vitis* proved to be in these areas a critical group, including, besides native *Vitis vinifera* L. (widely cultivated for wine production and fruit consumption), a number of naturalized American species and cultigen hybrids. These taxa and nothotaxa were introduced or obtained at the end of the 19th century for their resistance to some major grape diseases, unintentionally introduced from across the Ocean (e.g., phylloxera, powdery and downy mildews). Species and hybrids (between two or more American species or between American species and *V. vinifera*) were employed both as grafted rootstocks for *V. vinifera* or as "direct producers" for wine-making. American species and artificial hybrids have been demonstrated to escape, spread and form self-perpetuating populations, often behaving as noxious invasive species in both anthropogenic and natural environments of most southern Europe. The reproductive and ecological autonomy, along with an environmental impact usually greater in hybrids than in parental species, led the authors to formally describe five new nothospecies, naturalized/invasive over Italy and Europe: *V.* ×*instabilis* Ardenghi, Galasso, Banfi & Lastrucci (= *V. riparia* Michx. × *V. rupestris* Scheele), *V.* ×*koberi* Ardenghi, Galasso, Banfi & Lastrucci (= *V. berlandieri* Planch. × *V. riparia*), *V.* ×*ruggerii* Ardenghi, Galasso, Banfi & Lastrucci (= *V. berlandieri* × *V. rupestris*) (7), *V.* ×*bacoi* Ardenghi, Galasso & Banfi (= *V. riparia* × *V. vinifera*), and *V.* ×*golath* Ardenghi, Galasso & Banfi (= *V. riparia* × *V. rupestris* × *V. vinifera*) (8). This methodological choice provided full autonomy to the taxonomic investigation in this genus, marking a clear separation from the misleading ampelographic approach which deeply influenced the previous botanical contributions.

3.3. Article III (*Applied Plant Taxonomy*)

Ardenghi N.M.G., Foggi B., Orsenigo S., Maggioni L., Cauzzi P. & Rossi G., 2016 − *Festuca* and allied genera (Poaceae) as Crop Wild Relatives: checklists and red lists are urgently required. *Plant Biosystems*. DOI: 10.1080/11263504.2016.1165753

Taxonomy is often regarded as a purely academic or even superficial subject of little relevance to the urgent needs of man. This view, however, is far from the truth, since plant taxonomists have an important role in man's betterment, especially in a historical period, like the present, chracterized by a reduction and dispersal of the traditional natural resources (Stace, 1991).

Festuca and allied genera are among the most widely studied non-cereal grasses (Yamada, 2011); hundreds of cultivars of different taxa are cultivated worldwide for forage, as turf, ornamental grasses and for sport facilities lawns (Zeven & de Wet, 1982; Darbyshire & Pavlick, 2007; Rossi *et al.*, 2010; Ministero delle Politiche Agricole e Forestali, 2014). The problematic taxonomic scenario distinctive of this critical group seemingly affected a clear definition of the crop wild relatives (CWR) of the cultivated fescues, often resulting in incomplete and approximate CWR lists (see, e.g., University of Birmingham, 2005; Landucci *et al.*, 2014; University of Perugia, 2015).

Thanks to the employment of a consolidated generic and infrageneric treatment of *Festuca* s.l., traditionally adopted since Hackel (1881, 1882; see also paragraph 1.1), and a strict taxonomic approach, the first priority list of Italian CWRs of *Festuca* s.l. is defined, by following the Taxon Group (TG) concept introduced by Maxted *et al.* (2006). This list represents the first step of a conservation process that, starting from the individuation of threats and classification of more threatened taxa (Red List), must guarantee the *in situ* and *ex situ* conservation of wild species of interest for their agronomic and economic value. The case of *Festuca* s.l. highlights the importance of taxonomy to focus conservation efforts on taxa that require urgent conservation, thereby saving time and money.

Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology

Official Journal of the Societa Botanica Italiana

ISSN: 1126-3504 (Print) 1724-5575 (Online) Journal homepage: http://www.tandfonline.com/loi/tplb20

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To cite this article: N. M. G. Ardenghi, B. Foggi, S. Orsenigo, L. Maggioni, P. Cauzzi & G. Rossi (2016): Festuca and allied genera (Poaceae) as Crop Wild Relatives: Checklists and Red Lists are urgently required, Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology, DOI: 10.1080/11263504.2016.1165753

To link to this article: http://dx.doi.org/10.1080/11263504.2016.1165753

Plant Biosystems, 2016
http:/dx.doi.org/10.1080/11263504.2016.1165753

SHORT COMMUNICATION

Festuca and allied genera (Poaceae) as Crop Wild Relatives: Checklists and Red Lists are urgently required

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Abstract

Festuca s.l. is a crucial group of Crop Wild Relatives (CWR) genera, globally employed as fodder, lawn grasses and for habitat restoration. Lists elaborated strictly on the basis of a taxonomic approach are urgently needed to be used to find gaps in existing *ex situ* collections, to assess the conservation status of taxa of ascertained utility and include them in national Red Lists and to identify the most valuable taxa to be included in "preservation mixtures", as per Commission Directive 2010/60/EU. As an example, the first taxonomically based priority list of Italian CWRs of *Festuca* s.l. is here provided.

Keywords: *Crop Wild Relatives,* ex situ *conservation,* Festuca*, taxonomy, priority list*

Economic value of a critical group

Festuca L. and allied genera (*Drymochloa* Holub, *Leucopoa* Griseb., *Patzkea* G.H.Loos, *Schedonorus* P.Beauv.) are among the most widely studied non-cereal grasses (Yamada 2011), additionally included in the European Red List (Bilz et al. 2011). Hundreds of cultivars of different taxa are worldwide cultivated for forage [*Schedonorus arundinaceus* (Schreb.) Dumort., *S. pratensis* (Huds.) P.Beauv.], as turf [e.g. *F. rubra* L., *F. heteromalla* Pourr., *F. stricta* subsp. *trachyphylla* (Hack.) Patzke ex Pils, *F. filiformis* Pourr.], ornamental grasses and sport facilities lawns (e.g. *F. ovina* s.l. "Glauca") (Zeven & de Wet 1982; Kerguélen & Plonka 1989; Darbyshire & Pavlick 2007; Rossi et al. 2010; Ministero delle Politiche Agricole e Forestali 2014). On taxonomic ground, *Festuca* s.l. represents a problematic critical group of worldwide interest, for combination of intrinsic high phenotypic variability and nomenclatural complexity (Ardenghi et al. 2014). This aspect seemingly affected a clear definition of the Crop Wild Relatives (CWR) of the cultivated fescues, often resulting in incomplete and approximate CWR lists (see e.g. University of Birmingham 2005; Landucci et al. 2014; University of Perugia 2015). Although the conservation of the entire genetic diversity within the allied genera to which the cultivated taxa belongs is always desirable, the identification of a circumscribed list of CWR is of fundamental importance to establish conservation priorities (i.e. conservation status according to IUCN criteria) and intervention strategies at national level (i.e. *in*/*ex situ* conservation actions).

Taxonomy as a helping tool for the definition of a CWR

Among the different approaches available for the definition of a CWR (Harlan & de Wet 1971; Maxted et al. 2006; Vincent et al. 2013), the lack of specific studies evidencing the level of fertility in crosses between *Festuca* s.l. crops and the wild taxa, at least in Italy, led us to adopt the Taxon Group (TG) concept introduced by Maxted et al. (2006). A consolidated infrageneric treatment of *Festuca* s.l., traditionally employed since Hackel (1882), facilitated a circumscribed definition of the CWRs occurring in Italy, through the selection of members from TG2 (taxa belonging to the same series or section as crop) for *Festuca* s.s. and from TG4 (taxa belonging to the same genus as crop) for *Schedonorus*.

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The checklist

The resulting CWRs of *Festuca* s.l. for Italy, reported in Table I as an example of national priority list, amount to 48 taxa (35 species with 25 subspecies), about half of the taxa recorded from Italy (Ardenghi et al. 2014); 10 are the Italian endemics, equivalent to less than a quarter of the CWRs. According to available online databases, genebank collections of Italian germplasm are largely incomplete, with worldwide institutions conserving only few taxa, still in very limited numbers, clearly referable to the taxonomic treatment here reported. For many species, in fact, infraspecific ranks are not taken into account, although the number of accessions is relatively high (see e.g. *S. arundinaceus* (276), *S. pratensis* (32), *F. rubra* (10)).

Conclusions

This list represents the first step of a conservation process that, starting from the individuation of threats and classification of more threatened taxa (Red List), must guarantee the *in situ* and *ex situ* conservation of wild species of interest for their ag-

Table 1. Checklist of the Crop Wild Relatives of *Festuca* s.l. in Italy.

Species	Crop	End.	*Ex situ*
Festuca apuanica Markgr.-Dann.	o	E	0
Festuca arvernensis Auquier, Kerguélen and Markgr.-Dann. subsp. *costei* (St.-Yves) Auquier and Kerguélen	o	–	0
Festuca bauzanina (Pils) S.Arndt subsp. *bauzanina*	s	–	0
Festuca bauzanina (Pils) S.Arndt subsp. *rhaetica* S.Arndt	s	–	0
Festuca billyi Kerguén and Plonka	o	–	0
Festuca centroapenninica (Markgr.-Dann.) Foggi, F.Conti and Pignatti	o	E	0
Festuca cinerea Vill.	o	–	1
Festuca cyrnea (Litard. and St.-Yves) Signorini, Foggi and E.Nardi	r	–	0
Festuca filiformis Pourr.	o	–	0
Festuca gamisansii Kerguélen subsp. *aethaliae* Signorini and Foggi	o	E	0
Festuca guinochetii (Bidault) S.Arndt	s	–	0
Festuca heteromalla Pourr.	r	–	0
Festuca heterophylla Lam.	r	–	1
Festuca imperatrix Catonica	o	E	0
Festuca inops De Not.	o	–	0
Festuca laevigata Gaudin subsp. *crassifolia* (Gaudin) Kerguélen and Plonka	o	–	0
Festuca laevigata Gaudin subsp. *laevigata*	o	–	0
Festuca nigricans (Hack.) K.Richt.	r	–	1
Festuca nitida Kit. ex Schult.	r	–	0
Festuca norica (Hack.) K.Richt.	r	–	0
Festuca ovina L. subsp. *guestfalica* (Boenn. ex Rchb.) K.Richt.	o	–	1
Festuca ovina L. subsp. *molinieri* (Litard.) Foggi and Joch.Müll.	o	–	0
Festuca picturata Pils	r	–	0
Festuca pignattiorum Markgr.-Dann.	o	E	0
Festuca riccerii Foggi and Gr.Rossi	o	E	0
Festuca rivularis Boiss. subsp. *rivularis*	r	–	0
Festuca robustifolia Markgr.-Dann.	o	E	1
Festuca rubra L. subsp. *commutata* (Gaudin) Markgr.-Dann.	r	–	1
Festuca rubra L. subsp. *juncea* (Hack.) K.Richt.	r	–	0
Festuca rubra L. subsp. *microphylla* St.-Yves	r	–	0
Festuca rubra L. subsp. *rubra*	r	–	0
Festuca stricta Host subsp. *sulcata* (Hack.) Patzke	s	–	0
Festuca stricta Host subsp. *trachyphylla* (Hack.) Patzke ex Pils	s		0
Festuca ticinensis (Markgr.-Dann.) Markgr.-Dann.	o	–	0
Festuca trichophylla (Ducros ex Gaudin) K.Richt. subsp. *asperifolia* (St.-Yves) Al-Bermani	r	–	0
Festuca trichophylla (Ducros ex Gaudin) K.Richt. subsp. *trichophylla*	r	–	0
Festuca valesiaca Schleich. ex Gaudin subsp. *valesiaca*	s	–	1
Festuca veneris Gr.Rossi, Foggi and Signorini	o	E	0
Festuca violacea Schleich. ex Gaudin subsp. *italica* Foggi, Gr.Rossi and Signorini	r	E	0
Festuca violacea Schleich. ex Gaudin subsp. *puccinellii* (Parl.) Foggi, Gr.Rossi and Signorini	r	E	4
Festuca violacea Schleich. ex Gaudin subsp. *violacea*	r	–	0
Schedonorus arundinaceus (Schreb.) Dumort. subsp. *arundinaceus*	a/p	–	0
Schedonorus giganteus (L.) Holub	a/p	–	7
Schedonorus interruptus (Desf.) Tzvelev subsp. *corsicus* (Hack.) Foggi	a/p	–	0
Schedonorus interruptus (Desf.) Tzvelev subsp. *interruptus*	a/p	–	0
Schedonorus pratensis (Huds.) P.Beauv. subsp. *apenninus* (De Not.) H.Scholz and Valdés	a/p	–	19
Schedonorus pratensis (Huds.) P.Beauv. subsp. *pluriflorus* (Schult.) H.Scholz	a/p	–	0
Schedonorus pratensis (Huds.) P.Beauv. subsp. *pratensis*	a/p	–	0

Notes: Crop = related crop, “a/p” = *Schedonorus arundinaceus* and *S. pratensis*, “o” = *Festuca ovina* s.l., “r” = *F. rubra* s.l., “s” = *Festuca stricta*; End., E = Italian endemic (according to Peruzzi et al. 2014). Taxonomic conception of genera and species largely follows Euro+Med (2006−2015), with the exception of *S. arundinaceus* subsp. *mediterraneus* (Hack.) H.Scholz & Valdés and *S. uechtritzianus* (Wiesb.) Holub, here treated as synonyms of *S. arundinacues* subsp. *arundinaceus*, in accordance with Ardenghi (in Bovio 2014) and Foggi & Tison (2014). Despite the recent molecular results evidencing the inclusion of *Schedonorus* within *Lolium* L. (see e.g. Soreng et al. 2015), *Schedonorus* is here treated as an independent genus, since nomenclatural combinations under *Lolium* of some Italian taxa are still missing. *Ex situ* = Number of accessions of Italian origin conserved in worldwide genebanks, based on EURISCO (eurisco.ecpgr.org), GENESYS (www.genesys-pgr.org), Mediterranean Germplasm Database (http://ibbr.cnr.it/pma/) and PlantaRes (http://planta-res.entecra.it/).

ronomic and economic value. The case of *Festuca* s.l. highlights the importance of taxonomy to focus conservation efforts on taxa that require urgent conservation, thereby saving time and money.

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References

Ardenghi NMG, Foggi B, Rossi G. 2014. The genus *Festuca* s.l. (Poaceae) in Italy: Novelties and achievements in the new edition of 'Flora d'Italia'. 109° Congresso della Società Botanica Italiana, 2−5 September 2014, Firenze.

Bilz M, Kell SP, Maxted N, Lansdown RV. 2011. European red list of vascular plants. Luxembourg: Publications Office of the European Union.

Bovio M. 2014. Flora vascolare della Valle d'Aosta [Vascular flora of Valle d'Aosta]. Sarre: Testolineditore.

Darbyshire SJ, Pavlick LE. 2007. *Festuca* L. In: Barkworth ME, Capels KM, Long S, Anderton LK, Piep MB, editors. Flora of North America, 24. New York: Oxford University Press. pp. 389–443.

Euro+Med. 2006−2015. Euro+Med PlantBase – The information resource for Euro-Mediterranean plant diversity. Available: http://ww2.bgbm.org/EuroPlusMed/. Accessed Jun 2015 23.

Foggi B, Tison J-M. 2014. Schedonorus P. Beauv. In: Tison J-M, de Foucault B, editors. Flora Gallica. Flore de France [Flora of France]. Mèze: Biotope Éditions. pp. 278−279.

Hackel E. 1882. Monographia Festucarum europaearum [Monograph of European fescues]. Kassel: Theodor Fischer.

Harlan JR, de Wet JMJ. 1971. Toward a rational classification of cultivated plants. Taxon 20: 509–517.

Kerguélen M, Plonka F. 1989. Bulletin de la Société Botanique du Centre-Ouest. n.s., num. spec. 10: 1−368.

Landucci F, Panella L, Lucarini D, Gigante D, Donnini D, Kell S, et al. 2014. A prioritized inventory of crop wild relatives and wild harvested plants of Italy. Crop Sci 54: 1628–1644.

Maxted N, Ford-Lloyd BV, Jury SL, Kell SP, Scholten MA. 2006. Towards a definition of a crop wild relative. Biodivers Conserv 15: 2673–2685.

Ministero delle Politiche Agricole e Forestali. 2014. Catalogo delle varietà delle specie di piante agricole - anno 2014 [Catalogue of varieties of agricultural plant species]. Available: http://www.sementi.it/articoli/163/registro-nazionale-varieta-specie-agrarie. Accessed Jun 2015 23.

Peruzzi L, Conti F, Bartolucci F. 2014. An inventory of vascular plants endemic to Italy. Phytotaxa 168: 1–75.

Rossi G, Ardenghi N, Parolo G. 2010. Le festuche italiane, queste sconosciute [The Italian fescues, these unknown]. Acer, Il Verde Editoriale 5: 25.

Soreng RJ, Peterson PM, Romaschenko K, Davidse G, Zuloaga FO, Judziewicz EJ, et al. 2015. A worldwide phylogenetic classification of the Poaceae (Gramineae). J Syst Evol 53: 117–137.

University of Birmingham. 2005. CWRIS PGR forum crop wild relative information system. Available: http://www.pgrforum.org/cwris/cwris.asp?action=show&fact=677082. Accessed Jun 2015 23.

University of Perugia. 2015. Italian crop wild relative and wild harvested plant checklist (CWR/WHP List). Available: http://vnr.unipg.it/PGRSecure/. Accessed Jun 2015 23.

Vincent H, Wiersema J, Kell S, Fielder H, Dobbie S, Castañeda-Álvarez NP, et al. 2013. A prioritized crop wild relative inventory to help underpin global food security. Biol Conserv 167: 265–275.

Yamada T. 2011. *Festuca*. In: Kole C, editor. Wild crop relatives: Genomic and breeding resources. Berlin: Springer. pp. 153–164.

Zeven AC, de Wet JMJ. 1982. Dictionary of cultivated plants and their regions of diversity. Wageningen: PUDOC.

3.3.1. Additional ISI and non-ISI (*) publications on the same topic

(10) Abeli T., Orsenigo S., Ardenghi N.M.G., Lucassen E.C.H.E.T. & Smolders A.J.P., 2014 − Hydrochemical Characterization of A Stand of the Threatened Endemic *Isoëtes malinverniana*. *American Fern Journal*, 103(4): 241−244. DOI: 10.1640/0002-8444-103.4.241

(11*) Ardenghi N.M.G., 2016 − Novità esotiche e alcuni gruppi critici in Romagna. In: Verso un Atlante Floristico della Romagna. Atti della giornata di studio e incontro per la costituzione di un progetto comune per un Atlante Corologico della Romagna Zangheriana. Sabato 12 Marzo 2016 presso il Museo di Scienze Naturali di Cesena. Montanari S. (ed.). *Quaderno di Studi e Notizie di Storia Naturale della Romagna*, 43: 12−16.

(12) Ardenghi N.M.G. & Galasso G., 2014 – *Commelina virginica* (*Commelinaceae*), a "phantom" alien in the Euro-Mediterranean area. *Willdenowia*, 44(3): 423−429. DOI: 10.3372/wi.44.44313

(13*) Ardenghi N.M.G. & Pascale M., in press – *Lolium apenninum* (De Not.) Ardenghi & Foggi. In: Note floristiche piemontesi. Selvaggi A., Soldano A., Pascale M. & Dellavedova R. (eds.). *Rivista Piemontese di storia naturale*, 37.

(14*) Ardenghi N.M.G., Foggi B. & Rossi G., 2014 – The genus *Festuca* s.l. (Poaceae) in Italy: novelties and achievements in the new edition of 'Flora d'Italia'. *109° Congresso della Società Botanica Italiana - International Plant Science Conference (IPSC), from Nature to Technological Exploitations*, Florence, 2−5 September 2014: 149.

(15) Ardenghi N.M.G., Trentin M., Trivellini G. & Orsenigo S., 2014 − *Lycopus lucidus* Turcz. ex Benth. var. *hirtus* Regel (Lamiaceae) in Italy: a new naturalized alien species for the European flora. *Acta Botanica Gallica: Botany Letters*, 161(2): 183−188. DOI: 10.1080/12538078.2014.909326

(16*) Ardenghi N.M.G., Parolo G., Rossi G., Selvaggi A., Compagnoni A., Prete A., Cerutti G.V., Soldano A. & Fonio G., 2015 − 610. *Festuca intercedens* (Hack.) Lüdi ex Bech. In: Note floristiche piemontesi n. 604−705. Selvaggi A., Soldano A., Pascale M. & Dellavedova R. (eds.). *Rivista Piemontese di storia naturale*, 36: 284.

(17*) Ardenghi N.M.G., Selvaggi A., Lonati S. & Soldano A., 2015 − 630. *Festuca stricta* Host subsp. *trachyphylla* (Hack.) Patzke ex Pils. In: Note floristiche piemontesi n. 604−705. Selvaggi A., Soldano A., Pascale M. & Dellavedova R. (eds.). *Rivista Piemontese di storia naturale*, 36: 294.

(18*) Ardenghi N.M.G., Selvaggi A., Marangoni D., Compagnoni A. & Prete A., 2015 − 629. *Festuca rubra* L. subsp. *commutata* (Gaudin) Markgr.-Dann. In: Note floristiche piemontesi n. 604−705. Selvaggi A., Soldano A., Pascale M. & Dellavedova R. (eds.). *Rivista Piemontese di storia naturale*, 36: 293−294.

(19*) Ardenghi N.M.G., Selvaggi A., Marangoni D., Scotta M., Mondino G.P., Barni E., Bruno G., Davì E., Gorlier A. & Lonati M., 2015 − 612. *Festuca trichophylla* (Ducros ex Gaudin) K. Richt. subsp. *asperifolia* (St.-Yves) Al-Bermani. In: Note floristiche piemontesi n. 604−705. Selvaggi A., Soldano A., Pascale M. & Dellavedova R. (eds.). *Rivista Piemontese di storia naturale*, 36: 285.

(20*) Ardenghi N.M.G., Selvaggi A., Pascale M., Marangoni D., Compagnoni A. & Prete A., 2015 − 611. *Festuca rubra* L. subsp. *juncea* (Hack.) K. Richt. In: Note floristiche piemontesi n. 604−705. Selvaggi A., Soldano A., Pascale M. & Dellavedova R. (eds.). *Rivista Piemontese di storia naturale*, 36: 284-285.

(21*) Ardenghi N.M.G., Selvaggi A., Soldano A., Gallino B., Pace I., Pascal R., Foggi B., Bouvet D., Viñals N. & Pascale M., 2015 − 628. *Festuca inops* De Not. In: Note floristiche piemontesi n. 604−705. Selvaggi A., Soldano A., Pascale M. & Dellavedova R. (eds.). *Rivista Piemontese di storia naturale*, 36: 292−293.

(22) Ardenghi N.M.G., Barcheri G., Ballerini C., Cauzzi P. & Guzzon F., 2016 − *Gymnocoronis spilanthoides* (*Asteraceae*, *Eupatorieae*), a new naturalized and potentially invasive aquatic alien in S Europe. *Willdenowia*, 46(2): 265–273. DOI: 10.3372/wi.46.46208

(23*) Foggi B., Rossi G., Ardenghi N. & Parolo G., in press – 15-19. gen. *Festuca* L. *sensu lato*. In: Flora d'Italia, seconda edizione. Pignatti S. (ed.). *Edagricole*, Bologna.

(24) Gentili R., Gilardelli F., Bona E., Prosser F., Selvaggi A., Alessandrini A., Martini F., Nimis P.L., Wilhalm T., Adorni M., Ardenghi N.M.G., Barni E., Bonafede F., Bonini M., Bouvet D., Buffa G., Ciappetta S., Giordana F., Faggi G., Ghiani A., Ghillani L., Marcucci R., Masin R., Morelli V., Montagnani C., Montanari S., Peccenini S., Pellizzari M., Romani E., Saiani D., Scortegagna S., Sirotti M., Truzzi A., Vignodelli M., Bagli L., Fiandri F., Siniscalco C. & Citterio S., 2016 – Distribution map of *Ambrosia artemisiifolia* L. (Asteraceae) in Italy. *Plant Biosystems*. DOI: 10.1080/11263504.2016.1176966

(25) Guzzon F., Müller J.V., Abeli T., Cauzzi C., Ardenghi N.M.G., Balestrazzi A., Rossi G. & Orsenigo S., 2015 − Germination requirements of nine European *Aegilops* species in relation to constant and alternating temperatures. *Acta Botanica Gallica: Botany Letters*, 162(4): 349−354 + iii [Corrigendum]. DOI: 10.1080/12538078.2015.1088793 + 10.1080/12538078.2015.1116275 [Corrigendum]

(26*) Nicolella G., Latini M., Iberite M. & Ardenghi N.M.G., 2016 − *Festuca rubra* L. subsp. *juncea* (Hack.) K.Richt. (Poaceae). In: Notulae to the Italian native vascular flora: 1. Bartolucci F., Domina G., Adorni M., Alessandrini A., Angiulli F., Ardenghi N.M.G., Banfi E., Barberis G., Bedini G., Bonari G., Calbi M., Fenaroli F., Galasso G., Gestri G., Ghillani L., Gottschlich G., Iberite M., Latini M., Lazzeri V., Nicolella G., Olivieri N., Perrino E., Peruzzi L., Pisani G., Roma-Marzio F., Russo G., Scutellà F., Silletti G., Stinca A., Wagensommer R. & Nepi C. (eds.). *Italian Botanist*, 1: 9. DOI: 10.3897/italianbotanist.1.8780

(27) Orsenigo S., Gentili R., Smolders A.J.P., Efremov A., Rossi G., Ardenghi N.M.G., Citterio S. & Abeli T., 2016 − Reintroduction of a dioecious aquatic macrophyte (*Stratiotes aloides* L.) regionally extinct in the wild. Interesting answers from genetics. *Aquatic Conservation: Marine and Freshwater Ecosystems*. DOI: 10.1002/aqc.2626

(28) Rossi G., Montagnani C., Abeli T., Gargano D., Peruzzi L., Fenu G., Magrini S., Gennai M., Foggi B., Wagensommer R.P., Ravera S., Cogoni A., Aleffi M., Alessandrini A., Bacchetta G., Bagella S., Bartolucci F., Bedini G., Bernardo L., Bovio M., Castello M., Conti F., Domina G., Farris E., Gentili R., Gigante D., Peccenini S., Persiani A.M., Poggio L., Prosser F., Santangelo A., Selvaggi A., Villani M.C., Wilhalm T., Zappa E., Zotti M., Tartaglini N., Ardenghi N.M.G., Blasi C., Raimondo F.M. & Orsenigo S., 2014 – Are Red List really useful for plant conservation? The New Red List of the Italian Flora as a study case in the perspective of national conservation policies. *Plant Biosystems*, 148(2): 187−190. DOI: 10.1080/11263504.2013.868375

(29) Verloove F., Brusa G. & Ardenghi N.M.G., 2016 − Studies in the genus *Paspalum* (*Paniceae*, *Poaceae*) in Europe: 3. *Paspalum thunbergii*, a new naturalized neophyte in W Europe. *Willdenowia*, 46(1): 137−143. DOI: 10.3372/wi.46.46111

Besides helping to locate natural resources beneficial for the needs of man (such as land races and crop wild relatives), plant taxonomy is a basic aiding tool in further botany subdisciplines, such as phytogeography, plant conservation, and ecology. A careful taxonomic contribution is specifically requested in treating critical groups and alien taxa, whose mis-identification would unquestionably lead to wrongly documented experimental and observational results (Stace, 1991).

Phytogeography is one of the subdisciplines that benefits most from the availability of a rigorous and updated taxonomic treatment. It is the case of *Festuca* s.l., whose distributional knowledge across Italy has been improved thanks to the publication of different contributions enclosed in the present PhD thesis, such as the new treatment of this genus within the new edition of *Flora d'Italia* (in press) (14*, 23*), and floristic records regarding novelties at regional scale (11*, 13*, 16*−21*).

A variegated taxonomic knowledge extending beyond the boundaries of a single group of species or genera is often helpful in identifying new alien taxa landing in a circumscribed geographical area. This expertise, together with the practice of consulting international floras and specific taxonomic papers, resulted in the publication of a high number of papers recording new neophytes both at continental and national level (7−9, 11*, 12, 15, 22, 24, 29).

Eventually, taxonomy proved to be a solid starting point in different projects on ecology and plant conservation (10, 25, 27−28).

4. CONCLUSIONS

Thanks to the papers published during the PhD course, a number of relevant points regarding *Festuca* and allied genera have been clarified. The obtained results pertain to different phases of the systematic research, both basic (e.g., typification, chromosome counts, ploidy level estimation) and advanced (e.g., new nomenclatural combinations, application of plant taxonomy to further botany disciplines).

The typification of the name *Festuca apennina* De Not. (I) allowed to fill an important gap within the troubled nomenclatural scenario of the “broad-leaved fescues”. The examination of De Notaris’ original material and the subsequent visit to the *locus classicus*, enabled the authors to focus on De Notaris’ original concept of this taxon, with direct consequences on taxonomy. A careful matching of authors’ original morphological and ecological observations with data on karyology acquired from literature, led to choose the appropriate taxonomic rank (species instead of subspecies) and propose a new nomenclatural combination in *Lolium* L. [*L. apenninum* (De Not.) Ardenghi & Foggi], in order to align taxonomy with the most updated results in phylogeny. The acquired consciousness of the species’ effective diagnostic traits had additional consequences on phytogeography: following the revision of recent and ancient herbarium material, the presence of *L. apenninum* has been confirmed in Piedmont, north-western Italy (13*), where the species was reported in the past (Burnat, 1882; Saint-Yves, 1913).

The nomenclatural choice adopted by (I) inspired a subsequent and larger contribution intended to transfer all the combinations under *Schedonorus* P.Beauv. and *Micropyropsis* Romero Zarco & Cabezudo into *Lolium* (4). This work, supported by further phylogenetic evidences (e.g., Catalán *et al.*, 2007; Catalán, 2006; Inda *et al.*, 2008; Soreng *et al.*, 2015), represents the conclusion of the nomenclatural project originally started by Darbyshire (1993) and Banfi *et al.* (2005).

Besides the rank choice for *Festuca apennina*, another article enclosed within this PhD thesis provided results of taxonomic relevance regarding *Festuca* s.l.: new karyological data acquired from the examination of thirty populations belonging to ten different taxa of the *Festuca circummediterranea* Patzke group (II) filled some major gaps in the karyological knowledge of this group, providing, for example, the first chromosome counts for *F. jeanpertii* (St.-Yves) Markgr. subsp. *jeanpertii*, subsp. *achaica* Markgr.-Dann., and subsp. *gracilis* (Hack.) Raus. Furthermore, chromosome numbers and analyses of the karyotypes disclosed a uniform karyological scenario, which resulted to be in line with the morphological and ecological homogeneity previously evidenced for the whole aggregate by Foggi *et al.* (2009) and Foggi & Tison (2014). These results, which seem to lead towards a merging of the ten taxa into one or few taxonomic units, will be of fundamental support to a future systematic revision of the aggregate, which should consider also morphometric and molecular aspects.

An accurate and in-depth expertise in *Festuca* s.l. developed during the PhD course, allowed to employ the taxonomic knowledge in this critical group as a support to other botany subdisciplines, among them phytogeography: in addition to the aforementioned confirmation of *Lolium apenninum* in Piedmont (13*), the most relevant contribution to the geographical distribution of *Festuca* s.l. is represented by the treatment of this group within the new edition of *Flora d'Italia*, provided with new original line drawings of the leaf blade sections (23*, 14*). Further floristic novelties associated with the distribution of this genus across Italy have also been published (11*, 16*−21*, 26*).

Eventually, a rigorous taxonomic treatment of *Festuca* s.l. helped to define a checklist of the crop wild relatives (CWR) of fescues in Italy (III), the first example of a CWR priority list entirely dedicated to this critical group and elaborated exclusively on the basis of a strict taxonomic approach.

5. ACKNOWLEDGMENTS

I am grateful to my tutor, Prof. Graziano Rossi, and co-tutor, Dott. Bruno Foggi, for their help and constructive suggestions in each step of the research. A special thank is due to coordinator Prof. Anna Maria Picco and vice-coordinator Prof. M. Chiara Domeneghetti, for their valuable assistance during the PhD course.

Paolo Cauzzi (University of Pavia), Graziana Fiorini (University of Florence), Lorenzo Lastrucci (University of Florence), Andrea Coppi (University of Florence), Annalisa Santangelo (University of Naples “Federico II”), Sandro Strumia (University of Naples), Liliana Bernardo (University of Calabria), and Domenico Gargano (University of Calabria) are acknowledged for their assistance either in field and laboratory work. Dr. Gabriele Galasso (Museo di Storia Naturale di Milano) and Dr. Filip Verloove (Botanic Garden of Meise) are thanked for their precious corrections and observations.

Finally, I am deeply indebted to my girlfriend Sara, my family, and my friends Paolo, Filippo, and Claudio, for their endless patience and priceless encouragement during these years.

6. References

Al-Bermani A.-K.H.A., Catalán P. & Stace C.A., 1992 – A new circumscription of *Festuca trichophylla* (Gaudin) K. Richter (*Gramineae*). *Anales del Jardín Botánico de Madrid*, 50(2): 209−220.

Alexeev E.B., 1977 – To the systematics of Asian fescues (*Festuca*). 1. Subgenera *Drymanthele*, *Subulatae*, *Schedonorus*, *Leucopoa*. *Bulletin of Moscow Society of Naturalists, Biological Series*, 82(3): 95−102 [in Russian].

Ardenghi N.M.G., Signorini M.A., Parolo G., Rossi G., Pignotti L., Vitek E. & Foggi B., 2013 − Typification of names of taxa belonging to Festuca arundinacea (≡*Schedonorus arundinaceus*) aggregate (Poaceae) in Hackel's herbarium (W). *Phytotaxa*, 84(2): 55–59. DOI: 10.11646/phytotaxa.84.2.2

Arndt S., 2008 − Novelties in the *Festuca valesiaca* group (Poaceae) from the central Alps. *Plant Systematics and Evolution*, 271(3): 129−142. DOI:10.1007/s00606-007-0588-0

Auquier P., 1977 − Taxonomie et nomenclature de quelques *Festuca* tétraploïdes du groupe de *F. ovina* L. s.l. (Poaceae) en Europe moyenne. *Bulletin du Jardin Botanique National de Belgique*, 47(1/2): 99–116. DOI: 10.2307/3667986

Auquier P. & Kerguélen M., 1978 − Un groupe embrouillé de *Festuca* (Poaceae): les taxons désignés par l'épithète "*glauca*" en Europe occidentale et dans les regions voisines. *Lejeunia*, Ser. Nova, 89: 1−82.

Banfi E., Bracchi G., Galasso G. & Romani E., 2005 − Agrostologia placentina. *Memorie della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*, 33(2): 1−80.

Barkworth M.E., Capels K.M., Long S., Anderton L.K. & Piep M.B. (eds.), 2007 − Flora of North America north of Mexico, 24: Magnoliophyta: Commelinidae (in part): Poaceae, part 1. *Oxford University Press*, New York.

Bidault M., 1968 − Essai de taxonomie expérimentale et numérique sur *Festuca ovina* L. gr. dans les Sud-Est de la France. Thèse de Doctorat, Université Orsay.

Bidault M., 1969 − Essai de taxonomie expérimentale et numérique sur *Festuca ovina* L. gr. dans les Sud-Est de la France. *Revue de cytologie et de biologie végétales*, 31: 217–356.

Burnat E., 1882 – Catalogue des *Festuca* des Alpes Maritimes. *G. Bridel*, Lausanne.

Castiglioni L. & Mariotti S., 2005 – IL. Vocabolario della lingua latina, ed. 3. *Loescher Editore*, Milano.

Catalán P., 2006 − Phylogeny and evolution of *Festuca* L. and related genera of subtribe Loliinae (Poeae, Poaceae). In: Plant Genome: Biodiversity and evolution 1D, 10. Sharma A.K. & Scharma A. (eds.). *Science Publishers*, Enfield: 255–303.

Catalán P., Torrecilla P., López Rodríguez J.Á. & Olmstead R.G., 2004 − Phylogeny of the festucoid grasses of subtribe Loliinae and allies (Poeae, Pooideae) inferred from ITS and *trn*L-F sequences. *Molecular, Phylogenetics and Evolution*, 31(2): 517−541. DOI: 10.1016/j.ympev.2003.08.025

Catalán P., Torrecilla P., López-Rodríguez J.A., Müller J. & Stace C., 2007 − A systematic approach to Subtribe *Loliinae* (Poaceae: Pooideae) based on phylogenetic evidence. *Aliso*, 23: 380−405.

Cebolla Lozano C. & Rivas Ponce M.A., 2003 − Catálogo del género *Festuca* L. (Poaceae) en la Península Ibérica. *Candollea*, 58(1): 189–213.

Clayton W.D., Vorontsova M.S., Harman K.T. & Williamson H., 2006+ − GrassBase - The Online World Grass Flora. http://www.kew.org/data/grasses-db.html [accessed: 13 July 2016]

Danihelka J., Šmarda P. & Foggi B., 2009 − (1864) Proposal to reject the name *Festuca pannonica* (Poaceae). *Taxon*, 58(1): 295−296.

Darbyshire S.J., 1993 − Realignment of *Festuca* Subgenus *Schedonorus* with the Genus *Lolium* (Poaceae). *Novon*, 3: 239−243. DOI: 10.5962/bhl.title.744

Darbyshire S.J. & Pavlick L.E., 2007 − *Festuca* L. In: Flora of North America north of Mexico, 24: Magnoliophyta: Commelinidae (in part): Poaceae, part 1. Barkworth M.E., Capels K.M., Long S., Anderton L.K. & Piep M.B. (eds.). *Oxford University Press*, New York: 389−443.

Devesa J.A., Catalán P., Müller J., Cebolla C. & Ortúñez E., 2013 – Checklist de *Festuca* L. (Poaceae) en la Península Ibérica. *Lagascalia*, 33: 183−274.

Euro+Med, 2006+ − Euro+Med PlantBase - the information resource for Euro-Mediterranean plant diversity. http://ww2.bgbm.org/EuroPlusMed/ [accessed: 13 July 2016].

Fiorini G., Quercioli C. & Foggi B., 2008 − Reports (1679−1680). In: Mediterranean chromosome number reports − 18. Kamari G., Blanché C. & Siljak-Yakovlev S. (eds.). *Flora Mediterranea*, 18: 595−599.

Foggi B. & Müller J., 2009a − *Festuca*. In: Poaceae. Euro+Med Plantbase - the information resource for Euro-Mediterranean plant diversity. Valdés B. & Scholz H. (eds.), with contributions from Raab-Straube E. von & Parolly G. http://ww2.bgbm.org/EuroPlusMed/ [accessed: 11 July 2016]

Foggi B. & Müller J., 2009b − *Leucopoa*. In: Poaceae. Euro+Med Plantbase - the information resource for Euro-Mediterranean plant diversity. Valdés B. & Scholz H. (eds.), with contributions from Raab-Straube E. von & Parolly G. http://ww2.bgbm.org/EuroPlusMed/ [accessed: 11 July 2016]

Foggi B. & Rossi G., 1996 − A survey of the genus *Festuca* L. (Poaceae) in Italy. I. The species of the summit flora in the Tuscan-Emilian Apennines and Apuan Alps. *Willdenowia*, 26(1/2): 183−215.

Foggi B. & Signorini M.A., 1997 − A survey of the genus *Festuca* L. (Poaceae) in Italy. IV. Typification of the names of some Italian fescues. *Candollea*, 52(2): 429–433.

Foggi B. & Signorini M.A., 2001 − Contributo alla conoscenza del genere *Festuca* (Poaceae) in ltalia XIII. Una specie mal conosciuta: *F. robustifolia* Markgr.-Dann. *Webbia*, 56(1): 145−163. DOI: 10.1080/00837792.2001.10670708

Foggi B. & Tison J.-M., 2014 − *Festuca* L. In: Flora Gallica. Flore de France. Tison J.-M. & de Foucault B. (eds.). *Biotope Éditions*, Mèze: 236−248.

Foggi B., Rossi G. & Signorini M.A., 1999 − The *Festuca violacea* aggregate (Poaceae) in the Alps and Apennines (central southern Europe). *Canadian Journal of Botany*, 77(7): 989−1013. DOI: 10.1139/b99-054

Foggi B., Signorini M.A. & Vitek E., 2004 – Types of names of *Festuca* (Gramineae) in the herbarium W: types from Host's herbarium. *Annalen des Naturhistorischen Museums in Wien*, 105(B): 597−612.

Foggi B., Scholz H. & Valdés B., 2005 − The Euro+Med treatment of *Festuca* (Gramineae) − new names and new combinations in *Festuca* and allied genera. *Willdenowia*, 35(2): 241−244. DOI: 10.3372/wi.35.35202

Foggi B., Gherardi M.E., Signorini M.A., Rossi G. & Bruschi P., 2006 − *Festuca inops* and *Festuca gracilior* (Poaceae): are they two different species? *Botanical Journal of the Linnean Society*, 151(2): 239−258. DOI: 10.1111/j.1095-8339.2006.00496.x

Foggi B., Rossi G. & Parolo G., 2007 − Il genere *Festuca* e i generi affini per la nuova "Flora critica d'Italia". Introduzione. *Informatore Botanico Italiano*, 39(1): 193−197.

Foggi B., Quercioli C., Bruschi P., Signorini M.A. & Guidi T., 2009 − Il gruppo *Festuca* "*circummediterranea*" (Poaceae) in Italia. In: Gruppi critici della Flora d'Italia, Comunicazioni. Peccenini S. & Domina G. (eds.) *Società Botanica Italiana, Gruppo per la Floristica*, Roma, 30−31 October 2009: 11−12.

Foggi B., Parolo G., Rossi G., Ardenghi N.M.G. & Quercioli C., 2010 − Il genere *Festuca* e i generi affini per una flora critica dell'Italia. II. I generi *Leucopoa* e *Drymochloa* (Poaceae). *Informatore Botanico Italiano*, 42(1): 335−361.

Foggi B., Parolo G., Šmarda P., Coppi A., Lastrucci L., Lakušic D., Eastwood R. & Rossi G., 2012a − Revision of the *Festuca alpina* group (*Festuca* section *Festuca*, Poaceae) in Europe. *Botanical Journal of the Linnean Society*, 170(4): 618−639. DOI: 10.1111/j.1095-8339.2012.01313.x

Foggi B., Quercioli C., Gennai M., Nardi E. & Signorini M.A., 2012b − Lectotypification of taxa belonging to the "*Festuca circummediterranea*" group. *Candollea*, 67(2): 221−228.

Fuente V. de la & Ortuñez E., 1998 − Biosistemática de la sección *Festuca* del género *Festuca* L. (Poaceae) en la Penìnsula Ibérica. *Ed. UAM*, Madrid.

Fuente V. de la & Sanchez-Mata D., 1986 – Tipificación de algunos táxones ibéricos del género *Festuca* L. (Gramineae) descritos por E. Hackel. *Candollea*, 41(1): 165−171.

Fuente V. de la, Ferrero L.M. & Ortúñez E., 2001 − Chromosome counts in the genus *Festuca* L. section *Festuca* (Poaceae) in the Iberian Peninsula. *Botanical Journal of the Linnean Society*, 137(4): 385−398. DOI:10.1006/bojl.2001.0493

Fuente García V., Ortúñez Rubio E., Ferrero Lomas L.M., 1997 − Contribución al conocimiento del género *Festuca* L. (Poaceae) en el País Vasco y Sistema Ibérico septentrional (Península Ibérica). *Itinera Geobotanica* 10, 317−351.

Gaut B.S., Tredway L.P., Kubik C., Gaut R.L. & Meyer W., 2000. − Phylogenetic relationships and genetic diversity among members of the *Festuca-Lolium* complex (Poaceae) based on ITS sequence data. *Plant Systematics and Evolution*, 224(1−2): 33−53. DOI: 10.1007/BF00985265

Grisebach A., 1852 – 1045. *Leucopoa*. In: Flora Rossica, 4(13). Ledebour G.F. (ed.). *Sumptibus Librariae E. Schweizerbart*, Stuttgart: 383–384. DOI: 10.5962/bhl.title.6606

Hackel E., 1881 – Die verwandtschaftlichen Beziehungen und die geographische Verbreitung der europäischen *Festuca*-Arten. *Botanisches Zentralblatt*, 8(52): 401−419.

Hackel E., 1882 – Monographia Festucarum Europaearum. *Theodor Fischer*, Kassel, Berlin. DOI: 10.5962/bhl.title.15610

Hammond M., Mack. A.M. & Moskalew W., 1997 – T. Macci Plauti Miles Gloriosus. *Harvard University Press*, Cambridge, London.

Holub J., 1984 − New Genera in Phanerogamae (1–3). *Folia Geobotanica & Phytotaxonomica*, 19(1): 95–99.

Holub J., 1998 − Reclassifications and new names in vascular plants 1. *Preslia*, 70(2): 97–122.

Inda L.A., Segarra-Moragues J.G., Müller J., Peterson P.M. & Catalán P., 2008 − Dated historical biogeography of the temperate Loliinae (Poaceae, Pooideae) grasses in the northern and southern hemispheres. *Molecular Phylogenetics and Evolution*, 46(3): 932–957. DOI: 10.1016/j.ympev.2007.11.022

Janka V. de, 1860 − Adnotationes in plantas dacicas nonnullasque alias europaeas. *Linnaea*, 30(5): 549−622.

Jarvis C., 2007 − Order out of Chaos; Linnaean Plant Names and their Types. *Linnean Society of London and the Natural History Museum*, London.

Jarvis C.E., Stace C.A. & Wilkinson M.J., 1987 – Typification of *Festuca rubra* L., *F. ovina* L. and *F. ovina* var. *vivipara* L. *Watsonia*, 16: 299−302.

Kellogg E.A., 2015 − Flowering Plants. Monocots. Poaceae. In: The Families and Genera of Vascular Plants, 13. Kubitzki K. (ed.). *Springer*, Cham, Heidelberg, New York, Dordrecht, London. DOI: 10.1007/978-3-319-15332-2

Kerguélen M., 1975 − Les Gramineae (Poaceae) de la Flore Française: essai de mise au point taxonomique et nomen- claturale. *Lejeunia*, n.s., 75: 1–343.

Kerguélen M. & Plonka F. 1989 − Les *Festuca* de la flore de France (Corse comprise). *Bullettin Societé Botanique du Centre-Ouest Centre-Ouest*, *Numéro spécial*, 10: 1–368.

Krivotulenko U., 1960 − Novye sekzii roda *Festuca* L. (Generis *Festuca* L. sectiones novae). *Botanicheskie materialy Gerbariya Botanicheskogo Instituti imeni V.L. Komarova, Akademii Nauk S.S.S.R.*, 20: 48–67 [in Russian].

Landucci F., Panella L., Lucarini D., Gigante D., Donnini D., Kell S., Maxted N., Venanzoni R. & Negri V., 2014 − A Prioritized Inventory of Crop Wild Relatives and Wild Harvested Plants of Italy. *Crop Science*, 54(4): 1628−1644. DOI: 10.2135/cropsci2013.05.0355

Linnaeus C., 1753 – Species Plantarum. *Impensis Laurentii Salvii*, Holmiae [Stockholm]. DOI: 10.5962/bhl.title.669

Litardière R., 1949 – Observations caryosystématiques sur le *Festuca paniculata* (L.) Schinz et Thell. *Portugaliae acta biologica. Série B, sistemática, ecologia, biogeografia e paleontologia*, Vol. J. Henriques: 113−116.

Litardière R., 1950 − Nombres chromosomiques de diverses graminées. *Boletim da Sociedade Broteriana*, 2a Série, 24: 79−87.

Loos G.H., 2010 − Taxonomische Neukombinationen zur Flora Mittel- und Osteuropas, insbesondere Nordrhein-Westfalens. *Jahrbuch des Bochumer Botanischen Vereins*, 1: 114−133.

Malik C.P. & Thomas P.T., 1966 − Karyotypic studies in some *Lolium* and *Festuca* species. *Caryologia*, 19(2): 167−196. DOI: 10.1080/00087114.1966.10796216

Markgraf-Dannenberg I., 1976 − Die Gattung *Festuca* in Griechenland. In: Zur Vegetation und Flora von Griechenland. Dafis S. & Landolt E. (eds.) Veröffentlichungen des Geobotanischen Institutes der Eidg. Techn. Hochschule, Stiftung Rübel, in Zürich, 58: 92−182. DOI: 10.5169/seals-308448

Markgraf-Dannenberg I., 1980 − *Festuca* L. In: Flora Europaea, 5. Tutin T.G., Heywood V.H., Burges N.A., Moore D.M., Valentine D.H., Walters S.M. & Webb D.A. (eds.). *Cambridge University Press*, Cambridge: 125−153.

Maxted N., Ford-Lloyd B.V., Jury S.L., Kell S.P. & Scholten M.A., 2006 − Towards a definition of a crop wild relative. *Biodiversity & Conservation*, 15(8): 2673–2685. DOI: DOI: 10.1007/s10531-005-5409-6

McNeill J., Barrie F.R., Buck W.R., Demoulin V., Greuter W., Hawksworth D.L., Herendeen, P.S., Knapp S., Marhold, K., Prado J., Prud'homme Van Reine W.F., Smith G.F., Wiersema J.H. & Turland N.J. (eds.), 2012 − International Code of Nomenclature for algae, fungi, and plants (Melbourne Code). *Regnum Vegetabile*, 154. Koeltz Scientific Books, Königstein [online ed.: http://www.iapt-taxon.org/nomen/main.php].

Ministero delle Politiche Agricole e Forestali, 2014 − Catalogo delle varietà delle specie di piante agricole - anno 2014. http://www.sementi.it/articoli/163/registro-nazionale-varieta-specie-agrarie [accessed: 23 June 2015]

Müller J. & Catalán P., 2006 − Notes on the infrageneric classification of *Festuca* L. (Gramineae). *Taxon*, 55(1): 139−144. DOI: 10.2307/25065535

Nash G.V., 1913 – Gramíneae Juss. In: An Illustrated Flora of the Northern United States, ed. 2. Britton N.L. & Brown A. (eds.). *Charles Scribner's Sons*, New York: 107−295. DOI: 10.5962/bhl.title.940

Palisot de Beauvois A.M.F.J., 1812 − Essai d'une nouvelle agrostographie ou nouveaux genres de Graminées. *Fain*, Paris. DOI: 10.5962/bhl.title.474

Portal R., 1999. − *Festuca* de France. *Portal*, Vals-près-Le-Puy.

Reveal J.L., Terrell E.E., Wiersema J.H. & Scholz H., 1991 − Proposal to reject *Festuca elatior* L. with comments on the typification of *F. pratensis* and *F. arundinacea* (Poaceae). *Taxon*, 40(1): 135–137. DOI: 10.2307/1222939

Rossi G., Ardenghi N. & Parolo G., 2010 − Le festuche italiane, queste sconosciute. *Acer, Il Verde Editoriale*, 5: 25.

Saint-Yves A., 1913 − Les Festuca de la Section *Eu-Festuca* et leurs variations. *Georg & Co. Libraires-Éditeurs*, Genève, Bale, Lyon. DOI: 10.5962/bhl.title.15432

Saint-Yves A., 1927 − Tentamen. Claves analyticae Festucarum veteris orbis. Imprimeries Oberthur, Rennes.

Signorini M.A. & Foggi B., 1997 − A survey of the genus *Festuca* L. (Poaceae) in Italy. III. Nomenclatural notes on some *Festuca* belonging to *Festuca violacea*-group. *Candollea*, 52(2): 409−427.

Simon B.K., Clayton W.D., Harman K.T., Vorontsova M.S., Brake I., Healy D. & Alfonso Y., 2016 − GrassWorld. http://grassworld.myspecies.info [accessed: 13 July 2016]

Šmarda P., 2006 − DNA ploidy levels and intraspecific DNA content variability in Romanian fescues (*Festuca*, Poaceae) measured in fresh and herbarium material. *Folia Geobotanica*, 41(4): 417−432.

Šmarda P. & Kočí K., 2003 − Number Variability in Central European Members of the *Festuca ovina* and *F. pallens* Groups (Sect. *Festuca*). *Folia Geobotanica*, 38(1): 65−95. DOI: 10.1007/BF02803128

Šmarda P., Šmerda J., Knoll A., Bureš P. & Danihelka A., 2007 − Revision of central European taxa of *Festuca* ser. *Psammophilae* Pawlus: morphometrical, karyological and AFLP analysis. *Plant Systematics and Evolution*, 266(3): 197–232. DOI: 10.1007/s00606-007-0532-3

Smith W., 1842 – A Dictionary of Roman and Greek Antiquities. *Taylor and Walton*, London.

Soreng R.J., Terrell E.E., Wieresma J. & Darbyshire S.J., 2001 − (1488) Proposal to Conserve the Name *Schedonorus arundinaceus* (Schreb.) Dumort. against *Schedonorus arundinaceus* Roem. & Schult. (Poaceae: Poeae). *Taxon*, 50(3): 915−917. DOI: 10.2307/1223726

Soreng R.J., Peterson P.M., Romaschenko K., Davidse G., Zuolaga F.O., Judziewicz E.J., Filgueiras T.S., Davis J.I. & Morrone O., 2015 – A worldwide phylogenetic classification of the Poaceae (Gramineae). *Journal of Systematics and Evolution*, 53(2): 117−137. DOI: 10.1111/jse.12150

Stace C.A., 1991 − Plant taxonomy and biosystematics. Second edition. *Cambridge University Press*, Cambridge.

Torrecilla P. & Catalán P., 2002 − Phylogeny of Broad-Leaved and Fine-Leaved Festuca Lineages (Poaceae) Based on Nuclear ITS Sequences. *Systematic Botany*, 27(2): 241−251.

Torrecilla P., López Rodríguez J.A., Stancik D. & Catalán P., 2003 − Systematics of *Festuca* L. sects. *Eskia* Willk., *Pseudatropis* Kriv., *Amphigenes* (Janka) Tzvel., *Pseudoscariosa* Kriv. and *Scariosae* Hack. based on analysis of morphological characters and DNA sequences. *Plant Systematics and Evolution*, 239(1−2): 113−139. DOI: 10.1007/s00606-002-0265-2

Torrecilla P., López-Rodríguez J.-Á. & Catalán P., 2004 − Phylogenetic relationships of *Vulpia* and related genera (Poeae, Poaceae) based on analysis of ITS and *trn*L-F sequences. *Annals of the Missouri Botanical Garden*, 91(1): 124−158. DOI: 10.1016/j.ympev.2003.08.025

Torrecilla P., Acedo C., Marques I., Díaz-Pérez A.J., López-Rodríguez J.A., Mirones V., Sus A., Llamas F., Alonso A., Pérez-Collazos E., Viruel J., Sahuquillo E., Del Carmen Sancho M., Komac B., Manso J.A., Segarra-Moragues J.G., Draper D., Villar L. & Caralán P., 2013 − Morphometric and molecular variation in concert: taxonomy and genetics of the reticulate Pyrenean and Iberian alpine spiny fescues (*Festuca eskia* complex, Poaceae). *Botanical Journal of the Linnean Society*, 173(4): 676-706. DOI: 10.1111/boj.12103

University of Birmingham, 2005 − CWRIS PGR forum crop wild relative information system. http://www.pgrforum.org/cwris/cwris.asp?action=show&fact=677082 [accessed 23 June 2015]

University of Perugia, 2015 − Italian crop wild relative and wild harvested plant checklist (CWR/WHP List). http://vnr.unipg.it/PGRSecure/ [accessed 23 June 2015]

Watson L. & Dallwitz, M.J., 1992+ − The grass genera of the world: descriptions, illustrations, identification, and information retrieval; including synonyms, morphology, anatomy, physiology, phytochemistry, cytology, classification, pathogens, world and local distribution, and references. Version: 7th December 2015. http://delta-intkey.com/grass/ [accessed: 13 July 2016]

Willkomm M., 1861 − CXXXI. *Festuca* L. In: Prodromus florae hispanicae, 1(1). Willkomm M. & Lange J. (eds.). *Typis et sumtibus librariae E. Schweizerbart*, Stuttgartiae: 93−98. DOI: 10.5962/bhl.title.37768

Yamada T., 2011 − *Festuca*. In: Wild Crop Relatives: Genomic and Breeding Resources. Millets and Grasses. Kole C. (ed.). *Springer*, Berlin: 153–164. DOI: 10.1007/978-3-642-14255-0_9

Zeven A.C. & de Wet J.M.J., 1982 − Dictionary of cultivated plants and their regions of diversity. *PUDOC*, Wageningen.

APPENDIX I

Additional papers (ISI and not) on *Festuca* s.l.

TAXON

From Schedonorus and Micropyropsis to Lolium (Loliinae, Poaceae): new combinations and typifications

--Manuscript Draft--

Manuscript Number:	TAXON-D-16-00112
Full Title:	From Schedonorus and Micropyropsis to Lolium (Loliinae, Poaceae): new combinations and typifications
Short Title:	New combinations and typifications in Lolium.
Article Type:	Nomenclature Article
Section/Category:	Nomenclature
Keywords:	Festuca; Festulolium; Lolium; Micropyropsis; nomenclature; Schedonorus
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Abstract:	Twenty-two new combinations (Lolium adzharicum, L. ×aschersonianum, L. atlantigenum, L. ×brinkmannii, L. chayuense, L. duratum, L. ×elongatum, L. ×fleischeri, L. font-queri, L. formosanum, L. ×holmbergii, L. interruptum, L. interruptum subsp. corsicum, L. ×krasanii, L. liangshanicum, L. mairei, L. letourneuxianum, L. mediterraneum, L. pluriflorum, L. ×schlickumii, L. ×subnutans, L. tuberosum) and one new name (L. scabriflorum), fulfilling the relocation of the currently accepted Schedonorus and Micropyropsis taxa (including hybrids) under Lolium, are proposed. Moreover, the names Festuca adscendens, F. ×aschersoniana, F. ×brinkmannii, F. elongata, F. fleischeri, and F. ×holmbergii are lectotypified.
Suggested Reviewers:	
Opposed Reviewers:	

From *Schedonorus* and *Micropyropsis* to *Lolium* (Loliinae, Poaceae): new combinations and typifications

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Abstract Twenty-two new combinations (*Lolium adzharicum*, *L.* ×*aschersonianum*, *L. atlantigenum*, *L.* ×*brinkmannii*, *L. chayuense*, *L. duratum*, *L.* ×*elongatum*, *L.* ×*fleischeri*, *L. font-queri*, *L. formosanum*, *L.* ×*holmbergii*, *L. interruptum*, *L. interruptum* subsp. *corsicum*, *L.* ×*krasanii*, *L. liangshanicum*, *L. mairei*, *L. letourneuxianum*, *L. mediterraneum*, *L. pluriflorum*, *L.* ×*schlickumii*, *L.* ×*subnutans*, *L. tuberosum*) and one new name (*L. scabriflorum*), fulfilling the relocation of the currently accepted *Schedonorus* and *Micropyropsis* taxa (including hybrids) under *Lolium*, are proposed. Moreover, the names *Festuca adscendens*, *F.* ×*aschersoniana*, *F.* ×*brinkmannii*, *F. elongata*, *F. fleischeri*, and *F.* ×*holmbergii* are lectotypified.

Keywords *Festuca*; *Festulolium*; *Lolium*; *Micropyropsis*; nomenclature; *Schedonorus*

INTRODUCTION

Currently, the distinction between the genera *Schedonorus* P.Beauv. (= *Festuca* L. p.p.) and *Lolium* L. (Poaceae) is based on macro-morphological features concerning the synflorescence and the spikelets. However, the occurrence of intermediate phenotypes applicable to five natural hybrids originally described under *Festuca* or ×*Festulolium* Asch. & Graebn., has raised doubts about this distinction. A close relationship between the two genera is indicated by the ability of interspecific hybridization between various *Schedonorus* and *Lolium* species, as well as by the promiscuous pairing of homoeologous chromosome during meiosis in hybrids and frequent homoeologous recombination (Kopecký & al., 2005, 2008). Thus, Darbyshire (1993) treated *Schedonorus* [1812] as a synonym of *Lolium* [1753], introducing four new combinations under the latter genus. This nomenclatural choice was subsequently confirmed on phylogenetic grounds by various authors (Gaut & al., 2000; Torrecilla & Catalán, 2002; Torrecilla & al., 2003; Catalán & al., 2004, 2007) thereby delineating a monophylum. This was composed of the genera *Lolium, Micropyropsis* Romero Zarco & Cabezudo, and *Schedonorus* in opposition to *Festuca*. Later on, the monophylum was formalized by Soreng & al. (2015), who regarded *Micropyropsis* and *Schedonorus* as synonyms of *Lolium*. In the present contribution, an updated nomenclatural synopsis relocated all of the *Schedonorus* taxa, along with the monotypic genus *Micropyropsis*, into *Lolium*, thereby integrating or updating the previously published combinations (see Darbyshire, 1993; Banfi & al., 2005; Tison & al., 2010; Loos, 2010; Ardenghi & Foggi, 2015).

NOMENCLATURAL TREATMENT

Lolium L., Sp. Pl.: 83. 1753 -- Type (designated by Nash in Britton & A.Br., Ill. Fl. N.U.S., ed. 2: 281. 1913): *Lolium perenne* L.

= *Schedonorus* P.Beauv. ("*Schedonorus*" and "*Schenodorus*"), Ess. Agrostogr.: 99 (expl. 12, pl. 19, fig. 2). 1812 ≡ *Festuca* sect. *Schedonorus* (P.Beauv.) W.D.J.Koch, Syn. Fl. Germ. Helv. 1(2): 813. 1837 ≡ *Festuca* subg. *Schedonorus* (P.Beauv.) Peterm., Deutschl. Fl.: 643. 1846--1849 ≡ *Bromus* sect. *Schedonorus* (P.Beauv.) Ledeb., Fl. Ross. 4(13): 355. 1852 ≡ *Bromus* subg. *Schedonorus* (P.Beauv.) Nyman, Syll. Fl. Eur.: 418. 1885 ≡ *Lolium* subg. *Schedonorus* (P.Beauv.) Darbysh. in Novon 3(3): 241. 1993 -- Type (designated by Niles & Chase in Contr. U.S. Natl. Herb.: 193. 1925): *Festuca elatior* L.

= *Schedonorus* sect. *Plantynia* Dumort., Fl. Belg.: 159. 1827 ≡ *Festuca* sect. *Bromoides* Rouy in Rouy & Foucaud, Fl. France 14: 225. 1913, nom. illeg. (Arts. 52.1--2 of the *ICN*) ≡ *Festuca* sect. *Plantynia* (Dumort.) Tzvelev, Zlaki SSSR: 394. 1976 -- Type: *Schedonorus giganteus* (L.) Dumort. (≡ *Bromus giganteus* L.).

= *Festuca* [unranked] *Bovinae* Fr. ex Andersson, Pl. Scand. 2.: 17. 1852 ≡ *Festuca* sect. *Bovinae* (Fr. ex Andersson) Hack., Bot. Centralbl. 8(52): 407. 1881, nom. superfl. (Art. 52.3 of the *ICN*) -- Type (designated by Tzvelev, Zlaki SSSR: 394. 1976): *Festuca pratensis* Huds.

= *Drymonaetes* Ehrh., Beitr. Naturk. 4: 147. 1789, nom. nud. ≡ *Festuca* subg. *Drymonaetes* V.I.Krecz. & Bobrov, Fl. URSS 2: 533(--534). 1934 ≡ *Schedonorus* subg. *Drymonaetes* (V.I.Krecz. & Bobrov) Holub in Preslia 70(2): 112. 1998 -- Type: *Schedonorus giganteus* (L.) Dumort. (≡ *Bromus giganteus* L.).

= *Mycropyropsis* Romero Zarco & Cabezudo in Lagascalia 11(1): 95(94--99, fig. 11, tabs. 1--2). 1983 − Type: *Micropyropsis tuberosa* Romero Zarco & Cabezudo.

= ×*Schedolium* Holub in Preslia 70(2): 111(--112). 1998 [21 Jun 1998] (*Lolium* L. × *Schedonorus* P.Beauv.).

= ×*Schedololium* Soreng & Terrell in Phytologia 83(2): 86. 1998 [Aug 1997, publ. 27 Jul 1998] (*Lolium* L. × *Schedonorus* P.Beauv.).

Within the former *Schedonorus* taxa, Torrecilla & Catalán (2002) identified two distinct clades: a “European” one, including, among the others, *Festuca arundinacea* Schreb., *F. gigantea* (L.) Vill., and *F. pratensis* Huds. together with *Lolium perenne* L.; and a “Maghrebian” one, comprising mostly North-western African and South-western European taxa [*F. arundinacea* subsp. *atlantigena* (St.-Yves) Auquier, *F. arundinacea* var. *glaucescens* Boiss., *F. arundinacea* var. *letournexiana* (St.-Yves) Torrec. & Catalán, and *F. mairei* St.-Yves]. On the basis of this scenario, the separation of the two subgenera (*Lolium* and *Schedonorus*) is not practicable; owing to the fact that the taxa belonging to the second clade, unlike previous European sources (e.g., Foggi & Müller, 2009), cannot be treated as subspecies of *Lolium arundinaceum* (Schreb.) Darbysh., but rather as independent species.

Lolium adzharicum (Tzvelev) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** ≡ *Schedonorus adzharicus* Tzvelev in Novosti Sist. Vyssh. Rast. 43: 54(--55). 2011 -- Type: [Georgia] “Аджария, бассейн р. Коблиани, яйла Чечилья близ Батуми, на каменистой равнине в травяном высо- котравье” [“Adzharia, systema fl. Kobliani, jajla Czeczilja prope Batumi, in planitie lapidosa in altiherbeto graminoso”], 19 Aug 1949, *Naumova s.n.* (holotype LE).

Lolium apenninum (De Not.) Ardenghi & Foggi in Taxon 64(5): 1039. 2015 ≡ *Festuca apennina* De Not., Repert. Fl. Ligust.: 468. 1844 ≡ *Festuca elatior* var. *apennina* (De Not.) Hack. in Bot. Centralbl. 8(52): 407. 1881 ≡ *Festuca elatior* f. *apennina* (De Not.) Fiori in Fiori & Paol., Fl. Italia 1(1): 92. 1896 ≡ *Festuca pratensis* subsp. *apennina* (De Not.) Hegi, Ill. Fl. Mitt.-Eur. 1(10): 343. 1908 ≡ *Festuca pratensis* subsp. *apennina* (De Not.) Beldie in Săvul., Fl. Republ. Socialist. Romania 12: 501. 1972, isonym (Art. 6 Note 2 of the *ICN*) ≡ *Schedonorus apenninus* (De Not.) Tzvelev, Novosti Sist. Vyssh. Rast. 31: 259. 1998 ≡

Lolium pratense subsp. *apenninum* (De Not.) Banfi, Bracchi & Galasso in Mem. Soc. Ital. Sci. Nat. Mus. Civico Storia Milano 33(2): 8. 2005 ≡ *Schedonorus pratensis* subsp. *apenninus* (De Not.) H.Scholz & Valdés in Willdenowia 35(2): 243. 2005 -- Lectotype (designated by Ardenghi & Foggi in Taxon 64(5): 1039--1040. 2015): [Italy] "Mt. Gottro Lig. orient.", *s.d.*, *G. De Notaris s.n.* (FI barcode FI002995!). — Image of lectotype available at http://parlatore.msn.unifi.it/img72/FI002995.jpg

Lolium arundinaceum (Schreb.) Darbysh. in Novon 3(3): 241. 1993 subsp. ***arundinaceum*** ≡ *Festuca arundinacea* Schreb., Spic. Fl. Lips.: 57. 1771 [9 Jul--25 Oct 1771] ≡ *Festuca elatior* var. *arundinacea* (Schreb.) Roth, Tent. Fl. Germ. 1: 46. 1788 ≡ *Bromus arundinaceus* (Schreb.) Roth, Tent. Fl. Germ. 2(1): 141. 1789 ≡ *Schedonorus arundinaceus* (Schreb.) Dumort., Observ. Gramin. Belg.: 106. 1824, nom. cons. vs. *Schedonorus arundinaceus* Roem. & Schult. ("*Schenodorus*"), Syst. Veg., ed. 15 bis, 2: 700. 1817 (App. IV of the *ICN*) ≡ *Festuca elatior* subsp. *arundinacea* (Schreb.) Čelak., Prodr. F. Böhmen: 51. 1867 -- Lectotype (designated by Reveal & al. in Taxon 40(1): 136. 1991): [illustration in] Scheuchzer, Agrostographia: pl. V, fig. 18. 1719.

= *Festuca elatior* L., Sp. Pl. 1: 75. 1753, nom. rej. (App. V of the *ICN*) ≡ *Poa elatior* (L.) Moench, Enum. Pl. Hass.: 37. 1777, nom. rej. (App. V of the *ICN*) ≡ *Bromus elatior* (L.) Koeler, Descr. Gram.: 214. 1802, nom. rej. (App. V of the *ICN*) ≡ *Schedonorus elatior* (L.) P.Beauv., Ess. Agrostogr.: 177, 162, expl. 12. 1812, nom. rej. (App. V of the *ICN*) ≡ *Festuca pratensis* var. *elatior* (L.) Gaudin, Fl. Helv. 1: 293. 1828, nom. rej. (App. V of the *ICN*) ≡ *Bucetum elatius* (L.) Parn., Grass. Scotland: 107. 1842, nom. rej. (App. V of the *ICN*) ≡ *Tragus elatior* (L.) Panz. ex B.D.Jacks., Index Kew. 2(2): 1098. 1895, nom. rej. (App. V of the *ICN*) ≡ *Gnomonia elatior* (L.) Lunell in Amer. Midl. Naturalist 4(5): 224. 1915, nom. rej. (App. V of the *ICN*) -- Lectotype (designated by Terrell in Brittonia 19(2): 131. 1967): "*Habitat in Europae pratis fertilissimis*", Herb. Linn. 92.17 (LINN [image!]). — Image of lectotype available at http://linnean-online.org/1523

= *Poa phoenix* Scop., Fl. Carniol., ed. 2. 1: 74. 1771 [before 20 Sep 1771] ≡ *Festuca phoenix* (Scop.) Vill., Prosp. Hist. Pl. Dauphiné: 17. 1779 ≡ *Schedonorus phoenix* (Scop.) Holub in Preslia 70(2): 113. 1998 -- Type: not designated.

= *Festuca uechtritziana* Wiesb. in Oesterr. Bot. Z. 28(7): 218(--219). 1878 ≡ *Festuca elatior* var. *uechtritziana* (Wiesb.) Hack. in Bot. Centralbl. 8(52): 407. 1881 ≡ *Festuca arundinacea* subsp. *uechtritziana* (Wiesb.) Beck, Fl. Nieder-Österreich: 96. 1890 ≡ *Festuca arundinacea* [race] *uechtritziana* (Wiesb.) Rouy in Rouy & Foucaud, Fl. France 14: 227. 1913 ≡ *Schedonorus uechtritzianus* (Wiesb.) Holub in Preslia 70(2): 113. 1998 ≡

Schedonorus arundinaceus subsp. *uechtritzianus* (Wiesb.) H.Scholz & Valdés in Willdenowia 37(2): 442. 2007 -- Lectotype (designated by Ardenghi & al. in Phytotaxa 84(2): 58--59. 2013): [Austria] "M. Enzersdorf bei Wien, Weberwiese", 25 May 1878, *J.B. Wiesbaur 63* (W barcode 1916-0014975!). — Image of lectotype available at http://herbarium.univie.ac.at/database/detail.php?ID=166229

Lolium arundinaceum subsp. ***orientale*** (Hack.) G.H.Loos in Jahrb. Bochum. Bot. Vereins 1: 124. 2010 ≡ *Festuca elatior* subvar. *orientalis* Hack., Monogr. Festuc. Eur.: 154. 1882 ≡ *Festuca arundinacea* subsp. *orientalis* (Hack.) K.Richt., Pl. Eur. 1: 102. 1890 ≡ *Festuca orientalis* (Hack.) A.Kern. ex V.I.Krecz. & Bobrov, Fl. URSS 2: 531. 1934, nom. illeg. (Art. 53.1 of the *ICN*), non *Festuca orientalis* B.Fedtsch., Izv. Imp. Bot. Sada Petra Velikago 14(suppl. 2): 87. 1915 ≡ *Festuca arundinacea* subsp. *orientalis* (Hack.) Tzvelev, Spisok Rast. Gerb. Fl. S.S.S.R. Bot. Inst. Vsesoyuzn. Akad. Nauk 18(99): 17. 1970, isonym (Art. 6 Note 2 of the *ICN*) ≡ *Schedonorus arundinaceus* subsp. *orientalis* (Hack.) H.Scholz & Valdés in Willdenowia 35(2): 243. 2005 -- Lectotype (designated by Tzvelev & Czerepanov in Fl. Evropejskoj Časti SSSR: 259. 1974): [Hungary] Keresztur bei Pest, *s.d.*, *A.J. Kerner von Marilaun s.n.* (WU-Kerner barcode 0076936 [image!]). — Image of lectotype available at http://herbarium.univie.ac.at/database/detail.php?ID=501394

The lectotypification by Tzvelev & Czerepanov (1974) has priority over the one by Ardenghi & al. (2013).

= *Festuca arundinacea* var. *aristata* Regel in Trudy Imp. S.-Peterburgsk. Bot. Sada 7(2): 596(--597). 1881 ≡ *Schedonorus arundinaceus* var. *aristatus* (Regel) Tzvelev, Konspekt Fl. Kavkaza 2: 308. 2006 -- Type: not designated.

= *Festuca regeliana* Pavlov in Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. 47(1): 80. 1938 -- Type: Russia: Karatau mountains, village of Vannoskoe, meadow along the bank of irrigation channel, 1 Jun 1931, *N. Samsel 102* (holotype MW, isolectotype LE).

Lolium* ×*aschersonianum (Dörfl.) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** [*Lolium arundinaceum* (Schreb.) Darbysh. subsp. *arundinaceum* × *L. pratense* (Huds.) Darbysh.] ≡ *Festuca* ×*aschersoniana* Dörfl., Herb. Norm. Sched. Cent. 53--54: 108 (n. 5380). 1911, non *Festuca intermedia* Roem. & Schult., Syst. Veg., ed. 15 bis 2: 715(--716). 1817 ≡ *Festuca elatior* [unranked] *intermedia* Hack., Monogr. Festuc. Eur.: 151. 1882 ≡ *Festuca elatior* subsp. *intermedia* (Hack.) K.Richt., Pl. Eur. 1: 101. 1890 ≡ *Schedonorus* ×*aschersonianus* (Dörfl.) Holub in Preslia 70(2): 113. 1998 -- **Lectotype (designated here):** "HERBARIUM NORMALE./ editum ab I. Dörfler/ 5380. Festuca Aschersoniana

Dörfler./ (F. arundinacea × elatior)/ [synonyms omitted]/ Suecia. Scania. In pascuis maritimis ad „Bjerred“.”, Jul 1909 and Jun 1910, *O.R. Holberg 5380* (P barcode 00653919!, isolectotypes BM barcode BM001067173 [image!], DAO).

Lolium atlantigenum (St.-Yves) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** ≡ *Festuca elatior* var. *atlantigena* St.-Yves in Candollea 1(1): 36(--37). 1922 ≡ *Festuca arundinacea* subsp. *atlantigena* (St.-Yves) Auquier in Bull. Soc. Échange Pl. Vasc. Eur. Occid. Bassin Médit. 16: 142. 1976 ≡ *Festuca fenas* subsp. *atlantigena* (St.-Yves) Cebolla & Rivas Ponce in Candollea 58(1): 195. 2003 ≡ *Schedonorus arundinaceus* subsp. *atlantigenus* (St.-Yves) H.Scholz in Ber. Inst. Landschafts Pflanzenökol. Univ. Hohenheim Beih. 16: 74--75. 2003 -- Type: not designated.

= *Festuca elatior* subvar. *minutiflora* St.-Yves in Bull. Soc. Bot. France 71(1): 125(--126). 1924 ≡ *Festuca elatior* var. *minutiflora* (St.-Yves) Litard. in Candollea 10: 141. 1945 -- Type: [Spain] “Sierra Nevada: Dehesa de San Geronimo 2.000 m, Hut., P. et R. It. hisp. 1899 sub: «Festuca» n° 503” (holotype P-CO?).

Lolium ×brinkmannii (A.Braun) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** [*Lolium giganteum* (L.) Darbysh. × *L. perenne* L.] ≡ *Festuca ×brinkmannii* A.Braun in Index Seminum [Berlin] 1861(app.): 11(--12). 1862 (‘*Brinkmanni*’) ≡ *×Festulolium brinkmannii* (A.Braun) Asch. & Graebn., Syn. Mitteleur. Fl. 2(1, 7): 769. 1902 ≡ *×Schedolium brinkmanii* (A.Braun) Holub, Preslia 70(2): 112. 1998 [21 Jun 1998] ≡ *×Schedololium brinkmannii* (A.Braun) Soreng & Terrell in Phytologia 83(2): 87. 1998 [Aug 1997, publ. 27 Jul 1998] -- **Lectotype (designated here):** [Germany] “*Festuca Brinkmanni* A. Br./ mihi!/ Fl. Megapolit. pr. Rostochium. Herb. Dr. de Kühlewein./ olim spont. nunc in horto/ Brinkman. cult./ Herb. Pittoni”, *s.d.*, *D.F.L. Brinkmann s.n.* (W barcode 0032104 [image!]). — Image of lectotype available at http://herbarium.univie.ac.at/database/detail.php?ID=285312

Lolium chayuense (L.Liu) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** ≡ *Festuca chayuensis* L.Liu, Fl. Reipubl. Popularis Sin. 9(2): 387. 2002 – *Festuca chayuensis* L.Liu, Vasc. Pl. Hengduan Mount. 2: 2174. 1994, nom. nud. -- Type: [China] Xizang: Zayü, 3900 m, 26 Sep 1982, *Qinghai-Xizang Exped. 10706* (holotype PE).

Lolium duratum (B.S.Sun & H.Peng) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** ≡ *Festuca durata* B.S.Sun & H.Peng in Guihaia 13(3): 223(--224, fig. 1). 1993 -- Type:

[China] Hezhang (赫章), Jiucaiping (韭菜坪), 2580 m, roadside, 25 Oct 1989, *West Guizhou. Exped. 1864b* (holotype HGAS).

Lolium* ×*elongatum (Ehrh.) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** [*Lolium perenne* L. × *L. pratense* (Huds.) Darbysh.] ≡ *Festuca elongata* Ehrh., Beitr. Naturk. 6: 133. 1791 ≡ *Lolium* ×*festucaceum* Link in Linnaea 2(2): 235. 1827, nom. illeg. (Arts. 52.1--2 of the *ICN*) -- **Lectotype (designated here):** [Germany] "*Festuca elongata* Ehrh./ *Hannoveræ*./ 1. Ehrh. Calam. 93. [...]", *s.d*., *J.F. Ehrhart s.n*. (LINN-HS barcode 132.28.1, specimen on the left annotated with the number "1" [image!], isolectotypes W barcodes 0032288 [image!], 1889-0256346 [image!]). — Image of lectotype available at http://linnean-online.org/28162

Although the synflorescence is unbranched (*Lolium perenne*-like), the spikelets are shortly pedicellate and only slightly laterally compressed (as in *L. pratense*), these features indicate the hybrid origin of the specimens.

= *Festuca loliacea* Huds., Fl. Angl.: 38. 1762., non *Lolium loliaceum* (Bory & Chaub.) Hand.-Mazz. in Ann. K. K. Naturhist. Hofmus. 28: 32. 1914 ≡ *Festuca fluitans* var. *loliacea* (Huds.) Huds., Fl. Angl., ed. 2, 1: 47. 1778 ≡ *Poa loliacea* (Huds.) Koeler, Descr. Gram.: 207. 1802, nom. illeg. (Art. 53.1 of the *ICN*), non Huds., Fl. Angl.: 35. 1762 ≡ *Schedonorus loliaceus* (Huds.) P.Beauv., Ess. Agrostogr.: 177, 163. 1812 ≡ *Festuca pratensis* var. *loliacea* (Huds.) St.-Amans, Fl. Agen.: 42. 1821 ≡ *Brachypodium loliaceum* (Huds.) Link, Hort. Berol. 1: 42. 1827, nom. illeg. (Art. 53.1 of the *ICN*), non (Huds.) P.Beauv., Ess. Agrostogr.: 155, 175. 1812 ≡ *Lolium festucoides* Raspail in Ann. Sci. Observ. 2: 243(--244). 1829, nom. illeg. (Arts. 52.1--2 of the *ICN*) ≡ *Bucetum loliaceum* (Huds.) Parn., Grass. Scotland: 104. 1842 ≡ *Glyceria lolicacea* (Huds.) Godr., Fl. Lorraine 3: 168. 1844 ≡ *Festuca elatior* var. *loliacea* (Huds.) Wimm., Fl. Schles., ed. 3: 59. 1857 ≡ *Festuca elatior* subsp. *loliacea* (Huds.) Arcang., Comp. Fl. Ital., ed. 2: 62. 1894 ≡ *Tragus loliaceus* (Huds.) Panz. ex B.D.Jacks., Index Kew. 2(2): 1099. 1895 ≡ ×*Festulolium loliaceum* (Huds.) P.Fourn., Quatre Fl. France 3--5: 81. 1935 ≡ ×*Festulolium loliaceum* (Huds.) C.E.Hubb. in Bull. Misc. Inform. Kew 1939(2): 101. 1939, isonym (Art. 6 Note 2 of the *ICN*) ≡ ×*Schedolium loliaceum* (Huds.) Holub in Preslia 70(2): 112. 1998 [21 Jun 1998] ≡ ×*Schedololium loliaceum* (Huds.) Soreng & Terrell in Phytologia 83(2): 86. 1998 [Aug 1997, publ. 27 Jul 1998] ≡ ×*Schedololium loliaceum* (Huds.) Tzvelev in Novosti Sist. Vyssh. Rast. 31: 259. 1998 [Dec 1998], isonym (Art. 6 Note 2 of the *ICN*) -- Type: not designated.

= *Festuca loliacea* var. *aristata* A.Braun ex Döll, Fl. Baden 1(2): 164(--165). 1855 ≡ *Festuca* ×*braunii* K.Richt., Pl. Eur. 1: 103. 1890 ≡ ×*Festulolium adscendens* var. *braunii* (K.Richt.) Rouy in Rouy & Foucaud, Fl. France 14: 229. 1913 ≡ ×*Festulolium braunii* (K.Richt.) A.Camus in Bull. Mus. Natl. Hist. Nat. 33(6): 538. 1927 ≡ ×*Schedololium braunii* (K.Richt.) Soreng & Terrell in Phytologia 83(2): 87. 1998 ≡ ×*Schedolium braunii* (K.Richt.) Stace in Watsonia 27(3): 247. 2009 -- Type: not designated.

Festuca ×*braunii* K.Richt., based on *F. loliacea* var. *aristata* A.Braun ex Döll, is a short-awned form of *Lolium* ×*elongatum*, erroneously considered as a hybrid between *L. multiflorum* and *L. pratense*. The correct name of the latter is *L.* ×*subnutans* (Holmberg, 1930).

Lolium* ×*fleischeri (Rohlena) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** [*Lolium arundinaceum* (Schreb.) Darbysh. subsp. *arundinaceum* × *L. giganteum* (L.) Darbysh.] ≡ *Festuca fleischeri* Rohlena in Allg. Bot. Z. Syst. 8(5--6): 85(--86). 1903 ≡ *Schedonorus* ×*fleischeri* (Rohlena) Holub in Preslia 70(2): 113. 1998 -- Type: not designated.

= *Festuca* ×*gigas* Holmb. in Dörfl., Herb. Norm. Sched. Cent. 53--54: 107 (n. 5377). 1911 -- **Lectotype (designated here):** [Sweden] "HERBARIUM NORMALE./ editum ab I. Dörfler./ 5377. Festuca gigas *Holmberg*, nova hybr.!/ (Festuca arundinacea × gigantea)/ [Non F. arundinacea × gigantea *Neuman*, Sveriges Flora,/ p. 734 (1901)]. [description omitted]/ f. subarundinacea *Holmberg*./ [description omitted]/ Suecia. Scania. „Lund“ in horto culta e loco unico adhuc noto/ (Dania, Seelandia, Söndersö) introducta", Aug 1909 and Jul 1910, *O.R. Holmberg 5377* (W barcode JE00006517 [image!], isolectotypes W barcodes 1916-0031987 [image!], 1916-0031988 [image!], 1911-0005708 [image!], 2009-0017491 [image!], BRNU barcodes 350396, 003589, BM barcode BM001067174 [image!]). — Image of lectotype available at http://herbarium.univie.ac.at/database/detail.php?ID=114462

According to Art. 26.2 of the *ICN* (McNeill & al., 2012), the name *Festuca gigas* f. *subarundinacea* Holmb. is not validly published, since it is based on the same type specimen of *F. gigas* Holmb.

Lolium font-queri (St.-Yves) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** ≡ *Festuca font-queri* St.-Yves in Cavanillesia 3(1--5): 5(--7, fig.). 1930, non (Litard.) Romo in Willdenowia 16(1): 115. 1986 ≡ *Schedonorus font-queri* (St.-Yves) H.Scholz & Valdés in Willdenowia 35(2): 243. 2005 -- Lectotype (designated by López Rodríguez & Catalán in Fl. Medit. 9: 282. 1999): [Morocco] "Hab. in saxosis arenaceis montis Tidiguin (Atlante Riphaeo), ad 2400 m", 17 Jul 1929, *Font Quer s.n.* (G, specimen on the right).

= *Festuca yvesii* Litard. in Bull. Soc. Hist. Nat. Afrique N. 14(8): 337(--338, fig. 1). 1923, non Sennen & Pau in Treb. Inst. Catalana Hist. Nat. 3 (1917): 250(--251). 1918 ≡ *Festuca litardiereana* Vigo (‘*litardierana*’) in Acta Bot. Barcinon. 35: 687. 1983, nom. illeg. (Art. 53.1 of the *ICN*), non *Festuca litardiereana* Maire in Bull. Soc. Hist. Nat. Afrique N. 22(8): 323(--324, fig. 1). 1931 -- Lectotype (designated by López Rodríguez & Catalán in Fl. Medit. 9: 282. 1999): [Morocco] “Reraya: The. vallée de l’Acif Ouenkrime, rocailles porphyriques, 3050 m env.”, 24 Jul 1923, *R. de Litardière s.n.* (G).

= *Festuca font-queri* var. *lipskii* St.-Yves in Cavanillesia 3(1--5): 6(--7). 1930 -- Type: [Uzbekistan] “Asia media. Buchara: Scbachrisjals, 6700'; leg. LIPSKI, 3-VI-1896 (in herb. Hort. Bot. Petròp.)” (holotype LE?).

The aforementioned type specimen was not found at either LE or at G (López Rodríguez & Catalán, 1999).

Lolium formosanum (Honda) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** ≡ *Festuca formosana* Honda in Bot. Mag. (Tokyo) 42(495): 134. 1928, non *Festuca formosana* E.B.Alexeev in Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. 82(3): 99. 1977 -- Type: [China] Formosa, open ridge of m. Morrison, among rocks, 13000 ft., 23 Oct 1912, *W.R. Prince 993* (K).

Lolium giganteum (L.) Darbysh., Novon 3(3): 241. 1993 ≡ *Bromus giganteus* L., Sp. Pl. 1: 77(--78). 1753 ≡ *Festuca gigantea* (L.) Vill., Hist. Pl. Dauphiné 2: 110. 1787 ≡ *Avena gigantea* (L.) Salisb., Prodr. Stirp. Chap. Allerton: 23. 1796 ≡ *Zerna gigantea* (L.) Gray, Nat. Arr. Brit. Pl. 2: 116. 1821 ≡ *Schedonorus giganteus* (L.) Dumort., Fl. Belg.: 159. 1827 ≡ *Bucetum giganteum* (L.) Parn., Grass. Scotland: 108. 1842 ≡ *Forasaccus giganteus* (L.) Bubani, Fl. Pyren. 4: 383. 1901--1902 ≡ *Schedonorus giganteus* (L.) Holub in Preslia 70(2): 113. 1998 [21 Jun 1998], isonym (Art. 6 Note 2 of the *ICN*) ≡ *Schedonorus giganteus* (L.) Soreng & Terrell in Phytologia 83(2): 86. 1998 [Aug 1997, publ. 27 Jul 1998], isonym (Art. 6 Note 2 of the *ICN*) -- Lectotype (designated by Darbyshire in Cafferty & al. in Taxon 49(2): 248. 2000): “*Habitat in Europae sylvis siccis*”, *s.d*., *Herb. A. van Royen 913.62-78* (L).

= *Bromus triflorus* L., Sp. Pl., ed. 2, 1: 115. 1762 ≡ *Festuca triflora* (L.) Sm., Engl. Bot. 27: pl. 1918. 1808, nom. illeg. (Art. 53.1 of the *ICN*), non *Festuca triflora* J.F.Gmel., Syst. Nat., ed. 13[bis], 2(1): 187. 1791 ≡ *Zerna gigantea* var. *triflora* (L.) Gray, Nat. Arr. Brit. Pl. 2: 116. 1821 ≡ *Festuca gigantea* var. *triflora* (L.) Kunth, Révis. Gramin. 1: 132. 1829 ≡ *Festuca gigantea* var. *subtriflora* Schur, Enum. Pl. Transsilv.: 798. 1866, nom. illeg. (Arts.

52.1--2 of the *ICN*) ≡ *Festuca gigantea* subsp. *triflora* (L.) Arcang., Comp. Fl. Ital.: 793. 1882 ≡ *Festuca gigantea* f. *triflora* (L.) Hiitonen, Suom. Kasvio: 215. 1933 -- Lectotype (designated by Stace in Cafferty & al. in Taxon 49(2): 248. 2000): Scheuchzer (1719: pl. V, fig. 19).

= *Bromus aquaticus* Schrank, Baier. Fl. 1: 367(--368). 1789 -- Type: not designated.

= *Bromus bonassorum* Bornm. in Verh. Bot. Vereins Prov. Brandenburg 74(2): 188(--190). 1933 -- Type: not designated.

= *Festuca pseudogigantea* Ovcz. & Shibkova, Fl. Tadzhiksk. S.S.R. 1: 505. 1957 -- Type: [Tajikistan] "Jugum. Wachsch, prope pagum Sary-Mazor", 13 Jul 1932, *N. Gonczarov, G. Grigorjev & V. Nikitin s.n.* (holotype? LE).

Lolium* ×*holmbergii (Dörfl.) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** [*Lolium arundinaceum* (Schreb.) Darbysh. subsp. *arundinaceum* × *L. perenne* L.] ≡ *Festuca* ×*holmbergii* Dörfl., Herb. Norm. Sched. Cent. 53--54: 108 (n. 5379). 1911 ≡ ×*Festulolium holmbergii* (Dörfl.) P.Fourn., Quatre Fl. France 3--5: 81. 1935 ≡ ×*Schedolium holmbergii* (Dörfl.) Holub in Preslia 70(2): 112. 1998 [21 Jun 1998] ≡ ×*Schedololium holmbergii* (Dörfl.) Soreng & Terrell in Phytologia 83(2): 87. 1998 [Aug 1997, publ. 27 Jul 1998] -- **Lectotype (designated here):** [Sweden] "HERBARIUM NORMALE./ editum ab I. Dörfler./ 5379. Festuca Holmbergii *Dörfler*, nova hybr.!/ (Festuca arundinacea × Lolium perenne) [description omitted]/ Suecia. Scania. Inter parentes prope „Limhamn" frequens.", Aug 1909 and Jul 1910, *O.R. Holmberg 5379* (JE 00005151 [image!], isolectotypes BRNU 350392, BRNU 003590, WU 0040601 [image!], W 2002-011557 [image!], W 2009-0016713 [image!], W 1916-0031989 [image!], W 1911-0005706 [image!], W 2002-0011556 [image!], B 10 0250712 [image!], B 10 0250713 [image!], B 10 0250714 [image!], MPU-027853 [image!], ARIZ-140062 [image!]). — Image of lectotype available at http://herbarium.univie.ac.at/database/detail.php?ID=114463

Lolium interruptum (Desf.) Banfi, Galasso, Foggi, Kopecký & Ardenghi, ***comb. nov.*** subsp. ***interruptum*** ≡ *Festuca interrupta* Desf., Fl. Atlant. 1: 89. 1798 ≡ *Brachypodium interruptum* (Desf.) Roem. & Schult., Syst. Veg., ed. 15 bis, 2: 747. 1817 ≡ *Festuca arundinacea* var. *interrupta* (Desf.) Coss. & Durieu, Expl. Sci. Algérie 2(17): 170. 1855 ≡ *Festuca elatior* var. *interrupta* (Desf.) Cout. in Bol. Soc. Brot., ser. 2 10: 59. 1935 ≡ *Festuca arundinacea* subsp. *interrupta* (Desf.) Tzvelev in Bot. Zhurn. (Moscow & Leningrad) 56(9): 1253. 1971 ≡ *Schedonorus interruptus* (Desf.) Tvelev in Novosti Sist. Vyssh. Rast. 31: 259. 1998 -- Type: not designated.

= *Festuca fenas* Lag., Gen. Sp. Pl.: 4. 1816 ≡ *Poa fenas* (Lag.) Steud., Syn. Pl. Glumac. 1(3): 252. 1854 ≡ *Festuca elatior* var. *fenas* (Lag.) Hack. in Bot. Centralbl. 8(52): 407. 1881 ≡ *Festuca arundinacea* subsp. *fenas* (Lag.) Arcang., Comp. Fl. Ital., ed. 2: 61. 1894 ≡ *Festuca arundinacea* var. *fenas* (Lag.) Halácsy, Consp. Fl. Graec. 3(2): 405. 1904 ≡ *Festuca arundinacea* subsp. *fenas* (Lag.) Bornm. in Repert. Spec. Nov. Regni Veg. 25(14--22): 330. 1928, isonym (Art. 6 Note 2 of the *ICN*) ≡ *Schedonorus arundinaceus* subsp. *fenas* (Lag.) H.Scholz in Ber. Inst. Landschafts Pflanzenökol. Univ. Hohenheim Beih. 16: 74. 2003 ≡ *Lolium arundinaceum* subsp. *fenas* (Lag.) Banfi, Bracchi & Galasso in Mem. Soc. Ital. Sci. Nat. Mus. Civico Storia Milano 33(2): 8. 2005 ≡ *Schedonorus arundinaceus* subsp. *fenas* (Lag.) Tzvelev in Konspekt Fl. Kavkaza 2: 308. 2006, isonym (Art. 6 Note 2 of the *ICN*) -- Neotype (designated by Fuente & al. in Taxon 52(3): 609--610. 2003): [France] Jardin du Luxembuorg, 20 Jun 1823, *J.E. Gay s.n.* (K barcode K000912901 [image!]). — Image of neotype available at http://apps.kew.org/herbcat/getImage.do?imageBarcode=K000912901

Lolium interruptum subsp. ***corsicum*** (Hack.) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** ≡ *Festuca elatior* subvar. *corsica* Hack., Monogr. Festuc. Eur.: 157. 1882 ≡ *Festuca fenas* subsp. *corsica* (Hack.) K.Richt., Pl. Eur. 1: 102. 1890 ≡ *Festuca elatior* f. *corsica* (Hack.) Fiori, Fl. Italia 4(1, app.): 27. 1907 ≡ *Festuca interrupta* var. *corsica* (Hack.) Rouy in Rouy & Foucaud, Fl. France 14: 228. 1913 ≡ *Festuca arundinacea* subsp. *corsica* (Hack.) Kerguélen in Bull. Soc. Bot. France 123(5--6): 320. 1976 ≡ *Festuca arundinacea* var. *corsica* (Hack.) Kerguélen in Lejeunia 142: 22. 1993 ≡ *Schedonorus arundinaceus* subsp. *corsicus* (Hack.) Foggi & Signorini in Willdenowia 35(2): 243. 2005 ≡ *Schedonorus interruptus* subsp. *corsicus* (Hack.) Foggi in Arch. Geobot. 10(1--2): 98. 2007 -- Lectotype (designated by Kerguélen in Lejeunia 110: 6. 1983): [France, Corsica] Serra di Scopamène, par Sarténe. lieux humides, 3 Aug 1879, *E. Reverchon s.n.* (W barcode 1916-0014994 [image!]). — Image of lectotype available at http://herbarium.univie.ac.at/database/detail.php?ID=287402

=? *Festuca arundinacea* var. *insularis* Gennari, Sp. Fl. Sarda: 26. 1867 -- Type: not designated.

The characters reported in the diagnosis of *Festuca arundinacea* var. *insularis* point to *Lolium interruptum* subsp. *corsicum*; however, the lack of type material (not found at FI, but probably stored elsewhere, e.g., CAG) hampers the inclusion of this name among the synonyms of *L. interruptum* subsp. *corsicum*.

Lolium* ×*krasanii (H.Scholz), Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** [*Lolium arundinaceum* (Schreb.) Darbysh. subsp. *arundinaceum* × *L. multiflorum* Lam.] ≡ ×*Schedolium krasanii* H.Scholz in Kochia 2: 51(--52). 2007 -- Type: [Switzerland] Kanton Aargau, Aaretal, Gemeinde Schinznach-Dorf, Straßenrand, 8 June 2005, *R. Schmid-Hollinger s.n.* (holotype B, isotype *Herb. Schmid-Hollinger*).

Lolium liangshanicum (L.Liu) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** ≡ *Festuca liangshanica* L.Liu, Fl. Reipubl. Popularis Sin. 9(2): 387. 2002 -- Type: [China] Sichuan: Xichang, 12 Aug 1964, *Zhu Taiping 224* (holotype PE).

Lolium mairei (St.-Yves) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** ≡ *Festuca mairei* St.-Yves in Candollea 1(1): 45(--47, fig. 17). 1922 ≡ *Schedonorus mairei* (St.-Yves) Dobignard, Index Syn. Fl. Afrique N. 1: 404. 2010 -- Lectotype (designated by Cebolla Lozano & al. in Fontqueria 48: 81. 1997): [Morocco] M. Grand Atlas, Ourika: éboulis porphyriques et granitiques entre Abessen et le Tizi-Tachdirt, 2500--2600 m, 12 Jul 1921, *R. Maire s.n.* (G, specimen on the right, isolectotype: specimen on the left).

See the note regarding *Lolium.*

Lolium mazzettianum (E.B.Alexeev) Darbysh. in Novon 3(3): 241. 1993 ≡ *Festuca mairei* Hack. ex Hand.-Mazz., Symb. Sin. 7(5): 1288(--1289). 1936, nom. illeg. (Art. 53.1 of the *ICN*), non St.-Yves in Candollea 1(1): 45(--47, fig. 17). 1922 ≡ *Festuca mazzettiana* E.B.Alexeev in Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. 82(3): 99. 1977 ≡ *Schedonorus mazzettianus* (E.B.Alexeev) Holub in Preslia 70(2): 113. 1998 ≡ *Festuca kunmingensis* B.S.Sun, Fl. Yunnan. 9: 258. 2003, nom. illeg. (Arts. 52.1--2 of the *ICN*) -- Type: [China] Yunnan Sen, talus des Uzuru, 3 Jun 1908, *P.F. Dulcoux 867* (holotype W barcode 1916- [image!]). — Image of lectotype available at http://herbarium.univie.ac.at/database/detail.php?ID=246792

Lolium letourneuxianum (St.-Yves) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** ≡ *Festuca elatior* var. *letourneuxiana* St.-Yves, Candollea 1(1): 34(–36). 1922 ≡ *Festuca arundinacea* var. *letourneuxiana* (St.-Yves) Torrec. & Catalán in Syst. Bot. 27(2): 243. 2002 -- Type: not designated.

= *Festuca elatior* [var. *letourneuxiana*] subvar. *pitardii* St.-Yves in Candollea 1(1): 34(--36). 1922 -- Type: not designated.

= *Festuca elatior* [var. *letourneuxiana*] subvar. *pseudovulgaris* St.-Yves in Candollea 1(1): 34(--36). 1922 -- Type: not designated.

= *Festuca elatior* var. *cirtensis* St.-Yves in Candollea 1(1): 36. 1922 ≡ *Festuca arundinacea* subsp. *cirtensis* (St.-Yves) Gamisans, Cat. Pl. Vasc. Corse: 63. 1985 ≡ *Schedonorus arundinaceus* subsp. *cirtensis* (St.-Yves) H.Scholz & Valdés in Willdenowia 35(2): 243. 2005 -- Type: "Algérie. Province de Constantine: Djebel Ouahnche (herb. Joly in herb. Univ. Alg.)".

See the note regarding *Lolium*.

Lolium mediterraneum (Hack.) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** ≡ *Festuca elatior* subvar. *mediterranea* Hack., Monogr. Festuc. Eur.: 154(--155). 1882 ≡ *Festuca arundinacea* subsp. *mediterranea* (Hack.) K.Richt., Pl. Eur. 1: 102. 1890 ≡ *Festuca elatior* var. *mediterranea* (Hack.) Gaut., Cat. Fl. Pyrénées-Orientales: 450. 1897 ≡ *Festuca elatior* f. *mediterranea* (Hack.) Fiori, Fl. Italia 4(1, app.): 27. 1907 ≡ *Festuca arundinacea* [race] *mediterranea* (Hack.) Rouy in Rouy & Foucaud, Fl. France 14: 226. 1913 ≡ *Festuca mediterranea* (Hack.) Prain, Index Kew. Suppl. 5: 106. 1921 ≡ *Festuca arundinacea* subsp. *mediterranea* (Hack.) Franco & Rocha Afonso in Bol. Soc. Brot., sér. 2, 54(1): 88. 1980 ≡ *Lolium arundinaceum* subsp. *mediterraneum* (Hack.) Banfi, Bracchi & Galasso in Mem. Soc. Ital. Sci. Nat. Mus. Civico Storia Milano 33(2): 8. 2005 ≡ *Schedonorus arundinaceus* subsp. *mediterraneus* (Hack.) H.Scholz & Valdés in Willdenowia 35(2): 243. 2005 ≡ *Lolium arundinaceum* var. *mediterraneum* (Hack.) Jauzein in Biocosme Mésogéen 27(4): 119. 2010 -- Lectotype (designated by Kerguélen in Lejeunia 110: 6--7. 1983): [Algeria] "Hab. in ditione urbis Alger, loco dicto la Maison Carrée in pratis humosis pascuis", 14 May 1879, *M. Gandoger 337* (W barcode 1916-0014959 [image!]). — Image of lectotype available at http://herbarium.univie.ac.at/database/detail.php?ID=166145

= *Festuca arundinacea* var. *glaucescens* Boiss., Voy. Bot. Espagne 2(21): 675. 1844 ≡ *Festuca elatior* var. *glaucescens* (Boiss.) Briq., Prodr. Fl. Corse 1: 154. 1910 ≡ *Festuca pauneroi* Cebolla, López Rodr. & Rivas Ponce in Candollea 58(1): 195. 2003 ≡ *Schedonorus arundinaceus* subsp. *pauneroi* (Cebolla, López Rodr. & Rivas Ponce) H.Scholz in Willdenowia 35(2): 243. 2005 -- Lectotype (designated by Cebolla Lozano & al. in Fontqueria 48: 87. 1997): [Spain] "Hisp. merid. Inter Alhaurín et Coin. ad viam", May 1837, *E. Boissier s.n.* (G barcode 8034 432).

See the note regarding *Lolium*.

Lolium pluriflorum (Schult.) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** ≡ *Festuca pluriflora* Schult., Mant. 2: 402. 1824 ≡ *Festuca multiflora* C.Presl, Cyper. Gramin. Sicul.: 37. 1820, nom. illeg. (Art. 53 of the *ICN*), non Walter, Fl. Carol.: 81. 1788 ≡ *Festuca elatior* var. *sicula* Parl., Fl. Ital. 1(2): 455. 1850 ≡ *Festuca elatior* var. *multiflora* Hack. in Bot. Centralbl. 8(52): 407. 1881, nom. illeg. (Arts. 52.1–2 of the *ICN*) ≡ *Festuca elatior* subsp. *multiflora* Arcang., Comp. Fl. Ital., ed. 2: 61. 1894 ≡ *Festuca elatior* f. *multiflora* (Arcang.) Fiori in Fiori & Paol., Fl. Italia 1(1): 92. 1896 ≡ *Festuca elatior* var. *pluriflora* (Schult.) Halácsy, Consp. Fl. Graec. 3(2): 404. 1904, nom. superfl. (Art. 52.3 of the *ICN*) ≡ *Schedonorus pratensis* subsp. *pluriflorus* (Schult.) H.Scholz in Ber. Inst. Landschafts Pflanzenökol. Univ. Hohenheim Beih. 16: 75. 2003, nom. superfl. (Art. 52.3 of the *ICN*) ≡ *Schedonorus pluriflorus* (Schult.) Bergmeier & H.Scholz in Willdenowia 41(1): 174. 2011 -- Type: not designated.

For this taxon, the epithets *pluriflorum*, *multiflorum*, and *siculum* have priority at the ranks of species, subspecies, and form respectively.

Lolium pratense (Huds.) Darbysh. in Novon 3(3): 242. 1993 ≡ *Festuca pratensis* Huds., Fl. Angl.: 37. 1762 ≡ *Festuca fluitans* var. *pratensis* (Huds.) Huds., Fl. Angl., ed. 2, 1: 47. 1778 ≡ *Schedonorus pratensis* (Huds.) P.Beauv., Ess. Agrostogr.: 177, 163. 1812 ≡ *Bromus pratensis* (Huds.) Spreng., Syst. Veg. 1: 359. 1824 ≡ *Bucetum pratense* (Huds.) Parn., Grass. Scotland: 105. 1842 ≡ *Festuca elatior* subsp. *pratensis* (Huds.) Čelak., Prodr. F. Böhmen 1: 51. 1867 ≡ *Festuca elatior* var. *pratensis* (Huds.) A.Gray, Manual, ed. 5: 634. 1867 ≡ *Tragus pratensis* (Huds.) Panz. ex B.D.Jacks., Index Kew. 2(2): 1099. 1895 -- Lectotype (designated by Reveal & al. in Taxon 40(1): 135. 1991): [Great Britain], *Buddle s.n.*, Herb. Sloane 125.16 (BM-SL).

= *Festuca adscendens* Retz. in Kongl. Vetensk. Acad. Handl. 30: 245. 1769 ≡ ×*Festulolium adscensdens* (Retz.) Asch. & Graebn., Syn. Mitteleur. Fl. 2(1, 7): 768. 1902 -- **Lectotype (designated here):** "*Festuca adscendens*", *s.d.*, *s.coll*. (LD barcode 1286867 [image!]). — Images of lectotype available at http://www.botmus.lu.se/Lund/Images/1286867.jpg; http://www.botmus.lu.se/Lund/Images/1286867B.jpg

Although the synflorescence appears to be contracted in the lower part, the specimen is clearly referable to *Lolium pratense*: all the spikelets have two glumes, and the synflorescence is lax, without the rachis concavities typical to the subg. *Lolium*.

= *Festuca pooides* Michx. ("*poaeoides*"), Fl. Bor.-Amer. 1: 67: 1803, nom. illeg. (Art. 53.1 of the *ICN*), non *Festuca pooides* Thuill. ("*poaeoïdes*"), Fl. Env. Paris, ed. 2: 51. 1799 ≡ *Festuca americana* Pers. ("*Festuca poaeoides* (*americana*)"), Syn. Pl 1: 94. 1805, pro syn./nom. provv. (Art. 36.1.(b) and 36.1.(c) of the *ICN*) ≡ *Festuca americana* Michx. ex P.Beauv., Ess. Agrostogr.: 162(--163). 1812 ≡ *Festuca americana* F.Dietr., Nachtr. Vollst. Lex. Gärtn. 3: 332. 1817, isonym (Art. 6, Note 2 of the *ICN*) ≡ *Schedonorus americanus* (Michx. ex P.Beauv.) Roem. & Schult., Syst. Veg., ed. 15 bis, 2: 706. 1817 -- Type: "Hab. ad ripas fluv. St. Laurentii", (holotype CONN?; see Piper, 1906).

The question mark accompanying the name of Palisot de Beauvois (and the one of Roemer & Schultes), does not invalidate its publication, since it indicates a mere taxonomic doubt, which actually does not affect its acceptance by the author (Art. 36.1 of the *ICN*).

Lolium scabriflorum Banfi, Galasso, Foggi, Kopecký & Ardenghi, **nom. nov.** ≡ *Festuca scabriflora* L.Liu, Fl. Reipubl. Popularis Sin. 9(2): 387(--388). 2002, nom. illeg. (Art. 53.1 of the *ICN*), non *Festuca scabriflora* Steud., Syn. Pl. Glumac. 1(3): 314(--315). 1854 – *Festuca scabriflora* L.Liu, Vasc. Pl. Hengduan Mount. 2: 2174. 1994, nom. nud. -- Type: [China] Yunnan: Zhongdian, 17 August 1981, *Hengduanshan Exped*. *3111* (holotype PE).

Lolium* ×*schlickumii (Grantzow) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** [*Lolium giganteum* (L.) Darbysh. × *L. pratense* (Huds.) Darbysh.] ≡ *Festuca* ×*schlickumii* Grantzow, Fl. Uckermarck: 340. 1880 ≡ *Schedonorus* ×*schlickumii* (Grantzow) Holub, Preslia 70(2): 113. 1998 -- Type: not designated.

Lolium* ×*subnutans (Holmb.) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** [*Lolium multiflorum* Lam. × *L. pratense* (Huds.) Darbysh.] ≡ *Festuca* ×*subnutans* Holmb. in Bot. Not. 1930(2): 94(--94). 1930 -- Type: not designated.

Lolium tuberosum (Romero Zarco & Cabezudo) Banfi, Galasso, Foggi, Kopecký & Ardenghi, **comb. nov.** ≡ *Micropyropsis tuberosa* Romero Zarco & Cabezudo in Lagascalia 11(1): 95(94--99, fig. 11, tabs. 1--2). 1983 -- Type: In arenosis humidis loco dicto "El Martinazo", Parque Nacional de Doñana (Huelva, España), 13 May 1966, *Galiano & Novo s.n.* (holotype SEV-66232, isotypes MA, MAF, MAG).

NOMINA NUDA AND/OR ARTIFICIAL HYBRIDS

×Festulolium colinii Cugnac & A.Camus ex A.Camus ('*Colini*'), Bull. Soc. Bot. France 91(1–3): 16(–19, figs. C, C', a, b, c). 1944 [*Lolium pratense* (Huds.) Darbysh. ♂ × *L. temulentum* L. ♀] -- Type: not designated.

Artificial hybrid (Cugnac & Camus, 1944).

×Festulolium frederici Cugnac & A.Camus in Bull. Soc. Bot. France 91(1--3): 19. 1944, nom. nud. (Art. 39.1 of the *ICN*) [*Festuca rubra* L. × *Lolium perenne* L.]

×Festulolium frederici Cugnac & A.Camus, the only "authentic" *×Festulolium*, is based on a previous description in German (without name) by Nilsson (1933), thus it is not validly published (Art. 39.1 of the *ICN*). It is a spontaneous hybrid (Nilsson, 1933).

×Festulolium nilssonii Cugnac & A.Camus in Bull. Soc. Bot. France 91(1--3): 19. 1944, nom. nud. (Art. 39.1 of the *ICN*) [*Lolium giganteum* (L.) Darbysh. ♂ × *L. multiflorum* Lam. ♀]

= ×*Schedololium nilssonii* Soreng & Terrell in Phytologia 83(2): 87. 1998, nom. nud. (a putative new combination based on a nom. nud.)

= *×Schedolium nilssonii* Stace in Watsonia 27(3): 247. 2009, nom. nud. (a putative new combination based on a nom. nud.)

×Festulolium nilssonii Cugnac & A.Camus is based on a previous description in German (without name) by Nilsson (1930), thus it is not validly published (Art. 39.1 of the *ICN*). It is an artificial hybrid (Nilsson, 1930).

ACKNOWLEDGMENTS

The authors are grateful to Antonello Brunu (University of Sassari) for providing the protologue of *Festuca arundinacea* var. *insularis*. We are also indebted to Sarah Hanson (Royal Botanic Gardens, Millennium Seed Bank, Kew), kindly contacted by Filippo Guzzon (University of Pavia), for editing our English.

LITERATURE CITED

Ardenghi, N.M.G. & Foggi, B. 2015. Lectotypification and combination of *Festuca apennina* (Poaceae). *Taxon* 64(5): 1038--1041. http://dx.doi.org/10.12705/645.14

Ardenghi, N.M.G., Signorini, M.A., Parolo, G., Rossi, G., Pignotti, L., Vitek, E. & Foggi, B. 2013. Typification of names of taxa belonging to *Festuca arundinacea* (≡*Schedonorus arundinaceus*) aggregate (Poaceae) in Hackel's herbarium (W). *Phytotaxa* 84(2): 55--59. http://dx.doi.org/10.11646/phytotaxa.84.2.2

Banfi, E., Bracchi, G., Galasso, G. & Romani, E. 2005. Agrostologia placentina. *Mem. Soc. Ital. Sci. Nat. Mus. Civico Storia Milano* 33: 1--80.

Catalán, P., Torrecilla, P., López Rodríguez, J.Á. & Olmstead, R.G. 2004. Phylogeny of the festucoid grasses of subtribe Loliinae and allies (Poeae, Pooideae) inferred from ITS and trnL-F sequences. *Mol. Phylogenet. Evol.* 31(2): 517--541.

Catalán, P., Torrecilla, P., López-Rodríguez, J.A., Müller, J. & Stace C. 2007. A systematic approach to Subtribe Loliinae (Poaceae: Pooideae) based on phylogenetic evidence. *Aliso* 23: 380--405.

Cugnac, A. de & Camus, A. 1944. Un × *Festulolium* expérimental nouveau: *Festulolium Colini* = *Lolium temulentum* × *Festuca pratensis*. *Bull. Soc. Bot. France* 91(1--3): 16--19. http://dx.doi.org/10.1080/00378941.1944.10834307

Darbyshire, S.J. (1993) Realignment of *Festuca* Subgenus *Schedonorus* with the Genus *Lolium* (Poaceae). *Novon* 3: 239--243. http://dx.doi.org/10.5962/bhl.title.744

Foggi, B. & Müller, J. 2009 (last updated Apr 2015). *Schedonorus*. In: Valdés, B. & Scholz, H. (eds.), with contributions from Raab-Straube, E. von & Parolly, G., Poaceae. Euro+Med Plantbase - the information resource for Euro-Mediterranean plant diversity. http://ww2.bgbm.org/EuroPlusMed/ (accessed on 1 Apr 2016).

Gaut, B.S., Tredway, L.P., Kubik, C., Gaut, R.L. & Meyer, W. 2000. Phylogenetic relationships and genetic diversity among members of the Festuca-Lolium complex (Poaceae) based on ITS sequence data. *Pl. Syst. Evol.* 224(1--2): 33--53.

Holmberg, O.R. (1930) Ein unzweifelhafter Bastard zwischen *Festuca pratensis* Huds. und *Lolium multiflorum* Lam. nachgewiesen. *Bot. Not.* 1930(2): 91--94.

Kopecký, D., Lukaszewski, A.J. & Doležel, J. 2005. Genomic constitution of *Festulolium* cultivars released in the Czech Republic. *Pl. Breed.* 124(5): 454--458.

Kopecký, D., Lukaszewski, A.J. & Doležel, J. 2008. Cytogenetics of *Festulolium* (*Festuca* × *Lolium* hybrids). *Cytogenet. Genome Res.* 120(3--4): 370--383.

Loos, G.H. 2010. Taxonomische Neukombinationen zur Flora Mittel- und Osteuropas, insbesondere Nordrhein-Westfalens. *Jahrb. Bochum. Bot. Vereins* 1: 114--133.

López Rodríguez, J.Á. & Catalán, P. 1999. Taxonomic identity of the Maghrebian grass *Festuca fontqueri* St-Yves. *Fl. Medit.* 9: 281--286.

McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Prud'homme Van Reine, W.F., Smith, G.F., Wiersema, J.H. & Turland, N.J. (eds.) 2012. *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code)*. Regnum Vegetabile 154. Königstein: Koeltz Scientific Books. [online ed., http://www.iapt-taxon.org/nomen/main.php]

Nilsson, F. 1930. *Lolium multiflorum* Lam. ♀ × *Festuca gigantea* Vill. ♂. Ein neuer Gattungbastard. *Bot. Not.* 1930(2): 81--90.

Nilsson, F. 1933. Ein spontaner Bastard zwischen *Festuca rubra* und *Lolium perenne*. *Hereditas* 18(1--2): 1--15.

Piper, C.V. 1906. North American Species of *Festuca*. *Contr. U.S. Natl. Herb.* 10(1): 1--48.

Soreng, R.J. & Terrell, E.E. 1998. Taxonomic notes on *Schedonorus*, a segregate genus from *Festuca* or *Lolium*, with a new nothogenus, ×*Schedololium*, and new combinations. *Phytologia* 83(2, 1997): 85--88.

Tison, J.-M., Jauzein, P., Girod, C. & Espeut, M. 2010. Combinaisons et statuts nouveaux proposés dans la "Flore de la France méditerranéenne continentale". *Biocosme Mésogéen* 27(4): 109--133.

Torrecilla, P. & Catalán, P. 2002. Phylogeny of Broad-Leaved and Fine-Leaved *Festuca* Lineages (Poaceae) Based on Nuclear ITS Sequences. *Syst. Bot.* 27(2): 241--251.

Torrecilla, P., López Rodríguez, J.A., Stancik, D. & Catalán, P. 2003. Systematics of *Festuca* L. sects. *Eskia* Willk., *Pseudatropis* Kriv., *Amphigenes* (Janka) Tzvel., *Pseudoscariosa* Kriv. and *Scariosae* Hack. based on analysis of morphological characters and DNA sequences. *Pl. Syst. Evol.* 239(1--2): 113--139.

Tzvelev, N.N. & Czerepanov, S.K. 1974. *Flora Evropejskoj Časti SSSR* [Flora of the European part of the USSR], vol. 1. Leningrad: Akademiia Nauk SSSR. Botanicheskii institut imeni V.L. Komarova. [in Russian].

Cover letter

Novità esotiche e alcuni gruppi critici in Romagna

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La realizzazione di un atlante floristico si fonda sulla conoscenza dettagliata della distribuzione di ciascun taxon censito nell'area oggetto di studio. Ogni dato di presenza può derivare dall'osservazione diretta dei rilevatori sul campo oppure da un reperto verificabile anche a posteriori, come un campione d'erbario oppure una fotografia. Non sempre però le stesse modalità di rilevamento e riconoscimento consentono di cartografare in modo accurato la distribuzione di tutti i taxa. Infatti, per identificare alcune entità ed archiviare correttamente le relative informazioni distributive è talvolta necessario seguire particolari protocolli di campionamento, che spesso impongono al rilevatore la raccolta di un campione, spesso privilegiando precisi caratteri morfologici oppure uno specifico stadio fenologico. È questo il caso dei cosiddetti "gruppi critici", complessi di taxa (specie, sottospecie o addirittura generi) così simili sul piano morfologico che i confini tra un'unità sistematica e l'altra possono sovente apparire di difficile interpretazione o non universalmente accettati. Tuttavia, nel corso di un'indagine floristica l'ostacolo può essere superato mediante la consultazione di lavori specialistici, materiale erbariologico correttamente identificato oppure ricorrendo all'aiuto degli specialisti.

Un gruppo critico emblematico della flora italiana e, nello specifico, di quella romagnola, è indubbiamente rappresentato da *Festuca* L. e generi affini (*Drymochloa* Holub, *Leucopoa* Griseb., *Lolium* L. p.p. [= *Schedonorus* P.Beauv.], *Patzkea* G.H.Loos), i cui limiti tassonomici sono soggetti a continue variazioni sin dai tempi di Linneo (in *Festuca*, ad esempio, è attualmente confluito anche il genere *Vulpia* C.C.Gmel.; cfr. Soreng et al., 2015). Negli ultimi decenni è stato possibile far chiarezza sulla sistematica di questo gruppo, con notevoli progressi nella delimitazione sia dei generi che dei taxa specifici ed infraspecifici. Nonostante questo, il riconoscimento pratico delle singole specie continua a costituire una rilevante difficoltà per i "non addetti ai lavori", sia per le caratteristiche intrinseche del gruppo (in cui, ad esempio, gioca un ruolo fondamentale l'analisi dell'anatomia fogliare) sia per l'assenza di una trattazione globale ed aggiornata di respiro nazionale. Per la Romagna sino ad ora è mancata una revisione critica delle "festuche" (intese secondo la concezione di Pignatti, 1982, ovvero senza i taxa confluiti da *Vulpia*) tanto che il principale riferimento per quest'area geografica è ancora oggi rappresentato da Zangheri (1966). In tempi recenti, tuttavia, si è registrato un miglioramento delle conoscenze per l'area del Parco Nazionale delle Foreste Casentinesi (Viciani et al., 2010) ed interessanti scoperte sono state pubblicate online sul forum Acta Plantarum (http://www.actaplantarum.org/) soprattutto da G. Faggi; numerosi campioni (ancora in parte da revisionare) sono stati inoltre raccolti da G. Rossi e attualmente sono in fase di intercalazione nella costituenda *Collectio Festucarum* dell'Erbario dell'Università di Pavia (PAV) (Rossi & Ardenghi, 2016). Come già avvenuto per altre flore regionali e subprovinciali (ad es. Bovio, 2014; Saccani & Salvoni, 2015), il nascituro atlante floristico può costituire un'occasione unica per fornire, dopo mezzo secolo, un quadro scientificamente rigoroso ed aggiornato della distribuzione di *Festuca* e generi affini in Romagna.

Un consistente numero di gruppi critici si rileva anche nel contingente delle entità alloctone, alcuni dei quali ben rappresentati nella flora romagnola. Tra i più noti si ricordano i generi *Amaranthus* L., *Cyperus* L. e *Panicum* L., recentemente oggetto di importanti segnalazioni floristiche di rilevanza nazionale (Faggi et al., 2013; Iamonico et al., 2015; Verloove & Saiani, 2015). A fianco di questi "*evergreen*", negli ultimi anni in Europa e in Italia è emerso un ulteriore gruppo critico costituito in prevalenza da taxa di origine esotica: *Vitis* L. Specie e ibridi di viti americane furono introdotti nel continente europeo alla fine dell'Ottocento principalmente come portainnesto, per contrastare gli attacchi radicali perpetuati dalla fillossera ai danni dell'apparato radicale di *V. vinifera* L. Nel corso del tempo, svariate entità, favorite anche dalle caratteristiche di adattabilità pedoclimatica e resistenza ai patogeni per cui erano state in origine selezionate, si sono svincolate dal vigneto, colonizzando gli ambienti circostanti. Recenti contributi sul genere *Vitis* in Italia hanno rivelato la presenza sul suolo nazionale di una decina di viti alloctone, alcune delle quali invasive (Ardenghi et al., 2014, 2015a, 2015b); di queste, solo due risultano ufficialmente segnalate per la Romagna: *V. riparia* Michx. e *V. ×instabilis* Ardenghi et al. (Ardenghi et al., 2014; Montanari et al., 2014). Grazie a ricerche mirate condotte da S. Montanari e G. Faggi (pubblicate online sul forum Acta Plantarum) finalizzate ad aggiornare la distribuzione delle viti alloctone in Italia (Ardenghi et al., in prep.) e in Romagna, è stato possibile accertare la presenza di ulteriori taxa, alcuni già noti per la flora regionale (*V. rupestris* Scheele, *V. ×koberi* Ardenghi et al.) e altri inediti (*V. ×bacoi* Ardenghi et al., *V. ×goliath* Ardenghi et al., *V. ×ruggerii* Ardenghi et al.). Al fine di facilitare l'identificazione delle viti aliene in Romagna (e non solo), viene di seguito fornita una chiave aggiornata comprensiva di tutte le entità sino ad ora note per il territorio nazionale, inclusi *V. berlandieri* Michx. × *V. vinifera* e gli ibridi di *V. aestivalis* Michx., recentemente rinvenuti in Lombardia (Ardenghi et al., 2015b; Ardenghi & Polani, in press.).

1\. Nodi del fusto e punto d'inserzione del picciolo sulla pagina abassiale della lamina glaucescenti (nel secco assumono una caratteristica colorazione biancastro-cerosa); lamine evidentemente discolori:...... ibridi di ***V. aestivalis***

+\. Nodi del fusto e punto d'inserzione del picciolo sulla pagina abassiale della lamina mai glaucescenti; lamine discolori o concolori: **2**

2\. Lamine mature subglabre o con pelosità da tomentosa a fioccosa bianca o rossiccia sulla pagina abassiale; viticci o infiorescenze consecutivi su 2, 3 o più nodi; pagina adassiale reticolato-rugosa; sapore delle bacche mature almeno in parte fragolino; esocarpo non o scarsamente aderente al mesocarpo; mesocarpo mucillaginoso: ....**3** (*V. labrusca* e suoi ibiridi)

+\. Lamine mature prive di pelosità da tomentosa a fioccosa bianca o rossiccia sulla pagina abassiale; viticci o infiorescenze consecutivi su 2 nodi; pagina adassiale in genere liscia; sapore delle bacche mature mai fragolino; esocarpo fortemente aderente al mesocarpo; mesocarpo mai mucillaginoso: **4**

3. Viticci o infiorescenze sempre consecutivi su 3 o più nodi; lamine con densa pelosità tomentosa bianca o rossiccia sulla pagina abassiale; galle di fillossera assenti sulle lamine fogliari; pelosità irtella assente sulle parti vegetative; sapore delle bacche mature esclusivamente fragolino; succo incolore: ....***V. labrusca***

+. Viticci o infiorescenze consecutivi su 2, 3 o più nodi; lamine subglabre o con pelosità da tomentosa a fioccosa bianca o rossiccia sulla pagina abassiale; galle di fillossera in genere presenti sulle lamine fogliari; pelosità irtella in genere presente sulle parti vegetative; sapore delle bacche mature fragolino e astringente; succo di colore rosso cupo e tingente: ....***V. ×novae-angliae*** (*V. labrusca* × *V. riparia*)

4. Colore delle lamine a fine stagione vegetativa da rosso-porpora a violetto (rimane giallo nelle cultivar a bacca bianca di *V. vinifera* e nell'ibrido tra *V. vinifera* e *V. berlandieri*); lamine intere o da debolmente 3-lobate a profondamente (3-)5-7-lobate; sapore delle bacche mature da astringente a dolce come l'uva; lunghezza dei semi > 5 mm; rostro dei semi in genere > 1 mm: ....**5** (*V. vinifera* e suoi ibridi)

+. Colore delle lamine a fine stagione vegetativa da verde-giallastro a giallo; lamine intere o da subintere a 3- o debolmente 5-lobate; sapore delle bacche mature sempre astringente, occasionalmente dolciastro-erbaceo; lunghezza dei semi < 5 mm; rostro dei semi in genere < 1 mm: **8**

5. Base fogliare in genere a forma di lira; pagina abassiale delle lamine da uniformemente tomentosa a subglabra; sapore delle bacche mature di norma dolce come l'uva, solo talvolta aspro; galle di fillossera assenti sulle lamine: ... .***V. vinifera***

+. Base fogliare a forma di lira, a U, cuneata o troncata; pagina abassiale delle lamine mai uniformemente tomentosa; sapore delle bacche mature di norma astringente o appena dolce come l'uva; galle di fillossera in genere presenti sulle lamine: **6**

6. Margini fogliari con denti ottusi; denti in corrispondenza delle nervature laterali principali appena accennati; ciuffi all'ascella delle nervature sulla pagina abassiale assenti; peli irtelli molto radi o assenti; colore delle lamine a fine stagione vegetativa da verde-giallastro a giallo: ...***V. berlandieri*** × ***V. vinifera***

+. Margini fogliari con denti perlopiù acuti; denti in corrispondenza delle nervature laterali principali prominenti, acuminati; ciuffi all'ascella delle nervature sulla pagina abassiale molto sviluppati o incospicui; peli irtelli da abbondanti a radi; colore delle lamine a fine stagione vegetativa da rosso-porpora a violetto:.. **7**

7. Lamine fogliari cordate, da 3-5(-7)-lobate a subintere; base fogliare a forma di U o lirata: ***V. ×bacoi*** (*V. riparia* × *V. vinifera*)
+. Lamine fogliari da reniformi a largamente cordate, da debolmente 3-lobate a intere; base fogliare da cuneata a troncata o a forma di U allargata: ....***V. ×goliath*** (*V. riparia* × *V. rupestris* × *V. vinifera*)

8. Base fogliare da troncata a cuneata; pagina abassiale in genere glabra, a volte leggermente irtella e/o aracnoide sulle nervature all'inserzione del picciolo; lamine reniformi, conduplicate, leggermente più larghe che lunghe; piante cespitose, raramente rampicanti: ....***V. rupestris***
+. Base fogliare troncata, a forma di U, V o lira; pagina abassiale con pubescenza variabile o glabrescente; lamine da reniformi a cordate, conduplicate o no; piante in genere rampicanti: **9**

9. Pagina abassiale con o senza ciuffi di peli all'ascella delle nervature; inserzione del picciolo sulla pagina abassiale delle lamine con pelosità aracnoide sulle nervature; margini fogliari in prevalenza con denti ottusi; base fogliare a forma di U o lira: **10**
+. Pagina abassiale in genere con densi ciuffi di peli all'ascella delle nervature; inserzione del picciolo sulla pagina abassiale delle lamine occasionalmente con pelosità aracnoide sulle nervature; margini fogliari in prevalenza con denti acuti; base fogliare troncata, a forma di U o V: **11**

10. Foglie in genere largamente cordate, con base a forma di U o lira; lamine in genere lunghe più di 10 cm, non o debolmente conduplicate; pagina abassiale con ciuffi di peli all'ascella delle nervature; pagina adassiale verde scuro, in genere con nervature bianco-verdastre: ....***V. ×koberi*** (*V. berlandieri* × *V. riparia*)
+. Almeno alcune foglie reniformi o arrotondate, con base a forma di U o lira allargate; lamine in genere lunghe meno di 10 cm, almeno quelle sommitali conduplicate; pagina abassiale in genere senza ciuffi di peli all'ascella delle nervature; pagina adassiale da verde scuro a verde chiaro, spesso con nervature rosse almeno alla base: ....***V. ×ruggerii*** (*V. berlandieri* × *V. rupestris*)

11. Base fogliare a forma di U; lamine cordate, lunghe fino a 15 cm o più, mai conduplicate, sottili; pagina adassiale in genere opaca, senza nervature rosse; pelosità aracnoide assente: ....***V. riparia***
+. Base fogliare troncata, cuneata o a forma di U o V allargate; lamine da cordate a reniformi o leggermente arrotondate, in genere lunghe meno di 15 cm, almeno quelle sommitali conduplicate, sottili o spesse; pagina adassiale in genere lucida, con nervature rosse almeno alla base; pelosità aracnoide talvolta presente sulle nervature all'inserzione del picciolo sulla pagina abassiale delle lamine: ....***V. ×instabilis*** (*V. riparia* × *V. rupestris*)

Bibliografia citata

Ardenghi N.M.G. & Polani F., in press - La Flora della provincia di Pavia (Lombardia, Italia). I. L'Oltrepò Pavese. *Natural History Sciences*.

Ardenghi N.M.G., Galasso G., Banfi E., Zoccola A., Foggi B. & Lastrucci L., 2014 - A taxonomic survey of the genus Vitis L. (Vitaceae) in Italy, with special reference to Elba Island (Tuscan Archipelago). *Phytotaxa*, 166(3): 163-198.

Ardenghi N.M.G., Banfi E. & Galasso G., 2015a - A taxonomic survey of the genus Vitis L. (Vitaceae) in Italy, part II: the 'Euro-American' hybrids. *Phytotaxa*, 224(3): 232-246.

Ardenghi N.M.G., Galasso G., Banfi E. & Cauzzi P., 2015b - *Vitis ×novae-angliae* (Vitaceae): systematics, distribution and history of an "illegal" alien grape in Europe. *Willdenowia*, 45(2): 197-207.

Bovio M., 2014. - Flora vascolare della Valle d'Aosta. *Testolineditore*, Sarre.

Faggi G., Banfi E. & Alessandrini A., 2013 - Noterella 0025. *Panicum virgatum* L. *ActaPlantarum Notes*, 1: 78.

Iamonico D., Ardenghi N.M.G. & Faggi G., 2015 - *Amaranthus palmeri* Watson. In: Raab-Straube E. von & Raus Th. (eds.): Euro+Med-Checklist Notulae, 4. *Willdenowia*, 45(1): 119-120.

Montanari S., Faggi G., Sirotti M., Contarini E. & Alessandrini A., 2014 - Aggiornamenti floristici per la Romagna. Seconda serie. *Quad. Stud. Notiz. Storia Nat. Romagna*, 40: 1-29.

Pignatti S., 1982 - Flora d'Italia. *Edagricole*, Bologna.

Rossi G. & Ardenghi N.M.G., 2016 - Erbario dell'Università di Pavia (PAV). http://sciter.unipv.eu/site/home/risorse/sezione-di-ecologia-del-territorio/articolo720004775.html

Saccani A. & Salvoni M., 2015 - Gioielli della flora delle Alte Valli Taro e Ceno. *Stamperia scrl*, Parma.

Soreng R.J., Peterson P.M., Romaschenko K., Davidse G., Zuloaga F.O., Judziewicz E.J., Filgueiras T.S., Davis J.I. & Morrone O., 2015 - A worldwide phylogenetic classification of the Poaceae (Gramineae). *J. Syst. Evol.*, 53(2): 117-137.

Verloove F. & Saiani D., 2015 - Studies in Italian Cyperaceae: 3. *Cyperus erythrorhizos*, new to Europe, naturalized in Italy. *Webbia*, 70(1): 133-137.

Viciani D., Gonnelli V., Sirotti M. & Agostini N., 2010 - An annotated check-list of the vascular flora of the "Parco Nazionale delle Foreste Casentinesi, Monte Falterona e Campigna" (Northern Apennines, Central Italy). *Webbia*, 65(1): 3-131.

Zangheri P., 1966 - Repertorio della flora e fauna vivente e fossile della Romagna. *Mus. Civ. St. Nat. Verona, Mem. fuori ser.*, 1.

N.M.G. Ardenghi, M. Pascale

???. Lolium apenninum (De Not.) Ardenghi & Foggi

+ **PIE**: 1) Valle Gesso, comune di Valdieri (CN) "*In sylvis Alpium Valdierii*", La Sella, luglio 1826. *Leg.* Balbis? [*sic*], *det.* Belli *sub* (*Festuca elatior* L. s.r.), *F. pratensis* Huds var. *genuina* subv. *typica* Hack. (forma *mucronulata*), *rev*. N.M.G. Ardenghi 2015 (*hb.* TO); 2) Valle Stura di Demonte, comune di Vinadio (CN), Terme di Vinadio nei prati, 28 luglio 1889. *Leg.* E. Ferrari, *det.* S. Belli, *sub Festuca arundinacea* Schb. var. *genuina* subvar. *subalpina* Hackel, *rev*. N.M.G. Ardenghi 2015 (*hb.* TO); 3) Valle Pesio, comune di Chiusa di Pesio (CN), Certosa di Pesio: zone erbose umide sotto le Roccie [*sic*] Bruseis (Alpi marittime), 14 luglio 1906. *Leg.* E. Ferrari, S. Belli, F. Vallino, *det.* S. Belli sub *Festuca arundinacea* Schb. subvar. *subalpina* Hack. forma , *rev*. N.M.G. Ardenghi, 2015 (*hb.* TO); 4) Valle Tanaro, comune di Briga Alta (CN), salendo da Carnino Superiore alla Gola della Chiusetta (CN), calcare, pascolo, 1900 m, NE, 19 luglio 1999. *Leg. et det.* M. Pascale, *rev.* N.M.G. Ardenghi 2016 (*hb.* MRSN 8632); 5) Valle Stura di Demonte, comune di Argentera (CN), poco oltre la Fontana di Napoleone, pascolo fresco, calcare, 1960 m, SW, 10 luglio 2000. *Leg. et det.* M. Pascale, *rev.* N.M.G. Ardenghi 2016 (*hb.* MRSN); 6) Valle Stura di Demonte, comune di Argentera (CN), Colle della Maddalena, poco sopra il lago presso un'area di stazionamento del bestiame, 2050 m, NW, 20 luglio 2001. *Leg. et det.* M. Pascale, *rev.* N.M.G. Ardenghi, 2016 (*hb.* MRSN 8633); 7) Valle Stura di Demonte, comune di Vinadio (CN), Vallone di S. Anna, a SW del santuario, pascolo, silice, 2055 m, NE, 18 luglio 2008. *Leg. et det.* M. Pascale, *rev.* N.M.G. Ardenghi 2016 (*hb.* MRSN 8566); 8) Valle Stura di Demonte, comune di Vinadio (CN), frazione Bagni nel vallone di Tesina, megaforbieto, silice, 1710 m, NE, 25 luglio 2014. *Leg. et det.* M. Pascale, *rev.* N.M.G. Ardenghi, 2015 (*hb.* Pascale). 9) Valle Stura di Demonte, comune di Argentera (CN), Vallone del Puriac, megaforbieto, 1930 m, esp. N, 13 agosto 2004. *Obs.* L. Garraud, R. Pascal; 10) Valle Stura di Demonte, comune di Argentera (CN), Vallone del Puriac, margine ruscello, 2005 m, esp. NW, 13 agosto 2004. *Obs.* L. Garraud, R. Pascal; 11) Valle Stura di Demonte, comune di Argentera (CN), Vallone del Puriac, dintorni di Grange, 1870 m, esp. N, 25 luglio 2004; *Obs.* L. Garraud, R. Pascal; 12) Valle Pesio, comune di Chiusa Pesio (CN) , Pian del Lupo, 29 luglio 1997. *Leg. et det.* J.-L. Polidori *sub Festuca pratensis* subsp. *apennina* (De Not.) Hegi (*hb.* Ente Parco del Marguareis)

OSSERVAZIONI. La presenza di *Lolium apenninum* (De Not.) Ardenghi & Foggi (≡ *Festuca apennina* De Not.) era stata originariamente accertata in Piemonte da Burnat (1882) e Saint-Yves (1913), i quali segnalano la specie per gran parte delle Alpi Liguri e Marittime. In tempi più recenti a parte Bono (1965),che riprende comunque dati degli stessi Burnat e St-Yves, *L. apenninum* non viene più indicato per questa regione (cfr. Conti *et al.*, 2005). I reperti raccolti negli ultimi due decenni elencati in questa nota (assieme ad altri *exsiccata* ottocenteschi esaminati dagli autori) consentono di confermare la presenza della specie in Piemonte, dove sembra essere piuttosto diffusa nelle Alpi Marittime, soprattutto nei megaforbieti al di sopra dei 1500 m.

Bono G., 1965 – La valle Gesso e la sua vegetazione (Alpi Marittime). La flora. Webbia, 20: 1-216

BURNAT E., 1882 – Catalogue des *Festuca* des Alpes Maritimes. G. Bridel, Lausanne. 15 pp.

CONTI F., ABBATE G., ALESSANDRINI A., BLASI C. (eds.), 2005 – An annotated checklist of the Italian vascular flora. Palombi & Partner S.r.l., Roma. 253 pp.

SAINT-YVES, A., 1913 – Les *Festuca* de la Section *Eu-festuca* et leurs variations dans les Alpes Maritimes ». Annuaire du Conservatoire et du Jardine botaniques de Genève, 17: 1-128.

4.4 = THE GENUS *FESTUCA* S.L. (POACEAE) IN ITALY: NOVELTIES AND ACHIEVEMENTS IN THE NEW EDITION OF “FLORA D’ITALIA”

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The genus *Festuca* L. s.l. represents one of the most intricate and neglected critical groups of the Italian and Euro-Mediterranean flora. A combination of intrinsic high phenotypic variability and nomenclatural complexity, produced by two centuries of heterogeneous taxonomic interpretations, affected a comprehensive distributional and systematic knowledge of the whole genus in Europe, with substantial differences between the single countries (3). As recently observed (3), systematic researches on this genus had been very scarce in Italy during the 110 years period between Hackel’s monography (6) and Pignatti’s treatment (8). The situation changed from the middle 1990’s, when our research team started taxonomic investigations on this genus in Italy, through an approach involving the study of type material and nomenclature, new field collections, morpho-anatomical, karyological and molecular analyses.

The forthcoming new edition of “Flora d’Italia” by Sandro Pignatti is a crucial occasion to summarize and evaluate the current systematic knowledge on *Festuca* s.l. (including *Drymochloa*, *Leucopoa*, *Patzkea* and *Schedonorus*) in Italy. In comparison with the 1982 edition, some major differences are worth considering, most importantly the total number of taxa, which increased from 68 to 89 (76 species with 40 infraspecific taxa) (Fig. 1). This recruiting process is due either to the recent description of new taxa, the majority of them Italian endemics (e.g. *F. riccerii* Foggi & Gr.Rossi, *F. veneris* Gr.Rossi, Foggi & Signorini) (7), and to the recording of taxa previously passed unnoticed on the Italian territory (e.g. *F. nigricans* (Hack.) K.Richt., *F. rupicaprina* (Hack.) A.Kern.). Even though this trend appears lower than the French one (3), it should be noted that a number of taxa has been excluded from the Italian flora (e.g. *F. gracilior* (Hack.) Markgr.-Dann., *D. drymeja* (Mert. & W.D.J.Koch) Holub subsp. *drymeja*) as a consequence of recent specific taxonomic revisions (4, 5). The distribution of some lesser known species has been improved (e.g. *F. violacea* subsp. *puccinellii* (Parl.) Foggi, Gr.Rossi & Signorini and *F. robustifolia* Markgr.-Dann. resulted to occur in a more restricted area than previously stated) and the most recent nomenclatural updates have been taken into account, such as the new treatment at genus level of the “broad-leaved” fescues (1, 5).

Additional advantageous features are represented by updated identification keys and descriptions, summing up the major papers on Italian fescues published after 1982. A modern iconography replaces the old one acquired from (2) (in conflict with the current taxonomic concept of some species) and new original line drawings of leaf blade sections are provided (Fig. 2). This new treatment, although innovative and outlining the first updated scenario on *Festuca* s.l. in Italy after more than 30 years, is not to be considered exhaustive: some relevant groups are still obscure and under study (e.g. *F. circummediterranea* Patzke) and new explorations and new revisions are needed to pass from α- to Ω-taxonomy.

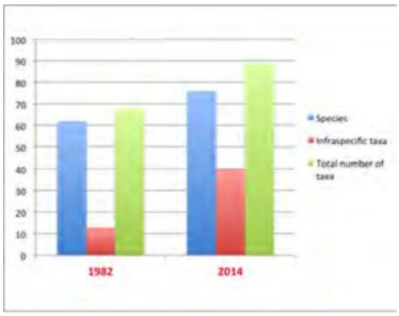

Fig. 1. Taxa of *Festuca* s.l. in Pignatti’s actual and “future” floras

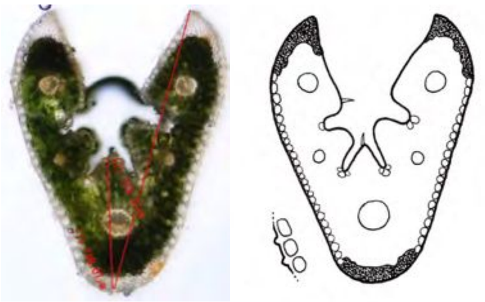

Fig. 2. Picture and drawing of a leaf section (by N. Ardenghi)

1) P. Catalán (2006), in: Plant genome: biodiversity and evolution. Enfield, Science Publishers, 255-303.
2) A. Fiori, G. Paoletti (1896) *Iconographia florae italicae*, 2. Padova, Tipografia del Seminario
3) B. Foggi, M.A. Signorini, G. Rossi (2003) Bocconea, 16(1), 55-64
4) B. Foggi, M.E. Gherardi, M.A. Signorini, G. Rossi, P. Bruschi (2006) Bot. J. Linn. Soc., 51, 239-258
5) B. Foggi, G. Parolo, G. Rossi, N.M.G. Ardenghi, C. Quercioli (2010) Inform. Bot. Ital., 42(1), 335-361
6) E. Hackel (1882) *Monographia Festucarum europaearum*. Kassel, Berlin, Theodor Fischer
7) L. Peruzzi, F. Conti, F. Bartolucci (2014) Phytotaxa, 168(1), 1-75
8) S. Pignatti (1982) Flora d’Italia, 3. Bologna, Edagricole

in passato (Silvestri, 1973; Peccenini Gardini *et al.,* 1986) tanto da essere considerata comune (Antonietti, 2005).

N.M.G. Ardenghi, G. Parolo, G. Rossi, A. Selvaggi, A. Compagnoni, A. Prete, G.V. Cerutti, A. Soldano, G. Fonio

610. Festuca intercedens (Hack.) Lüdi ex Bech. (*Poaceae*)

+ **PIE**: 1) Valli di Lanzo, Val d'Ala, comune di Balme (TO), Costa Gurin, lato orientale, 2270 m, rupi silicee, 22 luglio 2004. *Leg. et det.* A. Selvaggi *sub Festuca halleri* All., *rev.* N.M.G. Ardenghi (*hb.* IPLA); 2) Val Chisone, comune di Pragelato (TO), M. Blegier, 9 agosto 2005. *Leg.* A. Compagnoni, A. Prete *sub Festuca halleri* All., *rev.* N.M.G. Ardenghi 2015 (*hb.* IPLA); 3) Valsesia, comune di Rassa (VC), a SE del L. Scarpia, 2320 m, 20 luglio 2005. *Leg.* G.V. Cerutti, *det.* G. Parolo, G. Rossi (*hb.* MRSN); 4) Valli Ossolane, Valle Antrona, comune di Montescheno (VB), versante S di Passo Ogaggia, 1840 m, 10 giugno 2000. *Leg.* A. Soldano, G. Fonio, *det.* G. Parolo, G. Rossi (*hb.* MRSN).

OSSERVAZIONI. Entità non segnalata per la nostra regione da Pignatti (1982), Aeschimann *et al.* (2004), Conti *et al.* (2005); in Piemonte è stata indicata da Antonietti (2005) come entità rara presente in Ossola sulla base di Rieder *et al.* (1985), il cui dato è stato acquisito durante una escursione condotta dagli Autori in Val Formazza. La specie è stata recentemente rinvenuta in Valle d'Aosta (Bovio, 2014). Si attesta qui la presenza di questa specie nella nostra regione documentando quattro stazioni accertate da revisione specialistica.

N.M.G. Ardenghi, A. Selvaggi, M. Pascale, D. Marangoni, A. Compagnoni, A Prete

611. Festuca rubra L. subsp. **juncea** (Hack.) K. Richt. (*Poaceae*)

+ **PIE**: 1) Valli di Lanzo, Val d'Ala, comune di Balme (TO), Pian della Mussa, greto fluviale ciottoloso presso l'Alpe Rocca Venoni, 1860 m, 9 luglio 2003. *Leg et det.* A. Selvaggi, D. Marangoni *sub Festuca rubra s.l.*, *rev.* N.M.G. Ardenghi 2014 ; 2) Valli di Lanzo, Val d'Ala, comune di Balme (TO), Pian della Mussa, pendio sul lato Est del Rif. Città di Ciriè, 1833 m, arbusteti subalpini, 7 luglio 2003. *Leg et det.* A. Selvaggi, D. Marangoni *sub Festuca rubra s.l.*, *rev.* N.M.G. Ardenghi 2014; 3) Val di Susa, comune di Sauze d'Oulx (TO), Lago delle Launa, prateria subalpina, 2085 m, 16 luglio 2005. *Leg. et det.* A. Compagnoni, A. Prete *sub Festuca ovina* s.l., *rev.* N.M.G. Ardenghi (*hb.* IPLA); 4) Valle Gesso, comune di Valdieri (CN), fraz. S. Anna, vallone Meris tra i due laghi Sella, pascolo, silice, 2095 m, esposiz. SE 26 luglio 2010. *Leg.* M. Pascale, *det.* M. Pascale *sub Festuca rubra* L. subsp. *rubra*, rev. N.M.G. Ardenghi 2014 (*hb.* Pascale); 5) Valle Gesso, comune di Entracque (CN), fraz. S. Giacomo, vallone di Monte Colombo salendo al Rif. Moncalieri, pascolo, silice, 1970 m, esp. E, 13 luglio 2010. *Leg.* M. Pascale, *det.* M. Pascale *sub Festuca rubra* L. subsp. *rubra*, *rev.* N.M.G. Ardenghi 2014 (*hb.* Pascale).

OSSERVAZIONI. Entità riportata in Pignatti (1982) senza indicazioni di distrinino (Carrega & Silla, 1996; Orsino & Dameri, 1998) e pressochè in tutte le vallate alpine dalle Alpi Liguri all'Ossola (Antonietti, 2005; Ariello & Bellia, 1976; Barbero, 1970; Bono, 1965; Bono & Barbero, 1971; Camoletto Pasin & Dal Vesco, 1986; Mondino, 1964; Montacchini, 1966; Saint-Yves, 1913; Soldano & Sella, 2000). Si conferma in questa nota l'appartenenza di questa entità alla flora del Piemonte e se ne documenta la presenza in cinque vallate alpine con campioni recenti verificati da specialista del genere.

N.M.G. Ardenghi, A. Selvaggi, S. Lonati, A. Soldano
630. Festuca stricta Host subsp. **trachyphylla** (Hack.) Patzke ex Pils (*Poaceae*)

+ **SET**: Valli di Lanzo, Val d'Ala, comune di Balme (TO), Pian della Mussa, rimboschimento di abete rosso, all'interno e sui margini, 1756 m, 18 giugno 2003. *Leg. et det.* A. Selvaggi (*sub Festuca ovina* s.l.), *rev.* N.M.G. Ardenghi (*hb.* IPLA).

+ **SET**: Settori prealpini della Stura di Lanzo, comune di Val della Torre (TO): 1) pressi Borgata Brusa, 440 m, 20 maggio 2009. *Leg et det.* S. Lonati (*sub Festuca valesiaca* Schleich.), *rev.* N.M.G. Ardenghi (*hb.* IPLA); 2) tra Borgata Brusa e Borgata Prà Granero, 442 m, 26 maggio 2009. *Leg et det.* S. Lonati (*sub Festuca valesiaca* Schleich.), *rev.* N.M.G. Ardenghi (*hb.* IPLA).

+ **SET**: Colline delle Langhe: 1) comune di Montezemolo (CN), Sorgenti del Belbo, tra Tetti e Montezemolo, 747 m, praterie xeriche, 25 maggio 2006. *Leg. et det.* A. Selvaggi (*sub Festuca valesiaca s.l.*), *rev.* N.M.G. Ardenghi (*hb.* IPLA); 2) comune di Saliceto (CN), Sorgenti del Belbo, Costa Lorenza, praterie xeriche, 710 m, 19 giugno 2008. *Leg. et det.* A. Selvaggi (*sub Festuca valesiaca s.l.*), *rev.* N.M.G. Ardenghi (*hb.* IPLA).

+ **SET**: Pianura di Vercelli: 1) comune di Quinto Vercellese (VC), margine strada presso il ponte sul Cervo, 140 m, 14 maggio 1981. *Leg.* A. Soldano, *det.* N.M.G. Ardenghi (*hb.* MRSN); 2) comune di Vercelli (VC), sponda destra della Sesia appena a monte del ponte stradale per Novara, 130 m, 21 maggio 1981. *Leg.* A. Soldano, *det.* N.M.G. Ardenghi (*hb.* MRSN).

OSSERVAZIONI. Entità non indicata da Pignatti (1982) e Conti *et al.* (2005) per il Piemonte. E' stata tuttavia segnalata in Piemonte recentemente da Soldano & Sella (2000) per il Biellese (*sub Festuca brevipila* Tracey) e da Lonati & Lonati (2007) per la bassa Valsesia (*sub Festuca trachyphylla* (Hack.) Krajina); storicamente è stata segnalata da Belli (1900) e da Gola (1932-1933) (*sub Festuca ovina* L. var. *duriuscula* (L.) Fiori subvar. *trachyphylla* Hack.) rispettivamente per i dintorni di Lanzo torinese e per la Val Maira, quindi raccolta presso Rivarossa da E. Ferrari nel 1913 (Tosco & Ferraris, 1981). E' stata inoltre segnalata - dubitativamente - da Bouvet & Pivani (1998) sulla base dei dati inediti del 1982 di G.P. Mondino e M. Scotta contenuti nel Piano Naturalistico del Parco della Val Troncea (Val Chisone). Il ritrovamento attesta con certezza la presenza dell'entità nelle Valli di Lanzo, nel settore prealpino compreso tra Valli di Lanzo e Val di Susa, nelle Langhe e conferma la presenza della specie in Piemonte.

zioni *sub* "*Festuca glauca*" e altre combinazioni (la "vera" *F. glauca* Vill. è un'entità presente esclusivamente sui Pirenei orientali e in Svizzera; si vedano Portal, 1999, e Devesa *et al.*, 2013) relative ai settori più xerici della maggior parte delle valli piemontesi dalle Liguri alle Graie o dei rilievi interni: Valli Monregalesi, Valle Ellero e Valle Pesio (Bono, 1961; Barbero *et al.,* 1971) Val Grana (Mondino, 1964), Valle Stura di Demonte (Barbero & Loisel, 1971), Val Pellice (Mondino, 1974-1975), Val di Susa (Abbà, 1973; Montacchini, 1972), Valli di Lanzo (Mondino, 1967; Ariello *et al.,* 1974), Collina di Torino (Mondino & Giordano, 1962). La specie è stata osservata da Ardenghi nell'agosto 2014 anche nell'Appennino alessandrino, nei prati aridi calanchivi di Momperone (SP108, lato E del parcheggio del "Golf & Country Valcurone") e Montacuto (SP114, Mazzacani), sul confine con l'Oltrepò Pavese, dove *F. inops* è stata confermata di recente (Ardenghi *et al.*, 2012). I ritrovamenti recenti attestano per la prima volta o confermano la presenza di questa entità in settori e ambiti differenti del Piemonte e contribuiscono a delinearne il quadro distributivo generale.

N.M.G. Ardenghi, A. Selvaggi, D. Marangoni, A. Compagnoni, A. Prete
629. Festuca rubra L. subsp. **commutata** (Gaudin) Markgr.-Dann. (= *Festuca nigrescens* Lam.) (*Poaceae*)

+ **SET**: Valli di Lanzo, Val d'Ala, comune di Balme (TO), Pian Ciamarella, lungo il torrente, 2110 m, esp. SSW, prateria, 7 luglio 2003. *Leg. et det.* A. Selvaggi, D. Marangoni *sub Festuca ovina* L. *s.l.*, *rev.* N.M.G. Ardenghi (*hb.* IPLA).

+ **SET**:Valle Stura di Demonte, Comune di Argentera (CN), versante alta valle in esp. E tra Le Grange e il Colle della Maddalena, 2280 m, 22 luglio 2003. *Leg.* A. Selvaggi, D. Marangoni, *det.* A. Selvaggi *sub Festuca rubra s.l.*, *rev.* N.M.G. Ardenghi (*hb.* IPLA).

+ **SET**: Valle Orco, comune di Ceresole Reale (TO), pendii a W torbiera presso Alpe Foppa, 2 agosto 2013. *Leg.* A. Selvaggi, *det.* N.M.G. Ardenghi (*hb.* ANP).

+ **SET**: Val di Susa, comune di Exilles (TO), vallone Gran Comba, 2280 m, rodoro-vaccinieti, 22 luglio 2005. *Leg. et det.* A. Compagnoni, A. Prete *sub Festuca violacea* Schleich. ex Gaudin, *rev.* N.M.G. Ardenghi (*hb.* IPLA).

+ **SET**: Val Chisone, comune di Pragelato (TO), Alpeggio Assietta, 13 luglio 2005. *Leg. et det.* A. Compagnoni, A. Prete *sub Festuca rubra s.l.*, *rev.* N.M.G. Ardenghi (*hb.* IPLA).

OSSERVAZIONI. Entità non indicata in Piemonte da Conti *et al.* (2005) ma la cui presenza (*sub Festuca nigrescens* Lam.) era tuttavia segnalata da Pignatti (1982) e Aeschimann *et al.* (2004). La letteratura floristica e fitosociologica piemontese testimonia ampiamente la presenza di questa entità (a cui potrebbe essere ricondotta gran parte delle seguenti combinazioni: *Festuca nigrescens* Lam.; *Festuca rubra* L. var. *commutata* Gaudin; *Festuca rubra* L. subsp. *eu-rubra* Hack. var. *commutata* Gaudin subvar. *eu-commutata* St.-Yves; *Festuca rubra* subsp. *eu-rubra* Hack. var. *commutata* Gaudin subvar. *vulgaris* (Belli) St.-Yves; *Festuca rubra* L. subsp. *eu-rubra* Hack. var. *commutata* Gaudin subvar. *scabra* (Hack.) St.-Yves) in Appennino (Carrega & Silla, 1996; Orsino & Dameri, 1998) e pressochè in tutte le vallate alpine dalle Alpi Liguri all'Ossola (Antonietti, 2005; Ariello & Bellia, 1976; Barbero, 1970; Bono, 1965; Bono & Barbero, 1971; Camoletto Pasin & Dal Vesco, 1986; Mondino, 1964; Montacchini, 1966; Saint-Yves, 1913; Soldano & Sella, 2000). Si conferma in questa nota l'appartenenza di questa entità alla flora del Piemonte e se ne documenta la presenza in cinque vallate alpine con campioni recenti verificati da specialista del genere.

N.M.G. Ardenghi, A. Selvaggi, S. Lonati, A. Soldano
630. Festuca stricta Host subsp. **trachyphylla** (Hack.) Patzke ex Pils (*Poaceae*)

+ **SET**: Valli di Lanzo, Val d'Ala, comune di Balme (TO), Pian della Mussa, rimboschimento di abete rosso, all'interno e sui margini, 1756 m, 18 giugno 2003. *Leg. et det.* A. Selvaggi (*sub Festuca ovina* s.l.), *rev.* N.M.G. Ardenghi (*hb.* IPLA).

+ **SET**: Settori prealpini della Stura di Lanzo, comune di Val della Torre (TO): 1) pressi Borgata Brusa, 440 m, 20 maggio 2009. *Leg et det.* S. Lonati (*sub Festuca valesiaca* Schleich.), *rev.* N.M.G. Ardenghi (*hb.* IPLA); 2) tra Borgata Brusa e Borgata Prà Granero, 442 m, 26 maggio 2009. *Leg et det.* S. Lonati (*sub Festuca valesiaca* Schleich.), *rev.* N.M.G. Ardenghi (*hb.* IPLA).

+ **SET**: Colline delle Langhe: 1) comune di Montezemolo (CN), Sorgenti del Belbo, tra Tetti e Montezemolo, 747 m, praterie xeriche, 25 maggio 2006. *Leg. et det.* A. Selvaggi (*sub Festuca valesiaca s.l.*), *rev.* N.M.G. Ardenghi (*hb.* IPLA); 2) comune di Saliceto (CN), Sorgenti del Belbo, Costa Lorenza, praterie xeriche, 710 m, 19 giugno 2008. *Leg. et det.* A. Selvaggi (*sub Festuca valesiaca s.l.*), *rev.* N.M.G. Ardenghi (*hb.* IPLA).

+ **SET**: Pianura di Vercelli: 1) comune di Quinto Vercellese (VC), margine strada presso il ponte sul Cervo, 140 m, 14 maggio 1981. *Leg.* A. Soldano, *det.* N.M.G. Ardenghi (*hb.* MRSN); 2) comune di Vercelli (VC), sponda destra della Sesia appena a monte del ponte stradale per Novara, 130 m, 21 maggio 1981. *Leg.* A. Soldano, *det.* N.M.G. Ardenghi (*hb.* MRSN).

OSSERVAZIONI. Entità non indicata da Pignatti (1982) e Conti *et al.* (2005) per il Piemonte. E' stata tuttavia segnalata in Piemonte recentemente da Soldano & Sella (2000) per il Biellese (*sub Festuca brevipila* Tracey) e da Lonati & Lonati (2007) per la bassa Valsesia (*sub Festuca trachyphylla* (Hack.) Krajina); storicamente è stata segnalata da Belli (1900) e da Gola (1932-1933) (*sub Festuca ovina* L. var. *duriuscula* (L.) Fiori subvar. *trachyphylla* Hack.) rispettivamente per i dintorni di Lanzo torinese e per la Val Maira, quindi raccolta presso Rivarossa da E. Ferrari nel 1913 (Tosco & Ferraris, 1981). E' stata inoltre segnalata - dubitativamente - da Bouvet & Pivani (1998) sulla base dei dati inediti del 1982 di G.P. Mondino e M. Scotta contenuti nel Piano Naturalistico del Parco della Val Troncea (Val Chisone). Il ritrovamento attesta con certezza la presenza dell'entità nelle Valli di Lanzo, nel settore prealpino compreso tra Valli di Lanzo e Val di Susa, nelle Langhe e conferma la presenza della specie in Piemonte.

buzione regionale e non indicata in Conti *et al.* (2005) per il Piemonte. In Piemonte era stata segnalata precedentemente (*sub Festuca rubra* L. var. *genuina* Hack. subvar. *juncea* Hack.) solo da Belli (1900) “tra Torino e Chieri”, a “Vezzolano (Castelnuovo d’Asti)” e nel Vercellese al “Ghiarolo di Oldenico” quindi da Gola (1932-1933) per la Val Maira, dato probabilmente all’origine della generica indicazione di presenza nella provincia di Cuneo riportata da Aeschimann *et al.* (2004). Le segnalazioni attestano dunque la presenza attuale dell’entità in Piemonte nelle Valli di Lanzo , Val di Susa e Valle Gesso.

N.M.G. Ardenghi, A. Selvaggi, D. Marangoni, M. Scotta, G.P. Mondino, E. Barni, G. Bruno, E. Davi’, A. Gorlier, M. Lonati
612. Festuca trichophylla (Ducros ex Gaudin) K. Richt. subsp. **asperifolia** (St.-Yves) Al-Bermani (*Poaceae*)

+ **PIE**: 1) Valle Chisone, comune di Pragelato (TO), Val Troncea, Bergeria del Mey , 2070 m, pascolo, 8 luglio 1982. *Leg.* M. Scotta, *det.* G.P. Mondino *sub Festuca puccinellii* Parl., *rev.* N.M.G. Ardenghi 2014 (*hb.* IPLA); 2) Valle Stura di Demonte, comune di Argentera (CN), area subpianeggiante sopra il versante NE del Lago della Maddalena, 2055 m, 22 luglio 2003. *Leg.* A. Selvaggi, D. Marangoni, *det.* A. Selvaggi *sub Festuca rubra*, *rev.* N.M.G. Ardenghi 2014 (*hb.* IPLA); Val di Susa: 3) comune di Bussoleno (TO), località Argiassera, xerobrometo su terrazzamenti abbandonati, 598 m, 8 maggio 2014. *Leg.* E. Barni, G. Bruno, E. Davi’, A. Gorlier, M. Lonati, *det.* N.M.G. Ardenghi (*hb.* TO); 4) comune di Bussoleno (TO), località Meisonette,stipeto, 643 m,,12 maggio 2014. *Leg.* E. Barni, G. Bruno, E. Davi’, A. Gorlier, M. Lonati, *det.* N.M.G. Ardenghi (*hb.* TO); 5) comune di Mompantero (TO), località sentiero dei monaci, xerobrometo su terrazzamenti abbandonati, 943 m, 19 maggio 2014. *Leg.* E. Barni, G. Bruno, E. Davi’, A. Gorlier, M. Lonati, *det.* N.M.G. Ardenghi (*hb.* TO); 6), comune di Mompantero (TO), località Ponte Muet, xerobrometo su terrazzamenti abbandonati,1020 m,19 maggio 2014. *Leg.* E. Barni, G. Bruno, E. Davi’, A. Gorlier, M. Lonati, *det.* N.M.G. Ardenghi (*hb.* TO).

OSSERVAZIONI. La presenza in Piemonte di *Festuca trichophylla* (Ducros ex Gaudin) K. Richt. è stata segnalata per la prima volta da Abbà (1985) per la Val Casotto (Val Tanaro) quindi da Soldano & Sella (2000) per le brughiere biellesi, senza tuttavia indicazioni relative alla sottospecie. Pistarino *et al.* (1999) riportano inoltre la presenza di campioni in *hb.* TO-HP, revisionati da Belli, relativi a Val Maira e Val di Susa. Le raccolte oggetto di nota attestano per la prima volta la presenza della subsp. *asperifolia* in Piemonte nelle Alpi Marittime (Valle Stura di Demonte) e Cozie (Val Chisone, Val di Susa).

M. Pascale
613. Viscum album L. subsp. **abietis** (Wiesb.) Janch. (*Santalaceae*)

+ **PIE**: 1) Valle Stura di Demonte, comune di Vinadio (CN): 1) sopra la borgata Goletta nel vallone Palla, silice, su *Abies alba* Miller, 1220 m, esp. N, 15 dicembre in passato (Silvestri, 1973; Peccenini Gardini *et al.,* 1986) tanto da essere considerata comune (Antonietti, 2005).

N.M.G. Ardenghi, G. Parolo, G. Rossi, A. Selvaggi, A. Compagnoni, A. Prete, G.V. Cerutti, A. Soldano, G. Fonio

610. Festuca intercedens (Hack.) Lüdi ex Bech. (*Poaceae*)

+ **PIE**: 1) Valli di Lanzo, Val d'Ala, comune di Balme (TO), Costa Gurin, lato orientale, 2270 m, rupi silicee, 22 luglio 2004. *Leg. et det.* A. Selvaggi *sub Festuca halleri* All., *rev.* N.M.G. Ardenghi (*hb.* IPLA); 2) Val Chisone, comune di Pragelato (TO), M. Blegier, 9 agosto 2005. *Leg.* A. Compagnoni, A. Prete *sub Festuca halleri* All., *rev.* N.M.G. Ardenghi 2015 (*hb.* IPLA); 3) Valsesia, comune di Rassa (VC), a SE del L. Scarpia, 2320 m, 20 luglio 2005. *Leg.* G.V. Cerutti, *det.* G. Parolo, G. Rossi (*hb.* MRSN); 4) Valli Ossolane, Valle Antrona, comune di Montescheno (VB), versante S di Passo Ogaggia, 1840 m, 10 giugno 2000. *Leg.* A. Soldano, G. Fonio, *det.* G. Parolo, G. Rossi (*hb.* MRSN).

OSSERVAZIONI. Entità non segnalata per la nostra regione da Pignatti (1982), Aeschimann *et al.* (2004), Conti *et al.* (2005); in Piemonte è stata indicata da Antonietti (2005) come entità rara presente in Ossola sulla base di Rieder *et al.* (1985), il cui dato è stato acquisito durante una escursione condotta dagli Autori in Val Formazza. La specie è stata recentemente rinvenuta in Valle d'Aosta (Bovio, 2014). Si attesta qui la presenza di questa specie nella nostra regione documentando quattro stazioni accertate da revisione specialistica.

N.M.G. Ardenghi, A. Selvaggi, M. Pascale, D. Marangoni, A. Compagnoni, A Prete

611. Festuca rubra L. subsp. **juncea** (Hack.) K. Richt. (*Poaceae*)

+ **PIE**: 1) Valli di Lanzo, Val d'Ala, comune di Balme (TO), Pian della Mussa, greto fluviale ciottoloso presso l'Alpe Rocca Venoni, 1860 m, 9 luglio 2003. *Leg et det.* A. Selvaggi, D. Marangoni *sub Festuca rubra s.l.*, *rev.* N.M.G. Ardenghi 2014 ; 2) Valli di Lanzo, Val d'Ala, comune di Balme (TO), Pian della Mussa, pendio sul lato Est del Rif. Città di Ciriè, 1833 m, arbusteti subalpini, 7 luglio 2003. *Leg et det.* A. Selvaggi, D. Marangoni *sub Festuca rubra s.l.*, *rev.* N.M.G. Ardenghi 2014; 3) Val di Susa, comune di Sauze d'Oulx (TO), Lago delle Launa, prateria subalpina, 2085 m, 16 luglio 2005. *Leg. et det.* A. Compagnoni, A. Prete *sub Festuca ovina* s.l., *rev.* N.M.G. Ardenghi (*hb.* IPLA); 4) Valle Gesso, comune di Valdieri (CN), fraz. S. Anna, vallone Meris tra i due laghi Sella, pascolo, silice, 2095 m, esposiz. SE 26 luglio 2010. *Leg.* M. Pascale, *det.* M. Pascale *sub Festuca rubra* L. subsp. *rubra*, rev. N.M.G. Ardenghi 2014 (*hb.* Pascale); 5) Valle Gesso, comune di Entracque (CN), fraz. S. Giacomo, vallone di Monte Colombo salendo al Rif. Moncalieri, pascolo, silice, 1970 m, esp. E, 13 luglio 2010. *Leg.* M. Pascale, *det.* M. Pascale *sub Festuca rubra* L. subsp. *rubra*, *rev.* N.M.G. Ardenghi 2014 (*hb.* Pascale).

OSSERVAZIONI. Entità riportata in Pignatti (1982) senza indicazioni di distribuzione regionale e non indicata in Conti *et al.* (2005) per il Piemonte. In Piemonte era stata segnalata precedentemente (*sub Festuca rubra* L. var. *genuina* Hack. subvar. *juncea* Hack.) solo da Belli (1900) "tra Torino e Chieri", a "Vezzolano (Castelnuovo d'Asti)" e nel Vercellese al "Ghiarolo di Oldenico" quindi da Gola (1932-1933) per la Val Maira, dato probabilmente all'origine della generica indicazione di presenza nella provincia di Cuneo riportata da Aeschimann *et al.* (2004). Le segnalazioni attestano dunque la presenza attuale dell'entità in Piemonte nelle Valli di Lanzo , Val di Susa e Valle Gesso.

N.M.G. Ardenghi, A. Selvaggi, D. Marangoni, M. Scotta, G.P. Mondino, E. Barni, G. Bruno, E. Davi', A. Gorlier, M. Lonati
612. Festuca trichophylla (Ducros ex Gaudin) K. Richt. subsp. **asperifolia** (St.-Yves) Al-Bermani (*Poaceae*)

+ **PIE**: 1) Valle Chisone, comune di Pragelato (TO), Val Troncea, Bergeria del Mey , 2070 m, pascolo, 8 luglio 1982. *Leg.* M. Scotta, *det.* G.P. Mondino *sub Festuca puccinellii* Parl., *rev.* N.M.G. Ardenghi 2014 (*hb.* IPLA); 2) Valle Stura di Demonte, comune di Argentera (CN), area subpianeggiante sopra il versante NE del Lago della Maddalena, 2055 m, 22 luglio 2003. *Leg.* A. Selvaggi, D. Marangoni, *det.* A. Selvaggi *sub Festuca rubra*, *rev.* N.M.G. Ardenghi 2014 (*hb.* IPLA); Val di Susa: 3) comune di Bussoleno (TO), località Argiassera, xerobrometo su terrazzamenti abbandonati, 598 m, 8 maggio 2014. *Leg.* E. Barni, G. Bruno, E. Davi', A. Gorlier, M. Lonati, *det.* N.M.G. Ardenghi (*hb.* TO); 4) comune di Bussoleno (TO), località Meisonette,stipeto, 643 m,,12 maggio 2014. *Leg.* E. Barni, G. Bruno, E. Davi', A. Gorlier, M. Lonati, *det.* N.M.G. Ardenghi (*hb.* TO); 5) comune di Mompantero (TO), località sentiero dei monaci, xerobrometo su terrazzamenti abbandonati, 943 m, 19 maggio 2014. *Leg.* E. Barni, G. Bruno, E. Davi', A. Gorlier, M. Lonati, *det.* N.M.G. Ardenghi (*hb.* TO); 6), comune di Mompantero (TO), località Ponte Muet, xerobrometo su terrazzamenti abbandonati,1020 m,19 maggio 2014. *Leg.* E. Barni, G. Bruno, E. Davi', A. Gorlier, M. Lonati, *det.* N.M.G. Ardenghi (*hb.* TO).

OSSERVAZIONI. La presenza in Piemonte di *Festuca trichophylla* (Ducros ex Gaudin) K. Richt. è stata segnalata per la prima volta da Abbà (1985) per la Val Casotto (Val Tanaro) quindi da Soldano & Sella (2000) per le brughiere biellesi, senza tuttavia indicazioni relative alla sottospecie. Pistarino *et al.* (1999) riportano inoltre la presenza di campioni in *hb.* TO-HP, revisionati da Belli, relativi a Val Maira e Val di Susa. Le raccolte oggetto di nota attestano per la prima volta la presenza della subsp. *asperifolia* in Piemonte nelle Alpi Marittime (Valle Stura di Demonte) e Cozie (Val Chisone, Val di Susa).

M. Pascale
613. Viscum album L. subsp. **abietis** (Wiesb.) Janch. (*Santalaceae*)

+ **PIE**: 1) Valle Stura di Demonte, comune di Vinadio (CN): 1) sopra la borgata Goletta nel vallone Palla, silice, su *Abies alba* Miller, 1220 m, esp. N, 15 dicembre

N.M.G. Ardenghi, A. Selvaggi, A. Soldano, B. Gallino, I. Pace, R. Pascal, B. Foggi, D. Bouvet, N. Viñals, M. Pascale

628. Festuca inops De Not. (= *Festuca gracilior* (Hack.) Markgr. - Dann.) (*Poaceae*)

+ **SET**: Valle Vermenagna: 1) comune di Limone Piemonte (CN), fraz. S. Maurizio, sotto sacrario alpini, arbusteti xerofili a bosso, 915 m, esp. ESE, 16 luglio 2014. *Leg.* A. Selvaggi, I. Pace, *det*. N.M.G. Ardenghi (*hb.* ANP); 2) comune di Limone Piemonte (CN), Costa Murin, arbusteti xerofili a bosso, 1180 m, esp. SW, 26 giugno 2014. *Leg.* A. Selvaggi, I. Pace, *det*. N.M.G. Ardenghi (*hb.* ANP);

+ **SET**: Valle Stura di Demonte, comune di Argentera (CN): 1) sopra Grange lungo i tornanti salendo al Colle della Maddalena, 1790 m, esp. SSE, 7 luglio 2004. *Leg.* R. Pascal, A. Selvaggi, B. Foggi, *det.* B. Foggi (*hb.* Pascal e *hb.* Selvaggi) 2) rocce sotto Pra di Bals, 2100 m, esp. S, 11 luglio 2004. *Obs*. B. Gallino, I. Pace; 3) pendici in prossimità di La Tinetta, 1918 m, esp. SW, 10 luglio 2004. *Obs*. B. Gallino, I. Pace; 4) comune di Sambuco (CN), presso la fraz. Moriglione, prato sassoso arido, silice, 1420 m, esp. S, 18 giugno 2000. *Leg.* M. Pascale, *det.* N.M.G. Ardenghi (*hb.* TO);

+ **RAR**: Valle Tanaro, comune di Garessio (CN): 1) Rocca d'Orse, pendii rocciosi sopra la ferrovia tra Isola Perosa e Trappa, arbusteti xerofili a bosso, 660 m, esp. ESE, 25 luglio 2014. *Leg.* A. Selvaggi, *det*. N.M.G. Ardenghi (*hb.* ANP); 2) Trappa, sentiero tra Rio Parone e Rio delle Gaddane, 750 m, 25 luglio 2104. *Leg.* A. Selvaggi, I. Pace, *det*. N.M.G. Ardenghi (*hb.* ANP); 3) comune di Ormea (CN), vallone del rio delle Caranche, 900 m, esp. S, 3 settembre 2014. *Leg.* A. Selvaggi, *det.* N.M.G. Ardenghi (*hb.* ANP);

+ **RAR**: Valle di Susa, comune di Avigliana (TO), Borgata Sada, via Sada, cava di serpentinite abbandonata, 360 m ca., 20 giugno 2013. *Leg.* A. Soldano, D. Bouvet, N. Viñals, *det.* N.M.G. Ardenghi (*hb.* TO).

OSSERVAZIONI. *Festuca inops* De Not. è una specie di cui si è dimostrata recentemente (Foggi *et al.,* 2006) la coincidenza con *Festuca gracilior* (Hack.) Markgr.-Dann., sulla quale ha priorità nomenclaturale; è specie xerofila il cui areale distributivo va dall'Italia centrale fino alla val d'Aosta (Foggi *et al.*, 2006; Bovio, 2014). Entrambe le entità non furono considerate come appartenenti alla flora pedemontana da Pignatti (1982), viceversa, *sub F. gracilior,* Aeschimann *et al.* (2004) e Conti *et al.* (2005) ne indicarono la presenza rispettivamente nella provincia di Cuneo e in Piemonte. In base a Foggi *et al.* (2006) sono da ricondursi a *F. inops* le recenti segnalazioni piemontesi *sub F. gracilior* (Hack.) Markgr.-Dann. dell'Appennino piemontese (Carrega & Silla, 1996; Pistarino *et al.,* 1999) e delle Alpi Liguri monregalesi (Abbà, 1985) quindi i dati storici bibliografici (Belli, 1900; Saint-Yves, 1913; Gola, 1932-1933) (*sub F. ovina* L. var. *duriuscula* (L.) Fiori subvar. *gracilior* Hack.*; Festuca ovina* L. subsp. *eu-ovina* Hack. var. *duriuscula* Hack. subvar. *gracilior* (Hack.) St.-Yves) relativi a: Val Tanaro, Valli Monregalesi, Val Maira, Val Varaita, Val Chisone, Valle di Susa, Valli di Lanzo. Sono molto probabilmente da ricondurre a *F. inops* anche buona parte delle numerose segnalazioni *sub* "*Festuca glauca*" e altre combinazioni (la "vera" *F. glauca* Vill. è un'entità presente esclusivamente sui Pirenei orientali e in Svizzera; si vedano Portal, 1999, e Devesa *et al.*, 2013) relative ai settori più xerici della maggior parte delle valli piemontesi dalle Liguri alle Graie o dei rilievi interni: Valli Monregalesi, Valle Ellero e Valle Pesio (Bono, 1961; Barbero *et al.,* 1971) Val Grana (Mondino, 1964), Valle Stura di Demonte (Barbero & Loisel, 1971), Val Pellice (Mondino, 1974-1975), Val di Susa (Abbà, 1973; Montacchini, 1972), Valli di Lanzo (Mondino, 1967; Ariello *et al.,* 1974), Collina di Torino (Mondino & Giordano, 1962). La specie è stata osservata da Ardenghi nell'agosto 2014 anche nell'Appennino alessandrino, nei prati aridi calanchivi di Momperone (SP108, lato E del parcheggio del "Golf & Country Valcurone") e Montacuto (SP114, Mazzacani), sul confine con l'Oltrepò Pavese, dove *F. inops* è stata confermata di recente (Ardenghi *et al.*, 2012). I ritrovamenti recenti attestano per la prima volta o confermano la presenza di questa entità in settori e ambiti differenti del Piemonte e contribuiscono a delinearne il quadro distributivo generale.

N.M.G. Ardenghi, A. Selvaggi, D. Marangoni, A. Compagnoni, A. Prete
629. Festuca rubra L. subsp. **commutata** (Gaudin) Markgr.-Dann. (= *Festuca nigrescens* Lam.) (*Poaceae*)

+ **SET**: Valli di Lanzo, Val d'Ala, comune di Balme (TO), Pian Ciamarella, lungo il torrente, 2110 m, esp. SSW, prateria, 7 luglio 2003. *Leg. et det.* A. Selvaggi, D. Marangoni *sub Festuca ovina* L. *s.l.*, *rev.* N.M.G. Ardenghi (*hb.* IPLA).

+ **SET**:Valle Stura di Demonte, Comune di Argentera (CN), versante alta valle in esp. E tra Le Grange e il Colle della Maddalena, 2280 m, 22 luglio 2003. *Leg.* A. Selvaggi, D. Marangoni, *det.* A. Selvaggi *sub Festuca rubra s.l.*, *rev.* N.M.G. Ardenghi (*hb.* IPLA).

+ **SET**: Valle Orco, comune di Ceresole Reale (TO), pendii a W torbiera presso Alpe Foppa, 2 agosto 2013. *Leg.* A. Selvaggi, *det.* N.M.G. Ardenghi (*hb.* ANP).

+ **SET**: Val di Susa, comune di Exilles (TO), vallone Gran Comba, 2280 m, rodoro-vaccinieti, 22 luglio 2005. *Leg. et det.* A. Compagnoni, A. Prete *sub Festuca violacea* Schleich. ex Gaudin, *rev.* N.M.G. Ardenghi (*hb.* IPLA).

+ **SET**: Val Chisone, comune di Pragelato (TO), Alpeggio Assietta, 13 luglio 2005. *Leg. et det.* A. Compagnoni, A. Prete *sub Festuca rubra s.l.*, *rev.* N.M.G. Ardenghi (*hb.* IPLA).

OSSERVAZIONI. Entità non indicata in Piemonte da Conti *et al.* (2005) ma la cui presenza (*sub Festuca nigrescens* Lam.) era tuttavia segnalata da Pignatti (1982) e Aeschimann *et al.* (2004). La letteratura floristica e fitosociologica piemontese testimonia ampiamente la presenza di questa entità (a cui potrebbe essere ricondotta gran parte delle seguenti combinazioni: *Festuca nigrescens* Lam.; *Festuca rubra* L. var. *commutata* Gaudin; *Festuca rubra* L. subsp. *eu-rubra* Hack. var. *commutata* Gaudin subvar. *eu-commutata* St.-Yves; *Festuca rubra* subsp. *eu-rubra* Hack. var. *commutata* Gaudin subvar. *vulgaris* (Belli) St.-Yves; *Festuca rubra* L. subsp. *eu-rubra* Hack. var. *commutata* Gaudin subvar. *scabra* (Hack.) St.-Yves) in Appen-

15-19. gen. **FESTUCA** L. *sensu lato*[1]

La presente trattazione delle festuche (che oggi vengono distribuite tra 4 generi) non è un mero aggiornamento del testo del 1982 (comunque curato dalla specialista I. Markgraf-Dannenberg), ma una revisione originale di tutto il gruppo, ricca di novità ed approfondimenti. Le specie vengono trattate in stile monografico, differente da quanto è usuale in questa seconda edizione, tuttavia è chiaro che, se i testi venissero uniformati al resto, si avrebbe una ingente perdita di informazione, quindi abbiamo preferito mantenere questo stile più ampio e dettagliato, nella convinzione che esso sia un contributo essenziale per avvicinarsi alla conoscenza di questo difficile gruppo. La bibliografia e i codici eptanumerici vengono riportati alla fine del gruppo (dopo il gen. **19**).

Introduzione

Il genere *Festuca* s.l. è il più ampio fra le *Poaceae* ed è comunemente considerato un genere “difficile”, la trattazione che segue deve quindi essere considerata non esaustiva ma solo un tentativo di approssimazione anche perchè molte aree del territorio italiano risultano ancora inesplorate sotto il profilo floristico (Scoppola & Blasi, 2005). Quindi lo scopo di questa presentazione è anche quello di stimolare la ricerca su un genere così complesso ma che rappresenta la maggior parte della biomassa in varie formazioni prative.

Negli ultimi anni le ricerche sul genere *Festuca* s.l. si sono moltiplicate fornendo una base interpretativa dell’evoluzione del genere (Torrecilla & al., 2003; Catalán & al., 2004; Catalán, 2007; Smarda & al., 2007) per citare solo qualche esempio riguardante la parte europea. Da queste ricerche si evince la presenza di un gruppo di specie “a foglie larghe” ed un gruppo a “foglie fini”. Nel primo sono raggruppati i generi *Schedonorus*, *Leucopoa* (in massima parte), *Drymochloa* e le sect. *Subbulbosae* e *Lojaconoa*. Al secondo appartengono le specie del genere *Festuca* s.s. ed una parte del genere *Leucopoa* (*L. dimorpha*). Al primo gruppo appartiene anche il genere *Lolium* e questo sembra giustificare la riunione del genere *Schedonorus* a *Lolium*, strada che al momento abbiamo preferito non seguire prima di tutto per la mancanza di alcune combinazioni nomenclaturali in *Lolium* riguardanti taxa della flora italiana, poi per non far perdere, ai fini pratici di questa Flora, l’accezione corrente di *Lolium* ormai assimilata dalla grande maggioranza dei floristi, il quale si differenzia chiaramente dalle altre graminacee. Il genere *Leucopoa,* nonostante risulti diviso in due cladi ben separati, è qui adottato provvisoriamente in attesa che ne venga formalizzata l’attribuzione a due generi distinti. Il genere *Drymochloa* da una parte e il genere *Festuca* dall’altra risultano invece ben consolidati.

In ogni caso il genere *Festuca* considerato in toto risulta eterogeneo; per il rango al quale interpretare tale eterogeneità abbiamo scelto quello che è stato seguito nel progetto Euro+Med. (Foggi al., 2005).

Il genere *Drymochloa* risulta quello che, fra le festuche a foglie larghe, presenta caratteri di maggiore primitività; fra questi un genoma monoploide molto ampio (Smarda & al., 2007 sub. subgen. *Drymanthele*) e l’habitat boschivo. L’evoluzione delle “festuche a foglia larga” per allopoliploidia è stata dimostrata da Pasakinskiene & al. (1998) per i poliploidi appartenenti al genere *Schedonorus*, con decremento della grandezza del genoma.

All’interno del genere *Festuca* la posizione basale della sect. *Eskia* risulta evidente nei lavori sopra citati e i caratteri morfologici confermano questa situazione. Le sect. *Aulaxyper* (coincidente con le festuche a innovazioni extravaginali o miste) e *Festuca* (intravaginali) raggruppano le specie con corredi genetici monoploidi di piccole dimensioni e caratteri in genere derivati, l’habitat è secondario in quasi tutti i casi. All'interno di queste ultime due sezioni la prima comprende molte specie ad alti livelli di ploidia (soprattutto ottoploidi), mentre nella sezione *Festuca* vi sono ben rappresentati sia diploidi che decaploidi. Questi ultimi sono legati a substrati silicei ultramafici e non della Toscana.

Infine, dal punto di vista filogenetico la posizione dei generi *Vulpia, Ctenopsis, Micropyrum* e *Psilurus* è stata definitivamente dimostrata interna a *Festuca* s.s.; per ciascuno di essi può essere riconosciuta una sezione all’interno di *Festuca*. La sinonimizzazione di questi generi con *Festuca*, nome prioritario, è proposta da Soreng et al. (2015, lav. cit.) e viene adottata nella presente Flora, come pure nella nuova edizione della Checklist delle piante vascolari italiane (Conti et al., in prep.).

Morfologia

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[1] Revisione monografica dei gen. 15-19 (tranne le sp. 58-71) a cura di Bruno Foggi, Graziano Rossi, N. Ardenghi e Gilberto Parolo.

Portamento

Le festuche sono piante perenni e il loro modo di conquistare lo spazio dipende dal modo di propagarsi: *F. rubra* può emettere rizomi che possono allungarsi fino a decine di metri, ma anche specie della sect. *Festuca* possono formare cespi larghi qualche metro. Sono state calcolate le età di alcune piante: fino a 400 anni per un individuo di *F. rubra* con getti dello stesso rizoma distanti fino a 200 m; *F. ovina* (s.l.) fino a 1000 anni con cespi di 8 metri di diametro.

Il portamento dipende in larga parte dal modo di conquistare lo spazio ed accrescersi in biomassa di ciascuna specie. Due principali tipologie possono essere riconosciute:

1) cespitoso: le specie cespitose sono costituite da cespi ± densi, l'emissione dei nuovi getti avviene a partire dall'interno delle vecchie guaine, per cui l'individuo si allarga di poco;

2) rizomatoso: le specie rizomatose sono costituite da getti separati da fusti sotterranei più o meno lunghi, l'individuo si estende anche su grandi superfici ma lasciando spazi fra un getto e l'altro. In realtà le specie rizomatose possono avere rizomi molto brevi per cui simulano nel portamento le specie cespitose. In alcuni casi si determinano allungamenti dei culmi che formano una sorta di ramificazioni, tali situazioni possono essere definiti degli pseudostoloni. Questa situazione si trova in molte specie dei substrati mobili.

Innovazioni

Il portamento dipende in maniera determinante dal modello di accrescimento vegetativo. Due sono le tipologie principali:

1) innovazioni intravaginali: l'emissione di nuovi getti vegetativi avviene dall'interno delle guaine fogliari;

2) innovazioni extravaginali: l'innovazione dei getti nuovi avviene attraverso la fuoriuscita di getti sterili da un lato della guaina che viene perforata.

I due tipi di accrescimento determinano i modelli di portamento: le piante rizomatose avranno solo innovazioni extravaginali; le piante cespitose potranno avere innovazioni intravaginali oppure miste ma quelle extravaginali formeranno rizomi molto corti. La terza soluzione sono innovazioni miste, in parte intra ed in parte extravaginali, in questo caso il portamento sarà in genere cespitoso, più o meno lasso in funzione della lunghezza dei rizomi.

Guaine

Le guaine rappresentano la parte basale della foglia che in genere si allarga e avvolge i nuovi getti. Talvolta le parti opposte della foglia si chiudono e si fondono a formare un tubo. Talvolta rimangono insaldate, oppure saldate su una parte della loro lunghezza. La differenza fra le specie con guaine a tubo e guaine aperte è netta, mentre risulta difficile stabilire i livelli di fusione intermedia. In accordo con Stace (1997) e Chicouenne (1999) il livello di fusione della guaina spesso usato in molte chiavi (Pignatti, 1982; Markgraf-Dannemberg, 1980) è difficile da valutare e non verrà usato, salvo casi eccezionali. Ben utile è la valutazione della pelosità delle guaine, del tipo di pelosità; risulta inoltre importante osservare come le guaine si sfibrano, se la guaina rimane intera e forma un manicotto, se le guaine sono allungate o brevi, se sono rossastre, grigiastre, papiracee, ecc.

Ligule e stipole

La ligula è una membrana, talvolta ridotta a una stria di peli, posta all'apice della guaina. Talvolta la ligula si espande in due orecchiette, o stipole. Forma, lunghezza, pelosità delle ligule e delle orecchiette rappresentano caratteri molto importante, specialmente all'interno del genere *Schedonorus* e della sect. *Eskia*.

Lamina fogliare

Le maggiori differenze risultano fra le festuche a lamina piana e le festuche a lamina revoluta. Il colore è molto importante: le festuche del gr. "*violacea*" presentano un colore verde brillante, quelle del gr. "*rubra*" meno; alcune sono glaucescenti per la presenza di antociani nelle cellule epidermiche; la glaucescenza non deve essere confusa con la presenza di pruina, che è un rivestimento ceroso che va dal bluastro al biancastro e che può essere tolta grattando la superficie. Le foglie presentano un rivestimento di cere di varie tipologie che non sembra, almeno al momento, rivestire alcuna importanza sistematica. La lamina fogliare può essere scabra per la presenza di aculei più o meno lunghi e dispersi su tutta o parte della lunghezza. Il controllo della scabrescenza deve essere fatto passando fra le dita la parte laminare esterna (adassiale) della foglia, dall'apice verso la base, in quanto, in genere la superficie interna (abassiale) è quasi sempre scabra. Talvolta anche l'apice della foglia può essere considerato come carattere discriminante, soprattutto all'interno della sect. *Festuca*. Il colore delle foglie, soprattutto dovuto alla pruina e la scabrosità possono variare in condizioni di coltivazione standardizzata, è quindi buona pratica coltivare le piante per verificare il mantenimento di questi caratteri. Alcuni caratteri anatomici possono essere osservati, in campagna, anche con una sola semplice lente contafili. Per esempio se la lamina è piatta oppure ovale o spigolosa; si possono inoltre osservare se ci sono bande più chiare che corrispondono ai rinforzi sclerenchimatici.

Sezione della lamina

I caratteri derivati dall'osservazione della lamina in sezione trasversale sono stati introdotti da Hackel (1882) e rappresentano ancora uno dei fondamenti della sistematica di questo genere. Bisogna comunque sfatare un "mito": la sezione fogliare è un carattere come gli altri e come gli altri soggetto a variazione da un individuo all'altro, anche all'interno della stessa popolazione e talvolta anche in coltivazione. Comunque, il modello di riferimento tende a rimanere costante; in tal senso, è bene sottolineare che Hackel ha posto le basi per la standardizzazione delle osservazioni: la sezione fogliare deve essere eseguita su una foglia ben sviluppata, presa da un getto sterile (lamina di innovazione), al momento della fioritura; il taglio deve essere fatto alla metà della lunghezza della lamina (dalla ligula alla punta). Il miglior metodo è porre la lamina su un vetrino, posizionarlo sotto un binoculare e tagliare con una lametta posta perpendicolare alla lamina. Il taglio deve essere il più sottile possibile, per poter essere osservato al microscopio a trasmissione. Si effettuano varie sezioni, poi si aggiunge una goccia d'acqua e si mette il copriogetto. Per i campioni molto vecchi si può ricorrere ad una goccia d'aqua tiepida per ammorbidire il materiale. Le migliori lamette sono le "Gillette platinum plus" ormai difficilmente reperibili; si dividono a metà e si conservano nella confezione. Una lametta può durare per una cinquantina di sezioni poi si deteriora l'affilatura e tende a sfilacciare la lamina. Se le sezioni vengono fatte su piante ricche di sclerenchima la durata della lametta è minore. Da una sezione fogliare si possono trarre molti caratteri. In genere quasi tutti i caratteri si possono osservare a 100 x, ma in alcuni casi si deve ricorrere ad un ingrandimento di 200 x (vedi chiavi e/o descrizioni). Ulteriori informazioni su come descrivere una sezione fogliare possono essere ricercate in Ellis (1978).

Culmo

Il culmo delle festuche è in genere diritto, spesso liscio ma talvolta presenta delle scanalature più o meno profonde. Talvolta è scabro, almeno nella parte superiore, sotto la pannocchia. Talvolta è utile osservare la presenza di nodi e la loro posizione.

Foglia culmare

Talvolta può essere utile notare se la foglia culmare è del tipo di quelle basali oppure diversa.

Infiorescenza

L'infiorescenza tipica del genere *Festuca* s.l. e dei generi affini, è una pannocchia, cioè una infiorescenza di infiorescenze. La pannocchia può essere ampia, contratta, unilaterale, più o meno interrotta, formata da poche o molte spighette. I rami della pannocchia possono essere lunghi o corti (spighette ± lungamente peduncolate). In genere i rami sono scabri (carattere tipico del genere) ma la quanità di aculei per mm può variare ed essere un carattere utile. Talvolta i rami della pannocchia sono pelosi.

Spighetta

L'unità di base della pannocchia è la spighetta. La spighetta si riconosce perché alla sua base sono presenti due brattee sterili: le glume. Una gluma inferiore G1, corta ed uninervata, ed una gluma superiore G2 più lunga e trinervata. Talvolta tendono a diventare diseguali, comunque mai profondamente diseguali e generalmente la G2 solo raramente può superare il doppio della G1.

Hackel (1882) presenta una serie di standardizzazioni per il confronto delle misure eseguite sulle parti fiorali. La lunghezza della spighetta deve essere misurata all'apice del 4° lemma, esclusa la resta. Se la spighetta ha tre fiori alla misura del 3° lemma si aggiunge la differenza fra il 2° e il 3° lemma. Nel caso di spighette con due fiori si aggiunge la differenza fra il 1° e il 2° lemma. Il numero dei fiori esclude l'ultimo, apicale, generalmente sterile.

Il fiore delle graminacee è fortemente semplificato. I pezzi fiorali sono ridotti ad un lemma, una palea e due lodicule.

Lemma: si misura il secondo lemma, esclusa la resta; è utile osservare la presenza di peli, come sono disposti, se sono presenti dei bordi ialini e quanto sono larghi, se sono presenti strie colorate di violetto, presenza di ciglia marginali, forma del lemma: lanceolato, lineare, ovato-lanceolato, ecc.

Resta: è la resta del secondo lemma.

Palea: è quella del secondo fiore; è utile osservare la lunghezza, la presenza di ciglia sulle chiglie, e su quanta parte del margine sono distribuite.

Lodicule: sono il residuo del perianzio che si è fortemente ridotto a due piccole escrescenze membranose poste alla base della paleola; in genere non si riescono mai ad osservare bene per cui non vengono quasi mai prese in considerazione.

Antere: la lunghezza delle antere sembra un buon carattere, ed in genere viene quasi sempre fornito nelle descrizioni; le misure delle antere vanno fatte quando le antere sono fuori dal fiore.

Ovario: l'ovario nel suo sviluppo si salda, per una parte più o meno estesa alla palea. Questo carattere è stato usato per costruire gruppi, in realtà è di difficile osservazione e varia durante la maturità quindi non sempre risulta attendibile.
Cariosside: è il pericarpio derivante dall'ovario uniovulare proprio delle Poaceae, che contiene il seme, elemento fondamentale della dispersione ; le sue caratteristiche morfologiche possono essere utili a livello di sottogenere o sezione.

Per un buon lavoro occorre disporre di molto materiale nel pieno della fioritura, proveniente da più stazioni e possibilmente in condizioni ecologiche diverse per valutare in modo esauriente la variabilità dei caratteri morfologici e anatomici.
Per la determinazione consigliamo di consultare anche le monografie francesi (Kerguélen & Plonka, 1989; Portal 1999), Conert (1994-1996) per l'Europa Centrale e De La Fuente & Ortuñez (1998) sulla sect. *Festuca* nella Penisola Iberica.
Per quanto riguarda la situazione italiana, possiamo dire che molto lavoro è stato fatto, ma come era scritto nella precedente edizione "per chiarire i rapporti tassonomici e le distribuzioni geografiche resta ancora molto da fare". Il gruppo "*violacea*" e la sect. *Eskia* sono stati approfonditamente trattati (Foggi & al., 1999; Foggi & al., 2007b); i generi Leucopoa e Drymochloa sono stati trattati da Foggi et al. (2010); altre informazioni possono essere trovate consultando il sito www.unipv.it/labecove/festuche/home.htm, dove è riportata l'intera bibliografia degli ultimi 15 anni riguardante il genere *Festuca* s.l. in Italia e dove potranno essere visionati i contributi monografici che verranno via via pubblicati sui vari gruppi di questo difficile genere (Foggi & al., 2007a).

15. **DRYMOCHLOA** Holub, Folia Geobot. Phytotax. (Praha) 19: 95 (1984)

1. D. drymeja (Mert. et W.D.J.Koch) Holub, Folia Geobot. Phytotax., 19: 99 (1984) subsp. **exaltata** (C. Presl) Foggi et Signorini, Willdenowia 35: 242 (2005) - ●

Sinonimi

F. exaltata C. Presl, Fl. Sic. 1: 45 (1826)
F. montana subvar. *exaltata* (C. Presl) Hack., Bot. Centralbl. 8: 408 (1881)
F. montana subsp. *exaltata* (C. Presl) K. Richt., Pl. Eur. 1: 106 (1890)
F. drymeja subvar. *exaltata* (C. Presl) Litard., Candollea 10: 17 (1945)
Schoedonorus exaltatus (C. Presl) Schultes, Mantissa 3: 644 (1817)

Pianta alta 70-110 (150) cm, con rizomi avvolti da foglie squamiformi lunghe fino a 4-5 cm. Culmo eretto, 3 nodi, liscio. Innovazioni extravaginali. Ligula 2-3 mm. Lamina fogliare 20-80 cm, piana, eretta, liscia, verde brillante. Sezione fogliare 12-21 mm, lineare, con numerosi fascetti vascolari, numerose coste appena pronunciate, solco intercostale assente, sclerenchima in pilastri, tricomi assenti. Pannocchia 10-30 cm, oblunga, lassa, inclinata da un lato. Spighette 7-8 mm, 4-6 fiori, verde chiaro. G1 3-3.5 mm, largamente lanceolata, con evidente margine scarioso. G2 largamente lanceolata, con evidente margine scarioso 3.5-4 mm. Lemma 4-5.5 mm, glabro, con ampio margine scarioso, apice molto acuto, finemente rugoso, carenato, con resta nulla. Antere 3 mm.

Boschi di forra con carpino nero, faggete, querceti. - Abr., Molise, It. Merid. dagli Astroni e Ischia (Napoli), all'Aspromonte, Sic.: R. (500 - 1500 m). - Faggete eutrofiche, nelle vallate a clima suboceanico nella fascia montana. Nel sottobosco, in ambiente ombroso, umido. Suolo: una terra bruna, neutro-subacida, ben provvista di materia organica (Mull). Specie caratt. del Fagion, come specie differenziale delle faggete meridionali e siciliane (Geranio-Fagion), in Cal. e Sic. è comune anche negli aspetti più freschi dei Quercetalia ilicis. – Fi. IV-VI – Endem. It. centro-meridionale e Sic.

$2n = 14$.

Nota - la sottospecie nominale (subsp. *drymeja*) è stata erroneamente riportata per il Piemonte (Valle del Gesso): si tratta in realtà di entità estranea alla flora italiana.
Descr.: *D. drymeja* subsp. *drymeja* (= *Festuca drymeja* Mert. et W.D.J.Koch; *F. sylvatica* Host non Hudson; *F. montana* Sternb. et Hoppe non Savi) - Pianta alta 50-110 (150) cm, con rizomi avvolti da foglie squamiformi lunghe

fino a 4-5 cm. Culmo eretto, 3 nodi, liscio. Innovazioni extravaginali. Ligula 2-3 mm. Lamina fogliare 20-80 cm, piana, eretta, liscia, verde brillante. Sezione fogliare 5-15 mm, lineare, con numerosi fascetti vascolari, numerose coste appena pronunciate, solco intercostale assente, sclerenchima in pilastri, tricomi assenti. Pannocchia 10-30 cm, lassa, inclinata da un lato. Spighette 7-8 mm, 4-6 fiori, verde chiaro. G1 3-3.5 mm, lineare lanceolata, margine scarioso nullo o sottile. G2 3.5-4 mm, largamente lanceolata, con margine scarioso nullo o sottile. Lemma 4-5.5 mm, glabro, apice molto acuto, bidentato, resta nulla. Antere 3 mm. *Da ricercare nei boschi di forra del Tilio-Acerion. Sud Europ.-Medit. mont.*

2. D. sylvatica (Poll.) Holub, Folia Geobot. Phytotax. (Praha) 19: 99 (1984)
Sinonimi
Festuca sylvatica (Pollich) Vill., Hist. Pl. Dauph. 2: 105 (1787)
F. altissima All., Auct. Fl. Pedem.: 43 (1789)
F. calamaria Sm., Fl. Brit. 1: 121 (1800)
F. latifolia Host, Fl. Austr. 1: 52 (1827)
Poa sylvatica Pollich, Hist. Pl. Palat. 83 (1776)
P. trinervata Schrad., Spic.: 3 (1794)
Schedonorus silvaticus (Poll.) P.Beauv., Essai d'Agrost., 177 (1812)
S. altissimus (All.) P.Beauv., Essai d'Agrost. :177 (1812)
S. silvaticus Hoppe, Agr. Dec. 4 (1819)

Pianta alta 50-150 cm, ± densamente cespitosa, non rizomatosa. Culmo eretto, 3-4 nodi, liscio, avvolto alla base da guaine corte senza lamina, persistenti. Innovazioni extravaginali, contornate da un manicotto di guaine coriacee simili a scaglie. Ligula 2-5 mm. Lamina fogliare 10-60 cm, piana o ± convoluta, flessibile, liscia, verde, non pruinosa. Sezione fogliare 4-14 mm, lineare, con numerosi fascetti vascolari, numerose coste, solco intercostale poco profondo, sclerenchima in colonne, raram. in pilastri, tricomi assenti o radi. Pannocchia 10-20 (35) cm, lassa, inclinata. Spighette 5-8 mm, 2-5 fiori, verde pallido talvolta variegati di violetto. G1 2-3 mm, molto stretta, acuminata. G2 3-4 mm. Lemma 4-6 mm, glabro, apice molto acuto, finemente rugoso, carenato, con resta nulla. Antere 2-2.3 (3) mm.

Boschi mesofili di latifoglie, soprattutto faggete; margini delle faggete (megaforbie). It. Sett., Tosc.: C; Abr., Cal.: R; dubbia in V. Aosta e Molise. (500-1500 m). - Nella faggeta eutrofica, nelle vallate a clima suboceanico, nella fascia montana e collinare. Vive nel sottobosco, in ambiente ombroso, umido. Suolo: una terra bruna mesofila profonda, neutro-subacida, ben provvista di materia organica (Mull). Specie caratt. del *Fagion*. – Fi. IV-VI – Eurasiatica.

In tutto il terr., escluso le porzioni più meridionali: C.

2n = 14

16. LEUCOPOA Griseb. Fl. Ross. 4: 383 (1853)

1. L. calabrica (Huter, Porta et Rigo) H.Scholz et Foggi, Willdenowia 35: 242 (2005) - ●
Sinonimi
Festuca calabrica Huter, Porta et Rigo, Sched. Itin. Italico, III n. 461 (1877)
F. spectabilis subsp. *calabrica* (Huter, Porta et Rigo) Arcang., Comp. Fl. Ital., ed. 2: 61 (1894)

Pianta alta 40-60 cm, cespitosa, eretta, glaucescente, con rizomi brevi ed eretti e evidenti catafilli. Culmo striato, scabro. Innovazioni extravaginali. Ligula 4-10 mm nelle foglie del culmo, erosa sul margine. Lamina fogliare 25-35 (40) cm, piana ± convoluta sul bordo. Sezione fogliare 1-2 mm, 9-19 fasci vascolari, sclerenchima in trabecole, tricomi radi, brevi e rigidi. Pannocchia 9-15 cm, flessuosa, contratta, eretta. Spighette 9-11 mm, 3-4 fiori, glaucescenti. G1 7 mm. G2 8 mm. Lemma 6.5 mm, evidentemente nervato. Antere 3.5 mm.

Rupi e ghiaioni calcarei. - Nella Penisola dalla Camp. a Castellamare, verso sud, Basilicata a Chiaromonte e Pollino, Calabria al M. Montea: R. (800 - 1700 m). Nella vegetazione del Linarion purpureae - Fi. VI-VII. Endemica Italia centro-meridionale.

2n = mancano conteggi su popolazioni italiane.

2. L. dimorpha (Guss.) H.Scholz et Foggi, Willdenowia 35: 243 (2005) - ●
Sinonimi
Festuca dimorpha Guss., Pl. Rar. 34 (1826)
F. laxa var. *dimorpha* (Guss.) Fiori, N. Fl. Anal. Ital., 1: 39 (1923)
F. laxa subsp. *dimorpha* (Guss.) St.-Yves, Bull. Soc. Bot. Fr., 71: 132 (1924)
F. flavescens sensu Bertol., Fl. Ital. 1: 596 (1834) non Bellardi

Pianta alta (30) 40-70 (85) cm, cespitosa, eretta, con rizomi corti, scagliosi alla base, innovazioni extravaginali. Culmo con 2 nodi visibili, il superiore non oltre 1/2. Innovazioni extravaginali. Ligula 0.5-1.5 mm, bilobata, troncata, ciliolata. Lamina fogliare basale (6) 10-25 (50) cm, convoluto-setaceo-giunchiforme, flessibile, scabra, verde, non pruinosa. Lamina caulinare (6) 10-20 (40) cm piana, eretta, a mezza altezza della pianta. Sezione fogliare 0.6-0.8 mm, da suborbicolare a poligonale, 7-9 (11) fascetti, 5-7 (9) coste, solco intercostale abbastanza profondo, sclerenchima in trabecole a livello dei fascetti principali, in pilastri a livello dei secondari, tricomi da medi a lunghi, abbondanti. Pannocchia (4.5) 7-12 (16) cm, da contratta a debolmente lassa, ± inclinata, sorpassante di poco le innovazioni. Spighette 9-11 mm, (2) 3-4 (5) fiori, giallastre. G1 5.5 mm. G2 6.9-7,5 mm. Lemma (6) 7.3-7.5 (8) mm, largamente scarioso, dentato-sfrangiato verso l'apice, scabro-punctato, con breve resta o mucrone breve. Antere 2.6 mm.

Rupi e ghiaioni calcarei. - Lig., Piem., App. Romagnolo a Santa Sofia, Tosc. (Alpe della Luna): RR; App. Centr. e Merid. dai Sibillini al M. Sirino: R. (1300 - 2500 m). Specie guida del Festucion dimorphae – Fi. VI-VIII. Endemica: Italia nord occidentale-penisola, penetra in territorio francese in Provenza e Alpi Marittime.

2n = 14

3. L. laxa (Host) H. Scholz et Foggi, Willdenowia 35: 243 (2005) - ●
Sinonimi
Festuca laxa Host, Gram. Austr. 2: 58 (1802)
F. canescens Host, Fl. Austr., 1: 155 (1827)

Pianta alta 30-60 cm, con rizomi anche molto lunghi. Culmo eretto, 3-5 nodi, ± scabro in alto. Innovazioni extravaginali. Ligula 0.5-1 mm, con orecchiette ben evidenti. Lamina fogliare 6-20 cm, convoluto-giunchiforme. Sezione fogliare 0.5-1 mm, 7 (9) fascetti vascolari, trabecole in coincidenza dei fasci principali e pilastri in concidenza dei secondari. Pannocchia (4) 6-10 cm. Spighette 6-10 mm, 3-5 fiori, giallastre. G1 3-4 mm, largamente lanceolata. G2 4-5 (5.5) mm, largamente lanceolata. Lemma 5-7 mm, con margine scarioso ristretto, apice appena diviso in due dentelli, resta nulla o breve mucrone. Antere 2.5-3 mm.

Ghiaioni e macereti calcarei. - Alpi Giulie e Carniche: R; anche sul M. Cavallo, dubbia per le Vette di Feltre. (1300 - 2000 m). - Su pietrame grossolano, relativamente instabile, calcareo o dolomitico, nella fascia alpina e subalpina, generalm in stazioni soleggiate. Radici diffuse che raggiungono la falda di acqua fredda. Specie caratt. dei *Thlaspietalia rotundifolii.*
- Fi. V-VIII - Endemica Alpi orientali.

2n = 14, 28, 42

4. L. pulchella (Schrad.) H.Scholz et Foggi, Willdenowia 35: 243 (2005) - ●
(**a**) subsp. **pulchella**

Sinonimi

Festuca pulchella Schrad., Fl. Germ. 336, t. 5 (1806)
F. scheuchzeri Gaudin, Alpina (Winterthur) 3: 70-71 (1808)
F. scheuchzeri var. latifolia Ducommun, Taschnb. Schweiz. Bot.: 882 (1869)
F. pulchella var. *latifolia* (Ducommun) Becherer, Ber. Schweiz. Bot. Ges., 37: 148 (1928)
Schoenodorus nutans (Host) Roemer et Schultes, Syst. ed 2: 704 (1817)
S. scheuchzeri (Gaud.) Roemer et Schultes, Syst. ed 2: 703 (1817)
F. nutans Host, Icon. descr. Gram. 4: 35, t. 61 (1809) non Spreng.

Pianta alta (17) 35-50 (65) cm, da lassamente cespitosa a diffusa, lungamente rizomatosa (> 6 cm). Culmo 20-50 cm, gracile, liscio, con 2 nodi visibili. Innovazioni intravaginali. Ligula 1-2 mm nelle foglie del culmo. Lamina basale, quelle della base 0.4-2.5 cm, le altre più lunghe (5) 10-20 (35) cm, piana ± convoluta sul bordo, flessibile, liscia, verde sulla faccia abassiale, glauca su quella adassiale, non pruinosa. Lamina caulinare (2.5) 4-8 (20) cm, piana. Sezione fogliare (0.5) 0.7-1.5 (2) mm, lineare, piegata o a V, un po' angolosa, 13-21 fascetti, solco intercostale mediamente profondo, sclerenchima in trabecole gen. concidenti con tutti i fascetti, talvolta solamente in pilastri o isolotti sulla faccia adassiale e abassiale, tricomi da corti a medi, da poco ad abbastanza abbondanti. Pannocchia (4) 6-10 (16) cm, lassa, inclinata, ovale, aperta all'antesi con assi filiformi e rami capillari flessuosi e lisci, ramo inferiore che porta più di 5 spighette, passante da mediamente a abbastanza lungamente le innovazioni. Spighette (5.5) 6-7 (8) mm, 3-4 (6) fiori, violacee. G1 3.7 mm. G2 4.2-5.2 mm. Lemma (4) 4.3-5 (6) mm, con margine scarioso stretto, con nervature marcate, resta nulla. Antere 2.7-3 mm.

Prati rupestri e macereti con una certa umidità. - Indicata dalle Alpi Carn., Bellun., Trent., A.-Adige, ma da verif. (1200 - 2700 m). - Fi. VI-VIII – Endemica: Alpi interne e settentrionali.

2n = 14

Nota - Le segnalazioni relative al territorio italiano (Markgraf-Dannenberg I., 1979; Conert J., 1996; Aeschimann D. et al., 2004; Conti F. et al., 2005) sono da verificare o da riferire alla subsp. (**b**) e meritano ulteriori approfondimenti. Probabilm. da eliminare dalla flora italiana.

(**b**) subsp. **jurana** (Gren.) H.Scholz et Foggi, Willdenowia 35: 243 (2005)

Sinonimi

Festuca pulchella var. *jurana* Gren., Mém. Soc. Émul. Doubs, ser. 3, 10: 925 (1869)
F. scheuchzeri var. *angustifolia* Ducommun, Taschnb. Schweiz. Bot.: 882 (1869)
F. scheuchzeri var. *plicata* Huter, Oesterr. Bot. Z., 20: 338 (1870)
F. pulchella subvar. *plicata* (Huter) Hack., Mon. Fest. Europ.: 192 (1882)
F. pulchella var. *angustifolia* (Ducommun) Becherer, Ber. Schweiz. Bot. Ges., 37: 148 (1928)
F. pulchella subsp. *scheuchzeriformis* var. *plicata* (Huter) Krajina, Veroff. Geobot. Inst. Rubel, Zurich, 10: 52 (1933)
F. pulchella subsp. *jurana* (Gren.) Markgr.-Dann., Ber. Int. Fachtagung Bundesversuchsanst. Alpenländ. Landw. (Nachheft) 342 (1979)

Pianta alta 25-40 cm, subcespitosa, brevemente rizomatosa (< 4 cm). Culmo sottile, liscio, finemente striato sotto la pannocchia, violaceo, con 1 (2) nodi visibili. Innovazioni intravaginali. Ligula 1-2 mm nelle foglie del culmo. Lamina basale 5-15 (20) cm, piana, plicata, flessibile, liscia, verde sulla faccia abassiale, glauca su quella adassiale, non pruinosa. Lamina caulinare (3) 5-6 (7) cm, piana. Sezione fogliare 0.5-0.9 (1) mm, piegata o a V, un po' angolosa, 11-13 fascetti, solco intercostale mediamente profondo, sclerenchima in trabecole gen. concidenti con i tre fascetti principali, in pilastri o isolotti a livello dei fascetti secondari, sulla faccia adassiale e abassiale, tricomi gen. corti, da poco ad abbastanza abbondanti. Pannocchia (4) 5-6 (7) cm, lassa, inclinata, ovale, spesso aperta prima o dopo l'antesi. Spighette 7-8 mm, 3-4 fiori, violacee. G1 3.7-5.3 mm. G2 5.5-7 mm, brevemente mucronata. Lemma (5) 5.2-6 (6.3) mm, tomentoso, scabriuscolo, con margine scarioso molto stretto, resta nulla. Antere circa 3.2 mm.

Prati rupestri e macereti, soprattutto su calcare. - Alpi Or. dalle Giulie e Carniche alle Dolomiti, M. Baldo, Trent.-Alto Adige fino al Tonale e Lomb. alle Orobie: R. (1200 - 2500 m). - Colonizza ghiaia stabilizzata alla base dei ghiaioni dolomitici nella fascia subalpina ed alpina in stazioni soleggiate, calde ed aride. Suolo sassoso-sabbioso primitivo. Specie caratt. del Festucetum pulchellae (Thlaspion rotundifolii).- Fi. VI-VIII – Endemica: Alpi.

2n = 14

5. L. spectabilis (Bertol.) H.Scholz et Foggi, Willdenowia 35:243 (2005)

(**a**) subsp. **spectabilis**

Sinonimi

Festuca spectabilis Bertol., Fl. Ital. 1: 612 (1834)
F. spadicea var. *nemorosa* Pollini, Fl. Veron. 1: 117 (1822)
F. sieberi Tausch, Flora 20: 127 (1837)
F. spectabilis var. *coarctata* Hack., Termész. Füz. 2: 295 (1878)
F. nemorosa (Pollini) Fritsch, Excurs. Österr. Fl.: 67 (1897) non Latourr. 1785
F. spectabilis Jan, Elench. Hort. Parm., 2 (1827) *nomen nudum*
F. spadicea var. ? *nemorosa* Poll., Fl. Ver., 1: 117 (1822)

Pianta alta 60-120 cm, densamente cespitosa senza rizomi, con squame sfibrate alla base. Culmo eretto, 3-5 nodi, ± scabro in alto. Innovazioni extravaginali. Ligula 2-3 mm nelle foglie del culmo. Lamina fogliare 20-40 cm, piana, ± eretta. Sezione fogliare 4-6.5 mm, con 21-25 fascetti vascolari, numerose coste evidenti, sclerenchima in trabecole e in pochi pilastri a livello dei fascetti secondari, tricomi assenti. Pannocchia 10-30 cm, oblunga, lassa, tendenzialmente unilaterale. Spighette 7-8 mm, 3-6 fiori, giallastre. G1 4-5 mm, largamente lanceolata, con evidente margine scarioso. G2 5.5-6.5 mm, largamente lanceolata, con evidente margine scarioso. Lemma 5-6 mm, glabro, con ampio margine scarioso, apice molto acuto, finemente rugoso, carenato, con resta nulla. Antere 3 mm.

Ghiaioni calcarei e su serpentino; boscaglie e boschi aperti. - It. Sett. dalle Alpi Orobie (Introbio) alle Giulie dove il limite con la subsp. seguente è da accertare: R; App. Sett.: RR.
(200 - 1800 m). - Conoidi ciottolosi consolidati lungo i torrenti alla base delle montagne calcaree e dolomitiche: ambiente soleggiato, caldo, ma con una certa umidità atmosferica, nella fascia montana e subalpina. Suolo sabbioso-ghiaioso, primitivo. Specie caratteristica del *Festucetum spectabilis* (*Achnatherion calamagrostidis*), – Fi. V-VII – Endemica Alpi meridionali centrali e orientali-Appennino Ligure-Piacentino.

Nota - La distribuzione nell'Appennino Ligure-Piacentino deve essere accertata con precisione: fino ad oggi trovata solo in corrispondenza degli affioramenti serpentinosi detritici del Ferrierese, in alta Val Nure (Montanari et al., 1980; Guido & Montanari, 1983) e al M. Prinzera, sempre su serpentino. Una antica segnalazione per il M. Pisano deve essere confermata ma la sua presenza in questa area sembra molto dubbia.

2n = 14 (senza indicazione della sottospecie di riferimento)

(**b**) subsp. **carniolica** (Hack.) H.Scholz et Foggi, Willdenowia 35:243 (2005)

Sinonimi

Festuca spectabilis subsp. *eu-spectabilis* var. *carniolica* Hack., Mon. Fest. Europ.: 189 (1882)
F. carniolica (Hack.) K.Richter, Pl. Europ.: 106 (1890)
F. sieberi subsp. *carniolica* (Hack.) Hack. ex Hegi, Ill. Fl. Mitteleur., ed. 1, 1(10): 351 (1908)

Pianta alta 60-120 cm, densamente cespitosa senza rizomi, con squame sfibrate alla base. Culmo eretto, 3-5 nodi, ± scabro in alto. Innovazioni extravaginali. Ligula fino a 1 mm nelle foglie del culmo. Lamina fogliare 20-40 cm, piana appena convoluta nella parte distale, ± eretta. Sezione fogliare 2- 3 (4) mm, convoluta nella parte distale, con 13-17 fascetti vascolari, numerose coste evidenti, sclerenchima in trabecole e in pochi pilastri a livello dei fascetti secondari, tricomi assenti. Pannocchia 10-15 cm, oblunga, lassa, tendenzialmente unilaterale. Spighette 12 mm, 3-4 fiori, giallastre. G1 5 mm, largamente lanceolata, con evidente margine scarioso. G2 6-7 mm, largamente lanceolata, con evidente margine scarioso. Lemma 7-7.5 mm, glabro, con ampio margine scarioso, apice molto acuto, finemente rugoso, carenato, con resta nulla. Antere 3.5-4 mm.

Ghiaioni calcarei. - Conosciuta per alcune stazioni presso il confine (Val Rosandra, M. Cocusso) e fino alla Slovenia sul M. Nanos: RR. (200 - 1000 m). – Fi. V-VII – Endemica: Alpi meridionali orientali (Illirica).

17. **PATZKEA** G. H. Loos in Jahrb. Bochum. Bot. Vereins 1: 126 (2010)

Il genere si differenzia morfologicamente per la presenza di guaine che alla base si rigonfiano, come a formare una sorta di bulbo, e tendono a dissolversi in fibre più o meno evidenti. Secondo Müller & Catalán (2006), le specie una volta runite nella sect. *Subbulbosae* Nyman ex Hach. possono venir distinte in due sezioni: sect. *Lojaconoa* Catalán et Joch. Müll. e sect. *Subbulbosae* Nyman ex Hack., in quanto i caratteri morfologici distintivi sono in accordo con i dati derivati dall'analisi genetiche (Catalán & al., 2004). Recentemente (Loos, 2010) ha riunito queste due sezioni in un unico genere: **Patzkea**. Da un punto di vista filogenetico **Patzkea** appartiene al gruppo delle "festuche a foglie larghe", con contenuti di DNA intermedi fra **Drymochloa** e **Schedonorus**.

1. P. coerulescens (Desf.) H.Scholz Willdenowia 40: 200 (2010).
Sinonimi
F. coerulescens Desf., Fl. Atl. 1: 87 (1798)
Koeleria coerulescens (Desf.) Guss., Prodr. suppl. 1: 39 (1827)
Schoenodorus coerulescens (Desf.) Roem. et Schultes, Syst. 2: 609 (1817)

Pianta alta 30-70 cm, densamente cespitosa, con base formante un ingrossamento tuberoso circondato da fibre, non rizomatosa. Culmo 20-50 cm, 2.5-3 mm di diametro nella parte più alta, fino a 20 mm in basso, tre nodi evidenti. Innovazioni intravaginali. Guaine dissolventesi rapidamente in fibre longitudinali formanti un manicotto feltroso, denso. Ligula più breve di 1 mm. Lamina delle innovazioni 25 cm, piana, molle, flaccida, convoluta da giovane, glauca, ± pruinosa, scabrida sul margine. Sezione fogliare 1-2 mm, 7-11 fasci vascolari, coste in genere coincidenti con i fasci vascolari, solco intercostale da mediamente a molto profondo con evidenti cellule bulliformi, sclerenchima in trabecole ben sviluppate a livello dei fasci vascolari vascolari. Pannocchia 5-10 cm, flessuosa, compatta, con rami pubescenti. Spighette 10 mm, 3-4 fiori, violette. G1 5-6 mm. G2 6-7 mm. Lemma 6-7 mm, con vene evidenti, scabrido, margine scarioso, resta 0-0.5 mm. Antere 4 mm.

Rupi calc. - Sicilia, monti presso Palermo: Busambra, Pizzuta, ecc.: R. Da confermare in Puglia e Basilicata. (400 - 1500 m). Casmofita legata alle formazioni del Dianthion rupicolae, su falesie esposte a brezze umide. – Fi. IV-VI – Orofita sud ovest Mediterranea

2n = mancano conteggi su popolazioni italiane.

2. P. paniculata (L.) G.H. Loos, Jahrb. Bochum. Bot. Vereins. 1: 114-133 (2010).
Sinonimi
P. paniculata (L.) Schinz et Thell., Viert. Naturf. Ges. Zürich, 58: 40 (1913)
Anthoxanthum paniculatum L., Sp.Pl.: 28 (1753)
F. aurea Lam., Fl. Fr., 3 :598 (1779)
F. spadicea subsp. *aurea* (Lam.) K.Richt., Pl. Europ., 1: 103 (1890)
F. fibrosa Griseb., Spicil. Fl. Rom., 2: 433 (1844)

Pianta alta 40-100 cm, di grandi dimensioni, formante cespi isolati molto densi. Culmo robusto, eretto, con base allargata a formare una sorta di bulbo-tubero. Innovazioni intravaginali. Guaine lunghe fino a 10 cm, persistenti, dissolventisi in fibre grigiastre quando vecchie, non persistenti. Ligula fino a 1 mm. Lamina delle innovazioni convoluto-plicata. Lamina del culmo piana. Sezione fogliare 2-3 mm, 7-8 (9) fasci vascolari principali e fino a 20 fasci vascolari secondari, sclerenchima in 7-9 trabecole in corrispondenza dei fasci vascolari principali e fino a 20 piccoli blocchi talvolta formanti pilastri, 7-9 coste, con tricomi sparsi. Pannocchia 4-8 cm, ovoide, densa, talvolta pendente, di colore dorato-giallastro. Spighette 9-11 cm, 3-5 fiori, prima verdi ± soffuse di violetto poi verde-giallastro dorate. G1 4-6 mm, carenata. G2 5-6 mm. Lemma 7-9 (10) mm, largamente lanceolato, resta fino a 0.5 mm. Antere 3.5-4.5 mm.

Prati montani e subalpini, tendenzialmente su silice, nell'Appennino su calcare. Sulle montagne delle Alpi e degli Appennini fino all'Aspromonte, localmente abbondante: C. (1000 - 2500 m). - Pascoli soleggiati su suolo fertile, neutro-subacido ma ben provvisto di basi, sulle Alpi nella fascia subalpina ed alpina. In generale su substrati silicei (soprattutto lave e tufi), e presenza di materiale fine calcareo e dolomitico (apporto eolico, frane etc.); selezionata dal pascolo equino (?). Sulle Dolomiti specie caratt. del *Knautio-Trifolietum* (*Festucion variae*); sull'Appennino Sett. e Centr. nel *Nardion*. – Fi. VI-VIII – Orofita Sud Europea

2n = mancano conteggi su popolazioni italiane - autopoliploide Küpfer P., *Boissiera* 23: 251 (1974).

18. FESTUCA L. - Sp. Pl., 1: 73 (1753)

18a. *Incertae sedis*

La posizione sistematica di *F. morisiana* è ancora da indagare; Hackel (1882) la considera come specie separata, anche se con dubbio, perché poco nota. Inoltre, sebbene sia chiaro che si tratti di specie isolata, non risultano lavori circa le sue affinità. Preferiamo quindi mantenerla in una posizione isolata, in attesa di ulteriori indagini chiarificatorie.

1. F. morisiana Parl., Giorn. Bot. Ital. 1 (2), parte 1: 377 (1844) - ●
(**a**) subsp.**morisiana**
Sinonimi
F. ovina var. *morisiana* (Parl.) Fiori in Fiori et Paoletti, Fl. Anal.. Ital., 1: 91 (1896).

Pianta alta 15-30 (40) cm, cespitosa, con brevi rizomi. Culmo 10-30 cm. Innovazioni intravaginali. Guaine chiuse su tutta la lunghezza, dissolventesi in fibre. Ligula cortissima, ciliolata. Lamina delle innovazioni 2-7 cm, non molto rigida, eretta. Sezione fogliare (0.37) 0.45-0.7 mm, V aperto irregolarmente poligonale-rotondata, 5-7 fasci vascolari, 5-7 coste spesso con isolotti o cellule sclerenchimatiche, tricomi sparsi brevi, 3 isolotti sclerenchimatici, il mediano e i marginali grandi, in genere con altri 2 (4) piccoli isolotti laterali; cellule epidermiche mediamente larghe. Pannocchia 2-4 cm, eretta, contratta, lineare. Spighette 7-8 mm, (3) 4-5 fiori, verde opaco, talvolta variegati di violetto fino a violetto-nerastro. G1 3-3.5 mm, lanceolata. G2 5-5.5 mm, acuminata, con margine scarioso, lanceolata. Lemma 5-6 mm, ± scabrido nella parte distale, raram. peloso, resta 0.8-1.2 (1.5) mm. Antere 2.5-3 mm.

Praterie aride montane, su silice. - In Sardegna al M. Genargentu: RR. (1300 - 1700 m). - Creste e ambienti di vetta soleggiati e secchi, ma esposti alla brezza di mare (precipitazioni occulte), nella fascia collinare e montana. Suolo primitivo, acido, pietroso, sterile, su substrato siliceo. Specie caratt. del *Festucetum morisianae* (Carici-Genistetea lobelioidis). – Fi. IV-VI – Endemica Sardegna.

2n = 14

(**b**) subsp. **sicula** Cristaudo, Foggi, Galesi et Maugeri, Parlatorea, 9: 95 (2007)

Pianta alta 30-40 cm, cespitosa, con brevi rizomi. Culmo 20 cm. Innovazioni intravaginali. Guaine chiuse su tutta la lunghezza, dissolventesi in fibre. Ligula cortissima, ciliolata. Lamina delle innovazioni 5-15 cm, non molto rigide, erette. Sezione fogliare 0.45-0.9 mm, V aperto irregolarmente 7-9 (11) fasci vascolari, (5) 7-11 coste con isolotti sclerenchimatici, tricomi sparsi medi o lunghi, 3 isolotti di piccole-medie dimensioni, in genere con altri 2 (4) piccoli isolotti laterali, cellule epidermiche mediamente larghe. Pannocchia 4-6 cm, eretta, contratta, lineare. Spighette 7-8 mm, 3-4 fiori, verde opaco, talvolta variegati di violetto fino a violetto-nerastro. G1 3.5-4 mm, lineare. G2 5.5-6 mm, acuminata, con margine strettamente scarioso, lanceolata-lineare. Lemma 4-5 mm, ± gen. glabro, talvolta scabrido nella parte distale, resta 1.5-3 mm. Antere 2-2.5 mm.

Praterie in ambiente mesico montano, su silice. - In Sicilia sui M. Peloritani: RR. (1100 - 1300 m). - Nei pascoli montani del Plantaginion cupani. – Fi. IV-VI – Endemica Sicilia.

Nota - Recentem. rinvenuta nelle parti più elevate dei M. Peloritani; mostra lievi differenze di tipo quantitativo rispetto alla subsp. *morisiana* della Sardegna ed è quindi stata proposta a rango di sottospecie (Cristaudo & al., 2007). De Leonardis et al. (2009) hanno evidenziato le notevoli affinità di questo taxon con *F. sicula* C.Presl, somiglianza già nota a Parlatore e Lojacono, che ne esaminarono le differenze rispetto a *F. morisiana* s. str. Il problema resta aperto. Bibl. : Cristaudo et al., *Parlatorea* 9: 95-99 (2007); De Leonardis et al., *SBI – Gruppi critici della Fl. It.*: 37-38 (2009).

18b. Sect. Eskia Willk. in Willk., Lange Prodr. Fl. Hisp., 1: 95 (1861) - (sp. **2-12**)

Piante cespitose, con getti delle innovazioni intravaginali. Apice delle lamine fogliari pungente. Foglie di due tipi: interne brevi e esterni lunghe. Ligula ben evidente. Glume fertili apiculate.

La sect. *Eskia* Willk. può essere considerata un gruppo omogeneo di specie appartenenti al subgen. *Festuca* e poste, da un punto di vista filogenetico, vicino alle altre "festuche" a foglie fini fra le quali rappresentano un gruppo "base" (Torrecilla *et al.*, 2003). Sotto l'aspetto morfologico esse sono caratterizzate dai seguenti caratteri: cariosside non aderente alla palea, ilo lungo circa quanto la cariosside, innovazioni intravaginali, vernazione delle foglie conduplicata, assenza di catafilli e mancanza di trabecole di sclerenchima (Torrecilla *et al.*, 2003), oltre che dai caratteri usati da Willkomm (1861), per istituire la nuova sezione, presenti sia nelle specie iberiche (Fuente, Ortúñez, 2001) sia in quelle alpine e italiane in genere. Le specie italiane appartenenti alla sect. *Eskia* sono facilmente riconoscibili per le foglie generalmente pungenti (salvo *F. flavescens*), la presenza di due tipi di foglie, esterne brevi ed interne lunghe, la ligula sempre maggiore di 0,5 mm e generalmente assenza di orecchiette; possiamo dire che fra i botanici vi è una buona uniformità nella concezione di quello che viene definito come gruppo "*varia*".
Una recente messa a punto della sezione per il territorio italiano è di Foggi & al. (2007a, b), la chiave e la maggior parte delle informazioni derivano da questo lavoro al quale si rimanda per maggiori informazioni, le iconografie ed una più completa bibliografia.
Per quanto riguarda l'ecologia, si tratta di specie legate a cenge rocciose e substrati incoerenti sassosi: le entità silicicole caratterizzano collettivamente il Festucion variae. - Bibl. Wallosek, *Folia Geobot.* 34: 47-75 (1999).

2. F. alpestris Roem. et Schult., Syst. Veg., ed. 16, 2: 722 (1817) - ●
Sinonimi
F. varia subsp. *alpestris* (Roem. et Schult.) Hack., Bot. Centralbl., 8: 407 (1881)
F. pumila subsp. *alpestris* (Roem. et Schult.) Litard., Candollea, 10: 112 (1945)
F. flavescens subsp. *alpestris* (Roem. et Schult.) Nyman, Conspect. Fl. Europ.: 829 (1882)
F. pumila var. *alpestris* (Roem. et Schult.) Fiori in Fiori et Paol., Fl. Anal. Ital., 4: 28 (1907)
F. brizoides Wulf., Fl. Nor. Phan.: 141 (1859)
F. pungens var. *pseudoalpestris* Pénzes, Borbasia, 3 (1-3): 15 (1941).
F. alpina Host, Icon. Gram. Austr., 4: 36, t. 63 (1809), non Suter

Pianta alta 25-55 cm, cespitosa. Culmo 20-45 cm. Innovazioni intravaginali. Ligula delle foglie caulinari (2.2) 2.5-6.5 (7) mm, con tre nervature ben evidenti. Lamina delle innovazioni lunga 16-20 cm, rigida, apice pungente, liscia, glaucescente, non pruinosa. Foglie inferiori lunghe 1/16-1/8 delle superiori. Sezione fogliare 0.6-0.9 (1.1) mm, ellittica, 7-9 fascetti vascolari, 5-7 (9) coste ben evidenti in genere con blocchi o cellule sclerenchimatiche isolate, solchi intercostali profondi, sclerenchima continuo, abbastanza spesso, tricomi gen. abbondanti. Pannocchia 3-7 cm con rami finemente pelosi, lassa, sorpassante abbastanza lungamente le innovazioni. Spighette 7-9 mm, 3-7 fiori, giallastri. G1 3-4 mm. G2 3.5-5 mm ovale-lanceolata. Lemma 4.5-6 mm glabro con resta nulla o con un breve mucrone inferiore a 1 mm. Antere 2.5-3 mm.

*Prati sassosi, pendii rupestri, rupi, cenge erbose, boschi aperti, essenzialmente su calcare. - Alpi Orientali * dal Tagliamento fino al Bergam. (M. Legnone): C.* (200 - 2300 m). - Su cenge semirupestri e alluvioni ciottolose calcaree negli alvei dei fiumi prealpini a carattere torrentizio, fino all'alta pianura, nella fascia planiziare, collinare e montana. Suolo primitivo sabbioso-ciottoloso, in generale al di sopra del livello di piena, in stazioni soleggiate, con elevata umidità atmosferica. Specie caratt. del Centaureion dichroanthae (Festuco-Brometea). – Fi. V-VIII – Endemica: Alpi orientali, sulle catene merid.

2n = mancano conteggi su popolazioni italiane.

3. F. acuminata Gaudin, Agrost. Helv. 1: 287 (1811) - ●
Sinonimi
F. varia var. *acuminata* (Gaudin) Nyman, Sylloge Fl. Eur.: 417 (1855)
F. varia subvar. *acuminata* (Gaudin) Hack., Monogr.: 173 (1882)
F. varia subsp. *acuminata* (Gaudin) K. Richt., Pl. Europ., 1: 104 (1890)
F. varia f. *acuminata* (Gaudin) Hausskn., Mitth. Thüring. Bot. Vereins, N. F. 13-14: 55 (1899)
F. varia var. *acuminata* (Gaudin) Chenevard, Bull. Herb. Boissier, ser. 2,3: 450 (1903)
F. pumila var. *rigida* Ducomm, Taschenb. Schweiz. Bot.: 882 (1869)
F. flavescens sensu Gaudin, Agrost. Helv.: 272 (1811), non Bellardi

Pianta alta (20) 25-50 (60) cm, cespitosa. Culmo (20) 25-50 cm. Innovazioni intravaginali. Ligula delle foglie caulinari 0.6-1.7 (2.0) mm. Lamina delle innovazioni lunga (5) 10-20 (30) cm, capillare-setacea, rigida, apice ± pungente, liscia, glaucescente, non pruinosa. Foglie inferiori lunghe 1/10-1/6 delle superiori. Sezione fogliare (0.3) 0.5-0.9 (1) mm, gen. ovale talvolta ellittica, (5) 7-9 fascetti vascolari, 5 (7) coste poco sviluppate e ± appiattite, solchi intercostali da poco a mediamente profondi, sclerenchima continuo, in genere spesso 2-4 strati sui fianchi, tricomi corti gen. abbastanza abbondanti. Pannocchia (3.5) 4-7 (8.5) cm, lassa, inclinata, sorpassante abbastanza lungamente le innovazioni. Spighette (7.5) 8-10 (11) mm, 4-6 (9) fiori, giallastri, talvolta screziati di violetto chiaro. G1 2.3-4 mm. G2 3.8-5 mm da ovale-lanceolata a lanceolata. Lemma (5.1) 5.5-7 (7.5) mm glabro, con resta nulla o un mucrone fino a 0,4 mm. Antere 2.4-3.3 mm.

Prati sassosi, pendii rupestri, rupi, soprattutto su silice. - Alpi Occid. in Piem. e V. Aosta, verso est fino a Bormio: C; Liguria al M. Saccarello: RR. (800 - 2500 m). – Fi. V-VIII – Endemica: Alpi occidentali.

2n = 14.

4. F. luedii (Markgr.-Dann.) Foggi, Graz. Rossi, Parolo et Wallossek, Inf. Bot. Ital., 39(1): (2007) - ●
Sinonimi
F. scabriculmis subsp. *luedii* Markgr.-Dann., Bot. Journ. Linn. Soc., 76: 324 (1978).

Pianta alta 30-60 cm, densamente cespitosa. Innovazioni intravaginali. Culmo (20) 30-50 (60) cm, gen. scabro sotto la pannocchia, talvolta liscio. Ligula delle foglie caulinari (0.4) 0.7-1.2 (1.5) mm. Lamina delle innovazioni 20 cm, capillare, apice ± pungente, liscia o appena scabra, glauca fino a verde brillante, non pruinosa. Foglie inferiori lunghe 1/25-1/8 delle superiori. Sezione fogliare (0.3) 0.5-0.8 mm di diametro, ovale, (5) 7 fascetti, 1 costa, talvolta 2 piccole coste laterali, solco intercostale poco profondo, sclerenchima continuo, gen. sottile 1-3 strati lungo i fianchi, leggermente ispessito alla carena, tricomi corti rari o assenti. Pannocchia 4-10 cm, eretta, densa, asse e rami da scabri a molto scabri, passante da poco a mediamente le innovazioni. Spighette 9-12 mm. 4-6 fiori, ± screziati di violetto. G1 3-4.8 mm. G2 3.9-5.6 mm. Lemma (6) 7.6-8 mm, strettamente lanceolato, glabro, con margini scariosi, con resta di 1-1.7 mm. Antere 3-4 mm.

Praterie, pendii rupestri, rupi, su silice. - Alpi, dal Trent. (Presanella ad est fino a Val Nambrone) e M. Bugnol (Gruppo di Brenta) fino a Courmayeur e Gran Paradiso: C. (1300 - 3000 m). Può essere considerata una vicariante edafica di 4, con areale nettam. più occidentale. Sp. guida dell'Euphorbio cyparissiae-Festucetum luedii. – Fi. VI-VIII - Endemica: Alpi

2n = 14.

5. F. scabriculmis (Hack.) K. Richt., Pl. Europ., 1: 104 (1890) - ●
Sinonimi
F. varia subsp. *eu-varia* var. *scabriculmis* Hack., Mon. Fest. Europ.: 176 (1882)
F. pumila var. *varia* subvar. *scabriculmis* (Hack.) Fiori in Fiori et Paoletti, Fl. Anal. Ital., 4: 28 (1907)
F. pumila subsp. *eu-varia* var. *scabriculmis* (Hack.) Litard., Candollea, 10: 145 (1945)
F. varia var. *cenisia* Hack., Monogr.: 176 (1882)
F. cenisia (Hack.) K. Richt., Pl. Europ., 1: 104 (1890)
F. scabriculmis var. *cenisia* (Hack.) Wallossek, Köln. Geogr. Arbeit., 74: 18 (2000)
F. varia subvar. *cenisia* (Hack.) St.-Yves, Rev. Bret. Bot., 2: 103 (1927)
F. varia subvar. *spreta* St.-Yves, Ann. Cons. Jard. Bot. Geneve, 17: 183 (1913).
F. pumila subvar. *spreta* (St.-Yves) Litard., Candollea, 10: 114 (1945)
F. pumila var. *scabriculmis* subvar. *cenisia* (Hack.) Litard., Candollea, 10: 114 (1945)
F. scabriculmis f. *laevis* St.-Yves, Ann. Cons. Jard. Bot. Geneve, 17: 181 (1913)
F. pumila subsp. *eu-varia* var. *scabriculmis* f. *laevis* (St.-Yves) Litard., Candollea, 10: 145 (1945)

Pianta alta (20) 25-50 cm, densamente cespitosa, raram. pseudostolonifera. Innovazioni intravaginali. Culmo (20) 28-40 (50) cm, sovente scabro sotto la pannocchia. Ligula delle foglie caulinari 0.8-1.5 mm. Lamina delle innovazioni (4) 8-20 (30) cm, da capillare a setacea, rigida, flessibile, apice appena pungente, liscia o appena scabra, verde non pruinosa. Foglie inferiori lunghe 1/12-1/4 delle superiori. Sezione fogliare (0.5) 0.6-0.7 (0.75) mm di diametro, ± poligonale o cordiforme, talvolta orbicolare, (5)-7 fascetti, 1 costa, solco intercostale poco profondo, sclerenchima continuo, gen. sottile 1-3 strati lungo i fianchi, raram. interrotto o in isolotti; tricomi corti da poco ad abbastanza abbondanti. Pannocchia (3) 5-7 cm, lassa, eretta o inclinata, densa, paucispiculata, con il ramo alla base spesso solitario e che raggiunge 1/2 della pannocchia, asse e rami da scabri a molto scabri, passante da poco a mediamente le innovazioni. Spighette (9) 9.5-12 (12.5) mm, (3) 4-6 (7) fiori, screziati di verde, giallo o violetto. G1 (3.5) 4-5 mm. G2 (4.5) 4.6- 6 mm. Lemma (6) 6.5-8.5 (9) mm, glabro, scarioso, con resta (0.5) 1-1.7 mm, talvolta nulla. Antere 2.7-3.8 mm.

Praterie discontinue, pendii rupestri, ghiaioni, soprattutto su silice. - Alpi Occ., in Liguria, (solo sul M. Saccarello): RR; Piemonte, verso nord fino al M. Cenisio: R. (1500 - 3000 m). – Caratterizza il "*Festucetum variae*" delle Alpi francesi sec. Guinochet (1938). – Fi. VI-VIII – Endemica: Alpi occidentali.

2n = 14.

6. F. pseudovaria Vetter, Ann. Naturhist. Mus. Wien, 107: 131 (1950) - ●
Sinonimi
F. varia var. *handel-mazzettii* Krajina, Spisy Prir. Fak. Karlovy Univ., 106: 16 (1930).
F. varia auct. pl. Alpi nord. orientali (Dolomiti) non Haenke
F. eskia auct. pl. Alpi nord. orientali (Dolomiti) non Ramond

Pianta alta 40-55 cm, cespitosa, eretta. Innovazioni intravaginali. Culmo 40-45 cm, glabro e striato sotto la pannocchia. Ligula delle foglie caulinari 0.7-1.7 (2.2) mm, superiormente arrotondata e cigliata sul margine. Lamina delle innovazioni (10) 25-30 cm, flessibile, rigide, poco pungenti all'apice, liscia, verde, non pruinosa. Foglie inferiori lunghe 1/10 delle superiori. Sezione fogliare 0.5-0.8 (0.85) mm, obovata, compressa lateralmente, 7-9 fascetti, 3 (5) coste evidenti, talvolta con piccoli blocchi sclerenchimatici, solchi intercostali profondi, sclerenchima continuo, robusto e ispessito sui fianchi, raram. interrotto, talvolta con cordoni sclerenchimatici mediano e laterali che raggiungono i nervi. Tricomi lunghi, piuttosto radi. Pannocchia 5-9 cm, lassa, debolmente inclinata, con ramo alla base spesso solitario e che raggiunge un po' meno di 1/2 della pannocchia, rami fini, lisci con radi dentelli. Spighette 8-10 mm, (4) 5-6 (7) fiori, screziati di violetto intenso. G1 (3.5) 4-5 mm. G2 4.5-6 mm. Lemma 5.3-8 mm, glabro, con una sottile fascia scariosa nella parte distale, con resta di 0.5-1 mm, talvolta nulla. Antere 2.3-3 mm.

Praterie, pendii rupestri, su silice. - Alpi Orientali conosciuta solo per il territorio italiano, nelle province di Trento, Bolzano e Belluno: C. (1500 - 2700 m). - Pascoli soleggiati in stazioni esposte, su suolo acido ma ben provvisto di basi (apporto eolico?), sulle Alpi nella fascia subalpina ed alpina. In generale su macereti silicei consolidati. Sulle Dolomiti specie caratt. del Gentianello-Festucetum variae (Festucion variae). - Fi. V-VIII – Endemica: Alpi nord orientali, versante italiano.

2n = 42.

7. F. winnebachensis (Wallossek et Markgr.-Dann.) Foggi, Graz. Rossi, Parolo et Wallossek, Inf. Bot. Ital., 39(1): 209 (2007) - ●
Sinonimi
F. varia var. *winnebachensis* Wallossek et Markgr.-Dann., Folia Geobot., 34: 73 (1999).
F. pseudovaria subsp. *winnebachensis* (Wallossek et Markgr.-Dann.) J. Müller, Willdenowia, 35: 242 (2005).

Pianta alta 35-55 (73) cm, cespitosa, eretta. Innovazioni intravaginali. Culmo 30-45 (65) cm, glabro, liscio, lievemente striato sotto la pannocchia. Ligula delle foglie caulinari 0.8-1.8 (2.5) mm, superiormente arrotondata e cigliata sul margine. Lamina delle innovazioni 15-50 cm, giunchiforme, gen. da rigida a molto rigida, con apice pungente, liscia, glauca, non pruinosa. Foglie inferiori lunghe 1/10 delle superiori. Sezione fogliare 0.7-1.1 mm, ellittica raram. leggermente obovata; 7-9 fascetti, (5) 7 coste, solchi intercostali mediamente profondi, sclerenchima continuo, molto robusto di 4-6 strati di cellule e ispessito sui fianchi. Tricomi corti, piuttosto radi. Pannocchia 4-8.5 cm, lassa, debolmente inclinata, con rami debolmente scabri, con ramo alla base spesso solitario e che raggiunge un po' meno di 1/2 della pannocchia, rami fini, lisci con radi dentelli. Spighette 7.7-9 (10.8) mm, leggermente pruinose, 6-8 fiori, screziati di violetto scuro. G1 (3.5) 4-5 mm. G2 4.5-6 mm. Lemma 5.1-6.6 mm, scabrido verso l'apice e lungo la nervatura centrale, con resta di (0.2) 0.3-0.8 (1) mm. Antere 2.1-3 mm.

Praterie, pendii rupestri. - Alto Adige, sulle montagne fra Anterselva e il confine di Stato: R. (1800 - 2500 m). – Fi. V-VIII – Endemica: Alpi nord orientali.

2n = 42.

8. F. calva K. Richt., Pl. Eur. 1: 104 (1890)
Sinonimi
F. varia subsp. *varia* var. *calva* Hack., Monogr.: 174-175 (1882)
F. varia subsp. *calva* (Hack.) Hegi, Ill. Fl. Mitteleur., ed. 1, 1(10): 348 (1908)
F. varia subvar. *calva* (Hack.) St.-Yves, Bull. Soc. Bot. France 71: 128 (1924)
F. varia var. *cyllenica* subvar. *calva* (Hack.) St.-Yves, Candollea 3: 442 (1928)
F. pumila subvar. *calva* (Hack.) Litard., Candollea 10: 113 (1945)
F. varia var. *crassifolia* J. Koch, Synopsis Deutsch. Schweiz. Fl., I ed.,: 814 (1837)
F. eskia sensu Reichenb., Icon.: 27, tav. 1555 (1834) non Ramond
F. pumila var. eskia Fiori in Fiori et Paol., Fl. Anal. Ital., 4: 28 (1928) non Ramond

Pianta alta 30-60 cm, densamente cespitosa. Culmo 20-50 cm, glabro. Innovazioni intravaginali. Ligula delle foglie caulinari (0.6) 1-1.5 (2) mm. Lamina delle innovazioni lunga 30-40 cm, rigida, apice pungente, liscia, glaucescente, non pruinosa. Foglie inferiori lunghe 1/10-1/4 delle superiori. Sezione fogliare (0.4) 0.5-0.7 (1.0) mm, ovale, 7-9 fascetti vascolari, 7-9 coste non molto evidenti di norma con blocchi sclerenchimatici, solchi intercostali mediamente profondi, sclerenchima continuo, abbastanza spesso, 4-5 strati sui fianchi, tricomi gen. abbondanti. Pannocchia 6-9 cm, inclinata, con rami glabri, lassa, sorpassante abbastanza lungamente le innovazioni. Spighette 8-10.5 mm, 4-6 (8) fiori, screziati di violetto pallido. G1 (3) 3.5-4.5 (5) mm. G2 4-6.5 mm lanceolata con ampio margine scarioso. Lemma 5-7 mm, largamente lanceolato, con ampio margine scarioso, con resta nulla o con un breve mucrone inferiore a 0.5 mm. Antere 2.5-3.5 mm.

Praterie rocciose, pendii rupestri, rupi, ghiaioni grossolani, fessure delle rocce calcaree. - Alpi Giulie sul Matajur, Plauris, Valbruna, Gran Monte, M. Osternig: R. (800 - 2100 m). – Fi. V-VIII – Endemica: Alpi orientali.

2n = mancano conteggi su popolazioni italiane.

9. F. bosniaca Kumm. et Sendtn., Flora (Regensb.) 32: 756 (1849) subsp. **bosniaca**
Sinonimi
F. varia var. *bosniaca* (Kumm. et Sendtn.) Asch., Österr. Bot. Z., 19: 66 (1869)
F. varia var. *croatica* Hack., Act. Mus. Nat. Hung. 2: 295 (1878)
F. pungens Kit. ex Schult., Österr. Fl., ed. 2: 237 (1814), non Lam.
F. duriuscula var. *pungens* (Kit. ex Schult.) Lamotte, Cat. Pl. Vasc.: 99 (1847)
F. varia var. *pungens* (Kit. ex Schult.) Hack., Bot. Centralbl. 8: 408 (1881)
F. varia subsp. *pungens* (Kit. ex Schult.) Nyman, Consp. Fl. Eur.: 827 (1882)

Pianta alta 30-90 cm, densamente cespitosa. Culmo 20-70 cm, scabro sotto la pannocchia. Innovazioni intravaginali. Ligula delle foglie caulinari 0.4-1.6 mm. Lamina delle innovazioni lunga 30-40 cm, rigida, con apice pungente, liscia, glaucescente, non pruinosa. Foglie inferiori lunghe 1/10-1/6 (1/4) delle superiori. Sezione fogliare 0,3-1,2 mm, ellittica, 9-11 fascetti vascolari, (7) 9 coste ben evidenti di norma con blocchi sclerenchimatici, solchi intercostali profondi, sclerenchima continuo, abbastanza spesso (2) 3-4 cellule, tricomi gen. abbondanti. Pannocchia 6-9.5 cm, inclinata, con rami scabri, piuttosto lassa, sorpassante abbastanza lungamente le innovazioni. Spighette 8.5-13 mm, 4-7 fiori, screziati di violetto. G1 3-5 mm. G2 4-7.8 mm, lanceolata con ampio margine scarioso. Lemma 6.5-8.8 mm, strettamente lanceolato, con stretto margine scarioso, con resta lunga (0.8) 1.5-2.1 mm. Antere 3.3-4.0 mm.

Praterie rupestri, pinete rade. - Appennino Centr. e Merid., dal Lazio alla Cal.: R. (1500 - 2100 m). – Fi. V-VII – Orofita sud Est Europea.

2n = 14.

10. F. pumila Chaix, Pl. Vap., 1: 18 (1785)
Sinonimi
F. quadriflora Honck., Vollst. Verz. aller Gew. Teutschl.: 271 (1782) nomen
F. rigidior (Mutel) K.Richt., Pl. Europ.: 105 (1890)
F. varia subsp. *pumila* (Vill.) Hack., Bot. Centralbl., 8: 408 (1881)
F. varia var. *rigidior* (Mutel) Hack., Mon. Fest. Eur.: 171 (1882)
F. varia subvar. *rigidior* (Mutel) St.-Yves, Bull. Soc. Bot. Fr., 1924: 130 (1924)
F. varia var. *willczekiana* St-Yves, Ann. Cons. Jard. Bot. Geneve, 17: 193 (1913).
F. varia var. *villarsii* St-Yves, Bull. Soc. Bot. Fr., 1924: 130 (1924).
F. varia var. *jaccardii* St.-Yves, Bull. Soc. Bot. Fr., 1924: 130 (1924).
F. pumila var. *rigidior* Mutel, Fl. Fr., 4: 107 (1837)
F. pumila var. *wilczeckiana* (St.-Yves) Litard., Candollea, 10: 116 (1945)
F. pumila var. *jaccardii* (St.-Yves) Litard., Candollea, 10: 115 (1945)
F. pumila var. *negrii* Goiran, Sp. Morph.: 16 (1875)
F. varia var. *minor* Neilr., Fl. Nieder-Österr.: 79 (1859)
F. pumila var. *minor* (Neilr.) Litard., Candollea, 10: 114 (1945)
F. pumila var. *minor* subvar. *villarsii* (St.-Yves) Litard., Candollea, 10: 115 (1945)
F. pumila var. *minor* subvar. *rigidior* (Mutel) Litard., Candollea, 10: 115 (1945)

Pianta alta (6) 15-20 (30) cm, cespitosa in piccoli ciuffi serrati, non rizomatosa raram. pseudostolonifera. Innovazioni intravaginali. Culmo filiforme, gen. scabro verso l'alto. Ligula delle foglie caulinari 0.5-1.5 mm.

Lamina delle innovazioni (2) 6-12 (20) cm, setacea, flessibile, liscia, talvolta scabra verso l'apice, raram. su tutta la lunghezza, da verde a glaucescente, non pruinosa. Sezione fogliare (0.4) 0.6-0.7 (0.8) mm di diametro, poligonale, 5 (7) fasci vascolari, 1 costa, talvolta 2 appena accennate, solco intercostale poco profondo, sclerenchima in isolotti separati, di piccole o medie dimensioni, talvolta confluenti fino a formare un anello continuo, spesso non più di 1-2 strati sui fianchi; tricomi da corti a medi, gen. abbastanza abbondanti. Pannocchia (2) 3-4 (5,5) cm, da ± contratta a lassa, eretta, con poche spighette, rami scabri, passante di poco le innovazioni. Spighette 6.5-9 (10) mm, ellittiche, (2) 3-5 fiori (dei quali 3 verso la base, 5 verso l'alto), screziati di verde, giallo e violetto intenso. G1 circa 2.8 mm. G2 3.8-5.2 mm, ovale-lanceolata, lungamente acuminata, con banda violacea ± larga ed intensa. Lemma (3) 4-6 (7.2) mm, largamente lanceolato, scabro, scarioso nel 1/4 superiore, con una banda violacea ± larga ed intensa, glabro o scabriuscolo, con resta di 0.5-1 (1.3) mm, talvolta ridotta ad un mucrone o nulla. Antere 2-2.5 mm.

Praterie discontinue, pendii rupestri, ghiaioni grossolani, essenzialmente su calcare. - In tutto l'arco alpino, dalle A. Giulie al Piem.: C. (1500 - 3500 m). - Pascoli alpini su calcare, in stazioni soleggiate e calde: Alpi Orient. nella fascia alpina, scende sporadicam. nella fascia subalp., sempre su calcare o dolomia. Suolo umo-carbonatico poco profondo ma ben evoluto con orizz. A ricco di materia organica grezza. Specie caratt. del Seslerion albicantis, anche su ghiaioni consolidati. – Fi. VI-VIII – Orofita sud Europea.

2n = 14, 28.

11. F. sardoa (Hack. in Barbey) K. Richt., Pl. Europ., 1: 104 (1890) - ●

Sinonimi

F. varia Haenke subsp. *sardoa* Hack., in Barbey Fl. Sard. Comp.: 71-72 (1885).
F. pumila subsp. *sardoa* (Hack. in Barbey) Litard., (1945) Candollea, 10: 115.
F. pumila Chaix in Vill. var. *sardoa* (Hackel) Fiori in Fiori e Paoletti, Fl. Anal. Ital., 1: 93 (1896).

Pianta alta (12) 15-20 (37) cm, densamente cespitosa, non rizomatosa. Culmo alto 10-15 (20) cm, Ligula delle foglie caulinari 0.5-1 mm. Innovazioni intravaginali. Lamina delle innovazioni (2.5) 10-20 (25) cm, da capillare a subsetacea, flessibile, liscia, verde, non pruinosa. Sezione fogliare (0.3) 0.4-0.6 mm, da ellittico-cordiforme a ± poligonale, 5-7 fascetti, 1 costa ma talvolta altre 2 appena abbozzate, solco intercostale poco profondo, sclerenchima continuo, sottile 1-2 strati sui fianchi, talvolta interrotto in isolotti decorrenti, tricomi da corti a medi, poco abbondanti. Pannocchia (2) 3-5 (7) cm, lassa, eretta o inclinata, gen. munita di un'appendice fogliacea alla base, da giallastra a verde-giallastra, scariosa, superante da poco a mediamente le innovazioni. Spighette (8) 9-10 mm, 3-5 fiori, giallastri. G1 circa 3.6-4.3 mm. G2 circa 4.5-4.7 mm, mucronata. Lemma (5.2) 6-7 mm, glabro, scarioso, con resta di (1) 1.5-2 (2.2) mm, talvolta ridotta ad un mucrone. Antere 1.5-2 mm.

Pendii rupestri, rupi. - Sard. al M. Limbara: C. (800 - 2000 m). Specie guida del Festuco sardoae-Phyteumetum serrati. In Sardegna vegeta in formazioni attribuibili al Potentillion crassinerviae – Fi. V-VII – Endemica Sardo-Corsa.

2n = 14.

12. F. flavescens Bellardi, App. Fl. Pedem.: 11 (1792) - ●

Sinonimi

F. varia Haenke subsp. *flavescens* (Bell.) Hack., Bot. Centralbl., 8: 408 (1881).
F. pumila var. *flavescens* (Bell.) Fiori, Nuova Fl. Anal. Ital, 1: 138 (1923).
F. varia Haenke var. *firmior* Belli et Hack. ex Belli, Malpighia 14:303 (1900).
F. varia Haenke subsp. *flavescens* var. *aemula* Hack. ex St.-Yves, Ann. Cons. Jard. Bot. Genève 17: 187,197-198 (1913)
F. pumila subvar. *aemula* (St.-Yves) Litard., Candollea, 10: 114 (1945)

Pianta alta (25) 40-60 (70) cm, densamente cespitosa, eretta, non rizomatosa raram. pseudostolonifera. Culmo 20-50 cm, scabro sotto la pannocchia. Innovazioni intravaginali. Ligula delle foglie caulinari 0,5-1 mm. Lamina delle innovazioni 1.5-15 cm, le altre (5) 10-50 (65) cm, capillare flessibile, scabra, verde, non pruinosa. Sezione fogliare (0.3) 0.4-0.5 mm di diametro, da ± ellittica a poligonale, 5 fascetti, 1 costa, solco intercostale poco profondo, sclerenchima in isolotti, tricomi da medi a lunghi, abbastanza abbondanti. Pannocchia (4) 6-10 (14) cm, lassa, da eretta a inclinata, con rami capillari da finemente villosi a scabri, passante da poco a mediamente le innovazioni. Spighette (8) 9-11 (12) mm, (3) 4-5 (6) fiori, giallastri, raram. variegati di violetto. G1 3.4-4 mm. G2 4.4-5.3 mm, da lanceolata a ovale-lanceolata, da brevemente acuminata a subottusa. Lemma (5.5) 6-7 mm, glabro, scarioso, con resta lunga fino a 0.8 mm. Antere circa 2.5-3 mm.

Pendii rupestri, fessure delle rocce, peccete rade, boschi di larice. - Alpi Occ. a nord fino a Cogne, alle A. Maritt.: C, ma da ricercare in Lig. (500 - 2500 m). - Bosco misto di conifere e faggio (abeti-faggeta) in vallate a clima oceanico nell'ecotono nebbioso tra fascia montana e subalpina. Nel sottobosco, in ambiente ombroso, freddo e umido. Suolo: una terra bruna profonda subacida-acida, lisciviata e talora podsol. Sulle Alpi Maritt. specie caratt. del Veronico urticifoliae-Abietetum (Abieti-Piceion). – Fi. V-VIII – Endemica: Alpi occidentali.

2n = 14.

18c.-18d. Sect. Aulaxyper (sp. **13-23**) **+ Sect. Festuca** (sp. **24-57**)

All'interno delle sect. *Aulaxyper* e *Festuca* la differenziazione dei gruppi più avanzati da precursori con genomi di piccole dimensioni ha portato alla formazione di entità poliploidi (allo- e autopoliploidi) senza grandi incrementi del genoma.
All'interno della sect. *Aulaxyper* il gruppo "violacea" è quello che riunisce il maggior numero di diploidi, ha un genoma monoploide di medie dimensioni ma più grande rispetto a quello delle specie del gruppo "rubra" in gran parte esaploidi, ma anche ottoploidi e decaploidi e che sono legate ad habitat meno "naturali".
Nella sect. *Festuca* si potrebbe intravedere nel gruppo "halleri" quello più primitivo, molte specie diploidi corrispondono a genomi di medie dimensioni, sono in gran parte legate alla regione Mediterranea. Ma le cose si complicano all'interno degli altri gruppi dove varie coppie mono-poliploidi possono essere individuate e ciascuna ha avuto un suo modo di evolversi. In alcuni casi le differenze fra diploidi e polipoidi sono molto scarse e questo si verifica nei gruppi a genoma monoploide di piccole dimensioni, come nel griuppo "stricta-valesiaca" dove a livelli di ploidia diversi non corrispondono evidenti differenze morfologiche.
La formazione di nuovi habitat sia da parte dell'uomo, sia nelle regioni montuose in seguito al ritiro dei ghiacciai legati alle varie fasi glaciali e interglaciali, ha permesso l'incontro di entità affini che possono aver generato per allopoliploidia (Smarda & al., 2007) e la stabilizzazione di alcuni morfotipi che fra loro mostrano solo piccole differenze di tipo quantitativo.
Su questa situazione bio-ecologicamente "intricata" si sono innestate le interpretazioni della variabilità osservata da parte dei vari AA che si sono occupati di questo genere nel tentativo di produrre uno schema di facile lettura di questa diversità.
Gli schemi prodotti non sempre si sono mostrati adeguati a spiegare i modelli di variabilità, anche per la scarsa aderenza alle regole imposte dal Codice di Nomenclatura, al cui rispetto ogni tassonomo dovrebbe cercare di adeguarsi.
Quello che proponiamo è un ulteriore schema, anch'esso provvisorio perchè lo sviluppo della conoscenza è sempre in divenire, sperando che possa servire per invogliare altri botanici a studiare queste piante.

18c. Sect. Aulaxyper Dumort., Observ. Gram. F. Belg.: 102-104 (1824)

Piante a cespi più o meno lassi, rizomatose, con getti delle innovazioni miste. Guaine fuse a formare un tubo. Ligula appena evidente, quasi mai espansa in due orecchiette visibili.

18c1. gruppo di F. violacea (sp. **13-18**)

Piante in genere di piccole dimensioni, legate a prati alpini o subalpini, su silice o su calcare. Piante diploidi (2n = 14) la cui differenziazione potrebbe essere fatta risalire al ritiro dei ghiacciai pleistocenici. A questa regola generale fanno eccezione *F. norica* e *F. melanopsis* che invece sono specie di medie (grandi

dimensioni), poliploidi (*F. norica* presenta tre citotipi 2n = 14, 28 e 42) la cui origine potrebbe essere ricercata nella formazioni di ibridi con popolazioni del gruppo "rubra" (Pils, 1980), da cui le maggiori dimensioni ed il colore che non è tipicamente di bel verde brillante ma di un verde opaco e la loro minore ristrettezza ecologica, fino a diventare quasi sinantropica in *F. melanopsis*.
Per ulteriori informazioni, rispetto a quelle qui riportate, si rimanda alla revisione del gr. "violacea" (Foggi & al., 1999).

13. F. violacea Gaudin, Alpina (Winterthur), 3: 57 (1808)
(**a**) subsp. **violacea**

Sinonimi

F. rubra L. var. *violacea* (Gaudin) Hack., Bot. Centralbl. 8: 406 (1881)
F. rubra L. subsp. *violacea* (Gaudin) Hack., Bot. Centralbl. 8: 406 (1881)
F. rubra L. subvar. *schleicheri* St.-Yves, Bull. Soc. Bot. Fr., 71: 121 (1924)
F. rubra L. subvar. *aurata* Hack., Monogr. Festuc. Eur.: 133 (1882).
F. violacea subsp. *aurata* K. Richt., Pl. Europ. 1: 98 (1890).
Schedonorus violaceus (Gaudin) P. Beauv., Ess. Agrost.: 177 (1812)

Pianta alta 10-30 (40) cm, a cespi densi, talvolta con getti sterili ascendenti, talvolta stoloni brevi. Culmo (5)10-25 (35) cm. Innovazioni miste, più abbondanti le intravaginali. Ligula brevissima senza orecchiette. Guaine chiuse su tutta la lunghezza, fini, rossastre, dissolventisi in fibre longitudinali, glabre. Lamina delle innovazioni (3) 5-10 (14) cm, breve, eretta, non rigida, liscia o appena scabrida all'apice, di colore verde brillante. Lamina del culmo gen. convoluta. Sezione fogliare (0.21) 0.25-0.45(0.52) mm, a V irregolare, poligonale, (3) 5 fasci vascolari, sclerenchima in 5-7 blocchi, di piccole dimensioni, (3) 5 coste, tricomi da sparsi a densi lunghi, cellule epidermiche di grandi dimensioni. Pannocchia 3-7 (8) cm, gen. breve eretta, contratta. Spighette (5.5) 6-7.5 (8.1) mm, 3-4 (5) fiori, verde brillante ± sfumate di violetto fino al nerastro, talvolta giallastro-dorate. G1 (1.8) 2.2-3.2 (3.8) mm. G2 (2.9) 3.2-4.5 (5.1) mm, da acuta a cuminata, con margine appena scarioso. Lemma (3.5) 4-5 (5.8) mm, resta 1-2 (2.5) mm. Antere (1.5) 1.8-2.5 mm.

Praterie mesofitiche, neutrofile, ghiaioni consolidati, rupi umide. - Alpi, con baricentro occid., dalla Lomb. e Ticino alla Lig.: Diff. (1700 - 3400 m). – Fi. VI-VIII – Endemica: Alpi occidentali.

2n = 14.

(**b**) subsp. **puccinellii** (Parl.) Foggi, Graz.Rossi et Signorini, Can. J. Bot., 77 (7): 1004 (1999) - ●

Sinonimi

F. rubra var. *puccinellii* (Parl.) Fiori in Fiori et Paoletti, Fl. Anal. Ital., 1:91 (1896)
F. halleri sensu Bertolonii, Fl. Ital., I: 607 (1833) p.p. non All.,
F. halleri sensu Puccinelli, Giorn. Bot. Ital., 1 (1): 121 (1842) non All.
F. violacea sensu Caruel, Prodr. Fl. Toscana: 741 (1860) non Schleich.
F. rubra var. *nigricans* Hack., Monogr. Festuc. Eur.: 135 (1882) non Schleicher,
F. nigricans (Hack.) K.Richt., Pl. Europ.: 99 (1890) nom. illeg.
F. rubra var. *violacea* Bolzon, Fl. Prov. Parma:13 (1921) non Schleich. ex Gaud.
F. rubra subsp. *violacea* Negodi, Atti Soc.Nat. e Mat., Modena, 75: 15 (1944) non Schleich. ex Gaud.

Pianta alta 15-50 cm, a cespi lassi, usualmente con getti sterili ascendenti, talvolta stoloni brevi. Culmo (10) 15-35 (40) cm. Innovazioni miste, più abbondanti le intravaginali. Ligula brevissima senza orecchiette. Guaine chiuse su tutta la lunghezza, fini, rossastre, dissolventisi in fibre longitudinali, glabre. Lamina delle innovazioni setacea, non rigida, liscia o appena scabrida all'apice, di colore verde brillante. Lamina del culmo piana o debolmente convoluta. Sezione fogliare (0.35) 0.4-0.6 mm, a V irregolare, esagonale, 5 fasci vascolari, sclerenchima in 7 piccoli blocchi, 5 coste, tricomi da sparsi a densi lunghi, cellule epidermiche di grandi dimensioni. Pannocchia (3) 4-7 cm, gen. breve e non molto ampia. Spighette (8) 8.2-9.3 mm, (3) 4-6 fiori, verde brillante ± sfumate di violetto fino a diventare nerastre. G1 (2.5) 3.2-4 mm. G2 (3.8) 4.1-5.4 mm, scarsamente acuminata, con margine appena scarioso. Lemma 5.5-6.5 (7) mm, resta (2.5) 3-4 mm. Antere (2.5) 2.7-3 (3.3) mm.

Praterie mesofitiche, neutrofile, ghiaioni consolidati, rupi umide. - Alpi Apuane, App. Tosco-Emiliano: C, Falterona: RR. (1000 - 2100 m). – Fi. VI-VIII– Endemica: Appennino settentrionale.

2n = 14.

(**c**) subsp. **italica** Foggi, Graz.Rossi et Signorini, Fl. Med. 8: 31-36. (1998) - ●
Sinonimi
F. rubra L. var. *puccinellii* (Parl.) Fiori in Fiori et Paoletti, 1: 91 (1896) p. p.
F. violacea subsp. *macrathera* sensu Markgraf-Dannenberg, Fl Eur. 5: 139 (1980) p.p.
F. rubra L. var. *nigricans* sensu Fiori, N. Fl. Anal. Ital., 1: 136 (1923) p.p.
F. rubra L. var. *violacea* sensu Fiori, N. Fl. Anal. Ital., 1: 136 (1923) p.p.

Pianta alta 10-30 cm, a cespi densi, talvolta con getti sterili ascendenti, talvolta stoloni brevi. Culmo (11) 15-25 (28) cm. Innovazioni miste, più abbondanti le intravaginali. Ligula brevissima senza orecchiette. Guaine chiuse su tutta la lunghezza, fini, rossastre, dissolventisi in fibre longitudinali, sparsamente pelose con piccoli peli radi ricurvi in basso. Lamina delle innovazioni 3-10 cm, breve, rigida, talvolta ricurva, liscia o appena scabrida all'apice, di colore verde brillante. Lamina del culmo gen. convoluta. Sezione fogliare (0.18) 0.3-0.5 (0.65) mm, a V irregolare, esagonale, 3-5 fasci vascolari, sclerenchima in 5-7 blocchi, quello mediano gen. di maggiori dimensioni, 3-5 coste, tricomi da sparsi a densi lunghi, cellule epidermiche di grandi dimensioni. Pannocchia 3-5 (5,5) cm, gen. breve eretta, contratta. Spighette (6.1) 6.5-8.2 (8.6) mm, 3-5 (6) fiori, verde brillante ± sfumate di violetto. G1 2.7-4 (4.6) mm. G2 3.7-5.3 (5.6) mm, acuta, con margine appena scarioso. Lemma (4) 4.2-5.6 (5.9) mm, resta (1.9) 2.2-3.7 (4.5) mm. Antere (1.8) 2.2-3 (3.2) mm.

Praterie mesofitiche, neutrofile, ghiaioni consolidati, rupi umide. - App. Centr. e Merid. dal M. Catria al Pollino: R. (1500 - 2600 m). – Fi. VI-VIII– Endemica: Appennino centrale e meridionale.

2n = 14.

14. F. nitida Kit. ex Schultes, Oesterreichs Fl., ed. 2, 1: 239 (1814) subsp. **nitida**
Sinonimi
F. rubra L. subvar. *carnica* Hack., Mon. Fest. Eur.: 133 (1882)
F. violacea subsp. *minor* Hack., Termesz. Fuz., 2: 290 (1878)
F. carnica (Hack.) Fritsch, Excursionfl. Oesterr.: 65 (1897)
F. violacea var. *carnica* (Hack.) Hayek, Mitt. Naturwiss. Vereins Steiermark 40: 216 (1904)
F. violacea var. *nitida* (Kit. ex Schult.) Hegi, Ill. Fl. Mitteleur., ed. 1, 1(10): 339 (1908)
F. violacea var. *minor* (Hack.) Dalla Torre et Sarnth., Fl. Grafsch. Tirol 6: 260 (1906)

Pianta alta (15) 20-40 cm, lassamente cespitosa, con rizomi ± lunghi, getti vegetativi prostrato-ascendenti. Culmo (10) 20-30 cm, gen. da peloso a densamente peloso almeno nella parte distale. Innovazioni miste, ma soprattutto extravaginali. Guaine chiuse su tutta la lunghezza, scarsamente dissolventisi in fibre, gen. rossastre. Ligula cortissima, senza orecchiette. Lamina delle innovazioni (7) 10-30 cm, molle, liscia. Lamina del culmo talvolta piana. Sezione fogliare (0.25) 0.3-0.5 (0.6) mm, V aperto irregolarmente esagonale, (4) 5 fasci vascolari, 3 (5) coste, tricomi sparsi brevi, (5) 7 blocchi sclerenchimatici di piccole dimensioni, cellule epidermiche larghe o molto larghe. Pannocchia 3-6 cm, ampia, ± eretta, con rami pubescenti. Spighette (5.5) 5.8-7 (8) mm, 3-5 fiori, verde chiaro, talvolta variegate di violetto, talvolta giallastro chiaro. G1 2-3.1 (3.5) mm. G2 3-4 (4.8) mm, acuminata, Lemma (3.4) 3.6-4.8 (5.5) mm, largamente lanceolato, ± scabrido nella parte distale, raram. peloso, resta (0) 0.2-1.2 (1.7) mm. Antere 1.7-2.5(2.8) mm.

Praterie montane, subalpine e alpine, rupi e ghiaioni, su calcare. - Alpi Or., dalle A. Giulie alla Val Gardena: R. (700 - 2500 m). – Fi. VI-VII – Endemica: Alpi orientali.

2n = 14.

15. F. picturata Pils, Pl. Syst. Evol., 136 (1-2): 92-93 (1980)
Sinonimi
F. picta Kit. ex Schultes, Oesterreichs Fl., II ed., 1: 236 (1814) J. F. Gmel.

F. rubra L. subsp. *violacea* var. *picta* (Kit. ex Schultes) Hack., Bot. Central., 8: 406 (1881)
F. violacea var. *picta* (Kit. ex Schultes) Nyman, Consp. Fl. Europ.: 828 (1882)
F. violacea subsp. *picta* (Kit. ex Schultes) Hack. ex Hegi, Ill. Fl. Mitteleurop., 1: 339 (1908)
F. violacea subsp. *major* Hack., Termesz. Fuz., 2(4): 291 (1878)
F. picta var. *crassa* Nyarady, Acta Bot. Szeged., 1: 34 (1942)

Pianta alta 25-40 (50) cm, lassamente cespitosa, con rizomi ± lunghi, getti vegetativi prostrato-ascendenti. Culmo 15-40 cm, gen. da peloso a densamente peloso almeno nella parte superiore. Innovazioni miste, ma soprattutto extravaginali. Guaine chiuse su tutta la lunghezza, scarsamente dissolventisi in fibre, gen. marroni. Ligula cortissima, senza orecchiette. Lamina delle innovazioni 10-25 cm, molle, liscia, verde chiaro. Lamina del culmo talvolta piana. Sezione fogliare (0.4) 0.5-0.7 (0.82) mm, V aperto irregolarmente esagonale, 5 (7) fasci vascolari, 3-5 coste, tricomi sparsi brevi, 7 (9) blocchi sclerenchimatici di piccole dimensioni, cellule epidermiche larghe o molto larghe. Pannocchia 4-8 cm, ampia, ± eretta, con rami pubescenti. Spighette (5.8) 6.2-7.4 (8.5) mm, 3-5 fiori, verde chiaro, talvolta variegate di violetto fino al violetto-nerastro. G1 2-3 mm. G2 (2.5) 3-3.4 (4) mm, ottusetta. Lemma (3.5) 4.2-5 (5.7) mm, largamente lanceolato, ± scabrido nella parte distale, resta (1) 1.3-2.3 (2.6) mm. Antere (1.7) 2-2.5 (3) mm.

Arbusteti radi, praterie montane, subalpine e alpine, su silice. - Alpi orientali nello Zoldano (Spitz di Mezzodì) e Val di Fassa: R; segnalata anche sulle Alpi Giulie e Carn.* (1700 - 2500 m). – Fi. VI-VII – Sud Est Eurasiatica.

2n = 14.

16. F. norica (Hack.) K. Richt., Pl. Europ., 1: 99 (1890)
Sinonimi
F. rubra var. norica Hack., Mon. Fest. Eur.: 135-136 (1882)
F. violacea subsp. *norica* (Hack.) Hack. ex Hegi, Ill. Fl. Mitteleurop., 1: 339 (1908)
F. amethystina var. *norica* (Hack.) St.-Yves, Bull. Soc. Bot. Fr., 71:125 (1924).

Pianta alta 20-70 cm, densamente cespitosa, con rizomi brevi. Culmo 15-50 cm. Innovazioni miste, ma soprattutto extravaginali. Guaine chiuse su tutta la lunghezza, con replo usualmente spesso 2 cellule profondamente ripegato verso l'interno, scarsamente dissolventesi in fibre, gen. rossastra. Ligula cortissima, senza orecchiette. Lamina delle innovazioni 10-50 cm, subsetaceo-robuste, lisce o talvolta scabre almeno in alto, con coste evidenti. Lamina del culmo talvolta piana. Sezione fogliare (0.4) 0.5-0.8 (1.1) mm, V aperto irregolarmente esagonale o a U con margini convoluti, lateralmente rotondata, (6) 7-9 (11) fasci vascolari, 5-7 coste, tricomi sparsi brevi, blocchi sclerenchimatici (8) 9-11 (13), di piccole dimensioni, raram. 7 piccoli (popolazioni occidentali) oppure in trabecole o pilastri (popolazioni orientali), cellule epidermiche larghe. Pannocchia 5-10 cm, ampia, debolmente curvata. Spighette (5.5) 7-9.5 (10.2) mm, (3) 4-5 (9) fiori, verde opaco, talvolta variegate di violetto, talvolta glauco-pruinose. G1 (2) 3.2-4.2 (4.6) mm. G2 (3.4) 4-5.8 (6.2) mm, acuminata, Lemma (4) 4.5-6.5 (7) mm, largamente lanceolato, ± scabrido nella parte distale, raram. con margini pelosi, resta (0.6) 1.2-3.2 (4) mm. Antere (1.8) 2.1-3.3 (4) mm.

Prati aridi, rupi, ghiaioni, soprattutto su calcare, raramente su substrati silicei. – Alpi Or. dalle Giulie al Lago di Como: C. (1400 - 2500 m). - Pascoli alpini su calcare, in stazioni soleggiate e calde: Alpi Orient. nella fascia alpina e subalp., sempre su calcare o dolomia. Suolo umo-carbonatico profondo, ben evoluto, ricco di materia organica e con tendenza a formare un orizzonte profondo di dilavamento (spesso poco visibile). Specie caratt. del *Seslerion albicantis*. – Fi. VI-VII– Endemica: Alpi centrali e orientali.

2n = 14, 28, 42.

17. F. nigricans (Hack.) K. Richt., Pl. Europ., 1: 99 (1890)
Sinonimi
F. rubra var. *nigricans* Hack., Bot. Centralbl., 8: 406 (1881)
F. violacea subsp. *nigricans* (Hack.) Hegi, Ill. Fl. Mitteleur., 1: 342 (1908)

F. nigrescens Gaudin, Agrost. Helv., 1: 254 (1811), non Lam., Encycl. Méth. Bot. 2: 460 (1788)
F. puccinellii sensu Markgraf-Dannenberg Fl. Eur., 5: 139 (1980) non Parl.
F. melanopsis Foggi, Graz.Rossi et Signorini, Can. J. Bot., 77 (7): 1001 (1999).

Pianta alta 30-60 (70) cm, cespitosa, con brevi rizomi. Culmo (25) 40 (50) cm, talvolta con peli sparsi sotto la pannocchia. Innovazioni miste. Guaine chiuse su tutta la lunghezza, scarsamente dissolventisi in fibre, gen. rossastre. Ligula cortissima, senza orecchiette. Lamina delle innovazioni 20-30 (50) cm, non molto rigida, ± scabra nella parte distale. Sezione fogliare (0.37) 0.4-0.7 mm, V aperto irregolarmente poligonale-rotondata, 5 (7) fasci vascolari, 5 coste, tricomi sparsi brevi, 7 blocchi sclerenchimatici il mediano leggermente maggiore degli altri, cellule epidermiche mediamente larghe. Pannocchia (5) 7-11 (13) cm, ampia, ± eretta. Spighette (7.5) 7.9-9.8 (10.3) mm, (3) 4-6 (7) fiori, verde opaco, talvolta variegate di violetto fino a violetto-nerastro. G1 (2.7) 3.1-4.5 (4.7) mm. G2 (3.5) 4.1-6 (6.5) mm, acuminata, con margine strettamente scarioso, Lemma (4.7) 5.2-7 (7.5) mm, ± scabrido nella parte distale, raram. peloso, resta (1) 2.8-3.6 (4.6) mm. Antere 2.9-3.6 (4) mm.

Praterie montane, subalpine e alpine, indifferente al substrato, preferente la silice. – Alpi, dalle Dolom. (estremo orient. a Sesto/Sexten) alla Lig.: C. (1000 - 2800 m). - Pascoli alpini su calcare, in stazioni soleggiate e caldo-umide, nella fascia subalpina e alpina. Suolo neutro-subacido, umo-carbonatico, profondo, ricco di materia organica grezza. Specie caratt. dei Seslerietalia albicantis, a volte anche nei pascoli acidoclini (Festucion variae) oppure su ghiaioni consolidati.– Fi. VI-VIII– Endemica Alpica.

2n = 42.

18. F. heterophylla Lam., Fl. Fr., ed. 1, 3: 600 (1779) subsp. **heterophylla**

Pianta alta (50) 60-100 (150) cm, densamente cespitosa, molto frondosa alla base, eretta, verde, non rizomatosa. Culmo eretto, leggermente genicolato alla base, con 2-3 nodi. Innovazioni miste perlopiù intravaginali.Guaine chiuse su tutta la lunghezza, lisce. Ligula 0.3-0.5 mm. Lamina delle innovazioni (6) 20-45 (60) cm, capillare, flessibile, scabra, verde, non pruinosa. Lamina caulinare (3) 10-20 (30) cm, piana. Sezione fogliare 0.3-0.6 mm, triangolare-quadrangolare a losanga, a volte ± esagonale, 3 (5) fasci vascolari, 1 costa, solco intercostale mediamente profondo, sclerenchima in piccoli blocchi, tricomi medi poco abbondanti. Pannocchia 6-20 cm, lassa, pendente, unilaterale, asse e rami angolosi e scabri, rami inferiori accoppiati, passante mediamente le innovazioni. Spighetta 8-10 mm, 2-5 (7) fiori, verde pallido. G1 3-5.5 mm. G2 4-6.5 (7) mm, sovente mucronata. Lemma (4.7) 5-6.5 (8.5) mm, glabro, da lanceolato a strettamente oblungo di profilo, con bordi membranosi stretti, resta (1.5) 2-5 (6) mm. Antere 2.5-4.5 mm.

Boschi e arbusteti soprattutto acidofitici, bordi dei sentieri. - *In tutto il territorio: C.* (0 - 1800 m). - Diffusa nei boschi di latifoglie decidue in clima temperato dalla pianura alla fascia montana, con ampie penetrazioni in area mediterranea. Suolo mesofilo, oppure acidoclino, generalm. terra bruna ricca di materia organica, neutro-subacida. Specie caratt. dei *Querco-Fagetea*, si presenta nel sottobosco, spesso nelle faggete. – Fi. IV-VI – Eurasiatica.

2n = 14.

18c2. gruppo di F. trichophylla (sp. 19-20)

Piante di medie e grandi dimensioni; innovazioni miste; rizomi presenti e ben evidenti, talvolta a formare degli "pseudostoloni". Caratteristica di questo gruppo è la presenza di piccoli dentelli fra le cellule epidermiche (x 100-200). Rispetto alle specie del gruppo "violacea" si riconoscono per il rizomi ben evidenti e le cellule epidermiche di medie-grandi dimensioni; rispetto alle specie del gruppo "rubra" si distinguono per la presenza di blocchi sclerenchimatici di dimensione ineguale. Le specie di questo gruppo si riconoscono con sicurezza solo dopo l'osservazione 2n= 42. Piante di ambienti naturali.

19. F. trichophylla (Ducros ex Gaudin) K. Richt., Pl. Europ., 1: (1890)

(**a**) subsp. **trichophylla**

Sinonimi
F. rubra ? *trichophylla* Ducros ex Gaud., Fl. Helvet., 1: 288 (1828)
F. rubra subsp. *eu-rubra* var. *trichophylla* (Ducros ex Gaud.) Hack., Monogr. Festuc. Eur., (1882)
F. rubra var. *trichophylla* Fiori, N. Fl. Anal. Ital., 1: 136 (1923) nom. illeg.
? *F. pseudotrichophylla* Patzke, Decheniana, 117: 195 (1964)

Pianta alta 30-70 cm, in piccoli cespi lassi, con rizomi lunghi. Culmo 25-50 cm, gracile 0.4-1.4 mm di diametro, giallo chiaro. Innovazioni miste, più abbondanti le extravaginali. Guaine chiuse su tutta la lunghezza, fini, rossastre, lucenti, glabre. Ligula brevissima, senza orecchiete. Lamina delle innovazioni (3) 10-30 (50) cm, capillaceo-setacea, liscia, verde brillante. Lamina del culmo (3) 5-8 (15) cm, gen. piana. Sezione fogliare (0.2) 0.3-0.5 (0.6) mm, a V, poligonale, irregolare con carena evidente ma arrotondata, (3) 5 fasci vascolari, (3) 5-7 blocchi di sclerenchima ineguali in grandezza, talvolta confluenti, in genere quello mediano e i marginali più grandi, coste 1-3 talvolta con qualche cellula sclerenchimatica, tricomi lunghi e sparsi, cellule epidermiche grandi con piccole ondulazioni fra cellule adiacenti (200 x). Pannocchia (3) 5-8 (15) cm, ± contratta, ± eretta, rami molto fini, passante da poco a mediamente le innovazioni. Spighette (5.5) 7-8 (9) mm, 3-5 (8) fiori, verde chiaro a volte variegate di violetto. G1 2.7-4 mm. G2 4-5.7 mm. Lemma (3.6) 5- 6.2 mm, glabro, strettamente lanceolato, verde chiaro o leggermente screziato di violetto, scabro verso l'apice, resta da nulla a breve (1.5 mm). Antere 2.2 mm.

Praterie pingui, bordi dei fiumi. – Alpi, Appennini e Sic.: C.* (200 - 1700 m). – Fi. V-VII – Sud Europea.

2n = 42.

(**b**) subsp. **asperifolia** (St.-Yves) Al Bermani in Al Bermani et al., Anales Jard. Bot. Madrid, 50 (2): 219 (1992)

Sinonimi
F. rubra subvar. *asperifolia* St.-Yves, Ann. Cons. Jard. Bot. Geneve, 17: 125 (1913)
F. rubra var. *asperifolia* (St.-Yves) Markgr.-Dann., Kart. der Schweiz. Fl.: 80 (1968)
F. rubra subsp. *asperifolia* (St.-Yves) Markgr.-Dann. Veroff., Geobot. Inst. ETH Stiftung Rubel, 56: 143 (1976)

Pianta alta fino a 80 cm, ± lassamente cespitosa, con rizomi da medi a brevi. Culmo 15-50 cm, sottile. Innovazioni miste, più abbondanti le extravaginali. Guaine chiuse su tutta la lunghezza, fini, rossastre, sparsamente pelose per peli brevi. Ligula brevissima, senza orecchiete. Lamina delle innovazioni lunghe, scabra su tulla la lunghezza, verde brillante. Lamina del culmo ± piana. Sezione fogliare (0.6) 0.7-1.1 (1.3) mm, a V irregolare con carena evidente ma arrotondata, 7-9 fasci vascolari, 7-9 (11) blocchi di sclerenchima ineguali in grandezza, in genere quello mediano e i marginali più grandi, coste 5-9 talvolta con blocchi di sclerenchima o cellule sclerenchimatiche sparse, tricomi lunghi e sparsi, cellule epidermiche grandi con piccole ondulazioni fra cellule adiacenti (200 x). Pannocchia 10-20 cm, da ampia a lineare contratta. Spighette (7) 8-9 (11) mm, talvota suffuse di violetto. G1 2.5-4 mm. G2 4-5 mm. Lemma 5-6 (6.5) mm, resta 1.5-2.5 mm. Antere 3-3.5 mm.

Praterie magre, acidofitiche, montane. – Rilievi alpini ed appenninici e Sic.: C. (800 - 2000 m). – Fi. V-VII – Orofita Sud Europea.

2n = 42.

20. F. cyrnea (St.-Yves et Litard.) Signorini, Foggi et Nardi, Taxon, 52(3): 591-594 (2003)

Sinonimi
F. rubra var. *cyrnea* St.-Yves et Litard. in St.-Yves, Candollea 1: 20; 62 (1922).
F. cyrnea (St.-Yves & Litard.) Markgr.-Dann., Bot. J. Linn. Soc. 76: 327 (1978), nom. inval.
F. vizzavonae Ronniger, Verh. Zool.-Bot. Ges. Wien, 68: 226 (1918).

Pianta alta 20-40 cm, ± densamente cespitosa, rizomi brevi, pseudostolonifera. Culmo 15-30 cm. Innovazioni miste intravaginali ed extravaginali. Guaine chiuse su tutta la lunghezza, con brevi peli sparsi retrorsi. Ligula più breve di 0.5 mm. Lamina delle innovazioni (2) 4-10 (18) cm, capillari-setacee, rigidette, apice ± pungente, scabretta almeno nella parte distale, verde-grigiastra non pruinosa, talvolta con lunghi peli sparsi in basso. Sezione fogliare (0.3) 0.4-0.6 mm, a V compatto-poligonale, (3) 5 (7) fasci vascolari, 3-5 (7) blocchi sclerenchimatici, di forma e consistenza diseguale, in genere i marginali maggiori e i laterali più piccoli, talvolta ± confluenti, cellule epidermiche di grandi dimensioni con piccole ondulazioni fra cellule adiacenti (200 x). Pannocchia 3-7 (9) cm. Spighette (6.5) 7-9 (10) mm, 3-5 (6) fiori. G1 2.5-4 mm. G2 4-5 (6) mm, con largo margine scarioso. Lemma (4.7) 5-6.5 (6.9) mm, scabrido nella parte distale, gen. screziato di violetto, resta 1-2.5 (3) mm. Antere (2) 2.3-2.8 mm.

Prati, pascoli aridi. - Appennino dalle Alpi Apuane all'Aspromonte: R. (800 - 1500 m). – Fi. V-VII – Orofita sud Europeo-Mediterranea.

2n = 42.

Nota - Specie mal conosciuta e recentemente oggetto di chiarimenti nomenclaturali abbastanza complessi che hanno interessato anche "*F. vizzavonae*", una entità fino a poco tempo addietro mal interpretata (Foggi & Signorini, 1997; Signorini & al., 2003 a, b). Forse più comune di quanto non si conosca, da ricercare nelle praterie di mezza montagna di tutto l'Appennino.

18c3. gruppo di F. rubra (sp. 21-23)

Piante di medie dimensioni, da cespitose, per rizomi molto brevi, a anche lungamente rizomatose; innovazioni miste. Piante di colore verde opaco, talvolta grigiastre. 2n = 42-56. In genere le cellule epidermiche sono piccole, i blocchi sclerenchimatici di dimensioni simili fra loro; questo con l'eccezione di F. rubra subsp. juncea che presenta caratteri intermedi con le specie del gruppo "trichophylla". Specie di ambienti naturali o antropizzati, talvolta usate nei rinverdimenti. E' il gruppo di festuche con maggiori incertezze tassonomiche dovute anche alla presenza di cultivar di dubbia origine.

21. F. rubra L Sp. Pl.: 74 (1753)
(**a**) subsp. **rubra**

Sinonimi

F. dumetorum L., Sp. Pl., ed. 2: 109 (1762)
F. kitaibeliana Schult., Mantissa, 2: 398 (1824)
F. ovina var. *rubra* (L.) Sm., Engl. Fl., 1: 139 (1824)
F. repens Hegetschw. et Heer, Fl. Schweiz: 92 (1840)
F. rubra subsp. *dumetorum* (L.) Hack., Mon. Fest. Eur.: 145 (1882)
F. ovina subsp. *rubra* (L.) Hooker, Stud. Fl., ed. 3: 497 (1884)
F. barbata Schrank, Prim Fl. Salisb.: 46 (1792) on L. Sp.pl. (1753)
F. pubescens Willd. ex Link, Pl. Hort. Reg. Berol., 1: 91 (1821) non Roem. et Schult.

Pianta alta 30-50 (70) cm, con rizomi anche molto lunghi. Culmo 25-50 cm, con almeno due nodi evidenti. Innovazioni miste, ma prevalentemente extravaginali. Guaine chiuse su tutta la lunghezza, ± puberule, rossastre alla base. Ligula molto breve, senza orecchiette evidenti. Lamina delle innovazioni liscia, molle, talvolta scabrida nella parte distale, verde scuro opaco, non pruinosa. Sezione fogliare 0.6-0.9 mm, poligonale a V, (5) 7 (9) fasci vascolari, 7 blocchi sclerenchimatici non molto grandi e circa delle stesse dimensioni, (5) 7 coste talvolta con alcune cellule sclerenchimatiche, tricomi brevi e sparsi, cellule epidermiche piccole o medie. Pannocchia 6-15 cm, ampia, lassa, ramo inferiore allungato. Spighette 6-10 mm, (3) 5-6 (7) fiori, verde opaco talvolta screziati di violetto scuro opaco. G1 2.5-3.5 (4) mm. G2 3.5-4.5 (5) mm. Lemma 5-6 mm, resta 2-3 mm. Antere 2.5-3 mm. .

Prati, piste da sci, aree rinverdite: una delle graminacee maggiormente usate nelle miscele di sementi. - In tutto il territorio: C. (0 - 3000 m). – Fi. VI-VII – Originaria del Nord Europa, impiegata ovunque per semine e divenuta cosmopolita.

2n = 42 - raram. apomittica, cfr. Gregor Th. (2004).

(**b**) subsp. **commutata** (Gaudin) Markgr.-Dann., Kartierung der Schweizer Flora: 81 (1968)

Sinonimi

F. rubra "*commutata*" Gaudin, Fl. Helv., 1: 287 (1828)
F. nigrescens Lam., Encycl. Meth. Bot., 2(2): 460 (1788)
F. rubra var. *nigrescens* (Lam.) Lam., Dict. Encycl., 2: 490 (1789)
F. rubra var. *fallax* f. *alpestris* Hack., Monogr. Festuc. Eur.: 142 (1882)
F. cambrica Hudson Fl. Angl. ed. 2, 1: 142 (1778)
F. alpestris Wulf., Fl. Nor.: 151 (1859) non Roem. et Schult.

Pianta alta 20-40 (50) cm, a cespi densi, non rizomatosa. Culmo 15-35 cm, con almeno due nodi evidenti. Innovazioni miste intra ed extravaginali. Guaine chiuse su tutta la lunghezza, da puberule a pubescenti, raram. glabre, talvolta rossastre alla base. Ligula fino a 0,1 mm, senza orecchiette evidenti. Lamina delle innovazioni allungate (> ½ del culmo), liscia, talvolta scabrida nella parte distale, verde scuro opaco. Sezione fogliare (0.5) 0.6-0.8 (1) mm, poligonale a V, 5-7 fasci vascolari, 7 blocchi sclerenchimatici non molto grandi e circa delle stesse dimensioni, 5 (7) coste talvolta con alcune cellule sclerenchimatiche, tricomi brevi e sparsi, cellule epidermiche piccole o medie. Pannocchia (6) 15-18 (24) cm, contratta, lineare, talvolta unilaterale. Spighette (6.5) 7.5-9 (9.5) mm. G1 2-4 mm. G2 3-6 mm. Lemma (4.3) 5-6 (6.5) mm, da glabro a villoso ispido, resta (0.8) 1.5-2.5 (4) mm. Antere 2-3 mm.

Prati montani preferibilmente su silice o comunque su substrati acidificati; anche nelle piste da sci, aree rinverdite. - In tutto il territorio, escluse le Is.: C. (500 - 3000 m). - Stazioni naturali in pascoli magri, su suolo umificato (Moder): sulle Alpi nella fascia subalpina e alpina. Suolo a bassa fertilità, acido, su substrato generalm. siliceo. Specie caratt. del Nardion, anche nei pascoli dei Caricetalia curvulae.– Fi. VI-VII – Europea, impiegata ovunque per semine e divenuta cosmopolita.

2n= 42.

Nota - È forse la specie del gr. *rubra*, a portamento cespitoso, più comune in Italia, anche se risulta difficile capire quando si tratta di popolazioni naturali e quando di popolazioni costruite o ricostituite a partire da sementi di origine extraitaliana.

(**c**) subsp. **juncea** (Hack.) K.Richt. Pl. Europ., 1: 99 (1890)

Sinonimi

F. rubra subvar. *juncea* Hack., Monogr. Festuc. Eur.: 139 (1882)
F. uniflora Dumort., Obs. Gram. Fl. Belg.: 104 (1824)
F. steineri Patzke, Decheniana, 117: 195 (1964)

Pianta alta 30-50 (70) cm, a cespi densi, con rizomi brevi o di medie dimensioni. Culmi 25-50 cm, robusti. Innovazioni miste intra ed extravaginali. Guaine chiuse su tutta la lunghezza, da puberule a pubescenti, raram. glabre, talvolta rossastre alla base. Ligula fino a 0.3 mm, senza orecchiette evidenti. Lamina delle innovazioni giunchiforme, spesso falcata, scanalata, liscia, talvolta scabrida nella parte distale, verde scuro opaco, spesso pruinosa. Sezione fogliare 0.7-1 (1.2) mm, poligonale a V, oscuramente obovoide, 7-9 (11) fasci vascolari, 7 blocchi sclerenchimatici diseguali fra loro, il mediano e i submarginali più grandi, i submarginali e i marginali tendono talvolta a confluire, talvolta altri due piccoli blocchi in posizione laterale; 5-7 coste talvolta con piccoli blocchi o alcune cellule sclerenchimatiche, tricomi brevi e sparsi, cellule epidermiche piccole o medie, talvolta con ondulazioni fra cellule adiacenti (200 x), in area submediana. Pannocchia 6-12 cm, contratta, densa. Spighette (8) 8.5-11 (12) mm, 5-9 fiori. G1 2.5-3.5 (4) mm. G2 (4) 4.5-5 mm, ovato ellittica, acuminata. Lemma 5-6 (6.5) mm, da glabro a scabrido nella parte distale, resta 1.5-2.5 (4) mm. Antere 3-3.5 mm. .

Prati aridi montani, nardeti, brachipodieti. – It. Sett. e Centr., settentrione: C, sempre più rara scendendo verso sud, fino all'Abr.* (500 - 2500 m). - Prati stabili, regolarm. gestiti dall'uomo mediante concimazione e falciatura, spesso anche irrigazione, dalla pianura alla fascia montana e raram. subalpina (solo in stazioni favorite). Suolo profondo, fertile, spesso una terra bruna di origine forestale; nello strato medio (3-9 dm), massimo di fioritura tardo-primaverile (prima del primo sfalcio). Euriecia. Specie caratt. dell'Arrhenatherion elatioris – Fi. VI-VIII – Europeo Montana.

2n = 42.

(**d**) subsp. **microphylla** St.-Yves ex Coste, Monde Pl., 19 (134): 7 (1922)
Sinonimi
F. rubra var. *microphylla* (Coste) Liou, Arch. Bot. 3, Mèm. 1: 208 (1929)
F. microphylla (Coste) Patzke, Decheniana, 117: 195 (1964)
F. nigrescens subsp. *microphylla* (Coste) Markgr.-Dann., Bot. Jour. Linn. Soc. 76: 327 (1978)

Pianta alta (20) 40-50 (70) cm, cespitosa, non rizomatosa. Culmi 40-60 cm, snelli, eleganti. Innovazioni intra ed extravaginali. Guaine chiuse su tutta la lunghezza, pubescenti per lunghi peli rivolti verso il basso. Lamina delle innovazioni (2) 10-20 (25) cm, molto più breve del culmo (< 1/3), verde brillante-grigiastro chiaro, setacea, liscia o scabra soprattutto verso l'apice. Sezione fogliare (0.3) 0.4-0.5 (0.6) mm, poligonale a V, con (3) 5 (7) fasci vascolari, sclerenchima in blocchi piccoli, 3 (5) coste, solchi intercostali profondi, talvolta qualche cellula sclerenchimatica sulle coste interne, tricomi corti e radi. Pannocchia (5) 12-16 (20) cm, ± contratta, superante lungamente le innovazioni. Spighette (6) 7-8 (9.5) mm, (2) 4-5 (7) fiori, verdi talvolta sceziati di violetto. G1 2.5-2.8 (3.0) mm. G2 3.5-4.4 mm. Lemma (4) 4.6-5 (6) mm, resta (1) 1.5-2.2 (3) mm. Antere 2.5 mm.

Prati aridi, nardeti, bordi di strade, talvolta seminata, preferente substrati silicei. - In tutto il territorio, settentrione: R e da ricercare; penisola: R ma probabilmente poco osservata; manca in Sard. (800 - 2000 m) In Sic. è legata ai pascoli del Plantaginion cupanii – Fi. VI-VII – Europeo Montana.

2n= 42.

22. F. heteromalla Pourr. Hist. Mem. Acad. Roy. Sci. & Belles-Lettres, 3: 319 (1788)
Sinonimi
F. diffusa Dumort., Obs. Gram. Belg.: 106 (1824)
F. megastachys Hegetschw. et Heer, Fl. Schweiz.: 92 (1840)
F. rubra var. *fallax* (Thuill.) Hack., Bot. Centralbl. 8: 407 (1881)
F. rubra subsp. *fallax* (Thuill.) Nyman, Consp. Fl. Eur.: 827 (1882)
F. rubra subsp. *multiflora* (Hoffm.) Piper, Contr. U. S. Natl. Herb. 10: 22 (1906)
F. planifolia (Hack.) K. Richt., Pl. Eur., 1: 100 (1890)
F. rubra subvar. *grandiflora* Hack., Monogr.: 139 (1882)
F.rubra var. *grandiflora* (Hack.) Rouy, Fl. France 14: 205 (1913)
F. rubra subsp. *macrantha* K. Richt., Pl. Eur. 1: 99 (1890)
F. fallax Thuill., Fl. env. Paris ed. 2: 50 (1799)
F. rubra var. *alpina* Parl., Fl. Ital. I: 441 (1850)
F. rubra var. *latifolia* Roth, Tent. fl. Germ., 2: 125 (1789)
F. rubra var. *multiflora* Steudel, Nomencl. Bot. ed.1: 339 (1821)
F. rubra var. *planifolia* Hack., Bot. Centralbl., 8(13): 406 (1881)

Pianta alta fino a 130 cm, lassamente cespitosa, con lunghi rizomi. Culmo 40-80 cm. Innovazioni extravaginali. Guaine chiuse su tutta la lunghezza, talvolta di colore rossastro. Ligula fino a 0.3 mm. Lamina delle innovazioni 15-38 (60) cm, verde, piana. Lamina del culmo gen. piana, con carena evidente. Sezione fogliare (0.6) 0.8-1.5 mm, a V ampio, con evidente carena, 7-11 (13) fasci vascolari, 5-7 (9) coste prominenti talvolta con cellule sclerenchimatiche, solchi profondi, tricomi lunghi, talvolta abbondanti. Pannocchia (9) 12-22 cm, lassa a rami ineguali. Spighette 8-12 mm, 7-10 fiori, talvolta screziati di violetto. G1 4 mm. G2 5.2-6.3 mm. Lemma (5) 6.5-8.5 (9.5) mm, glabro, resta (1) 1.2-2 (3) mm. Antere 3-4 mm.

Praterie montane, margini dei boschi ripariali. – It. Sett. e Penisola fino alla Camp.: C. (300 - 2000 m). – Fi. VI-VIII – Europea, ampiamente coltivata e naturalizzata in tutto il mondo.

2n = 42, 56.

Nota - Specie molto difficile da interpretare sia per la complessa storia nomenclaturale sia per il fatto che viene comunemente usata nei miscugli di semi. È probabilmente la specie del gruppo “rubra” a rizomi lunghi più comune in Italia, ma la sua distribuzione deve essere ancora indagata.

23. F. rivularis Boiss., Elenchus Pl. Nov.: 90 (1838) subsp. **rivularis**
Sinonimi
F. rubra var. *rivularis* (Boiss.) Hack., in Bot. Centralbl. 8: 407 (1881).

Pianta alta 30-60 cm, in cespi isolati e con rizomi allungati. Culmo 30-60 cm, con un nodo posto poco sotto la metà del culmo. Innovazioni extravaginali. Guaine chiuse su tutta la lunghezza, arrossate, in genere glabre su tutta la superficie. Ligula senza ciglia o con poche e sparse ciglia appena pronunciate. Lamina delle innovazioni (3) 10-30 (50) cm, da setacea a subgiunchiforme o a V, liscia o scabra soprattutto verso l’apice, verde chiara, non pruinosa. Lamina caulinare (3) 6-15 cm, piana o appena conduplicata. Sezione fogliare 0.7-0.8 mm, poligonale, con carena evidente, 7 fasci vascolari, sclerenchima in 7 blocchi separati di grandezza simile, 5 coste interne ben sviluppate, talvolta con blocchi sclerenchimatici o cellule sclerenchimatiche isolate, sull'apice; sparsamente pubescente nella parte adassiale, per tricomi lunghi 0.03-0.06 mm; cellule bulliformi sempre presenti; cellule epidermiche che, a partire dal blocco sclerenchimatico mediano, si riducono procedendo verso i lati. Pannocchia 8-10 cm, ± lassa, lunga con asse inferiore di oltre 2 cm, assi della pannocchia lisci. Spighette 6.8-7.3 mm, 4-5 fiori. G1 2.5-2.6 mm. G2 3.8-4.1 mm. Lemma 4.9-5.2 mm, appena scabro sul dorso nella metà distale, resta 2.7-3 mm. Antere 2.4-2.6 mm.

Prati umidi montani, bordi dei ruscelli e delle paludi, tendenzialmente su silice. - *Aspromonte, ai Piani di Galata: RR.* (900 - 1000 m). Vegetazione fontinale montana, nelle formazioni del Caricion remotae (Montio-Cardaminetea) – Fi. VI-VII – Sud Europea montana.

2n = mancano conteggi su popolazioni italiane.

Nota - Rinvenuta recentemente (Parolo et al., 2006) sull’Aspromonte; forse più comune e da ricercare in altre aree delle montagne meridionali e della Sicilia.

18d. Sect. Festuca (sp. **24-57**)

Piante cespitose, con getti delle innovazioni intravaginali. Guaine aperte o fuse, talvolta a formare un tubo fuso su tutta la lunghezza. Apice delle lamine fogliari mai pungente. Ligula appena evidente, quasi sempre espansa in due orecchiette.

18d1. gruppo di F. halleri / F. circummediterranea (sp. **24-36**)

Piante di colore verde brillante o giallo dorato, quando secche. Piante con sclerenchima in tre isolotti non o solo brevemente decorrenti; guaine fuse per la maggior parte della loro lunghezza. Cellule epidermiche generalmente di piccole dimensioni. Generalmente diploidi (2n = 14). Tendenzialmente specie di ambienti naturali. Il gruppo è mal noto: le specie presenti e la loro delimitazione potranno essere oggetto di cambiamenti anche nel prossimo futuro. In particolare i rapporti fra **24**-**25** da una parte e **33**-**36** dall'altra sono oggetto di studi tassonomici.

Sottogruppo F. alpina

Il gruppo è stato oggetto di una recente revisione (Foggi et al., cit.) dove vengono illustrati i rapporti con **24** e viene proposta una nuova articolazione a livello di sottospecie per **25**. Per quanto riguarda l’interpretazione di **25** e soprattutto i suoi rapporti con F. vizzavonae Ronn. vedi: Foggi et Signorini (1997), Signorini et al. (2003 a, b). - Bibl.: Foggi B., Parolo G., Šmarda P., Coppi A., Lastrucci L., Lakušić D., Rossi G. *Bot. J. Linn. Soc.*, 170 (4): 618–639, December 2012 (2012).

1) Spighette 4.1-6.4 mm; G1 2.7-4.1 mm; antere 0.8-1.4 mm; Pirenei, Alpi Carpazi occidentali: *F. alpina*

1b) Spighette 6.6-8.2 mm; G1 3.6-4.8 mm; antere 0.9-2.1 mm, Appenino, Corsica, Sardegna, Penisola Balcanica: **2**

2a) Spighette 7.3-8.2 mm; antere 1.6-2.1; Corsica, Sardegna: *F. alfrediana* subsp. *alfrediana*

2b) Spighette 6.6-7.7 mm; antere 0.9-1.7; Appenini: *F. alfrediana* subsp. *ferrariniana*

24. F. alpina Suter, Helvet. Fl., 1: 55 (1802)

Sinonimi

F. ovina subsp. *alpina* (Suter) Hack. Bot. Centralbl. 8: 406 (1881)
F. ovina var. *alpina* Clairv. Man. Herb. Suisse: 24 (1811)
F. capillaris Wulfen, Fl. Nor. Phaner.: 144 (1858) non Lilj.

Pianta alta (5) 10-20 (30) cm, densamente cespitosa. Culmo 10-20(30) cm. Innovazioni intravaginali. Guaine chiuse fino all'apice. Ligula molto breve, auriculata. Lamina delle innovazioni (1) 5-10 (14) cm, capillare, eretta, liscia, verde, non pruinosa. Sezione fogliare (0.2) 0.3-0.4 (0.5) mm, ellittica ± ovale, talvolta cordiforme o a V, 3 (5) fasci vascolari vascolari, 1 costa raram. 1-2 appena abbozzate, solco intercostale poco profondo, sclerenchima in 3 blocchi, raram. 2 mediani aggiuntivi, tricomi corti poco abbondanti. Pannocchia (1) 1.5-4 (5) cm ± lassa, dritta, in media passante poco le innovazioni. Spighette 4.6-5 mm (3-flora), 5.5-6.5 mm (4-flora), 2-3 (4) fiori, verdi-giallastri talvolta leggermente screziati di violetto. G1 2-4 mm, lineare. G2 2.8-4.0 mm subulata, lungamente acuminata. Lemma (2.9) 3.2-4.5 mm, ovale-lanceolato, glabro o appena scabrido verso l'apice, senza bordi membranosi, resta (0.8) 1.2-2.0 (2.6) mm. Antere 0.8-1.4 mm.

Rupi e macereti su vari substrati, preferenza su calcare. Alpi, dalle Giulie alle Maritt.: C. (1000 - 3000 m). - Su roccia calcarea e dolomitica, nelle fessure o dove si accumula un po' di sabbia, in ambiente alpino, esposto, arido, in pieno sole. Suolo primitivo, talora con accumulo di poco humus grezzo. Sulle Alpi calcaree, specie caratt.del Potentillion caulescentis, sporadicam. compare su pietrame calcareo (Thlaspion rotundifolii) oppure in pascoli pietrosi del Seslerion albicantis. Fi. - VI-VIII – Orofita sud Europea.

2n = 14.

Nota – Si tratta di una specie molto variabile, ma ancora non è chiaro come questa variazione possa essere trattata dal punto di vista tassonomico. Attualmente la variabilità di **24** e i suoi rapporti con **25** sono in corso di studio. *F. alpina* subsp. *riverae* Chas, Kerguélen et Plonka sembra solo una forma a spighette variegate di **24** (Garraud, 2003; J.-M. Tison comm. pers.). Le segnalazioni di *F. alpina* subsp. *riverae* per il Gran Sasso d'Italia (Catonica, 2001) sono da riferire a **25** subsp. *ferrariniana*.

25. F. alfrediana[1] Foggi et Signorini Parlatorea, 2: 128 (1997)

(a) subsp. **alfrediana**

Sinonimi

F. ovina var. *briquetii* St. Yves in Litardière, Bull. Soc. Sc. Hist. et Nat. Corse, 42: 201, 1922
F. alpina subsp. *briquetii* (St.-Yves) Markgr.-Dann., Veröff. Geobot. Inst. Rübel (Zürich), 56: 134 (1976)
F. vizzavonae sensu Markgr.-Dann., Fl. Europ., 5: 143 (1980) p. p., non Ronniger
F. vizzavonae sensu Pignatti & Markgr.-Dann. in Pignatti, Fl. Ital., 3: 500 (1982) p. p., non Ronniger

Pianta alta 10-30 cm, ± densamente cespitosa. Culmo 10-20 (30) cm. Innovazioni intravaginali. Guaine chiuse fino all'apice, grigiastre e irregolarmente sfibrate in senescenza. Ligula molto breve, acuminata, auriculata. Lamina delle innovazioni setacea, glabra, liscia, molle, eretta. Sezione fogliare a V irregolare, ± chiusa, a forma poligonale, 0.31-0.54 (0.6) mm; (3) 5 (6) fasci vascolari, 3 piccoli blocchi sclerenchimatici, solo raram. con 2 blocchi sclerenchimatici accessori molto piccoli, submarginali, 1 (3) coste adassiali scarsamente pronunciate, sparsamente irsute. Pannocchia 1.5-5 cm, con rami brevi ± patenti. Spighette 7.3-8.2 mm, 4-5 (6) fiori. G1 (2.6) 2.8-3.4 (3.8) mm, subulata. G2 3.9-4.5 mm, subulata. Lemma (4.5) 4.7-5.4 (5.7) mm, subulato, appena scabrido all'apice, resta (2.9) 3.2-5.4 (5.7) mm. Antere 1.6-2.1 mm.

Rupi su vari substrati, in Sardegna solo su calcare. Sard. nel Nuorese: RR (800 - 1900 m). Fi. - V-VII – Orofita Sardo-Corsa.

2n = 14

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[1] Alfred St.-Yves, botanico francese, pubblicò un fondamentale studio monografico sul gen. *Festuca*.

(b) subsp. **ferrariniana** Foggi, Parolo, G.Rossi

Sinonimi

F. vizzavonae sensu Markgr.-Dann., Fl. Europ., 5: 143 (1980) p. p., non Ronniger
F. vizzavonae sensu Pignatti & Markgr.-Dann. in Pignatti, Fl. Ital., 3: 500 (1982) p. p., non Ronniger

Pianta alta 10-30 cm, ± densamente cespitosa. Culmo 10-20 (30) cm. Innovazioni intravaginali. Guaine chiuse fino all'apice, grigiastre e irregolarmente sfibrate in senescenza. Ligula molto breve, acuminata, auriculata. Lamina delle innovazioni setacea, glabra, liscia, molle, eretta. Sezione fogliare a V irregolare, ± chiusa, a forma poligonale, 0.31-0.54 (0.6) mm; (3) 5 (6) fasci vascolari, 3 piccoli blocchi sclerenchimatici, solo raram. con 2 blocchi sclerenchimatici accessori molto piccoli, submarginali, 1 (3) coste adassiali scarsamente pronunciate, sparsamente irsute. Pannocchia 1.5-5 cm, con rami brevi ± patenti. Spighette 6.6-7.7 mm, 3-4 (5) fiori. G1 (2.6) 2.8-3.4 (3.8) mm, subulata. G2 3.9-4.5 mm, subulata. Lemma (4.5) 4.7-5.4 (5.7) mm, subulato, appena scabrido all'apice, resta (2.9) 3.2-5.4 (5.7) mm. Antere 0.9-1.7 mm.

Rupi e macereti su vari substrati, preferenza su calcare. Appennini: R* (800 - 2500 m). Fi. - V-VII – Orofita Appenninica.

2n = 14

26. F. austrodolomitica Pils et Prosser, Pl. Syst. Evol., 195: 188 (1995) - ●

Pianta alta (10) 12-17 (25) cm, densamente cespitosa. Culmo 12-17 (20) cm. Innovazioni intravaginali. Guaine chiuse su tutta la lunghezza, dissolventesi in fibre in senescenza. Ligula molto breve. Lamina delle innovazioni (1) 5-10 (14) cm, molle, capillare, eretta, liscia, verde, non pruinosa. Sezione fogliare (0.4) 0.5-0.7 (0.75) mm, da ovale compressa a V, 5-7 fasci vascolari, 1-3 coste, solco intercostale poco profondo, sclerenchima in 3 isolotti di piccole dimensioni. Pannocchia 1.5-3 cm. Spighette 4.5-5 mm, 2-3 (4) fiori, verdi, variegati di viola intenso. G1 1.8-2 mm, lineare. G2 2.6-2.8 (3) mm, lanceolata. Lemma (2.8) 3.3-4.2 mm, glabro, resta da nulla a 1 (1.6) mm. Antere (0.9) 1.3 (1.7) mm.

Vallette nivali su calcare. – Dolomiti nel Veneto e Trentino-Alto Adige: R. (1800 - 2500 m). Fi. - VI-VII – Endemica: Alpi orientali.

2n = 14.

Nota – Per nuovi dati sull'areale cfr. Prosser F., *Ann. Mus. Civ. Rovereto, Sci. Nat, Suppl* 14: 31-64 (2000).

27. F. rupicaprina (Hack.) A. Kerner, Sched. Fl. Exsicc. Austro-Hung., 3: 145 (1884) - ●

Sinonimi

F. ovina subsp. *frigida* var. *rupicaprina* Hack., Mon. Fest. Europ.: 114-115 (1882)
F. ovina subsp. *glacialis* var. *rupicaprina* (Hack.) Aschers. et Graebn., Syn. Mitteleurop. Fl., 2 (1): 485 (1900)
F. ovina var. *alpina* Neilr., Fl. v. Nied.-Oesterr.: 73 (1859) non Koch
F. halleri Caflisch, Fl. v. SO-Deutschl. non All.

Pianta alta (5) 10-20 (30) cm, cespitosa, non rizomatosa. Culmo 5-15 cm, ± scabro nella parte apicale. Innovazioni intravaginali. Guaine chiuse fino all'apice. Lamina delle innovazioni (1) 4-10 (17) cm, capillare, flessibile, liscia, verde brillante, non pruinosa. Lamina caulinare (0.5) 2-3.5 cm, arrotolata. Sezione fogliare (0,4) 0,5-0,6 mm, ± ellittica o obovale, (3) 5 fasci vascolari, 1 costa, talvolta altre 1 o 2 appena abbozzate, solco intercostale poco profondo, sclerenchima in 3 isolotti, tricomi corti e poco abbondanti. Pannocchia (1.5) 2-4 (5) cm, poco contratta, eretta, passante da poco ad abbastanza lungamente le innovazioni. Spighette (5.5) 6-7 (7.5) mm, (2) 3-4 (6) fiori, verdi, tinte di violetto. G1 2.2-3 mm. G2 3.3-4 mm. Lemma (3.5) 3.8-4.6 mm, glabro o scabriuscolo verso l'apice, resta (1) 1.5-2 (2.5) mm. Antere (1.8) 2.2-2.6 mm.

Prati di altitudine, esclusivamente su calcare. – Alpi Or., dal Friuli-Ven. Giulia alla Lomb.: RR. (2000 - 3000 m). - Fi. VII-VIII – Endemica: Alpi centro-orientali

2n = 14.

Note - Recenti indagini (Parolo et al., 2007) hanno chiarito la distribuzione in Italia di questa specie.

28. F. stenantha (Hack.) K.Richt., Pl. Europ., 1: 96 (1890) - ●

Sinonimi

F. ovina var. *stenantha* Hack., Mon. Fest. Europ.: 110 (1882)
F. laevis var. *stenantha* (Hack.) Nyman, Consp. Fl. Europ., 4: 828 (1882)
F. halleri subsp. *stenantha* (Hack.) Aschers. et Graebn. ex Hegi, Ill. Fl. Mitteleurop., 1: 335 (1908)
F. halleri var. *stenantha* (Hack.) Schroeter, Pflanzenleb.: 292 (1908)

Pianta alta (9) 20-30 cm, densamente cespitosa, verde pallido, non rizomatosa. Culmo con 4-5 angoli grossolani, solcato verso l'alto, 1 nodo visibile verso il 1/4 inferiore. Innovazioni intravaginali. Guaine chiuse fino all'apice. Ligula brevissima. Lamina delle innovazioni (2) 10-15 (20) cm, setacea, gen. flaccida, liscia, verde, non pruinosa. Lamina caulinare (2) 3-6 (12) cm, ± piana. Sezione fogliare (0.5) 0.6-0.7 (0.9) mm, obovale o a V, talvolta ellittico-allungata, poco compressa lateralmente, (5) 7 fasci vascolari, 3 coste, raram. altre 2 appena abbozzate, solco intercostale gen. mediamente profondo, sclerenchima in 3 isolotti di piccole-medie dimensioni, raram. 1-2 isolotti supplementari lungo i fianchi, tricomi da corti a medi, poco abbondanti. Pannocchia (2) 3-5 (8.5) cm, lassa, eretta, con ramo inferiore ramificato, portante da 4 a 8 spighette, passante da poco a mediamente le innovazioni. Spighette (6) 7-8 (9) mm, (2) 4-6 (7) fiori, verdi giallastre pallide, un po' screziate di violetto. G1 2.3-3.5 mm, subulata-acuminata. G2 3.5- 4.5 mm, subulata-acuminata. Lemma (4.5) 5-6 (6.2) mm, subulato-acuminato, glabro, raram. scabriuscolo, resta (1) 2-3 (4) mm. Antere 1.5-2.5 mm.

Praterie e pendii rupestri, rupi, esclusivamente su calcare. – Alpi Or., dalle Giulie al Bormiese: R.* (1000 - 2000 m). - Fi. VI-VII – Endemica: Alpi

2n = 14.

29. F. halleri All., Fl. Pedem. 2: 253 (1785) subsp. **halleri**

Sinonimi

F. ovina subsp. *laevis* var. *halleri* (All.) Hack., Bot. Centralbl., 8: 406 (1881)
F. decipiens Clairv., Man. Herbor. Suisse, ed. 1: 24 (1811)
F. halleri subsp. *decipiens* (Clairv.) Aschers. et Graebn. ex Hegi, Ill. Fl. Mitteleurop., 1: 335 (1908)
F. hirsuta Host, Icon. Descr. Gram. Austr., 2: 61 (1802)
F. gaudinii Kunth, Enum. Pl., 1: 399 (1833)

Pianta alta 6-15 (20) cm, cespitosa, non rizomatosa. Culmo 3-10 cm. Innovazioni intravaginali. Guaine chiuse fino all'apice, ± glabre. Ligula 0,02-0,04 mm, di peli. Lamina delle innovazioni (1) 3-10 (14) cm, da capillare a setacea, flessibile, liscia, da verde a glaucescente, talvolta leggermente pruinosa. Lamina caulinare (1.5) 2-4 cm ± convoluta. Sezione fogliare (0.3) 0.5-0.7 mm di diametro, ± ellittica, obovale o a V, 5-7 fasci vascolari, 3 coste raram. poco marcate, solco intercostale mediamente profondo, sclerenchima in 3 blocchi, talvolta 1-2 piccoli blocchi supplementari sui fianchi, tricomi corti, poco abbondanti. Pannocchia (1) 2-3 (4) cm, da contratta a ± lassa, eretta, con ramificazioni glabre o finemente villose, semplice, ± spiciforme con ramificazione inferiore isolata, passante di poco le innovazioni. Spighette (5) 6-7 (7,6) mm, strettamente ellittiche con fiori spaziati, lasse, (3) 4-5 (6) fiori, bruno-violacee, raram. giallastre. G1 2.5-3.5 mm. G2 (3.5) 4-4.5 mm. Lemma (3.7) 4-5 (5.2) mm, lungamente acuminato, glabro o scabriuscolo, resta (1.5) 2.5-4.4 (5) mm. Antere 2-3 mm.

Prati alpini e subalpini, tendenzialmente su silice, nardeti e curvuleti. - In tutta la catena alpina: C.* (1800 - 3400 m). Fi. - VII-VIII – Endemica Alpica

2n = 14.

30. F. intercedens (Hack.) Lüdi ex Bech. Ber. Schweiz. Bot. Ges., 50: 388 (1940) - ●
Sinonimi
F. ovina var. *intercedens* Hack., in Stebler et Schroter, Schweizer Grsersamml.: 173 (1892)
F. alpina var. *intercedens* Hack., Ber. Schweiz. Bot. Ges., 2: 98 (1892)
F. halleri var. *intercedens* (Hack.) Markgr.-Dann. ex Janchen, Catal. Fl. Austriae, 1 (4): 808 (1960)

Pianta alta (6) 10-15 (20) cm, densamente cespitosa, non rizomatosa. Culmo da glabro a densamente pubescente sotto la pannocchia, solcato irregolarmente, nodo superiore visibile solo verso la base. Innovazioni intravaginali. Guaine gen. aperte fino a circa 1/2, talvolta totalmente, brunastre, glabre o villose. Ligula molto breve. Lamina delle innovazioni (2) 5-10 (14) cm, setacea, flessibile, liscia, da verde a glaucescente, non pruinosa. Lamina caulinare (1) 1.5-2.5 (3.5) cm, piegata. Sezione fogliare (0.3) 0.5-0.6 (0.7) mm, ellittica o obovale, raram. poligonale, 5-7 fasci vascolari, 1-3 (4) coste, solco intercostale da poco a mediamente profondo, sclerenchima in 3 blocchi, raram. 2 piccoli blocchi sui fianchi, tricomi corti, poco abbondanti. Pannocchia (1) 2-4 (5) cm, da contratta a ± lassa, rami con peli corti molto densi, eretta, passante di poco le innovazioni. Spighette (5.2) 6.5-7.5 (8) mm, (2) 3-5 fiori, viola pallido, glauche un po' pruinose. G1 2.8-3.3 mm, ciliolata ai margini verso l'apice. G2 3.8-4 mm, lanceolata, ciliolata ai margini verso l'apice. Lemma 4 -5 mm, villoso o scabro, ciliolato ai margini, resta (1) 1.5-2.5 mm. Antere 1.2-1.7 mm.

Prati sassosi alpini e subalpini, tendenzialmente su silice, talvota su calcari, elineti, curvuleti. – Alp, dal P. Rolle al Bormiese ed al M. Bianco: RR. (1800 - 2700 m). - Fi. - VI-VIII – Endemica: Alpi centrali orientali

2n = 28.

31. F. pseudodura Steudel, Syn. Pl. Glum., 1: 306 (1854) - ●
Sinonimi
F. dura Host, Icon. Descr. Gram. Austr., 1: 306 (1802) non Villars 1787
F. ovina subsp. *laevis* var. *dura* (Host) Hack., Mon. Fest. Europ.: 111 (1882)
F. laevis subsp. *pseudodura* (Steudel) Nyman, Consp. Fl. Europ.: 828 (1882)
F. halleri subsp. *dura* (Host) Aschers. et Graebn. ex Hegi, Ill. Fl. Mitteleur., 1: 335 (1908)
F. ovina var. *dura* (Host) Fiori in Fiori et Paoletti, Fl. Anal. Ital., 1: 91 (1908)
F. tauricola J. Vetter, Verh. Zool.-Bot. Ges. Wien, 77: 41 (1927)
F. halleri subsp. *dura* var. *tauricola* (J. Vetter) Suessenguth ex Hegi, Ill. Fl. Mitteleur., ed. 2, 1: 437 (1936)
F. pseudodura var. *tauricola* (J. Vetter) Neumayer, Oesterr. Bot. Z., 91: 218 (1942)

Pianta alta 20-40 (50) cm, cespitosa, non rizomatosa. Culmo 15-30 (40) cm, glabro, talvolta con pubescenza sparsa sotto la pannocchia. Innovazioni intravaginali. Guaine chiuse fino all'apice. Lamina delle innovazioni lunga 5-15 cm, rigidetta, ± ricurva, liscia, verde. Sezione fogliare 0.5-0.7 (1.0) mm, ellittico-allungata, 7 (9) fasci vascolari vascolari, 3-5 coste, poco marcate, solco intercostale mediamente profondo, sclerenchima in 3 isolotti ben evidenti, non o poco decorrenti, talvolta 1-2 piccoli isolotti supplementari sui fianchi, tricomi corti. Pannocchia densa (2) 4-7 cm, da contratta a ± lassa, eretta, con ramificazioni glabre o finemente villose, semplice, ± spiciforme con ramificazione inferiore isolata, passante poco le innovazioni. Spighette 7-8.5 mm, 4-5 (6) fiori, grigio-verdi ± screziate di violetto fino a bruno-violacee, raram. giallastre. G1 2.5-4.2

mm. G2 3.5-5.3 mm. Lemma 4.9-6.2 mm, lungamente acuminato, gen. scabriuscolo, raram. completamente glabro, resta 2.2-3.4 (4) mm. Antere 2.7-3.3 mm.

*Prati di altitudine, soprattutto su silice. – Alpi, dalla Carnia alla Lomb.: R; dubbia in Abr.**. (1500 - 2500 m). - Fi. VII-VIII – Endemica: Alpi centro-orientali

2n = 42.

32. F. plonkae Foggi et Signorini, Willdenowia, 35: 242 (2005) - ●
Sinonimi
F. halleri subsp. *yvesii* Kerguélen et Plonka, Bull. Soc. Bot. centre-ouest, n.s., 19: 18 (1988)

Pianta alta 15-20 cm, densamente cespitosa. Culmo 10-15 cm, con un nodo evidente. Innovazioni intravaginali. Guaine chiuse su tutta la lughezza. Ligula brevissima, con peli brevi ma evidenti. Lamina delle innovazioni non superante la metà del culmo, setacea, rigidetta. Sezione fogliare 0.5-0.7 mm, (5) 7 fasci vascolari, 3 blocchi sclerenchimatici ben evidenti, talvolta con ulteriori due blocchi di piccole dimensioni laterali, (1) 3 coste, tricomi sparsi. Pannocchia 2.5-5 cm, densa. Spighette 7-8 mm. G1 2.5-3.5 mm. G2 4-4.5 mm. Lemma 4.5-5.5 mm, talvolta scabrido nella parte distale, resta 2-2.5 mm. Antere 2.8-3.3 mm.

Rupi e praterie discontinue di altitudine, soprattutto su substrati silicei. - Alpi Maritt. (da ricercare sul versante italiano); Appennino Tosco-Emiliano al M. Cimone e Corno alle Scale: RR.* (1700 - 2200 m). - Fi. VI-VIII – Endemica: Alpi sud-occidentali, Appenino Tosco-Emiliano.

2n = 28.

33. F. circummediterranea Patzke in Guterman, Ehrendorfer et Fischer, Oesterr. Bot. Zeitschr. 122: 261 (1974)
Sinonimi
F. laevis (Hack.) Nyman, Consp. Fl. Eur.: 828 (1882)
F. ovina subsp. *laevis* Hack., Monogr. 107 (1882)
F. duriuscula subsp. *laevis* (Hack.) Rouy, Fl. France 14, 8: 214 (1913)
F. halleri var. *laevis* (Hack.) Honda, J. Fac. Sci., Imp. Univ. Tokyo, Sect. 3, Bot. 3: 46 (1930)
F. leiocolea Kerguélen, Lejeunia, n.s., 75: 160 (1975)
F. ovina var. *laevis* (Hack.) Fiori, N. Fl. Anal. Ital., 1:135 (1923)
F. duriuscula Auct. fl. siculae p.p., non L.

Pianta alta (10) 25-70 cm, ± densamente cespitosa. Culmo 20-50 cm, 1-2 nodi. Innovazioni intravaginali. Guaine chiuse fino a 1/2-3/4, di aspetto cartilagineo e spesso sfumata di rosso. Ligula molto breve, con orecchiette appena evidenti. Lamina delle innovazioni 10-15 (20) cm, glabra, talvolta glauco-pruinosa, lunghe e diritte oppure brevi e talvolta ricurve. Sezione fogliare (0.5) 0.9-1.2 (1.5) mm, ad U o V, fortemente compressa lateralmente, 7 (9) fasci vascolari, sclerenchima in tre blocchi di grandi dimensioni, talvolta due supplementari di piccole dimensioni laterali, 3-5 coste ben evidenti, solchi intercostali mediamente profondi, tricomi brevi e sparsi, epidermide con cellule di piccole dimensioni. Pannocchia (3) 5-9 (11) cm, lassa, contratta negli individui di piccole dimensioni, con ramo inferiore patente. Spighette (6) 7-8 (8.5) mm, 3-7 fiori, talvolta variegati di violetto. G1 2.5-3 mm. G2 3-5 (5.5) mm. Lemma (4) 4.8-6 mm, resta 1.5-2.6 mm. Antere 2-2.8 mm.

Prati aridi. – Dal Piem. e Lig. In tutta la Pen. ed Is.: C; anche nel Ven. e Lomb.: R. (100 - 2000 m). Comune nella vegetazione dei Festuco-Brometea, nel sud diviene progressivam. orofila, fino a localizzarsi in prevalenza nella vegetazione pulvinare altomontana dei Rumici-Astragaletea siculi. Fi. - IV-VII – Sud Europea-Mediterranea

2n = 14.

Nota - Specie molto variabile sia dal punto di vista morfologico sia rispetto alle esigenze ecologiche. Il modello di variazione, attualmente in corso di studio, sembra inoltre molto più ampio rispetto a quello comunemente rilevato. Per la tipificazione di **33** e di **35** si veda Foggi et al. (cit., 2012).

34. F. humifusa Brullo et Guarino, Bocconea, 13: 410 (2001) - ●

Pianta alta (10) 15-30 cm, densamente cespitosa. Culmo 8-20 (25) cm, prostrato-ascendente. Innovazioni intravaginali. Guaine chiuse fino a 1/2, di aspetto cartilagineo. Ligula molto breve con orecchiette troncate, minutamente cigliate. Lamina delle innovazioni (5) 7-18 (25) cm, glabra, glauca, talvolta curvata. Sezione fogliare 0.6-0.8 mm, ad U ± fortemente compressa lateralmente, 5-7 fasci vascolari, sclerenchima in tre blocchi di medie-piccole dimensioni, talvolta i marginali leggermente decorrenti, 3-5 coste ben evidenti, solchi intercostali profondi, tricomi brevi e sparsi, epidermide a cellule di piccole dimensioni. Pannocchia 2.5-6 cm, compatta, lineare. Spighette 6-7.5 mm, 5-6 fiori, talvolta variegati di violetto. G1 3-3.2 mm, subulato-lanceolata. G2 4 mm. Lemma 3.5-4 mm, resta 0.8-1 mm. Antere 1.8-2 mm.

Prati xerofitici e rupi nei pressi della costa. – Sic. a Capo Tindari: R. (0 - 270 m). Pendii scoscesi e ventosi, su substrati scistosi con suoli franosi e poco consolidati, in praterie termoxerofile dell'Hyparrhenion hirtae. Da qui, **34** scende fin quasi al mare, entrando in contatto con la vegetazione dei Crithmo-Limonietea. Fi. - IV-VII – Endemica: Sicilia.

2n = 14.

Nota - Recentem. rinvenuta sulle pendici rupestri costiere di Capo Tindari (Brullo & Guarino, 2001). Nelle vicinanze si trova, a quote più elevate, **33**, specie molto simile e con lo stesso livello di ploidia: ulteriori indagini saranno necessarie per capire i rapporti fra queste due entità.

35. F. jeanpertii (St.-Yves) Markgr. in Hayek, Prodr. Fl. Penins. Balc. 3: 276 (1933) subsp. **campana** (N.Terracc.) Markgr.-Dann., Bot. J. Linn. Soc. 76: 325 (1978)

Sinonimi

F. duriuscula var. *campana* N.Terracc., Rel. Int. Peregr. Terra di Lavoro: 195 (1872)
F. ovina subsp. *duriuscula* var. *campana* (N.Terracc.) Hack., Monogr.: 109 (1882)
F. laevis subsp. *campana* (N. Terracc.) K. Richt., Pl. Eur. 1: 96 (1890)
F. campana (N.Terracc.) E.B.Alexeev, Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. 78 (3): ? (1973)
F. heldreichii subsp. *campana* (N.Terracc.) Markg.-Dann., Veroff. Inst. Geobot. Rubel (Zurich), 56: 122 (1976)

Pianta 30-60 cm, ± densamente cespitosa. Culmo 20-40 cm. Innovazioni intravaginali. Guaine chiuse fino a 1/2, di aspetto cartilagineo e talvolta sfumata di rosso. Ligula molto breve con orecchiette appena evidenti. Lamina delle innovazioni lunghe e diritte oppure brevi e talvolta ricurve. Sezione fogliare 0.5-0.9 (1.1) mm, ad U ± fortemente compressa lateralmente, 7 fasci vascolari, sclerenchima in tre blocchi di medie-grandi dimensioni, talvolta i laterali leggermente decorrenti, 3-5 coste ben evidenti, solchi intercostali mediamente profondi, tricomi brevi e sparsi, epidermide con cellule di piccole dimensioni. Pannocchia 7-11 (13) cm, ± lassa. Spighette (5) 5.5-7.8 mm, (3) 4-5 fiori. G1 2.5-3.2 mm. G2 3.6-4.2 mm. Lemma (3.9) 4-5 mm, resta 0.5-1.5 mm. Antere 2-2.5 mm.

Praterie xeriche, indifferente al substrato. - Campania: C; Puglia al Gargano: RR. (100 - 1000 m). - Fi. IV-VI– Italia centro meridionale-Grecia

2n = 14.

Nota - Spesso confusa con **33** ed altre specie a sclerenchima in tre blocchi ben distinti. La posizione sistematica, la distribuzione e l'ecologia di **35** sono oggetto di studio.

36. F. marginata (Hack.) K. Richt. subsp. **gallica** (Hack. ex Charrel) Breistr., Bull. Soc. Brot. Fr., 110, sess. extr. 89, : 79 (1966)

Sinonimi

F. ovina subsp. *laevis* var. *gallica* Hack. ex Charrel, Bull. Trin. Soc. Bot. Geol. Var et Corse: 18, 5, 7 (1920)
F. ovina subsp. *sulcata* var. *gallica* Hack., Soc. ètude Fl. Franco-Helv. exs. n. 569 (1895)
F. ovina subsp. *laevis* var. *gallica* subvar. *hervieri* St.-Yves in Litard., Bull. Soc. roy. Bot. Belg., 55: 106 (1923)
F. gallica (ST.-Yves) Bidault, Rev. Cytol. Biol. Vég., 31 (4): 321 (1969) comb. invalida
F. hervieri (St.-Yves) Patzke, Decheniana, 114: 213 (1962) p.p.

Pianta alta (12) 20-40 (50) cm, cespitosa, non rizomatosa. Culmo (25) 40 (50) cm. Innovazioni intravaginali. Guaine aperte fino a circa 1/2. Ligula < 0.3 mm. Lamina delle innovazioni (1) 5-20 (30) cm, da setacea a giunchiforme, scabra almeno nella metà superiore. Lamina caulinare (1) 1.5-5 (8) cm. Sezione fogliare (0.6) 0.7-0.9 mm, V ± aperto e ± convoluta, ± rigida, liscia, talvolta scabra sulla carena, glauca, gen. pruinosa, 7 (9) fasci vascolari, 3 coste, solco intercostale da poco a mediamente profondo, sclerenchima in 3 isolotti molto spessi, tricomi lunghi, radi. Pannocchia 4-8 (11) cm, contratta, ± eretta, passante abbastanza lungamente le innovazioni. Spighette 6-7.5 mm, (3) 4-6 fiori. G1 2.2-2.8 (3.5) mm. G2 3-4.5 mm. Lemma (3.6) 4.3-5.2 mm, glabro, talvolta un po' violetto, resta 0.5-1 (1.5) mm. Antere circa 1.8-2.4 mm.

Praterie xeriche e mesoxeriche, indifferente al substrato. - Piem. nel Cuneese a Vernante e a Limone: RR; anche in Lig. (?). (800 - 1300 m). – Fi. V-VI – Sud est Francia-Italia occidentale

2n = 14.

Note - La presenza in Italia (cfr. Parolo et al., 2007) deve essere ulteriormente indagata soprattutto nelle regioni di confine con la Francia, dove è nota per molte località (Portal, 1999; Garraud, 2003).

18d2. gruppo di F. ovina (sp. 37-54)

Piante generalmente di colore verde brillante oppure giallo-dorate, con lamine lisce, raramente scabre; piante di dimensioni da piccole a grandi. Sclerenchima in anello continuo, talvolta più o meno debolmente interrotto, ma comunque derivato da un anello continuo, talvolta ispessito a livello dei fascetti mediano e marginali; cellule epidermiche di medie-grandi dimensioni, solo talvolta con piccole ondulazioni fra due cellule (200 x). 2n = 14-70 (84). Tendenzialmente specie di ambienti naturali.

37. F. ovina L., Sp. Pl. 73 (1753).
(**a**) subsp. **guestfalica** (Boenn. ex Reichenb.) K. Richt., Pl. Eur.: 93 (1890)

Sinonimi

F. guestfalica Boenn. in Rchb.. Fl. Germ. Exsic. 140
F. ovina subvar. *guestfalica* (Boenn. ex Reichenb.) Hack., Mon. Fest. Eur.: 87 (1882)

Pianta alta (15) 30-50 (65) cm, densamente cespitosa, eretta, verde o pruinosa, non rizomatosa. Culmo (10) 20-40 (65) cm, liscio, da glabro a pubescente verso l'alto, angoloso con due nodi verso la base. Innovazioni intravaginali. Guaine aperte fino circa alla base. Lamina delle innovazioni (3) 10-25 (50) cm, da capillare a setacea, da flessibile a poco rigida, poco o molto scabra, verde o raram. glaucescente, non pruinosa. Lamina caulinare (1) 2.5-6 (10) cm, arrotolata. Sezione fogliare (0.3) 0.5-0.7 (1) mm, da ellittica a obovale, con carena evidente, (5) 7 (9) fasci vascolari, 1 (3) coste, solco intercostale da poco a mediamente profondo, sclerenchima continuo, sottile 1-2 (3) strati sui fianchi, appena ispessito a livello del fascetto mediano, raram. interrotto in posizione submediana, tricomi corti, gen. abbondanti. Pannocchia (1.5) 4-8 (11.5) cm, contratta, gen. eretta, passante da mediamente a lungamente le innovazioni, raram. un po' separata dalle innovazioni. Spighette (4.5) 5.5-6.4 (7) mm, (2) 4-5 (8) fiori, verdi, raram. glaucescenti, talvolta tinte di violetto. G1 (1.4) 1.6-2.8 (3.2) mm. G2 (2.2) 2.5-3.8 (4) mm, lanceolata. Lemma (3) 3.6-4.1 (4.5) mm, glabro o raram. pubescente/ispido, resta (0.5) 1-1.5 (1.8) mm, raram. nulla. Antere 1.4-2.4 mm.

Prati xerici, brughiere, soprattutto su silice. – Alpi Or. nel Bellun. (Feder), Trent. (Caoria) e pr. Sondrio: RR.* (100 - 2000 m). – Fi. V-VI – Europa centrale.

2n = 28.

Nota - La presenza della specie in Italia dovrebbe essere ulteriormente indagata. Al momento possiamo confermare la sua presenza attraverso alcuni exsiccata provenienti dal Trentino-Alto Adige (Prosser), dalla Lombardia (PAV) e dal Veneto (TSB) (Parolo et al., 2007). Non è stato possibile verificare la segnalazione per le Capanne di Marcarolo, al confine tra Piemonte e Liguria (Barberis et al., 2004).

(**b**) subsp. **molinierii** (Litard.) O. Bolòs et Vigo, Fl. Paisos Catalans, 4: 351 (2001)
Sinonimi
F. airoides Lam., Encycl. Méth. Bot. 2: 464 (1788)
F. ovina var. *molinieri* Litard., Bull. Soc. Bot. Fr., 84(1-2): 101 (1937)
F. ovina subsp. *molinerii* (Litard.) J.Muller et Foggi, Willdenowia, 35: 242 (2005) isonimo
? *F. supina* Schur, Enum. Pl. Transs.: 784 (1866)
? *F. ovina* var. *sudetica* Kittel, Taschenb. Deutsch. Fl. ed. 3, 1:125 (1853)
? *F. vulgaris* var. *sudetica* (Kittel) Hayek et Markgr., Prodr. Fl. Penins. Balc., 3: 276 (1932)
? *F. ovina* var. *supina* (Schur) Hack., Mon. Fest. Europ.: 88 (1882)

Pianta alta (10) 15-30 cm, cespitosa, non rizomatosa. Culmo 10-20 (30) cm debolmente scabro fino a densamente vellutato verso l'alto. Innovazioni intravaginali. Guaine chiuse fino a 3/4. Ligula brevissima, con orecchiette. Lamina delle innovazioni (3) 10-20 (30) cm, da capillare a setacea, rigida, talvolta scabra verso l'apice, verde, non pruinosa. Lamina caulinare (1) 2-5 (8) cm convoluta. Sezione fogliare (0.3) 0.5-0.7 mm, ellittica o ovale, con carena evidente, (5) 7 fasci vascolari, 1 costa, talvolta altre 2 appena accennate, solco intercostale poco o mediamente profondo, sclerenchima continuo, sottile 1-2 strati sui fianchi, talvolta interrotto, raram. presente anche sulla faccia adassiale; tricomi gen. corti, poco abbondanti. Pannocchia (2) 3-5 (7) cm, contratta, eretta, a rami corti fortemente scabri, passante di poco le innovazioni. Spighette 4.3-5.5 mm, (2) 3-5 (6) fiori, verdi tinte di violetto o violacee. G1 (1.8) 2.2-2.7 mm, talvolta cigliata sui margini. G2 (2.3) 2.7-4.2 (5.3) mm, ovale-lanceolata a lanceolato-acuminata. Lemma (3.3) 3.5-4.5 (5.5) mm, glabro, lanceolato-acuminato, leggermente scabro nella metà superiore, resta (0.5) 1-1.5 (2.3) mm. Antere 1.4-1.5 (2) mm.

Prati acidofitici del piano subalpino e alpino, nardeti, curvuleti. – Alpi, dalla V. Venosta alla Valtellina e Cuneese: R. (1800 - 2500 m). – Fi. VI-VIII – Eurasiatica.

2n = 28.

Nota - I rapporti con *F. supina* Schur dei Carpazi meritano ulteriori approfondimenti: Alexeev ritiene che le due entità siano distinte, da qui i dubbi sui sinonimi con *F. supina*.

38. F. filiformis Pourr., Mèm. Acad. Sci. Toulouse 3: 319 (1788)
Sinonimi
F. tenuifolia Sibth., Fl. Oxon: 44 (1794)
F. paludosa Gaudin, Agrost. Helv., 1: 229 (1811)
F. ovina var. *tenuifolia* (Sibth.) Sm., Fl. Brit. 1: 113 (1800)
F.ovina var. *mutica* Parl., Fl.Ital. I: 435 (1850).
F. mutica Wulf., Fl. Nor. Phan.: 145 (1858)
F. ovina var. *capillata* Hack., Monogr. Festuc. Eur.: 85 (1882) non Lam.
F. ovina var. *capillata* Fiori, N. Fl. Anal. Ital., 1: (1923) non Lam.

Pianta alta 10-30 cm, densamente cespitosa. Culmo 8-25 cm. Innovazioni intravaginali. Guaine aperte fino alla base. Ligula < 0.5 mm. Lamina delle innovazioni 4-10 (25) cm, capillare, verde, non pruinosa, scabra. Sezione fogliare 0.2-0.5 mm, (3) 5 (7) fasci vascolari, una costa interna debolmente prominente, anello sclerenchimatico continuo, tricomi brevi e radi. Pannocchia (2) 4-8 (14) cm, eretta, contratta, talvolta un pò interrotta. Spighette 4-5 (5.5) mm, 3-6 fiori. G1 (1) 1.5-2 (2.5) mm. G2 2.2-3.5 mm. Lemma 2.5-3.5 (4.3) mm, resta al massimo fino a 0.4 mm. Antere 1-2 mm.

Boschi, arbusteti, prati, pascoli soprattutto su silice. – It. Sett.: C; anche in Tosc., da ric. in Abr.* (500 - 1500 m). – Fi. V-VI – Eurasiatica, introdotta e naturalizzata in N-America.

2n = 14.

39. F. inops De Not., Repert. Fl. Ligust.: 466 (1844)
Sinonimi
F. ovina subvar. *inops* (De Not.) Hack., Monogr.: 95 (1882)
F. ovina subvar. *gracilior* Hack., Monogr.: 90 (1882)
F. duriuscula subp. *gracilior* (Hack.) K. Richt., Pl. Europ., 1: 94 (1890)
F. gracilior (Hack.) Markgr.-Dann., Bot. J. Linn. Soc., 76: 325 (1978)
F. duriuscula var. *submutica* Parl., Fl Ital., 437 (1850)

Pianta alta 25-40 (60) cm, ± densamente cespitosa. Culmo (8) 15-35 (50) cm, liscio e glabro per tutta la lunghezza. Innovazioni intravaginali. Guaine chiuse per circa 1/2, papiracee. Ligula 0.2-0.3 mm, con orecchiette ottuse. Lamina delle innovazioni (2.5) 5-15 (30) cm, liscia e glabra, lievemente scabrida nella parte distale, ± pruinosa, dritta, talvolta rigida, mai pungente. Sezione fogliare (0.4) 0.6-0.9 (1.1) mm, ovale-ellittica, 5-7 (9) fasci vascolari, coste (1) 3-5, anello sclerenchimatico intero, di spessore ± uniforme di 1-3 cellule, talvolta ispessito lateralmente a 5-6 strati di cellule, talvolta appena interrotto lateralmente, tricomi sparsi. Pannocchia (3) 4-8 (10) cm, contratta o lassa, spesso interrotta, con rami pubescenti e scabridi. Spighette (4.3) 6-7 (8) mm, 4-7 fiori, ± pruinose, talvolta screziate di violaceo, da glabre a ± pubescenti. G1 (1.9) 2.5-3 (4) mm. G2 (2.9) 3.5-4 (4.8) mm. Lemma (3.5) 4-5 (5.8) mm, acuto, resta breve 0.1-0.7 (2) mm, talvolta assente. Antere 2-2.3 (2.8) mm.

Prati aridi, indifferente al substrato. - Italia di nord ovest: R; Penisola, fino al Lazio, Abr.* e Molise: C.* (100 - 1800 m). – Fi. IV-VI – Francia sud est, Italia.

2n = 14.

Nota - La sua variabilità ed i rapporti con *F. gracilior* (Hack.) Markgr.-Dann. sono stati recentemente chiariti da Foggi et al. (2006).

40. F. pignattiorum Markgr.-Dann., Giorn. Bot. Ital., 116 (1-2): 94 (1983) - ●
Sinonimi
F. pignattiorum Markgr.-Dann. ex Pignatti E. et Markgr.-Dann. in Pignatti S., Fl. Ital., 3: 496 (1982) nom. inval.

Pianta alta 30 cm, densamente cespitosa. Culmi 25 cm. Innovazioni intravaginali. Guaine chiuse nel 1/2 inferiore, glabre. Ligula con orecchiette cigliate. Lamina delle innovazioni 15 cm, abbastanza rigida, leggermente incurvata, liscia, glauca, leggermente pruinosa. Sezione fogliare 0.35-0.5 mm, 7 fascetti, 1 costa, talvolta con altre due coste laterali poco prominenti, sclerenchima in anello ± continuo, con 1-2 strati di cellule, leggermente ispessito sui fianchi. Pannocchia lunga 4.5 cm, con rami scabri. Spighette 7 mm, 3-4 fiori. G1 3.2 mm, lanceolata. G2 3.9 mm, oblungo lanceolata. Lemma 4.5-5.2 mm, oblungo-lanceolato, talvolta lungamente acuminato, scabro nella parte terminale, resta 0.8-1 mm. Antere ?

Creste ventose su substrato acido. – Raccolta una volta in Sic. sulle Madonie al M. Quacella, locus classicus, e non ritrovata in seguito, da ricercare. (1400-1900 m). – Fi V – Endemica (?).

2n = mancano conteggi su popolazioni italiane.

Nota - Questa specie è conosciuta solo per la descrizione contenuta nella precedente edizione di questa flora. Non abbiamo mai visto un campione e neppure il tipo, che sembrerebbe andato perso. Campioni in PAL del Monte San

Salvatore (Madonie) determinati come **40** sono in realtà da attribuire a **49** subsp. (**b**). Anche ricerche condotte nell'erbario di Trieste (TSB) e nell'erbario Markgraf a Zurigo (Z) si sono dimostrate vane.

41. F. centroapenninica (Markgr.-Dann.) Foggi, Conti et Pignatti, Bocconea, 10: 14 (1998) - ●
Sinonimi
F. ovina var. *centro-apenninica* Markgr.-Dann., Arch. Bot. Biogeogr. Ital., 48(1-2): 25 (1972)
F. centro-apenninica (Markgr.-Dann.) Markgr.-Dann. ex Pignatti et Markgr.-Dann. in Pignatti, Fl. Ital., 3: 498 (1982) nom. inval.

Pianta alta 30-50 (60) cm, cespitosa. Culmo. 20-40 cm. Innovazioni intravaginali. Guaine aperte o chiuse solo alla base o poco più, minutamente puberule. Ligula molto breve. Lamina delle innovazioni 10-30 cm, giunchiforme o debolmente compressa sui lati, scabra su tutta la lunghezza, verde scuro, non pruinosa, rigidetta. Sezione fogliare 0.3-0.6 mm, ovata irregolare, (6) 7 fasci vascolari, 3 coste, sclerenchima gen. in anello continuo, abbastanza regolarmente ispessito con 3-4 strati di cellule. Pannocchia 8-12 cm, eretta, densa. Spighette 3.4-4.4 mm, 3-4 fiori, ± glauco pruinose e spesso violacee. G1 2.5-2.9 mm; G2 (3.2) 3.5-4.5 mm. Lemma 4.5-5.5 mm, irsuto o scabro nella parte distale, resta (1.3) 1.7-2.5 mm. Antere 1.7-2.2 mm.

Prati aridi. - App. Centr. al Pian Grande, Sibillini, M. Sabini (un campione dubbio), Abruzzo: R. (500 - 1500 m). – Fi. V-VI – Endemica: Appennino centrale.

2n = mancano conteggi su popolazioni italiane.

Note - Specie mal conosciuta, manca al momento una chiara delimitazione di **43**. I campioni da noi osservati sono pochissimi e quindi i rapporti con le specie vicine, in particolare **41**, non sono molto chiari, anche se le foglie scabre su tutta la lunghezza e le reste del lemma gen. maggiori di 2 mm, sembrano confermare che si tratti di una specie diversa.

42. F. cinerea Vill. in Gilib., Fl. Delphinalis: 8 (1785) - ●
Sinonimi
F. ovina subvar. *cinerea* (Vill.) Hack., Monogr. Festuc. Eur.: 95 (1882)

Pianta alta 20-40 cm, ± densamente cespitosa. Culmo 20-50 cm, 1-2 (3) nodi. Innovazioni intravaginali. Guaine chiuse fino a 1/5-1/4, talvolta debolmente pelosa. Ligula molto breve con orecchiette evidenti. Lamina delle innovazioni 10-30 cm, giunchiforme o debolmente compressa sui lati, glabra, pruinosa, glauca, verde scuro. Sezione fogliare (0.5) 0.7-0.9 (1.2) mm, obovata irregolare, 7-9 fasci vascolari, (1) 3 (5) coste non elevate, sclerenchima gen. in anello continuo, gen. ispessito lateralmente, talvolta interrotto sui lati, tricomi lunghi, abbondanti. Pannocchia (2) 4-6 cm, densa, con poche spighette. Spighette 7-7.5 (8) mm, 4-7 fiori, ± pruinose. G1 3-3.2 mm. G2 4-4.2 mm. Lemma (4.2) 4.6-5.2, spesso barbato nella parte distale, resta 2.6 mm. Antere 3.3-3.5 mm.

Prati aridi e mesofili, rupi e macereti, preferenza su calcare e serpentino. – Piem., Lig., A. Apuane: R., forse anche in Lomb., V. Aosta ed Emilia-Romagna: distribuzione da accertare.* (500 - 1500 m). – Fi. V-VI – Europa sud ovest.

2n = 28.

Nota - Attualmente la specie è conosciuta per vari campioni provenienti dalle Alpi Apuane (Foggi & Rossi, 1996) e pochi esemplari delle Alpi Marittime. Varie sono le segnalazioni per altre regioni* che, al momento, non possiamo confermare con sicurezza. È sicuramente da escludere dalla Flora d'Abruzzo* per un errore di determinazione con **39**. I rapporti con alcune specie vicine della Francia meridionale (*F. degenti* (St.-Yves) Markgr.-Dann.) devono essere approfonditi.

43. F. veneris Graz. Rossi, Foggi et Signorini, Webbia, 51 (2): 22 (1996) - ●
Sinonimi
F. ovina var. *glauca* subvar. *tenuior* Hack. *nomen*

Pianta alta (15) 18-20 (25) cm, a cespi isolati ma densi. Culmi 15-20 cm, bianco-grigiastri. Innovazioni intravaginali. Guaine chiuse fino a 3/4-4/5, minutamemente ciliolate. Ligula 0.2-0.3 mm, con orecchiette appena evidenti, ciliolate. Lamina delle innovazioni (8) 10-16 (22) cm, liscia, glabra, pruinosa, diritta, debolmente ripiegata, acuminata. Sezione fogliare 0.47-0.53 (0.6) mm, ovale o V-ovale, 5 (7) fasci vascolari, sclerencima in anello continuo ± ugualmente ispessito (1) 2-3 cellule, (1) 3 coste non molto alte, tricomi brevi e radi. Pannocchia 3.5-4.5 (5) cm, stretta, lineare, densa ma talvolta interrotta. Spighette 6.5-7 mm, 4 fiori, pruinose. G1 (2.5) 3-4 mm, subulata. G2 (3.5) 4-4.7 mm, acuminata, con margine scarioso largo fino a 1/3 di metà della parte laminare. Lemma (4) 4.5-5.2 mm, scabridulo, resta 1-1.7 (2) mm. Antere (1.8) 2-2.2 (2.6) mm.

Rupi e garighe costiere su calcare. – Lig. a Portovenere, Palmaria: RR. (20 - 150 m). – Fi. IV-V – Endemica: Portovenere, Palmaria.

2n = 14.

44. F. riccerii Foggi et Graz. Rossi, Willdenowia 26(1): 206 (1996) - ●
Sinonimi
F. duriuscula sensu Auct. Fl. Ital. p.p. quoad pl. App. Tosco-Emiliano non L.
F. robustifolia Auct. Fl. et Veg. App. Tosco-Emiliano non Markgr.-Dann.

Pianta alta 10-25 (30) cm, densamente cespitosa. Culmo 10-15 cm. Innovazioni intravaginali. Guaine chiuse su 1/2-1/3. Ligula molto breve, con orecchiette evidenti, ciliolate. Lamina delle innovazioni liscia, verde, non pruinosa, gen. eretta, talvolta ± recurvata, non pungente. Sezione fogliare (0.5) 0.6-0.8 (1) mm, irregolarmente obovale-ellittica a V ± aperto, 7 fasci vascolari, sclerenchima in anello interrotto a livello della parte laterale, talvolta continuo ma irregolarmente ispessito, (1) 3 (5) coste, tricomi brevi. Pannocchia (2.5) 3-5 (6) cm, breve, densa. Spighette 7-8 (8.5) mm. G1 (2) 2.8-3.5 mm. G2 3.8-4.5 (5) mm. Lemma 4.5-5.5 mm, resta 2-4 mm. Antere 2-2.5 mm.

Praterie discontinue di vetta, su arenaria. - Appennino Tosco-Emiliano e Lig.: C.* (1600 - 2100 m). – Fi. VI-VII – Endemica: Appennino Tosco-Emiliano.

2n = 28.

45. F. imperatrix Catonica, Plant Biosystems, 135 (3): 275-276 (2001) - ●

Pianta alta 13-40 cm, densamente cespitosa. Culmi (10) 18-25 (35) cm, glauchi. Innovazioni intravaginali. Guaine chiuse nel 1/3-1/4 inferiore, sparsamente pelose. Ligula subnulla. Lamina delle innovazioni (4.5) 6-8.5 (10) cm, liscia o debolmente scabrida all'apice, pruinosa, spesso a spirale. Sezione fogliare (0.52) 0.58-0.82 (1.05) mm, a V ± aperto, ovata, 5-7 fasci vascolari, 3-5 coste mediamente profonde, sclerenchima ad anello interrotto, talvolta continuo, con 1-3 strati di cellule. Pannocchia lunga 2.8-5.1 cm, con rami scabri. Spighette 5.5-8.6 mm, 2-3 fiori, glauche, pruinose, screziate di violetto. G1 2.5-3.2 mm, cigliata. G2 3.3-3.9 mm. Lemma 4.5-5.7 mm, ovato-lanceolato, brevemente acuminato, glabro o pubescente, cigliato, resta 1.9-3.1 mm. Antere 2-2.3 mm.

Praterie montane e subalpine. - App. Centr. in Abr. sul Gran Sasso d'Italia, Campo Imperatore, Monte Velino: C. (1400 - 2500 m). – Fi. VI-VII – Endemica: Gran Sasso d'Italia.

2n = 28.

Nota - Questa specie presenta notevoli somiglianze con **44**, dell'Appennino Tosco-Emiliano. Le due entità meritano di essere studiate ulteriormente.

46. F. robustifolia Markgr.-Dann., Bot. Journ. Linn. Soc., 76: 328 (1978) - ●
Sinonimi
F. ovina subsp. *eu-ovina* var. *duriuscula* subvar. *robusta* Hack., Mon. Fest. Europ.: 91 (1882)
F. ovina var. *robusta* (Hack.) Fiori in Fiori et Béguinot, Schedae ad Floram Italicum exsiccatam, series II n.1623 N.Giorn.Bot.Ital., n.s., 19:526-527 (1912)
F. ovina var. *robusta* f. *pubiscula* Fiori in Fiori et Béguinot, Schedae ad Floram Italicum exsiccatam, series II n.1623 N.Giorn.Bot.Ital., n.s., 19: 527 (1912)

Pianta alta 30-60 cm, ± densamente cespitosa. Culmi 25-50 cm, scanalati, ± scabri nella metà superiore per brevi peli sparsi aculeiformi, rivolti verso l'alto. Innovazioni intravaginali. Guaine chiuse fino a 1/3, glabre. Ligula breve con orecchiette appena evidenti, ciliolate. Lamina delle innovazioni brevi e contorte oppure allungate ed erette, gen. ± scabre su tutta la loro lunghezza, raram. lisce in basso e scabre solo nella metà apicale, ± pruinose, di colore variabile da verde chiaro a glauco. Sezione fogliare 0.8-1.2 mm, di forma ovale regolare, con 7(9) fasci vascolari, anello sclerenchimatico continuo, regolarmente ispessito (3-5 file di cellule), cellule epidermiche di grandi dimensioni, 3 (5) coste adassiali, con peli lunghi e densi. Pannocchia (3.5) 5-10 (11) cm, piuttosto densa, eretta o leggermente incurvata, con rami da poco a molto scabri. Spighette (8) 8.3-9.5 (10) mm, (4) 5-6 fiori, ± pubescenti, raram. glabre. G1 (2.7) 3-4 (4.2) mm, subulata, glabra o con una linea di peli lungo la nervatura centrale. G2 (4) 4.5-5 (5.3) mm, ± densamente coperta di peli. Lemma (5.5) 5.8-6.5 (6.8) mm, acuto, da densamente pubescente a glabro con peli marginali solo nella metà apicale, resta 2-3.2 (3.7) mm. Antere (2.6) 2.8-3.3 mm.

Praterie discontinue su ofioliti. – Lig., App. Piem.* e Emiliano, Tosc.:C.* (100 - 1000 m). – Fi. IV-V – Endemica:

2n = 70.

Nota - Specie in passato mal interpretata (cfr. Foggi et Signorini 2001, 2002).

47. F. apuanica Markgr.-Dann., Bot. J. Linn. Soc., 76: 322 (1978) - ●
Sinonimi
F. duriuscula sensu Auct. Fl Ital. p.p. quoad pl. Alp. Ap., non L.
F. glauca Auct. Fl Ital. p.p. quoad pl. Alp. Ap., non Vill.

Pianta alta 35-60 cm, ± lassamente cespitosa. Culmo 20-50 cm. Innovazioni intravaginali. Guaine chiuse su 1/8-1/2. Ligula molto breve con orecchiette evidenti. Lamina delle innovazioni giunchiforme, liscia o debolmente scabra nella parte distale, grigio-verde, più lunghe della metà del culmo. Sezione fogliare 0.7-1 (1.1) mm, semipoligonale-rotondata-ovale, 7 fasci vascolari, sclerenchima in 7 isolotti decorrenti oppure continuo, ma ispessito in 7 punti (a livello dei fasci vascolari), talvolta in un anello continuo, ma sempre irregolare, cellule epidermiche abassiali larghe o molto larghe, 3-5 coste adassiali, superficie adassiale con peli sparsi. Pannocchia 6-14 cm, ampia, lassa, spesso interrotta, con rami inferiori patenti durante la fioritura. Spighette 8-9 (9.4) mm, 3-5 (6) fiori, gen. verdi. G1 3-3.5 mm. G2 3.2-4.5 (5.5) mm, con margine scarioso evidente. Lemma 5.2-6 (7) mm, 5-nervio, scabro nella metà distale, resta (1.5) 2-2.5 (3) mm. Antere 2-2.5 mm.

Rupi e macereti preferibilmente su silice, raramente anche su calcare. - Alpi Apuane: C. (300 - 1500 m). – Fi. V-VI – Endemica: Alpi Apuane.

2n = 70.

48. F. gamisansii subsp. **aethaliae** Signorini et Foggi, Plants Biosystems, 132(2): 106 (1998) - ●
Sinonimi
F. indigesta subsp. *litardierei* (St.-Yves) Kerguélen, Lejeunia, n.s., 75: 158 (1975) p. p., quoad plantas Insulae Ilvae.
F. duriuscula Auct. Fl. Ital. p. p., quoad plantas Insulae Ilvae, non L.

Pianta alta 20-60 cm, ± densamente cespitosa. Culmo (15) 30-45 (60) cm, canaliculato, scabro nella parte superiore. Innovazioni intravaginali, talvolta rossastre alla base. Guaine verdastre, chiuse per 1/3, puberule alla base. Ligula 0.2-0.3 mm, con orecchiette ciliolate. Lamina delle innovazioni (5) 15-30 (40) cm, non pungente, glabra, lievemente scabra almeno nella parte distale. Sezione fogliare 0.8-1.1 mm, a V-obovale, 7 fasci vascolari, sclerenchima formante un anello continuo, raram. interrotto, ispessito in coincidenza della nervatura mediana e di quelle marginali, 3-5 coste, tricomi abbondanti e lunghi. Pannocchia (3) 6.2-8 (9) cm, densa, con rami scabridi e pubescenti. Spighette (8.5) 8.7-10.3 (10.7) mm, (3) 4-5 (6) fiori. G1 2.5-4,5 mm, densamente coperta da lunghi peli, talvolta solo pochi peli lunghi nella parte distale. G2 (4) 4.2-6.3 mm, acuta, talvolta brevemente acuminata, densamente coperta da lunghi peli, talvolta solo pochi peli lunghi nella parte distale. Lemma (5.3) 5.5-7 (7.2) mm, acuto, densamente coperto da lunghi peli, resta (2.4) 2.5-3.8 (4.2) mm. Antere (2.8) 3-3.4 (3.6) mm.

Ginestreti a dominanza di Genista desoleana. - Isola d'Elba, al M. Capanne: C. (400 - 1000 m). – Fi. IV-VI – Endemica: Isola d'Elba.

2n = 84.

49. F. laevigata Gaudin, Alpina (Winterthur) 3: 60 (1808)
(**a**) subsp. **laevigata**

Sinonimi

F. duriuscula var. *laevigata* (Gaudin) Lamotte, Cat. pl. vasc.: 99 (1847)
F. duriuscula var. *curvula* (Gaudin) Mert. et Koch in Rohling, Deutschl. Fl., 1: 649 (1823)
F. glauca var. *curvula* (Gaudin) Schur Enum. Pl. Transsilv.: 790 (1866)
F. ovina f. *laevigata* (Gaudin) Hack., Monogr.: 92 (1882)
F. ovina f. *curvula* (Gaudin) Hack., Monogr.: 93 (1882)
F. cinerea var. *curvula* (Gaudin) Stohr, Wiss. Z. Univ. Halle, Math.-Nat., 9(3): 401 (1932)
F. duriuscula c. *longifolia* Parl., Fl. Ital., 1: 437 (1850) non Thuill.

Pianta alta (20) 40-60 (70) cm, cespitosa, non rizomatosa. Culmo glabro, liscio, ± pentagonale, striato sotto la pannocchia, 1-3 nodi, il superiore a 1/3 inferiore, circa. Innovazioni intravaginali. Guaine aperte fino circa alla base. Ligula 0,1-0,2 mm. Lamina delle innovazioni (5) 10-30 (40) cm, da setacea a giunchiforme, rigida, liscia o un po' scabra verso l'apice, gen. verde. Lamina caulinare (1) 3-9 (15) cm, convoluta. Sezione fogliare (0.7) 0.9-1.2 (1.5) mm, da ± ellittica a obovale, talvolta a V o a Y, 7-9 (11) fasci vascolari, 3 (5) coste, solco intercostale mediamente profondo, sclerenchima ± continuo, gen. con 1-2 (3) strati sui fianchi, ispessito in corrispondenza del fascetto mediano e dei marginali, ma mai come la subsp. (**b**), spesso interrotto con 3 blocchi decorrenti, tricomi da corti a medi, abbastanza abbondanti, cellule epidermiche di piccole o medie dimensioni. Pannocchia (3) 5-10 (13) cm, ± contratta, eretta, sorpassante da poco a mediamente le innovazioni. Spighette (8) 9-10 (11) mm, erette, abbastanza lasse, sovente interrotte, (3) 4-6 (8) fiori, verde tinte di violetto. G1 4 mm, glabra. G2 5.8 mm, glabra. Lemma (5) 6-7 (7.5) mm, glabro o scabriuscolo nella parte distale, talvolta cigliato ai margini o villoso, resta (1.5) 2-3.5 (4) mm. Antere 3-4.2 mm.

Prati alpini e subalpini, indifferente al substrato, preferente il calcare. Alpi, dalle Carn. alle Maritt., Alpi Apuane, App. Emil.,e Centr,: C.* (800 - 2000 m). – Fi. VI-VIII – Orofita centro-sud Europea.

2n = 56.

(**b**) subsp. **crassifolia** (Gaudin) Kerguélen et Plonka, Lejeunia, n.s., 142: 15 (1993)

Sinonimi

F. glauca var. *crassifolia* Gaudin Fl., Helv.: 284 (1828)
F. duriuscula var. *crassifolia* (Gaudin) Mutel, Fl. Fr. 4: 101 (1837)
F. duriuscula subvar. *crassifolia* (Gaudin) Krajina, Acta Bot. Bohem. 9: 193 (1930)
F. duriuscula subsp. *crassifolia* (Gaudin) K. Richt., Pl. Europ., 1: 94 (1890)
F. ovina subvar. *crassifolia* (Gaudin) Hack., Monogr.: 91 (1882)
F. ovina var. *crassifolia* (Gaudin) Chenevard, Bull. Herb. Boiss., 2. Sér 3: 449 (1903)

F. cinerea subsp. *crassifolia* (Gaudin) Stohr, Wiss. Z. Univ. Halle, Math.-Nat., 9(3): 402 (1960)
F. curvula subsp. *crassifolia* (Gaudin) Markgr.-Dann., Bot. Jour. Linn. Soc., 76: 328 (1978)

Pianta alta 30-60 cm, cespitosa, non rizomatosa. Culmo spesso scabrido nella parte superiore. Innovazioni intravaginali. Guaine aperte fino alla base. Ligula 0,1-0,2 mm. Lamina delle innovazioni (5) 20-30 (4) cm, giunchiforme, rigida, apice ± pungente, liscia o un po' scabra verso l'apice, gen. verde. Lamina caulinare (3) 5-12 cm, convoluta. Sezione fogliare 1-1.3 (1.7) mm, a U, da ± ellittica a obovale, 7-9 fasci vascolari, 3-5 coste, solco intercostale mediamente profondo, sclerenchima continuo, gen. di spessore irregolare 2-4 (5) strati di cellule sui fianchi, maggiormente ispessito in corrispodndenza della carena e dei margini fino a formare tre blocchi ben evidenti anche sul secco, talvolta interrotto, tricomi da corti a medi, gen. abbondanti, cellule epidermiche di piccole o medie dimensioni. Pannocchia 6-10 cm, ± contratta, eretta, passante da mediamente ad abbastanza lungamente le innovazioni. Spighette (7) 8-9 mm, 4-6 fiori, verde talvolta screziate di violetto. Lemma (4.5) 6-7 mm, glabro o scabriuscolo, talvolta un po' villoso verso l'apice, resta 2-3.5 mm. Antere 3.5-4.2 mm.

Prati aridi montani e subalpini, tendenzialmente su calcare (in Sic. su quarzareniti). - Alpi Occid. (R), App. Centr. e Merid. (C), Sicilia alle Madonie (RR).* (800 - 2000 m). – Fi. VI-VIII – Orofita W Alpi- Appennino centrale.

2n = 56.

Nota - La distinzione delle due sottospecie è debole e basata, quasi esclusivamente, sui caratteri dello sclerenchima. Il tipo morfologico corrispondente alla subsp. (**b**) sembra dominare sui rilievi calcarei dell'Appennino centrale. Il dato riguardante la Sicilia (Monte San Salvatore) si riferisce a campioni conservati in PAL (sub **40**).

50. F. billyi Kerguélen et Plonka, Bull. Soc. Ech. Pl. Vascul. Eur. Bass. Mèdit., 23: 87 (1991)
Pianta alta (25) 35-60 cm, ± densamente cespitosa. Culmo 20-50 cm, 1-2 (3) nodi. Innovazioni intravaginali. Guaine chiuse fino a 1/10, talvolta debolmente pelose. Ligula molto breve con orecchiette evidenti. Lamina delle innovazioni 10-30 cm, giunchiforme o debolmente compressa sui lati, glabra, verde scuro, non pruinosa. Sezione fogliare (0.9) 1-1.3 (1.5) mm, ovata irregolare, 7-9 (11) fasci vascolari, 5-7 coste rotondato-acute, sclerenchima gen. in anello continuo, talvolta brevemente interrotto lateralmente, tricomi radi e piccoli. Pannocchia 8-12 cm, ampia, spesso interrotta. Spighette 8-9 (11) mm, 4-7 fiori. G1 3.5-4 mm. G2 5.5-6 (6.5) mm. Lemma 5.5-7 mm, resta (0.8) 1.5-2.3 (3.4) mm. Antere 3-3.5 mm.

Vaccinieti, brachipodieti, su silice. – App. Sett. in Emilia e Tosc.: R. (1500 - 1900 m). – Fi. VI-VIII – Massiccio centrale, Appennino settentrionale.

2n = 42.

Nota - La specie è stata descritta recentemente per il Massiccio centrale (Francia) e ritrovata nell'Appennino settentrionale (Foggi & Rossi, 1996). I caratteri morfologici, cariologici e stazionali-ecologici, delle popolazioni nord appenniniche, ricordano molto da vicino quelle delle popolazioni francesi. È logico aspettarsi di ritrovare la specie anche sulle Alpi occidentali.

51. F. ticinensis (Markgr.-Dann.) Markgr.-Dann., Bot. Journ. Linn. Soc., 76: 328 (1978) - ●
Sinonimi
F. ovina subsp. *ticinensis* Markgr.-Dann., Veröff.Geobot. Inst. Stiftung Rübel, Zürich, 57: 62 (1976)

Pianta alta 25-65 cm, densamente cespitosa, eretta, verde glauco o pruinosa, non rizomatosa. Culmo 25-50 cm, robusto, solcato e talvolta scabro nella parte superiore, con 1-2 nodi. Innovazioni intravaginali. Guaine aperte fino a circa la base o a 4/5, da densamente pelose a glabre. Ligula brevissima, con orecchiette poco visibili. Lamina delle innovazioni (10) 15-50 cm, giunchiforme, eretta, non molto rigida, scabra almeno nella parte superiore, verde. Sezione fogliare 0.7-1.3 mm, V un po' aperto, giunchiforme, non o poco appiattito lateralmente, (5) 7 (9) fasci vascolari, 1-3 (5) coste gen. poco sviluppate, solco intercostale da poco a mediamente profondo, sclerenchima gen. continuo, con la parte mediana e marginale appena più spessa rispetto ai fianchi, talvolta discontinuo, tricomi da corti a medi, cellule epidermiche medie. Pannocchia 5-16 cm, allungata, eretta, da verde glauco a pruinosa, talvolta variegata di violetto scuro. Spighette (6) 6.5-9 (10) mm, (3) 5-8 fiori distanziati fra loro, da verdi ad appena glauche. G1 3,9-4,2 mm. G2 4.3-4.7 (5) mm. Lemma 5-6.5 (7) mm, resta 2.5-3.5 (4) mm. Antere 2.5-4 mm.

Pendii rupestri su calcare o silice. - Presso il Lago di Como, Dervio e Varese: RR.* (800 - 1500 m). – Fi. VI-VII – Endemica: Canton Ticino (Italia e Svizzera), lago di Como e lago Maggiore.

2n = 42.

52. F. arvernensis Auquier, Kérguelen et Markgr.-Dannenb., Lejeunia 89: 15 (1977) subsp. **costei** (St.-Yves) Auquier et Kerguélen, Lejeunia, n.s., 89: 22 (1978)
Sinonimi
F. ovina subvar. *costei* St.-Yves, Bull. Soc. Roy. Bot. Belg., 55: 107 (1923)
F. costei (St.-Yves) Markgr.-Dann., Bot. J. Linn. Soc., 76: 327 (1978)
F. hervieri subsp. *costei* (St.-Yves) O. Bolos, Masalles et Vigo, Collect. Bot. (Barcelona) 17: 96 (1988)
F. hervieri var. *costei* (St.-Yves) Auquier, Bull. Jard. Bot. Belg. 39: 119 (1969)
F. marginata subvar. *costei* (St.-Yves) Auquier, Bull. Soc. Bot. France 110, 89. Sess. Extr.: 78 (1961)

Pianta alta (15) 30-70 (110) cm, cespitosa, glabra e pruinosa, in ciuffi robusti con foglie ricadenti in fasci, non rizomatosa. Culmo 10-80 cm. Iinnovazioni intravaginali. Guaine aperte fino a circa la base, lisce, glabre, con la base spesso violacea. Lamina delle innovazioni (3) 15-40 (60) cm, allungata e molle soprattutto nelle piante che crescono nelle stazioni rupestri, liscia, glauca, pruinosa. Lamina caulinare (2) 5-13 (17) cm, a V aperto fino a diventare piana. Sezione fogliare (0.7) 0.9-1.3 (1.8) mm, a V aperto con braccia allungate e spesse, 7-9 (13) fasci vascolari, 3 (5) coste arrotondate, solco intercostale mediamente profondo, sclerenchima gen. in 3 blocchi ± decorrenti solo raram. continuo, ma in questo caso ispessito ai margini e alla carena, tricomi corti ± abbondanti. Pannocchia 6-10 (18) cm, ± contratta, da eretta a ± inclinata, passante mediamente le innovazioni. Spighette (6) 8-8.5 (11) mm, 3-5 (7) fiori, glauco-pruinose. G1 (2.2) 2.8-3.3 (3.7) mm. G2 (3.3) 3.8-4.2 (4.8) mm. Lemma (3.5) 5-5.8 (7.5) mm, glabro o cigliato ai margini, resta (1) 1.2-2.2 (2.9) mm. Antere (2.2) 2.5-3 (3.2) mm.

Pendii rocciosi, prateria, bordi di strade, sabbie fluviali. - Piem. sulle A. Maritt. a Vinadio: RR. (800 - 900 m). – Fi. V-VI – Europea.

2n = mancano conteggi su popolazioni italiane.

Nota - Segnalata per l'Italia in più occasioni, sia per il Piemonte che per la Calabria. Possiamo confermare solo le indicazioni per il Piemonte, dove è stata ritrovata recentemente (Parolo et al., 2007). L'entità è stata identificata solo su base morfologica e ulteriori ricerche devono essere eseguite per capire a quale livello di ploidia (2 n = 14; 28) corrisponda la popolazione individuata.

53. F. longifolia Thuill., Fl. Envir. Paris ed. 2, 50 (1799) subsp. **pseudocostei** Auquier et Kerguélen, Lejeunia, n.s., 89: 45-46 (1977)
Sinonimi
F. patzkei Markgr.-Dann., Bot. J. Linn. Soc., 76: 325 (1978)

Pianta alta (20) 30-50 (75) cm, cespitosa, non rizomatosa. Culmo 15-50 cm. Innovazioni intravaginali. Guaine aperte fino circa alla base. Ligula < 0.3 mm. Lamina delle innovazioni (10) 15-30 (40) cm, giunchiforme, rigida, liscia, glauca, pruinosa. Lamina caulinare (2) 4-9 (15) cm, arrotolata. Sezione fogliare 0.8-1.2 (1.4) mm, ellittico ± allungata, a V ± aperto, 7-9 (11) fasci vascolari, (3) 5 (7) coste gen. appiattite, solco intercostale mediamente profondo, sclerenchima interrotto, raram. subcontinuo, sottile 1-2 strati sui fianchi, talvolta in 3 blocchi decorrenti, tricomi da medi a lunghi, abbondanti. Pannocchia (4) 6-9 (13) cm, contratta, eretta, multispiculata, passante da poco a mediamente le innovazioni. Spighette (6.2) 6.8-7.5 (8.3) mm, (3) 4-5 (6) fiori, glauche. G1 (1.8) 2-2.6 (2.9) mm. G2 (2.8) 3.1-3.6 (3.9) mm. Lemma (4.1) 4.2-4.7 (5.4) mm, glabro, resta (0.9) 1.1-1.7 (2.3) mm. Antere ?

Praterie, pendii rocciosi, bordi delle vie, (indifferente al substrato ?). - Non segnalata da noi, ma da ricercare in Liguria e Piemonte (popolazioni in terr. francese fino al confine). (200 - 1000 m). – Fi. V-VI – Francia meridionale

2n = mancano conteggi su popolazioni italiane.

54. F. heteropachys (St.-Yves) Patzke ex Auquier in De Langhe et al., Nouv. Fl. Belg. 759 (1973)
Sinonimi
F. ovina var. *heteropachys* (St.-Yves) Stohr, Wiss. Z. Univ. Halle, Math.-Nat., 9 (3): 406 (1960)
F. ovina subvar. *heteropachys* St.-Yves, Bull. Soc. Bot. Fr., 71: 31 (1924)

Pianta alta (15) 50-70 (95) cm, densamente cespitosa, eretta, verde o pruinosa, non rizomatosa, Culmo eretto, abbastanza robusto, puberulento verso l'alto, cilindrico o poco solcato sotto la pannocchia, con 2-3 nodi, il superiore gen. visibile a 1/4-1/3 dell'altezza della pianta. Innovazioni intravaginali. Guaine aperte su tutta la lunghezza. Ligula 0.1-0.2 mm. Lamina delle innovazioni di 2 tipi in una stessa innovazione: lamine lunghe (30-50 cm di lunghezza, 1 mm di diametro), lamine brevi (10-20 cm di lunghezza, 0.5 mm di diametro) e flessuose, entrambe flessibili, scabre, verdi o glauche, talvolta verde-grigiastro, non o debolmente pruinose. Lamina caulinare 5-8 (12) cm piana o ± convoluta. Sezione fogliare 0.5-1.44 mm, da subovale a obovale-ellittica, 7 (9) fasci vascolari, 1 costa o 2 supplementari appena accennate, solco intercostale poco profondo; foglie spesse con anello sclerenchimatico continuo, spesso 2-3 strati sui fianchi, raram. in 3 isolotti decorrenti, foglie sottili con anello sclerenchimatico continuo, ma più sottile 1-2 strati lungo i fianchi, interrotto o in isolotti, raram. in 3 isolotti decorrenti, tricomi da corti a lunghi, abbastanza abbondanti. Pannocchia (2.5) 8-11 (15) cm, ± eretta, stretta, interrotta alla base, gen. paucispicolata con rami abbastanza corti, spesso puberulenti, più raram. scabri. Spighette (5.4) 6.5-8 (10) mm, (2) 3-6 (7) fiori, verde pallido o ± glauche, raram. tinte di viola. G1 (1.8) 2.5-3 (4) mm, con margini ciliolati. G2 (2.8) 3.4-4 (5.1) mm. Lemma (3.3) 4-5.3 (6.2) mm, glabro, talvolta villoso ai margini e arruffato verso l'apice, resta 2-2.5 mm. Antere 2.2-2.6 (2.8) mm.

Stazioni rupestri, bordi di strade. - Val Venosta: RR. Dubbia per il Piemonte. (500 - 1500 m). – Fi. V-VII –. Europa centrale.

2n = mancano conteggi su popolazioni italiane.

18d3. gruppo di F. stricta/F.valesiaca (sp. 55-57)

Piante di colore verde scuro, non brillante, glauco-pruinose, con lamine spesso anche molto scabre almeno in alto; spighette spesso pelose; piante di medie-grandi dimensioni. Sclerenchima in tre isolotti decorrenti, talvolta confluenti a formare un anello continuo, ma derivato da tre isolotti che tendono a confluire; cellule epidermiche piccole, sempre con piccole ondulazioni fra due cellule (200 x). 2n = 14-70. Con l'eccezione di **56** subsp. (**b**), che si trova spesso in habitat antropizzati e viene usata nei rinverdimenti come "festuca duretta", le altre specie sono conosciute per le aree steppiche delle Alpi, soprattutto in quelle centrali e orientali.

55. F. bauzanina (Pils) Arndt Plant Syst. Evol. 271: 129-142 (2008) - ●
Sinonimi
F. stricta Host, Gram. Austr. 2:62 (1802) subsp. *bauzanina* Pils Phyton, 24(1): 61 (1984)

Pianta alta 30-60 cm, densamente cespitosa. Culmo 25-50 cm, con 1-2 (3) nodi. Innovazioni intravaginali. Guaine chiuse fino a 1/2, gen. glabre. Ligula molto breve. Lamina delle innovazioni 7-50 cm, convoluta, capillare, eretta, scabra, verde scuro ± glauca, non pruinosa. Sezione fogliare 0.5-1.1 mm, a V ± aperto talvolta, tendente a chiudersi e diventare quasi obovale-rotondata, 5 (7) fasci vascolari, 3 (5) coste, 3 (4) solchi profondi, sclerenchima in 3 blocchi di grandi dimensioni, talvolta altri due piccoli blocchi laterali spesso fra loro confluenti fino a formare un anello completo, ma con le parti mediana e marginali a maggiore ispessimento; cellule epidermiche di piccole dimensioni, con evidenti ondulazioni fra le cellule adiacenti (200 x). Pannocchia 5.5-15 cm. Spighette 6.4-8.7 mm, 4-8 fiori. G1 3.4-3.8 mm, lanceolata. G2 4.5-5.1 mm ellittica. Lemma 5-6.5 mm, resta 1-3.4 mm. Antere 2.4-4 mm.

Prati aridi, bordi di strade. – Dal Trent. (Cavalese) ed a nord fino a Bolzano, alla Valtellina (Uzza): R. (1000 - 2000 m). – Fi. VI-VIII– Endemica: Alpi sud orientali.

2n = 56 (42 ?).

Nota – Probabilm. solo in territorio italiano. Per la distribuzione in Italia vedi anche Parolo et al. (2007). Nella varietà di questa entità viene al momento ricondotta anche *F. ovina* var. *guinochetii* Bidault, un decaploide (2n = 70) descritto per S. Antonio, presso Bormio. Sec. Arndt S., *Plant Syst. Evol.* 271: 129-142 (2008) dovrebbe essere considerata a rango di specie.

56. F. stricta Host, Gram. Austr. 2: 62 (1802)

(**a**) subsp**. sulcata** (Hack.) Patzke ex J. Mull., Haussknechtia 7 (1999): 67.

Sinonimi

F. ovina var. *sulcata* (Hack.) Hack., in Halácsy et Braun, Nachtr. Fl. Nieder-Oesterr.: 26 (1882)
F. ovina subsp. *sulcata* (Hack.) Arcangeli, Comp. Fl. Ital., ed. 2 (1894): 59.
F. valesiaca subsp. *sulcata* (Hack.) Volkart, in Schinz et Keller, Fl. Schweiz, ed. 2 1: 59 (1905)
F. ovina race *sulcata* (Hack.) Rouy, Fl. France 14: 211 (1913).
F. valesiaca var. *sulcata* (Hack.) Cadevall, Fl. Catal. 6: 254(1936).
F. stricta subsp. *sulcata* (Hack.) Patzke, Oesterr. Bot. Z., 108 (4-5): 506 nomen
F. ovina subsp. *sulcata* var. *sulcata* Hack., Bot. Centralbbl., 8: 405 (1881)
F. ovina subsp. *sulcata* var. *genuina* Hack., Mon. Fest. Eur.: 104 (1882)
F. vallesiaca subp. *sulcata* (Hack.) Schinz et Keller, Fl. Schweiz, ed. 2: 26 (1905)
F. sulcata (Hack.) Nyman, Consp.Fl.Europ.: 828 (1882)
F. rupicola Heuffel Enum. Pl. Banat., Verh. k.k. Zool. Bot. Gesell., Wien: 233 (1858)
F. megaphylla Schur, Enum. Pl. Transs.: 789 (1866)
F. ganeschini Drobov, Trudy Bot. Muz. Imp. Akad. Nauk, 14: 175 (1915)
F. carnutina Tracey, Pl. Syst. Evol., 128: 291 (1977)
F. stricta subsp. *carnutina* (Tracey) Pils, Phyton, 24(1): 54 (1981)

Pianta alta (15) 25-40 (50) cm, densamente cespitosa, eretta, slanciata, verde glauco o pruinosa, non rizomatosa. Culmo 25-50 cm, solcato e talvolta scabro nella parte superiore, con 1 (2) nodi, situato nel ¼ inferiore. Innovazioni intravaginali. Guaine aperte fino circa alla base o a 3/4, da densamente pelose a glabre. Ligula brevissima, con orecchiette poco visibili. Lamina delle innovazioni (2) 5-15 (20) cm, setacea, eretta o debolmente curvata, gen. ± scabra, molto raram. liscia, verde o glaucescente, ± pruinosa. Sezione fogliare (0.4) 0.6-0.7 (0.8) mm, ± obovale o a V un po' aperto, 5 (7) fasci vascolari, gen. 3 coste, solco intercostale da poco a mediamente profondo, sclerenchima in 3 isolotti spessi ± decorrenti, talvolta 1-2 isolotti supplementari sui fianchi, tricomi da corti a medi, da poco ad abbastanza abbondanti, cellule epidermiche di piccole dimensioni, con evidenti ondulazioni fra le cellule adiacenti (200 x). Pannocchia (3) 5-7 (10), allungata, ± contratta, eretta, rami a peli ispidi, passante da mediamente ad abbastanza lungamente le innovazioni. Spighette (6) 6.5-7.5 (9) mm, (3) 4-6 fiori, verdi. G1 3-3.1 mm, ciliolata. G2 2.9-5.2 mm, ovale-lanceolata, acuminata. Lemma (3.8) 4.2-4.8 mm, glabro o ispido, resta 1.5-2 (2.8) mm. Antere 2.5 mm.

Prati aridi montani. Carso Triest., Friuli nei magredi, Alpi Or. dalle Giulie alle Grigne: C; nelle Marche e in Umbria: R, da ricercare in Tosc.; campioni dubbi provengono dall'Abr. (100 - 1000 m). - Diffuso componente dei prati steppici, in stazioni aride e soleggiate delle zone con clima continentale e subcontinentale, sulle Alpi e gli Appennini nella fascia collinare e montana, anche nell'alta pianura e prati carsici. Suolo sterile, poco profondo, povero di materia organica: forma uno strato di 1-pochi dm che ricopre la roccia madre (calcarea o silicea) oppure su sedimenti ciottolosi. Specie caratt. dei Festuco-Brometea. – Fi. V-VII– Eurasiatica.

2n = 42 - raram. apomittica, cfr. Gregor Th. (2004).

(**b**) subsp. **trachyphylla** (Hack.) Patzke ex Pils Phyton, 24(1): 58 (1984)

Sinonimi

F. ovina subvar. *trachyphylla* Hack., Mon. Fest. Europ.: 91 (1882)
F. stricta Host subsp. *trachyphylla* (Hack.) Patzke, Oester. Bot. Zeitschr., 108 (4-5): 506 (1961) nomen
F. duriuscula subsp. *trachyphylla* (Hack.) K. Richt., Pl. Eur., 1: 94 (1890)
F. ovina var. *trachyphylla* (Hack.) Druce, List. Brit. Pl.: 83 (1908)
F. trachyphylla (Hack.) Kraj., Act. Bot. Bohem., 9: 190, tab. 2, fig. 5,6 (1930) non Hackel ex Druce
F. ovina subsp. *sulcata* var. *trachyphylla* (Hack.) Markgr.-Dann., Ber. Bayer. Bot. Ges., 28: 204 (1950)
F. rupicola subsp. *trachyphylla* (Hack.) Markgr.-Dann. ex Janchen, Catal. Fl. Austriae, Erg.-Heft.: 108 (1963)
? *F. brevipila* Tracey, Plant Syst. Evol., 128: 287-292 (1977)

Pianta alta (15) 25-40 cm, densamente cespitosa, eretta, verde glauco o pruinosa, non rizomatosa. Culmo 25-50 cm, robusto, solcato e talvolta scabro nella parte superiore, con 2-3 nodi, il superiore gen. non visibile situato presso la base, raram. a 1/5-1/4. Innovazioni intravaginali. Guaine aperte fino circa alla base o a 4/5, da densamente pelose a glabre. Ligula brevissima, con orecchiette poco visibili. Lamina delle innovazioni 7-20 (37) cm, giunchiforme, eretta o debolmente curvata, rigida, poco o molto scabra, molto raram. liscia, verde o glaucescente, ± pruinosa. Sezione fogliare (0.5) 0.7-1 (2) mm, ellittica o a V un po' aperto, compressa lateralmente, 7-9 (11) fasci vascolari, gen. 3 (5) coste gen. poco sviluppate, solco intercostale da poco a mediamente profondo, sclerenchima gen. in 3 isolotti lungamente decorrenti, fino a diventare raram. continuo, in questo caso sclerenchima molto sottile sui fianchi con un ispessimento maggiore a livello del fascetto mediano e dei marginali, tricomi da corti a medi abbondanti, cellule epidermiche piccole o medie, con evidenti ondulazioni fra le cellule adiacenti (200 x). Pannocchia 5-9 (16) cm, allungata, contratta, eretta, da verde glauco a pruinosa, talvolta variegata di violetto scuro, rami abbastanza corti, angolosi e scabri. Spighette (5) 6.5-8 (10.8) mm, (3) 5-8 fiori, da verdi a glauche, sovente violacee. G1 (1.8) 2.4-2.9 (3.3) mm, sublanceolata, brevemente cigliata verso l'alto. G2 (3) 3.5-4,4 (5) mm, lanceolata, talvolta mucronata. Lemma (3.8) 4.4-5 (6.5) mm, cigliato, talvolta ispido, resta (0.5) 1.5-2.2 (3) mm. Antere (1.7) 1.8-2.1 (3) mm.

Prati aridi, bordi di strade, sinantropica, indifferente al substrato. – It. Sett. e Centr, verso sud fino alla Campania: C.* (300 - 1400 m). – Fi. V-VI – Europea, spesso seminata e divenuta cosmopolita.

2n = 42.

Nota - Entità piuttosto controversa la cui delimitazione rispetto alle altre specie del gr. "stricta" deve essere ulteriormente precisata; al momento risulta peraltro difficile capire la sua distribuzione poichè molte delle precedenti segnalazioni di "*F. duriuscula* auct." dovrebbero rientrare nella circoscrizione di **56** subsp. (**b**). Le cose sono complicate dal fatto che semi di questa enità sono disponibili sotto il nome commerciale di "Festuca duretta" in gran parte provenienti dalla Polonia o dall'Olanda. Controversa è anche la sinonimia con *F. brevipila* Tracey.

57. F. valesiaca Schleich. ex Gaudin, Agr. Helv., 1: 242 (1811) subsp. **valesiaca**

Sinonimi

F. ovina var. *valesiaca* (Gaudin) Link, Hort. Reg. Bot. Berol., 2: 267 (1833)
F. ovina subsp. *sulcata* var. *valesiaca* (Schleicher ex Gaudin) Koch ex Hack., Bot. Centralbl.8: 405 (1881)
F. sulcata subsp. *valesiaca* (Gaudin) Nyman, Consp. Fl. Europ.: 828 (1882)
F. ovina subsp. *sulcata* var. *valesiaca* subvar. *tenuissima* Hack., Mon. Fest. Eur.: 103 (1882)
F. pseudovina subsp. *tenuissima* (Hack.) K. Richt., Pl. Europ., 1: 95 (1890)
F. duriuscula subsp. *tenuis* Hack., Acta Mus. Nat. Hung., 2: 288 (1878)
F. glaucantha Blocki, Oesterr. Bot. Z., 39: 155 (1889)

F. meredisensis Nyarady, Stud. Cerc. Biol. Acad. R.P.R., 16(3): 184 (1964)

Pianta alta (5) 20-50 (60) cm, densamente cespitosa, eretta, non rizomatosa. Innovazioni intravaginali. Culmo 20-30 (50) cm. Guaine aperte fino circa alla base. Lamina delle innovazioni (2.5) 4-20 (35) cm, da capillare a setacea, da flessibile a poco rigida, scabra, verde grigiastro o glaucescente, gen. pruinosa. Lamina caulinare (1) 2-4 (6,5) cm, convoluta. Sezione fogliare 0.3-0.5 (0.7) mm, ellittica, obovale o a V, 5 fasci vascolari, 3 coste, solco intercostale mediamente profondo, sclerenchima in 3 isolotti ± spessi, talvolta 1-2 supplementari sui fianchi, tricomi da corti a medi, poco abbondanti, cellule epidermiche di piccole dimensioni, con evidenti ondulazioni fra le cellule adiacenti (200 x). Pannocchia (1.2) 3-10 cm, contratta ± eretta, oblunga, passante da poco a mediamente le innovazioni. Spighette (4.8) 5.5-6.5 (7) mm, (2) 3-5 (7) fiori, da verde a verde-grigiastre, talvolta variegate di violetto. G1 2.3 mm, subulata-lanceolata, sovente cigliolata sul margine. G2 3 mm. Lemma 3.7-4.5 (5.2) mm, glabro, ± villoso verso l'apice, strettamente lanceolato, resta 0.6-1 (1.5) mm. Antere 2.5 mm.

Prati aridi. - It. Sett.-arco alpino: C, una stazione isolata sull'App. Sett. alla Pietra di Bismantova: RR. (0 - 2000 m.). - Pascoli steppici nelle vallate centroalpine ad elevata continentalità: stazioni soleggiate, in estate calde e aride e fredde in inverno, nella fascia collinare e montana. Suolo neutro-subacido, ricco di materia organica, profondo oppure con roccia (graniti, porfidi, lave) affiorante. Specie guida dei Festucetalia valesiacae (a distribuzione eurasiatica).– Fi. VI-VIII– Eurasiatica.

2n = 14 - raram. apomittica, cfr. Gregor Th. (2004).

18e. Sect. *Vulpia* (incl. *Nardurus, Ctenopsis*, *Micropyrum*, *Psilurus*) - sp. 58-71

Piante annuali o perenni prive di innovazioni (eccetto **58**); pannocchia da spiciforme a piramidale; distribuzione centrata sul Mediterraneo. I generi *Vulpia*, *Festuca*, *Drymochloa, Leucopoa, Schedonorus* e *Lolium*, secondo i risultati delle ricerche a livello molecolare di Bulińska-Radomska e Lester (*cit.*) sono da considerare strettamente affini; a questi si devono aggiungere *Ctenopsis, Micropyrum e Psilurus*, successivamente inseriti nell'analisi filogenetica (Catalán et al., 2004 cit.; Catalán et al., 2007 cit.): secondo gli Autori è probabile che essi derivino da una unica forma ancestrale, dalla quale si potrebbero esser differenziati, da un lato *Festuca pratensis* (e la serie *Festuca – Vulpia – Ctenopsis – Micropyrum – Psilurus* più alcuni altri generi estranei alla flora italiana) e dall'altro *Lolium perenne* (e le altre specie del gen. *Lolium*).

x = 7

58. F. incurva (Gouan) Guterm. (= *Psilurus incurvus* [Gouan] Schinz et Thell., *P. nardoides* Trin.) - Setol. - 0404001 - T scap - Erba annuale, 1-3 dm. Culmi gracili, fascicolati, spesso ricurvi. Fg. glabre con lamina larga fino a 3 mm, alla fine convoluta; ligula brevissima. Spiga lineare (8-20 cm), flessuosa, generalm. incurvata, alla base spesso avvolta dalla guaina della fg. sup.; sp.tte 1(2)flore, una su ogni dente del rachide, appressate all'asse; gluma unica (tranne nella sp.tta terminale), ridotta ad una squama di 1 mm o meno; lemma lanceolato-lineare 5 mm con resta di 3-5 mm.

Radure e macchie, garighe, pascoli aridi. - Lig., Pen., Sic., Sard. ed Is. minori: C; aree collinari attorno alla Pad.*, dal Triest. e Trent.* al Bergam.* le Langhe: R.* (0 - 1000 m). Nella vegetazione effimera acidofila dei Tuberarietea guttatae - Fi. IV-V - Euri-Medit.

2n = 14.

59. F. lachenalii (J.F.Gmel.) Spenner (= *Micropyrum tenellum* [L.] Link, *Triticum t.* L., *Nardurus halleri* Fiori et Paol.) – L. di Haller* - 0385802 – T scap – Erba annuale, 5-60 cm. Culmi gracili, ma abbastanza rigidi, eretti. Fg. filiformi. Inflor. (racemo spiciforme) lunga al mass. 20 cm, rigida e di norma indivisa; sp.tte 3-11 mm, ± appressate all'asse; gluma inf. 2.1-5 mm, la sup. 2.4-6 mm; lemma 2.7-5 mm con margini aculeolati nella metà inf., mutico o con resta non più lunga del lemma stesso; antere 0.5-1. 3 mm.

Incolti e margini su sabbie o detrito fine (silice). - Regioni occid. della Penisola, Marche, Sic. e Sard.: R.* (0 - 600 m). Substrati sabbiosi e piccole cenge di affioram. rocciosi: suoli embrionali poverissimi di sostanza organica e soggetti forte inaridimento estivo. Caratt. dei Tuberarietalia guttatae (*Airo caryophyllae-Micropyretum tenelli*) – Fi. V-VI – Euri-Medit.-Occid.

2n = 14.

Nota. – Inizialmente ascritta, assieme a *Vulpia unilateralis*, al gen. *Nardurus* (Bluff, Nees et Schauer) Rchb., che include nominalmente entità del Nordafrica e nella circoscrizione di Reichenbach risulta eterogeneo e polifiletico oltre che "fluttuante" non essendogli stata designata una specie-tipo, **59** è una pianticella complessivamente rara, sebbene i suoi popolamenti possano presentarsi localmente gregari ed estesi. Tale si mostra, per esempio, sulle ghiaie laviche dell'Etna o sui detriti scistosi delle scogliere tra Riomaggiore e Vernazza, nel Parco delle Cinque Terre (prov. La Spezia). *Micropyrum*, ora *Festuca*, comprende almeno altre tre specie (*M. albaredae* Paunero, *M. mamoraeum* [Maire] Stace e *M. patens* Rothm.ex Pilger) ad areale N-africano e/o iberico, testimoni di un centro W-mediterraneo-atlantico di differenziazione del gruppo.

60. F. gypsophila Hack. (= *Ctenopsis gypsophila* [Hack.] Paunero, *Vulpia delicatula* [Lag.] Dumort. var. *gypsacea* Willk.) - P. spagnolo - 0385601 - T scap - Erba annuale,15-35 cm. Culmi gracili, eretti o ginocchiati; fg. sup. del culmo con ligula di 0.5-1.5 mm; pannocchia racemiforme o con qualche ramo alla base, grande al massimo 5 × 2 cm; sp.tte 5.5-12 mm con 4-14 fi.; gluma inf. 0.7-1.5 mm, 1-nervia, con largo margine ialino e spinuloso, la sup. 3-5 mm, 1-3-nervia, subulata all'apice; lemma 3.2-4.2 mm, ± bruscam. acuminato, con resta lunga circa la metà; antere 3, di 0.5-1.5 mm.

Garighe, pascoli e incolti aridi su suolo gessoso – Sic. occidentale: RR e non ritrovata di recente. (0 - 600 m). - Su substrati evaporitici, come sp. guida del Sedo-Ctenopsion gypsophilae. Forte irraggiamento solare e precoce inaridimento estivo. - Fi. IV-V - SW-Stenomedit. (Europa). - Bibl.: Stace C. A., *Flora Europ.* 5: 157 (1980).

2n = 14.

61. F. sicula C.Presl (= *Vulpia sicula* [C.Presl] Link, incl. *V. setacea* Parl.) - P. siciliano - 0385901 - H caesp - Erba perenne, 2-7 dm. Culmi fascicolati, eretti, robusti. Fg. con lamina convoluto-setacea (diam. 1 mm), glabra e ligula subnulla (0.4 mm). Pannocchia stretta con rami inf. eretti, scabri; sp.tte 7-8 mm (senza le reste), 3-5flore; glume di 1-1.3 e 3-4 mm rispettivam. con mucrone apicale di 1 mm, la sup. più breve della parte laminare del lemma; lemma 3-4 mm con resta lunga 1-3 mm.

Radure, pascoli montani. - Sic. (Nebrodi, Madonie, Palermit. ecc.), Sard.: R; anche in Lig., Teram. e Calabria: RR. (600 - 1500 m). In Sic. è comune nei pascoli montani del Plantaginion cupani - Fi. IV-V - W-Medit.-Mont.

2n = 14 (Raimondo F. M. et al., 1980; Bartolo G. et al., 1981).

Nota: *Vulpia setacea* Parl. veniva distinta per un look complessivamente più robusto, con misure dei caratteri sia vegetativi sia riproduttivi mediamente un po' maggiori. Tuttavia si tratta di popolamenti prevalentemente insulari (Sardegna e Sicilia), con individui che si ritrovano saltuariamente anche in altri territori (Calabria, Liguria ecc.) e vanno interpretati come semplice espressione del pool genetico della specie.

62. F. geniculata (L.) Lag. et Rodr. (= *Vulpia geniculata* [L.] Link) - P. ginocchiato - 0385902 - T caesp - Erba annuale, 3-7 dm. F. semplici o fascicolati, ginocchiato-ascendenti, robusti. Fg. con lamina di 2-2.5 mm, generalm. convoluta all'apice e ligula troncata (0.5-1 mm). Pannocchia ampia, lunga 5-20 cm, con rami eretto-patenti; sp.tte 7 mm (senza le reste), generalm. 3flore, portate da peduncoli ingrossato-clavati di 3-5 mm; gluma inf. lunga 1/2 della sup.; lemma con parte laminare lunga circa quanto la gluma sup. e resta un po' più breve.

Garighe, incolti, muri. - Lig., coste tirren., It. Merid., Sic., Sard.: R; anticam. osservata anche pr. Bassano e

Como. (0 - 600 m). Nei praticelli effimeri acidofili dei Tuberarietea guttatae, talvolta anche sinantropica nell'Hordeion leporini. - Fi. IV-VI - Steno-Medit.-Occid.

2n = 14.

63. F. ligustica (All.) Bertol. (= *Vulpia ligustica* [All.] Link) P. ligure - 0385913 - T caesp - Erba annuale, (1)2-4 dm. Simile a **3**, ma ligula subnulla; gluma inf. ridotta ad una breve (1-2 mm) squama, la sup. di 8 mm, mutica o con un mucrone breve; lemma di 5-6 mm (dunque decisam. minore della gluma sup.) con resta di 4-5 mm.

Incolti, prati, campi, lungo le vie. - Lig., Pen. (verso N fino a Cervia e Faenza), Sic., Sard. ed Is. minori: C; recentem. osservata in Ven. e Trent.*.* (0 - 600 m). - Vegetazione erbacea in ambienti mediterranei frequentemente incendiati e con sovrapascolamento, su substrato sabbioso blandamente acido, in praticelli effimeri dei Tuberarietea guttatae. Nella Campagna Romana specie guida del Vulpio-Dasypyretum (Thero-Brometalia). **-** Fi. IV-VI **-** Steno-Medit. (baricentro occid.).

2n = Ignoto.

64. F. alopecuros Schousb. (= *Vulpia alopecuros* [Schousb.] Dumort.) P. tirrenico **-** 0385904 - T caesp (H bienn) - Erba annuale, 1-7 dm. Simile a **6**, ma talora prostrata e substolonifera, bienne; lamina larga 2-6 mm; pannocchia portata da un f. nudo allungato; sp.tte 12-15 mm; gluma inf. 1-2.7 mm, lunga meno di 1/5 della sup.; lemma 8-12 mm con resta di 15-20 mm.

Sabbie dei litorali. - Coste tirreniche dall'Argentario al Napol. ed Elba: RR. (lit.) - Fi. IV-VI - Steno-Medit.-Sudoccid.

2n = 14.

b) antere 1-3, alla fior. racchiuse o appena sporgenti apicalm. dai lemmi (fi. cleistogami), lunghe 0.4-2 mm; piante annuali

65. F. ciliata Gouan (= *Vulpia ciliata* Dumort., *V. danthonii* [Asch. et Gr.] Volkart) - P. cigliato - 0385911 - T caesp - Erba annuale, 2-4 dm. Culmi solitari o fascicolati, ginocchiati, generalm. avvolti dalle fg. fino all'inflor. Fg. con lamina larga 1-1.5 mm, presto convoluta; ligula subnulla. Pannocchia lineare (5-15 cm), spiciforme, multilaterale; sp.tte, subsessili di 7-10 mm (senza le reste), 3-7flore (solo 1-3 fi. basali fertili); gluma inf. 0.1-1 mm, lunga ¼ della sup. (2-3 mm); lemma 5-6.5 mm, con resta lunga 1-2 volte tanto callo emisferico 0.1 mm e resta di 5-6 mm; antere 1-3 di 0.4-0.6 mm.

Garighe, incolti, bordi di vie. - In tutto il terr.; Lig., Pen., Sic., Sard.: C; It. Sett. solo nell'area della vite: R. (0 - 1300 m). - Ecologia: simile a **7**, ma meno selettiva per quanto riguarda i substrati e più comune di questa nella vegetazione sinantropica degli Stellarietea mediae. - Fi. IV-VI - Euri-Medit.

2n = 28.

Variab. - In Sard. si presenta anche la variante descritta come *V. danthonii* var. *tripolitana* Pamp., che si distingue per i lemmi più densam. cigliati e con ciglia patenti allungate sul bordo, cfr. Arrigoni P.V., *Webbia* 19: 349-454 (1964). Tuttavia individui con le stesse caratteristiche sono presenti talvolta in mezzo ai normali popolamenti della specie un po'in tutta la sua area di distribuzione, come per es., da noi, in Liguria presso Riomaggiore (SP) e in Lucania, a Brienza, sui gradoni della salita al castello Caracciolo (Banfi, osserv. pers.), dimostrando che non si tratta di un taxon distinto, ma di un'espressione fenotipica rientrante nei canoni della specie.

66-68. F. myuros (aggr.) - Annuali a ciclo breve. F. fascicolati o solitari, ginocchiato-ascendenti, avvolti dalle fg. fino all'inflor. Fg. con lamina larga 2 mm, alla fior. generalm. convoluta; ligula subnulla (0.3-0.4 mm). Pannocchia spiciforme, lineare (1 x 8-20 cm), ± unilaterale ed all'apice spesso un po' incurvata; sp.tte multilaterali 5-11 mm (senza reste), 3-7flore, distintam. (0.5-3.5 mm) peduncolate; fi. fertili, salvo 1-2(3) all'apice della sp.tta; lemma 4.5-7.5 mm, con resta lunga 1-3 volte tanto e callo emisferico 0.2 mm; antere 1(3), lunghe 0.3-0.8 mm, rar. più. - Descr. in gran parte sec. Stace C. A. & Cotton R., in *Flora Europaea* 5:

154-156 (1980).

Aggregato che include di-, tetra- ed esaploidi in specie distinte anche a livello molecolare, ma difficili da riconoscere sulla base di caratteri morfologici; anche la distribuzione geografica, altitudinale ed ecologica sono poco differenti.

66. F. myuros L. (= *Vulpia myuros* [L.] C.C.Gmel., incl. *F. pseudomyuros* Soy.-Will.) - P. sottile - 0385910 - T caesp - Erba annuale, 1-5 dm. Guaina della fg. sup. in generale abbracciante la base dell'inflor. Gluma inf. 0.4-2.5 mm, da 1/10 a 2/5 della sup. (2.5-6.5 mm); lemma con parte laminare di 0.8-1.3 x 4.5-7.5 mm e resta lunga 1-2 volte tanto.

Incolti aridi, bordi di vie, pascoli, garighe. - In tutto il terr.: C, però al Nord generalm. limitata ai terreni aridi ed alla fascia della vite; spesso sinantropica nei contesti urbani. (0 - 1300 m). - Pratelli effimeri con dominanza di terofite a sviluppo primaverile precoce, su substrati subacidi o francamente acidi, sabbiosi o ciottolosi; specie guida dei Tuberarietalia guttatae. - Fi. IV-VI - Subcosmop.

2n = 28, 42. - E' stato dimostrato che l'estratto di questa specie (e di altre *Vulpia*) contiene sostanze fitotossiche, ad es. nei riguardi di *Triticum*, che si mantengono nel terreno, con azione allelopatica, cfr. Min An et al., *Journ. Chem. Ecol.* 27: 383-394 (2004). La sperimentazione è stata eseguita in Australia, dove **7** è ampiam. naturalizzata. Va verificato se questo effetto sia osservabile anche quando essa cresce nel suo habitat naturale.

67. F. bromoides L. (=*Vulpia bromoides* [L.] S.F.Gray, *V. dertonensis* [All.] Gola, *V. sciuroides* [Roth] C. C. Gmelin) - P. bromoide - 0385908 - T caesp - Erba annuale, 1-5 dm. F. lungam. nudo sotto l'inflor.; asse della pannocchia generalm. diritto; gluma inf. 2.5-5 mm, da 1/2 a 3/4 della sup. (4.5-9 mm); lemma con parte laminare di 1.3-1.9 x 4.5-7.5 mm e resta lunga 1 volta tanto.

Incolti aridi, pascoli. - It. Sett., Centr. e Merid., con lacune (da ricercare), Sic. e Sard.: R.* (0 - 1000 m). - Ecologia: simile a **66**. - Specie emettitrice di isoprenoidi (De Lillis M., Loreto F., Bianco P. in pubbl.) - Fi. IV-V - Paleotemp.

2n = 14.

68. F. muralis Kunth (= *Vulpia muralis* [Kunth] Nees, *V. broteri* Boiss. et Reuter; *V. myuros* subsp. *longearistata* [Willk.] Hayek) - P. di Tortona - 0385909 - T caesp - Erba annuale, 1-5 dm. F. lungam. nudo sotto l'inflor.; gluma inf. 1-3(6) mm, da ¼ a 1/2 della sup. (4-8, rar. 10 mm); lemma con parte laminare di 0.8-1.3 x 4 -7(10) mm e resta lunga 2 volte tanto.

Incolti aridi, pascoli - It. Merid., Sic. e Sard.: R. (0 - 1000 m). – Ecologia: simile a **66**. Frequente anche nella vegetazione commensale delle colture di cereali, su substrato siliceo (Scleranthion annui). In Calabria sp. caratt. del *Sileno tenuiflorae-Vulpietum muralis*. - Fi. IV-V - Steno-Medit. Occid.

2n = Ignoto.

69. F. fasciculata Forssk. (= *Vulpia fasciculata* [Forssk.] Fritsch, *V. membranacea* auct., non [L.] Dumort.; *V. uniglumis* [Solander] Dumort.) - P. delle spiagge - 0385905 - T caesp - Erba annuale, 1-5 dm. Culmi solitari o fascicolati, generalm. ginocchiato-ascendenti, non ricoperti dalla guaina superiore su meno di 5 cm a pannocchia matura. Fg. con lamina larga 2-3 mm, ma generalm. convoluto-cilindrica; ligula troncata (0.5-1 mm). Pannocchia breve (4-10 cm), regolarm. unilaterale (soprattutto dopo la fior.); sp.tte 3-9flore, peduncolate (3-7 mm); gluma inf. ridotta ad una squama breve (0.5-2 mm), la sup. di 15-30 mm; lemma > 10 mm con callo appuntito 0.5-08 mm e resta di 10-20 mm; antere 1-3, di 0.8-2 mm; cariosside provvista di almeno qualche pelo all'apice.

Dune maritt. – Accertata sulle coste sarde (C), altrove da verificare a causa di confusione con **70** (lit.). - Sui litorali sabbiosi, sia sulle prime dune che nei cordoni arretrati, spesso moltissimi individui in popolazioni diffuse. Suolo sabbioso con scarsa fertilità, arido, a salinità quasi nulla; forte radiazione solare. Sui litorali della Sardegna e presumibilmente altrove almeno al Sud, specie guida dei Malcolmietalia. - Fi. IV-VI – Stenomedit.

2n = 28 (Stace C. A. & Cotton R., 1974).

70. F. pyramidata Link (= *Vulpia membranacea* [L.] Dumort.) – P. delle spiagge – xxxxxxx – T scap – Distinta da **69** per la cariosside glabra all'apice, la gluma sup. < 12 mm e il culmo nudo per più di 5 cm sotto la pannocchia in frutto.

Dune maritt. – Presumibilmente diffusa lungo tutte le spiagge dal Triestino e dal confine francese verso Sud fino a gran parte del rimanente territorio nazionale, ma da riaccertare a causa di confusione con **10** (lit.). – Fi. IV-VI – Medit.-Atl.

2n = 14

Nota: **69** e **70** sono davvero molto simili tra loro e le differenze morfologiche si riducono essenzialmente a questioni dimensionali; inoltre presentano ecologia e habitat apparentemente identici. **70** sembra prevalente o esclusiva lungo le coste atlantiche, mentre **69** appare centrata su quelle mediterranee; dopo l'uscita di Flora Europaea (vol. 5, 1980) sembrava che in Italia **70** non dovesse essere presente e che tutti i record di *Vulpia membranacea* fossero da ricondurre a **69**, ma in seguito al ritrovamento di morfotipi con le caratteristiche di **70** si è dovuto cambiare idea al riguardo. Sul fatto poi che queste due entità debbano ritenersi realmente distinte gli Autori sono abbastanza in disaccordo, ma per il territorio italiano resta comunque la necessità di capire qual è la reciproca distribuzione di entrambe.

71. F. maritima L. (= *Vulpia unilateralis* [L.] Stace, *Nardurus unilateralis* [L.] Boiss., *N. maritimus* [L.] Murb., *N. tenellus* Rchb.) - P. unilaterale - 0385801 - T scap - Erba annuale, 5-25 cm. Culmi gracili, fascicolati, ascendenti. Fg. generalm. convoluto-filiformi (diam. 0.5 mm) con ligula 0.6-0.8 mm. Pannocchia lineare spiciforme lunga 3-10 cm, diritta o un po' arcuata, quasi unilaterale; sp.tte subsessili di 6-7 mm, 5-6flore; glume ineguali, l'inf. 1/3-1/2 della sup.; lemma 3.5-5 mm con resta di ca. 1-5 mm; callo emisferico 0.1 mm; antere 3 di 0.7-1.3 mm. [cfr. anche **59**]

Radure nelle macchie, incolti aridi. - Veron., Rovereto, Torin., Riviera, Parmig.,, Abr., Camp., Sard.: R.* (0 - 900 m). - Fi. V-VI - Eurasiat. temp.

2n = 14

19. SCHEDONORUS P. Beauv.

Da non confondere con *Schoenodorus* Roem. et Schult. grafia scorretta (come etimologia) e comunque invalida, usata talora per il gen. **8** (*Bellardiochloa*). Sulla nomenclatura cfr. Soreng R. J. et al., *Taxon* 50: 915 (2001). Come già detto, questo genere attende di essere riunito a *Lolium.*

1. S. arundinaceus (Schreb.) Dumort., Observ. Gramin. Belg. 106 (1824)
Sinonimi
S. arundinaceus subsp. *mediterraneus* (Hack.) H.Scholz et Valdés, Willdenowia 35: 243 (2005)
S. arundinaceus subsp. *uechtritzianus* (Wiesb.) H.Scholz et Valdés, Willdenowia 37 (2): 442 (2007)
S. phoenix (Scop.) Holub, Preslia 70(2): 113 (1998)
S. uechtritzianus (Wiesb.) Holub, Preslia 70(2): 113 (1998)
Festuca arundinacea Schreber, Spicil. Fl. Lips.: 57 (1771)
F. arundinacea subsp. *mediterranea* (Hack.) K. Richt., Pl. Eur.: 102 (1890)
F. arundinacea subsp.*uechtritziana* (Wiesb.) Hack. ex Hegi, Ill. Fl. Mitteleur., 1: 345 (1906)
F. arundinacea var. *uechtriziana* (Wiesb.) Beck, Fl. Nieder.-Oesterr., 1: 96 (1890)

F. elatior subsp. *arundinacea* (Schreb.) Hack., Mon. Fest. Europ.: 153 (1882)
F. elatior subsp. *arundinacea* var. *genuina* subvar. *mediterranea* Hack., Mon. Fest. Europ.: 154-155 (1882)
F. uechtriziana Wiesb., Oesterr. Bot. Z., 28: 218 (1878)
Lolium arundinaceum subsp. *mediterraneum* (Hack.) Banfi et Soldano, Mem. Soc. Ital. Sci. Nat. Mus. Civico Storia Nat. Milano, 33(2): 8 (2005)

Pianta alta (70) 120-130 (140) cm, lassamente cespitosa, non rizomatosa o talvolta con rizomi poco abbondanti. Culmo eretto spesso e robusto, non ramificato, con 2 o 3 nodi, liscio o scabro sotto l'infiorescenza. Innovazioni extravaginali. Ligula 0.5-2 mm, con orecchiette brevemente cigliate. Lamina delle innovazioni 10-50 (75) cm, piana, rigidetta, scabra, verde, non pruinosa. Lamina del culmo (8) 15-25 (75) cm, piana. Sezione fogliare 2-10 mm di larghezza, lineare, numerosi fascetti vascolari, numerose coste, solco intercostale poco profondo, sclerenchima in trabecole o in colonne a livello dei fascetti vascolari principali, in isolotti o in pilastri a livello dei fascetti vascolari secondari, presenza di isolotti o colonne sulla faccia adassiale, tricomi corti o subnulli. Pannocchia 10-25 (50) cm, da poco contratta a ± espansa o lassa, ± scalata, ± dritta, passante lungamente le innovazioni. Spighette 8-10 (12) mm, (3) 4-8 (9) fiori verdi, talvolta violacei. G1 3-6 mm. G2 4.5-7 mm. Lemma 6-8 (9) mm, glabro, scabro per uncini sulla sola nervatura centrale oppure su tutte le nervature, resta 0.5-1.5 (3) mm. Antere 3-4 mm.

Prati da umidi (anche salmastri) ad aridi, boschi cedui, bordi dei boschi e dei fiumi, margini dei campi e delle vie, sinantropica. - In tutto il terr.: C. (0 - 2000 m). - Fi. V-VII - Europea, largamente introdotta in varie parti del mondo, divenuta cosmopolita.

Nota – La specie è conosciuta per la notevole variabilità dei suoi popolamenti. Diversi taxa infraspecifici sono stati descritti relativamente a caratteri quali la lunghezza della resta, la presenza o meno di asperità sul tratto distale del culmo, la configurazione dello sclerenchima nella sezione fogliare, la glaucescenza ecc., tuttavia si tratta di stati di carattere difficilmente riferibili a manifestazioni genotipiche di rilevanza sistematica. È il caso di *S. arundinaceus* subsp. *mediterraneus* e di *S. a.* subsp. *uechtritzianus*, indicate rispettivamente per Lombardia/Italia Centrale e Val d'Aosta/Toscana/Sicilia, che vanno a nostro giudizio riconsiderate in termini di diversità infrapopolazionale della specie condizionata da flusso genico.

2. S. interruptus (Desf.) Tzvel., Novosti Sist. Vissh. Rast., 31: 259 (1998)
(**a**) subsp. **interruptus**

Sinonimi

S. arundinaceus subsp. *fenas* (Lag.) H.Scholz, Landschafts-Pflanzenökol. Univ. Hohenheim, Beih. 16: 74 (2003)
Festuca interrupta Desf., Fl. Atlant., 1: 89 (1798)
F. fenas Lag., Elenc. Pl. Horti Regio Bot., 1815 (I-VIII): 4 (1816)
F. elatior subsp. *arundinacea var. fenas* (Lag.) Hack., Bot. Centralbl., 8: 407 (1881)
F. arundinacea subsp. *fenas* (Lag.) Corb., Nouv. Fl. Normandie: 647 (1894)
F. arundinacea subsp. *fenas* (Lag.) Arcang., Compendio Fl. Ital.: 61 (1894)

Pianta alta (20) 40-100 cm, lassa, rizomatosa con rizomi abbondanti. Culmo eretto, spesso e robusto, non ramificato, con 2 o 3 nodi. Innovazioni extravaginali. Ligula 1-2 mm, con orecchiette brevemente cigliate. Lamina delle innovazioni (3) 6-30 cm, piana, divenente precocemente convoluta, talvolta curvata, gen. glauca, non pruinosa. Lamina del culmo (2) 7-20 (30) cm, piana, divenente presto arrotolata. Sezione fogliare 2-4 (6) mm di larghezza, lineare, numerosi fascetti vascolari, numerose coste, solco intercostale poco profondo, sclerenchima in colonne, a livello dei fascetti vascolari principali, in isolotti o in pilastri a livello dei fascetti vascolari secondari, presenza di isolotti o di colonne sulla faccia adassiale, tricomi corti, nulli o subnulli. Pannocchia (3) 10-25 (30) cm, ± contratta, dritta, strettamente lineare, ± interrotta alla base. Spighette (5) 7-9 (10) mm, (3) 4-6 fiori, verdi talvolta violacee. G1(3) 4.6-4.8 mm. G2 (4) 4.5-5 mm. Lemma (4) 5-6.8 mm, glabro, liscio sul dorso, resta fino a 0.3 mm. Antere 2.4-3.3 mm.

Prati aridi, bordi dei fiumi, sinantropica. - Penisola: C; zone meridionali delle Alpi: R. (0 - 1000 m). – Fi. VI-VII – Sud-Europea-Mediterranea.

(**b**) subsp. **corsicus** (Hack.) Foggi, Arch. Geobot., 10 (1-2) 2004: 98 (2007) - ●

Sinonimi

S. arundinaceus subsp. *corsicus* (Hack.) Foggi et Signorini, Willdenowia 35:243 (2005)
Festuca elatior var. *corsica* Hack., Monogr. 157 (1882)
F. arundinacea subsp. *corsica* (Hack.) Kerguélen, Bull. Soc. Bot. Fr., 123 (5-6): 320 (1976)
F. elatior subsp. *arundinacea* var. *fenas* subvar. *corsica* Hack., Mon. Fest. Europ.: 157 (1882)
F. fenas subsp. *corsica* (Hack.) K. Richt., Pl. Europ., 1: 102 (1890)

Pianta alta (35) 50-80 (100) cm, cespitosa, rizomatosa con rizomi abbondanti. Culmo eretto, spesso e robusto, non ramificato, con 3-4 nodi, 2 visibili. Innovazioni extravaginali. Ligula fino a 0.5 mm, con orecchiette brevemente cigliate. Lamina delle innovazioni 10-35 cm, piana, un poco rigida, scabra, da verde a glaucescente, non pruinosa. Lamina del culmo (5) 10-15 (20) cm, piana fino a convoluta. Sezione fogliare 1-3 mm di larghezza, lineare, numerosi fascetti vascolari, numerose coste, solco intercostale poco profondo, sclerenchima in colonne a livello dei fascetti vascolari principali, in isolotti o in pile a livello dei fascetti vascolari secondari, presenza di isolotti o di colonne sulla faccia adassiale, tricomi corti subnulli. Pannocchia 7-15 (20) cm, ± contratta, dritta, interrotta, il ramo inferiore con poche spighette. Spighette 8-10 (10.5) cm, (3) 4-7 fiori, da verde pallido a glaucescente. G1 4 mm, largamente scariosa verso l'apice. G2 (4.5) 4.7-5.3 mm, scariosa verso l'apice. Lemma (4) 6.5-7 (7.3) mm, acuminato, glabro, scabro per uncini sulla nervatura centrale, resta 1-2 (2.5) mm. Antere 3.5 mm.

Alvei dei fiumi, fiumare, oleandreti. - Arcipelago Toscano a Capraia: RR. (0 - 100 m). – Fi. VI-VII – Endemica: Corsa-Arcipelago Toscano.

2n = mancano conteggi su popolazioni italiane.

Nota - Abbiamo campioni di questa entità solo per Capraia (Foggi & Grigioni, 1999; Foggi et al., 2001), negli oleandreti che si sviluppano lungo i due vadi principali. Il confronto con il materiale tipo conferma la determinazione, ma non aiuta a capire se si tratta di una entità realmente differente da *S. interruptus* e a che rango tale variazione potrebbe essere trattata.

3. S. giganteus (L.) Holub, Preslia 70: 113 (1998)

Sinonimi

Bromus giganteus L., Sp. Pl. 77 (1753)
B. triflorus L., Sp. pl., ed. 2 1: 115 (1762)
F. gigantea (L.) Vill., Hist. Pl. Dauph. 2: 110 (1787)
F. triflora (L.) Sm., Engl. bot.: tab. 1918 (1808) non J. F. Gmel.
F. gigantea var. *triflora* (L.) Kunth, Rev. Gram. 1: 132 (1829)
F. gigantea subsp. *triflora* (L.) Arcang., Comp. fl. ital.: 793 (1882)

Pianta alta 50-150 (200) cm, ± lassamente cespitosa, non rizomatosa, interamente glabra. Culmo eretto, gen. spesso alla base, 5 mm di diametro (2 mm sotto la pannocchia), non ramificato con 2-5 (6) nodi sovente violacei. Innovazioni extravaginali. Ligula 1-2,5 mm, con orecchiette abbraccianti il culmo e prolungantesi in due cornetti. Lamina delle innovazioni 10-70 cm, piana, sottile, liscia o scabra, verde non pruinosa. Lamina del culmo (5) 15-40 (55) cm, piana. Sezione fogliare 3-18 mm di larghezza, lineare, numerosi fascetti, numerose coste, solco intercostale poco profondo, sclerenchima in isolotti, in pilastri o trabecole, presenza di isolotti sulla faccia adasiale, tricomi da nulli a subnulli. Pannocchia (10) 20-35 (50) cm, largamente aperta, lassa e pendente, passante lungamente le innovazioni, con rami flessuosi, scabri. Spighette 10-13 mm, (3) 5-7 (9) fiori, verde pallido, talvolta variegate di violetto. G1 4-7 mm, con bordo membranoso. G2 5-8 mm. Lemma 6-9 mm, glabro, scabro con bordo ialino nella metà superiore, resta 10-20 mm, molto fine, spesso flessuosa. Antere 2.5-3 mm.

Boschi di latifoglie mesofile, faggete e bordi dei boschi. - Alpi e Pen.(escl. Puglia): Diff.: anche nelle Langhe, dubbia per la V. Aosta.* (0 - 1500 m). – Fi. VI-VIII – Eurasiatica.

2n = mancano conteggi su popolazioni italiane - apomissia gametofitica, cfr. Gregor Th. (2004).

4. S. pratensis (Huds.) P.Beauv., Ess. Agrost. 99: 163 y 177 (1812)
(**a**) subsp. **pratensis**

Sinonimi

Festuca pratensis Huds., Fl. Angl.: 37 (1762)
F. elatior subsp. *pratensis* (Huds.) Hack., Mon. Fest. Europ.: 150 (1882)

Pianta alta 30-70 (100) cm, lassamente cespitosa, non rizomatosa, di colore verde chiaro. Culmo eretto, ± robusto, liscio con 2-4 nodi. Innovazioni extravaginali. Ligula fino a 1 mm, con orecchiette ciliate abbraccianti il culmo e prolungantesi in due cornetti. Lamina delle innovazioni 10-30 (45) cm, piana, flessibile, liscia o poco scabra, verde non pruinosa. Lamina del culmo 6-20 (40) cm, piana. Sezione fogliare 2-5 mm di larghezza, lineare, numerosi fascetti, numerose coste, solco intercostale poco profondo, sclerenchima in pilastri a livello dei fascetti principali, raram. in trabecole, in isolotti a livello di quelli secondari, presenza di isolotti sulla faccia adassiale, tricomi corti subnulli. Pannocchia (6) 10-20 (35) cm, da poco contratta a aperta, divenente unilateralmente pendente, con rami a 2 a 2, diseguali, angolosi, scabri, il ramo inferiore è il più corto con 1-2 spighette, peduncoli fino a 5 mm, da verde a violacea, passante abbastanza lungamente le innovazioni. Spighette (9) 10-13 (15) mm, (3) 5-7 (14) fiori, verde pallido, talvolta tinte di violetto. G1 2.5-3.5 mm. G2 3.5-4.5 mm. Lemma 6-7 mm, liscio, glabro, raram. scabriuscolo verso l'apice che è ± ottuso da strettamente oblungo a lanceolato visto di profilo, resta fino a 0.8 mm. Antere 3-4 mm.

Prati mesofili e mesoigrofili. - In tutto il terr.: C (dubbia in Sic.). (0 - 1000 m). - Prati stabili, regolarm. gestiti dall'uomo mediante concimazione e falciatura, spesso anche irrigazione, dalla pianura alla fascia montana e raram. subalpina (solo in stazioni favorite). Suolo profondo, fertile, spesso una terra bruna di origine forestale. Specie caratt. dell'Arrhenatherion elatioris.– Fi. VI-VII – Eurasiatica, divenuta cosmopolita.

(**b**) subsp. **pluriflorus** (Schult.) H.Scholz, Ber. Inst. Landschafts- Pflanzenökologie Univ. Hohenheim, Beih. 16: 75 (2003) - ●

Sinonimi

Festuca pluriflora Schult., Mantissa 2: 402 (1824)
F. elatior b *sicula* Parl., Fl. Ital., 1: 455 (1861)

Pianta alta 40-60 cm, lassamente cespitosa, non rizomatosa, di colore verde chiaro. Culmo eretto, ± robusto, liscio con 2-4 nodi. Innovazioni extravaginali. Ligula fino a 1 mm, con orecchiette cigliate abbraccianti il culmo e prolungantisi in due cornetti. Lamina delle innovazioni 5-20 cm, piana. Sezione fogliare 2-3 mm di larghezza. Pannocchia 8-12 cm, lineare, eretta subcontratta a rachide a rami scaberuli. Spighette 12 mm, 5-8 fiori. G1 3 mm. G2 5 mm, ovato-oblunga ottusa, con margine scarioso. Lemma 6 mm, lanceolato, con margine scarioso, resta 3 mm.

Margini dei boschi umidi. - Sicilia: R. (800 - 1500 m) – Fi. V-VI – Endemica: Sicilia

2n = mancano conteggi su popolazioni italiane - raram. apomittica, cfr. Gregor Th. (2004).

5. S. apenninus (De Not.) Tzvelev, Novosti Sist. Vyssh. Rast. 31: 259. 1998

Sinonimi

S. pratensis subsp. *apenninus* (De Not.) H.Scholz et Valdés, Willdenowia 35: 243 (2005)
Festuca apennina De Not., Repert. Fl. Ligust. 468 (1844)
F. pratensis subsp. *apennina* (De Not.) Hegi, Ill. Fl. Mittel., 1(10): 343 (1908)
F. elatior var. *apennina* (De Not.) Hack., Mon. Fest. Europ.: 152 (1882)
Lolium pratense subsp. *apenninum* (De Not.) Banfi, Bracchi et Galasso, Mem. Soc. Ital. Sci. Nat. Mus. Civico Storia Nat. Milano, 33(2): 8 (2005)
Lolium apenninum (De Not.) Ardenghi & Foggi, Taxon 64(5): 1039. 2015.

Pianta alta 40-90 cm, lassamente cespitosa, non rizomatosa, di colore verde chiaro. Culmo eretto, ± robusto, liscio con 2-4 nodi. Innovazioni extravaginali. Ligula fino a 1 mm, con orecchiette ciliate abbraccianti il culmo e prolungantesi in due cornetti. Lamina delle innovazioni 20-30 (45) cm, piana, flessibile, liscia o poco scabra, verde non pruinosa. Lamina del culmo (10) 15-30 (40) cm, piana. Sezione fogliare 4-8 mm di larghezza, lineare, numerosi fascetti, numerose coste, solco intercostale poco profondo, sclerenchima in pilastri a livello dei fascetti principali, raram. in trabecole, in isolotti a livello di quelli secondari, presenza di isolotti sulla faccia adassiale, tricomi corti subnulli. Pannocchia (10) 15-20 (30) cm, lineare-oblunga, eretta o inclinata soprattutto all'apice, passante da mediamente ad abbastanza lungamente le innovazioni. Spighette (9) 11-13 (15) mm, (4) 6-9 (11) fiori, rachilla molto scabra, giallastre talvolta tinte di violetto. G1 3.5-4 mm, ± ottusa, scariosa verso l'apice. G2 4.5-5.5 mm ± ottusa, scariosa verso l'apice. Lemma 7-9 (9.2) mm, glabro, raram. scabriuscolo verso l'apice, che è appena bilobato, e sulla carena, con punteggiature cristalline verso la base, resta (1) 1.8-3 (3.5) mm. Antere 2.2 mm.

Prati mesofili, megaforbieti, bordi delle faggete. - Diffusa nell'It. Sett. e Centr. (dubbia in Lomb., manca in Lazio). (700 - 2000 m). – Fi. VI-VII – Centro Europea, tendente a diventare Cosmopolita.

Bibliografia

Aeschimann D., Lauber K., Moser D.M. & Theurillat J.-P., 2004. Flora Alpina. Zanichelli, Bologna.

Arndt S. 2008. Novelties in the Festuca valesiaca group (poaceae) from the Central Alps. Pl. Syst. Evol., 271: 129-142.

Barberis G., Orsino F. & Marsili S., 2004. Check list della flora del Parco Naturale delle Capanne di Marcarolo. www.parcocapanne.it/checklist_flora_marcarolo.pdf

Brullo S. & Guarino R., 2001. *Festuca humifusa* (*Graminaceae*) a new species from Sicily. *Bocconea* 10: 409-412.

Catalán P., 2007. Phylogeny and Evolution of Festuca L: and Related Genera of Subtribe Loliinae (Poeae, Poaceae). In Sharma A.K. & Sharma A. (eds.) *Plant Genome: Biodiversity and Evolution*. Science Pubbl., U.S.

Catalán P., Torrecilla P., Lòpez Rodriguez J.A. & Olmstead R.G., 2004. Phylogeny of the festucoid grasses of subtribe *Loliinae* and allies (*Poeae*, *Pooideae*) inferred from ITS and trnL-F sequences. *Molec. Phylog. Evol*., 31: 517-641.

Catonica C., 2001. A new species and a new record of *Festuca* (*Poaceae*) from the Gran Sasso of Italy (central Apennines). *Plant Biosystems*, 135(3): 271-283.

Chicouenne D., 1999. Realite et perspectives dans la description morphologique des festuques. In: Portal R., 1999 *Festuca* de France: 22-32. Vals-près-Le Puy, France.

Conert J., 1994-1996. Gen. *Festuca*. In: Hegi G. (ed.), Illustrierte Flora von Mittel-Europa, 1 (3), 7: 530-560; 8-9: 561-633. Blackwell, Berlin.

Conti F., Abbate G., Alessandrini A., Blasi C. (eds.), 2005. An annotated checklist of the Italian Vascular Flora. Palombi Editore.

Cristaudo A., Foggi B., Galesi R. & Maugeri G., 2007. *Festuca morisiana* subsp. *sicula* (*Poaceae*) entità nuova per la flora della Sicilia. *Parlatorea*, 9: 95-99.

Fiorini G., Quercioli C. & Foggi B., 2007. Chromosome Number Report (1680). *Flora Medit.* 18: 595-599.

Foggi B. & Rossi G., 1996. A survey of the genus *Festuca* L. (*Poaceae*) in Italy. I. The species of the summit flora in the Tuscan-Emilian Apennines and Apuan Alps. *Willdenowia*, 26: 183-215.

Foggi B. & Signorini M.A., 1997. Indagine sul genere *Festuca* L. (*Poaceae*) in Italia. V. *Festuca vizzavonae* Ronniger e *F. alfrediana* Foggi et Signorini, nom. nov. *Parlatorea* 2: 125-131.

Foggi B. & Signorini M. A., 2001. Contributo alla conoscenza del genere *Festuca* (*Poaceae*) in Italia XIII. Una specie mal conosciuta: *F. robustifolia* Markgr.-Dann. Webbia, 56(1): 145-163.

Foggi B. & Signorini M. A. 2002. La misteriosa *Festuca robustifolia* Markgr.-Dann., specie mal conosciuta della Flora Italiana. In Scoppola A. (ed.) Gruppi critici della flora italiana: aggiornamenti e confronti - II. Società Botanica Italiana, Gruppo di Lavoro per la Floristica. *Inf. Bot. Ital*., 33 (2): 514-519.

Foggi B., Gherardi M. E., Signorini M. A., Rossi G. & Bruschi P., 2006. *Festuca inops* De Not. and *Festuca gracilior* (Hack.) Markgr.-Dannenb. (*Poaceae*): are they two different species? *Botanical Journal of the Linnean Society*, 151 (2): 239-258.

Foggi B., Rossi G. & Parolo G., 2007a. Il genere *Festuca* e i generi affini per la nuova "Flora Critica dell'Italia". I. Introduzione. *Inf. Bot. Ital*., 39(1): 193-197.

Foggi B., Rossi G. & Signorini M.A., 1999. The *Festuca violacea* aggregate (*Poaceae*) in the Alps and Apennines (Central-Southern Europe). *Can. J. Bot.,* 77(7): 989-1013.

Foggi B., Rossi G., Parolo G., Ardenghi L. & Quercioli C. 2010 Il genere Festuca e i generi affini per una flora critica dell'Italia". II. Gen. Leucopoa e Drymochloa. Inf. Bot. Ital., 42(1): 335-361.

Foggi B., Rossi G., Parolo G. & Wallossek C., 2007b. Il genere *Festuca* e i generi affini per la nuova "Flora Critica dell'Italia". I. *Festuca* sect. *Eskia* Willk. (Poaceae). *Inf. Bot. Ital*., 39(1): 199-232.

Foggi B., Scholz H. & Valdés B., 2005. The Euro+Med. traitment of *Festuca* L. – new names and new combinations for *Festuca* and allied genera. *Willdenowia*, 35(2): 241-244.

Foggi B., Signorini M. A. & Rossi G., 2003. The genus *Festuca* in Italy. *Bocconea*, 16: 55-64

Fuente V. de la & Ortúñez E., 2001. *Festuca* sect. *Eskia* (*Poaceae*) in the Iberian Peninsula. *Folia Geobot*., 36: 358-421.

Garraud L. 2003 Flore de la Drome. Cons. Bot. National Alpin de Gap-Charance. Imprimerie de Duex Ponts.

Hackel E., 1882. Monographia Festucarum Europearum. T. Fischer, Kassel.

Kerguélen M. & Plonka F., 1989. Les *Festuca* de la flore de France (Corse comprise). Bull. Soc. Bot. Centre-Ouest, n.s., numéro spécial 10: 1-368.

Markgraf-Dannenberg I., 1979 Festuca-problem in Okologischen Soziologischen Zusammenhang. Ber. Intern. Fach., 12-13 September, 1978. Bundesversuchsanstalt fur Alpenlandische Landwirtshaft Gumpenstein, Gumpstein.

Markgraf-Dannenberg I., 1980. Gen. *Festuca* L. In Tutin T.G. & al. (eds.) Flora Europaea 5: 125-153. Cambridge University Press, Cambridge.

Müller J. & Catalán P., 2006. Notes on the infrageneric classification of *Festuca* L. (*Gramineae*). *Taxon*, 55(1): 139-144.

Parolo G., Foggi B. & Rossi G., 2006. *Festuca rivularis* Boiss. subsp. *rivularis* (*Poaceae*), new for Italy. *Webbia*, 61(1): 13-17.

Parolo G., Foggi B. & Rossi G., 2007. Novità sul genere *Festuca* L. s.l. in Italia. *Archivio Geobotanico*, 10(1-2): 97-99 (2004).

Pasakinskiene I., Anamthawat-Jonsson K., Humphreys M.W., Paplauskiene V. & Jones R.N., 1998. New molecular evidence on genome relationships and chromosome identification in fescue (*Festuca*) and ryegrass (*Lolium*). *Heredity*, 81: 659-665.

Pignatti S., 1982. Flora d'Italia. Edagricole, Bologna, 3 Voll.

Pignatti S., 1983. Note critiche sulla flora d'Italia. VII supplemento. Giorn. Bot. Ital. 116: 93-95.

Portal R., 1999. *Festuca* de France. Ed. Portal, Vals-près-Le-Puy.

Scoppola A. & Blasi C. (eds.), 2005. Stato delle conoscenze sulla flora vascolare d'Italia. Palombi ed., Roma.

Signorini M. A., Foggi B., & Nardi E., 2003a. Taxonomic and nomenclatural notes on genus *Festuca* L. (*Poaceae*): the *Festuca vizzavonae* Ronniger and "*F. cyrnea*" problem. *Taxon* 52 (3): 591-594.

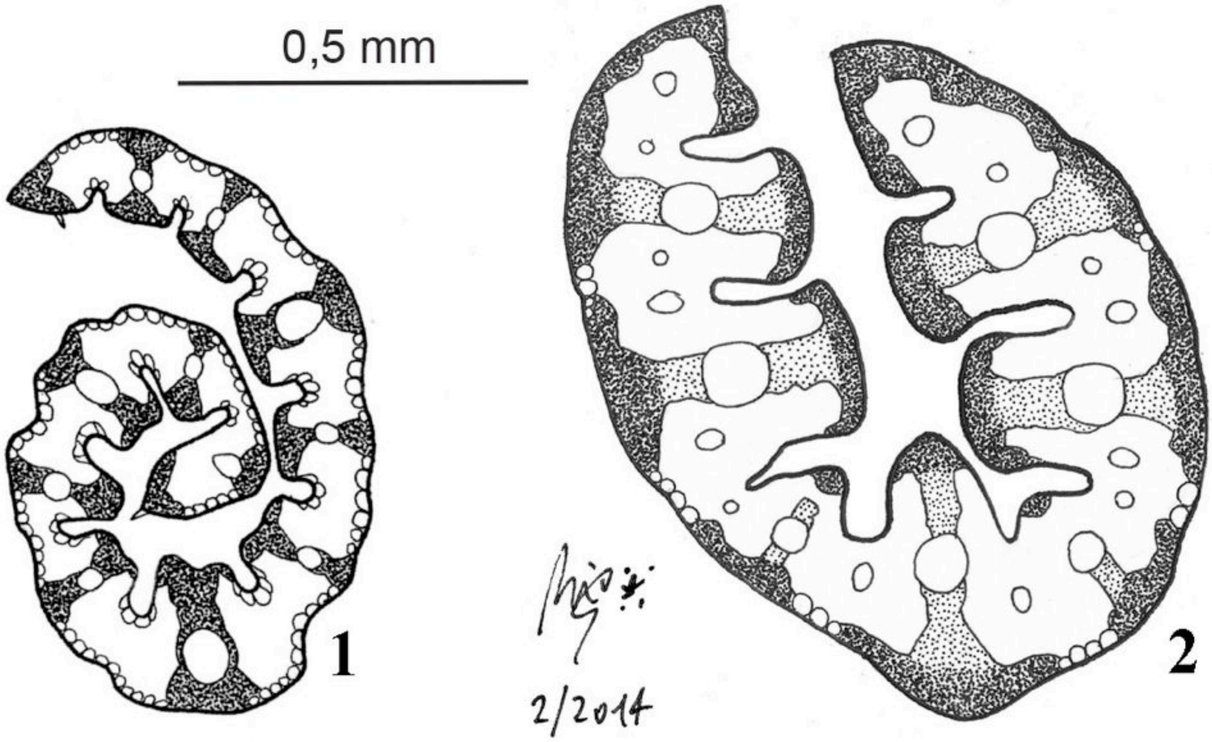
Signorini M. A., Foggi B., & Nardi E., 2003b. (1599) Proposal to reject the name *Festuca vizzavonae* (*Poaceae*). *Taxon* 52 (3): 632.

Šmarda P., Bureš P., Horová L. Foggi B. & Rossi G., 2007. Evolution of *Festuca* (*Poaceae*): a cycle of genome size and GC content expansion and riverse reduction. *Ann. Bot.* 100(1): 141-50.

Stace C.A., 1997. New Flora of the British Isles. Cambridge University Press, Cambridge.

Torrecilla P, Lopez Rodriguez J.A., Stancik D. & Catalan P., 2003. Systematics of *Festuca* sect. *Eskia* Willk., *Pseudatropis* Kriv., *Amphigenes* (Janka) Tzvel., *Pseudoscariosa* Kriv. and *Scariosae* Hack. based on analysis of morphological characters and DNA sequences. *Plant Syst. Evol.*, 239: 113-139.

Willkomm M., 1861. Fam. 19: *Gramineae* Juss. In: Willkomm M. & Lange J. (eds.) Prodromus florae hispanicae. I: 33-118. Stuttgart.



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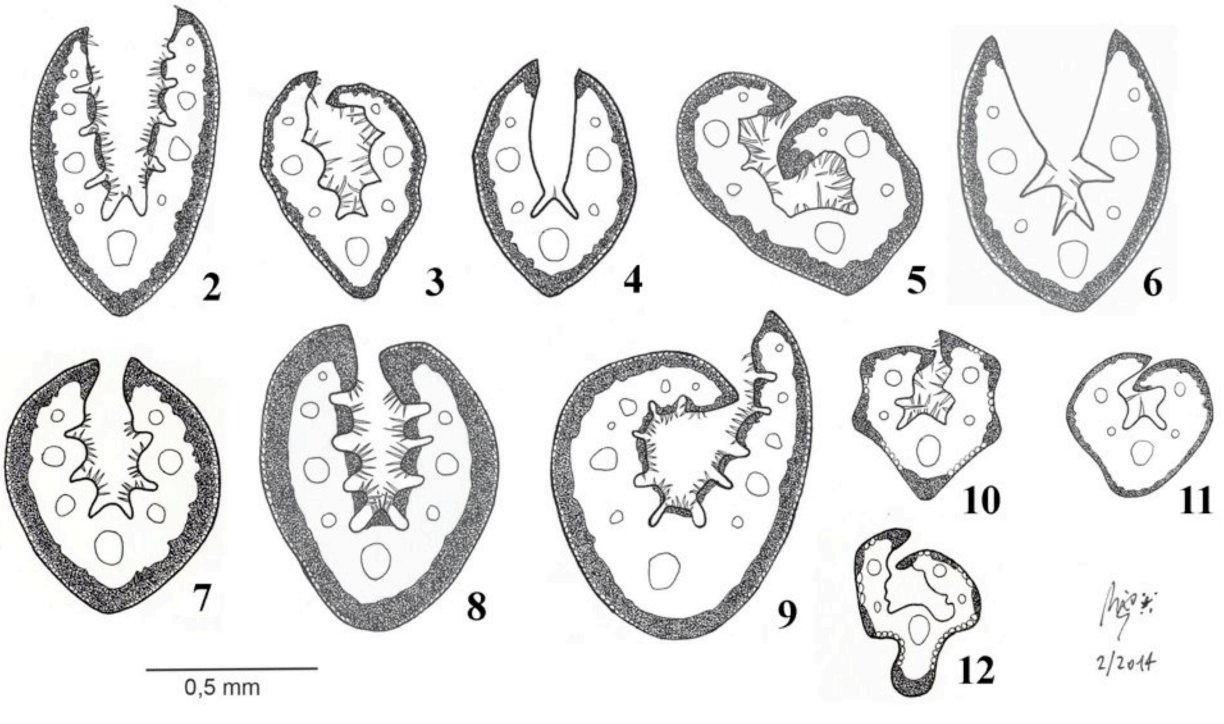

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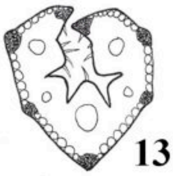
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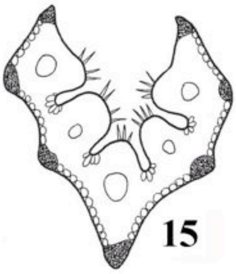
14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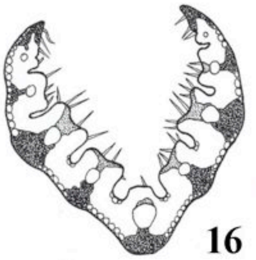
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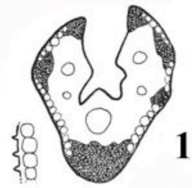
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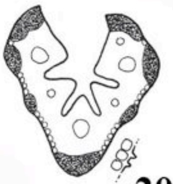
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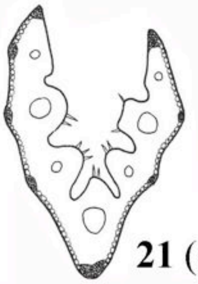
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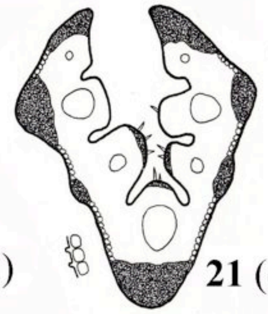
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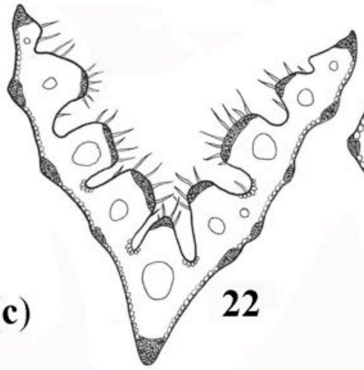
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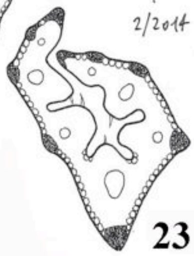
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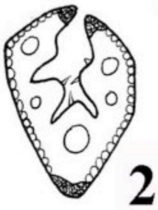
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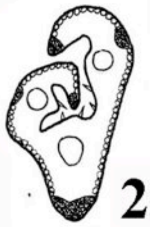
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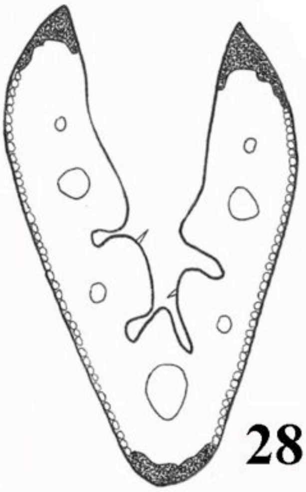
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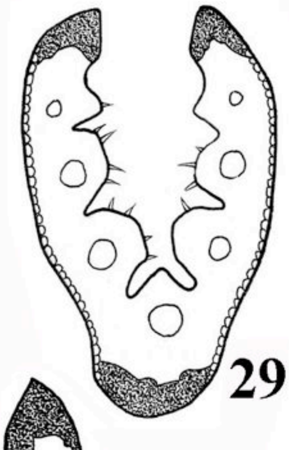
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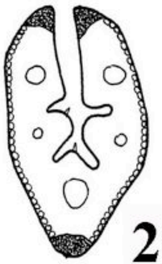
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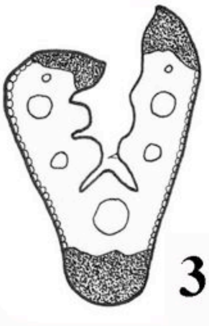
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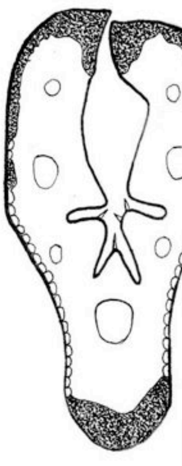
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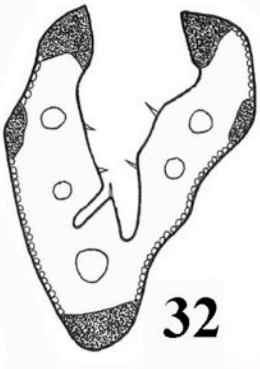
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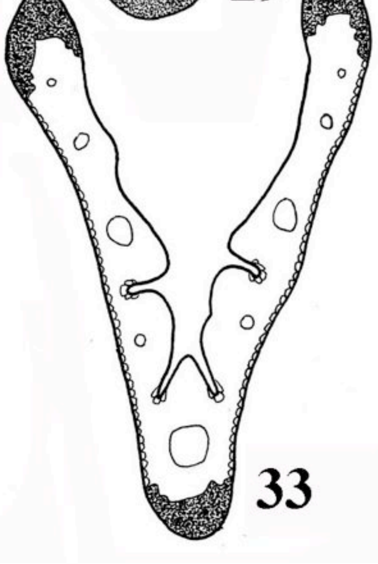
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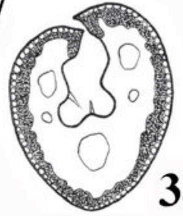
37 (b)


37 (a)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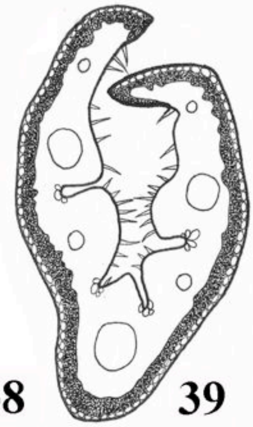
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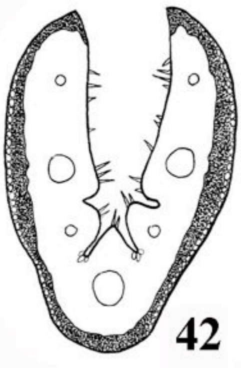
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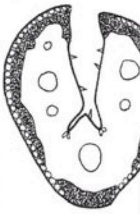
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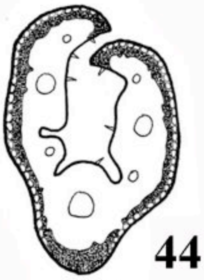
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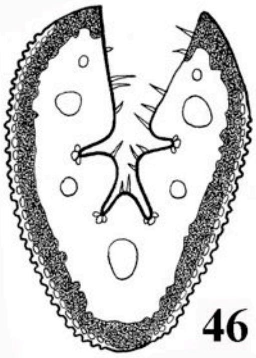
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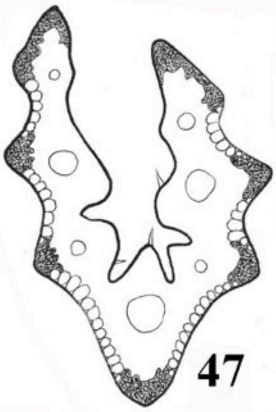
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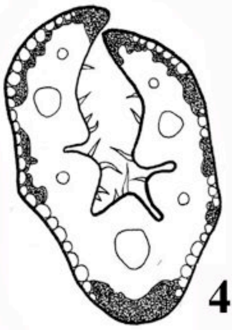
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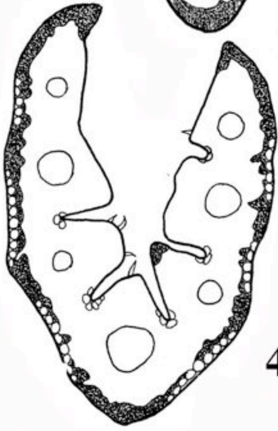
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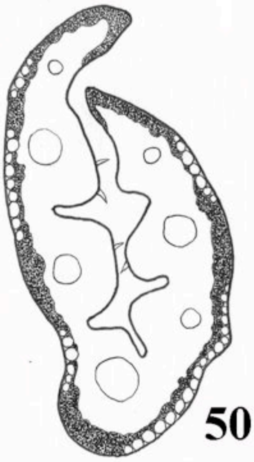
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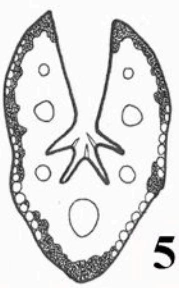
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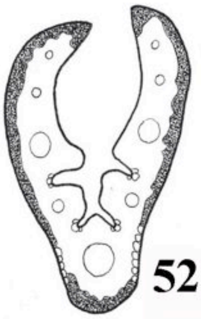
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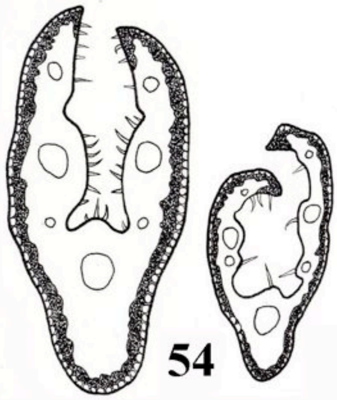
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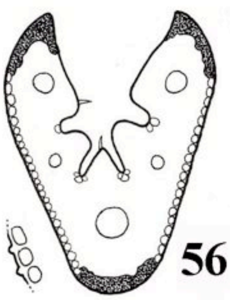
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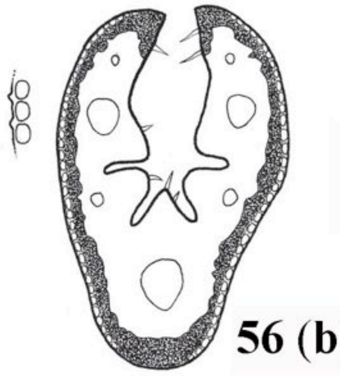
56 (b)


57

0,5 mm

2/2014

Festuca rubra L. subsp. *juncea* (Hack.) K.Richt. (Poaceae)

+ **LAZ**: Vico nel Lazio (Frosinone), Monti Ernici, Campovano (WGS84: 41.822527°N; 13.373242°E), prateria di alta quota, 1880 m, 12 July 2015, *G. Nicolella*, det. *N.M.G. Ardenghi* (FI, RO). – Subspecies new for the flora of Lazio.

This subspecies is quite widespread in northern and central Italy (see Conti et al. 2005, Ardenghi et al. 2015), where it grows mostly in mountain grasslands, on acidic or superficially acidified basic soils (Foggi and Rossi 1996). However, its presence has probably been neglected due to confusion with *F. rubra* subsp. *commutata* (Gaudin) Markgr.-Dann., from which it can be safely separated based on tiller leaf blade anatomy and the presence of rhizomes (that, however, are difficult to sample).

G. Nicolella, M. Latini, M. Iberite & N.M.G. Ardenghi

Galeopsis bifida Boenn. (Lamiaceae)

+ **LIG**: Valbrevenna (Genova), Senarega (WGS84: 44.55715°N; 9.119247°E), orto incolto, 730 m, 9 September 2014, *M. Calbi* (FI). – Species new for the flora of Liguria.

It is a species with a Eurosiberic distribution. It was reported from Italy only in Lombardia, Trentino-Alto Adige, Veneto, Friuli Venezia Giulia and, doubtfully, in Piemonte (Conti et al. 2005); it was not yet recorded from Liguria.

G. Barberis & M. Calbi

Genista aetnensis (Biv.) DC. (Fabaceae)

+ (INV) **CAM**: Status change from naturalized to invasive alien in Campania.

Genista aetnensis is endemic to the Mt. Etna in Sicilia and some localities in Sardegna (Pignatti 1982). It was imported in the Vesuvian area (Campania) one century ago within a reforestation program aimed at mitigating soil erosion and increasing slope stability (Agostini 1959). Nowadays, this species has become the dominant plant species on the Vesuvius Grand Cone, where it forms continuous plant communities of shrubs. According to Stinca et al. (2015), over a period of approximately 40 years *G. aetnensis* has succeeded in accumulateng considerable reserves of C, N, and P in the soil, thereby also modifying soil hydrological properties. For these reasons, this species should be considered invasive (“transformers” *sensu* Pyšek et al. 2004) in Campania.

A. Stinca

Appendix II

Additional ISI papers

Lectotypification of *Leonurus quinquelobatus* (Lamiaceae)

Nicola M.G. Ardenghi

Department of Earth and Environmental Sciences, University of Pavia, Via S. Epifanio 14, 27100 Pavia, Italy; sahfen@hotmail.com

DOI http://dx.doi.org/10.12705/641.27

Abstract The name *Leonurus quinquelobatus* is discussed and lectotypified using a specimen from the Gilibert Herbarium at KW.

Keywords Jean Emmanuel Gilibert; *Leonurus cardiaca*; *Leonurus quinquelobatus*; nomenclature; taxonomy; typification

■ INTRODUCTION

According to Krestovskaya (1989, 1990, 1992), the genus *Leonurus* L. (Lamiaceae Martinov, Lamioideae Harley, Leonureae Dumort.) is divided into three sections and five subsections and includes approximately 24 species. Included within *L.* subsect. *Leonurus* are *L. cardiaca* L., the type of the genus (Greuter & al., 1993), and *L. quinquelobatus* Gilib., two species that are morphologically quite similar (Krestovskaya, 1992: 146). Due to their morphological closeness, *L. cardiaca* and *L. quinquelobatus* have not always been treated as separate species but rather two varieties or subspecies (under *L. cardiaca*) or a single species (*L. quinquelobatus* being treated as a synonym of *L. cardiaca*) with no infraspecific taxa (e.g., Holub, 1993; Tomšovic, 2000). However, recent molecular studies support the recognition of the two as distinct species (Marciniuk & al., 2014).

Leonurus quinquelobatus is native to eastern Europe and south-western Asia (Kupryanova, 1977; Holub, 1993). Its use as a valuable medicinal and melliferous plant (Hanelt, 2001; Marciniuk & al., 2014) led to its introduction and naturalization in central and western Europe. Even though *L. quinquelobatus* is often misidentified as *L. cardiaca*, it has been increasingly reported from the non-native areas of its range over the last two decades (Holub, 1993; Verloove, 2012; Ardenghi & Montanari, 2013).

The aim of this paper is to typify the name *Leonurus quinquelobatus* Gilib., a basic step towards the revision of the systematics and distribution of *L.* subsect. *Leonurus*.

■ TYPIFICATION OF THE NAME *LEONURUS QUINQUELOBATUS*

Krestovskaya (1990: 142) did not mention any type specimen for *Leonurus quinquelobatus* and expressed doubt about the possible existence of original material at LY. Jean Emmanuel Gilibert (1741–1814), a French botanist and physician from Lyon, spent eight years (1775–1783) as a professor of botany at Grodno (Belarus) and Vilnius (Lithuania), where he founded two botanical gardens and studied the local flora, publishing *Flora lithuanica inchoata* (Gilibert, 1782a, b), the first Flora of Lithuania. After he departed for Lyon in 1783, only a small portion of Gilibert's specimens was returned to France (in 1790). The major part of Gilibert's herbarium remained at the University of Vilnius until 1841, when it was transferred to the University of St. Vladimir in Kiev (Shiyan & al., 2010; Daszkiewicz, 1999).

Searches conducted at LY and MPU by N.M. Shiyan (Head Curator at KW) did not result in any Gilibert specimens being discovered. However, Shiyan did report to the author four Gilibert specimens from KW that are relevant to *Leonurus quinquelobatus*:

(1) "*leonurus cardiaca*? florebat 28 augusti communis prope grod[nam] circa rudera. non est *cardiaca* militat inter *marubiastrum*, credo novam speciem. Fl. Lith p. 84", *J.E. Gilibert 857* (KW-Gilibert KW000087355 [digital image!]);

(2) "1a. *Leonurus cardiaca*, Fl. Lith p. 84, Didy. gym.", *J.E. Gilibert 858* (KW-Gilibert KW000087743 [digital image!]);

(3) "*leonurus cardiaca ~~marubiastrum~~* var circa grodnam. Fl. Lith p. 85", *J.E. Gilibert 859* (KW-Gilibert KW000087745 [digital image!]);

(4) "*leonurus ~~marubiastr.~~ cardiaca* L, prope grodnam. Fl Lith p. 85.", *J.E. Gilibert 860* (KW-Gilibert KW000087744 [digital image!]).

Although Gilibert's signature is not present on the labels, the handwriting on the specimens is undoubtedly his, it matching the calligraphy provided by Burdet (1974: 517–518). In 1934, the four specimens were correctly annotated as "*Leonurus quinquelobatus* Gilib." by Russian botanist Vitalii Ivanovich Kreczetowicz (1901–1942), who wrote "*typus*!" on KW000087355 (a later label with the printed word "HOLOTYPUS" is also attached). Kreczetowicz's typification statement cannot be taken as an effective lectotypification, since it was not published (*ICN* Art 7.9; McNeill & al., 2012). Since Gilibert (1793) did not explicitly make clear that he used only a single specimen or indicate a single specimen as type, no specimen can be taken as the holotype of *Leonurus quinquelobatus* (*ICN* Art. 9.1; McNeill & al., 2012). Gilibert (1793) did cite only a single locality, "Grodna" (Grodno), and this appears on three of the four specimens at KW.

Received: 19 Jan 2014 | returned for (first) revision: 30 Jun 2014 | (last) revision received: 12 Jan 2015 | accepted: 19 Jan 2015 || publication date(s): online fast track, n/a; in print and online issues, 2 Mar 2015 || © International Association for Plant Taxonomy (IAPT) 2015

Even though KW000087745 was originally identified by Gilibert as "*Leonurus cardiaca* var", it has been selected as lectotype because of the abbreviation "Fl. Lith p. 85", which refers to page 85 of his *Flora lituanica inchoata* (Gilibert, 1782a) where the description of *Cardiaca quinquelobata* Gilib., synonymous with *L. quinquelobatus* (but not validly published, the work being included in App. VI, with names of species and infraspecific taxa not to be accepted as validly published; Wiersema & al., 2015), is reported.

KW000087355 is provided with a more detailed label, displaying habitat information ("*rudera*") and the sentence "*Non est cardiaca militat inter marubiastrium, credo novam*

Fig. 1. Lectotype of *Leonurus quinquelobatus* Gilib. (KW-Gilibert KW000087745).

speciem" (very similar, but not identical, to the one reported in the protologue: "*militat inter Leonurum tataricum & Marubiastrum L.*"). However, the specimen is not taken as definitive original material of *Leonurus quinquelobatus*, the abbreviation "Fl. Lith p. 84" referring to the description of *Cardiaca trilobata* Lam. (≡ *Leonurus cardiaca* L.) and the characters of the material only partially matching with the original description of *L. quinquelobatus*, lacking the diagnostic stem leaves ("*folia petiolata, inferiora, & caulina subpeltata in quinque lobis profunde incisa, rotunda, quoque lobo iterum inciso, & dentato*").

Leonurus quinquelobatus Gilib. in Usteri, P. (ed.), Delect. Opusc. Bot. 2: 321. 1793 – **Lectotype (designated here):** [Belarus, Grodno Region, Grodno] "*leonurus cardiaca ~~marubiastrum~~* var circa grodnam. Fl. Lith p. 85", *J.E. Gilibert 859* (KW-Gilibert barcode KW000087745 [No. 087745; digital image!]. — For image of lectotype, see Fig. 1.

■ ACKNOWLEDGEMENTS

The author is grateful to Natalia M. Shiyan, Head Curator of the National Herbarium of Ukraine (KW), for providing the digital images of the specimens discussed in the present paper and for the information on Gilibert's collection. The author expresses his gratitude also to Bruno Foggi, Department of Biology – Plant Biology, University of Florence (Italy), for the valuable nomenclatural suggetions, and to Gerry Moore, NRCS, Greensboro (U.S.A.), for his helpful and constructive comments to the manuscript.

■ LITERATURE CITED

Ardenghi, N.M.G. & Montanari, S. 2013. *Leonurus quinquelobatus* Gilib., esotica nuova per l'Italia (Dicotyledones Lamiaceae). *Quad. Stud. Not. Storia Nat. Romagna* 37: 35–45.

Burdet, H.M. 1974. Cartulae ad botanicorum graphicem. V. *Candollea* 29: 489–522.

Daszkiewicz, P. 1999. J.E. Gilibert's phytogeographic map of Lithuania. *Arch. Nat. Hist.* 26: 433–434. http://dx.doi.org/10.3366/anh.1999.26.3.433

Gilibert, J.E. 1782a ("1781"). *Flora lituanica inchoata*, vol. 1 [*Collectio* I–III]. Grodno: typis S.R.M.

Gilibert, J.E. 1782b. *Flora lithuanica inchoata*, vol. 2 [*Collectio* IV–V]. Wilna: typis S.R.M. penes Academiam.

Gilibert, J.E. 1793. Flora lituanica inchoata. Pp. 255–430 in: Usteri, P. (ed.), *Delectus opusculorum botanicorum*, vol. 2. Argentorati [Strasbourg]: in Bibliopol. Academico. http://dx.doi.org/10.5962/bhl.title.45191

Greuter, W., Brummitt, R.K., Farr, E., Kilian, N., Kirk, P.M. & Silva, P.C. 1993. *Names in current use for extant plant genera*. Regnum Vegetabile 129. Königstein: Koeltz Scientific Books.

Hanelt, P. 2001. *Mansfeld's Encyclopedia of agricultural and horticultural crops*. Berlin, Heidelberg: Springer.

Holub, J. 1993. *Leonurus intermedius*, species nova – with additional notes on some other *Leonurus* taxa. *Preslia* 65: 97–115.

Krestovskaja, T. 1989. Generis *Leonurus* L. (Lamiaceae) systema et conspectus, 1. *Novosti Sist. Vyssh. Rast.* 26: 142–149.

Krestovskaja, T. 1990. Generis *Leonurus* L. (Lamiaceae) systema et conspectus, 2. *Novosti Sist. Vyssh. Rast.* 27: 139–144.

Krestovskaja, T. 1992. Systematics and phytogeography of *Leonurus* L. Pp. 139–148 in: Harley, R.M. & Reynolds, T. (eds.), *Advances in Labiate science*. Richmond: Royal Botanic Gardens, Kew.

Kupryanova, L.A. 1977. *Leonurus* L. Pp. 105–114 in: Shishkin, B.K. (ed.), *Flora of the U.S.S.R.* Israel Program for Scientific Translations 21. Jerusalem: Keter Publishing House Jerusalem.

Marciniuk, P., Gawrońska, B., Marciniuk, J. & Joachimiak, A.J. 2014. Taxonomic individuality of *Leonurus cardiaca* and *Leonurus quinquelobatus* in view of morphological and molecular studies. *Pl. Syst. Evol.* 300: 255–261. http://dx.doi.org/10.1007/s00606-013-0878-7

McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Prud'homme Van Reine, W.F., Smith, G.F., Wiersema, J.H. & Turland, N.J. (eds.) 2012. *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code): Adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011*. Regnum Vegetabile 154. Königstein: Koeltz Scientific Books. http://www.iapt-taxon.org/nomen/main.php

Shiyan, N.M., Optasyuk, O.M. & Zavialova, L.V. 2010. The J.E. Gilibert collection in the National Herbarium of Ukraine (KW). *Ukrayins'k. Bot. Zhurn.* 67: 680–688.

Tomšovic, P. 2000. *Leonurus* L. Pp. 609–610 in: Slavík, B. (ed.), *Květena ČR*, díl 6. Prague: Academia.

Verloove, F. 2012. *Leonurus cardiaca* subsp. *villosus*, a long forgotten and probably neglected xenophyte in Belgium. In: Manual of the Alien Plants of Belgium. http://alienplantsbelgium.be/content/leonurus-cardiaca-subsp-villosus, accessed 18 Jan 2014.

Wiersema, J.H., McNeill, J., Turland, N.J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Prud'homme van Reine, W.F. & Smith, G.F. (eds.) 2015. *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code): Adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011; Appendices II–VIII.* Regnum Vegetabile 157. Königstein: Koeltz Scientific Books.

Phytotaxa 233 (1): 098–100
www.mapress.com/phytotaxa/

Correspondence

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

http://dx.doi.org/10.11646/phytotaxa.233.1.10

Lectotypification of the name *Alnus brembana* (Betulaceae), a controversial Alpine endemic species

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Alnus brembana Rota (1853: 102, 79) (Betulaceae) was described by Italian botanist Lorenzo Rota (1819−1855) within his flora of the province of Bergamo (Rota 1853). Since its publication, the treatment of this taxon as an autonomous species did not reach a general agreement among botanists, as it was often recongnized at different taxonomic ranks, e.g. a variety or a subspecies (see e.g., Regel 1865, Parlatore 1868, Cesati *et al.* 1872, Arcangeli 1882, Fiori 1923, Schmidt 1996), or a synonym of *A. alnobetula* (Ehrhart 1783: 193) Koch (1872: 625). Some contemporary authors (Landolt 1993, 2010, Martini *et al*. 2012) still recognize the species as a local endemic to the southern Alps. Most current European floras and checklists (see e.g., Ball 1964, Pignatti 1982, Greuter *et al*. 1984, Ball 1993, Aeschimann *et al*. 2004, Conti *et al*. 2005, Euro+Med 2006 onwards) do however list it as a synonym of *A. alnobetula* subsp. *alnobetula* or its synonym *A. viridis* (Chaix 1785: 70) Candolle in Candolle & Lamarck (1805: 304). Its separation from *A. alnobetula* is questionable, since, as stated by Landolt (1993) himself, transitional forms occur within their alleged distribution areas.

Since no type material was mentioned in the protologue (Rota 1853: 102, 79), and the name *Alnus brembana* has not been typifed by subsequent authors who studied this taxon (see e.g., Landolt 1993, 2010, Martini *et al*. 2012), we designate here a lectotype in order to prevent misinterpretation of this name in future.

The protologue of *Alnus brembana* consists of a detailed description of the species vegetative and floral traits (e.g., leaf blades, petioles, staminate catkins), followed by the only locality of provenance, the forests surrounding Branzi, a village located in Val Brembana, northern Lombardy ("Boschi a fondo Gneis e Schisto sopra Branzi").

The majority of the specimens collected by Lorenzo Rota (10,650 sheets) are currently stored at the herbarium of the Bergamo Botanical Garden (BER), while a smaller amount (494 *exsiccata*) is kept at the Erbario Lombardo of the University of Pavia (PAV), where Rota studied and worked as an assistant to Professor Giuseppe Moretti from 1837 to 1845, before relocating to Bergamo to pursue the profession of physician (Saccardo 1901, Rinaldi 2009). Among these collections, we discovered the following six specimens, whose labels have been fully transcribed:

1) "Rizzi Marisa, 29, domestica, ~~nubile~~ povera, in Bergamo C.ª S. Alessandro [...] / sevante [?], [...] religiosa, abuso di liquori, [...] / minacce saltare dalle finestre e strangolarsi, e ci impedisce di andare / alla ricerca di un [...]. [first four rows struck through with four oblique lines] / Differt a [...] Sect. Iª (*Piloselloidea*) ob pilos foliorum et caulium […] et stellatos / Differt ab *A. minoris Alnus* (*Betula*) *brembana* Rota. frutex altitudinem humum, / [...], a basi ramosa, ramis strictis arrectis, cortice obscure cinereis, gemmis fol. linearibus acutis resinosis, folios strictos petiolo / 6 millim. lungo pubescente, lamina fol. ovata acuta [...] 23 millim. longa 11 mill. lata, ramoso-venosa subtus in venis / pubescentibus, margine duplicato-serrata incisaque, ciliata, amenta mascula pedunculata / ante anthesim long. 10 mill. diametro 2 mill. glutinosa, squamae cordato-ovatis obtusis ciliatis.......... /......... / *Betula Brembana* Rota", s.loc., s.d., [*L. Rota*] (BER-Rota 29793 [digital image!]);
2) "tra Branzi e Valleve in Val Brembana", s.d., [*L. Rota*] (RO-Cesati [digital image!]);
3) "*Alnus brembana* Rota / Branzi, Ag. [= "agosto, August", *sine anno*]", [*L. Rota*] (PAV-Erbario Lombardo!, ex *Herb. Rota*);
4) "*Alnus Brembana* Rota", s.loc., s.d., [*L. Rota*] (PAV-Erbario Lombardo!, ex *Herb. O. Balzarini*, 2 specimens);
5) "*Alnus Brembana* Rota / - 188 [printed number belonging to the piece of paper carved from a university register or a calendar and then used as a label] / Val Sanguigna", s.d., [*L. Rota*] (PAV-Lombardo!, ex *Herb. O. Balzarini*).

Each specimen, identified either as "*Alnus brembana* Rota" or as "*Betula brembana* Rota" (the latter binomial has never been validly published, but the name "*Betula*" appears in brackets in the protologue), bears a label undoubtedly written by Rota's hand: his handwriting was confirmed by comparison with the calligraphy on herbarium labels and original documents pictured by Rinaldi (2009), and with the handwritten labels attached to Rota's *exsiccata* at PAV.

Accepted by Fabrizio Bartolucci: 8 Oct. 2015; published: 30 Oct. 2015

However, only four of the aforementioned *exsiccata* can be considered useful for typification purposes: two specimens from the collection of Ottorino Balzarini at PAV (one of the two without locality and the one from "Val Sanguigna", i.e. Val Sanguigno) match the diagnosis only partially, since they feature staminate catkins more than 30 mm long (vs. "*10-millimetra longis*") and leaf blades at an early stage of developement, preventing an evaluation of their effective size (the plants were presumably collected early in spring).

The handwritten label attached to the specimen at BER (reproduced in Martini *et al.* 2012: 152) is divided into two distinct paragraphs, probably written at different times, as revealed by the slightly dissimilar ink colour: the first one, struck through with three oblique lines, discloses the tragic story of a woman from Bergamo, who attempted to commit suicide after liquor abuse. The episode is certainly linked to Rota's medical activities, who recorded the event on a piece of paper later used as a herbarium label. The second paragraph begins with an isolated and obscure sentence probably referring to the genus *Pilosella* Vaillant (1754: 703), then a detailed diagnosis of *Alnus brembana* follows, very similar (but not identical) to the one reported in the protologue; no information concerning the provenance of the plant is given. On the basis of the diagnosis-like description, Martini *et al*. (2012) regarded the specimen as "typus" within the figure caption on page 152. However, according to Art 7.10 of the ICN (McNeill *et al*. 2012), the designation of the type is not achieved, since the typification statement (following 1 January 2001) does not include the phrase "designated here" or an equivalent.

Even though the specimen at PAV features only pistillate catkins, it is chosen here as the lectotype of *Alnus brembana* because of the stated provenance, "Branzi", which perfectly matches the protologue. Moreover, the specimen was collected in August ("Ag.") and exhibits well-developed leaf blades, whose size is compatible with the measurements mentioned in diagnosis.

The ICN does not clearly indicate when a name is to be considered a replaced name or a new taxon; here we choose to treat the names of Regel, Parlatore and Cesati, with a short diagnosis (in Latin in Regel and Parlatore, in Italian in Cesati) and the citation of *Alnus brembana* in synonymy, as replaced names at a new rank of *Alnus brembana* Rota, and homotypic with it. According to the orginal material seen, *Alnus brembana* has to be regarded as heterotypic synonym of *A. alnobetula* subsp. *alnobetula.*

Alnus brembana Rota 1853: 102, 79.

≡ *Alnus viridis* var. *parvifolia* Regel (1865: 422) ≡ *Alnus viridis* var. *minor* Parlatore (1868: 131), nom. illeg. (Arts. 52.1−2 of the ICN) ≡ *Alnus viridis* var. *microphylla* Ces. in Cesati *et al.* (1872: 216), nom. illeg. (Arts. 52.1−2 of the ICN), non *Alnus microphylla* Arvet-Touvet (1879: 20) ≡ *Alnus viridis* var. *brembana* (Rota) Nyman (1881: 672), nom. superfl. (Art. 52.3 of the ICN) ≡ *Alnus viridis* subsp. *microphylla* Arcangeli (1882: 631) ≡ *Alnus alnobetula* var. *brembana* (Rota) W.Winkl. in Winkler (1904 [17.VI.1904]: 106), nom. superfl. (Art. 52.3 of the ICN) ≡ *Alnus minor* var. *brembana* (Rota) Fiori (1923: 355), nom. superfl. (Art. 52.3 of the ICN) ≡ *Duschekia viridis* subsp. *brembana* (Rota) Holub (1973: 176), nom. superfl. (Art. 52.3 of the ICN) ≡ *Alnus viridis* subsp. *brembana* (Rota) Schmidt (1996: 33), nom. superfl. (Art. 52.3 of the ICN).

- *Alnus alnobetula* var. *brembana* (Rota) Callier in Schneider (1904 [VI.1904]: 121), isonym (Art. 6.3 Note 2 of the ICN)

Lectotype (designated here):—ITALY. **Lombardia**: Branzi, August [without year], [*L. Rota*] (PAV-Erbario Lombardo!).

= ***Alnus alnobetula*** (Ehrhart 1783: 193) Koch (1872: 625) subsp. ***alnobetula***

Type:—Not designated (see Furlow 1979: 198).

Acknowledgements

We are thankful to Silvio Frattini (Brescia), who stimulated the present research, to Francesco Zonca (BER) and Mauro Iberite (RO), who provided digital images of specimens of our interest.

References

Aeschimann, D., Lauber, K., Moser, D.M. & Theurillat, J.-P. (2004) *Flora alpina* 1. Haupt Verlag, Bern, 1159 pp.

Arcangeli, G. (1882) *Compendio della flora italiana*. E. Loescher, Torino, Roma, 889 pp.

http://dx.doi.org/10.5962/bhl.title.9995

Arvet-Touvet, C. (1879) *Additions à la monographie des Pilosella et des Hieracium du Dauphiné suivie de l'analyse de quelques autres plantes*. Prudhomme, Grenoble, 20 pp.

Ball, P.W. (1964) *Alnus* Miller. *In:* Tutin, T.G., Heywood, V.H., Burges, N.A., Valentine, D.H., Walters, S.M. & Webb, D.A. (Eds.) *Flora Europaea* 1. Cambridge University Press, Cambridge, pp. 59.

Ball, P.W. (1993) *Alnus* Miller. *In*: Tutin, T.G., Burges, N.A., Chater, A.O., Edmondson, J.R., Heywood, V.H., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A. (Eds.) *Flora Europaea,* ed. 2, 1. Cambridge University Press, Cambridge, pp. 69–70.

Candolle, A.P. de & Lamarck, J.B.A.P.M. de (1805) *Flore française*, ed. 3, 3. Desray, Paris, 731 pp.

Cesati, V., Passerini, G. & Gibelli, G. (1872) *Compendio della flora italiana* 2 (10). Francesco Vallardi, Milano, pp. 209−232.

Chaix, D. (1785) *Plantae vapincincenses sive enumeratio in agro vapincensi observatarum stirpium*. Baux.

Conti, F., Abbate, G., Alessandrini, A. & Blasi, C. (Eds.) (2005) *An annotated checklist of the Italian vascular flora*. Palombi Editori, Roma, 420 pp.

Ehrhart, J.F. (1783) Bestimmung einiger Bäume und Sträucher aus unsern Lustgebüschen. *Gartenkalender* 2: 189−193.

Euro+Med (2006 onwards) *Euro+Med PlantBase – the information resource for Euro-Mediterranean plant diversity*. Available from: http://ww2.bgbm.org/EuroPlusMed/ (accessed 19 May 2015)

Fiori, A. (1923) *Nuova flora analitica d'Italia* 1 (3). Tipografia di M. Ricci, Firenze, pp. 321−480.

Furlow, J.J. (1979) The Systematics of the American Species of *Alnus* (Betulaceae). *Rhodora* 81: 1−121.

Greuter, W., Burdet, H. & Long, G. (1984) *Med-Checklist* 1. Conservatoire et Jardin botaniques de la Ville de Genève, Genève, 330 pp.

Holub, J. (1973) New Names in Phanerogamae 2. *Folia geobotanica et phytotaxonomica* 8: 155–179. http://dx.doi.org/10.1007/BF02854562

Koch, K. (1872) *Dendrologie* 2 (1). Verlag von Ferdinand Enke, Erlangen, 665 pp. http://dx.doi.org/10.5962/bhl.title.20459

Landolt, E. (1993) Die systematische und pflanzensoziologische Stellung von *Alnus brembana* (Betulaceae) in den Südalpen. *Fragmenta floristica et geobotanica suppl.* 2: 521−537.

Landolt, E. (2010) *Flora indicativa. Ökologische Zeigerwerte und biologische Kennzeichen zur Flora der Schweiz und der Alpen.* Haupt Verlag, Bern, Stuttgart, Wien, 378 pp.

Martini, F., Bona, E., Federici, G., Fenaroli, F. & Perico, G. (2012) *Flora vascolare della Lombardia centro-orientale* 1. LINT Editoriale, Trieste, 602 pp.

McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Prud'Homme van Reine, W.F., Smith, G.F., Wiersema, J.H. & Turland, N.J. (Eds.) (2012) International Code of Nomenclature for algae, fungi, and plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011. *Regnum Vegetabile* 154: 1–208.

Nyman, C.F. (1881) *Conspectus florae europaeae* 3. Örebro Suecicae, typis Officinae Bohlinianae, pp. 493−677. http://dx.doi.org/10.5962/bhl.title.10533

Parlatore, F. (1868) *Flora italiana* 4 (1). Tipografia Le Monnier, Firenze, pp. 1−288. http://dx.doi.org/10.5962/bhl.title.6341

Pignatti, S. (1982) *Flora d'Italia* 1. Edagricole, Bologna, 790 pp.

Regel, E. (1865) Bemerkungen uber die Gattungen *Betula* und *Alnus* nebst Beschreibung einiger neuer Arten. *Bulletin de la Société impériale des naturalistes de Moscou* 38 (2): 388−434.

Rinaldi, G. (2009) *Lorenzo Rota 150 anni dopo*. Orto Botanico di Bergamo "Lorenzo Rota", Bergamo, 136 pp.

Rota, L. (1853) *Prospetto della flora della Provincia di Bergamo*. Tipografia Mazzoleni, Bergamo, 104 pp.

Saccardo, P.A. (1901) *La Botanica in Italia. Materiali per la storia di questa scienza. Parte seconda*. Tipografia Carlo Ferrari, Venezia, 172 pp.

Schmidt, P.A. (1996) Zur Systematik und Variabilität der mitteleuropäischen Erlen (Gattung *Alnus* Mill.). *Mitteilungen der Deutschen Dendrologischen Gesellschaft* 82: 15−42.

Schneider, C.K. (1904) *Illustriertes Handbuch der Laubholzkunde* 1 (1). Verlag von Gustav Fischer, Jena, pp. 1−160. http://dx.doi.org/10.5962/bhl.title.194

Vaillant, S. (1754) Neue Kennzeichen dreyer Classen von Pflanzen mit zusammengesetzeten Blumen, nämlich: der *Cynarocephalarum*, derer mit Artischockenhäuptern; *Corymbiferarum*, die zusammengesetzte, scheibenförmige Blumen tragen; *Cichoracearum*, wegwartartiger. Der Königl. Akademie der Wissenschaften in Paris. Anatomische, Chymische und Botanische Abhandlungen 5: 143–194, 333–377, 545–613, 697–750.

Winkler, H.J.P. (1904) Betulaceae. *In*: Engler, H.G.A. (Ed.) *Das Pflanzenreich* 19. Wilhelm Engelmann, Berlin, 149 pp.

Phytotaxa 212 (2): 133–140
www.mapress.com/phytotaxa/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

http://dx.doi.org/10.11646/phytotaxa.212.2.2

Discovered outdoors: typification of names of taxa described from Italy outside their native range

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Abstract

Between the 18th and the early 20th century, a number of naturalized neophytes were described in Europe, outside their area of origin. Although most of the names of these taxa, discovered in a period without fast computer-mediated communication and world-wide electronic availability of taxonomic papers, today are treated as synonyms, their existence allows to shed light on a peculiar taxonomic phenomenon connected to the early stages of the European alien flora studies. In this paper we select two lectotypes and one neotype for three neophytes described in Italy, belonging to the critical graminoid genera *Cyperus* (*C. aristatus* var. *boeckeleri*), *Echinochloa* (*Panicum erectum*), and *Eleocharis* (*Scirpus erraticus*). The selected types are conserved at PAV-Erbario Lombardo and RO.

Key words: Alien species, *Cyperus*, *Echinochloa*, *Eleocharis*, nomenclature, taxonomy

Introduction

The description of alien taxa outside their native range dates back to Linnaeus, when he described, for instance, the Asiatic *Commelina communis* Linnaeus (1753: 40), and *Cyperus glomeratus* Linnaeus (1756: 5) from “America” and “Italiae” respectively; besides botany, a number of cases are also known from the zoology field (especially entomology, see e.g. *Microus mocquerysi* Chaudoir (1876: 9), described from France but native to Sub-Saharan Africa). Many later examples of this curious taxonomic phenomenon are known from Italy, where a significant number of neophytes were described between the 18th and the early 20th century, especially from the northern regions’ rice fields, a historical and crowded scene of several introductions in the course of the centuries: *Cornelia verticillata* Arduino (1764: 9), *Panicum oryzoides* Arduino (1764: 16), *Caulinia alagnensis* Pollini (1814: 13), *Xanthium italicum* Moretti (1822: 326), *Scirpus erraticus* Rota ex De Notaris (1845: 20), *Cyperus aristatus* Rottbøll (1772: 22) var. *boeckeleri* Cavara (1899: 26), *Panicum erectum* Pollacci (1914: 228), and *Impatiens mathildae* Chiovenda (1928: 1053). Probably as a consequence of the scarce chorological and taxonomic knowledge of that period, the majority of these taxa were more or less implicitly considered as native of Italy, regardless of their natural area of origin; only the last two were clearly mentioned as “introduced” by their authors, members of an early generation of botanists more conscious of the alien invasion processes (see e.g., Cavara 1894).

The names of three aforementioned taxa (*Cyperus aristatus* var. *boeckeleri*, *Panicum erectum*, *Scirpus erraticus*) resulted not yet typified. Hence, we proceeded with the designation of their nomenclatural types, which may be useful for preventing misinterpretations of their taxonomy, as they currently belong to critical genera such as *Cyperus* Linnaeus (1753: 44), *Echinochloa* Palisot de Beauvois (1812: 53), and *Eleocharis* Brown (1810: 224) (see e.g., Costea & Tardif 2002, Verloove 2010, 2014).

Accepted by Lorenzo Peruzzi: 6 May 2015; published: 4 Jun. 2015

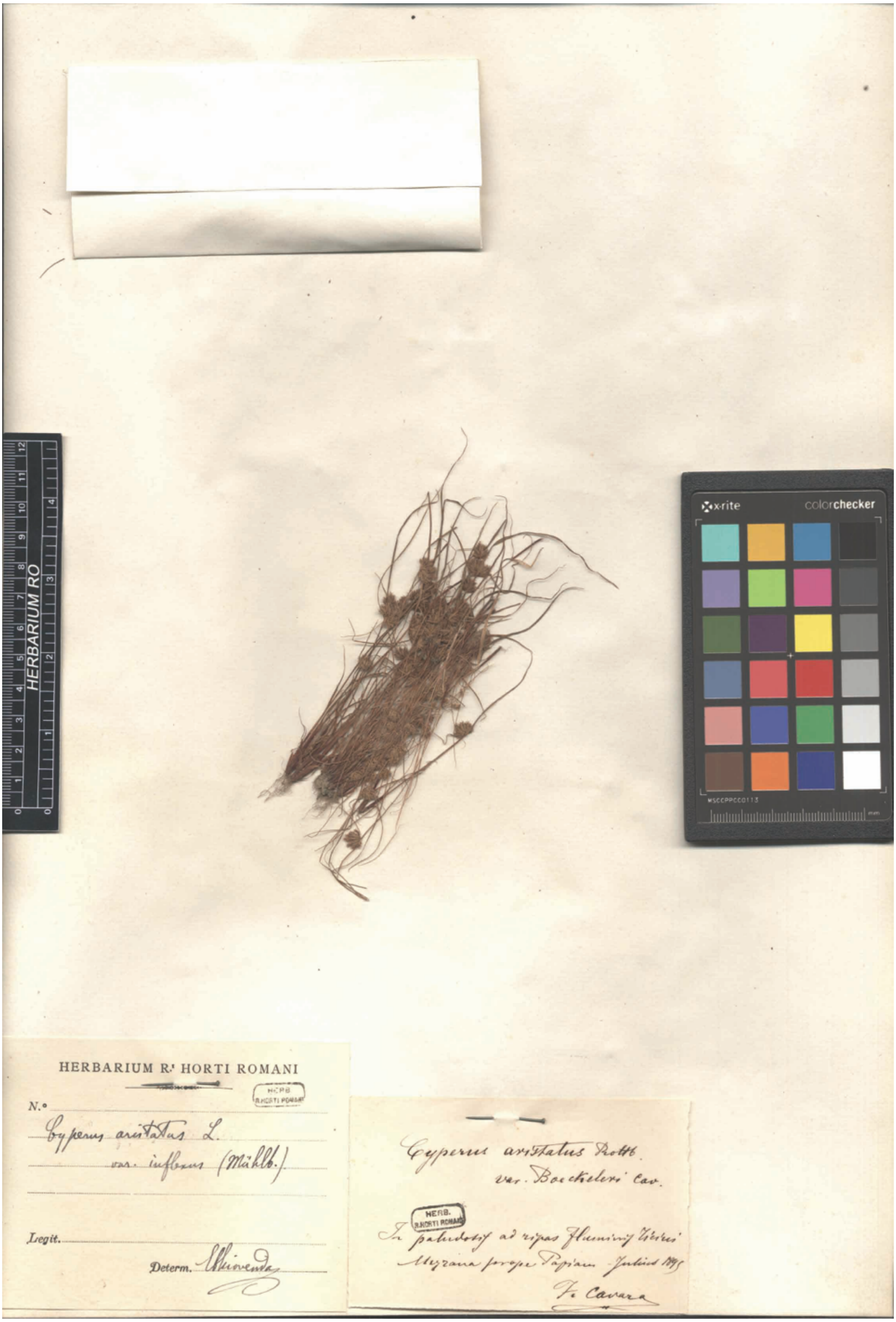

FIGURE 1. Lectotype of *Cyperus aristatus* var. *boeckeleri* (packet opened) (RO).

Material and Methods

Different Italian herbaria (BER, FI, GDOR, GE, PAV, RO; acronyms according to Thiers 2015) were consulted in order to find original material of our interest.

For each taxon typified, in addition to the type specimen citation, we list: additional specimens examined; localities mentioned in the protologue ("protologue citation"); typification notes (with possible nomenclatural notes); currently accepted name and related type citation accompanied by the link to the online image (whenever available); information regarding its chorology and invasiveness status outside the native range.

Typification of the names

Cyperus aristatus Rottb. var. *boeckeleri* Cavara (1899: 26)

Type (lectotype designated here)**:**—ITALY. **Lombardia**: In paludosis ad ripas fluminis Ticini, Mezzana prope Papiam, July 1895, *F. Cavara s.n.* (RO image! isolectotype PAV-Erbario Lombardo!) (Fig. 1).

Additional specimens examined:—ITALY. **Lombardia**: Mezzanella-Rive del Ticino, 1895, *F. Cavara s.n.* (PAV-Erbario Lombardo!); Rive del Ticino a Pavia, 1895, *F. Cavara 7923* (RO [image!]).

Protologue citation:—"In paludosis ad ripas Fluminis Ticini. Mezzana prope Papiam." "La osservai poco lungi da Pavia e precisamente lungo un tratto della riva sinistra del Ticino compreso tra le Frazioni Mezzana e Mombolone, sotto S. Pietro in Verzolo.".

Typification notes:—Four specimens were discovered at PAV and RO, collected by Fridiano Cavara (1857–1929). All these specimens can be considered original material. We designate the specimen at RO as the lectotype, since the data on its label completely match the protologue citation. According to Art. 60.6 of the ICN (McNeill *et al*. 2012), the varietal epithet, mentioned in the protologue as "*Böckeleri*" [dedicated to Johann Otto Böckeler (1803–1899), German apothecary at Varel in Oldenburg, see Stafleau & Cowans 1976: 246], is to be written with the diphthong "oe", which replaces the letter "ö", as correctly did Cavara on the labels of the lectotype and the other specimen from Mezzana.

= ***Cyperus squarrosus*** Linnaeus (1756: 6). Type (lectotype designated by Kern 1960: 642)**:**—INDIA. *Habitat in India*, s.d., Herb. Linn. 70.8, right specimen (LINN image! available at: http://linnean-online.org/359/).

Chorology and invasiveness status:—*Cyperus squarrosus* is a cosmopolite species, native to Americas, Asia, Africa, and Oceania, and naturalized in Europe (Verloove 2014). It was first discovered in the European continent by Cavara (1899) along the river Ticino near Pavia (Banfi & Galasso 2010). Currently, outside its native range, it is distributed in northern Italy (Celesti-Grapow *et al*. 2009, Banfi & Galasso 2010, Masin & Scortegagna 2012), and Croatia (Rottensteiner 2014). According to Cavara (1899), the plant was probably introduced as a rice impurity; actually it occurs mostly on temporarily wet, sandy exposed river banks.

Panicum erectum Pollacci (1914: 228)

Type (lectotype designated here)**:**—ITALY. **Lombardia**: Presso Pavia, October 1907, *G. Pollacci s.n.* (PAV-Erbario Lombardo "118"! isolectotypes PAV-Erbario Lombardo "124"!, "141"!, "123"!, "137" -2 sheets-!, "139"!, "140"!) (Fig. 2).

Additional specimens examined:—ITALY. **Lombardia**: Piante raccolte nelle risaie del Pavese verso il 1900, per la tipizzazione di *P. erectum* Pollacci, [ca. 1900], [*G. Pollacci*] (PAV-Erbario Lombardo "107" -3 sheets-!, "108" -2 of 3 sheets-!); Piante raccolte verso il 1900 per la tipizzazione di *Panicum erectum* Pollacci, [ca. 1900], [*G. Pollacci*] (PAV-Erbario Lombardo "116" -1 of 3 sheets-!); Piante raccolte verso il principio del XX° secolo per la tipizzazione della specie, [early 20th century], [*G. Pollacci*] (PAV-Erbario Lombardo "119" -2 sheets-!).

Protologue citation:—"In agris *Oryza sativa* cultis, prope Papiam (Italia)." "Tale pianta la raccolsi poco lungi da Pavia e precisamente in risaie appartenenti alla Cascina Campomaggiore (riva destra del Ticino) condotta dai signori Livraga, distinti agricoltori di questa zona agricola. [...] Questa nuova pianta io l'ho raccolta solo in due campi [...].".

Typification notes:—Thirteen specimens identified as "*Panicum erectum* Pollacci" and allegedly collected by Gino Pollacci (1872–1963) were discovered at PAV-Erbario Lombardo. Five specimens are composed by more than one sheet and each specimen bears a number handwritten in pencil on the upper left angle of the first or unique sheet; this number neither represents a univocal identification code of the specimens nor the collector number, but only a progressive numeration for the specimens within a genus, in this case *Panicum* Linnaeus (1753: 55) (including *Echinochloa* P.Beauv.). Since these numbers are the unique tool available to identify the *exsiccata* bearing identical labels, they have been transcribed between quotation marks after the herbarium acronym.

FIGURE 2. Lectotype of *Panicum erectum* (PAV-Erbario Lombardo).

All the specimens match Pollacci's morphological description, with some exceptions: the *exsiccatum* numbered "136" (1 sheet) actually belongs to *Echinochloa oryzoides* (Arduino) Fritsch (1891: 742) as the individual on the third sheet of the specimen "116". The identification of the plants pinned on the third sheet of the specimen "108", on the second sheet of "116", and on the unique sheet of "138" is not practicable for the lack of inflorescences. The remaining sheets, for a total of eleven specimens, can be positively assigned to *Panicum erectum* and thus they are regarded as original material.

All the specimens feature unawned lower lemmas, with the exception of "107" (first and second sheets) and "108" (second sheet): the plants mounted on these three sheets correspond to "forma aristata", while the other specimens to "forma mutica" mentioned by Pollacci (1914: 228). Pollacci's conception of "forma" does not correspond to the homonymous secondary rank taken into account by Art. 4.1 of the ICN (McNeill *et al*. 2012). Actually, Pollacci's "forma" represents an informal descriptive term with no nomenclatural significance, employed to distinguish awned and unawned individuals as extremes within the variability of the species. The words "forma mutica" and "forma aristata", in fact, do not match the grammatical gender of *Panicum erectum,* sounding more as the homonymous Italian words (they are not italicised); moreover, they are used in the same way on page 227, to explain the variability of *Echinochloa crus-galli* (Linnaeus 1753: 56) Palisot de Beauvois (1812: 53).

The identity of five specimens ("107", "108", "119", "123", "124") was confirmed by Peter W. Michael, who correctly revised them (on 22 March 1978) as *Echinochloa crus-galli* subsp. *hispidula* (Retzius 1789: 18) Honda (1930: 267). Additionally, he suggested "123" as the possible lectotype of *P. erectum* by writing on a separate label the following sentence: "I think that this specimen should be designated lectotype of Pollacci's *Panicum erectum*". However, he did not proceed with a formal designation in his subsequent conference paper regarding the taxonomy of *Echinochloa*, but simply mentioned the "type collection" of *Panicum erectum* "from rice fields in Italy", without any reference to the location of the specimens (Michael 1983: 301). The *exsiccatum* numbered "123" belongs to a group of seven specimens ("118", "123", "124", "137", "139", "140", "141") bearing a label handwritten by Pollacci himself [the calligraphy has been confirmed by comparison with the signed portaits available from Biblioteca dell'Orto Botanico di Padova (2014) and the one exhibited at the Botanical Garden of the University of Pavia], only three of which ("118", "124", "141") are signed. The remaining four *exsiccata* ("107", "108", "116", only the first sheet, and "119") display typewritten labels, probably authored by Sandro Pignatti in the early 1950's, without a precise collecting date and explicit reference to the collector. Among these, we select "118" as the lectotype of *P. erectum*, since the specimen exhibits a well-developed inflorescence and Pollacci's signature.

= ***Echinochloa hispidula*** (Retzius 1789: 18) Nees in Royle (1840: 416). Type**:**—"*India Orientali*", no date, *F.G. König s.n.* (holotype, LD).

Chorology and invasiveness status:—*Echinochloa hispidula* is a species probably originated in south-eastern Asia; it is widespread in tropical and temperate areas of Asia, Africa, America, and Australia (Costea & Tardif 2002). In Europe, it is naturalized in the western (France) and southern countries (Greece, Italy, Portugal, and Spain), where it occurs mostly as a weed of rice fields (Costea & Tardif 2002, Celesti-Grapow *et al.* 2009, Banfi & Galasso 2010, Euro+Med 2006–2014).

Scirpus erraticus Rota ex De Notaris (1845: 20)

Type (neotype designated here)**:**—ITALY. **Lombardia**: Lungo il Ticino, June [without year], [*L. Rota*] (PAV-Erbario Lombardo!). (Fig. 3).

Protologue citation:—"Habui semina, speciminaque in pascuis secus Ticinum lecta Cl. inventore.".

Typification notes:—Giuseppe De Notaris (1805–1877) apparently described *Scirpus erraticus* on the basis of specimens he obtained from Lorenzo Rota (1818–1855) (De Notaris 1845). However, no specimens from De Notaris' collections have been traced at GDOR, GE, and RO. Instead, four different specimens collected by Rota and identified by him as "*Scirpus erraticus* Rota" were discovered at BER-Rota, FI, PAV-Erbario Lombardo, and RO-Cesati.

After searches at GE, GDOR, and RO, no specimens with elements evidencing a direct examination by De Notaris (such as signature or handwritten labels) has been detected. Therefore, no De Notaris' original material is available and neotypification is chosen against lectotypification, in accordance with Arts. 9.7 and 9.16 of the ICN (McNeill *et al.* 2012), by using Rota's specimens. We select the specimen stored at PAV-Erbario Lombardo as the neotype of *Scirpus erraticus*.

= ***Eleocharis atropurpurea*** (Retzius 1789: 14) J.Presl & C.Presl in Presl (1828: 196). Type**:**—"In humidiusculis uliginosis Indiae crescit", s.d., *F.G. König s.n.* (holotype, LD).

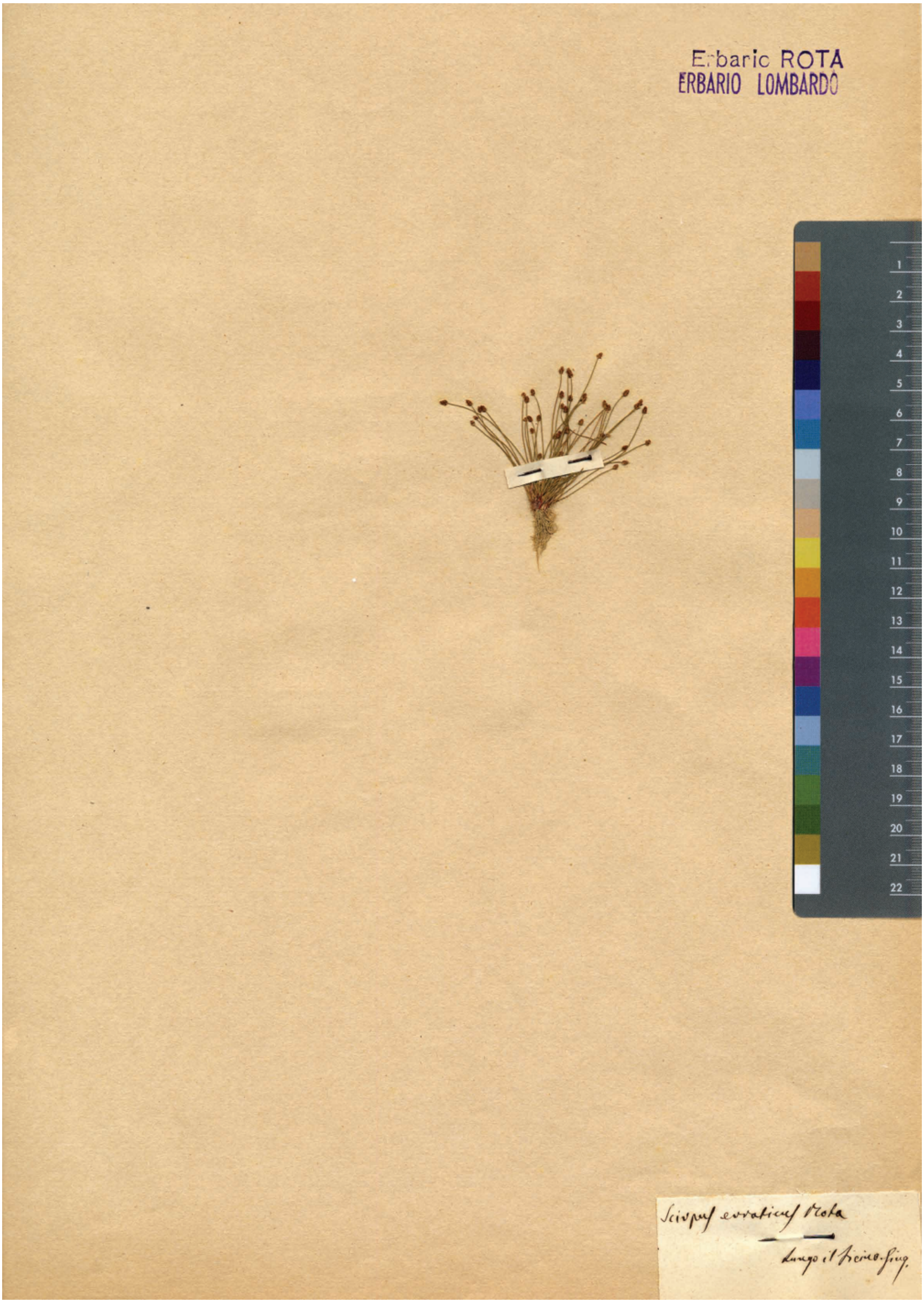

FIGURE 3. Neotype of *Scirpus erraticus* (PAV-Erbario Lombardo).

Chorology and invasiveness status:—*Eleocharis atropurpurea* is a pantropical and substropical species, distributed in Sub-Saharan Africa, Middle East, Asia, Australia, and America (Kumar 2014). In Europe, it is naturalized in Italy, and Switzerland, where it occurs mostly on temporarily wet, sandy exposed river banks (Banfi & Galasso 2010, Celesti-Grapow *et al*. 2009, Euro+Med 2006–2014, Kumar 2014).

Acknowledgments

The authors are grateful to Chiara Nepi and Egildo Luccioli (FI), Francesco Zonca (BER), Maria Tavano (GDOR), Simonetta Peccenini (GE), Mauro Iberite, and Agnese Tilia (RO) for sending digital images of some *exsiccata* of our interest. The authors are also indebted with Giulia Ardenghi (Stradella, Pavia), for the valuable graphic assistance in the digital image preparation.

References

Arduino, P. (1764) *Animadversionum botanicarum specimen alterum.* Ex Typographia Sansoniana, Venetia, 42 pp.

Banfi, E. & Galasso, G. (2010) *La flora esotica lombarda*. Museo di Storia Naturale di Milano, Milano, 274 pp. + CD-ROM.

Biblioteca dell'Orto Botanico di Padova (2014) *Iconoteca dei Botanici*. Biblioteca dell'Orto Botanico, Università degli Studi di Padova. Available from: http://www.bibliorto.cab.unipd.it/in-biblioteca/iconoteca-botanici (accessed 3 November 2014)

Brown, R. (1810) *Prodromus florae Novae Hollandiae*, 1. J. Johnson & Co., London, pp. 145–590.

Cavara, F. (1894) Nuova stazione della *Solidago serotina* Ait. *Malpighia* 8: 94–95.

Cavara, F. (1899) Di una Ciperacea nuova per la Flora europea (*Cyperus aristatus* Rottb. var. *Böckeleri* Cav.). *Atti dell'Istituto Botanico dell'Università di Pavia*, ser. 2 (5): 23–28.

Celesti-Grapow, L., Pretto, F., Brundu, G., Carli, E. & Blasi, C. (Eds.) (2009) *A thematic contribution to the National Biodiversity Strategy. Plant invasion in Italy, an overview*. Ministry for the Environment Land and Sea Protection, Nature Protection Directorate, Roma, 32 pp. + CD-ROM.

Chaudoir, M. (1876) Etude monographique des Masoréides, des Tetragonodérides et du genre *Nematotarsus*. *Bulletin de la Societé Impériale des Naturalistes de Moscow* 51: 1–84.

Chiovenda, E. (1928) Una nuova specie di "Impatiens,, spontaneizzata nell'Italia settentrionale. *Nuovo Giornale Botanico Italiano*, n. ser. 34: 1049–1056.

Costea, M. & Tardif, F.J. (2002) Taxonomy of the most common weedy european *Echinochloa* species (Poaceae: Panicoideae) with special emphasis on characters of the lemma and caryopsis. *Sida, Contributions to Botany* 20: 525–548.

De Notaris, G. (1845) *Index Seminum regii horti botanici Genuensis an. 1845*. Regio Horto Botanico Genuensis, Genuae, 20 pp.

Euro+Med (2006–2014) *Euro+Med PlantBase - the information resource for Euro-Mediterranean plant diversity*. Botanic Garden and Botanical Museum Berlin-Dahlem. Available from: http://ww2.bgbm.org/EuroPlusMed/ (accessed 4 November 2014)

Fritsch, C. (1891) Beiträge zur Flora von Salzburg. III. *Verhandlungen der kaiserlich-königlichen zoologisch-botanischen Gesellschaft in Wien* 41: 741–750.

Honda, M. (1930) Monographia poacearum Japonicarum, Bambusoideis exclusis. *Journal of the Faculty of Science, University of Tokyo. Section 3, botany* 3: 1–484.

Kern, J.H. (1960) Florae Malesianae precursores 25. Notes on Malaysian and some SE Asian Cyperaceae 8. *Blumea* 10: 635–651.

Kumar, B. (2014) *Eleocharis atropurpurea*. *In: The IUCN Red List of Threatened Species*. Version 2014.2. Available from: http://www.iucnredlist.org (accessed 4 November 2014)

Linnaeus, C. (1753) *Species Plantarum* 1. L. Salvius, Stockholm, 560 pp.

Linnaeus, C. (1756) *D. D. Centuria II. plantarum.* Excud. L.M. Höjer, Reg. Acad. Typogr., Upsaliae, 33 pp.

Masin, R. & Scortegagna, S. (2012) Flora alloctona del Veneto centro-meridionale (province di Padova, Rovigo, Venezia e Vicenza - Veneto - NE Italia). *Natura Vicentina* 15 (2011): 5–54.

McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Prud'Homme van Reine, W.F., Smith, G.F., Wiersema, J.H. & Turland, N.J. (Eds.) (2012) International Code of Nomenclature for algae, fungi, and plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011. *Regnum Vegetabile* 154, 208 pp.

Michael, P.W. (1983) Taxonomy and distribution of *Echinochloa* species with special reference to their occurrence as weeds of rice. *Proceedings of the Conference on Weed Control in Rice, Los Baños, Philippines, 31 August–4 September 1981*: 291–306.

Moretti, G. (1822) De quibusdam Plantis Italiae. Decas Quinta. *Giornale di fisica, chimica, storia naturale, medicina, ed arti*, ser. 2 (5):

321–326.

Palisot de Beauvois, A.M.F.J. (1812) *Essai d'une nouvelle agrostographie ou nouveaux genres de Graminées*. Fain, Paris, 182 pp.

Pollacci, G. (1914) Su una Graminacea nuova, infestante del riso (*Panicum erectum* n. sp.). *Atti dell'Istituto Botanico dell'Università di Pavia*, ser. 2 (13): 223–230.

Pollini, C. (1814) *Catalogo delle piante dell'orto botanico veronese per l'anno 1814 con un cenno di varie piante nuove*. Tipografia Mainardi, Verona, 34 pp.

Presl, C.B. (1828) *Reliquiae haenkeanae* 1. Apud J.G. Calve bibliopolam, Pragae, 356 pp.

Retzius, A.J. (1789) *Observationes Botanicae* 5. Apud Siegfried Lebrecht Crusium, Lipsiae, 32 pp.

Rottbøll, C.F. (1772) *Descriptiones plantarum rariorum*. Litteris N. Mölleri, Reg. Maj. Typogr. Auligi, Havniæ, 32 pp.

Rottensteiner, W.K. (2014) Beiträge zur Flora von Istrien IV: Neue und seltene Taxa für Istrien, Kroatien und Slowenien. *Fritschiana* 77: 1–61.

Royle, J.F. (1840) *Illustrations of the botany of the Himalayan Mountains* 1 (11). Wm.H. Alland and Co., London, pp. 385–472.

Stafleau, F.A. & Cowans, R.S. (1976) *Taxonomic literature*. *Second edition. Volume 1: A–G*. Bohn, Scheltema & Holkema, Utrecht, 1136 pp.

Thiers, B. (2015) [continuously updated] *Index herbariorum: a global directory of public herbaria and associated staff*. New York Botanical Garden. Available from: http://sweetgum.nybg.org/ih/ (accessed 3 November 2014)

Verloove, F. (2010) Studies in Italian Cyperaceae 1. *Eleocharis pellucida*, new to Europe, naturalised in Piemonte (Italy). *Webbia* 65: 133–140.
http://dx.doi.org/10.1080/00837792.2010.10670868

Verloove, F. (2014) A conspectus of *Cyperus* s.l. (Cyperaceae) in Europe (incl. Azores, Madeira and Canary Islands), with emphasis on non-native naturalized species. *Webbia* 69: 179–223.
http://dx.doi.org/10.1080/00837792.2014.975013

Phytotaxa 236 (3): 283–286
www.mapress.com/phytotaxa/

Correspondence

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

http://dx.doi.org/10.11646/phytotaxa.236.3.10

Typification of the Linnaean name *Bignonia peruviana* (Vitaceae)

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Vitaceae Juss. is a family of 15 genera and about 750 species mainly distributed in tropical regions of Asia, Africa, Australia, the neotropics, and the Pacific islands, with a few genera [*Vitis* Linnaeus (1753: 202), *Parthenocissus* Planchon [1887: 447(–448)], *Ampelopsis* Michaux (1803: 159), and *Nekemias* Rafinesque (1838: 87)] occurring in temperate regions (APGIII 2009, Wen 2007, Wen *et al.* 2014). The family is well known for its economical importance since several species, especially *Vitis vinifera* Linnaeus (1753: 202) and several artificial hybrids of *Vitis*, are important sources of grapes, wine, and raisins (Ardenghi *et al.* 2014). *Bignonia peruviana* Linnaeus (1753: 625), one of the 19 Vitaceae names published by Carl Linnaeus (see Jarvis 2007) appears to be yet untypified, and is here investigated as part of ongoing studies on: (1) Linnaean types (by D. Iamonico, see e.g., Ferrer-Gallego *et al.* 2014, Iamonico 2014a, 2014b, 2014c, Iamonico *et al.* 2014, 2015, Sukhorukov *et al.* 2014); (2) the genus *Vitis* in Italy (by N.M.G. Ardenghi, E. Banfi, and G. Galasso, see e.g. Ardenghi *et al.* 2014, 2015a, 2015b); (3) the Neotropical Vitaceae (by J. Lombardi, see e.g., Lombardi 1995, 1997, 2000, Rodrigues *et al.* 2014); and (4) the Bignoniaceae (by L.G. Lohmann, see e.g., Lohmann *et al.* 2013, Lohmann & Taylor 2014, Fonseca *et al.* 2015, Medeiros & Lohmann 2015, Zuntini *et al.* 2014).

The Linnaean protologue (Linnaeus 1753: 625) consisted of a short diagnosis ("*BIGNONIA foliis decompositis: foliolis incisis, geniculis cirrhosis*"), the first part of which was taken directly from Linnaeus (1738: 317), and synonyms by Royen (1740: 290), Plumier (1703: 5), and Plukenet (1692: pl. 162 fig. 4; 1696: 108) were cited. Linnaeus (1738: 317) originally reported the provenance of *Bignonia peruviana* as "*Crescit in America*", and subsequently as "*Habitat in Peru*" (1753: 625).

Plukenet (1692, 1696) provided an iconography that is original material for the name *Bignonia peruviana*. In the Clifford Herbarium at BM, there is one sheet ("*Bignonia 5*" barcode BM000646173) that includes the Clifford phrase "*Bignonia americana arbor, flore luteo, fraxini folio*" which is linked to Plumier's synonym cited by Linnaeus (1753). This sheet represents original material. No other original material was located at any other Linnaean or Linnaean-linked herbaria (see Jarvis 2007).

The illustration by Plukenet matches the Linnaean diagnosis partially as it shows composite leaves with incised margins ("*foliis decompositis: foliolis incisis* [...]"), but lacks tendrils at nodes ("*geniculis cirrhosis*"). This illustration, therefore, seems to disagree from the diagnosis and we prefer to avoid it for typification purposes. On the other hand, the Clifford specimen perfectly matches the diagnosis of Linnaeus and is here designated as the lectotype of the name *Bignonia peruviana*.

The Clifford specimen is characterized by the following traits: liana habit; stem glabrous; stipulate, alternate, bipinnate leaves; leaflets ovate with margins dentate to incised, base attenuate, apex acute, abaxially sparsely pubescent; tendrils opposite to leaves. The specimen shows two very young inflorescence buds, showing the little flowers characteristic of Vitaceae. Another important character recovered from Clifford's specimen is the opposite position of tendrils that is so typical of members of the family Vitaceae. Among the Neotropical Vitaceae, the only species that shows a leaf that resembles that of *Bignonia peruviana* is *Nekemias arborea* (L.) J.Wen & Boggan in Wen *et al.* (2014: 13, see e.g., Lombardi, 2000). A detailed comparison of Clifford's specimen with the type of *Vitis arborea* Linnaeus (1753: 203) [an image by Plukenet (1705: pl. 412 fig. 2, "*Frutex scandens Petroselini foliis Virginianus, claviculis donatus*") designated by J. Reveal in Jarvis (2007: 925)] further indicates that the Clifford specimen at BM indeed represents *Nekemias arborea*.

Accepted by Anna Trias-Blasi: 7 Nov. 2015; published: 1 Dec. 2015

However, the provenance of *Bignonia peruviana* ("*Habitat in Peru*", according to the protologue) is incongruent with the current distribution of *Nekemias arborea*, which is only known from North America and Mexico (see Lombardi 2000: 25), and originally described by Linnaeus (1753: 203) as being restricted to portions of North America ("*Habitat in Carolina, Virginia*"). Therefore, the "*Peru*" element was probably taken by Linnaeus from the polynomial "*Clematis peruviana…*" by Plukenet (1696: 108) (C. Jarvis, pers. comm.). Unfortunately, there seems to be no corresponding voucher material among Plukenet's specimens in the Sloane herbarium (see http://www.nhm.ac.uk/research-curation/scientific-resources/collections/botanical-collections/sloane-herbarium/database/index.dsml). Therefore, the epithet "*peruviana*" appears to be inappropriate (C. Jarvis, pers. comm.).

All things stated, the synonymization of the name *Bignonia peruviana* with *Vitis arborea* is here proposed. Since both names were published in the same year (1753) the Art. 11.5 of the ICN is to be applied (McNeill *et al.* 2012). Jarvis (2007), the first author to unite both names, chose the name *Vitis arborea*, which deserves priority.

Nekemias arborea (L.) J.Wen & Boggan in Wen *et al.* (2014: 13).

Basionym: *Vitis arborea* Linnaeus (1753: 203) ≡ *Hedera arborea* (L.) Walter (1788: 102) ≡ *Ampelopsis bipinnata* Michaux (1803: 160), *nom. illeg.* (Art. 52.1 of the ICN) ≡ *Cissus stans* Persoon (1805: 143), *nom. nov.*, non *Cissus arborea* Forsskål (1775: 32) ≡ *Cissus bipinnata* Nuttall (1818: 144), *nom. illeg.* (Art. 52.1 of the ICN) ≡ *Vitis bipinnata* Torrey & A.Gray (1838: 243), *nom. illeg.* (Art. 52.1 of the ICN) ≡ *Nekemias bipinnata* Rafinesque (1838: 87), *nom. illeg.* (Art. 52.1 of the ICN) ≡ *Cissus arborea* (L.) Des Moulins in Durand (1862: 156), *nom. illeg.* (Art. 53.1 of the ICN), non Forsskål (1775: 32) nec Blanco (1845: 51) ≡ *Ampelopsis arborea* (L.) Koehne (1893: 400) ≡ *Ampelopsis arborea* (L.) Rusby in Britton *et al.* (1894: 221), isonym (Art. 6 Note 2 of the ICN).

Type (lectotype designated by Reveal in Jarvis 2007: 925): [icon] *Frutex scandens Petroselini foliis Virginianus, claviculis donatus*" in Plukenet (1705: pl. 412 fig. 2). [Image of lectotype available at http://bibdigital.rjb.csic.es/ing/Libro.php?Libro=4820&Hojas=].

= *Bignonia peruviana* Linnaeus (1753: 625).

Type (lectotype designated here): Herb. Clifford: 317, *Bignonia* 5 (BM-000646173 [digital image]!). [Image of lectotype available at http://www.nhm.ac.uk/resources/research-curation/projects/clifford-herbarium/lgimages/BM000646173.JPG].

Acknowledgements

The authors are grateful to G. Thijsse (National Herbarium Nederland, Leiden University) for the information provided about the van Royen Herbarium, and to C. E. Jarvis (Natural History Museum, London) and A. R. Zuntini (Universidade de São Paulo) for useful discussions about the Linnaean references and specific epithet.

References

APG III (2009) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. *Botanical Journal of the Linnean Society* 161: 105–121.
http://dx.doi.org/10.1111/j.1095-8339.2009.00996.x

Ardenghi, N.M.G., Galasso, G., Banfi, E., Zoccola, A. & Lastrucci, L. (2014) A taxonomic survey of the genus *Vitis* L. (Vitaceae) in Italy, with special reference to Elba Island (Tuscan Archipelago). *Phytotaxa* 166 (3): 163–198.
http://dx.doi.org/10.11646/phytotaxa.166.3.1

Ardenghi, N.M.G., Galasso, G., Banfi, E. & Cauzzi, P. (2015a) *Vitis* ×*novae-angliae* (*Vitaceae*): systematics, distribution and history of an "illegal" alien grape in Europe. *Willdenowia* 45: 197–207.
http://dx.doi.org/10.3372/wi.45.45206

Ardenghi, N.M.G., Banfi, E. & Galasso, G. (2015b) A taxonomic survey of the genus *Vitis* L. (Vitaceae) in Italy, part II: the 'Euro-American' hybrids. *Phytotaxa* 224 (3): 232–246.
http://dx.doi.org/10.11646/phytotaxa.224.3.2

Blanco, F.M. (1845) *Flora de Filipinas*. D. Miguel Sanchez, Manila, 619 pp.

Britton, N.L., Coulter, J.M., Rusby, H.H., Kellermann, W.A., Coville, F.W., Underwood, L.M. & Ward, L.F. (1894) List of Pteridophyta and Spermatophyta growing without cultivation in Northeastern North merica. *Memoirs of the Torrey Botanical Club* 5: 1−377.

Durand, M.E. (1862) Vites Boreali-Americanae. *Actes de la Société linnéenne de Bordeaux* 24: 156−176.

Ferrer-Gallego, P.P., Iamonico, D., Iberite, M., Laguna, E. & Crespo, M.B. (2014) Lectotypification of two names in *Limoniastrum* (Plumbaginaceae). *Taxon* 63: 1342−1346.
http://dx.doi.org/10.12705/636.4

Fonseca, L.H.M., Cabral, S.M., Agra, M.F. de & Lohmann, L.G. (2015) Taxonomic updates in *Dolichandra* Cham. (Bignonieae, Bignoniaceae). *Phytokeys* 46: 35−43.
http://dx.doi.org/10.3897/phytokeys.46.8421

Forsskål, P. (1775) *Flora Aegyptiaco-Arabica*. E Officina Mölleri, Hauniae, 220 pp.

Iamonico, D. (2014a) *Amaranthus gangeticus* (Amaranthaceae), a name *incertae sedis*. *Phytotaxa* 162 (5): 299−300.
http://dx.doi.org/10.11646/phytotaxa.162.5.2

Iamonico, D. (2014b) Lectotypification of the Linnaean name *Marchantia cruciata* L. (Lunulariaceae). *Journal of Bryology* 36: 253−254.
http://dx.doi.org/10.1179/1743282014Y.0000000107

Iamonico, D. (2014c) *Arenaria tenuifolia* versus *Arenaria hybrida* (Caryophyllaceae): Nomenclatural study and taxonomic implications. *Phytotaxa* 173 (3): 235−240.
http://dx.doi.org/10.11646/phytotaxa.173.3.6

Iamonico, D., McKenzie, R.J. & Barker, N.P. (2014) (2281) Proposal to reject the name *Arnica coronopifolia* (Asteraceae). *Taxon* 63 (2): 436−437.
http://dx.doi.org/10.12705/632.29

Iamonico, D., Galasso, G., Banfi, E. & Ardenghi, N.M.G. (2015) Typification of Linnaean names in the genus *Vitis* L. (Vitaceae). *Taxon* 64: 1048–1050.
http://dx.doi.org/10.12705/645.17

Jarvis, C. (2007) *Order out of Chaos; Linnaean Plant Names and their Types*. Linnean Society of London and the Natural History Museum, London, 1017 pp.

Koehne, B.A.E. (1893) *Deutsche Dendrologie*. Verlag von Ferdinand Enke, Stuttgart, 602 pp.

Linnaeus, C. (1738) *Hortus cliffortianus*. Salomonem Schouten, Amsterdam, 518 pp.

Linnaeus, C. (1753) *Species plantarum*, vols. 1−2. Laurentii Salvius, Stockholm, 899 pp.

Lohmann, L.G. & Taylor, C.M. (2014) A new generic classification of tribe Bignonieae (Bignoniaceae). *Annals of the Missouri Botanical Garden* 99: 348−489.
http://dx.doi.org/10.3417/2003187

Lohmann, L.G., Bell, C., Calió, M.F. & Winkworth, R.C. (2013) Pattern and timing of Biogeographic history in the neotropical tribe Bignonieae (Bignoniaceae). *Botanical Journal of the Linnean Society* 171: 154−170.
http://dx.doi.org/10.1111/j.1095-8339.2012.01311.x

Lombardi, J.A. (1995) Typification of names of South American *Cissus* (Vitaceae). *Taxon* 44: 193−206.
http://dx.doi.org/10.2307/1222442

Lombardi, J.A. (1997) Types of names in *Ampelocissus* and *Cissus* (Vitaceae) referring to taxa in the Caribbean, Central and N. America. *Taxon* 46: 423−432.
http://dx.doi.org/10.2307/1224385

Lombardi, J.A. (2000) Vitaceae: Gêneros *Ampelocissus*, *Ampelopsis* e *Cissus*. *In: Flora Neotropica Monographs*, vol. 80. Botanical Garden Press, New York, 250 pp.

McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Proud'Homme van Reine, W.F., Smith, J.F. & Wiersema, J.H. (Eds.) (2012) International Code of Nomenclature for algae, fungi and plants (Melbourne Code): Adopted by the Eichteenth International Botanical Congress, Melbourne, Australia, July 2011. *Regnum Vegetabile* 154: 1–274.

Medeiros, M.C.M.P. de & Lohmann, L.G. (2015) Taxonomic revision of *Tynanthus* (Bignonieae, Bignoniaceae). *Phytotaxa* 216 (1): 1–60.
http://dx.doi.org/10.11646/phytotaxa.216.1.1

Michaux, A. (1803) *Flora Boreali-Americana*, vol. 1. Typis Caroli Crapelet, Parisiis & Argentorati, 330 pp.

Nuttall, T. (1818) *The Genera of North American Plants and a catalogue of the species*, vol. 1. Printed by the author, Philadelphia, 312 pp.

Persoon, C.H. (1805) *Synopsis Plantarum*. Crol. Frid. Camerum. & J. G. Cottam, Parisiis & Tubingae, 546 pp.

Planchon, J.E. (1887) *Parthenocissus*. *In:* Candolle, A. de (Ed.) *Monographiae Phanerogamarum Prodromi nunc continuatio, nunc revisio*, vol. 5. Sumptibus G. Masson, Parisiis, pp. 447−453.

Plukenet, L. (1692) *Phytographia*, vol. 3. Printed by the author, London, without pagination.

Plukenet, L. (1696) *Almagestum botanicum sive phytografie Plukenetianae onomasticon*. Published by the author, London, 402 pp.

Plukenet, L. (1705) *Amaltheum Botanicum*. Published by the author, London, 214 pp.

Plumier, C. (1703) *Nova plantarum Americanarum genera*. Viduam & Filium S. Schoutem, Lugduni Batavorum, 22 pp.
http://dx.doi.org/10.5962/bhl.title.59135

Rafinesque, A.M. (1838) *Sylva Telluriana*. Printed by the author, Philadelphia, 184 pp.

Rodrigues, J.G., Lombardi, J.A. & Lovato, M.B. (2014) Phylogeny of *Cissus* (Vitaceae) focusing on South American species. *Taxon* 63: 287−298.
http://dx.doi.org/10.12705/632.33

Royen, A. (1740) *Florae Leydensis prodromus*. Apud Samuelem Luchtmans Lugduni Batavorum, 538 pp.

Sukhorukov, A.P., Iamonico, D. & Jarvis, C.E. (2014) The typification of *Anabasis foliosa* L. (Chenopodiaceae) revisited. *Taxon* 63: 929.
http://dx.doi.org/10.12705/634.16

Torrey, J. & Gray, A. (1838) *A Flora of North America: containing abridged descriptions of all the known indigenous and naturalized plants growing north of Mexico*, vol. 1(1). Wiley & Putnam, New York, 711 pp.

Walter, T. (1788) *Flora caroliniana*. Sumptibus J. Fraser, Londini, 263 pp.

Wen, J. (2007) Vitaceae Juss. *In:* Kubitzki, K. (Ed.) *The Families and Genera of Vascular Plants*, vol. 9. Springer, Berlin, Heidelberg, pp. 467–479.
http://dx.doi.org/10.1007/978-3-540-32219-1_54

Wen, J., Boggan, J. & Nie, Z.-L. (2014) Synopsis of *Nekemias* Raf., a segregate genus from *Ampelopsis* Michx. (Vitaceae) disjunct between eastern/southeastern Asia and eastern North America, with ten new combinations. *PhytoKeys* 42: 11–19.
http://dx.doi.org/10.3897/phytokeys.42.7704

Zuntini, A.R., Taylor, C.M. & Lohmann, L.G. (2014) (2334) Proposal to conserve the name *Bignonia magnifica* (Bignoniaceae) with a conserved type. *Taxon* 63: 1376−1377.
http://dx.doi.org/10.12705/636.25

Typification of Linnaean names in the genus *Vitis* (Vitaceae)

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DOI http://dx.doi.org/10.12705/645.17

Abstract The typification of the Linnaean names *Vitis laciniosa* and *V. vinifera* var. *apyrena* is discussed. The names are lecto- and neotypified, respectively, using specimens from LINN.

Keywords lectotype; Mediterranean; neotype; nomenclature; *Vitis laciniosa*; *Vitis vinifera*

■ INTRODUCTION

Vitis L. is a genus of about 60 species, mainly distributed in the Northern Hemisphere (Ren & Wen, 2007; Wen, 2007). Among these, *V. vinifera* L. has played a significant role in human culture. Domesticated since the Chalcolithic, numerous cultivars of *V. vinifera* were developed for wine and fruit production. Linnaeus (1753, 1771) published nine names under *Vitis*, of which four are currently placed in other genera (see Jarvis, 2007: 925–926). Two names appear to be yet untypified and are here investigated as part of the studies carried out by the authors on nomenclature of *Vitis* (see Ardenghi & al., 2014) and Linnaean names (by D. Iamonico, see, e.g., Iamonico & Jarvis, 2012a, b; Iamonico, 2013, 2014a, b; Di Pietro & Iamonico, 2014; Ferrer-Gallego & al., 2014; Iamonico & Iberite, 2014; Iamonico & Peruzzi, 2014; Iamonico & Sánchez Del Pino, 2014; Iamonico & al., 2014; Sukhorukov & al., 2014; Iamonico & Hjertson, 2015).

■ TYPIFICATIONS

Vitis laciniosa

Linnaeus's protologue of *Vitis laciniosa* (Linnaeus, 1753: 203) consists of a short diagnosis ("VITIS foliis quinatis: foliolis multifidis") taken from Linnaeus (1738: 74) and Royen (1740: 223), plus two synonyms cited from Cornut (1635: 182) and Bauhin & Cherler (1651: 73). No provenance was given. Both Cornut, and Bauhin & Cherler provided iconographies ("*t.* 183", and "Vitis apii folio" ["Vitis folio apii" in Bauhin & Cherler], respectively) that are original material.

In the Clifford Herbarium at BM there is one sheet (barcode 000558135, image available at http://www.nhm.ac.uk/resources/research-curation/projects/clifford-herbarium/lgimages/BM000558135.JPG) that bears one plant whose features match the Linnaean diagnosis. There is another sheet at the Herbarium Burser at UPS (XVII: 32) with the original annotation "*Vitis apii folia Ioh. Bauh.*" that corresponds to the Linnaean synonym from Bauhin & Cherler (1651). This specimen is also taken as original material for the name *V. laciniosa*, although it is not cited by Jarvis (2007).

We also found one sheet at LINN (no. 281.9) bearing one leaf matching the diagnosis by Linnaeus (1753: 203) and featuring the Linnaean annotation "*6 laciniosa*". Since "*6*" corresponds to the *Species plantarum* number of *Vitis laciniosa*, the sheet no. 281.9 can be considered an ante-1753 addition to the collection and thus original material for the name (Jarvis, 2007: 46–47). Jarvis (2007) cited the Linnaean sheet no. 281.6 (*V. labrusca* L., image available at http://linnean-online.org/2855/) as original material. However, this was an error, the sheet number and species number being switched (C.E. Jarvis, pers. comm.).

No specimens linked to the Royen synonym were found at L. We also did not locate any further original material in any other Linnaean or Linnaean-linked herbaria (see also Jarvis, 2007).

All the original elements identified (specimens from Linnaeus, Burser and Clifford Herbaria; images by Cornut, and Bauhin & Cherler) match Linnaeus's diagnosis. For typification, specimens are generally preferred over illustrations because of their potential ability to provide a larger number of additional characters (e.g., micro-morphological, chemical, molecular; see Jarvis, 2007: 21–22). Among the three specimens identified we designate 281.9 as lectotype.

According to Galet (1964: 2985–2987; 1979: 125; 1990: 88), *V. laciniosa* represents a fixed mutation (culton; Hetterscheid & Brandenburg, 1995) of *V. vinifera*, possibly as a consequence of degeneration diseases. This culton is well known in the ampelographic and viticultural fields under the cultivar name 'Chasselas Cioutat'. It is mostly cultivated for ornamental purposes, both for its peculiar foliage (which led Linnaeus to describe a new species), and its lower fruit production

Received: 18 Jul 2014 | returned for (first) revision: 22 Oct 2014 | (last) revision received: 4 Apr 2015 | accepted: 13 May 2015 || publication date(s): online fast track, 30 Sep 2015; in print and online issues, 28 Oct 2015 ||

(Pasquale, 1876: 341; Viala & Vermorel, 1901: 8–10; Galet, 1964: 2987; Vouillamoz & Arnold, 2009).

Vitis laciniosa L., Sp. Pl.: 203. 1753 ≡ *Vitis vinifera* var. *laciniosa* (L.) Fiori, Nuov. Fl. Italia 2: 109. 1925 – **Lectotype (designated here):** Herb. Linn. No. 281.9 (LINN [digital image!]). — Image of lectotype available at http://linnean-online.org/2857/

= ***Vitis vinifera*** L., Sp. Pl.: 202. 1753 – Lectotype (designated by Siddiqi in Jafri & El-Gadi, Fl. Libya 83: 2. 1980): Herb. Linn. No. 281.1 (LINN [digital image!]). — Image of lectotype available at http://linnean-online.org/2850/

Vitis vinifera var. *apyrena*

Linnaeus (1753: 202) published the name *Vitis vinifera* ("VITIS foliis lobatis sinuatis nudis") including the variety "β. *apyrena*" (Bauhin & Cherler, 1651: 72: "*Vitis corinthiaca* f. *apyrena*", without illustration). The name *Vitis vinifera* was lectotypified by Siddiqi (1980: 83) using Herb. Linn. No. 281.1 (LINN; image available at http://linnean-online.org/2850/), this also serving as the type of *Vitis* (designated by Hitchcock, 1929: 135).

At LINN there is one sheet (281.3) bearing two leaf blades and one inflorescence. On this sheet there are two Linnaean annotations, "*Vitis corinthiaca*" (lower edge of the sheet), and "*Madera* [= Madeira]" (below the inflorescence), as well as "*V. vinifera apyrena*" written in Smith's hand. As highlighted by his note, Linnaeus identified the specimen (possibly collected in Madeira) as *V. corinthiaca*, a binomial corresponding to his *V. vinifera* β. *apyrena* (see Linnaeus, 1753: 202); Smith came to the same conclusion, as suggested by his annotation. According to the leaf morphology (shape of leaf blades, basal sinus and teeth), the specimen can be identified as *V. vinifera*, most probably a cultivar as confirmed by the hermaphroditic flowers (see Ardenghi & al., 2014). Unfortunately, this sheet lacks the *Species plantarum* number "1", and it is probably a post-1753 addition to the collection and thus not original material for the name.

Additionally, we found two sheets at UPS (Herb. Burser XVII: 30, and XVII: 31), the first one bearing a terminal part of one plant with four leaves, the second sheet including a single leaf. Burser's annotations are: "*Vitis vinifera Bauh. Weinstock. In Bohemia. Et quidem pro peculiari specie ibi colitur*" (XVII: 30), and "*Alia vitis viniferae species peculiaris. Monspelii in horto Regio.*" (XVII: 31). Unfortunately, these scripts do not match the synonym cited by Linnaeus (1753, "*Vitis corinthiaca* f. *apyrena*"), so we prefer not to consider these specimens as part of the original material.

On the basis of the results of our research, no original material appears to be extant (see also Jarvis, 2007). As a consequence, a neotypification is indicated. We designate 281.3 (LINN) as the neotype of *Vitis vinifera* var. *apyrena* below.

Vitis vinifera var. *apyrena* is taken as a synonym of *V. vinifera*. Even though Galet (1988: 172) stated "*V. apyrena* ou *V. corinthiaca* f. *apyrena* désigne sans ambiguité le Raisin de Corinthe aux grains sans pépins [i.e., cultivar 'Black Corinth']", the lack of well-developed fruits (necessary to establish the occurrence or absence of seeds) does not allow a certain identification of the neotype with this cultivar. Moreover, besides the well-known seedless 'Sultanina' and 'Black Corinth' (Zohary & al., 2012: 121), a large number of additional seedless cultivars exist (typically employed for the production of raisins and fresh grapes), whose identification is allowed mostly by means of the berries' shape and colour (see, e.g., Eynard & Dalmasso, 1990: 245–257). Anyway, the identification of the cultivar represents a task which goes far beyond the scope of this paper.

Vitis vinifera var. *apyrena* L., Sp. Pl.: 202. 1753 ≡ *V. corinthiaca* var. *apyrena* (L.) Raf., Med. Fl. 2: 141. 1830 ≡ *V. corinthiaca* var. *sultana* Raf., Med. Fl. 2: 141. 1830, nom. superfl. et illeg. – **Neotype (designated here):** Herb. Linn. No. 281.3 (LINN [digital image!]). — Image of neotype available at http://linnean-online.org/2852/

= ***Vitis vinifera*** L.

= *Vitis corinthiaca* Raf., Med. Fl. 2: 141. 1830 – Type: not designated.

■ ACKNOWLEDGEMENTS

The authors are grateful to C.E. Jarvis (British Museum Natural History, London) for comments about the Linnaean specimen of *Vitis vinifera* var. *apyrena*, to G. Thijsse (National Herbarium Nederland, Leiden University) for the information provided about the Van Royen Herbarium, and to M. Hjertson (Museum of Evolution, Uppsala) for the images of the Burser Herbarium.

■ LITERATURE CITED

Ardenghi, N.M.G., Galasso, G., Banfi, E., Zoccola, A. & Lastrucci, L. 2014. A taxonomic survey of the genus *Vitis* L. (Vitaceae) in Italy, with special reference to Elba Island (Tuscan Archipelago). *Phytotaxa* 166: 163–198. http://dx.doi.org/10.11646/phytotaxa.166.3.1

Bauhin, J. & Cherler, J.H. 1651. *Historia plantarum*, vol. 2. Ebroduni [Yverdon].

Cornut, I. 1635. *Canadensium plantarum, aliarúmque nondum editarum historia*. Parisiis [Paris]: venundantur apud Simonen le Moyne.

Di Pietro, R. & Iamonico, D. 2014. (2337) Proposal to reject the name *Plantago recurvata* (Plantaginaceae). *Taxon* 63: 1380–1381. http://dx.doi.org/10.12705/636.28

Eynard, I. & Dalmasso, G. 1990. *Viticoltura moderna: Manuale pratico*. Milano: Hoepli.

Ferrer-Gallego, P.P., Iamonico, D., Iberite, M., Laguna, E. & Crespo, M.B. 2014. Lectotypification of two names in *Limoniastrum* (Plumbaginaceae). *Taxon* 63: 1342–1346. http://dx.doi.org/10.12705/636.4

Galet, P. 1964. *Cépages et vignobles de France*, vol. 4. Montpellier: Imprimiere du Paysan du midi.

Galet, P. 1979. *A practical ampelography: Grapevine identification*. Ithaca: Comstock.

Galet, P. 1988. *Cépages et vignobles de France*, vol. 1, *Les vignes américaines*. Montpellier: Déhan.

Galet, P. 1990. *Cépages et vignobles de France*, vol. 2, *L'Ampélographie Française*. Montpellier: Déhan.

Hetterscheid, W.L.A. & Brandenburg, W.A. 1995. Culton versus taxon: Conceptual issues in cultivated plant systematics. *Taxon* 44: 161–175. http://dx.doi.org/10.2307/1222439

Hitchcock, A.S. 1929. [Standard-species of Linnean genera of Phanerogamae (1753–54)] Genera 1–500. Pp. 114–155 in: *International Botanical Congress, Cambridge (England), 1930: Nomenclature; Proposals by British Botanists*. London: His Majesty's Stationary Office.

Iamonico, D. 2013. Typification of the Linnaean name *Hypochaeris maculata* (Asteraceae). *Nordic J. Bot.* 31: 222–224.

Iamonico, D. 2014a. *Amarathus gangeticus* (Amaranthaceae), a name incertae sedis. *Phytotaxa* 162: 299–300. http://dx.doi.org/10.11646/phytotaxa.162.5.2

Iamonico, D. 2014b. Lectotypification of Linnaean names in the genus *Achyranthes* L. (Amaranthaceae). *Taxon* 63: 405–407. http://dx.doi.org/10.12705/632.2

Iamonico, D. & Hjertson, M. 2015. Lectotypification of Linnaean names in *Tussilago* (Asteraceae). *Bot. Serbica* 39: 45–48.

Iamonico, D. & Iberite, M. 2014. Lectotypification of the Linnaean names *Riccia fluitans* and *R. natans* (Ricciaceae). *Taxon* 63: 394–395. http://dx.doi.org/10.12705/632.9

Iamonico, D. & Jarvis, C.E. 2012a. Lectotypification of two Linnaean names in *Chenopodium* L. (Amaranthaceae). *Taxon* 61: 864–865.

Iamonico, D. & Jarvis, C.E. 2012b. Lectotypification of Linnaean names in the genus *Celosia* L. (Amaranthaceae). *Taxon* 61: 1101–1102.

Iamonico, D. & Peruzzi, L. 2014. Typification of Linnaean names in Malvaceae for the Italian Flora. *Taxon* 63: 161–166. http://dx.doi.org/10.12705/631.11

Iamonico, D. & Sánchez Del Pino, I. 2014. Lectotypification of the Linnaean name *Gomphrena vermicularis* L. (Amaranthaceae). *Taxon* 63: 403–404. http://dx.doi.org/10.12705/632.4

Iamonico, D., McKenzie, R.J. & Barker, N.P. 2014. (2281) Proposal to reject the name *Arnica coronopifolia* (Asteraceae). *Taxon* 63: 436–437. http://dx.doi.org/10.12705/632.29

Jarvis, C.E. 2007. *Order out of chaos: Linnaean plant names and their types*. London: Linnean Society of London and The Natural History Museum.

Linnaeus, C. 1738 ("1737"). *Hortus cliffortianus*. Amstelaedami [Amsterdam]. http://dx.doi.org/10.5962/bhl.title.690

Linnaeus, C. 1753. *Species plantarum*, vol. 1. Holmiae [Stockholm]: impensis Laurentii Salvii. http://dx.doi.org/10.5962/bhl.title.669

Linnaeus, C. 1771. *Mantissa plantarum altera*. Holmiae [Stockholm]: impensis direct. Laurentii Salvii. http://dx.doi.org/10.5962/bhl.title.69083

Pasquale, G.A. 1876. *Manuale di arboricoltura da servire pe' proprietarii, agricoltori, orticoltori, ingegneri, ecc*. Naples: Dottor V. Pasquale Editore nella R. Università.

Ren, H. & Wen, J. 2007. *Vitis* L. Pp. 210–222 in: Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.), *Flora of China*, vol. 12, *Hippocastanaceae through Theaceae*. Beijing: Science Press; St. Louis: Missouri Botanical Garden Press.

Royen, A. van 1740. *Florae leydensis prodromus*. Lugduni Batavorum [Leiden]: apud Samuelem Luchtmans. http://dx.doi.org/10.5962/bhl.title.693

Siddiqi, M.A. 1980. Vitaceae. Pp. 1–4 in: Jafri, S.M.H. & El-Gadi, A. (eds.), *Flora of Libya*, vol. 83. Tripoli: Al-Faateh University.

Sukhorukov, A.P., Iamonico, D. & Jarvis, C.E. 2014. The typification of *Anabasis foliosa* L. (Chenopodiaceae) revisited. *Taxon* 63: 929. http://dx.doi.org/10.12705/634.16

Viala, P. & Vermorel, V. 1901. *Ampélographie*, vol. 2. Paris: Masson.

Vouillamoz, J.F. & Arnold, C. 2009. Etude historico-génétique de l'origine du 'Chasselas'. *Rev. Suisse Vitic. Arboric. Hort.* 41: 299–307.

Wen, J. 2007. Vitaceae. Pp. 467–479 in: Kubitzki, K. (ed.), *The families and genera of vascular plants*, vol. 9. Berlin, Heidelberg: Springer. http://dx.doi.org/10.1007/978-3-540-32219-1_54

Zohary, D., Hopf, M. & Weiss, E. 2012. *Domestication of plants in the Old World*, ed. 4. New York: Oxfrod University Press.

Phytotaxa 166 (3): 163–198
www.mapress.com/phytotaxa/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

http://dx.doi.org/10.11646/phytotaxa.166.3.1

A taxonomic survey of the genus *Vitis* L. (Vitaceae) in Italy, with special reference to Elba Island (Tuscan Archipelago)

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Abstract

As resulted from recent floristic investigations conducted in southern and central Europe, the genus *Vitis* proved to be, in these areas, an intricate critical group, whose interpretation, often influenced by ampelographic approaches, needed to be clarified in a strict taxonomic sense. The current paper analyzes the taxonomy and the distribution of seven taxa recorded in Italy and assigns new names to three nothospecies, naturalized and/or invasive in additional European countries: *V.* ×*instabilis* (= *V. riparia* × *V. rupestris*), *V.* ×*koberi* (= *V. berlandieri* × *V. riparia*), *V.* ×*ruggerii* (= *V. berlandieri* × *V. rupestris*). Nomenclatural and systematic aspects regarding *V. vinifera* are also discussed. Original and detailed descriptions, identification keys, illustrations and information on distribution and ecology are provided.

Key words: alien species, Italy, nothotaxa, systematics, *Vitis*

Introduction

Linnaeus described the genus *Vitis* Linnaeus (1753: 202, 1754: 95) on the basis of the European grapevine (*V. vinifera* Linnaeus 1753: 202), later designated as the lectotype of the genus (Britton & Brown 1913; Hitchcock in Hitchcock & Green 1929), to which were gradually ascribed further different species; today, only a part of them persist in their original attribution, as a number of species were subsequently transferred to distinct genera, such as *Ampelocissus* Planchon [1884: 371(–372)], *Ampelopsis* Michaux [1803a: 159(–160)], *Cayratia* Jussieu (1818: 103), and even *Schefflera* Forster & Forster (1775: 23), a representative of the Araliaceae. Currently, *Vitis* includes about 60 species, mainly distributed in the northern Hemisphere (Wen 2007, Ren & Wen 2007), with a slight numerical prevalence in North America, where a major diversity of the genus is recorded and evidenced by the presence, besides the nominal section (distributed between the southern United States and Mexico), of the sect. *Muscadinia* Planchon (1887: 324) [≡ subgen. *Muscadinia* (Planchon) Rehder (1927: 601)]; as supported by molecular studies (Tröndle *et al.* 2010, Zecca *et al.* 2011, Nie *et al.* 2012), this section has to be considered a separate genus (Weakley *et al.* 2011), *Muscadinia* (Planchon) Small (1903: 756, 1335), represented by two species, *M. popenoei* [Fennell 1940: 17(–19)] Weakley & Gandhi in Weakley *et al.* (2011: 453), and *M. rotundifolia* (Michaux 1803b: 231) Small (1903: 757, 1335), the latter articulated in three varieties: *munsoniana* (Simpson ex Planchon 1887: 615) Weakley & Gandhi in Weakley *et al.* (2011: 452), *pygmaea* (McFarlin ex Ward 2006: 219) Weakley & Gandhi in Weakley *et al.* (2011: 452), and *rotundifolia*. A third species should be added to this genus,

Accepted by Federico Luebert: 15 Mar 2014; published: 25 Apr. 2014

as a consequence of the recent phylogenetic contribution on *Ampelopsis* by Nie *et al.* (2012), where *A. erdvendbergiana* Planchon (1885: 94–95) is added to the *Muscadinia* clade. Furthermore, previous phylogenetic studies evidenced that *Muscadinia* is sister of the whole Eurasiatic complex, where *V. vinifera* is in turn sister of the Asiatic group, outlining a nominal section and another one (yet unnamed) including all the Asiatic taxa.

During the course of recent evolution, the impact of *Vitis* on *Homo sapiens* took place in the Mediterranean-West Asiatic scenario and involved *Vitis vinifera* (Scossiroli 1988, Zohary & Hopf 2000); however, the employment of grapevine fruits as food and the related production of wine independently took into account further species of *Vitis* and *Muscadinia*, as occurred in China with *V. romanetii* Romanet du Caillaud (1883: 53) (Ren & Wen 2007), still used for local wine-making, and in North America with *V. labrusca* Linnaeus (1753: 203) and *M. rotundifolia* (Robinson 1986). Nevertheless, no other species than *V. vinifera* gained such a relevant role through the millennia in the human culture and economy to require, after the discovery of the Americas, the employment of semi-domestic and wild species from overseas, in order to recover a crop production facing the extinction: in the second half of the 19th century, the European vineyards fell under the scourge of the phylloxera (*Daktulosphaira vitifoliae* Fitch.), accidentally introduced from North America, and the grape cultivation run the risk of being abandoned (the historical "bottleneck" of viticulture). The catastrophic ending was prevented by employing American grapevines, which, unlike the European *V. vinifera*, are naturally resistant to the phylloxera attacks on the root system. A number of species were introduced as grafted rootstocks for *V. vinifera* and the crop was finally immunized. The choice of American hybrids as rootstocks, however, was not immediate: it stemmed from a long and intricate recruiting process of wild species with their natural variations and, above all, from hybridization experiments between them and with the European grapevine. Initially, the research, exclusively conducted in Europe, advanced on two fronts: genetic prevention by transferring root resistance genes to *V. vinifera* through the production of Euro-American hybrids (direct-producer hybrids) and vegetative defense by developing rootstocks reinforced through repeated crossings between American species. Eventually, the experimentation with direct-producer hybrids returned unsatisfactory results (high sterility), while the hybrid selection of American rootstocks provided the successful and expected solution. A large number of American species have been employed either as "pure" or as parental in hybridogenic rootstocks, but only three, in comparatively recent years, proved to be the most advantageous: *V. berlandieri* Planchon [1880: 425(–428)], *V. riparia* Michaux (1803b: 231), and *V. rupestris* Scheele (1848: 591) (Olivieri 1936, Galet 1988, Eynard & Dalmasso 1990).

In southern Europe, especially in Italy, the development of hybrids of American *Vitis* marked a new and significant contribution to the floristic globalization, with clear consequences on biodiversity. In the last decade, European botanists began to understand the occurrence in natural and seminatural habitats of the American species [still known in the past, but only as cultivated plants, see e.g., Fiori & Paoletti (1900), and Pignatti (1982)] and artificial hybrids commonly employed as rootstocks, proving their tendency (in some cases greater than the parental species) to escape from cultivation, spread (either vegetatively and by ornithochory) and form self-perpetuating populations, often behaving as noxious invasive (Laguna Lumbreras 2003a, 2003b, 2004, Arrigo & Arnold 2007, Galasso *et al.* 2007, Facsar & Udvardy 2008, Celesti-Grapow *et al.* 2009). This reproductive autonomy and the related environmental impact allow the authors of the present paper to regard these hybrids as authentic species (nothospecies), "irreversible ferals" (Banfi 2013) capable of responding to environmental selective pressures and sustaining populations without direct intervention by humans. In order to highlight this perspective, a name, accompanied by description and nomenclatural type designation, is assigned to three hybrids, until now identified in the botanical literature only by means of impractical hybrid formulas. Each treated nothospecies, unknown in the area of origin of the parental species (although partially sympatric) (Moore 1991), is described upon naturalized specimens collected in Italy. The current choice marks a methodological and conceptual distinction from the ampelographic treatment, whose selection of diagnostic characters is intended only to identify and describe cultivars with productive significance (wine and table grape varieties and rootstocks), regardless of their real taxonomic value and natural variability (Olivieri 1936, Galet 1988, Eynard & Dalmasso 1990).

Besides the pioneering (although still influenced by an ampelographic approach) contributions of Laguna Lumbreras (2003a, 2004) for the Iberian Peninsula, and the floristic treatments of Facsar & Udvardy (2008) and Banfi & Galasso (2010) for Hungary and Italy respectively, in Europe no specific studies on the morphology of naturalized *Vitis* rootstock hybrids are available. In addition to some useful diacritic features traditionally employed in ampelograpy (such as the shape of leaf blade base and marginal teeth) and subsequently adopted by Laguna Lumbreras (2003a, 2004), the foliar indumentum surveyed by scanning electron microscopy proved to be a key and innovative character to separate the different phenotypes, allowing (even using an optical microscope) an effective identification of the different types of trichomes (and their combinations) in taxa and nothotaxa.

The choice of Elba Island (Italy, Tuscan Archipelago) as a study area for the present research is explained by the simultaneous presence of all *Vitis* taxa and nothotaxa (excluding *V. labrusca*) in a restricted territory (unique case in Italy, besides Oltrepò Pavese, Lombardy), a valuable feature which enabled a greater accuracy in mapping and assessing the invasiveness of each taxon. Furthermore, the paper integrates a series of developing contributions to the knowledge of the alien flora (phytogeography, ecology, and taxonomy) of Tuscan Archipelago (Lastrucci *et al*. 2012, Lazzaro *et al*. 2013, Ferretti *et al.* 2013).

Material and Methods

The current paper is based on the study of material collected at field trips in Elba Island (Tuscan Archipelago, Italy) in June 2007 and June 2008, and on the revision of exsiccata from other Italian localities held at APP, CAT, FI, MSNM, PAV, and ROV (see Appendix 1). The studied specimens from Elba Island are housed at the Museo di Storia Naturale di Milano Herbarium (MSNM) and in the Herbarium Centrale Italicum, Florence (FI), and are listed in Appendix 1, along with field records.

Species and hybrids were identified and described on the basis of specimens collected only from wild populations and taking into account the descriptions by Moore (1991) and, to a minor extent, by Laguna Lumbreras (2003a); type specimens of the parent taxa were also investigated. Unlike Laguna Lumbreras (2003a, 2004), ampelographic treatments (e.g., Olivieri 1936, Galet 1988, Eynard & Dalmasso 1990) and cultivated rootstock material from nurseries were used only for comparison and not as a primary source of morphological information. Although not occurring in the wild and not employed as a rootstock in Italy, *V. berlandieri* was additionally described in order to highlight its characters and its contribution to the morphology of two hybrids.

For the treated taxa, we list: synonyms, nomenclatural types, morphological description, etymology (only for the new nothotaxa here described), ecology (based on field observations and literature analysis, and referring to the whole Italian territory), area of origin, geographical distribution in Europe, in Italy, and in Elba Island, degree of naturalization in Elba Island and information on the employment as rootstock in Italy (acquired from Eynard & Dalmasso 1990, Ministero delle Politiche Agricole, Alimentari e Forestali 2013, Morando 1994, Villa 2012).

Morphological traits regarded as diagnostic in recent monographs (Moore 1991, Laguna Lumbreras 2003a, 2004) were taken into account and integrated with original observations and measurements by the authors both on live and herbarium specimens. Particular attention was paid to the leaf morphology and to the indumentum of vegetative parts; terminology of these characters is shown in Table 1 and illustrated in Fig. 4. Diagnostic characters of each taxon are summarized in Table 2.

TABLE 1. Terminology employed in the description of foliar indumentum (see Payne 1978) and leaf morphology.

Character	Description
Leaf blade shape	
cordate	heart-shaped, longer than wide, widest in the basal half, sinus narrow (e.g., Fig. 5)
kidney-shaped	wider than long, without a distinct basal sinus (e.g., Fig. 9)
Leaf margin teeth	
acute	triangle-shaped, longer than wide (Figs. 4E, 4G)
obtuse	rounded (Fig. 4F), triangle-shaped, curly brackets-shaped (Fig. 4H) or pointed arch-shaped, wider than long
Indumentum	
arachnoid	with long, delicate and loosely entangled hairs; micromorphology: hairs strongly to loosely twisted, indistinctly septate, approximately 7–15 µm wide (Figs. 2C–D, 3A, 3G, 6F)
axillary hairs	tufts of hairs growing on the abaxial leaf blade surface at the vein axils (Figs. 7B, 7D, 7H), not to be confused with hairs growing on the veins and projecting over the vein axils (Figs. 7C, 7E–F)
hirsute	with long and stiff hairs; micromorphology: hairs strongly compressed, distinctly septate, approximately 25–45 µm wide (Figs 2F, H)
hirtellous	with short and stiff hairs; micromorphology: as in the hirsute indumentum (Fig. 2C, 3C)
tomentose	with dense, soft and matted hairs, pressed close to the surface; micromorphology: as in the arachnoid indumentum (Fig. 2E, 3B)

In order to allow a visual comparison between the leaf morphology of each taxon, dried mature leaf blades were scanned at 600 dpi resolution using a Canon MP230 scanner (Figs 1, 5, 9, 10, 13, 15, 18). The provenance of the individuals sampled is reported in Appendix 2.

Leaf blade and petiole indumentum was examined using a backscattered scanning electron microscope (SEM) JEOL JSM-5610LV. Small fragments of leaf surface (about 1 cm^2 in size) were carved from dried leaves around the petiole insertion and in the center of the leaf blade, in order to examine the trichomes on petioles, along leaf margins, at the vein axils and on the abaxial leaf surface. The samples were then mounted on aluminum stubs using conductive carbon adhesive tabs. At least four images for each treated taxon [plus *Vitis cinerea* (Engelmann in Gray 1867: 679) Engelmann ex Millardet (1880: 319), for comparison] were taken at three different magnifications (×35, ×70, ×100) on the leaf underside (Figs 2, 3, 6, 7). The provenance of the sampled specimens is reported in Appendix 2.

Reproductive characters were omitted from the descriptions of the hybrids, because of their lesser taxonomic value and the low availability of flowers and fruits in wild populations. Moreover, some traits commonly adopted in the ampelographic literature (e.g., hairiness and colour of the shoots, measures of the angles between the veins, berries shape and colour, see also Storchi & Lelli 2005) were not taken into account, since their diagnostic value is significant only in cultivar characterization (Galet 1988, Martinez & Grenan 1999).

TABLE 2. Comparison of taxonomically useful morphological characters and character states (+ occurring, (+) rarely occurring, − absent).

	vinifera	*labrusca*	*riparia*	*rupestris*	*×koberi*	*×ruggerii*	*×instabilis*
Habit							
climbing/creeping	+	+	+	−	+	+	+
erect	−	−	−	+	−	+	+
Tendrils							
consecutive on 3+ nodes	−	+	−	−	−	−	−
consecutive on 2 nodes	+	−	+	+	+	+	+
Leaf habit							
folded	−	−	−	+	−	+	+
not folded	+	+	+	−	+	−	+
Leaf length (up to cm)	20	20	15+	7	15+	10	15
Leaf consistence							
thin	+	−	+	−	−	−	+
thick	−	+	−	+	+	+	+
Leaf shape							
cordate	+	+	+	−	+	(+)	(+)
kidney-shaped	−	−	−	+	−	+	+
Leaf division							
5- or more-lobed	+	(+)	−	−	−	−	−
3-lobed	+	+	−	−	+	−	−
shallowly 3-lobed	+	+	+	−	+	(+)	+
entire	+	+	+	+	−	+	+
Lobes at the end of central and 2 lateral nerves							
absent	+	+	−	+	−	−	+
incospicuous	+	+	−	(+)	+	+	+
acuminate/cuspidate	+	−	+	−	−	−	+

......continued on the next page

TABLE 2. (Continued)

	vinifera	*labrusca*	*riparia*	*rupestris*	*×koberi*	*×ruggerii*	*×instabilis*
Leaf veins colour (adaxial leaf surface)							
whitish/greenish-white	+	+	+	–	+	–	–
red (at least at the base)	–	–	–	+	–	+	+
Abaxial leaf surface							
glabrous	+	–	–	+	(+)	+	+
hirtellous	+	–	+	–	+	–	+
tomentose	+	+	–	–	–	–	–
Tufts of hairs at vein axils	+	–	+	–	+	–	+/–
Petiole insertion (abaxial leaf surface)							
hirtellous	+	–	+	(+)	+	+	+
arachnoid	+	+	–	(+)	+	+	+
glabrous	+	–	–	+	–	–	–
Veins surface (abaxial leaf surface)							
glabrous	+	–	–	+	–	–	–
hirtellous	+	–	+	(+)	+	+	+
arachnoid	+	+	–	(+)	+	+	–
Leaf margin teeth							
acute	+	–	+	+	–	(+)	+
obtuse	+	+	–	–	+	+	–
Leaf base							
lyre-shaped	+	–	–	–	+	–	–
U-shaped	–	+	+	–	+	+	–
broadly U-shaped	–	–	–	–	–	+	+
V-shaped	–	+	–	–	(+)	+	+
truncate	–	–	–	+	–	+	+
Petiole pubescence							
glabrous	+	+	–	+	–	–	–
hirsute	–	–	+	–	–	–	+
hirtellous	–	–	+	–	+	+	+
arachnoid	+	+	–	+	+	+	+
Petiole colour							
red/reddish	–	–	–	+	–	+	+
green/greenish	+	+	+	–	+	–	+

Taxonomic treatment

Key to species and hybrids of *Vitis* in Italy

1. Leaf blades heavily whitish or yellowish tomentose beneath, concealing the abaxial surface but not always the veins; tendrils consecutive on 3 or more nodes .... ***V. labrusca***

– Leaf blades not heavily tomentose beneath; tendrils consecutive on 2 nodes 2

2. Leaf blades evenly arachnoid beneath, usually deeply (3–)5–7-lobed, sometimes entire, with round sinuses ...... *V.* ***vinifera***

– Leaf blades unevenly arachnoid to glabrous beneath, entire, 3- or shallowly 5-lobed, sinus present or absent.................... 3

3. Leaf base always truncate to cuneate; abaxial surface usually glabrous, sometimes slightly hirtellous and/or arachnoid pubescent at the petiole insertion; blades kidney-shaped, conduplicately folded, slightly wider than long; plants usually caespitose, rarely climbing .... *V.* ***rupestris***

– Leaf base truncate, U-, V- or lyre-shaped; abaxial surface variously pubescent to glabrate, blades kidney-shaped or cordate, conduplicately folded or not; plants usually climbing.. 4

4. Abaxial leaf surface without or with inconspicuous tufts of hairs at the vein axils; abaxial leaf base always arachnoid pubescent on the veins at the petiole insertion; most leaves with obtuse teeth and U- or lyre-shaped base.......................... 5

– Abaxial leaf surface with dense tufts of hairs at the vein axils; abaxial leaf base occasionally arachnoid pubescent on the veins at the petiole insertion; obtuse teeth occasionally present, teeth usually acute; leaf base truncate, U- or V-shaped.... 6

5. Leaves usually broadly cordate, with U- or lyre-shaped base; blades usually more than 10 cm long, not or slightly conduplicately folded; abaxial leaf surface with tufts of rigid hairs at the vein axils (even if not well developed); adaxial surface dark green, usually with greenish-white veins .... *V.* **×*koberi*** (*V. berlandieri* × *riparia*)

– At least some leaves kidney-shaped or rounded, with broadly U- or broadly lyre-shaped base; blades usually less than 10 cm long, at least the uppermost conduplicately folded; abaxial leaf surface without tufts of rigid hairs at the vein axils; adaxial surface light green, with bright red veins, at least basally .... *V.* **×*ruggerii*** (*V. berlandieri* × *rupestris*)

6. Leaf base always U-shaped; blades cordate, up to 15 cm long or more, not conduplicately folded, thin; adaxial surface usually dull, without evident bright red veins; arachnoid pubescence absent .... *V.* ***riparia***

– Leaf base truncate/cuneate to broadly U- or V-shaped; blades cordate to kidney-shaped or slightly rounded, usually less than 15 cm long, at least the uppermost conduplicately folded, thick and coriaceous; adaxial surface usually lustrous, with bright red veins, at least basally; arachnoid pubescence sometimes on the veins at the petiole insertion .... *V.* **×*instabilis*** (*V. riparia* × *rupestris*)

Species

Vitis berlandieri Planchon [1880: 425(–428)]

≡ *Vitis cinerea* (Engelmann in Gray 1867: 679) Engelmann ex Millardet (1880: 319) var. *berlandieri* (Planchon) Comeaux (1987: 15), *comb. inval.*

Type (lectotype designated by Moore 1991 as holotype: 352):—UNITED STATES OF AMERICA. New Mexico and Texas, 1834, *J.L. Berlandier 2412* (PH, isolectotypes MO 5117647!, MPU 018269!, 018270!, US 00094534!)

= *Vitis cordifolia* Michaux (1803b: 231) var. *helleri* Bailey in Gray (1897: 424)

≡ *Vitis cinerea* (Engelmann in Gray) Engelmann ex Millardet var. *helleri* (Bailey) Moore (1991: 352)

≡ *Vitis helleri* (Bailey) Small (1903: 754)

Type (lectotype designated by Moore 1991: 352):—UNITED STATES OF AMERICA. Texas: Kerrville, Kerr County, 1600–2000 feet, 14–21 May 1894, *A.A. Heller 1750* (BH 000051930!, isolectotypes BH 000051931!, 000051932!)

Deciduous woody vine, climbing, dioecious; branchlets slightly angled, moderately to densely arachnoid pubescent, generally lacking hirtellous pubescence. ***Tendrils*** bifurcate to trifurcate, a tendril or inflorescence present at only 2 consecutive nodes. ***Leaf blades*** usually thick and semi-coriaceous, up to 15 cm long, not conduplicately folded, cordate to slightly rounded, usually from unlobed to shallowly 3-lobed, lobes obtuse to acuminate. ***Adaxial surface*** dark green, glabrous to sparsely arachnoid pubescent in mature leaves; ***abaxial surface*** pale green (but not glaucous), dull, sparsely arachnoid to glabrous in mature leaves, with dense whitish to yellowish arachnoid pubescence on the veins at the petiole insertion; veins surface with arachnoid and hirtellous pubescence, usually with inconspicuous to dense whitish to yellowish tufts of hairs at their axils. ***Margins*** crenate to dentate, teeth typically obtuse (rounded, broadly triangular, curly brackets-shaped or pointed arch-shaped); teeth at the ends of the central and the two main lateral veins usually inconspicuous, obtuse to shortly acuminate. ***Leaf base*** from lyre- to broadly V- and U-shaped. ***Petiole*** with slight to dense whitish or yellowish arachnoid pubescence, greenish to yellowish-green. ***Panicles*** 10–25 cm long, usually broadly triangular in outline.

Infrutescences usually with more than 25 berries; berries 4–8 mm in diameter, globose, black, slightly to heavily glaucous, without lenticels, with 3–4 seeds. ***Seeds*** obovoid, 2–4 mm long, brown.

Ecology:—moist soils; calcifile.

Area of origin and distribution in Europe:—native to Texas and Mexico (Galet 1988, Moore 1991); never recorded in the wild outside its native range.

Distribution in Italy:—absent.

Distribution and habitat in Elba island:—absent.

Degree of naturalization in Elba island:—none.

Rootstock use:—despite its high resistance to limestone and phylloxera, pure *V. berlandieri* is not employed as a rootstock, being impossible its reproduction from cuttings (Galet 1988, Eynard & Dalmasso 1990, Ministero delle Politiche Agricole, Alimentari e Forestali 2013).

Notes:—according to Gandhi & Brown (1989), we recognize this taxon as a distinct species.

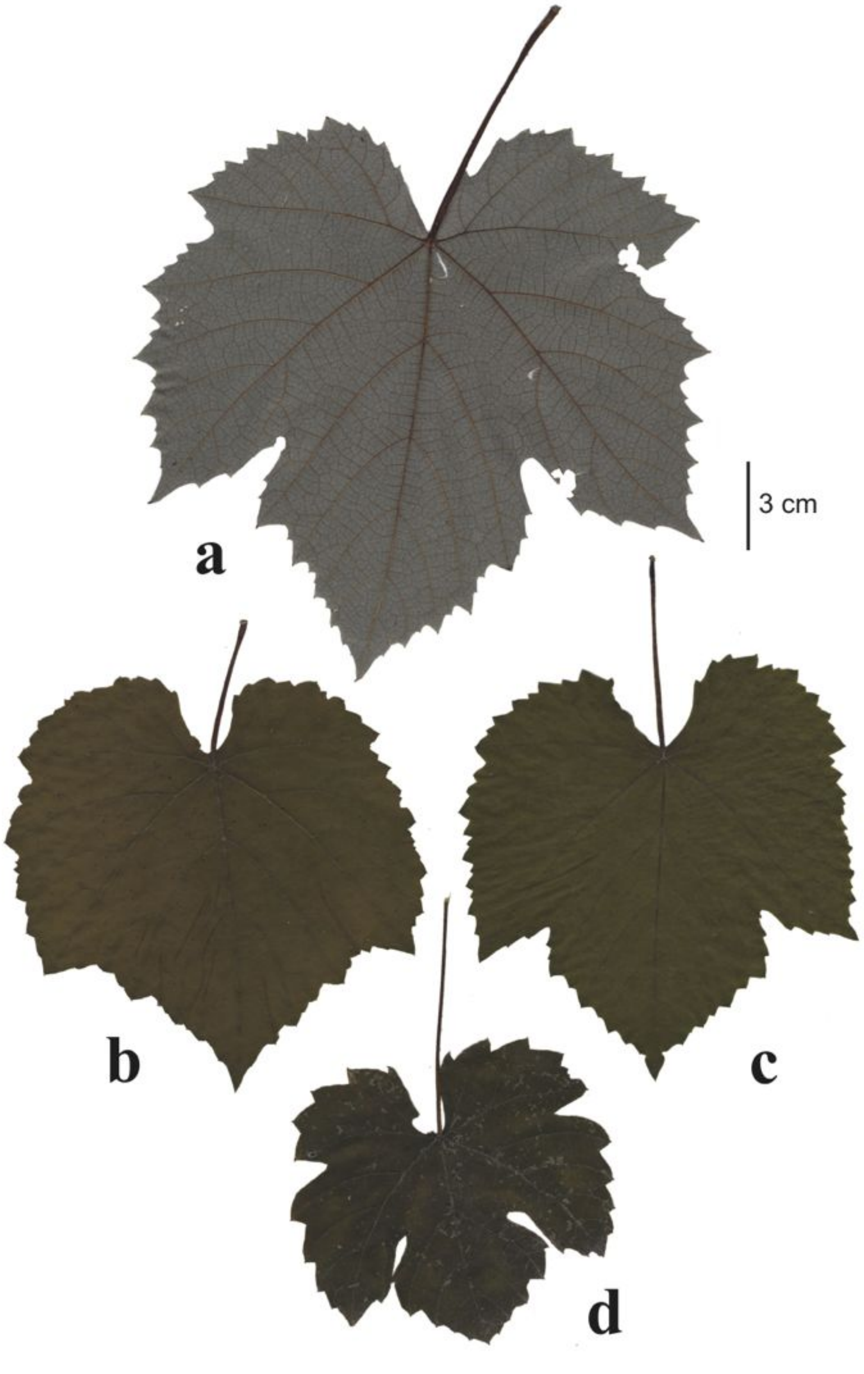


FIGURE 1. *Vitis labrusca*. Leaf blade variability: **a**) abaxial surface; **b**–**d**) adaxial surface.

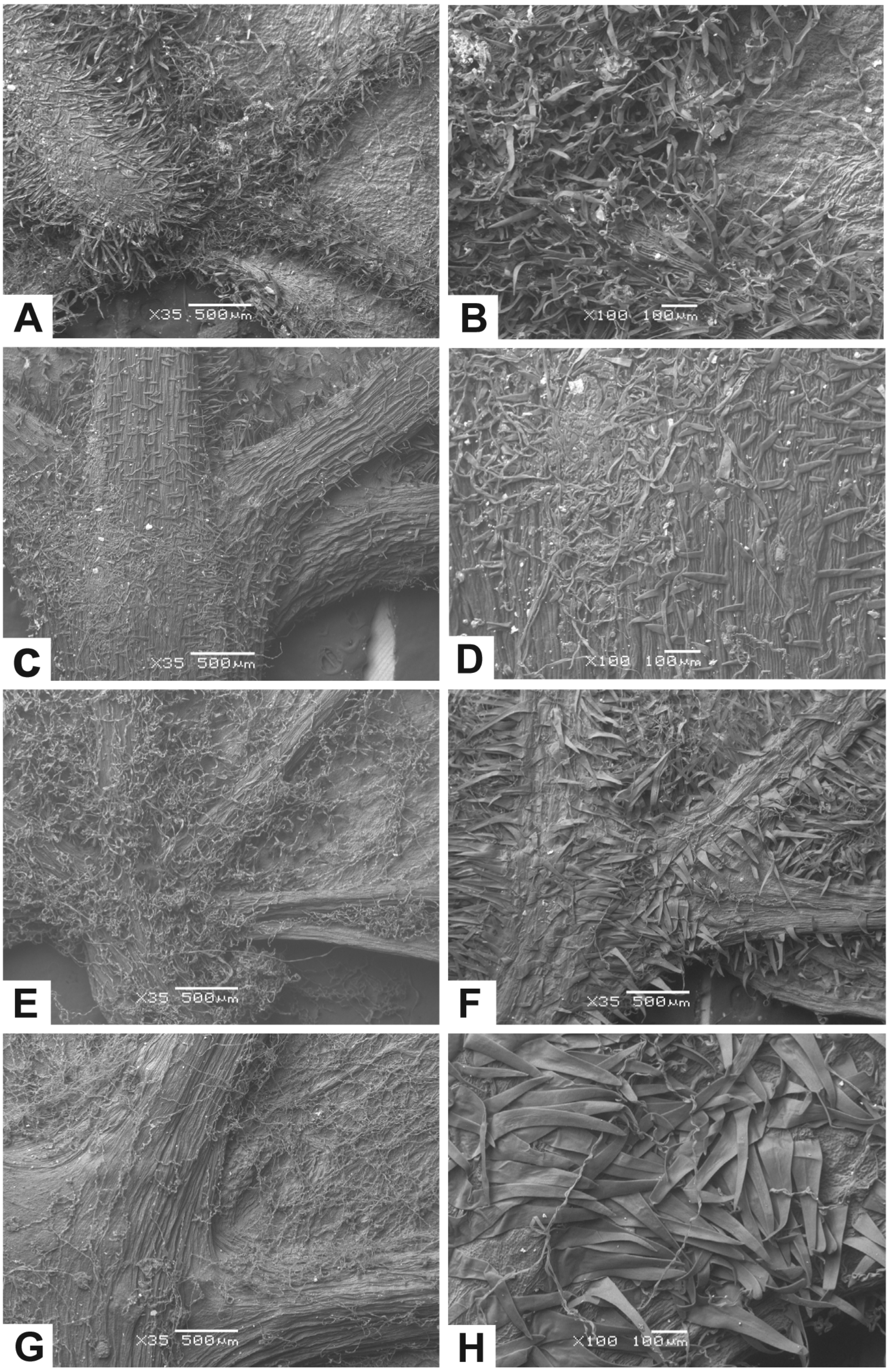


FIGURE 2. **A**, **C**, **E**–**G**) Petiole insertion (abaxial surface); **B**, **D**, **H**) petiole insertion detail. **A**–**B**) *V. cinerea*; **C**–**D**) *V.* ×*koberi*; **E–F**, **H**) *V. vinifera*; **G**) *V. labrusca*. All photos by Michele Zilioli.

Vitis labrusca Linnaeus (1753: 203). Figs. 1, 2G, 3B.
≡ *Cissus labrusca* (Linnaeus) Kuntze (1881: 501)
≡ *Vitis vinifera* Linnaeus (1753: 202) var. *labrusca* (Linnaeus) Kuntze (1891: 132)
Type (lectotype designated by Bailey 1934: 186):—"*Habitat in America septentrionali*", no date, *Herb. Linn. 281.5* (LINN!)

Deciduous woody vine, climbing, hermaphrodite or dioecious. ***Tendrils*** bifurcate to occasionally trifurcate, a tendril or inflorescence consecutive on 3 or more nodes. ***Leaf blades*** thick, up to 20 cm long, not conduplicately folded, broadly cordate, usually slightly 3-lobed, occasionally entire to slightly 5-lobed. ***Adaxial surface*** dark green, dull or slightly lustrous, glabrous to slightly arachnoid pubescent in mature leaves, densely arachnoid pubescent to tomentose in immature ones, veins whitish; ***abaxial surface*** heavily whitish or yellowish tomentose, concealing the surface but not the veins. ***Margins*** arachnoid pubescent to subglabrous, crenate to crenate-dentate, teeth obtuse (broadly triangular to rounded). ***Leaf base*** broadly to narrowly U- or V-shaped. ***Petiole*** arachnoid pubescent to glabrous. ***Panicles*** 6–14 cm long, usually globose to cylindrical in outline. ***Infrutescences*** usually with more than 25 berries; berries more than 12 mm in diameter, globose, usually black (yellowish in some cultivars), slightly or not at all glaucous, without lenticels, with 2–6 seeds, flavour sweet, strawberry-like ("foxy"). ***Seeds*** obcordate, 5–8 mm long, brown.

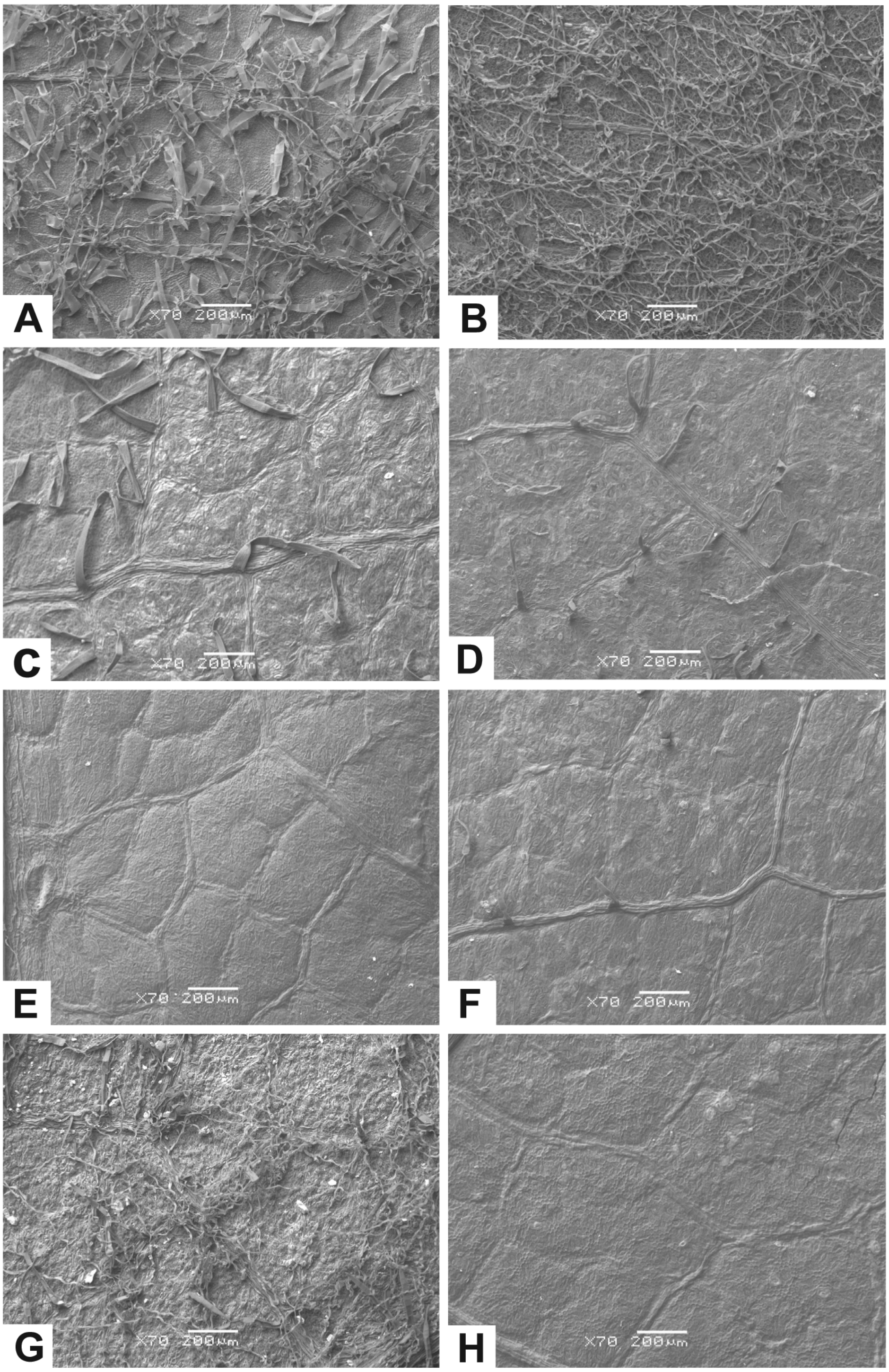


FIGURE 3. **A–H**) Abaxial leaf surface pubescence. **A**) *V. vinifera*; **B**) *V. labrusca*; **C**) *V. riparia*; **D**) *V.* ×*koberi*; **E**) *V. rupestris*; **F**) *V.* ×*instabilis*; **G**) *V. cinerea*; **H**) *V.* ×*ruggerii*. All photos by Michele Zilioli.

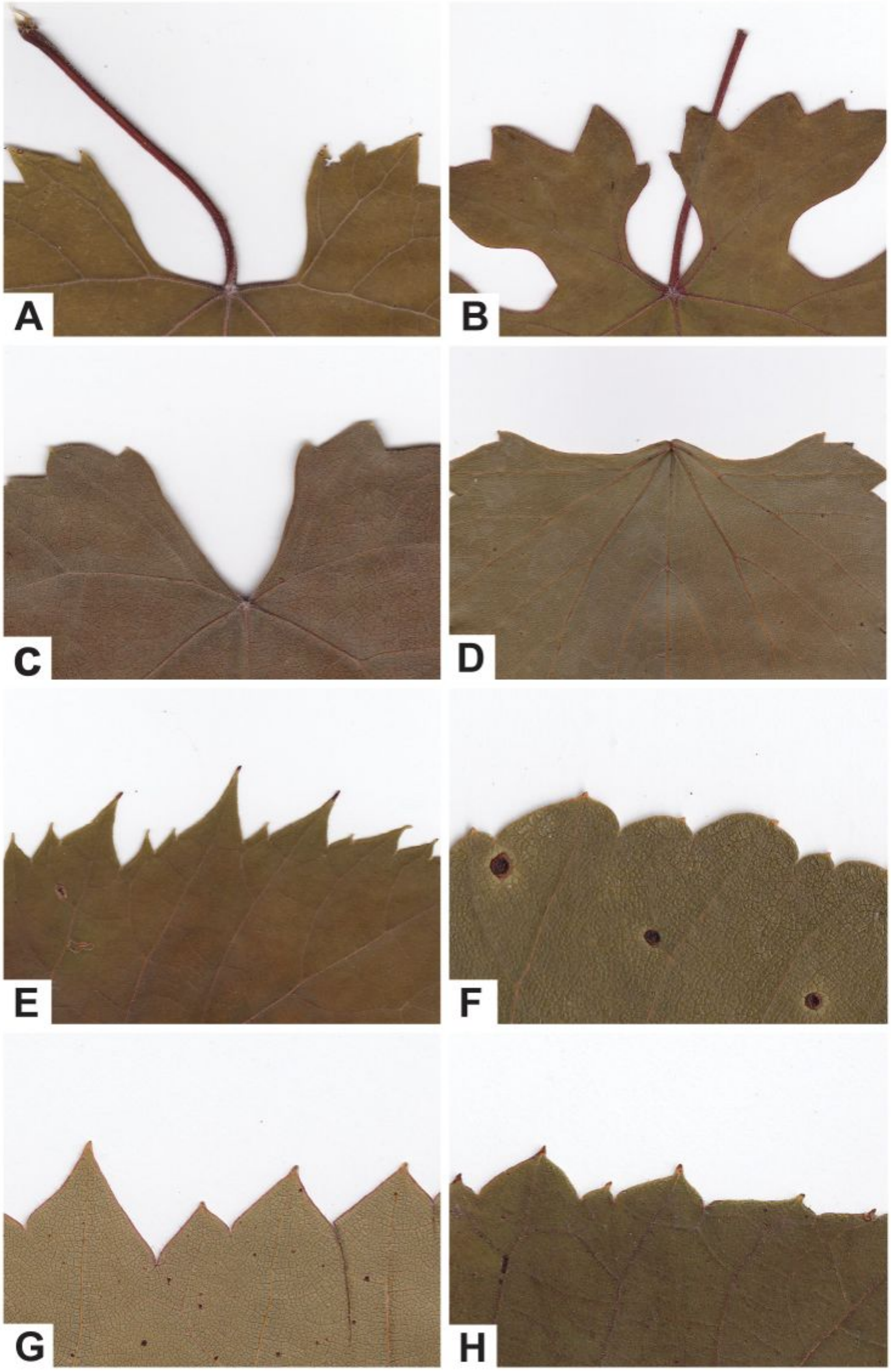


FIGURE 4. **A**–**D**) Leaf bases; **E**–**H**) leaf margin teeth. **A**) U-shaped leaf base in *V.* ×*instabilis*; **B**) Lyre-shaped leaf base in *V. vinifera*; **C**) V-shaped leaf base in *V.* ×*ruggerii*; **D**) truncate leaf base in *V. rupestris*; **E**, **G**) acute teeth in *V. riparia* (E) and in *V.* ×*instabilis* (G); **F**, **H**) obtuse teeth in *V* ×*ruggerii* (F) and in *V.* ×*koberi* (H).

Ecology:—well-drained to moist soils; calcifuge, heliophilous.

Area of origin and distribution in Europe:—eastern North America (Moore 1991). In Europe, it is known as a casual or naturalized alien in the Azores, Portugal, Spain, France, Austria, Hungary, Ukraine, European part of Russia (Daisie 2013) and Greece (Ardenghi & Galasso 2013).

Distribution in Italy:—northern regions (except Valle d'Aosta and Trentino-Alto Adige), Lazio, Abruzzo, Basilicata, Sicily and Sardinia (Celesti-Grapow *et al.* 2009); recorded as casual everywhere, except in Lombardy, where it is naturalized (Ardenghi 2010).

Distribution and habitat in Elba island:—absent.

Degree of naturalization in Elba island:—none.

Rootstock use:—none.

Notes:—plants featuring intermediate characters with *V. riparia* (e.g., tendrils consecutive on 3 or more nodes, abaxial leaf surface with scattered patches of whitish-yellowish arachnoid pubescence, tufts of rigid hairs at the vein axils, leaf lobes shortly cuspidate) have been recently collected in northern Italy. Their identity, distribution and invasiveness is still under study.

Vitis riparia Michaux (1803b: 231). Figs. 3C, 4E, 5, 6A, 7B.

≡ *Vitis cordifolia* Michaux (1803b: 231) var. *riparia* (Michaux) Gray (1856: 78)

≡*Vitis vulpina* Linnaeus (1753: 203) subsp. *riparia* (Michaux) Clausen (1949: 8)

Type (lectotype designated by Moore 1991: 360; see also Fisk & Krings 2009: 739):—UNITED STATES OF AMERICA. Ohio, Mississippi: "*ad ripas et insulas, Ohio, Misissipi*", 1897, *A. Michaux s.n.* (P, IDC microfiche no. 122, photo 19, bottom specimen)

—*Vitis vulpina* auct., non Linnaeus (1753: 203)

Deciduous woody vine, climbing or creeping-prostrate, dioecious; branchlets terete, glabrous to slightly hirtellous. ***Tendrils*** usually bifurcate, a tendril or inflorescence present at only 2 consecutive nodes. ***Leaf blades*** thin, up to 15 cm long or more, not conduplicately folded, cordate, from entire to shallowly 3-lobed. ***Adaxial surface*** yellowish-green, dull or rarely slightly lustrous, glabrous in mature leaves, pubescent in immature ones, veins whitish to greenish-white, rarely reddish at the base; ***abaxial surface*** with scattered rigid short hairs, veins hirtellous, with dense whitish tufts of rigid hairs at their axils. ***Margins*** hirtellous, sharply dentate, teeth acute (usually acute triangle-shaped), narrow; teeth at the ends of the central and the two main lateral veins very prominent, acuminate, sometimes slightly hooked. ***Leaf base*** U-shaped. ***Petiole*** hirtellous to hirsute (hairs sometimes concentrated in a single line), yellowish-green to brownish-green. ***Panicles*** 7–12 cm long, usually narrow triangular in outline. ***Infrutescences*** with more than 25 berries; berries 8–12 mm in diameter, globose, black, heavily pruinose, without lenticels, with 3–4 seeds, flavour herbaceous or acid. ***Seeds*** obpyriform, 5–6 mm long, brown to dark brown.

Ecology:—moist and highly fertile soils; calcifuge, heliophilous.

Area of origin and distribution in Europe:—central and eastern North America (Moore 1991). In Europe, it is known as a casual or naturalized alien at least in Spain (Laguna Lumbreras 2004), France (Daisie 2013), Czech Republic (Pyšek *et al.*2002), Hungary (Facsar & Udvardy 2008) and European part of Russia (Daisie 2013); possibly more widespread, but confused with similar species. Known hybrids with *Vitis vinifera* (subsp. *silvestris*) (Bodor *et al.* 2011, Arrigo & Arnold 2007).

Distribution in Italy:—northern and central regions (except Valle d'Aosta, Friuli-Venezia Giulia, Liguria, Umbria and Lazio) (Celesti-Grapow *et al.* 2009, this paper), Sicily and Sardinia (Celesti-Grapow *et al.* 2009); mostly invasive (especially in northern Italy). The presence of *V. riparia* in Italy dates back at least to 1977 (Ardenghi 2012; see *specimina visa*).

Distribution and habitat in Elba island:—rather rare: recorded in three sites in Campo nell'Elba, Rio nell'Elba and Portoferraio municipalities (Fig. 8); edges of cultivated fields, abandoned vineyards, garrigues at 37−143 m.

Degree of naturalization in Elba island:—(locally) invasive.

Rootstock use:—rare. Contrary to its diffusion in nature as an invasive alien, pure *V. riparia* is employed in only one rootstock, 'Gloire de Montpellier', one of the first introduced after the phylloxera crisis in Europe. In the last century its use decreased in Italy, on behalf of its hybrids with *V. berlandieri* and *V. rupestris*, more resistant to limestone and drought.

Notes:—very similar to *V. riparia* is *V. acerifolia* Rafinesque (1830: 130, pl. 99) [= *V. longii* Prince & Prince (1830: 184) = *V. solonis* Planchon (1875: 119) = *V. nuevo-mexicana* Lemmon ex Munson (1885:132)], native to central North America; even if not officially employed as a rootstock in Italy (Eynard & Dalmasso 1990, Ministero delle Politiche Agricole, Alimentari e Forestali 2013) its presence (or its hybrids with *V. riparia*) could be plausible, being recorded in other European countries (e.g., Spain, see Laguna Lumbreras 2004). It is differentiated by its growing tips slightly to densely pubescent (vs. glabrous to slightly pubescent), branchlets of the year with slight to dense arachnoid pubescence (lacking in *V. riparia*), inflorescences usually less than 8 cm long (vs. greater than 8 cm long) (Moore 1991) and leaf blades from kidney-shaped to cordate, sometimes 3-lobed, with marginal teeth usually longer and hooked especially at the ends of the central and the two main lateral veins ('Solonis') (Laguna Lumbreras 2003a).

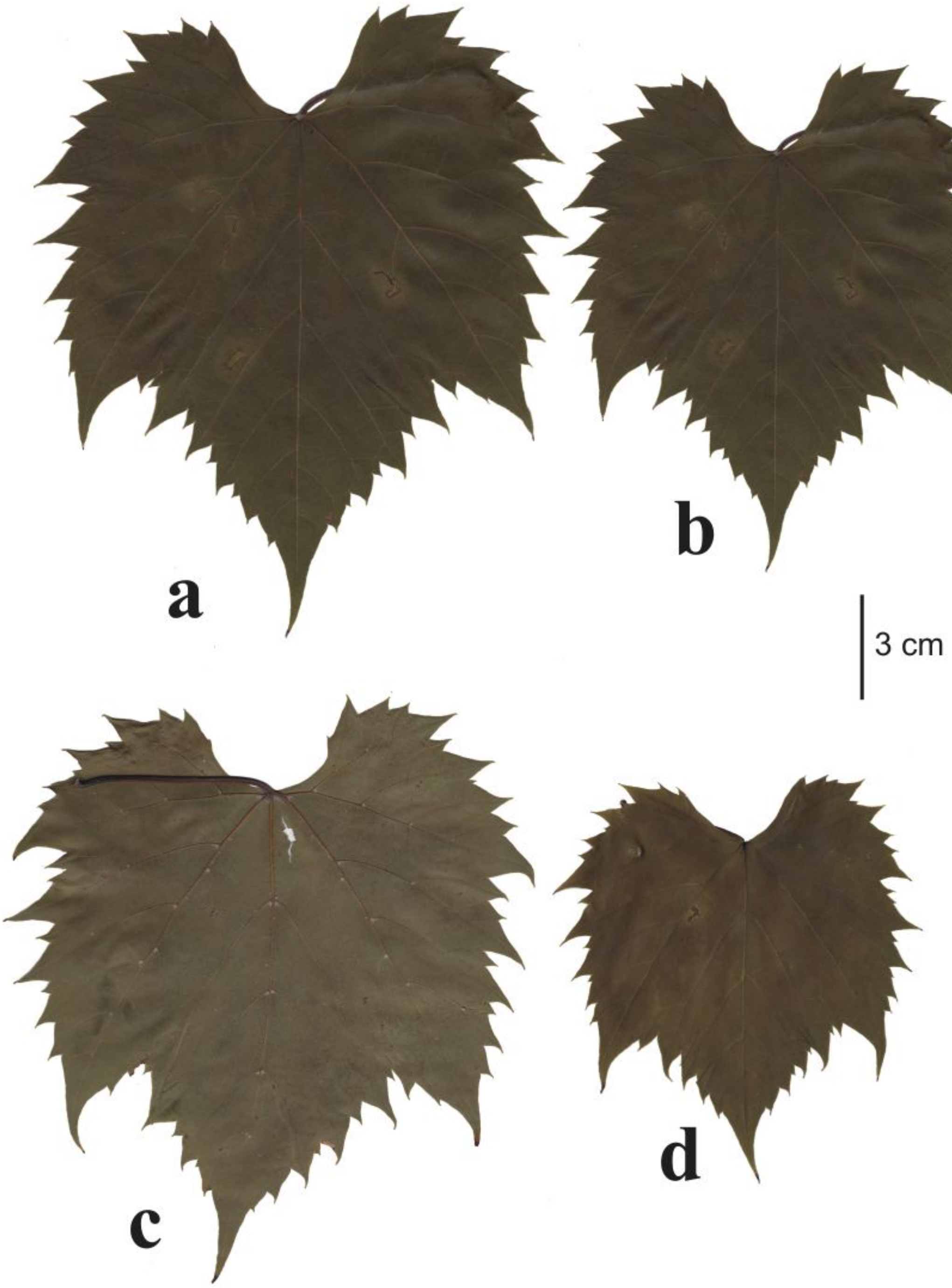


FIGURE 5. *Vitis riparia*. Leaf blade variability: **a–b**, **d**) adaxial surface; **c**) abaxial surface.

Vitis rupestris Scheele (1848: 591). Figs. 3E, 4D, 6E−F, 7E, 9.

Type (neotype selected by Moore 1991: 361):—UNITED STATES OF AMERICA. Missouri: Dent Co., all around gravel bed deposits covering large area around Meramec river headwaters, T33N, R4W, sect. 14, 2 mi. SE of Max, 10 August 1936, *J.A. Steyermark 12842* (MO 1116726!)

= *Vitis rupestris* Scheele var. *dissecta* Eggert ex Bailey in Gray (1897: 422)

≡ *Vitis rupestris* Scheele f. *dissecta* (Eggert ex Bailey) Fernald (1939: 431)

Type (lectotype designated by Moore 1991: 361):—UNITED STATES OF AMERICA. Missouri, Jefferson County: brooks, 22 May 1892, *H. Eggert s.n.* (NY 00415163!, isolectotypes F V0074775F!, US 00289256!, 00289256!)

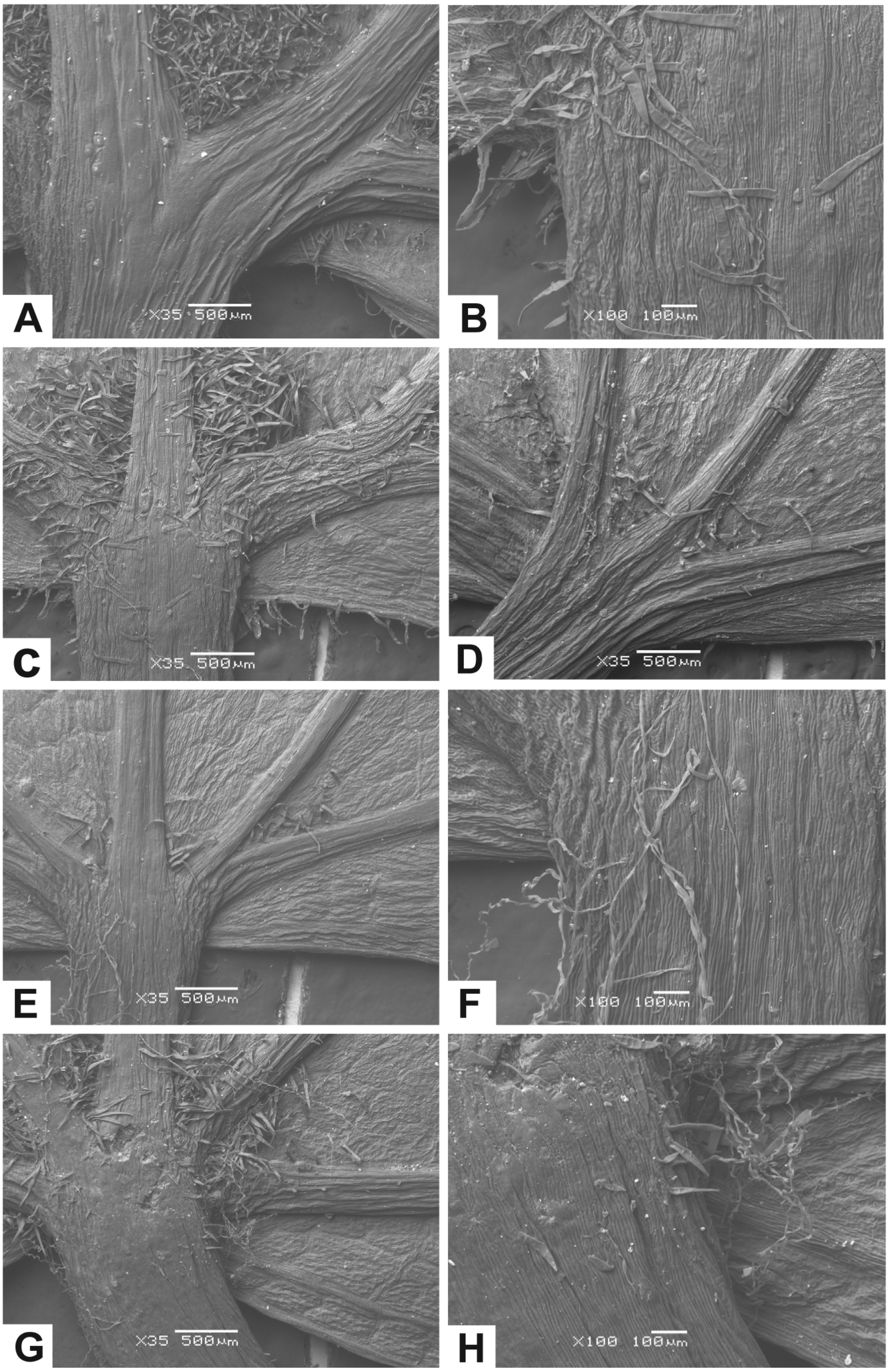


FIGURE 6. **A**, **C–E**, **G**) Petiole insertion (abaxial surface); **B**, **F**, **H**) petiole insertion detail. **A**) *V. riparia*; **B–D**) *V. ×instabilis*; **E–F**) *V. rupestris*; **G–H**) *V. ×ruggerii*. All photos by Michele Zilioli.

Deciduous woody vine, usually round-caespitose, occasionally climbing, densely branched, dioecious; branchlets from pale green to bright red, terete at maturity, glabrous or slightly arachnoid pubescent. ***Tendrils*** usually limited to the uppermost nodes (occasionally absent), bifurcate or entire, very short (less than 11 cm), reddish, a tendril or inflorescence present at only 2 consecutive nodes. ***Leaf blades*** thick and coriaceous, usually up to 7 cm long (rarely more than 10 cm), conduplicately folded (particularly when young), kidney-shaped, slightly wider than long, entire (rarely shallowly 3-lobed). ***Adaxial surface*** bright green to glaucous green, lustrous, typically glabrous in mature leaves, veins bright red at least basally; ***abaxial surface*** glabrous, occasionally with sparse arachnoid and/or hirtellous pubescence on the veins at the petiole insertion, along the veins and at their axils. ***Margins*** glabrous, reddish, serrate-dentate, teeth usually acute (equilateral triangle-shaped, broad, rarely slightly rounded); teeth at the ends of the central and the two main lateral veins inconspicuous or slightly prominent, broadly triangular to shortly acuminate. ***Leaf base*** typically truncate to broadly cordate, without a distinct sinus. ***Petiole*** glabrous to arachnoid pubescent, usually bright red. ***Panicles*** 4–7 cm long, usually globose in outline. ***Infrutescences*** lax, cylindrical, with 12–25 berries; berries 8–12 mm in diameter, globose, black, slightly pruinose, without lenticels, with 3–4 seeds, flavour herbaceous or acid. ***Seeds*** obovoid, 5–6 mm long, light brown.

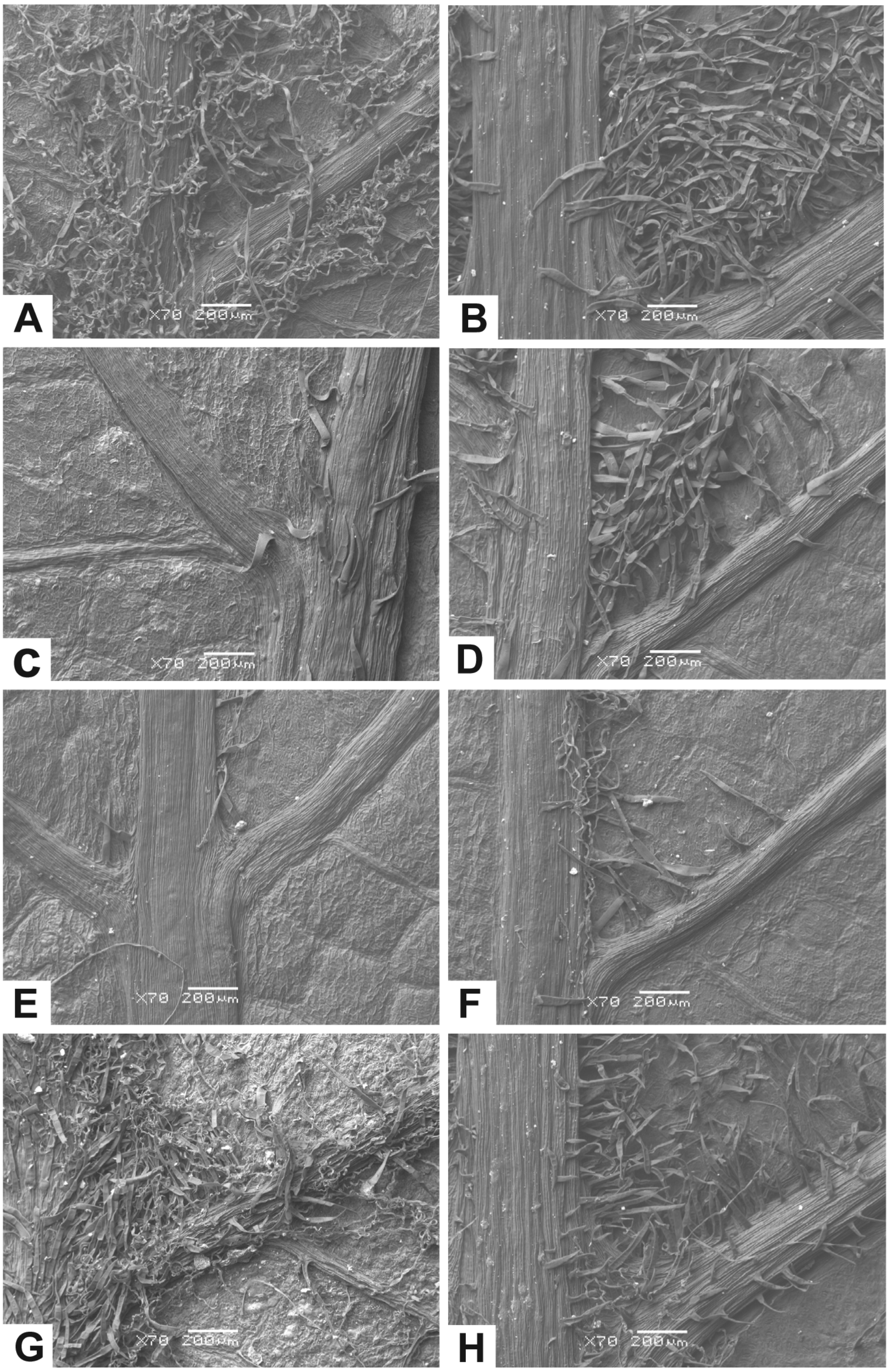


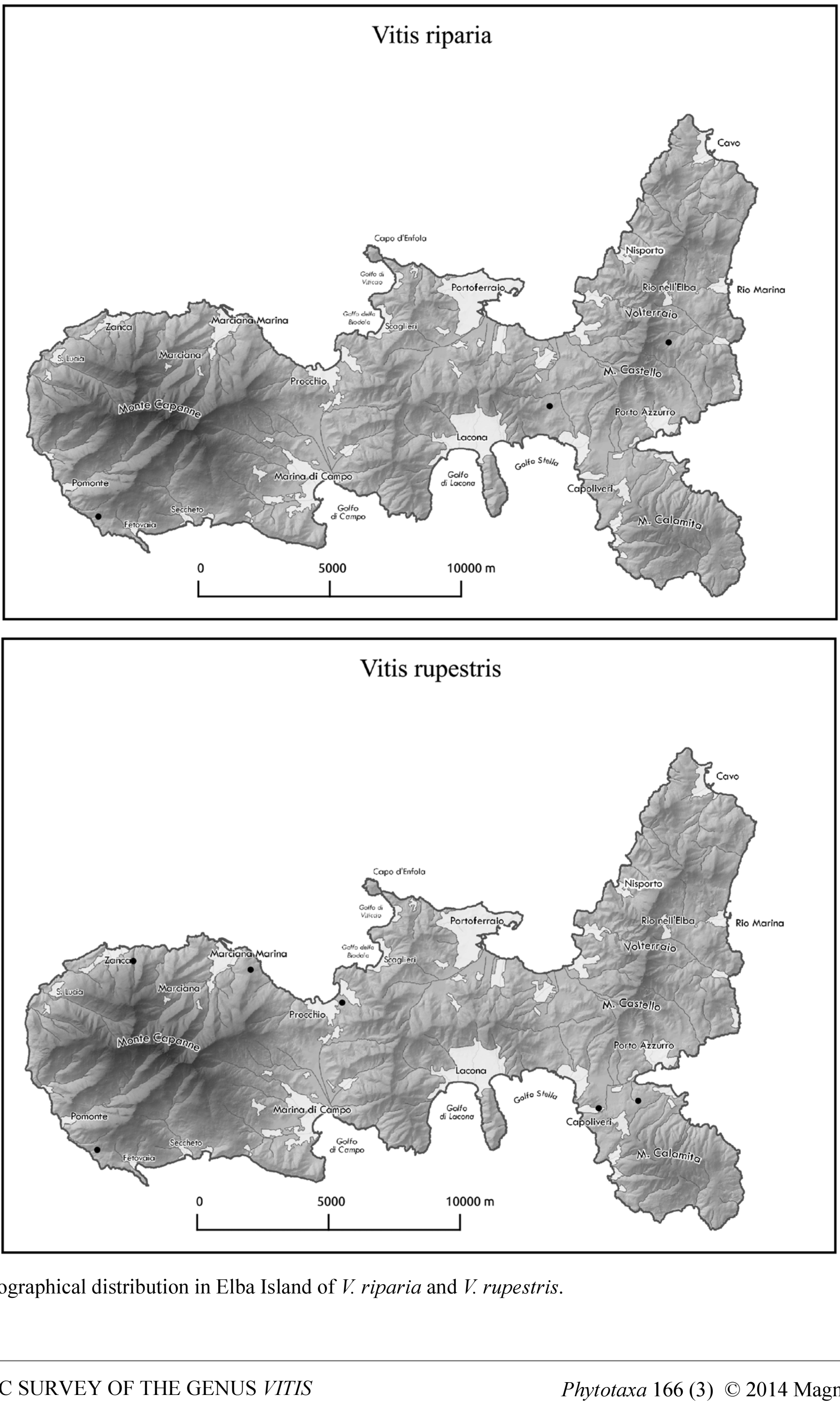
FIGURE 7. **A**–**H**) Vein axils (abaxial leaf surface). Tuft of hairs are distinctly visible in (B), (D), (H). **A**) *V. vinifera*; **B**) *V. riparia*; **C**–**D**) *V.* ×*instabilis*; **E**) *V. rupestris*; **F**) *V.* ×*ruggerii*; **G**) *V. cinerea*; **H**) *V.* ×*koberi*. All photos by Michele Zilioli.

Ecology:—barren, dry and shallow soils; moderately calcifile, heliophilous.

Area of origin and distribution in Europe:—south-eastern North America. In Europe, it has been recorded as a naturalized or casual alien in Spain (Laguna Lumbreras 2004), and France (Daisie 2013); its occurrence in Hungary is doubtful (Facsar & Udvardy 2008).

Distribution in Italy:—Piedmont (this paper), Lombardy (Ardenghi *et al.* 2010), Emilia-Romagna (Bracchi & Romani 2010), Liguria (this paper), Tuscany (Lazzeri *et al.* 2013b), Lazio (Acosta *et al*. 2007), Marche, Abruzzo (Celesti-Grapow *et al*. 2009), Calabria (Bernardo *et al.* 2012), Sardinia (Lazzeri *et al.* 2013a), and Sicily (this paper); naturalized. The presence of *V. rupestris* in Italy dates back at least to 1969 (see *specimina visa*).

Distribution and habitat in Elba island:—rather rare: recorded in the territory of Marciana Marina, Marciana, Campo nell'Elba, and Capoliveri municipalities (Fig. 8); edges of roads, garrigues, edges of *Quercus ilex* Linnaeus (1753: 995) woods at 42–185 m.


Vitis riparia

Vitis rupestris

FIGURE 8. Geographical distribution in Elba Island of *V. riparia* and *V. rupestris*.

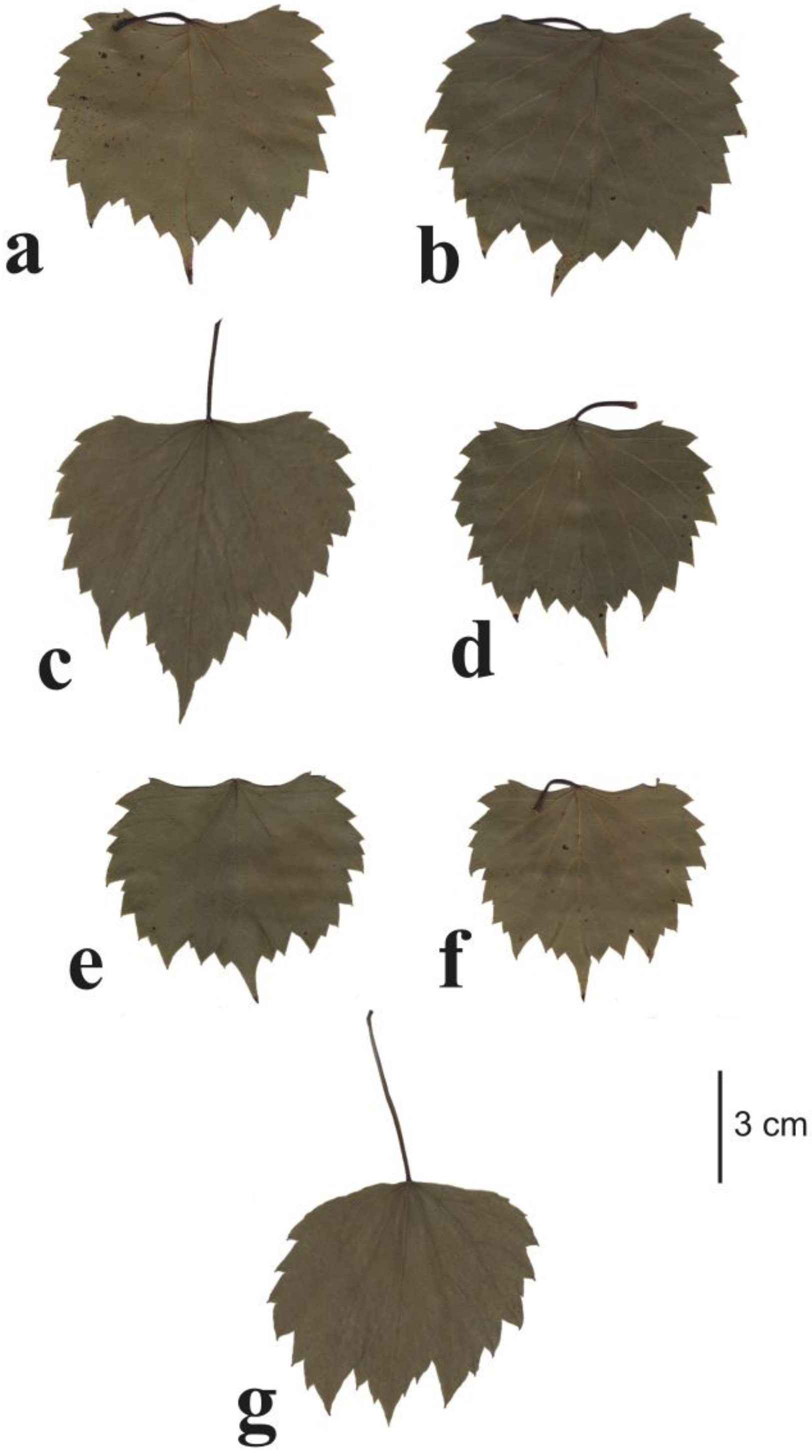


FIGURE 9. *Vitis rupestris*. Leaf blade variability: **a**–**e**, **g**) adaxial surface; **f**) abaxial surface.

Degree of naturalization in Elba island:—naturalized.

Rootstock use:—rare. Pure *V. rupestris* is employed in only one rootstock, 'du Lot', scarcely used in Italy; it is highly vigorous and adapted to well-drained, gravelly and sandy soils.

Vitis vinifera Linnaeus (1753: 202). Figs. 2E–F, 2H, 3A, 4B, 7A, 10.

≡ *Cissus vinifera* (Linnaeus) Kuntze (1881: 501)

Type (lectotype designated by Siddiqi 1980: 83):—"*Habitat in Orbis quatuor partibus temperatis*", no date, *Herb. Linn. no. 281.1* (LINN!)

= *Vitis sylvestris* Gmelin (1805: 543), *nom. illeg*., non Bartram (1804: 21, 23)

≡ *Vitis vinifera* Linnaeus (1753: 202) subsp. *silvestris* Hegi [1925: 70(–72)]

Type:—not designated.

Deciduous woody vine, climbing, dioecious or hemaphrodite. ***Tendrils*** bifurcate or trifurcate (rarely entire), a tendril or inflorescence present at only 2 consecutive nodes. ***Leaf blades*** thin, up to 20 cm long, not conduplicately folded, broadly cordate, usually 5–7-palmate-lobed, with deep round sinuses, sometimes 3-lobed or entire. ***Adaxial surface*** dark green, dull or slightly lustrous, glabrous to slightly arachnoid pubescent, veins whitish to greenish-white; ***abaxial surface*** subglabrous to densely and evenly arachnoid or tomentose, sometimes hirtellous or hirsute over the veins and with tufts of hairs at their axils. ***Margins*** glabrous to subglabrous, sharply dentate, teeth acute or obtuse. ***Leaf base*** usually lyre-shaped. ***Petiole*** subglabrous to slightly arachnoid or even hirsute. ***Panicles*** up to 10 cm or more long, cylindrical to narrow triangular in outline. ***Infrutescences*** usually with more than 25 berries; berries 6–35 mm in diameter, globose to ellipsoidal, variable in colour, without lenticels, with 0–4 seeds, flavour sweet or acid. ***Seeds*** obpyriform, 5–6 mm long, brown.

Ecology:—moderately moist soils; calcifile, heliophilous.

Area of origin and distribution in Europe:—Mediterranean basin and south-western Asia (= subsp. *silvestris*); cultigen (= subsp. *vinifera*). Naturalization of cultivated grapes and their hybridization with wild forms have complicated the precise determination of the wild grape original geographical distribution. Cultigen forms are actually naturalized almost worldwide.

Distribution in Italy:—all regions, except Valle d'Aosta (Conti *et al.* 2005).

Distribution and habitat in Elba island:—rather diffuse: recorded in the territory of Marciana, Marciana Marina, Campo nell'Elba and Capoliveri municipalities (Fig. 11); abandoned vineyards, edges of roads, mediterranean maquis, garrigues and woods at 14–230 m.

Degree of naturalization in Elba island:—spontaneous and naturalized from cultigen forms.

Rootstock use:—none.

Notes:—wild populations, commonly identified as *V. vinifera* subsp. *silvestris*, differ from the cultivated grapes particularly by their relatively small and acid fruits, which are, however, quite suitable for wine production. They may also be recognized by more numerous (3–4) seeds per berry, and by somewhat more globular seeds, generally with a shorter beak. But the range of variation in seed morphology is enormous; furthermore, the range in the cultivated assemblage and in the wild forms overlaps considerably. For this reason, seed shape can not be regarded as a safe diagnostic trait for distinguishing between wild and cultivated *V. vinifera* remains in archaeological excavations (Zohary & Hopf 2000) and in herbarium specimens.

As in most other fruit trees, viticulture is based on the fixation and maintenance of vegetative clones. Almost all cultivars bear hermaphrodite flowers and set fruit by self-pollination. Under cultivation, grape vines are propagated vegetatively by cuttings or by grafting. Domestication (which occurred in the Levant since the Chalcolithic) originated numerous cultivars (used for wine-making and as table grapes), changing the reproductive biology, firstly in the shift from sexual to vegetative propagation, secondly from dioecy and cross-pollination to hermaphroditism and self-pollination; sex determination in *V. vinifera* is governed by a single gene (Olmo 1995). These cultivars, known as 'vitigni', vary widely, among others, in the shape, size, colour, and sweetness of their fruits: juicy, small-berried clones with a rather acid taste are commonly used for wine-making, especially in Europe; types with sweet, large fruits prevail as table grapes; others, such as 'Sultanina', bear small, seedless berries appreciated in raisin production.

Referring to these observations, it is hard to recognize a taxonomical independence to the wild and cultigen populations. Moreover, in the Mediterranean basin and in south-western Asia, the situation is complicated by the presence, along with a variable complex of wild forms (growing in primary habitats), of escapees of cultivation, seed-propagated weedy types (mainly in disturbed habitats) and secondary derivatives of spontaneous crossing between wild plants and cultivars (Zohary & Hopf 2000). However, for the sake of completeness, a couplet for distinguishing the two extremes wild and *culton* is provided:

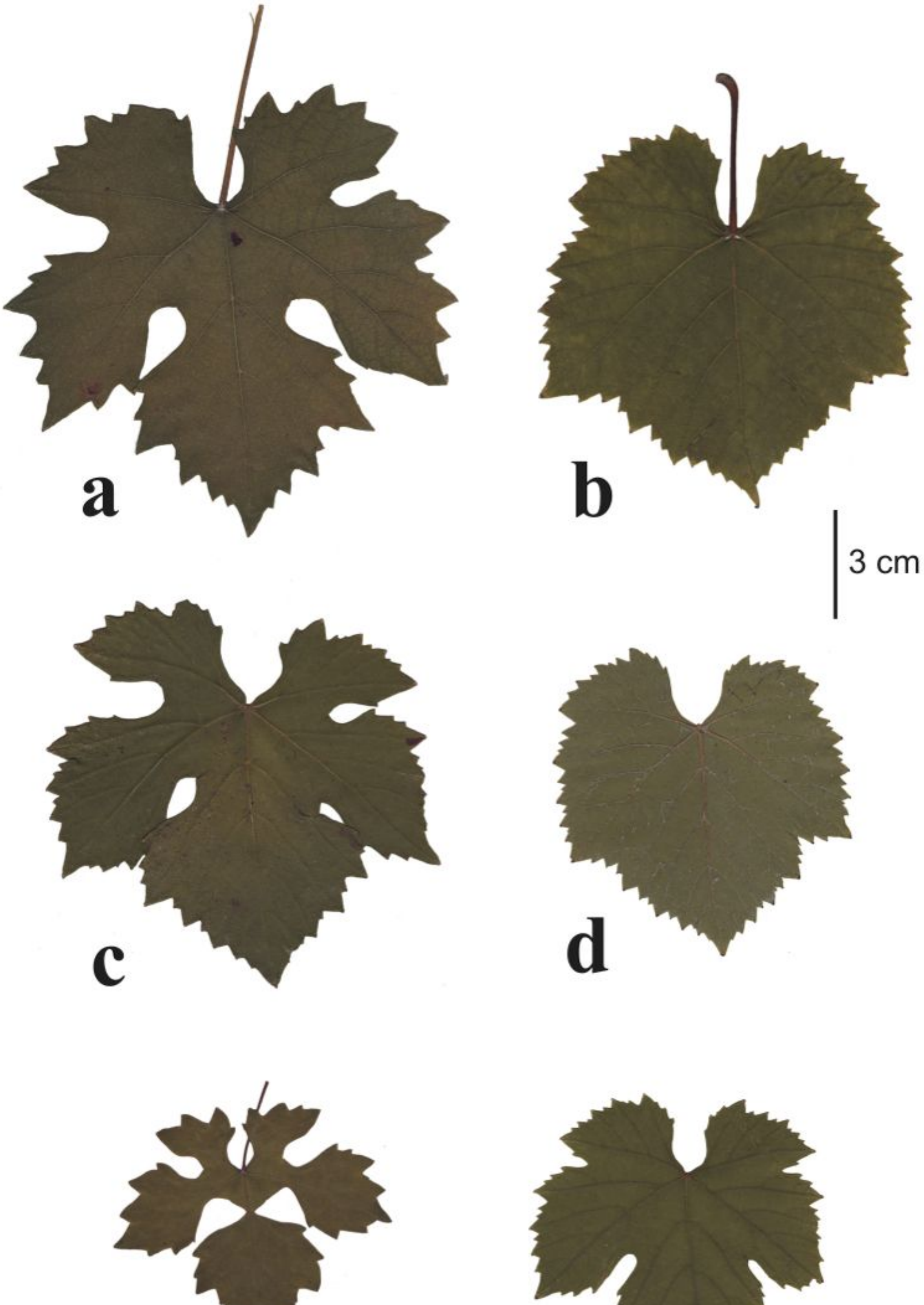


FIGURE 10. *Vitis vinifera*. Leaf blade variability: **a**–**c**, **e**–**f**) adaxial surface; **d**) abaxial surface.

1. Flowers generally hermafrodite; berries 6–35 mm in diameter, sweet- or rather acid-tasting; seeds 0–4, fully developed to underdeveloped. .... "subsp. *vinifera*"
- Flowers generally unisexual; berries 6 mm in diameter, usually acid-tasting; seeds usually 3–4, always fully developed.... ...."subsp. *silvestris*"

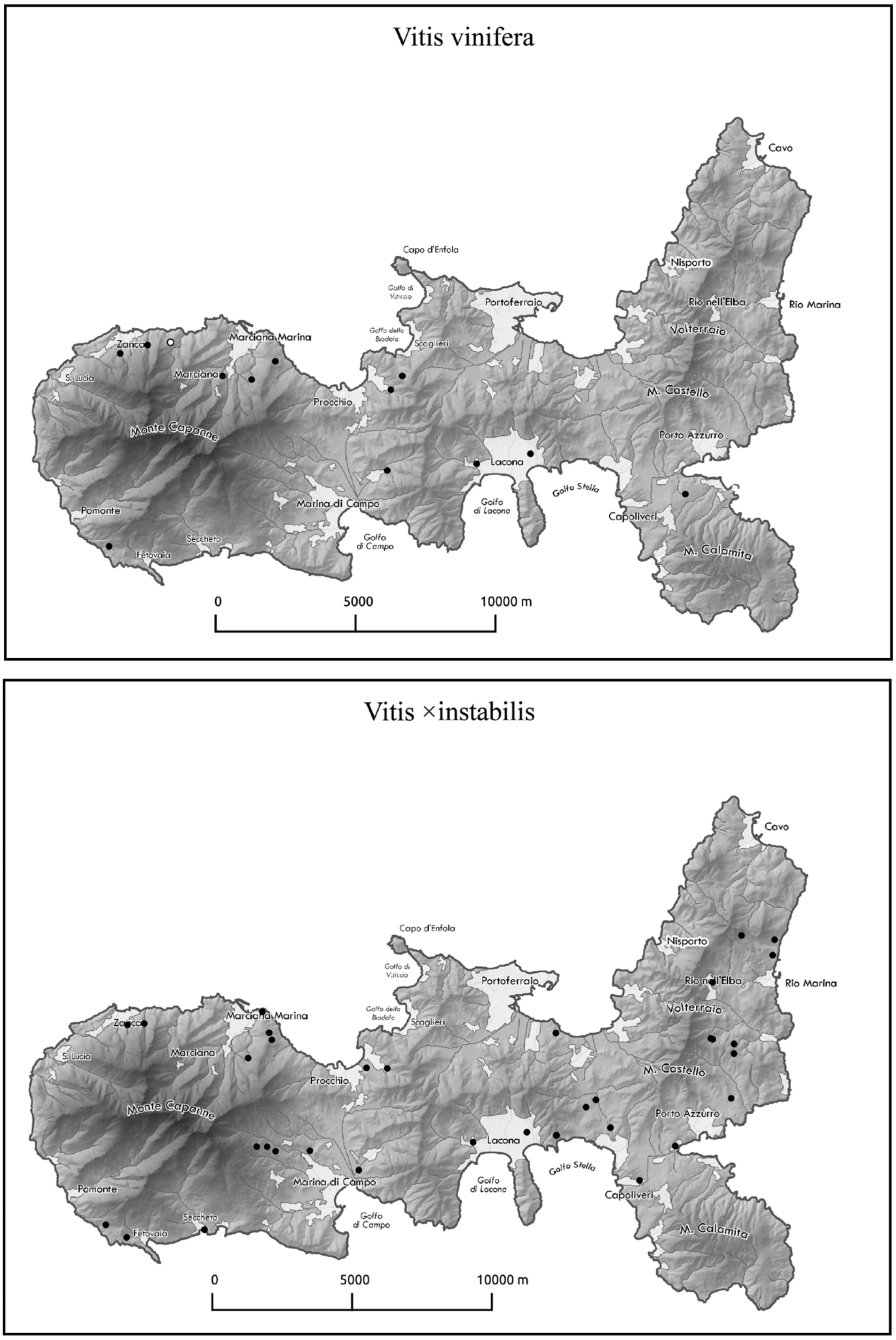


FIGURE 11. Geographical distribution in Elba Island of *V. vinifera* and *V.* ×*instabilis*. The white dot identifies the two close historical growing sites of *V. vinifera*.

The name *V. sylvestris* Gmelin (1805: 543) is illegitimate, being a later homonym of *V. sylvestris* Bartram (1804: 21, 23) (ICNAFP Art. 53.1: McNeill *et al.* 2012); therefore, the name of Hegi (*V. vinifera* subsp. *silvestris*) has to be regarded not as a new combination but as a new name at a new rank (subspecific) (ICNAFP Art. 58.1) and then the Hegi spelling should be accepted, with an "i" in place of the "y", as a choice of greater consistency with the classical Latin. Moreover, Herbert K.E. Beger is not mentioned by Hegi at all. Volume 5(1) of *Illustrierte Flora von Mittel-Europa* was issued by Hegi (1924–1925) in collaboration with other authors, among them Beger, but here the individual contributions are not specified; only in the notes on page 674 of the second edition (Hegi 1965) the name's authorship is clearly attributed to Beger. However, the name was already validly published in the first edition, where only a single internal evidence to determine the nomenclatural novelties authorship exists and it is represented by the stated author of the whole work, Hegi himself (ICNAFP Art. 46.8); therefore, neither external evidences (ICNAFP Art. 46.9) nor the second edition (ICNAFP Art. 37.5) are usable.

Hybrids

Vitis* ×*instabilis Ardenghi, Galasso, Banfi & Lastrucci, *hybr. nov.* Figs. 3F, 4A, 4G, 6B–D, 7C–D, 12, 13.
(*V. riparia* Michaux × *V. rupestris* Scheele)

Planta hybrida, variabilissimo habitu quae a V. riparia foliorum basi truncata vel cuneata usque ad U vel V formam suscipienti, laminis cordato-reniformibus, in longitudinem plicatis (saltem superioribus), magis coriaceis et lucidioribus, nervis rubris, interdum pubescentia araneosa supra petioli iuncturae nervis differt; a V. rupestri foliorum laminis longioribus, interdum cordatis vel rotundatis, basi non semper truncata vel cuneata, pilorum fasciculis saepe in superficiei abaxialis nervorum axillis differt.

Type:—ITALY. **Tuscany**: Capoliveri (Livorno), via Capo ai Pini (SP 30), Casa Riccio (WGS84: 42.764248°N 10.333038°E; staz. 25), 56 m, exp. SE, margine arbustato, 22 June 2008, *G. Galasso s.n.* (holotype MSNM!, 2 sheets, isotype FI!, 1 sheet) (Fig. 12)

HERBARIUM MUSAEI CIVICI
HISTORIAE NATURALIS MEDIOLANENSIS

Vitis* ×*instabilis Ardenghi, Galasso, Banfi & Lastrucci
= *Vitis riparia* Michx. × *Vitis rupestris* Scheele
HOLOTYPUS, part A
locus: Italia; Toscana; LI (Arcipelago Toscano, Isola d'Elba); Capoliveri; via Capo ai Pini (SP 30), Casa Riccio (coord. geogr. WGS84: 42.764248"N 10.333038"E)(staz. 25)
dies: 22/06/2008
altitudo: 56 m s.l.m.
expositio: sudest
legit: Gabriele Galasso
determinaverunt: Gabriele Galasso & Nicola Ardenghi
habitat: margine arbustato

HERBARIUM MUSAEI CIVICI
HISTORIAE NATURALIS MEDIOLANENSIS

Vitis* ×*instabilis Ardenghi, Galasso, Banfi & Lastrucci
= *Vitis riparia* Michx. × *Vitis rupestris* Scheele
HOLOTYPUS, part B
locus: Italia; Toscana; LI (Arcipelago Toscano, Isola d'Elba); Capoliveri; via Capo ai Pini (SP 30), Casa Riccio (coord. geogr. WGS84: 42.764248"N 10.333038"E)(staz. 25)
dies: 22/06/2008
altitudo: 56 m s.l.m.
expositio: sudest
legit: Gabriele Galasso
determinaverunt: Gabriele Galasso & Nicola Ardenghi
habitat: margine arbustato

FIGURE 12. Holotype of *V.* ×*instabilis* Ardenghi, Galasso, Banfi & Lastrucci (MSNM).

Deciduous woody vine, caespitose or climbing; branchlets hirtellous or arachnoid pubescent. ***Tendrils*** usually bifurcate, a tendril or inflorescence present at only 2 consecutive nodes, sometimes limited to the uppermost ones. ***Leaf blades*** from thin to almost thick and coriaceous, up to 15 cm long, usually conduplicately folded (particularly when young) or slightly so, cordate to kidney-shaped or slightly rounded, entire to shallowly 3-lobed, lobes from inconspicuous to cuspidate (occasionally the central one shorter than the two lateral). ***Adaxial surface*** yellowish-green to bright green, lustrous, glabrous or with scattered rigid short hairs in mature leaves, veins bright red at least basally, glabrous or hirtellous; ***abaxial surface*** glabrous or with scattered rigid short hairs, sometimes with arachnoid pubescence on the veins at the petiole insertion; veins surface generally hirtellous, with very lax to dense whitish tufts of rigid hairs at their axils. ***Margins*** hirtellous, reddish, sharply dentate, teeth usually acute (acute to equilateral triangle-shaped); teeth at the ends of the central and the two main lateral veins prominent or not. ***Leaf base*** truncate to broadly U-shaped or V-shaped. ***Petiole*** hirtellous to hirsute, sometimes with arachnoid pubescence, yellowish-green to bright red.

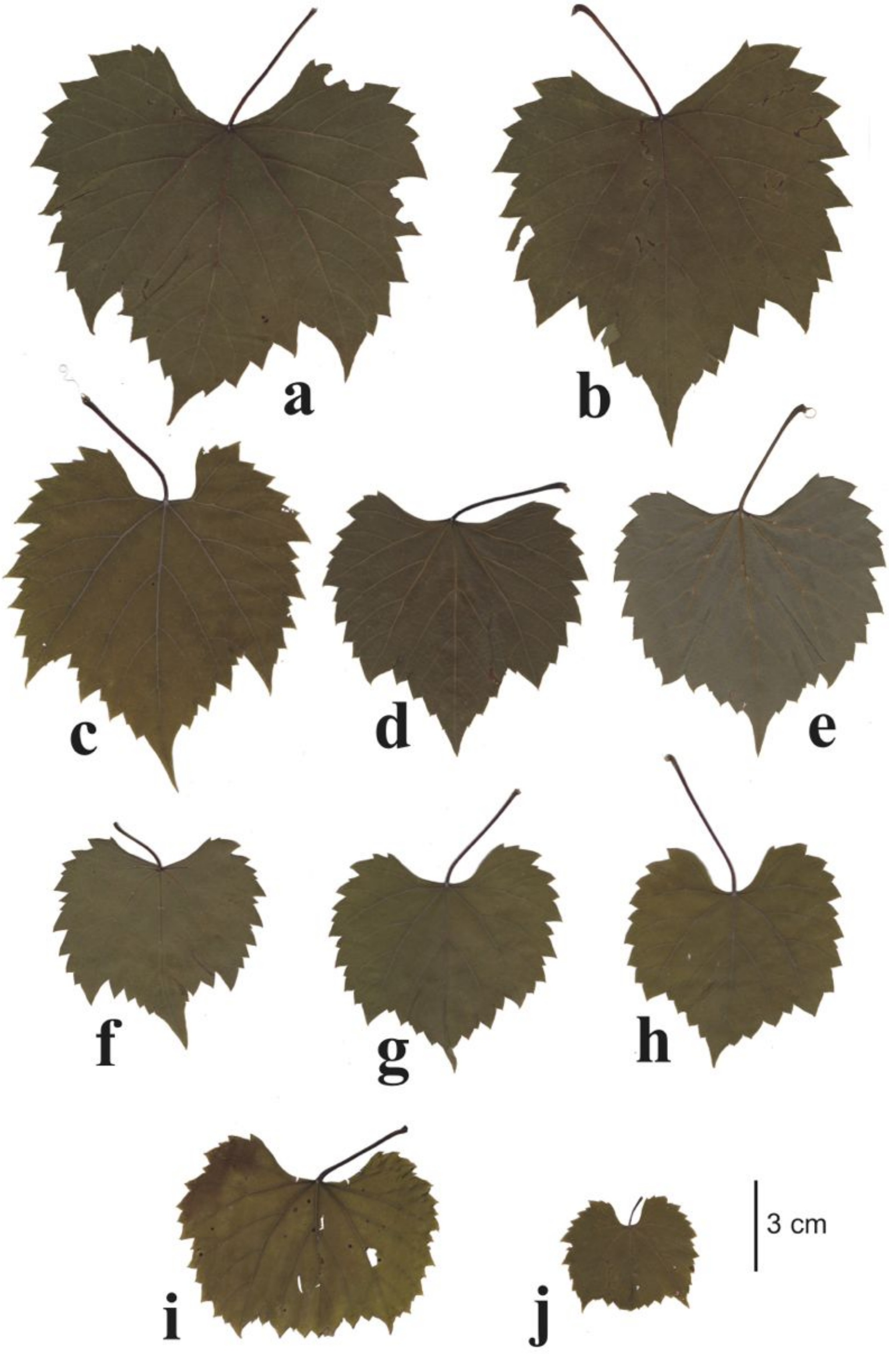


FIGURE 13. *Vitis ×instabilis*. Leaf blade variability: **a**–**d**, **g**–**j**) adaxial surface; **e**–**f**) abaxial surface.

Etymology:—the specific epithet refers to the highly variable leaf morphology, usually intermediate between the two parental species, but often closely resembling either *V. riparia* or *V. rupestris*.

Ecology:—moderately moist soils; usually calcifuge, heliophilous.

Area of origin and distribution in Europe:—rootstock hybrid originated in Europe. In Europe, it is known as a casual or naturalized alien in Spain (Laguna Lumbreras 2004), and Greece (Ardenghi & Galasso 2013).

Distribution in Italy:—Piedmont (this paper), Lombardy (Ardenghi *et al.* 2010), Liguria (Galasso *et al.* 2007, originally misidentified with *V. riparia*), Emilia-Romagna (Bracchi & Romani 2010), Marche (Conti *et al.* 2013), Tuscany (Lastrucci *et al.* 2012), Lazio (G. Nicolella 2012, http://www.actaplantarum.org), Apulia (Galasso 2011) and Calabria (Bernardo *et al.* 2012); mostly invasive. The presence of *V. ×instabilis* in Italy dates back at least to 1982 (see *specimina visa*).

Distribution and habitat in Elba island:—widespread: recorded in all the municipalities (Fig. 11); road edges, abandoned vineyards, garrigues, edges of mediterranean maquis, edges of woods at 4–327 m.

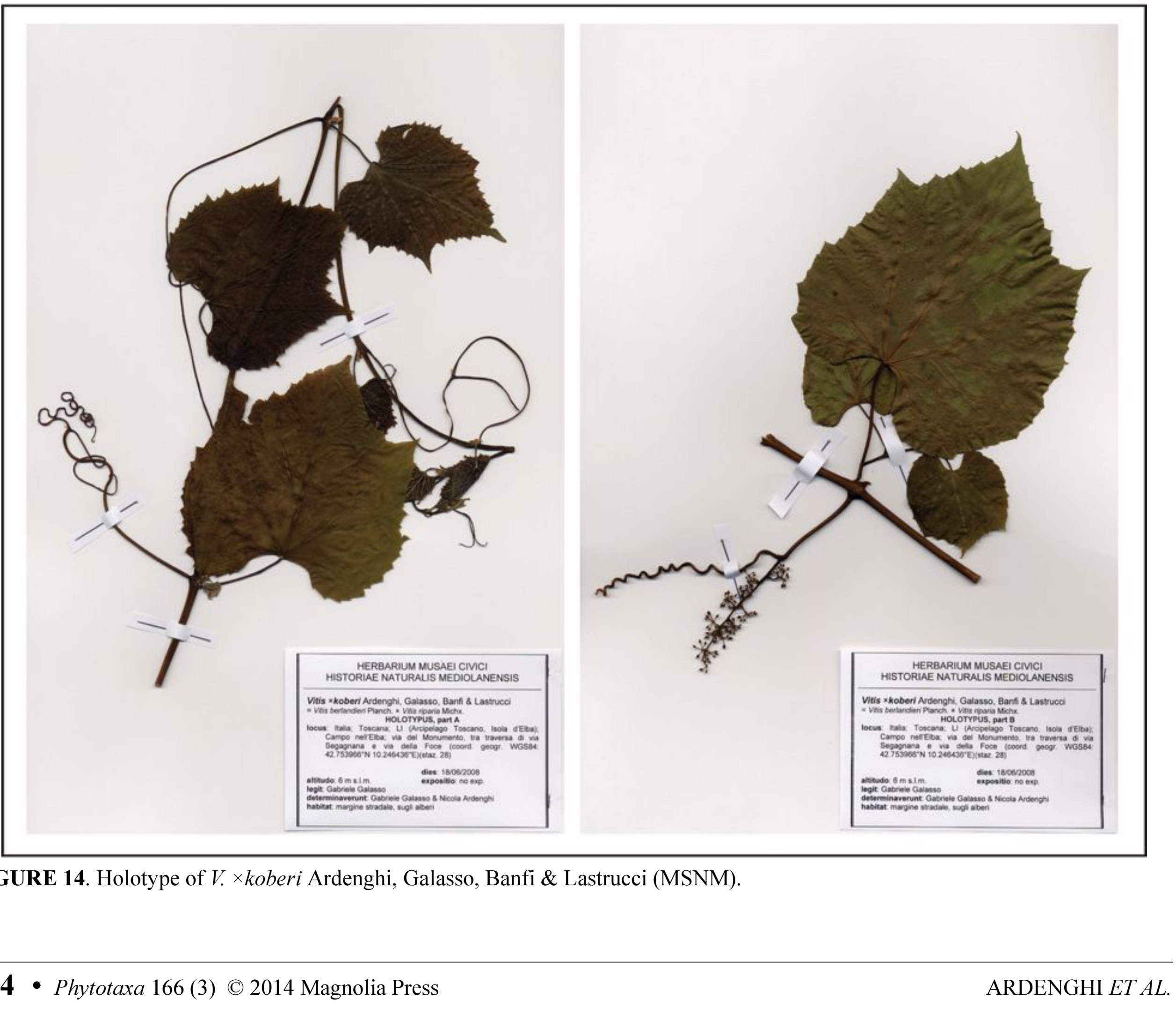
Degree of naturalization in Elba island:—invasive.

Rootstock use:—infrequent. In Italy this hybrid was more widespread at the beginning of 20th century. Currently, only three rootstocks are employed (among these, '3309 C' and '101.14' are the most known), usually susceptible to limestone and poorly resistant both to excessive drought and moisture of soil.

Vitis* ×*koberi Ardenghi, Galasso, Banfi & Lastrucci, *hybr. nov.* Figs. 2C–D, 3D, 4H, 7H, 14, 15.
(*V. berlandieri* Planchon × *V. riparia* Michaux)

Planta hybrida, a V. riparia foliorum laminae dentibus obtusis, pubescentia araneosa supra nervos in petioli iunctura, foliorum basi interdum lyrata differt; a V. berlandieri minus discoloribus laminis et pilorum fasciculis in superficiei abaxialis nervorum axillis differt.

Type:—ITALY. **Tuscany**: Campo nell'Elba (Livorno), via del Monumento, tra traversa di via Segagnana e via della Foce (WGS84: 42.753966°N 10.246436°E; staz. 28), 6 m, no exp., margine stradale, sugli alberi, 18 June 2008, *G. Galasso s.n.* (holotype MSNM!, 2 sheets, isotype FI!, 2 sheets) (Fig. 14)



HERBARIUM MUSAEI CIVICI
HISTORIAE NATURALIS MEDIOLANENSIS

Vitis* ×*koberi Ardenghi, Galasso, Banfi & Lastrucci
= *Vitis berlandieri* Planch. × *Vitis riparia* Michx.
HOLOTYPUS, part A
locus: Italia; Toscana; LI (Arcipelago Toscano, Isola d'Elba); Campo nell'Elba; via del Monumento, tra traversa di via Segagnana e via della Foce (coord. geogr. WGS84: 42.753966"N 10.246436"E)(staz. 28)
dies: 18/06/2008
altitudo: 6 m s.l.m.
expositio: no exp.
legit: Gabriele Galasso
determinaverunt: Gabriele Galasso & Nicola Ardenghi
habitat: margine stradale, sugli alberi

HERBARIUM MUSAEI CIVICI
HISTORIAE NATURALIS MEDIOLANENSIS

Vitis* ×*koberi Ardenghi, Galasso, Banfi & Lastrucci
= *Vitis berlandieri* Planch. × *Vitis riparia* Michx.
HOLOTYPUS, part B
locus: Italia; Toscana; LI (Arcipelago Toscano, Isola d'Elba); Campo nell'Elba; via del Monumento, tra traversa di via Segagnana e via della Foce (coord. geogr. WGS84: 42.753966"N 10.246436"E)(staz. 28)
dies: 18/06/2008
altitudo: 6 m s.l.m.
expositio: no exp.
legit: Gabriele Galasso
determinaverunt: Gabriele Galasso & Nicola Ardenghi
habitat: margine stradale, sugli alberi

FIGURE 14. Holotype of *V. ×koberi* Ardenghi, Galasso, Banfi & Lastrucci (MSNM).

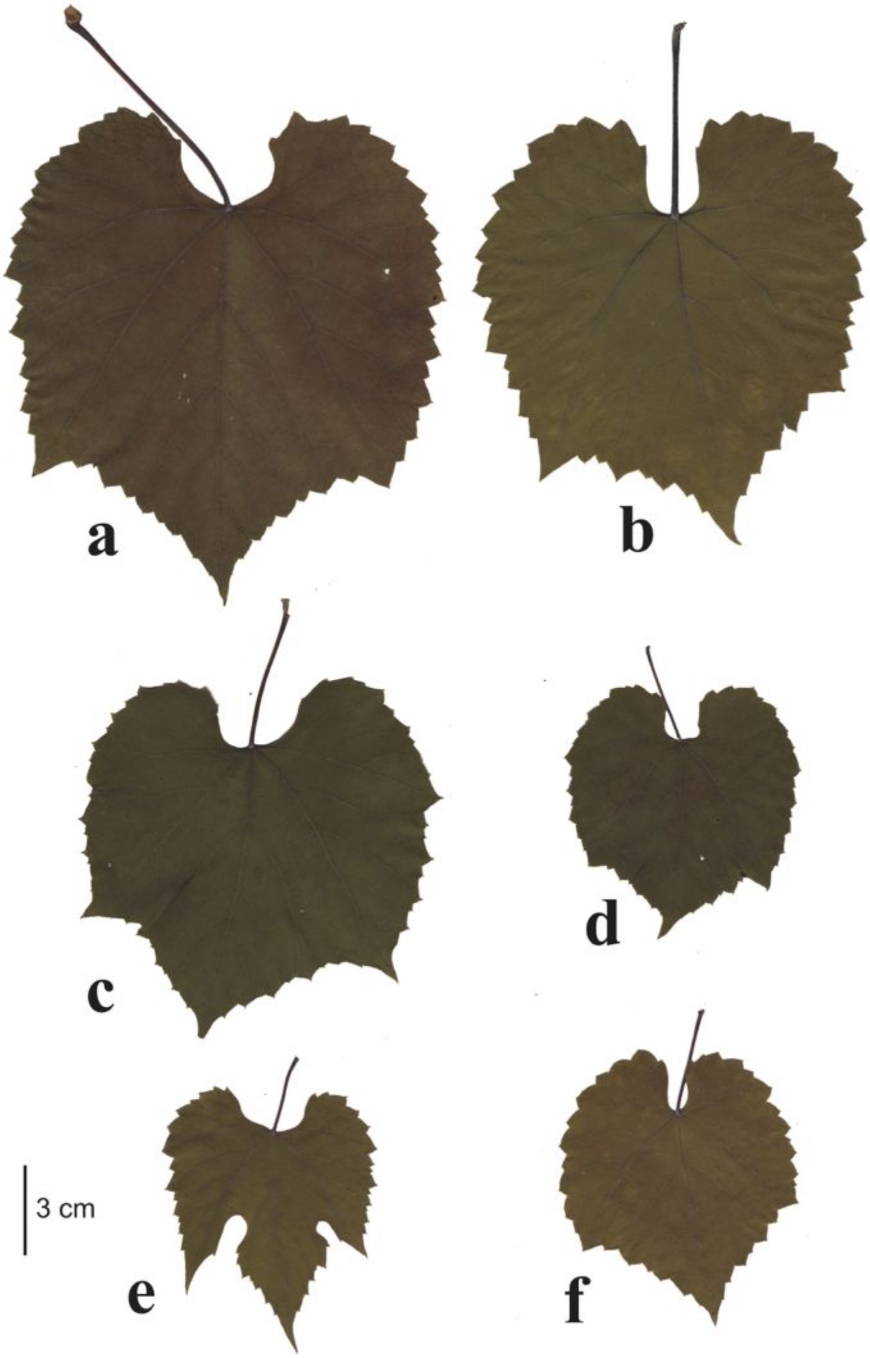


FIGURE 15. *Vitis ×koberi*. Leaf blade variability: **a–f**) adaxial surface.

Deciduous woody vine, climbing or creeping-prostrate; branchlets with arachnoid pubescence. ***Tendrils*** bifurcate, a tendril or inflorescence present at only 2 consecutive nodes. ***Leaf blades*** usually thick and semi-coriaceous, up to 15 cm long or more, not or slightly conduplicately folded, broadly cordate (occasionally slightly rounded to quadrangular), usually shallowly 3-lobed, sometimes with only one lobe developed, lobes broadly triangular in mature leaves (almost cuspidate in immature ones). ***Adaxial surface*** green to dark green, slightly lustrous, glabrous in mature leaves, arachnoid pubescent in immature ones, veins whitish to greenish-white, with hirtellous and arachnoid pubescence; ***abaxial surface*** glabrescent to hirtellous (densely arachnoid in immature leaves), with dense whitish arachnoid pubescence on the veins at the petiole insertion; veins surface with arachnoid and hirtellous pubescence, usually with lax and inconspicuous whitish tufts of hairs at their axils. ***Margins*** hirtellous, crenate to dentate, teeth typically obtuse (rounded, broadly triangular, curly brackets-shaped or pointed arch-shaped) in mature leaves; teeth at the ends of the central and the two main lateral veins usually inconspicuous in mature leaves, obtuse to shortly acuminate (very prominent and acuminate in immature ones). ***Leaf base*** usually from U-shaped to lyre-shaped, rarely broadly V-shaped. ***Petiole*** with arachnoid and hirtellous pubescence, yellowish-green to reddish-brown.

Etymology:—dedicated to Franz Kober (1864–1943), Austrian agronomist famous for selecting the rootstock hybrid 'Kober 5 BB', one of the most successfully employed in viticulture (Bauer 2009).

Ecology:—deep, highly fertile and moist soils; calcifile, heliophilous. Reported as characteristic of the association *Rubo ulmifolii-Salicetum albae* Allegrezza, Biondi & Felici 2006 (Allegrezza *et al.* 2006).

Area of origin and distribution in Europe:—rootstock hybrid originated in Europe. In Europe, it is known as a naturalized alien in Spain (Laguna Lumbreras 2004).

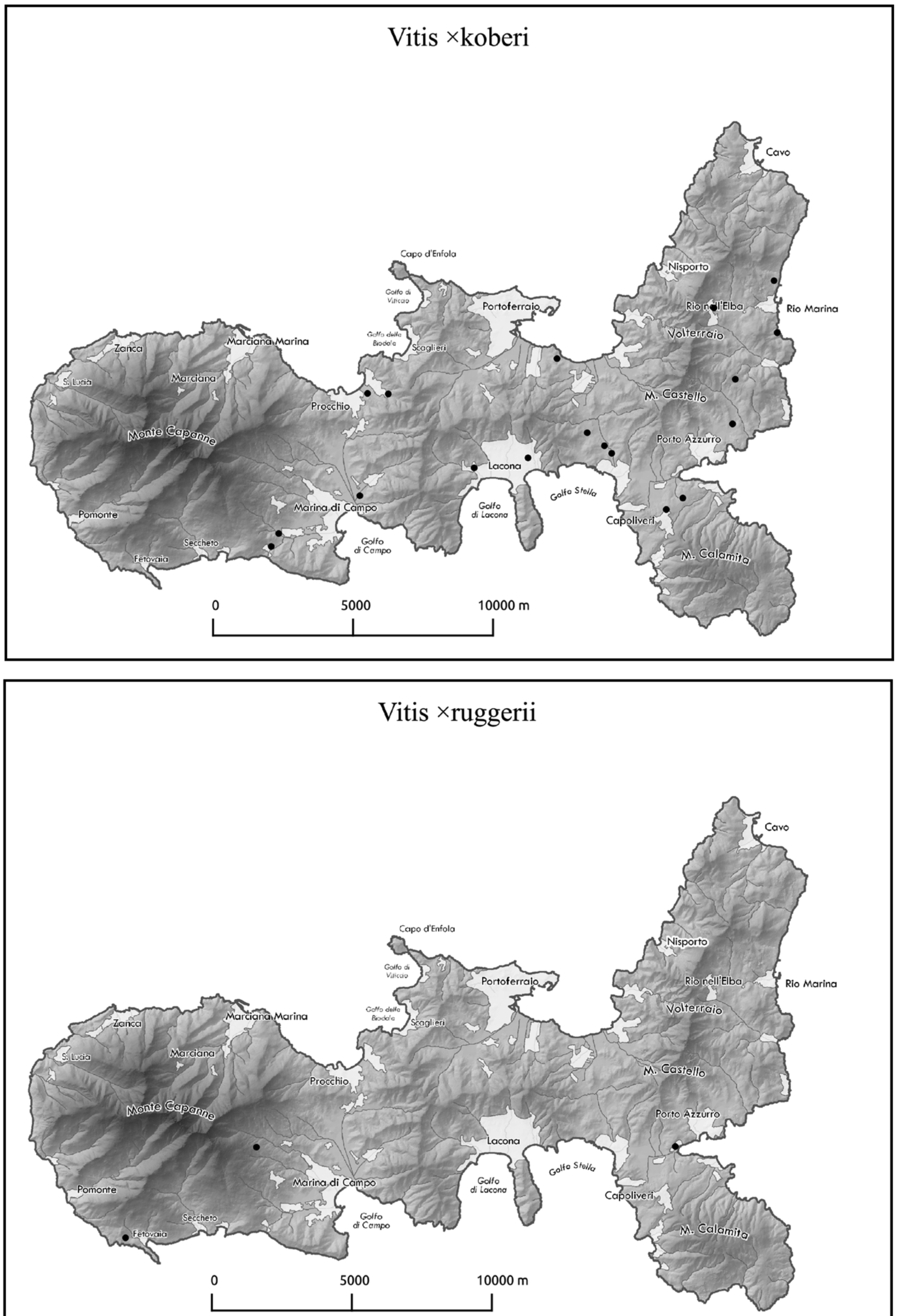


FIGURE 16. Geographical distribution in Elba Island of *V.* ×*koberi* and *V.* ×*ruggerii*.

Distribution in Italy:—Piedmont (Galasso *et al.* 2007, originally misidentified with *V. riparia*), Lombardy (Ardenghi *et al.* 2010), Trentino-Alto Adige and Veneto (Prosser *et al.* 2009), Liguria (Galasso *et al.* 2007, originally misidentified with *V. riparia*), Emilia-Romagna (Galasso *et al.* 2007, originally misidentified with *V. riparia*, Bracchi & Romani 2010), Marche (Biondi *et al.* 2003, Conti *et al*. 2013), Tuscany (Galasso *et al.* 2007, originally misidentified with *V. riparia*), Abruzzo (Galasso 2011), Apulia (Bartolucci & Conti 2009, originally misidentified with *V. riparia*, Galasso 2011), and Sardinia (Lazzeri *et al.* 2013a); invasive, much more than *V. riparia*. The presence of *V.* ×*koberi* in Italy dates back at least to 1892 (specimen from Tuscany in FI; see *specimina visa*).

Distribution and habitat in Elba island:—widespread: recorded in the municipalities of Campo nell'Elba, Marciana, Capoliveri, Portoferraio, Rio Marina, Rio nell'Elba, and Porto Azzurro (Fig. 16); edges of roads, abandoned vineyards, edges of mediterranean maquis and woods at 6–137 m.

Degree of naturalization in Elba island:—invasive.

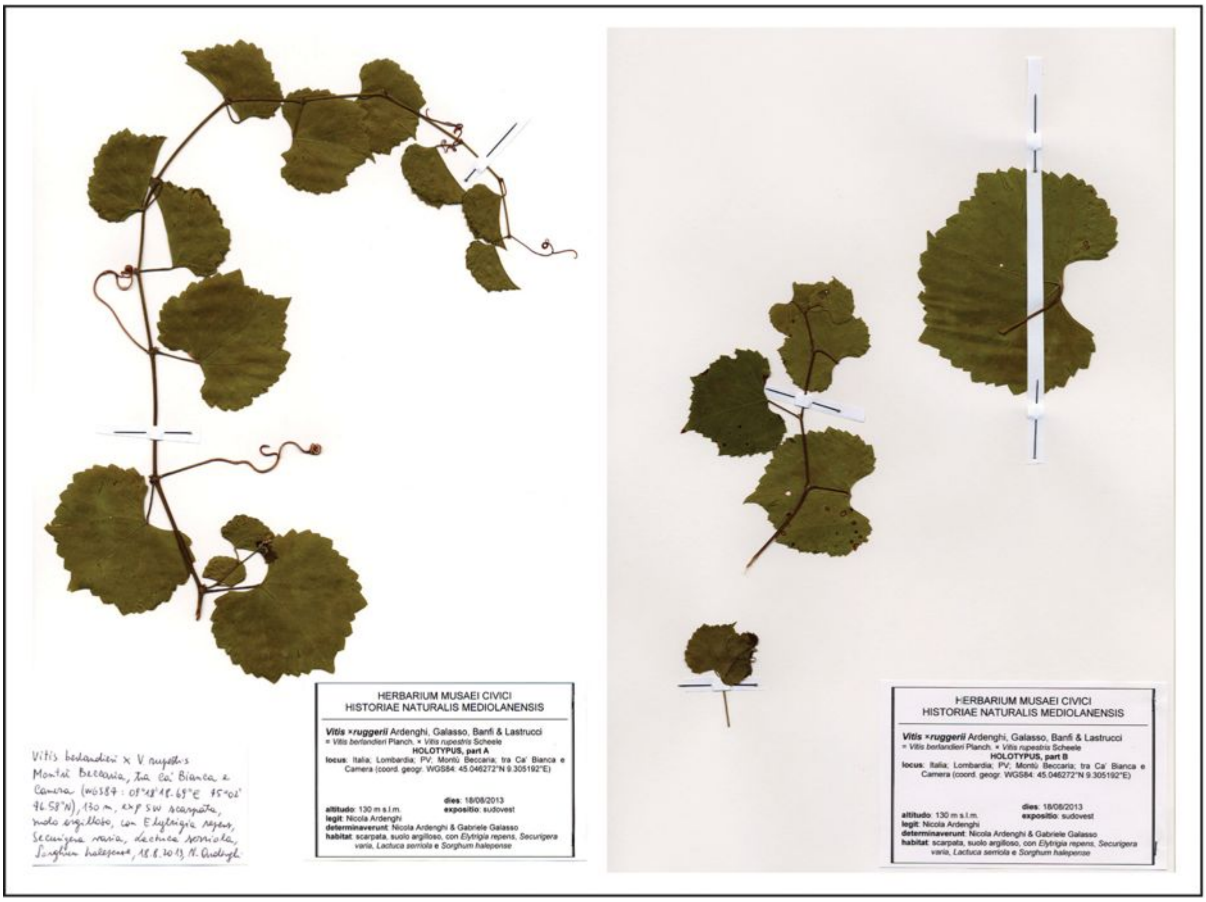
Rootstock use:—very frequent. About half of the rootstocks used in Italy employ this hybrid. The most widespread ('Kober 5 BB', '157-11', 'S.O.4', '34 E.M.', '225 Ru', '420 A') are well adapted to limestone-based soils, but not always to drought. A hybrid between *V. berlandieri* and *V. vinifera* ('41 B'), highly resistant to limestone, is sometimes used.

Notes:—the record of *V. berlandieri* × *vinifera* by Bracchi & Romani (2010) is to refer to *V.* ×*koberi* (see: http://www.actaplantarum.org/floraitaliae/viewtopic.php?f=121&t=12852).

Vitis ×***ruggerii*** Ardenghi, Galasso, Banfi & Lastrucci, *hybr. nov.* Figs. 3H, 4C, 4F, 6G–H, 7F, 17, 18.
(*V. berlandieri* Planchon × *V. rupestris* Scheele)

Planta hybrida, a V. rupestri foliorum laminae dentibus obtusis, pubescentia araneosa supra nervos in petioli iunctura, foliorum basi interdum lyrata vel U usque ad V formam suscipienti differt; a V. berlandieri laminis minoribus, cordato-rotundatis, in longitudinem plicatis (saltem superioribus), nervis rubris differt.

Type:—ITALY. **Lombardy**: Montù Beccaria (Pavia), tra Ca' Bianca e Camera (WGS84: 45.046272°N 9.305192°E), 130 m, exp. SW, scarpata, suolo argilloso, con *Elytrigia repens*, *Securigera varia*, *Lactuca serriola* e *Sorghum halepense*, 18 August 2013, *N. Ardenghi s.n.* (holotype MSNM!, 2 sheets, isotype FI!, 2 sheets) (Fig. 17)



Vitis berlandieri × V. rupestris
Montù Beccaria, tra Ca' Bianca e
Camera (WGS84: 09°18'18.69"E 45°02'
46.58"N), 130 m, exp SW scarpata,
suolo argilloso, con Elytrigia repens,
Securigera varia, Lactuca serriola,
Sorghum halepense, 18.8.2013, N. Ardenghi

HERBARIUM MUSAEI CIVICI
HISTORIAE NATURALIS MEDIOLANENSIS

Vitis ×ruggerii Ardenghi, Galasso, Banfi & Lastrucci
= *Vitis berlandieri* Planch. × *Vitis rupestris* Scheele
HOLOTYPUS, part A
locus: Italia; Lombardia; PV; Montù Beccaria; tra Ca' Bianca e Camera (coord. geogr. WGS84: 45.046272"N 9.305192"E)
dies: 18/08/2013
altitudo: 130 m s.l.m.
expositio: sudovest
legit: Nicola Ardenghi
determinaverunt: Nicola Ardenghi & Gabriele Galasso
habitat: scarpata, suolo argilloso, con *Elytrigia repens*, *Securigera varia*, *Lactuca serriola* e *Sorghum halepense*

HERBARIUM MUSAEI CIVICI
HISTORIAE NATURALIS MEDIOLANENSIS

Vitis ×ruggerii Ardenghi, Galasso, Banfi & Lastrucci
= *Vitis berlandieri* Planch. × *Vitis rupestris* Scheele
HOLOTYPUS, part B
locus: Italia; Lombardia; PV; Montù Beccaria; tra Ca' Bianca e Camera (coord. geogr. WGS84: 45.046272"N 9.305192"E)
dies: 18/08/2013
altitudo: 130 m s.l.m.
expositio: sudovest
legit: Nicola Ardenghi
determinaverunt: Nicola Ardenghi & Gabriele Galasso
habitat: scarpata, suolo argilloso, con *Elytrigia repens*, *Securigera varia*, *Lactuca serriola* e *Sorghum halepense*

FIGURE 17. Holotype of *V.* ×*ruggerii* Ardenghi, Galasso, Banfi & Lastrucci (MSNM).

Deciduous woody vine, caespitose or climbing; branchlets with arachnoid pubescence. ***Tendrils*** bifurcate, a tendril or inflorescence present at only 2 consecutive nodes. ***Leaf blades*** usually thick, generally up to 10 cm long (occasionally longer), conduplicately folded (particularly when young) or slightly so, slightly cordate to kidney-shaped, sometimes slightly wider than long, entire (rarely shallowly 3-lobed). ***Adaxial surface*** dark green to bright green, lustrous, glabrous in mature leaves, veins bright red at least basally; ***abaxial surface*** glabrous, with whitish arachnoid pubescence on the veins at the petiole insertion; veins surface with arachnoid pubescence, sometimes accompanied by short hirtellous hairs (usually shorter and more scattered than in *V. riparia* and its hybrids), without dense tufts of hairs at their axils. ***Margins*** glabrous (hirtellous pubescence sometimes concentrated near the petiole insertion), reddish, serrate-dentate, teeth usually obtuse, sometimes equilateral triangle-shaped, broad; teeth at the ends of the central and the two main lateral veins inconspicuous or slightly prominent, broadly triangular. ***Leaf base*** truncate, broadly U-shaped, V-shaped or broadly lyre-shaped. ***Petiole*** arachnoid pubescent and shortly hirtellous, usually reddish to bright red.

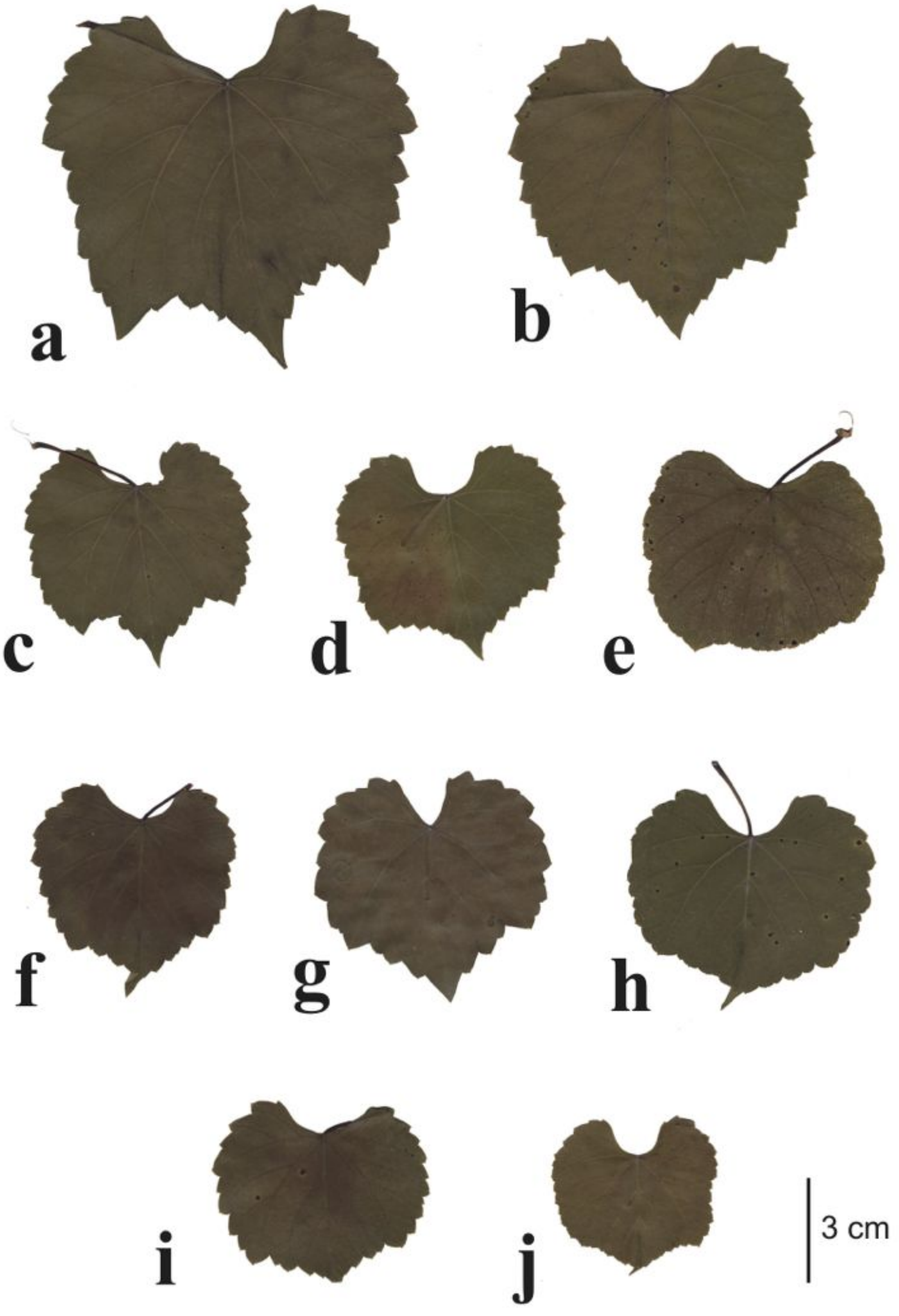


FIGURE 18. *Vitis ×ruggerii*. Leaf blade variability: **a–f)** adaxial surface.

Etymology:—dedicated to Antonio Ruggeri (1859–1915), Italian agronomist, who selected in 1897 the hybrid '140 Ru', one of the most widespread and employed rootstock in viticulture (Galet 1988, Tricamo 2010).

Ecology:—dry and compact soils; calcifile, heliophilous.

Area of origin and distribution in Europe:—rootstock hybrid originated in Europe. In Europe, it is known as a naturalized alien in Spain (Laguna Lumbreras 2004).

Distribution in Italy:—Lombardy (Ardenghi *et al.* 2010), and Tuscany (Lazzeri *et al*. 2013a, but only as casual); naturalized.

Distribution and habitat in Elba island:—rather rare: recorded from Campo nell'Elba and Capoliveri municipalities (Fig. 16); edges of roads, and shrublands at 4–327 m.

Degree of naturalization in Elba island:—naturalized.

Rootstock use:—frequent. In Italy, this hybrid is employed in nine rootstocks; among these, '140 Ru', '1103 P', '779 P', and '775 P' are the most used, mainly in the central and southern regions. They are characterized by resistance to drought and limestone.

Notes:—the scarce diffusion of this hybrid in the wild is possibly due to its recent employment in the Italian vineyards and to its difficult reproduction from cuttings (Eynard & Dalmasso 1990).

Acknowledgments

The authors are indebted to Dr. Michele Zilioli (Laboratorio di Entomologia/Microscopia Elettronica, Museo di Storia Naturale di Milano), for kindly acquiring the images at the scanning electron microscope, and to Dr. Giulia Ardenghi (Stradella, Pavia), for the precious graphic assistance in the digital image preparation. We are also grateful to Dr. Anna M. Stalter (BH), for sending pictures of type specimens of *V. cordifolia* var. *helleri*, to Dr. Alina Freire-Fierro and Dr. Chelsea Smith (PH), for the information regarding the holotype of *V. berlandieri*, and to Dr. Filippo Prosser (ROV), for providing exsiccata from Trentino-Alto Adige and Veneto.

References

Acosta, A., Carranza, M.L., Ciaschetti, G., Conti, F., Di Martino, L., D'Orazio, G., Frattaroli, A., Izzi, C.F., Pirone, G. & Stanisci, A. (2007) Specie vegetali esotiche negli ambienti costieri sabbiosi di alcune regioni dell'Italia Centrale. *Webbia* 62(1): 77–84.
http://dx.doi.org/10.1080/00837792.2007.10670817

Allegrezza, M., Biondi, E. & Felici, S. (2006) A phytosociological analysis of the vegetation of the Central Adriatic sector of the Italian Peninsula. *Hacquetia* 5(2): 135–175.

Ardenghi, N.M.G. (2010) Notulae 8–21. *In*: Galasso, G. & Banfi, E. (eds.), Notulae ad plantas advenas longobardiae spectantes: 1(1–28). *Pagine Botaniche* 34: 22–30.

Ardenghi, N.M.G. (2012) Notulae 51–94. *In*: Galasso, G. & Banfi, E. (eds.), Notulae ad plantas advenas longobardiae spectantes: 2 (29–140). *Pagine Botaniche* 35(2011): 58–78.

Ardenghi, N., Arrigoni, P., Assini, S., Banfi, E., Bona, I., Bonali, F., Brusa, G., Cattaneo, G., Ceffali, G., Colatore, A., Federici, G., Fenaroli, F., Ferranti, R., Frattini, S., Galasso, G., Gariboldi, L., Giordana, F., Gruppo Botanico Milanese, Gruppo Flora Alpina Bergamasca, Gruppo Bresciano di Ricerca Floristica, Guiggi, A., Kleih, M., Martini, F., Mauri, S., Parolo, G., Perico, M., Prosser, F., Rovelli, P., Sartori, F., Truzzi, A., Villa, M. & Zanotti, E. (2010) Dati su presenza e distribuzione provinciale. *In*: Banfi, E. & Galasso, G. (eds.), *La flora esotica lombarda*. Museo di Storia Naturale di Milano, Milano, 274 pp. + CD-ROM.

Ardenghi, N.M.G. & Galasso, G. (2013) *Vitis labrusca* L.. *In*: Greuter, W. & Raab-Straube, E. von (eds.), Euro+Med-Checklist Notulae, 2 [Notulae ad floram euro-mediterraneam pertinentes 31]. *Willdenowia* 43(2): 245.
http://dx.doi.org/10.3372/wi.43.43202

Arrigo, N. & Arnold, C. (2007) Naturalised *Vitis* Rootstocks in Europe and Consequences to Native Wild Grapevine. *PLoS ONE* 2(6): e521.
http://dx.doi.org/10.1371/journal.pone.0000521

Bailey, L.H. (1934) The Species of Grapes peculiar to North America. *Gentes Herbarum* 3(4): 149–244.

Banfi, E. (2013) Le piante viaggiano, il mondo cambia. *Altre Modernità* 10: 1–10.

Banfi, E. & Galasso, G. (2010) *La flora esotica lombarda*. Museo di Storia Naturale di Milano, Milano, 274 pp. + CD-ROM.

Bartolucci, F. & Conti, F. (2009) Notula: 1539. *In*: Nepi, C., Peccenini, S. & Peruzzi, L. (eds.), Notulae alla checklist della flora vascolare italiana: 7 (1530–1567). *Informatore Botanico Italiano* 41(1): 131.

Bartram, W. (1804) Account of the Species, Hybrids, and Other Varieties of the Vine of North-America. *Medical Repository* ser. 2, 1: 19–24.

Bauer, W. (2009) Kober, Franz (1864–1943). *In*: Claus, P. (ed.), Persönlichkeiten der Weinkultur. Kurz-Biographien aus 16 Jahrhunderten. *Schriften zur Weingeschichte* 140, 2., erweiterte Auflage 2002, mit Ergänzungen 2005 und 2009. Available from: http://www.geschichte-des-weines.de/ (accessed: 16 December 2013).

Bernardo, L., Bartolucci, F., Cancellieri, L., Costalonga, S., Galasso, G., Galesi, R., Gargano, D., Iberite, M., Iocchi, M., Lattanzi, E., Lavezzo, P., Magrini, S., Peccenini, S., Sciandrello, S., Scoppola, A., Signorino, G., Tilia, A. & Spampinato, G. (2012) Contributo alla conoscenza floristica della Calabria: resoconto dell'escursione del Gruppo di Floristica (S.B.I.) nel 2008 nella Presila Catanzarese. *Informatore Botanico Italiano* 44(1): 125–151.

Biondi, E., Pinzi, M. & Banchelli, M. (2003) La flora della Selva di Gallignano. *I Quaderni della Selva* 1: 1–84.

Bodor, P., Deák, T., Höhn, M. & Bisztray, G.D. (2011) Morphological and molecular identification of invasive and autochthonous *Vitis* taxa along Hungary. *In*: Bohren, C., Bertossa, M., Schoenenberger, N., Rossinelli, M. & Conedera, M. (eds.), *3rd International Symposium on Environmental Weeds and Invasive Plants. Abstracts. October 2 to 7, 2011. Monte Verità, Ascona, Switzerland.* Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, p. 38.

Bracchi, G. & Romani, E. (2010) *Checklist aggiornata e commentata della flora vascolare della Provincia di Piacenza*. Museo Civico di Storia Naturale di Piacenza, Piacenza, 395 pp.

Britton, N.L. & Brown, A. (1913) *An Illustrated Flora of the northern United States, Canada and the British possessions: from Newfoundland to the parallel of the southern boundary of Virginia, and from the Atlantic Ocean westward to the 102d meridian. ed. 2*. Charles Scribner's Sons, New York, 735 pp.
http://dx.doi.org/10.5962/bhl.title.55504

Celesti-Grapow, L., Pretto, F., Brundu, G., Carli, E. & Blasi, C. (eds.) (2009) *A thematic contribution to the National Biodiversity Strategy. Plant invasion in Italy, an overview*. Ministry for the Environment Land and Sea Protection, Nature Protection Directorate, Roma, 32 pp. + CD-ROM.

Clausen, R.T. (1949) Checklist of the vascular plants of the Cayuga quadrangle 42°-43° N., 76°-77° W. *Cornell University Agricultural Experiment Station Memoir* 291: 1–87.

Comeaux, B.L. (1987) Overview of the native grapes of Texas. *Proceedings of the Texas Grape Growers Association* 10: 15.

Conti, F., Abbate, G., Alessandrini, A. & Blasi, C. (eds.) (2005) *An Annotated Checklist of the Italian Vascular Flora*. Palombi Editori, Roma, 420 pp.

Conti, F., Bracchetti, L. & Gubellini, L. (2013) *Flora della Riserva naturale regionale Sentina: atlante fotografico delle piante vascolari*. FastEdit, Acquaviva Picena, 162 pp.

Daisie (2013) *Delivering Alien Invasive Species Inventories for Europe*. Available from: http://www.europe-aliens.org (accessed: 30April 2013).

Eynard, I. & Dalmasso, G. (1990) *Viticoltura moderna: manuale pratico*. Hoepli, Milano, 747 pp.

Facsar, G. & Udvardy, L. (2008) Adventive grapevine species (*Vitis*-species). *In*: Botta-Dukát, Z. & Balogh, L. (eds.), *The most important invasive plants in Hungary.* Institute of Ecology and Botany, Hungarian Academy of Sciences, Vácrátót, pp. 47–54.

Fennell, J.L. (1940) Two new North American species of *Vitis*. *Journal of the Washington Academy of Sciences* 30(1): 15–19.

Fernald, M.L. (1939) New Species, Varieties and Transfers. *Rhodora* 41(489): 423–461.

Ferretti, G., Lazzaro, L., Giuliani, C. & Foggi, B. (2013) Secondo contributo alla conoscenza della flora esotica dell'Arcipelago Toscano, Italia. *Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano* 154(2): 115–130.

Fiori, A. & Paoletti, G. (1900) *Flora analitica d'Italia* 2(1). Tipografia del Seminario, Padova, pp. 1–256.

Fisk, C. & Krings, A. (2009) Clarification of the typification of Michaux names in eastern North American *Vitis* (Vitaceae). *Journal of the Botanical Research Institute of Texas* 3(2): 739–740.

Forster, J.R. & Forster, G. (1775) *Characteres Generum Plantarum, quas in itinere ad insulas maris Australis, collegerunt, descripserunt, delinearunt, annis MDCCLXXII-MDCCLXXV.* B. White, T. Cadell, & P. Elmsly, Londini, 75 pp.
http://dx.doi.org/10.5962/bhl.title.4448

Fossi Innamorati, T. (1983) La flora vascolare dell'Isola d'Elba (Arcipelago Toscano). Parte prima. *Webbia* 36(2): 273–411.
http://dx.doi.org/10.1080/00837792.1983.10670255

Galasso, G. (2011) Notulae: 111–112. *In*: Barberis, G., Nepi, C., Peccenini, S. & Peruzzi, L. (eds), Notulae alla checklist della flora vascolare italiana: 12 (1823–1883). Notulae alla flora esotica d'Italia: 5 (90–114). *Informatore Botanico Italiano* 43(2): 376–377.

Galasso, G., Banfi, E., Alessandrini, A., Lastrucci, L., Padula, M. & Zoccola, A. (2007) Notula: 1286. *In*: Conti, F., Nepi, C. & Scoppola, A. (eds.), Notulae alla checklist della flora vascolare italiana: 3 (1267–1310). *Informatore Botanico Italiano* 39(1): 243–244.

Galet, P. (1988) *Cépages et vignobles de France. Tome 1: Les vignes américaines*. Déhan, Montpellier, 560 pp.

Gandhi, K.N. & Brown, L.E. (1989) A nomenclature note on *Vitis cinerea* and *V. berlandieri* (Vitaceae). *Sida* 13(4): 506–509.

Gmelin, C.C. (1805) *Flora badensis alsatica* 1. In officina Aul. Mülleriana, Karlsruhe, 768 pp.

Gray, A. (1856) *A manual of the botany of the Northern United States. Second edition.* George P. Putnam & Co., New York, 739 pp.

Gray, A. (1867) *A manual of the botany of the Northern United States. Fifth edition.* Ivison, Phinney, Blakeman, & Co., New York and Chicago, 701 pp.

Gray, A. (1897) *Synoptical Flora of North America* 1(1[2]). American Book Company, New York, Cincinnati and Chicago, pp. 207–506.

Hegi, G. (1924–1925) *Illustrierte Flora von Mittel-Europa. Mit besonderer Berücksichtigung von Deutschland, Oesterreich und der Schweiz. Zum Gebrauche in den Schulen und zum Selbstunterricht* 5(1). J.F. Lehmanns Verlag, München, pp. 1–674 [pp. 1–156 (parts 64–66) October 1924, pp. 157–316 (parts 67–69) December 1924, pp. 317–476 (parts 70–72) April 1925, pp. 477–674 (parts 73–76) August 1925].

Hegi, G. (1965) *Illustrierte Flora von Mittel-Europa. ed. 2* 5(1). Carl Hanser Verlag, München, pp. 1–678d.

Hitchcock, A.S. & Green, M.L. (1929) Standard species of Linnean genera of Phanerogamae (1753–54). *In*: Fifth International Botanical Congress, Nomenclature: Proposals by British Botanist. His Majesty's Stationary Office, London, pp. 111–199.

Jussieu, A.L. de (1818) *In*: Cuvier, G.F. *Dictionnaire des Sciences Naturelles, dans lequel on traite méthodiquement des différens êtres de la nature, considérés soit en eux-mêmes, d'aprés l'état actuel de nos connoissances, soit relativement à l'utilité quén peuvent retirer la médecine, l'agriculture, le commerce et les arts. ed. 2* 10. F. G. Levrault, Strasbourg, Le Normant, Paris, pp. 103.
http://dx.doi.org/10.5962/bhl.title.42219

Kuntze, O. (1881) *Um die Erde.* Verlag von Paul Frohberg, Leipzig, 514 pp.

Kuntze, O. (1891) *Revisio generum plantarum* 1. Arthur Felix, Leipzig, pp. 1–374.

Laguna Lumbreras, E. (2003a) Sobre las formas naturalizadas de *Vitis* L. (*Vitaceae*) en la Comunidad Valenciana, I. Especies. *Flora Montiberica* 23: 46–82.

Laguna Lumbreras, E. (2003b) Datos sobre la producción de fruto de las especies e híbridos invasores de vides (*Vitis* L.). *Toll Negre* 2: 10–15.

Laguna Lumbreras, E. (2004) Datos foliares de la especies e híbridos alóctonos de vides (género *Vitis*) en el territorio valenciano. *Toll Negre* 3: 11–25.

Lastrucci, L., Calamassi, R., Ferretti, G., Galasso, G. & Foggi, B. (2012) Contributo alla conoscenza della flora esotica dell'Isola di Capraia (Arcipelago Toscano, Italia). *Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano* 153(1): 127–134.

Lazzaro, L., Ferretti, G., Galasso, G., Lastrucci, L. & Foggi, B. (2013) Contributo alla conoscenza della flora esotica dell'Arcipelago Toscano, Italia. *Atti della Societa Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano* 154(1): 3–24.

Lazzeri, V., Mascia, F., Sammartino, F., Campus, G., Caredda, A., Carlesi, V., Fois, M., Gestri, G., Mannocci, M., Mazzoncini, V., Lombraña, A.C. & Santinelli, M. (2013a) Novità floristiche per le regioni Sardegna e Toscana. *ActaPlantarum Notes* 2: 42–59.

Lazzeri, V., Sammartino, F. & Santinelli, M. (2013b) Noterella 0081. *Vitis rupestris* Scheele. *ActaPlantarum Notes* 1: 134.

Linnaeus, C. (1753) *Species Plantarum*. L. Savius, Stockholm, 1200 pp.
http://dx.doi.org/10.5962/bhl.title.669

Linnaeus, C. (1754) *Genera Plantarum, ed. 5*. L. Savius, Stockholm, 500 pp.
http://dx.doi.org/10.5962/bhl.title.746

Martinez, M.-C. & Grenan, S. (1999) A graphic reconstruction of an average vine leaf. *Agronomie* 19: 491–507.
http://dx.doi.org/10.1051/agro:19990607

McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Prud'Homme van Reine, W.F., Smith, G.F., Wiersema, J.H. & Turland, N.J. (eds.) (2012) International Code of Nomenclature for algae, fungi, and plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011. *Regnum Vegetabile* 154, 208 pp.

Michaux, A. (1803a) *Flora boreali-americana* 1. Typis Caroli Crapelet, apud Fratres Levrault, Paris & Strasbourg, 330 pp.

Michaux, A. (1803b) *Flora boreali-americana* 2. Typis Caroli Crapelet, apud Fratres Levrault, Paris & Strasbourg, 340 pp.

Millardet, A. (1880) Études sur quelques espèces de vignes sauvages de l'Amérique du Nord, faites au point de vue de leur application a la reconstitution des vignobles détruits par le phylloxera. *Mémoires de la Société des Sciences Physiques et Naturelles de Bordeaux* 2: 305–350.

Ministero delle Politiche Agricole, Alimentari e Forestali (2013) *Registro nazionale delle varietà di vite*. Available from: http://catalogoviti.politicheagricole.it/home.php (accessed: 13 September 2013).

Moore, M.O. (1991) Classification and systematics of eastern North American *Vitis* L. (Vitaceae) North of Mexico. *Sida* 14(3): 339–367.

Morando, A. (1994) Materiali e tecniche per l'impianto del vigneto. *Vignevini* 22(10): 15–24.

Munson, T.V. (1885) Native grapes of the United States. *Transactions of the American Horticultural Society* 3: 128–140.

Nie, Z.-L., Sun, H., Manchester, S.R., Meng, Y., Luke, Q. & Wen, J. (2012) Evolution of the intercontinental disjunctions in six continents in the *Ampelopsis* clade of the grape family (Vitaceae). *BioMed Central Evolutionary Biology* 12: 17.
http://dx.doi.org/10.1186/1471-2148-12-17

Olivieri, O. (1936) *Vitigni. Porta-innesti americani. Loro riconoscimento ed attitudini colturali.* Ulrico Hoepli, Milano, 251 pp.

Olmo, H.P. (1995) Grapes. *In*: Smartt, J. & Simmonds, N.W. (eds.), *Evolution of crop plants. 2nd ed.* Longman, London, pp. 485–490.

Payne, W.W. (1978) A glossary of plant hair terminology. *Brittonia* 30(2): 239–255.
http://dx.doi.org/10.2307/2806659

Pignatti, S. (1982) *Flora d'Italia* 2. Edagricole, Bologna, 732 pp.

Planchon, J.É. (1875) *Les vignes américaines: leur culture, leur résistance au Phylloxera et leur avenir en Europe*. C. Coulet, Montpellier, and Adrien Delahaye, Paris, 240 pp.

Planchon, J.É. (1880) Le *Vitis Berlandieri*, nouvelle espèce de vigne amèricane. *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences* 91: 425–428.

Planchon, J.É. (1884) *Les vignes américaines: leur culture, leur résistance au Phylloxera et leur avenir en Europe* 8(1). C. Coulet, Montpellier, and Adrien Delahaye, Paris, pp. 370–381.

Planchon, J.É. (1885) *La vigne américaine (et la viticulture in Europe); sa culture, son avenir en Europe* 9(3). C. Coulet, Montpellier, and Adrien Delahaye, Paris, pp. 93–96.

Planchon, J.-E. (1887) Ampelideae. *In*: Candolle, A. de & Candolle, C. de (eds.), *Monographiae phanerogamarum Prodromi nunc continuatio, nunc revisio* 5(2). Sumptibus G. Masson, Parisiis, pp. 305–630.

Prince, W.R. & Prince, W. (1830) *A treatise on the vine.* T. & J. Swords [etc.], New York, 354 pp.
http://dx.doi.org/10.5962/bhl.title.30498

Prosser, F., Bertolli, A. & Festi, F. (2009) *Flora illustrata del Monte Baldo*. Edizioni Osiride, Rovereto (TN), 1236 pp.

Pyšek, P., Sádlo, J. & Mandák, B. (2002) Catalogue of alien plants of the Czech Republic. *Preslia* 74(2): 97–186.

Rafinesque, C.S. (1830) *Medical Flora; or, Medical Botany of the United States of North America* 2. Atkinson & Alexander, Philadelphia, 276 pp.
http://dx.doi.org/10.5962/bhl.title.524

Rehder, A. (1927) *Manual of cultivated trees and shrubs hardy in North America exclusive of the subtropical and warmer temperate regions*. The Macmillan Company, New York, 930 pp.

Ren, H. & Wen, J. (2007) 8. Vitis Linnaeus. *In*: Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.), *Flora of China* 12 (Hippocastanaceae through Theaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis, pp. 210–222.

Robinson, J. (1986) *Vines, Grapes, and Wines: The wine drinker's guide to grape varieties*. Mitcheell Beazley, London, 280 pp.

Romanet du Caillaud, F. (1883) Spinovitis davidi et Vitis romaneti. *Revue Horticole* 55: 53–56.

Scheele, A. (1848) Beiträge zur Flor von Texas. *Linnaea* 21(5): 576–602.

Scossiroli, R.E. (1988) Origine ed evoluzione della vite. *Atti dell'Istituto Botanico e del Laboratorio Crittogamico dell'Università di Pavia* s. 7, 7: 35–55.

Siddiqi, M.A. (1980) Vitaceae. *In*: Jafri, S.M.H. & El-Gadi, A. (eds.), *Flora of Libya* 83. Al-Faateh University, Tripoli, 4 pp.

Small, J.K. (1903) *Flora of the southeastern United States; being descriptions of the seed-plants, ferns and fern-allies growing naturally in North Carolina, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Arkansas, Louisiana and the Indian territory and in Oklahoma and Texas east of the one-hundredth meridian. Flora of the Southeastern United States*. Published by the author, New York, 1370 pp.
http://dx.doi.org/10.5962/bhl.title.133

Storchi, P. & Lelli, L. (2005) Recupero, descrizione e conservazione del germoplasma viticolo toscano. *In*: Turchi, R. (ed.), *Il germoplasma viticolo della Toscana. 1. Vitigni ad uva nera*. ARSIA-Regione Toscana, Firenze, pp. 13–40.

Tricamo, M. (2010) *Antonio Ruggeri (1859–1915), scienziato dimenticato*. BlogSicilia, Palermo. Available from: http://blogsicilia.it (accessed: 1 May 2013).

Tröndle, D., Schöder, S., Kassemeyer, H.-H., Kiefer, C., Koch, M.A. & Nick, P. (2010) Molecular phylogeny of the genus *Vitis* (Vitaceae) based on plastid markers. *American Journal of Botany* 97(7): 1168–1178.
http://dx.doi.org/10.3732/ajb.0900218

Villa, P. (2012) *Coltivare la Vite*. De Vecchi, Giunti Editore, Firenze, Milano, 190 pp.

Ward, D.B. (2006) Keys to the flora of Florida - 13, *Vitis* (Vitaceae). *Phytologia* 88(2): 216–223.

Weakley, A.S., LeBlond, R.J., Sorrie, B.A., Estes, L.D., Mathews, K.G., Witsell, C.T., Gandhi, K. & Ebihara, A. (2011) New combinations, rank changes, and nomenclatural and taxonomic comments in the vascular flora of the southeastern United States. *Journal of the Botanical Research Institute of Texas* 5(2): 437–455.

Wen, J. (2007) Vitaceae. *In*: Kubitzki K. (ed.), *The Families and Genera of Vascular Plants* 9 (Flowering Plants. Eudicots). Springer, Berlin, Heidelberg, pp. 467–479.
http://dx.doi.org/10.1007/978-3-540-32219-1_54

Zecca, G., Abbott, J.R., Sun, W.B., Spada, A., Sala, F. & Grassi, F. (2011) The timing and the mode of evolution of wild grapes (*Vitis*). *Molecular Phylogenetic and Evolution* 62(2): 736–747.
http://dx.doi.org/10.1016/j.ympev.2011.11.015

Zohary, D. & Hopf, M. (2000) *Domestication of Plants in the Old World. 3rd ed.* Oxford University Press, New York, 328 pp.

Appendix 1. *Specimina visa* and field records.

V. labrusca

Specimina visa**:**—ITALY. **Piedmont**: Valenza (Alessandria), loc. Garzaia di Valenza, “Parco del Po e dell’Orba”, sinistra idrografica del fiume Po, 85 m, siepe di *Rubus caesius* di fronte ad un casolare abbandonato all’interno della boscaglia ripariale, 26 May 2009, *N. Ardenghi s.n.* (*Herb. N. Ardenghi* 000101); **Lombardy**: Zerbolò (Pavia), Riserva Naturale Integrale “Bosco Siro Negri”, 75 m, querceto misto con *Quercus robur*, *Robinia pseudoacacia* e *Populus nigra*, 31 July 2010, *N. Ardenghi & G. Rossi s.n.* (*Herb. N. Ardenghi* 001343); Pavia (PV), via Trieste (UTM ED50: 32T 0511884.5004498), 78 m, no exp., siepe di *Ligustrum sinense*, 24 August 2010, *N. Ardenghi s.n.* (MSNM); **Liguria**: Giustenice (SV), torrente Scarincio, destra idrografica, poco a nord dell’autostrada (ED50: 8°16'32"E 44°09'46"N), ca. 10 m, no exp., vegetazione ripariale, 31 July 2007, *G. Galasso s.n.* (MSNM).

V. riparia

Specimina visa**:**—ITALY. **Lombardy**: Orzinuovi (Brescia), Bosco degli Arrighini, 11 August 1977, *C. Zucchi s.n.* (PAV sub *V. vinifera* L.); Stradella (Pavia), regione S. Zeno, destra idrografica del torrente Versa, 83 m, boscaglia ripariale con *Robinia pseudoacacia* L. e *Sambucus nigra* L., fitto popolamento avvolgente la maggior parte degli alberi e degli arbusti circostanti, 3 August 2009, *N. Ardenghi s.n.* (*Herb. N. Ardenghi* 000628); **Emilia-Romagna**: Ravenna, via Romea Nord (SS309), Pineta di San Vitale, Parco Regionale del Delta del Po, 6 m, margine boschivo a ridosso della scarpata stradale, 30 May 2009, *N. Ardenghi s.n.* (*Herb. N. Ardenghi* 000356); **Tuscany**: Rio nell’Elba (Livorno), Case Canovaro (WGS84: 42.794313°N 10.401926°E; staz. 18), 143 m, exp. E, ex vigneto invaso da arbusti, 18 June 2008, *G. Galasso s.n.* (MSNM); Portoferraio (Livorno), Case Norsi (WGS84: 42.773118°N 10.346124°E; staz. 24), 37 m, exp. E, margine stradale, 18 June 2008, *G. Galasso s.n.* (MSNM, 2 sheets).

Localities recorded only in the field:—ITALY. **Tuscany**: Campo nell’Elba (Livorno), via della Costa (SP 25), al Km 16, presso C. Vecchia (WGS84: 42.737522°N 10.135644°E; staz. 31bis), 84 m, exp. SW, gariga, 19 June 2008, *G. Galasso*.

V. rupestris

Specimina visa**:**—ITALY. **Piedmont**: Brignano-Frascata (Alessandria), SP109, ca. 700 m SW da Mola (UTM ED50: 32T 504.4963), 359 m, fosso a lato della strada, con *Cynodon dactylon*, *Lactuca saligna*, *L. serriola*, *Hordeum murinum*, *Mentha spicata* e *Helminthotheca echioides*, 8 August 2013, *N. Ardenghi & M. Barcella s.n.* (FI, *Herb. N. Ardenghi*); **Lombardy**: Stradella (Pavia), tra regione S. Zeno e regione Casamassimini, 110 m, scarpatella alla base di un vigneto, 21 June 2009, *N. Ardenghi s.n.* (*Herb. N. Ardenghi* 000637); Montù Beccaria (Pavia), frazione Molino Quaroni, 89 m, passaggio agricolo presso un vigneto, 10 August 2009, *N. Ardenghi s.n.* (*Herb. N. Ardenghi* 000665); Montebello della Battaglia (Pavia), Tangenziale di Casteggio, presso la rotonda con la SS10, 90 m, ciglio stradale, 2 September 2010, *N. Ardenghi s.n.* (*Herb. N. Ardenghi* 000905); **Liguria**: Pietra Ligure (Savona), torrente Scarincio, sinistra idrografica, tra via Corte e l’autostrada (UTM ED50: 32T 044224.489030), ca. 10 m, no exp., vegetazione ripariale, 14 July 2007, *G. Galasso s.n.* (FI, MSNM, APP, BR); **Tuscany**: Capoliveri (Livorno), Vigne Vecchie (WGS84: 42.749575°N 10.383432°E; staz. 34bis), 97 m, no exp., margine stradale, sugli alberi, 18 June 2008, *G. Galasso s.n.* (MSNM, 4 sheets); Marciana (Livorno), Procchio, strada tra Portoferraio e Procchio, poco prima del Km 7.5 (WGS84: 42.786855°N 10.250458°E; staz. 03), 42 m, exp. NW, margine boschivo, 19 June 2008, *G. Galasso s.n.* (MSNM, 2 sheets); **Calabria**: Sersale (CZ), Contrada Melissaro, verso la discesa per il fiume Uria (UTM WGS84: ca. 33S 0647066.4316972), ca. 380 m, macchia, 5 June 2008, *G. Galasso s.n.* (MSNM); **Sicily**: Pantano Longarini (Pozzallo), 25 April 1969, *S. Brullo s.n.* (CAT 029788 sub *V. vinifera* L.); Salina, Timpone Rosso, 14 May 1970, *S. Brullo* (CAT 029787 sub *V. vinifera* L.).

Localities recorded only in the field:—ITALY. **Tuscany**: Capoliveri (Livorno), La Madonnina (WGS84: 42.749267°N 10.368967°E; staz. 33), 85 m, exp. E, margine stradale, sugli alberi, 18 June 2008, *G. Galasso*; Marciana Marina (Livorno), via dei Pini, loc. I Pini (WGS84: 42.798602°N 10.208139°E; staz. 08), 150 m, exp. NE, margine boschivo, 19 June 2008, *G. Galasso*; Marciana (Livorno), strada tra Zanca e l’Aia, Fosso della Noce (WGS84: 42.802127°N 10.153616°E; staz. 47), 185 m, exp. NE, margine boschivo d’impluvio, 19 June 2008, *G. Galasso*; Campo nell’Elba (Livorno), via della Costa (SP 25), al Km 16, presso C. Vecchia (WGS84: 42.737522°N 10.135644°E; staz. 31bis), 84 m, exp. SW, gariga, 19 June 2008, *G. Galasso*.

V. vinifera

Specimina visa**:**—ITALY. **Lombardy**: Cremona (CR), stazione ferroviaria (WGS84: 45.143684°N 10.018167°E ± 300 m), ca. 45 m, no exp., margine incolto, 6 September 2013, *F. Bonali s.n.* (MSNM); **Tuscany**: Presso Forte Focardo, subspont., 10 May 1898, *S. Sommier s.n.* (FI); S. Anna Macerelli, 7 May 1900, *S. Sommier s.n.* (FI); Bagnaia, nella valle [cultivated, see Fossi Innamorati 1983], 21 July 1974, *T. Fossi Innamorati s.n.* (FI); Marciana (Livorno), strada tra Portoferraio e Procchio, ca. al Km 4.5, presso l’impluvio che scende alla loc. Porticciolo, poco oltre il confine comunale tra Portoferraio e Marciana (WGS84: 42.791003°N 10.264652°E; staz. 01), 134 m, exp. NE, margine boschivo d'impluvio, probabile popolazione selvatica, 26 June 2007, *A. Zoccola s.n.* (MSNM, 3 sheets); *ibidem*, 19 June 2008, *G. Galasso s.n.* (MSNM, 3 sheets); Marciana Marina (Livorno), via dei Pini, loc. I Pini, Villa Maria Stella (WGS84: 42.796311°N 10.209281°E; staz. 09), 177 m, exp. E, margine boschivo, 26 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Campo nell'Elba (Livorno), via del Monumento, poco a est di Bonalaccia-Filetto (WGS84: 42.760672°N 10.257447°E; staz. 44), 73 m, exp. NW, margine stradale, 19 June 2008, *G. Galasso s.n.* (MSNM, 4 sheets); Marciana (Livorno), strada tra Zanca e l'Aia, Fosso della Noce (WGS84: 42.802127°N 10.153616°E; staz. 47), 185 m, exp. NE, margine boschivo d'impluvio, 19 June 2008, *G. Galasso s.n.* (MSNM, 4 sheets); Marciana (Livorno), strada tra Zanca e l'Aia, Fosso Marconi (WGS84: 42.799511°N 10.141608°E; staz. VIT18), 165 m, exp. N, margine boschivo d'impluvio, 21 June 2008, *G. Galasso s.n.* (MSNM, 3 sheets); Marciana (Livorno), Poggio (WGS84: 42.791836°N 10.186183°E; staz. VIT21), 158 m, exp. NE, margine arbustato, 21 June 2008, *G. Galasso s.n.* (MSNM, 2 sheets); **Calabria**: Sersale (CZ), Contrada Melissaro, verso la discesa per il fiume Uria (UTM WGS84: ca. 33S 0647066.4316972), ca. 380 m, macchia, 5 June 2008, *G. Galasso s.n.* (MSNM).

Localities recorded only in the field:—ITALY. **Tuscany**: Capoliveri (Livorno), Lacona, via Capo ai Pini, La Follia (WGS84: 42.765334°N 10.320069°E; staz. 26), 35 m, no exp., margine stradale, sugli alberi, 18 June 2008, *G. Galasso*; Capoliveri (Livorno), Casa Foresi (WGS84: 42.762380°N 10.296517°E; staz. 27), 14 m, exp. SE, margine stradale, 18 June 2008, *G. Galasso*; Capoliveri (Livorno), Case Gualdo (WGS84: 42.751590°N 10.387338°E; staz. 34), 58 m, no exp., margine stradale, a terra e sugli alberi, 18 June 2008, *G. Galasso*; Marciana (Livorno), Procchio, strada tra Portoferraio e Procchio, ca. al Km 6.5, poco oltre l'impluvio della V. Gualdarene (WGS84: 42.786593°N 10.259525°E; staz. 02), 60 m, exp. N, margine boschivo, probabile popolazione selvatica, 19 June 2008, *G. Galasso*; Marciana (Livorno), via Lavacchio (WGS84: 42.790550°N 10.198837°E; staz. 46), 230 m, exp. NW, margine stradale, sugli alberi, 19 June 2008, *G. Galasso*; Campo nell'Elba (Livorno), via della Costa (SP 25), al Km 16, presso C. Vecchia (WGS84: 42.737522°N 10.135644°E; staz. 31bis), 84 m, exp. SW, gariga, 19 June 2008, *G. Galasso*.

Vitis* ×*instabilis

***Specimina visa*:**—ITALY. **Piedmont**: Dernice (Alessandria), SP110, lato S, tra Fontanelle e Vigana (UTM ED50: 32T 505.4957), 479 m, exp. SE, scarpata stradale rinforzata (gabbioni con pietre), con *Rubus* sect. *Corylifolii*, *Elytrigia repens*, *Dactylis glomerata*, *Galium mollugo* e *Cephalaria transsylvanica*, 8 August 2013, *N. Ardenghi & M. Barcella s.n.* (FI, *Herb. N. Ardenghi*); Dernice (Alessandria), Vigoponzo, SP110, dietro al cimitero (UTM ED50: 32T 503.4955), 529 m, exp. SE, scarpata a ridosso della strada, con *Elytrigia repens*, *Cephalaria transsylvanica*, *Dactylis glomerata*, *Centaurea jacea* subsp. *gaudinii*, *Inula bifrons*, 8 August 2013, *N. Ardenghi & M. Barcella s.n.* (FI, *Herb. N. Ardenghi*); **Lombardy**: Rivolta d'Adda (CR), bordo bosco, 19 April 1982, *R. Cavani, V. Terzo & R. Zucchetti s.n.* (PAV sub *V. vinifera* L.); Manerba del Garda (BS), Crociale, via Trevisago, al margine della strada (WGS84: 45.545060°N 10.532049°E ± 300 m), ca. 119 m, no exp., margine stradale, 3 October 2007, *G. Ceffali s.n.* (MSNM); Stradella (Pavia), località Rile, 120 m, sponda di un fosso, 8 May 2009, *N. Ardenghi s.n.* (*Herb. N. Ardenghi* 000217, 000227); Godiasco (Pavia), a S del ponte di Via Chiesa Nuova, destra idrografica del torrente Staffora, 185 m, robinieto (*Balloto nigrae-Robinion*), accanto ad una piccola discarica abusiva di tegole, 8 July 2010, *N. Ardenghi s.n.* (*Herb. N. Ardenghi* 002141); Bordolano (CR), strada tra Cascina Crotta e Cascina Villa Alpino, lungo la roggia Crottina (UTM ED50: 32T 0575753.5016673), 59 m, no exp., boschina, 3 September 2010, *F. Bonali s.n.* (MSNM sub *V. riparia*); Montagna in Valtellina (Sondrio), sterrata a N di Via Dosso, a E dell'acquedotto, 632 m, margine di boscaglia con *Quercus pubescens* Willd. e *Q. petraea* (Matt.) Liebl., 23 October 2010, *N. Ardenghi & G. Parolo s.n.* (*Herb. N. Ardenghi* 001026); Ranzanico (BG), loc. Dosso, margine di via Bergamo (UTM ED50: 32T 0572606.5069745), 355 m, exp. S, margine stradale, 4 November 2010, *G. Federici s.n.* (MSNM); Caprino Bergamasco (BG), via Pozzoni, bivio per la loc. Celana (UTM ED50: 32T 0537668.5066645), 356 m, exp. S, boscaglia, 28 September 2011, *G. Federici s.n.* (MSNM); Milano (MI), via Novara, lato dei numeri dispari all'altezza di Quinto Romano, di fronte al distributore GPL (UTM ED50: 32T 0507974.5036474±10 m), 128 m, no exp., margine stradale, 12 May 2013, *G. Galasso s.n.* (MSNM); **Trentino-Alto Adige**: Rovereto (Trento), Navesel, al depuratore, 170 m, inselvatichita, 13 May 2003, *C. Raffaelli s.n.* (ROV sub *V. vinifera* L.); Avio (Trento): sponda destra dell'Adige a SE della zona industriale (WGS84: 10.940006°E 45.726718°N), 130 m, boscaglia di sponda, un esemplare avventizio (originato da radici scaricate sulla sponda?), 14 September 2006, *A. Bertolli & F. Prosser s.n.* (ROV sub *V.* cf. *riparia* Michx.); **Veneto**: Cerea (Verona): ca. 300 m a W di Tombolo, 15 m, in un pioppeto, 27 April 2002, *F. Prosser s.n.* (ROV sub *V. labrusca* L.); **Liguria**: Tovo San Giacomo (SV), torrente Maremola, destra idrografica a sud del centro abitato (accesso da via 18 gennaio 57) (ED50: 8°16'11" 44°10'26"), ca. 20 m, no exp., boscaglia ripariale ad *Alnus glutinosa*, 14 July 2007, *G. Galasso s.n.* (FI, MSNM, APP, BR sub *V. riparia* Michx.); Pietra Ligure (Savona), torrente Scarincio, sinistra idrografica, presso la confluenza col torrente Maremola (UTM ED50: 32T 044252.489017), ca. 10 m, no exp., vegetazione ripariale, 14 July 2007, *G. Galasso s.n.* (FI, MSNM, APP, BR); Villanova d'Albenga (Savona), torrente Arroscia, presso Villanova, sinistra idrografica (UTM ED50: 32T 043150.487804), ca. 40 m, no exp., margine stradale, 1 August 2007, *G. Galasso s.n.* (FI, MSNM, APP); Pietra Ligure (Savona), Rocca delle Fene, sterrata tra via Piave e via Ranzi (UTM ED50: 32T 0442322.4889658 ± 70 m), ca. 100 m, exp. N, margine boschivo, 10 August 2008, *G. Galasso s.n.* (FI, MSNM, APP); **Emilia-Romagna**: Cesena (FC), Gattolino, lungo il Canale Emiliano-Romagnolo (WGS84: 44°10'N 12°17'E), 15 m, no exp., sponda erbosa, early

November 2013, *G. Faggi s.n.* (MSNM); **Tuscany**: Marciana (Livorno), Procchio, strada tra Portoferraio e Procchio, poco prima del Km 7.5 (WGS84: 42.786855°N 10.250458°E; staz. 03), 42 m, exp. NW, margine boschivo, 26 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); *ibidem*, 19 June 2008, *G. Galasso s.n.* (MSNM, 2 sheets); Marciana Marina (Livorno), via dei Pini (WGS84: 42.805377°N 10.205311°E; staz. 07), 81 m, exp. NW, margine boschivo, 26 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); *ibidem*, 19 June 2008, *G. Galasso s.n.* (MSNM, 4 sheets); Marciana Marina (Livorno), via dei Pini, loc. I Pini (WGS84: 42.798602°N 10.208139°E; staz. 08), 150 m, exp. NE, margine boschivo, 26 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); *ibidem*, 19 June 2008, *G. Galasso s.n.* (MSNM, 2 sheets); Campo nell'Elba (Livorno), strada tra Sant'Ilario e Poggio, Torre San Giovanni (WGS84: 42.762060°N 10.202015°E; staz. 11), 327 m, exp. E, margine arbustato, 26 June 2007, *A. Zoccola s.n.* (MSNM); Campo nell'Elba (Livorno), strada tra Sant'Ilario e Poggio, oltre il bivio per San Piero in Campo (WGS84: 42.761976°N 10.206559°E; staz. 12), 264 m, exp. SE, margine arbustato, 26 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Campo nell'Elba (Livorno), strada tra Sant'Ilario e Poggio, poco oltre il bivio per San Piero in Campo (WGS84: 42.760506°N 10.210209°E; staz. 13), 220 m, exp. SE, margine arbustato, 26 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Campo nell'Elba (Livorno), Santa Trinità (WGS84: 42.760491°N 10.225119°E; staz. 14), 67 m, exp. NW, margine arbustato, 26 June 2007, *A. Zoccola s.n.* (MSNM, 3 sheets); Rio nell'Elba (Livorno), Case Leonardi (WGS84: 42.792704°N 10.411183°E; staz. 17), 129 m, exp. NE, ex vigneto invaso da arbusti, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Rio nell'Elba (Livorno), Case Canovaro (WGS: 42.794313°N 10.401926°E; staz. 18), 143 m, exp. E, ex vigneto invaso da arbusti, 27 June 2007, *A. Zoccola s.n.* (MSNM); Rio Marina (Livorno), Vigneria (WGS84: 42.821060°N 10.428721°E; staz. 19), 34 m, exp. E, margine stradale, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Rio nell'Elba (Livorno), Case Canovaro (WGS84: 42.794659°N 10.400846°E; staz. 20), 144 m, exp. NE, margine stradale, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Capoliveri (Livorno), Mola (WGS84: 42.760166°N 10.384792°E; staz. 21), 4 m, no exp., margine stradale, 27 June 2007, *A. Zoccola s.n.* (MSNM); Porto Azzurro (Livorno), Case Signorini (WGS84: 42.766375°N 10.356636°E; staz. 22), 12 m, no exp., margine stradale, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Portoferraio (Livorno), Case Norsi (WGS84: 42.773118°N 10.346124°E; staz. 24), 37 m, exp. E, margine stradale, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Capoliveri (Livorno), via Capo ai Pini (SP 30), Casa Riccio (WGS84: 42.764248°N 10.333038°E; staz. 25), 56 m, exp. SE, margine arbustato, 27 June 2007, *A. Zoccola s.n.* (MSNM); *ibidem*, 22 June 2008, *G. Galasso s.n.* (holotype MSNM, 2 sheets, isotype FI); Campo nell'Elba (Livorno), via del Monumento, tra traversa di via Segagnana e via della Foce (WGS84: 42.753966°N 10.246436°E; staz. 28), 6 m, no exp., margine stradale, sugli alberi, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); *ibidem*, 18 June 2008, *G. Galasso s.n.* (MSNM, 2 sheets); Campo nell'Elba (Livorno), via della Costa, tra Cavoli e Seccheto (WGS84: 42.735591°N 10.181444°E; staz. 30), 27 m, exp. S, margine stradale, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Capoliveri (Livorno), La Madonnina (WGS84: 42.749267°N 10.368967°E; staz. 33), 85 m, exp. E, margine stradale, sugli alberi, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Portoferraio (Livorno), strada costiera, tra gli Scoglietti e la Punta delle Grotte (WGS84: 42.797139°N 10.333414°E; staz. 36), 32 m, exp. NE, margine arbustato, 27 June 2007, *A. Zoccola s.n.* (MSNM); *ibidem*, 19 June 2008, *G. Galasso s.n.* (MSNM, 2 sheets); Capoliveri (Livorno), Casa Foresi (WGS84: 42.762380°N 10.296517°E; staz. 27), 14 m, exp. SE, margine stradale, 18 June 2008, *G. Galasso s.n.* (MSNM, 2 sheets); Rio nell'Elba (Livorno), San Quirico (WGS84: 42.827576°N 10.415254°E; staz. 42), 214 m, exp. SE, margine stradale, 18 June 2008, *G. Galasso s.n.* (MSNM, 3 sheets); Marciana (Livorno), Procchio, strada tra Portoferraio e Procchio, ca. al Km 6.5, poco oltre l'impluvio della V. Gualdarene (WGS84: 42.786593°N 10.259525°E; staz. 02), 60 m, exp. N, margine boschivo, 19 June 2008, *G. Galasso s.n.* (MSNM, 3 sheets); Marciana (Livorno), via Lavacchio (WGS84: 42.790550°N 10.198837°E; staz. 46), 230 m, exp. NW, margine stradale, sugli alberi, 19 June 2008, *G. Galasso s.n.* (MSNM, 4 sheets); Marciana (Livorno), strada tra Zanca e l'Aia, Fosso della Noce (WGS84: 42.802127°N 10.153616°E; staz. 47), 185 m, exp. NE, margine boschivo d'impluvio, 19 June 2008, *G. Galasso* s.*n.* (MSNM); Campo nell'Elba (Livorno), via della Costa, poco a ovest di Fetovaia (WGS84: 42.733431°N 10.144344°E; staz. 31), 76 m, exp. S, margine stradale, 20 June 2008, *G. Galasso s.n.* (MSNM); Arcipelago Toscano, Isola di Capraia, paese, area un tempo presumibilmente coltivata a vite ma ormai abbandonata e incolta, June 2011, *L. Lastrucci, B. Foggi & R. Calamassi s.n.* (FI); **Apulia**: Bovino (FG), Strada Statale 90, all'altezza della Stazione ferroviaria di Bovino (UTM ED50: 33T 0530895.4569920), 262 m, no exp., margine stradale, 29 May 2011, *G. Galasso s.n.* (FI, MSNM); **Calabria**: Sersale (CZ), Contrada Melissaro, verso la discesa per il fiume Uria (UTM WGS84: ca. 33S 0647066.4316972), ca. 380 m, macchia, 5 June 2008, *G. Galasso s.n.* (MSNM).

Localities recorded only in the field:—ITALY. **Tuscany**: Porto Azzurro (Livorno), Casa Rosario (WGS84: 42.775209°N 10.409575°E; staz. 15), 32 m, exp. SE, margine stradale, 18 June 2008, *G. Galasso*; Capoliveri (Livorno), Lacona, via Capo ai Pini, La Follia (WGS84: 42.765334°N 10.320069°E; staz. 26), 35 m, no exp., margine stradale, sugli alberi, 18 June 2008, *G. Galasso*; Rio Marina (Livorno), via Bivio Boni Cavo, presso il depuratore (WGS84: 42.826019°N 10.429704°E; staz. 41), 55 m, exp. E, margine stradale, 18 June 2008, *G. Galasso*; Rio nell'Elba (Livorno), via Aldo Moro (WGS84: 42.812625°N 10.402315°E; staz. 43), 133 m, exp. SE, margine stradale, 18 June 2008, *G. Galasso*; Portoferraio (Livorno), Campo ai Peri (WGS84: 42.775435°N 10.350441°E; staz. 23bis), 29 m, no exp., margine stradale, 18 June 2008, *G. Galasso*; Marciana Marina (Livorno), via dei Pini, loc. I Pini, Villa Maria Stella (WGS84: 42.796311°N 10.209281°E; staz. 09), 177 m, exp. E, margine boschivo, 19 June 2008, *G. Galasso*; Rio Marina

(Livorno), San Felo (WGS84: 42.789562°N 10.411111°E; staz. 16), 137 m, exp. SE, margine arbustato, 19 June 2008, *G. Galasso*; Marciana (Livorno), strada tra Zanca e l'Aia, Fosso della Scalinata (WGS84: 42.801742°N 10.146222°E; staz. 48), 180 m, exp. NW, margine stradale, sugli alberi, 19 June 2008, *G. Galasso*; Campo nell'Elba (Livorno), via della Costa (SP 25), al Km 16, presso C. Vecchia (WGS84: 42.737522°N 10.135644°E; staz. 31bis), 84 m, exp. SW, gariga, 19 June 2008, *G. Galasso*.

V. ×koberi

Specimina visa:—ITALY. **Piedmont**: Bolzano Novarese (NO), strada tra Invorio e Bolzano Novarese, sulla sinistra (ED50: 8°27'17" 45°45'46"), ca. 440 m, no exp., piccola boscaglia a *Corylus avellana*, 20 August 2006, *G. Galasso s.n.* (FI, MSNM sub *V. riparia* Michx.); Valenza (Alessandria), loc. Garzaia di Valenza, "Parco del Po e dell'Orba", sinistra idrografica del fiume Po, 85 m, siepe lungo la sterrata che si dirama dalla SS494, 26 May 2009, *N. Ardenghi s.n.* (*Herb. N. Ardenghi* 000145 sub *V. riparia* Michx.); **Lombardy**: Carnate (MB), sinistra idrografica del torrente Molgora, tra Cascina Corrada (Usmate Velate) e San Maurizio (Vimercate), dove il torrente fa una doppia ansa (UTM ED50: 32T 0528.5053), 207 m, no exp., boscaglia umida, con *Filipendula ulmaria*, *Robinia pseudoacacia*, *Aconitum lycoctonum*, *Stellaria aquatica*, 1995, *P. Rovelli s.n.* (MSNM sub *V. vinifera*); Sondrio (SO), frazione Sant'Anna, località Colombera, lungo la strada (WGS84: 46.173180°N 9.856748°E ± 200 m), ca. 485 m, exp. S, margine stradale (naturalizzata), zona vitivinicola, 20 June 2007, *G. Ceffali s.n.* (MSNM); Manerba del Garda (BS), Crociale, via Trevisago, al margine della strada (WGS84: 45.545060°N 10.532049°E ± 300 m), ca. 119 m, no exp., margine stradale, 3 October 2007, *G. Ceffali s.n.* (MSNM); Soncino (CR), Riserva Naturale "Bosco di Barco", fiume Oglio, sinistra idrografica (coord. G-B Roma 40: fuso W 1.569.600-5.025.470) (0625/1: Soncino), 65 m, no exp., boscaglia igrofila, 14 October 2007, *G. Galasso s.n.* (MSNM); Orzinuovi (BS), SP668, distributore Tamoil poco dopo Cascina Cadevilla (WGS84: 45.405008°N 9.961193°E ± 50 m), 81 m, no exp., margine stradale, 1 November 2007, *G. Galasso s.n.* (MSNM); Stradella (Pavia), tra via Ticino e località Corriggio, 66 m, margine stradale, 17 May 2009, *N. Ardenghi s.n.* (*Herb. N. Ardenghi* 000360, 000361); Zerbolò (Pavia), Riserva Naturale Integrale "Bosco Siro Negri", 75 m, querceto misto con *Quercus robur*, *Corylus avellana*, *Ulmus minor*, *Populus nigra*, *Prunus padus* e *Acer campestre*, 31 July 2010, *N. Ardenghi & G. Rossi s.n.* (*Herb. N. Ardenghi* 001344); Ranzanico (BG), incolto a valle di via San Bernardino (UTMED50: 32T 0572968.5071511), 510 m, S, siepe con *Rubus* sp. in terreno coltivato a vite fino a 40 anni fa, 4 November 2010, *G. Federici s.n.* (MSNM); Bergamo (BG), strada vicinale della Mina Benaglia, a E della Circonvallazione Leuceriano (CFCE 0323-2: Treviolo) (UTM ED50: 32T 0548971.5059696), 210 m, exp. S, siepe al margine stradale, 19 July 2011, *G. Federici s.n.* (MSNM); Grumello del Monte (BG), via Fontana Santa (UTM ED50: 32T 0567524.5054400), 231 m, exp. S, siepe al margine stradale, 31 October 2011, *G. Federici s.n.* (MSNM). **Trentino Alto Adige**: Mori (Trento), Lago di Loppio, a Nord dell'Isola di S. Andrea (WGS84: 45.868395°N 10.916435°E), 216 m, da un esemplare inselvatichito nell'alveo asciutto del lago, 11 October 2005, *F. Prosser s.n.* (ROV sub *V.* cf. *riparia* Michx.); Nago-Torbole (Trento) Lago di Loppio, margine NW (dove la pista ciclabile inizia a salire) (WGS84: 45.869045°N 10.911665°E), 220 m, scarpata alberata, da pianta nata autonomamente da seme, 19 October 2005, *F. Prosser s.n.* (ROV sub *V.* cf. *riparia* Michx.); Trento (TN), Piazzale Area ex Zuffo, sotto al cavalcavia di via Dotto Vela (WGS84: 46.075380°N 11.110088°E), 194 m, recinzione di un deposito di laterizi, 4 June 2010, *N. Ardenghi & O. Bellicini s.n.* (MSNM); **Veneto**: Lessini, Vaio Squaranto (Verona): presso la strada poco a nord del vaio di Contrada Roboli, 490 m, base di rupe, bosco, 29 September 2001, *F. Prosser s.n.* (ROV sub *V. vinifera* L.); M. Lessini (Verona): Valpantena, Dorighi, presso loc. Spioncia, 150 m, siepe, inselvatichita, 8 September 2001, *F. Prosser s.n.* (ROV sub *V. vinifera* L.); Torri del Benaco (Verona), Monte Baldo: tra Piaghen e S. Zeno di Montagna, sentiero a valle di loc. Buco della Volpe (WGS84: 45.642291°N 10.722615°E), 340 m, margine radura arida, su calcare, un esemplare, inselvatichito o resto di coltura?, 29 May 2006, *A. Bertolli & F. Prosser s.n.* (ROV sub *V.* cf. *riparia* Michx.); Brentino Belluno (Verona), Valle dell'Adige: sponda destra del F. Adige a ENE di Belluno Veronese (WGS84: 45.689419°N 10.910983°E), 120 m, un esemplare sulla scarpata boscata umida, 18 September 2006, *A. Bertolli & F. Prosser s.n.* (ROV sub *V.* cf. *riparia* Michx.); Rivoli Veronese (Verona), Valle dell'Adige: sponda destra dell'Adige a SE di Canale (WGS84: 45.583933°N 10.840192°E), 100 m, boscaglia umida di ripa, 25 September 2006, *A. Bertolli & F. Prosser s.n.* (ROV sub *V. vinifera* L.); Rivoli Veronese (Verona), Valle dell'Adige: sponda destra del F. Adige a W di Dolcè (WGS84: 45.601129°N 10.845883°E), 105 m, bosco ripariale, 25 September 2006, *A. Bertolli & F. Prosser s.n.* (ROV sub *V.* cf. *riparia* Michx.); Brentino Belluno (Verona), Valle dell'Adige: ca. 1,5 km a NE di Brentino, sulla sponda destra del F. Adige (WGS84: 45.647328°N 10.88962°E), 115 m, boscaglia umida di sponda, 4 October 2006, *A. Bertolli & F. Prosser s.n.* (ROV sub *V.* cf. *riparia* Michx.); **Liguria**: Pietra Ligure (Savona), torrente Scarincio, destra idrografica, tra la confluenza col torrente Maremola e la via Corte (UTM ED50: 32T 044236.489020), ca. 10 m, no exp., vegetazione ripariale, 14 July 2007, *G. Galasso s.n.* (FI, MSNM); **Emilia-Romagna**: Mesola, Bosco della Mesola, 3 August 1966, *P. Stampi s.n.* (FI sub *V. rupestris* Scheele); Modena (MO), lungo il fiume Secchia, destra idrografica, ca. 500 m a valle della cassa d'espansione (UTM ED50: 32T PQ 446.466), ca. 39 m, no exp., margine di bosco igrofilo, 18 June 2006, *A. Alessandrini s.n.* (FI, MSNM sub *V. riparia* Michx.); **Tuscany**: [...] Fiorentino, October 1892, *U. Martelli 13818* (FI sub *V. cordifolia*); Subbiano (AR), fiume Arno, sinistra idrografica presso il Podere San Domenico (UTM ED50: 32T QP 322.202), ca. 260 m, no exp., terrazzo inondabile, 25 June 2006, *L. Lastrucci, M. Padula & A. Zoccola s.n.* (FI sub *V. riparia* Michx.); Marciana (Livorno), Procchio, strada tra Portoferraio e Procchio, ca. al Km 6.5, poco oltre l'impluvio della V. Gualdarene (WGS84: 42.786593°N 10.259525°E; staz. 02), 60 m, exp. N, margine boschivo, 26 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Porto Azzurro (Livorno), Casa Rosario (WGS84: 42.775209°N 10.409575°E; staz. 15), 32 m, exp. SE, margine stradale, 27 June 2007, *A. Zoccola s.n.* (MSNM); Rio Marina (Livorno), San Felo (WGS84: 42.789562°N 10.411111°E; staz. 16), 137 m, exp. SE, margine arbustato, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Porto Azzurro (Livorno), Case Signorini (WGS84: 42.766375°N 10.356636°E; staz. 22), 12 m, no exp., margine stradale, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Capoliveri (Livorno), Villaggio Valdana (WGS84: 42.768897°N 10.353501°E; staz. 23), 25 m, no exp., margine stradale, sugli alberi, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Capoliveri (Livorno), Lacona, via Capo ai Pini, La Follia (WGS84: 42.765334°N 10.320069°E; staz. 26), 35 m, no exp., margine stradale, sugli alberi, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Capoliveri (Livorno), Casa Foresi (WGS84: 42.762380°N 10.296517°E; staz. 27), 14 m, exp. SE, margine stradale, 27 June 2007, *A. Zoccola s.n* (MSNM, 2 sheets); Campo nell'Elba (Livorno), via della Costa, presso Gli Alzi (WGS84: 42.742236°N 10.210807°E; staz. 29), 29 m, exp. E, margine stradale, sugli alberi, 27 June 2007, *A. Zoccola s.n* (MSNM, 2 sheets); Campo nell'Elba (Livorno), Colle di Palombaia (WGS84: 42.738039°N 10.207475°E; staz. 32), 55 m, exp. SE, margine boschivo, 27 June 2007, *A. Zoccola s.n.* (MSNM, 1 sheet); Capoliveri (Livorno), Case Gualdo (WGS84: 42.751590°N 10.387338°E; staz. 34), 58 m, no exp., margine stradale, a terra e sugli alberi, 27 June 2007, *A. Zoccola s.n.* (MSNM); *ibidem*, 18 June 2008, *G. Galasso s.n.* (MSNM, 3 sheets); Capoliveri (Livorno), tra il campo sportivo e il Cimitero Nuovo (WGS84: 42.747985°N 10.380049°E; staz. 35), 126 m, exp. N, scarpata al margine stradale, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets); Portoferraio (Livorno), Case Norsi (WGS84: 42.773118°N 10.346124°E; staz. 24), 37 m, exp. E, margine stradale, 18 June 2008, *G. Galasso s.n.* (MSNM, 1 sheet); Campo nell'Elba (Livorno), via del Monumento, tra traversa di via Segagnana e via della Foce (WGS84: 42.753966°N 10.246436°E; staz. 28), 6 m, no exp., margine stradale, sugli alberi, 18 June 2008, *G. Galasso s.n.* (holotype MSNM, 2 sheets, isotype FI, 2 sheets); Rio Marina (Livorno), via Calabaroccia Porticciolo (WGS84: 42.804298°N 10.429742°E; staz. 45), 57 m, exp. NE, margine stradale, 19 June 2008, *G. Galasso s.n.* (MSNM, 2 sheets); **Abruzzo**: Città Sant'Angelo (PE), viale Torre Costiera (UTM ED50: 33T 0429816.4708543), 2 m, no exp., margine stradale arbustato, 25 May 2011, *G. Galasso s.n.* (FI, MSNM); *ibidem*, via della Scafa, presso la rotonda con viale 22 maggio 1944 (UTM ED50: 33T 0429201.4708035), 5 m, no exp., aggruppamento ad *Arundo donax*, 25 May 2011, *G. Galasso s.n.* (FI, MSNM); **Apulia**: Otranto (LE), Largo Alimini Piccolo in loc. Fontanelle, coord. UTM 34 T BK 82.51, 7 m, no exp., incolti, 8 August 2008, *F. Bartolucci s.n.* (FI sub *V. riparia* Michx.); San Severo (FG), Autostrada Adriatica A14, corsia est, ca. 1,1 Km a nord della Stazione di Servizio Gargano est (UTM ED50: 33T 0540881.4605472), 43 m, no exp., margine stradale arbustato, 29 May 2011, *G. Galasso s.n.* (FI, MSNM).

Localities recorded only in the field:—ITALY. **Tuscany**: Rio nell'Elba (Livorno), via Aldo Moro (WGS84: 42.812625°N 10.402315°E; staz. 43), 133 m, exp. SE, margine stradale, 18 June 2008, *G. Galasso*; Marciana (Livorno), Procchio, strada tra Portoferraio e Procchio, poco prima del Km 7.5 (WGS84: 42.786855°N 10.250458°E; staz. 03), 42 m, exp. NW, margine boschivo, 19 June 2008, *G. Galasso*; Rio Marina (Livorno), Vigneria (WGS84: 42.821060°N 10.428721°E; staz. 19), 34 m, exp. E, margine stradale, 19 June 2008, *G. Galasso*; Portoferraio (Livorno), strada costiera, tra gli Scoglietti e la Punta delle Grotte (WGS84: 42.797139°N 10.333414°E; staz. 36), 32 m, exp. NE, margine arbustato, 19 June 2008, *G. Galasso*.

V.* ×*ruggerii

***Specimina visa*:**—ITALY. **Lombardy**: Stradella (Pavia), via dell'Industria e dell'Artigianato, 63 m, margine stradale, davanti ad un vigneto, 18 July 2009, *N. Ardenghi s.n.* (*Herb. N. Ardenghi* 000412); Stradella (Pavia), E di Peschiera, 97 m, campo di erba medica (forse ex vigneto), 19 October 2010, *N. Ardenghi s.n.* (*Herb. N. Ardenghi* 000923); Montù Beccaria (Pavia), tra Ca' Bianca e Camera (WGS84: 45.046272°N 9.305192°E), 130 m, exp. SW, scarpata, suolo argilloso, con *Elytrigia repens*, *Securigera varia*, *Lactuca serriola* e *Sorghum halepense*, 18 August 2013, *N. Ardenghi s.n.* (holotype MSNM, 2 sheets, isotype FI, 2 sheets); **Tuscany**: Campo nell'Elba (Livorno), strada tra Sant'Ilario e Poggio, Torre San Giovanni (WGS84: 42.762060°N 10.202015°E; staz. 11), 327 m, exp. E, margine arbustato, 26 June 2007, *A. Zoccola s.n.* (MSNM); Capoliveri (Livorno), Mola (WGS84: 42.760166°N 10.384792°E; staz. 21), 4 m, no exp., margine stradale, 27 June 2007, *A. Zoccola s.n.* (MSNM); Campo nell'Elba (Livorno), via della Costa, poco a ovest di Fetovaia (WGS84: 42.733431°N 10.144344°E; staz. 31), 76 m, exp. S, margine stradale, 27 June 2007, *A. Zoccola s.n.* (MSNM, 2 sheets).

Appendix 2. Provenance of the specimens sampled for the pictures.

Vitis cinerea
Figs. 2A–B, 3G, 7G: ITALY. **Lombardy**: Torrazza Coste (Pavia), loc. Riccagioia, Centro Vitivinicolo Riccagioia (Villa Riccagioia) (WGS84: 44.982167°N 9.091577°E ± 50 m), 145 m, no exp., *planta culta*, 6 September 2007, *G. Galasso s.n.* (MSNM).

Vitis ×instabilis
Figs. 3F, 4A, 4G, 6B–C, 7D, 13a–h, 13j: ITALY. **Lombardy**: Stradella (Pavia), San Zeno (WGS84: 45.064197°N 9.311438°E), 7 September 2013, *N. Ardenghi*, no voucher.
Figs. 6D, 7C: ITALY. **Tuscany**: Marciana (Livorno), strada tra Zanca e l'Aia, Fosso della Noce (WGS84: 42.802127°N 10.153616°E; staz. 47), 185 m, exp. NE, margine boschivo d'impluvio, 19 June 2008, *G. Galasso* s.*n.* (MSNM).
Fig. 13i: ITALY. **Piedmont**: Dernice (Alessandria), Vigoponzo, SP110, dietro al cimitero (WGS84: 44.753609°N 9.046351°E), scarpata a ridosso della strada, con *Elytrigia repens*, *Cephalaria transsylvanica*, *Dactylis glomerata*, *Centaurea jacea* subsp. *gaudinii*, *Inula bifrons*, 529 m, exp. SE, 8 August 2013, *N. Ardenghi & M. Barcella s.n.* (*Herb. N. Ardenghi*).

Vitis ×koberi
Figs. 2C–D, 3D, 4H, 7H, 15a, 15c–d: ITALY. **Lombardy**: Canneto Pavese (Pavia), SP45, curve, Casa San Fermo (WGS84: 45.049927°N 9.297672°E), 7 September 2013, *N. Ardenghi*, no voucher.
Figs. 15b, 15e–f: ITALY. **Lombardy**: Montù Beccaria (Pavia), Molino Quaroni (WGS84: 45.047131°N 9.303425°E), 9 October 2013, *N. Ardenghi*, no voucher.

Vitis labrusca
Figs. 1, 2G, 3B: ITALY. **Lombardy**: Pavia, via Paolo Frisi, between the Hispanic walls and the railroad (WGS84: 45.184641°N 9.165536°E), 9 September 2013, *N. Ardenghi*, no voucher.

Vitis riparia
Fig. 3C: ITALY. **Tuscany**: Portoferraio (Livorno), Case Norsi (WGS84: 42.773118°N 10.346124°E; staz. 24), 37 m, exp. E, margine stradale, 18 June 2008, *G. Galasso s.n.* (MSNM).
Figs. 4E, 5, 6A, 7B: ITALY. **Lombardy**: Canneto Pavese (Pavia), SP45, Casa San Fermo (WGS84: 45.050277°N 9.296388°E), 20 August & 7 September 2013, *N. Ardenghi*, no voucher.

Vitis ×ruggerii
Figs. 3H, 4F, 6G–H, 7F, 18a–f, 18h–j: ITALY. **Lombardy**: Canneto Pavese (Pavia), SP45, curve between Beria and Casa San Fermo (WGS84: 45.048258°N 9.298191°E), 20 August & 7 September 2013, *N. Ardenghi*, no voucher.
Figs. 4C, 18g: ITALY. **Lombardy**: Stradella (Pavia), San Zeno (WGS84: 45.058888°N 9.306944°E), 7 September 2013, *N. Ardenghi*, no voucher.

Vitis rupestris
Figs. 3E, 4D, 6E–F, 7E, 9a–b, 9d–f: ITALY. **Lombardy**: Stradella (Pavia), SP201, Beria (WGS84: 45.056280°N 9.301480°E), 7 September 2013, *N. Ardenghi*, no voucher.
Figs. 9c, 9g: ITALY. **Lombardy**: Calvignano (Pavia), near Stanga (WGS84: 44.988527°N 9.161150°E), 31 May 2013, *N. Ardenghi s.n.* (*Herb. N. Ardenghi*).

Vitis vinifera
Figs. 2E, 7A: ITALY. **Tuscany**: Marciana (Livorno), strada tra Portoferraio e Procchio, ca. al Km 4.5, presso l'impluvio che scende alla loc. Porticciolo, poco oltre il confine comunale tra Portoferraio e Marciana (WGS84: 42.791003°N 10.264652°E; staz. 01), 134 m, exp. NE, margine boschivo d'impluvio, probabile popolazione selvatica, 19 June 2008, *G. Galasso s.n.* (MSNM).
Figs. 2F, 2H, 3A: ITALY. **Tuscany**: Campo nell'Elba (Livorno), via del Monumento, poco a est di Bonalaccia-Filetto (WGS84: 42.760672°N 10.257447°E; staz. 44), 73 m, exp. NW, margine stradale, 19 June 2008, *G. Galasso s.n.* (MSNM).
Figs. 4B, 10a, 10e: ITALY. **Lombardy**: Montù Beccaria (Pavia), Molino Quaroni (WGS84: 45.047131°N 9.303425°E), cultivated, 9 October 2013, *N. Ardenghi*, no voucher.
Figs. 10b–d, 10f: ITALY. **Lombardy**: Stradella (Pavia), San Zeno (WGS84: 45.066033°N 9.312813°E), cultivated, 9 October 2013, *N. Ardenghi*, no voucher.

Phytotaxa 224 (3): 232–246
www.mapress.com/phytotaxa/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

http://dx.doi.org/10.11646/phytotaxa.224.3.2

A taxonomic survey of the genus *Vitis* L. (Vitaceae) in Italy, part II: the 'Euro-American' hybrids

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Abstract

New names are assigned to two 'Euro-American' nothospecies of *Vitis* originating from the artificial crossing of Euro-Mediterranean *V. vinifera* with two American species, employed both as rootstocks and for wine production, and spontaneously occurring in Italy and other European countries: *V.* ×*bacoi* (= *V. riparia* × *V. vinifera*) and *V.* ×*goliath* (= *V. riparia* × *V. rupestris* × *V. vinifera*). Original and detailed descriptions, illustrations and information on distribution and ecology are provided, along with an updated identification key. Late-season leaf pigmentation, presence/absence of phylloxera galls, ripe berries flavor, and seed morphology proved to be useful characters for the identification of the treated species and nothospecies. Nomenclatural aspects regarding *V. riparia* × *V. vinifera* are also discussed.

Key words: alien species, Italy, nothotaxa, seed morphology, systematics, *Vitis*

Introduction

The current paper represents a continuation of the first taxonomic survey of the genus *Vitis* Linnaeus (1753: 202, 1754: 95) in Italy (Ardenghi *et al.* 2014), an increasingly consulted work for the identification of wild grapes in Europe (see e.g., Iamonico 2014, Iamonico *et al.* 2014, Montanari *et al.* 2014, Villa & Arrigoni 2014, Ardenghi 2015, Ardenghi & Bernardo 2015, Ardenghi & Maggioni 2015, Bernardo 2015, Gariboldi & Ardenghi 2015, Nicolella *et al.* 2015, Conti & Bartolucci 2015), followed by the record of *Vitis* ×*novae-angliae* Fernald [1917: 146 (144−147)] (pro sp.) (Ardenghi *et al.* 2015).

While the first contribution focused on the species and the binary hybrids between American taxa employed as rootstock and the second one on an American-American hybrid, the present work deals with the 'Euro-American' nothotaxa originating from the crossing of Euro-Mediterranean *V. vinifera* Linnaeus (1753: 202) with American species, in our case *V. riparia* Michaux (1803: 231) and *V. rupestris* Scheele (1848: 591). Most of these hybrids were obtained to be used as 'direct-producers', an early strategy against the spread of phylloxera (*Daktulosphaira vitifoliae* Fitch in Shimer 1866: 365), downy mildew [*Plasmopara viticola* (Berkeley & Curtis in Ravenel 1848: 90) Berlese & De Toni 1888: 239], and powdery mildew [*Uncinula necator* (Schweinitz 1834: 270) Burrill in Ellis & Everhart 1892: 15] over the European continent, accidentally introduced from North America in the second half of the 19th century. Although this solution, which simultaneously allowed wine production and resistance to the new pests, appeared to be more expeditious and cheaper than grafting *V. vinifera* on hybridogenic rootstock, affected the quality of the final product, which acquired the peculiar flavors of American grapes, excessively bitter or 'foxy' for the oenological standards. Nevertheless, some of these wines, such as 'Clinton' and 'Bacò' [originating from the crossing of *V. riparia* with *V. labrusca* (Linnaeus 1753: 203) and *V. vinifera*, respectively], had a relevant success in Europe until the 1950's, especially among the working classes (Galet 1988, Eynard & Dalmasso 1990, Ardenghi *et al.* 2015). On the other hand, a number of 'Euro-American' hybrids are still used as rootstock. Among them *V. rupestris* × *V. vinifera* 'Aramon-Rupestris Ganzin n° 1' and '1202 C', *V. berlandieri* Planchon [1880: 425(–428)] × *V. vinifera* '41 B', and *V. riparia* × *V. rupestris* × *V. vinifera* 'Golia' (Galet 1988, Eynard & Dalmasso 1990).

Accepted by Federico Luebert: 5 Aug. 2015; published: 2 Sept. 2015

In order to allow an effective identification of the nothotaxa treated within this paper, new morphological traits have been introduced, besides the vegetative ones employed by Ardenghi *et al.* (2014): late-season leaf pigmentation (already noticed by Terpó 1988), presence/absence of phylloxera galls, ripe berries flavor, and seed morphology (Table 1). Although the examination of these characters proved to be very practical for identification purposes (even in the field), their availability is seasonally limited to summer and autumn (with the exception of late-season leaf pigmentation, observed by the authors as early as mid-June in the Mediterranean area), adding a further critical element to the taxonomy of this complex genus.

TABLE 1. Comparison of taxonomically useful morphological characters. Data acquired from literature not authored by the authors are indicated by means of an asterisk ("*").

	V. ×bacoi	***V. ×goliath***	*V. ×instabilis*	*V. riparia*	*V. rupestris*	*V. vinifera*
Habit	climbing/creeping	climbing/creeping	climbing/creeping or erect	climbing/creeping	erect	climbing/creeping
Phylloxera galls on leaf blades	present	present	present	present	present	absent
Late-season leaf pigmentation	usually purplish red to purple	purplish-red to purple	yellowish-green to yellow	yellowish-green to yellow	yellowish-green to yellow	usually purplish red to purple (yellow in white-berried cultivars)
Leaf habit	not folded	not folded	folded or not	not folded	folded	not folded
Leaf shape	cordate	kidney-shaped to broadly cordate	kidney-shaped to cordate	cordate	kidney-shaped	cordate
Leaf division	3–5(–7)-lobed to subentire	3-lobed to entire	usually entire	usually entire	entire	5–7-lobed to entire
Leaf veins color (adaxial leaf surface)	whitish to greenish-white	whitish to greenish-white, sometimes red basally	red, at least basally	whitish to greenish-white	red	whitish to greenish-white
Abaxial leaf surface (mature leaves)	sparsely hirtellous to subglabrous	glabrous	hirtellous to glabrous	hirtellous	glabrous	glabrous, hirtellous or tomentose
Tufts of hairs at vein axils (abaxial leaf surface)	dense	lax	from dense to absent	dense	absent	from dense to absent
Petiole insertion (abaxial leaf surface)	hirtellous and arachnoid	glabrous to sparsely arachnoid or hirtellous	glabrous to hirtellous, sometimes with few arachnoid hairs	hirtellous	usually glabrous	hirtellous, arachnoid or glabrous
Veins surface (abaxial leaf surface)	hirtellous and arachnoid	glabrous to sparsely arachnoid or hirtellous	usually hirtellous	hirtellous	glabrous	glabrous, arachnoid or hirtellous
Leaf base	U- to lyre-shaped	cuneate to truncate or broadly U-shaped	truncate to broadly U-shaped or V-shaped	U-shaped	cuneate or truncate	usually lyre-shaped
Infructescence compactness	compact	lax to irregularly compact	lax to compact	lax	lax*	compact
Berries diameter (mm)	8–10	(8–)9–11(–12)	(5–)7–9(–10)	5–9(–10)	8–12*	6–35*
Flavour	astringent	sweet to astringent	astringent to sweetish-herbaceous	astringent	astringent*	sweet or sharp
Seeds length (mm)	5.5–5.8	(4.5–)5.0–6.5	(3.3–)3.5–4.5(–4.7)	3.5–4.5	3–5(–6)*	(3.7–)5.3–6.2(–8.1)*
Seeds width (mm)	3.8–4.1	3.9–5.0	(2.5–)2.8–4.1	2.8–3.5	3–5(–6)*	(1.8–)3.6–4.0(–5.2)*
Seeds body shape	spheroidal to ellipsoidal-obovoid	spheroidal to ellipsoidal-obovoid	spheroidal to ellipsoidal-spheroidal	spheroidal to ellipsoidal-spheroidal	spheroidal*	ellipsoidal-obovoid to obovoid*
Seeds beak length (mm)	1.0–1.5	0.5–1.1	0.3–0.5(–0.7)	0.2–0.5	<0.5*	(0.4–)1.3–1.9(–3.7)*

Material and Methods

The present work is based on the study of material collected during field trips in Italy (see Appendix 1). The studied specimens are kept at the Museo di Storia Naturale di Milano Herbarium (MSNM) and at the Herbarium Centrale Italicum, Florence (FI).

Similarly to Ardenghi *et al.* (2014), hybrids were identified and described on the basis of specimens collected only from wild populations. Infructescences and seeds morphological data regarding *V. riparia* were acquired from Ardenghi *et al.* (2015), while those regarding *V. rupestris* and *V. vinifera* from Munson (1909), Galet (1988), Moore (1991), Laguna (2003), and Rivera *et al.* (2007). Fruit production has never been recorded from Italian populations of *V. rupestris*, that are provided only with male flowers like *V.* ×*ruggerii* Ardenghi, Galasso, Banfi & Lastrucci (2014: 187) (authors' personal observations). Populations of *V.* ×*instabilis* Ardenghi, Galasso, Banfi & Lastrucci (2014: 182) sampled for the infructescence and seed measurements are reported in Appendix 2. Type specimens of the parent taxa were also investigated, including the lectotype of *V. riparia* held at P, not seen by Ardenghi *et al*. (2014). Ampelographic treatments (e.g., Galet 1988, Eynard & Dalmasso 1990) and cultivated rootstock material from nurseries were used only for comparison and not as a primary source of morphological information.

For the treated taxa, we list: synonyms, nomenclatural types, morphological description (terminology according to Ardenghi *et al.* 2014: Table 1), etymology, ecology (based on field observations and referring to the whole Italian territory), area of origin, geographical distribution in Europe and Italy, habitat, degree of naturalization in Italy, and information on their use (acquired from Galet 1988, Eynard & Dalmasso 1990, Ministero delle Politiche Agricole, Alimentari e Forestali 2015). Eventually, an updated key is provided for all spontaneous taxa of *Vitis* until now recorded from Italy. Taxonomic treatment follows Ardenghi *et al.* (2014), especially for *V. vinifera* [thus, the wild populations, classified by some authors as *V. vinifera* subsp. *silvestris* Hegi (1925: 364), are not recognized as an independent taxon].

Leaf blade and petiole indumentum were examined using a backscattered scanning electron microscope (SEM) JEOL JSM-5610LV. Small fragments of leaf surface (about 1 cm^2 in size) were carved from dried leaves around the petiole insertion and in the center of the leaf blade, in order to examine the trichomes on petioles, along leaf margins, at the vein axils, and on the abaxial leaf surface. The samples were then mounted on aluminum stubs using conductive carbon adhesive tabs. At least four images for each treated taxon were taken at three different magnifications (×35, ×70, ×100) on the leaf underside (Fig. 2). The provenance of the sampled specimens is reported in Appendix 2.

Digital color photos of the seeds (ventral and dorsal sides) of each treated nothotaxon, their respective parental species (with the exception of *V. rupestris*) and similar hybrids, were taken by means of a Canon Power Shot S50 mounted on an ocular tube of a Leica MS5 stereomicroscope (Fig. 3).

Taxonomic treatment

Key to species and hybrids of *Vitis* in Italy

1. Mature leaf blades white or rufescent-floccose to -tomentose or subglabrous on abaxial surface; tendrils or inflorescences consecutive on 2, 3 or more nodes; adaxial leaf surface reticulate-rugose; ripe berries flavor at least partially foxy; exocarp adherence null or scarce; mesocarp mucilaginous .... 2 (*V. labrusca* and hybrids)

\- Mature leaf blades not heavily tomentose on abaxial surface; tendrils or inflorescences consecutive on 2 nodes; adaxial leaf surface usually smooth; berries flavor never foxy; exocarp adherence strong; mesocarp soft, never mucilaginous 3

2. Tendrils or inflorescences always consecutive on 3 or more nodes; leaf blades always white or rufescent-tomentose on abaxial surface; phylloxera galls always absent on leaf blades; hirtellous pubescence absent on vegetative parts; ripe berries flavor exclusively foxy; juice colorless .... ***V. labrusca***

\- Tendrils or inflorescences consecutive on 2, 3 or more nodes; leaf blades white or rufescent-tomentose to -floccose or subglabrous on abaxial surface; phylloxera galls usually present on leaf blades; hirtellous pubescence usually present on vegetative parts; ripe berries flavor foxy and astringent; juice dark red.. ***V.* ×*novae-angliae*** (*V. labrusca* × *V. riparia*)

3. Late-season (late-spring−autumn) leaf pigmentation usually purplish-red to purple (yellow in white-berried cultivars of *V. vinifera*); leaf blades entire or slightly 3-lobed to deeply (3–)5–7-lobed; ripe berries flavor astringent to grape-like sweet; seeds length > 5 mm; seeds beak length usually > 1 mm ....4 (*V. vinifera* and hybrids)

- Late-season (late-spring−autumn) leaf pigmentation always yellowish-green to yellow; leaf blades entire or subentire to 3- or shallowly 5-lobed; ripe berries flavor always astringent, occasionally sweetish-herbaceous; seeds length < 5 mm; seeds beak length < 1 mm ..6

4. Leaf base usually lyre-shaped; abaxial leaf surface from evenly tomentose to subglabrous; ripe berries flavor usually grape-like sweet, but sometimes acid-tasting; phylloxera galls always absent on leaf blades .... ***V. vinifera***

- Leaf base lyre-, U-shaped, cuneate or truncate; abaxial leaf surface never tomentose; ripe berries flavor astringent or slightly grape-like sweet; phylloxera galls usually present on leaf blades 5

5. Leaf blades cordate, 3−5(−7)-lobed to subentire; leaf base U- to lyre-shaped .... ***V.* ×*bacoi*** (*V. riparia* × *V. vinifera*)

- Leaf blades kidney-shaped to broadly cordate, shallowly 3-lobed to entire; leaf base cuneate to truncate or broadly U-shaped....... .... ***V.* ×*goliath*** (*V. riparia* × *V. rupestris* × *V. vinifera*)

6. Leaf base always truncate to cuneate, abaxial surface usually glabrous, sometimes slightly hirtellous and/or arachnoid pubescent at the petiole insertion, blades kidney-shaped, conduplicately folded, slightly wider than long; plants usually caespitose, rarely climbing.. ***V. rupestris***

- Leaf base truncate, U-, V- or lyre-shaped, abaxial surface variously pubescent to glabrate, blades kidney-shaped or cordate, conduplicately folded or not; plants usually climbing 7

7. Abaxial leaf surface without or with inconspicuous tufts of hairs at the vein axils; abaxial leaf base always arachnoid pubescent on the veins at the petiole insertion; most leaves with obtuse teeth and U- or lyre-shaped base..8

- Abaxial leaf surface with dense tufts of hairs at the vein axils; abaxial leaf base occasionally arachnoid pubescent on the veins at the petiole insertion; obtuse teeth occasionally present, teeth usually acute; leaf base truncate, U- or V-shaped 9

8. Leaves usually broadly cordate, with U- or lyre-shaped base; blades usually more than 10 cm long, not or slightly conduplicately folded; abaxial leaf surface with tufts of rigid hairs at the vein axils (even if not well developed); adaxial surface dark green, usually with greenish-white veins .... ***V.* ×*koberi*** (*V. berlandieri* × *V. riparia*)

- At least some leaves kidney-shaped or rounded, with broadly U- or broadly lyre-shaped base; blades usually less than 10 cm long, at least the uppermost conduplicately folded; abaxial leaf surface usually without tufts of rigid hairs at the vein axils; adaxial surface dark to light green, with bright red veins, at least basally .... ***V.* ×*ruggerii*** (*V. berlandieri* × *V. rupestris*)

9. Leaf base always U-shaped; blades cordate, up to 15 cm long or more, not conduplicately folded, thin; adaxial surface usually dull, without evident bright red veins; arachnoid pubescence absent .... ***V. riparia***

- Leaf base truncate/cuneate to broadly U- or V-shaped; blades cordate to kidney-shaped or slightly rounded, usually less than 15 cm long, at least the uppermost conduplicately folded, thick and coriaceous; adaxial surface usually lustrous, with bright red veins, at least basally; arachnoid pubescence sometimes on the veins at the petiole insertion........... ***V.* ×*instabilis*** (*V. riparia* × *V. rupestris*)

Nothospecies

Vitis* ×*bacoi Ardenghi, Galasso & Banfi, *hybr. nov.* Figs. 1, 2A, 2C, 2E, 2G, 3A, 4
(*V. riparia* Michaux × *V. vinifera* Linnaeus)

Planta hybrida, a V. riparia foliorum laminis ab ultimo vere rubescentibus, initialibus quinque vel septem lobatis, pubescentia araneosa in nervos et seminibus longioribus differt; a V. vinifera bacis sapore asperrimo, pilorum fasciculis semper in superficiem abaxialem foliorum ad nervorum axillas positis differt; a V. ×goliath foliorum basi lyrata usque ad formam U differt.

Type:—ITALY. **Lombardy**: Santo Stefano Ticino (Milano), Cascina Fontana, lato N della ferrovia (WGS84: 45.479962°N 8.918647°E), 145 m, no exp., robinieto su sponda di fossato alla base della massicciata ferroviaria, con *Robinia pseudoacacia*, *Rubus* sect. *Corylifolii*, *Parthenocissus quinquefolia*, 13 September 2014, *N. Ardenghi s.n.* (holotype MSNM!, 6 sheets, isotype FI!, 4 sheets). [Fig. 4; images of parts A−F are available at http://www.comune.milano.it/dseserver/webcity/documenti.nsf/0/49839462f80662afc12571010055c8c5?OpenDocument (accessed: 5 September 2015)].

= ‘*Vitis* ×*andrasovszkyana* Terpó’ (1988: 37), *nom. inval.* (see “Notes”)

Type:—originally not indicated.

Deciduous woody vine, climbing or creeping-prostrate, hermaphrodite. ***Tendrils*** bifurcate, a tendril or inflorescence present at only 2 consecutive nodes. ***Leaf blades*** thin, up to 25 cm long, not conduplicate, cordate, from 5(–7)-palmate-lobed, with deep round sinuses (especially in the oldest leaves), to slightly 3-lobed or subentire, usually with phylloxera

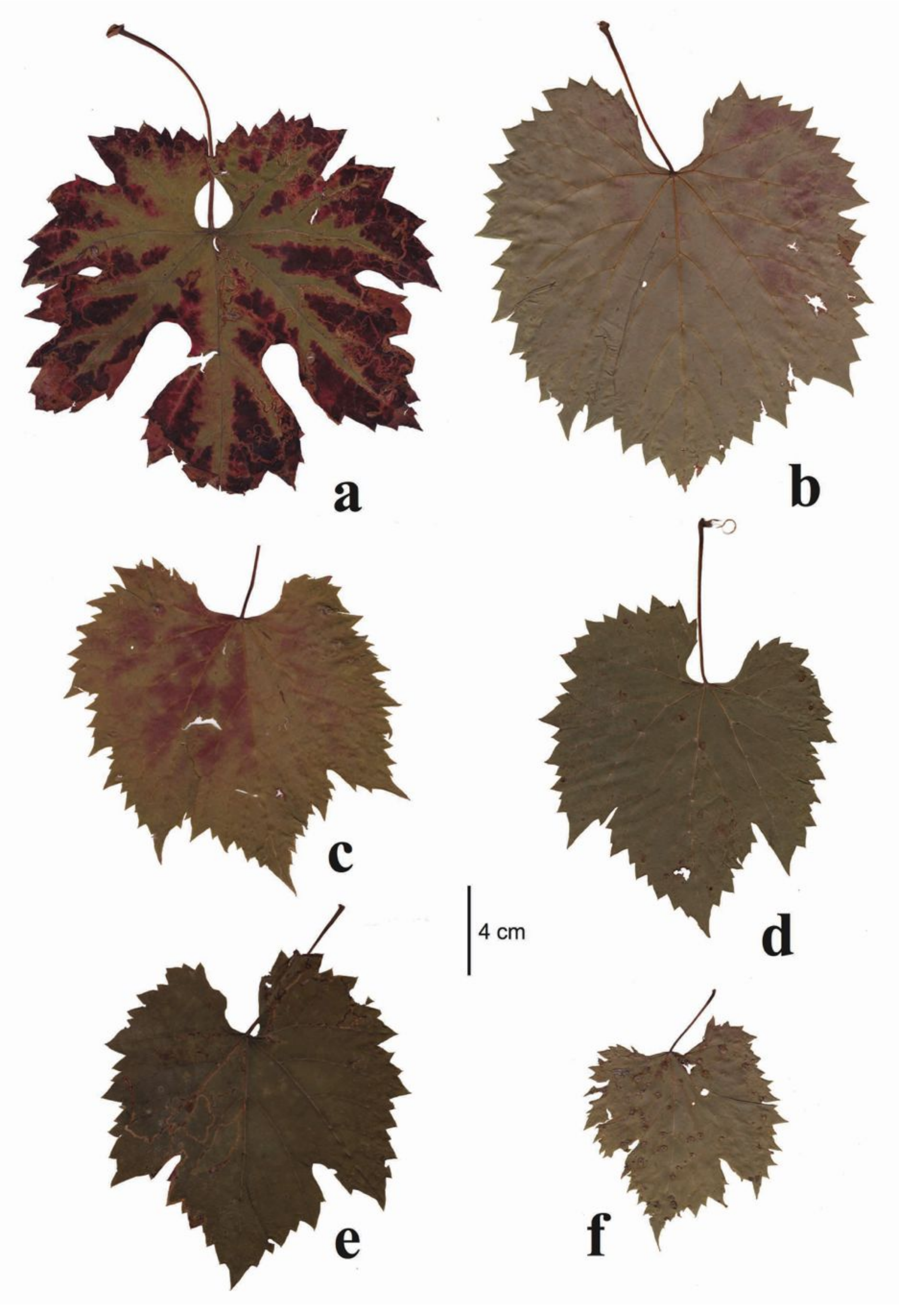

FIGURE 1. *Vitis* ×*bacoi*. Leaf blade variability: **a**, **c**, **e**) adaxial surface; **b**, **d**, **f**) abaxial surface.

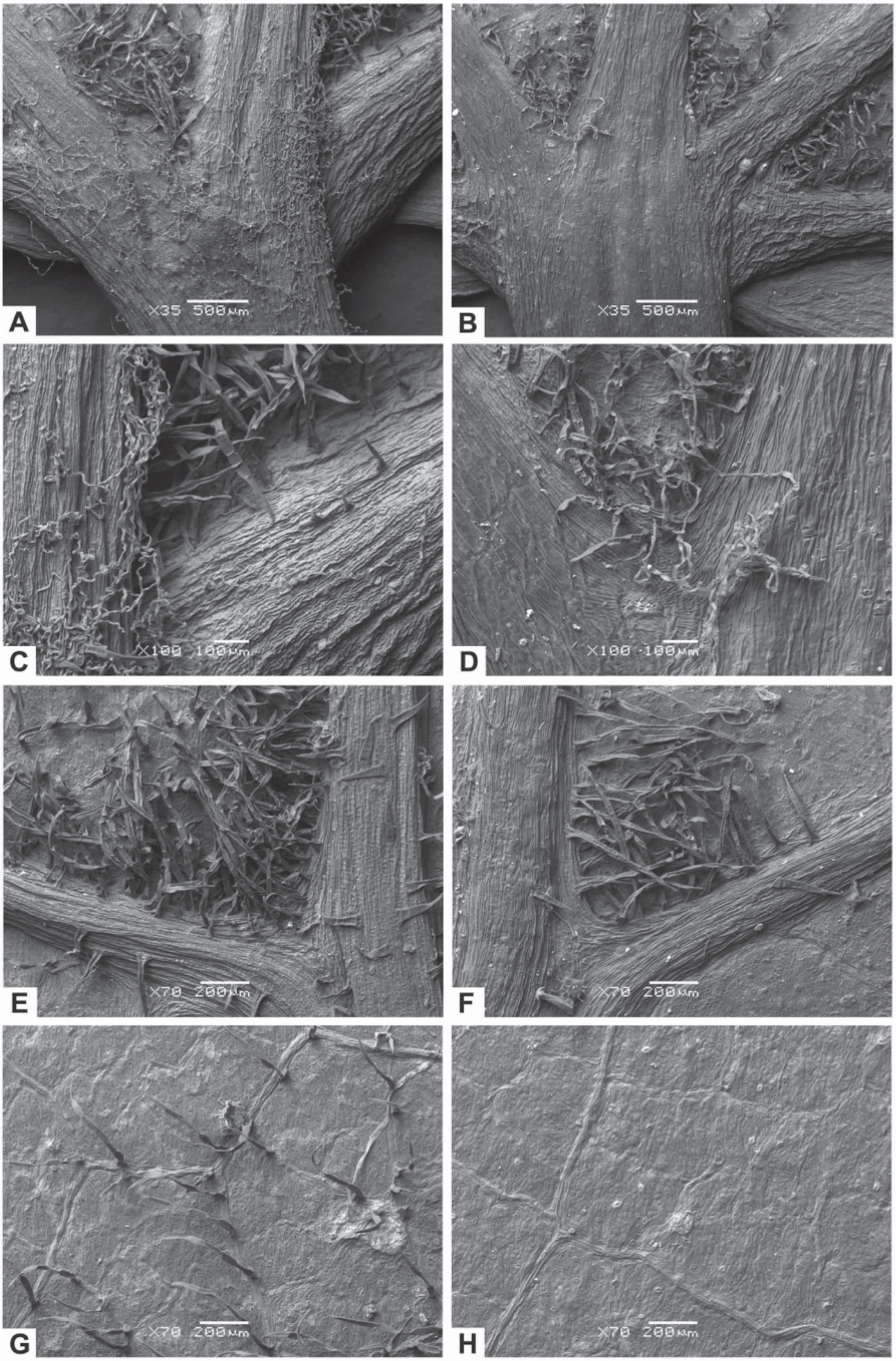

FIGURE 2. **A–B**) Petiole insertion (abaxial surface). **C–D**) Petiole insertion detail. **E–F**) Vein axils (abaxial leaf surface). **G–H**) Abaxial leaf surface pubescence. **A**, **C**, **E**, **G**) *V.* ×*bacoi*; **B**, **D**, **F**, **H**) *V.* ×*goliath*. All photos by Michele Zilioli.

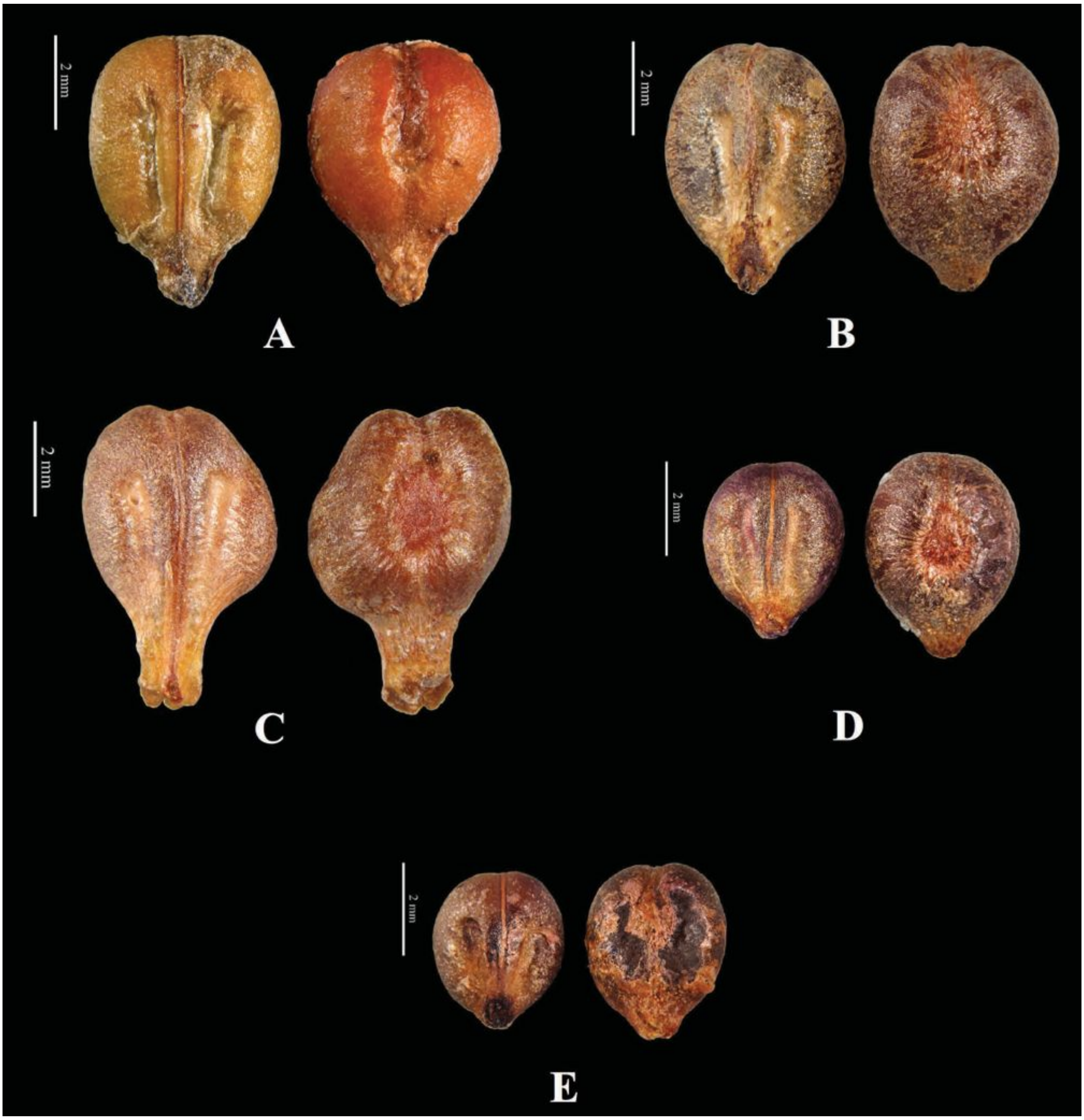

FIGURE 3. Seeds, ventral (on the left) and dorsal (on the right) sides. **A**) *V.* ×*bacoi*; **B**) *V.* ×*goliath*; **C**) *V. vinifera*; **D**) *V. riparia*; **E**) *V.* ×*instabilis*. All photos by Michele Zilioli.

galls. ***Adaxial surface*** dark green, in late-season leaves usually with large purplish-red to purple blotches (anthocyanic pigmentation) extending from the margins towards the centre of the blade (this feature, persisting in dried specimens, is due not only to normal leaf senescence, but also to nutrient deficiency, injuries, virus and fungal infections, see Eynard & Dalmasso 1990, and Keller 2015), dull, tomentose in immature leaves, glabrous or with sparse arachnoid pubescence in mature ones, veins whitish to greenish-white, with arachnoid and hirtellous pubescence; ***abaxial surface*** tomentose in immature leaves, sparsely hirtellous to subglabrous in mature ones, with hirtellous and whitish arachnoid pubescence on the veins at the petiole insertion; veins surface hirtellous and arachnoid pubescent, with dense whitish tufts of rigid hairs at their axils. ***Margins*** hirtellous, with sparse to dense arachnoid pubescence, sharply dentate, teeth acute (usually acute triangle-shaped), narrow, rarely obtuse (broadly triangular or pointed-arch shaped); teeth at the ends of the central and the two main lateral veins usually prominent, acuminate. ***Leaf base*** U-shaped to lyre-shaped, in the latter case with the ends sometimes overlapping. ***Petiole*** glabrous to glabrescent, with sparse arachnoid pubescence, usually yellowish-green. ***Flowers*** hermaphrodite. ***Infructescences*** up to 10.5 cm long and 3.5 cm wide or more, cylindrical in outline, usually compact (berries touching each other); peduncle about 8 cm long; rachis glabrescent, with sparse arachnoid pubescence; pedicels 6−8 mm long. ***Berries*** up to 60 or more per cluster, 8−10 mm in diameter, spherical, black with a thin layer of pruine; exocarp ("skin") adherent to the mesocarp; mesocarp ("flesh") yellowish-red. ***Flavor*** sharp and astringent. ***Seeds*** 1−2 per berry, 5.5−5.8 mm long, 3.8-4.1 mm wide (including beak); body spheroidal to ellipsoidal-obovoid, apex roundish, brown; beak 1.0−1.5 mm long, 1.3−1.8 mm wide (at seed base), usually obtrapezoidal in outline, brownish; chalaza 1.3−1.9 mm long, 0.8−0.9 mm wide, ovate.

FIGURE 4. Holotype of *V.* ×*bacoi* Ardenghi, Galasso & Banfi, parts A, C, D, F (MSNM).

Etymology:—Dedicated to François Baco (1865−1947), French agronomist, famous for selecting in 1902 the direct-producer hybrid 'Baco 1', also known as 'Baco noir' and '24–23 Baco' (Galet 1988), employed for the production of the red wine 'Baco' or 'Bacò' (whose name is not related to the Greek god Bacchus, as wrongly stated by some sources), very popular in different parts of Europe until the late 20th century.

Ecology:—Moist and deep to drained and light soils; moderately calciphile, heliophilous.

Area of origin and distribution in Europe:—Artificial hybrid originating in France (Galet 1988), although spontaneous hybridization between the two parental species may occur in nature (Terpó 1988, Laguna 2005, Bodor *et al*. 2011). In Europe, it is known as a casual or naturalized alien in Spain (Laguna 2005) and Hungary (Terpó 1988, Bodor *et al*. 2011).

Distribution in Italy and habitat:—Lombardy, Friuli Venezia Giulia, and Tuscany (this paper). Mesic woodlands often dominated by *Robinia pseudoacacia* Linnaeus (1753: 722), wasteland.

Degree of naturalization:—Naturalized.

Use:—Hybrids between *V. riparia* and *V. vinifera* belong to a series of hybridogenic cultivars obtained between the 1880's and the early 1900's (especially in France) to face phylloxera and some major fungal diseases affecting viticulture. They followed the earliest generation of hybrids originating from the crossing of *V. labrusca* with *V. vinifera* and/or other American species, including *V. riparia* (see Galet 1988, Eynard & Dalmasso 1990, Ardenghi *et al.* 2015). Hybrids between *V. riparia* and *V. vinifera* were originally employed as rootstock (e.g., '142 E.M.', '143 Mgt', and '26 Geisenheim'), but soon discarded for unsatisfactory root system-resistance to phylloxera (trait inherited from *V. vinifera*) and susceptibility to limestone (character acquired from *V. riparia*) (Galet 1988). However, thanks to their hardiness, easy reproduction from cuttings, early ripening, and low sensibility both to powdery and downy mildew, they had an increasing success as direct-producers, allowing wine production mainly in areas traditionally unsuitable for viticulture, such as mountain and nordic regions (Galet 1988), in a similar way to *V. labrusca* × *V. riparia* (Ardenghi *et al.* 2015). The most successful cultivar proved to be 'Baco 1' (or 'Baco noir'), selected in 1902 by the French agronomist François Baco, who crossed *V. vinifera* 'Folle blanche' with *V. riparia.* The resulting product was 'Baco' (known also as 'Bacò' and 'Baco noir'), a very alcoholic red wine, deeply colored, with a characteristic *riparia*-like bitter and herbaceous flavor, which soon became popular in France and Italy, well-appreciated by both viticulturists and subsistence farmers. 'Baco 1' vineyards reached a cover of 11,000 ha in France (Galet 1988), and about 800 ha in Italy (Istituto centrale di statistica & Ministero dell'agricoltura e delle foreste 1972), despite legislative obstacles to the direct-producers plantation since the early 1930's (see Ardenghi *et al.* 2015). However, a major decreasing of 'Baco 1' vineyards occurred from the 1950's, which evolved into a complete abandonment of the cultivation during the second half of the century: although the plantation of *riparia*-*vinifera* hybrids is implicitly allowed by Council Regulation (EC) No. 479/2008 [Article 24, paragraph 1(a)], currently 'Baco 1' does not appear in the national wine grape cultivar catalogues of France and Italy (Galet 1988, Robinson *et al*. 2012, FranceAgriMer 2015, Ministero delle Politiche Agricole, Alimentari e Forestali 2015), thus preventing its cultivation for the purpose of commercial wine production. The hybrid is still commercially planted on a small scale in Switzerland and its employment as a wine grape is increasing in the United States and Canada (Robinson *et al*. 2012, Ufficio federale dell'agricoltura UFAG 2014+).

Notes:—Terpó (1988) proposed the name '*Vitis* ×*andrasovszkyana*' for the hybrid between *V. riparia* [sub '*V. vulpina* Linnaeus (1753: 203) subsp. *riparia* (Michaux) Terpó' (1988: 34)] and *V. vinifera*. However, in accordance with Art. 30.8 of the ICN (McNeill *et al.* 2012), this name is invalid, having been published within a doctoral thesis not including an explicit statement or other internal evidence that it is regarded as an effective publication by the author. Additionally, neither an International Standard Book Number (ISBN) nor the name of the printer, publisher, or distributor is provided (see Art. 30 Note 4). Two further elements make Terpó's name invalid: no type specimen is indicated (see Art. 40.1) and the name is not accompanied by a Latin description or diagnosis or by a reference to a previously and effectively published Latin description or diagnosis, but only by a Czech description (see Arts. 32.4, 39.1, and H.10.1). Moreover the rank is inappropriate for the proposed hybrid formula (Art. H.5).

The same problems regarding the name '*V.* ×*andrasovszkyana*' apply to the other nothotaxa described by Terpó in his doctoral thesis, namely: '*V.* ×*rathayana* Terpó var. *rathayana*' [1988: 35(−36)] and 'var. *karpatiana* Terpó' (1988: 36; 'kárpatiána') [= *V. sylvestris* Gmelin (1805: 543) × *V. vulpina*], '*V.* ×*kozmae* Terpó var. *kozmae*' [1988: 36(−37)], and 'var. *zemplenica* Terpó' (1988: 37) (= *V. sylvestris* × *V. vinifera*).

Since Terpó's doctoral thesis is not acceptable as a publication, the new combinations there proposed are not valid. Among them, '*V. vulpina* subsp. *riparia* (Michaux) Terpó' (1988: 34) is additionally a later isonym (Art. 6 Note 2), having already been published by Clausen (1949: 9).

Unisexual individuals belonging to this nothotaxon may occur in the wild: a number of *V.* ×*bacoi* cultivars, in fact, bear unisexual flowers, such as '143 Mgt' (male), '142 E.M.', and '26 Geisenheim' (female) (Galet 1988).

Vitis* ×*goliath Ardenghi, Galasso & Banfi, *hybr. nov.* Figs. 2B, 2D, 2F, 2H, 3B, 5, 6
(*V. riparia* Michaux × *V. rupestris* Scheele × *V. vinifera* Linnaeus)

Planta hybrida, a V. riparia, V. rupestri et V. ×instabili foliorum laminis ab ultimo vere rubescentibus, initialibus trilobatis, bacis sapore dulciusculo differt; a V. vinifera et V. ×bacoi foliorum laminis basi truncata vel cuneata differt.

Type:—ITALY. **Lombardy**: Stradella (Pavia), cavalcavia di via Valle Badia, lato S (WGS84: 45.078178°N 9.286523°E), 71 m, exp. S, robinieto su scarpata stradale, con *Robinia pseudoacacia*, *Convolvulus sepium*, *Bryonia dioica*, *Sambucus ebulus*, *Phytolacca americana*, *Juglans regia*, 20 August 2014, *N. Ardenghi s.n.* (holotype MSNM!, 4 sheets, isotype FI!, 2 sheets). [Fig. 6; images available also at http://www.comune.milano.it/dseserver/webcity/documenti.nsf/0/49839462f80662afc12571010055c8c5?OpenDocument (accessed: 5 September 2015)].

Deciduous woody vine, climbing or creeping-prostrate, hermaphrodite. ***Tendrils*** bifurcate, a tendril or inflorescence present at only 2 consecutive nodes. ***Leaf blades*** thin, up to 22 cm long, not conduplicate, kidney-shaped to broadly cordate, entire to shallowly 3-lobed, lobes from inconspicuous to cuspidate, usually with phylloxera galls. ***Adaxial surface*** dark green, in late-season leaves usually with large purplish-red to purple blotches (anthocyanic pigmentation), extending from the margins towards the centre of the leaves (this feature, persisting in dried specimens, is due not only to normal leaf senescence, but also to nutrient deficiency, injuries, virus and fungal infections, see Eynard & Dalmasso 1990, and Keller 2015), dull, glabrous, veins whitish to greenish-white and sometimes bright red basally, glabrous or with sparse arachnoid and hirtellous pubescence; ***abaxial surface*** glabrous; veins at the petiole insertion glabrous or with sparse arachnoid or hirtellous pubescence; veins surface glabrous to sparsely hirtellous and/or arachnoid pubescent, with lax whitish tufts of rigid hairs at their axils (more developed in immature leaves). ***Margins*** hirtellous, sharply dentate, teeth acute (usually acute triangle-shaped), narrow; teeth at the ends of the central and the two main lateral veins usually prominent, acuminate, occasionally slightly hooked. ***Leaf base*** cuneate to truncate or broadly U-shaped. ***Petiole*** glabrous to glabrescent, with sparse hirtellous or arachnoid pubescence (more prominent in immature leaves), usually bright red. ***Flowers*** hermaphrodite. ***Infructescences*** 10.5−14.8 cm long, 5.4−9.9 cm wide, conical to widely conical in outline, lax to irregularly compact (only some berries touching each other); peduncle 2−4 cm long; rachis glabrous, occasionally with sparse arachnoid pubescence; pedicels 4−6 mm long. ***Berries*** up to 50 or more per cluster, (8−)9−11(−12) mm in diameter, spheroidal, usually flattened at the poles (oblate), black with a thin layer of pruine; exocarp ("skin") adherent to the mesocarp; mesocarp ("flesh") yellowish. ***Flavor*** initially sweet (as in cultigen *V. vinifera*), then decidedly sharp and astringent; sometimes only sweet or sharp. ***Seeds*** (1−)2(−4) per berry, (4.5−)5.0−6.5 mm long, 3.9−5.0 mm wide (including beak); body spheroidal to ellipsoidal-obovoid, apex roundish to slightly notched, brown; beak 0.5−1.1 mm long, 1.2−1.8 mm wide (at seed base), usually obtrapezoidal in outline, brownish; chalaza 1.3−2.2 mm long, 0.9−1.3 mm wide, ovate.

Etymology:—The specific epithet refers to "Golia", the cultivar name given to one of the best known *V. riparia* × *V. rupestris* × *V. vinifera* rootstock hybrids, obtained in Italy (see below). "Golia" is the Italian translation of the name "Goliath", the biblical Philistine giant, whose legendary strength probably inspired the Pirovano's in naming their hardy rootstock.

Ecology:—Compact and moderately moist soils; usually calciphile, heliophilous.

Area of origin and distribution in Europe:—Artificial hybrid originating in Europe (Galet 1988, Eynard & Dalmasso 1990). In the European continent, it is known as a casual or naturalized alien in Spain (Laguna 2004, 2005).

Distribution in Italy and habitat:—Lombardy and Tuscany (this paper). Mesic woodlands dominated by *Robinia pseudoacacia*, wasteland.

Degree of naturalization:—Naturalized.

Use:—In Italy, this fertile complex hybrid is exclusively employed as rootstock. The only cultivar listed in the national grape cultivars catalogue is 'Golia' (Ministero delle Politiche Agricole, Alimentari e Forestali 2015), a vigorous chlorosis-resistant rootstock obtained in 1913 by Italian agronomists Luigi and Alberto Pirovano (father and son) by crossing the hybrid '15.612 Castel' (= *V. vinifera* 'Carignan' × *V. riparia*) with *V. rupestris* 'du Lot' (Cosmo *et al.* 1958, Fregoni & Bavaresco 1986, Galet 1988, Eynard & Dalmasso 1990). 'Golia' is employed mostly in northern and central regions, but is less widespread than other rootstock (Istituto centrale di statistica & Ministero dell'agricoltura e delle foreste 1972, Galet 1988). Its production decreased in the last five years (Ministero delle Politiche Agricole, Alimentari e Forestali 2015). 'Golia' has also been planted in Brazil by Italian immigrants (Galet 1988, 2000).

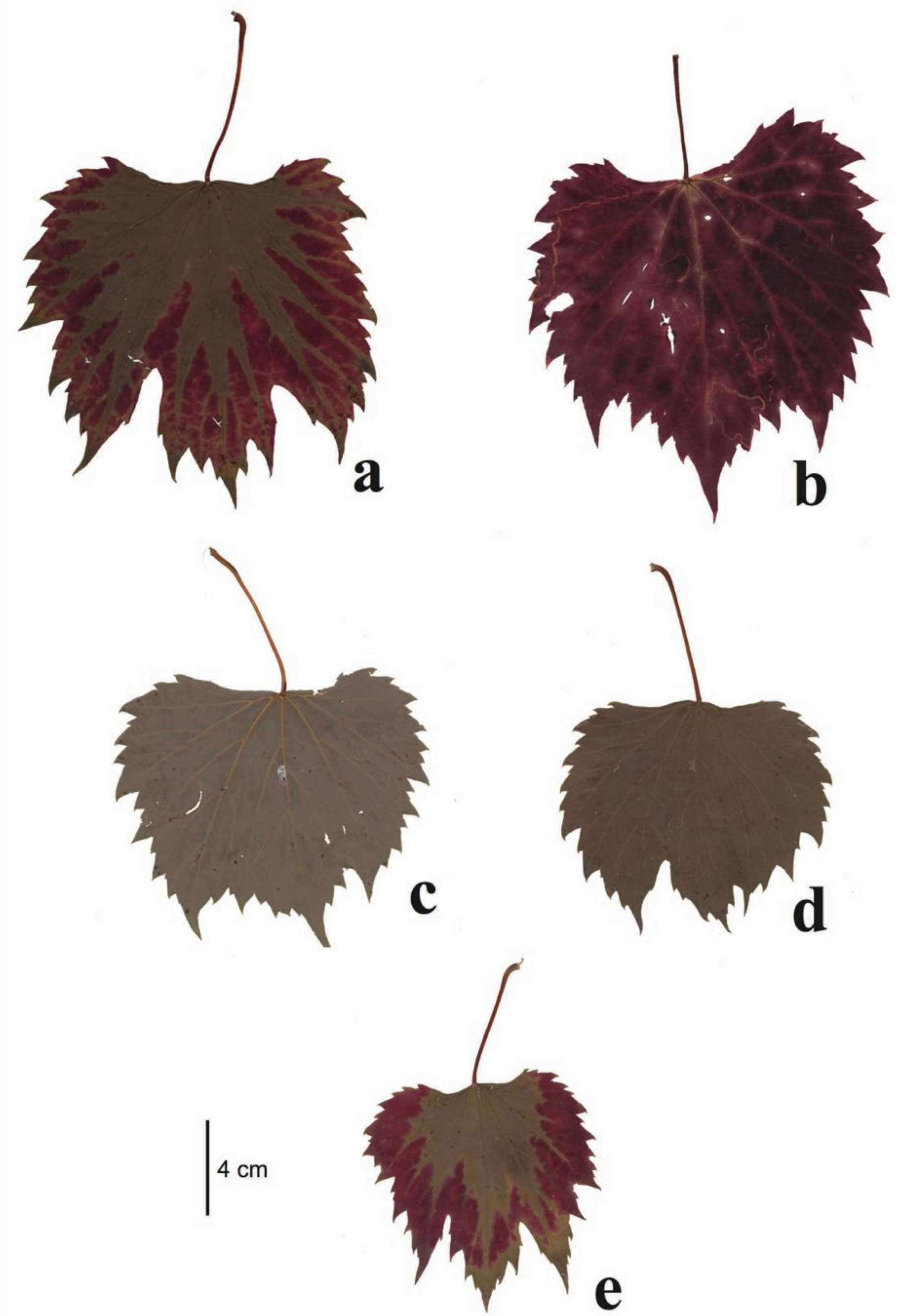

FIGURE 5. *Vitis ×goliath*. Leaf blade variability: **a**–**b**, **d**–**e**) adaxial surface; **c**) abaxial surface.

45207

HERBARIUM MUSAEI CIVICI 45207
HISTORIAE NATURALIS MEDIOLANENSIS

Vitis ×goliath Ardenghi, Galasso & Banfi
= *Vitis riparia* Michx. × *Vitis rupestris* Scheele × *Vitis vinifera* L.
HOLOTYPUS, part A
locus: Italia; Lombardia; PV; Stradella; cavalcavia di via Valle Badia, lato S (coord. geogr. WGS84: 45.078178°N 9.286523°E)
dies: 20/08/2014
altitudo: 71 m s.l.m.
expositio: sud
legit: Nicola Ardenghi
determinaverunt: Nicola Ardenghi, Gabriele Galasso & Enrico Banfi
habitat: robinieto su scarpata stradale, con *Robinia pseudoacacia*, *Convolvulus sepium*, *Bryonia dioica*, *Sambucus ebulus*, *Phytolacca americana*, *Juglans regia*

45208

HERBARIUM MUSAEI CIVICI 45208
HISTORIAE NATURALIS MEDIOLANENSIS

Vitis ×goliath Ardenghi, Galasso & Banfi
= *Vitis riparia* Michx. × *Vitis rupestris* Scheele × *Vitis vinifera* L.
HOLOTYPUS, part B
locus: Italia; Lombardia; PV; Stradella; cavalcavia di via Valle Badia, lato S (coord. geogr. WGS84: 45.078178°N 9.286523°E)
dies: 20/08/2014
altitudo: 71 m s.l.m.
expositio: sud
legit: Nicola Ardenghi
determinaverunt: Nicola Ardenghi, Gabriele Galasso & Enrico Banfi
habitat: robinieto su scarpata stradale, con *Robinia pseudoacacia*, *Convolvulus sepium*, *Bryonia dioica*, *Sambucus ebulus*, *Phytolacca americana*, *Juglans regia*

45209

HERBARIUM MUSAEI CIVICI 45209
HISTORIAE NATURALIS MEDIOLANENSIS

Vitis ×goliath Ardenghi, Galasso & Banfi
= *Vitis riparia* Michx. × *Vitis rupestris* Scheele × *Vitis vinifera* L.
HOLOTYPUS, part C
locus: Italia; Lombardia; PV; Stradella; cavalcavia di via Valle Badia, lato S (coord. geogr. WGS84: 45.078178°N 9.286523°E)
dies: 20/08/2014
altitudo: 71 m s.l.m.
expositio: sud
legit: Nicola Ardenghi
determinaverunt: Nicola Ardenghi, Gabriele Galasso & Enrico Banfi
habitat: robinieto su scarpata stradale, con *Robinia pseudoacacia*, *Convolvulus sepium*, *Bryonia dioica*, *Sambucus ebulus*, *Phytolacca americana*, *Juglans regia*

45210

HER RIUM MUSAEI CIVICI 45210
HISTORIAE N TURALIS MEDIOLANENSIS

tis ×goliath Ardenghi, Galasso & Banfi
Vitis riparia Michx. × *Vitis rupestris* Scheele × *Vitis vinifera* L.
HOLOTYPUS, part D
us: Italia; Lombardia; PV; Stradella; cavalcavia di via Valle Badia, lato S (coord. geogr. WGS84: 45.078178°N 9.286523°E)
dies: 20/08/2014
altitudo: 71 m s.l.m.
expositio: sud
legit: Nicola Ardenghi
determinaverunt: Nicola Ardenghi, Gabriele Galasso & Enrico Banfi
habitat: robinieto su scarpata stradale, con *Robinia pseudoacacia*, *Convolvulus sepium*, *Bryonia dioica*, *Sambucus ebulus*, *Phytolacca americana*, *Juglans regia*

FIGURE 6. Holotype of *V. ×goliath* Ardenghi, Galasso & Banfi, parts A−D (MSNM).

Outside Italy (e.g., France, Spain, Denmark, Switzerland, United States, and Canada), further cultivars with the same genetic composition are employed both as rootstock (e.g., '196-17 Castel' and '4.010 Castel', unisexual hybrids obtained by crossing *V. rupestris* × *V. vinifera* with *V. riparia*) and direct-producers (e.g., 'Maréchal Foch' and 'Léon Millot', originating from the crossing of *V. riparia* × *V. rupestris* with *V. vinifera*) (Galet 1988, Laguna 2004, Robinson *et al.* 2012).

Notes:—Hybrids between *V. rupestris* and *V. vinifera*, featuring similar leaf morphology, may as well be present in the wild over the Italian territory. These artificial crossings, already recorded from Spain (Laguna 2004, 2005), were employed as rootstock mostly in central and southern Italy. One of the best known is 'Aramon-Rupestris Ganzin n° 1', one of the oldest Euro-American hybrids, obtained in France in 1879. Successfully and largely used at the beginning of the phylloxera crisis for its hardiness and ease of grafting, it was then rejected for the low root-resistance to phylloxera, especially in warm climates (Olivieri 1936, Cosmo *et al.* 1958, Istituto centrale di statistica & Ministero dell'agricoltura e delle foreste 1972, Galet 1988, Eynard & Dalmasso, 1990, Ministero delle Politiche Agricole, Alimentari e Forestali 2015).

Unisexual individuals of *V. ×goliath* may be found in the wild, since a number of male clones, such as '196-17 Castel' and '4.010 Castel', occur in cultivation (Galet 1988).

Acknowledgments

Gábor Tóth (Kézirattár és Régi Könyvek Gyűjteménye, Budapest) is acknowledged for providing A. Terpó's doctoral thesis and Franco Giordana (Crema, Cremona) and Alberto Fumagalli (Spilimbergo, Pordenone), for sharing information on some Italian populations examined. The authors are also grateful to Michele Zilioli (Laboratorio di Entomologia/Microscopia Elettronica, Museo di Storia Naturale di Milano), for kindly delivering the microscope images of seeds and leaf indumentum, and to Giulia Ardenghi (Stradella, Pavia), for the precious graphic assistance in the digital image preparation. Eventually, Editor Federico Luebert (Universität Bonn) and two anonymous reviewers are thanked for their worthwhile comments.

References

Ardenghi, N.M.G. (2015) Notulae 269–272. *In*: Galasso, G. & Banfi, E. (Eds.) Notulae ad plantas advenas Longobardiae spectantes: 5 (263–310). *Pagine Botaniche* 38 (2014): 22–23.

Ardenghi, N.M.G. & Bernardo, L. (2015) Notulae: 252−253. *In*: Galasso, G., Nepi, C., Domina, G. & Peruzzi, L. (Eds.) Notulae alla flora esotica d'Italia: 12 (244–287). *Informatore Botanico Italiano* 47 (1): 79−80.

Ardenghi, N.M.G., Galasso, G., Banfi, E., Zoccola, A., Foggi, B. & Lastrucci, L. (2014) A taxonomic survey of the genus *Vitis* L. (Vitaceae) in Italy, with special reference to Elba Island (Tuscan Archipelago). *Phytotaxa* 166 (3): 163−198. http://dx.doi.org/10.11646/phytotaxa.166.3.1

Ardenghi, N.M.G., Galasso, G., Banfi, E. & Cauzzi, P. (2015) *Vitis ×novae-angliae* (Vitaceae): systematics, distribution and history of an "illegal" alien grape in Europe. *Willdenowia* 45 (2): 197−207. http://dx.doi.org/10.3372/wi.45.45206

Ardenghi, N.M.G. & Maggioni, L. (2015) Notula: 259. *In*: Galasso, G., Nepi, C., Domina, G. & Peruzzi, L. (Eds.) Notulae alla flora esotica d'Italia: 12 (244–287). *Informatore Botanico Italiano* 47 (1): 81−82.

Berlese, A.N. & De Toni, J.B. (1888) Phycomiceteae *In:* Saccardo, P.A. (Ed.) *Sylloge fungorum* 7(1). Typis seminarii, Patavii, pp. 181−322. http://dx.doi.org/10.5962/bhl.title.5371

Bernardo, L. (2015) Notulae: 280−281. *In*: Galasso, G., Nepi, C., Domina, G. & Peruzzi, L. (Eds.) Notulae alla flora esotica d'Italia: 12 (244–287). *Informatore Botanico Italiano* 47 (1): 87−88.

Bodor, P., Deaìk, T., Hőhn, M. & Bisztray, G.D. (2011) Morphological and molecular identification of invasive and autochthonous Vitis taxa along Hungary. *In*: Bohren, C., Bertossa, M., Schoenenberger, N., Rossinelli, M. & Conedera, M. (Eds.) *3rd International Symposium on Environmental Weeds and Invasive Plants. Abstracts. October 2 to 7, 2011. Monte Veritaì, Ascona, Switzerland*. Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, p. 38.

Clausen, R.T. (1949) Checklist of the vascular plants of the Cayuga quadrangle 42°-43° N., 76°-77° W. *Memoir, Cornell University Agricultural Experiment Station* 291: 1–87.

Conti, F. & Bartolucci, F. (2015) *The Vascular Flora of the National Park of Abruzzo, Lazio and Molise (Central Italy)*. Geobotany Studies, Springer International Publishing, Cham, 254 pp.
http://dx.doi.org/10.1007/978-3-319-09701-5_1

Cosmo, I., Comuzzi, A. & Polsinelli, M. (1958) *Portinnesti della vite.* Edizioni Agricole, Bologna, 172 pp.

Ellis, J.B. & Everhart, B.M. (1892) *The North American Pyrenomycetes*. Ellis & Everhart, Newfield, 793 pp.
http://dx.doi.org/10.5962/bhl.title.3807

Eynard, I. & Dalmasso, G. (1990) *Viticoltura moderna: manuale pratico*. Hoepli, Milano, 747 pp.

Fernald M.L. (1917) A new *Vitis* from New England. *Rhodora* 19: 144−147.

FranceAgriMer (2015) *Catalogue officiel des variétés de vigne*. Available from: http://www.franceagrimer.fr/ (accessed 1 April 2015)

Fregoni, M. & Bavaresco, L. (1986) Il contributo italiano nel miglioramento genetico della vite. *In:* Atti del 4° simposio internazionale di genetica della vite, Verona (Italia), 13−18 Avril 1985. *Vignevini* 12 (suppl.): 2−6.

Galet, P. (1988) *Ceìpages et vignobles de France. Tome 1: Les vignes ameìricaines*. Deìhan, Montpellier, 560 pp.

Galet, P. (2000) *Dictionnaire encyclopédique des cépages*. Hachette Pratique, Paris, 936 pp.

Gariboldi, L. & Ardenghi, N.M.G. (2015) Notulae: 256−257. *In*: Galasso, G., Nepi, C., Domina, G. & Peruzzi, L. (Eds.) Notulae alla flora esotica d'Italia: 12 (244–287). *Informatore Botanico Italiano* 47(1): 80−81.

Gmelin, C.C. (1805) *Flora badensis alsatica* 1. In officina Aul. Mülleriana, Karlsruhe, 768 pp.

Hegi, G. (1925) *Illustrierte Flora von Mittel-Europa. Mit besonderer Berücksichtigung von Deutschland, Oesterreich und der Schweiz. Zum Gebrauche in den Schulen und zum Selbstunterricht* 5 (1). J.F. Lehmanns Verlag, München, pp. 317–476.

Iamonico (2014) *Vitis* × *koberi* (Vitaceae) alle Isole Tremiti. *Thalassia Salentina* 36: 71−77.

Iamonico, D., Iberite, M. & Nicolella, G. (2014) Aggiornamento alla flora esotica del Lazio (Italia centrale). II. *Informatore Botanico Italiano* 46 (2): 215−220.

Istituto centrale di statistica & Ministero dell'agricoltura e delle foreste (1972) *Catasto viticolo (rilevazione al 25 ottobre 1970)* 1 (1). Failli, Roma, 553 pp.

Keller, M. (2015) *The Science of Grapevines: Anatomy and Physiology.* Second Edition. Academic Press, Oxford, 522 pp.

Laguna, E. (2003) Sobre las formas naturalizadas de *Vitis* L. (*Vitaceae*) en la Comunidad Valenciana, I. Especies. *Flora Montiberica* 23: 46–82.

Laguna, E. (2004) Datos foliares de la especies e híbridos alóctonos de vides (género *Vitis*) en el territorio valenciano. *Toll Negre* 3: 11–25.

Laguna, E. (2005) *Especies invasoras de Vitis L. en España: identificatión y datos sobre su capacidad de exspansión*. II Congreso de Biología de la Conservación de Plantas, Jardín Botánico Atlántico, Gijón, Spain, 21−23 September 2005. Available from: http://botanico.gijon.es/multimedia_objects/download?object_id=77463&object_type=document (accessed 1 Apri 2015)

Linnaeus, C. (1753) *Species Plantarum*. L. Savius, Stockholm, 1200 pp.
http://dx.doi.org/10.5962/bhl.title.669

Linnaeus, C. (1754) *Genera Plantarum, ed. 5*. L. Savius, Stockholm, 500 pp.
http://dx.doi.org/10.5962/bhl.title.746

McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Prud'Homme van Reine, W.F., Smith, G.F., Wiersema, J.H. & Turland, N.J. (Eds.) (2012) *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011. Regnum Vegetabile* 154, 208 pp.

Michaux, A. (1803) *Flora boreali-americana* 2. Typis Caroli Crapelet, apud Fratres Levrault, Paris & Strasbourg, 340 pp.

Ministero delle Politiche Agricole Alimentari e Forestali (2015) *Registro nazionale delle varietà di vite*. Available from: http://catalogoviti.politicheagricole.it/home.php (accessed 23 February 2015)

Montanari, S., Faggi, G., Sirotti, M., Contarini, E. & Alessandrini, A. (2014) Aggiornamenti floristici per la Romagna. Seconda serie. *Quaderno di Studi e Notizie di Storia Naturale della Romagna* 40: 1−29.

Moore, M.O. (1991) Classification and systematics of eastern North American *Vitis* L. (Vitaceae) North of Mexico. *Sida, Contributions to Botany* 14 (3): 339–367.

Munson, T.V. (1909) *Foundations of American Grape Culture*. Orange Judd Company, New York, 252 pp.

Nicolella, G., Maggioni, L., Di Giuseppe, R. & Ardenghi, N.M.G. (2015) Noterella 0143. *Vitis ×koberi* Ardenghi, Galasso, Banfi & Lastrucci. *Acta Plantarum Notes* 3: 82.

Olivieri, O. (1936) *Vitigni. Porta-innesti americani. Loro riconoscimento ed attitudini colturali*. Ulrico Hoepli, Milano, 251 pp.

Planchon, J.É. (1880) Le *Vitis Berlandieri*, nouvelle espèce de vigne américane. *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences* 91: 425–428.

Ravenel, H.W. (1848) *Fungi Caroliniani Exsiccati*, 5. Russell & Jones, Charleston, 100 pp.

Rivera, D., Miralles, B., Oboìn, C., CarrenÞo, E. & Palazoìn, J.A. (2007) Multivariate analysis of *Vitis* subgenus *Vitis* seed morphology.

Vitis 46 (4): 158−167.

Robinson, J., Harding, J. & Vouillamoz, J. (2012) *Wine Grapes. A complete guide to 1,368 vine varieties, including their origins and flavour*. Allen Lane, London, 1280 pp.

Scheele, A. (1848) Beiträge zur Flora von Texas. *Linnaea* 21 (5): 576–602.

Schweinitz, L.D. de (1834) Synopsis Fungorum in America Boreali media degentium. *Transactions of the American Philosophical Society, new ser.* 4 (2): 141−316.

Shimer, H. (1866) "Grape leaf louse" − *Daktulosphaira Vitifoliae*. *The Prairie Farmer, n.s.* 34: 365.

Terpó, A. (1988) *A pannóniai területek természetes előfordulású szőlő (*Vitis*) populációinak eredete, taxonómiája és gyakorlati jelentősége*. Doctoral thesis, Budapest, 63 pp. (unpublished).

Ufficio federale dell'agricoltura UFAG (2014) *L'anno viticolo 2013. Statistiche vitivinicole*. Confederazione Svizzera, Ufficio federale dell'agricoltura UFAG. Available from: http://www.blw.admin.ch/ (accessed 23 February 2015)

Villa, M. & Arrigoni, P. (2015) Notula 276. *In*: Galasso, G. & Banfi, E. (Eds.) Notulae ad plantas advenas Longobardiae spectantes: 5 (263–310). *Pagine Botaniche* 38 (2014): 26.

Appendix 1. *Specimina visa*.

V.* ×*bacoi:—ITALY. **Lombardy**: Crema (Cremona), Ca' delle Mosche (WGS84: ca. 45.35159°N 9.71231°E), 72 m, bosco in evoluzione, October 2002, *F. Giordana s.n.* [photographs available from: http://www.actaplantarum.org/floraitaliae/viewtopic.php?f=40&t=1965 (accessed: 1 April 2015)]; Santo Stefano Ticino (Milano), Cascina Fontana, lato N della ferrovia (WGS84: 45.479962°N 8.918647°E), 145 m, no exp., robinieto su sponda di fossato alla base della massicciata ferroviaria, con *Robinia pseudoacacia*, *Rubus* sect. *Corylifolii*, *Parthenocissus quinquefolia*, 13 September 2014, *N. Ardenghi s.n.* (holotype MSNM, 6 sheets, isotype FI, 4 sheets); **Friuli Venezia Giulia**: Ovaro (Udine), via Caduti II Maggio, giardino privato (WGS84: 46.481212°N 12.867456°E), 527 m, exp. S, cresciuta spontaneamente in un giardino privato, 8 November 2014, *A. Fumagalli s.n.* (MSNM); **Tuscany**: Portoferraio (Livorno), Case Norsi (WGS84: 42.773118°N 10.346124°E; staz. 24), 37 m, exp. E, margine stradale, 18 June 2008, *G. Galasso* s.n. (MSNM 44787, 44788 sub *V. riparia* Michx.).

V.* ×*goliath:—ITALY. **Lombardy**: Torrazza Coste (Pavia), loc. Riccagioia, Centro Vitivinicolo Riccagioia (Villa Riccagioia) (WGS84: 44.982167°N 9.091577°E ± 50m), 145 m, no exp., planta culta, 6 September 2007, G. Galasso s.n. (MSNM sub *V. riparia* Michx. × *V. rupestris* Scheele, 4 sheets); Canneto Pavese (Pavia), Montué, quadrante C.F.C.E. 0921-2, 232 m, no exp., margine di sterrata a lato di un vigneto, 8 August 2009, *N. Ardenghi s.n.* (*Herb. N. Ardenghi* 001146 sub *V. riparia* Michx. × *V. rupestris* Scheele); Stradella (Pavia), cavalcavia di via Valle Badia, lato S (WGS84: 45.078178°N 9.286523°E), 71 m, exp. S, robinieto su scarpata stradale, con *Robinia pseudoacacia*, *Convolvulus sepium*, *Bryonia dioica*, *Sambucus ebulus*, *Phytolacca americana*, *Juglans regia*, 20 August 2014, *N. Ardenghi s.n.* (holotype MSNM, 4 sheets, isotype FI, 2 sheets); *ibidem*, 25 August 2014, *N. Ardenghi s.n.* (MSNM, 4 sheets, APP, 2 sheets, BR, 2 sheets); Montù Beccaria (Pavia), lato NW dell'incrocio tra la SP43 e la strada per Molino Quaroni, all'altezza di Roncole (WGS84: 45.033826°N 9.300432°E), 117 m, no exp., incolto con *Robinia pseudoacacia*, *Acer negundo*, *Clematis vitalba*, *Elytrigia repens*, *Equisetum telmateia*, *Urtica dioica*, 26 August 2014, *N. Ardenghi s.n.* (MSNM, 4 sheets); **Tuscany**: Arcipelago Toscano: Isola di Capraia, paese, area un tempo presumibilmente coltivata a vite ma ormai abbandonata e incolta, June 2011, *L. Lastrucci*, *B. Foggi & R. Calamassi s.n.* (FI sub *V. riparia* Michx. × *V. rupestris* Scheele).

Appendix 2. Populations sampled for the infructescence and seed measurements of *Vitis* ×*instabilis* reported in Table 1.

V.* ×*instabilis:—ITALY. **Lombardy**: Stradella (Pavia), 200 m a S di C.na Valletti di Sopra, ingresso di terreno con vigneti (WGS84: 45.089670°N 9.295162°E), 64 m, no exp., recinzione con rete metallica, tappezzante, 5 August 2014, *N. Ardenghi* (MSNM, 2 sheets); Stradella (Pavia), via Valle Badia, lato S (WGS84: 45.079839°N 9.288289°E), 71 m, no exp., fossato alla base della strada, con *Juglans regia*, *Rubus* sect. *Corylifolii*, *Lycopus exaltatus*, 20 August 2014, *N. Ardenghi s.n.* (MSNM, 4 sheets); Arena Po (Pavia), lato SE della rotonda della SP200 prima del ponte sul Fiume Po (WGS84: 45.096312°N 9.343708°E), 57 m, no exp., spiazzo in asfalto, con *Rubus* sect. *Corylifolii*, *Cynodon dactylon*, *Erigeron canadensis*, tappezzante, 22 August 2014, *N. Ardenghi s.n.* (MSNM, 2 sheets).

Vitis ×novae-angliae (*Vitaceae*): systematics, distribution and history of an "illegal" alien grape in Europe

Author(s): Nicola M. G. Ardenghi, Gabriele Galasso, Enrico Banfi & Paolo Cauzzi
Source: Willdenowia, 45(2):197-207.
Published By: Botanic Garden and Botanical Museum Berlin (BGBM)
DOI: http://dx.doi.org/10.3372/wi.45.45206
URL: http://www.bioone.org/doi/full/10.3372/wi.45.45206

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Vitis ×novae-angliae (*Vitaceae*): systematics, distribution and history of an "illegal" alien grape in Europe

Abstract

Ardenghi N. M. G., Galasso G., Banfi E. & Cauzzi P.: *Vitis ×novae-angliae* (*Vitaceae*): systematics, distribution and history of an "illegal" alien grape in Europe. – Willdenowia 45: 197–207. 2015. – Version of record first published online on 13 July 2015 ahead of inclusion in August 2015 issue; ISSN 1868-6397; © 2015 BGBM Berlin.

DOI: http://dx.doi.org/10.3372/wi.45.45206

Systematics and distribution in Europe of *Vitis ×novae-angliae* (= *V. labrusca* × *V. riparia*, *Vitaceae*), a naturalized North American neophyte introduced for wine production in the 19th century, are investigated. Original identification tools are provided and diagnostic characters are discussed in detail, with special reference to leaf, fruit and seed morphology and the flavour of ripe berries. The complex of events that led to its introduction and eventually to its prohibition in Europe are also taken into account. Original morphological data regarding infructescences and seeds of related taxa are also reported.

Additional key words: alien species, nothotaxa, seed morphology, *Vitis labrusca*, *Vitis riparia*

Introduction

The occurrence of *Vitis ×novae-angliae* Fernald (pro sp.) as a spontaneous alien in Europe was firstly recorded by Laguna (2005), who placed this hybrid among the "variedades más comunes cultivadas y asilvestradas" in the Iberian Peninsula and the Balearic Islands, regarding it as "rare". Its presence in N Italy was then supposed by Ardenghi & al. (2014), who reported plants with intermediate characters between *V. labrusca* L. and *V. riparia* Michx. Some months later, Tison & de Foucault (2014) recorded, under "*V. labrusca* s.l.", a series of hybrids of *V. labrusca* from France, among them *V. labrusca* × *V. riparia*, yet without giving any further detail regarding diagnostic characters and distribution.

This research outlines the currently known distribution of *Vitis ×novae-angliae* in Europe, confirming its presence in Italy; additionally, it provides original identification tools to allow its distinction from the parental species and other spontaneous cultigen hybrids.

The systematics of the genus *Vitis* L. in Europe have been recently treated in depth by Ardenghi & al. (2014), who assigned new names to three nothospecies largely employed as rootstocks and naturalized and/or invasive in various European countries. This paper is a subsequent step toward the investigation of this critical group, focusing on a member of the so-called "direct-producer hybrids", natural or artificial crosses between American species or between American species and *V. vinifera* L., which represented an early solution to phylloxera, simultaneously oriented to the production of wines, which, although "surrogate", gained great popularity in many parts of Europe (such as 'Clinton', a cultivar and home-made wine still well-known in N Italy). In line with the previous contribution (Ardenghi & al. 2014), a strictly taxonomic approach has been followed to evaluate the

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Table 1. Comparison of the main diagnostic features of *Vitis* ×*novae-angliae*, *V. labrusca*, *V. riparia* and *V.* ×*koberi*. Terminology is largely according to Ardenghi & al. (2014: 165) for the vegetative traits, and to Rivera & al. (2007) for the seeds; the letters “w-” and “r-” stand for “white” and “rufescent”, respectively.

	V.* ×*novae-angliae	***V. labrusca***	***V. riparia***	***V.* ×*koberi***
Tendrils consecutive on	2, 3+ nodes	3+ nodes	2 nodes	2 nodes
Petiole insertion (abaxial leaf surface)	w-r-floccose or w-r-arachnoid and sometimes hirtellous	tomentose	hirtellous	w-arachnoid and hirtellous
Petiole pubescence	w-r-floccose or w-r-arachnoid and sometimes hirtellous	glabrous or w-r-arachnoid	hirtellous	w-arachnoid and hirtellous
Phylloxera galls on leaf blades	present	absent	present	present
Abaxial/adaxial leaf colour	discolorous	discolorous	concolorous	concolorous
Lobes at end of central and 2 lateral nerves	absent or inconspicuous	absent or inconspicuous	acuminate to cuspidate	inconspicuous
Abaxial leaf surface	w-r-floccose to w-r-tomentose or glabrous	w-r-tomentose	hirtellous	glabrescent to hirtellous
Adaxial leaf surface	reticulate-rugose	reticulate-rugose	smooth	smooth
Tufts of hairs at vein axils	present	absent	present	absent
Vein surface (abaxial leaf surface)	w-r-floccose and hirtellous	w-r-tomentose	hirtellous	hirtellous and w-arachnoid
Leaf base	U- or V-shaped	U- or V-shaped	U-shaped	U- or lyre-shaped
Leaf margin teeth	obtuse	obtuse	acute	obtuse
Infructescence compactness	compact	compact	lax	lax or compact
Berry diameter [mm]	10–15	>12	5–9(–10)	(4–)5–9(–10)
Exocarp adherence	none or scarce	none	strong	strong
Juice colour	dark red	colourless	dark red	dark red
Flavour	“foxy” and astringent	“foxy”	astringent	astringent
Seed body shape	ellipsoid-obovoid, polygonal	ellipsoid-obovoid, polygonal	spheroidal to ellipsoid-spheroidal	spheroidal to ellipsoid-spheroidal
Seed length [mm]	6–7.2	5–8	3.5–4.5	(4–)4.2–5.1
Seed width [mm]	(3.5–)3.9–4.4	4.4–4.5(–4.7)	2.8–3.5	3.2–3.7(–3.9)
Seed apex	± rounded to slightly notched	notched	rounded	slightly notched to notched
Seed beak shape	rectangular to obtrapezoidal	broadly obtrapezoidal	broadly obtrapezoidal	subcylindric
Seed beak length [mm]	1–1.9	1.6–2.1	0.2–0.5	(0.4–)0.5–0.8
Seed beak width at base [mm]	1.9–2.2(–2.3)	2.1–2.9	0.8–1.1	0.9–1.1(–1.2)

natural variability of the nothotaxon and its relationship with the parental taxa. Viticultural and ampelographic sources played an important role in tracing the biological, historical and cultural events that led to the introduction, the success and the eventual disappearance of *V.* ×*novae-angliae*, indispensable requirements to understanding the ecology and geographic distribution of a taxon until now largely unknown to botanists.

Material and methods

The present paper is based on the study of material collected during field trips in N Italy between 2013 and 2015, on the revision of exsiccata held at FI, MNAV, MSNM, P, PAD, PAV and VER (herbarium codes according to Index Herbariorum: Thiers 2015+) and European floristic literature regarding the genus *Vitis* (e.g. Laguna 2004, 2005; Tison & de Foucault 2014).

The description of *Vitis* ×*novae-angliae* and the morphological data regarding infructescences and seeds of *V. labrusca*, *V. riparia* and *V.* ×*koberi* Ardenghi & al. reported in Table 1 are the result of original observations and measurements by the authors on specimens collected in the wild and currently stored at MSNM (see Specimens examined and Appendix). The *Vitis labrusca* data were completed with information acquired from literature (Moore 1991).

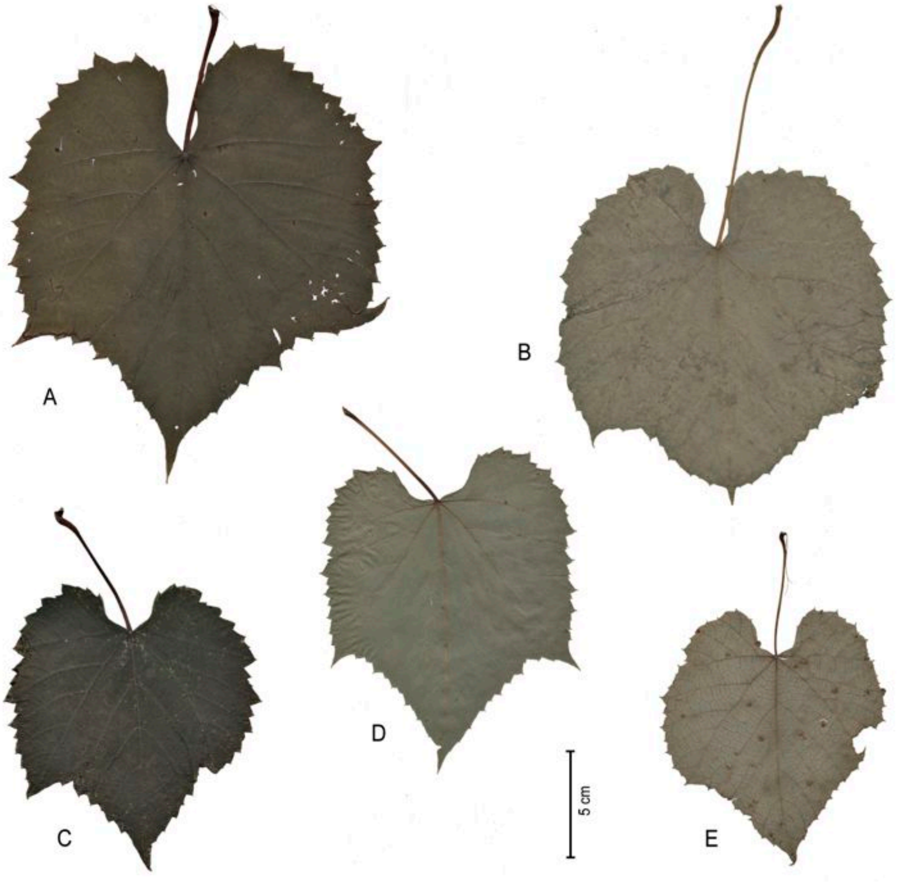

Fig. 1. *Vitis* ×*novae-angliae* leaf blades – A & C: adaxial surface; B & D: abaxial surface; E: abaxial surface with phylloxera galls. – A & D: Santo Stefano Ticino, Italy; B & E: Bereguardo (Moriano), Italy; C: Treviglio, Italy. – Scans by N. M. G. Ardenghi.

Particular attention was paid to leaf and seed morphology, the indumentum of vegetative parts and the flavour of ripe berries. Exsiccated mature leaf blades of *Vitis* ×*novae-angliae* were scanned at 600 dpi resolution using a Canon MP230 scanner (Fig. 1); the leaf blade and petiole indumentum were examined using a back-scattered scanning electron microscope (SEM) JEOL JSM-5610LV. Small fragments of leaf surface (about 1 cm^2) were carved from dried leaves around the petiole insertion and in the centre of the leaf blade, in order to examine the trichomes on petioles, along leaf margins, at the vein axils and on the abaxial leaf surface. Leaf samples were mounted on aluminium stubs using conductive carbon adhesive tabs. Four images were taken at three different magnifications (×35, ×70, ×100) for the leaf details (Fig. 2). Seeds of *V.* ×*novae-angliae*, *V. labrusca*, *V. riparia*, and *V.* ×*koberi* were pictured by means of a Nikon D300 reflex camera (Fig. 3).

The identity of the investigated exsiccata was confirmed by their comparison with the type specimens of *Vitis* ×*novae-angliae* stored at GH and NY, and the descriptions of both the nothospecies and the parental species provided by Fernald (1917), Moore (1991), and Ardenghi & al. (2014). Information useful to confirm the identity of our plants was additionally acquired from the examination of cultivated individuals of ‘Clinton’ from Castelleone (Italy, see specimens examined) and ampelographic literature, which served also as a source for tracing the cultivation history of the *labrusca-riparia* hybrids in Europe.

Results and Discussion

Nomenclature

Vitis* ×*novae-angliae Fernald in Rhodora 19: 146. 1917, pro sp.
= *Vitis labrusca* L. × *V. riparia* Michx.
Lectotype (designated by Moore 1991: 364): [United States of America, Maine, Penobscot County], “Thicket by the river, Orono”, 27 Jun 1906, *M. L. Fernald s.n.* (GH 00051708 [image!]; isolectotypes: GH 00061709 [image!], GH 00061747 [image!], GH 00061748 [image!], NY 00415161 [image!], PH); syntypes: *ibid.*, 17 Aug 1908, *M. L. Fernald s.n.* (GH 00051711 [image!]); *ibid.*, late Sep 1908, *M. L. Fernald s.n.* (GH 00051710 [image!], GH 00061749 [image!]).

Description

Vines woody, deciduous, climbing or creeping-prostrate. *Branchlets* with sparse white to rufescent floccose pubescence; *bark* exfoliating in shreds on mature stems. *Tendrils* bifurcate to occasionally trifurcate, a tendril or inflorescence present at 2, 3 or more consecutive nodes. *Petiole* white to rufescent floccose, usually with hirtellous pubescence, rarely glabrous, yellowish-green; *leaf blade* usually thick and coriaceous (thinner in immature leaves), discolorous, 9–24 cm long, not conduplicately folded, broadly cordate, from subentire to slightly 3-lobed, usually with phylloxera galls; *abaxial surface* pale green, dull, glabrous, with white to rufescent floccose pubescence or with a continuous whitish to rufescent thin layer of tomentum (more evident in immature leaves), with dense to sparse floccose or arachnoid pubescence on veins at petiole insertion, sometimes accompanied by rigid hairs; *veins* with sparse to dense white to rufescent floccose and hirtellous pubescence, with lax to dense tufts of rigid hairs at axils; *adaxial surface* dark green, slightly lustrous, usually reticulate-rugose in appearance for sunken veins, glabrous (white to rufescent tomentose in apical leaves not yet expanded); *veins* greenish- or yellowish-white, glabrous or with arachnoid or floccose white to rufescent pubescence, occasionally hirtellous; *leaf base* U- or V-shaped. *leaf margin* with hirtellous and white to rufescent floccose pubescence, dentate-crenate, teeth obtuse (usually broadly triangular, occasionally curly bracket-shaped, pointed-arch-shaped or rounded) in mature leaves, sometimes acute in immature ones, teeth at ends of central and 2 main lateral veins usually broadly triangular, acute to shortly acuminate. *Infructescences* 3.6–10.1 cm long, 3.5–5.3 cm wide, from cylindric to obconic in outline, sometimes lobed in upper part, usually compact (berries touching each other); *peduncle* 1.4–4.8 cm long; *rachis* slightly arachnoid and/or hirtellous pubescent; *pedicels* (3–)4–7 mm long. *Berries* 16–50 per infructescence (sometimes more in cultivated plants), 10–15 mm in diam., globose, black with a thin pruinose layer; *exocarp* (“skin”) scarcely to moderately adherent to mesocarp; *mesocarp* (“flesh”) mucilaginous, grey-yellowish, dark red around seeds; *juice* staining dark red; *flavour* initially “foxy”, then decidedly sharp and astringent, finally a residual piquancy is perceived on tongue tip. *Seeds* 1–3 per berry, 6–7.2 mm long, (3.5–)3.9–4.4 mm wide (including beak); *seed body* ellipsoid-obovoid, rarely spheroidal, usually polygonal, apex from ± rounded to slightly notched, grey-brownish; *beak* 1–1.9 mm long, 1.9– 2.2(–2.3) mm wide (at junction of seed body), from rectangular to obtrapezoidal in outline, brownish; *chalaza* not always well developed, 1.3–2.2 mm long, 0.9–1.3 mm wide, ovate, yellowish-brown; *fossettes* yellowish to yellowish-brown.

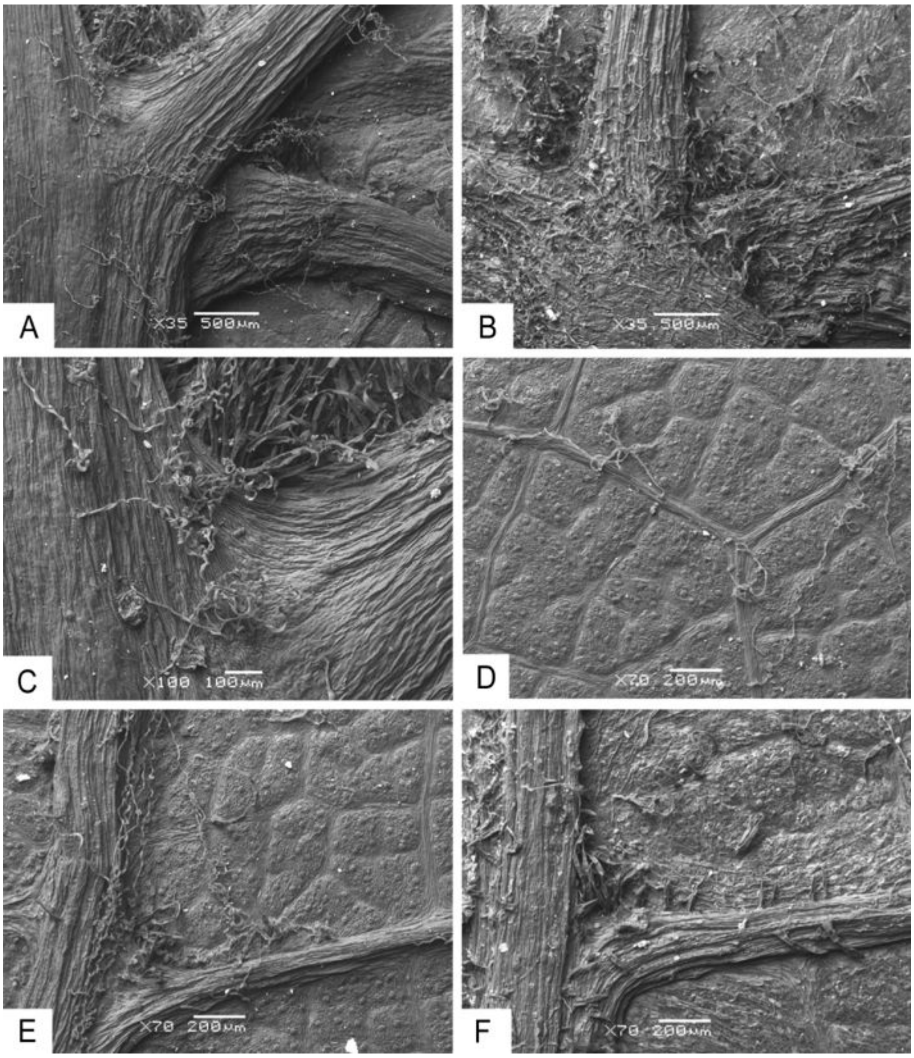

Fig. 2. *Vitis ×novae-angliae* leaf indumentum on abaxial leaf surface – A & B: petiole insertion; C: detail of petiole insertion; D: abaxial leaf surface; E & F: vein axils. – A, C–E: Santo Stefano Ticino, Italy; B & F: Missaglia, Italy. – Photographs by M. Zilioli.

Systematics and identity of the specimens

French botanist and ampelographer Alexis Millardet (1838–1902) was the first to identify hybrids between *Vitis labrusca* and *V. riparia*. In 1874, he suspected a hybrid origin of the cultivars (known as “vitigni” in Italy, and “vignes” in France) ‘Clinton’, ‘Taylor’, and ‘Vialla’ (syn. ‘La Touratte’) (Millardet 1876), until that time simply regarded as cultivars of *V. riparia* (*V. cordifolia* auct. non Michx.; *V. vulpina* auct. non L.) by different American and European authors, such as Strong (1866), Engelmann (1868) and Planchon (1875). Further studies allowed Millardet to confirm the *labrusca-riparia* parentage of these three cultivars (Millardet 1877a, b, 1880, 1882, 1885), then under the spotlight of viticulturists for their resistance to phylloxera; his results were subsequently followed by Munson (1885, 1909), Viala & Ravaz (1892), Hedrick (1908), and, with caution, by Bailey (1934). Besides ‘Clinton’ and ‘Taylor’, dozens of additional cultivars were recognized within *V. labrusca* × *V. riparia*, among them ‘Elvira’, ‘Montefiore’, ‘Noah’, ‘Oporto’, and ‘Sherman’ (Millardet 1885; Viala & Ravaz 1892; Hedrick 1908; Galet 1988). As reported in most of the aforementioned sources (e.g. Millardet 1877a, 1885; Munson 1909), later supported also by Galet (1988), ‘Clinton’ and ‘Taylor’ were spontaneous (or “accidental”,

Fig. 3. *Vitis* ×*novae-angliae*, *V. labrusca*, *V. riparia* and *V.* ×*koberi* seeds, ventral (on left) and dorsal (on right) sides, on 1 mm squared paper – A: *V.* ×*novae-angliae* (Albuzzano, Italy); B: *V. labrusca* (Pavia, Italy); C: *V. riparia* (Portalbera, Italy); D: *V.* ×*koberi* (Montù Beccaria, Italy). – Photographs by C. Ballerini.

according to their terminology) hybrids that originated in natural habitats of E North America (states of New York and Tennessee, respectively, see Hedrick 1908), then discovered and transferred into cultivation during the first half of the 19th century (to serve also as a basis for the selection of the other cultivars). However, artificial crossing between *V. labrusca* and *V. riparia* is likely to have occurred in European nurseries, as stated by Viala & Ravaz (1892), who excluded a direct employment of American "hybrides sauvages" in France, being of little viticultural interest.

In 1917, the American botanist Merritt Lyndon Fernald (1873–1950) described *Vitis novae-angliae* from New England (Fernald 1917). Although featuring characters intermediate between *V. labrusca* and *V. riparia*, Fernald did not accept his taxon as a hybrid, since, according to his own observations, the two species did not occur together, at least in some parts of the study area. More recently, Moore (1991), who examined Fernald's specimens and typified *V. novae-angliae*, regarded it as a hybrid, as previously did Munson and Bailey, who studied the New England populations mentioned by Fernald (see Fernald 1917).

Our specimens are clearly intermediate between *Vitis labrusca* and *V. riparia* (Table 1) and correspond in every feature to the type specimens of *V. novae-angliae*, to its protologue (Fernald 1917), and to the description provided by Moore (1991). Moreover, their morphological traits (along with their ecology, see the next paragraph) coincide with those reported for the *labrusca-riparia* black-berried cultivars, especially 'Clinton', by the major ampelographic sources, such as Millardet (1877c, 1880, 1885), Munson (1909) and Galet (1988). Therefore, we can safely confirm the hybrid origin of our plants and regard them as nothospecies, adopting Fernald's binomial combination transferred to the hybrid category by Moore (1991), according to Art. 50 and Art. H.10 Note 1 of the ICN (McNeill & al. 2012).

At a first analysis, *Vitis novae-angliae* looks very similar to the parental species and another related hybrid, *V.* ×*koberi* (= *V. berlandieri* Planch. × *V. riparia*), from which it can be distinguished mainly on the basis of disposition of tendrils (Fig. 4), indumentum of vegetative parts (Fig. 2), leaf blade colour (Fig. 1) and consistency, size of seeds (Fig. 3) and berries, adherence of exocarp to mesocarp (Fig. 4) and flavour of ripe berries (Table 1). Further confusion, however, may occur with hybrids of *V. aestivalis* Michx., such as those belonging to the group of cultivars named 'Seibel', especially *V. aestivalis* var. *lincecumii* (Buckley) Munson × *V. rupestris* Scheele × *V. vinifera*. This direct-producer hybrid was employed in various parts of Europe (including Italy); currently it is known as spontaneous in Spain (Laguna 2004) and a specimen recently collected in N Italy [Monticelli Pavese (Pavia), Umellina, lato N della strada, 47°05'10.2"N, 09°30'48.9"E (WGS84), 48 m, ciglio e scarpata stradale con *Elytrigia repens* e *Rubus* sect. *Corylifolii*, 3 Jun 2014, *N. Ardenghi*, *P. Cauzzi* & *S. Bodino s.n.* (MSNM)], at first identified as *V.* ×*novae-angliae*, is most likely to be referred to this taxon. It can be distinguished for its 3-lobed leaf blades with lyre-shaped basal sinus (acquired from *V. vinifera*), reniform to roundish in shape (as in *V. rupestris*), with abaxial leaf surface slightly glaucous, paler than the adaxial, and vegetative parts covered exclusively by reddish floccose pubescence [traits inherited from *V. aestivalis* var. *lincecumii*; according to Moore (1991) and Art. 60.1 of the ICN (McNeill & al. 2012), the correct spelling of the varietal epithet is "*lincecumii*" and not "*linsecomii*", the latter being a typographical error].

Ecology

Similar to the parental species (see Ardenghi & al. 2014), *Vitis* ×*novae-angliae* is a calcifuge and heliophilous taxon, usually occurring on moist, deep and highly fertile soils. Although superficial and well-drained soils are commonly regarded by viticulturists to promote the establishment of phylloxera on the root systems of cultivars of *V.* ×*novae-angliae* (whose susceptibility derives from *V. labrusca*, see next paragraph), the individuals recorded from shallow anthropogenic substrates (e.g. railway ballasts) did not seem to be affected by the insect.

In its native range, *Vitis* ×*novae-angliae* occurs in alluvial thickets, along ponds, streams, roads and fences (Moore 1991). Similarly, most of the Italian populations were discovered in woodland and shrub communities with *Robinia pseudoacacia* L., and ruderal and semi-ruderal habitats within or surrounding human settlements, often colonized by biennial and perennial vegetation of the phytosociological class *Artemisietea vulgaris* Lohmeyer, Preising & Tüxen ex Von Rochow 1951. Like other *V. riparia* hybrids (e.g. *V.* ×*koberi* and *V*. ×*instabilis* Ardenghi & al.), a preference for the linear transportation structures (especially railways) was noticed (Fig. 5). The largest population (located in Moriano, Bereguardo, Italy) has been recorded from an alluvial mesic woodland dominated by *R. pseudoacacia* (degrading stage of the *Populetalia albae* Braun-Blanquet ex Tchou 1948 forests), growing on a gravelly-sandy siliceous fluvial terrace. *V.* ×*novae-angliae* is indicated for similar habitats also in France (Tison & de Foucault 2014).

Fig. 4. *Vitis* × *novae-angliae* additional morphological traits – A: continuous tendrils; B: stem and exfoliating bark; C: infructescence and pedicels with characteristic residuals of red mesocarp after detachment of berries; D: berry with mucilaginous mesocarp clearly separating from exocarp. – A, C, D: Albuzzano, Italy; B: Bereguardo (Moriano), Italy. – Photographs by N. M. G. Ardenghi.

Distribution

According to Moore (1991), the native range of *Vitis* ×*novae-angliae* comprises the states of New England (NE United States), where it was described by Fernald (1917). However, its occurrence in further sites where the ranges of *V. labrusca* and *V. riparia* overlap is possible, as suggested by the discovery, in the states of New York and Tennessee, of the spontaneous hybrids from which the cultivars ‘Clinton’ and ‘Taylor’ were obtained (Hedrick 1908).

Outside the United States, the plant is currently known from Spain (Laguna 2005), France (Tison & de Foucault 2014), and Italy (this paper); especially in the latter two countries, many of its cultivars were grown until the middle 20th century (see “History and pathways of introduction”). The distribution in Spain and France is not well defined and needs further investigation; particularly, Tison & de Foucault (2014) did not treat *Vitis labrusca* and its hybrids separately, but grouped them under the name “*V. labrusca* s.l.” (among them, hybrids

Fig. 5. *Vitis* ×*novae-angliae* naturalized population in Albuzzano, Italy, covering railway ballast. – Photograph by N. M. G. Ardenghi.

with *V. aestivalis* and with both *V. aestivalis* and *V. riparia* were also mentioned, whose occurrence in the wild is quite doubtful, due to their difficult reproduction from cuttings and their susceptibility to phylloxera and downy mildew, deficiencies which soon caused their rejection from French viticulture, see Galet 1988). In Italy, *V.* ×*novae-angliae* is currently known from the N part of the Po Plain from Lombardia to Veneto, which corresponds, along with the NE part of Emilia-Romagna, to the traditional and most important cultivation area of 'Clinton' in the country (Rossi 1920; Istituto centrale di statistica del Regno d'Italia 1937; Istituto centrale di statistica & Ministero dell'agricoltura e delle foreste 1973, 1974). The presence of *V.* ×*novae-angliae* is expected in further European countries (e.g. Austria, Hungary, Romania, Switzerland, former Yugoslavia), where the cultivation of *labrusca-riparia* hybrids is reported (Galet 1988; Ufficio federale dell'agricoltura UFAG 2014+).

Invasion status

The river Ticinum floodplain in Moriano (Bereguardo) hosts the largest population of *Vitis* ×*novae-angliae* recorded in Italy. The plant, growing in a *Robinia pseudoacacia* woodland (*Chelidonio-Robinietalia* Jurko ex Hadač & Sofron 1980), occupies an area of 175 m^2, with a 50 % cover on both the shrub and tree layers, reaching the canopy at 7 m from the ground. The plant has been present in this site at least since August 2011, when one of the present authors (Ardenghi) first detected the population, but misidentified it as *V. labrusca*. The size of the stand and the high number and the diameter of the stems (Fig. 4), however, suggest that its introduction probably occurred earlier. Similarly, the presence of *V.* ×*novae-angliae* in Treviglio dates back at least to September 2010, when it was unintentionally pictured in a panoramic view for the web mapping service "Google Street View".

It is likely that the Moriano population originated from discarded pruned stems (*Vitis* ×*novae-angliae* easily propagates from cuttings) or seeds disseminated by birds (whose feeding activities on 'Clinton' were already noticed by Hedrick 1908); the latter mode of dispersal is highly probable also for the other populations, especially those recorded from the railway areas, where vegetative parts are unlikely to be brought by trains or farmers. Although the seed germination capability of *V.* ×*novae-angliae* and related taxa is still under study by the authors, evidence of this feature is available in ampelographic literature (e.g. cultivars 'Vialla' and 'Noah' are commonly reported to be seedlings of 'Clinton' and 'Taylor', respectively; see Munson 1885 and Galet 1988). Additionally, fruit production seems common in this taxon and it has been recorded from five of the known Italian populations (Albuzzano, Milano, Moriano, Santo Stefano Ticino, Treviglio).

On the basis of these observations, we consider *Vitis* ×*novae-angliae* naturalized in Italy, according to the definitions provided by Celesti-Grapow & al. (2009); the same invasion status has been adopted in France (Tison & de Foucault 2014).

History and pathways of introduction

The first (Euro-)American grapes to be imported in Europe were probably hybrids between *Vitis labrusca* and *V. vinifera* [*V.* ×*alexanderi* Prince ex Jacques (pro sp.) = *V.* ×*isabellae* Jacques (pro sp.) var. *alexanderi* (Jacques) Jacques, nom. illeg. = *V.* ×*isabella* Otto & A. Dietr. (pro sp.) = *V.* ×*prolifera* Raf. (pro sp.) = *V.* ×*labruscana* L. H. Bailey (pro sp.)], spontaneously arisen in the E United States between the late 17th and the early 18th century, and sold, under the well-known cultivar name 'Isabella' or 'Isabelle' [this name is sometimes applied to cultivars of *V. labrusca*; it seems that one of the often accepted synonyms of 'Isabella' is the Italian-named 'Fragola', which some authors, such as Hillier & Coombes (2002), uncorrectly assign to *V. vinifera*], at least as early as 1830 in France (Mabberley 1999) also as an ornamental vine. As a consequence of their introduction, less than two decades later the first cases of powdery mildew [*Uncinula necator* (Schwein.) Burrill] were recorded in the United Kingdom (in 1845) and France (in 1847). Thanks to its resistance to the fungal disease, the cultivation of 'Isabella' increased and provided a fertile ground for the spread of new pests from North America: phylloxera [*Daktulosphaira vitifoliae* (Fitch 1855)], first recorded in France in 1863, and downy mildew [*Plasmopara viticola* (Berk. & M. A. Curtis) Berl. & De Toni], detected in 1878 (Galet 1988; Calò & al. 1996; Quéré 2012).

Since the beginning of the phylloxera crisis, two different strategies were elaborated in order to recover European viticulture: grafting of *Vitis vinifera* on phylloxera-resistant American rootstocks (see Ardenghi & al. 2014), and employment of "direct-producer hybrids". The latter solution considered two separate categories of hybrids, suitable both for wine production and resistance to the new pests: "Euro-American" hybrids, resulting from the crossing of *V. vinifera* with one or more American species, and "American-American" hybrids, which involved only American species. The majority of the early "American-American" hybrids saw *V. labrusca* as the primary source of resistance genes; among these, the most successful since the 1870's were the binary crosses with *V. riparia*, mainly represented by the cultivars 'Clinton' and 'Vialla' (black-berried) and 'Elvira', 'Noah' and 'Taylor' (white-berried). For a brief period at the beginning of the phylloxera invasion, these cultivars were used also as rootstocks. However, the susceptibility of their roots to the insect, especially in superficial, dry, and nutrient-poor soils (character inherited from *V. labrusca*), and their sensitivity to limestone (derived from both parental species), limited their role almost to wine production, with the exception of 'Vialla' and 'Clinton': while the latter was sometimes deceptively sold as a *V. berlandieri* Planch. × *V. riparia* rootstock, five certified clones of the former are still cultivated in France as grafters (Galet 2000; FranceAgriMer 2014, 2015).

Wines obtained from the *labrusca-riparia* hybrids featured a prominent and typical "foxy" flavour (acquired from *Vitis labrusca*), always regarded with disgust by most of the oenologists, along with a low alcohol content, which prevented their conservation for more than five to six months. Nonetheless, these cultivars were progressively welcomed, both by professional viticulturists and subsistence farmers: hardiness, easy reproduction from cuttings, immunity to powdery and downy mildew, and high productivity allowed the wine production even in areas notoriously unsuitable for vineyards (especially those characterized by humid and cold climates, such as the French Atlantic departements, the Po Plain and the Prealps in Italy), and made this culture accessible at lower costs, by reducing the expenses for its management (Millardet 1885; Lampertico 1899, 1900a, b, 1904; Galet 1988). The combination of these elements led to a highly successful spread of the *labrusca-riparia* hybrids and their wines over the European countries, often earning a larger popularity than the "authentic" wine obtained from *V. vinifera*. Eventually, legislators tried to stop the phenomenon: in Italy, for example, the cultivation of every direct-producer hybrid has been banned since 1931 (Law 23 March 1931, no. 376), while in France a list of six "cépages prohibés" was drawn up in 1935, which included two *labrusca-riparia* cultivars, namely 'Clinton' and 'Noah' (Galet 1988). However, difficulties related to the application of the law and the outbreak of the Second World War increased the cultivation of the illegal direct-producers, which reached its peak in the early 1950s, especially in Italy and France, where they covered about 10 % (285 491 ha, mostly 'Isabella' and 'Clinton') and 4 % (62 478 ha) of the vine-cultivated surface, respectively (Istituto nazionale di economia agraria 1951; Galet 1988). In the subsequent decades, changes in viticulture and tastes for wine, along with further legislative tools, caused a gradual decrease of the outlawed hybrids: during 1968–1970, in France they extended for 8585 ha, while in Italy plantations of 'Clinton' up to three years old covered only 464 ha (Istituto centrale di statistica & Ministero dell'agricoltura e delle foreste 1972; Galet 1988). Today, their occurrence in cultivation for wine production is mainly confined to few enthusiasts for non-commercial purposes, in compliance with Council Regulation (EC) No. 479/2008, which maintains a list of six "prohibited" direct producers (not classified as "wine grape varieties") to be cultivated only for scientific purposes and domestic consumption: 'Clinton', 'Isabella', 'Noah', 'Othello' (the latter a hybrid between *V. labrusca*, *V. riparia* and *V. vinifera*), 'Jacquez' and 'Herbemont' (both *V. aestivalis* × *V. cinerea* (Engelm.) Millardet × *V. vinifera*).

Specimens examined

Geocoordinates are according to WGS84 or UTM ED50. ITALY: LOMBARDIA: Bereguardo (Pavia), c. 450 m SW da Cascina Orsine, 45.24725°N, 09.00742°E, 96 m, no exp., margine degradato di querceto, con *Quercus robur* e *Robinia pseudoacacia*, 6 Jul 2012, *N. Ardenghi & S. Mossini s.n.* (MSNM); Milano (Milano), ex-scalo ferroviario di Milano-Porta Romana, 45.44536°N, 09.20714°E, 112 m, no exp., binari di carico e scarico merci abbandonati, 15 May 2013, *N. Ardenghi s.n.* (MSNM); Milano (Milano), ferrovia presso il ponte su via Giovanni Pezzotti, 45.44378°N, 09.18433°E, 119 m, exp. N, massicciata ferroviaria, con *Ulmus pumila*, 15 May 2013, *N. Ardenghi s.n.* (MSNM); Milano (Milano), ferrovia tra i ponti su via Fedro e via Carlo Bazzi, 45.44417°N, 09.18636°E, 119 m, no exp., binari ferroviari, 15 May 2013, *N. Ardenghi s.n.* (MSNM); Milano (Milano), ferrovia tra la stazione FFSS di Milano-San Cristoforo e quella di Milano-Romolo, all'incirca all'altezza di via Pesto, 45.44806°N, 09.15278°E, 118 m, exp. N, massicciata, con *Robinia pseudoacacia*, 15 May 2013, *N. Ardenghi s.n.* (MSNM); Missaglia (Lecco), Maresso, loc. Brughiera, a N di via San Franceso, 45.692473°N, 09.370785°E, 271 m, E, margine boschivo, 23 Aug 2013, *M. Villa s.n.* (MSNM); Santo Stefano Ticino (Milano), stazione FFSS di Corbetta-Santo Stefano, binario 1, recinzione tra terreno incolto (cantiere edile in allestimento) e la massicciata ferroviaria, 45°28'53.2"N, 08°55'08.4"E, 144 m, no exp., recinzione, con *Rubus ulmifolius* e *Phytolacca americana*, 20 Sep 2013, *N. Ardenghi s.n.* (MSNM); ibid., recinzione di cantiere edile e incolto retrostante, recinzione, con *Artemisia verlotiorum*, *Phytolacca americana*, *Rubus ulmifolius*, si estende anche sulla massicciata, con *Robinia pseudoacacia* e *Parthenocissus quinquefolia*, 13 Sep 2014, *N. Ardenghi* (MSNM); Treviglio (Bergamo), dietro alla stazione FFSS Treviglio Ovest, incrocio tra via Murena e via Istria, 45°30'52.5"N, 09°35'27.4"E, 121 m, S, muretto e recinzione in cemento alla base della massicciata ferroviaria, 21 Sep 2013, *N. Ardenghi s.n.*

(MSNM, Herb. N. Ardenghi); ibid., muretto e recinzione in cemento alla base della massicciata ferroviaria, con *Clematis vitalba* e *Hedera helix*, 13 Sep 2014, *N. Ardenghi s.n.* (MSNM, APP, FI); Cavaria con Premezzo (Varese), stazione FFSS di Cavaria-Oggiona-Jerago, binario 2, sopra il sottopasso di via Monte Grappa, 45°41'50.0"N, 08°48'11.6"E, 278 m, no exp., massicciata ferroviaria, con *Clematis vitalba*, *Phytolacca americana*, *Hedera helix*, 12 Oct 2013, *N. Ardenghi s.n.* (MSNM, Herb. N. Ardenghi); Castelleone (Cremona), Corte Madama, Cascina Guzzona, via Montecollero, rete di recinzione della cascina, 45°15'40.5"N, 09°47'45.4"E, 58 m, no exp., planta culta (cultivar 'Clinton'): residuo di coltivazione sulla rete di recinzione della cascina, 27 Jul 2014, *P. Cauzzi s.n.* (MSNM); Albuzzano (Pavia), stazione FFSS, 32T 0520587.5002138, 72 m, S, massicciata ferroviaria, con *Humulus japonicus*, *Elytrigia repens*, *Fallopia convolvulus*, *Parthenocissus quinquefolia*, *Artemisia verlotiorum*, 29 Aug 2014, *N. Ardenghi s.n.* (MSNM, APP, FI); Bereguardo (Pavia), Moriano, a W dell'autostrada A7 Milano-Genova, 32T 0502739.5009493, 77 m, E, robinieto su terrazzo fluviale, vegetazione: *Robinia pseudoacacia*, *Rubus ulmifolius*, *Sambucus nigra*, *Chelidonium majus*, *Hedera helix*, *Phytolacca americana* (*Robinietea*), suolo sabbioso-ghiaioso siliceo, 17 Oct 2014, *N. Ardenghi*, *P. Cauzzi & S. Pedrini s.n.* (MSNM, BR); Torre d'Isola (Pavia), Cascina Santa Sofia, lato NE dell'ex poligono militare, 45.19719°N, 09.08050°E, 63 m, no exp., arbusteto a *Rubus* sect. *Corylifolii*, *Corylus avellana* e *Crataegus monogyna*, la popolazione si estende nel prato arido adiacente, 9 May 2015, *N. Ardenghi s.n.* (MSNM); Garlasco (Pavia), via Circonvallazione alle Bozzole (SP206), lato S, davanti al "Bar Bordese", 45.21739°N, 08.93442°E, 98 m, no exp., incolto con *Artemisia verlotiorum*; margine boschivo, con *Robinia pseudoacacia*, *Ailanthus altissima* e *Sambucus nigra*, 17 May 2015, *N. Ardenghi s.n.* (MSNM). — Veneto: M.te Pastello, da Monte verso la cima, 600 m, 31 May 1985, *L. Zavarise s.n.* (VER sub *V. vinifera*); Pontecchio Polesine (Rovigo), sponda del Canal Bianco a monte di Pontecchio, 32T 0720.4989, c. 5 m, no exp., sponda, con *Cornus sanguinea* s.l. e *Rubus caesius*, May 2012, *R. R. Masin s.n.* (MSNM).

Acknowledgements

The authors are grateful to Milena Villa (Rovagnate, Italy) and Rizzieri Roberto Masin (Montegrotto Terme, Italy), for providing two gatherings of *Vitis* ×*novae-angliae*, and to Francesco Di Carlo and Roberta Salmaso (VER), for locating a valuable exsiccatum; Antonio Dal Lago (MNAV) and Rossella Marcucci (PAD) are acknowledged for kindly checking their collections. We express our gratitude also to Rocco Giorgio Guerini and Paolo Morandi (Azienda Agricola Guzzona, Castelleone, Italy), who allowed the authors to collect and taste their 'Clinton' grape, Giulia Ardenghi (Stradella, Italy), for the digital image preparation, Michele Zilioli (Laboratorio di Entomologia/Microscopia Elettronica, Museo di Storia Naturale di Milano), for acquiring the images on the scanning electron microscope, Claudio Ballerini (Trivolzio, Italy), for taking the pictures of the seeds, and to Giuseppe De Paolis (Biblioteca della Scienza e della Tecnica, University of Pavia), for his patience in locating many bibliographical sources. Finally, the authors are deeply thankful to Emilio Laguna (Servicio de Vida Silvestre, Valencia) and Filip Verloove (Botanic Garden of Meise, Meise) for their valuable and constructive comments during the review process of this paper.

References

Ardenghi N. M. G., Galasso G., Banfi E., Zoccola A., Foggi B. & Lastrucci L. 2014: A taxonomic survey of the genus *Vitis* L. (*Vitaceae*) in Italy, with special reference to Elba Island (Tuscan Archipelago) – Phytotaxa **166:** 163–198.

Bailey L. H. 1934: The species of grapes peculiar to North America. – Gentes Herb. **3:** 151–244.

Calò A., Paronetto L. & Rorato G. 1996: Storia regionale della vite e del vino in Italia. Veneto. – Milano: Unione Italiana Vini.

Celesti-Grapow L., Pretto F., Brundu G., Carli E. & Blasi C. (ed.) 2009: A thematic contribution to the National Biodiversity Strategy. Plant invasion in Italy, an overview. – Roma: Ministry for the Environment Land and Sea Protection, Nature Protection Directorate.

Engelmann G. 1868: The North American grapes. – Amer. Naturalist **2:** 320–322.

Fernald M. L. 1917: A new *Vitis* from New England. – Rhodora **19:** 144–147.

FranceAgriMer 2014: Registre des matériels de multiplication relatifs au catalogue français des variétés de vigne. Variétés de porte-greffe. – Published at http://www.franceagrimer.fr/ [accessed 4 Jun 2015].

FranceAgriMer 2015: Catalogue officiel des variétés de vigne. Liste des variétés de vigne dont les plants peuvent être commercialisés au sein de l'Union européenne, mais qui ne sont pas éligibles au classement viti-vinicole en France. – Published at http://www.franceagrimer.fr/ [accessed 4 Jun 2015].

Galet P. 1988: Cépages et vignobles de France. Tome 1: Les vignes américaines. – Montpellier: Déhan.

Galet P. 2000: Dictionnaire encyclopédique des cépages. – Paris: Hachette Pratique.

Hedrick U. P. 1908: The grapes of New York. Report of the New York Agricultural Experiment Station for the year 1907, II. – Albany: J. B. Lyon Company.

Hillier J. & Coombes A. 2002: The Hillier manual of trees & shrubs. – Newton Abbot: David & Charles.

Istituto centrale di statistica & Ministero dell'agricoltura e delle foreste 1972: Catasto viticolo (rilevazione al 25 ottobre 1970) **1.** – Roma: Failli.

Istituto centrale di statistica & Ministero dell'agricoltura e delle foreste 1973: Catasto viticolo (rilevazione al 25 ottobre 1970) **2.** – Roma: Failli.

Istituto centrale di statistica & Ministero dell'agricoltura e delle foreste 1974: Catasto viticolo (rilevazione al 25 ottobre 1970) **2.** – Roma: Failli.

Istituto centrale di statistica del Regno d'Italia 1937: Periodi di semina e di raccolto per le principali coltivazioni. – Roma: Istituto poligrafico dello Stato.

Istituto nazionale di economia agraria 1951: Annuario dell'agricoltura italiana. **IV.** 1950. – Roma: Ramo editoriale degli agricoltori.

Laguna E. 2004: Datos foliares de las especies e híbridos alóctonos de vides (género *Vitis*) en el territorio valenciano. – Toll Negre **3:** 11–25.

Laguna E. 2005: Especies invasoras de *Vitis* L. en España: identificación y datos sobre su capacidad de expansión. – II Congreso de Biología de la Conservación de Plantas, Jardín Botánico Atlántico, Gijón, Spain, 21–23 September 2005. – Published at http://botanico.gijon.es/multimedia_objects/download?object_id=77463&object_type=document

Lampertico D. 1899: Il «Clinton» nel Veneto. – Giorn. Vinicolo Ital. **44:** 521–523.

Lampertico D. 1900a: La questione del Clinton. – Padova: Società Cooperativa Tipografica.

Lampertico D. 1900b: A proposito del Clinton nel Veneto. – Giorn. Vinicolo Ital. **10:** 111–113.

Lampertico D. 1904: Sulla resistenza del Clinton all'oidio e alla peronospora. – Coltivatore (Casale Monferrato) **23:** 732.

Mabberley D. J. 1999: *Vitis ×alexanderi* Prince ex Jacques (*Vitaceae*), the first 'American Hybrid' grapes. – Telopea **8:** 377–379.

McNeill J., Barrie F. R., Buck W. R., Demoulin V., Greuter W., Hawksworth D. L., Herendeen P. S., Knapp S., Marhold K., Prado J., Prud'homme van Reine W. F., Smith G. F., Wiersema J. H. & Turland N. J. (ed.) 2012: International Code of Nomenclature for algae, fungi, and plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011. – Königstein: Koeltz Scientific Books. – Regnum Veg. **154.**

Millardet A. 1876: Étude sur les vignes d'origine américaine qui résistent au Phylloxera. – Mém. Divers Savants Acad. Roy. Sci. Inst. Roy. France, Sci. Math. **22:** 1–46.

Millardet A. 1877a: La question des vignes américaines au point de vue théorique et pratique. – Bordeaux: Féret.

Millardet A. 1877b: De la résistence au Phylloxera de quelques vignes d'origine américaine II. – J. Agric. Prat., sér. 6, **2:** 177–179.

Millardet A. 1877c: De la résistence au Phylloxera de quelques vignes d'origine américaine III. – J. Agric. Prat., sér. 6, **2:** 209–213.

Millardet A. 1880: La résistence au Phylloxera du Clinton et du Taylor. – J. Agric. Prat., sér. 6, **1:** 24–27.

Millardet A. 1882: De l'hybridation entre les diverses espèces de vignes américaines a l'état sauvage. – J. Agric. Prat., sér. 6, **2:** 82–84.

Millardet A. 1885: Histoire des principales variétés et espèces de vignes d'origine américaine qui résistent au phylloxera. – Bordeaux: Féret et fils.

Moore M. 1991: Classification and systematics of eastern North American *Vitis* L. (*Vitaceae*) north of Mexico. – Sida **14:** 339–367.

Munson T. V. 1885: Native grapes of the United States. – Trans. Amer. Hort. Soc. **3:** 128–40.

Munson T. V. 1909: Foundations of American grape culture. – New York: Orange Judd Company.

Planchon J. É. 1875: Les vignes américaines: leur culture, leur résistance au Phylloxera et leur avenir en Europe. – Paris and Montpellier: C. Coulet and Adrien Delahaye.

Quéré M. 2012: Cépages hybrides: une expérience de viticulture et vinification en Berry. – Lulu.com.

Rivera D., Miralles B., Obón C., Carreño E. & Palazón J. A. 2007: Multivariate analysis of *Vitis* subgenus *Vitis* seed morphology. – Vitis **4:** 158–167.

Rossi G. B. (ed.) 1920: Primo Annuario generale vinicolo italiano illustrato. Anno 1919–20. – Torino: L'Italia Industriale Artistica Editrice.

Strong W. C. 1866: Culture of the Grape. – Boston: J. E. Tilton and Company.

Thiers B. 2015+ [continuously updated]: Index herbariorum: a global directory of public herbaria and associated staff. – New York Botanical Garden. – Published at: http://sweet gum.nybg.org/ih/ [accessed 12 Jan 2015].

Tison J.-M. & de Foucault B. (ed.) 2014: Flora gallica. Flore de France. – Mèze: Biotope Éditions.

Ufficio federale dell'agricoltura UFAG 2014+ [continuously updated]: L'anno viticolo 1994–2013. – Published at http://www.blw.admin.ch/ [accessed 12 Jan 2015].

Viala P. & Ravaz L. 1892: Les vignes américaines. Adaptation, culture, greffage, pépinières. – Montpellier: Camille Coulet, Paris: Georges Masson.

Appendix

Populations sampled for the infructescence and seed measurements reported in Table 1. Geocoordinates are according to WGS84 or UTM ED50.

Vitis ×novae-angliae

ITALY: LOMBARDIA: Castelleone (Cremona), Corte Madama, Cascina Guzzona, via Montecollero, rete di recinzione della cascina, 45°15'40.5"N, 09°47'45.4"E, 58 m, no exp., planta culta (cultivar 'Clinton'): residuo di coltivazione sulla rete di recinzione della cascina, 27 Jul 2014, *P. Cauzzi s.n.* (MSNM); Albuzzano (Pavia), stazione FFSS, 32T 0520587.5002138, 72 m, S, massicciata ferroviaria, con *Humulus japonicus*, *Elytrigia repens*, *Fallopia convolvulus*, *Parthenocissus quinquefolia*, *Artemisia verlotiorum*, 29 Aug 2014, *N. Ardenghi s.n.* (APP, FI, MSNM); Treviglio (Bergamo), dietro alla stazione FFSS Treviglio Ovest, incrocio tra via Murena e via Istria, 45°30'52.5"N, 09°35'27.4"E, 121 m, S, muretto e recinzione in cemento alla base della massicciata ferroviaria, con *Clematis vitalba* e *Hedera helix*, 13 Sep 2014, *N. Ardenghi s.n.* (APP, FI, MSNM).

Vitis labrusca

Italy: Lombardia: Pavia (Pavia), via Trieste, 32T 0511781.5004296, 78 m, no exp., vecchia siepe di *Ligustrum sinense*, con *Sambucus ebulus*, *Hedera helix*, *Ailanthus altissima*, *Laurus nobilis*, 29 Aug 2014, *N. Ardenghi s.n.* (MSNM).

Vitis riparia

Italy: Lombardia: Montù Beccaria (Pavia), tra la SP43 e la strada per Molino Quaroni, 32T 0523833.4987071, 122 m, no exp., incolto, con *Elytrigia repens*, 5 Aug 2014, *N. Ardenghi s.n.* (MSNM); Portalbera (Pavia), Campo Fortuna, lato N della SP67, 32T 0524441.4994353, 59 m, no exp., robinieto, 6 Aug 2014, *N. Ardenghi s.n.* (MSNM); San Damiano al Colle (Pavia), sponda sinistra del Torrente Bardonezza, a S dell'incrocio tra la SP189 e strada del Merlino, 32T 0529232.4988393, 96 m, no exp., margine di boscaglia ripariale, con *Robinia pseudoacacia*, *Rubus caesius*, *Sicyos angulatus*, *Convolvulus sepium*, *Urtica dioica*, *Equisetum telmateia*, *Galium aparine*, 9 Aug 2014, *N. Ardenghi s.n.* (MSNM).

Vitis* ×*koberi

Italy: Lombardia: Bosnasco (Pavia), sponda sinistra del Torrente Bardonezza, all'altezza di Balanzine, 32T 0529947.4989362, 86 m, no exp., boscaglia ripariale, con *Robinia pseudoacacia*, *Alnus glutinosa*, *Rubus* sect. *Corylifolii*, *Salix alba*, *Juglans regia*, *Populus* ×*canadensis*, *Sicyos angulatus*, *Amorpha fruticosa*, 9 Aug 2014, *N. Ardenghi s.n.* (MSNM); Arena Po (Pavia), SP144, lato W della stazione FFSS, 32T 0528294.4992154, 67 m, N, massicciata ferroviaria, con *Robinia pseudoacacia*, *Anisantha sterilis*, *Galium aparine*, *Rubus* sect. *Corylifolii*, *Prunus persica*, 10 Aug 2014, *N. Ardenghi s.n.* (MSNM); Stradella (Pavia), Badia, cavalcavia di via Valle Badia, lato S, 32T 0522620.4991858, 72 m, S, fossato alla base della scarpata stradale, boscaglia mesoigrofila con *Robinia pseudoacacia* e *Salix alba*, 20 Aug 2014, *N. Ardenghi s.n.* (MSNM); Montù Beccaria (Pavia), strada per Molino Quaroni, vigneto abbandonato, 32T 0523874.4988123, 105 m, no exp., planta culta: vigneto abbandonato, ricacci di portainnesti completamente ricoprenti i filari, 26 Aug 2014, *N. Ardenghi s.n.* (MSNM).

Hydrochemical Characterization of A Stand of the Threatened Endemic *Isoëtes malinverniana*

Author(s): T. Abeli , S. Orsenigo , N. M. G. Ardenghi E.C.H.E.T. Lucassen and A.J.P. Smolders

Source: American Fern Journal, 103(4):241-244. 2014.

Published By: The American Fern Society

DOI: http://dx.doi.org/10.1640/0002-8444-103.4.241
URL: http://www.bioone.org/doi/full/10.1640/0002-8444-103.4.241

American Fern Journal 103(4):241–244 (2014)

SHORTER NOTES

Hydrochemical Characterization of A Stand of the Threatened Endemic *Isoëtes malinverniana*.—*Isoëtes malinverniana* Ces. & De Not. is an aquatic quillwort endemic to Northern Italy that, as with many other quillworts, is facing drastic changes in its habitat (Wen *et al.,* J. Freshwater Ecol. 18:361–367. 2003.). *Isoëtes malinverniana* grows in running water canals used for rice field water supply (usually with *Ranunculion fluitantis* vegetation), but in the past it probably occurred in natural streams generated by springs and minor river branches, characterized by oligotrophic waters (Abeli *et al.,* Aquatic Conserv: Mar. Freshw. Ecosyst. 22:66–73. 2012). During the last forty years the distribution range of *I. malinverniana* has been rapidly decreasing as a consequence of changes in the rice cultivation practices in Northern Italy. Particularly, the use of herbicides and fertilizers, the regimentation of water courses with water removal in winter, and the mechanical re-profiling of the canals are the major threats to the species (Barni *et al.,* Aquat. Bot. 107:39–46. 2013). Although the species is protected at European and national levels, its conservation status is critical (Bilz *et al.,* European Red List of Vascular Plants. Publications Office of the European Union, Luxembourg. 2011; Rossi *et al.,* Lista Rossa della Flora italiana. 1. Policy Species e altre specie minacciate. Comitato Italiano IUCN e MATTM. 2013), and urgent conservation actions are needed to stop the decline of the species, by reinforcing some extant populations and/or reintroducing new populations within the historical range. The major problem with respect to reintroduction actions is the fact that the original habitat of *I. malinverniana* has been greatly modified. This reduces the probability of successful translocations and also affects the possibility to study the real ecological requirements of the species. However, a site of *I. malinverniana* with about 30 plants discovered a few years ago in a natural stream in the Ticino river basin at La Sforzesca near Vigevano (voucher specimen in PAV) still has many of the characteristics of the original habitat. Here we have analyzed the ion concentrations of surface water and, for the first time, sandy sediment pore water along a 30 m long transect crossing the population. Pore water samples were collected in three points along the transect at about 10 m from each other, while a single surface water sample was collected in the middle of the transect. Sediment pore water samples were collected at a depth of about 10 cm using ceramic cups (Eijkelkamp Agrisearch Equipment, Giesbeek, the Netherlands), connected to 100% vacuum PVC syringes (50 ml) by means of a PVC tube, according to Van Der Welle *et al.* (Freshwater Biol. 52:434–447. 2007). For each water sample, pH, electrical conductivity and temperature were immediately recorded, while ion concentrations were analyzed at the laboratory of the Radboud University (Nijmegen, The Netherlands).

Surface water pH, electrical conductivity and temperature were identical among the three samples (6.8; 271 μS/cm; 11°C, respectively). This pH was lower than in populations within channels used for rice field water supply (Barni *et al.,* 2013; Table 1), but higher than the mean pH values found in Dutch and Norwegian populations of *I. lacustris* and *I. echinospora* (Table 1). The pH of the sediment pore water was remarkably high, reaching a mean value of 8.7 ± 0.9, which also results in very low pore water carbon dioxide concentrations. Mean pH values in Dutch and Norwegian *Isoëtes* stands are around 6, whereas pore water carbon dioxide concentrations are typically (much) higher than surface water concentrations (Table 1). Being able to take up carbon dioxide by the roots, this situation provides a competitive advantage for isoëtid species compared to non-isoëtid species, which lack this ability (Smolders *et al.,* Aquat. Bot. 73:325–350. 2002). Therefore *Isoëtes* species thrive very well in soft water lakes and streams where carbon availability in the water layer is low and species dependent on carbon uptake from the water layer are unable to grow. The high calcium, magnesium and bicarbonate concentrations of the water layer and sediment pore water indicate that the water in the stand from the Ticino river basin is relatively well-buffered compared to the Dutch and the Norwegian *Isoëtes* stands, which were found in weakly buffered soft waters. The Ticino population is probably dependent on the uptake of carbon dioxide from the water layer where carbon dioxide concentrations are much higher than in the sediment pore water. Pedersen *et al.* (J. Exp. Bot. 62:4691–4700. 2011.) showed the potential gas exchange via the leaves to be substantial for *I. australis,* although the resistance to gas exchange was up to three times higher than for roots. The uptake of CO_2 via the roots may have further lowered CO_2 concentrations and indirectly increased the pH of the sediment pore water in the Ticino stand.

Regarding the surface water, the concentration of phosphate, total-P and ammonia are at the lower end of the ranges found for Dutch and SW Norwegian *Isoëtes* stands and are also lower than the mean values found for other *I. malinverniana* stands (Table 1). However, the nitrate concentration is unnaturally high (Table 1), suggesting water nutrient enrichment probably due to the presence of rice and cornfields just a few hundred meters upstream from the population.

High concentration of nitrate was also evident in sediment pore water. Although for the parameters analyzed in the sediment pore water, it was not to possible to make a comparison with other stands of *I. malinverniana*, pore water nitrate was very high compared with values measured in Dutch and Norwegian *Isoëtes* stands (Table 1) and values reported for isoëtid lakes in Spain (Catalan *et al.,* Hydrobiologia 274:17–27. 1994; Gacia *et al.,* J. Limnol. 68:25–36. 2009) and in Scandinavia (Vestergaard & Sand-Jensen, Aquat. Bot. 67:85–107. 2000). *Isoëtes* species generally grow on mineral, usually sandy, sediments with low oxygen consumption rates and actively maintain the sediment in an oxidized state by leaking oxygen via the roots (Pedersen *et al.,* 2011). Due to the oxidized conditions nitrate, iron and sulphate reduction, are normally not important in isoëtid stands. This results in low iron concentrations in sediment pore water, as iron is not mobilized by iron reduction (Table 1), which also results in a low mobility of phosphorus, which is

TABLE 1. Ion concentration for surface water and sediment pore water of a stand of *Isoëtes malinverniana*. Values of surface water concentration from Barni *et al.,* 2013 and unpublished data for three *Isoëtes* stands from the Netherlands (A.J.P. Smolders) and different *Isoëtes* stands from 9 lakes in SW Norway, sampled in 1995 and 2010 (E.C.H.E.T. Lucassen) are shown for comparison. Data are expressed in µmol/L.

	Barni et al. (2013)	This study			
Surface water	*Isoëtes malinverniana*		(Neth, 2005) *Isoëtes*	(Norw, 1995) *Isoëtes*	(Norw, 2010) *Isoëtes*
pH	7,6	See text	5,8 (0,2)	5,7 (0,7)	6,2 (0,6)
HCO3		1303	35,3 (7,5)	12,0 (25,5)	113 (168)
CO2		454	123,3 (13,7)	76,4 (16,3)	84,1 (88,8)
P		0,4	3,0 (1,9)	0,8 (0,7)	0,4 (0,3)
PO4	3,55	0,13	0,4 (0,2)	0,3 (0,3)	0,3 (0,3)
NO3	26,6	149	16,1 (13,7)	11,1 (5,1)	9,2 (7,2)
NH4	5,5	1,6	12,7 (8,3)	3,8 (3,4)	2,7 (3,7)
Ca	520	819	246 (145)	38,3 (20,3)	35,9 (16,1)
Mg		277	81,5 (36,5)	23,8 (6,2)	23,5 (5,0)
Na		316	413 (191)	145 (41,0)	182 (25,0)
Cl		216	613 (290)	166 (41,6)	172 (28,5)
K		54,4	110 (57,8)	10,4 (11,0)	13,8 (13,0)
Fe		0,1	6,5 (5,9)	1,2 (0,9)	1,8 (2,2)
Mn		0,02	2,2 (2.3)	0,2 (0,2)	0,1 (0,1)
SO4		302	107 (35,5)	31,9 (8,0)	22,6 (1,9)
Si		181	36,6 (30,8)	15,7 (5,8)	6,2 (7,4)
Al		0,02	13,1 (8,6)	7,3 (3,2)	1,8 (0,6)
n		1	3	8	9

	Barni et al. (2013)	This study			
Pore water		*Isoëtes malinverniana*	(Neth, 2005) *Isoëtes*	(Norw, 1995) *Isoëtes*	(Norw, 2010) *Isoëtes*
pH		8,7 (0,9)	6,0 (0,1)	5,9 (1,0)	6,1 (0,5)
HCO3		3069 (569)	395 (189)	175 (224)	192 (175)
CO2		16 (3)	730 (115)	336 (306)	275 (177)
P		9,6 (1,1)	3,1 (2,3)	0,6 (0,4)	1,5 (0,8)
NO3		119 (21,9)	10,3 (12,6)	11,8 (12,7)	15,5 (17,1)
NH4		3,5 (3,4)	29,4 (13,6)	3,9 (2,2)	1,7 (2,2)
Ca		1021 (95)	337 (169)	102 (61,4)	146 (127)
Mg		816 (326)	126 (54,7)	73,8 (55,5)	60,8 (34,8)
Na		1988 (802)	435 (192)	214 (78)	228 (122)
Cl		1780 (643)	435 (192)	192 (94)	197 (121)
K		330 (186)	96,7 (31,4)	13,7 (19,3)	31,0 (25,0)
Fe		0,2 (0,2)	8,1 (4,9)	2,6 (2,2)	0,9 (1,3)
Mn		1,3 (1,6)	3,1 (0,8)	1,2 (1,8)	0,4 (0,7)
SO4		344 (16,4)	200 (233)	70,9 (51,6)	69,4 (17,4)
Si		246 (25,5)	83,5 (55,6)	98,3 (68,7)	125,9 (90,7)
Al		0,2 (0,1)	21,9 (18,2)	10,3 (7,7)	2,9 (6,6)
n		3	3	30	20

efficiently bound to oxidized iron(hydr)oxides (Smolders *et al.*, 2002). Also the observation that at our location nitrate and sulphate concentrations do not differ between water layer and pore water suggest the lack of microbiological consumption of nitrate or sulphate in the sediment, indicating oxidative conditions in the sediment.

The chemical characterization of the *I. malinverniana* habitat shows that the species is growing on an oxidized sediment with a relatively low availability of phosphorus. The water layer and sediment are relatively well buffered and characterized by a high pH and a very low availability of carbon dioxide in the sediment pore water. Although the surface water phosphorus concentrations are still low, the nitrate enrichment due to the intensive agricultural activity of the area is evident even in a site apparently less impacted than other stands. As a consequence even a temporary increase of the phosphorus availability in the water layer might easily lead to an excessive growth of algae. This poses serious threats for the conservation of this endemic species for which a suitable site for translocation is at the moment unavailable. Flowing water may strongly benefit the species under more eutrophic conditions because in flowing water algae are less likely to become dominant and uptake of CO_2 from the water layer is facilitated. Nevertheless increased nutrient levels in the water layer will at least lead to the growth of epiphytic algae as has been observed in many of the remaining *I. malinverniana* populations (e.g. Arborio, Vigevano), which may depress growth by shading and by depletion of inorganic carbon and nutrients at the leaf surface.—T. Abeli (e-mail: thomas.abeli.it@gmail.com), S. Orsenigo and N. M. G. Ardenghi, DSTA, Department of Earth and Environmental Sciences, University of Pavia, via S. Epifanio 14, 27100, Pavia, Italy, E.C.H.E.T. Lucassen and A.J.P. Smolders, Department of Aquatic Ecology and Environmental Biology, Radboud University, Heyendaalseweg 135, 6525 AJ Nijmegen, The Netherlands.

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Commelina virginica (*Commelinaceae*), a "phantom" alien in the Euro-Mediterranean area

Abstract

Ardenghi N. M. G. & Galasso G.: *Commelina virginica* (*Commelinaceae*), a "phantom" alien in the Euro-Mediterranean area. – Willdenowia 44: 423–429. 2014. – Version of record first published online on 13 November 2014 ahead of inclusion in December 2014 issue; ISSN 1868-6397; © 2014 BGBM Berlin-Dahlem.

DOI: http://dx.doi.org/10.3372/wi.44.44313

Commelina virginica, a North American xenophyte recorded in the Euro-Mediterranean area since the late 19th century, is excluded from the flora of this region. As a result of extensive literature and herbarium research, all the records of this species proved to be erroneous and referable mostly to *C. communis*. The first historical and misleading record of *C. virginica* is discussed in detail and the diagnostic morphological features actually accepted to distinguish the two species are reported.

Additional key words: *Commelina communis*, misidentification, neophyte, North America, rice fields flora, taxonomy, weeds

Introduction

Commelina L. (*Commelinaceae*: *Commelineae*) is a genus of about 170 species, distributed worldwide, mainly in tropical and subtropical regions (Faden 1998, 2000; Burns & al. 2011). Some species are economically important either as ornamentals or as noxious weeds in agricultural production systems (Isaac & al. 2013). Ten species are recorded in the Euro-Mediterranean region (Clement & Foster 1994; DAISIE 2003+; Euro+Med 2006+), three of which are native to Egypt (*C. boissieriana* C. B. Clarke and *C. forsskalii* Vahl) and Madeira and the Canary Islands (*C. diffusa* Burm. f.) (Euro+Med 2006+), while eight are neophytes, mostly casual, with the exception of *C. communis* L., a troublesome glyphosate-resistant weed of rice field embankments in NW Italy (Rissone 2008; Nandula & al. 2005; Banfi & Galasso 2010; Weller & al. 2010).

As a consequence of recent floristic explorations in the rice fields of NW Italy, doubts arose about the existence in this area of *Commelina virginica* L., a North American neophyte first recorded in Europe near the town of Pavia (N Italy) at the end of the 19th century (Bozzi 1888). Even though this finding (repeated by Fiori 1896) was soon regarded as questionable by Farneti (1900), the species persisted in subsequent national and international floras (e.g. Saccardo 1909; Fiori 1923; Viegi & al. 1974; Zangheri 1976; Pignatti 1982; Webb 1980; Conti & al. 2005; Celesti-Grapow & al. 2009). Additionally, new records from further Italian localities and European countries increased, especially during the last six decades.

The purpose of this paper is to verify whether or not *Commelina virginica* is present in the Euro-Mediterranean area by checking all the literature records and the related herbarium voucher specimens.

Material and methods

The present study is based on the critical revision of herbarium specimens originally labelled as "*Commelina virginica*" stored in the following herbaria (codes according to Thiers 2014+): BON, FI, HBBS, MI, MSNM, P, PAV,

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RO, TO and TSM. The herbaria were selected on the basis of being (1) the location of the voucher specimens reported in the surveyed literature, and (2) the largest collections, which were supposed to include material of our interest.

The identity of each specimen was checked by consulting descriptions and keys reported in the recent taxonomic treatments of the genus *Commelina* in North America (Faden 1993, 2000) and by comparison with the type specimens of *C. chamissonis* Klotzsch ex C. B. Clarke (at B) and *C. communis* and *C. virginica* (both at LINN).

Results and Discussion

Luigi Bozzi’s first record

Commelina virginica was recorded for the first time in the European continent by Luigi Bozzi (Bozzi 1888: 285–286), assistant at the Botanical Garden of the University of Pavia (1882–1883) and physician in that city (Saccardo 1895: 36; 1901: 23, 140), today best remembered as the person responsible for the first and intentional introduction of *Azolla filiculoides* Lam. into Italy (Bozzi 1888: 287–288). Bozzi first observed *C. virginica* around 1883–1884 near the village of Cava Manara, province of Pavia, N Italy (WGS84: 45.15177°N, 09.09629°E), on the suggestion of the botanist Romualdo Pirotta, who found it around the late 1870’s (Bozzi 1888: 286). In 1890, Pirotta recorded *C. communis* L. for the first time in Lombardia, collected during August 1889 in Garlasco, 15 km NW of Cava Manara, emphasizing the presence of two different species of *Commelina* in a restricted area (Pirotta 1890; Banfi & Galasso 2010; specimens in FI! and P!).

Taking into account the morphological characters of *Commelina virginica* actually regarded as diagnostic to distinguish this species from *C. communis* (Table 1), most of the bibliographical sources consulted by Bozzi to identify the specimens from Cava Manara (Linnaeus 1762: 61; Willdenow 1797: 251; Pursh 1814: 31; Hooker 1826; Clarke 1881: 182–183) appear to be inaccurate and superficial (Bozzi additionally mentioned specimens of *C. virginica* in FI used for comparison, but he did not examine them personally). Among these, the most complete description was reported by Linnaeus (1762: 61) (then repeated by Willdenow 1797: 251), who specified both the colour of the hairs on the leaf sheath summit (“*pilis ferrugineis*”), clearly visible on the lectotype, and the presence of three blue petals. On the other hand, the description by Pursh (1814: 31) is poor (the hair colour is not mentioned), while that of Hooker (1826, under *C. deficiens* Hook.), along with his iconography, is controversial: firstly the provenance of the described specimen is “the neighbourhood of Rio Janeiro” (*C. virginica* is distributed only in E North America), and secondly the illustration is ambiguous, showing, along with reddish hairs clearly noticeable on the leaf sheaths, the absence of the proximal petal and a solitary spathe. Similarly, Clarke (1881: 182–183), besides omitting the colour of the sheath hairs and the number of blue petals, reported the occurrence of different varieties in South America, among these *C. virginica* var. *angustifolia* (Michx.) C. B. Clarke (≡ *C. angustifolia* Michx.), a synonym of *C. erecta* L. (Faden 2000): Clarke’s description includes a mix of characters both from *C. virginica* and *C. erecta*, as evidenced, for example, by the citation of “auricled leaf sheaths” (“*vaginae saepe inflato auriculato*”), a typical character of *C. erecta* (Faden 1993, 2000).

These heterogeneous and partially incongruent treatments clearly influenced and misled Bozzi, who stated that his specimens did not fit with the descriptions provided by Linnaeus and Pursh, but were instead “perfectly correspondent” to those by Clarke and Hooker (which were ambiguous). In Bozzi’s description, in fact, flowers are reported to feature two blue petals and a third one similar to the “colourless and transparent” sepals, while the sheath hairs are described as “short and barely visible” (Bozzi 1888: 286), characters unmistakably leading to *Commelina communis* (Table 1). Bozzi’s specimens stored at FI, MI and RO (Fig. 1) are congruent with his description and feature all the diagnostic characters of *C. communis* reported in Table 1 (Fig. 2), with the exception of the capsules: described as 3-locular by Bozzi (character typical of *C. virginica*), they were not observed on the investigated specimens.

Table 1. Nomenclature and diagnostic characters of *Commelina virginica* and *C. communis*, based on Faden (2000) and personal observations.

Nomenclature	*Commelina virginica* L., Sp. Pl., ed. 2., 1: 61. 1762 ≡ *C. caerulea* Salisb., Prodr. Stirp. Chap. Allerton: 216. 1796, nom. illeg. – Lectotype (designated by Hunt 1993: 145): Herb. Linn. No. 65.7 (LINN [digital image!]). = *C. deficiens* Hook. in Bot. Mag. 53: t. 2644. 1826.	*Commelina communis* L., Sp. Pl., 1: 40(–41). 1753. – Lectotype (designated by Faden & Reveal in Jarvis & al. 1993: 36): Herb. Linn. No. 65.1 (LINN [digital image!]).
Spathes	clustered, surface uniformly green, without contrasting veins, margins connate	solitary, surface green, pale or whitish basally with contrasting dark green veins, margins distinct to base
Leaf sheath summit	with long red hairs	glabrous or with short to long white hairs
Petals	all pale blue, proximal one smaller	proximal petal paler or white, much reduced, distal ones blue to bluish purple
Antherodes	entirely yellow	entirely yellow or with central maroon spot
Capsule	3-locular	2-locular

Fig. 1. Specimen of *Commelina communis*, identified as "*C. virginica*", collected in 1889 by Luigi Bozzi in Cava Manara and stored at the "Erbario Generale" of the Sapienza University of Rome (RO). – Scan by M. Iberite.

Further literature and herbarium records

The floristic record by Bozzi (1888), associated with imprecise and erroneous morphological descriptions of *Commelina virginica* in some Italian floras (e.g. Fiori 1923; Pignatti 1982) and the incorrect synonymy of *C. virginica* with *Tradescantia virginiana* L. introduced by Zangheri (1976), led to an overestimation of the presence of this species, at least in Italy. Based on extensive literature and herbarium research, *C. virginica* is absent from the Euro-Mediterranean flora. The records of this species are to be referred mostly to *C. communis*, and, to a lesser extent, to *C. chamissonis*, *T. fluminensis* Vell. and *T. virginiana* (see also Specimens examined).

Fig. 2. Detail of Bozzi's specimen labelled as "*Commelina virginica*", belonging to the Ferdinando Sordelli herbarium stored at MI (Andreis 2000). Some relevant diagnostic features of *C. communis* are clearly identifiable: spathes solitary, pale green basally, with darker contrasting veins, lack of long red hairs at the leaf sheath summit and only two well-developed blue distal petals. – Photograph by N. M. G. Ardenghi.

Italy — Two years after Bozzi's record (1888), Rodolfo Farneti, from the University of Pavia, searched for *Commelina virginica* in the province of Pavia, but without any success; he added that specimens assigned to that species examined by himself (probably the same ones collected by Bozzi) belonged to *C. communis* (Farneti 1900: 157). Unfortunately, his interesting remarks passed unnoticed and *C. virginica* was subsequently accepted and treated in the major national floras and checklists, such as Saccardo (1909: 41), Béguinot & Mazza (1916: 425), Fiori (1923: 227), Viegi & al. (1974: 158), Zangheri (1976: 895), Pignatti (1982: 448) and Conti & al. (2005: 79). Italian records of *C. virginica* increased during the second half of 20th century and an updated national distribution was later outlined by Celesti-Grapow & al. (2009), based on literature references and personal communications.

Piemonte — Montelucci (1949: 692–693) indicated *Commelina virginica* for the mouth of the torrent Orco, near Chivasso. This record, missed by Celesti-Grapow & al. (2009), refers to *C. communis*, as can be seen by the examined voucher at RO. Montelucci's finding was repeated by Abbà (1980) under the binomial *Tradescantia virginiana*; probably, Abbà's incorrect synonymization of *C. virginiana* with *T. virginiana* derived from Zangheri (1976). Abbà (1980) additionally reported a "genuine" record of *T. virginiana* from the province of Asti (Piemonte), taken from Camisola (1854). Abbà's records and erroneous synonymy were then cited by Viegi & Cela Renzoni (1981), who, on the other hand, accepted *C. virginica* as the correct binomial, treating *T. virginiana* as its synonym.

Lombardia — After Bozzi (1888), the species was recorded for further localities in the province of Pavia by Pignatti (1957: 259) (Villanova d'Ardenghi, Pieve Albignola, fields between Sairano and Zinasco Vecchio) and Pavan Arcidiaco & al. (1990: 19) (town centre of Pavia); no specimens of Pignatti were traced, whereas the voucher collected by Pavan Arcidiaco and colleagues (PAV) is to be assigned to *Commelina communis*, as is the collection from Bosco Fontana, Mantova, by R. Barini stored at FI. The record for the province of Brescia by Banfi & Galasso (2010), ignored by the subsequent flora of that province (Martini & al. 2012), originated from the misinterpretation of a personal communication by E. Zanotti, whose collections, stored at HBBS, comprise only one specimen of *C. communis* (a variegated form, identifiable, according to Faden 2000, as var. *ludens* (Miq.) C. B. Clarke f. *aureostriata* MacKeever) and one of *Tradescantia virginiana*. The occurrence in the province of Varese, reported by Banfi & Galasso (2010), was based on a nomenclatural mistake during a field observation of *T. virginiana* by G. Galasso.

Friuli-Venezia Giulia — Two specimens collected by C. Zirnich in Zaule (Trieste) and Gorizia (TSM) during the first half of the 20th century (later mentioned by Mezzena 1986: 62) were re-identified as *Commelina communis*; no vouchers relating to the records of Martini & Poldini (1995: 238) and Poldini (2009: 240) were found.

Liguria — A peculiar series of mistakes involved the most recent record for this region, a short note by Iamonico (2010: 533); it is based on an exsiccatum stored at FI, actually belonging to *Tradescantia fluminensis*, collected by G. Gresino in Varazze (Savona) in 1927. The specimen was originally identified by its collector as "*Tradescantia virginica* ε *f. a fiori bianchi*", then revised by Iamonico as *T. virginiana*, but, for inexplicable reasons, recorded by the latter as *Commelina virginica*. An additional specimen labelled as "*C. virginica*", collected in 1928 by O. Mattirolo and P. Fontana in Riomaggiore (La Spezia) and stored in TO, is similarly referable to *T. fluminensis*. The record of *C. virginica* for Liguria by Viegi & Cela Renzoni (1981) was probably based on both or one of these two exsiccata.

Emilia-Romagna — The indication by Celesti-Grapow & al. (2009), the only one known for this region, is erroneous, as communicated to us by A. Alessandrini, regional referee for that work.

Toscana — The herbarium voucher at FI, collected by A. Chiarugi in 1956 in Badia a Settimo (Firenze province), is to be assigned to *Tradescantia fluminensis*. All the records of *Commelina virginica* from Toscana were solely based on this specimen (Viegi & Cela Renzoni 1981: 28–29; Arrigoni & Viegi 2011: 118).

Lazio — As pointed out by L. Celesti-Grapow (pers. comm.), the records by Celesti-Grapow & al. (2009, 2014: 1075) for Lazio and the city of Roma respectively, are erroneous, possibly to be referred to *Tradescantia virginiana*.

Great Britain — Clement & Foster (1994: 368) reported *Commelina virginica* for a single locality, Trafford Park, Manchester. The related voucher specimen (under the binomial *C. caerulea* Salisb.), stored at BON, was examined and assigned to *C. communis*. This record is not mentioned in later British floras, such as Sell & Murrell (1996) and Stace (2010).

Croatia — *Commelina virginica* is mentioned as "previously registered" for Croatia by Milović & al. (2010: 412). However, this statement is incorrect, as communicated to us by Milović himself, after checking the Croatian floristic literature and the Zagreb herbarium (ZA). Moreover, the species does not appear in the Flora Croatica Database (Nikolić 2014).

Algeria — Two specimens from Algeria labelled as "*Commelina virginica*" were discovered at the Herbier National de Paris (P). These exsiccata, collected by R. Maire, actually belong to *C. chamissonis*, a neophyte native to the Philippines and possibly Australia (Merrill 1925: 195; Maire 1957: 328) and already known for Algeria (Maire 1957: 327–328; Euro+Med 2006+; African Plant Database 2012+). Identification of these collections was made by comparison with the holotype of *C. chamissonis* (stored at B [digital image!]), its protologue (Clarke 1881: 186–187) and the description provided by Maire himself (Maire 1957: 327–328), who seemingly misidentified the plant with *C. virginica* when he first collected it.

Specimens examined

Commelina chamissonis Klotzsch ex C. B. Clarke
ALGERIA: Alger, naturalisé dans le jardin de l'Université, Aug–Sep 1922, *R. Maire 4569* (P P02203469, P02203470 sub *Commelina virginica*).

Commelina communis L.
GREAT BRITAIN: GREATER MANCHESTER: Trafford Park, "superheaters", found by Rev. C. E. Shaw, 15 Sep 1959, *B. W. Fox s.n.* (BON 85.1984.291 sub *Commelina caerulea*). ITALY: PIEMONTE: Presso Chivasso, nel greto dell'Orco, presso l'incrocio con la strada di Torino, nuova per il Piemonte, 7 Sep 1943, *G. Montelucci 6250* (RO sub *Commelina* "dubbia"). — LOMBARDIA: Anlimata [?] presso Pavia, 9 Aug 1888, *L. Bozzi s.n.* (FI sub *C. virginica*); Altipiano di Cava Manara a 6 Chilometri da Pavia, Aug [1889], *L. Bozzi s.n.* (RO sub *C. virginica*); Altipiano di Cava Manara, Aug 1889, *L. Bozzi s.n.* (MI-Sordelli sub *C. virginica*); Vigevano: dintorni, comunissima d'estate lungo fossati, siepi ecc. ecc., s.d., *L. Bozzi s.n.* (MI-Sordelli sub *C. virginica*); Mantova, Bosco Fontana, fossati dietro la palazzina NW, 20 Aug 1977, *R. Barini 409* (FI sub *C. virginica*); Entro il perimetro delle mura della città di Pavia, Via Calchi, 12 Jul 1980, *L. Pavan*, *M. G. Valcuvia & M. Vittadini s.n.* (PAV sub *C. virginica*); Oglio Barco, Orzinuovi, incolto, 13 Jun 1983, *E. Zanotti s.n.* (HBBS 21175-027577). — FRIULI-VENEZIA GIULIA:

Zaule (Trieste), dietro gli oleifici, 18 Aug 1930, *C. Zirnich 632* (TSM-Zirnich sub *C. virginica*); Dietro il Giardino Pubblico di Gorizia lungo il Corno in un solo punto, ma ivi copiosa, 4 Oct 1943, *C. Zirnich 631* (TSM-Zirnich sub *C. virginica*).

Tradescantia fluminensis Vell.
ITALY: LIGURIA: Varazze, in un fosso, spontanea, 18 Jun 1927, *G. Gresino s.n.* (FI sub “*Tradescantia virginica* ε f. a fiori bianchi”); Riomaggiore (Spezia), nei canale [sic] presso il paese, 4 Jun 1928, *O. Mattirolo & P. Fontana s.n.* (TO sub *Commelina virginica*). — TOSCANA: Badia a Settimo (Firenze), Podere “Grioli”, 7 Apr 1956, *A. Chiarugi s.n.* (FI sub *C. virginica*).

Tradescantia virginiana L.
ITALY: LOMBARDIA: Breno (BS), coltivato nelle aiuole di una stazione di servizio di carburante, 8 Jul 1993, *S. Danieli s.n.* (HBBS 21176-033551); Lonato (Esenta), coltivata in un giardino, 25 May 1995, *E. Zanotti s.n.* (HBBS 21177-027578).

Acknowledgements

The authors are grateful to Carlo Andreis and Mario Beretta (MI) and Mauro Iberite and Anna Millozza (RO) for allowing the consultation of valuable herbarium specimens and their reproduction in the present paper. We express our gratitude also to Stefano Armiraglio and Franco Fenaroli (HBBS), Laura Guglielmone (TO), Chiara Nepi (FI), Don Stenhouse (BON) and Fulvio Tomsich Caruso (TSM) for their help in locating further significant exsiccata. Alessandro Alessandrini (Istituto Beni Culturali Regione Emilia-Romagna, Bologna, Italy), Laura Celesti-Grapow (Sapienza University of Rome, Italy), Fabrizio Martini (University of Trieste, Italy), Milenko Milović (Medical and Chemical School, Šibenik, Croatia), Simonetta Peccenini (University of Genoa, Italy) and Eugenio Zanotti (Orzinuovi, Italy) are acknowledged for the information provided on some records of *Commelina virginica*. Finally, Timothy M. Evans (GVSC) and an anonymous reviewer are thanked for their comments on an earlier version of this paper.

References

Abbà G. 1980: Flora esotica del Piemonte. Specie coltivate spontaneizzate e specie avventizie. – Atti Soc. Tosc. Sci. Nat. Pisa Mem., ser. B, **86:** 263–302.

African Plant Database 2012+ [continuously updated]: African Plants Database (version 3.4.0). – Conservatoire et Jardin botaniques de la Ville de Genève and South African National Biodiversity Institute, Pretoria: published at http://www.ville-ge.ch/musinfo/bd/cjb/africa/ [accessed 2 May 2014].

Andreis C. 2000: Presentation. – Pp. 15–23 in: Orsenigo M., Rodondi G., Sala E. & Molinari A. (ed.), L’erbario micologico di Augusto Napoleone Berlese. – Milano: Università degli Studi di Milano.

Arrigoni P. V. & Viegi C. 2011: La flora vascolare esotica spontaneizzata della Toscana. – Firenze: Regione Toscana.

Banfi E. & Galasso G. (ed.) 2010: La flora esotica lombarda. – Milano: Museo di Storia Naturale di Milano.

Béguinot A. & Mazza O. 1916: Le avventizie esotiche della flora italiana e le leggi che ne regolano l’introduzione e la naturalizzazione. – Nuovo Giorn. Bot. Ital., n.s., **23:** 403–465.

Bozzi L. 1888: Alcune piante americane naturalizzate nei dintorni di Pavia. – Atti Soc. Ital. Sci. Nat. **31:** 281–288.

Burns J. H., Faden R. B. & Steppan S. J. 2011: Phylogenetic studies in the *Commelinaceae* subfamily *Commelinoideae* inferred from nuclear ribosomal and chloroplast DNA sequences. – Syst. Bot. **36:** 268–276.

Camisola G. 1854: Flora Astese secondo il sistema sessuale di Linneo: con cenni sulla virtù di molte piante indigene impiegate in medicina, non tanto sull’Astese che su altre provincie del Piemonte nascenti. – Asti: Tip. Paglieri.

Celesti-Grapow L., Capotorti G., Del Vico E., Lattanzi E., Tilia A. & Blasi C. 2014: The vascular flora of Rome. – Pl. Biosyst. **147:** 1059–1087.

Celesti-Grapow L., Pretto F., Brundu G., Carli E. & Blasi C. (ed.) 2009: A thematic contribution to the National Biodiversity Strategy. Plant invasion in Italy, an overview. – Roma: Ministry for the Environment Land and Sea Protection, Nature Protection Directorate.

Clarke C. B. 1881: *Commelinaceae*. – Pp. 113–324 in: Candolle A. de & Candolle C. de (ed.), Monographia phanerogamarum **3.** – Parisiis: G. Masson.

Clement E. J. & Foster M. C. 1994: Alien plants of the British Isles. – London: Botanical Society of the British Isles.

Conti F., Abbate G., Alessandrini A. & Blasi C. (ed.) 2005: An annotated checklist of the Italian vascular flora. – Roma: Palombi Editori.

DAISIE 2003+ [continuously updated]: DAISIE European Invasive Alien Species Gateway – European Commission: published at http://www.europe-aliens.org/ [accessed 18 May 2014].

Euro+Med 2006+ [continuously updated]: Euro+Med PlantBase – the information resource for Euro-Mediterranean plant diversity. – Botanic Garden and Botanical Museum Berlin-Dahlem: published at http://ww2.bgbm.org/EuroPlusMed/ [accessed 2 May 2014].

Faden R. B. 1993: The misconstrued and rare species of *Commelina* (*Commelinaceae*) in the eastern United States. – Ann. Missouri Bot. Gard. **80:** 208–218.

Faden R. B. 1998: *Commelinaceae*. – Pp. 109–128 in: Kubitzki K. (ed.), The families and genera of vascular plants **4.** – Berlin: Springer.

Faden R. B. 2000: *Commelinaceae*. – Pp. 170–197 in: Flora of North America Editorial Committee (ed.), Flora of North America **22.** – New York: Oxford University Press.

Farneti R. 1900: Aggiunte alla flora pavese e ricerche sulla sua origine. – Atti Ist. Bot. Univ. Pavia, ser. 2, **6:** 121–164.

Fiori A. 1896: Flora analitica d'Italia **1(1).** – Padova: Tipografia del Seminario.

Fiori A. 1923: Nuova flora analitica d'Italia **1(2).** – Firenze: Tipografia di M. Ricci.

Hooker W. 1826: *Commelina deficiens*. Two-petaled *Commelina*. – Bot. Mag. **53:** t. 2644.

Hunt D. 1993: *Commelinaceae*. – Pp. 130–201 in: McVaugh R. (ed.), Flora Novo-Galiciana **13.** – Ann Arbor: University of Michigan Herbarium.

Iamonico D. 2010: Notula 44. – In: Nepi C., Peccenini S. & Peruzzi L. (ed.), Notulae alla flora esotica d'Italia 3 (38–53). – Inform. Bot. Ital. **42:** 533.

Isaac W.-A., Gao Z. & Li M. 2013: Managing *Commelina* species: Prospects and limitations. – Pp. 543–561 in: Price A. J. & Kelton J. A. (ed.), Herbicides – Current research and case studies in use. – Rijeka: InTech.

Jarvis C. E., Barrie F. R., Allan D. M. & Reveal J. L. (ed.) 1993: A list of Linnean generic names and their types. – Regnum Veg. **127.**

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

Maire R. 1957: Flore de l'Afrique du Nord **4.** – Paris: Paul Lechevalier.

Martini F., Bona E., Federici G., Fenaroli F. & Perico G. 2012: Flora vascolare della Lombardia centro-orientale. **1.** – Trieste: LINT.

Martini F. & Poldini L. 1995: The hemerophytic flora of Friuli-Venezia Giulia (N.E. Italy). – Fl. Medit. **5:** 229–246.

Merrill E. D. 1925: An enumeration of Philippine flowering plants **1.** – Manila: Bureau of Science.

Mezzena R. 1986: L'Erbario di Carlo Zirnich (Ziri). – Atti Mus. Civico Storia Nat. Trieste **38.**

Milović M., Mitić B. & Alegro A. 2010: New neophytes in the flora of Croatia. – Nat. Croatica **19:** 407–431.

Montelucci G. 1949: Fitocenosi esotiche sul Po. – Nuovo Giorn. Bot. Ital., n.s., **56:** 690–693.

Nandula V. K., Reddy K. N., Duke S. O. & Poston D. H. 2005: Glyphosate-resistant weeds: Current status and future outlook. – Outlooks Pest Managem. **16:** 183–187.

Nikolić T. 2014: Flora Croatica Database. – Faculty of Science, University of Zagreb: published at http://hirc.botanic.hr/fcd [accessed 10 May 2014].

Pavan Arcidiaco L., Valcuvia Passadore M. & Vittadini Zorzoli M. 1990: La flora del centro storico di Pavia. – Atti Ist. Bot. Lab. Crittog. Univ. Pavia, ser. 7, **9:** 7–26.

Pignatti S. 1957: La vegetazione messicola delle colture di Frumento, Segale e Avena nella provincia di Pavia. – Arch. Bot. Biogeogr. Ital. **33:** 1–77.

Pignatti S. 1982: Flora d'Italia **3.** – Bologna: Edagricole.

Pirotta R. 1890: Sulla presenza in Lombardia di *Commelina communis* L. – Nuovo Giorn. Bot. Ital. **22:** 143–144.

Poldini L. 2009: Guida alla Flora - IV. La diversità vegetale del Carso fra Trieste e Gorizia. Lo stato dell'ambiente. Le guide di Dryades **5** – Series Florae **IV** (F-IV). – Trieste: Ed. Goliardiche.

Pursh F. 1814: Flora Americae septentrionalis **1.** – London: White, Cochrane, and Co.

Rissone W. 2008: Il diserbo della risaia. Prove sperimentali 2007. – Ente Nazionale Risi, Milano: published at http://www.enterisi.it/upload/enterisi/gestionedocumentale/Novara20Febbraio2008-Rissone_784_2325.pdf [accessed 18 May 2014].

Saccardo P. A. 1895: La botanica in Italia. Materiali per la storia di questa scienza. –Venezia: Tipografia Carlo Ferrari.

Saccardo P. A. 1901: La botanica in Italia. Materiali per la storia di questa scienza. Parte seconda. – Venezia: Tipografia Carlo Ferrari.

Saccardo P. A. 1909: Cronologia della flora italiana ossia repertorio sistematico delle più antiche date ed autori del rinvenimento delle piante (Fanerogame e Pteridofite) indigene, naturalizzate e avventizie d'Italia e della introduzione di quelle esotiche più comunemente coltivate fra noi. – Padova: Tipografia del Seminario.

Sell P. & Murrell G. 1996: Flora of Great Britain and Ireland **5.** – Cambridge: University Press.

Stace C. A. 2010: New flora of the British Isles, ed. 3. – Cambridge: University Press.

Thiers B. 2014+ [continuously updated]: Index herbariorum: a global directory of public herbaria and associated staff. – New York Botanical Garden: published at http://sweetgum.nybg.org/ih/ [accessed 18 May 2014].

Viegi L. & Cela Renzoni G. 1981: Flora esotica d'Italia: le specie presenti in Toscana. – Pavia: Consiglio Nazionale delle Ricerche, Collana «Promozione della qualità dell'ambiente», AQ/1/132.

Viegi L., Cela Renzoni G. & Garbari F. 1974: Flora esotica d'Italia. – Lav. Soc. Ital. Biogeogr., n.s., **4:** 125–220.

Webb D. A. 1980: *Commelina* L. – P. 117 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: University Press.

Weller S. C., Owen M. D. K. & Johnson W. G. 2010: Managing glyphosate-resistant weeds and population shifts in Midwestern U.S. cropping systems. – Pp. 213–232 in: Nandula V. K. (ed.), Glyphosate resistance in crops and weeds. – Hoboken: John Wiley & Sons.

Willdenow C. L. 1797: Caroli a Linné species plantarum, ed. 4, **1(1).** – Berolini: Impensis G. C. Nauk.

Zangheri P. 1976: Flora italica **1.** – Padova: CEDAM.

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Acta Botanica Gallica: Botany Letters
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/tabg20

Lycopus lucidus Turcz. ex Benth. var. hirtus Regel (Lamiaceae) in Italy: a new naturalized alien species for the European flora

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Published online: 26 Jun 2014.

To cite this article: Nicola M.G. Ardenghi, Marina Trentin, Guido Trivellini & Simone Orsenigo (2014): Lycopus lucidus Turcz. ex Benth. var. hirtus Regel (Lamiaceae) in Italy: a new naturalized alien species for the European flora, Acta Botanica Gallica: Botany Letters, DOI: 10.1080/12538078.2014.909326

To link to this article: http://dx.doi.org/10.1080/12538078.2014.909326

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Acta Botanica Gallica: Botany Letters, 2014
http://dx.doi.org/10.1080/12538078.2014.909326

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Lycopus lucidus Turcz. ex Benth. var. *hirtus* Regel (Lamiaceae) in Italy: a new naturalized alien species for the European flora

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Abstract: *Lycopus lucidus* Turcz. ex Benth. var. *hirtus* Regel (Lamiaceae), a neophyte native to Asia, is recorded for the first time in Europe. A naturalized population was discovered in the Milan railway area (Italy). Diagnostic characters and an updated identification key for the genus *Lycopus* in Europe are presented. Furthermore, the invasive status and the possible means of introduction are discussed.

Keywords: alien species; floristic records; Italy; *Lycopus lucidus* var. *hirtus*; railway; urban flora

Introduction

Urbanization has destroyed and fragmented natural habitats, causing threats to biodiversity and species extinctions (McKinney 2002). Fragmentation by transportation corridors such as highways, railways and other linear structures usually disturbs and alters natural ecosystems (Forman and Alexander 1998). However, in very dense urban areas, railways can sometimes promote the presence of green buffer zones (e.g. around the railway embankments and freight yards) that act as effective wildlife refuges, so influencing the degree of ecological connectivity and the composition of the taxonomic communities (Vergnes, Le Viol, and Clergeau 2012). Abandoned areas such as railway embankments and freight yards, where plant species grow without control, can be important for their high floristic diversity (Zerbe et al. 2003; Herbst and Herbst 2006). Moreover, highways and railways often act as ecological corridors for the spread and establishment of native (Penone et al. 2012) and non-native (Hansen and Clevenger 2005; Wilkomirski et al. 2012; Barina et al. 2013; Rutkovska et al. 2013) plant species, especially neophytes, with new arrivals almost every year (e.g. Ardenghi 2013). The presence of neophytes has become increasingly important in urban biodiversity in the last decades (Kowarik 2008).

During a floristic study in two railway freight yards of the Milan urban area (Lombardy, Italy), in spring and summer 2013, a large population of an unknown *Lycopus* was discovered. After a taxonomical and floristic literature analysis, the plant was identified as *Lycopus lucidus* Turcz. ex Benth. var. *hirtus* Regel, an Asian species that is new to the European flora (Ball 1972; Euro+Med 2006–2014; Lambdon et al. 2008; Celesti-Grapow et al. 2009; Banfi and Galasso 2010; DAISIE 2014) and has never been recorded as an alien outside its native distribution range.

Material and methods

The floristic novelty here presented is the result of field trips conducted by the authors in the disused freight yards of Milano Porta Romana and Milano San Cristoforo (Milan, Lombardy, Italy; Figure 1) between March and September 2013, within the project *Rotaie Verdi* ("Green Railways"). The project has the objective of achieving a feasibility study to realize an ecological corridor inside the urban area of Milan, exploiting the still active railway lines and the related connected buffer zones. The studied area connects disused freight yards as potential future urban oases, covering more than 8 km of active passenger railway lines. Voucher specimens of the treated taxon are preserved in the Museo Civico di Storia Naturale di Milano herbarium (MSNM).

Results

Nomenclature

Lycopus lucidus Turcz. ex Benth. var. ***hirtus*** Regel, Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 7., 4: 115 (1861)
≡ *Lycopus lucidus* f. *hirtus* (Regel) Kitag., Neolin. Fl. Manshur.: 546 (1979)
Lectotype (designated by Krestovskaya 2012): RUSSIA. "Sungatschi", [1859], *R.K. Maack*, s.n. (LE).
= *Lycopus lucidus* var. *formosanus* Hayata, Icon. Pl. Formosan. 8: 102 (1919)
= *Lycopus formosanus* (Hayata) Sasaki, Trans. Nat. Hist. Soc. Formosa 18: 171 (1928)
Holotype: TAIWAN. Sekiko*, s.d.*, *G. Nakahaba*, s.n. (TI).

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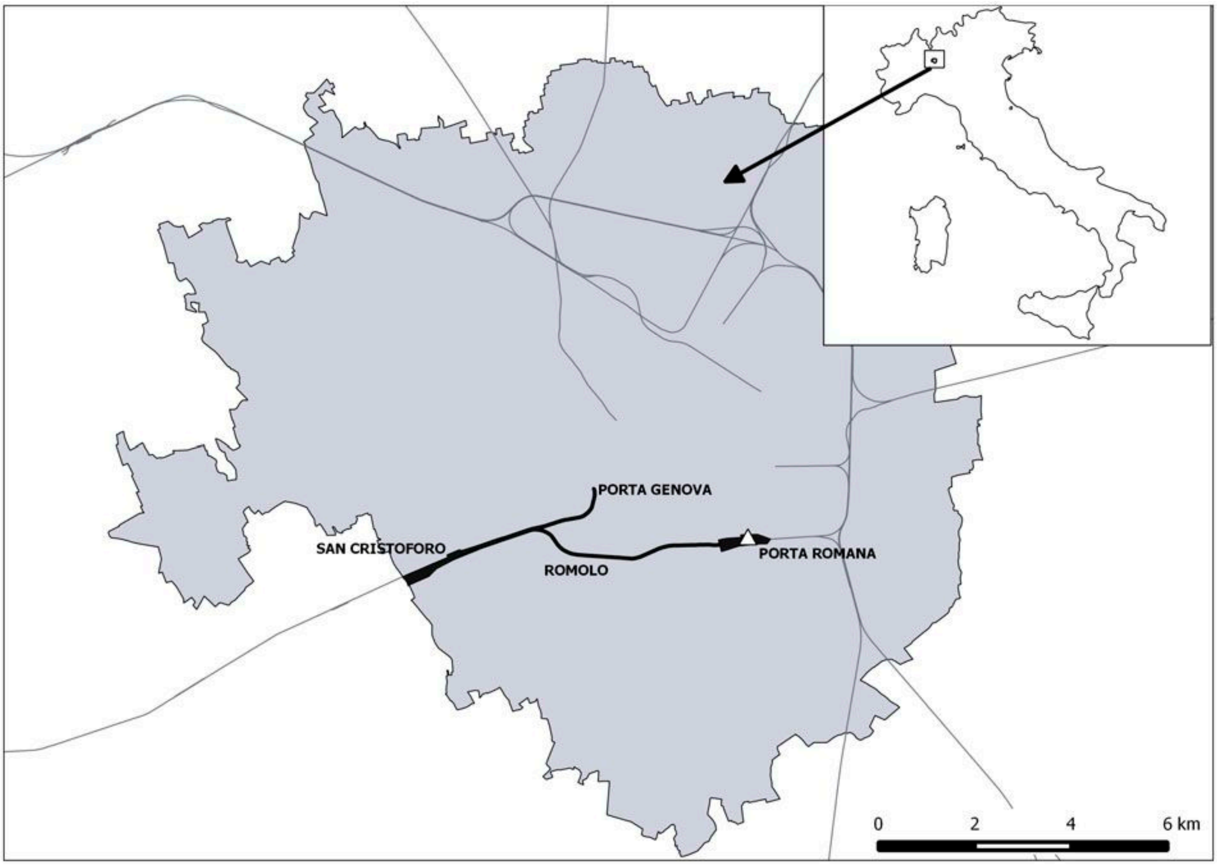

Figure 1. Maps of the studied area. Boundaries of the Milan municipality including the railway lines and the studied area of *Rotaie Verdi* project (in black); the white triangle indicates the site where the population of *Lycopus lucidus* var. *hirtus* was discovered.

Description of the specimens

Perennial herb, rhizomatous. Rhizomes long creeping, swollen at apex, scaly, whitish. Stems erect, > 100 cm, stout, from simple to branched (branches slender), distinctly tetragonous, angles obtuse and hirtellous (especially in the upper part of the stem), faces with prominent grooves, nodes densely hirsute with purple-red tinge. Leaves opposite, from sessile to subsessile, elliptic-lanceolate, ± arcuate, 11–16 cm long, 3–5 cm wide, base gradually attenuate, apex acute to acuminate, margins ciliate, with a small tuft of cilia at the tooth basal sinuses, minutely revolute, coarsely dentate-serrate, teeth acute to acuminate, usually forward curving, adaxial surface minutely hirtellous, slightly lustrous, dark green, abaxial surface hirsute, especially on the primary and secondary veins, impressed glandular, paler than the adaxial surface. Inflorescence composed of axillary and loose verticillasters, 0.7–1.5 cm wide, subtended by ovate-lanceolate bracts, one- to three-veined, 5–8 mm long, apex spinescent, margins ciliolate, surfaces scabrous. Calyx sessile to subsessile, campanulate, 3 mm long, glabrous, glandular (glands yellowish and translucent); five teeth, lanceolate-triangular, apex spinescent, margins ciliolate. Corolla campanulate, up to 3 mm long, slightly exceeding the calyx, throat villous; limb indistinctly two-lipped, white, with prominent yellowish and translucent glands in the distal half; lower lip three-lobed, with irregular purple spots, the middle lobe larger. Nutlets not observed (Figure 2).

Systematics

The genus *Lycopus* L. (Lamiaceae: Mentheae) includes approximately 16 species, distributed in the northern Hemisphere and in Australia (Henderson 1962; Cantino 2004; Moon and Hong 2006; Morales 2010; Moon, Kim, and Hong 2013). In Europe, two species are known: *Lycopus europaeus* L. and *Lycopus exaltatus* L.f. (Euro+Med 2006–2014). Historically, Briquet (1897) recognized two sections within *Lycopus*, sect. *Stoloniferi* Briq. and sect. *Astolonosi* Briq. (the latter consisting of only one species, *Lycopus americanus* Muhl. ex W.P.C. Barton), mainly based on the presence/absence of long runners from the lower nodes of the stem. Briquet's infrageneric classification was not followed by Henderson (1962), nor Moon and Hong (2006), who identified four groups of species on the basis of the nutlet morphology and anatomy.

As for the whole genus, *Lycopus lucidus* is characterized by a high degree of variability (especially

Figure 2. *Lycopus lucidus* var. *hirtus*. **(A)** Rhizome; **(B)** details of the stem nodes and the abaxial leaf surface's indumentum; **(C)** leaf margins coarsely dentate-serrate; **(D)** habitus. (Photographs by N. Ardenghi.)

regarding the vegetative traits), which has been interpreted at different taxonomic ranks. Unlike Henderson (1962), Li and Hedge (1994) recognize three varieties: var. *lucidus*, var. *hirtus* (treated as a form by Kitagawa 1979), and var. *maackianus* Maxim. ex Herder, considered a distinct species (*Lycopus maackianus* (Maxim. ex Herder) Makino) by Henderson (1962) and Moon, Kim, and Hong (2013). This latter taxon can be distinguished by its slender stems, 20–50 cm height (versus robust and > 100 cm), the lower cauline leaves elliptic to lanceolate, ± pinnatipartite, and the upper ones narrowly lanceolate, ± entire (versus leaves evenly oblong-lanceolate and coarsely serrate-dentate) (Henderson 1962; Li and Hedge 1994; Moon, Kim, and Hong 2013). *Lycopus lucidus* var. *hirtus* is separated from the nominal variety by its leaves, which are hirsute on both surfaces (versus glabrous) and also longer (8–15 cm versus 4–8 cm), and by taller stems (> 1 m versus 50–100 cm) (Li and Hedge 1994; Moon, Kim, and Hong 2013), features well represented in the Milan population.

A new original identification key to distinguish *L. lucidus* var. *hirtus* from the other two native European *Lycopus* representatives is presented here.

(1) At least the upper cauline leaves pinnatifid, with linear, acute lobes; nutlet dorsal side with open collar base……………………………*L. exaltatus*

(2) Cauline leaves from sinuately dentate to coarsely dentate-serrate, sometimes pinnatifid in the proximal half; nutlet dorsal side with closed collar base………………………………………2

(3) Cauline leaves sinuately dentate, sometimes pinnatifid in the proximal half, teeth straight to slightly curving; adaxial leaf surface dull, usually not differing in color from the abaxial one; stems up to 100 cm tall; nutlets 1.5–1.8 mm long, 1.1–1.4 mm wide……………….………*L. europaeus*

(4) Cauline leaves coarsely dentate-serrate, teeth distinctly forward curving; adaxial leaf surface lustrous, darker than the abaxial one; stem over 100 cm tall; nutlets 2.0–2.85 mm long, 1.2–1.8 mm wide…………………………***L. lucidus* var. *hirtus***

Chorology and ecology

Lycopus lucidus var. *hirtus* is an Asian plant; its native range includes eastern Russia, China, Japan and Korea (Moon, Kim, and Hong 2013), where it grows mostly in marshy areas between 300 and 2400 m above sea level (Li and Hedge 1994; Moon, Kim, and Hong 2013). *Lycopus lucidus* grows also in broadleaved deciduous forests (Barkalov et al. 2010), and it is regarded as a diagnostic species of the association *Lycopo lucidi–Quercetum mongolicae* Krestov et al. 2006 (mesic secondary forests dominated by *Quercus mongolica*

Fisch. ex Ledeb.) (Krestov et al. 2006). In eastern Russia, it has been recorded as a native weed on waste grounds, in crops (wheat cultures, soya and corn) and along banks of rice field irrigation canals (Luneva 2005).

Site location, invasion status and pathways of introduction

Lycopus lucidus var. *hirtus* was found in the southeastern part of the Milan urban area (Lombardy, Italy), in the disused freight yard of Milano Porta Romana (also known as Scalo Romana) (WGS84 coordinates: 45°26′45″ N, 09°12′35″ E), located on the Milan "southern belt" railway line. Its commercial activities started in July 1896 and stopped around 2004, when the yard's buildings underwent demolition (Daverio and Sbrini 2010–2011); for many decades it played a central role in the railway goods traffic of Milan and northern Italy. The abandoned yard, currently crossed only by a pair of active passenger rail tracks, covers an area of 216,430 m^2 (Comune di Milano 2009), which is partially occupied by unauthorized shacks and dense monospecific *Ailanthus altissima* (Mill.) Swingle thickets (especially along the disused rail tracks).

The population consists of about 200 flowering scapes growing in an area of 50 m^2, on disturbed soil with anthropic debris between two abandoned rail tracks (Figure 3). In the flowering season (mid-summer), it appears almost monospecific, with a 95% cover, allowing within its extension only a few individuals of annual and biennial ruderal species (such as *Papaver rhoeas* L., *Daucus carota* L., *Lactuca serriola* L., *Chenopodium album* L. and *Convolvulus arvensis* L.). The high density of the stand is due to vegetative reproduction through rhizomes, a common feature in *Lycopus* (Henderson 1962). This strategy replaces seed production in the Milan population (although regularly flowering), as recorded for other congeneric species growing outside marshy sites (Tyrrell 1986).

In view of the size of the population and its competition with the surrounding ruderal vegetation, *Lycopus lucidus* var. *hirtus* can be regarded as locally naturalized, according to the definition provided by Celesti-Grapow et al. (2009). Moreover, its introduction probably dates back to more than a year ago: as for other rhizomatous aliens like *Cyperus schweinitzii* Torr. and *Cyperus lupulinus* (Spreng.) Marcks recently recorded in French and Italian railway freight yards (Verloove and Soldano 2011; Ardenghi 2013), the presence of underground reproductive structures might have enhanced the persistence of the species against the mowing operations occurring in the area. The potential risk of impact was evaluated accordingly to Brunel et al. (2010), suggesting the inclusion of the species in the "observation list", since spread potential (A.5) and negative impact on native species, habitats and ecosystems (A.6) gave a "medium" result, while potential negative impact on agriculture, horticulture and forestry (A.7) gave a "low" result and no negative impact on human health, infrastructures and recreational activities (A.8) was recorded.

The pathway of introduction is still obscure: taking into account the location of the population (near the former railroad car washing site), it is possible that seeds arrived through freight trains stopping at the yard. However, it seems also plausible that the presence of the plant is connected with inhabitants of the railway yard, who accidentally introduced the species by rejecting the

Figure 3. Growing site with the dense, monospecific population (Photographs by N. Ardenghi).

rhizomes as a food waste: *Lycopus lucidus* var. *hirtus* is cultivated in eastern Asia both for its rhizomes and its aerial parts, which are employed in traditional medicine (Hanlet 2001; Li 2006; Ślusarczyk et al. 2009; Wagner 2011).

Specimina visa

ITALY. Milano, ex-scalo ferroviario di Milano Porta Romana (WGS84: 45°26′45″ N, 09°12′35″ E), binari in disuso, assieme a *Arabidopsis thaliana*, *Daucus carota*, *Papaver rhoeas*, popolamento pressoché monospecifico, 112 m, 3-V-2013, *N. Ardenghi & S. Orsenigo*, *s.n.* (MSNM!); *ibidem*, 1-VII-2013, *N. Ardenghi*, *s.n.* (MSNM!).

Acknowledgements

The authors would like to express their thanks to the partners of the *Rotaie Verdi* project: Social Cooperative Eliante, Municipality of Milan and WWF Italia. The project would not have been realized without the funding activity of Fondazione Cariplo, Milano and the help, during the fieldwork, of the railway Company RFI (Rete Ferroviaria Italiana).

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Nicola M.G. Ardenghi: finding and identification of the specimens, morphological description, taxonomical information, identification key, invasiveness assessment, writing the manuscript.

Marina Trentin: drafter and coordinator of the project *Rotaie Verdi*. She checked and revised the draft of the manuscript.

Guido Trivellini: drafter and coordinator of the biological monitoring (zoological and botanical) of the project *Rotaie Verdi*. He checked and revised the draft of the manuscript.

Simone Orsenigo: finding and identification of the specimens, writing of the manuscript and preparation of the figures.

References

Ardenghi, N. M. G. 2013. "*Cyperus schweinitzii* (Cyperaceae): a new naturalized alien in Italy." *Webbia* 68 (1): 73–76.

Ball, P. W. 1972. "34. *Lycopus* L." In *Flora Europaea. Volume 3: Diapensiaceae to Myoporaceae*, edited by T. G. Tutin, V. H. Heywood, N. A. Burges, D. M. Moore, D. H. Valentine S. M. Walters, and D. A. Webb, 183. Cambridge: Cambridge University Press.

Banfi, E., and G. Galasso. 2010. *La flora esotica lombarda.* [The exotic flora of Lombardia]. Milano: Museo di Storia Naturale di Milano.

Barina, Z., M. Shevera, C. Sîrbu, and G. Pinke. 2013. "Current distribution and spreading of *Euphorbia davidii* (*E. dentata* agg.) in Europe." *Central European Journal of Biology* 8 (1): 87–95.

Barkalov, V. Y., A. E. Vrishch, P. V. Krestov, and V. V. Yakubov. 2010. Растительный мир Уссурийской тайги: полевой атлас-определитель. [Plants of the Ussuri taiga (field guide)]. Vladivostok: Far Eastern University, "Phoenix" Fund, WCS.

Briquet, J. 1897. "Labiatae." In: *Die natürlichen Pflanzenfamilien. IV. Teil,* edited by A. Engler, and K. Prantl, 183–375. Leipzig: Wilhelm Engelmann.

Brunel, S., E. Branquart, G. Fried, J. Van Valkenburg, G. Brundu, U. Starfinger, S. Buholzer, A. Uludag, M. Joseffson, and R. Baker. 2010. "The EPPO prioritization process for invasive alien plants." *EPPO Bulletin* 40 (3): 407–422.

Cantino, P. D. 2004. "135. *Lycopus*." In: *The Families and Genera of Vascular Plants, Volume VII. Flowering Plants. Dicotyledons: Lamiales (except Acanthaceae including Avicenniaceae)*, edited by J. W. Kadereit, 237. Berlin, Heidelberg: Springer.

Celesti-Grapow, L., A. Alessandrini, P. V. Arrigoni, E. Banfi, L. Bernardo, M. Bovio, G. Brundu, et al. 2009. "Inventory of the non-native flora of Italy." *Plant Biosystems* 143 (2): 386–430.

Comune di Milano. 2009. *Proposta. Accordo di Programma. Rif. Dis. codice n° 2089/01-12/A/09/06.* Milano: Comune di Milano. http://www.comune.milano.it/dseserver/WebCity/documenti.nsf/0/7c2789de288d6f50c12576950037cad6/$FILE/RELAZIONE.pdf. Accessed 11 March 2014.

DAISIE, 2014. "DAISIE European Invasive Alien Species Gateway." Accessed 18 February 2014. http://www.europe-aliens.org/

Daverio, A., and G. Sbrini. 2010–2011. "Milano Porta Garibaldi: un nuovo progetto per la città." Degree thesis, Politecnico di Milano, Facoltà di Architettura Civile, Milan.

Euro+Med. 2006–2014. *Euro+Med PlantBase – the information resource for Euro-Mediterranean plant diversity*, edited by E. von Raab-Straube. http://ww2.bgbm.org/EuroPlusMed/. Accessed 18 February 2014.

Forman, R. T. T., and L. E. Alexander. 1998. "Roads and their major ecological effects." *Annual Review of Ecology and Systematics* 29: 207–231.

Hanlet, P. 2001. *Mansfeld's Encyclopedia of Agricultural and Horticultural Crops*. Berlin: Springer-Verlag, Heidelberg.

Hansen, M. J., and A. P. Clevenger. 2005. "The influence of disturbance and habitat on the presence of non-native plant species along transport corridors." *Biological Conservation* 125 (2): 249–259.

Henderson, N. C. 1962. "A Taxonomic Revision of the Genus *Lycopus* (Labiatae)." *American Midland Naturalist* 68 (1): 95–138.

Herbst, H., and V. Herbst. 2006. “The development of an evaluation method using a geographic information system to determine the importance of wasteland sites as urban wildlife areas.” *Landscape and Urban Planning* 77 (1–2): 178–195.

Kitagawa, M. 1979. *Neo-Lineamenta Florae Manshuricae: or enumeration of the spontaneous vascular plants hitherto known from Manchuria (North Eastern China) together with their synonyms and distribution*. Lehre: Cramer.

Kowarik, I. 2008. “On the role of alien species in urban flora and vegetation.” In *Urban Ecology. An International Perspective on the Interaction Between Humans and Nature*, edited by J. Marzluff, E. Shulenberger, W. Endlicher, M. Alberti, G. Bradley, C. Ryan, C. ZumBrunnen, and U. Simon 321–338. New York, NY: Springer US.

Krestov, P. V., J.-S. Song, Y. Nakamura, and V. P. Verkholat. 2006. “A phytosociological survey of the deciduous temperate forests of mainland Northeast Asia.” *Phytocoenologia* 36 (1): 77–150.

Krestovskaya, T. V. 2012. “Type specimens of the Siberian and Russian Far Eastern taxa of Lamiaceae Martinov kept in the Herbarium of the Komarov Botanical Institute (LE).” *Turczaninowia* 15 (2): 45–58.

Lambdon, P. W., P. Pyšek, C. Basnou, M. Hejda, M. Arianoutsou, F. Essl, V. Jarošík, et al. 2008. “Alien flora of Europe: species diversity, temporal trends, geographical patterns and research needs.” *Preslia* 80 (2): 101–149.

Li, T. S. C. 2006. *Taiwanese Native Medicinal Plants. Phytopharmacology and Therapeutic Values*. Boca Raton: CRC Press, Taylor & Francis Group.

Li, X.-W., and I. C. Hedge. 1994. “*Lycopus* Linnaeus.” In *Flora of China, Vol. 17*, edited by Z. Y. Wu, and P. H. Raven, 239–241. Beijing and St. Louis: Science Press and Missouri Botanical Garden.

Luneva, N. N. 2005. “*Lycopus lucidus* Turz. – Rough Bugleweed, Shiny Bugleweed.” In *Interactive Agricultural Ecological Atlas of Russia and Neighboring Countries: Economic Plants and their Diseases, Pests and Weeds*, edited by A. N. Afonin, S. L. Greene, N. I. Dzyubenko, and A. N. Frolov. 2008. Accessed 2 December 2013. http://www.agroatlas.ru/en/content/related/Lycopus_lucidus/

McKinney, M. L. 2002. “Urbanization, biodiversity, and conservation.” *BioScience* 52 (10): 883–890.

Moon, H.-K., and S.-P. Hong. 2006. “Nutlet morphology and anatomy of the genus Lycopus (Lamiaceae: Mentheae).” *Journal of Plant Research* 119 (6): 633–644.

Moon, H.-K., Y.-C. Kim, and S.-P. Hong. 2013. “Diagnostic characters and new populations of *Lycopus lucidus* var. *hirtus* (Lamiaceae).” *Korean Journal of Plant Taxonomy* 43 (2): 99–102.

Morales, R. 2010. “17. *Lycopus* L.” In *Flora Iberica, Volume 12: Verbenaceae-Labiatae-Callitrichaceae*, edited by R. Morales, A. Quintanar, F. Cabezas, A. J. Pujadas, and S. Cirujano, 331–333. Madrid: Real Jardín Botánico, CSIC.

Penone, C., N. Machon, R. Juillard, and I. Le Viol. 2012. “Do railway edges provide functional connectivity for plant communities in an urban context?” *Biological Conservation* 148: 126–133.

Rutkovska, S., I. Pučka, P. Evarts-Bunders, and J. Paidere. 2013. “The role of railway lines in the distribution of alien species in the territory of Daugavpils City (Latvia).” *Estonian Journal of Ecology* 62 (3): 212–225.

Ślusarczyk, S., M. Hajnos, K. Skalicka-Woźniak, and A. Matkowski. 2009. “Antioxidant activity of polyphenols from *Lycopus lucidus* Turcz.” *Food Chemistry* 113 (1): 134–138.

Tyrrell, L. E. 1986. “Patterns of biomass allocation in *Lycopus americanus* and *L. uniflorus* (Lamiaceae).” *The Ohio Academy of Science* 86 (2): 4.

Vergnes, A., I. Le Viol, and P. Clergeau. 2012. “Green corridors in urban landscapes affect the arthropod communities of domestic gardens.” *Biological Conservation* 145: 171–178.

Verloove, F., and A. Soldano. 2011. “Studies in Italian Cyperaceae. 2. Miscellaneous notes.” *Webbia* 66 (1): 69–75.

Wagner, H. 2011. “Herba Lycopi lucidi – Zelan”. In *Chromatographic fingerprint analysis of Herbal Medicines: Thin-layer and High Performance Liquid Chromatography of Chinese Drugs*, edited by H. Wagner, R. Bauer, D. Melchart, P.-G. Xiao, and A. Staudinger, 141–149. 2nd ed. Wien: Springer-Verlag, Wien.

Wilkomirski, B., H. Galera, B. Sudnik-Wójcikowska, T. Staszewski, and M. Malawska. 2012. “Railway Tracks – Habitat Conditions, Contamination, Floristic Settlement – A Review.” *Environmental and Natural Resources Research* 2 (1): 86–95.

Zerbe, S., U. Maurer, S. Schmitz, and H. Sukopp. 2003. “Biodiversity in Berlin and its potential for nature conservation.” *Landscape and Urban Planning* 62 (3): 139–148.

Gymnocoronis spilanthoides (*Asteraceae, Eupatorieae*), a new naturalized and potentially invasive aquatic alien in S Europe

Author(s): Nicola M. G. Ardenghi , Giovanni Barcheri , Claudio Ballerini , Paolo Cauzzi & Filippo guzzon
Source: Willdenowia, 46(2):265-273.
Published By: Botanic Garden and Botanical Museum Berlin (BGBM)
DOI: http://dx.doi.org/10.3372/wi.46.46208
URL: http://www.bioone.org/doi/full/10.3372/wi.46.46208

Willdenowia
Annals of the Botanic Garden and Botanical Museum Berlin-Dahlem

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Gymnocoronis spilanthoides (*Asteraceae*, *Eupatorieae*), a new naturalized and potentially invasive aquatic alien in S Europe

Abstract: *Gymnocoronis spilanthoides*, a naturalized South American neophyte introduced as an aquarium and aquatic ornamental plant, is recorded for the first time from southern Europe. Two populations were found in irrigation canals and in a rice field in northern Italy. Distribution, invasion status, ecology, and pathways of introduction of the species are presented. Additionally, the modes of dispersal, never investigated before in the European continent, are discussed and the potential invasive behaviour and impacts in the new growing sites are assessed.

Key words: *Asteraceae*, *Compositae*, *Eupatorieae*, *Gymnocoronis*, *Gymnocoronis spilanthoides*, Italy, biological invasion, aquarium trade, rice fields flora, weeds, seed germination

Article history: Received 17 March 2016; peer-review completed 3 June 2016; received in revised form 15 June 2016; accepted for publication 28 June 2016.

Citation: Ardenghi N. M. G., Barcheri G., Ballerini C., Cauzzi P. & Guzzon F. 2016: *Gymnocoronis spilanthoides* (*Asteraceae*, *Eupatorieae*), a new naturalized and potentially invasive aquatic alien in S Europe. – Willdenowia 46: 265–273. doi: http://dx.doi.org/10.3372/wi.46.46208

Introduction

The genus *Gymnocoronis* DC. (*Asteraceae*, *Eupatorieae*, *Adenostemmatinae*) includes two aquatic species, *G. latifolia* Hook. & Arn. and *G. spilanthoides* (D. Don ex Hook. & Arn.) DC., native to Mesoamerica and South America, respectively (Turner 1997; Tippery & al. 2014). *Gymnocoronis spilanthoides* (Senegal tea plant, water snowball) has been traded worldwide as an aquarium and aquatic ornamental plant since the second half of the 20th century and has been recorded as an invasive alien in E Asia, Australia, New Zealand, and C Europe, which has a single site in Hungary (Lukács & al. 2014; Tippery & al. 2014). The species represents a serious threat in Australia, where it is listed on the "National Environmental Alert List" (Australian Government 2012), and is rapidly expanding across China and Japan (Kadono 2004; Gao & Liu 2007; Gao & Chen 2011). In 2012, the European and Mediterranean Plant Protection Organization (EPPO) listed *G. spilanthoides* on the "EPPO Observation List of invasive alien plants" (EPPO 2016), which contains plant species (absent or present in the EPPO region) featuring a medium risk or for which information currently available is not sufficient to produce an accurate assessment.

In July 2015, an extended population of *Gymnocoronis spilanthoides* was discovered in an irrigation canal in Zerbolò (province of Pavia, Lombardia, Italy); further field surveys conducted in the following months revealed a wider distribution of the species across the local irrigation network. *Gymnocoronis spilanthoides* is a novelty to the flora of Italy and S Europe, but the presence of this aquarium plant in the study area was not to-

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tally unexpected: the aquarium and aquatic ornamental species trade is emerging as a major pathway for the introduction of new alien taxa (Padilla & Williams 2004; Hussner 2012), enhanced in recent times by online commerce, which is poorly regulated and accessible to a large number of users (Padilla & Williams 2004; Derraik & Philipps 2010; Mazza & al. 2015). Species like *Egeria densa* Planch., *Elodea nuttallii* (Planch.) H. St. John, *Lagarosiphon major* (Ridl.) Moss and *Myriophyllum aquaticum* (Vell.) Verdc., invasive or potentially invasive in Italy (Lastrucci & al. 2006; Celesti-Grapow & al. 2009; Banfi & Galasso 2010; Mazza & al. 2015), were originally introduced for ornamental purposes and, like *G. spilanthoides*, found rice fields and related irrigation infrastructures to be a suitable artificial freshwater ecosystem to establish and spread.

The potential risk of *Gymnocoronis spilanthoides* is regarded as "medium" in the EPPO region (Brunel 2009; EPPO 2016), and the species is declared invasive in every country where it has been introduced. Therefore, its mode of dispersal and spread potential in the Italian growing sites have been investigated with the aid of germination tests, in order to evaluate the role of sexual reproduction. Additionally, the potential impacts and invasive behaviour have been assessed by means of the EPPO prioritization process scheme for invasive alien plants (EPPO/OEPP 2012).

Material and methods

The present paper is based on observations and material collected on field trips conducted by the authors in Zerbolò (province of Pavia, Lombardia, Italy) and surrounding localities between July 2015 and July 2016. Voucher specimens are stored at BR, FI, MSNM and PAV (herbarium codes according to Index Herbariorum: Thiers 2016+).

Germination tests were conducted on achenes collected from the population located along the provincial road 185 in Zerbolò, in December 2015. Achenes were sown on 1 % distilled water-agar held in 90 mm diameter Petri dishes, using five replicates of 20 achenes for each temperature treatment; they were placed in temperature and light-controlled incubators (LMS Ltd, Sevenoaks, United Kingdom) using a 12-h daily photoperiod (photosynthetically active radiation 40–50 µmol $m^{-2}s^{-1}$). Germination was tested at five temperature treatments, two constant (15 °C, 25 °C) and three alternating (15/5 °C, 20/10 °C, 25/15 °C) regimes (in alternating temperatures, light was provided during the warm phase). The experiment lasted six weeks, during which germinated achenes were counted every five days. Germination was defined as visible radicle emergence. Achenes were not removed once germinated but kept on the Petri dishes to check the rate of seedling establishment of germinated achenes. We considered a seedling established when the cotyledons were fully unfolded. Seedling establishment rate was calculated as the percentage of germinated achenes that established seedlings. Data were analysed in SPSS 21.0. Final germination and seedling establishment responses to temperature treatments were tested using univariate ANOVA test. Homogeneity of variances was tested by means of Levene's test. The Bonferroni post-hoc test was applied to find out the differences between temperature treatments. Achene samples are stored at the University of Pavia Seed Bank.

Mean temperatures in the growing sites were acquired from WorldClim (2016+).

Potential impacts and invasive behaviour of the Italian populations were assessed following the "EPPO prioritization process for invasive alien plants" introduced by the European and Mediterranean Plant Protection Organization (EPPO/OEPP 2012).

Results and Discussion

Nomenclature

Gymnocoronis spilanthoides (D. Don ex Hook. & Arn.) DC., Prodr. 7(1): 266. 1838 ≡ *Alomia spilanthoides* D. Don ex Hook. & Arn. in Compan. Bot. Mag. 1(8): 238. 1835. – Lectotype (designated by Freire & Ariza Espinar 2014: 351): [Argentina, Buenos Aires], "Buenos Ayres", s.d., *J. Tweedie s.n.* (K K000486489 [image!]). – Image of the lectotype available at http://apps.kew.org/herbcat/getImage.do?imageBarcode=K000486489 [accessed on 20 Feb 2016].

= *Gymnocoronis attenuata* DC., Prodr. 5: 106. 1836 ≡ *Piqueria attenuata* (DC.) Gardner in London J. Bot. 6: 430. 1847 ≡ *Gymnocoronis spilanthoides* var. *attenuata* (DC.) Baker in Martius, Fl. Bras. 6(2): 183. 1876. – Holotype: [Brazil, Rio Grande do Sul], "Brésil. Province de Rio-Grande", 1833, *C. Gaudichaud 782* (P P02458159 [image!]; isotype: G-DC G00465443). – Image of the holotype available at http://science.mnhn.fr/institution/mnhn/collection/p/item/p02458159 [accessed on 12 Jun 2016].

= *Gymnocoronis subcordata* DC., Prodr. 5: 106. 1836 ≡ *Piqueria subcordata* (DC.) Gardner in London J. Bot. 6: 430. 1847 ≡ *Gymnocoronis spilanthoides* var. *subcordata* (DC.) Baker in Martius, Fl. Bras. 6(2): 184. 1876. – Holotype: [Brazil, Rio Grande do Sul], "Brésil. Province de Rio-Grande", 1833, *C. Gaudichaud 886* (P P02458162 [image!]; isotype: G-DC G00465429). – Image of the holotype available at http://science.mnhn.fr/institution/mnhn/collection/p/item/p02458162 [accessed on 12 Jun 2016].

Description of the specimens

Helophyte, rhizomatous, 1–1.5 m tall. *Stems* erect or ascending, to 1.5 cm in diam., branched, fistulose, glabrous. *Leaves* opposite; *petiole* 1–7 cm long; *leaf blade* dark

Fig. 1. *Gymnocoronis spilanthoides* morphological traits (Zerbolò, Italy, August 2015) – A: inflorescence; B: rooting stem nodes; C: young individual. – Photographs by C. Ballerini.

green, glossy, 7.5–18 cm long, 3.5–7.5 cm wide, thick, coriaceous, pinnately veined, glabrous, base attenuate, occasionally truncate to slightly cordate, margin irregularly obtusely serrate, apex acute. *Synflorescence* terminal, cymose; axis and branches with short glandular hairs. *Capitula* pedunculate, homogamous and discoid, >100-flowered, 9–14 mm long, 14–17 mm in diam., peduncle with short glandular hairs; *involucre* hemispherical, 5–7 mm long, 9–11 mm in diam.; *phyllaries* 2-seriate, narrowly lanceolate, with subsessile to sessile glands; *receptacle* epaleaceous, glabrous and with discrete oval scars. *Corollas* yellowish to white, narrowly funnelform, 3.5–4 mm long, with shortly stalked glands on outer surface; *lobes* green, as wide as long; *style branches* white, oar-shaped, mamillose except at apex. *Achenes* pale brown, ellipsoid, slightly curved, 1.7–2 mm long, 0.8–0.9 mm wide, 5-ribbed, gland-dotted; *carpopodium* white, from conical to cylindrical, very short; *pappus* absent. – Fig. 1A–C.

Worldwide distribution, ecology, and pathways of introduction

Gymnocoronis spilanthoides is a neotropical species, native to Peru, N Argentina, Bolivia, Paraguay, Uruguay and S Brazil (King & Robinson 1974; Cabrera & Freira 1997; Dillon & Sagastegui Alva 2002; Hind 2011). Since the early 1980s it has been recorded as an invasive al-

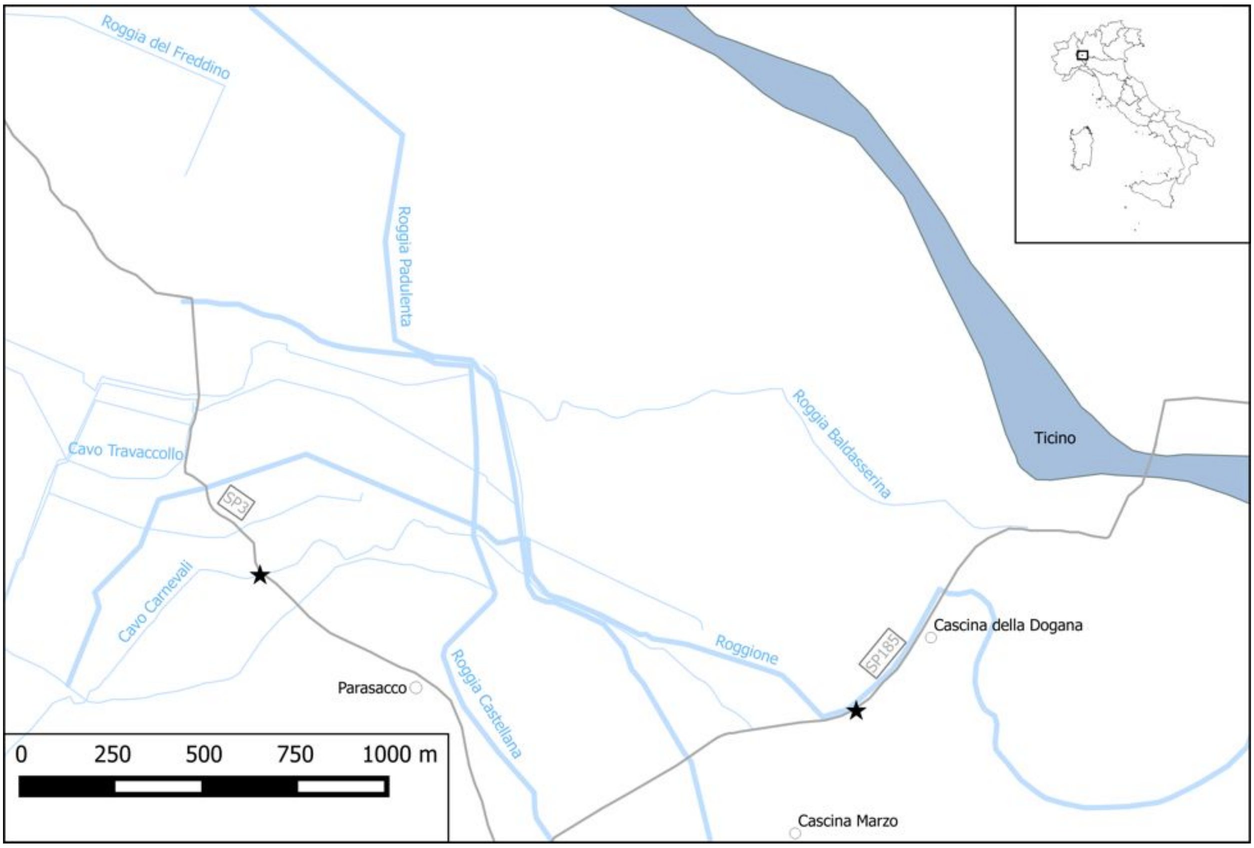

Fig. 2. Location of the Italian populations of *Gymnocoronis spilanthoides* (★). – Map by C. Ballerini.

ien in Australia (Cook 1990; Porteners 1992; Parsons & Cuthbertson 2001; Gunasekera & al. 2002), New Zealand (Timmins & Mackenzie 1995; Howell 2008), Japan (Suyama 2001; Kadono 2004), China and Taiwan (Gao & Liu 2007; Chen & al. 2011; Gao & Chen 2011). In Europe, it has been known since 1988 from the thermal lake of Hévíz, Hungary (Szabó 1998, 2002; Hussner 2012; Lukács & al. 2014), the northernmost growing site within its range.

In its primary and secondary ranges, *Gymnocoronis spilanthoides* grows in freshwater habitats, mainly in marshes and waterbodies with slow-running to standing water, such as ponds, creeks and drains (Cook 1990; Cabrera & Freira 1997; Porteners 1992; Parsons & Cuthbertson 2001; Chen & al. 2011). It is resistant to frost and is able to survive periods of submersion (Timmins & Mackenzie 1995).

Gymnocoronis spilanthoides (including cultivars featuring reddish stem and foliage or variegated leaves) has been traded worldwide as an aquarium plant since the 1960s; it is also cultivated outdoors in water gardens and occasionally as a water purifier and for its butterfly-attracting flowers. The species, popular for its hardiness, is commonly propagated from cuttings (Cook 1990; Parsons & Cuthbertson 2001; Kadono 2004; Allgayer & al. 2007; Brunel 2009; Panetta 2009; Champion & al. 2010; Lowe 2013). A survey of the online aquarium shops conducted in February 2016 revealed that the species is currently sold in Italy on at least seven different websites, at relatively low prices (€ 3.50 to € 5.82).

The new Italian populations: location and invasion status

Gymnocoronis spilanthoides was discovered in the S part of Lombardia (NW Italy), within the area of the regional natural park "Parco Lombardo della Valle del Ticino", in two different localities of the town of Zerbolò (province of Pavia): provincial road 185 between Cascina Marzo and Cascina della Dogana, both canals running along the sides of the road (45.22872°N, 08.99742°E); and canal Cavo Carnevali in Parasacco (45.23191°N, 08.97683°E). The two populations are located at a distance of 1.9 km from each other and grow in two canals belonging to the same irrigation network (Fig. 2). The growing sites are characterized by hot summers, in which the monthly mean maximum temperatures approaches 30 °C, and relatively cold winters with the mean minimum temperature of January slightly below −1 °C (Fig. 3A). The plant was first detected in July, and its presence was confirmed the following year at the end of and after the winter season in early March and mid-July, respectively.

In these waterbodies, about 1 m deep, the species occupies extended stretches up to 519 m long, forming isolated but dense monospecific mats with a 90–100 % cover, usually occupying the whole canal width (1–4 m)

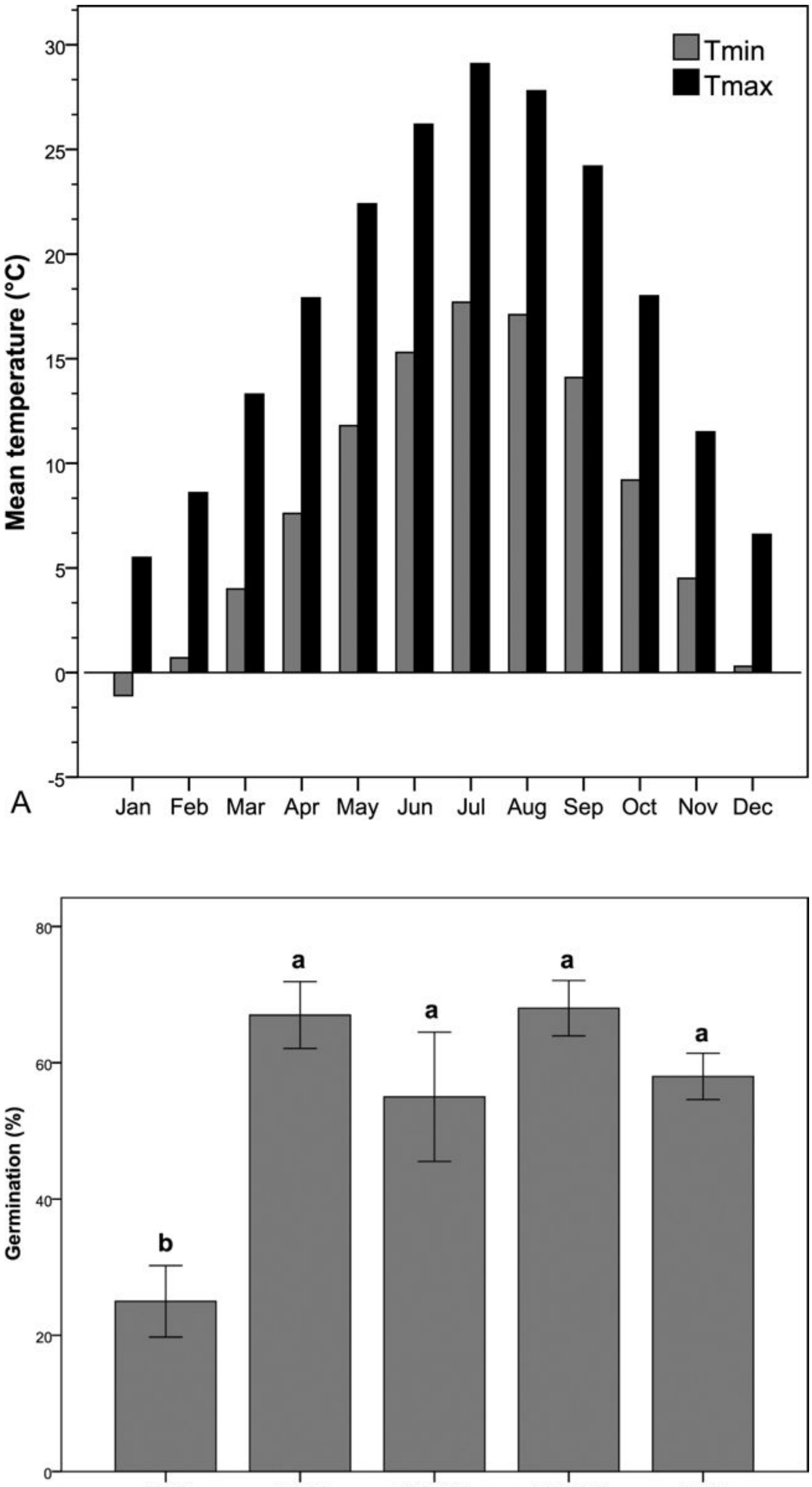

Fig. 3. *Gymnocoronis spilanthoides*, temperatures in the growing sites and achene germination – A: monthly mean maximum temperatures (Tmax) and monthly mean minimum temperatures (Tmin) in the location of achene collection (45.22872°N, 08.99742°E). Data acquired from WorldClim (2016+); B: mean final germination percentages at the five temperature treatments tested. Error bars represent mean final germination percentage ± st.err. Lowercase letters indicate statistically significant differences among temperature treatments; same letter indicates non-significant differences; different letters indicate differences significant at P<0.05.

(Fig. 4A). The plant grows both in the bed and on the banks, surrounded by submerged rooted (*Potametalia pectinati* Koch 1926) and amphibious (*Phragmito-Magnocaricetea* Klika in Klika & V. Novák 1941) vegetation. A large stand, covering an area of 12 m^2, was also detected on the edge and within a rice field, in proximity of the southern canal running along the provincial road 185 (Fig. 4B).

Similarly to other alien macrophytes recently discovered in the surroundings (e.g. *Myriophyllum aquaticum*, naturalized in a drain near a farmhouse in Vigevano, see Ardenghi & Cauzzi 2014), *Gymnocoronis spilanthoides* was probably introduced from private aquaria deliberately or unintentionally after cleaning.

Taking into account the observed distributional pattern and the occurrence of several young individuals without flowers (Fig. 1C), it is likely that the presence of the species in Zerbolò dates back to more than a year ago. The introduction probably occurred near the bridge on the Cavo Carnevali canal, whose banks are close to private dwellings. On the west side of the bridge, where the plant is still present, a dense roundish mat, resembling in shape those of *Gymnocoronis spilanthoides*, can be spotted within a panoramic picture taken in October 2011 for the web mapping service "Google Street View", about four years before our discovery; unfortunately, the considerable distance between the mat and the camera prevents an accurate identification of the plant. From here, in the course of one or more vegetative seasons, it is likely that achenes or vegetative fragments reached the drains and the rice fields between Cascina Marzo and Cascina della Dogana, transported by the flow of water, which runs from the first site southwards to the second one.

In view of the of extension of the populations, the establishment of the species and its competition with the surrounding vegetation, we consider *Gymnocoronis spilanthoides* naturalized in Italy, in line with the definition provided by Celesti-Grapow & al. (2009).

Dispersal and achene germination

Spread by vegetative fragmentation represents the primary mode of dispersal in the secondary range of the species. It occurs when parts of the stem or the rhizome containing nodes break off from the parent plant and are transported away by the streamflow; these fragments quickly develop adventitious roots and stems, generating new colonies. New plants have been observed to arise also from leaf fragments provided with the midrib (Timmins & Mackenzie 1995; Parsons & Cuthbertson 2001; Panetta 2009). The growth rate of adult individuals is c. 15 cm a week in optimal conditions; it is slower when the plant is completely under water (Timmins & Mackenzie 1995).

In Zerbolò, dispersal of vegetative parts may have been enhanced by mechanical cleaning of the rice fields canals, whose vegetation (weedy or not) is regularly mown at least once a year. The population located between Cascina Marzo and Cascina della Dogana was still observed in July 2016, eight months after the last mowing operations, and new growth was noticed emerging from mown stems (Fig. 4C).

Spread by means of achenes is reported to be less significant than vegetative dispersal, at least in the areas of introduction: being relatively heavy and without

Fig. 4. *Gymnocoronis spilanthoides* naturalized population in Zerbolò (provincial road 185 between Cascina Marzo and Cascina della Dogana), Italy, August 2015 (A–B) and March 2016 (C) – A: monospecific stand in irrigation canal; B: dense mat in a rice field; C: emergence of new growths from mowed stems. – Photographs by C. Ballerini.

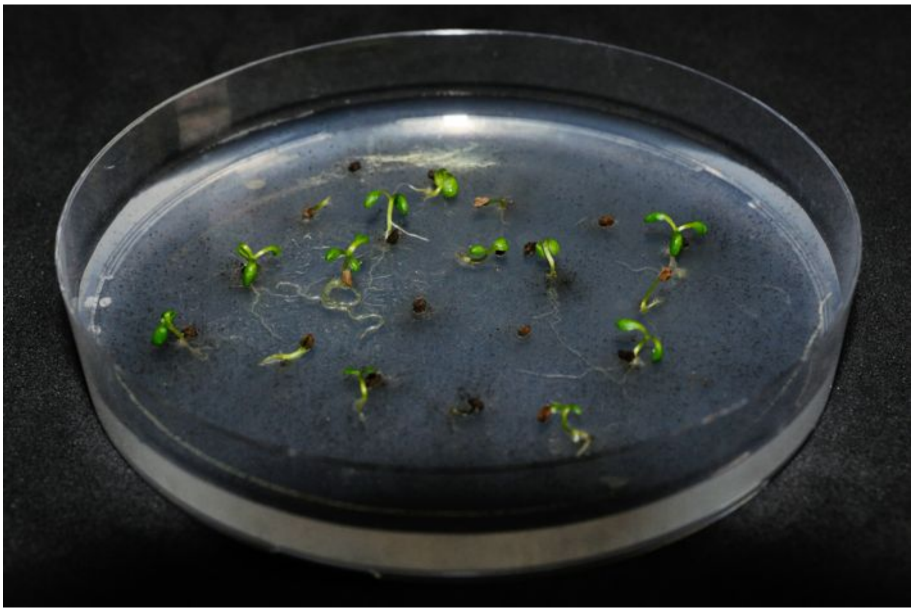

Fig. 5. *Gymnocoronis spilanthoides*, seedling emergence during germination tests. – Photograph by C. Ballerini.

pappus, they are not dispersed by wind but only by water and mud sticking to animals or machinery (Timmins & Mackenzie 1995; Parsons & Cuthbertson 2001; Panetta 2009). Achenes are very persistent, remaining viable for about 3 years when half-buried or located on the soil surface, and up to 16 years if completely buried (Panetta 2009).

In the Italian growing sites considered here, flowering has been observed from July until November, while achene production has been recorded from August. Germination tests conducted on the collected achenes confirmed their high viability (Fig. 5). Additionally, the effect of the different temperature treatments proved to be significant on final germination percentages (F=9,006; P<0,001). The final germination percentage at 15 °C (25 %) was significantly lower than at the other temperatures, while there were no significant differences among the other temperatures (25 °C, 15/5 °C, 20/10 °C, 25/15 °C). The best germination results were achieved at the two alternating temperatures, 15/5 °C (67 %) and 25/15 °C (68 %) (Fig. 3B). The mean seedling establishment rate was high for all the treatments, with the percentage of germinated achenes that reached the seedling establishment always higher than 60 %, without differences between the temperature treatments (F=2,429; P=0,081).

The germination requirements of *Gymnocoronis spilanthoides* are typical of wetland species: lack of germination in darkness (Vivian-Smith & al. 2005) and better performances under alternating temperatures. This can be explained by the need to enhance the germination near the soil surface and prevent its occurrence under the water table (Fenner 2000). On the basis of our results, germination and seedling establishment can occur, to a large extent, at a temperature regime comparable to that at the time and place in which the achene dispersal has been recorded (Fig. 3A). *Gymnocoronis spilanthoides* achenes are persistent in the soil (Panetta 2009) and are reported to be capable of surviving winter low temperatures and germinating when the temperatures increase after the cold season (Department of Agriculture, Fisheries and Forestry. Biosecurity Queensland 2014). This, linked to the wide range of temperatures in which the germination occurs, makes it likely that the achenes of *G. spilanthoides* can germinate throughout most of the year in the study area. Thus, as already noticed in Australia (see Panetta 2009), achenes can be safely regarded as a vector for the dispersal and establishment of *G. spilanthoides* across the study area.

Impact and potential invasive behaviour

In view of the establishment of *Gymnocoronis spilanthoides* discussed in the previous paragraphs, positive responses are given to questions A.1 and A.2 of the prioritization process scheme for evaluating the invasive behaviour of alien plants (EPPO/OEPP 2012), the species being a naturalized alien (neophyte) in the area under assessment.

The spread potential (question A.5) is "high", since both vegetative and sexual reproduction take place in the study area; moreover, the plant is able to spread over distances longer than 500 m, either by water or unintentionally by human activities (mechanical cleaning of irrigation canals). Uncertainty rating is therefore ranked as "low".

The potential negative impact on native species, habitats, and ecosystems in the area under assessment (question A.6) is regarded as "medium": *Gymnocoronis spilanthoides* forms large and dense populations but only in habitats modified by human activities (irrigation canals and rice fields); its negative impact on agriculture (question A.7) is ranked as "low", since the presence of the species in rice fields seems to be currently accidental, with no evidence of yield- or economic losses. The occurrence of additional impacts, especially on infrastructures (question A.8), is "medium": in other countries outside its native range (e.g. Australia, see Gunasekera & al. 2002), *G. spilanthoides* produces dense mats, similar to those recorded from the study area, capable of obstructing irrigation canals. Uncertainty ratings for these three questions are ranked as "low".

The combination of the spread potential ranking ("high") with the maximum rating obtained from the questions on the adverse impacts ("medium"), suggest that *Gymnocoronis spilanthoides* be included in the "observation list of the invasive alien plants"; thus, the prioritization process for the identification of invasive aliens worthy of pest risk analysis (section B) is not required. Overall uncertainty is regarded as "medium", since the species, although present in the area under assessment, is a newcomer.

The results of the EPPO prioritization process confirm that *Gymnocoronis spilanthoides* is a potential invasive alien in Italy and agree with the listing of this species on the "EPPO Lists of Invasive Alien Plants" (EPPO 2016). The absence of *G. spilanthoides* from the list of the invasive and potentially invasive plants for Italy sold online (Mazza & al. 2015: Table 1) suggests an increase in its trade in our country during the last four years (online aquarium stores were surveyed in 2012 by Mazza & al. 2015). Pending further research across the study area, the high spread-potential of this macrophyte, along with the considerable extension of suitable habitats surrounding the discovered growing sites and the possibility of further introductions linked to its growing commerce, are likely to cause a shift in invasive behaviour, as has already occurred in Hungary, Australia and E Asia.

Specimens examined

ITALY: LOMBARDIA: Zerbolò (Pavia), SP185 tra Cascina Marzo e Cascina della Dogana, 45.22872°N, 08.99742°E, 68 m, corsi d'acqua, Jul 2015, leg. *G. Barcheri s.n.*, det. *N. Ardenghi* (PAV); Zerbolò (Pavia), SP185 tra Cascina Marzo e Cascina della Dogana, canale sul lato S della strada, 45.22829°N, 08.99596°E, 68 m, sponda di canale con *Glyceria maxima*, *Lolium arundinaceum*, *Galium palustre* subsp. *elongatum*, *Filipendula ulmaria*, *Urtica dioica*, 5 Aug 2015, *N. Ardenghi*, *C. Ballerini* & *P. Cauzzi s.n.* (FI); Zerbolò (Pavia), SP185 tra Cascina Marzo e Cascina della Dogana, lato S della strada, 45.22880°N, 08.99788°E, 68 m, margine inondato di risaia, con *Setaria pumila*, *Echinochloa crus-galli*, *Veronica anagallis-aquatica*, *Digitaria sanguinalis*, *Spirodela polyrhiza*, *Heteranthera reniformis*, 5–6 m dentro la risaia, 5 Aug 2015, *N. Ardenghi*, *C. Ballerini* & *P. Cauzzi s.n.* (BR, MSNM); Zerbolò (Pavia), Parasacco, Cavo Carnevali, su entrambi i lati del ponte di via Borgo San Siro (SP3), a N della chiesa, 45.23191°N, 08.97683°E, 69 m, sponda con *Urtica dioica*, *Persicaria* cfr. *hydropiper*, *Rubus* sect. *Corylifolii*, 5 Aug 2015, *N. Ardenghi*, *C. Ballerini* & *P. Cauzzi s.n.* (FI).

Acknowledgements

The authors are grateful to Silvia Bodino (University of Pavia) for her helpful logistic support, and to Nicholas Tippery (University of Wisconsin Whitewater) and an anonymous reviewer, whose comments improved the text.

References

Allain G., Maître-Allain T., Breitenstein A. & Allgayer R. 2007: Encyclopédie visuelle de l'aquarium. – Losange: Artémis editions.

Ardenghi N. M. G. & Cauzzi P. 2014: Notulae 238–239. – In: Galasso G. & Banfi E. (ed.), Notulae ad plantas advenas Longobardiae spectantes: 4 (209–262). – Pag. Bot. **37(2013):** 56–57.

Australian Government 2012: National Environmental Alert List. – Published at: http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/alert.html [accessed 20 Feb 2016].

Banfi E. & Galasso G. (ed.) 2010: La flora esotica lombarda. – Milano: Museo di Storia Naturale di Milano.

Brunel S. 2009: Pathway analysis: aquatic plants imported in 10 EPPO countries. – Bull. OEPP/EPPO Bull. **39:** 201–213.

Cabrera A. L. & Freire S. E. 1997: 280. *Asteraceae*, parte 8. Tribu II. *Eupatorieae* (excepto *Mikania*) – Pp. 3–54 + 76–104 in: Hunziker A. T. (ed.), Flora fanerogámica Argentina **47(8).** – Cordoba: ProFlora Conicet.

Celesti-Grapow L., Pretto F., Brundu G., Carli E. & Blasi C. (ed.) 2009: A thematic contribution to the National Biodiversity Strategy. Plant invasion in Italy, an overview. – Roma: Ministry for the Environment Land and Sea Protection, Nature Protection Directorate.

Champion P. D., Clayton J. S. & Hofstra D. E. 2010: Nipping aquatic plant invasions in the bud: weed risk assessment and the trade. – Hydrobiologia **656:** 167–172.

Chen Y. L., Kawahara T. & Hind D. J. N. 2011: *Eupatorieae*. – Pp. 879–891 in: Wu Z. Y., Raven P. H. & Hong D. Y. (ed.), Flora of China **20–21.** – Beijing: Science Press & St. Louis: Missouri Botanical Garden Press.

Cook C. D. K. 1990: Aquatic plant book. – The Hague: SPB Academic Publishing.

Department of Agriculture, Fisheries and Forestry. Biosecurity Queensland 2014: Senegal Tea. *Gymnocoronis spilanthoides*. Fact sheet. Declared Class 1 Pest Plant. February 2014. – Published at: https://www.daf.qld.gov.au/__data/assets/pdf_file/0012/70500/IPA-Senegal-Tea-Plant-PP50.pdf [accessed 16 Mar 2016].

Derraik J. G. B. & Phillips S. 2010: Online trade poses a threat to biosecurity in New Zealand. – Biol. Invas. **12:** 1477–1480.

Dillon M. O. & Sagastegui Alva A. 2002: Tribal classification and diversity in the *Asteraceae* of Peru. – Arnaldoa **8(2):** 25–44.

EPPO 2016: EPPO lists of invasive alien plants. – Published at: http://www.eppo.int/INVASIVE_PLANTS/ias_lists.htm [accessed 21 Feb 2016].

EPPO/OEPP 2012: EPPO prioritization process for invasive alien plants. – Bull. OEPP/EPPO Bull. **42:** 463–474.

Fenner M. (ed.) 2000: Seeds: the ecology of regeneration in plant communities, ed. 2. – Wallingford: CABI Publishing.

Freire S. E. & Ariza Espinar L. 2014: *Gymnocoronis* (Tribu *Eupatorieae*.) – Pp. 350–352 in: Zuloaga F. O., Belgrano M. J. & Anton A. M. (ed.), Flora Argentina: Flora vascular de la República Argentina **7(1):** *Dicotyledoneae–Asteraceae* (Freire S. E., co-ord.): *Anthemideae* a *Gnaphalieae*. – San Isidro: Instituto de Botánica Darwinion.

Gao H.-J. & Chen Z.-H. 2011: *Gymnocoronis*: a new naturalized genus in Eastern China. – J. Zhejiang A & F Univ. **28:** 992–994.

Gao T.-G. & Liu Y. 2007: *Gymnocoronis*, a new naturalized genus of the tribe *Eupatorieae*, *Asteraceae* in China. – Acta Phytotax. Sin. **45:** 329–332.

Gunasekera L., Krake K. & Piggott P. 2002: New aquatic weed threats in northern Victoria. – Pp. 124–125 in: Spafford-Jacob H., Dodd J., Moore J. H. (ed.), 13th Australian Weeds Conference, papers and proceedings. – Perth: Plant Protection Society of Western Australia.

Hind D. J. N. 2011: An annotated preliminary checklist of the *Compositae* of Bolivia (version 2). – Published at http://www.kew.org/science/tropamerica/boliviacompositae/checklist.pdf [accessed 28 Aug 2015].

Howell C. 2008: Consolidated list of environmental weeds in New Zealand. – DOC Research & Development Series **42:** 1–42.

Hussner A. 2012: Alien aquatic plant species in European countries. – Weed Res. 52: 297–306.

Kadono Y. 2004: Alien aquatic plants naturalized in Japan: history and present status. – Global Environm. Res. **8:** 163–169.

King R. M. & Robinson H. 1974: Studies in the *Eupatorieae* (*Asteraceae*). CXXVII. Additions to the American and Pacific *Adenostemmatinae*. *Adenostemma*, *Gymnocoronis* and *Sciadocephala*. – Phytologia **29:** 1–20.

Lastrucci L., Foggi B. & Becattini R. 2006: *Myriophyllum aquaticum* (Vell.) Verdc. (*Haloragaceae*): una nuova specie esotica invasiva per la Toscana. – Inform. Bot. Ital. **37:** 1133–1136.

Lowe J. 2013: Tennessee & Kentucky. Month by month gardening: what to do each month to have a beautiful garden all year. – Minneapolis: Cool Springs Press.

Lukács B. A., Mesterházy A., Vidéki R. & Király G. 2014: Alien aquatic vascular plants in Hungary (Pannonian ecoregion): historical aspects, data set and trends. – Pl. Biosyst. 150: 388–395.

Mazza G., Aquiloni L., Inghilesi A. F., Giuliani C., Lazzaro L., Ferretti G., Lastrucci L., Foggi B. & Tricarico E. 2015: Aliens just a click away: the online aquarium trade in Italy. – Managem. Biol. Invas. **6:** 253–261.

Padilla D. K. & Williams S. L. 2004: Beyond ballast water: aquarium and ornamental trades as sources of invasive species in aquatic ecosystems. – Frontiers Ecol. Environm. **2:** 131–138.

Panetta F. D. 2009: Seed persistence of the invasive aquatic plant, *Gymnocoronis spilanthoides* (*Asteraceae*). – Austral. J. Bot. **57:** 670–674.

Parsons W. T. & Cuthbertson E. G. 2001: Noxious weeds of Australia. Second Edition. – Collingwood: CSIRO Publishing.

Porteners M. F. 1992: *Gymnocoronis* – P. 149 in: Harden G. J. (ed.), Flora of New South Wales **3.** – Sydney: University of New South Wales Press Ltd.

Suyama C. 2001: A new naturalized plant, *Gymnocoronis spilanthoides* DC., in Japan [in Japanese]. – J. Phytogeogr. Taxon. **49:** 183–184.

Szabó I. 1998: Termofitonok Hévíz és Keszthely meleg vizeiben. – Kitaibelia **3:** 295–297.

Szabó I. 2002: Melegvizi növényfajok Hévíz és Keszthely vizeiben. – Bot. Közlem. **89:** 105–115.

Thiers B. 2016+ [continuously updated]: Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's virtual herbarium. – Published at http://sweetgum.nybg.org/science/ih/ [accessed 21 Feb 2016].

Timmins S. M. & Mackenze I. W. 1995: Weeds in New Zealand protected natural areas database. – Department of Conservation Technical Series **8:** 1–287.

Tippery N. P., Schilling E. E., Panero J. L., Les D. H. & Williams C. S. 2014: Independent origins of aquatic *Eupatorieae* (*Asteraceae*). – Syst. Bot. **39:** 1217–1225.

Turner B. L. 1997: The comps of Mexico, **1:** *Eupatorieae*. – Phytologia Mem. **11:** 1–272.

Vivian-Smith G., Hinchliffe D. & Weber J. 2005: Fecundity and germination of the invasive aquatic plant, Senegal tea (*Gymnocoronis spilanthoides* (D. Don) DC.). – Pl. Protect. Quart. **20:** 145–147.

WorldClim 2016+ [continuously updated]: WorldClim – Global climate data. – Published at: http://www.worldclim.com/ [accessed 20 Feb 2016].

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Online ISSN 1868-6397 · Print ISSN 0511-9618 · Impact factor 0.500

Published by the Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin

Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology

Official Journal of the Societa Botanica Italiana

ISSN: 1126-3504 (Print) 1724-5575 (Online) Journal homepage: http://www.tandfonline.com/loi/tplb20

Distribution map of Ambrosia artemisiifolia L. (Asteraceae) in Italy

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To cite this article: R. Gentili, F. Gilardelli, E. Bona, F. Prosser, A. Selvaggi, A. Alessandrini, F. Martini, P. L. Nimis, T. Wilhalm, M. Adorni, N. M. G. Ardenghi, E. Barni, F. Bonafede, M. Bonini, D. Bouvet, G. Buffa, S. Ciappetta, F. Giordana, G. Faggi, A. Ghiani, L. Ghillani, R. Marcucci, R. Masin, V. Morelli, C. Montagnani, S. Montanari, S. Peccenini, M. Pellizzari, E. Romani, D. Saiani, S. Scortegagna, M. Sirotti, A. Truzzi, M. Vignodelli, L. Bagli, F. Fiandri, C. Siniscalco & S. Citterio (2016): Distribution map of Ambrosia artemisiifolia L. (Asteraceae) in Italy, Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology, DOI: 10.1080/11263504.2016.1176966

To link to this article: http://dx.doi.org/10.1080/11263504.2016.1176966

Plant Biosystems, 2016
http:/dx.doi.org/10.1080/11263504.2016.1176966

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Distribution map of *Ambrosia artemisiifolia* L. (Asteraceae) in Italy

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Abstract

The spread of the invasive and allergenic *Ambrosia artemisiifolia* L. in Italy was analysed and mapped using distribution data from a wide range of sources. *Ambrosia artemisiifolia* occupies 1057 floristic quadrants which are mostly distributed in the Po plain. The distribution obtained represents the basis to implement urgent management strategies.

Keywords: *Alien species prioritization, black list, control actions, invasion history, neobiota*

Introduction

Biological invasions are considered worldwide one of the major threats to biodiversity with both ecological and economic impacts (EC 2008; Kumschick et al. 2015). According to European policies [European Regulation (EU) No 1143/2014], there is an urgent need for comprehensive information about occurrence, distribution and impacts of alien species to implement effective management measures aiming at contrasting their invasion and spread (EC 2011; Katsanevakis et al. 2012).

Common ragweed, *Ambrosia artemisiifolia* L. (Asteraceae), is an annual weed native to the prairie regions of North America; in Europe, it is an alien species (neophyte) that has became of main concern due to both its invasiveness (Chauvel et al. 2006; Galzina et al. 2010; Gladieux et al. 2011) and its

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negative effect on human health as it produces highly allergenic pollen (Ghiani et al. 2012).

In 2009, in Nyon (Switzerland), a multidisciplinary group of scientists founded the International Ragweed Society (IRS; www.internationalragweedsociety.org) with the aim to promote knowledge and solutions concerning this problematic species by investigating its direct and indirect impacts on environment and human health as well as improving education, information, technical development and laws regarding the ragweed control. In 2012, the European Union supported the EU-COST Action (FA1203) on "Sustainable management of *Ambrosia artemisiifolia* in Europe" (SMARTER) with the aim of developing effective management strategies to control the species at European level and also understanding its history and degree of invasion (see www.ragweed.eu).

The occurrence of *A. artemisiifolia* in Europe was first documented at the end of the eighteenth century, when the species was cultivated in botanical gardens (Allioni 1770–1773; Chauvel et al. 2006). Its spread across Europe probably started later, during the nineteenth century, from France, Germany and central and eastern Europe due to accidental introduction events (Hegi 1918; Chauvel et al. 2006). To date, the species is expanding further towards northern Europe due to its great dispersal ability, perhaps also favoured by climate changes (Brandes & Nitzsche 2006; Cunze et al. 2013). Across its invasive range, *A. artemisiifolia* grows mostly in anthropogenic habitats and tolerates different soil and climate conditions: it is widely distributed in disturbed areas such as wastelands, road sides, railways and river corridors (Smith et al. 2013).

Reconstructing the distribution of an invasive alien species is a fundamental step to identify its invasion pattern, the reasons for its success and then to implement control and eradication actions (Lawson Handley et al. 2011; Gentili et al. 2015). Although the spatiotemporal spreading of invasive species generally proceeds discontinuously, it can be documented through direct field observations, as well as through herbarium specimens.

Chauvel et al. (2006) investigated the introduction and spread of *A. artemisiifolia* and documented its distribution pattern in France using information from herbarium specimens. According to this study, at the end of the nineteenth century, *A. artemisiifolia* mostly occurred in crop fields (around 80% of specimens); later, it was also found along road sides and in ruderal habitats. Galzina et al. (2010) gathered comprehensive distributional data on the species in Croatia and reported its presence in crop fields and urban and peri-urban areas. Comprehensive distributional data (mostly based on herbarium specimens) were gathered in other European countries or regions, e. g. Austria, Poland and Serbia (Csontos et al. 2010; Tokarska-Guzik et al. 2011). Recent studies have predicted its current and future distribution across Europe (Cunze et al. 2013). In Italy, the first occurrence was reported from the surroundings of Alba (Cuneo province) in 1902, as a casual species in the garden of the Agricultural High School (Vignolo-Lutati 1934, 1935; Bouvet et al. 2013); another early record goes back to 1907 when Heimerl (1911) had been observing some plants in the cemetery of Bressanone (Bolzano Province) for several years; after 1950, it has spread across the Po valley and towards central Italy (Celesti-Grapow et al. 2009).

Several floristic investigations on *A. artemisiifolia* have been carried out at regional or provincial level in Italy (often supported by databases; see Supplementary File 1), but a comprehensive study on its distribution at national level is still lacking. Our work aims at organizing occurrence data of the species gathered from several different sources (herbarium specimens, literature data and field observations) to produce a complete and updated distributional map. This study will contribute to understand and monitor the spreading pattern of *A. artemisiifolia* across Italy.

Materials and methods

Data collection

During the period 2013–2014, data on the distribution of *A. artemisiifolia* in Italy were collected. In particular, we planned to reconstruct the Italian range of the species through three main data sources from scientific museums, universities, regional institutions (botanical gardens, local health authorities, high schools, botanical associations and libraries) and local experts:

(1) *herbarium specimens*: specimens stored in 56 institutional herbaria were included and georeferenced (GIS database, UTM ED50). In the database, only samples identified by expert botanists and reporting precise information on sampling location (along with the date of sampling, the collector, habitat, elevation, etc.) were included (Supplementary File 2).
(2) *published occurrence data*: previously published local/regional occurrences, databases and maps were georeferenced and included in the database, e.g. data from the regional Flora of Central-Eastern Lombardy (Martini et al. 2012) as well as those from the published data stored in the Piedmont floristic database of IPLA (Selvaggi 2007) were included (Supplementary File 1).

(3) *direct field observations*: unpublished georeferenced occurrences from regional/local botanists and professionals belonging to the Local Health Authorities (Bonini et al. 2012), eventually stored in regional databases, as the Piedmont floristic database of IPLA (Selvaggi 2007).

In the analysis, we did not consider specimens collected from the same population on the same date by the same collectors; we also excluded samples of uncertain taxon attribution (after our examination), those lacking detailed information on the locality of collection and those collected/cultivated in botanical gardens. Finally, we excluded previously published field observations lacking of complete information on the locality and date of collection.

Mapping

The distribution of *A. artemisiifolia* was obtained by mapping the presence of the species in the grid units of the Central European Mapping System, that is based on the European middle UTM-ED50 reference (Ehrendorfer & Hamann 1965; Niklfeld 1971; Carrea 2008). The base area is a fourth of the IGM (Istituto Geografico Militare) cartography sheet 1:50.000 (6′ of latitude × 10′ of longitude); each base grid unit is further divided into four equal parts, named "quadrants" (3′ × 5′, i.e. 6 × 5 km). Such a representation allows to avoid mistakes in locating occurrences on the map, especially for those occurrences ascertained through herbarium specimens. The distribution map was built using the GIS software ArcMap 10.1. On the basis of the georeferenced occurrences, a polygon-shape file of the findings and a distribution map for the studied species were created (Figure 1 and Supplementary Figure 1).

Overlapping with biogeographic maps

To assess possible biogeographic patterns in the distribution of *A. artemisiifolia* across Italy, we overlaid its distribution map onto two thematic maps of the main biogeographic subdivisions of Italy (Figure 1 and Supplementary Figure 2): (a) the biogeographic map by Rivas-Martínez et al. (2004) and (b) the European biogeographical regions (available at http://www.eea.europa.eu/).

Results

A total of 3,671 present records of *A. artemisiifolia* in Italy were collected from different data sources: (a) herbarium specimens, (b) published occurrence data and (c) direct field observations. These are distributed in 1057 floristic quadrants (Figure 1) out of a total of 9272 quadrants in Italy. For the most part, the quadrants occupied by the species are located in northern Italy, in the western Po plain. As of now, the species has not been recorded in southern Italy (comprising Sardinia and Sicily islands). The northernmost quadrant is located in the Trentino-Alto Adige administrative region, and the southernmost one in the Lazio administrative region (at Rome). The highest elevation at which the species has been recorded is 1834 m a.s.l. at Sestrières Borgata (Val Chisone, TO, Piedmont; see Bouvet et al. 2013), while the lowest one reaches the sea level, in Emilia-Romagna administrative region (Ravenna sea port). The most commonly invaded habitats are road sides, railways, river corridors and agricultural areas.

The oldest specimen from a naturalized population of *A. artemisiifolia* in Italy dates back to 1902 and was collected in the Agricultural High School of Alba (Piedmont, Alba, T. Ferraris, 1902, herbarium TO). First occurrences of invasion were recorded in Piedmont and Lombardy (see Banfi & Galasso 2010; Bouvet et al. 2013); these two administrative regions at present show the highest concentration of occurrences and the highest number of occupied floristic quadrants (Figure 1(A)). According to the collection dates of the herbarium specimens, the occurrences recorded from the eastern Po plain are more recent (Supplementary File 2). However, along the eastern and southernmost limits of the Italian distribution, different events of introduction probably occurred: (a) close to Genoa in the 1930s (Liguria, Bolzaneto, unknown collector, 17/06/1934, herbarium RO); (b) around Trieste in the 1950s (Friuli Venezia-Giulia, Sagrado, C. Zirnich, 28/09/1939, herbarium TSM) and (c) close to Pesaro in the 1960s (Marche, Pesaro, A.J.B. Brilli-Cattarini, 02/09/1963, herbarium PESA). Southwards, the species has been discontinuously recorded in Rome and Florence starting from the 1930s (Lazio, Rome, unknown collector, 24/08/1931, herbarium RO; Tuscany: cfr. Passerini 1932).

From a biogeographic point of view, most quadrants are comprised within the Eurosibirian region (i.e. Continental region; Figure 1(A)–(C)) (75.40% according to the Rivas-Martinez's biogeographic regions and 78.48% according to the EU biogeographic regions; see also Supplementary Figure 1); only a few quadrants fall into the Mediterranean region (Figure 1(A)–(D)) in both maps. The Alpine region includes a moderate number of quadrants (24.21% according to Rivas-Martinez's bioregions and 19.14% according to EU bioregions).

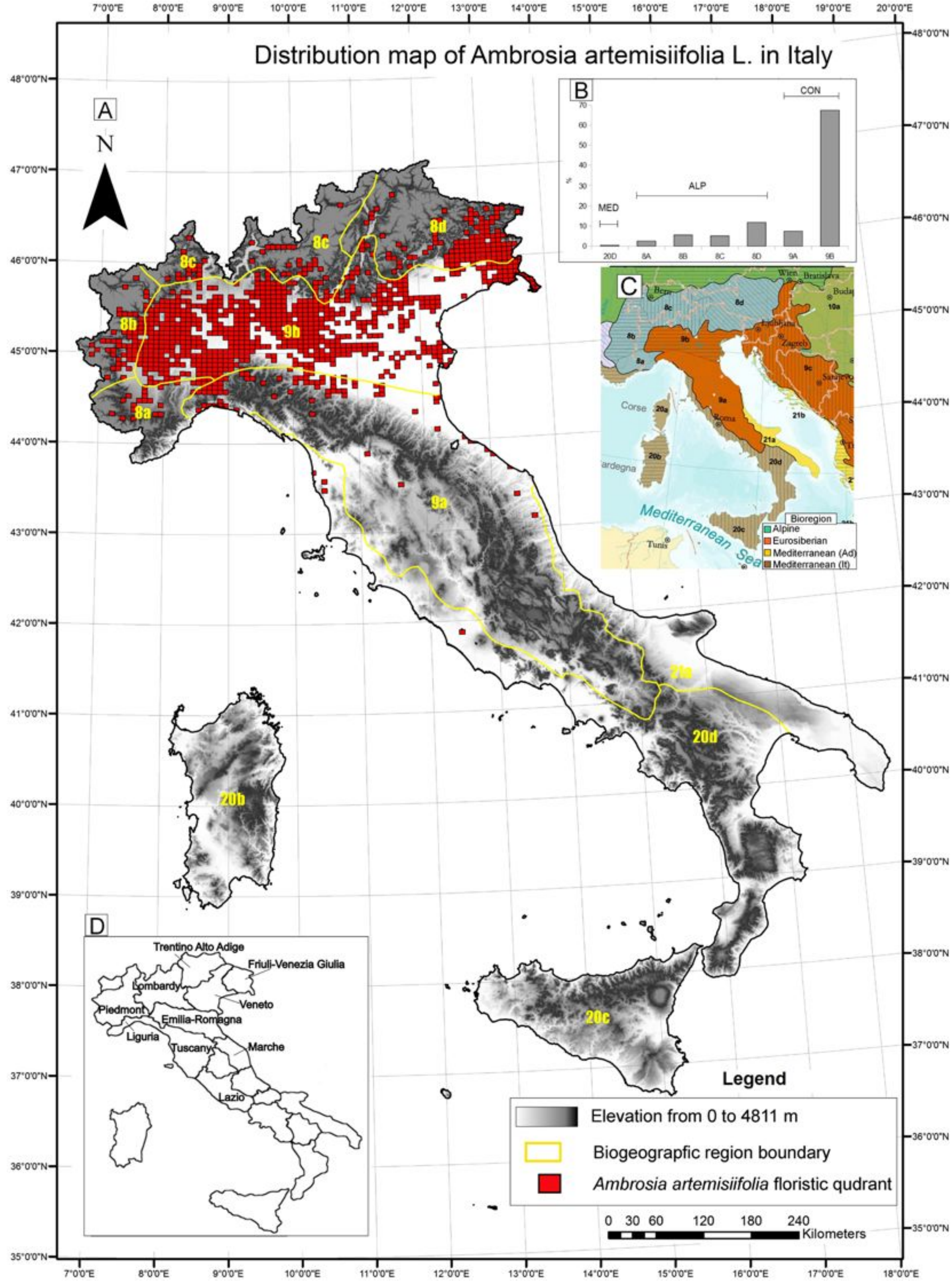


Figure 1. (A) Distribution map of *Ambrosia artemisiifolia* L. in Italy. (B) Per cent frequency of floristic quadrants across the Italian biogeographic regions/provinces according to the subdivision of Rivas-Martinez et al. (2004); Legend: ALP = Alpine; MED = Mediterranean; CON = Continental (i.e. Eurosibirian). (C) Modified extract (Italy) of the Biogeographic Map of Europe of Rivas-Martinez et al. (2004). Legend: Eurosibirian bioregion: 8a, b, c, d = Alpine province (Maritime-Alpine, West-Alpine, Middle-Alpine and East-Alpine), 9a,b = Apennine–Balkan province (Apenninic); Mediterranean biogeographic region: 20d = Italo–Tyrrhenian province (Coastal West Italian). (D) Cited Italian administrative regions.

Discussion

The distribution map of *A. artemisiifolia* in Italy describes the current status of its establishment across Italian regions, showing differences in the regional distributional patterns. The species is more frequent in north-western Italy (Piedmont and Lombardy), which is also the area with the highest ragweed pollen level in Italy (Makra et al. 2011). Results confirm that the oldest *A. artemisiifolia* specimen collected in Italy dates back to 1902. From the north-west Italy, the species probably spread towards north-east, downward the Po valley, where a lower frequency of *A. artemisiifolia* presence seems to reflect a more recent colonization. Differences in its distribution at a regional scale are also likely due to differences in biogeographic (bioclimatic) characteristics among the Italian regions as well as local habitat preferences. Over the last century, the species has greatly spread across Italy (Celesti-Grapow et al. 2010; Bouvet et al. 2013). Based on the numerous recent new records and due to the effects of climate change, *A. artemisiifolia* is expected to further spread (Cunze et al. 2013), towards higher elevations also, as already observed for *Senecio inaequidens* DC., another highly invasive species in Italy (Vacchiano et al. 2013).

The records of *A. artemisiifolia* in the Mediterranean biogeographic region (central and southern Italy) are infrequent and/or ephemeral (like in the surroundings of Florence and Rome).

The only significant occurrences of *A. artemisiifolia* along the Mediterranean coasts are in (a) the Marche administrative region (around Pesaro city), that is included into the Eurosibirian (Continental) biogeographic region both in the Rivas-Martinez's (Apennine–Balkan province) and in the EU subdivisions; (b) in the Liguria administrative region, that is partially included (where *A. artemisiifolia* occurs) in the Eurosibirian (Continental) biogeographic region for the Rivas-Martinez subdivision (Apennine–Balkan province). This pattern is in accordance with the large presence of *A. artemisiifolia* in the Balkans. On the contrary, in areas featuring a typical Mediterranean bioclimate, the species is substantially absent. For the southern Italy, the species was previously observed in the Calabria region (Conti et al. 2005); however, such observation was not confirmed later (not included in the map).

Such a pattern seems to be confirmed by the species distribution models built by Cunze et al. (2013) and Rasmussen (2013), which predict a scarce presence of the species in southern Italy and an expansion towards northern Europe. In our opinion, the difficulty for the species to colonize strictly Mediterranean regions could be due to the competition of more adapted species and to bioclimatic filters (Haider et al. 2010; Kueffer et al. 2013).

Prevention of *A. artemisiifolia* invasion across free regions of Italy requires public education and specific measures to avoid or reduce seeds' dispersal from infested areas (Essl et al. 2015). If an invasion event occurs, rapid detection, immediate eradication and management should be applied.

Conclusions

The implementation of a prioritization process to assess the potential risk of impact of alien species requires the knowledge of their current invasion pattern. Our results highlight the massive presence of *A. artemisiifolia* in northern Italy, a moderate presence in central Italy and its absence in southern Italy. After the publication of the European Regulation "(EU) No 1143/2014" on "the prevention and management of the introduction and spread of invasive alien species", our map may support strategic plans on *A. artemisiifolia* management in Italy and a European strategy of control (IRS activities and EU-COST Action SMARTER). In addition, the results of this study may provide information to aerobiological and allergological studies, as well as to pollen mapping of this highly allergenic species across Europe.

Acknowledgements

We also acknowledge support from EU COST Action FA1203 "Sustainable management of *Ambrosia artemisiifolia* in Europe (SMARTER)". We are grateful to the botanists who provided a relevant number of unpublished botanical records to regional databases or information about the species: F. Andreucci, A. Antonietti, B. Augustinus, L. Bernardo, G. Bruno, M. Castelli, F. Conti, R. Dellavedova, S. Lonati, C. Minuzzo, S. Picco, L. Sitzia, A. Tisi, P. Varese, F. Verloove and A.G. Zanetta.

Funding

This study was planned and supported by Milano-Bicocca University.

Supplemental data

Supplemental data for this article can be accessed at http://dx.doi.org/10.1080/11263504.2016.1176966.

References

Allioni C. 1770–1773. Auctarium ad synopsim methodicam stirpium Hortii Regi Taurinensis. Mél Phil Math Soc Roy Turin. [Adding synopsis to the ordered plants of the royal garden of Turin] 5: 53–96.

Banfi E, Galasso G. 2010. La flora esotica lombarda. Milano: Museo di Storia Naturale di Milano.

Bonini M, Cislaghi G, Colombo P, Cornaggia N, Panzeri A, Valerio E, Gramegna M. 2012. Ragweed pollinosis primary prevention: Over ten years experience of the Lombardy Region and the Local Health Authority ASL Milan 1. Ambroisie 27: 27–32.

Bouvet D, Selvaggi A, Siniscalco C, Soldano A. 2013. *Ambrosia artemisiifolia* L. In: Bouvet D, editor. Piante esotiche invasive in Piemonte. Riconoscimento, distribuzione, impatti. Torino: Museo Regionale di Scienze Naturali di Torino. pp. 55–68.

Brandes D, Nitzsche J. 2006. Biology, introduction, dispersal, and distribution of common ragweed (*Ambrosia artemisiifolia* L.) with special regard to Germany. Nachrichtenbl Deut Pflanzenschutzd 58: 286–291.

Carrea A. 2008. A rapid methodology for the survey of Floristic Cartography quadrants in the Po Plain (North-Italy). Scientific Acta 2: 55–59.

Celesti-Grapow L, Pretto F, Brundu G, Carli E, Blasi C. 2009. Plant invasion in Italy – An overview. Roma: Ministry of the Environment Land and Sea protection, Palombi & Partners Srl. 36 pp.

Celesti-Grapow L, Pretto F, Carli E, Blasi C. 2010. Flora vascolare alloctona e invasiva delle regioni d'Italia. Roma: Casa Editrice Università La Sapienza. 208 pp.

Chauvel B, Dessaint F, Cardinal-Legrand C, Bretagnolle F. 2006. The historical spread of *Ambrosia artemisiifolia* L. in France from herbarium records. J Biogeogr 33: 665–673.

Conti F, Abbate G, Alessandrini A, Blasi C, editors. 2005. An annotated checklist of the Italian vascular flora. Roma: Palombi Editori.

Csontos P, Vitalos M, Barina Z, Kiss L. 2010. Early distribution and spread of *Ambrosia artemisiifolia* in Central and Eastern Europe. Bot Helv 120: 75–78.

Cunze S, Leiblein MC, Tackenberg O. 2013. Range expansion of *Ambrosia artemisiifolia* in Europe is promoted by climate change. ISRN Ecol Article ID 610126: 1–9.

EC. 2008. Towards an EU strategy on invasive species. COM/2008/789. Brussels: European Commission. 10 pp.

EC. 2011. Our life insurance, our natural capital: An EU biodiversity strategy to 2020. COM/2011/244. Brussels: European Commission. 16 pp.

Ehrendorfer F, Hamann U. 1965. Vorschläge zu einer floristichen Kartierung von Mitteleuropa. Ber Deutsch Bot Ges 78: 35–50.

Essl F, Biró K, Brandes D, Broennimann O, Bullock JM, Chapman DS, et al. 2015. Biological Flora of the British Isles: Ambrosia artemisiifolia. J Ecol 103: 1069–1098.

Galzina N, Baric K, Šcepanovic M, Goršic M, Ostojic Z. 2010. Distribution of invasive weed *Ambrosia artemisiifolia* L. in Croatia. Agric Consp Scient 75: 75–81.

Gentili R, Gilardelli F, Ciappetta S, Ghiani A, Citterio S. 2015. Inducing competition: intensive grassland seeding to control *Ambrosia artemisiifolia*. Weed Res 55: 278–288.

Ghiani A, Aina R, Asero R, Bellotto E, Citterio S. 2012. Ragweed pollen collected along high-traffic roads shows a higher allergenicity than pollen sampled in vegetated areas. Allergy 67: 887–894.

Gladieux P, Giraud T, Kiss L, Genton BJ, Jonot O, Shykoff JA. 2011. Distinct invasion sources of common ragweed (*Ambrosia artemisiifolia*) in Eastern and Western Europe. Biol Invasions 13: 933–944.

Haider S, Alexander J, Dietz H, Trepl L, Edwards PJ, Kueffer C. 2010. The role of bioclimatic origin, residence time and habitat context in shaping non-native plant distributions along an altitudinal gradient. Biol Invasions 12: 4003–4018.

Hegi G. 1918. Illustrierte Flora von Mittel-Europa, 6(1). München: Verlag von J. F. Lehmann. pp. 497–544.

Heimerl A. 1911. Flora von Brixen a.E. Wien: Deuticke.

Katsanevakis S, Bogucarskis K, Gatto F, Vandekerkhove J, Deriu I, Cardoso AC. 2012. Building the European Alien Species Information Network (EASIN): A novel approach for the exploration of distributed alien species data. BioInvasions Rec 1: 235–245.

Kueffer C, Pyšek P, Richardson DM. 2013. Integrative invasion science: Model systems, multi-site studies, focused meta-analysis and invasion syndromes. New Phytol 200: 615–633.

Kumschick S, Gaertner M, Vilà M, Essl F, Jeschke JM, Pyšek P, et al. 2015. Ecological impacts of alien species: Quantification, scope, caveats, and recommendations. BioScience 65: 55–63.

Lawson Handley LJ, Estoup A, Evans D, Thomas C, Lombaert E, Facon B, et al. 2011. Ecological genetics of invasive alien species. BioControl 56: 409–428.

Makra L, Matyasovszky I, Thibaudon M, Bonini M. 2011. Forecasting ragweed pollen characteristics with nonparametric regression methods over the most polluted areas in Europe. Int J Biometeorology 55: 361–371.

Martini F, Bona E, Federici G, Fenaroli F, Perico G. 2012. Flora vascolare della Lombardia centro-orientale. 2 voll. Trieste: Ed. LINT.

Niklfeld H. 1971. Bericht uber die Kartierung der Flora Mitteleuropas. Taxon 20: 545–571.

Passerini N. 1932. *L'Ambrosia artemisiifolia* L., in Toscana. Boll Ist Sup Agr Pisa 8: 787–788.

Rasmussen K. 2013. Potential effect of climate change on the distribution of allergenic ragweeds (*Ambrosia* spp.) in Europe. PhD thesis. Aarhus University.

Rivas-Martínez S, Penas A, Díaz T. 2004. Biogeographic map of Europe. Cartographic Service, University of León. Available: http://www.globalbioclimatics.org. Accessed Jul 2011 11.

Selvaggi A. 2007. Banche dati floristico vegetazionali e cartografia floristica. In: Mondino GP, editor. Flora e vegetazione del Piemonte. Savigliano, CN: L'Artistica editrice. pp. 63–65.

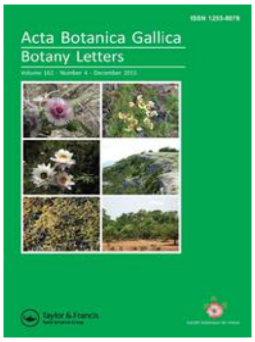
Smith M, Cecchi L, Skjøth CA, Karrer G, Šikoparija B. 2013. Common ragweed: A threat to environmental health in Europe. Environ Int 61: 115–126.

Tokarska-Guzik B, Bzdęga K, Koszela K, Zabinska I, Krzus B, Sajan M, Sendek A. 2011. Allergenic invasive plant *Ambrosia artemisiifolia* L. in Poland: Threat and selected aspects of biology. Biodiv Res Conserv 21: 39–48.

Vacchiano G, Barni E, Lonati M, Masante D, Curtaz A, Tutino S, Siniscalco C. 2013. Monitoring and modeling the invasion of the fast spreading alien *Senecio inaequidens* DC. in an alpine region. Plant Biosyst 147: 1139–1147.

Vignolo-Lutati F. 1934. L'*Ambrosia artemisiifolia* L. in Italia. N Giorn Bot Ital ns 41: 172–173.

Vignolo-Lutati F. 1935. Il Genere "Ambrosia" in Italia. N Giorn Bot Ital ns 42: 364–378.



Acta Botanica Gallica
Botany Letters

ISSN: 1253-8078 (Print) 2166-3408 (Online) Journal homepage: http://www.tandfonline.com/loi/tabg20

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To cite this article: Filippo Guzzon, Jonas V. Müller, Thomas Abeli, Paolo Cauzzi, Nicola M.G. Ardenghi, Alma Balestrazzi, Graziano Rossi & Simone Orsenigo (2015) Germination requirements of nine European Aegilops species in relation to constant and alternating temperatures, Acta Botanica Gallica, 162:4, 349-354, DOI: 10.1080/12538078.2015.1088793

To link to this article: http://dx.doi.org/10.1080/12538078.2015.1088793

Acta Botanica Gallica: Botany Letters, 2015
Vol. 162, No. 4, 349–354, http://dx.doi.org/10.1080/12538078.2015.1088793

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Société botanique de France

Germination requirements of nine European *Aegilops* species in relation to constant and alternating temperatures

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(*Received 28 July 2015; accepted 25 August 2015*)

Abstract: The genus *Aegilops* represents the secondary gene pool of wheat. A better understanding of the germination behaviour of *Aegilops* species is important to improve their use in breeding programmes and strengthen their *in situ/ex situ* conservation. In this study, we investigated the germination behaviour of nine *Aegilops* species, five of them not yet investigated, under two alternating and two constant temperatures. Seed germination was higher than 60% in all temperature treatments and species. Alternating temperatures promoted higher germination rates in all the species and significantly enhanced seed germination in three species (*Aegilops biuncialis*, *Aegilops geniculata* and *Aegilops neglecta*), in comparison with constant temperatures. One of the rarest and least productive species in the genus (*Aegilops uniaristata*) displayed the highest germination. This study suggests that different (seed) regeneration strategies/niches occur across *Aegilops* species.

Keywords: crop wild relatives; ecology; seed germination; pre-breeding characterization; reproductive strategy; Poaceae; alternating temperatures

Introduction

Crop wild relatives (CWR) are important sources of useful alleles for plant breeding and crop improvement (Khalighi, Arzani, and Poursiahbidi 2008; Alnaddaf, Moualla, and Haider 2012; Perrino, Wagensommer, and Medagli 2014). They possess essential traits that contribute to a resilient and high-yielding agricultural production. The primary benefit of CWR is the introgression of genes into crop varieties to overcome biotic (e.g. pest resistance) and abiotic (e.g. drought tolerance) stresses, and also in relation to climate change (Dempewolf et al. 2014). This is also the case for the genus *Aegilops*, which represents the largest part of the secondary gene pool of wheat. *Aegilops* played a key role in wheat evolution and domestication and has been used extensively in wheat breeding programmes (Kilian et al. 2011; Vincent et al. 2013). However, before CWR can be used in breeding programmes for crop improvement, an ecological and trait characterization is required as part of the pre-breeding activities. In this respect, investigating the seed germination behaviour and requirements of CWR is fundamentally important, as germination is a key event in the life cycle of plants.

The genus *Aegilops* L., nom. cons., belongs to the tribe *Triticeae* Dumort., family Poaceae, and includes 23 species, divided into five sections (*Aegilops*, *Comopyrum*, *Cylindropyrum*, *Vertebrata*, and *Sitopsis*). Eleven species are diploid and 12 species are allopolyploid (Kilian et al. 2011; Perrino, Wagensommer, and Medagli 2014). The nomenclature of the *Aegilops* species in this paper follows the Euro+Med PlantBase (Valdés and Scholz 2009). *Aegilops* is a Mediterranean–western Asiatic element occurring in southern Europe, North Africa, the Middle East, and western and central Asia. Many *Aegilops* species show adaptations to disturbed, secondary habitats such as pastures, garrigues, field margins (especially of cereals and legumes) and wastelands, both in ruderal and in segetal environments, in dry and thermophile sites (van Slageren 1994). In their natural habitats, *Aegilops* species start to bloom generally in April or May, whereas the caryopses are ripening in June/July; after the ripening of the caryopses, the spikes fall to the ground (Perrino, Wagensommer, and Medagli 2014). Seed germination starts during the seasonal rainfalls at the end of summer (van Slageren 1994; Onnis et al. 1995). Some species show a weedy or invasive behaviour within their non-native ranges; *Aegilops cylindrica* Host is a troublesome weed in some areas of continental Europe and North America, sometimes affecting crop production (Fandrich and Mallory-Smith 2005; Ardenghi and Parolo 2012);

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This article was originally published with errors. This version has been corrected. Please see Corrigendum (http://dx.doi.org/10.1080/12538078.2015.1116275).

similarly, *Aegilops tauschii* Coss. is considered an invasive species in winter wheat-producing regions of China (Fang 2012). Because wheat producers suffer losses of several million dollars annually, research is addressing the germination behaviour of those species to control their invasiveness. In contrast, for many species of the genus *Aegilops*, little is known about their germination requirements in their natural habitats, which is important for both pre-breeding purposes (i.e. to find potential stress-resistance traits) and from an *in situ/ex situ* conservation perspective (Kilian et al. 2011; Perrino, Wagensommer, and Medagli 2014).

In this study, we investigated the seed germination behaviour at different temperatures (constant and alternating) of nine of the 13 Euro-Mediterranean *Aegilops* species (Table 1) belonging to three sections *Aegilops*, *Comopyrum* and *Cylindropyrum*. In five of these species, germination requirements have not been investigated so far (*Aegilops biuncialis* Vis., *Aegilops columnaris* Zhuk., *Aegilops peregrina* (Hack.) Maire & Weiller, *Aegilops caudata* L. and *Aegilops uniaristata* Vis.). Previous studies on seed germination in *Aegilops* showed that alternating temperatures increased germination in *A. cylindrica* Host. and in various other grasses (Thompson and Grime 1983; Fandrich and Mallory-Smith 2005). Moreover, most of the studies on germination in *Aegilops* focused only on a single species (Onnis et al. 1995; Fandrich and Mallory-Smith 2005; Fang 2012) or a few species (Marañon 1989), whereas the study presented here is the most comprehensive so far, considering most of the European species within the genus.

Material and methods

Seed collection and germination experiment

Fruitlets of nine Euro-Mediterranean *Aegilops* species were collected at the time of natural dispersal in June 2014 from wild populations in Crete (Greece) and Italy (Table 1). Immediately after harvest, fruitlets containing the caryopses (hereafter referred as “seeds”) were brought to the seed laboratory, cleaned manually and sown on 1% distilled water–agar held in 90-mm-diameter Petri dishes, using three replicates of 15 seeds for each species. Seeds were placed in temperature- and light-controlled incubators (LMS Ltd, Sevenoaks, UK) using a 12-h daily photoperiod (photosynthetically active radiation 40–50 μmol m^{-2} s^{-1}). Seeds were exposed to four different temperature treatments, considering both constant (10°C and 20°C) and alternating (20/10°C and 25/15°C) regimens (in alternating temperatures, light was provided during the warm phase). Germination experiments lasted for 4 weeks, during which germinated seeds were counted and removed weekly. Germination was defined as radicle emergence from at least 2 mm. Seed samples and herbarium vouchers are stored at the Millennium Seed Bank (MSB), Royal Botanic Gardens, Kew and at the Herbarium of the University of Pavia (PAV), respectively.

Data analysis

For each temperature regimen, the final seed germination percentage was compared between species and, for each species, it was compared between the temperatures tested. Non-parametric tests (Mann–Whitney) were performed in SPSS 13.0.

Results

All nine *Aegilops* species germinated readily under all four temperatures tested (always > 60%) within 2 weeks (Figure 1). However, the final germination differed significantly between species and temperatures. *Aegilops uniaristata* showed the highest germination percentage, reaching 100% in all treatments, while *Aegilops peregrina* showed the lowest germination percentage (between 69% and 80%). *Aegilops biuncialis*, *Aegilops geniculata* Roth. and *Aegilops neglecta* Req. ex Bertol. showed significant differences between temperatures (Table 2), with the lowest level of germination observed at 10°C and the highest level under alternating temperatures. *Aegilops geniculata* showed the greatest differences in germination between temperatures ranging from 65% at 10°C to 100% at 20/10°C. In *Aegilops biuncialis* the final germination under the two constant temperatures was significantly lower compared to the germination under alternating temperatures (Table 2). Similar behaviour was found in *Aegilops geniculata*, where, however, germination at 20°C did not differ from the germination under alternating temperatures. In *Aegilops neglecta* the final germination at 10°C was significantly lower compared to the other temperature regimens. Alternating temperatures increased germination up to 80% in all the species, with the highest germination at 20/10°C.

Discussion and conclusions

Seed germination was higher than 60% in all temperature treatments and species. Alternating temperatures promoted higher germination rates in all the species, showing the best results at 20/10°C (Figure 1), although differences in germination between constant and alternate temperatures were significant only in three species (*Aegilops biuncialis*, *Aegilops geniculata* and *Aegilops neglecta*). In contrast, 10°C elicited the lowest germination performance.

Aegilops uniaristata, a very rare European taxon, showed the highest germination percentage, with 100% of seeds germinating in all treatments. The locality in Crete where this species was collected is at an elevation of 1041 m above sea level, representing the highest point where this species has been reported so far (Kilian et al. 2011; Perrino, Wagensommer, and Medagli 2014). The germination behaviour of *Aegilops uniaristata* may be explained by the absence of seed heteroblasty and by the low number of fertile spikelets (two to five)

Table 1. Geographical locations of the sampled populations of the nine *Aegilops* species included in the experiment.

Section	Species	Locality	Latitude	Longitude	Elevation (m a.s.l.)	Habitat
Aegilops	*Aegilops biuncialis* Vis.	Lakki, Crete (Greece)	35°24′00″ N	23°56′28″ E	501	roadside
Cylindropyrum	*Aegilops caudata* L.	Lakki, Crete (Greece)	35°23′48″ N	23°56′18″ E	524	roadside
Aegilops	*Aegilops columnaris* Zhuk.	Askordalos, Crete (Greece)	35°24′42″ N	23°56′34″ E	397	roadside
Cylindropyrum	*Aegilops cylindrica* Host	Costa Pelata, Lombardy (Italy)	44°57’32″ N	09°11′24″ E	363	dry grassland
Aegilops	*Aegilops geniculata* Roth	Mondondone, Lombardy (Italy)	44°56′38″ N	09°04′16″ E	343	dry grassland
Aegilops	*Aegilops neglecta* Req. ex Bertol.	Omalos, Crete (Greece)	35°20′35″ N	23°54′15″ E	1041	wasteland
Aegilops	*Aegilops peregrina* (Hack.) Maire & Weiller	Askordalos, Crete (Greece)	35°24′42″ N	23°56′34″ E	397	roadside
Aegilops	*Aegilops triuncialis* L.	Frascineto, Calabria (Italy)	39°50′40″ N	16°14′31″ E	569	roadside
Comopyrum	*Aegilops uniaristata* Vis.	Omalos, Crete (Greece)	35°20′35″ N	23°54′15″ E	1041	wasteland

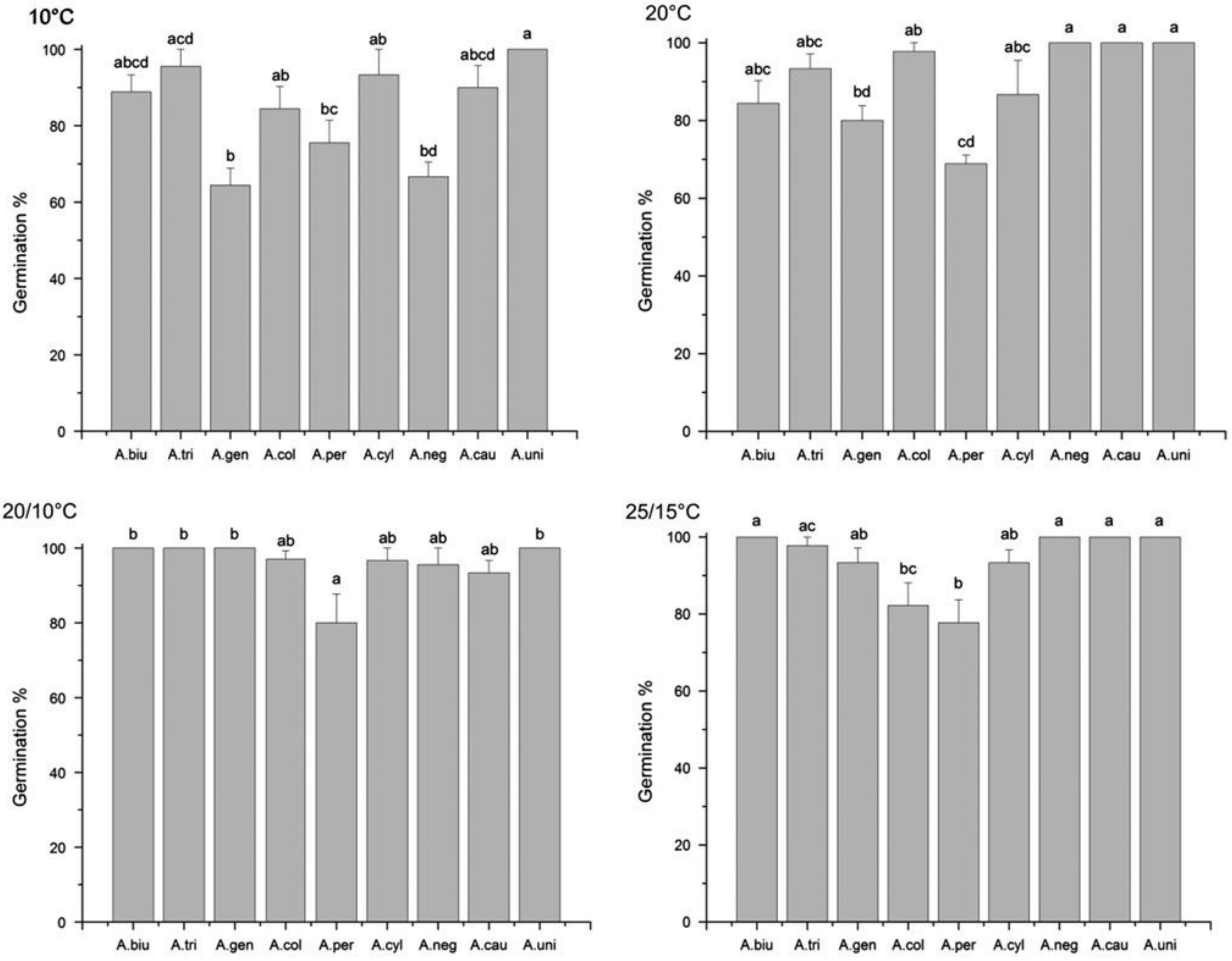

Figure 1. Final germination percentages of the nine *Aegilops* species included in the experiment under four temperature treatments. Lowercase letters indicate statistically significant differences between species; same letters indicate non-significant differences; different letters indicate differences significant at $p < 0.05$.

Table 2. Comparison of the final germination percentages between temperatures for three species: *Aegilops biuncialis*, *Aegilops geniculata* and *Aegilops neglecta*.

		10°C	20°C	20/10°C	25/15°C
A. biuncialis	10°C	–	n.s.	0.034	0.034
	20°C	–0.696	–	0.037	0.037
	20/10°C	–2.121	–2.087	–	n.s.
	25/15°C	–2.121	–2.087	0	–
A. geniculata	10°C	–	n.s.	0.034	0.046
	20°C	–1.798	–	0.037	n.s.
	20/10°C	–2.121	–2.087	–	n.s.
	25/15°C	–1.993	–1.771	–1.549	–
A. neglecta	10°C	–	0.046	0.046	0.037
	20°C	–1.993	–	n.s.	n.s.
	20/10°C	–1.993	–0.258	–	n.s.
	25/15°C	–2.087	–1	–1	–

For each species, the levels of significance are reported above the diagonal, while the Mann–Whitney *z* value is reported below the diagonal.

produced in this species (one of the lowest in the *Aegilops* genus; van Slageren 1994; Perrino, Wagensommer, and Medagli 2014; Bogdanović, Ljubičić, and Clementi 2015). As a consequence, the capacity of *Aegilops uniaristata* to germinate under a wide range of different temperatures can be interpreted as a strategy to maximize the chances of survival of the few seeds produced, which therefore have high quality and viability. On the other hand the germination in *Aegilops biuncialis*, the other low-productive species in the genus, was straightforward at all temperatures (> 80%), with alternating temperatures significantly enhancing germination (100% under both alternating temperatures treatments). So, the germination of *Aegilops biuncialis* is more strongly influenced by temperature fluctuation than the germination of *Aegilops uniaristata*. *Aegilops geniculata* is the species that showed the largest variability in seed germination across temperatures. Together with *Aegilops triuncialis*, *Aegilops geniculata* is the most widespread species of the genus, with a large ecological amplitude and growing from sea level to 1750 m above sea level (Kilian et al. 2011). However, as demonstrated by our results, low temperatures limit its germination and distribution in continental regions (Zaharieva, Prosperi, and Monneveux 2004). Similarly, *Aegilops neglecta*, which is considered more frost resistant than *Aegilops geniculata* (Zaharieva, Prosperi, and Monneveux 2004), showed a reduced germination at low temperatures.

The results found in this study can be explained by looking at the reproductive ecology of species in the genus *Aegilops* in their native areas of distribution, where seed dispersal takes place during the dry and hot summer (van Slageren 1994). According to Baskin and Baskin (2014) winter annual species can have dormancy mechanisms that are broken by hot, dry conditions; therefore, germination occurs in the autumn. Moreover, winter annuals can be conditionally dormant, meaning that they are capable of germinating over a narrow range of conditions, or may be non-dormant and then germinate over a wide range of conditions. In this regard, as demonstrated by our results, *Aegilops* species are not dormant or partially dormant at the time of dispersal and can germinate at a wide range of temperatures. Hence, the main factor limiting the germination is likely to be the water availability after dispersal. Supporting this view, in our experiments fresh *Aegilops* seeds germinated without any pre-treatment, indicating that the first autumnal rains (typical of Mediterranean climates) should trigger a prompt germination in these species. Furthermore, our observations show that germination is higher under alternating temperatures, suggesting the presence of mechanisms that promote seedling emergence in open habitats (Pons 2000) and/or at the soil surface, where temperatures vary significantly during the day/night cycle.

Previous studies showed that seed germination of several species in the sections *Aegilops* and *Cylindropyrum* (such as *Aegilops geniculata*, *Aegilops kotschyi* Boiss., *Aegilops triuncialis* and *Aegilops cylindrica*) varies depending on the position of seeds on the spike (e.g. Marañon 1989; Onnis et al. 1995; Fandrich and Mallory-Smith 2006). In our study, seeds have been removed from the spikelets and used without distinction, so we could not test this hypothesis and further investigations are needed to clarify the behaviour of dimorphic sibling seeds and of seeds positioned in different spikelets. Moreover, further studies simulating different soil moisture conditions will help to clarify the effect of drought on germination in *Aegilops*.

In conclusion, understanding the germination strategy of *Aegilops* species is important for pre-breeding purposes, to identify useful traits for the improvement of modern wheat cultivars through gene introgression. For instance, *Aegilops uniaristata* showed an interestingly high seed viability, demonstrated by a final germination percentage of 100% in all tested conditions, a result comparable or even exceeding the germination capacity of wheat, especially at low temperatures (Hampson and Simpson 1990). Moreover, understanding the germination requirement in the genus *Aegilops* will contribute to more effective conservation actions, both *in situ* and *ex situ*, for these useful plants.

Funding

This work was supported by Regione Lombardia D.G. Istruzione, Formazione e Lavoro, Struttura Asse V - Interregionalità e Transnazionalità POR FSE 2007-2013, Project ID 46547514 'Advanced Priming Technologies for the Lombardy Agro-Seed Industry-PRIMTECH' (Action 2). P.C. has been awarded a Research Fellowship from Regione Lombardia within the same project.

Notes on contributors

Filippo Guzzon is postgraduate student at the Millennium Seed Bank of the Royal Botanic Gardens, Kew. *Contribution:* designed the experiment, performed the statistical analysis and wrote the manuscript.

Jonas V. Müller is senior research leader at the Millennium Seed Bank of the Royal Botanic Gardens, Kew. *Contribution:* wrote the manuscript and made the linguistic revision.

Thomas Abeli is postdoc researcher at the University of Pavia, department of Earth and Environmental Sciences. *Contribution:* designed the experiment, performed the statistical analysis and contributed to the writing of the manuscript.

Paolo Cauzzi is research fellow at the University of Pavia, department of Biology and Biotechnology. *Contribution:* collected the samples and performed the statistical analysis; he also revised the draft of the manuscript.

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Graziano Rossi is full professor at the University of Pavia, department of Earth and Environmental Sciences. *Contribution:* designed the experiment and revised the draft of the experiment.

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References

Alnaddaf, L.M., M.Y. Moualla, and N. Haider. 2012. "Resolving genetic relationships among *Aegilops* L. and *Triticum* L. species using analysis of chloroplast DNA by cleaved amplified polymorphic sequence (CAPS)." *Asian Journal of Agricultural Science* 4(4): 270–279.

Ardenghi, N.M.G., and G. Parolo. 2012. Notula 97. "*Triticum cylindricum* (Host) Ces., Pass. & Gibelli (Poaceae)." *Pagine Botaniche* 35(2011): 79−80.

Baskin, C.C., and J.M. Baskin. 2014. *Seeds. Ecology, Biogeography, and Evolution of Dormancy and Germination, 2nd Edition*. San Diego, USA: Academic Press.

Bogdanović, S., I. Ljubičić, and M. Clementi. 2015. "*Aegilops uniaristata* Vis. (Poaceae): typification and occurrence in Croatia." *Acta Botanica Croatica* 74(1): in press.

Dempewolf, H., R. J. Eastwood, L. Guarino, C. K. Khoury, J.V. Müller, and J. Toll. 2014. "Adapting Agriculture to Climate change: A global Initiative to Collect, Conserve, and use Crop Wild Relatives." *Agroecology and Sustainable Food Systems* 38 (4): 369–377.

Fandrich, L., and C. Mallory-Smith. 2005. "Temperature effects on jointed goatgrass (*Aegilops cylindrica*) seed germination." *Weed Science* 53(5): 594–599.

Fandrich, L., and C. Mallory-Smith. 2006. "Jointed goatgrass (*Aegilops cylindrica*) seed germination and production varies by spikelet position on the spike." *Weed Science* 54 (3): 443–451.

Fang, F. 2012. "Factors affecting Tausch's Goatgrass (*Aegilops tauschii* Coss.) seed germination and seedling emergence." *Journal of Agricultural Sciences* 4(1): 114–121.

Hampson, C.R., and G.M. Simpson. 1990. "Effects of temperature, salt, and osmotic potential on early growth of wheat (*Triticum aestivum*). I. Germination." *Canadian Journal of Botany* 68: 524–528.

Khalighi, M., A. Arzani, and P.A. Poursiahbidi. 2008. "Assessment of genetic diversity in *Triticum spp*. and *Aegilops spp*. using AFLP markers." *African Journal of Biotechnology* 7(5): 546–552.

Kilian, B., K. Mammen, E. Millet, R. Sharma, A. Graner, F. Salamini, K. Hammer, and H. Özkan. 2011. "*Aegilops*." Chapter 1 in: *Wild Crop Relatives Genomic and Breeding Resources, Cereals*, edited by C. Kole, 1–76. Berlin Heidelberg: Springer-Verlag.

Marañon, P. 1989. "Variation in seed size and germination in three *Aegilops* species." *Seed Science and Technology* 17: 583–588.

Onnis, A., A. Bertacchi, T. Lombardi, and A. Stefani. 1995. "Morphology and germination of yellow and brown caryopses of *Aegilops geniculata* Roth (Gramineae) populations from Italy." *Plant Biosystems* 129(3): 813–821.

Perrino, E.V., R.P. Wagensommer, and P. Medagli. 2014. "*Aegilops* (Poaceae) in Italy: taxonomy, geographical distribution, ecology, vulnerability and conservation." *Systematics and Biodiversity* 12 (3): 331–349.

Pons, T.L. 2000. "Seed responses to light." in *Seeds: the ecology of regeneration in plant communities*, 2nd ed., edited by M. Fenner, Chapter 10, 237–260. Wallingford: CAB International.

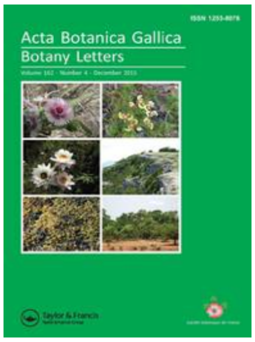
Valdés, B., and H. Scholz 2009: Poaceae (pro parte majore). *Euro+Med Plantbase –the information resource for Euro-Mediterranean plant diversity*. http://ww2.bgbm.org/EuroPlusMed/.

Thompson, K., and J.P. Grime. 1983. "A comparative study of germination responses to diurnally-fluctuating temperatures." *Journal of Applied Ecology* 20(1): 141–156.

van Slageren, M.W. 1994. *Wild wheats: a monograph of Aegilops* L. *and Amblyopyrum* (Jaub. & Spach) Eig *(Poaceae)*. Wageningen: Agricultural University Papers.

Vincent, H., J. Wiersema, S. Kell, H. Fielder, S. Dobbie, N.P. Castañeda-Álvarez, L. Guarino, R. Eastwood, B. Leon, and N. Maxted. 2013. "A prioritized crop wild relative inventory to help underpin global food security." *Biological Conservation* 167: 265–275.

Zaharieva, M., J. Prosperi, and P. Monneveux. 2004. "Ecological distribution and species diversity of *Aegilops* L. genus in Bulgaria." *Biodiversity and Conservation* 13 (12): 2319–2337.



Acta Botanica Gallica

Botany Letters

ISSN: 1253-8078 (Print) 2166-3408 (Online) Journal homepage: http://www.tandfonline.com/loi/tabg20

Corrigendum

To cite this article: (2015) Corrigendum, Acta Botanica Gallica, 162:4, iii-iii, DOI: 10.1080/12538078.2015.1116275

To link to this article: http://dx.doi.org/10.1080/12538078.2015.1116275

Acta Botanica Gallica: Botany Letters, 2015
Vol. 162, No. 4, iii, http://dx.doi.org/10.1080/12538078.2015.1116275

Taylor & Francis
Taylor & Francis Group

Société botanique de France

Corrigendum

Guzzon, F., Müller, J.V., Abeli, T., Cauzzi, P., Ardenghi, N.M.G., Balestrazzi, A., Rossi, G. and Orsenigo, S. (2015) Germination requirements of nine European *Aegilops* species in relation to constant and alternating temperatures. *Acta Botanica Gallica: Botany Letters*. http://dx.doi.org/10.1080/12538078.2015.1088793

When the above article was first published online, T. Abeli, N.M.G. Ardenghi and G. Rossi's affiliation was listed in error as *Dipartimento di Scienze del Territorio e dell'Ambiente, Pavia, Italy*. This has now been corrected in both the print and online versions to *Dipartimento di Scienze della Terra e dell'Ambiente, Pavia, Italy*.

The Authors apologise for this error.

AQUATIC CONSERVATION: MARINE AND FRESHWATER ECOSYSTEMS
Aquatic Conserv: Mar. Freshw. Ecosyst. (2016)

DOI: 10.1002/aqc.2626

*Reintroduction of a dioecious aquatic macrophyte (*Stratiotes aloides *L.) regionally extinct in the wild. Interesting answers from genetics*

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ABSTRACT

1. The reintroduction of a plant species regionally extinct in the wild poses a stimulating conservation challenge. If the species is dioecious and the *ex situ* preserved population is only of one sex, the challenge is even more difficult. To assess whether the female population of *Stratiotes aloides* originally studied requires a reinforcement to increase its genetic variation, and to determine from which source male individuals should be taken to re-establish a viable population, the genetic structure of nine different accessions of *S. aloides* across Europe and Asia were analysed – six native populations and the last three Italian populations, preserved *ex situ*.

2. Amplified fragment length polymorphism (AFLP) fingerprinting of 190 individuals from these populations was performed using six primer combinations and chromosome counts.

3. AFLP markers revealed medium to high values of genetic diversity at the population level, unexpectedly including residual *ex situ* accessions. Neighbour-joining tree, PCoA and STRUCTURE analyses indicate the presence of three genetic patterns identifiable in the central-western, central and eastern Europe–Asian populations. Chromosome counts revealed the presence of diploid ($2n = 24$) and tetraploid ($2n = 48$) populations.

4. Similarity between populations belonging to different hydrographical basins, and differences between neighbouring populations could be explained through long-distance bird-mediated dispersal events. Genetic analysis showed that reinforcement with female individuals from other European populations to increase the genetic diversity of the Italian female population is not necessary. Surprisingly, the geographically closest male population (Bavaria) to the Po basin is not the best option for male reintroduction. Instead, male individuals should be reintroduced from the Rhine basin (Netherlands) and eastern part of the Danube basin (Romania).

Received 18 April 2015; Revised 20 October 2015; Accepted 23 December 2015

KEY WORDS: lake; pond; endangered species; genetics; reintroduction; macrophytes; nutrient enrichment; pollution

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INTRODUCTION

The re-establishment of populations of species or genotypes extinct in the wild from *ex situ* preserved stocks of individuals is now quite common practice worldwide (Aguraiuja, 2011; Seddon *et al.*, 2014). A similar approach is currently needed for *Stratiotes aloides* L. (Hydrocharitaceae), an aquatic dioecious plant threatened in many European countries and extinct in the wild in Italy, but preserved *ex situ*. However, the number of genotypes is often low in *ex situ* collections, which complicates the re-establishment of the genetic properties of the original populations (Rucinska and Puchalski, 2011). When only part of the original genetic variation of a species is maintained *ex situ* it is important to maximize the number of founder individuals to increase the chance of survival of a reintroduced population (Maunder *et al.*, 2000). On the other hand, when local genotypes of widespread species are the subject of a conservation translocation, the selection of potential sources for population reinforcement may be more challenging owing to the genetic structure of the global population, the species' dispersal strategy and the limitations to dispersal. Pre-reintroduction genetic analyses allow the choice of best source populations (Maschinski and Haskins, 2012). In fact, widely-distributed species may show complex genetic patterns and the choice of a given source population may determine different dynamics and success (e.g. inbreeding and outbreeding depression; Pelabon *et al.*, 2005; Becker *et al.*, 2006). So, the genetic structure, the genetic variability and the effective population size of the source population(s) are important issues for a successful translocation.

As a general principle, the greater the genetic variability and effective population size, the higher the probability of successful population establishment (Forsman, 2014). Moreover, the right balance between inbreeding and outbreeding of translocated populations together with gene flow between populations should be assured (Godefroid *et al.*, 2011). It is well established that an understanding of the genetic structure of the source populations is very important for planning breeding programmes with an appropriate mix of source populations and gene flow management. This especially applies to animals, where the release of both sexes with a correct balance is also essential (Stanley-Price, 1991; Snyder and Snyder, 2000).

For plant species, dioecy may greatly complicate the re-establishment of viable self-sustaining populations (IUCN, 2013). The separation of sexes is rather rare in flowering plants, occurring in about 6% of all species (Renner and Ricklefs, 1995) and for this reason this aspect has rarely been considered in the literature on translocations (see Maschinski and Haskin, 2012 and references therein). For instance, in a reintroduction trial of the Australian dioecious species *Symonanthus bancroftii* (F. Muell.) L. Haegi, Ye *et al.* (2007) highlighted the need to determine the optimal sex ratio and the possibility of strong inbreeding depression following the *ex situ* cultivation of the two remnant male and female individuals. Moreover, they demonstrated that different crosses between remnant individuals may result in different reproductive performance and fitness of translocated individuals.

In this context, an interesting case is represented by the dioecious *Stratiotes aloides* L. This Euro-Siberian species is widely distributed in lakes, ponds, ditches and canals (Figure 1(A), (B)) where it often dominates macrophyte communities (Efremov and Sviridenko, 2008). Their stands harbour a high diversity of macroarthropod fauna, containing species of high conservation concern (Suutari *et al.*, 2009), including the larvae of *Aeshna viridis* (Rantala *et al.*, 2004), a Near Threatened dragonfly species (Kalkman *et al.*, 2010) protected by the nature conservation legislation of the European Union.

Despite its broad distribution, *Stratiotes aloides* is declining in Western Europe (Cook and Urmi-Konig, 1983; Smolders *et al.*, 2003; Zantout *et al.*, 2011), where it has recently become extinct at the southern edge of its range. *Stratiotes aloides* was abundant in wetlands of the eastern Po Plain (N. Italy), until the beginning of the twentieth century, with mostly female populations (Orsenigo *et al.*, 2012). The major reason for decline (and regional extinction) is the increased inorganic nitrogen (in particular nitrates) in the water, as a consequence of intensive agriculture and farming (Abeli *et al.*, 2014). Considered lost forever, remnants of the Italian population of *S. aloides* have recently been

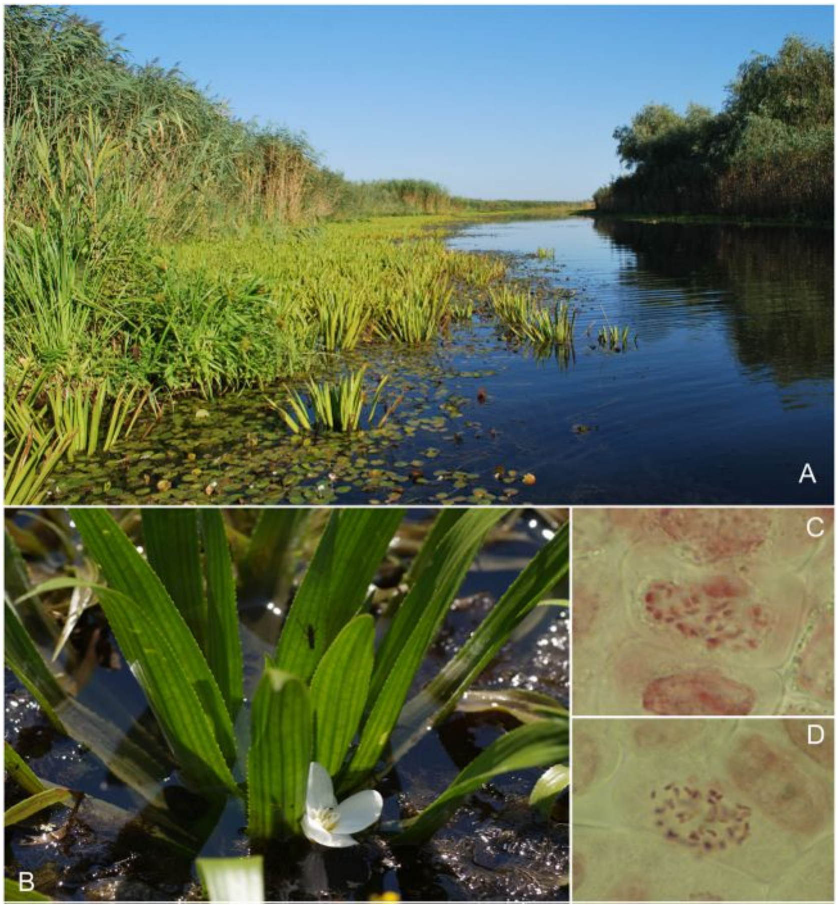

Figure 1. (A) Population of *Stratiotes aloides* in Sulina, Danube Delta (Romania). (B) A female individual of *Stratiotes aloides* from Bavarian population (Plattling, Germany). (C) Mitotic metaphase plate of BAV; 2n = 24 (×1000). (D) Mitotic metaphase plate of NED; 2n = 48 (×1000).

re-discovered *ex situ*. However, only female plants are preserved *ex situ* – offsprings of a few plants (exact number unknown) collected from the Mantua Lakes (Lombardy, Italy) at the beginning of the 20th century. These have reproduced vegetatively for many years, and are at present preserved in three *ex situ* private collections, while male individuals are considered definitively extinct. The discovery of surviving plants of *S. aloides* provides the opportunity to reintroduce the native Italian population in historical sites of occurrence or other sites in the historical distribution area (provided that conditions are suitable). It also raises several interesting questions concerning the recovery of plants extinct in the wild, but preserved *ex situ,* and the problem related to dioecy.

The aim of this study was to investigate the opportunities and problems of reintroducing *S. aloides,* a dioecious plant extinct in the wild in Italy, from plant individuals preserved *ex situ*. A DNA molecular analysis was used to study the genetic pattern of several *S. aloides* populations with the principal goal of selecting a gene pool that would be useful for reintroduction programmes (McKay *et al.*, 2005; Gentili *et al.*, 2010). Such analysis was based on the AFLP approach, which is considered an effective tool to reveal variability and population structure within a single species (Bruni *et al.*, 2013). The genetic variation of the Italian accessions was investigated in the broader context of the genetic variation and structure of nine populations of *S. aloides* in Europe and Asia, with the following specific aims: (1) to assess whether the original Italian female population requires reinforcement to increase its genetic variation; and (2) to determine from which source population male individuals should be taken to re-introduce the male population. Three hypotheses were proposed: (1) low genetic variation of the Italian *ex situ* population of *S. aloides*, as a consequence of long-term vegetative reproduction of the plants collected in the wild; (2) the *ex situ* population represents only a small portion of the species/population gene pool owing to the random collection of few individuals from the wild ('collector-mediated' founder effect and genetic drift); and (3) the geographically closest populations of *S. aloides* may represent the best source populations for male reintroduction.

MATERIAL AND METHODS

Sampling materials

DNA analyses were performed on nine accessions from six natural populations of *S. aloides* from the Netherlands (NED), Germany (BAV), Romania (populations ROM1 and ROM2), Western (EUR) and Central Russia (ASR) (Table 1), two *ex situ* populations (MN1 and MN2), remnants of the last Italian wild populations of Mantua, cultivated by two different amateur botanists, and one population cultivated at the Ferrara Botanical Garden (Italy), originating from specimens introduced from the Botanical Garden of Berlin (FE). Populations were sampled in five different river basins: the Rhine and the Danube are the closest to the Po basin, where the original Italian population occurred, and the Volga and the Ob from Russia (Table 1). Possibly the accession from Ferrara, originally derived from Berlin, may belong to a different basin. Within each population, 9–42 individuals were sampled, depending on the population size. Table 1 shows the locations and characteristics of the sampled populations. Male and female individuals of the mixed Dutch population were sampled and analysed separately, in order to determine differences in genetic diversity between sexes. The Italian female population of *S. aloides* is preserved *ex situ* at C.R.E.A. (Centro Riqualificazione Ecosistemi Autoctoni, Cornaredo, Milan, A. Nania), at three private floriculturists (Lilium Aquae, Castelfranco Veneto, Treviso Az. Agricola Beschi Alvaro & Giulio, Brescia, Italy, MN1, and at P. Vanetti, Inarzo, Varese, Italy, MN2) and more recently at the Botanical Garden of the University of Pavia.

DNA extraction and AFLP

DNA extraction and AFLP genotyping were conducted by Ecogenics GmbH, Schlieren (Switzerland), based on standard protocols. 200–500 ng genomic DNA was digested with EcoRI/MseI and ligated with corresponding AFLP adapters. Preselective PCR (pre amplification) was performed with the AFLP primers EcoRI-A (E01) and MseI-C (M02). Selective PCR (selective amplification) was done on 1:50 dilutions of the pre-amplification reactions using the specified selective primer combinations (Supplementary information, Table S1). In all the reactions, only the EcoRI primers were 5' labelled with a fluorescent dye (6-FAM). For fragment length analysis Applied Biosystems 3730xl DNA Analyzer was used. To assess the reproducibility of the analysis, the whole procedure (i.e. from DNA extraction to capillary electrophoresis) was repeated for 20 samples (about 10% of the total) and the error rate was calculated as the number of phenotypic differences over the total number of phenotypic comparisons (Bonin *et al.*, 2004; Dettori *et al.*, 2014).

Genetic diversity

The number and proportion of polymorphic loci (PPL-5% at the 5% level, corresponding to P95) were calculated using AFLP-SURV version 1.0 (Vekemans, 2002). With the same software Nei's gene diversity Hj (analogous to H or He in most publications; Nei, 1973), Ht (total gene diversity: gene diversity in the overall sample), Hw (average gene diversity within populations) were calculated. AFLP-SURV allowed the calculation of allele frequencies using the default Bayesian method with non-uniform prior distribution (Zhivotovsky, 1999). The effective allele number (ne) and Shannon's information index (I) at the population level, was determined using GenAlEx 6.5 (Peakall and Smouse, 2006). The number of locally common bands (restricted to a limited area and found in $\leq$25–50% of populations) was determined using GenAlEx 6.5 (Peakall and Smouse, 2006). The binary matrix generated with AFLP analysis was subjected to Principal Coordinates Analyses (PCoA) in PAST 2.1 software. A Neighbour-joining (NJ) analysis based on a matrix of Nei–Li

Table 1. Sampled populations and estimates of genetic diversity in *Stratiotes aloides*; PPL5% = number and proportion of polymorphic fragments at the 5% level; I = Shannon's information index; Hj = Nei's heterozygosity; ne = effective number of alleles

Population	Location	Country	River basin	Coordinates	Pop.size	Habitat	Samples	Gender	Ploidy level	PPL-5%*	I	Hj	ne
BAV	Isar Mouth	Germany	Danube	48°46'N-12°55'E	<5000	Isolated oxbow lake	27	♀	2n = 2x = 24	64.5 (338)	0.315 ± 0.010	0.212 ± 0.006	1.269 ± 0.007
FE	*Ex situ*	Italy	Unknown	-	-	-	15	♀	-	68.9 (361)	0.327 ± 0.009	0.232 ± 0.004	1.301 ± 0.006
MN1	*Ex situ*	Italy	Po	-	-	-	15	♀	2n = 4x = 48	88.5 (464)	0.313 ± 0.008	0.213 ± 0.003	1.270 ± 0.005
MN2	*Ex situ*	Italy	Po	-	-	-	15	♀	-	92.2 (483)	0.365 ± 0.008	0.248 ± 0.003	1.329 ± 0.005
NED	Gieethorn	Netherlands	Rhine	52°44'N-06°06'E	> 10.000	Ditches between meadows	42	♀ + ♂	2n = 4x = 48	75.3 (395)	0.269 ± 0.002	0.181 ± 0.002	1221 ± 0.025
ROM1	Charaorman Channel	Romania	Danube	45°08'N-29°21'E	Ca. 10.000	Secondary river channels in the delta	30	♀	-	68.5 (359)	0.236 ± 0.006	0.147 ± 0.002	1.172 ± 0.003
ROM2	Sulina	Romania	Danube	45°13'N-29°18'E	Ca. 10.000	Secondary river channels in the delta	19	Unknown	-	79.4 (416)	0.318 ± 0.008	0.213 ± 0.004	1.271 ± 0.005
ASR	Rasvet	Russia	Ob'	55°13'N-73°01'E	> 10.000	Isolated oxbow lake	18	♀ + ♂	-	87.2 (457)	0.433 ± 0.010	0.319 ± 0.004	1.468 ± 0.008
EUR	Kachkashur	Russia	Volga	58°08'N-52°44'E	Ca. 5000	Isolated oxbow lake	9	♀ + ♂	-	89.3 (468)	0.411 ± 0.009	0.311 ± 0.007	1.452 ± 0.007

*5% criterion applied to Bayesian estimates of allele frequencies

Species level

Ht	Hw	Hb	Fst
0.245	0.226	0.019	0.077

distance was conducted with TREECON 1.3b (Van de Peer and De Wachter, 1994). The tree was edited graphically using the program SplitsTree 4.13 software (Huson and Bryant, 2006); support of nodes was assessed with 1000 bootstrap replicates.

Ancestry of *S. aloides* samples was estimated to model population structure using Bayesian methods as described by Falush *et al.* (2007) in STRUCTURE v. 2.3.4 (see also Pritchard *et al.*, 2000). The allele frequencies of the different *S. aloides* populations were assumed to be correlated, which is a realistic model for populations that are likely to be similar because of common migration events or shared ancestry. To determine the best number of clusters, 20 independent runs of K ($K = 1$–10; see Supplementary File F1) were performed with an admixture model at 100 000 Markov chain Monte Carlo (MCMC) iterations and a 20 000 burn-in period (LOCPRIOR option; estimate λ). The admixture model assumes that each individual is supposed to have inherited some proportion of its ancestry from each population, so this is a ubiquitous approach to capture latent population structure in genetic samples. The ΔK, the second-order rate of change in ln P ($X|K$) for successive values of K to determine the number of clusters (Evanno *et al.*, 2005) was used. The distribution map of STRUCTURE was plotted according to K value at the highest log likelihood. To estimate genetic structure and degree of genetic differentiation within populations, among populations and among biogeographic districts analysis of molecular variance (AMOVA) was performed using the Genalex software version 6.1 (Peakall and Smouse, 2006). The significance of the estimates was obtained through 999 data replications. Since no genetic differences were found among male and female Dutch populations, the results were grouped and statistically analysed together.

Chromosome counts

Chromosomes were counted by N. Ardenghi using individuals of the Italian remnant populations and those populations closest to Italy (MN1, ROM2, BAV and NED) growing *ex situ* at the Botanical Garden of the University of Pavia. Meristems from the tips of developing roots not yet penetrated in the sediment were collected. The root tips were pretreated in hydroxyquinoline for 3 h at room temperature, then fixed in Carnoy's solution (3:1, 3 parts of ethanol and 1 of glacial acetic acid) and preserved at 4°C until preparation. After hydrolysis in 1 N HCl for $6-7$ min at 60°C, they were stained with lacto-propionic orcein overnight, dissected and squashed on clean glass slides with 1 or 2 drops of 45% acetic acid, before examination under a Zeiss Axiophot light microscope (1000×).

RESULTS

The six primer combinations averaged a low scoring error rate (3.67%; based on phenotypic comparisons among replicated individuals, Bonin *et al.*, 2004) which stressed the repeatability of the AFLP data set. The final data set consisted of 190 individuals from nine populations surveyed for AFLP variation, and about 524 fragments in the range of 50–600 bp, of which 92% were polymorphic overall across populations (Supplementary Table S1). All 190 individuals had a unique profile.

Genetic diversity

The results of the genetic diversity analyses of *S. aloides* populations are presented in Table 1. The percentage of polymorphism ranged from 64.5% (in pop. BAV) to 92.2% (in pop. MN2). The effective number of alleles (ne) ranged from 1.172 (ROM2) to 1.468 (ASR). The AFLP variation within populations, estimated as Hj, ranged from 0.147 (ROM1) to 0.319 (ASR); the average gene diversity within the nine investigated populations (Hw) was 0.226, and the total gene diversity (Ht) was 0.245. The lowest value for Shannon's information index (I) was also found in ROM1 (0.236), and the highest in ASR (0.433).

Population structure of *Stratiotes aloides*

In general, the neighbour-joining analysis conducted at the individual level using Nei and Li distances grouped individuals belonging to the same populations; support was medium to low (<50%) for basal branches (black ramifications) but quite high for upper levels branches (>90%; Figure 2(A)). The relationships among the populations of *S. aloides* were initially investigated by PCoA analysis (Dice index; transformation exponent, c = 2; Figure 2 (B)) and cluster analysis (Box). The first two main components in PCoA explained 17.7% and 10.7% of the total variation, respectively. PCoA analysis showed a relative clustering of the populations and a relative separation of populations BAV, FE and ROM1, in the lower part of the scatter plot (Figure 2 (B)). However, BAV and FE scored positive values along the first coordinate, while ROM1 showed a slightly separated distribution, with a degree of negative value along the first coordinate. In contrast, the individuals from the other six populations (MN1, MN2, NED, ROM2, ASR and EUR) were mostly located in the upper part of the scatter plot. MN1, MN2, NED, ROM2 displayed negative scores along

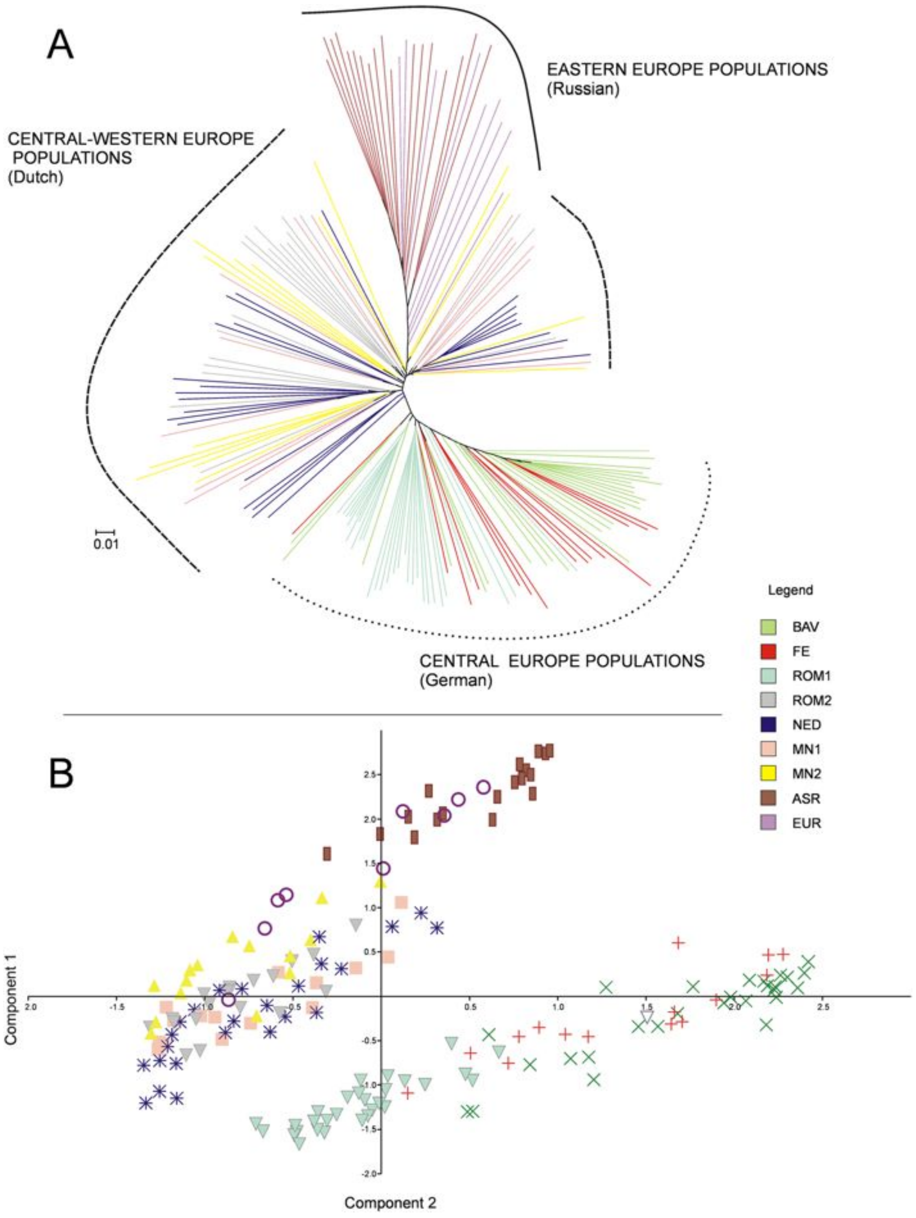

Figure 2. (A) Unrooted neighbour-joining tree based on Nei and Li distances. Bootstrap values were <50% for all branches. (B) PCoA based on Hamming genetic distances. The first two principal coordinates explained 27.2% and 15.9%, respectively, of the molecular variance.

the first axis (Figure 2(B)); EUR and ASR populations showed positive values along the first and second axes.

Cluster analysis revealed that populations BAV and FE were related (both originating from Germany); populations MN1, MN2, NED and ROM2 formed a core group, while ROM1, EUR and ASR clustered in isolated ramifications.

STRUCTURE analysis estimated the highest mean log likelihood at K = 7 (ln P(D) (–177375.7)), indicating that populations of *S. aloides* are subdivided into seven distinct genetic clusters. The results are based on an Admixture model in which individuals may have mixed ancestors from different populations. Figure 3(A), (B) shows a degree of

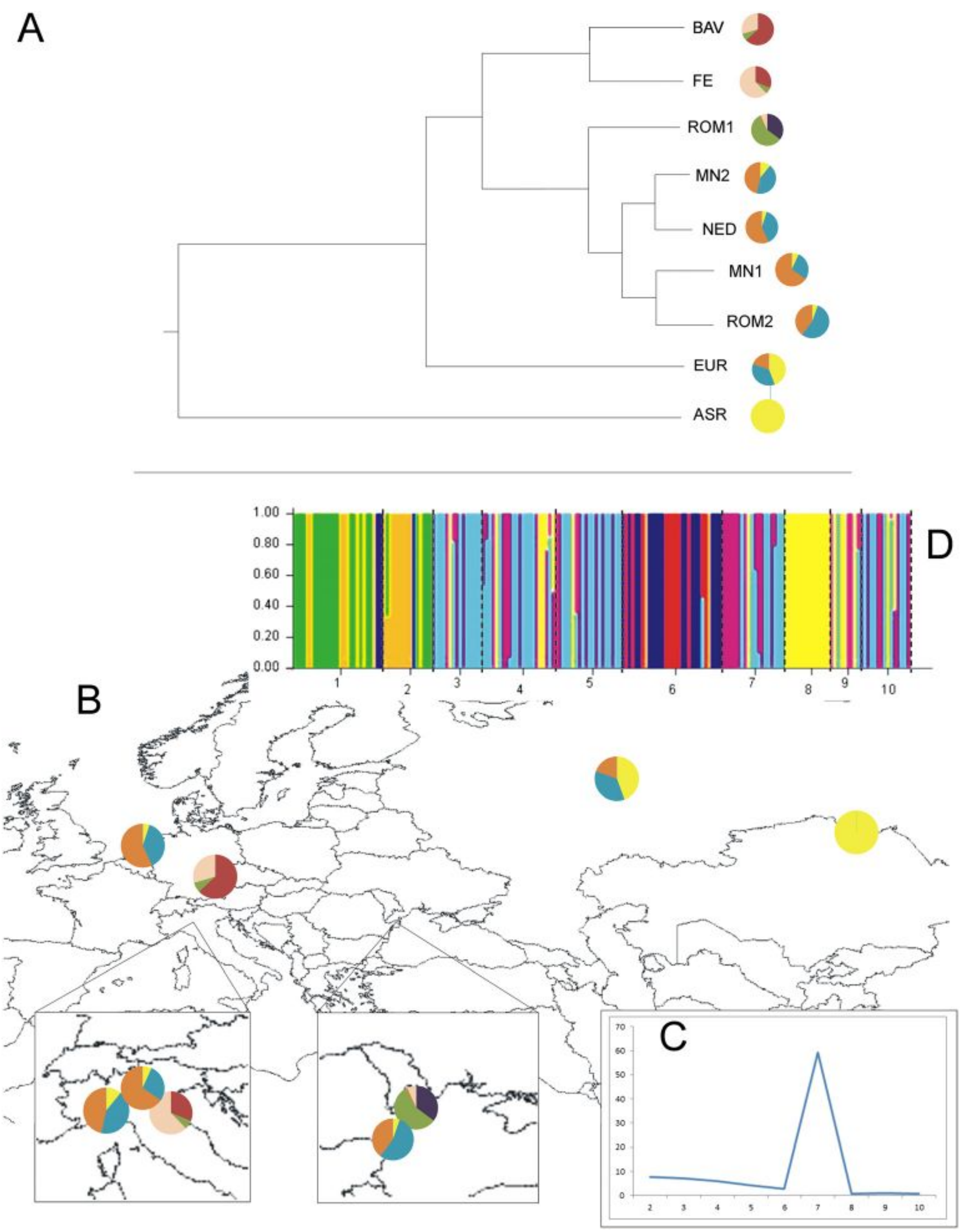

Figure 3. (A) Cluster analysis based on Nei's genetic (UPGMA) distance between *S. aloides* populations associated with results of STRUCTURE analysis. (B) Geographic location populations and STRUCTURE analysis. (C) Results of the ΔK calculation (see Methods for details). (D) In the bar diagram different colours represent the proportion of ancestry in each of the K populations.

structure in *S. aloides* populations which seem to be subdivided into three main subsets: (a) BAV and FE (Germany); (b) MN2, NED, MN1 and ROM2; and (c) EUR and ASR (Russia). Population ROM1 appears to be the most distinct from the others.

The overall genetic differentiation among populations (F_{ST}) was 0.077. AMOVA (Table 2) showed that most of the genetic variation (about 87.6% in both the non-hierarchical and the hierarchical analysis) was allocated within populations, while a small, but substantial, proportion of the variation is explained by between-group differences. The between-group differences were evaluated for several combinations changing the position of the population ROM1, the most dissimilar from the others and then showing unclear attribution to the grouping revealed by the support of cluster, PcoA and STRUCTURE analyses. The percentage of genetic variation among regions (15.2%) and populations (6%) was higher (in total 21.2%) when considering the following grouping of the total variation (Table 2): [BAV, FE] [NED, MN1, MN2, ROM1, ROM2] [ASR, EUR]. Mantel's test between pairwise comparisons of population differentiation values from F_{ST} and Φ_{ST} matrices found significant correlation ($R = 0.92$; $P < 0.001$; Euclidean distance). Mantel's tests between the F_{ST} and Φ_{ST} population differentiation values and geographic distances were significant (F_{ST}: $R = 0.46$; $P = 0.049$; Φ_{ST}: $R = 0.65$; $P = 0.026$; see supplementary Table ST1 for the F_{ST}, Φ_{ST} and kilometric distance matrices).

Chromosome counts

Among the three populations analysed, only BAV proved to be diploid, with $2n = 2x = 24$ (Figure 1 (C)); MN1 and NED were shown to be tetraploid, with $2n = 4x = 48$ (Figure 1(D)). The data confirm the chromosome counts already reported in literature: $2n = 24$ (Schürhoff, 1926, origin unknown) and $2n = 48$ (Gadella and Kliphuis, 1973, from Loosdrecht, Netherlands). The count by Negodi (1929) ($2n =$ 'slightly higher than 20'), probably from Po Plain (Italy), can be interpreted as a diploid count rather than an aneuploid, as stated by Letz *et al.* (1999); no aneuploid counts (such as that by Letz *et al.*, 1999, $2n = 40$, from Veľké Leváre, Slovakia) occurred. Unfortunately, the count for the population ROM2 failed.

Table 2. Results of five analyses of molecular variance (AMOVA) of AFLP data (squared Euclidean distance) from nine populations of *S. aloides.* In the four groupings the relative positions of the population ROM1 were checked. The maximum diversity (variance among groups + variance among populations within groups) were obtained in the following combination [BAV, FE] [NED, MN1, MN2, ROM1, ROM2] [ASR, EUR]

Grouping	N	Source of variation	df	SS	variance (%)	*P*
no grouping	9	among populations	8	8246.67	16.0%	0.001
		within populations	164	36582.35	84.0%	0.001
[BAV, FE] [NED, MN1, MN2, ROM2] [ASR, EUR] [ROM1]	4	among groups	3	6341.1	15.2%	0.001
		among populations within groups	5	1905.5	3.4%	0.001
		within populations	164	36582.4	81.4%	0.001
[BAV, FE] [NED, MN1, MN2, ROM1, ROM2] [ASR, EUR]	3	among groups	2	5022.0	14.6%	0.001
		among populations within groups	6	3224.7	6.0%	0.001
		within populations	164	36582.4	79.5%	0.001
[BAV, FE, ROM1] [NED, MN1, MN2, ROM2] [ASR, EUR]	3	among groups	2	4687.5	11.8%	0.001
		among populations within groups	6	3559.1	7.2%	0.001
		within populations	164	36582.4	81.1%	0.001
[BAV, FE] [NED, MN1, MN2, ROM2] [ASR, EUR, ROM1]	3	among groups	2	3414.0	5.1%	0.001
		among populations within groups	6	4832.6	12.0%	0.001
		within populations	164	36582.4	82.8%	0.001

df = degrees of freedom; SS = mean sum of squares

DISCUSSION

Genetic diversity

In this study the genetic diversity and structure of different populations of *S. aloides* were investigated in order to select an appropriate source to re-establish the male population of *S. aloides* in Italy, where the species is currently extinct in the wild and where only females are preserved *ex situ*. A low genetic variation was expected in the remnant females after several years of *ex situ* clonal reproduction and we hypothesized that the German populations, the closest to the historical area of occurrence of the species in Italy, best represent the original Italian male genotype.

The first investigation of the genetic diversity of *S. aloides*, based on nine populations of the species across its Eurasian range, showed medium to high values of genetic diversity at the population level using AFLP markers (Nei's gene diversity ranged from 0.147 in ROM1 to 0.319 in ASR; mean = 0.226). Such values were comparable with that of *Thalassia testudinum* Banks and Sol. ex K.D. Koenig, another clonal dioecious species belonging to the family Hydrocharitaceae: mean Nei's H = 0.35, detected by AFLP (Waycott and Barnes, 2001). Similar values were also found in *Halophila ovalis* (R. Brown) J. D. Hooker (Hydrocharitaceae), by means of SSR analyses ($H_E = 0.306$ and $H_E = 289$ in Indian and Pacific populations, respectively; Nguyen *et al.*, 2014). Hence, the expectation that genetic variability would be low in clonal populations (e.g. *Marsilea quadrifolia*; Bruni *et al.*, 2013) is not supported in some cases. Although vegetative reproduction is known to occur in *S. aloides* (Smolders *et al.*, 1995a), other specific processes may have led to such high values of genetic diversity even in small populations. In particular, the prevalent outcrossing mating system, the occasional occurrence of hermaphrodite plants (Forbes, 2000), somaclonal mutation events (often observed in aquatic plants) and a likely persistent gene flow (favoured by dispersal of vegetative floating propagules: Sarneel (2013)) may provide the basis of the unexpected high genetic diversity, including the genetic diversity of the female individuals of the remnant Italian population. In addition, the ploidy level (4x) found in the Italian remnant females may also explain their high genetic variation despite the founder effect and the many years of *ex situ* clonal growth. Regarding the other accessions analysed, the results confirm the karyological heterogeneity previously reported in the literature, where different chromosome numbers are indicated: $2n = 24$ (Schürhoff, 1926) and $2n = 48$ (Gadella and Kliphuis, 1973). The variable number of cytotypes within *S. aloides* suggested by the literature and confirmed by the experimental data, are in line with intrageneric and intraspecific chromosome number variation described by Les and Philbrick (1993) for the family Hydrocharitaceae and, in general, for most aquatic angiosperms. Possibly, the karyological variability evidenced by the results of the present study may also explain the different genetic clusters shown by the STRUCTURE analysis. In fact, somatic doubling of chromosome number is a common, if not predominant, mode of polyploidy in aquatic plants. Prevalence of clonal growth above sexual reproduction, associated with high vagility of asexual propagules in aquatic habitats, is effective in increasing the opportunity for somatic doubling to occur (Les and Philbrick, 1993).

Genetic structure

The results suggest that wild populations of *S. aloides* across its Euro-Asiatic range have different genetic patterns. Both PCoA, and NJ tree and cluster analysis indicated the presence of three main genetic patterns identifiable in the central-western (MN1, MN2, NED and ROM2), central (BAV and FE) and eastern (EUR and ASR) Eurasian populations. ROM1 is partially separated but seems more similar to the central-western Europe group according to clustering of populations and AMOVA. On the other hand, STRUCTURE analysis showed seven main ancestral populations that may be the result both of the high variability of AFLP analysis (detected by this highly sensitive analysis) and the sex separation. In any case PCoA, NJ and cluster analysis do not seem in conflict with

STRUCTURE analysis as the former analyses showed a certain degree of grouping subsets. In all the analyses, the Russian populations (eastern range, in Asia) clearly show a distinct ancestry, while the genetic analyses confirmed the German origin of the specimens cultivated at the Botanical Garden of Ferrara. A reintroduction attempt with plants of unknown origin promoted in north-eastern Italy by an amateur botanist, if successful, may have introduced a non-native genotype in Italy. This suggests extreme caution in the use of plant sources of uncertain provenance and highlights the importance of genetic analysis before translocation.

Considering that most of the variation was detected within populations, the similarity between populations belonging to different hydrographical basins could be explained through long-distance bird-mediated dispersal events, as first proposed by Forbes (2000), but not proved owing to the lack of direct or indirect observation of birds feeding on *Stratiotes* seeds (Dessborn *et al.*, 2011; L. Dessborn personal communication). Recently, coots (*Fulica atra*), which in some cases may perform long-distance migrations, have been observed (in the Netherlands: Smolders, and in Russia: Efremov, personal observations) to eat *S. aloides*. Considering the timing of seed dispersal and bird migration events and the diet of different species of waterfowl other dispersal vectors might include teal, mallard, shoveler and moorhen (Cramp, 2000). It is interesting that germination of *S. aloides* is enhanced when seeds pass through the animal digestive tract (Smolders *et al.*, 1995b). Thus, the late summer migration of waterfowl, which generally occurs in north–south and east–west directions (Boere *et al.*, 2006) may help to explain the genetic structure of *S. aloides* in Europe. However, as demonstrated by the Mantel test between F_{ST}/Φ_{ST} matrices and geographic distances, unconnected populations of *S. aloides* (e.g. NED, BAV and ASR) have low or absent gene flow, resulting in a higher degree of differentiation over time. Consistently, aquatic macrophytes such as *S. aloides* that often occur in isolated hydrographic basins may be affected by recurring population bottlenecks, cycles of local colonization and extinction that together affect genetic patterns across populations (Incagnone *et al.*, 2015).

Previous genetic analyses on clonal dioecious aquatic species belonging to Hydrocharitaceae yielded discordant results. A high level of between-population differentiation has previously been reported in *Thalassia testudinum* using AFLP (Waycott and Barnes, 2001); on the contrary, low differentiation between populations was detected in *Vallisneria spinulosa* S. Z. Yan (Chen *et al.*, 2007) by using allozyme variation and in other aquatic species, such as the aquatic fern *Marsilea quadrifolia* L. using AFLP (Bruni *et al.*, 2013). Species-specific characteristics and different dispersal ability may explain such differences.

Implications for reintroduction

Stratiotes aloides is ecologically important because it supports a rich macroarthropod diversity and some invertebrate and vertebrate species are exclusively or largely dependent on its presence, such as the dragonfly *Aeshna viridis* (Suhonen *et al.*, 2013) and the black tern *Chlidonias niger* (Beintema, 1997). Therefore, its conservation is of increasing importance in Europe, and experience from Italy, where the species is preserved *ex situ*, can contribute to the elaboration of an integrated conservation strategy for this species throughout its whole range.

Ex situ preserved populations are often characterized by depauperate genetic diversity (Rucińska and Puchalski, 2011), which makes the reintroduction of species or genotypes extinct in the wild challenging. Restoration practices are generally successful in re-establishing populations that hold a degree of genetic diversity comparable with those of natural populations, especially when calibrated for the number of individuals sampled (Halbur *et al.*, 2014; Gentili *et al.*, 2015). In the case of *S. aloides*, our first hypothesis of low genetic diversity in the original Italian female population should be rejected, despite many years of *ex situ* clonal reproduction. In fact, AFLP analysis revealed a medium level of genetic variability suggesting that this population is not inbred. Whatever the reason (somaclonal mutation, residual diversity or polyploidy), reinforcement with female individuals from other European populations aimed at increasing the population's genetic diversity might not be necessary in a translocation trial. However, an important task for the re-establishment of a viable population in the long term is the reintroduction of male individuals. These must necessarily be introduced from a population outside of Italy, as the Italian males became extinct more than 50 years ago. Two strategies can be adopted: maximizing genetic diversity by mixing genotypes from different clusters, or preserving the original genotype by introducing male plants from populations belonging to the same cluster as the Italian females. In the first strategy, the risk of altering the adaptability of the original Italian population through outbreeding depression should be taken into account (Edmands, 2007). Moreover, the natural gene flow that was responsible for the present genetic structure of *S. aloides* may also be compromised. In the second strategy, the outbreeding depression is avoided but it may result in reduced within-population genetic variation. In any case, the present study proves that suppositions on the genetic structure of plant populations based on geographical proximity may be wrong and that the choice of the closest population as source material for translocation may not be the best solution.

An alternative option might be considered, in which male and female individuals are translocated from populations with ecological characteristics (e.g. water quality, turbidity; Boedeltje *et al.*, 2001) similar to the translocation release site, irrespective of the genotypic cluster. This option is interesting because *S. aloides* was shown to be extirpated in Italy by the degraded water quality in the Po Basin (Abeli *et al.*, 2014). The Po river basin in particular is characterized by high levels of inorganic nitrogen (i.e. nitrites and nitrates) so individual plants taken from localities with similar ecological conditions may be more tolerant of this type of water pollution. The choice of source populations, however, requires further detailed experimentation on the tolerance limits of *S. aloides* to different environmental stressors (Harpenslager *et al.*, 2016). Moreover, this option might lead to the artificial genetic breeding of the Italian population. Therefore, considering that the within-population variation is possibly at an acceptable level, reintroducing males from the same cluster of the Italian females would be the best practical option for restoring a viable population of *S. aloides*. In particular, male individuals should be taken from NED or from ROM2 populations. The choice of the source population for male reintroduction is not the only important consideration in the translocation of a dioecious species as sex ratio and ploidy should also be considered. An inappropriate sex ratio (related to the reproductive strategy of the species) may result in low reproductive success. Ploidy should be considered, especially when different chromosome numbers are found in different populations; in the present study polyploidy contributed to maintaining a high genetic variation in *ex situ* populations.

The case of *S. aloides* highlights the issues related to the reintroduction of dioecious species that although not very common, represent a particular challenge for conservationists (Rottenberg and Parker, 2003; Ye *et al.*, 2007). Problems regarding the genetic structure and ploidy of the source populations should be addressed with ad hoc studies, especially for those species characterized by a long-distance dispersal strategy, even if long-distance dispersal events occur only occasionally. In addition, the approach used here to identify the most appropriate source population(s) for reintroduction is relevant in the context of de-extinction, in which new wild populations are established from *ex situ* genetic materials. This practice is likely to become increasingly important in the future, especially for plants.

ACKNOWLEDGEMENTS

The authors are grateful to: A. Nania (Milano, Italy) and S. Frattini (Brescia, Italy) for their help in recovering the two surviving Italian populations; Dr O.A. Kapitonova (Udmurt State University, Izhevsk, Russia) for help in collecting EUR population; Professor F. Piccoli (Ferrara University, Italy) and Dr E. Zippel (Botanical Museum Berlin Dahlem, Germany) for information on the historical cultivation of *S. aloides* in their Botanical Gardens; Dr W.

Zahlheimer (Landshut, Germany), Dr M. Costa (Regione Emilia-Romagna, Italy) and Dr A. Doroşencu (DDNI, Tulcea, Romania), for their assistance during field work; Dr L. Dessborn (Kristianstad University, Sweden) and Professor G. Bogliani (University of Pavia) for their contribution to the paragraphs on bird migrations; Dr G. Fiorini (University of Florence) for her help in chromosome counts; Dr M. E. Sabatini and Professor A. Balestrazzi (University of Pavia) for their assistance in preparing reagents used in karyological analysis. Professor K. Dixon (Kings Park and Botanic Garden, Perth, WA) and R. Gerdol (University of Ferrara, Italy) made helpful comments on the manuscript and P. Cauzzi (University of Milan, Italy), C. Amosso (Golder Associates, Italy), S. Pedrini (Kings Park and Botanic Garden, Perth, WA) and M. Simonazzi (Mantua, Italy) contributed to the research. The research was supported financially by Centro Flora Autoctona of the Lombardy Region, Parco del Monte Barro through the project Cariplo 'Mitigazione'.

REFERENCES

Abeli T, Rossi G, Smolders AJP, Orsenigo S. 2014. Nitrogen pollution negatively affects *Stratiotes aloides* in Central-Eastern Europe. Implications for translocation actions. *Aquatic Conservation: Marine and Freshwater Ecosystems* **24**: 724–729.

Aguraiuja R. 2011. Reintroduction of the endangered fern species *Woodsia ilvensis* to Estonia: a long-term pilot study. *Biodiversity and Conservation* **20**: 391–400.

Becker U, Colling G, Dostal P, Jakobsson A, Matthies D. 2006. Local adaptation in the monocarpic perennial *Carlina vulgaris* at different spatial scales across Europe. *Oecologia* **150**: 506–518.

Beintema AJ. 1997. European Black Terns (*Chlidonias niger*) in trouble: examples of dietary problems. *Colonial Waterbirds* **20**: 558–565.

Boedeltje G, Somolders AJP, Roelofs JGM, Van Groenendael JM. 2001. Constructed shallow zones along navigation canals: vegetation establishment and change in relation to environmental characteristics. *Aquatic Conservation: Marine and Freshwater Ecosystems* **11**: 453–471.

Boere GC, Galbraith CA, Stroud DA (eds). 2006. *Waterbirds Around the World*. The Stationery Office: Edinburgh.

Bonin A, Bellemain E, Eidesen PB, Pompanon F, Brochmann C, Taberlet P. 2004. How to track and assess genotyping errors in population genetics studies. *Molecular Ecology* **13**: 3261–3273.

Bruni I, Gentili R, De Mattia F, Cortis P, Rossi G, Labra M. 2013. A multi-level analysis to evaluate the extinction risk of and conservation strategy for the aquatic fern *Marsilea quadrifolia* L. in Europe. *Aquatic Botany* **111**: 35–42.

Chen L, Xu L, Huang H. 2007. Genetic diversity and population structure in *Vallisneria spinulosa* (Hydrocharitaceae). *Aquatic Botany* **86**: 46–52.

Cook CDK, Urmi-Konig K. 1983. A revision of the genus *Stratiotes* (Hydrocharitaceae). *Aquatic Botany* **16**: 213–249.

Cramp S. 2000. *The Birds of the Western Palearctic. Vol. 1. Ostriches to Ducks*, Oxford University Press: Oxford.

Dessborn L, Elmberg J, Englund G. 2011. Pike predation affects breeding success and habitat selection of ducks. *Freshwater Biology* **56**: 579–589.

Dettori CA, Sergi S, Tamburini E, Bacchetta G. 2014. The genetic diversity and spatial genetic structure of the Corso-Sardinian endemic *Ferula arrigonii* Bocchieri (Apiaceae). *Plant Biology (Stuttgart)* **16**: 1005–1013.

Edmands S. 2007. Between a rock and a hard place: evaluating the relative risks of inbreeding and outbreeding for conservation and management. *Molecular Ecology* **16**: 463–475.

Efremov AN, Sviridenko BF. 2008. The ecobiomorph of water soldier *Stratiotes aloides* L. (Hydrocharitaceae) in the west Siberian part of its range. *Inland Water Biology* **3**: 225–230.

Evanno G, Regnaut S, Goudet J. 2005. Detecting the number of clusters of individuals using the software STRUCTURE: a simulation study. *Molecular Ecology* **14**: 2611–2620.

Falush D, Stephens M, Pritchard JK. 2007. Inference of population structure using multilocus genotype data: dominant markers and null alleles. *Molecular Ecology Notes* **7**: 574–578.

Forbes RS. 2000. Assessing the status of *Stratiotes aloides* L. (water-soldier) in Co. Fermanagh, Northern Ireland. *Watsonia* **23**: 179–196.

Forsman A. 2014. Effects of genotypic and phenotypic variation on establishment are important for conservation, invasion, and infection biology. *Proceedings of the National Academy of Sciences of the United States of America* **111**: 302–307.

Gadella TWJ, Kliphuis E. 1973. Chromosome numbers of flowering plants in the Netherlands VI. *Proceedings of the Koninklijke Nederlandse, Series C* **76**: 303–311.

Gentili R, Abeli T, Rossi G, Li M, Varotto C, Sgorbati S. 2010. Population structure and genetic diversity of the threatened quillwort *Isoëtes malinverniana* Cesati & De Notaris and implication for conservation. *Aquatic Botany* **93**: 147–152.

Gentili R, Fenu G, Mattana E, Citterio S, De Mattia F, Bacchetta G. 2015. Conservation genetics of two island endemic *Ribes* spp. (Grossulariaceae) of Sardinia: survival or extinction? *Plant Biology* **17**: 1085–1094.

Godefroid S, Piazza C, Rossi G, Buord S, Stevens AD, Aguraiuja R, Cowell C, Weekley CW, Vogg C, Iriondo JM, *et al*. 2011. How successful are plant species reintroductions? *Biological Conservation* **144**: 672–682.

Halbur MH, Sloop CM, Zanis MJ, Emery MC. 2014. The population biology of mitigation: impacts of habitat creation on an endangered plant species. *Conservation Genetics* **15**: 679–695.

Harpenslager SF, Lamers LPM, van der Heide T, Roelofs JGM, Smolders AJP. 2016. Harnessing facilitation: why successful re-introduction of *Stratiotes aloides* requires high densities under high nitrogen loading. *Biological Conservation* **195**: 17–23.

Huson DH, Bryant D. 2006. Application of phylogenetic networks in evolutionary studies. *Molecular Ecology and Evolution* **23**: 254–267.

Incagnone G, Marrone F, Barone R, Robba L, Naselli-Flores L. 2015. How do freshwater organisms cross the 'dry ocean'? A review on passive dispersal and colonization processes with a special focus on temporary ponds. *Hydrobiologia* **750**: 103–123.

IUCN. 2013. *IUCN Guidelines for Reintroductions and other Conservation Translocations*, IUCN Species Survival Commission, IUCN: Gland and Cambridge.

Kalkman VJ, Boudot J-P, Bernard R, Conze K-J, De Knijf G, Dyatlova E, Ferreira S, Jović M, Ott J, Riservato E, Sahlén G. 2010. *European Red List of Dragonflies*, Publications Office of the European Union: Luxembourg.

Les DH, Philbrick CT. 1993. Studies of hybridization and chromosome number variation in aquatic angiosperms: evolutionary implications. *Aquatic Botany* **44**: 181–228.

Letz R, Uhríková A, Májovský J. 1999. Chromosome numbers of several interesting taxa of the flora of Slovakia. *Biologia (Bratislava)* **54**: 43–49.

Maschinski J, Haskins KE (eds). 2012. *Plant Reintroduction in a Changing Climate: Promises and Perils*. Island Press: Washington, DC.

Maunder M, Culham A, Alden B, Zizka G, Orliac C, Lobin W, Bordeu A, Ramirez JM, Glissmann-Gough S. 2000. Conservation of the Toromiro Tree: case study in the management of a plant extinct in the wild. *Conservation Biology* **14**: 1341–1350.

McKay K, Christian CE, Harrison S, Rice KJ. 2005. 'How Local Is Local?' – a review of practical and conceptual issues in the genetics of restoration. *Restoration Ecology* **13**: 432–440.

Negodi G. 1929. Reperti anatomici sugli ovari e sulle fruttificazioni di 'Stratiotes aloides L'. *Archivio Botanico per la Sistematica, Fitogeografia e Genetica* **5**: 207–217.

Nei M. 1973. Analysis of gene diversity in subdivided populations. *Proceedings of the National Academy of Sciences of the United States of America* **70**: 3321–3323.

Nguyen VX, Detcharoen M, Tuntiprapas P, Soe-Htun U, Sidik JB, Harah MZ, Prathep A, Papenbrock J. 2014. Genetic species identification and population structure of *Halophila* (Hydrocharitaceae) from the Western Pacific to the Eastern Indian Ocean. *BMC Evolutionary Biology* **14**: 92.

Orsenigo S, Frattini S, Simonazzi M, Pedrini S, Beretta M, Brusa G, Rossi G. 2012. *Stratiotes aloides* L. In Schede per una Lista Rossa della Flora vascolare e crittogamica italiana. Rossi G, Foggi B, Gennai M, Gargano D, Montagnani C, Orsenigo S (eds). *Informatore Botanico Italiano* **44**: 249–251.

Peakall R, Smouse PE. 2006. Genalex 6: genetic analysis in Excel. Population genetic software for teaching and research. *Molecular Ecology Notes* **6**: 288–295.

Pelabon C, Carlson ML, Hansen TF, Armbruster WS. 2005. Effects of crossing distance on offspring fitness and developmental stability in *Dalechampia scandens* (Euphorbiaceae). *American Journal of Botany* **92**: 842–851.

Pritchard JK, Stephens M, Donnelly O. 2000. Inference of population structure using multilocus genotype data. *Genetics* **155**: 945–959.

Rantala MJ, Ilmonen J, Koskimäki J, Suhonen J, Tynkkynen K. 2004. The macrophyte, *Stratiotes aloides*, protects larvae of dragonfly *Aeshna viridis* against fish predation. *Aquatic Ecology* **38**: 77–82.

Renner SS, Ricklefs RE. 1995. Dioecy and its correlates in the flowering plants. *American Journal of Botany* **82**: 596–606.

Rottenberg A, Parker JS. 2003. Conservation of the critically endangered *Rumex rothschildianus* as implied from AFLP diversity. *Biological Conservation* **114**: 299–303.

Rucinska A, Puchalski J. 2011. Comparative molecular studies on the genetic diversity of an *ex situ* garden collection and its source population of the critically endangered polish endemic plant *Cochlearia polonica* E. Fröhlich. *Biodiversity and Conservation* **20**: 401–413.

Sarneel JM. 2013. The dispersal capacity of vegetative propagules of riparian fen species. *Hydrobiologia* **710**: 219–225.

Schürhoff PN. 1926. *Die Zytologie der Blütenpflanzen*, Verlag von Ferdinand Enke: Stuttgart.

Seddon PJ, Griffiths CJ, Soorae PS, Armstrong DP. 2014. Reversing defaunation: restoring species in a changing world. *Science* **345**: 406–412.

Smolders AJP, den Hartog C, Roelofs JGM. 1995a. Observations on fruiting and seed-set of *Stratiotes aloides* in the Netherlands. *Aquatic Botany* **51**: 259–268.

Smolders AJP, den Hartog C, Roelofs JGM. 1995b. Germination and seedling development in *Stratiotes aloides* L. *Aquatic Botany* **51**: 269–279.

Smolders AJP, Lamers LPM, den Hartog C, Roelofs JGM. 2003. Mechanisms involved in the decline of *Stratiotes aloides* L. in the Netherlands: sulphate as a key variable. *Hydrobiologia* **506–509**: 603–610.

Snyder N, Snyder H. 2000. *The Californian Condor: Saga of Natural History and conservation*, Princeton University Press: Princeton, NJ.

Stanley-Price MR. 1991. *Animal Re-introductions: The Arabian Oryx in Oman*, Cambridge University Press: Cambridge.

Suhonen J, Suutari E, Kaunisto KM, Krams I. 2013. Patch area of macrophyte *Stratiotes aloides* as a critical resource for declining dragonfly *Aeshna viridis*. *Journal of Insect Conservation* **17**: 393–398.

Suutari E, Salmela J, Paasivirta L, Rantala MJ, Tynkkynen K, Luojumäki M, Suhonen J. 2009. Macroarthropod species richness and conservation priorities in *Stratiotes aloides* (L.) lakes. *Journal of Insect Conservation* **13**: 413–419.

Van de Peer Y, De Wachter R. 1994. TREECON for Windows: a software package for the construction and drawing of evolutionary trees for the Microsoft Windows environment. *Computer Applications in the Biosciences* **10**: 569–570.

Vekemans X. 2002. *AFLP-SURV version 1.0*, Distributed by the author. Laboratoire de Génétique et Ecologie Végétale, Université Libre de Bruxelles: Bruxelles, Belgium.

Waycott M, Barnes PAG. 2001. AFLP diversity within and between populations of the Caribbean seagrass *Thalassia testudinum* (Hydrocharitaceae). *Marine Biology* **139**: 1021–1028.

Ye Q, Bunn E, Krauss SL, Dixon KW. 2007. Reproductive success in a reintroduced population of a critically endangered shrub, *Symonanthus bancroftii* (Solanaceae). *Australian Journal of Botany* **55**: 425–432.

Zantout N, Wilfert P, Smolders AJP, Weber G, Zacharias D. 2011. Effects of sediment pore water qualities on the decline of *Stratiotes aloides* L. stands in Bremen, Germany. *Fundamental and Applied Limnology* **179**: 131–136.

Zhivotovsky LA. 1999. Estimating population structure in diploids with multilocus dominant DNA markers. *Molecular Ecology* **8**: 907–913.

Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology

Official Journal of the Societa Botanica Italiana

ISSN: 1126-3504 (Print) 1724-5575 (Online) Journal homepage: http://www.tandfonline.com/loi/tplb20

Are Red Lists really useful for plant conservation? The New Red List of the Italian Flora in the perspective of national conservation policies

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To cite this article: G. Rossi, C. Montagnani, T. Abeli, D. Gargano, L. Peruzzi, G. Fenu, S. Magrini, M. Gennai, B. Foggi, R.P. Wagensommer, S. Ravera, A. Cogoni, M. Aleffi, A. Alessandrini, G. Bacchetta, S. Bagella, F. Bartolucci, G. Bedini, L. Bernardo, M. Bovio, M. Castello, F. Conti, G. Domina, E. Farris, R. Gentili, D. Gigante, S. Peccenini, A.M. Persiani, L. Poggio, F. Prosser, A. Santangelo, A. Selvaggi, M.C. Villani, T. Wilhalm, E. Zappa, M. Zotti, N. Tartaglini, N.M.G. Ardenghi, C. Blasi, F.M. Raimondo, G. Venturella, D. Cogoni, M. Puglisi, P. Campisi, L. Miserere, E.V. Perrino, S. Strumia, M. Iberite, F. Lucchese, G. Fabrini & S. Orsenigo (2014) Are Red Lists really useful for plant conservation? The New Red List of the Italian Flora in the perspective of national conservation policies, Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology, 148:2, 187-190, DOI: 10.1080/11263504.2013.868375

To link to this article: http://dx.doi.org/10.1080/11263504.2013.868375

Plant Biosystems, 2014
Vol. 148, No. 2, 187–190, http://dx.doi.org/10.1080/11263504.2013.868375

Are Red Lists really useful for plant conservation? The New Red List of the Italian Flora in the perspective of national conservation policies

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Abstract

"The New Red List of the Italian Flora" includes all the Italian policy species and other species of known conservation concerns for a total of 400 *taxa*, 65% of which are threatened with extinction. The Red List is based on a huge georeferenced data-set useful for conservation purposes.

Keywords: *Endemic species, GIS database, IUCN protocol, Italy, policy species*

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The New Red List of the Italian Flora in the perspective of national conservation policies

In line with the global strategy for plant conservation and the European strategy for plant conservation, the Italian national strategy for the conservation of biodiversity (MATTM 2010) declared the necessity to enhance the knowledge about the conservation status of the national flora in order to set up an effective conservation strategy by 2020. Rossi and Gentili (2008) highlighted the need of a national reliable list of plants deserving legal protection and focused the attention on the most recent International Union for Conservation of Nature (IUCN) Red List protocol as "starting point" to guide it. The IUCN Red Lists provide reliable tools to evaluate the extinction risk of species; IUCN criteria are clearly defined, scientifically sound, adaptable from global to local scale and based on quantitative data, which makes the Red Lists the most used assessment system all over the world (De Grammont & Cuarón 2006; IUCN 2012). To date, there have been attempts to define the conservation status of Italian species, but just for restricted geographical areas (Argenti & Lasen 2004; Wilhalm & Hilpold 2006; Cortini Pedrotti & Aleffi 2011), or taxonomic groups (i.e. Cogoni et al. 2012; Fenu et al. 2012; Nascimbene et al. 2012; Foggi et al. 2013) or on setting priorities among large number of endemic species (Bacchetta et al. 2012). The only comprehensive national Red List of threatened plants (Conti et al. 1992, 1997) is based on an older version of the Red List system, different from the current IUCN standards (IUCN 2012).

The first challenge of the agreement between the Italian Ministry of Environment for the Protection of Land and Sea (MATTM) and Italian Botanical Society (SBI) for a New Red List of the Italian Flora (Rossi et al. 2013a) was the choice of species to be first assessed. Target species selection was on *taxa* listed in the Habitat Directive 92/43 EEC and the Bern Convention annexes occurring in Italy (*policy species*, PS) on one side, while a screening process was conducted to add further *taxa* of conservation concern, not included in the aforementioned annexes (*non-policy species*, NPS). NPS were chosen among *taxa* endemic to Italy and/or species living in highly threatened habitats (e.g. wetlands and coastal habitats) with a documented decline in the last 30 years. More than 1500 vascular *taxa* and a short list of non-vascular *taxa* were identified and a further selection was made to obtain a "ready to use" list. Most of the assessments was made applying the IUCN criterion B, based on the extent of the range of geographical species. In particular, the area of occupancy of the species was assessed by counting the number of cells occupied by each *taxon* in a 2 × 2 km grid superimposed to a map of Italy in a Geographical Information System (GIS) (Gargano 2011).

To promote and improve non-vascular *taxa* conservation, 86 lichen and bryophyte entities were also assessed, of which 51 were PS and 13 were fungal species, in order to support the initiatives of the IUCN Species Survival Commission's fungal and bryophyte specialist groups and the International Society for Fungal Conservation (Minter 2011). Such assessments were conducted by the relative specialistic working groups from SBI.

But, what does this Red List imply in a national conservation strategy? What is its role and how could it improve plant conservation in Italy?

Red Lists highlight the most pressing issues in biodiversity conservation, showing which *taxa* are closer to extinction (Cogoni et al. 2013).

Citing Mace et al. (2008), "there is an important difference between measuring threats and assessing conservation priorities", Red Lists only allow to identify the species risk status, without establishing direct conservation priorities (Possingham et al. 2002; Bacchetta et al. 2012). In fact, Red Lists may be policy relevant, but they cannot be considered policy prescriptive (IUCN 2012; Bilz et al. 2011). Conservation priorities have to be set in a policy perspective and Red Lists can only provide suggestions.

"The New Red List of the Italian Flora" (Rossi et al. 2013a; www.governo.it/backoffice/allegati/71184–8693.pdf), including at the moment about 400 *taxa*, 65% of which identified as threatened with extinction, should provide a road map to implement a future national strategy for the conservation of plant biodiversity. A national law act, or a guide for the different regional laws (the administrative regions Sardinia, Sicily, Apulia, Marches and Piedmont are still currently lacking a regional law for the protection of the flora), might start from this Red List to compile priority lists for legal protection of species, but should also take into account other elements, such as distribution (e.g. endemic *taxa*) and potential economic value (e.g. Crop Wild Relatives; Keller & Bollman 2004; Bilz et al. 2011) and cost and feasibility of the conservation actions (Rodrigues et al. 2006).

Moreover, we stress that the establishment of protected areas or implementation of laws alone is not sufficient to prevent the loss of biodiversity (Heywood & Iriondo 2003; Stoll-Kleemann 2010), as confirmed by the percentage of threatened PS (45%) found in Italy and also in the European Union (Bilz et al. 2011).

Further active measures have to be studied and applied based on a systematic conservation planning approach (Margules & Pressey 2000). Efforts for *in situ* and *ex situ* (e.g. conservation of germplasm in seed banks and cultivation in botanical gardens) conservation measures should be improved, both inside and outside protected areas (Rossi et al. 2012). In particular, translocations are likely to become very important for conservation in a changing climate (Sala et al. 2000; Godefroid et al. 2011; Rossi et al. 2013b). Moreover, since many threats will show their effects on plant species in the next decades (e.g. climate change, biological invasions and so on), long-term monitoring programmes have to be developed in order to show changes in the species conservation status (Balmford et al. 2003). In this context, the huge amount of data collected in this project represent a very important conservation data source, as a first georeferenced data-set equipped with distribution and trend information about the PS of the Italian flora. The data-set might support threatened monitoring and subsequent conservation actions (e.g. helping in the species periodic monitoring report specified by article 17 of Habitat Directive 92/43 EEC). Accordingly, many data included in the 2013 Italian report for the European Commission are derived from the Red List project. However, to make the database an effective tool in a rapidly changing world, we strongly recommend to frequently update it by a continuous flow of information from experts (Magurran et al. 2010).

We hope a rapid improvement of "the New Red List of the Italian Flora" with the assessment of all the NPS identified (at least 1500 vascular *taxa* and more threatened non-vascular *taxa*), as a first step towards the Red List of the whole Italian flora (about 15,000 *taxa*). Finally, an implementation at the biogeographical level would also be desirable for a better knowledge of plant conservation status (Gentili et al. 2010), not just depending on artificial administrative boundaries but also on effective transnational management policy species (e.g. Alps and Mediterranean area).

Hence, "the New Red List of the Italian Flora" represents just the starting point of a process of conservation of the national biodiversity and provides a powerful tool to support future management and legislative choices.

Acknowledgements

The Authors would like to thank E. Dupré and M.C. Giarratano (Direzione Generale per la Protezione della Natura e del Mare, MATTM) and SBI secretariat for their support during the progress of the work. We would also like to thank all the Italian botanists who provided their field data, since without their collaboration this work would not have been possible. The New Red List of the Italian Flora has been financially supported by the Italian Ministry of Environment for the Protection of Land and Sea.

References

Argenti C, Lasen C. 2004. Lista Rossa della flora vascolare della provincia di Belluno. Belluno: ARPAV.

Bacchetta G, Farris E, Pontecorvo C. 2012. A new method to set conservation priorities in biodiversity hotspots. Plant Biosyst 146(3): 638–648.

Balmford A, Green RE, Jenkins M. 2003. Measuring the changing state of nature. Trends Ecol Evol 18: 326–330.

Bilz M, Kell SP, Maxted N, Lansdown RV. 2011. European Red List of vascular plants. Luxembourg: Publications Office of the European Union.

Cogoni A, Campisi P, Aleffi M, Carratello A, Colacino C, Dia MG, et al. 2012. A project for an Italian Red List of bryophytes. 8th ECCB Conference, 19–22 April 2012, Budapest.

Cogoni D, Fenu G, Concas E, Bacchetta G. 2013. The effectiveness of plant conservation measures: the Dianthus morisianus reintroduction. Oryx 47: 203–206.

Conti F, Manzi A, Pedrotti F. 1992. Libro rosso delle Piante d'Italia. Roma: Ministero Ambiente, WWF Italia, Società Botanica Italiana.

Conti F, Manzi A, Pedrotti F. 1997. Liste Rosse Regionali delle Piante d'Italia. Camerino: WWF Italia, Società Botanica Italiana, CIAS, Univ.

Cortini Pedrotti C, Aleffi M. 2011. Lista rossa delle Briofite del Trentino. Studi Trent Sci Nat 88: 5–27.

De Grammont PC, Cuarón AD. 2006. An evaluation of threatened species categorization systems used on the American continent. Conserv Biol 20: 14–27.

Fenu G, Mattana E, Bacchetta G. 2012. Conservation of endemic insular plants: the genus *Ribes* L. (Grossulariaceae) in Sardinia. Oryx 46(2): 219–222.

Foggi B, Viciani D, Baldini RM, Carta A, Guidi T. 2013. The IUCN assessment of the endemic plants of the Tuscan Archipelago (North Mediterranean Sea). Oryx (in press).

Gargano D. 2011. Verso la redazione di nuove Liste Rosse della flora d'Italia: una griglia standard per la misura dell'*Area of Occupancy* (AOO). Inf Bot Ital 43: 455–458.

Gentili R, Rossi G, Abeli T, Bedini G, Foggi B. 2010. Assessing extinction risk across borders: integration of a biogeographical approach into regional IUCN assessment? J Nat Cons 19: 69–71.

Godefroid S, Piazza C, Rossi G, Buord S, Stevens A-D, Aguraiuja R, et al. 2011. How successful are plant species reintroductions? Biol Conserv 144: 672–682.

Heywood VH, Iriondo JM. 2003. Plant conservation: old problems, new perspectives. Biol Conserv 113: 321–335.

IUCN. 2012. IUCN Red List categories and criteria: version 3.1. 2nd ed., Gland, Switzerland and Cambridge: IUCN Species Survival Commission, IUCN. p.iv+32 pp.

Keller V, Bollman K. 2004. From Red List to species of conservation concern. Conserv Biol 18: 1636–1644.

Mace GM, Collar NJ, Gaston KJ, Hilton-Taylor C, Akçakaya HR, Leader-Williams N, et al. 2008. Quantification of Extinction Risk: IUCN's System for Classifying Threatened Species. Conserv Biol 22: 1424–1442.

Magurran AE, Baillie SR, Buckland ST, Dick JM, Elston DA, Scott EM, et al. 2010. Long-term datasets in biodiversity research and monitoring: assessing change in ecological communities through time. Trends Ecol Evol 25: 574–582.

Margules CR, Pressey RL. 2000. Systematic conservation planning. Nature 405: 243–253.

MATTM. 2010. La Strategia Nazionale per la Biodiversità. Ministero dell'Ambiente e della Tutela del Territorio e del Mare.

Minter D. 2011. Fungal conservation needs help from botanists. Plant Biosyst 145(4): 945–949.

Nascimbene J, Ravera S, Nimis PL. 2012. Evaluating the conservation status of epiphytic lichens of Italy: A red list. Plant Biosyst, DOI: 10.1080/11263504.2012.748101.

Possingham HP, Andelman SJ, Burgman MA, Medellín RA, Master LL, Keith DA. 2002. Limits to the use of threatened species lists. Trends Ecol Evol 17: 503–507.

Rodrigues ASL, Pilgrim JD, Lamoreux JF, Hoffmann M, Brooks TM. 2006. The value of the IUCN Red List for conservation. Trends Ecol Evol 21: 71–76.

Rossi G, Amosso C, Orsenigo S, Abeli T. 2013b. Linee guida per la traslocazione di specie vegetali spontanee. Quad Cons Natura 28. Roma: MATTM – Ist. Sup. Protezione e Ricerca Ambientale (ISPRA).

Rossi G, Bonomi C, Gandini M, editors. 2012. RIBES e la conservazione *ex situ* della flora spontanea autoctona. Studi Trent Sci Nat 90., pp. 1–30.

Rossi G, Gentili R. 2008. A partnership project for a New Red List of the Italian Flora. Plant Biosyst 142: 302–304.

Rossi G, Montagnani C, Gargano D, Peruzzi L, Abeli T, Ravera S, et al. editors. 2013a. Lista Rossa della Flora Italiana. 1. Policy Species e altre specie minacciate. Comitato Italiano IUCN e Ministero dell'Ambiente e della Tutela del Territorio e del Mare. Roma: Stamperia Romana. Scaricabile all'indirizzo. http://www.governo.it/backoffice/allegati/71184-8693.pdf

Sala OE, Chapin FSIII, Armesto JJ, Berlow E, Bloomfield J, Dirzo R, et al. 2000. Global biodiversity scenarios for the year 2100. Science 287: 1770–1774.

Stoll-Kleemann S. 2010. Evaluation of management effectiveness in protected areas: methodologies and results. Basic Appl Ecol 11: 377–382.

Wilhalm T, Hilpold A. 2006. Rote Liste der gefährdeten Gefäßpflanzen Südtirols. Gredleriana 6: 115–198.

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

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Source: Willdenowia, 46(1):137-143.
Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

DOI: http://dx.doi.org/10.3372/wi.46.46111
URL: http://www.bioone.org/doi/full/10.3372/wi.46.46111

Willdenowia
Annals of the Botanic Garden and Botanical Museum Berlin-Dahlem

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

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*

Article history: Received 2 December 2015; peer-review completed 24 February 2016; received in revised form and accepted for publication 26 February 2016.

Citation: Verloove F., Brusa G. & Ardenghi N. M. G. 2016: Studies in the genus *Paspalum* (*Paniceae*, *Poaceae*) in Europe: 3. *Paspalum thunbergii*, a new naturalized neophyte in W Europe. – Willdenowia 46: 137–143. doi: http://dx.doi.org/10.3372/wi.46.46111

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 plano-convex, 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

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*)

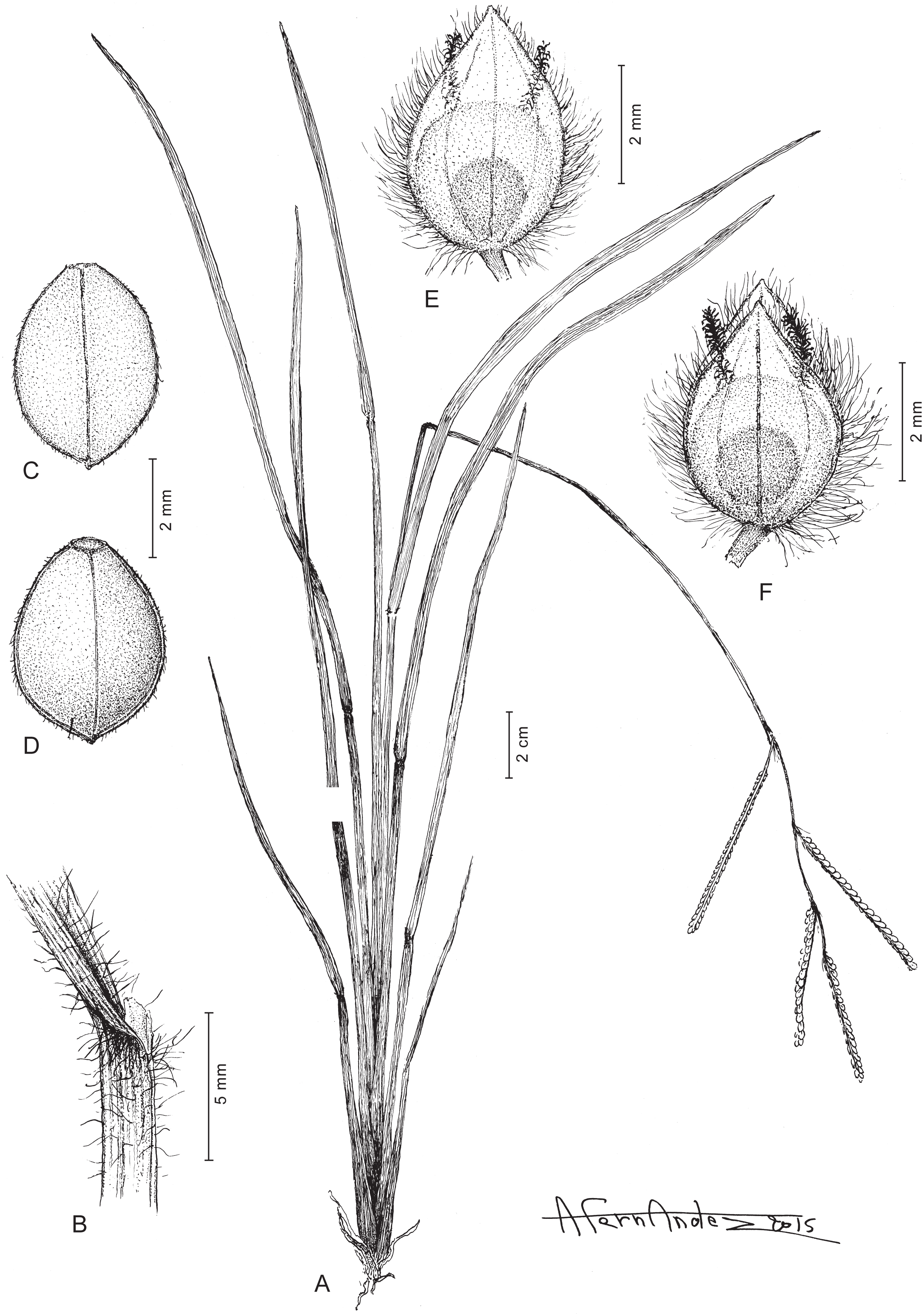

Fig. 2. *Paspalum thunbergii*: A: general habit; B: leaf sheath; C: spikelet abaxial surface; D: spikelet adaxial surface. – *Paspalum dilatatum*: E: spikelet abaxial surface; F: spikelet adaxial surface. – Drawn by Antonio Fernandez; A-D from [see selected specimens examined] *G. Brusa s.n.* (BR); E,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

– 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 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.]).

Acknowledgements

Jan-Frits Veldkamp (Leiden, Netherlands), Robert J. Soreng (Washington DC, U.S.A.), Gerrit Davidse (St. Louis, U.S.A.) and Nicholas Turland (Berlin, Germany) are thanked for their assistance with nomenclatural issues. Gabriele Galasso (Milano, Italy) and Daniela Bouvet (Torino, Italy) are thanked for providing herbarium specimens or scans from the herbaria MSNM and TO, respectively. Antonio Fernandez (Meise, Belgium) prepared the line drawings. Sara Mossini (Terdobbiate, Italy) is acknowledged for her field assistance. Finally, Jeffery M. Saarela (Ottawa, Canada) and Robert J. Soreng are thanked for their reviews of an earlier version of this paper.

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.

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.

Willdenowia

Open-access online edition www.bioone.org/loi/will BioOne

Online ISSN 1868-6397 · Print ISSN 0511-9618 · Impact factor 0.721

Published by the Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin