A survey of the *Elymus* L. s. l. species complex (Triticeae, Poaceae) in Italy: taxa and nothotaxa, new combinations and identification key

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Abstract - *Elymus* s. l. is a critical topic on which only a little light has begun to be made regarding phylogenetic reticulation, genome evolution and consistency of genera. In Italy, *Elymus* s. l. officially includes ten species (nine native, one alien) and some well-established and widespread hybrids generally not treated as little or nothing is known of them. In this paper fourteen species (with two subspecies) and six hybrids are taken into account and the following seven new combinations are proposed: *Thinopyrum acutum* (DC.) Banfi, *Thinopyrum corsicum* (Hack.) Banfi, *Thinopyrum intermedium* (Host) Barkworth & Dewey subsp. *pouzolzii* (Godr.) Banfi, *Thinopyrum obtusiflorum* (DC.) Banfi, *Thinopyrum* ×*duvalii* (Loret) Banfi, ×*Thinoelymus drucei* (Stace) Banfi, ×*Thinoelymus mucronatus* (Opiz) Banfi. Some observations are provided for each subject and a key to species, subspecies and hybrids is made available.

Key words: combinations, *Elymus, Elytrigia,* hybrids, Italy, key, nomenclature, taxonomy, *Thinopyrum,* ×*Thinoelymus*.

Riassunto - I recenti progressi della filogenesi in campo genomiale hanno consentito di riproporre la delimitazione di alcuni generi più o meno sommersi in *Elymus* s. l. In Italia ad *Elymus* s. l. sono ascritte ufficialmente dieci specie (nove autoctone e una alloctona) oltre ad alcuni ibridi stabilizzati e ben diffusi, ma poco considerati in quanto mal conosciuti. In questa sede sono prese in considerazione quattordici specie (con due sottospecie) e sei ibridi, inoltre vengono proposte le seguenti sette nuove combinazioni: *Thinopyrum acutum* (DC.) Banfi, *Thinopyrum corsicum* (Hack.) Banfi, *Thinopyrum intermedium* (Host) Barkworth & Dewey subsp. *pouzolzii* (Godr.) Banfi, *Thinopyrum obtusiflorum* (DC.) Banfi, *Thinopyrum* ×*duvalii* (Loret) Banfi, ×*Thinoelymus drucei* (Stace) Banfi, ×*Thinoelymus mucronatus* (Opiz) Banfi. Ad ogni entità trattata sono affiancate delle osservazioni e infine si fornisce una chiave per la determinazione di specie, sottospecie e ibridi.

Parole chiave: chiave, combinazioni, *Elymus, Elytrigia,* ibridi, Italia, nomenclatura, tassonomia, *Thinopyrum,* ×*Thinoelymus*.

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INTRODUCTION

Elymus L. s. l. is one of the most debated topic among genera within the tribe Triticeae (Poaceae), with representatives spread all over the world. It has been the subject of basic studies (Löve A., 1984; Dewey, 1984) that have opened important horizons not only in the field of agrogenetic research, but also and especially on systematics and taxonomy. However, the still rather coarse knowledge of the genomes and the lack of a satisfactory interpretation of their role in the highly reticulate phylogeny of Triticeae for a long time discouraged taxonomists to clarify species relationships within *Elymus* s. l., trying to circumscribe genera consistent on genetic and morphological basis. Subsequently many researchers supported by phylogenetic investigation have solved problems of genome identity succeeding in a more and more better clarification of intergenomial affinities and confirming more and more reliably the genome donors (see for example Chen *et al*., 1998; Dızkirici *et al*., 2010; Fan *et al*., 2013; Mason-Gamer, 2013; Dong *et al*., 2015; Gao *et al*., 2016). For taxonomic purposes, some correlations between genetic arrangement (expressible through genomial formulas) and morphology, ecology and phytogeography have gradually been highlited although much remains to be done. The synthesis of current knowledge is summarized in the taxonomic model adopted by Soreng *et al*. (2017), where *Elymus* s. l. is resolved into five genera [in the haplome acronym, P stands for *Agropyron* Gaertn., H for *Hordeum* L. sect. Stenostachys Nevski, Y possibly for *Peridictyon sanctum* (Janka) Seberg and W for *Australopyrum* (Tzvelev) Á.Löve.]: *Douglasdeweya* C.Yen, J.L.Yang & B.R.Baum (haplome: StP), *Elymus* L. [LT: *E. sibiricus* L.] (= *Campeiostachys* Drobow*, Elytrigia* Desv.*, Hystrix* Moench*, Roegneria* K.Koch*, Sitanion* Raf.; haplomes: StH, StStH, StHY, StY), *Kengyilia* C.Yen & J.L.Yang (haplome: StYP), *Pseudoroegneria* (Nevski) Á.Löve (haplome: St) and *Thinopyrum* Á.Löve (haplome: J). On this basis, the European *Elymus* s. l. (Melderis, 1980) consists of three genera, *Elymus* s. s., *Pseudoroegneria* and *Thinopyrum*, among which *Elymus* and *Thinopyrum* are represented in Italy.

The knowledge of *Elymus* s. l. in Italy remained substantially the same for a long time, starting from Fiori (1923), who reported sub *"Agropyrum"* six species (incl. *Agropyron cristatum* (L.) Gaertn. subsp. *pectinatum*

(M.Bieb.) Tzvelev = *A. pectiniforme* Roem. & Schult.), fourteen varieties and two hybrids. Pignatti (1982), adopting again *Agropyron*, considered a total of ten species and two hybrids; finally Pignatti (2017), recovering *Elymus* and keeping apart *A. pectiniforme*, takes into account nine species, three subspecies and four hybrids. The current treatment is reported in the checklist of the Italian flora (Bartolucci *et al*., 2018; Galasso et al., 2018). No doubt, the major troubles in systematics and taxonomy of Italian *Elymus* are derived largely from the strong diversity of *Elymus repens* and its gene flow relationships with *Thinopyrum* species, still overall difficult to interpret and so far only partially resolved. In this regard, the most influenced morphological characters are the glaucescence, the profile, thickness and sequence of ribs on the adaxial blade surface, the morphology of glumes and lemmas and the hairiness. Hohla & Scholz (2011) have investigated some Austrian *Elytrigia* populations concluding with the description of two species, *Elytrigia aeneana* and *E. laxula*, recognized by these authors as separated from the sympatric *Elytrigia repens* (= *Elymus repens*) and *E. atherica* (= *Thinopyrum acutum*, see below) and believed to be endemic to Austria. Unfortunately, nothing is known about ploidy level and genome, however, because of pollen sterility documented by the same authors, *E. aeneana* and *E. laxula* are likely to fall into the hybrid complex of *Elymus campestris*, *E. repens* and *Thinopyrum acutum*, shared by most of the populations from Europe, including Italy. Such phenotypes, for example, can be observed in France (Tison & de Foucault, 2014), where thrive both *Elymus campestris* subsp. *campestris* and *E. c.* subsp. *maritimus* (Tzvelev) Lambinon, the first one known as the parental of hybrids with *Elymus repens* and *Thinopyrum intermedium*. In Italy *E. campestris* subsp. *campestris* was erroneously reported by Fiori (1923) as a synonym of *Agropyron repens* (L.) P.Beauv. var. *arenosum* (Spenner) Fiori (≡ *Elymus arenosus* (Spenner) Conert), generating a double issue since 1) the synonymy is mistaken, 2) the distributional area of *E. arenosus* is limited to northern Atlantic Europe. Nevertheless, as we will see later, there are concrete indications of the occurrence of *Elymus campestris* in Italy and at least of its hybrid with *Elymus repens*. Anyway, it is necessary to conclude by reiterating that at least two hybrids are relevantly widespread in Italy, since they behave like perfectly autonomous nothospecies which bypass the sterility barrier by a very efficient vegetative propagation, imposing themselves on open vegetations over significant extensions. Without checking male sterility, these nothospecies are regularly mistaken for their parental species, that is *Elymus repens* (glaucous versions) and *Thinopyrum acutum*, as frequently reported in the floras.

MATERIALS AND METHODS

To approach somewhat critical material, specimens have been examined which belong to collections of Liguria (MSNM), Lombardy (PAV), Tuscany (SI) and Puglia (MSNM). By means of a binocular microscope Wild Heerbrugg MB, the specimens' sterility was investigated in relation to the development of pre- and post-anthetic anthers, the quantity and quality of the pollen and the presence of normally developed caryopses in late season collected specimens. Furthermore, the morphology of the leaf adaxial surface was taken into account, especially regarding the kind of ribs (thickness and profile), their succession from margin to margin on blade surface and the presence of trichomes such as spinules, short hairs, long hairs. Cilia and spinules have also been checked on the edges of the rachis and rachilla segments as well as on margins and keels of glumes, lemmas and paleas together with free margins and surface of the sheath. A particular kind of spinules called papillae, provided with a bulbous base with an aculeate apex facing forward (antrorse) recalling the sting of a scorpion, has been investigated on the adaxial, concave surface of the glumes as an important diagnostic character. Finally, dimensional characters of the synflorescence, spikelet and flower, together with features of the vegetative shoots, culm bases and rhizomes, have also been taken into consideration.

TAXA AND NOTHOTAXA TREATED, NEW COMBINATIONS

According to the checklist of both native and alien Italian flora (Bartolucci *et al*., 2018; Galasso *et al*. 2018), *Elymus* s. l. (excl. *Agropyron*) in Italy is represented by ten species, nine of which native and one alien (*E. obtusiflorus*); there are three subspecies, one of which (*E. hispidus* subsp. *pouzolzii*) is indicated as possibly present, but until now not confirmed. The Italian (regional) distribution for each taxon is reported with further information in the aforementioned checklists. In the present treatment, six species, that for some reasons concern the Italian flora, have also been taken into account. Furthermore I have considered three nothotaxa and three unnamed hybrids, both actually and potentially widespread in Italy, which are poorly known, possibly confused with the parental species and only marginally mentioned in the floras. I did not take into consideration the genus *Agropyron* since it appears sufficiently separated from *Elymus* s.l., to which is related only as genome donor.

Because of the aforementioned correlation existing between phenotypes and modernly revised genomes taken as a criterion for delimiting and recognizing the genera, there is a need to update the nomenclature for four taxa and three nothotaxa representative of the Italian flora. This occasion also requires the establishment of the new nothogenus ×*Thinoelymus* for hybrids *Thinopyrum* × *Elymus*, except for one of them, currently unnamed, the type of which at the moment cannot be designated and for two cases in which the genome of one of the parental species (*Elymus campestris*) is still unknown. Ultimately, seven new combinations are proposed here.

Elymus campestris (Godr. & Gren.) Kerguélen subsp. ***campestris*** (≡ *Agropyron campestre* Godr. & Gren. ≡ *Elytrigia campestris* (Godr. & Gren.) M.A.Carreras ≡ *Elymus pungens* (Pers.) Melderis subsp. *campestris* (Godr. & Gren.) Melderis ≡ *Elytrigia pungens* (Pers.) Tutin subsp. *campestris* (Godr. & Gren.) Á.Löve). 2n=56(?), genome unknown.

The placement of *Agropyron campestre* in the genus *Elymus* remains provisional until its genome will be sufficiently known. The species consists of two subspecies: the nominal one and the subsp. *maritimus* (Tzvelev) Lambinon, growing along the North Sea and Channel coasts. Subsp. *campestris*, common in France, has never been reported from Italy while it is considered possibly present in Poland (Mizianty *et al*., 2001) and has been confirmed in Croatia, Istria and the isle of Cres by Rottensteiner (2014:717, 2017:227). Recently the writer had the opportunity to examine Italian collections from Liguria, Lombardy and Tuscany: all the specimens showed glumes more or less densely sprinkled with pointed papillae facing forward (antrorse) on the adaxial surface. This character, according to Tison & de Foucault (2014), is diagnostic for the species. It is worth noting that there were few individuals with anthers bearing normally developed pollen grains, while the majority showed a predominant proportion of sterile ones or no grains at all, betraying a hybrid origin. Therefore it must be concluded that in Italy there are both *E. campestris* and its most probable hybrid, that one with *E. repens*. Living material possibly attributable to this hybrid is currently being studied for cytology; it comes from Liguria and Lombardy, the second provenance already reported by Ardenghi & Polani (2016) in a note to *Elymus repens* for the flora of the province of Pavia. Furthermore, the presence of *E. campestris* × *Thinopyrum intermedium* subsp. *intermedium* is also likely, this hybrid being already known in France where it is not infrequent. For this reason I think necessary to add to the identification key (see further) this species with related hybrids.

Elymus caninus (L.) L. (≡ *Triticum caninum* L. ≡ *Agropyron caninum* (L.) P.Beauv. ≡ *Goulardia canina* (L.) Husn. ≡ *Roegneria canina* (L.) Nevski) (= *Triticum biflorum* Brign. ≡ *Elymus caninus* subsp. *biflorus* (Brign.) Á.Löve & D.Löve). 2n=28, haplome: StY.

This species belongs to *Elymus* sect. Goulardia (Husn.) Tzvelev.

Elymus panormitanus (Parl.) Tzvelev (≡ *Agropyron panormitanum* Parl. ≡ *Roegneria panormitana* (Parl.) Nevski). 2n=28, haplome: StY.

This species belongs to *Elymus* sect. Goulardia (Husn.) Tzvelev.

Elymus repens (L.) Gould (≡ *Triticum repens* L. ≡ *Agropyron repens* (L.) P.Beauv. ≡ *Elytrigia repens* (L.) Nevski). 2n=42, haplome: StStH.

This species is the type-species of *Elymus* sect. Elytrigia (Desv.) Melderis. It is unanimously assumed to be a highly polymorphic taxon that encompasses numerous infrataxa described at subspecies, variety and form rank. Part of such diversity has been resolved in recognizing distinct species, often recovered in rank from the intraspecific pool of *E. repens*, as is the case of the already cited subsp. *arenosus* ("Petif") Melderis, appropriately recombined at species rank under *Elymus arenosus* (Spenner) Conert or *Elytrigia arenosa* (Spenner) H.Scholz. Anyway, the lectotype of *Elymus repens* (LINN 104.7) as designated by Bowden (1965) corresponds to the green (not glaucous) phenotype bearing spikelets with lemmas very shortly awned, feature which does not resolve the remaining diversity, but helps to fix a morphological point of reference.

Elytrigia aenaeana Hohla & H.Scholz (= *Agropyron campestre* auct. nonnulli, non Godr. & Gren.). 2n=?, genome: unknown.

Elytrigia laxula Hohla & H.Scholz (= *Triticum acutum* auct. nonnulli, non DC.). 2n=?, genome: unknown.

These two species have been described for Austria (Hohla & Scholz, 2011), where they form populations growing mainly on sandy soils in various, open habitats along the rivers Inn, Salzach and Donau. Updating the genus for both species is not practicable in the absence of knowledge about their genome, therefore they must be temporarily kept under the original binomials. Although *E. aenaeana* and *E. laxula* are considered by their authors endemic to Austria, the last word on their distribution cannot be said, especially considering the long-lasting confusion that persisted between these species on one side and the unresolved glaucous phenotypes of *Elymus repens* together with *Thinopyrum acutum* and the hybrids of *Elymus campestris* on the other. Anyway also these two taxa are added to the key for Italian species, given the possibility that they share a range wider than previously assumed.

Thinopyrum acutum (DC.) Banfi, **comb. nov.** Bas.: *Triticum acutum* DC., Cat. Pl. Horti Monsp.: 153. 1813 [Feb-Mar 1813]. (≡ *Agropyron acutum* (DC.) Roem.& Schult. ≡ *Elymus acutus* (DC.) M.-A. Thiébaud ≡ *Elytrigia acuta* (DC.) Tzvelev (pro hybr.) (= *Triticum athericum* Link ≡ *Elymus athericus* (Link) Kerguélen ≡ *Elytrigia atherica* (Link) M.A.Carreras) (= *Triticum pycnanthum* Godr. ≡ *Elymus pycnanthus* (Godr.) Melderis ≡ *Elytrigia pycnantha* (Godr.) Á.Löve ≡ *Thinopyrum pycnanthum* (Godr.) Barkworth). 2n=42, haplome: J_1StP.

Since Thiébaud (1987), the epithet *acutum* was erroneously applied to the supposed hybrid between this species and *Thinopyrum junceum* (L.) Á.Löve, until Tison & de Foucault (2014) pointed out that the type specimen of *Triticum acutum* exactly fits the species in question. Consequently, the epithet of De Candolle has priority over all others.

Thinopyrum corsicum (Hack.) Banfi, **comb. nov.** Bas.: *Agropyron caespitosum* K.Koch var. *corsicum* Hack., in Briquet J., Prodr. Fl. Cors. 1: 187. 1910. (≡ *Agropyron corsicum* (Hack.) Rouy ≡ *Elymus corsicus* (Hack.) Kerguélen ≡ *Elytrigia corsica* (Hack.) Holub ≡ *Elymus nodosus* (Nevski) Melderis subsp. *corsicus* (Hack.) Melderis). 2n=28, haplome: J_1J_1.

Strictly speaking this species does not belong to the Italian flora, however here it has been taken into account as it was traditionally included in the national treatments.

Thinopyrum elongatum (Host) D.R.Dewey (≡ *Triticum elongatum* Host ≡ *Elymus elongatus* (Host) Runemark ≡ *Elytrigia elongata* (Host) Nevski ≡ *Lophopyrum elongatum* (Host) Á.Löve) (= *Agropyron scirpeum* C.Presl var. *scirpeum*). 2n=14, haplome: J_1.

Thinopyrum flaccidifolium (Boiss. & Heldr.) Moustakas (≡ *Agropyron scirpeum* C.Presl var. *flaccidifolium* Boiss. & Heldr. ≡ *Elymus flaccidifolius* (Boiss.& Hel-

dr.) Melderis ≡ *Elytrigia flaccidifolia* (Boiss.& Heldr.) Holub ≡ *Lophopyrum flaccidifolium* (Boiss.& Heldr.) Á.Löve) (= *Elytrigia scirpea* sensu Holub, not *Agropyron scirpeum* C.Presl var. *scirpeum* ≡ *Lophopyrum scirpeum* sensu Á.Löve, not *Agropyron scirpeum* C.Presl var. *scirpeum* ≡ *Elymus scirpeus* sensu Arrigoni, not *Agropyron scirpeum* C.Presl var. *scirpeum*). 2n=28, haplome: J_1J_2.

This species, described from Greece, was already known in Italy from Sicily and recently has been reported from Sardinia (Arrigoni, 2015: 295). It has been and still is subject to nomenclatural confusion due to the exchange of types between *Agropyron scirpeum* var. *scirpeum* and *A. s.* var. *flaccidifolium.* To this regard, the protologue of var. *flaccidifolium* by Boissier & Heldreich (1859) states: *"Folia radicalia* [....] *facie superiori breviter et patule hirsuta"*, to be intended as a character distinctive from the nominal variety of the species. *T. elongatum*, in fact, shows scattered spinules on the adaxial blade surface of basal leaves, sometimes accompanied by short setae not at all comparable with the tomentum of short hairs typical of *T. flaccidifolium*.

Thinopyrum junceum (L.) Á.Löve (≡ *Triticum junceum* L. ≡ *Braconotia juncea* (L.) Godr. ≡ *Festuca juncea* (L.) Moench ≡ *Frumentum junceum* (L.) E.H.L.Krause ≡ *Elytrigia juncea* (L.) Nevski) (= *Triticum farctum* Viv. ≡ *Elymus farctus* (Viv.) Runemark ex Melderis subsp. *farctus*) (= *Agropyron junceum* (L.) P.Beauv. subsp. *mediterraneum* Simonet) (= *Thinopyrum runemarkii* Á.Löve). 2n=42, haplome: $J_1J_2J_3$.

As already mentioned, this species of the beaches, nominal for the Mediterranean phytosociological alliance *Agropyrion juncei* (Tüxen in Br.-Bl. & Tüxen 1952) Géhu et al. 1984, is vicariated on the Atlantic European coasts by *T. junceiforme* (2n=28, haplome: J1J2) in the alliance *Ammophilion arenariae* (Tüxen in Br.-Bl. & Tüxen 1952) Géhu 1988.

Thinopyrum podperae (Nábělek) D.R.Dewey (≡ *Agropyron podperae* Nábělek ≡ *Elymus hispidus* subsp. *podperae* (Nábělek) Melderis ≡ *Elymus hispidus* var. *podperae* (Nábělek) Assadi ≡ *Elytrigia podperae* (Nábělek) Holub ≡ *Elytrigia intermedia* subsp. *podperae* (Nábělek) Á.Löve) . 2n=42, haplome: J_1J_2P.

Thinopyrum sartorii (Boiss. & Heldr.) Á.Löve (≡ *Agropyron junceum* var. *sartorii* Boiss. & Heldr.) (= *Agropyron rechingeri* Runemark = *Elymus rechingeri* (Runemark) Runemark = *Elymus farctus* subsp. *rechingeri* (Runemark) Melderis). 2n=28, haplome: J_1J_2.

The presence in Italy of *T. podperae* (Iran, Iraq, Turkey) and *T. sartorii* (Aegean region) is quite surprising, especially for the first one. It can indirectly be deduced from the table 1 in the paper of Baum & Johnson (2017), where authors include Italy among territories interested by the range of these species. If this report is correct, I do not know the origin of such information, but the fact remains that until now there is no evidence of these species neither from field observations nor from herbarium material. Pignatti (2017) in a note to *T. junceum* (under *Elymus farctus*) suggests the possible presence in Italy of *Thinopyrum bessarabicum* (Săvul. & Rayss) Á.Löve (Black Sea coasts) to explain the presence of caespitose individuals occasionally meeting in normally rhizomatous populations. It would perhaps be more likely to think that this unusual habit can be expected within the extremes of diversity of *T. junceum*.

Thinopyrum intermedium (Host) Barkworth & D.R.Dewey subsp. ***intermedium*** (≡*Triticum intermedium* Host ≡ *Agropyron glaucum* var. *intermedium* (Host) Beck ≡ *Elytrigia intermedia* (Host) Nevski ≡ *Trichopyrum intermedium* (Host) Á.Löve) (= *Agropyron hispidum* Opiz ≡ *Elymus hispidus* (Opiz) Melderis). 2n=42, haplome: J_1J_2P.

The nominal subspecies represents the commonest lineage in Italy.

Thinopyrum intermedium (Host) Barkworth & D.R.Dewey subsp. ***barbulatum*** (Schur) Barkworth e D.R.Dewey (≡ *Agropyron barbulatum* Schur ≡ *Agropyron glaucum* subsp. *barbulatum* (Schur) K.Richt. ≡ *Agropyron glaucum* var. *barbulatum* (Schur) K.Richt. ≡ *Agropyron trichophorum* f. *barbulatum* (Schur) Anghel & Morariu ≡ *Elymus hispidus* subsp. *barbulatus* (Schur) Melderis ≡ *Elytrigia intermedia* subsp. *barbulata* (Schur) Á.Löve ≡ *Trichopyrum intermedium* subsp. *barbulatum* (Schur) Á.Löve) (= *Triticum trichophorum* Link ≡ *Agropyron trichophorum* (Link) K.Richt. ≡ *Agropyron glaucum* var. *trichophorum* (Link) Beck ≡ *Agropyron intermedium* subsp. *trichophorum* (Link) Asch. & Graebn. ≡ *Agropyron intermedium* var. *trichophorum* (Link) Halácsy ≡ *Agropyron truncatum* subsp. *trichophorum* (Link) Soó ≡ *Elytrigia trichophora* (Link) Nevski ≡ *Elytrigia intermedia* subsp. *trichophora* (Link) Á.Löve & D.Löve). 2n=42, haplome: J_1J_2P.

Very localized in Italy.

Thinopyrum intermedium (Host) Barkworth & D.R.Dewey subsp. ***pouzolzii*** (Godr.) Banfi, **comb. nov.** Bas.: *Triticum pouzolzii* Godr., Mém. Soc. Emul. Doubs Ser. 2, 5 (1854): 11. 1854. (≡ *Elymus hispidus* (Opiz) Melderis subsp. *pouzolzii* (Godr.) Melderis ≡ *Elytrigia intermedia* (Host) Nevski subsp. *pouzolzii* (Godr.) M.A.Carreras ≡ *Trichopyrum intermedium* (Host) Á.Löve subsp. *pouzolzii* (Godr.) Á.Löve) (= *Triticum latronum* Godr. = *Agropyron latronum* (Godr.) P.Candargy). 2n=42, haplome: J_1J_2P.

Until now not observed or possibly mistaken for impoverished forms of subsp. *intermedium*. Its presence, at least in the continental sector of extreme North West Italy, is very likely.

Thinopyrum obtusiflorum (DC.) Banfi, **comb. nov.** Bas.: *Triticum obtusiflorum* DC., Cat. Pl. Horti Monsp.: 153. 1813. (≡ *Elymus obtusiflorus* (DC.) Conert ≡ *Elytrigia obtusiflora* (DC.) Tzvelev) (= *Triticum ponticum* Podp. ≡ *Elymus ponticus* (Podp.) N.Snow ≡ *Elymus elongatus* (Host) Runemark subsp. *ponticus* (Podp.) Melderis ≡ *Elytrigia pontica* (Podp.) Holub ≡ *Lophopyrum ponticum* (Podp.) Á.Löve ≡ *Thinopyrum ponticum* (Podp.) Barkworth & D.R.Dewey). 2n=70, haplome: $JJ-JJ_sJ_s$.

The epithet *obtusiflorum* has priority on *ponticum*. Valdés & Scholz (2006) in the Euro+Med treatment consider this species as native to Italy, however its primary range concerns the European and Near Asian

East with occasional occurrences in France and Italy, events that can be explained as a secondary introduction (Barchieri & Ardenghi, 2013; Tison & de Foucault, 2014; Pignatti, 2017). On the other hand, Jarvie (1992) already questioned the indigenate of this species regarding France and Italy, so Galasso et al. (2018) correctly implemented it in the checklist of the Italian alien species.

Thinopyrum* ×*duvalii (Loret) Banfi, **comb. nov.** Bas.: *Triticum* ×*duvalii* Loret, in Loret H. & Barrandon A., Fl. Montpellier ed. 2: 575. 1886., in adnot. (≡ *Agropyron* ×*duvalii* (Loret) P.Candargy ≡ *Elytrigia* ×*duvalii* (Loret) Tzvelev) (= *Elymus* ×*acutus* sensu Thiébaud ≡ *Elytrigia* ×*acuta* sensu Tzvelev, sensu Kerguélen and sensu Stace) (*T. acutum* × *junceum*). 2n=42, genome: $J_1J_1J_2J_3$StP.

According to some authors (e.g. Stace, 2001; Tison & de Foucault, 2014), the parental species *Elytrigia juncea* (= *Thinopyrum junceum*) consists of two intraspecific taxa: the Mediterranean subsp. *juncea* and the North Atlantic subsp. *boreoatlantica* (Simonet & Guin.) Hyl. (≡ *Agropyron junceum* subsp. *boreali-atlanticum* Simonet & Guin.), so their respective hybrids with *T. acutum* must be treated as nothosubspecies of the same nothospecies. The epithet of this one must be chosen between the available names *duvalii* and *obtusiusculum*, depending on types identity and priority, but this is not our case. In fact, starting from a different point of view, I agree with authors who believe that *juncea* and *boreoatlantica* are distinct species to be named respectively *Thinopyrum junceum* (L.) Á.Löve and *Thinopyrum junceiforme* (Á.Löve & D.Löve) Á.Löve on the basis of a clearly different morphology, ploidy level (6x versus 4x) and geography. Stace (2001) demonstrated that *Agropyron* ×*obtusiusculum* Lange, described for the North Atlantic region, has *T. junceiforme* as parental species while *Triticum* ×*duvalii* (= *Elytrigia* ×*acuta* sensu Stace), described for the coast of Montpellier (Mediterranean France), has *T. junceum* as parental species. It follows that the Italian hybrid population certainly must be referred to *T.* ×*duvalii*.

×***Thinoelymus drucei*** (Stace) Banfi, **comb. nov.** Bas.: *Elytrigia* ×*drucei* Stace, Watsonia 23(4): 546. 2001. (≡ *Elymus* ×*drucei* (Stace) Lambinon) (= *Elymus* ×*oliveri* auct., non *Agropyron oliveri* Druce) (*Thinopyrum acutum* × *Elymus repens*). 2n=42, genome: J_1StStStHP.

As anticipated above, I propose here the nothogenus ×*Thinoelymus* for hybrids between *Thinopyrum* and *Elymus*. T. ×*drucei* was long reported under the epithet *oliveri* that Druce (1914) began to apply to the material sent to Hackel (*Thinopyrum acutum* × *Elymus repens*), without having previously specified the taxon identity in his original collection (Blakeney, Norfolk, England). Stace (2001) demonstrated that the type specimen (OXF), labelled by its author as *Agropyron pungens* [= *Thinopyrum acutum*] × *repens*, actually is the hybrid *Thinopyrum junceiforme* × *Elymus repens*, known as *Triticum* ×*laxum* Fr. (pro sp.) whose presence in the Mediterranean area is unlikely.

According to Pignatti (2017), this nothospecies is widespread in northern and central Italy, especially along the coasts. However, due to the very likely coexistence of the hybrid *Elymus campestris* × *repens*, easily mistakable with ×*T. drucei*, it is prudent to avoid hasty conclusions.

×***Thinoelymus mucronatus*** (Opiz) Banfi, **comb. nov.** Bas.: *Agropyrum mucronatum* Opiz, Naturalientausch 6: 42. 1824 [29 Jan 1824]. (≡ *Elymus* × *mucronatus* (Opiz) Conert ≡ *Elytrigia* × *mucronata* (Opiz) Prokudin ≡ *Elytrigia intermedia* (Host) Nevski subsp. *mucronata* ("Bercht.") Valdés & H.Scholz (*Thinopyrum intermedium* × *Elymus repens*). 2n=42, genome: J_1J_2StStHP.

Because of the intraspecific diversity of *Thinopyrum intermedium*, at the moment it is impossible to define the nothosubspecies for this hybrid.

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KEY TO SPECIES, SUBSPECIES AND HYBRIDS

1 Synflorescence soft, easily flexible; glumes and lemmas papery, the first ones progressively aculeolate on ribs towards the apex, the second with a thin, sometimes a bit flexuous apical awn *2*

\- Synflorescence more or less rigid, scarcely flexible; glumes and lemmas subcoriaceous, the first ones aculeolate just on the keel, the second unawned, mucronate or with a thick, straight apical awn *3*

2 Glumes shorter then the first lemma, ribs spaced .... *Elymus caninus*

\- Glumes at least as long as the first lemma, ribs crowded ..... *Elymus panormitanus*

3 Anthers in bud turgid, regularly dehiscent; pollen with grains subequal, mostly well developed and viable (never vitreous); caryopses regularly formed *4*

\- Anthers somewhat flat and flaccid in bud, hardly dehiscent; pollen grains scarce or lacking, unequal, very irregular, often empty and vitreous; the caryopses do not form *16*

4 Rhizomes absent, culms in well delimited tufts *5*

\- Rhizomes more or less developed, culms sparse or in loose, often undefined tufts *9*

5 Adaxial blade surface finely velvety-tomentose with hairs < 0.3 mm; blades not wider than 2 mm *6*

\- Adaxial blade surface spinulose, glabrous or sparsely hairy (hairs > 0.3 mm), never velvety-tomentose; blades to 5 mm wide *8*

6 Rachis fragile, self-disarticulating at maturity .... *Thinopyrum sartorii*

\- Rachis robust, not disarticulating at maturity *7*

7 Culms (incl. sheaths) between 2nd and 4th node mainly not more than 1.5 mm thick; spikelets usually not or little compressed .... *Thynopyrum corsicum*

- Culms (incl. sheaths) between 2nd and 4th node mainly not less than 2.5 mm thick; spikelets usually compressed .... *Thinopyrum flaccidifolium*

8 Rachilla segments almost smooth on the edges; lemmas mainly 7-veined; spikelets 10-17 mm with 7-8 flowers ..... *Thinopyrum elongatum*
- Rachilla segments on the edges with papillae; lemmas mainly 3-5-veined; spikelets 17-25 mm with 8-13 flowers ..... *Thinopyrum obtusiflorum*

9 Adaxial blade surface finely velvety-tomentose by hairs < 0.3 mm; rachis fragile, self-disarticulating at maturity, with smooth edges .... *Thinopyrum junceum*
- Adaxial blade surface glabrous to sparsely hairy with hairs > 0.5 mm; rachis robust, not disarticulating at maturity, denticulate with papillae on the edges *10*

10 Mature spikelets with flowers loosely imbricate, the 2nd rachilla segment ≥ 20% of the adjacent lemma; glumes (excluding apical mucro or awn) obtuse to obliquely truncated *11*
- Mature spikelets with flowers thickly imbricate, the 2nd rachilla segment ≤ 20% of the adjacent lemma; glumes (excluding apical mucro or awn) acute to obtuse *14*

11 Spikelets mainly with 4-5 flowers, scarcely appressed to the rachis to erecto-patent *12*

12 Glumes and lemmas ciliate at the margins only . ..... *Thinopyrum podperae*
- Glumes and lemmas ciliate everywhere or glabrous *13*

13 Glumes and lemmas hairless .... *Thinopyrum intermedium* subsp. *intermedium*
- Glumes and lemmas hairy .... *Thinopyrum intermedium* subsp. *barbulatum*

14 Adaxial blade surface on average with 1 prominent rib every 4; glumes (excluding mucro or awn) acute; leaves and culms green to glaucous .... *Elymus repens*
- Adaxial blade surface on average with 1 prominent rib every 2 or with all ribs prominent; glumes (excluding mucro or awn) subobtuse to obtuse (acute in *Thinopyrum acutum*); leaves and culms always glaucous-green to glaucous *15*

15 Adaxial surface of the glumes without papillae (smooth); lemma (excluding mucro or awn) usually not more than 0.5 mm exceeding the palea; adaxial blade surface with all or almost all ribs prominent; plants growing along the coasts, less frequently far from the sea .... *Thinopyrum acutum*
- Adaxial surface of the glumes coated with papillae; lemma (excluding mucro or awn) usually exceeding the palea for at least 0.5 mm; adaxial blade surface with alternation of prominent and thin ribs; plants usually growing away from beaches .... *Elymus campestris* subsp. *campestris*

16 Adaxial blade surface more or less densely velvety by hairs < 0.5 mm; rachis edges smooth or bearing more or less sparse, minute papillae which are deciduous under flexion of the mature synflorescence; glumes and lemmas on average 11-14 mm long; coastal plants *17*
- Adaxial blade surface glabrous or with sparse hairs > 0.5 mm; edges of the rachis denticulate with minute papillae not deciduous under flexion of the mature synflorescence; glumes and lemmas 6-12 mm long; coastal and inner land plants *18*

17 Adaxial blade surface with subequal ribs .... *Thinopyrum* ×*duvalii*
- Adaxial blade surface with clearly unequal ribs ..... *Thinopyrum junceum* × *Elymus repens*

18 Glumes (excluding mucro or awn) evidently obtuse; flowers of mature spikelets loosely imbricate, the 2nd rachilla segment ≥ 20% of the adjacent lemma *19*
- Glumes (excluding mucro or awn) subacute to acute at least in proximal spikelets; mature spikelets with flower thickly imbricated, the 2nd rachilla segment ≤ 20% of the adjacent lemma *20*

19 Adaxial surface of the glumes smooth (no papillae); adaxial blade surface on average with 1 prominent rib every 4 or with 3 types of ribs: prominent, slightly prominent and thin .... ×*Thinoelymus mucronatus*
- Adaxial surface of the glumes, at least in the middle, more or less papillose; adaxial blade surface on average with 1 prominent rib every 2 .... *Thinopyrum intermedium* subsp. *intermedium* × *Elymus campestris* subsp. *campestris*

20 Glumes lanceolate, gradually narrowed at the apex into an awn to 1 mm long; adaxial blade surface with prominent ribs rounded at the top *21*
- Glumes ovate-lanceolate to oblong-lanceolate, apiculate to mucronate or awned; adaxial blade surface with prominent ribs flattened or truncate at the top *22*

21 Internodes of the rachis 4-6(-8) mm; spikelets 3-5-flowered; glumes 5-6-veined; leaves and culms slightly glaucous; blades near the ligula adaxially and abaxially glabrous; free margins of sheaths sparsely ciliolate to glabrous .... *Elytrigia aenaeana*
- Internodes of the rachis 6-10(-12) mm; spikelets 5-7-flowered; glumes 5-8-veined; leaves and culms strongly glaucous to glaucous-green; blades near the ligula adaxially and abaxially puberulous; free margins of sheaths glabrous ..... *Elytrigia laxula*

22 Adaxial surface of the glumes, at least in the middle, more or less papillose ..... *Elymus campestris* subsp. *campestris* × *Elymus repens*
- Adaxial surface of the glumes without papillae .. .. ×*Thinoelymus drucei*

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