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Post-harvesting late summer-autumn weed vegetation in small size arable fields in Veneto: new insights into root crop communities in North East Italy

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Key words: arable fields, *Echinochloo-Setarietum pumilae*, kitchen gardens, *Panico-Polygonetum persicariae*, *Veronico-Lamietum hybridi*, summer weed vegetation.

Ključne besede: obdelana polja, *Echinochloo-Setarietum pumilae*, zelenjavni vrt, *Panico-Polygonetum persicariae*, *Veronico-Lamietum hybridi*, poletna plevelna vegetacija.

Abstract

A research was conducted in the Veneto region (NE-Italy) inside kitchen gardens and potato fields of outer pre-Alps, and in asparagus fields on the low Po plain near the Adriatic coast, in late summer-autumn after harvesting. Original vegetation-plot records were compared with historic and recent materials from Italy, especially N-Italy, and with comparable associations from Central and South-Eastern Europe, to ensure a consistent syntaxonomical frame of this highly dynamic vegetation. At the same time it was possible to shed light on the actual occurrence of past coenoses, cited by Italian authors for the Po plain. The analysis not only confirmed the occurrence of *Echinochloo-Setarietum pumilae* in north-eastern Italian territories, but also showed that it was more extensive than previously thought. It also confirmed the persistence of *Panico-Polygonetum persicariae*. The historical presence of *Veronico-Lamietum hybridi* occurring in pre-Alps and Dolomites needs confirmation. Further regional-scale investigations of summer crop weed vegetation appear necessary.

Izvleček

Naredili smo raziskavo zelenjavnih vrtov in krompirjevih njiv v Benečiji (SV Italija) v predalpski regiji in špargljevih polj v Padski nižini ob Jadranski obali v poznem poletju in jeseni po žetvi. Izvirne popise smo primerjali z zgodovinskim in novejšim popisnim gradivom iz Italije, še posebej severne Italije in primerljivimi asociacijami iz srednje in južne Evrope. To omogoča primerljiv sintaksonomski okvir za ta zelo dinamičen vegetacijski tip. Prav tako smo lahko preučili trenutno pojavljanje združb iz preteklosti, ki so jih navajali italijanski avtorji v Padski nižini. Z analizami smo potrdili pojavljanje asociacije *Echinochloo-Setarietum pumilae* v severovzhodni Italiji, hkrati pa ugotovili, da so ti sestoji bolj ekstenzivni kot nekoč. Potrdili smo tudi pojavljanje asociacije *Panico-Polygonetum persicariae*. Pojavljanje asociacije *Veronico-Lamietum hybridi*, o kateri so poročali iz predalpskega območja in Dolomitov, pa je potrebno še potrditi. Z regionalnimi raziskavami poletne okopavinske plevelne vegetacije bi bilo nujno nadaljevati tudi v prihodnje.

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Introduction

Traditionally, in the phytosociological classification an important distinction is made between winter and summer crop weed vegetation (Braun-Blanquet et al., 1936). The former is characterised by high rate of specialist species, often archaeophytes, which are vanishing because of agricultural practice intensifications, whereas the latter is rich in neophytes and generalist species. Intrinsically highly dynamic components of agroecosystems (Holzner, 1978), arable weed flora and vegetation began to show evidence of drastic changes in Central Europe as early as in the 1960s as a consequence of new agronomic systems (Tuxen, 1962). Disappearance of coenoses and displacements of previous association by floristically poorer ones are phenomena that have been well-documented (e.g., Kornaś, 1961; Hilbig, 1985; Kropáč, 1988). In the same decade, Lorenzoni (1963; 1965; 1967, 1968) surveyed weed communities in maize cultivations along Italian Peninsula, but by the end of the 1970s heavy use of herbicides and irrigation no longer allowed the recognition of the coenoses detected or described only a few years earlier (Lorenzoni, 1979). By re-surveying Lorenzoni's relevés (1967) in Latium (central Italy), Fanfarillo et al. (2019) recently confirmed strong qualitative and quantitative changes in arable flora of maize fields. Shifts in floristic composition complicated the recognition of described weed associations which are per se characterised as being difficult to classify into abstract formal unities according to classical syntaxonomic concepts (Holzner, 1978). Small arable fields such as vegetable gardens or small-scale horticultural productions represent marginal areas where intensive, industrial tilling is neglected with benefit of traditional and low-impact cultivation methods, facilitating the difficult comparison work of present weed communities with associations described in the past. The aim of this paper is to characterise and frame such examples of non-industrial agriculture collected in the Veneto region. The few studies on row-crop, except maize, date back some 50 years (Lorenzoni, 1964; Caniglia & Marchi, 1974) in Veneto and to the end of last century in Northern Italy (Poldini et al., 1998). We took this opportunity to evaluate real occurrence and actual syntaxonomic reference of summer weed vegetation reported during the second half of the 20th century from Northern Italy, also in view of recent, controversial opinions about actual occurrence of *Panico-Polygonetum persicariae* in north-eastern Italian territories (Poldini et al., 1998; Viciani et al., 2020).

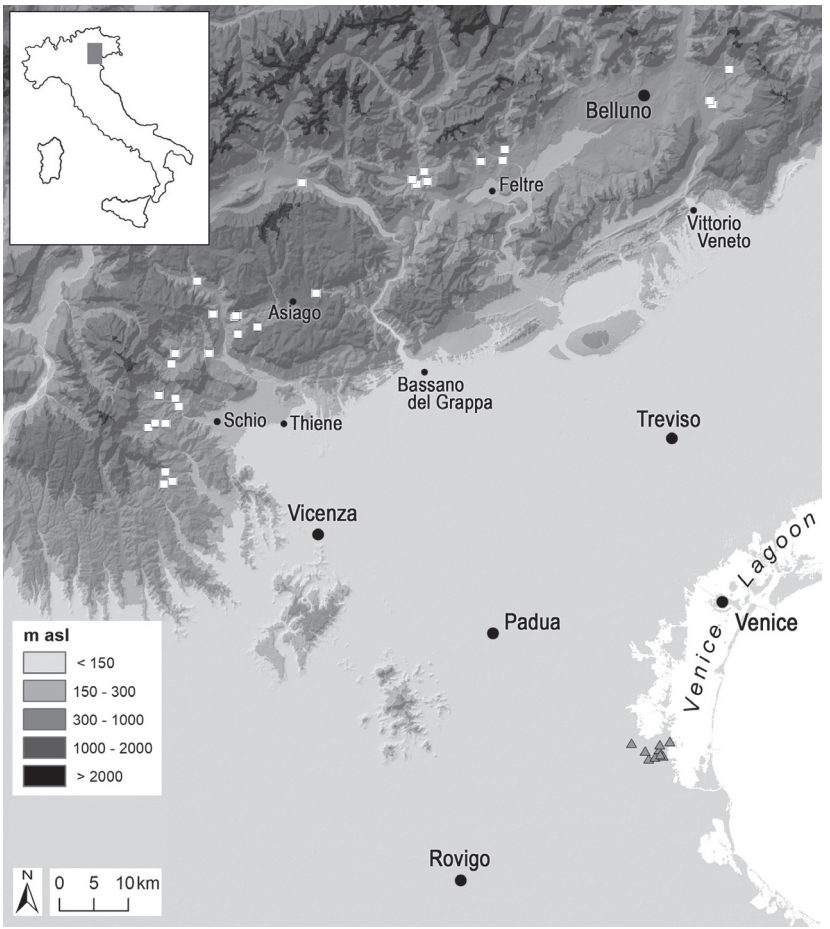


Figure 1: The study area in the NE Italian context with the localities of the original stands. □: pre-Alpine potato and bean field relevés, ▲: asparagus crop relevés.

Slika 1: Preučevano območje v severovzhodni Italiji z lokacijami izvirnih popisov. □: predalpski popisi krompirjevih in fižolovih polj, ▲: popisi špargljevih polj.

Study area

Original relevés were gathered inside the Veneto region (NE-Italy), in pre-Alpine kitchen gardens and potato fields, and in low plain bordering the coast in horticultural asparagus production areas (Figure 1).

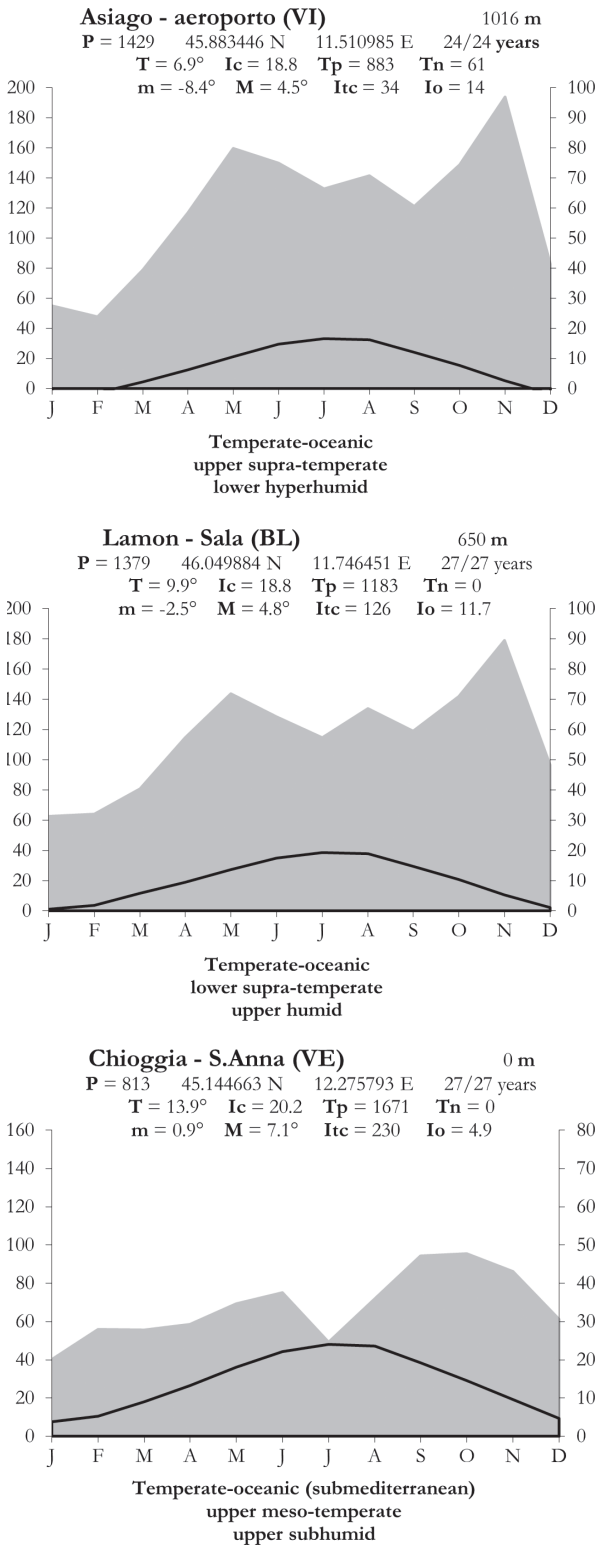


Figure 2: Climograms of Asiago, Lamon-Sala and Chioggia-S. Anna thermopluviometric stations.
Slika 2: Klimagrami za Asiago, Lamon-Sala in Chioggia-S. Anna termopluviometrične postaje.

The Venetian Pre-Alps are mostly composed of carbonate rocks, however, at their south-western limit emerges the crystalline basement; surveys were carried out in both geological contexts. Climatic parameters and bioclimatic indices of the study area were calculated on thermopluviometric data of Asiago (1016 m a.s.l.), Lamon-Sala (650 m a.s.l.) and Chioggia-S. Anna (0 m a.s.l.) stations (https://www.arpa.veneto.it). According to Rivas-Martínez and Rivas-Saenz's bioclimate classification system (1996–2021), the highest survey area lying in the Asiago Plateau belongs to the temperate-oceanic bioclimate, upper supra-temperate thermotype and lower hyperhumid ombrotype, whereas in sectors in front of pre-Alps chain (Lamon pluvio-thermic station) a lower supra-temperate thermotype and upper humid ombrotype prevails (Figure 2a-b). In the study area near the Adriatic coast, calcareous prevalently silty soils of fluvial origin on depressed reclaimed lagoon areas (Calcari-Gleyic Fluvisols) occur (ARPAV, 2005). The bioclimate here is a submediterranean variant of the temperate-oceanic, with an upper mesotemperate thermotype and upper subhumid ombrotype (Figure 2c).

Materials and Methods

Original data were collected in late summer or autumn in small size arable fields after harvesting was completed. Plots were placed in central areas of well-developed vegetation fields. Pre-Alpine kitchen gardens or potato fields (n = 34) and asparagus fields in low plain close to the Adriatic coast (n = 9, hereafter 'asp_or') constitute the original weed vegetation plot records here analysed. A preliminary analysis was made to assess homogeneity of the pre-Alpine stands occurring in a wide range between 380 and 1150 m a.s.l. In neighbouring territories two not easily recognizable associations can occur in the mountain belt inside potato and bean fields: *Galeopsio-Galinsogetum parviflorae* and *Echinochloo-Setarietum* (Poldini et al., 1998; Šilc & Čušin, 2005). Authors stated that the difficult delimitation between *Galeopsio-Galinsogetum* and *Echinochloo-Setarietum* is mostly based on altitude and related presence/absence of thermophiluos C4 plants, progressively decreasing with altitude. Consequently, our pre-Alpine relevés were compared with stands of *Galeopsio-Galinsogetum* and *Echinochloo-Setarietum* from Friuli-Venezia Giulia (Poldini et al., 1998), with relevés of *Echinochloo-Setarietum* and *Echinochloo-Setarietum Galeopsis tetrahit*-altitudinal form (Čušin & Šilc, 2002) and with *Galeopsio-Galinsogetum* vegetation plot from north-western Slovenian territories (Šilc & Čušin, 2005). An analysis computing data concerning altitude, cover percentage and frequency of C4 species of each relevé was conducted.

For selection of C4 plants, the checklist by Pyankov et al. (2010) was used. After transforming cover values according to Gigante et al. (2012; see Figure 1: Braun Blanquet modified by Barkman et al., 1964), data were first standardised by means of standard deviation, then performed with a PCA and the resulting axis scores were finally tested for dissimilarity by means of cluster analysis (Podani 1994; Jongman et al., 1995). Relevés were compared by means of 'incremental sum of squares' (MISSQ), using Wishart's similarity ratio (Podani, 1994). Our pre-Alpine samples merging with the *Echinochloo-Setarietum* relevé group (n = 23, hereafter 'p-b_or') rather than with the *Galeopsio-Galinsogetum* relevé cluster (n = 11, hereafter 'm pb_or') were treated as two independent synthetic tables. Subsequently, our three synthetic tables ('p-b_or', 'm p-b_or' and 'asp_or') were compared with published data. Data for comparison include all old or more recent summer annual weed vegetations described or recognised from Northern Italy, but also relevés from the rest of the Italian territory concerning the most widespread association (*Panico-Polygonetum persicariae*), at least in historical time, were used. Associations and subassociations were treated as separated synthetic tables, but not variants (with the exception of *Galinsogeto-Portulacetum* in Pedrotti 1959 because of clearly different ecological features), facies etc. In particular, following plant communities were used from published Italian literature (in brackets the acronym used in the analysis results are also given):

Amarantheto-Panicetum sanguinalis (Tab. 5 in Pignatti, 1953; AP_P_V)
Panico-Polygonetum persicariae (Tab. 6 in Pignatti, 1953; PP_P_V)
Galinsogeto-Portulacetum (Tab. 7 in Pignatti, 1953; GP_P_V)
Galinsogeto-Portulacetum neutral variant (rel. 1–15 in Pedrotti, 1959; GPn_Pe_T)
Galinsogeto-Portulacetum acidophilous variant (rel. 16–30 in Pedrotti, 1959; GPa_Pe_T)
Panico-Polygonetum persicariae typicum (Tab. 1: rel. 1–39 and 43–46, in Lorenzoni, 1963; PPt_L_V; rel. 40–42 are included in PP_L_Vi)
Panico-Polygonetum persicariae Panicum capillare-subass. (Tab. 1: rel. 47–56, in Lorenzoni, 1963; PPpa_L_V)
Oxaleto-Chenopodietum polyspermi typicum (Tab. 2: rel. 57–71, in Lorenzoni, 1963; OCt_L_V)
Oxaleto-Chenopodietum polyspermi Galinsoga parviflora-subass. (Tab. 2: rel. 72–78, in Lorenzoni, 1963 and Tab. 6: rel. 66–68 in Lorenzoni, 1964; OCg_L_V)
Panico-Polygonetum persicariae (Tab. 5, in Lorenzoni, 1964; PP_L_Vi)
Oxaleto-Chenopodietum polyspermi typicum (Tab. 6: rel. 63–65, in Lorenzoni, 1964; OCt_L_Vi)
Amarantheto-Panicetum sanguinalis (Tab. 8 in Lorenzoni, 1964; AP_L_Vi)
Fumarietum officinalis (Tab. 9 in Lorenzoni, 1964; Fo_L_Vi)
Panico-Polygonetum persicariae typicum (Tab. 1: rel. 1–24, in Lorenzoni, 1965; PPt_L_T)
Panico-Polygonetum persicariae Heliotropium europaeum-subass. (Tab. 1: rel. 25–31, in Lorenzoni, 1965; PPh_L_T)
Panico-Polygonetum persicariae typicum (Tab. 1: rel. 1–6, in Lorenzoni, 1967; PPt_L_L)
Panico-Polygonetum persicariae Cyperus rotundus-subass. (Tab. 1: rel. 7–10, in Lorenzoni, 1967; PPc_L_L)
Panico-Polygonetum persicariae typicum (Tab. 1: rel. 1–12, in Lorenzoni, 1968; PPt_L_B)
Panico-Polygonetum persicariae Amaranthus albus-Amaranthus sylvester-subass. (Tab. 1: rel. 13–20, in Lorenzoni, 1968; PPa_L_B)
Panico-Polygonetum persicariae (Tab. 1 in Caniglia & Salvioni, 1978; PPm_C_d)
Panico-Polygonetum persicariae (Tab. 1 in Caniglia & Marchi, 1978; PPb_C_d)
Panico-Polygonetum persicariae (Tab. s.n.: rel. 1–10, in Chiesura Lorenzoni & Lorenzoni, 1979; PP_L_Or)
Panico-Polygonetum persicariae (Tab. 1: cluster I, in Gerdol & Piccoli, 1979; PP1_G_Fe)
Panico-Polygonetum persicariae (Tab. 1: cluster II, in Gerdol & Piccoli, 1979; PP2_G_Fe)
Panico-Polygonetum persicariae (Tab. 3 in Zanin et al., 1991; PP_Z_N)
Panico-Polygonetum persicariae sorghetosum halepensis (Tab. 8: rel. 69–73, in Baldoni, 1995; PPs_B_M)
Panico-Polygonetum persicariae (Tab. 8: rel. 74–83, in Baldoni, 1995; PP_B_M)
Echinochloo-Setarietum pumilae (Tab. 6: rel. 1–23 and 29–63, in Poldini et al., 1998; ES_Po_F)
Echinochloo-Setarietum pumilae xanthietosum italici (Tab. 6: rel. 24–28, in Poldini et al., 1998; ESx_Po_F)
Galeopsio tetrahit-Galinsogetum parviflorae (Tab. 7 in Poldini et al., 1998; GG_Po_F)
Echinochloo-Setarietum pumilae (Tab. 4 in Tasinazzo, 2011; ES_T_V)
Panico-Polygonetum persicariae sorghetosum halepensis (Tab. 1: rel. 1–9, in Latini et al., 2020; PPs_La_L)
Panico-Polygonetum persicariae cyperetosum rotundi (Tab. 1: rel. 10–16, in Latini et al., 2020; PPc_La_L)

To facilitate correct interpretation both of original relevés and historical Italian ones and to make comparison more consistent from a European perspective, synthetic tables of similar coenoses from Central or Southern Europe were also selected and incorporated into analyses. Data from the

following associations were considered (in brackets the acronym used in the analysis results are also given):
Panico-Chenopodietum (Tab. 3a in Tüxen, 1937; PC_T_G)
Panico-Chenopodietum stachyetosum palustris (Tab. 3b in Tüxen, 1937; PCs_T_G)
Panico-Chenopodietum typicum (Tab. 7: rel. 1–9, in Kruseman & Vlieger, 1939; PCt_K_H)
Panico-Chenopodietum bidentetosum tripartiti (Tab. 7: rel. 10–15, in Kruseman & Vlieger, 1939; PCb_K_H)
Veroniceto-Lamietum hybridi (Tab. 10 in Kruseman & Vlieger, 1939; VL_K_H)
Setario-Galinsogetum parviflorae (Tab. 149: column 16, in Oberdorfer, 1993; ES_O_G)
Oxaleto-Chenopodietum polyspermi (Tab. 149: column 21, in Oberdorfer, 1993; PC_O_G)
Panico-Chenopodietum (Tab. 2: column 8, in Šilc & Čarni, 2007; PC_S_SI)
Galeopsio-Galinsogetum (Tab. 2: column 10, in Šilc & Čarni, 2007; GG_S_SI)
Echinochloo-Setarietum (Tab. 2: column 11, in Šilc & Čarni, 2007; ES_S_SI)
Echinochloo-Setarietum (Tab. 1: column 13, in Pinke & Pál, 2008; ES_Pi_Hu)
Veronico-Lamietum hybridi (Tab. 3: column 7, in Lososová et al., 2009; VL_Lo_C)
Panico-Chenopodietum (Tab. 3: column 12, in Lososová et al., 2009; PC_Lo_C)
Echinochloo-Setarietum (Tab. 3: column 13, in Lososová et al., 2009; ES_Lo_C)
Echinochloo-Setarietum (Tab. 1: column 9, in Májeková & Zaliberová, 2014; ES_M_S)

With the above cited original, Italian, and European data a synoptic table was constructed, which was arranged according to the hierarchical classification obtained by applying the same method used for the comparisons of relevés in the analytical tables (MISSQ – Wishart's similarity ratio). In old papers giving species occurrence only as frequency class (e.g., Tüxen, 1937; Pignatti, 1953) the central value of the frequency class was chosen for the analyses. In the few cases where closely related species of an aggregate (*Amaranthus hybridus* agg., *Sonchus oleraceus* agg.) were separately listed in a synthetic table, we processed the greater frequency value. Original data were collected according to Braun-Blanquet (1964) methodology with modification of 2a and 2b cover values as in Barkman et al. (1964). Numerical comparisons were performed with the SYN-TAX 2000 program package (Podani, 2001). Class diagnostic species prevalently refer to Mucina et al. (2016), the nomenclature of vascular plant species follows Bartolucci et al. (2018) and Galasso et al. (2018).

Results and discussion

Relationships among synthetic tables of original relevés, available stands concerning summer weed vegetation in northern Italy as well as all published *Panico-Polygonetum* data, and a selection of summer weed vegetation types from Europe are shown in Figure 3. The synoptic table arranged according to the classification result is given in Table 1. Our original relevés split up into two well-separated clusters. Synthetic data from asparagus fields (asp_or) aggregate with the stands of the association *Panico-Polygonetum persicariae* (cluster A in Figure 3), so it is appropriate to classify them into *Panico-Polygonetum persicariae*. The studied stands recorded in pre-Alpine kitchen gardens (p-b_or and m p-b_or), prevalently potato and bean fields, join the different provenances of association *Echinochloo-Setarietum pumilae* (cluster B in Figure 3), so they are classified into *Echinochloo-Setarietum pumilae*.

Classification of the original relevés in asparagus, potato and bean fields in Veneto (NE-Italy)

Panico-Polygonetum persicariae Pignatti 1953

Floristic composition. Original stands recorded in asparagus crops appear clearly two-layered. In the upper layer *Amaranthus blitum*, *Chenopodium album*, *Sonchus oleraceus* agg. and *Solanum nigrum* occur with high frequencies (V-IV frequency class) and often with high cover values; in the lower layer *Stellaria media*, *Portulaca oleracea* agg., *Capsella bursa-pastoris*, *Galinsoga quadriradiata*, *Poa annua* and *Erigeron annuus* (*juv.*) reach the highest frequencies (V-IV frequency class).

Syntaxonomy. Pignatti (1953) described the association through a synthetic table, as vicarious association of widespread Central European *Panico-Chenopodietum polyspermi* (as 'ass. *Panicum crus galli* and *Spergula arvensis* (Krusem. et Vl. 1939) Tx. 1950'). Lorenzoni (1963) goes along with Pignatti, underlining the different floristic composition despite a general resemblance with the same coenosis (as '*Echinochloo-Setarietum* Kruseman et Vlieger (1939–1940)'). According to the multivariate analysis here proposed, original relevés on asparagus-growing join the cluster A (Figure 3) including all synthetic tables concerning *Panico-Polygonetum* and other communities reported by Italian authors. Higher levels of similarity are shared with *Amarantho-Panicetum sanguinalis* reported from asparagus-growing coming from Bassano del Grappa (Lorenzoni, 1964) and with

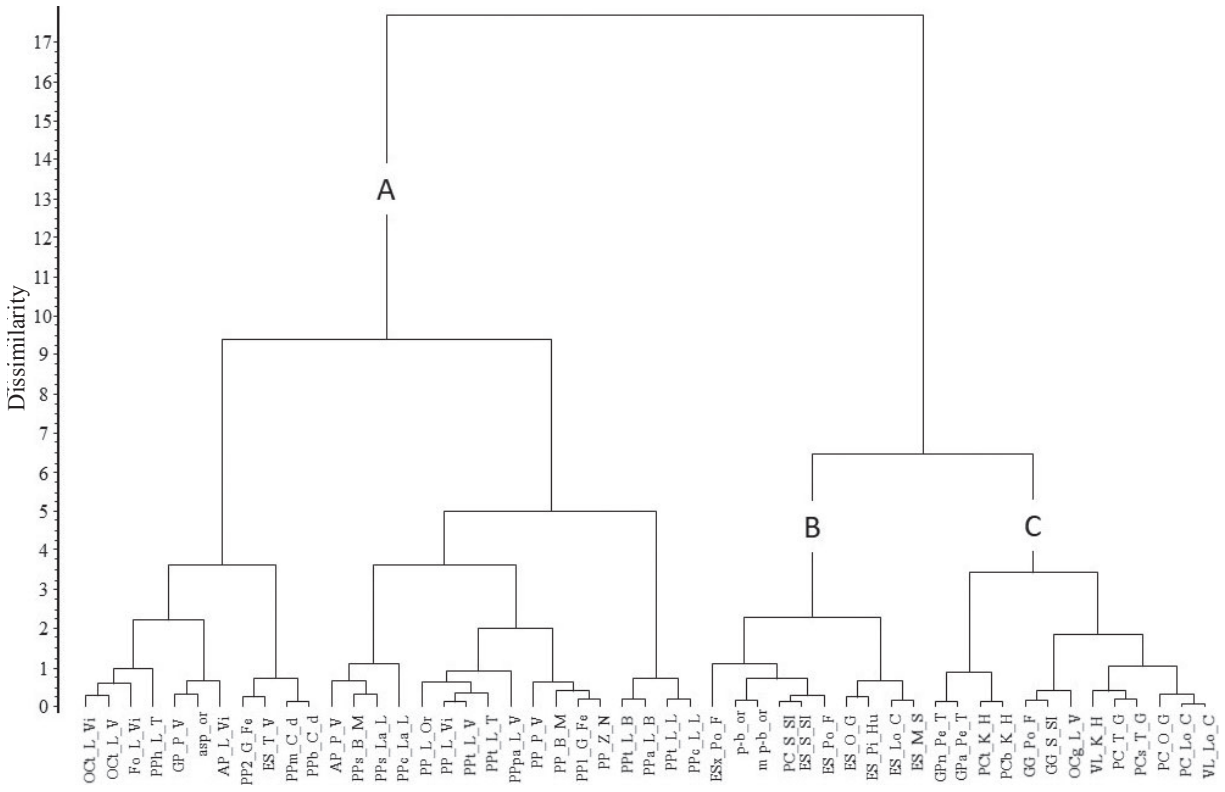


Figure 3: Classification of synthetic tables of original relevés (asp_or, p-b_or, m pb_or) and some Italian and European summer weed vegetation units. MISSQ-similarity ratio. For acronyms see text or Table 1.

Slika 3: Klasifikacija sintetskih tabel izvirnih popisov (asp_or, p-b_or, m pb_or) in nekaterih poletnih plevelnih vegetacijskih tipov iz Italije in Evrope. MISSQ-razmerje podobnosti. Za okrajšave glej tekst ali Tabelo 1.

Galinsogo-Portulacetum from high Friulian plain and Friulian Pre-Alps (Pignatti, 1953). The latter is constituted of only two relevés which are well separated from *Galinsogo-Portulacetum* from continental Val di Sole (Pedrotti, 1959). *Amarantho-Panicetum* was described by Pignatti (1953) as a ruderal vegetation thriving in uncultivated areas and roadside verges, whereas Lorenzoni (1964) detected it also on crops. The two character species *Amaranthus retroflexus* and *Digitaria sanguinalis* must be regarded as generalist weeds and they are included, as characteristic or not, among those quoted also for *Panico-Polygonetum*. *Amarantho-Panicetum* appears poorly differentiated, so that later Lorenzoni (1978) believed that it could be attributed to *Panico-Polygonetum*, as our analysis confirms. Also synthetic table of segetal vegetation of autumn-winter crops recorded on the low Venetian plain and in the Po Delta, and previously referred to as *Echinochloo-Setarietum* (Tasinazzo, 2011), merges with the cluster A, showing close similarity with root crop or maize weed vegetation stands coming from the same or neighbouring territories in the low Po Plain (PP2_G_Fe; PPm_C_d; PPb_C_d). Consequently, with a conservative approach it is consistent to consider most of the synthetic tables grouped in cluster A – with the exclusion of *Oxalido-Chenopodietum typicum* and *Fumarietum officinalis* sensu Italian authors – as representative of a unique association, i.e., *Panico-Polygonetum persicariae*. Our original relevés are characterised by the occurrence of *Chenopodium ficifolium*, *Poa annua*, *Galinsoga quadriradiata*, *Urtica urens* and *Ranunculus sceleratus*. Recently formalised *Digitario-Eragrostietea* class encompasses *Spergulo-Erodion*, that is the alliance which Pignatti (1953; as *Panico-Setarion*) referred the association to. *Digitario-Eragrostietea* class is not yet supported by contributions that define characteristic species of the lower syntaxonomical levels, also in relation to other very close ruderal and segetal vegetation. In our stands, *Papaveretea* species are very frequent and predominant, but the high rate of C4 species justifies the framing of *Panico-Polygonetum* into *Digitario-Eragrostietea* class, despite the weak adherence to *Spergulo-Erodion* alliance (Table 2).

Synecology. In Veneto the association was spread on very damp and neutral soils of the Po Plain, including reclaimed land soils (Lorenzoni, 1963). In the light of the available current evidence, it still occurs on silty soils planted with specialised crops, where it develops in au-

tumn at the end of the harvest season before tilling, and as weed vegetation in winter cereal crops. The occurrence of *Bidentetea* species (*Chenopodium ficifolium*, *Persicaria lapathifolia*, *Ranunculus sceleratus*) highlights the dampness of the soil, as effect of the low elevation where present and previous sampling units were performed, that is below sea level or around 0 m a.s.l. Forthcoming studies on field-scale vegetable weed vegetation along the Venetian Adriatic coast will make it possible to establish the presence of *Panico-Polygonetum* also on sandy soils, where *Bidentetea* species are scarce.

Synchorology. According to Lorenzoni (1963), the association was the main weed vegetation in maize crop in Northeast Italy. Later, the same author extended the distribution area of the coenosis to plains and irrigated terrains on most of the Italian peninsula (Lorenzoni, 1965; 1967; 1968), including Sardinia (Chiesura Lorenzoni & Lorenzoni, 1979). Successive and recent studies confirm its current occurrence in Central Italy (Baldoni, 1995; Latini et al., 2020). Albeit within the limit imposed by the failure to identify in the relevés some species, which were aggregated, the weed association was still recognised on the Po Plain in the mid-1980s (Zanin et al., 1991). Ten years later Poldini et al. (1998) interpreted *Panico-Polygonetum* as syntaxonomic synonym of *Echinochloo-Setarietum*, thereby excluding its occurrence from cultivated fields in Friulian territories and on the eastern Venetian plain. In Veneto it was found on the low plain close to the coast, where the production zone of refined asparagus is (in particular, Conche asparagus), and on reclaimed agricultural lands in the Po Delta. On the basis of the new data interpretation, it has to be looked for in the neighbouring Friulian coastal belt, where also asparagus cultivation exists (i.e., Fossalon di Grado). Further studies, e.g., in vegetables on sandy soils and in the hilly Venetian belt, combined with a statistical approach that considers in a separate way subraces and variants of Friulian material might lead to a better understanding of the occurrence of *Panico-Polygonetum* and clarify its distribution limits in relation to *Echinochloo-Setarietum*. It must be noted that in the Slovenian territories bordering Italy, relevés previously attributed to *Panico-Polygonetum* were merged with *Panico-Chenopodietum*, so that the association is no longer considered present (Šilc & Čarni, 2007).

Echinochloo-Setarietum pumilae Felföldy 1942 corr. Mucina 1993

Floristic composition. The upper layer of our relevés appears poorly developed with *Chenopodium album* and *Echinochloa crus-galli* frequently occurring (V-IV frequency class) but with low cover values; most of the stand biomass is in the lower layer, where *Galinsoga quadriradiata* and *Stellaria media* (V frequency class) and sometimes *Digitaria sanguinalis* (IV) with *Galinsoga parviflora* (II) dominate. The dominance of *Galinsoga* species constitutes a convergence factor with *Veronico-Lamietum*, a fact that requires further investigations.

Syntaxonomy. In his compendium Pignatti (1953) countered the Central European *Panico-Chenopodietum* with the occurrence on the Po Plain of newly described and vicariant *Panico-Polygonetum persicariae*. He also adopted *Oxaleto-Chenopodietum* from Tüxen (1950), but disregarded *Setario glaucae-Galinsogetum parviflorae* that the German author argued was made different from *Panico-Chenopodietum* by *Amaranthus retroflexus*, *Digitaria sanguinalis* and *Setaria pumila* (and lacking *Rumex acetosella*, *Scleranthus annuus* and *Spergula arvensis*), among the most significant species of *Echinochloo-Setarietum*. Indeed, *Setaria pumila* surprisingly does not appear in any species list or relevé produced by Pignatti (1953). He also only attributed to *Panico-Polygonetum* a stand collected by Braun-Blanquet (1936) at a pond edge near Mestre (Venice), with dominant *Xanthium strumarium*, *Cynodon dactylon*, and occurring *Setaria pumila*. Whereas Tuxen (1950) interpreted the same Braun-Blanquet relevé as an autonomous association very similar to *Setario glaucae-Galinsogetum parviflorae*, now synonym of *Echinochloo-Setarietum pumilae*. Interestingly, Sissingh (1950, see Figure 7, pag. 82) included Northern Italy in the distribution area of '*Echinochloeto-Setarietum*'. However, only at the end of the 20th century Poldini et al. (1998) were the first to clearly recognise *Echinochloo-Setarietum pumilae* within national boundaries and in particular in Friulian maize, soybean and potato crops. The classification of weed vegetation synthetic tables from Northern and Central Italy and analogous Central European ones maintains our original prealpine relevés close to each other, inside the cluster with available *Echinochloo-Setarietum pumilae* from Friuli-Venezia Giulia, Slovenia, Germany, Hungary, Czech Republic, and Slovakia (cluster B in Figure 3), so they can be easily attributed to *Echinochloo-Setarietum*. Consequently, all pre-Alpine original relevés (p-b_or and m p-b_or) have been gathered into a unique table representing *Echinochloo-Setarietum* (Table 3). In particular, the physiognomy arising from the dominance of *Galinsoga* spp. agrees with the cool variant of the Friulian subrace, but also in the European context *Galinsoga parviflora* highlights a variant inside *Echinochloo-Setarietum* (e.g., Mochnacký, 2000).

Based on our provisional data, currently in Veneto differential species of *Echinochloo-Setarietum* can be considered *Galinsoga quadriradiata*, *Echinochloa crus-galli*, *Ca-*

lystegia sepium, *Setaria pumila* and *Galinsoga parviflora*. The framing in *Digitario-Eragrostietea* is suggested by numerous C4 species that characterise the class: *Digitaria sanguinalis*, *Echinochloa crus-galli* and *Setaria pumila* are the most frequent. However, the weight of *Papaveretea rhoeadis* species appears predominant, in particular with regard to mountain relevés (m pb_or).

Synecology. Original relevés were collected in small fields and kitchen gardens near settlements; potatoes and beans, often as mixed cultivation, rarely radicchio or maize are the typical crops. They are usually grown with traditional methods and the use of manure is frequent. Soils are fertile and heavy, also as consequence of the humid mesoclimate where the coenosis thrives. Weeds develop undisturbed at the end of harvesting in summer or early autumn and prosper until late autumn, as tilling occurs in the following spring. Hence, the coenosis reaches its maximum in late autumn and after seed dispersal it is destroyed by cold weather.

Synchorology. On the basis of this study, in the Veneto region the association was for the time being detected at the bottom of pre-Alpine valleys and in the pre-Alps where it occurs in the altitudes up to approximately 1000 m. The mean altitude is about 640 m a.s.l. Further researches into intensive maize and root crop cultivations can confirm its likely occurrence on the Veneto hill belt and plain, as in neighbouring Friuli.

Syntaxonomic notes on the other summer-autumn weed associations recorded in the past in Northern Italy

Oxalido-Chenopodietum polyspermi sensu Lorenzoni 1963

Following Tüxen (1950), Pignatti (1953) theorized about the occurrence of *Oxaleto-Chenopodietum polyspermi medioeuropaeum* on the eastern Po Plain without including any relevé or list of species, only reporting *Oxalis stricta* and *Chenopodium polyspermum* as character species and few other companion ones. He highlighted the unclear differences between this association and the newly described *Panico-Polygonetum persicariae*, stating that the two coenoses were ecologically and floristically very close. Indeed, *Oxalido-Chenopodietum* is now considered synonym of *Panico-Chenopodietum* (Oberdorfer, 1993; Mucina, 1993; Lososová et al., 2009), that is the cenosis whose presence in Italy had already been excluded by Pignatti (1953). Lorenzoni (1963) was the first and only one to produce table material collected as weed association in Northern Italy maize crop, also referring to a homonymous association by Sissingh (1950; *Oxaleto-Chenopodietum polyspermi*). The tables of *Oxaleto-Chenopodietum* in Lorenzoni (1963; 1964) differ a great deal with respect to relevés of *Panico-Chenopodietum* elsewhere in Europe (Tüxen, 1937; Kruseman & Vlieger, 1939; Oberdorfer, 1993; Šilc & Čarni, 2007; Lososová et al., 2009). Differences are in the occurrence of the Mediterranean *Ajuga chamaepitys*, *Chaenorrhinum minus* and *Sherardia arvensis*, in the presence of *Digitaria sanguinalis* and *Fumaria officinalis* and in the absence of a numerous group of species such as: *Argentina anserina*, *Atriplex prostrata*, *Atriplex laciniata*, *Euphorbia peplus*, *Fallopia convolvulus*, *Gnaphalium uliginosum*, *Matricaria maritima*, *Mentha arvensis*, *Persicaria lapathifolia*, *Scleranthus annuus*, *Urtica urens* and *Veronica agrestis*.

The same author (Lorenzoni, 1963; 1978) proposed *Veronica persica*, *Euphorbia helioscopia*, *Sonchus oleraceus*, *Lipandra polysperma*, *Fumaria officinalis*, *Geranium dissectum* and *Lamium purpureum* as character species both of association and alliance *Polygono-Chenopodion polyspermi* (= *Veronico-Euphorbion*) which the coenosis was referred to. Indeed, *Lipandra polysperma* was simultaneously mentioned by the author as characteristic both of *Oxalido-Chenopodietum polyspermi* and *Panico-Polygonetum persicariae* and many of the cited species have now to be considered as differential of higher syntaxa, mainly *Veronico-Euphorbion* (Oberdorfer, 1993; Lososová et al., 2009). In our opinion, its classification is into *Veronico-Euphorbion*, rather than in acidic and more humid *Oxalidion europaeae* as proposed by Lososová et al. (2009: 123). Lorenzoni (1963; 1964) recognised two subassociations: *typicum* and *Galinsoga parviflora*-subass. The comparison through hierarchical classification of relevés shows that most stands of *Oxalido-Chenopodietum typicum* merge with those of *Fumarietum officinalis*, whereas stands of *Galinsoga parviflora*-subass. group in a separate cluster (Figure 4).

In light of the above, it is therefore reasonable to consider the relevés of *Oxalido-Chenopodietum typicum* and *Fumarietum officinalis* by Lorenzoni (1963; 1964) as a unique disappeared autonomous association that occurred on drier soils than *Panico-Polygonetum* (Lorenzoni, 1963; 1978). The possible framing in *Mercurialietum annuae* (cf. Pignatti, 1953) has to be excluded on the basis of the analysis we made, as *Oxalido-Chenopodietum typicum* and *Fumarietum officinalis* group separately from *Mercurialietum annuae* coming from various sources (Figure 5). The disappearance of the community dates back to at least the 1980s (Zanin et al., 1991), maybe because of the introduction of irrigation and heavy weeding (Lorenzoni, 1979).

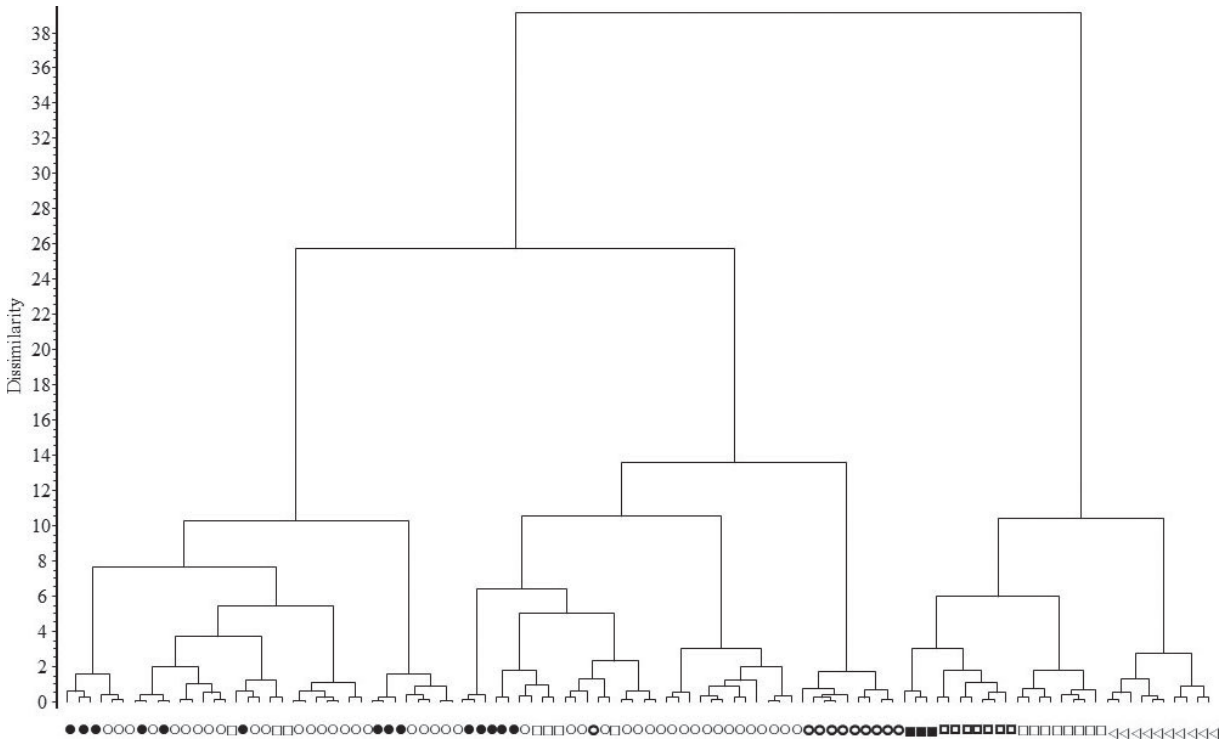
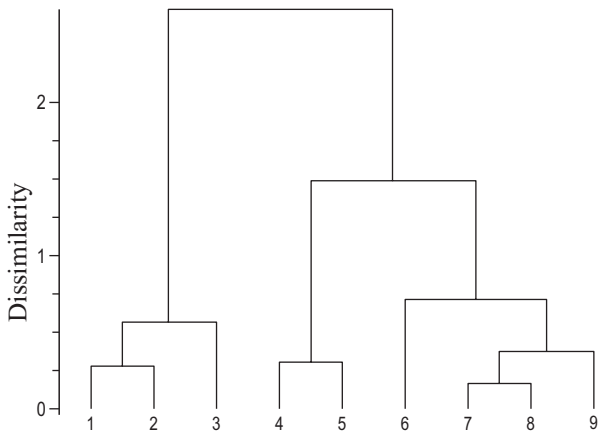


Figure 4: Classification of *Panico-Polygonetum* (●: PP_L_Vi), *Panico-Polygonetum typicum* (○: PPt_L_V), *Panico-Polygonetum Panicum capillare*-subass. (⊙: PPpa_L_V), *Oxalido-Chenopodietum typicum* (■: OCt_L_Vi; □: OCt_L_V), *Fumarietum officinalis* (◘: Fo_L_Vi), and *Oxalido-Chenopodietum Galinsoga parviflora*-subass. (◁: OCg_L_V) from Northern Italy according to Lorenzoni's data (Lorenzoni, 1963; 1964). MISSQ-similarity ratio (cover data). For acronyms see text.

Slika 4: Klasifikacija *Panico-Polygonetum* (●: PP_L_Vi), *Panico-Polygonetum typicum* (○: PPt_L_V), *Panico-Polygonetum Panicum capillare*-subass. (⊙: PPpa_L_V), *Oxalido-Chenopodietum typicum* (■: OCt_L_Vi; □: OCt_L_V), *Fumarietum officinalis* (◘: Fo_L_Vi) in *Oxalido-Chenopodietum Galinsoga parviflora*-subass. (◁: OCg_L_V) iz severne Italije s podatki Lorenzonija (Lorenzoni, 1963; 1964). MISSQ-razmerje podobnosti (s pokrovnimi vrednostmi). Za okrajšave glej tekst.



Stands of the *Galinsoga parviflora*-subass. demonstrating greater similarity with the association *Galeopsio-Galinsogetum* sensu south-eastern European authors (Figure 3) can be referred to *Veronico-Lamietum hybridi* (see below).

The distribution area of *Oxalido-Chenopodietum polyspermi typicum* was on the high Po Plain according to Lorenzoni (1965, see Figure 8, pag 24), whereas the *Galinsoga parviflora*-subass. occurred in pre-Alps and Alpine valleys (Lorenzoni, 1963; 1964).

Figure 5: Dendrogram of *Oxalido-Chenopodietum polyspermi typicum* (**1**: Lorenzoni, 1964; **2**: Lorenzoni, 1963), *Fumarietum officinalis* (**3**: Lorenzoni, 1964), and *Mercurialietum annuae* from various sources (**4**: Tab. 7 in Poldini, 1980 + Tab 18: rel. 16–19, in Poldini, 1989; **5**: Tab. 3 in Baldoni, et al. 2001; **6**: Tab. 8 in Kruseman & Vlieger, 1939; **7**: Tab. 149, column 24, in Oberdorfer, 1993; **8**: Tab. 2, column 4, in Šilc & Čarni, 2007; **9**: Tab. 3, column 6, in Lososová et al., 2009). MISSQ-similarity ratio.

Slika 5: Dendrogram sintaksonov *Oxalido-Chenopodietum polyspermi typicum* (**1**: Lorenzoni, 1964; **2**: Lorenzoni, 1963), *Fumarietum officinalis* (**3**: Lorenzoni, 1964) in *Mercurialietum annuae* iz različnih virov (**4**: Tab. 7 in Poldini, 1980 + Tab 18: rel. 16–19, in Poldini, 1989; **5**: Tab. 3 in Baldoni et al., 2001; **6**: Tab. 8 in Kruseman & Vlieger, 1939; **7**: Tab. 149, column 24, in Oberdorfer, 1993; **8**: Tab. 2, column 4, in Šilc & Čarni, 2007; **9**: Tab. 3, column 6, in Lososová et al., 2009). MISSQ-razmerje podobnosti.

Veronico-Lamietum hybridi Kruseman et Vlieger 1939

Poldini et al. (1998) described *Galeopsio tetrahit-Galinsogetum parviflorae* as a montane weed vegetation in potato and bean fields from Friuli-Venezia Giulia. According to the authors, the coenosis develops under cold climate in mountain areas with high rainfalls on rendzinas and brown soils, with an agronomic scheme involving manure input and low tilling procedures. The floristic resemblance and difficulties in delimitation of *Galeopsio-Galinsogetum* against *Echinochloo-Setarietum* were highlighted by Šilc & Čušin (2005) and Šilc & Čarni (2007). Hierarchical classification allowed to attribute our original pre-Alpine, mountainous stands to *Echinochloo-Setarietum*, but relevés of *Oxalido-Chenopodietum Galinsoga parviflora*-subass. by Lorenzoni (1963; 1964; OCg_L_V) join the subcluster with stands from Friuli-Venezia Giulia (GG_Po_F) and Slovenia (GG_S_SI) attributed to *Galeopsio-Galinsogetum* (Poldini et al., 1998; Šilc & Čarni, 2007).

Currently, *Galeopsio-Galinsogetum* is regarded in Czech Republic as one of the several synonyms of *Veronico-Lamietum hybridi*, occurring without exclusive diagnostic species (Lososová et al., 2009), whereas the association was initially described from Holland with *Veronica opaca*, *V. polita*, *V. persica*, *Lamium purpureum* var. *hybridum* and *Galium tricornutum* as character species (Kruseman & Vlieger, 1939). *Galeopsio-Galinsogetum* of Southern Alps authors is negatively distinguished by the lack of many of the latter species and, conversely, by the presence of *Calystegia sepium*. This constitutes the only major difference in vegetation plots. *Lamium purpureum* var. *hybridum* was reported also in material from Friuli (Lorenzoni, 1963). Cluster C in Figure 3 confirms the close relationship between the Central European and the southeastern data synthetic tables. *Veronico-Lamietum* has a wide distribution range throughout Central Europe (Lososová et al., 2009). According to Lorenzoni's stands (1963), in Veneto the coenosis occurs in alpine context where it thrives at the limit of maize cultivation (Cadore). To confirm its actual occurrence in Veneto, conducting a survey that includes potato, bean and cabbage fields or household gardens inside inner Venetian Alpine territories is necessary.

Galinsogo-Portulacetum Br.-Bl. 1949 ex Pedrotti 1959

Braun-Blanquet (1949) described the association from southern alpine valleys (Valtellina, Chiavenna). Later, two relevés led Pignatti (1953) to recognise the coenosis in pre-Alpine lower reaches of Friulian rivers in Northeast Italy. Our analysis allows for their reduction to the variability of *Panico-Polygonetum persicariae*, and, in any event, they do not classify together with *Galinsogo-Portulacetum* reported by Pedrotti (1959; 2013) for continental Val di Sole, where ten years ago this was already disappearing and reduced to fragments (Pedrotti, 2013). According to (Kropáč, 2006), *Galinsogo-Portulacetum* is only regarded as a regional association; its occurrence is in the Italian Central Alps (Alto Adige and Trentino regions).

Syntaxonomic scheme

On the basis of the present study, pending ongoing research results dealing with spring weed vegetation in stubble fields and vegetable gardens, weed vegetation of root crops in North East Italy is for the time being summarised in the following syntaxonomical scheme:

Digitario sanguinalis-Eragrostietea minoris Mucina, Lososová et Šilc in Mucina et al. 2016
- *Eragrostietalia* J. Tx. ex Poli 1966
  - *Spergulo arvensis-Erodion cicutariae* J.Tx. in Passarge 1964
    - *Panico-Polygonetum persicariae* Pignatti 1953 (syn.: *Amarantho-Panicetum sanguinalis* Pignatti 1953; pseudonym: *Galinsogo-Portulacetum sensu* Pignatti 1953 non Br.-Bl. 1949 ex Pedrotti 1959; pseudonym: *Echinochloo-Setarietum pumilae sensu* Tasinazzo 2011 non Felföldy 1942 corr. Mucina 1993)
      - *Echinochloo-Setarietum pumilae* Felföldy 1942 corr. Mucina 1993
        - *xanthietosum italici* Poldini et al. 1998
      - *Galinsogo-Portulacetum* Br.-Bl. 1949 ex Pedrotti 1959

Papaveretea rhoeadis S. Brullo et al. 2001
- *Papaveretalia rhoeadis* Hüppe et Hofmeister ex Theurillat et al. 1995
  - *Veronico-Euphorbion* Sissingh ex Passarge 1964
    - *Oxalido-Chenopodietum polyspermi typicum sensu* Lorenzoni 1963 non *Oxalido-Chenopodietum polyspermi* Sissingh in Westhoff et al. 1946 (syn.: *Fumarietum officinalis sensu* Lorenzoni 1964 non Tüxen 1950)
    - *Veronico-Lamietum hybridi* Kruseman et Vlieger 1939 (corresp. name: *Oxalido-Chenopodietum galinsogetosum parviflorae* Lorenzoni 1963 *nom. corr. hoc loco*; syn.: *Galeopsio tetrahit-Galinsogetum parviflorae* Poldini et al. 1998)
    - *Mercurialietum annuae* Kruseman et Vlieger ex Westhoff et al. 1946
    - *Cerastio tenoreani-Geranietum dissecti* Poldini 1980

Other syntaxa quoted in the text

Echinochloo-Setarietum viridis Kruseman et Vlieger in Sissingh et al. 1940
Oxalidion europaeae Passarge 1978
Oxalido-Chenopodietum polyspermi medioeuropaeum Tüxen 1950
Panico-Chenopodietum polyspermi stachyetosum palustri Tüxen 1937
Panico-Chenopodietum polyspermi Tüxen 1937 *bidentetosum tripartiti* Kruseman & Vlieger 1939
Panico-Chenopodion polyspermi Koch 1926
Panico-Polygonetum persicariae Pignatti 1953 *Amaranthus albus-Amaranthus sylvester* subass.
Panico-Polygonetum persicariae Pignatti 1953 *cyperetosum rotundi* Lorenzoni 1967 corr. Latini et al. 2020
Panico-Polygonetum persicariae Pignatti 1953 *Heliotropium europaeum* subass.
Panico-Polygonetum persicariae Pignatti 1953 *Panicum capillare* subass.
Panico-Polygonetum persicariae Pignatti 1953 *sorghetosum halepensis* Baldoni 1995
Setario glaucae-Galinsogetum parviflorae Tüxen 1950
Soncho-Veronicetum agrestis Br.-Bl. 1948 em. Müller et Oberd. 1993

Conclusions

Viciani et al. (2020) question conclusions in Poldini et al. (1998) which consider *Panico-Polygonetum persicariae* and *Oxalido-Chenopodietum polyspermi* as syntaxonomic synonyms of *Echinochloo-Setarietum pumilae*, because of the partial use of available Italian contributions and imprecise references to the material used in the analysis. The present study includes all published synthetic tables concerning North Italian summer weed associations, national materials regarding *Panico-Polygonetum persicariae* - the widespread coenosis on the Po Plain in the recent past - and some selected tables from Central and Southern European weed vegetation. Italian material was arranged taking into consideration coenoses down to the subassociation level, disregarding redundant variants and facies. Our results on kitchen garden and potato field weed vegetation in the outer Venetian pre-Alps confirm the occurrence of *Echinochloo-Setarietum* in Northeast Italy as it was asserted by Poldini et al. (1998). Nevertheless, contrary to their findings, it was possible to ascertain the occurrence of *Panico-Polygonetum* on the low Eastern Venetian plain and reject the idea that *Panico-Polygonetum* is a syntaxonomic synonym of *Echinochloo-Setarietum*. The last study detecting *Panico-Polygonetum* on the Po Plain goes back to the late 1980s (Zanin et al. 1991), even if authors have not distinguished some close species due to early summer relevé time (e.g., different *Amaranthus* species was reported as *Amaranthus* spp.). The real area of distribution and limit of the two coenoses, that the same multivariate analysis is not able to unambiguously separate, remain an unresolved issue. Further and comprehensive investigations including other specialised horticultural cultivations (e.g., radicchio) spreading along the Adriatic coast on sandy soils, but also the main and here disregarded monocultures extending on the Po Plain (maize, soya bean, sugar beet) are necessary. *Echinochloo-Setarietum pumilae* is also not easily separable from *Panico-Chenopodietum polyspermi* (Mucina 1993; Čušin & Šilc, 2002; Šilc 2005; Šilc & Čarni 2007). Although the presence of *Panico-Chenopodietum* has to be excluded from Italy since Pignatti's work (1953), its occurrence throughout Slovenia and also very close to the Italian national border (Šilc & Čarni 2007), requires consideration.

On the basis of our syntaxonomic revision of historical summer-autumn weed vegetation in Northern Italy, the *Oxalido-Chenopodietum polyspermi* by Lorenzoni (1963; 1964) cannot identify with central European *Oxalido-Chenopodietum polyspermi* (syn. *Panico-Chenopodietum*). The lack of available information makes it impossible to refer to a syntaxon the *Oxalido-Chenopodietum polyspermi medioeuropaeum* by Pignatti (1953). Indeed, Italian material (Lorenzoni 1963; 1964) comprises two subassociations: the *typicum* has to be regarded as an autonomous association now disappeared, whereas the *Galinsoga parviflora*-subass. can be referred to *Veronico-Lamietum hybridi*, coenosis recently reported as *Galeopsio tetrahit-Galinsogetum parviflorae* from Friuli-Venezia Giulia (Poldini et al. 1998).

Finally, local contributions on a larger scale are awaited which will deal with the characterisation of recently formalized *Digitario-Eragrostietea* class and its separation from other similar anthropogenic syntaxa.

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Table 1: Synoptic table of original data sets (asp_or, p-b_or, m pb_or) in comparison with a selection of Italian and European summer weed communities. Among other species, only those occurring at least once in ≥ II frequency class are included.

Successive number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Relevé acronym	OCt_L_Vi	OCt_L_V	Fo_L_Vi	PPh_L_T	GP_P_V	asp_or	AP_L_Vi	PP2_G_Fe	ES_T_V	PPm_C_d	PPb_C_d	AP_P_V	PPs_B_M	PPs_La_L	PPc_La_L	PP_L_Or	PP_L_Vi	PPt_L_V	PPt_L_T	PPpa_L_V	PP_P_V
№ of relevés	3	15	7	7	2	9	3	21	5	52	45	21	5	9	7	10	14	43	24	10	11
Cluster in Figure 3																		A			
Characteristic species of *Digitario-Eragrostietea*																					
Echinochloa crus-galli		27				22		57	80	83	62		80	11	14	100	86	93	79	100	50
Setaria italica/viridis		100	29	86	100					65	44	90	100		14	40	86	95	96	100	50
Digitaria sanguinalis	33	67		43	100	33	100	14	40	60	18	90	60	22	71	100	36	91	79	90	90
Setaria pumila	33	60	100	100		11	67	29	60	2	2			11	14	50	50	51	92	100	
Portulaca oleracea		13				100	100	5	40	31	16	10	60	44	71	100	57	53	63		30
Amaranthus blitum	67	20	14	43		89		5		13						30	79	65	71	40	
Cynodon dactylon	67		29			22		5		65	49			33		50	29				
Sorghum halepense		20	57			33		19	80	27	18		100	100		20	14	9	17	30	
Erigeron canadensis					50	44		19	20	10	11	50	60		14	60		2			10
Diplotaxis tenuifolia		60	71					10				50					29	2	4		30
Heliotropium europaeum				100				5							29	30		2			
Amaranthus graecizans/sylvestris													40				21				
Setaria verticillata				43				52		56	13							5	8		
Panicum capillare												10								100	10
Erigeron sumatrensis						33			40						29						
Amaranthus albus																					
Euphorbia chamaesyce				86										11							
Amaranthus deflexus																			21		
Eleusine indica						22						30				10					10
Hibiscus trionum																					
Diplotaxis muralis										4	4										
Amaranthus emarginatus						11															
Chamaesyce prostrata															29						
Panicum miliaceum																					
Eragrostis minor												10									10
Panicum dichotomiflorum																					
Chamaesyce maculata															14						
Senecio vernalis																					
Tribulus terrestris												10									
Amaranthus blitoides																					
Chamaesyce humifusa																					
Eragrostis cilianensis																					
Characteristic species of *Papaveretea rhoeadis*																					
Sonchus oleraceus agg.	67	60	43	57	50	100		86	80	52	40			33	86	10	14	19	75		10
Convolvulus arvensis	100	73	57			56	100	71	60	67	49			66	57	40	43	49		70	30
Solanum nigrum s.l.	67	33	29	43	100	100	100	62	100	77	96	30	20			70	50	60	50	90	50
Persicaria maculosa		60			50	11		81	80	8	2		40	22		50	93	84		90	90
Capsella bursa-pastoris	67	80	29		100	89	67	24	60	19	27						7	9	21		
Stellaria media		20			100	100			20	8	9					10		19	8		
Veronica persica	67	73	14			22		14					20		43	10	14	33	17		
Fallopia convolvulus		7	14					19	20	10	9		20				21	9	4		

Table 1: Synoptic table of original data sets (asp_or, p-b_or, m pb_or) in comparison with a selection of Italian and European summer weed communities. Among other species, only those occurring at least once in ≥ II frequency class are included.

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
PP_B_M	PP1_G_Fe	PP_Z_N	PPt_L_B	PPa_L_B	PPt_L_L	PPc_L_L	ESx_Po_F	p-b_or	m p-b_or	PC_S_SI	ES_S_SI	ES_Po_F	ES_O_G	ES_Pi_Hu	ES_Lo_C	ES_M_S	GPn_Pe_T	GPa_Pe_T	PCt_K_H	PCb_K_H	GG_Po_F	GG_S_SI	OCg_L_V	VL_K_H	PC_T_G	PCs_T_G	PC_O_G	PC_Lo_C	VL_Lo_C
10	22	55	12	8	6	4	5	23	11	127	55	58	421	269	73	44	15	15	9	6	23	39	10	13	8	13	308	202	193
											B												C						
80	64	82	50	25	100	100	100	78	55	95	89	55	58	91	96	64	53	7	100	100	13	3			37		28	40	26
80		20	92	50	100	100		13		28	13	21	63	42	59	11	100	100	67	17	26	5	10		25		9	3	4
40	36	38	17	13	33	75	40	83	27	74	45	71	49	42		5	67	40			9	5	10				5		
	45	7	17		50		100	65	45	87	69	67	23	84	62	41	93	20			48	10	40		13		17	4	8
50	36	18		38	100	100		13				21	7	28		2		7											
	14		83	100	83	100		17		24	9																4		
	23	4	100	75	67	75		4		6	11	14		25								3	10						
	32	42	8	13	17		40	9				29																	
10	14		8	13	17		20		9			7	32	30	26	18	80	67						8				9	6
	9			25	17			9	9			10	2				7	7											
20			8		33	25						3		3															
40				88								19					33	13											
	41													15															
	5							13																					
	14			88																									
			33	38																									
							40					17				2													
									9	4	4	19																	
								30																					
		2										3				5	7				4								
		11						4																					
													10														1		
																5													
	5													1															
	14	5	83	25	33	50	100	22	82	31	25	59	32	18	19	16	100	93	22		74	31	60	100	100	100	87	39	61
	41	35	58	38	50	25				65	67	52	48	82	52	57	100	100			74	54	90	38	50	24	29	36	42
80	95	73	58	38	50	25	60	13		27	11	64	15	30		14	13	20	100	67		10		77	37	31	11	2	1
60	45	65	50		17			78	64	80	51	81	20	17	11	7	100	100	100	100	96	62	30	38	62	100		25	19
	9	15			17			52	73	76	55	57	62	55	42	32	100	93	78	50	74	69	70	100	100	69	65	65	63
		15			17			87	91	83	58	38	82	69	32	14	93	87	89	100	96	87	100	92	100	100	90	75	58
30		11	33	13			20	70	100	49	44	45	9	30	29	18	100	100			26	64	70	100	50	54	59	48	65
50	32	53		13	17			9	18	31	15	34	40	28	27	57	87	100	89	100	83	49	20	77	75	85	60	56	60

Successive number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Cirsium arvense		20		43		11		67	40	37	49		20	22	14			14	13	10	
Euphorbia helioscopia	100	67	100	43	50									22			21	21		30	
Galinsoga parviflora		20			100	33	67										50	42			
Lipandra polysperma	33	40		29				52	40								21	47	4	40	30
Lysimachia arvensis	33		14					38	80	37	64				29						
Lamium purpureum		13				22												16			
Senecio vulgaris	67	40			50	33		5	20	15	16							2	8	80	
Mentha arvensis		7	57														29	12		10	
Papaver rhoeas		53		14		22		14	80	4	11							2			
Mercurialis annua	67		14	43				33						44			14	2	38		
Viola arvensis																					
Fumaria officinalis	100	47	100				67														
Matricaria chamomilla						44		33	80	25	44								13		
Galinsoga quadriradiata						67															
Lolium temulentum			14	43													7	5	8		
Veronica arvensis		40	29							2							7	2	4	10	
Oxalis stricta				14					20									21	8		
Sinapis arvensis			29											22				2			
Anthemis arvensis	33	40	29																		
Thlaspi arvense			29																		
Lamium amplexicaule						22															
Abutilon theophrasti						11		5	100	17	7		40	44							
Tripleurospermum inodorum																					
Euphorbia peplus			86	14																	
Sherardia arvensis	67	20																		30	
Spergula arvensis																10					
Alopecurus myosuroides								29	80	13	20										
Ajuga chamaepitys	67	13	43	86				10													
Anchusa arvensis		13		29															25		
Galium spurium																					
Rapistrum rugosum		13						24	40	38	40						29	2	4		
Lactuca serriola								19	40				40						13		
Kickxia elatine								52	40	8	18				57	10					
Lysimachia foemina														11				2	13		
Scleranthus annuus/annuus																					
Vicia tetrasperma																					
Euphorbia falcata			57					38					20				14	5			
Apera spica-venti																					
Cyanus segetum		7																			
Veronica hederifolia		20								13	36					10		2	21		
Euphorbia exigua				71				14											8		
Vicia hirsuta																					
Kickxia spuria								10	20									2			
Veronica polita																					
Aethusa cynapium																					
Veronica agrestis																					
Euphorbia platyphyllos									80	10	16										
Buglossoides arvensis																	7		4		
Oxalis corniculata					50			5										9	8		
Stachys arvensis																					

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
50	50	4	17		17			4	36	57	51	29	28	61	42		60	80			43	77	30	77	75	69	50	53	66
	5						60	39	73	45	25	66	9		23	18	73	40	11		65	13	80	62	50	62	18	36	84
		2						35	9	63	53	59	90	72	34	11	100	100	22	33	74	67	100		13	23	12	27	21
	45	20					40	43	45	91	16	31	8	16	11	27		27			30	38	40	8	13	31	71	79	12
	5	18	58	63	50	75			9	24	9	7	13	14	22	18	27	27				18	10	54	62	54	32	36	48
		2						65	64	53	36	22	20	12	8	9	47	80			57	56	60	69	75	69	45	55	50
		5	17	13			20	13	27	22	5	24	44			2	7	20	44	33		3	20	92	87	85	41		
			25	25				9	9	37	31		7		7	11	53	33	22		39	64	30	8	62	92	49	21	21
	9	16	8		17	50			27	5	7		5	13	7	7	80	73				18		23		31	13	9	18
50	55	11			17			4		6		24	12	24	1	14	13	7			4		10		25	31	7	2	2
								4		39	15			9	21	25			89	67		26	20		37	24	45	47	58
		4			33					3			2		5	7	60	20					20			11	9	15
		5		13						18	4		16	6		5	33	20	22	17	9	8		69		8		4	5
								96	100	17	7	5	17		5						26	33				10	61	15
			83	100	50	75										2	13											
		5	50	13						6	4		11		7	7		7	11			5		15		54	25	23	25
							20	22	9	61	5	5	3	7	1	11					4	10			15	67	38	8
		2						4	18	10	7	12	1	6	16	11	13	7	11	33	9	8		46		24	13	17	28
				13	17					13	16		15		4			40	11	17		10			37		27	9	11
									9				8		23	27								69	50	8	17	39	48
									9	2		2	44	8	7	7	60	67				3		8	37	8		3	16
	9	16					20	4	18																				
	5								9					38	55	52								8			10	51	58
		7										2							11				30	62	25	31	6		
			25	13		25									4	2	7	20			4		10				11	5	16
													49						78	67							34	12	6
	5			25					9											17				31		8			
	5													3		2						3							
																	73	73								8	3		
															7	5	100	87							13			5	5
		2							9													3							
			17	25										12	8	7												7	10
		2												3															
			17	38	33	50								4	3	7												1	2
	5								9	1			19		4			33	11	17		3			25		31	5	7
										2	4				4	2	20	60		17		3			25			16	15
	18									1		2		2	1							3						1	1
										1	2		6		7	14		40	11	17		5		8		15	13	10	11
										1	5			4		7		47	56	17		3						4	8
									9	1						5					4	3		15		8			8
	5														4	9								15		8	4	4	10
									9	4	2			3	1	2			22	17	4	3			25	24		14	12
			42	25	33					1	2			1		2													
										5	2			4	5	5								85		8	1	5	14
								4	18					3	5						30				25	8	6	15	14
													5											69	25	15	4		
		7																									2		
						25											47								13			1	1
								4				3					7	7			4								
													1						33	17			10				1		

Successive number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Veronica opaca																					
Consolida regalis																					
Diplotaxis erucoides													20						17		
Medicago orbicularis																			4		
Papaver dubium																			4		
Ammi majus								19													
Visnaga daucoides															29						
Oxalis dillenii																					
Agrostemma githago																					
Adonis aestivalis																					
Characteristic species of *Chenopodietea*																					
Sonchus arvensis	33								40	42	44							2	4		
Myosotis arvensis																					
Avena fatua			43	14				19	40		11		10								
Cyperus rotundus														11	100						
Cerastium glomeratum									20												
Fumaria capreolata																					
Rumex pulcher													60								
Lamium hybridum																					
Acalypha virginica									20								21				
Legousia speculum-veneris		13																			
Phalaris brachystachys																					
Legousia hybrida																					
Phalaris canariensis									20	4											
Nigella damascena																			4		
Lathyrus aphaca									20												
Characteristic species of *Sisymbrietea*																					
Chenopodium album	100	67	71	57	100	78	100	71	100	52	73	70	80	66	14	80	93	88	71	90	70
Amaranthus retroflexus		7	14			33	100	67	40	40	33	90	80	78	57	10	57	67	63	80	50
Amaranthus hybridus agg.		7		14		44					2			11				7	13		
Chaenorhinum minus	67	47	29					10									14			80	
Atriplex patula																		5			
Geranium dissectum		33																	4		
Datura stramonium						22		5		8	4			22		10			4		
Geranium rotundifolium						11	33											9			
Urtica urens						56											7				
Erysimum cheiranthoides																					
Malva neglecta										2				11					4		
Ambrosia artemisiifolia																					
Chenopodiastrum hybridum																			4		
Sisymbrium officinale																			8		
Bidens bipinnata		7															7	5		20	
Atriplex tatarica																					
Descurainia sophia																					
Lactuca saligna									20												
Characteristic species of *Artemisietea*																					
Elymus repens								33	20	8	31										
Artemisia vulgaris	33	13											40	33		10	21	12	17		
Helminthotheca echioides						22		43	100	67	84		60	11							
Erigeron annuus		7		29		56	67		20								7	2	8	50	

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
																								54			1		
						25								1	4	11						8						1	2
10																													
					17	25																							
					17			4							1											8		1		
	5																						10						
								4						4															
																						5							
																2												1	1
		2	33	13	17	25		4	9	15	33	12	3		5	25	7				13	31	30	69	50	46	35	18	67
						25				19	16		18	2	11	7	27	93			26	26	30	46		69	64	47	40
			25	25	17	25									14	25	40	20										7	12
						100																							
					17					28	2											3	30				33		
				63	17																								
20																													
																							20	54					
		7						4				3																	
			8							1								27				3							
			8	38																									
			8	25																									
								4													4								
			25																										
60	77	69	100	100	100	75	100	96	91	88	71	90	94	95	71	80	100	100	100	83	100	54	70	54	100	69	84	82	70
90	77	69	42	75	50	25	100	43	45	68	38	91	15	71	33	23	100	67				8					5	14	13
			8	25				78	55	19	7		1	81	10	16	13					3					1	3	4
		5							9			2	1	2			53						10				2		
10		4						4		20	11		4		18	20	7	7				3		38		46	32	24	22
								9	18	8	2		4		8	2						8	30	46			17	21	13
	36	7				25	40					9																	
								9	36	1							20	47											
													13						11					8	37	31	2		
									9							7								38			14	49	5
								13	45				1		8						4						4	3	5
														86		7													
													5	42	1		13	7									3	5	3
				38															11					8					
																					4				25				
														2	5	7								8				2	5
	9						40	13	27	35	38	34	38	47	48	66	33	60	56	67	4	51		69	13	54	32	47	55
10	5	2										14	5	33	26	16	87	87			4				13	8	1	18	20
20	5	2	17	13	17							2																	
							60	26	9	24	11	24		22							17	8								

Successive number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Medicago sativa		13								23	33					10		9		30	
Symphyotrichum squamatum									40	12	18		20			30					
Cichorium intybus		13						14		8				11				2	8	20	
Artemisia verlotiorum														11	43						
Linaria vulgaris		13																	4		
Anchusa officinalis																					
Marrubium vulgare										21	18										
Artemisia absinthium																					
Other species																					
Polygonum aviculare agg.	67	13	71	29				86	80	48	89	30	60		29	30	43	51	38		10
Taraxacum sect. *Ruderalia*		80	14			33	33									10	14	30	4	10	
Calystegia sepium	67	40	29			22	33	29	40	77	36					10	50	35			
Persicaria lapathifolia						44			40	52	80						14	19		40	
Equisetum arvense		13							40	19	20		10				21	30		50	
Plantago major s.l.		20					67	52	80		33					10	7	16			10
Poa annua		13	14			78		10			7	30						5			
Galium aparine	33		29					5	20		2								4		
Trifolium repens/repens		20	14					24	60	6	9						7	26	13	60	
Medicago lupulina								48	100	33	49							7	4		
Ranunculus repens									20	2	2						14	12	8		
Galeopsis tetrahit				71																	
Vicia sativa s.l.		20	14						20	4	7					10	7	14	8		
Rumex obtusifolius		7							60	8	9					50		9			
Erodium cicutarium																					
Verbena officinalis	33	13						48	40	23	24	30				20	36	7			
Silene vulgaris		47	86				33										7	2		20	
Arenaria serpyllifolia agg.																		2	4		
Plantago lanceolata			29					14		8	29	30				10	7	2	8	30	
Bidens tripartita									20				60					5			10
Xanthium italicum												30	40	67	14		14	9	4	20	10
Daucus carota				14				19		46	78					10		5	4		
Rumex acetosella																					
Stachys palustris										4											
Bothriochloa ischaemum	100	53	14														29	26		10	
Achillea millefolium										2	2	30						2			
Rumex crispus								33	60	12	27			11	29						
Potentilla reptans		7						5	20	15	2				14	20	36	28		10	
Lapsana communis																					
Urtica dioica						22				4	2										
Raphanus raphanistrum s.l.														11							
Cerastium arvense		47																12	8	70	
Lolium perenne								24		8	18							2			
Trifolium pratense/pratense									20	6	13							2			
Rumex acetosa		13	43	14			33										14	19	4		
Equisetum ramosissimum				43				29		15	7							7	4		30
Gnaphalium uliginosum																					
Vicia cracca																		2	4		
Lolium multiflorum cv.								14	20				60	11							
Polygonum hydropiper																		5			
Polygonum bellardii				43			67												50		

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
					17							2					7	13											
10																													
	5		17									2			1													2	3
	5							26																					
		2						4						3	3		7	20										2	5
																	7	40											
																		33											
10	59	36			50		60	9	18	53	62	28	33	53	52		93	100	22	33	9	38	20	62	63	46	61	40	51
		15			17		60	35	64	29	31	52	20	37	40	14	53	93	11		26	18		38	37	24	36	67	53
	36					25	100	74	55	46	58	69				2					65	49	40						
	5						100	17	36	54	31	5	24	50	25	50			67	67		15	30	15	37	15	59	52	39
60		7		13		25	60	4		21	33	19	50	21	8	36	80	87	22	50	22	15	10	54		69	42	21	22
	5		25	13	50				18	31	13		9	25	37	32	7					10	20	38	13	54	38	55	38
	5							4	18	22	5	3	17	8	21		7		56	83	17	26		54	62	54	36	37	23
		2	38						18	23	13		10	11	18	16					70	51	10	69	50	54	52	42	53
						25		17	36	12	13	12			18	9	87	67			17	38	10					44	21
	18	4	8			50				8	9	16	4	5	11	5	100	53				5		23			10	14	19
			17				20	22	27	45	51	29	4		10	7			22	17	22	41		15		77	51	40	20
									9	6	9		7		1	5	27	67	33	83	65	44				46	51	34	25
					33	50	20	9	36	4	7	7			1	5	87	60	33	33	4	10						9	7
		5		25				17	18	26	29	7			3		20	40	11		4	33		8				27	9
									18	1	2	7	52		15		100	73	56	50					25		5	3	9
	14		25	38			40	4				5																	
		2	8						18			5					93	67			4								
								9	27	9	7	3	3	2	10	2	93	100				10	30	23		38	7	2	5
	9		25	25	33				27	9	7	7			12							21		8				18	10
		7					100					3								100	39				25				
		5	8		17	25	80					2																	
							20					9	1		11	7					13		10	23			3	14	15
		2							9				15		3			20	67	83							90	5	4
										34	9	5			11	20					39	21		15		77		25	22
			8		17																		20						
									9	10	11	2	18		15	5	33	33	11			21					17	27	24
	9									2	2	12			5			13				3		15				17	17
			17		50			9	9			9			1		7											3	4
													5		3	2		53	11	17						54	42	39	35
	5					25		13	9						5		13	67			9		10		25	24		20	6
		7								16	5		42		8	11				17		5			25	24	44	6	11
					17	25																	50						
			17	13					18				5	15			53	13						8			3		
								13	18			19			8		33	13			17							17	13
			25	25																									
	55																												
													15	4	1	2		33		17					25	24	34	15	13
									27			2					60	87											
									55			2									4								
													3		1	5				83						8	31	17	9

Successive number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Chenopodium ficifolium						78		5	20												
Equisetum telmateia								33	40								29	5	17		
Chondrilla juncea													40								
Prunella vulgaris		13	29							10	2							14	4	50	
Phragmites australis								5	40	23	42						7				
Rorippa sylvestris						11															
Sedum acre																					
Glechoma hederacea		7			50													19			
Paspalum distichum						33		14								70					
Trifolium arvense							67							11							
Viola tricolor/tricolor																					
Malva sylvestris			14						20								7	5			
Bidens frondosa									40												
Atriplex prostrata										8	18										
Silene latifolia/alba										2									4		10
Chenopodium rubrum																		7	4		
Matricaria maritima																					
Persicaria amphibia								5													
Lythrum salicaria		13				11				2	2						36	5			
Ranunculus acris					50												29	7			
Poa sylvicola+trivialis	33							5	20	2								5			
Pimpinella major										27							7				
Leontodon hispidus		7																		10	
Medicago minima		33		14														19	4		
Lepidium coronopus								5		15	22										
Ranunculus sceleratus						33			40												
Galeopsis speciosa																					
Arabidopsis thaliana		20															14				
Agrostis stolonifera																					
Ranunculus sardous								5	60												
Galega officinalis										19	18		20								
Bromus tectorum																					
Echium vulgare s.l.																					
Lamium album					50																
Lotus corniculatus								5		8	27					10		2			
Argentina anserina																					
Ranunculus bulbosus		20																19		10	
Vicia villosa/varia																					
Saponaria officinalis																		5			
Trofolium stellatum																					
Mentha spicata agg.								10													
Tussilago farfara																					
Ajuga reptans	33		14																		
Lycopus europaeus								5													
Galeopsis pubescens																					
Lepidium ruderale										17	24										
Stellaria aquatica									20												
Rubus caesius+fruticosus (Pedrotti)										2								2			
Filago arvensis																					
Trifolium fragiferum									40												

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
																5				17				23					
	23																												
20												2					27	53											
												2					13				4								
																								23					
								9	18	29	45	3										23							
																	73	47											
								9	9			3				2					9		10						
																2		33											
												3					20	87											1
	9																13	20						8	13				
							60					2				5													
				13												5								23	37				
								13	27					7		5	7	20			9								
					17																		40	15	13				
																									50	46			
																								31			60		
							20					3																	
																					4								
		2	8							3												8							
							40					7																	
										11	25											28							
			8																										
																								31					
																					48				13		11		
											2		16	1	1												10	4	3
												5			1		20		11									17	16
														5															
10																													
																		60									5		
			25	38																									
								4													9								
	5																				4								
																2									25	31			
										1	4																		
														3		2		47											
																	13	33											
						50																							
							20	9				10																	
																2								15		31			
							40																						
								4	36																		4		
								13													9								
												5				5	20	7											
																		40											

Successive number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Trifolium dubium												30									
Cuscuta europaea										8	29										
Cuscuta cesattiana								33													
Agrostis capillaris																					
Galeopsis segetum																					
Lamium orvala	33																				
Echinochloa oryzicola																	21	9			
Eruca sativa																					
Galium sylvaticum agg.																					
Polygonum mite								10													
Centaurium pulchellum															29						
Hylotelephium maximum																					
Echium italicum																					
Crepis capillaris																					
Ornithopus perpusillus																					
Morus alba (pl)						22															
Juncus bufonius									20												
Acer negundo									20												
Polypogon monspeliensis									20												

1 OCt_L_Vi (*Oxaleto-Chenopodietum polyspermi typicum*, Tab. 6: rel. 63–65, in Lorenzoni 1964)
2 OCt_L_V (*Oxaleto-Chenopodietum polyspermi typicum*, Tab. 2: rel. 57–71, in Lorenzoni 1963)
3 Fo_L_Vi (*Fumarietum officinalis*, Tab. 9, in Lorenzoni 1964)
4 PPh_L_T (*Panico-Polygonetum persicariae Heliotropium europaeum*-subass., Tab. 1: rel. 25–31, in Lorenzoni 1965)
5 GP_P_V (*Galinsogeto-Portulacetum*, Tab. 7, in Pignatti 1953)
6 asp_or (Tab. 2, in this study)
7 AP_L_Vi (*Amarantheto-Panicetum sanguinalis*, Tab. 8, in Lorenzoni 1964)
8 PP2_G_Fe (*Panico-Polygonetum persicariae*, Tab. 1: cluster II, in Gerdol & Piccoli 1979)
9 ES_T_V (*Echinochloo-Setarietum pumilae*, Tab. 4, in Tasinazzo 2011)
10 PPm_C_d (*Panico-Polygonetum persicariae*, Tab. 1, in Caniglia & Salvioni 1978)
11 PPb_C_d (*Panico-Polygonetum persicariae*, Tab. 1, in Caniglia & Marchi 1978)
12 AP_P_V (*Amarantheto-Panicetum sanguinalis*, Tab. 5, in Pignatti 1953)
13 PPs_B_M (*Panico-Polygonetum persicariae sorghetosum halepensis*, Tab. 8: rel. 69–73, in Baldoni 1995)
14 PPs_La_L (*Panico-Polygonetum persicariae sorghetosum halepensis,* Tab. 1: rel. 1–9, in Latini et al. 2020)
15 PPc_La_L (*Panico-Polygonetum persicariae cyperetosum rotundi*, Tab. 1: rel. 10–16, in Latini et al. 2020)
16 PP_L_Or (*Panico-Polygonetum persicariae*, Tab. s.n.: rel. 1–10, in Chiesura Lorenzoni & Lorenzoni 1979)
17 PP_L_Vi (*Panico-Polygonetum persicariae*, Tab. 5, in Lorenzoni 1964)
18 PPt_L_V (*Panico-Polygonetum persicariae typicum*, Tab. 1: rel. 1–39 and 43–46, in Lorenzoni 1963)
19 PPt_L_T (*Panico-Polygonetum persicariae typicum*, Tab. 1: rel. 1–24, in Lorenzoni 1965)
20 PPpa_L_V (*Panico-Polygonetum persicariae Panicum capillare*-subass., Tab. 1: rel. 47–56, in Lorenzoni 1963)
21 PP_P_V (*Panico-Polygonetum persicariae*, Tab. 6, in Pignatti 1953)
22 PP_B_M (*Panico-Polygonetum persicariae*, Tab. 8: rel. 74–83, in Baldoni 1995)
23 PP1_G_Fe (*Panico-Polygonetum persicariae*, Tab. 1: cluster I, in Gerdol & Piccoli 1979)
24 PP_Z_N (*Panico-Polygonetum persicariae*, Tab. 3, in Zanin et al. 1991)
25 PPt_L_B (*Panico-Polygonetum persicariae typicum*, Tab. 1: rel. 1–12, in Lorenzoni 1968)
26 PPa_L_B (*Panico-Polygonetum persicariae Amaranthus albus-Amaranthus sylvester*-subass., Tab. 1: rel. 13–20, in Lorenzoni 1968)
27 PPt_L_L (*Panico-Polygonetum persicariae typicum*, Tab. 1: rel. 1–6, in Lorenzoni 1967)
28 PPc_L_L (*Panico-Polygonetum persicariae Cyperus rotundus*-subass., Tab. 1: rel. 7–10, in Lorenzoni 1967)
29 ESx_Po_F (*Echinochloo-Setarietum pumilae xanthietosum italici*, Tab. 6: rel. 24–28, in Poldini et al. 1998)
30 p-b_or (Table 3: rel. 1–23, in this study)
31 m p-b_or (Table 3: rel. 24–34, in this study)
32 PC_S_SI (*Panico-Chenopodietum*, Tab. 2, column 8, in Šilc & Čarni 2007)
33 ES_S_SI (*Echinochloo-Setarietum*, Tab. 2, column 11, in Šilc & Čarni 2007)
34 ES_Po_F (*Echinochloo-Setarietum pumilae*, Tab. 6: rel. 1–23 and 29–63, in Poldini et al. 1998)
35 ES_O_G (*Setario-Galinsogetum parviflorae*, Tab. 149, column 16, in Oberdorfer 1993)
36 ES_Pi_Hu (*Echinochloo-Setarietum*, Tab. 1, column 13, in Pinke & Pál 2008)
37 ES_Lo_C (*Echinochloo-Setarietum*, Tab. 3, column 13, in Lososová et al. 2009)

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
																								8					
													3						22								8		
																							20		13				
																							30						
																							30						
							20																						
																		27											
				25																									
																		20			4								
													1						22										
																2													

38 ES_M_S (*Echinochloo-Setarietum*, Tab. 1, column 9, in Májeková & Zaliberová 2014)
39 GPn_Pe_T (*Galinsogeto-Portulacetum neutral variant*, rel. 1–15, in Pedrotti 1959)
40 GPa_Pe_T (*Galinsogeto-Portulacetum acidophilous variant*, rel. 16–30, in Pedrotti 1959)
41 PCt_K_H (*Panico-Chenopodietum typicum*, Tab. 7: rel. 1–9, in Kruseman & Vlieger 1939)
42 PCb_K_H (*Panico-Chenopodietum bidentetosum tripartiti*, Tab. 7: rel. 10–15, in Kruseman & Vlieger 1939)
43 GG_Po_F (*Galeopsio tetrahit-Galinsogetum parviflorae*, Tab. 7 in Poldini et al. 1998)
44 GG_S_SI (*Galeopsio-Galinsogetum*, Tab. 2, column 10, in Šilc & Čarni 2007)
45 OCg_L_V (*Oxaleto-Chenopodietum polyspermi Galinsoga parviflora*-subass., Tab. 2: rel. 72–78, in Lorenzoni 1963 and Tab. 6: rel. 66–68, in Lorenzoni 1964)
46 VL_K_H (*Veroniceto-Lamietum hybridi*, Tab. 10, in Kruseman & Vlieger 1939)
47 PC_T_G (*Panico-Chenopodietum*, Tab. 3a, in Tüxen 1937)
48 PCs_T_G (*Panico-Chenopodietum stachyetosum palustris*, Tab. 3b, in Tüxen 1937)
49 PC_O_G (*Oxaleto-Chenopodietum polyspermi*, Tab. 149, column 21, in Oberdorfer 1993)
50 PC_Lo_C (*Panico-Chenopodietum*, Tab. 3, column 12, in Lososová et al. 2009)
51 VL_Lo_C (*Veronico-Lamietum hybridi*, Tab. 3, column 7, in Lososová et al. 2009)

Table 2: Original relevés, classified in *Panico-Polygonetum persicariae* Pignatti 1953.
Tabela 2: Izvirni popisi, uvrščeni v asociacijo *Panico-Polygonetum persicariae* Pignatti 1953.

Relevé №	1	2	3	4	5	6	7	8	9		
Area (m2)	100	100	100	50	100	100	100	100	100		
Cover (%)	90	90	90	80	100	100	70	95	95		
Altitude (m a.s.l.)	1	1	1	0	1	0	0	1	1		
№ species	17	26	24	22	21	14	22	28	14		
Crop	asp	asp	asp	asp	asp	asp	asp	asp	asp		
										pr	fr%
Local differential species of *Panico-Polygonetum persicariae*											
Chenopodium ficifolium			+	+	+	+	+	+	1	7	78
Urtica urens		+	1	+	+			+		5	56
Characteristic species of *Spergulo-Erodion*											
Echinochloa crus-galli							+	+		2	22
Setaria pumila		+								1	11
Characteristic species of *Digitario-Eragrostietea*											
Portulaca oleracea	+	+	1	+	+	+	1	2b	2b	9	100
Amaranthus blitum/blitum	2a	3	2b	+	+	+	+		1	8	89
Erigeron canadensis		+	+	+	+					4	44
Erigeron sumatrensis		+	+		+					3	33
Digitaria sanguinalis	+	2a						+		3	33
Sorghum halepense	+				+		+			3	33
Cynodon dactylon			+				+			2	22
Eleusine indica		+	2a							2	22
Amaranthus emarginatus					2a					1	11
Characteristic species of *Papaveretea rhoeadis*											
Stellaria media	1	2a	2a	4	4	4	2b	2a	2a	9	100
Solanum nigrum/nigrum	4	3	3	+	1	2a	1	+	+	9	100
Sonchus asper	+	1	+	+	+	+	+	1	+	9	100
Sonchus oleraceus	+	1	+	+	+	+	+	1	+	9	100
Capsella bursa-pastoris		1	+	2b	1	1	1	+	2a	8	89
Galinsoga quadriradiata		1	+			4	2a	4	+	6	67
Convolvulus arvensis	+	1		+			2b	+		5	56
Matricaria chamomilla				+	+	1	+			4	44
Galinsoga parviflora	+	1	1							3	33
Senecio vulgaris					+		1	+		3	33
Helminthotheca echioides							+	r		2	22
Lamium amplexicaule			+					1		2	22
Lamium purpureum			+	r						2	22
Papaver rhoeas		r		+						2	22
Veronica persica				r				+		2	22
Abutilon theophrasti								r		1	11
Cirsium arvense								+		1	11
Persicaria maculosa								+		1	11
Solanum nigrum/schultesii		+								1	11

Relevé №	1	2	3	4	5	6	7	8	9	pr	fr%
Characteristic species of *Sisymbrietea*											
Chenopodium album s.l.		2a	2b	+		+	1	+	4	7	78
Amaranthus retroflexus	+	+							+	3	33
Amaranthus hybridus		+	+					+		3	33
Chenopodium betaceum		+						+	+	3	33
Datura stramonium							2b	+		2	22
Amaranthus bouchonii									+	1	11
Amaranthus tuberculatus									+	1	11
Geranium rotundifolium				r						1	11
Characteristic species of *Artemisietea vulgaris*											
Erigeron annuus (juv.)		+	+	1	+		+			5	56
Phytolacca americana			+							1	11
Other											
Poa annua		+	1	+	1	2a	1	1		7	78
Persicaria lapathifolia	1					+	+	+		4	44
Paspalum distichum					+	+	+			3	33
Ranunculus sceleratus				1	+			+		3	33
Taraxacum sect. *Ruderalia*	r		+		r					3	33
Calystegia sepium	1	+								2	22
Morus alba (pl)	+		+							2	22
Urtica dioica	+				+					2	22
Equisetum palustre								+		1	11
Hypochaeris radicata		+								1	11
Lythrum salicaria				+						1	11
Rorippa sylvestris								+		1	11
Ulmus minor (pl)	+									1	11
Cardamine hirsuta				+						1	11

Table 3: Original relevés, classified in *Echinochloo-Setarietum pumilae* Felföldy 1942 corr. Mucina 1993.

Relevé №	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Area (m2)	50	40	60	25	40	60	30	50	50	40	50	60	25	20	50
Cover (%)	75	90	100	90	100	90	90	100	95	90	95	95	90	80	80
Altitude (m a.s.l.)	440	640	440	620	400	400	580	580	620	420	460	400	380	390	540
№ species	19	18	23	19	11	18	21	19	18	19	15	20	10	17	16
Crop	b	b	b	p	m+b	p	p	b	b	p	b	b	r	p	p+r
Differential species of *Echinochloo-Setarietum pumilae*															
Galinsoga quadriradiata (C2)	4	5	3	4	3	4	3	3	3	4	5	5	5	4	4
Echinochloa crus-galli (All/O/C1)		+		+	+	+	2a	2a	1	+	1	+		+	+
Calystegia sepium	+	+	1	r	1		1	+	1	+	+	+	1	+	1
Setaria pumila (All/O/C1)	+		+	+	+		+	+	2a	+	1	+	+	+	
Galinsoga parviflora (C2)			4		4	2b	3		3			+		2a	
Characteristic species of *Digitario-Eragrostietea* (C1)															
Digitaria sanguinalis	+	1	+	+		+	+	1	+		1	+		+	2a
Amaranthus emarginatus	+	1								1				+	
Amaranthus blitum/blitum		+	+												
Polygonum aviculare	+									+					
Portulaca oleracea				+						+					
Panicum capillare								+				+			
Setaria italica/viridis															
Sorghum halepense											r				
Erigeron canadensis															
Cynodon dactylon				+											
Panicum dichotomiflorum	+														
Diplotaxis tenuifolia															
Diplotaxis muralis															
Characteristic species of *Papaveretea rhoeadis* (C2)															
Stellaria media		2a	2b	2b	1	2a	2b	3	+	+	1	1	+	+	2a
Veronica persica	+	+	+	2b	1	+	+				1	1		+	1
Persicaria maculosa	1	1	+					+	r	1	+	+	+	1	1
Lamium purpureum	+	1	2a	+	1	1	+	+		+	+	2a			+
Capsella bursa-pastoris		+		1		+	+	1			+				1
Euphorbia helioscopia		+		+		1	+	+							+
Sonchus oleraceus agg.				+	+	+									
Lipandra polysperma		r	1			+			+		1			+	
Oxalis stricta	+									+					
Senecio vulgaris		r		+											
Cirsium arvense															
Convolvulus arvensis															
Fallopia convolvulus															
Solanum nigrum s.l.								+				r			+
Mentha arvensis												+			
Aethusa cynapium												1			
Sinapis arvensis															
Papaver rhoeas															
Abutilon theophrasti	r														
Oxalis dillenii	+														
Papaver dubium				1											
Mercurialis annua															
Oxalis corniculata															
Viola arvensis															

Table 3: Izvirni popisi, uvrščeni v asociacijo *Echinochloo-Setarietum pumilae* Felföldy 1942 corr. Mucina 1993.

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34		
40	15	40	70	50	40	100	30	80	100	40	80	100	15	20	40	100	15	50		
90	90	90	90	100	90	80	90	100	100	90	90	80	80	90	90	80	80	100		
750	510	340	360	440	640	1055	880	860	780	750	880	870	980	1150	750	760	620	1070		
11	21	20	16	23	12	15	20	23	32	18	25	22	22	21	23	29	19	22		
m+b	p	b	b+p	p	b+p	p	p	p	p	b	p	p	p+r	p	b	b	b	p		
																			pr	fr%
5	4	3	3		2b	3	4	4	4	5	3	3	3	4	5	3	4	1	33	97
+	+	+	+	+		+		+	+					+	+	+	+		24	71
		2a	1	1				+	r			+			+	1	+		23	68
		1	1	r					+	r					+	+	+		20	59
	1															3			9	26
2a	+	3	3	4	4		+								2a	+	+		22	65
			+	2a		+													7	21
			2a	+															4	12
														2a				1	4	12
			+																3	9
	+																		3	9
	2a			+			1												3	9
						+													2	6
												r			r				2	6
																			1	3
																			1	3
													r						1	3
											+								1	3
+	1	+		1	+	+		1	3	1	1	+	3	+		1	2a	2a	30	88
+	+			+	+		+	1	+	+	+	1	2a	1	+	+	1	2a	27	79
+	+	2b	1	2a	2a	+			1	+			+	1	+	1		4	25	74
+	+						1		1	+	2a		1	1		1	1		22	65
	+	+	+		+		1	2a	3	1	1	1	1			+		+	20	59
		+		+	+			+	+	1	+	+	r	2a				r	17	50
+					+	+	+	+	+		+	+	+		+	+	r	+	16	47
		+		+	1		+						r	+	+	+	+		15	44
		1	+	+											+				6	18
					+				+		r							+	6	18
							+	1			+	1				+			5	15
							+			1	1	1			+				5	15
		+		+											r			+	4	12
																			3	9
			2a						1										3	9
										+	+								3	9
						r		2a				r							3	9
								2a		+	+								3	9
												r				r			3	9
																			1	3
																			1	3
	+																		1	3
	+																		1	3
						r													1	3

Relevé №	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Anagallis arvensis															
Scleranthus annuus/annuus															
Veronica hederifolia															
Lamium amplexicaule															
Thlaspi arvense															
Alopecurus myosuroides															
Rapistrum rugosum															
Tripleurospermum inodorum															
Vicia hirsuta															
Characteristic species of *Sisymbrietea*															
Chenopodium album agg.	1	1	+	+	1	+	+	+	+	+	+	+	1	+	1
Amaranthus powellii		+					1		+	+	2a	+		+	
Amaranthus retroflexus	1	+					+			2a		+	+	+	+
Amaranthus hybridus			+					+					1		1
Malva neglecta			+				+								
Geranium rotundifolium									+						
Amaranthus bouchonii									+		+				
Geranium dissectum															
Geranium molle															
Geranium pusillum									+						
Geranium columbinum															
Atriplex patula															
Nicandra physalodes															
Euphorbia lathyris															
Chaenorhinum minus															
Erysimum cheiranthoides															
Characteristic species of *Artemisietea*															
Erigeron annuus			+						1	+				+	
Artemisia verlotiorum	3	2a						3		1					
Rumex obtusifolius	+									2a			+		
Silene latifolia/alba							+								+
Geranium pyrenaicum															
Linaria vulgaris															
Other															
Taraxacum sect. *Ruderalia*			+	+			r	+	+				+		
Ranunculus repens			1			+		+	r						
Trifolium repens/repens			+				+								
Persicaria lapathifolia					1	1		+				+			
Elymus repens	+														
Vicia segetalis p. max. p.															
Lolium multiflorum															
Trifolium pratense/pratense			+				+								+
Arenaria serpyllifolia				+											
Galeopsis pubescens									+						
Urtica dioica			+				+								
Rorippa sylvestris			+			+									
Brassica rapa cv.						r	+								
Stellaria aquatica			+											+	
Glechoma hederacea								+				+			
Potentilla reptans										+					
Poa annua															

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	pr	fr%
													+						1	3
														+					1	3
																1			1	3
											1								1	3
											+								1	3
																		+	1	3
																		r	1	3
																		+	1	3
									+										1	3
+	2a	+	+	1		1	r	2a	+	+	2a	3	+	1	+	1		+	32	94
+		1	+	2b			3	1					+			+			15	44
+	2a										1	+		+	1	+			15	44
	1					3		+	+						+	+			10	29
				+						+	r		r		+	+			8	24
	+								+	+	r					+			6	18
								+		1					+	+			6	18
		r		+				r	+										4	12
	+								+				+						3	9
																r			2	6
							1												1	3
						+													1	3
						+													1	3
													+						1	3
												+							1	3
																		1	1	3
	+	+													+				7	21
			1				+												6	18
				+					1							+			6	18
							+	+			r	+							6	18
				r															1	3
							+												1	3
					1		+		+		+		+	+	+	+	+		15	44
					1								+	+			+		8	24
	+	1							+					+		r	+		8	24
								1			+	2a						r	8	24
						+	+		1					+				+	6	18
				r			+	+	+		+				+				6	18
								+	+	+	+	+					+		6	18
									+			+							5	15
							+	1		+		1							5	15
									1					+		r		3	5	15
		+															r		4	12
														+			1		4	12
				2a															3	9
		+																	3	9
																	1		3	9
				+											+				3	9
	+												+				+		3	9

Relevé №	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Vicia cracca															
Plantago lanceolata															
Sonchus arvensis						+									
Plantago major s.l.															
Erodium cicutarium															
Silene vulgaris															
Lolium perenne															
Equisetum arvense						1									
Ipomoea purpurea												+			
Lamium album			+												
Mentha longifolia				+											
Mentha suaveolens	1														
Persicaria dubia															
Verbena officinalis										+					
Phalaris canariensis															
Achillea millefolium															
Cerastium fontanum/vulgare															
Impatiens glandulifera															
Phacelia tanacetifolia															
Rumex acetosella															
Acalypha virginica															
Geranium sibiricum														r	
Galeopsis tetrahit															

b: bean
p: potato
r: radicchio
m: maize (kitchen garden)

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	pr	fr%
									+	+					+				3	9
									r		+	r							3	9
																	+		2	6
													+	+					2	6
								+					+						2	6
									r			+							2	6
									r									+	2	6
																			1	3
																			1	3
																			1	3
																			1	3
																			1	3
		1																	1	3
																			1	3
						r													1	3
														+					1	3
																		+	1	3
																		r	1	3
																		+	1	3
									+										1	3
			+																1	3
																			1	3
														+					1	3

Appendix 1

Localities, dates, and geographical coordinates (WGS84) of relevés of Table 2

rel. 1: Conche (Codevigo-PD), 31/10/2017, 45,2287338N – 12,173329E;
rel. 2: Conche (Codevigo-PD), 31/10/2017, 45,2377333N – 12,167823E;
rel. 3: Conche (Codevigo-PD), 04/11/2017, 45,2304843N – 12,1836964E;
rel. 4: top. Piovini (Choggia-VE), 04/11/2017, 45,2479869N – 12,2091711E;
rel. 5: Fogolana (Codevigo-PD), 11/11/2017, 45,248098N – 12,1458786E;
rel. 6: C. Rossa-Piovini (Choggia-VE), 04/11/2017, 45,2389336N – 12,1907654E;
rel. 7: C. Val d'Ostreghe (Choggia-VE), 04/11/2017, 45,2315126N – 12,1975008E;
rel. 8: C. Montalbano (Choggia-VE), 13/11/2021, 45,2331417N – 12,1929258E;
rel. 9: Capitello Piovini (Chioggia-VE), 13/11/2021, 45,2448069N – 12,1929761E.

Appendix 2:

Localities, dates, and geographical coordinates (WGS84) of relevés of Table 3

rel. 1: C.da Chiumenti (Valli del Pasubio-VI), 09/2015, 45,7511471N – 11,2357077E;
rel. 2: C.da Santa Giuliana di sotto (Recoaro-VI), 08/10/2015, 45,7069607N – 11,2136061E;
rel. 3: Pian del Vescovo (Lamon-BL), 17/10/2015, 46,031753N – 11,7571863E;
rel. 4: C.da Zerbati (Altissimo-VI), 12/11/2015, 45,6283731N – 11,2408502E;
rel. 5: loc. Bastia (Farra d'Alpago-BL), 24/10/2015, 46,1259364N – 12,3502082E;
rel. 6: loc. Bastia (Farra d'Alpago-BL), 24/10/2015, 46,1313625N – 12,3451928E;
rel. 7: Lamon (BL), 17/10/2015, 46,0383159N – 11,7500857E;
rel. 8: Lamen (BL), 30/10/2015, 46,0596091N – 11,8863753E;
rel. 9: Sorriva (BL), 17/10/2015, 46,0486267N – 11,7737484E;
rel. 10: C.da Stoffele (Torrebelvicino-VI), 01/10/2015, 45,7351324N – 11,2742866E;
rel. 11: C.da Canderle (Posina-VI), 12/10/2021, 45,7939846N – 11,2625534E;
rel. 12: C.da Valoje (Arsiero-VI), 23/10/2015, 45,8069909N – 11,337351E;
rel. 13: Umin (Feltre-BL), 30/10/2015, 46,0601254N – 11,9305992E;
rel. 14: Top. Le Brustolae (Castel Ivano-TN), 23/08/2016, 46,0385644N – 11,5309678E;
rel. 15: Arson (Feltre-BL), 30/10/2015, 46,0755966N – 11,9349315E;
rel. 16: C.da Zovi (Valdagno-VI), 12/11/2015, 45,6451043N – 11,2440605E;
rel. 17: Scalzeri (Pedemente-VI), 20/10/2017, 45,9075169N – 11,317748E;
rel. 18: C.da Pelè (Valli del Pasubio-VI), 01/10/2015, 45,7473025N – 11,2685031E;
rel. 19: C.da Pelè (Valli del Pasubio-VI), 01/10/2015, 45,7462693N – 11,2684328E;
rel. 20: C.da Sigismondi (Recoaro-VI), 08/10/2015, 45,7119983N – 11,2475588E;
rel. 21: C.da Pianalto (Recoaro-VI), 08/10/2015, 45,7129396N – 11,2270605E;
rel. 22: Tresché Conca (Roana-VI), 10/09/2019, 45,8416564N – 11,4342108E;
rel. 23: Castelletto (Rotzo-VI), 11/10/2015, 45,8575959N – 11,3940448E;
rel. 24: Castelletto (Rotzo-VI), 11/10/2015, 45,8559728N – 11,3896209E;
rel. 25: C.da Lago di Castelvecchio (Valdagno-VI), 12/11/2015, 45,6319192N – 11,2577094E;
rel. 26: loc. Binchele-C.da Bragioli (Laghi-VI), 12/10/2015, 45,8087123N – 11,2700619E;
rel. 27: Castelletto (Rotzo-VI), 11/10/2015, 45,8585399N – 11,3960297E;
rel. 28: Castelletto (Rotzo-VI), 11/10/2015, 45,8577165N – 11,3918282E;
rel. 29: Tonezza del Cimone (VI), 23/10/2015, 45,8613754N – 11,3471975E;
rel. 30: Malghe del Costo (Roana-VI), 20/08/2019, 45,8325209N – 11,3950046E;
rel. 31: C.da Bragioli (Laghi-VI), 12/10/2015, 45,8087123N – 11,2700619E;
rel. 32: Faller (BL), 17/10/2015, 46,0347388N – 11,7790485E;
rel. 33: Lamosano (BL), 24/10/2015, 46,1733813N – 12,3859938E;
rel. 34: Gallio (VI), 30/07/2018, 45,8860485N – 11,551863E.