# Weed vegetation in southern Moravia (Czech Republic): a formalized phytosociological classification

**Plevelová vegetace jižní Moravy: formalizovaná fytocenologická klasifikace**

Zdeňka L o s o s o v á

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A phytosociological synthesis of weed vegetation of southern Moravia (Czech Republic) was performed using the Braun-Blanquet approach. Gradsect sampling, i.e. a priori stratified selection of sampling sites, was used for the field survey. Using this method, 115 quadrants of the Central European mapping grid (6 × 5.6 km) were chosen. Three hundred and ten relevés recorded in 1997–2002 were classified, based on the Cocktail method, which defines sociological species groups and then creates formal definitions of vegetation units. In total, nine associations of the class *Stellarietea mediae* were distinguished in southern Moravia. Three associations were included in the alliance *Caucalidion lappulae* (*Lathyro-Adonidetum*, *Euphorbio-Melandrietum*, *Veronicetum hederifolio-triphylli*) and three in the alliance *Scleranthion annui* (*Aphano-Matricarietum*, *Spergulo-Scleranthetum*, *Erophilo-Arabidopsietum*). For each of the alliances *Veronico-Euphorbion, Spergulo-Oxalidion* and *Panico-Setarion* one association was distinguished, respectively, *Setario-Fumarietum*, *Panico-Chenopodietum polyspermi* and *Echinochloo-Setarietum pumilae* . Species composition of these associations is documented in a synoptic table. Their structure, ecology, and distribution are commented.

K e y w o r d s : arable field, Cocktail method, Czech Republic, plant community, *Stellarietea mediae*, weed vegetation

## Introduction

The weeds associated with *Stellarietea mediae* class include synanthropic therophytic plants, which occur mainly in arable fields (Tüxen 1950). These plants are adapted to various agrocultural practices and cropping cycle. The dominant and most frequent species are annual weeds that have a ruderal strategy (Mucina 1993, Jarolímek et al. 1997).

The last survey of Czech weed vegetation was made by Kropáč (1995), who recognized 18 weed communities. However, many of them were documented only locally and in the 1950s to 1980s. Weed vegetation is well studied in Bohemia (Kropáč et al. 1971, Volf 1974, Volf & Kropáč 1974, Kropáč 1981, 1985, 1988, Koblihová 1989, Kropáč 1997) and other countries of Central Europe: Slovakia (Kropáč 1974, Kropáč & Hejný 1975, Passarge & Jurko 1975, Krippelová 1981, Vilčeková 1981, Mochnacký 1984, 1986, 1987, Kropáč & Mochnacký 1990, Hadač et al. 1997, Jarolímek et al. 1997), Austria (Holzner 1973, Ries 1992, Mucina 1993), Germany (Müller 1964, Passarge 1964, Hilbig 1967, 1973, Meisel 1967, 1973, Schubert & Mahn 1968, Nezadal 1975, Oberdorfer 1983, Hüppe & Hofmeister 1990), Poland (Kornaś 1959, Wnuk 1976a, b, Anioł-Kwiatkovska 1974, Wójcik 1978, Borowiec et al. 1985, Anioł-Kwiatkovska 1990, Trcińska-Tacik 1991) and Hungary (Felföldy 1942, Timár 1956, Soó 1964). The weed vegetation of

southern Moravia has not been systematically studied with the exception of the Bílé Karpaty Mts (Otýpková 2001) and the Podyjí/Thayatal National Park (Cigánek 1998). Kühn (1972, 1978a, 1978b) published some data on the relationships of weeds to soil type and crop. Floristic records of southern Moravian weeds come from Laus (1908), Lososová & Otýpková (2000) and Otýpková (2003).

This paper presents a phytosociological survey of weed vegetation of southern Moravia (Czech Republic), using the Cocktail method combined with a similarity-based assignment of relevés to vegetation units.

## Materials and methods

### *Study area and its stratification*

The study area is located in a quadrant delimited by 48°36' N, 15°15' E (SE) and 49°45' N, 17°30' E (NW) and covers ca 12 800 km$^2$ of southern Moravia except for the Bílé Karpaty Mts, where the weed vegetation was surveyed by Otýpková (2001). Vegetation surveys of such large areas are often biased by the researcher's preferences for particular sampling sites. To eliminate this, a modified method of gradsect sampling (Gillison & Brewer 1985, Austin & Heyligers 1989, Austin & Heyligers 1991, Austin 1998, Cooper & Loftus 1998) was used. This provides a representative sample of the range in variation in vegetation composition in the study area (Austin 1998). The purpose of the survey was to obtain a representative sample of a wide ecological and geographical range of weed communities, both common and widespread and rare or unique.

A priori stratification of the study area was based on maps of environmental factors. Data for climate, soil, geology, and reconstructed natural vegetation were estimated or recorded for every field of the Central European mapping grid of quadrants of size 5' × 3' (approx. 6 × 5.6 km). This information was obtained from soil, natural vegetation and climate maps (Novák 1989–1993, Mikyška et al. 1968-1972, Quitt 1975). Type of bedrock was divided into 16 categories (acid gravel, pit-run gravel, loess, carbonate sand, clay, marl, alluvial acid sediment, alluvial carbonate sediment, sandstone, acid metamorphic rock, basic metamorphic rock, serpentinite, limestone, flysch slate, slate, marlstone). Soils were divided into 12 categories (rendzina, pararendzina, chernozem, orthic greyzem, orthic luvisol, luvisol, cambisol, podzol, dystric planosol, dystric gleysol, histosol, fluvisol), climate into 9 categories according to Quitt (1975) ( cold district CH7, mild districts MT3, MT5, MT7, MT9, MT10, MT11, and warm district T2, T4), and reconstructed natural vegetation into 14 categories (alluvial forests, oak-hornbeam forests, ravine forests, herb-rich beech forests, acidophilous beech forests, thermophilous oak forests, subcontinental thermophilous oak forests, acidophilous oak forests, fens, raised bogs and transitional mires, serpentine pine forests, acidophilous pine forests, montane beech forests, bog spruce forests). Surface area of each environmental category in each quadrant was estimated on a percentage scale. Only four quadrants in southern Moravia were omitted because of the lack of arable fields.

Percentage data on environmental characteristics of quadrants were arranged in a matrix with 382 quadrants and 51 environmental categories. The similarity of quadrants was established using the cluster analysis (complete linkage, Euclidean distance) in the program SYN-TAX (Podani 1994). The resulting dendrogram clustered the quadrants according to their environmental conditions. A chaining level of 0.08 in the dendrogram was

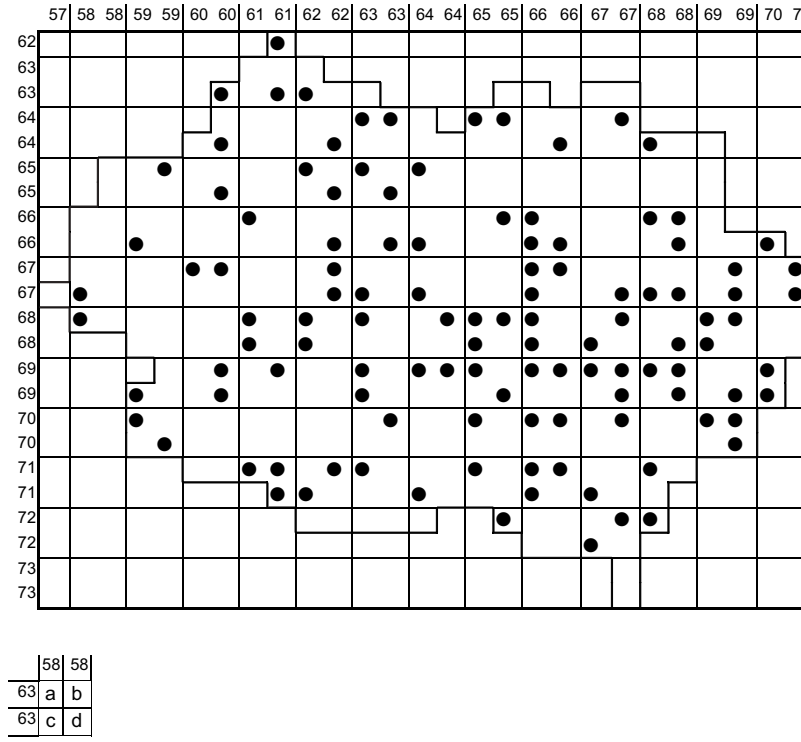


Fig. 1. – Map of quadrants (5' × 3') in southern Moravia (delimited by bold line). Quadrants chosen for field sampling are indicated by dots.

subjectively selected to divide southern Moravia into areas with more or less homogeneous environmental conditions. In each of these areas, one quadrant was randomly chosen for field research (Fig. 1). In total, 115 quadrants from 115 clusters were selected. The size of the clusters varied from 1 to 15 quadrants.

*Data sampling*

The weed vegetation in the chosen quadrants was sampled randomly in different fields three times a year in order to record seasonal changes. Vernal weed communities were not found in some quadrants at higher altitudes. In total, 310 relevés of weed vegetation were made in 1997–2002, including 256 by the author, 22 by Z. Otýpková, 13 by T. Vymyslický, 12 by M. Chytrý and 7 by J. Danihelka. Of these, 278 were done following the above-described sampling design, while those from southern Moravia were based on occasional sampling. The standard plot size used for sampling was 20 $m^2$, but smaller plots (9–12 $m^2$) were used in few cases if the weed vegetation occurred only in small patches. The relevés were made according to the Braun-Blanquet method (Braun-Blanquet 1964) and stored in a TURBOVEG database (Hennekens & Schaminée 2001).

Nomenclature of taxa follows Kubát et al. (2002). *Veronica hederifolia* agg. includes *V. hederifolia* and *V. sublobata,* but not *V. triloba*. *Vicia cracca* agg. includes *V. cracca* and *V. tenuifolia*. Mosses were also recorded and their nomenclature follows Frey et al. (1995).

*Cocktail groups and classification*

The Cocktail method (Bruelheide 1995, 2000) was used to define the sociological species groups of weed communities. To create formal definitions of weed communities, a data set of 21,794 relevés of different vegetation types from the whole Czech Republic was used (Chytrý & Tichý 2003), which was prepared by geographically stratified selection of relevés from the Czech National Phytosociological Database (Chytrý & Rafajová 2003). The species groups were created by calculating the phi coefficient of association (Sokal & Rohlf 1995, Chytrý et al. 2002), using JUICE 6.0 software (Tichý 2002). The phi coefficient was used to measure species tendency to occur together in relevés included in the data set. Only those species that have similar ecological affinities were included in the same sociological group (Table 1). Usually the species included in the groups were identical with diagnostic species of weed communities in phytosociological literature. Sociological species groups were considered to be present if the relevé included at least half of the species of a group. Most relevés contained more than one and a few no species group.

After defining the sociological species groups, Cocktail definitions of weed associations were created using sociological species groups that were combined by logical operators (Bruelheide 1997). The results of cluster analysis of weed vegetation in the Czech and Slovak Republics (Lososová et al. 2004) were used as a guide to the delimitation of individual weed associations using the Cocktail method.

Table 1. – Sociological species groups used in the Cocktail classification of the weed vegetation of southern Moravia. Species in each group are ranked in order of decreasing fidelity to the group, calculated as the phi coefficient in the data set of 21,794 relevés of all vegetation types of the Czech Republic (values in parentheses). Numbers of the relevés containing each group refer to this data set.

| Species group | No. of relevés | Species (phi values) |
|---|---|---|
| *Adonis aestivalis* | 27 | *Adonis aestivalis* (0.44), *Camelina microcarpa* (0.44), *Anthemis austriaca* (0.34) |
| *Amaranthus retroflexus* | 100 | *Solanum nigrum* (0.64), *Amaranthus retroflexus* (0.62), *Chenopodium hybridum* (0.54), *Amaranthus powellii* (0.47) |
| *Aphanes arvensis* | 174 | *Centaurea cyanus* (0.65), *Apera spica-venti* (0.53), *Aphanes arvensis* (0.53), *Vicia angustifolia* (0.50), *Vicia hirsuta* (0.47), *Matricaria recutita* (0.40) |
| *Arabidopsis thaliana* | 139 | *Erophila verna* (0.66), *Myosotis stricta* (0.58), *Arabidopsis thaliana* (0.49) |
| *Caucalis platycarpos* | 24 | *Conringia orientalis* (0.73), *Galium tricornutum* (0.61), *Bifora radians* (0.50), *Caucalis platycarpos* (0.48) |
| *Chenopodium polyspermum* | 107 | *Oxalis fontana* (0.56), *Galinsoga quadriradiata* (0.54), *Chenopodium polyspermum* (0.53), *Erysimum cheiranthoides* (0.46) |
| *Consolida regalis* | 272 | *Euphorbia exigua* (0.78), *Silene noctiflora* (0.75), *Avena fatua* (0.65), *Anagallis arvensis* (0.60), *Sinapis arvensis* (0.59), *Consolida regalis* (0.55), *Lathyrus tuberosus* (0.53) |
| *Setaria pumila* | 71 | *Setaria pumila* (0.60) *Setaria viridis* (0.48), *Echinochloa crus-galli* (0.47) |
| *Spergula arvensis* | 125 | *Spergula arvensis* (0.71), *Raphanus raphanistrum* (0.51), *Scleranthus annuus* (0.49), *Persicaria lapathifolia* (0.33), *Persicaria maculata* (0.32) |
| *Stachys annua* | 34 | *Euphorbia falcata* (0.70), *Kickxia spuria* (0.61), *Stachys annua* (0.55), *Anagallis foemina* (0.54), *Ajuga chamaepitys* (0.46) |
| *Stellaria media* | 1046 | *Viola arvensis* (0.78), *Veronica persica* (0.75), *Thlaspi arvense* (0.73), *Stellaria media* (0.73), *Capsella bursa-pastoris* (0.71), *Fallopia convolvulus* (0.67) |
| *Veronica triphyllos* | 171 | *Lamium amplexicaule* (0.64), *Veronica hederifolia* agg. (0.63), *Veronica triphyllos* (0.40) |

Table 2. – Synoptic table of the *Stellarietea mediae* communities in southern Moravia. The numbers in the columns are percentage frequencies, the fidelity categories for the species in the columns are indicated by numbers in parentheses, e.g. (0) = 0 < phi < 0.10; (1) = 0.10 < phi < 0.20. Values of diagnostic species are shown in bold and ranked in order of decreasing fidelity, calculated as the phi coefficient. Species not exceeding 20% frequency in any of the associations are not shown. LA: *Lathyro-Adonidetum*, EM: *Euphorbio-Melandrietum*, Vht: *Veronicetum hederifolio-triphylli*, SV: *Setario-Fumarietum*, AM: *Aphano-Matricarietum*, SS: *Spergulo-Scleranthetum*, EA: *Erophilo-Arabidopsietum*, ES: *Echinochloo-Setarietum*, PC: *Panico-Chenopodietum*.

| Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Community | LA | EM | Vht | SF | AM | SS | EA | ES | PC |
| Number of relevés | 18 | 28 | 91 | 34 | 12 | 61 | 24 | 20 | 19 |
| Mean altitude | 272 | 270 | 277 | 265 | 470 | 491 | 464 | 279 | 309 |
| Mean Ellenberg indicator values: | | | | | | | | | |
| Light | 7.0 | 6.9 | 6.7 | 6.9 | 6.8 | 6.7 | 6.7 | 6.9 | 6.8 |
| Temperature | 6.0 | 6.0 | 5.9 | 6.0 | 5.8 | 5.7 | 5.8 | 6.1 | 5.9 |
| Continentality | 4.7 | 4.3 | 4.2 | 4.4 | 4.1 | 3.9 | 3.9 | 4.4 | 3.9 |
| Moisture | 4.4 | 4.5 | 4.6 | 4.6 | 4.7 | 5.0 | 4.9 | 4.6 | 5.0 |
| pH | 7.4 | 7.4 | 7.0 | 7.1 | 6.2 | 6.3 | 6.4 | 7.0 | 6.7 |
| Nutrients | 5.8 | 6.1 | 6.4 | 6.8 | 6.1 | 6.5 | 6.4 | 6.4 | 6.8 |
| C r o p | | | | | | | | | |
| *Triticum aestivum* | 31 | 16 | 60 | . | 45 | 16 | 52 | . | 6 |
| *Hordeum distichon* | 12 | 20 | 8 | . | 55 | 21 | 17 | . | . |
| *Brassica napus* | 19 | 16 | 20 | . | . | 5 | 13 | 5 | . |
| *Avena sativa* | . | 8 | 4 | . | 9 | 23 | 4 | 5 | . |
| *Solanum tuberosum* | . | 8 | . | 6 | . | 23 | . | 10 | 18 |
| *Zea mays* | . | 4 | . | 19 | . | 3 | 4 | 20 | 12 |
| *Beta vulgaris* | . | 4 | . | 20 | . | 5 | . | . | . |
| *Medicago sativa* agg. | 20 | 4 | 2 | 3 | . | . | . | 10 | . |
| *L a t h y r o - A d o n i d e t u m* | | | | | | | | | |
| *Adonis aestivalis* | **56 (5)** | 4 | 4 | . | . | . | . | . | . |
| *Anthemis austriaca* | **38 (4)** | . | 4 (0) | . | . | . | . | . | . |
| *Consolida orientalis* | **12 (3)** | . | . | . | . | . | . | . | . |
| *Lithospermum arvense* | **38 (3)** | 4 | 10 (1) | . | . | . | 4 | . | . |
| *Caucalis platycarpos* | **25 (2)** | 12 (1) | 2 | 3 | . | . | . | 5 (0) | . |
| *Bromus sterilis* | **31 (2)** | 8 (0) | 10 (1) | 3 | . | . | 4 | . | . |
| *E u p h o r b i o - M e l a n d r i e t u m* | | | | | | | | | |
| *Anagallis foemina* | 6 | **44 (5)** | . | 3 | . | . | . | 20 (1) | . |
| *Stachys annua* | 12 (0) | **56 (4)** | 1 | 19 (1) | 9 | . | . | 30 (1) | . |
| *Silene noctiflora* | 19 (0) | **64 (3)** | 10 | 32 (1) | 18 | 8 | . | 20 (0) | 6 |
| *Anagallis arvensis* | 19 | **80 (3)** | 4 | 45 (1) | 36 (0) | 33 (0) | 13 | 30 (0) | 24 |
| *Avena fatua* | 12 (0) | **44 (3)** | 2 | 10 | 18 (0) | 5 | . | 15 (0) | 18 (0) |
| *Ajuga chamaepitys* | . | **16 (3)** | . | 6 (1) | . | . | . | . | . |
| *Sinapis arvensis* | 25 (0) | **52 (2)** | 9 | 23 (0) | 18 | 13 | 13 | 20 (0) | 12 |
| *V e r o n i c e t u m h e d e r i f o l i o - t r i p h y l l i* | | | | | | | | | |
| *Veronica hederifolia* agg. | 12 | . | **74 (7)** | . | . | 2 | 17 | . | . |
| *Lamium amplexicaule* | 19 | 4 | **62 (5)** | 13 | 9 | 7 | 26 | 10 | 12 |
| *Veronica polita* | 25 | 36 (0) | **69 (4)** | 29 | . | 11 | 13 | 15 | 18 |
| *Descurainia sophia* | 56 (1) | 28 | **74 (5)** | 10 | . | 8 | 9 | 10 | 6 |
| *Papaver rhoeas* | 75 (1) | 56 (1) | **75 (4)** | 16 | 36 | 7 | 30 | 10 | . |
| *Thlaspi perfoliatum* | 12 (0) | . | **15 (2)** | . | . | . | . | . | . |
| *Veronica triphyllos* | . | . | **11 (2)** | . | . | . | 9 (0) | . | . |
| *Holosteum umbellatum* | . | . | **8 (2)** | . | . | . | 4 (0) | . | . |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Setario-Fumarietum* | | | | | | | | | | | | | | | | | | | | | | |
| *Chenopodium hybridum* | 6 | | 24 | (1) | 3 | | **65** | **(5)** | . | | . | | . | | 5 | | 6 | |
| *Solanum nigrum* | . | | 4 | | . | | **39** | **(5)** | . | | . | | . | | . | | 6 | (0) |
| *Amaranthus retroflexus* | . | | 28 | (0) | 1 | | **81** | **(5)** | . | | 7 | | . | | 55 | (2) | 47 | (1) |
| *Amaranthus powellii* | . | | 12 | (0) | . | | **48** | **(4)** | . | | 2 | | . | | 30 | (2) | . | |
| *Malva neglecta* | . | | . | | 4 | | **32** | **(3)** | . | | . | | . | | 15 | (1) | . | |
| *Aphano-Matricarietum* | | | | | | | | | | | | | | | | | | | | | | |
| *Vicia hirsuta* | . | | . | | 7 | | . | | **73** | **(4)** | 16 | (1) | 9 | | . | | . | |
| *Vicia angustifolia* | 6 | | 12 | | 4 | | . | | **82** | **(4)** | 18 | (1) | 17 | (0) | . | | 6 | |
| *Matricaria recutita* | . | | 4 | | 2 | | . | | **45** | **(3)** | 5 | | 13 | (1) | . | | . | |
| *Apera spica-venti* | 12 | | . | | 10 | | 3 | | **82** | **(3)** | 31 | (1) | 26 | (0) | 10 | | 6 | |
| *Spergularia rubra* | . | | . | | . | | . | | **9** | **(2)** | . | | . | | . | | . | |
| *Myosotis ramosissima* | . | | . | | . | | . | | **9** | **(2)** | . | | . | | . | | . | |
| *Galeopsis pubescens* | . | | . | | . | | . | | **27** | **(2)** | 10 | (2) | . | | . | | . | |
| *Vicia cracca* agg. | . | | 4 | (0) | . | | 3 | | **27** | **(2)** | 5 | (0) | 4 | (0) | 5 | (0) | . | |
| *Spergulo-Scleranthetum* | | | | | | | | | | | | | | | | | | | | | | |
| *Spergula arvensis* | . | | . | | . | | . | | 18 | (0) | **39** | **(5)** | . | | . | | . | |
| *Matricaria discoidea* | 6 | | 12 | | 9 | | . | | 9 | | **59** | **(5)** | 26 | (0) | . | | 12 | |
| *Galeopsis tetrahit* | . | | . | | . | | . | | 18 | (0) | **38** | **(5)** | 4 | | . | | 6 | |
| *Fallopia convolvulus* | 31 | | 76 | (1) | 20 | | 35 | | 91 | (1) | **95** | **(4)** | 30 | | 60 | (0) | 53 | (0) |
| *Persicaria maculosa* | . | | 16 | | 1 | | 16 | | 18 | (1) | **48** | **(3)** | 4 | | 15 | | 47 | (1) |
| *Galeopsis bifida* | . | | . | | . | | . | | . | | **15** | **(3)** | . | | . | | . | |
| *Myosotis arvensis* | 6 | | 16 | | 12 | | 13 | | 45 | (0) | **62** | **(3)** | **78** | **(3)** | 5 | | 18 | |
| *Holcus mollis* | . | | . | | . | | . | | . | | **10** | **(2)** | . | | . | | . | |
| *Gnaphalium uliginosum* | . | | . | | . | | . | | . | | **11** | **(2)** | 4 | (0) | . | | . | |
| *Erophilo-Arabidopsietum* | | | | | | | | | | | | | | | | | | | | | | |
| *Arabidopsis thaliana* | . | | . | | 9 | | 3 | | 18 | (0) | 3 | | **61** | (5) | . | | . | |
| *Lapsana communis* | 6 | | 16 | | 2 | | 3 | | 36 | (1) | 25 | (1) | **52** | **(3)** | 10 | | 18 | (0) |
| *Veronica arvensis* | . | | . | | 15 | | . | | 27 | (0) | 34 | (2) | **57** | (2) | . | | 12 | |
| *Vicia tetrasperma* | . | | . | | 2 | | . | | 9 | (0) | 5 | (0) | **17** | (2) | . | | . | |
| *Erophila verna* | . | | . | | 2 | (0) | . | | . | | . | | **9** | (2) | . | | . | |
| *Echinochloo-Setarietum* | | | | | | | | | | | | | | | | | | | | | | |
| *Setaria pumila* | . | | 12 | (0) | . | | 10 | (0) | 9 | | . | | . | | **65** | **(5)** | 18 | (0) |
| *Setaria viridis* | . | | 4 | | . | | 23 | (2) | . | | . | | . | | **55** | **(5)** | . | |
| *Echinochloa crus-galli* | . | | 8 | | 2 | | **48** | **(2)** | . | | 16 | | 4 | | **90** | **(4)** | 47 | (1) |
| *Euphorbia exigua* | . | | 24 | (2) | . | | 10 | (0) | . | | . | | . | | **30** | **(2)** | 6 | |
| *Sonchus asper* | . | | 20 | (1) | . | | 23 | (1) | . | | 2 | | . | | **35** | **(2)** | 12 | (0) |
| *Panico-Chenopodietum polyspermi* | | | | | | | | | | | | | | | | | | | | | | |
| *Plantago uliginosa* | . | | . | | . | | . | | . | | 3 | (0) | . | | . | | **24** | **(3)** |
| *Sonchus oleraceus* | . | | 16 | (0) | 1 | | 29 | (2) | 9 | | 5 | | . | | 10 | | **47** | **(3)** |
| *Chenopodium polyspermum* | . | | . | | . | | 10 | (1) | . | | 3 | | . | | . | | **24** | **(2)** |
| *Galinsoga quadriradiata* | . | | . | | . | | 13 | (0) | . | | 11 | (1) | . | | 10 | (0) | **35** | **(2)** |
| *Caucalidion lappulae* | | | | | | | | | | | | | | | | | | | | | | |
| *Consolida regalis* | **62** | **(2)** | 40 | (1) | **53** | **(3)** | 10 | | 9 | | . | | 9 | | 20 | | . | |
| *Lathyrus tuberosus* | **31** | **(2)** | 44 | (1) | 16 | (0) | 6 | | . | | . | | 9 | | 30 | (1) | . | |
| *Camelina microcarpa* | **19** | **(2)** | 12 | (1) | 2 | | . | | . | | . | | . | | . | | . | |
| *Bromus japonicus* | 25 | (1) | 8 | (1) | 1 | | . | | . | | . | | . | | . | | . | |
| *Fumaria vaillantii* | 12 | (1) | . | | 7 | (1) | . | | . | | . | | . | | . | | . | |
| *Veronica triloba* | . | | . | | 6 | (1) | . | | . | | . | | . | | . | | . | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Scleranthion annui* | | | | | | | | | | | | | | | | | | | | |
| *Centaurea cyanus* | . | | . | | . | | . | | **64** | **(4)** | 7 | | **30** | **(2)** | . | | 12 | (0) | | |
| *Persicaria lapathifolia* | . | | 32 | (1) | . | | 16 | | 9 | (2) | 34 | | . | | 30 | (0) | 47 | (2) | | |
| *Rumex acetosella* | . | | . | | . | | . | | 9 | (1) | 7 | (1) | . | | . | | . | | | |
| *Scleranthus annuus* | . | | . | | 2 | | 3 | | 18 | (1) | 11 | (1) | 17 | (1) | . | | . | | | |
| *Mentha arvensis* | . | | 8 | | 1 | | 6 | | 18 | (0) | 21 | (2) | . | | 20 | (1) | 6 | | | |
| *Lycopsis arvensis* | 12 | (0) | 4 | | 2 | | . | | 9 | (0) | 16 | (2) | 9 | (0) | 5 | | . | | | |
| *Stachys palustris* | . | | 8 | | 3 | | . | | 18 | (0) | 18 | (1) | 4 | | 10 | (0) | 12 | (0) | | |
| *Raphanus raphanistrum* | . | | . | | 3 | | 3 | | 9 | (0) | 13 | (1) | 13 | (0) | 10 | (1) | 6 | | | |
| *Anthemis arvensis* | . | | . | | 4 | | . | | 18 | (0) | 13 | (1) | 17 | (1) | . | | . | | | |
| *Neslia paniculata* | 6 | (0) | . | | 1 | | . | | . | | 13 | (1) | 4 | | 15 | (1) | 6 | | | |
| *Rumex acetosa* | . | | . | | . | | . | | . | | 3 | (1) | . | | . | | . | | | |
| *Stellarietea mediae* | | | | | | | | | | | | | | | | | | | | |
| *Tripleurospermum inodorum* | 62 | | 72 | | 78 | (0) | 65 | | 64 | | 69 | | 91 | (1) | 65 | | 47 | | | |
| *Cirsium arvense* | 81 | (0) | 84 | (1) | 53 | | 65 | (0) | 82 | | 61 | | 74 | (0) | 55 | (0) | 82 | | | |
| *Capsella bursa-pastoris* | 44 | | 24 | | 76 | (1) | 52 | | 55 | | 77 | (1) | 57 | | 45 | | 59 | | | |
| *Chenopodium album* agg. | 38 | | 84 | (1) | 27 | | 84 | (1) | 55 | | 89 | (2) | 17 | | 85 | (1) | 76 | (0) | | |
| *Viola arvensis* | 62 | | 60 | | 71 | (1) | 29 | | 82 | (1) | 70 | (1) | 91 | (1) | 25 | | 35 | | | |
| *Galium aparine* | 62 | (0) | 44 | | 73 | (1) | 29 | | 27 | | 61 | (0) | 74 | (0) | 50 | | 47 | | | |
| *Stellaria media* | 19 | | 24 | | 65 | (1) | 55 | (0) | 36 | | 66 | (1) | 48 | | 20 | | 59 | (0) | | |
| *Thlaspi arvense* | 38 | | 44 | | 54 | (0) | 19 | | 45 | | 67 | (1) | 70 | (1) | 45 | | 29 | | | |
| *Elytrigia repens* | 81 | (1) | 60 | (0) | 28 | | 39 | | 64 | (0) | 64 | (1) | 61 | (0) | 50 | (0) | 65 | | | |
| *Veronica persica* | 31 | | 48 | | 47 | | 55 | (0) | 27 | | 46 | | 70 | (1) | 45 | (1) | 71 | | | |
| *Polygonum aviculare* agg. | 56 | | 76 | (1) | 31 | | 58 | (0) | 45 | | 54 | 0 | 22 | | 60 | (0) | 35 | | | |
| *Convolvulus arvensis* | 56 | (0) | 60 | (0) | 33 | | 71 | (1) | 27 | | 25 | | 35 | | 90 | (2) | 71 | (1) | | |
| *Taraxacum* sect. *Ruderalia* | 31 | | 24 | | 36 | | 68 | (2) | 64 | (1) | 33 | | 30 | | 25 | | 47 | (0) | | |
| *Euphorbia helioscopia* | 44 | (0) | 40 | (0) | 28 | | 39 | (0) | 27 | | 31 | | 13 | | 65 | (1) | 59 | (1) | | |
| *Lamium purpureum* | 6 | | 8 | | 51 | (2) | 23 | | 27 | | 34 | | 35 | | 5 | | 76 | (2) | | |
| *Artemisia vulgaris* | 19 | | 28 | (0) | 24 | (0) | 19 | | 18 | | 26 | | 30 | | 35 | (0) | 35 | (0) | | |
| *Poa annua* | . | | 12 | | 30 | (0) | 26 | | 18 | | 41 | (1) | 30 | (0) | . | | 12 | | | |
| *Geranium pusillum* | 6 | | 8 | | 27 | (0) | 32 | (0) | 9 | | 23 | | 22 | | 35 | (0) | 12 | | | |
| *Plantago major* | 6 | | 4 | | 10 | | 45 | (2) | 18 | | 31 | (1) | . | | 25 | (0) | 24 | (0) | | |
| *Equisetum arvense* | 25 | (0) | 12 | | 8 | | 13 | | 18 | (0) | 21 | (0) | 17 | (0) | 15 | (1) | 41 | | | |
| *Lactuca serriola* | 25 | (0) | 36 | (1) | 11 | | 16 | (0) | 36 | (1) | 8 | | 9 | | 10 | | 12 | | | |
| *Galinsoga parviflora* | 6 | | 24 | (0) | 2 | | 29 | (1) | 18 | (0) | 16 | (0) | . | | 25 | (0) | 47 | (2) | | |
| *Sonchus arvensis* | . | | 32 | (1) | 3 | | 23 | (0) | 18 | (0) | 15 | (0) | 17 | (0) | 15 | | 29 | (1) | | |
| *Erodium cicutarium* | 6 | | . | | 11 | | 16 | (0) | 27 | (0) | 13 | (0) | 22 | | 20 | (0) | 6 | | | |
| *Ranunculus repens* | 6 | | . | | 10 | (0) | 3 | | 27 | (1) | 15 | (0) | 17 | (0) | . | | 6 | | | |
| *Galium spurium* | . | | 32 | (2) | 1 | (0) | 13 | (0) | 27 | (1) | 10 | | 17 | | 10 | | . | | | |
| *Atriplex patula* | . | | 12 | (0) | 1 | | 26 | (1) | 9 | | 7 | | . | | 25 | (1) | 29 | (1) | | |
| *Fumaria officinalis* | 12 | (0) | 8 | | 7 | | 3 | | 18 | (0) | 8 | | 4 | | 10 | (0) | 24 | (1) | | |
| *Aethusa cynapium* | 6 | | 20 | (1) | 1 | | 13 | (0) | 9 | (0) | 2 | | . | | 20 | (1) | 12 | (0) | | |
| *Arenaria serpyllifolia* agg. | 25 | (1) | 8 | (0) | 7 | (0) | 3 | (0) | 18 | | 2 | | 4 | | 5 | | . | | | |
| *Tussilago farfara* | . | | 8 | (0) | 2 | | 3 | | . | | 10 | (0) | 13 | | . | | 24 | (1) | | |
| *Sherardia arvensis* | 6 | | 20 | (1) | 2 | | 3 | | 9 | (0) | 3 | | 13 | (0) | 5 | | . | | | |
| Other species | | | | | | | | | | | | | | | | | | | | |
| *Achillea millefolium* agg. | 38 | (1) | 12 | | 6 | | . | | 27 | (0) | 20 | (1) | 9 | | 5 | | 12 | | | |
| *Rumex obtusifolius* | . | | . | | 4 | | 3 | | 18 | (0) | 15 | (1) | 4 | | . | | 35 | (2) | | |
| *Daucus carota* | 19 | (1) | 24 | (2) | 2 | | . | | 9 | (0) | 2 | | 4 | | 10 | (0) | 18 | (1) | | |
| *Arrhenatherum elatius* | 38 | (1) | 8 | (0) | 2 | | . | | . | | . | | 4 | (0) | 5 | | . | | | |
| *Medicago lupulina* | . | | 24 | (2) | . | | 6 | (0) | 9 | (0) | 2 | | 4 | | . | | 6 | (0) | | |
| *Trifolium repens* | . | | 4 | | 1 | | 3 | | 27 | (2) | 3 | | . | (0) | 5 | | 12 | (1) | | |
| *Euphorbia esula* | 6 | (0) | 20 | (2) | 1 | (0) | 3 | | . | | . | | 4 | | 5 | (0) | . | | | |
| *Linaria vulgaris* | . | | 20 | (2) | . | | . | | 9 | (0) | 2 | | . | | . | | . | | | |
| *Galeopsis* sp. | . | | . | | 4 | | . | | . | | 7 | (0) | 26 | (2) | 5 | | . | | | |

The Cocktail definitions of associations were then applied to 310 relevés of weed vegetation from southern Moravia. Assignment of these relevés to associations according to Cocktail definitions was made using the JUICE 6.0 program (Tichý 2002). Forty five relevés, which did not contain any group of diagnostic species, were classified subsequently on the basis of their similarity to defined units. The similarity of each of these 45 relevés to each column of a synoptic table created from the relevés, which were assigned to the associations by the Cocktail definitions, were calculated using the frequency-fidelity index (Kočí et al. 2003). The relevés were then assigned to the most similar association. The results are presented in a synoptic table (Table 2). Diagnostic species for the associations were defined as those with phi > 0.25. Diagnostic species for the alliances *Caucalidion* and *Scleranthion* were calculated separately for the synoptic table of alliances.

The detrended correspondence analysis (DCA; Hill & Gauch 1980) in the program CANOCO (ter Braak & Šmilauer 1998) was used to present the variation in southern Moravian weed communities. The square-root transformed percentage constancy table was used as an input matrix for the DCA. The distribution maps of weed communities were prepared using the DMAP program (Morton 2001).

## Results

Table 1 shows the Cocktail groups of the weed vegetation of the Czech Republic. Some of these groups (e.g. *Adonis aestivalis*, *Caucalis platycarpos*, and *Veronica triphyllos*) include specialized species of weed, which can be used to define associations. Some of the groups (e.g. *Stellaria media*, *Cirsium arvense*) define vegetation classes or alliances. These groups or their combinations were used to formally define associations. The following nine communities of weed vegetation were distinguished in southern Moravia[1]:

*Caucalidion lappulae* (R. Tx. 1950) von Rochow 1951

*Lathyro tuberosi-Adonidetum aestivalis* Kropáč et Hadač in Kropáč et al. 1971

Diagnostic species: ***Adonis aestivalis, Anthemis austriaca,*** *Arenaria serpyllifolia* agg., *Bromus japonicus,* ***Bromus sterilis,*** *Camelina microcarpa,* ***Caucalis platycarpos,*** *Consolida regalis,* ***Consolida orientalis****, Descurainia sophia, Elytrigia repens, Euphorbia falcata, Fumaria vaillantii*, *Lathyrus tuberosus*, ***Lithospermum arvense,*** *Papaver rhoeas.*

Constant species: *Adonis aestivalis*, ***Cirsium arvense***, *Consolida regalis*, *Convolvulus arvensis, Descurainia sophia*, ***Elytrigia repens***, *Galium aparine, Papaver rhoeas*, *Polygonum aviculare* agg., *Tripleurospermum inodorum*, *Viola arvensis.*

Cocktail definition: Adonis aestivalis Group AND NOT Caucalis platycarpos Group

The vegetation is species rich but with a low cover of weeds and lacks a striking dominant species. Mosses occur rarely. The stands are divided into two different layers. The height of the first is dependent on the crop (80–100 cm), the lower layer is of 10–30 cm tall species

[1] In descriptions of associations, diagnostic species with a high fidelity are in bold, while diagnostic species with lower fidelity (0.15 < phi < 0.25) are in normal letters. Constant species reported in descriptions of associations were defined as species with frequencies higher than 50%; species with frequencies higher than 80% are in bold.

(*Anagallis arvensis*, *Arenaria serpyllifolia* agg., *Caucalis platycarpos*). Archaeophytic[2] therophytes predominate.

This community is well developed mainly in cereal fields and its phenology is closely related to the crop. The seasonal optimum of *Lathyro-Adonidetum* is in June. In the same fields *Veronicetum hederifolio-triphylli* can be found in spring.

*Lathyro-Adonidetum* was found on calcareous soils in the warm and dry area of southern Moravia (Fig. 2). Otýpková (2001) reported it occurred in the southern part of the Bílé Karpaty Mts. Kropáč et al. (1971), Kropáč (1985) and Koblihová (1989) described it from western and central Bohemia. *Lathyro-Adonidetum* was rarely found in the southern and southeastern part of Slovakia (Jarolímek et al. 1997). Species composition of the association *Galio-Adonidetum* (Hilbig 1966, 1967, 1973), described from Germany, is closely similar to that in Moravia.

*Euphorbio exiguae-Melandrietum noctiflori* G. Müller 1964

Diagnostic species: *Aethusa cynapium,* ***Ajuga chamaepitys***, ***Anagallis arvensis***, ***Anagallis foemina***, ***Avena fatua***, *Camelina microcarpa, Consolida regalis, Euphorbia esula, Euphorbia exigua, Fallopia convolvulus, Galium spurium, Lathyrus tuberosus, Sherardia arvensis,* ***Silene noctiflora***, ***Sinapis arvensis***, *Sonchus arvensis,* ***Stachys annua***.

Constant species: ***Anagallis arvensis***, ***Chenopodium album***, ***Cirsium arvense***, *Convolvulus arvensis, Elytrigia repens, Fallopia convolvulus, Papaver rhoeas, Polygonum aviculare* agg., *Silene noctiflora, Sinapis arvensis, Stachys annua, Tripleurospermum inodorum*, *Viola arvensis.*

Cocktail definition: (Consolida regalis Group OR Stachys annua Group) AND NOT (Adonis aestivalis Group OR Caucalis platycarpos Group OR Spergula arvensis Group)

A species rich community that occurs mainly in cereal fields or in stubble fields. The moss layer is absent or weakly developed in stubble fields. The most frequent weeds are *Tripleurospermum inodorum, Cirsium arvense* and some diagnostic species of this community or of the alliance *Caucalidion* (*Consolida regalis*, *Descurainia sophia*, *Lathyrus tuberosus*). Many vernal ephemeral species occur in the lower layers.

Two seasonal variants of this community were distinguished. The first develops in fields before the harvesting of cereals. The second is found mainly in stubble fields in August and September, and consists of mainly species of the *Stachys annua* group.

*Euphorbio-Melandrietum* prefers nutrient-rich, basic or neutral soils.

This community is widely distributed in the whole southern Moravian range of thermophilous flora (Fig. 2), including the Bílé Karpaty Mts (Otýpková 2001). It is widespread in cereal fields in warmer areas of Bohemia (Kropáč 1981, Koblihová 1989) and other Central European countries (Müller 1964, Hilbig 1966, 1967, 1973, Holzner 1973, Kropáč 1974, Krippelová 1981, Borowiec et al. 1985, Ries 1992, Mucina 1993).

*Veronicetum hederifolio-triphylli* Slavnić 1951

Diagnostic species: *Capsella bursa-pastoris,* ***Consolida regalis***, ***Descurainia sophia***, *Fumaria vaillantii, Galium aparine,* ***Holosteum umbellatum***, ***Lamium amplexicaule***, ***Lamium purpureum***, ***Papaver rhoeas***, *Stellaria media,* ***Thlaspi perfoliatum***, ***Veronica hederifolia*** **agg.**, ***Veronica polita***, *Veronica triloba,* ***Veronica triphyllos***.

[2] Of alien origin, introduced before the year 1500 (Pyšek et al. 2002).

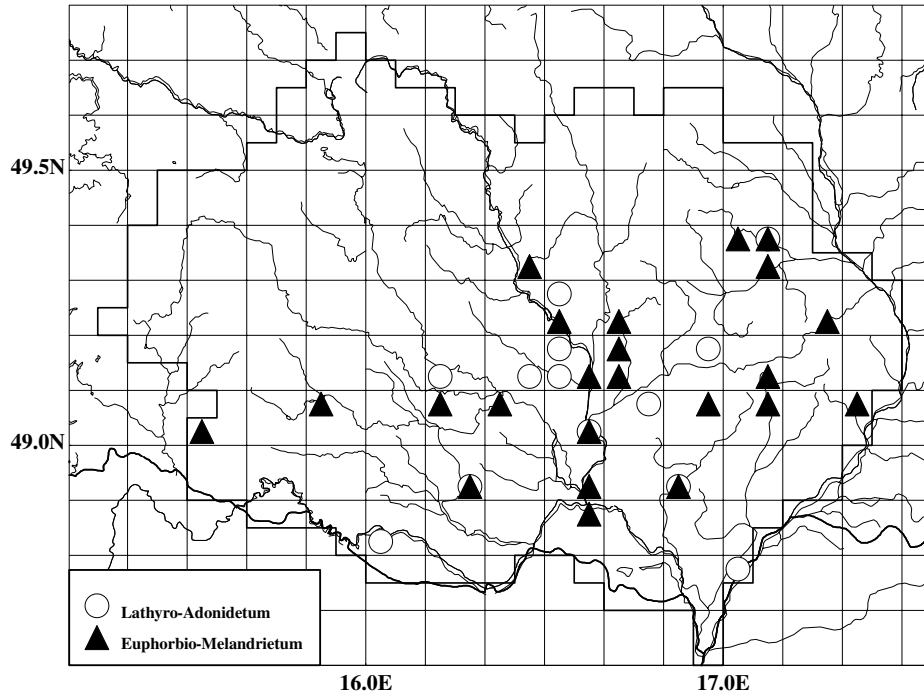


Fig. 2. – Distribution of weed communities of the alliance *Caucalidion* in southern Moravia.

Constant species: *Capsella bursa-pastoris, Cirsium arvense*, *Consolida regalis*, *Descurainia sophia*, *Galium aparine, Lamium amplexicaule*, *Lamium purpureum*, *Papaver rhoeas*, *Stellaria media*, *Thlaspi arvense*, *Tripleurospermum inodorum*, *Veronica hederifolia* agg., *Veronica polita*, *Viola arvensis.*

Cocktail definition: Veronica triphyllos Group AND NOT (Arabidopsis thaliana Group OR Spergula arvensis Group)

This community occurs in winter wheat fields, in vineyards and abandoned fields. Winter annuals predominate and some juvenile *Caucalidion* species can be distinguished. The herb layer is only 10–20 cm high.

*Veronicetum hederifolio-triphylli* is an ephemeral spring community. Its phenological optimum is in April and May, and then the species disappear from fields. Some of them (e.g. *Veronica polita*, *Lamium amplexicaule*, *Capsella bursa-pastoris*) can re-appear in September. This community was found at altitudes 150–510 m. In warmer regions of southern Moravia, thermophilous species such as *Veronica triloba*, *V. triphyllos* and *Thlaspi perfoliatum* were present. These species are absent in colder regions, where *Veronica sublobata* usually dominates.

This association is very common in warm and dry regions of the study area (Fig. 3). It occurs in the whole Pannonian region (Slavnić 1951, Holzner 1973, Mochnacký 1986, Mucina 1993, Kropáč 1997).

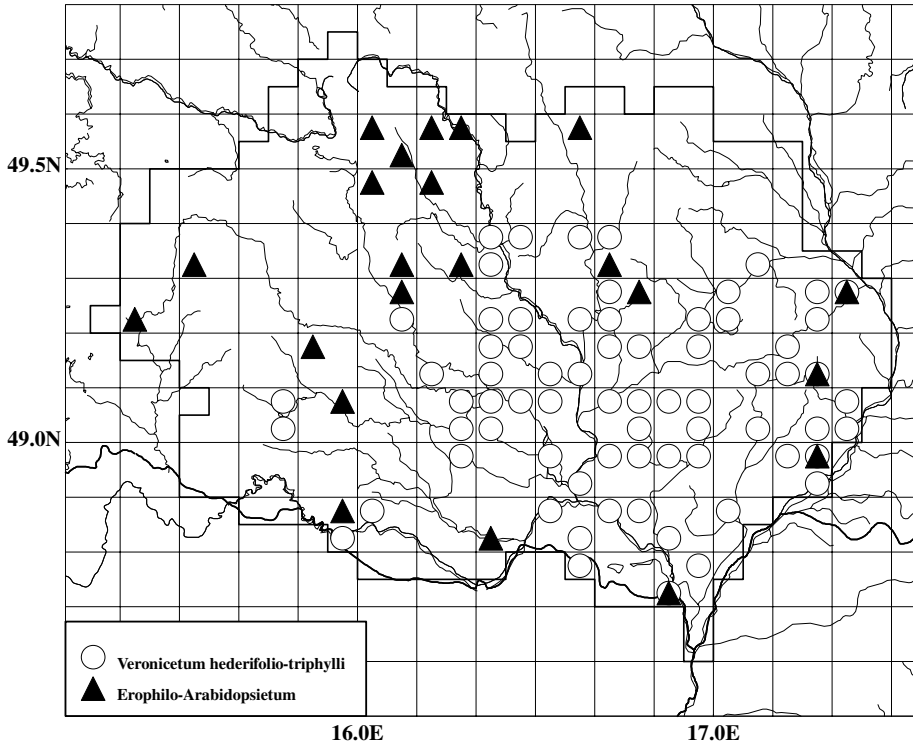


Fig. 3. – Distribution of vernal weed communities in southern Moravia.

*Veronico-Euphorbion* Sissingh ex Passarge 1964

*Setario-Fumarietum* J. Tüxen 1955

Diagnostic species: ***Amaranthus powellii, Amaranthus retroflexus,*** *Atriplex patula, Convolvulus arvensis,* ***Echinochloa crus-galli,*** *Chenopodium album* agg., ***Chenopodium hybridum, Malva neglecta,*** *Plantago major, Setaria viridis,* ***Solanum nigrum,*** *Sonchus asper, Sonchus oleraceus, Taraxacum* sect. *Ruderalia.*

Constant species: ***Amaranthus retroflexus***, *Capsella bursa-pastoris, Cirsium arvense, Convolvulus arvensis,* ***Chenopodium album*** **agg.,** *Chenopodium hybridum, Polygonum aviculare* agg., *Stellaria media*, *Taraxacum* sect. *Ruderalia, Tripleurospermum inodorum*, *Veronica persica.*

Cocktail definition: Amaranthus retroflexus Group AND NOT Consolida regalis Group

This community occurs mainly in root-crop fields. Cover of weeds depends on the frequency of disturbance. Its height is 30–80 cm. The stands consist mainly of summer thermophilous annuals (*Amaranthus retroflexus*, *A. powellii*, *Chenopodium album* agg., *C. hybridum*). Some diagnostic species of the *Caucalidion* alliance may be present. Mosses are present only rarely and at a low frequency.

The phenological optimum of *Setario-Fumarietum* is late summer (August and September). This community prefers nutrient rich, basic soils in the Pannonian region of southern Moravia, at altitudes between 190–320 m.

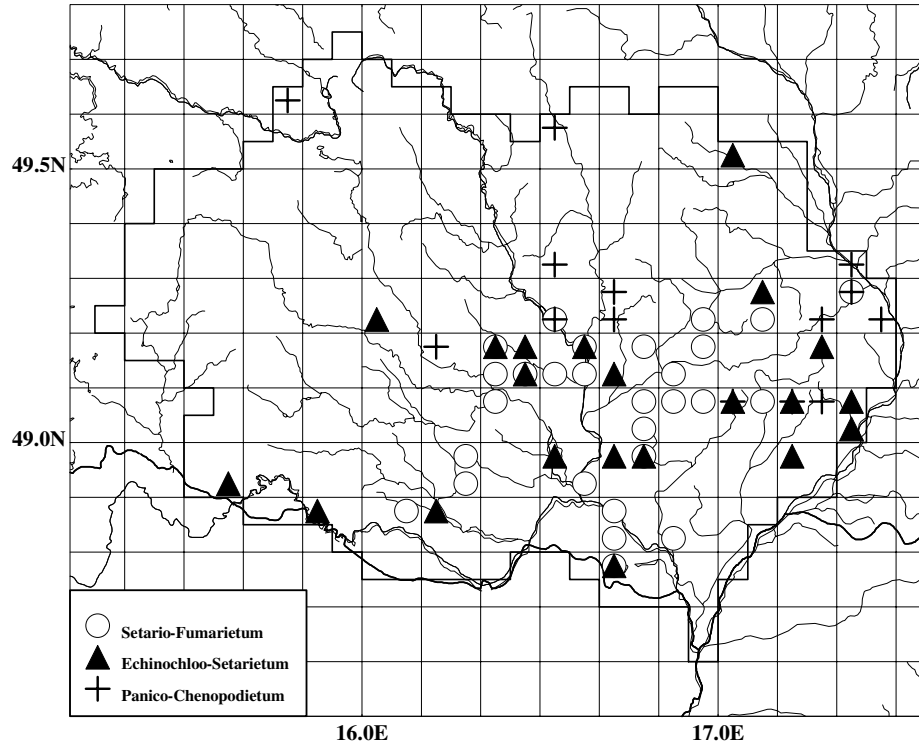


Fig. 4. – Distribution of weed communities *Setario-Fumarietum*, *Echinochloo-Setarietum*, and *Panico-Chenopodietum* in southern Moravia.

This vegetation is widely distributed in the southeastern part of the study area (Fig. 4). Otýpková (2001) found a community with similar diagnostic species in warm areas of the Bílé Karpaty Mts. *Setario-Fumarietum* is recorded in south Germany (J. Tüxen 1955) and Slovakia (Vilčeková 1981).

*Scleranthion annui* (Kruseman et Vlieger 1939) Sissingh in Westhoff et al. 1946

*Aphano arvensis-Matricarietum chamomillae* R. Tx. 1937

Diagnostic species: ***Apera spica-venti, Centaurea cyanus,*** *Fallopia convolvulus,* ***Galeopsis pubescens, Matricaria recutita, Myosotis ramosissima,*** *Persicaria lapathifolia,* ***Spergularia rubra, Vicia angustifolia, Vicia cracca*** **agg.,** ***Vicia hirsuta.***

Constant species: ***Apera spica-venti,*** *Capsella bursa-pastoris, Centaurea cyanus,* ***Cirsium arvense****, Elytrigia repens*, *Chenopodium album* agg., *Taraxacum* sect. *Ruderalia, Tripleurospermum inodorum*, ***Vicia angustifolia****, Vicia hirsuta,* ***Viola arvensis***.

Cocktail definition: Aphanes arvensis Group AND NOT Arabidopsis thaliana Group

This community occurs in cereal fields. It consists of two layers; the tallest plants (60–80 cm) are the herbs *Apera spica-venti*, *Centaurea cyanus* and *Cirsium arvense*, and herbaceous lianas *Vicia hirsuta*, *V. angustifolia*, *V. cracca* agg. The lower layer includes inconspicuous but constant species *Spergularia rubra*, *Viola arvensis*, *Myosotis arvensis* and *M. ramosissima*.

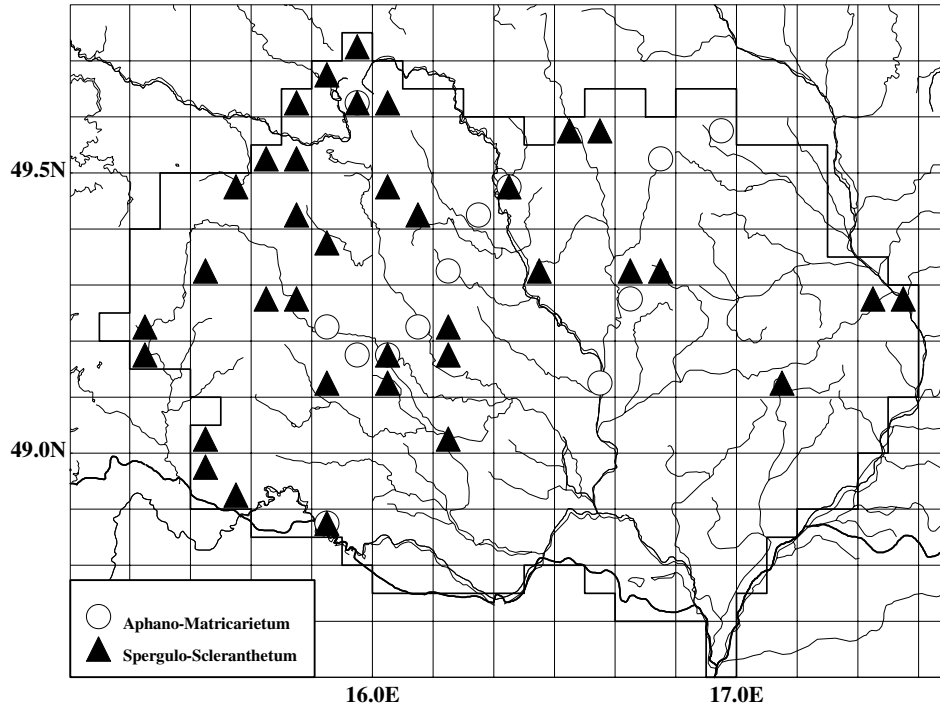


Fig. 5. – Distribution of weed communities of the alliance *Scleranthion* in southern Moravia.

*Aphano-Matricarietum* grows on neutral or acidic soils at altitudes of 220–670 m. Its phenological optimum is June and July.

This community was previously found in the western part of the study area, at lower altitudes in the Českomoravská vrchovina Uplands (Fig. 5) and localities near the towns of Letovice, Jevíčko and Jedovnice. *Aphano-Matricarietum* is one of the most widespread weed communities in Central Europe. It has frequently been recorded in Bohemia (Kropáč 1981) and other countries (Passarge 1964, Hilbig 1966, 1967, 1973, Meisel 1967, 1973, Holzner 1973, Nezadal 1975, Wójcik 1978, Oberdorfer 1983, Anioł-Kwiatkowska 1990, Hüppe & Hofmeister 1990, Ries 1992, Jarolímek 1997).

### *Spergulo arvensis-Scleranthetum annui* Kuhn 1937

Diagnostic species: *Apera spica-venti, Capsella bursa-pastoris,* ***Fallopia convolvulus, Galeopsis bifida,*** *Galeopsis pubescens,* ***Galeopsis tetrahit, Gnaphalium uliginosum, Holcus mollis, Chenopodium album*** **agg.,** *Lycopsis arvensis,* ***Matricaria discoidea,*** *Mentha arvensis,* ***Myosotis arvensis,*** *Neslia paniculata,* ***Persicaria maculosa,*** *Plantago major, Rumex acetosa, Rumex acetosella,* ***Spergula arvensis,*** *Stachys palustris, Thlaspi arvense, Veronica arvensis.*

Constant species: *Capsella bursa-pastoris, Cirsium arvense, Elytrigia repens,* ***Fallopia convolvulus****, Galium aparine,* ***Chenopodium album*** **agg.,** *Matricaria discoidea, Myosotis arvensis, Polygonum aviculare* agg., *Stellaria media, Thlaspi arvense, Tripleurospermum inodorum*, *Viola arvensis.*

Cocktail definition: Spergula arvensis Group AND NOT Aphanes arvensis Group

This community occurs in root-crop and cereal fields. The herb layer is relatively species-rich, with a height of 30–80 cm. Mosses are often present. This association is composed of annual weeds and perennial species, e.g. *Rumex acetosella, R. acetosa, Holcus mollis* and *Potentilla anserina*.

*Spergulo-Scleranthetum* grows predominantly on acidic soils in more humid and cold areas of southern Moravia at altitudes between 230–680 m. Phenological optimum is late summer.

This vegetation occurs mainly in the central part of the Českomoravská vrchovina Uplands and other colder areas of southern Moravia (Fig. 5). In the western part of the study area, *Spergulo-Scleranthetum* is the most common weed association. It was also found in the central part of the Bílé Karpaty Mts (Otýpková 2001). It is sporadically recorded occurring in adjacent countries (Oberdorfer 1983, Mucina 1993, Jarolímek 1997).

*Erophilo-Arabidopsietum thalianae* Kropáč in Krippelová 1981

Diagnostic species: *Anthemis arvensis*, ***Arabidopsis thaliana, Centaurea cyanus, Erophila verna, Lapsana communis, Myosotis arvensis,*** *Scleranthus annuus,* ***Veronica arvensis, Vicia tetrasperma,*** *Viola arvensis.*

Constant species: *Arabidopsis thaliana*, *Capsella bursa-pastoris*, *Cirsium arvense, Elytrigia repens, Galium aparine, Lapsana communis, Thlaspi arvense,* ***Tripleurospermum inodorum***, *Veronica arvensis*, *Veronica persica,* ***Viola arvensis***.

Cocktail definition: (Arabidopsis thaliana Group AND Stellaria media Group) AND NOT Veronica triphyllos Group

This vernal association mainly occurs in winter cereal fields. The vegetation is only about 20 cm high. Dominants include ephemeral weeds such as *Arabidopsis thaliana* and *Erophila verna*. Juvenile individuals of some diagnostic species of the alliance *Scleranthion annui* and some constant weed species (*Viola arvensis*, *Thlaspi arvense*) may also be present. Mosses are absent.

*Erophilo-Arabidopsietum* dominates fields in May before the summer weed associations of the alliance *Scleranthion* develop. This weed vegetation prefers humid acidic or neutral soils. The relevés are from altitudes between 210–640 m.

Localities of *Erophilo-Arabidopsietum* are mostly in the western part of the study area (Fig. 3). Some localities are also in the Bílé Karpaty Mts, Hostýnské vrchy Mts, Vsetínské vrchy Mts, Javorníky Mts and Chřiby Hills (Otýpková 2001). The Moravian range of this association extends into adjacent Bohemia (Kropáč 1981, 1997). This community is also reported from eastern Slovakia (Krippelová 1981, Mochnacký 1984).

*Spergulo-Oxalidion* Görs in Oberd. et al. 1967

*Panico-Chenopodietum polyspermi* R. Tx. 1937

Diagnostic species: *Amaranthus retroflexus, Atriplex patula, Echinochloa crus-galli, Galinsoga parviflora,* ***Galinsoga quadriradiata, Chenopodium polyspermum,*** *Lamium purpureum, Persicaria lapathifolia, Persicaria maculosa,* ***Plantago uliginosa, Sonchus oleraceus,*** *Tussilago farfara.*

Constant species: *Capsella bursa-pastoris*, ***Cirsium arvense***, *Convolvulus arvensis, Elytrigia repens*, *Euphorbia helioscopia*, *Fallopia convolvulus*, *Chenopodium album* agg., *Lamium purpureum*, *Stellaria media, Veronica persica.*

Dominant species: *Galinsoga parviflora.*

Cocktail definition: Chenopodium polyspermum Group AND NOT (Aphanes arvensis Group OR Spergula arvensis Group)

This association occurs mainly in root-crop fields or in gardens. The herb layer of weeds is 30–80 cm high, dominated mostly by *Galinsoga parviflora*. Other weeds, e.g. *Amaranthus retroflexus, Conyza canadensis, Equisetum arvense* and *Chenopodium polyspermum,* are also frequently present. In the lower sub-layer, *Lamium purpureum, Oxalis fontana*, *Persicaria maculosa* and *Plantago uliginosa* are common.

The phenological optimum of this community is August and September. It is confined to moist, heavy soils, rich in nutrients. The altitudinal range is between 190–420 m.

This community was recorded in the surroundings of the towns of Brno, Kroměříž, Letovice, Náměšť nad Oslavou (Fig. 4) in the Bílé Karpaty Mts (Otýpková 2001), and in the Podyjí/Thayatal National Park (Cigánek 1998). Outside the Czech Republic, *Panico-Chenopodietum* is recorded from Slovakia (Passarge & Jurko 1975, Krippelová 1981, Hadač et al. 1997), Germany (Hilbig 1967, 1973, Nezadal 1975), Poland (Anioł-Kwiatkowska 1990), Austria (Mucina 1993) and Romania (Morariu 1943).

*Panico-Setarion* Sissingh in Westhoff et al. 1946

*Echinochloo-Setarietum pumilae* Felföldy 1942 corr. Mucina in Mucina et al. 1993

Diagnostic species: *Amaranthus powellii, Amaranthus retroflexus, Anagallis foemina, Convolvulus arvensis,* ***Echinochloa crus-galli, Euphorbia exigua,*** *Euphorbia helioscopia,* ***Setaria pumila, Setaria viridis, Sonchus asper,*** *Stachys annua.*

Constant species: *Amaranthus retroflexus*, *Cirsium arvense*, ***Convolvulus arvensis***, ***Echinochloa crus-galli***, *Elytrigia repens, Euphorbia helioscopia*, *Fallopia convolvulus, Galium aparine,* ***Chenopodium album*** **agg**., *Polygonum aviculare* agg., *Setaria pumila, Setaria viridis, Tripleurospermum inodorum.*

Dominant species: *Galinsoga parviflora.*

Cocktail definition: Setaria pumila Group AND NOT (Consolida regalis Group OR Amaranthus retroflexus Group)

This association was found in fields with various crops. Summer annual grasses (*Setaria pumila, S. viridis, Digitaria ischaemum, Echinochloa crus-galli* ) dominate the species composition. *Galinsoga parviflora* is very common in gardens. Occasionally present is a moss layer with *Barbula unguiculata, Bryum capillare* and *Phascum cuspidatum*.

This community occurs primarily on dry sandy soils in the warm regions of southern Moravia. Its phenological optimum is late summer, when the annual grasses *Setaria pumila*, *S. viridis* and *Echinochloa crus-galli* dominate.

Localities of *Echinochloo-Setarietum* are mostly concentrated in the eastern part of the study area (Fig. 4). This community is widespread in lowlands throughout the Czech Republic (Kropáč 1995). It is found in Slovakia (Jarolímek et al. 1997), Germany (Hilbig 1973, Nezadal 1975) and Austria (Ries 1992, Mucina 1993).

The distribution maps of weed communities show a striking difference between the weed vegetation in the dry and warm areas of the southern Moravian Thermophyticum[3] and that of the colder and more humid parts of Mesophyticum. The most common com-

[3] Units of the regional phytogeographical division of the Czech Republic (Skalický 1988).

munities in the study area are *Spergulo-Scleranthetum* and *Euphorbio-Melandrietum*, and both vernal associations (*Veronicetum hederifolio-triphylii, Erophilo-Arabidopsietum*).

*Ordination*

DCA ordination of the southern Moravian weed communities (Fig. 6) reveals variations in this vegetation. The gradient of the first ordination axis is determined by soil and climate. Communities of fields with a high pH at lower altitudes are on the left of the ordination diagram and communities of fields with a neutral to low pH in more humid and colder areas are on the right. The second axis gradient correlates with seasonal changes in the species composition of southern Moravian weed vegetation. Vernal species are situated in the upper and summer species in the lower part of the ordination diagram.

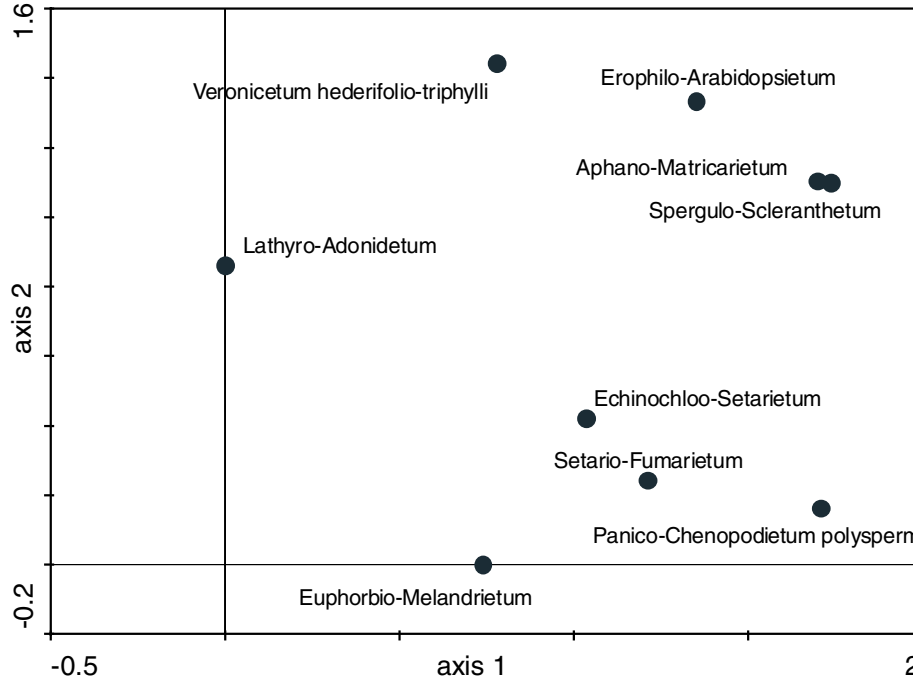


Fig. 6. – DCA ordination diagram of southern Moravian weed communities based on square-root transformed percentage constancy matrix.

## Discussion

The Cocktail method combined with subsequent assignment of relevés to associations based on similarity efficiently classified the weed communities of southern Moravia.

Delimitation of the nine associations characterized above follows more the Slovak phytosociological system (Jarolímek et al. 1997). The Czech phytosociological system of weed vegetation (Kropáč 1995) differs from the Slovak in the delimitation of associations

of root crop weed communities (order *Atriplici-Chenopodietalia albi*). The communities *Amarantho-Fumarietum*, *Amarantho-Chenopodietum* and *Digitario-Portulacetum,* distinguished by Kropáč (1995), are poorly characterized by diagnostic species. Their interpretation is unclear, so they were not adopted in this study. There are no clear differences between *Rorippo-Chenopodietum* and *Oxalido-Chenopodietum* (Kropáč 1981, 1995) in Bohemia.

Delimitations of cereal weed communities (*Caucalidion* and S*cleranthion* alliances) are similar in the Czech and Slovak Republics (Kropáč 1995, Jarolímek et al. 1997).

However, some earlier recognized associations of cereal weeds could not be defined using the Cocktail method. No group of diagnostic species could be found for the *Consolido-Anthemidetum* community (Kropáč & Mochnacký 1990). The diagnostic species mentioned by these authors (*Anthemis austriaca*, *Consolida regalis*, *Centaurea cyanus*) have different ecological affinities and do not distinguish this community from other types of weed vegetation. Similarly, there was no support for a group of diagnostic species of the alliance *Sherardion*. The species group reported by Kropáč (1981, 1995) as characteristic for this alliance (*Aethusa cynapium, Galeopsis ladanum, Geranium dissectum, Neslia paniculata, Sherardia arvensis, Valerianella dentata*) was tested in the data set for the whole of the Czech Republic, but never formed a coherent group.

Some authors (Hilbig 1967, Schubert & Mahn 1968, Holzner 1973, Volf & Kropáč 1974, Nezadal 1975, Hüppe & Hofmeister 1990, Kropáč 1981, 1995) distinguish the *Holco-Galeopsietum* community as the most montane type of the *Scleranthion* alliance. The *Holco-Galeopsietum* should be defined by *Holcus mollis*, *Galeopsis tetrahit*, *Spergula arvensis*, *Rumex acetosella*, *Raphanus raphanistrum* and *Scleranthus annuus*. However, this was not confirmed by the data from the Czech Republic in which it was not possible to discriminate between *Holco-Galeopsietum* and *Spergulo-Scleranthetum*.

The *Caucalido daucoidis-Conringietum orientalis* community of the *Caucalidion* alliance was also reported for the Czech Republic by Kropáč (1995). This vegetation may have been widespread in southern Moravian cereal fields in the first half of the 20th century (Lososová 2003). Using the Cocktail method, however, did not reveal this association in the southern Moravian data set.

In addition to nine communities characterized in this paper, other types of weed vegetation are reported from Slovakia. Some of the communities described from high altitudes in Slovakia (*Rhinantho-Avenetum fatuae*, *Lathyro-Avenetum fatuae* and *Myosotido-Sonchetum arvensis* – Passarge & Jurko 1975, Jarolímek et al. 1997) or only from eastern Slovakia (*Cannabio ruderalis-Silenetum noctiflorae, Stachyo annui-Setarietum pumilae* – Mochnacký 1989, Jarolímek et al. 1997) are not found in southern Moravia due to the lack of suitable habitats.

## Souhrn

Plevelová vegetace jižní Moravy byla studována v letech 1997–2002. Pro zachycení celkové variability této vegetace byla zvolena metodika stratifikovaného výběru lokalit fytocenologických snímků. Ta spočívala v charakteristice přírodních podmínek jednotlivých kvadrantů sítě středoevropského mapování a v následné numerické klasifikaci kvadrantů pomocí těchto charakteristik. Z každé skupiny podobných kvadrantů byl pro terénní výzkum náhodně vybrán pouze jeden kvadrant, kde byla plevelová vegetace zapisována. Ve 115 vybraných kvadrantech bylo zapsáno celkem 278 fytocenologických snímků. Do klasifikace bylo dále zahrnuto 32 příležitostně zapsa-

ných snímků plevelové vegetace z jižní Moravy. Získané fytocenologické snímky byly klasifikovány na základě formalizovaného přístupu pomocí metody Cocktail. Nejprve byly sestaveny sociologické skupiny druhů plevelové vegetace (tab. 1). Ty byly definovány v obsáhlém souboru 21 794 snímků z České národní fytocenologické databáze, aby byla ověřena jejich platnost v celé České republice a vyhraněnost vzhledem k ostatním vegetačním jednotkám. Každá skupina diagnostických druhů obsahovala 3–7 druhů s podobnými ekologickými nároky a byla nazvána podle jednoho z obsažených druhů. V programu JUICE byly fytocenologické snímky plevelové vegetace jižní Moravy vybírány a klasifikovány podle toho, zda obsahují alespoň polovinu z taxonů některé diagnostické skupiny. Ve většině případů snímek obsahoval jednu nebo více diagnostických skupin, v některých případech však neobsahoval skupinu žádnou. Vytvořené diagnostické skupiny, případně jejich kombinace, byly použity k sestavení formálních definic asociací plevelové vegetace. Přítomnost nebo naopak absence jedné nebo více diagnostických skupin ve snímku byla rozhodujícím kritériem pro zařazení snímku k jednotlivým asociacím. Pokud snímek neobsahoval žádnou diagnostickou skupinu nezbytnou pro jeho zařazení, byl jako další krok pro přiřazení snímku k asociaci použit výpočet podobnosti snímku se snímky už jednoznačně zařazenými do asociací pomocí formálních definic.

Formalizovaná klasifikace metodou Cocktail stanovila jednoznačná kriteria pro zařazení fytocelonogických smínků do asociací, která jsou platná pro plevelovou vegetaci celé České republiky. Na základě popsané formální klasifikace bylo na jižní Moravě rozlišeno devět asociací. Svaz *Caucalidion lappulae*: 1. *Lathyro tuberosi-Adonidetum aestivalis,* plevelové společenstvo obilných polí. Na jižní Moravě se vyskytuje na bazických substrátech v nejteplejších oblastech. 2. *Euphorbio exiguae-Melandrietum noctiflori* se vytváří především v obilných polích a později na strništích. Asociace je hojná na jižní Moravě s výjimkou území Českomoravské vrchoviny a jejího podhůří. 3. *Veronicetum hederifolio-triphylli* zahrnuje porosty tvořené jarními efemerními druhy plevelů. Vytváří se především na polích s ozimou pšenicí a ve vinohradech. Společenstvo se na jižní Moravě vyskytuje na bazických až neutrálních půdách v termofytiku a v přilehlých oblastech mezofytika. Svaz *Veronico-Euphorbion*: 4. *Setario-Fumarietum* je teplomilné společenstvo vyskytující se především v porostech okopanin. Na jižní Moravě bylo nalezeno na živinami bohatých půdách. Svaz *Scleranthion annui*: 5. *Aphano arvensis-Matricarietum chamomillae* zahrnuje převážně porosty plevelů v obilných polích na neutrálních až mírně kyselých půdách. Těžiště rozšíření na jižní Moravě má asociace v podhůří Českomoravské vrchoviny. 6. *Spergulo arvensis-Scleranthetum annui* je nejčastější plevelová vegetace v chladných a vlhkých územích jižní Moravy. Společenstvo se vyskytuje v obilných i okopaninových kulturách na neutrálních až kyselých půdách. 7. *Erophilo-Arabidopsietum thalianae* zahrnuje jarní společenstva ozimých obilných polí na kyselých až neutrálních půdách. Společenstvo bylo nejčastěji pozorováno v západní části jižní Moravy. Svaz *Spergulo-Oxalidion*: 8. *Panico-Chenopodietum polyspermi* je společenstvo plevelů vyskytujících se v chladnějších oblastech jižní Moravy. Společenstvo se vyvíjí především v okopaninách. Svaz *Panico-Setarion*: 9. *Echinochloo-Setarietum pumilae* je společenstvo tvořené převážně jednoletými travami. Vyskytuje se na písčitých, vysychavých půdách teplých oblastí jižní Moravy.

Při sestavování diagnostických skupin druhů pro jednotlivá společenstva plevelové vegetace České republiky nebyla potvrzena vhodnost používání některých asociací uváděných v dosavadní literatuře. Za použití popsané metodiky nebylo možné na základě skupin diagnostických druhů odlišit společenstvo *Consolido-Anthemidetum* od společenstva *Lathyro-Adonidetum* a společenstvo *Holco-Galeopsietum* od asociace *Spergulo-Scleranthetum*. Dále nebyla nalezena skupina diagnostických druhů pro svaz *Sherardion*.

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