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VEGETATION OF THE CLASSES *Stellarietea mediae* AND *Agropyretea repentis* IN THE VINEYARDS OF BOSNIA AND HERZEGOVINA

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ABSTRACT

This paper shows the results of many years researches of the weed vegetation of vineyards in western Balkan which includes eight associations: *Panico-Galinsogetum parviflorae* Tüxen et Becker 1942, *Panico-Portulacetum oleraceae* Lozanovski 1962, *Cynodono-Sorghetum halepensae* (Laban 1974) Kojić 1979, *Amarantho-Fumarietum* Tüxen 1955, *Diplotaxietum muralis* Kovačević 2013, *Convolvulo-Polygonetum aviculare* Kovačević 2014, *Erigerono-Setarietum glaucae* Šumatić 1997 and *Convolvulo-Agropyretum repentis* Felföldy 1943. By projecting the plant communities on the main components (Principal Component Analysis) and comparing them to the ecological indices (variables), it shows that *Cynodono-Sorghetum halepensae* and *Diplotaxietum muralis* are similar according to their humidity (F) and temperature (T) requirements and *Cynodono-Sorghetum halepensae* and *Diplotaxietum muralis* are similar according to their chemical reaction of the soil (R). *Amarantho-Fumarietum* and *Erigerono-Setarietum glaucae* are the similar according to their demands for the light (L).

Key words: ecological indices, weed vegetation, agroecosystem

INTRODUCTION

Weed flora and vegetation mostly depend on ecological conditions of the particular area, the kind of the crop and applied agrotechnical measurements [Shrestha et al. 2002, Barać and Garić 2004, Ubavić et al. 2004].

Weed vegetation of Bosnia and Herzegovine (B&H) is very rich and various, as the result of the geographical area, climatic, geological, hydrological and other characteristics as well as anthropological conditions. The research of the weed vegetation, specific shapes of the plant cover of the tertiary type developed in agro-ecosystems is a very important aspect in studying the floral communities. Phytosociology researches point out the antropogenic conditionality of the weed communities which gives the starting base for the proper approach in choosing the most optimal measurements of the weed control [Sîrbu 2004].

There are several data about weed vegetation of the particular parts of the Balkan Peninsula [Kojić and Pejčinović 1982, Hüppe and Hofmeister 1990, Hadač et al. 1997, Poldini et al. 1998, Topić 1998, Chytrý and Rafajová 2003, Dujmović-Purgar and Hulina 2004, Šilc 2005, Kropáč 2006]. However, data about weed vegetation in the area of B&H are poor and mostly fragmented [Šumatić 1993, Čekić

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and Kovačević 2015]. It is Kojić et al. [2005] that first give the greater data about the weeds of orchards in B&H, while the studying of the weed flora and vegetation in orchards of B&H is neglected when compared to other agroecosystems [Kovačević 2013, 2014].

Vineyards are the unstable perennial agrophytocenoses where the grown plant (the grapevine) is agroedificator and its edification role is enabled by the human activities. Weeds are common factors of agrophytocenoses of vineyards where they are entering the competitive relations with agroedificator harming it. Grapevine is very sensitive to weed composition in the time when a vineyard is being formed as well as in the elder plants at the time of the exploitation of the vineyard [Čanak and Parabućski 1976].

The characteristics of the soil have the great influence on the weed flora and vegetation of vineyards. It is recommended to use deep, loose and porose soil for grapevine growing and the content of the calcium and kalium in soil has a great role [Mijović 1995]. The applied agrotechnical measurements influence the composition of the weed communities and the state of the weediness of the vineyard [Derksen et al. 1993, Poldini et al. 1998, Konstantinović and Meseldžija 2004].

The vineyaed production in BiH can be observed on the two larger units, which differ in climate, edaphic characteristics and the method of growing grapes, such as the northern mountaining parts and lowland parts of the Pannonian valley and the southern Submediterranian karst parts of Herzegovine (fig. 1).

The aim of the paper is to analyse the weed vegetation of the vineyards from the floristic, ecological and phytogeographical aspects and to complete the data about the plant communities developed in the vineyards as the specific type of agroecosystem.

MATERIAL AND METHODS

Floristic-phytosociology researches were performed by the principles and methods of the Switzerland-French phytosociologic school [Braun-Blanquet 1964]. The research includes 51 regions from the area of eighteen municipalities where 197 phytosociologic snapshots were taken. In the orchard region of northern Bosnia, the phytosociologic snapshots were done on 32 locations, and in the orchard region Herzegovina on 19 locations (fig. 1).

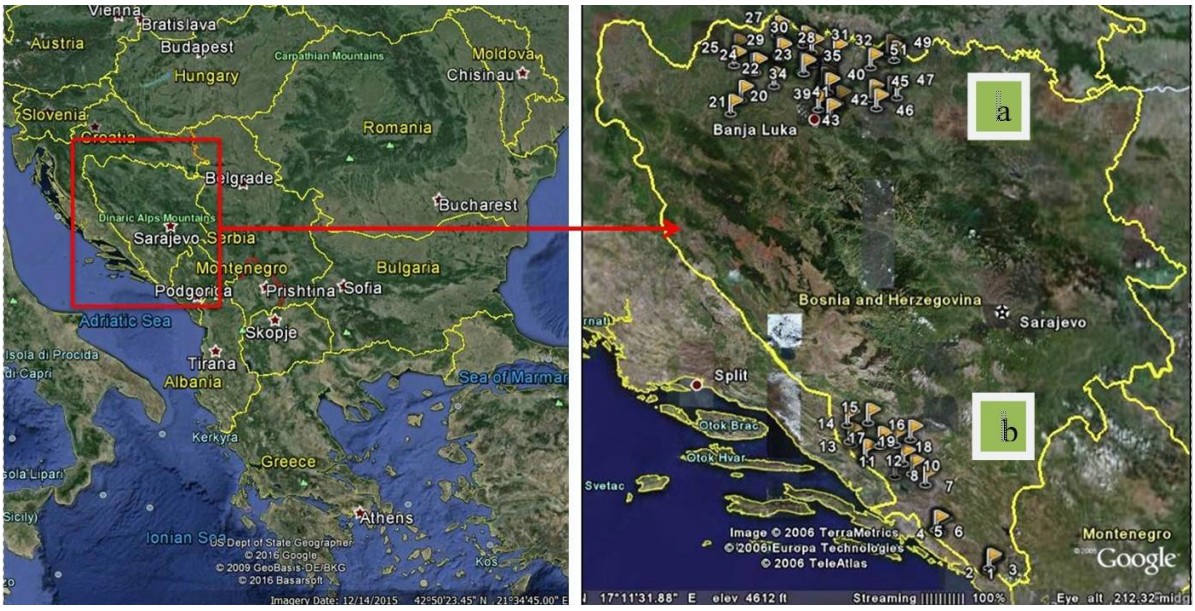


Fig. 1. Study area and sites in the regions of northern Bosnia (a) and Herzegovina (b)

Determination of the plant species was performed according to Tutin [1964–1980], Josifović [1970–1977], Domac [1994], Javorka and Csapody, [1979] and Fiori and Paoletti [1921]. Taxonomy and the nomenclature were given according to Tutin [1964–1980]. Ecological optimum (ecological values) for each weed species was determined according to Kojić et al. [1997] who presents the adjusted ecological indices of the other authors [Ellenberg 1974, Landolt 1977, Soó 1980], with amendments for the types characteristic for the researched region. There are ecological indices for the soil humidity (F), chemical reaction of the soil (R), content of nitrogen in the soil (N), light (L) and temperature (T). The life forms of the plants are classified according to the model of Ellenberg and Mueller-Dambois [1967] based on the principles of Raunkie [Raunkiaer 1934] determined according to Sarić [1992]. Affiliation of the species to floristic elements is determined according to Oberdorfer [2001]. Sintaxonomic review of the vegetation is given according to Kojić et al. [1998]. Since Braun-Blanquet [1964] combined scale of number and cover consists of, not only the numeral, but descriptive grades as well, it was undertaken the modification of the estimated values according to the scale of Westhoff and van der Maarel [1973] what is complitely numerical which enabled the statistical processing of the data. Statistical processing of the data was done by using the program Statistica 12.6 and R 3.2.3. Phytosociologic differentiation of the associations included the numerical classification which was completed by correspondence analysis [Hill 1974].

Study area

Theritory of B&H is between 42°26' and 45°15' northern latitude and 15°45' and 19°41' eastern latitude. It covers the surface of 52.129 km^2. B&H enters the western zone of the Mediterranean of the young mountain range. Northern parts cross over the Pannonian Basin, whereas southern and southwestern ones are over the direct edge of the Adriatic inlet. The area of the researches (fig. 1) occupies the area of two vineyard regions: the region of the northern Bosnia (a) and region of Herzegovina (b) which differ a lot because of the morphostructural characteristics [Avramov 1991].

According to Milosavljevic [1980], region of northern Bosnia belongs to the type of moderate continental climate with moderately cold winters, while the summers are warm or partially warm. Speaking in terms of climate, the area of northern Bosnia covers the southern half of the moderate zone, almost in the middle between the subtropical zone of the high and subpolar zone of the low air pressure. Favourable conditions for developing the vineyards in the region north Bosnia mostly refer to hill areas with altitude of 350 to 400 m. In the area of northern Bosnia the annual isotherms are from 10 to 12°C. The average annual temperature is about 11°C, with the absolute maximum of about 40°C and minimum of about -26°C. Relative humidity of the air is about 80%. The annual sum of rainfall is from 794 to 1048 mm. The monthly amount of the rainfall is unequable and moves from 60 to 110 mm. The dry period is characteristic for July. Nonfrost period lasts 3 to 5 months (from May to September). Insolation is about 1813 h. Growing of the grapevine in the continental climate is mostly limitted by its resistance to the low temperatures, which demands the cultivation of the introduced resistant cultivars of the shorter vegetation period [Kojić and Jusović 2003]. Soil conditions in the area of the northern Bosnia are very heterogeneous, and the most common are: alluvium, meadow land, acid brown soil, illimerised soil, pseudogley and vertisol. In this area the vineyards are of the following soil types: pseudogley distric cambisol on acid silicate rocks and semigley [Burlica and Vukorep 1980]. According to Okiljević et al. [1997] stagnosol covers about 33% and distric cambisol about 12% of the area of the northern Bosnia.

Region of Herzegovina from the point of the climate and soil characteristics, and tradition as well has got all conditions for the intensive development of the viticulture. Partially limiting factor is soil capacity [Tarailo 2001]. Submediterranian area of Herzegovina is characterized by the average annual temperature of air beyond 14°C, with the absolute maximum of about 40°C and minimum of about -9°C. The

relative air humidity is about 60%. The annual amount of rainfall is much bigger than on the area of northern Bosnia, is about 1500 mm. Maximal monthly amount of rainfall is in November and December (about 200 mm), and minimal is in July (48 mm). Dry period lasts from June to August and mean monthly temperatures during a year are positive. Nonfrost period lasts six months (from May to October). Insolation is about 2300 h. The vineyards of Herzegovina are characterised by sand-loamy, easily permeable substrate with the following dominant types of soil: calcocambisol on limestone, mosaic calcocambisol-terra-rossa on limestone and dolomite and terra rossa on limestone and dolomite [Burlica and Vukorep 1980].

RESULTS AND DISCUSSION

In order to have a better control of weeds in the agroecosystems, it is necessary to have knowledge about their floristic composition as well as the characteristics and dynamics of their communities in comparison with ecological conditions which rule on the particular area. This is highly expressed in the vineyards because of their specific structure and the space between the rows [Benvenuti et al. 2006] as well as the application of herbicides and agronomic practices [Knežević and Baketa 1990, Šinžar et al. 1992, Poldini et al. 1998, Benvenuti et al. 2006].

Based on the ten-year-long floristic-phytosociological researches can be concluded that the weed vegetation of vineryards in Bosnia and Herzegovina (western Balkan) consists of eight communities divided into 4 alliances, 4 orders and 2 classes. During the researching period, besides the described stands, it was also noticed the presence of the stands of two new associations *Diplotaxietum muralis* Kovačević 2013 [Kovačević 2013] and *Convolvulo-Polygonetum aviculare* Kovačević 2014 [Kovačević 2014], which are optimally developed only in the vineyard region of Herzegovina.

In accordance with syntaxonomic review of vegetation by Kojić et al. [1998], the weed communities are classified into the following units of vegetation:

Class Stellarietea mediae Tx., Lohm. et Prsg. 1950.
- Order Chenopodietalia albi Tx., Lohm. et Prsg. 1950.
  - Alliance Polygono-Chenopodion Koch 1926 em. Sissing 1946.
    - Ass. Panico-Galinsogetum parviflorae Tx. et Becker 1942.
    - Ass. Panico-Portulacetum oleraceae Lozan. 1962.
    - Ass. Cynodono-Sorghetum halepensae (Laban 1974) Kojić 1979.
    - Ass. Amarantho-Fumarietum Tüxen 1955.
- Order Chenopodietalia mediterranea Br.-Bl. 1931 em 1936.
  - Alliance Diplotaxion Br.-Bl. 1931 em 1936.
    - Ass. Diplotaxietum muralis Kovačević 2013.
    - Ass. Convolvulo-Polygonetum aviculare Kovačević 2014.
- Order Centauretalia cyani Tx., Lohm. et Prsg. 1950.
  - Alliance Galeopsion speciosae-pubescentis Kojić 1972.
    - Ass. Erigerono-Setarietum glaucae Šumatić 1997.

Class Agropyretea repentis Oberd., Müll. et Görs 1967.
- Order Agropyretalia repentis Oberd., Müll. et Görs 1967.
  - Alliance Convolvulo-Agropyrion repentis Görs 1966.
    - Ass.Convolvulo-Agropyretum repentis Felf. 1943.

Table 1. Synoptic table of the plant communities of the vineyards in Bosnia and Herzegovina

Associations*			Pan-Gal	Pan-Port	Cyn-Sorgh	Ama-Fum	Dipl-Mur	Con-Poly	Erig-Seta	Con-Agrop
Number of species			50	61	79	43	38	56	53	66
Characteristic species of the associations										
Life forms**	Floristic elements***		DP – CV****							
T	cosm	*Echinochloa crus-galli* (L.) Beauv.	V–2713	IV–2630	I–48	IV–340		I–98	IV–1101	I–44
T	adv	*Galinsoga parviflora* Cav.	V–5763	III–442	I–16	III–448		I–56	III–363	II–196
T	adv	*Portulaca oleracea* L.	I–214	V–3380	II–48	II–286	III–1002	IV–709	I–50	I–174
G	cosm	*Cynodon dactylon* (L.) Pers.	I–225	II–390	V–4672	II–554	III–1404	IV–1597	I–300	II–337
G	adv	*Sorghum halepense* (L.) Pers.	I–1	I–20	IV–611	I–269		I–56	II–76	I–1
T	adv	*Amaranthus retroflexus* L.	IV–1165	V–1182	II–298	V–6143	II–425	III–738	III–265	II–99
T	euroas.suboc	*Fumaria officinalis* L.	I–1	I–1	I–16	V–220				I–1
T/H	med-smed	*Diplotaxis muralis* (L.) DC.			I–1		V–734	II–29		
SG	cosm	*Convolvulus arvensis* L.	II–325	IV–1010	IV–1197	IV–947	V–1616	V–5556	IV–863	V–4207
T	cosm	*Polygonum aviculare* L.		I–251	I–501		I–298	V–3623		I–120
T	cosm	*Setaria glauca* (L.) Beauv.	IV–1314	III–1171	III–634	IV–1393	IV–675	III–334	V–6875	II–142
T/H	adv	*Erigeron annuus* (L.) Pers.	I–1	I–22	I–17	I–1			II–28	II–121
T	smed	*Kickxia elatine* (L.) Dum.							I–25	
T	cosm	*Veronica persica* Poir.	I–213	I–90	I–391	I–268		II–403	I–1	II–88
G	cosm	*Agropyron repens* (L.) Beauv.		I–90	I–55					V–1909
Characteristic species of the alliances: *Polygono-Chenopodion, Diplotaxion, Galeopsion speciosae-pubescentis and Convolvulo-Agropyrion repentis*										
T	med-smed, circ	*Digitaria sanguinalis* (L.) Scop.	V–2013	III–831	I–102	II–589		I–98	IV–1188	II–207
T	euroas.smed	*Lamium purpureum* L.	IV–876	I–71	II–267	II–572		I–56	I–26	II–121
T	cosm	*Setaria viridis* (L.) Beauv.	I–50	I–180	I–71	I–126	II–212		II–263	I–228
T/H	med-smed-cont	*Chondrilla juncea* L.		I–1	I–55		II–462	II–84		
T	cosm	*Euphorbia helioscopia* L.		I–20	II–344		II–3	II–223		I–1
T/H	cont	*Berteroa mutabilis* (Vent.) DC.			I–266		I–173	I–98		
H	bor-euroas.suboc	*Achillea millefolium* L.	I–1	I–21	I–16	I–1			I–27	III–469
H	bor-euroas	*Mentha arvensis* L.	I–26	I–21	I–1	III–39		I–28	II–53	II–338
T	med-smed	*Heliotropium europaeum* L.		I–110	I–109		II–42	II–223		
T	med	*Satureja montana* L.			I–1		I–482			

Table 1. cont.

H	cosm	*Rumex crispus* L.	II–27	I–22	II–142	I–36		I–1	I–50	I–22
H	euroas	*Stachys palustris* L.	I–188			I–36			I–1	I–1
T	med	*Picris echioides* L.			I–172			I–28		
T	med	*Euphorbia chamaesyce* L.						I–153		
H	adv	*Oxalis stricta* L.						I–28	I–88	I–1
T	cosm	*Tribulus terrestris* L.		I–70	I–16			I–1		
H	mod.cont-subatl-smed	*Rumex obtusifolius* L.	I–1	I–1	I–2				I–1	II–67
T/H	med-smed	*Lactuca saligna* L.					I–39	II–29		
T	euroas.suboc	*Chenopodium polyspermum* L.			I–62					
H	mod.cont	*Crepis biennis* L.	I–25	I–21		I–1			I–2	I–1
H/T	smed-med	*Reseda lutea* L.			I–1		II–40			
H	med-atl	*Echium italicum* L.					I–38			
G	subatl-smed	*Allium vineale* L.			I–1			I–28		
T	adv	*Avena barbata* Pott. ex Link.			I–16		I–1			
H	med-smed-euroas.cont	*Marrubium vulgare* L.						I–1		
T	ist.med	*Satureja hortensis* L.						I–1		
Characteristic species of the order: *Chenopodietalia albi, Chenopodietalia mediterranea, Centauretalia cyani and Agropyretalia repentis*										
G	bor-euroas.smed	*Cirsium arvense* (L.) Scop.	I–89	II–462	I–71	II–73	II–847	I–209	II–639	III–371
T	boreal-euroas	*Chenopodium album* L.	III–185	IV–214	II–244	III–179	V–965	IV–488	IV–80	III–241
T	ist.smed	*Hibiscus trionum* L.	I–27	I–40	I–195	II–109	III–924			
T	euroas.suboc	*Polygonum lapathifolium* L.	III–240	II–152	I–16	III–485			IV–266	
T	cosm	*Datura stramonium* L.	I–2	I–1	I–1	I–1	II–616	I–28	I–1	
T/H	med-smed	*Geranium molle* L.		I–40	II–325			I–209		I–22
T/H	cosm	*Capsella bursa-pastoris* (L.) Med.	III–290	I–21	I–71	III–4	I–1	I–97	I–1	II–110
T/H	cosm	*Sonchus oleraceus* L.	I–1	I–1	I–1	I–1	I–2	II–264	I–1	I–1
T	cosm	*Senecio vulgaris* L.			II–134		II–2	I–98		
T	cosm	*Solanum nigrum* L.	I–1	I–1	I–16	I–1	II–2	I–29	I–1	I–1
H	cosm	*Verbena officinalis* L.	I–1	I–40	I–1	I–1	I–1	I–1	I–1	I–1

Characteristic species of the class *Stellarietea mediae* and *Agropyretea repentis*										
T	cosm	*Stellaria media* (L.) Vill.	III–1950	I–170	II–1447	II–1964		I–903	I– 463	III–1338
T/H	euroas.suboc-med	*Anthemis arvensis* L.	I–213	I–151	I–32	I–1	II–78	I–28	II–52	II–66
T	adv	*Conyza canadensis* (L.) Cronq.	I–1	I–21	I–1	I–1	II–40	I–1	IV–404	I–1
T	cosm	*Anagallis arvensis* L.		I–1						I–1
T/H	euroas-suboc	*Viola arvensis* Murr.		I–0	I–16				I–1	I–1
T	med-smed	*Raphanus raphanistrum* L.			I–1		II–2			
T	smed	*Kickxia spuria* (L.) Dum.			I–1		I–1			
H	med	*Lepidium draba* L.			I–16			I–1		I–1
T/SH	cosm	*Bilderdykia convolvulus* (L.) Dumort.			I–1					
T/H	euroas-smed	*Medicago lupulina* L.			I–297			I–56		I–174

Companions: *Ambrosia artemisiifolia* L., *Rorippa sylvestris* (L.) Bess., *Trifolium repens* L., *Crepis sancta* (L.) Babcock, *Taraxacum officinale* Weber, *Vicia sativa* L., *Poa annua* L., *Calystegia sepium* (L.) R.Br., *Potentilla reptans* L., *Plantago lanceolata* L., *Poa trivialis* L., *Glechoma hederacea* L., *Equisetum arvense* L., *Plantago media* L., *Papaver rhoeas* L., *Aristolochia clematitis* L., *Agrostis stolonifera* L., *Geranium dissectum* L., *Gypsophila muralis* L., *Malva sylvestris* L., *Ranunculus repens* L., *Leontodon autumnalis* L., *Sambucus ebulus* L. *Trifolium pratense* L. *Vicia cracca* L. *Rubus caesius* L., *Petrorhagia saxifraga* (L.) Link., *Bellis perennis* L., *Bidens bipinnata* L., *Cichorium intybus* L., *Daucus carota* L., *Plantago major* L., *Rubus ulmifolius* Schott., *Pteridium aquilinum* (L.) Kuhn in Decken, *Lathyrus tuberosus* L., *Rumex acetosa* L., *Prunella vulgaris* L., *Galium mollugo* L., *Amaranthus albus* L., *Muscari racemosum* (L.) Mill., *Xanthium italicum* Moretti, *Urtica dioica* L., *Linaria vulgaris* Mill., *Ranunculus arvensis* L., *Lactuca serriola* L., *Holcus lanatus* L., *Leucanthemum vulgare* Lam., *Clematis flammula* L., *Foeniculum vulgare* Mill., *Ornitogalum umbellatum* L., *Phleum pratense* L., *Inula britannica* L. *Mentha longifolia* (L.) Huds. *Bidens tripartita* L. *Scrophularia nodosa* L. *Hypericum perforatum* L. *Lotus corniculatus* L., *Ajuga reptans* L., *Myosotis arvensis* (L.) Hill., *Veronica chamaedrys* L.

Legend: * Pan-Gal – *Panico-Galinsogetum parviflorae*; Pan-Port – *Panico-Portulacetum oleracea*; Cyn-Sorgh – *Cynodono-Sorghetum halepensae*; Ama-Fum – *Amarantho-Fumarietum*; Dipl-Mur – *Diplotaxietum muralis*; Con-Poly – *Convolvulo-Polygonetum aviculare*; Erig-Seta – *Erigerono-Setarietum glaucae;* Con-Agrop – *Convolvulo-Agropyretum repentis*. ** Life forms: T – Therophytes, H – Hemikryptophytes, G – Geophytes, P – Phanerophytes, S – Scandenophytes.

*** Floristic elements: adv – adventive, bor – Boreal, euroas – Eurasian, smed – submediterranean, suboc – subocean, subatl – subatlantic, circ – circumpolar, cont – continental, med – Mediterranean, ist – Eastern, cosm – cosmopolitan, atl – Atlantic, mod.cont – moderately continental. **** DP – degree of presence (I –V), CV – covering values

Table 2. Biological spectrum of the plant communities of the vineyards in Bosnia and Herzegovina

Life form*	Associations															
	Pan-Gal		Pan-Port		Cyn-Sorgh		Ama-Fum		Dipl-Mur		Con-Poly		Erig-Seta		Con-Agrop	
	No.**	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
T	23	46.00	34	55.74	45	56.96	22	51.16	26	68.42	35	62.50	23	43.40	28	42.42
H	21	42.00	20	32.79	24	30.38	15	34.88	9	23.68	13	23.21	22	41.51	29	43.94
G	4	8.00	5	8.20	7	8.86	4	9.30	2	5.26	6	10.71	5	9.43	6	9.09
P	–	–	–	–	1	1.27	1	2.33	–	–	1	1.79	1	1.89	1	1.52
S	2	4.00	2	3.28	2	2.53	1	2.33	1	2.63	1	1.79	2	3.77	2	3.03

Legend:
* – see legend at Table 1
** – number of species

Table 3. Chorological spectrum of the plant communities of the vineyards in Bosnia and Herzegovina

Floristic elements*	Associations															
	Pan-Gal		Pan-Port		Cyn-Sorgh		Ama-Fum		Dipl-Mur		Con-Poly		Erig-Seta		Con-Agrop	
	No.**	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
cosm	21	42.00	27	44.26	27	34.18	17	39.53	14	36.84	24	42.86	20	37.74	24	36.36
euroas	9	18.00	9	14.75	12	15.19	10	23.26	5	13.16	4	7.14	13	24.53	13	19.70
med	2	4.00	5	8.20	12	15.19	1	2.33	7	18.42	12	21.43	1	1.89	3	4.55
bor	7	14.00	7	11.48	6	7.59	6	13.95	2	5.26	4	7.14	8	15.09	11	16.67
adv	7	14.00	8	13.11	11	13.92	7	16.28	5	13.16	7	12.50	8	15.09	8	12.12
smed	1	2.00	3	4.92	6	7.59	1	2.33	4	10.53	3	5.36	1	1.89	3	4.55
subatl	1	2.00	–	–	3	3.80	–	–	–	–	1	1.79	–	–	2	3.03
mod.cont	2	4.00	2	3.28	1	1.27	1	2.33	–	–	–	–	2	3.77	2	3.03
cont	–	–	–	–	1	1.27	–	–	1	2.63	1	1.79	–	–	–	–

Legend: *
– see legend at Table 1
** – number of species

Ass. *Panico-Galinsogetum parviflorae* Tüxen et Becker 1942 is the most typical weed community of row crop spread in the middle Europe [Tüxen 1950]. Kojić et al. [1998] ascertian this community on the area of western Balkan in the different types of soil (cambisol, vertisol, alluvium, etc.), on different elevetions in almost all regions where the corn and the other arables are grown. The community was studied in detail in Serbia [Kojić et al. 1988, Ajder 1992, Stepić 1995, Ilić and Nikolić 2011] Croatia [Topić 1998, Hulina 2005] and Bosnia and Herzegovina [Šumatić 1993, 1997, Kojić et al. 2005].

In the researcher area ass. *Panico-Galinsogetum parviflorae* has the very important place in the weed

vegetation of the vineyards of the region north Bosnia, in the different types of the soil: distric cambiosol, pseudogley and semigley. Regional specificity of this association is on one side the result of geographical and on the other side of climatic and edaphic differences as well, particularly conditioned by the system of growing whereas the basic importance is due to intensity of the mechanical measurements of the weed control without the use of herbicides. Stands of ass. *Panico-Galinsogetum parviflorae* build 50 plant species (tab. 1) whereas from the total nuumber, 46.00% present the characteristic species of associations and of high syntaxonomic units which points out the fact that this association in the vineyards of the region north Bosnia is typically expressed and optimally developed.

The basic physiognomic and edificator characteristic of association stands is given by the specific types of associations: *Galinsoga parviflora* and *Echinochloa crus-galli*, which appears in all the stands where the extremely huge diagnostical importance of the species *G. parviflora* is pointed out and which is reflected in the maximum degree of presence and high cover value (V; 5763). The complete characteristic collection of the association is made of 6 species: *G. parviflora*, *E. crus-galli*, *Digitaria sanguinalis*, *Setaria glauca*, *Lamium purpureum* and *Amaranthus retroflexus*. Biological spectrum of the association (tab. 2) shows the extanding therophytic-hemicriptophytic character (46% therophyte, 42% hemocryptophyte). In the spectrum of areal types (tab. 3) there were established eight goups of floristic elements in which plants of the broad distribution (cosmopolitan, Euroasian, adventive and boreal) are dominant (44 of 50 species). Correspondence analysis (fig. 2 a) distinguishes floristically similar stands (1–11) in comparison with the stands noticed in the autumn aspect (12, 13, 14, 16, 17, 18 and 19) in which there is not *Ambrosia artemisiifolia* L. which gives a specific mark to this association.

Ass. *Panico-Portulacetum oleraceae* Lozanovski 1962 is firstly described in Macedonia (Pelargonia). It is broadly present in Serbia [Kojić and Pejčinović 1982] as well as in the parts of Bosnia and Herzegovina [Kojić 1975]. Stands of this association are present in various arable crops: corn, sugar beet and sunflower, especially in orchard and vineyard crops [Lozanovski and Piperkovska 1992, Šinžar and Živanović 1993] as well as in horticultural crops grown according to the organic principles where the stands of this community are much poorer [Nikolić et al. 2009]. In the weed vegetation of vineyards of the researched area ass. *Panico-Portulacetum oleraceae* is widely present in the both regions which means that it has not got the regional personality and it develops on the surfaces which are not treated with the herbicides, but the weed is controlled by the use of the mechanical measurements. There are 61 species in the floristic composition (tab. 1). This association in the vineyards of Bosnia and Herzegovina is typically expressed and optimally developed, since 25 species (40.98% of the total number) present the characteristic association species and the other higher syntaxonomic units. Since it is about prevalence in Eurosiberian-northamerican region of the continental parts and Mediterranean region, the number of followers is enlarged (36 species; 59.02%). Characteristic species of the association are *Portulaca oleracea* and *Echinochloa crus-galli* which give a specific physiognomic personality to some stands. The complete characteristic group of the association consists of five species: *P. oleracea*, *E. crus-galli*, *Amaranthus retroflexus*, *Chenopodium album* and *Convolvulus arvensis*. Particularly huge diagnostical importance belongs to *P. oleracea*, which appears in all the stands of the association and has the largest cover value (V; 3380). Biological spectrum of the association belongs to therophytic-hemicriptophytic character (tab. 2), similar to the previous association with the greater participation of therophytes which is certainly the result of the mechanical measures of weed control, without applying of the herbicide. Stands of the association are most commonly developed in the soils such as distric cambiosol, pseudogley, semigley, calcocambisol, mosaic calcocambiosol-terra rossa and terra rossa. Diapason of the altitude where the stands of this association were developed is going from 53 to 293 m. In areal spectrum of the association there are 7 groups of floristic established (tab. 3), where the elements of the wide distribution dominate. There is cosmopolitan amongst them (27 species; 44.26%).

The correspondence analysis (fig. 2 b) shows rathar large similarity of the floristic composition of the association stands whereas the stands 10 and 11, 23–25 are further from the large group of stands on the ordinative diagram. Separation of the stands 10 and 11 on the ordinative diagram is conditioned by the higher floristic differentiation. Stands 23–25 are relatively floristically richer and are particularly characterised by the presence of the followers: *Convolvulus arvensis*, *Rorippa sylvestris* and *Cirsium arvense*. Stands 14, 19 and 20 are noticed in the vineyards of the region Herzegovina whereas they have got some species in the floristic composition which are not at all or are less present on the locations of the northern Bosnia such as: *Heliotropium europaeum*, *Tribulus terrestris*, *Chondrilla juncea*, etc.

Ass. *Cynodono-Sorghetum halepensae* (Laban 1974) Kojić 1979 is mostly detailed described in the area of Kosovo [Kojić and Pejčinović 1982]. In Bosnia and Herzegovina the association is typically developed in the region of Herzegovina [Kovačević et al. 2015] and mostly in the microhabitat of the order where the weed control with chemical measurements is dominant. In vineyards of the region of northern Bosnia the association stands are developed on the whole area due to the low level of applying of the agrotechnical measurements, even due to the and even, sometimes the absence of tillage. The other specific point that strongly affects the structure of the association is heterogeneity of the conditions of the habitat, which also significantly affects the floristic richness of the stand (79 species). The characteristic species of the association are: *Cynodon dactylon* and *Sorghum halepense* (tab. 1). Although *C. dactylon*, strongly considering, is not specifically characteristic for this association, however, it is present in this association in all the stands with the great number and cover, so it has got the significant place in the structure of the association. There is *Convolvulus arvensis* (IV; 1197) in the content of the complete characteristic group besides the characteristic species of the associations. In the biological spectrum of the association (tab. 2), therophyte and chemocriptophyte dominate, which totally make almost 90% of the species. Although the content of therophyte is pretty large, the presence of the this life form is still less than in the other weed community where the applying of the agrotechnical measurements is intensive. However, geophytes which are, in percentages, less present (8.86%) give the specific character to the stands of the association since the characteristic species of the association belong to this cathegory. Stands of the association are developed on the soils of calcocambisol, mosaic calcocambisol-terra rossa, terra rossa, distric cambisol and pseudogley. In spectrum of the areal types of the association (tab. 3), floristic elements of the broad usage dominate, particularly cosmopolitan (27 species; 34.18%) and Euroasian (12 species; 15.19%). In the floristic stand of the association it is also felt Mediterranean-submediterranean influence, because 18 species (22.78%) belongs to Mediterranean-submediterranean floral element. Ordination can clearly single out three groups of stand (fig. 2 c). The first group of stands (1–17) is characteristic for the summer and autumn aspect in the vineyards of the Herzegovina region and is reflected by the presence of the large number of the species which are characteristic for syntaxonomic units (association, alliance, order and class). Namely, from 32 species in total, 23 of them are characteristic for the syntaxonomic units. The second group of stands (18–27) is characteristic for the spring aspect in the vineyards of the Herzegovina region. From 32 species in total, 19 of them are characteristic for the syntaxonomic units. For this group of stands, the spring ephemeres are specific. The third group of stands (28–32) is characteristic for the summer and autumn aspect in the vineyards in the region of northern Bosnia. From 32 species in total, only 10 of them are characteristic for the syntaxonomic units and edificator species *S. halepense* has not been noticed. The presence of the species such as: *Medicago lupulina*, *Rorippa sylvestris*, *Trifolium pratense*, *Prunella vulgaris*, etc. denotes the valley type of this group of the stands due to often absence of the agrotechnical measurements.

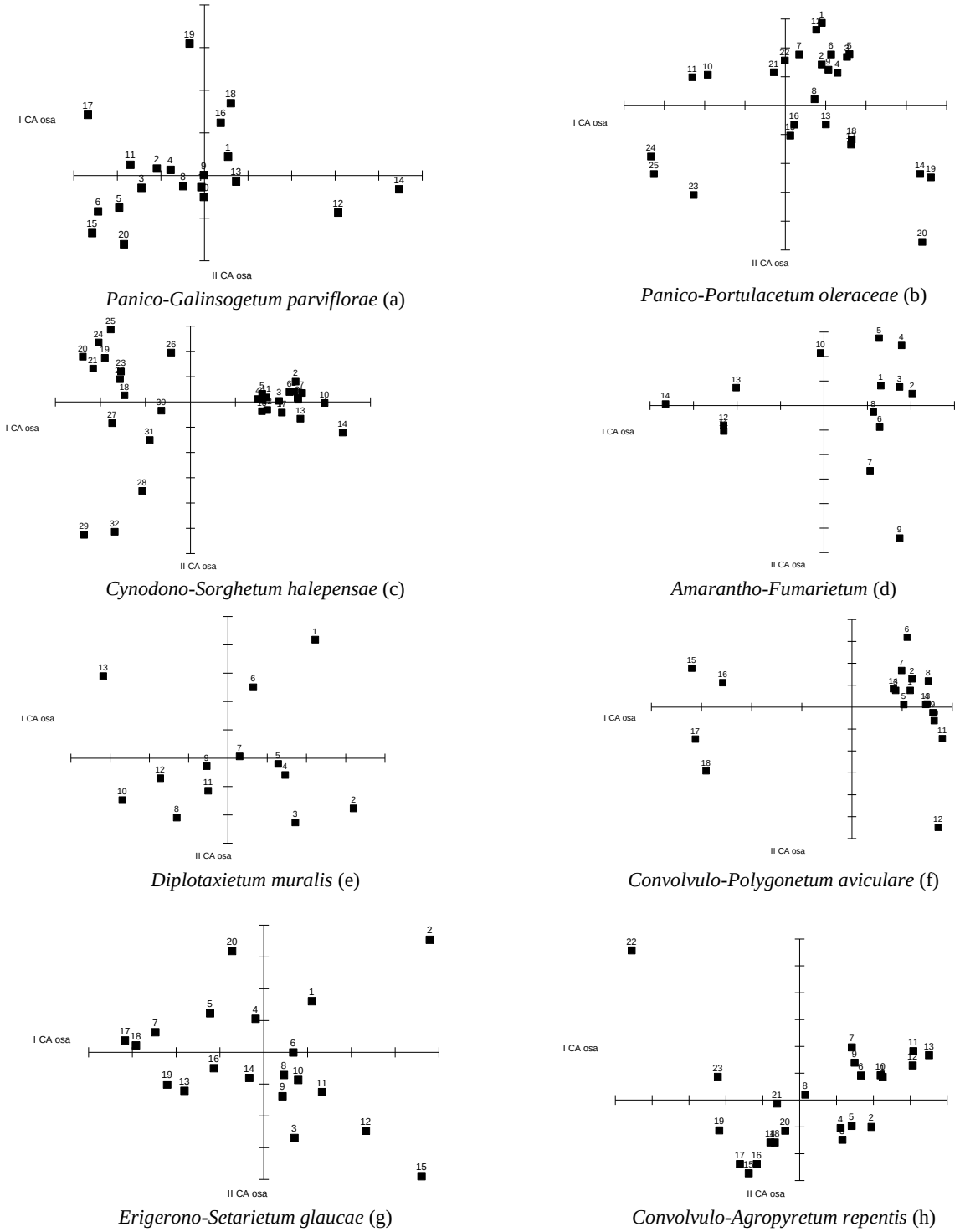
The ass. *Amarantho-Fumarietum* Tüxen 1955 has not been paid enough attention so far. Šinžar and Živanović [1992] point out that in the weed vegetation of the orchards of Fruska Gora, (north Serbia) *Amaranthus retroflexus* in the microhabitat of the row spacing has got the maximal number and cover,

the biggest percentage of the presence and the cover value. Lososová [2004] do not classify ass. *Amarantho-Fumarietum* in the syntaxonomic review of the weed vegetation of the Czech Republic because due to not getting clear differential species that were presented by Kropáč [2006], while Jarolímek et al. [1997] classify it amongst nine characteristic associations in prodromus of the weed vegetation of the Slovakia. In vineyards of Bosnia and Herzegovina ass. *Amarantho-Fumarietum* shows the regional characteristics which is conditioned mostly by the edaphic characteristics and applying the agronomic practices, so it is widely spread in the vineyards of the region northern Bosnia. Floristic composition of the association consists of 43 species of which the species of the association *Amaranthus retroflexus* and *Fumaria officinalis* are characteristic. The both species are constantly present providing that *A. retroflexus* absolutely dominates according to its number and cover so it gives the main physiognomic characteristic of the association (tab. 1). The complete characteristic group besides the characteristic species of the association builds *Setaria glauca*, *Convolvulus arvensis* and *E. crus-galli*. From 43 species in total, 21 of them appear with the percentage of the presence one and only 19 species have got greater cover value than 100 which points out the dynamic of the association but also the dominance of the edificator *A. retroflexus*. It is noticed with the analysis of the biological spectrum of the association that the therophytic-chemocriptophytic character is much similar to the other associations of the alliance *Polygono-Chenopodion* (tab. 2). The stands of this association in the vineyards of the region northern Bosnia are developed on the soil distric cambiosol, pseudogley and semigley. Areal spectrum of the associations is characterised with the presence of the seven groups of floristic elements with the domination of the species with the wide presence (tab. 3). Three groups of stands can be pointed out (fig. 2 d). The first group consist of stands (1–5) whose floristic composition is characterised by the presence of the ruderal species: *Ambrosia artemisiifolia*, *Erigeron annuus*, *Achillea millefolium*, *Cichorium intybus* and *C. arvensis*. The second group consists of the stands that are noticed in the summer aspect (6–9) where the weed-ruderal species *Cynodon dactylon*, *Taraxacum officinale* etc. are represented. The third group consists of the stands (11–14) that are noticed in the autumn aspect (the end of September and the beginning of October) whose floristic composition is characterized by *Stellaria media* and *Lamium purpureum* which make them very different from the other two groups of stands. The specific meadow species such as *Agrostis stolonifera*, *Plantago lanceolata* and *Ranunculus repens* make the floristic composition of these stands. The floristic composition of the stand 10 has a lot of the similarities with the stands of the first group (1 to 5) due to number of the species *Ambrosia artemisiifolia* and *Convolvulus arvensis* and the stands of the group three (11 to 14) due to the presence of the common species: *Anthemis arvensis*, *Conyza canadensis* and *Verbena officinalis* which are not in the floristic composition of the stands 1 to 9.

Ass. *Diplotaxietum muralis* Kovačević 2013 is firstly described in details in the vineyards of Bosnia and Herzegovina. Stands of this association show the regional character conditioned by the climate characteristics, so they are optimally developed in the vineyards of the region of Herzegovina. The association was classified into the Mediterranean syntaxonomic unit (*Diplotaxion* from the ordo *Chenopodietalia mediterranea*) which differes a lot from the synatxonomic units of the Eurosiberian region (*Polygono-Chenopodion* and *Eragrostion*) firstly due to participation of thermophilic species (*Avena barbata*, *Satureja montana*, *Lactuca saligna*, *Echium italicum* etc.). Stands of this association are made of 38 species. Of the total floristic composition of the association, 68.42% of the species are characteristic for the stands and higher syntaxonomic units which means that the association is typically expressed and optimally developed. The characteristic species of association, *Diplotaxis muralis* with a bit less number and cover, is present in all the thirteen stands. The complete characteristic group of the association is made of four species *D. muralis*, *Convolvulus arvensis*, *Chenopodium album* and *Setaria glauca* which is the only one that has got the degree of presence four and the least cover value (tab. 1). The edificatory species *D. muralis* as an interim life form (T/H) is more frequent in the shape of the terrestrial rosette, while the

half-consciously scape is less noticeable because of the weak competition of the species with aggressive xenobiont of the association besides the places where the floral cover is rare, actually where the general cover is less. The great diagnostic value in the stands of the association is given to the *C. arvensis* and *C. album.* Namely, both the species are coenobiont of the eleven stands whose the main characteristics are not only associations but edificators as well. By the analysis of the biological spectrum of the association (tab. 2) it can be clarified the high therophytic character (68.42%), because the hemicryptophytes have got the very low cover value and certainly with regard to taking the measures of control the presence of two types of the geophytic species (*Cynodon dactylon* and *Cirsium arvense*) and one geophytic scandenophyte (*C. arvensis*) should not be ignored. Such biological spectrum is the consequence of the mechanical measurements of the weed control, but with the absence of the chemical measurements. The less presence of the hemocriptophytes points out the unstability of this association which is confirmed by the fact that the half of the floristic composition is made of the followers. Stands of this association are being developed on the soil of the type terra rossa, mosaic calcocambisol-terra rossa and calcocambisol. Areal spectrum of their association (tab. 3) is made of seven groups of the floristic elements and are different from the spectrum of the described associations from the *Chenopodietalia albi*. The analysis of the areal spectrum clearly shows the Meditteranean and Submeditteranean influence. Namely, in the content of the cosmopolite group (14 species: 36.84%) the most species have got the original areals in the area of Meditteranean and Submeditteranean (8 species). The second species according to the presence is Meditteranean group of the floristic elements which is made of 11 species (28.95%) from the total number together with the Submeditteranean. The representatives of the Euroasian group of the floristic elements belong to the subgroups which areal are spreading in the areas of Meditteranean and Submeditteranean. Amongst the adventive species, the largest cover value has got the species *Portulaca oleracea* which original areal is in the area of Meditteranean. Two groups of stands (fig. 2 e) can be singled out by the ordination of the stands of the associations. The first group is a bit more homogenous (1–5) and *Setaria glauca*, *Chenopodium album* and *Hibiscus trionum* are always present in the floristic composition. The second group of stands (6–13) is rather heterogenous. Comparing it with the stands of the first group, the absence of the species *C. album* is characteristic, and similarity is the presence of *H. trionum*. The greater number of the species *P. oleracea* and *Chondrilla juncea* is characteristic for the second group of the stands.

Ass. *Convolvulo-Polygonetum aviculare* Kovačević 2014 shows the regional characteristic conditioned by the climatic characteristic with the optimal development in the vineyards of the region Herzegovina. Floristic composition of the particular stands is characterised by the significant participation of the thermophile species which classifies it in the alliance of *Diplotaxion* from the ordo *Chenopodietalia mediterranea* which mostly differs from the alliances of the Eurosiberian region (*Polygono-Chenopodion* and *Eragrostion*) firstly in the participation of the thermophile species *Crepis sancta*, *Heliotropium europaeum*, *Euphorbia helioscopia*, *Euphorbia chamaesyce*, *Chondrilla juncea* etc. Stands of this association are made of 56 species, and characteristic species of the association with the largest degree of presence and the high cover values are present in all the stands (tab. 1). The complete characteristic group of the association is made of five species: *Convolvulus arvensis*, *Polygonum aviculare*, *Cynodon dactylon*, *Portulaca oleracea* and *Chenopodium album*. The therophitic-geophytic character of this association can be clarified by the analysis of it biological spectrum. Geophytic character of the association is specially given by the edificators *C. arvensis* as well as species *C. dactylon* and *Cirsium arvense*. Stands of this association in the vineyards of the region Herzegovina are developed in the soil mosaic calcocambisol-terra rossa, terra rossa and calcocambisol. Areal spectrum of the association points out the domination of the species of cosmopolitan (42.86%) and Meditarrenean (21.43%) group of the floristic elements (tab. 2). By the analysis of the areal spectrum (tab. 3) it is noticeable the strong Meditteranean and Submeditteranean influence. In the content of the cos-



Panico-Galinsogetum parviflorae (a)

Panico-Portulacetum oleraceae (b)

Cynodono-Sorghetum halepensae (c)

Amarantho-Fumarietum (d)

Diplotaxietum muralis (e)

Convolvulo-Polygonetum aviculare (f)

Erigerono-Setarietum glaucae (g)

Convolvulo-Agropyretum repentis (h)

Fig. 2. The correspondence analysis of stands of eight plant communities

mopolitan group, 12 species have got the original areal in the area of Meditteranean and Submeditteranean. Fifteen species (26.79%) belong to Meditteranean and Submeditteranean group of the floral elements. Two adventive species have got the original areal in the area of Meditteranean, and two Euroasian and one Subatlantic species are spreading their areal in the area of Submeditteranean. Based on that it can be clarified that, widely observed, 32 species (57.15%) are of Meditteranean and Submeditteranean origin. By the ordination of the stands of the association, two groups of stands can be singled out (fig. 2 f). The first group of stands (1–14) is recorded in the summer and autumn aspect and is characterised by 27 species which are not in the content of the stands of the second group, and larger cover values amongst them belong to: *P. oleracea*, *C. album*, *Amaranthus retroflexus*, *Setaria glauca* and *H. europaeum*. The second group of stands (15–18) is recorded in the spring aspect and is characterised by 15 species which are not part of the floristic stand composition of the first group, and *C. sancta* is the species that has got the largest influence on the physiognomy of the spring aspect of the association.

Association *Erigerono-Setarietum glaucae* Šumatić 1997 is for the first time described as the weed community of the cereal (stubble) in the area of the northern Bosnia on: eugley, pseudogley and semigley soils. In the weed vegetation of the vineyards in Bosnia and Herzegovina, the ass. *Erigerono-Setarietum glaucae* is widely spread in the vineyard region north Bosnia and in the western parts of the vineyard region Herzegovina. Association is made of 53 plant species. The characteristic species of the association are: *Setaria glauca*, *Conyza canadensis*, *Kickxia elatine* and *Veronica persica*. The main floristic and physiognomic characteristic in all the stands is given by the edificator species *S. glauca* which is present with a great number in all the stands and has got a far larger cover value (tab. 1). The characteristic group of the association is made of 8 species: *S. glauca*, *C. canadensis*, *Convolvulus arvensis*, *A.artemisiifolia*, *Digitaria sanguinalis*, *E.crus-galli*, *Polygonum lapathifolium* and *Chenopodium album*. Five species of the characteristic group are the followers and *A. artemisiifolia*, *D. sanguinalis* and *E. crus-galli* have got large cover values. A small number of species (9 species) is characteristic for the large syntaxonomic units (alliance, ordo and class) where six of them appear with the smallest degree of the presence. Really small number of species (10 species) appear with the degree of presence III–V, while 81.13% (43 species) are with the presence degree I and II which means that there is a large dynamism of the association and the dominance of the species which belong to the characteristic group, especially the species *S. glauca*. By the analysis of the biological spectrum of the associations, it can be clarified therophytic-geophytic character (tab. 2). Specially, therophytes are the main coenobiont of the association while the low frequent hemicryptophytes, although with the higher percentage of presence than with the geophyte, have got the less influence in building the stands of the associations. The overall cover value of hemicryptophytes is 759.50, and of fewer geophytes is 1154 whose total value is 2017 when the cover value of geophyte scandenophyte *C. arvensis* is added. The significant difference of the stands developed on the stubble and the vineyards is in the presence of hemicryptophytes and geophytes [Šumatić 1997]. Specifically, in the stands of the orchards, hemicryptophytes have got almost dubble the percentage of the presence while the number of the geophytes is three times less. The stands of the association in vineyards of Bosnia and Herzegovina are developed in the soil distric cambiosol, pseudogley, semigley, terra rossa and mosaic calcocambisol-terra rossa. Areal spectrum of the association (tab. 3) shows the domination of the floristic elements of the wide presence amongs which cosmopolitan (37.74%) and Euroasian (24.53%) dominate. Twenty species belong to the cosmopolitan group of the floristic elements amongst which there are the species of the characteristic group *S. glauca*, *C. arvensis* and *E. crus-galli*. The results of the ordination show the similarity of the floristic composition where the stands 2, 15 and 20 are a bit more distant from the main group of the stands on the ordinative diagram (fig. 2 g). The distance of those stands on the ordinative diagram is conditioned by the bigger number of species because they are floris-

tically the richest, and they differ from the other stands in the number of followers: *Bidens tripartita*, *Rubus caesius*, *Leontodon autumnalis*, *Stachys palustris*, *Scrophularia nodosa*, *Datura stramonium*, *Lotus corniculatus*, *Verbena officinalis* and *Solanum nigrum*.

Ass. *Convolvulo-Agropyretum repentis* Felföldy 1943 is widely spread in many parts of Europe (Hungary, Czech Republic, Poland, Germany and Serbia). In the area of Bosnia and Herzegovina it is widely spread, especially in the weed vegetation of the vineyards in the region north Bosnia [Kovačević 2016].

Association is made of 66 species in total, and their number per stands varies from 5 to 23 (tab. 1). The characteristic species of the association which give the main physiognomic and floristic character to all the stands are *Convolvulus arvensis* and *Agropyron repens*, and at the same time they represent the complete characteristic group of the association. Really small number of species (9 species) have got the degree of presence III–IV, and 57 species (86.36%) have got the degree of presence I and II. Seventeen species of 37 species with the least degree of presence, are noticed in only one stand. Forty coenobionts of the association have got value less than 100. Vertical statification of the overground part of the floral cover of the association is very interesting. In the vineyards where the stronger agrotechnical measurements (chemical or mechanical) are done, we can see that the floor of the short plants high up to 30 cm dominate, regarding the stands whose the main physiognomic character is given by the subsided species *C. arvensis*. In the vineyards with the lower intensity of the applying of the agronomic practices which are mostly mowing or hewing, there is dominant the floor of the middle high and high plants, mostly *A. repens* and *C. arvensis* which curves around the trunk of the high plants in this case. Biological spectrum of the association unlike all the other clarified associations has got the hemicryptophytic-therophytic-geophytic character (tab. 2). Hemicryptophytes are presented with 29 species (43.94%), a bit less therophyte (28 species; 42.42%) and six geophytic species have got significant cover values and the great influence on the physiognomy of the stands of the associations where the edificator of the association *C. arvensis* is with the largest cover value and presence in all the stands. Despite the percentual dominance of hemicryptophytes and therophytes in the assocoation, the largest significance belongs to the geophytic species, because the characteristic species of the association belong to this life form. Soil where the stands of the association are developed in the vineyards of the region north Bosnia is distric cambiosol and pseudogley. Areal spectrum of the association shows the dominance of the floristic elements of the huge spreading (tab. 3). The greatest number of species (24) belongs to cosmopolitan group of the floristic elements amongst which we can find the both characteristic associations. The results of the ordination distinguish two groups of stands (fig. 2 h). The certain difference in the first group of stands (1–13) is extriction of the subgroup (1–5) of the stands as floristicaly similar, and the result of it is greater numberof the species: *A. artemisiifolia*, *Mentha arvensis*, *C. dactylon* etc., and stands of the second subgroup (6–13) is characterised by 27 species that are not present in the stands of the first subgroup which tells more about floristic richness of the stands of the second subgroup. For the second group of stands (14–23) recorded in the summer aspect the following species are characteristic: *Stellaria media*, *Rorippa sylvestris* and *Trifolium repens*, as well as 18 species that are not in the floristic composition of the stands of the first group.

Ecological relations between communities

For the evaluation of the ecological relations, among the described plant communities, according to the ecological indices of the total floristic composition of the each community and the established number and coverness of each species in the community, from the transformed values, the statistical process of the data was undertaken. Starting from the corelation matrix of the average values of the five ecological indices (F, R, N, L, T) for all the communities described (tab. 4), by applying the method PCA (Principal Component Analysis), the reduction of the beginning group of the changable (ecological indices) is undertaken onto two main components which explain

80.7% of the variability of the beginning group of the changables.

Table 4. Matrix of Pearsons correlation coefficients of ecological indices

Variables	F	R	N	L	T
F	1.000000	0.180907	0.265372	-0.466252	-0.710560*
R	0.180907	1.000000	0.144023	0.702902	-0.575070
N	0.265372	0.144023	1.000000	-0.024746	-0.525991
L	-0.466252	0.702902	-0.024746	1.000000	-0.087184
T	-0.710560*	-0.575070	-0.525991	-0.087184	1.000000

* – $p < 0.05$

Table 5. Correlation of principal components with the initial variables

Variables	Principal components	
	PC1	PC2
F	0.872337*	-0.275937
R	0.380055	0.868181*
N	0.635195	0.070624
L	-0.218237	0.958584*
T	-0.916525*	-0.293330

* – $p < 0.05$

Biplot diagram (fig. 3) shows at the same time the ecological indices (vectors) and is given the projection of some plant communities onto the main components [Zelterman 2015]. The sharp angles between the vectors show the positive correlation while the obtuse angle shows the negative correlation of the appropriate changables. So the values of the ecological indices F and N as well as R and L are positively correlated, and values of the indices F and T, and R and T are negatively correlated. Orthogonality of the vectors shows the absence of the correlation which can be visible at the values of the ecological indices for the nutrients (N) and lights (L) where the correlation is almost zero.

If the plant communities are observed in coordinant system determined by the main components, it can be noticed that axis PC1 separates the plant communities with a bit lower average values for humidity (F) and larger values for the temperature (T): *Amarantho-Fumarietum*, *Erigerono-Setarietum glaucae*, *Cynodono-Sorghetum halepensae* and *Diplotaxietum muralis* which are on the positive side of the axis, from the communities *Panico-Galinsogetum parviflorae*, *Panico-Portulacetum oleraceae*, *Convolvulo-Polygonetum aviculare* and *Convolvulo-Agropyretum repentis* on the negative side of the axis which are characterised by the average values for the humidity (F) and lower average values for the temperature (T). Regarding PC1 the most similar are plant communities *Cynodono-Sorghetum halepensae* and *Diplotaxietum muralis* which are characterised by the similar values of the indices F and T which are in the largest correlation with PC1.

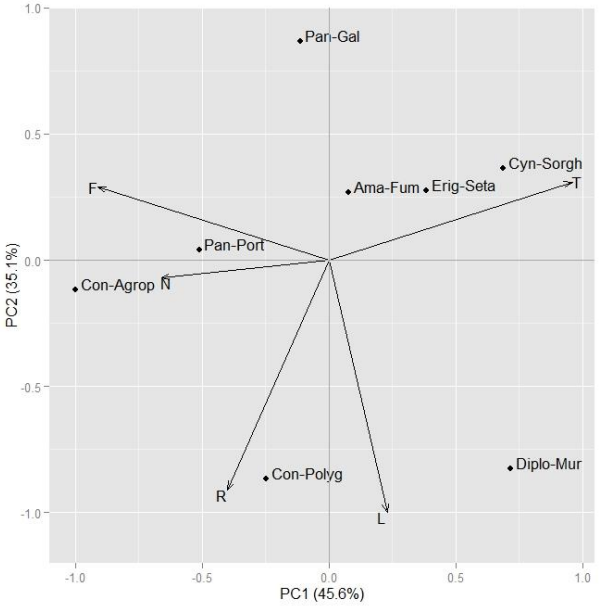


Fig. 3. Biplot diagram of plant communities and ecological indices

The second axis PC2 separates plant communities with lower values of the ecological indices for the chemical reaction of the soil (R) and light (L) which are on the positive side of the PC2: *Panico-Galinsogetum parviflorae*, *Panico-Portulacetum oleraceae*, *Amarantho-Fumarietum*, *Erigerono-Setarietum glaucae and Cynodono-Sorghetum halepensae* from the communities *Diplotaxietum muralis*, *Convolvulo-Polygonetum aviculare* and *Convolvulo-*

Agropyretum repentis which are on the negative side of PC2. Regarding PC2, the most similar communities are *Amarantho-Fumarietum* and *Erigerono-Setarietum glaucae* which are characterised by the similar demand considering the chemical reaction of the soil (R) and light (L).

CONCLUSION

On the researched area, it was clarified that eight weed plant communities that are characterised and clearly defined, which is conditioned by the reduced applying of the herbicides and generally weaker agronomic practices which reflected on the floristic difference since it is known that the intensive applying of the herbicides and the other agronomic practices leads to the significant changes of the structure and makes the biodiversity of the weed communities much poorer. Such diversity of the plant communities and species on the researched area, besides the applied agronomic practices and pedological character, is certainly influenced by the agroecologial conditions related to the vineyards as the specific agroecosystems since the weed plant communities are very dynamic and changable in time and space which is confirmed by the presence of the stands of two new described communities.

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