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Ana A. ANĐELKOVIĆ[1*], *Dragana P. MARISAVLjEVIĆ*[1], *Dušanka Lj. CVIJANOVIĆ*[2], *Snežana B. RADULOVIĆ*[2], *Danijela M. PAVLOVIĆ*[1]

[1] Institute for Plant Protection and Enviroment, Department of Weed Research, Teodora Drajzera 9, Belgrade 11040, Serbia
[2] University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Trg Dositeja Obradovića 2, Novi Sad 21125, Serbia

BIOLOGICAL SPECTRUM OF THE WEED FLORA IN THE VRŠAC VINEYARDS (SERBIA)

ABSTRACT: Agrotechnical measures are the main factor defining the vineyard weed flora structure and composition, while adequate weed control measures simultaneously ensure that vineyards are being well-managed, thus securing good grapevine health and high quality of wine. Given that the biological spectrum of weeds affects the choice of weed control measures, the aim of this study was to determine the biological properties of the weed flora in Vršac vineyards, by assessing dominant life forms and phenology of the identified weeds. The floristic analysis was conducted during the 2016 vegetation season (March–November) at 60 plots (1 m^2), at three field sites. The presence of 97 plant taxa, belonging to 26 families, was determined. The biological spectrum of the vineyards weed flora has shown a thero-phyto-hemicryptophyte character (therophytes: 57.73% and hemicryptophytes: 34.02%). The scapose herbaceous plants with summer-flowering phenology were dominant within the therophytes and hemicryptophytes. The obtained results have shown a higher weed diversity in vineyards, when compared to previous research of the weed flora in the study area, but similar to more recent studies conducted in the neighbouring countries. Furthermore, the dominant presence of therophytes in the vineyard weed flora was expected, bearing in mind the primarily mechanical weed control measures traditionally applied in vineyards.

KEYWORDS: biological spectrum, life form, phenology, vineyard, Vršac vineyards, weeds

INTRODUCTION

Grapevine is one of the oldest cultivated plants, cultivation of which is considered to have begun in the area between the Black and Caspian seas (Lloret et al., 2011), in the territory of present-day Iran. It is estimated that vineyards occupy more than 5.5 million hectares in Europe, Africa, Australia, New Zealand

* Corresponding author. E-mail: ana.andjelkovic21@gmail.com

and the United States (Steenwerth and Belina, 2010). According to the last official statistical data, grapevine is grown on about 22.150 hectares in Serbia (Ivanišević and Jakšić, 2014), with a total production of 165.568 tons of fresh grapes and 993 hectoliters of wine in 2017, according to the International Organization of Vine and Wine (OIV, 2019).

Composition of the vineyard weed flora is predominately affected by applied agrotechnical measures (Gago et al., 2007). Weed control is primarily focused on vineyard rows, where weeds compete with the grapevine directly for both water and nutrients (Fredrikson et al., 2011). Nevertheless, weed control in between rows is also of great importance, in order to achieve a seedbank reduction and consequently reduce the need for in-row weed control in the following vegetation period (Fredrikson et al., 2011). Weed control in vineyard rows in done either by mechanical – tillage and harrowing, or chemical measures – herbicide application (Steenwerth and Belina, 2010). However, these physical control measures can actually favor the survival of certain weed groups (i.e. annual weeds) and be inefficient in controlling the rhizomatous weed species (Gago et al., 2007; Fredrikson et al., 2011). Given that vineyard weed communities are rather diverse, due to climate, soil and topographic properties, they should therefore be studied in each area. Knowing their biodiversity and biological spectrum is crucial when choosing appropriate management measures in order to achieve a good vineyard health status and appropriate yield and wine quality (Gago et al., 2007).

Furthermore, certain weed species have a negative impact on grapevine growth, wine quality and health of the vineyard as a whole (Saayman and Huyssteen, 1983; Hulina, 1998; Dujmović Purgar and Hulina, 2004; Jelenić, 2015). Additionally, they can act as natural reservoirs of phytoplasmas and fungi and hosts of potential insect vectors of various plant viruses and phytoplasmas (Cvrković, 2009; Filippin et al., 2009; Agustí-Brisach et al., 2011; Cvrković et al., 2011; Atanasova, 2015). Also, adequate weed control in vineyards reduces the degree of water retention in the field, thus reducing the potential for development of various diseases (Jelenić, 2015).

Bearing all this in mind, the need for keeping vineyards in a good condition and thereby preserving the quality of the grapevine plants and wine, through adequate weed control, is paramount (Lloret et al., 2011). As the biological spectrum of the weed flora is one of the factors affecting the choice of agrotechnical measures which are being applied (Gago et al., 2007; Fredrikson et al., 2011), the aim of the study was to determine the properties of the weed flora in the Vršac vineyards by assessing the prevailing life forms and their morphological and phenological characteristics.

MATERIAL AND METHODS

Study area

The Vršac Mountains (in Serbian Vršačke planine, also known as Vršački breg), are the only mountain area in the Banat region. Their highest point

Guduričkі vrh (641 m a.s.l.) is also the highest point of the Vojvodina Province (Vasiljević, 2015). Their area encompasses 170 km^2, out of which 122 km^2 are located in the territory of Serbia (Papp and Sabovljević, 2010). The study area is characterized by a continental climate, with extremely cold winters and semi-arid summers (PSUZŽS, 2018). Avramov et al. (2000) define the climate of this winegrowing district as sub-humid, with mean annual air temperatures of 11.5 °C, an average annual air humidity of 73% and 659 mm of precipitation, and 86 sunny days per year, on average (Živković, 2014). This area is under strong influence of the southeastern košava winds (avg. speed 4.6 m/s), which are especially prevalent during the winter (PSUZŽS, 2018).

While their northern slopes are steep, southern slopes of the Vršac Mountains are milder and covered in vineyards (Papp and Sabovljević, 2010). Perennial cultures, primarily vineyards, are the main landmark of their eastern and southern slopes, where winegrowing has been one of the most important agricultural activities for centuries (PSUZŽS, 2018). In fact, the area of Vršac Mountains is considered to be the biggest single area under vineyards in Europe (PSUZŽS, 2018). According to the latest national classification, areas under grapevine in Serbia are divided into three winegrowing regions and 22 winegrowing areas (Ivanišević and Jakšić, 2014). Following this, the study area belongs to the winegrowing region of Vojvodina, winegrowing area (sub-region) of Southern Banat and the winegrowing district Vršačko vinogorje.

Field research and data analysis

Field research in Vršački vinogradi (Figure 1) was conducted on three field sites: 1) Magareći breg (lat. +45.096897, long. +21.345669); 2) Izlaz and Šeribl (lat. +45.100456, long. +21.32049); 3) Kozluk and Majdan (lat. +45.150152, long. +21.353299). Field research was carried out during the 2016 vegetation season (from March to November), once per month, in order to include the spring, summer and autumn vegetation aspects.

A combined weed control system was applied in the study area during the vegetation season of 2016, with mechanical weed control measures applied between rows and chemical weed control being applied in the rows. Given the general paucity of available herbicides registered for weed control in vineyards in Serbia (DZBS, 2018), glyphosate-based herbicides were used for chemical weed control in the studied field sites. It is important to highlight that in 2016 the Vršac region experienced meteorological conditions which strongly favored weed germination and growth. High humidity with frequent rainfalls and temperature fluctuations during the spring were followed by a summer period with extremely high temperatures, with intermittent heat waves and an above average precipitation (Radičević et al., 2016).

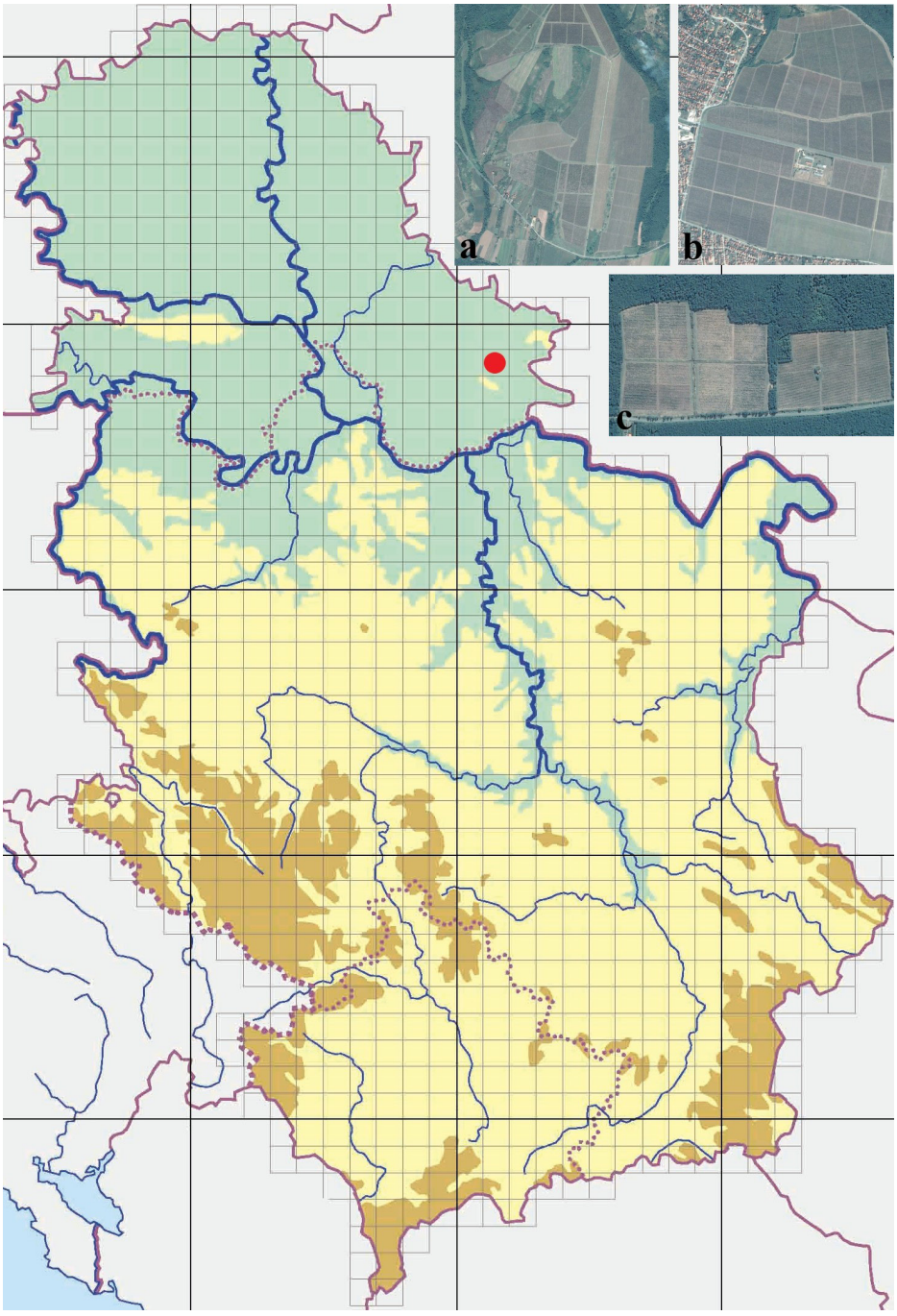

Figure 1. Map of Serbia showing the study area, and satellite images of the three field sites: a) Magareći breg, b) Izlaz and Šeribl, c) Kozluk and Majdan (*source*: Google Earth).

Floristic analysis was carried out at 60 permanent 1 m^2 plots. In each of the three studied field sites, 20 plots were set up (16 plots between the vine rows and four in-row plots). The plant material was identified in the field or collected and then identified in the Laboratory of the Department of Weed Research of the Institute for Plant Protection and Environment, Belgrade. Plants were determined according to Josifović (1970–1977), Tutin et al. (1964, 1968, 1972, 1976, and 1980) and Javorka and Csapody (1975). Taxa nomenclature is in line with the Euro+Med PlantBase (Euro+Med, 2006–2019). Life forms were determined following the Raunkiaer system (Ellenberg and Muller-Dombois, 1976), edited by Stevanović (1992) for the territory of Serbia.

RESULTS

The presence of 97 plant taxa was determined in the studied field sites of the Vršac vineyards during the research period. Recorded species belong to 26 families, with the dominance of Asteraceae (21 species), Poaceae (18) and Fabaceae (12) species.

Analysis of the biological spectrum has shown that weed flora of the studied area has the therophyto-hemicryptophytic character. Therophytes (T) were the dominant life form, followed by a significant presence of hemicryptophytes (H) (Table 1).

Therophytes make up 57.73% of the recorded species (56 species, Table 1). Ratio of the main groups within this life form is given in Table 1, which shows that among the therophytes scapose herbaceous plants (T scap) are the most numerous, making 73.21% of all therophytes. Representatives of annual caespitose life forms (T caesp) make up 8.93% of all the therophytes (four species): *Bromus sterilis* L., *Echinochloa crus-galli* (L.) Beauv, *Hordeum murinum* L. and *Poa annua* L., while representatives of other groups are recorded with a lower number of species (Table 1).

Six species (6.18% of the total number of species, Table 1) belonging to the therophyte-hemicryptophyte transitional life form have also been recorded. Within this T/H group of species, five are biennial scapose plants with no rosette (T/H scap bienn), while one is characterized by the presence of rosette (T/H ros bienn) – *C. bursa-pastoris*.

The therophytes phenology analysis has shown the dominant presence of summer species (a) – 26 species (46.43%), followed by a significant presence of spring-summer (v-a – 16.07%), spring (v – 10.71%) and spring-autumn (v-aut – 10.71%), as well as summer-autumn (a-aut – 8.93%) flowering species (Table 1).

The growth form analysis has shown a significant presence of the medium to large therophytes: Mes-Meg (10 species), Mes-Mac (10 species) and Mes (8 species). Small to medium therophytes (Mi-Mes) were represented by seven species, with the dominance of *Lamium amplexicaule* L. and *L. purpureum* L. The big and tall (Mac-Alt) therophytes were present with six species, while other growth form categories were represented to a lesser degree (Table 1).

Table 1. Biological spectrum of the Vršac vineyards weed flora

life form	morphology	no. spec.	% within the life form	% of the total species number (97)	phenology	no. spec.	% within the life form	% of the total species number (97)	growth form	no. spec.	% within the life form	% of the total species number (97)
therophyte (T)	T scap	41	73.21%	42.27%	a	26	46.43%	26.80%	Mes-Mac	10	17.86%	10.31%
	T/H scap bienn	5	8.93%	5.15%	v-a	9	16.07%	9.28%	Mes-Meg	10	17.86%	10.31%
	T caesp	5	8.93%	5.15%	v-aut	6	10.71%	6.19%	Mes	8	14.29%	8.25%
	T rept	2	3.57%	2.06%	v	6	10.71%	6.19%	Mi-Mes	7	12.50%	7.22%
	ST herb	1	1.79%	1.03%	a-aut	5	8.93%	5.15%	Mac-Alt	6	10.71%	6.19%
	T scap semiros	1	1.79%	1.03%	ver-a	3	5.36%	3.09%	Meg-Alt	4	7.14%	4.12%
	T/H ros bienn	1	1.79%	1.03%	ver	1	1.79%	1.03%	Mac	2	3.57%	2.06%
									Mac-Meg	2	3.57%	2.06%
									Meg	2	3.57%	2.06%
									Mi-Meg	2	3.57%	2.06%
									Mes-Alt	1	1.79%	1.03%
									Mi	1	1.79%	1.03%
									Mi-Mac	1	1.79%	1.03%
total	**therophytes**	**56**	**100%**	**57.73%**		56	100%	57.73%		56	100%	57.73%
hemicryptophyte (H)	H scap	17	51.52%	17.53%	a	19	57.58%	19.59%	Mes-Meg	7	21.21%	7.22%
	H caesp	5	15.15%	5.15%	v-a	9	27.27%	9.28%	Meg-Alt	5	15.15%	5.15%
	H rept	2	6.06%	2.06%	a-aut	2	6.06%	2.06%	Mac-Meg	4	12.12%	4.12%
	H scap bienn	2	6.06%	2.06%	ver-a	2	6.06%	2.06%	Meg	4	12.12%	4.12%
	H ros	2	6.06%	2.06%	v-aut	1	3.03%	1.03%	Mes	4	12.12%	4.12%
	H bienn (T scap)	1	3.03%	1.03%					Mac-Alt	3	9.09%	3.09%
	H scap (T scap)	1	3.03%	1.03%					Mes-Mac	2	6.06%	2.06%
	H scap perenn	1	3.03%	1.03%					Mac	1	3.03%	1.03%
	H scand	1	3.03%	1.03%					Mi-Mac	1	3.03%	1.03%
	SH herb (Hscap)	1	3.03%	1.03%					Mi-Meg	1	3.03%	1.03%
									Mi-Mes	1	3.03%	1.03%
total	**hemicryptophyte**	**33**	**100%**	**34.02%**		33	100%	34.02%		33	100%	34.02%
geophyte (G)	G rhiz caesp	2	40.00%	2.06%	a	4	80.00%	4.12%	Meg-Alt	2	40.00%	2.06%
	G herb rhiz	1	20.00%	1.03%	a-aut	1	20.00%	1.03%	Alt	1	20.00%	1.03%
	G rad	1	20.00%	1.03%					Mac	1	20.00%	1.03%
	G rhiz (H rept)	1	20.00%	1.03%					Mes-Meg	1	20.00%	1.03%
total	**geophyte**	**5**	**100%**	**5.15%**		5	100%	5.15%		**5**	**100%**	**5.15%**
phanerophyta (P)	NP caesp	2	**100%**	**2.06%**	v-a	2	**100%**	**2.06%**	fo dec	2	**100%**	**2.06%**
chamaephyta (Ch)	Ch frut	1	**100%**	**1.03%**	v-a	**1**	**100%**	**1.03%**	Mi-Mes	1	**100%**	**1.03%**

scap – scapose, bienn – biennial, caesp – cespitose, dec – deciduous; fo – forb; rept – creeping, herb – herbaceous, semiros – semirossette, ros – rosette, perenn – perennial, scand – scandetophyta, rhiz – rhizomatous, rad – root, a – summer-flowering, aut – autumn-flowering, v/ver – spring-flowering, Alt – tall, >100 cm, Mac – large, long, Meg – large, robust, Mes – medium, Mi – small.

In the analyzed weed flora, the presence of 33 hemicryptophytes (34.02%) was documented, with the dominance of perennial scapose plants (17 species or 51.52%), Table 1. Within this group species *Achillea millefolium* L., *Cichorium intybus* L., *Galium mollugo* L., *Hypericum perforatum* L., *Rumex crispus* L. and *Sonchus arvensis* L. were the most abundant. Within the hemicryptophyte life forms (Figure 2), the second most represented group (15.15%) were the five perennial caespitose species (H caesp), primarily grasses (fam. Poaceae). Hemicryptophytes with a rosette (H ros), *Plantago lanceolata* L. and *Taraxacum officinale* Weber in Wiggers, creepers (H rept) *Glechoma hederacea* L. and *Ranunculus repens* L. and only one species (*C. sepium*) of the scandetophyte life form (H scan) were also recorded.

When analyzing the phenology of hemicryptophytes, it is evident that plants with a summer flowering period (a) were dominant, with 19 species (57.58%), followed by the group of plants with a spring-summer flowering period (v-a – 27.27%). All other transitional groups (a-aut, v-aut and ver-a) are less represented (Table 1).

Hemicryptophyte growth form analysis has shown a relatively equal presence of individual growth form groups (Table 1). Medium to large (Mes-Meg) growth form group, with 7 species (21.21%) and robust and tall (Meg-Alt) group, with 5 species (15.15%) were characterized by a somewhat higher number of species, when comparing to the others.

The geophytes (G), with five species (5.16%), were the third most represented life form. Four rhizomatous geophytes (G rhiz) and one root-budding geophyte (G rad) were recorded within this life form (Table 1).

Regarding their phenology (Table 1), the recorded geophytes are primarily summer flowering (a – 80%), with the exception of *Sorghum halepense* (L.) Pers. which flowers in the summer-autumn (a-aut) period. Different growth forms are equally represented among the geophytes (Table 1).

Phanerophytes were represented in the study area by two nanophanerophyte species (2.06%, Table 1): *Rosa canina* L. and *Rubus caesius* L., both being deciduous forbs lower than 2 m (life from: fo dec NP caesp) and chamaephytes with only one species – *Thymus vulgaris* L.

DISCUSSION

The recorded diversity of the Vršac vineyards weed flora has doubled, when compared to previous studies in the same locality, conducted 40 years ago by Anđelić (1976) and Šinžar and Živanović (1980), citing the presence of 46 and 35 weed species in the vineyards of the Vršac region, respectively. However, the results of the study are similar to more recent research of vineyards weed flora conducted in Croatia (Dujmović Purgar and Hulina, 2004) and Bosnia and Herzegovina (Kovačević et al., 2015). Therefore, such a discrepancy in weed species numbers in the studied area 40 years ago and today could most likely be a result of different sampling techniques, with previous studies (Anđelić, 1976; Šinžar and Živanović, 1980) possibly sampling a much

smaller study area, or not recording the weed diversity all-year round. Alternatively, it could also result from an increase in weed species numbers, due to consistent disturbances over the past four decades and high propagule pressure from the surrounding agricultural landscape. Given that the recorded diversity has doubled, such a dramatic increase is most likely a result of a combination of both restricted sampling technique in previous studies and an actual increase in weed diversity in the study area over time.

Although hemicryptophytes are best adapted to temperate climate conditions, which many studies have previously confirmed in Serbia (Diklić, 1984; Popović and Obratov-Petković, 2006; Stanković-Kalezić, 2007; Jakovljević et al., 2008; Brković, 2015; Gavrilović, 2016), the obtained results have shown a dominance of therophytes in the vineyard weed flora. This has also been previously observed by Šinžar and Živanović (1980). On the other hand, Dujmović Purgar and Hulina (2004) have recorded a dominance of hemicryptophytes in the vineyards of northwestern Croatia, which is inconsistent with the results obtained. Nevertheless, despite the general prevalent presence of hemicryptophytes in Serbia (Diklić, 1984; Popović and Obratov-Petković, 2006; Stanković-Kalezić, 2007; Jakovljević et al., 2008; Brković, 2015; Gavrilović, 2016) and in Croatia (Dujmović Purgar and Hulina, 2004), our results were expected, as therophyto-hemicryptophytic character of weed flora is also evident in vineyards across the region (Šinžar and Živanović, 1992; Kovačević et al., 2008, 2015; Kovačević, 2013; Rotim, 2016). Furthermore, a similar dominance of annual broadleaf weed species (therophytes), followed by hemicryptophytes, has also been shown to be characteristic for vineyards weed flora in other parts of the world, e.g. in Spain (Buján, 1991; Gago et al., 2007), Czech Republic (Lososová et al., 2003) and North America (Baumgartner et al., 2008; Fredrikson, 2011).

Despite the hemicryptophytic character of the flora of Serbia (Diklić, 1984) and the entire temperate zone (Raunkier, 1934), the documented dominance of therophytes in the weed flora of vineyards is a result of intensive agrotechnical measures (Lososová et al., 2003; Kovačević, 2013; Jelenić, 2015) and microclimatic conditions in vineyards (Asproudi et al., 2016). The prevalence of therophytes is primarily caused by mechanical weed control measures such as soil cultivation – tillage (Lososová et al., 2003; Kovačević, 2013) and therefore frequent ecosystem disturbances (Kovačević, 2013) to which therophytes are well-adapted (Jelenić, 2015). Even though Konstantinović et al. (2012) have concluded that mechanical tillage between the vineyard rows reduces the number of weed species, Lososová et al. (2003) have shown that this management practice actually favors the high proportion of therophytes. Therefore, a high percentage of therophytes which was recorded (57.73%, Table 1) was expected, given that tillage has for years been the main management practice between the grapevine rows in the study area.

In line with the proportion of therophyte groups shown in Table 1, a recent study of the vineyard seedbank (Konstantinović et al., 2012) has also shown a high abundance of seeds of three scapose therophytes (*Portulaca oleracea* L., *A. retroflexus* and *Chenopodium album* L.) in the top (0–10 cm) soil layer. Similarly, the vineyard weed association *Diplotaxis muralis* Kovačević 2013 is

also characterized by absolute dominance (73%) of the T scap life form among the recorded therophytes (Kovačević, 2013), as is the overall vineyard weed flora of the Herzegovina winegrowing region (81.2%; Kovačević et al., 2008). *C. bursa-pastoris* was also the only species of the biennial rosette T/H life form recorded by Kovačević (2013) in the vineyards of the Herzegovina region, which was confirmed in this study.

According to Šinžar and Živanović (1980) a high proportion of hemicryptophytes (and geophytes to some degree) in some vineyards can be correlated with soil types. Namely, their presence is related with more productive soils, which are characteristic for the southern parts of the Vršac region (Vasiljević, 2015). Also, it has been recorded that both hemicryptophytes and geophytes are more abundant in the in-row weed vegetation, while therophytes are more numerous in the spaces between rows (Šinžar and Živanović, 1992), which is expected due to the implementation of different control measures in-row and between the rows during the vegetation season. Also, although *C. sepium* is the only documented species of the scandetophyte hemicryptophytes, its presence is important for vine growers from the phyto pathological point of view as in vineyards *C. sepium* is one of the principal host plants of the cixiid planthopper *Hyalesthes obsoletus* (Langer and Maixner, 2004), which is the main insect vector of the stolbur phytoplasma (Cvrković et al., 2014).

The geophytes were significantly less represented in the study area, compared to therophytes and hemicryptophytes, which was also confirmed by Kovačević (2013) for the vineyards of the Herzegovina region. The results have shown a slight decrease in the number of root geophytes in favor of rhizome geophytes (Table 1), compared to the results of Šinžar and Živanović (1980) in the same study area. A higher incidence of rhizomatous weed species in vineyards can be a consequence of mechanical cultivation practices, which propagate their rhizomes within the field (Fernandez, 2003).

Information pertaining to the phenology of the dominant weed species is relevant for the vine growers, as it enables them to choose appropriate control techniques to achieve good weed control (Gago et al., 2007). The highest proportion of summer flowering plants in the vineyards weed flora was expected, when bearing in mind the climate of the study area. Recent studies have shown that *S. halepense* is one of the most represented summer-autumn flowering weed species in the eastern winegrowing district of Srijem in Croatia (Rac Papak, 2019). Differences in the phenology of the weed life forms between the study area and the vineyards studied in the region of Herzegovina (Kovačević, 2013) reflect the regional uniqueness of the Herzegovina vineyards, primarily related to the climate conditions.

CONCLUSION

Results of the current study have shown that weed flora of the Vršac vineyards is of a therophyto-hemicrypthophytic character, with a strong prevalence of summer flowering medium-large therophyte and tall hemicryptophyte

species. Such results were expected given the common cultivation practices and frequent ecosystem disturbances of these vineyards and should impact the future decision-making of appropriate weed control measures. Seeing how the meteorological conditions during the 2016 vegetation season favored rapid weed development and regrowth, thus making glyphosate-based chemical weed control obsolete in some instances, it would be recommended to include soil-applied herbicides in those vineyards where more persistent weed species are recorded. Soil-applied herbicide which would be appropriate for vineyard application, as it does not affect the grapevine health or the wine quality, while simultaneously efficiently controlling both annual and perennial grass and broadleaf weeds, is flazasulfuron, from the herbicide group of sulphonylureas (Bourdrez and Beraud, 1999). Additionally, its prolonged residual action would enable a fall application of this herbicide to keep the vineyards weed-free for a period of five to eight months. Conversely, if the weather conditions are as favorable for weed growth as they were in 2016, it is possible to also apply it in spring, thus controlling the weed infestation all-year round.

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БИОЛОШКИ СПЕКТАР КОРОВСКЕ ФЛОРЕ ВРШАЧКИХ ВИНОГРАДА (СРБИЈА)

Ана А. АНЂЕЛКОВИЋ[1], Драгана П. МАРИСАВЉЕВИЋ[1], Душанка Љ. ЦВИЈАНОВИЋ[2], Снежана Б. РАДУЛОВИЋ[2], Данијела М. ПАВЛОВИЋ[1]

[1] Институт за заштиту биља и животну средину, Одсек за хербологију, Теодора Драјзера 9, Београд 11040, Србија
[2] Универзитет у Новом Саду, Природно-математички факултет, Департман за биологију и екологију, Трг Доситеја Обрадовића 2, Нови Сад 21000, Србија

РЕЗИМЕ: Агротехничке мере представљају основни фактор који одређује структуру и састав коровске флоре у виноградима. Адекватне мере сузбијања корова у исто време обезбеђују добро одржавање винограда, чиме се осигурава добро здравствено стање винове лозе и висок квалитет вина. Имајући у виду да биолошки спектар корова утиче на ефикасност мера контроле, циљ овог истраживања био је да се утврде биолошка својства коровске флоре Вршачких винограда, анализом доминантних животних форми корова и њихове фенологије. Флористичка анализа вршена је током вегетацијске сезоне (у периоду март–новембар) 2016. године, на 60 трајних огледних парцела величине 1 m^2 на три локалитета на подручју Вршачких винограда. Утврђено је присуство 97 врста, у оквиру 26 различитих фамилија. Анализа биолошког спектра показала је да је коровска флора винограда истраживаног подручја терофитско-хемикриптофитског карактера (терофите: 57,73% и хемикриптофите: 34,02%). У оквиру представника животних форми терофита и хемикриптофита, доминантно су заступљене вишегодишње зељасте биљке са стабљиком (T scap), док је у погледу фенолошке динамике највећи број врста које цветају током лета. Резултати до којих се дошло у склопу овог истраживања указују на свеукупно виши диверзитет корова, у поређењу са ранијим истраживањима коровске флоре винограда истог истраживаног подручја. Међутим, приказани резултати су у складу са резултатима новијих истраживања диверзитета коровске флоре винограда спроведених у земљама у региону. Такође, доминантан удео терофита у коровској флори винограда био је очекиван, имајући у виду примарне механичке мере контроле које се у виноградима традиционално примењују.

КЉУЧНЕ РЕЧИ: биолошки спектар, виноград, Вршачки виногради, животна форма, корови, фенолошка динамика