

## PHYTOGEOGRAPHICAL ANALYSIS OF THE VRŠAC VINEYARDS (SERBIA) WEED FLORA

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### Abstract

Application of various agrotechnical measures is the key factor defining the composition of the vineyard weed flora. Vineyard weed communities are highly diverse, due to specific environmental characteristics and frequent disturbances of these agroecosystems. Bearing all this in mind and due to a limited number of studies of the vineyard weed flora in Serbia, the aim of this research was to assess the phytogeographical characteristics of the vineyard weed flora in the Vršac vineyards. Field research encompassed the entire vegetation season (March–November) in 2016 and was performed at three localities within the area of the Vršac vineyards. Floristic analysis was done at 60 fixed 1 m<sup>2</sup> plots (48 between-row and 12 in-row plots). Phytogeographical analysis has determined that 97 weed species which were recorded belong to eight areal types. Weed species predominately belonged to the Eurasian areal type, with 49 recorded species (51%). Results have shown the presence of 14 species of cosmopolitan distribution, while the Pontic-Mediterranean areal type was represented by 10 weed species (10%). This transitional areal type was represented by four areal groups, of which the Pontic-CentralAsian-Submediterranean group was the most numerous. Of the plants typical for the Pannonian region of Serbia, i.e. the steppe species, belonging to the Pontic-SouthSiberian areal type, only two weed species (*Asperugo procumbens* and *Senecio vernalis*) were recorded. Allochthonous species (adventive areal type) were represented by eight weed species, with species originating from North America (*Amaranthus retroflexus*, *Erigeron annuus*, *E. canadensis*, *Panicum capillare* and *Xanthium strumarium* subsp. *italicum*) being dominant.

**Keywords:** *areal type; biogeography; floral element; Vojvodina province; Vršac vineyards.*

### Introduction

The tradition of winegrowing has for centuries been one of the main agricultural activities on the southern slopes of the Vršac mountains (South Banat region, Autonomous Province of Vojvodina, Serbia; PSUZŽS, 2018). Weeds compete with grapevines, thus affecting the plant vigor, final yield, and the quality of wine itself (Dujmović Purgar and Hulina, 2004; Ingels et al., 2005). Diversity of vineyard weed communities is the result of specific environmental conditions and frequent disturbances of these agroecosystems (Gago et al., 2007). These weed communities are highly dependent on the human factor (Kovačević et al., 2015), with various agrotechnical measures affecting their composition (Gago et al., 2007). Both in-row and between-row weed control is of vital importance for maintaining the vineyards weed-free and reducing the weed seedbank (Fredrikson et al., 2011), equally affecting the weed flora. Bearing all this in mind and due to a limited number of studies of the vineyard weed flora in Serbia, the aim of this research was to assess the phytogeographical characteristics of the vineyard weed flora in the Vršac vineyards.

## Material and Methods

Field research was done once per month in the March-November period of 2016, with the aim to encompass all vegetation aspects during the vegetation season. The floristic analysis was performed at three localities within the Vršac vineyards area: Magareći breg, Izlaz-Šeribl and Kozluk-Majdan, at 60 fixed 1 m<sup>2</sup> plots - 48 between-row and 12 in-row plots, distributed evenly between the field sites. The recorded weed species were identified in the field or collected and subsequently identified, using the standard identification keys: Josifović (1970-1977), Javorka and Csapody (1975) and Sarić (1992). Nomenclature of the weed species follows the Euro+Med PlantBase (Euro+Med, 2006-2020).

Weed species classification based on floristic elements into appropriate phytogeographical units (areal types and areal groups) was done according to Gajić (1980) and the chorological classification of Meusel et al. (1965, 1978), with necessary regional modifications of the classification as defined by Stevanović (1992) for the territory of Serbia. The spectrum of the represented areal types and areal groups is given as a percentage of the total number of recorded species. An index of floristic originality (OR) was computed following Malyshev (1991):  $OR = (S - \hat{S})/S$ , where  $S$  and  $\hat{S}$  are the actual and expected species numbers. The expected species number is calculated by following the method of least squares (Malyshev, 1969 in Malyshev, 1991):  $\hat{S} = 314.1 + 0.004538 * G^2$ , where  $G$  is the observed number of genera.

## Results and Discussion

Field research in vineyards has determined the presence of 97 weed species, belonging to 26 families (Anđelković et al., *in press*). Subsequent phytogeographical analysis has determined that the recorded species belong to eight areal types (Figure 1), divided into 17 different areal groups (Table 1). The number of recorded floral elements is similar to those recorded by Kovačević et al. (2008) for the vineyards in the Herzegovina vineyard region.

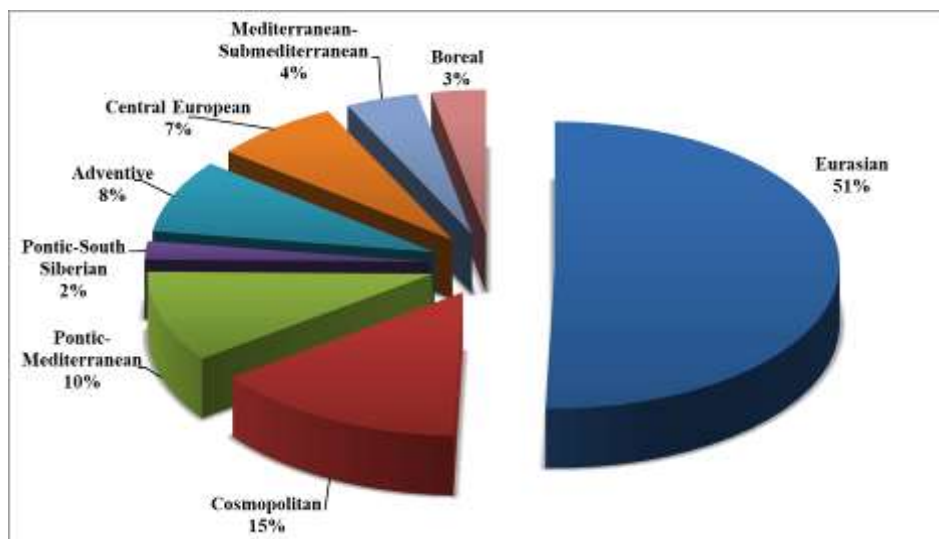


Figure 1. Phytogeographical spectrum of the vineyard weed flora in the Vršac vineyards

The results (Figure 1) have shown that the recorded weed species predominately belong to the Eurasian areal type, with 49 recorded species (51%). Such an abundance of Eurasian species was expected, given that this floristic chorion had the strongest impact on the floristic origins of the flora in the study area (Gavrilović, 2016). Additionally, the dominance of Eurasian

species is also easily explained, knowing their wide geographical distribution and broad ecological valence (Jušković et al., 2010; Tmušić et al., 2019).

Given that the same ecological characteristics are also true for cosmopolitan species, it is not surprising that this areal type is the second most represented group of species, with 14 weed species (Figure 1). A similar prevalence of Eurasian and cosmopolitan species has also been recorded in the vineyards of Bosnia and Herzegovina (Kovačević et al., 2008; 2015) and the regional potato weed flora (Stešević and Jovović, 2005; Nikolić et al., 2013; Mehmeti et al., 2019). In addition to their ecological characteristics, a relatively high incidence of cosmopolitan species (15%, Figure 1), can be explained by the fact that plant species belonging to this group are common agricultural weeds, and therefore understandably more abundant in agroecosystems (Kovačević et al., 2008; 2015) and ruderal areas (Jakovljević and Jovanović, 2005), when compared to natural habitats in Serbia (e.g. Petrović et al., 2007; Jušković et al., 2010), where they are among the least represented floral elements.

The presence of transitional areal types, i.e. Pontic-Mediterranean and Pontic-SouthSiberian is the result of varying influences affecting the biogeography of the Pannonian part of Serbia (Gavrilović, 2016). Weed species of the Pontic-Mediterranean areal type represent the third most represented group, with 10 species (10%; Figure 1). This transitional areal type is represented by four areal groups: Subpontic-Submediterranean, Pontic-CentralAsian-Submediterranean, Pontic-EasternSubmediterranean and Pontic-Submediterranean areal group, of which the Pontic-CentralAsian-Submediterranean group was the most numerous, with 40% of species within this areal type (Table 1).

Of the plants belonging to the Pontic-South Siberian areal type, i.e. steppe-like species, only two weed species (*Asperugo procumbens* and *Senecio vernalis*) were recorded. Although a higher presence of typical steppe vegetation species was expected, given the geographical position of the study area, the presence of only two such species is a result of specific agroecological conditions and weed control measures which have been applied in the Vršac vineyards for a long period of time. A similarly small presence of this areal type was also recorded in the ruderal flora by Jakovljević and Jovanović (2005), which points to the fact that this floristic element, although generally expected in this geographic area, is much more prevalent in those habitats where the environmental conditions are favorable for the development of such xerothermic, steppe-like vegetation (Randelović et al., 2007).

The calculated index of floristic originality is -2.49, with the expected number of species being 338. Such a negative value of OR indicates a strong presence of allochthonous plant species in the study area (Malyshev, 1991). Consequently, the presence of eight allochthonous species, belonging to the adventive areal type is not surprising. Species originating from North America (*Amaranthus retroflexus*, *Erigeron annuus*, *E. canadensis*, *Panicum capillare* and *Xanthium strumarium* subsp. *italicum*) are dominant (Table 1) within this floral element. A similar number of adventive species was also characteristic for weedy-ruderal community of invasive *Asclepias syriaca* (ass. *Asclepiadetum syriacae* Lániková in Chytrý 2009) documented by Popov et al. (2016), highlighting that the high incidence of allochthonous plant species is not uncommon in weedy vegetation. A strong presence of both adventive and cosmopolitan areal types (Figure 1) is indicative of frequent disturbances and strong anthropogenic pressures, characterizing both ruderal (Jakovljević and Jovanović, 2005; Gavrilović, 2016) and agroecosystems, such as vineyards.

A similarly low proportion of floral elements belonging to the Pontic-SouthSiberian, CentralEuropean and Boreal areal types has been recorded in the vineyards of the Herzegovina region (Kovačević et al., 2008). Our results have shown that the CentralEuropean areal type was represented by seven weed species in the weed flora of the Vršac vineyards, most of them (85%) belonging to the SubcentralEuropean areal group (Table 1). Given that these species are predominantly characteristic for the mesophilous deciduous

forests of the temperate zone, a relatively small presence of CentralEuropean species in the vineyard weed flora is not surprising, knowing the ecological conditions prevailing in this perennial agroecosystem. Finally, three species of the boreal areal type were documented in the study area: *Poa pratensis*, *Rubus idaeus* and *Rumex acetosella*, making 3% of the total number of recorded species (Figure 1). As vineyards positioned on the southern slopes of the Vršac mountains are not favorable habitats for the development of plants characteristic for colder and more humid northern regions (Jušković et al., 2010), their poor representation in the total vineyard flora was to be expected.

Table 1. Phytogeographical spectrum of the vineyard weed flora in the Vršac vineyards

Areal type	number of species	%	Areal group	number of species
Eurasian	49	51	Eurasian	28
			Sub-Eurasian	21
Cosmopolitan	14	14		
Pontic-Mediterranean	10	10	Subpontic-Submediterranean	3
			Pontic-Central Asian-Submediterranean	4
			Pontic-EasternSubmediterranean	1
			Pontic-Submediterranean	2
Pontic-SouthSiberian	2	2	Subpontic-Central Asian	1
			Sub-south Siberian	1
Adventive	8	8	North America	5
			Asia	2
			North and Central America	1
Central European	7	7	Central European	1
			Subcentral European	6
Mediterranean-Submediterranean	4	4	Mediterranean	1
			Sub-Mediterranean	3
Boreal	3	3	Circumpolar	1
			Subcircumpolar	2

## Conclusions

Phytogeographical analysis has shown that weed flora of the Vršac vineyards belongs to eight areal types, with 17 different floristic elements identified. Eurasian species are the most dominant species group (with 51%), followed by cosmopolitan species (15%). The obtained phytogeographical spectrum dominated by species of wide distribution and high ecological plasticity is to be expected in a vineyard ecosystem often disturbed by anthropogenic activities. Of the remaining areal types represented to a lesser degree, the adventive areal type (8%) is of importance, owing to the invasive potential of non-native plant species.

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