The effect of the different vineyard management to composition of weed species

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Abstract: The aim of the study was to define which kinds of weeds were occurred in selected vineyards in Žabčice and evaluated the differences in weed infestation in vineyards with different management. The first vineyard was divided to three parts: grassed space between rows, the part close to the vine trunk and cultivated space between rows. In this vineyard were done common works in growing season (cutting, etc.) and herbicides were applied. In the second vineyard were cultivated spaces between rows left to spontaneous grassing, application of herbicides was limited and common works in growing season weren´t done. The evaluation was taken by phytocenological reléves in years 2013 and 2014. Obtained data were processed by multivariate analysis of ecological data. The most common species in the first vineyard were *Bromus hordeaceus*, *Bromus inermis*, *Digitaria sanguinalis*, *Elytrigia repens*, *Erodium cicutarium*, *Euphorbia cyparissias*, *Fallopia convolvulus*, *Galium aparine*, *Geranium pusillum*, *Geum urbanum*, *Hordeum murinum*, *Chenopodium hybridum*, *Lamium purpureum*, *Lycopsis arvensis*, *Plantago major*, *Robinia pseudoacacia*, *Senecio vulgaris* and *Stellaria media*. The most common species in the second vineyard were *Bromus* sp., *Bromus tectorum*, *Calamagrostis epigejos*, *Convolvulus arvensis*, *Conyza canadensis*, *Cornus sanguinea*, *Echinochloa crus-galli*, *Epilobium ciliatum*, *Chenopodium album*, *Chenopodium pedunculare*, *Lactuca serriola*, *Plantago lanceolata*, *Potentilla argentea*, *Sambucus nigra*, *Taraxacum officinale*, *Tragopogon orientalis*, *Tripleurospermum inodorum* and *Viola arvensis*.

Key-Words: weeds, vineyards, biodiversity

Introduction

Vineyards such as permanent crops are rich to weed spectrum due to management [1]. The occurrence of individual species largely affects geographical, agro-ecological and agro-technical conditions of the vineyard. Many species are in vineyard, annual, perennial, dangerous for vine or harmless. Large numbers of flowering plants enhances the biodiversity, and not least have an aesthetic function. Way of farming in the vineyard, works in growing season and all management have affects at growth and development of plant communities. The aim of this paper is to compare the range of weed species in two vineyards with different ways of management and statistically evaluate the differences. Many authors studied impact of different technologies to weed infestation, f. e. [2, 3, 4, 5]. Possibility of grassing [6] is after years of research in vine growing in the real use [7, 8].

Material and Methods

The aim of this paper was to determine which weeds were occurred in selected vineyards in the area of Žabčice and evaluate the differences in the weeds spectrum in vineyards with different management. GPS coordinates of selected vineyards are 49°00'10.1"N 16°35'25.3"E for intensive managed vineyard and 49°00'25.7"N 16°34'55.5"E for extensive managed vineyard.

Žabčice locates about 25 km south of Brno, in the production area of maize. The altitude of locality is 185 meters above sea level. The average annual temperature is 9.2 °C, which ranks Žabčice to the warmest locations in the Czech Republic. The average rainfall is 480.3 mm. Rainfalls are distributed unevenly during the growing season. Dried winds increase the drought. The first vineyard is kept in intensive management. Grassed strip and cultivated strip are alternated. Space close to the vine trunk is maintained by herbicides. Works in growing season (cutting the vine, chipping of

secundary leaders, trimming of top part of vine plant, defoliation in grapes area, etc.) are making in agronomic terms. The second vineyard is kept in extensive management. The cultivating strips were left spontaneous grassing; application of herbicides in space close to the vine trunk is limited. Works in growing season are not made.

Vegetation was evaluated using the phytocenological reléves in August in 2013 and 2014. Phytocenological reléves were written in part close to the vine trunk, cultivated strip and in grassed strip. In each vineyard were done 10 phytocenological reléves in part close to the vine trunk, 10 from cultivated strip and 10 in grassed strip. Total were made 60 phytocenological reléves in each year. Images were always evaluated in the same place. The abundance of weeds was assessed estimation methods in percentages. Czech and Latin names of each weed species were used in accordance with Kubát [9].

The obtained data were processed by Multivariate Analysis of Ecological Data. The optimal analyze was guided by Length of Gradient, which was obtained by Detrended Correspondence Analysis (DCA). Canonical Correspondence Analysis (CCA) was used for further processing. Data were processed by a computer program CANOCO 4.0. [10]. Significant difference was retrieved by test Monte-Carlo. It was converted 499 permutations.

Results and Discussion

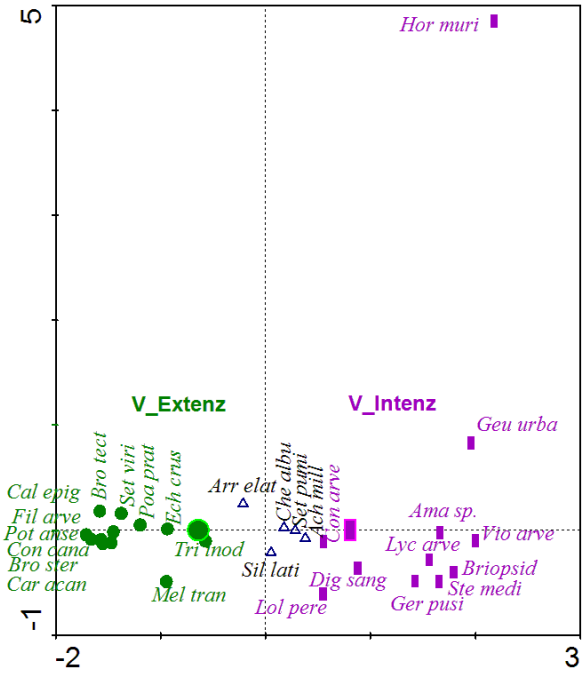
The obtained data of the frequency and coverage of plant species were processed DCA analysis. A length of Gradient was 3.787. Based on this calculation was chosen Canonical Correspondence Analysis for further processing. This analysis defines the spatial arrangement of individual species and selected vineyards. This layout is graphically displayed in the ordination diagram (Fig. 1). Weeds and management of vineyards points are shown with different shape and color. Species and sums of coverage are summarized in Tab. 1.

CCA results show that kind of management have an impact to the frequency and types of coverage in the vineyard. The result is significant at the significance level $\alpha = 0.002$ for all canonical axes. Management mode (intensive/extensive) should have an impact on the species composition of weeds in the vineyards. Therefore, these two different modes of vineyard management were used as factors that influence the occurrence of individual plant species. Purple point shows the factor of intensive management in vineyard, green point shows the factor of extensive management in vineyard. Species are color-divided into three groups in the ordination diagram. Weed species, which were occurred most frequently in vineyard with extensive management, are marked in green colour. When is point of weed species close to the point of factor, that factor affecting their occurrence. The same applies for species marked in purple color. The last group is the types that are marked in black. Those are species which occurrence strongly affects another factor that analysis is not included.

Table 1 The sums of coverage species in intensively and extensively maintained vineyard

Latin name	Kind of management	
	Intensive	Extensive
Achillea millefolium	168	76
Amaranthus sp.	617	335
Arrhenatherum elatius	259	474
Briopsida	122	298
Bromus tectorum		378
Calamagrostis epigejos	205	167
Carduus acanthoides	26	38
Convolvulus arvensis	151	13
Digitaria sanguinalis	521	145
Filago arvensis		1660
Geranium pusillum	219	20
Geum urbanum	164	53
Hordeum murinum	117	13
Chenopodium album	259	177
Lolium perenne	1250	339
Lycopsis arvensis	119	66
Poa pratensis	40	36
Potentilla argentea	79	23
Setaria pumila	315	128
Stellaria media	193	496
Viola arvensis	206	110
Other species	811	1539

Fig. 1 Ordination diagram expressing the impact factor of vineyard management to weed spectrum



Explanatory notes:
Ach mill (*Achillea millefolium*), *Ama sp.* (*Amaranthus* sp.), *Arr elat* (*Arrhenantherum elatius*), *Briopsid* (Briopsida), *Bro ster* (*Bromus sterilis*), *Bro tect* (*Bromus tectorum*), *Cal epig* (Calamagrostis epigejos), *Car acan* (*Carduus acanthoides*), *Con arve* (*Convolvulus arvensis*), *Con cana* (*Conyza canadensis*), *Dig sang* (*Digitaria sanguinalis*), *Ech crus* (*Echinochloa crus-galli*), *Fil arve* (*Filago arvensis*), *Ger pusi* (*Geranium pusillum*), *Geu urba* (*Geum urbanum*), *Hor muri* (*Hordeum murinum*), *Che albu* (*Chenopodium album*), *Lol pere* (*Lolium perenne*), *Lyc arve* (*Lycopsis arvensis*), *Mel tran* (*Melica transsi-lvanica*), *Poa annu* (*Poa annua*), *Pot anse* (*Potentilla argenta*), *Set pumi (Setaria pumila*), *Set viri* (*Setaria viridis*), *Sil lati* (*Silene latifolia*), *Ste medi* (*Stellaria media*), *Tri inod* (*Tripleurospe-rmum inodorum*) and *Vio arve* (*Viola arvensis*).

The most frequent weed species in intensive maintained vineyard were annual species *Amaranthus* sp., *Digitaria sanguinalis*, *Stellaria media*, *Viola arvensis*, perennial species *Convolvulus arvensis*, *Geranium pusillum*, *Geum urbanum*, *Hordeum murinum*, *Lolium perenne* and *Lycopsis arvensis*. Totally were identified 37 annual weed species and 23 perennial weed species.

Crabgrass (*Digitaria sanguinalis*) was species with the most coverage percentage in intensive maintained vineyard. It occurs mainly on sandy soils, not only in fields, but also in vineyards. We can found it in the unconnected stands where there is enough space for growth and development. Its competitiveness is increasing with abundance. Great coverage this kind is likely related with high production of seeds [11].

Another abundant species in the reporting vineyard was small-flowered cranesbill (*Geranium pusillum*). This species is relatively undiscerning to soil alkalinity. It is occupying acidic and alkaline positions with enough of rainfall and sunshine.
Chickweed (*Stellaria media*) is an annual creeping herb. It is often found on disturbed positions. It is a kind, which is typical for repeated mechanically cultivated soil [2].

The most frequent weed species in extensive maintained vineyard were annual species *Bromus sterilis*, *Bromus tectorum*, *Conyza canadensis*, *Echinochloa crus-galli*, *Filago arvensis*, *Setaria viridis* and *Tripleurospermum inodorum*, perennial species *Carduus acanthoides*, *Calamagrostis epigejos*, *Melica transsilvanica*, *Poa annua* and *Potentilla argentea*. Overall, it was identified 32 annual species and 20 perennial species in this vineyard. In general, vineyards with extensive maintained are richer in plant and weed spectrum [12, 13]. After time, there is competing fight between weed species. Annual species are disappearing over time and abundance of dominant weed species is increasing [14, 15].

Extensive management of the vineyard and spontaneous greening originally cultivated strips could have under certain conditions a negative impact on the culture. In the Žabčice are frequent low summer rainfall and dry winds, which in conjunction with excessive greening can cause drought stress, thereby, reducing not only the quantity but also the quality of grapes and wine [16]. Bushgrass (*Calamagrostis epigejos*) was species with the most coverage percentage in extensive maintained vineyard. It is a perennial grass with thick rhizomes, which is ecologically very plastic. Grass is able to suppress competitively weaker species in a relatively short time in the low-tech management [17, 18]. This invasive species produces large quantities of biomass [19, 20, 21] and seeds [22]. Another abundant species in this vineyard was Silverleaf Cinquefoil (*Potentilla argentea*). It is a permanent type, with creeper root bines. It has a high competitive ability; it quickly fills the free space [23]. This species hates repeated processing of soil and regular mowing [24]. This kind of management suits its growth in this vineyard.

Barnyardgrass (*Echinochloa crus-galli*) is annual grass, which is occurring in whole Czech Republic, from plains to hilly country. Together with other annuals weeds is located at the beginning of

uninterrupted succession, then it is extruded via more dominant species [25].

Scentless Mayweed (*Tripleurospermum inodorum*) abounded not only in the field but also in other synanthrophic areas. This species produces large quantities of seeds [26], but it can occupy only unconnected stands. At a greater involvement of the crop, seedlings not able to get ahead [23].

Wood Avens (*Geum urbanum*) is a ruderal species, which is found on all positions, which affects a person by their activities.

Annual species are dominant in intensive maintained vineyard, for example *Amaranthus* sp., *Digitaria sanguinalis*, *Stellaria media* or *Viola arvensis*. Perennial species have greater abundance under extensive management in vineyard, for example *Calamagrostis epigejos*, *Melica transsilvanica* or *Potentilla argentea*. Similar results have many authors in their research [2, 28, 29, 30].

Conclusion

Spectrum of weed species was evaluated in two vineyards with a different way management in the area Žabčice in 2013 and 2014. Total were identified 61 weed species in the vineyard with intensive management. More coverage had 37 annual species, 23 perennial species had lower coverage. Further, it was identified 52 weed species in a vineyard with extensive management. This number including 32 annual species and 20 perennial species. Perennial species had higher coverage. Competitively stronger species gradually displace species with low competitive ability.

This study proves that the way in vineyard management significantly influences the composition of the species spectrum of weeds. The results not only contribute to the monitoring of the occurrence of weeds in vineyards, but also allows look into the course of succession on abandoned areas.

Acknowledgement

The results in paper are output of project of Internal Grant Agency, AF MENDELU, No. TP 10/2013 "Optimalization of crop management practices in areas threatened by drought" and project of NAZV QI111A184 „Optimization of weed control in the precision farming system".

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