Weed species spectrum of chosen field crops

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Abstract: The aim of this thesis was to evaluate weed infestation of chosen crops, to compare weed infestation among each crop and evaluate used regulation interventions, eventually to suggest another solution. Evaluation was made in winter oilseed rape, winter wheat and spring barley. *Viola arvensis, Veronica hederifolia, Veronica persica, Achillea millefolium, Stellaria media, Cirsium arvense, Tripleurospermum inodorum, Thlaspi arvense, Rumex obtusifolius, Triticum aestivum, Geranium pusillum, Lamium purpureum, Euphorbia cyparissias, Agropyron repens* and *Capsella bursa-pastoris* were found in winter oilseed rape. *Viola arvensis, Veronica hederifolia, Galium aparine, Veronica persica, Stellaria media, Matricaria recutita, Polygonum aviculare,Geranium pusillum, Lamium purpurem* and *Apera spica-venti* were in winter wheat. *Viola arvensis, Brassica napus ssp. napus, Rumex obtusifolius, Lamium purpureum, Fallopia convolvulus, Chenopodium album, Stellaria media, Galinsoga parviflora, Thlaspi arvense* and *Galeopsis tetrahit* occurred in spring barley. As conclusion was suggested using different methods of weed regulation.

Key-Words: spring barley, weed, winter oilseed rape, winter wheat

Introduction

In the current agriculture it may seem, that weeds are eliminated by wide range of herbicides offered by many companies and weed control is therefore not a serious problem. But the opposite is true, pay special attention to weed control is important even today [1].

We currently have several methods for determining the actual weed infestation, which are used depending on the objectives of monitoring [2].

Numerical method – individual weed species are counted per unit area (1 m^2) and are not considered their developmental stage. Evaluation may be very imprecise, even when it is repeatedly performed in several places. A relatively small part of the total area is mapped. Monitored area is generally defined by a square frame with a length of 0.25 m or 1 m [3]. The method is accurate enough in suggesting control treatments with knowledge of the damage thresholds of individual weeds [4].

Estimation method – percentages of individual weed species cover were estimated. Evaluation is performed within the plots repeatedly with all disadvantages of previous method [5]. It is fast but subjective method. Estimation method is more efficient than the numerical method, because it is an expression of number of weeds and takes into account their developmental stage at the same time [6].

Weighting method – detects weight of above-ground biomass of weed species per unit area. All above-ground parts of plants are collected close above the ground on the monitored area and dried plant material is weighed. Arrangement and samplings are similar to numerical method [7].

Combined method – is a combination of numerical and weighting method. Weeds are classified according to weed species on the monitored area, quantity is determined and weighed after drying [6].

Bonitation scale EWRC – this scale allows the estimation of the direct herbicide effects on monitored weeds. This method belongs to estimated method and it is burdened with subjective error of evaluator [5].

Phytocenological scanning – it is analysis and description of weedy communities in nature, its resulting report is called phytocenological relevé. Size of the study area is recommended from 25–100 m^2 [7].

These methods are very laborious and for targeted applications are less suitable. Therefore more accurate methods without possible influence of human factor are searched. There is a solution in use of computer technology nowadays [2].

State Plant Protection Administrative carries out an annual survey of the weed occurrence and its distribution in the Czech Republic by using general

phytocenological methodologies. Data are evaluated using computer technology since 1968. Weed monitoring was focused on one or a maximum of two basic crops in previous years. For data processing are used programs as JUICE, Turboveg for Windows, Canoco for Windows a CanoDraw for Windows since 2007 [8].

Phytocenological relevé are entered in web applications called Monitoring – weed infestation. All acquired relevé from that year are transferred from a web application to the program JUICE, where is adjusted the nomenclature according to the publication Key to the flora of the Czech Republic. Using JUICE is calculated the mean vegetation cover and frequency and characteristic species for the production area, previous crops, crops species and areas are determined Ordination methods are used to detect the main environmental gradients influencing species composition of weed communities. Specifically the method of canonical correspondence analysis (CCA). The influence of monitored environment variables on species composition is tested by Monte Carlo permutation test using CANOCO for Windows. By using LPIS applications are compiled maps for selected weed species. Its incidence and vegetation cover is shown in the maps, localization is only approximate [9].

Material and Methods

Characteristic of Experimental Location

Agricultural enterprise Pluhuv Zdar (GPS 49.226480, 14.893355) is located in southern Bohemia in Jindrichuv Hradec district, between cities Kardasova Recice and Destna, approximately 16 km away from Jindrichuv Hradec city. Production area is situated in the transition between potato and cereal production area. It lies at an altitude of 470 to 550 m a.s.l. Long-term precipitation of experimental area were used from www.chmi.cz. Data for 2012 were applied from teranos.ala1.com of Pluhuv Zdar station.

Enterprise focuses on crop and livestock production and operates on the total agricultural area of 2 140 ha till January 1, 2012. 1 750 ha are arable lands and the rest is permanent grassland. Enterprise manages farm lands with different soil surface type (0.15, 0.30 m) and varying granularity. Conventional tillage dominates in this enterprise, minimum tillage is used only for clover growths to save soil moisture establishing in August.

Meteorological values for the year 2012 are shown in Table 1.

Determination and evaluation of weed infestation

Current status of weed infestation of selected lands was conducted in winter wheat, oilseed rape and spring barley by numerical method. All weed species individuals, which were found at a given point, were summed during each observing. Measurements were carried out on randomly selected plots on area of $1m^2$. And each measurements represented 1 ha of selected land area. Overview of evaluated lands is given in Table 2.

A multivariate analysis of ecological data was used to determine the effect of environment factors to weed species occurred on monitored lands. Selection of the optimal analysis followed the length of the gradient (*Lengths of Gradient*), which was detected by segment analysis DCA (*Detrended Correspondence Analysis*). Furthermore, canonical correspondence analysis CCA was used. A total number of 499 permutations were calculated in Monte-Carlo test. Collected data were processed by a computer program Canoco 4.0 [10]. Czech and Latin terms of found species are listed according to Kubat [11].

Table 1 Meteorological figures measured in meteorological station in Pluhuv Zdar in 2012

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	average
Average temperature (°C)	-0.4	-5.8	5.3	8.5	14.3	17.2	18.2	18.4	13.5	7.4	4.6	-1.2	8.3
Precipitation total (mm)	91	41	22	59	62	129	166	145	64	59	45	67	950

Table 2 Characteristic of observed fields of monitored agricultural enterprise in 2012

Plot	Acreage	Crop
Stražky	19.94 ha	Oilseed rape
U Remizu	10.08 ha	Oilseed rape
Za Zastavkou	12.33 ha	Oilseed rape
Zahumenky - I	3.14 ha	Oilseed rape
Zahumenky - II	1.12 ha	Oilseed rape
Pod Stražky	25.26 ha	Winter wheat
Padělka	25.26 ha	Winter wheat
Travniky	50.76 ha	Spring barley

Table 3 Average number of found weeds in selected crops

Species of weeds (pcs.m^{-2})	Crop		
	Oilseed rape	Winter wheat	Spring barley
Agropyron repens	0.2		
Achillea millefolium	0.1		
Apera spica-venti		0.3	
Brassica napus ssp. Napus			9.5
Capsella bursa-pastoris	0.4		
Cirsium arvense	0.2		
Euphorbia cyparissias	0.6		
Fallopia convolvulus			0.2
Galeopsis tetrahit			0.5
Galinsoga parviflora			0.5
Galium aparine		0.7	0.3
Geranium pusillum	0.3	0.4	
Chenopodium album			3.1
Lamium purpureum	0.3	1.0	1.6
Matricaria recutita		0.2	
Polygonum aviculare		0.1	
Rumex obtusifolius	0.1		
Secale cereale	0.2		
Stellaria media	0.3	2.6	01
Thlaspi arvense	0.4		1.7
Tripleurospermum inodorum	0.1		
Triticum aestivum	0.3		
Veronica hederifolia	0.4	3.3	
Veronica persica	1.2	0.8	0.2
Viola arvensis	5.3	18.0	11.8

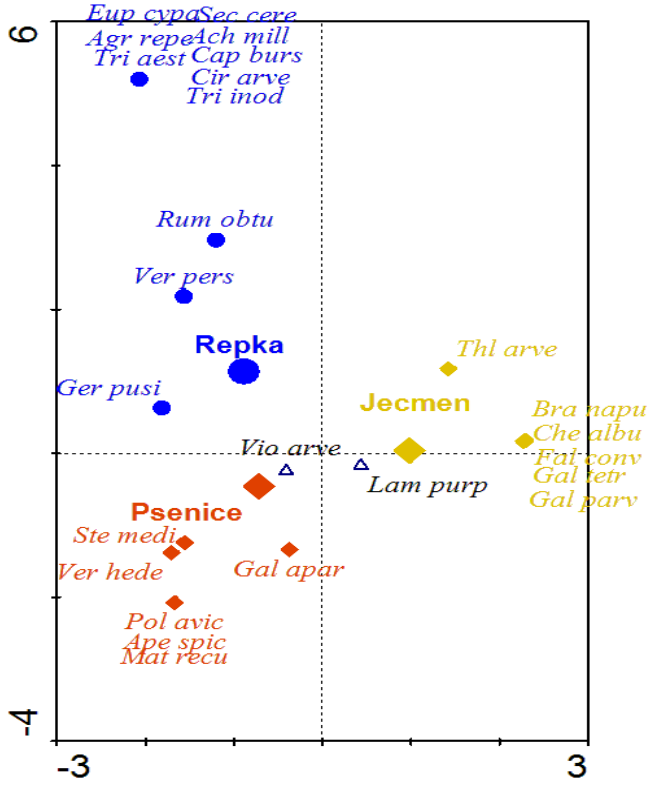
Results and Discussion

25 weed species were found within the monitoring period. Average numbers of weeds in selected crops were shown in Table 3.

Results of evaluation of weed infestation were initially processed by DCA analysis, which figured out the length of gradient (*Lengths of Gradient*). The length of gradient is 4.646. Based on this calculation was to further processing selected Canonical Correspondence Analysis CCA. Analysis CCA defines the spatial arrangement of particular weed species and variants of factors on the basis of the data that was on the frequency of occurrence of detected weed species. This is subsequently graphically displayed in the ordination diagram (Fig.1). Weed species and monitored crops are represented by points of different shapes and colors. Results of analysis CCA, which evaluated the influence of crop on weed occurrence are significant at the significant level $\alpha = 0.002$ for all canonical axes. Based on the analysis CCA (Fig. 1) is possible the found weed species divided into 4 groups. First group of weeds occurred mainly in stands of oilseed rape, it were species: *Agropyron repens*, *Euphorbia cyparissias*, *Secale cereale*, *Achillea millefolium*, *Capsella bursa-pastoris*, *Triticum aestivum*, *Cirsium arvense*, *Tripleurospermum inodorum*, *Rumex obtusifolius*, *Veronica persica* and *Geranium pusillum*. Second weed group was tied to the growth of winter wheat and these species occurred: *Stellaria media*, *Veronica hederifolia*, *Galium aparine*, *Polygonum aviculare*, *Apera spica-venti* and *Matricaria recutita*. Third group of weeds occurred mainly in spring barley: *Thlaspi arvense*, *Brassica napus ssp. napus*, *Chenopodium album*, *Fallopia convolvulus*, *Galeopsis tetrahit* and *Galinsoga parviflora*. And fourth weed group was more affected by different factors and is represented by these species: *Viola arvensis* and *Lamium purpureum*.

Low to medium weed infestation by species *Viola arvensis* may not cause yield losses, but there is a large seed production, which significantly enriches the soil seed stock and in subsequent years the weed infestation may be mass, which is confirmed by Jursik et al. [13]. Kazda et al. [14] state, that *Viola arvenis* is quickly spreading in cereals and oilseed rape in recent years and occurs in all crops. This statement can be confirmed in the given conditions, because *Viola arvensis* was present in all monitored crops and plots.

Fig. 1 Ordination diagram expressing relations between weed occurrence and monitored crops



Legend: Explanatory notes of used abbrevations in ordination diagram:
Crops: Repka – oilseed rape, Psenice – winter wheat, Jecmen – spring barley
Weeds: *Cap burs – Capsella bursa-pastoris, Cir arve – Cirsium arvense, Tri inod - Tripleurospermum inodorum, Tri aest - Triticum aestivum, Agr repe - Agropyron repens, Ach mill - Achillea millefolium, Eup cypa - Euphorbia cyparissias, Sec cere - Secale cereale, Rum obtu – Rumex obtusifolius, Ver pers – Veronica persica, Ger pusi - Geranium pusillum, Thl arve – Thlaspi arvense, Bra napu - Brassica napus* ssp.*napus,Che albu - Chenopodium album, Fal conv - Fallopia convolvulus, Gal tetr – Galeopsis tetrahit, Gal parv – Galinsoga parviflora, Ste medi - Stellaria media, Verhede - Veronica hederifolia, Gal apar - Galium aparine, Pol avic - Polygonum aviculare, Ape spic – Apera spica-venti, Mat recu – Matricaria recutita,Lam purp - Lamium purpureum, Vio arve – Viola arvensis*

Species *Stellaria media* is often weed in winter cereals. *Stellaria media* begins growth in early spring, is rapidly expanding and with species *Lamium* sp., *Capsella bursa-pastoris* and *Veronica* sp. generates characteristic community at this time. It can significantly compete just in early spring or fall, because later on is very fast overgrowth of cereals. Despite its negative character is considered as less important weeds according to Mikulka, Kneifelova et al. [15].

Brassica napus ssp. napus is crop with high risk of second growth, because seeds fall freely on the ground. Seeds can withstand alive in soil for long period. Dvorak, Smutny [16] reported that under field conditions weed infestation by oilseed rape after 24 years of its seeding was observed. It follows that the weed infestation caused by oilseed rape can be expected in a series of subsequent crops. However, it is well herbicide controllable in most of the crops except of oilseed rape growths.

Conclusion

Viola arvensis, *Veronica hederifolia*, winter barley, *Veronica persica*, *Achillea millefolium*, *Stellaria media*, *Cirsium arvense*, *Thlaspi arvense*, *Tripleurospermum inodorum*, *Rumex obtusifolius*, *Triticum aestivum*, *Geranium pusillum*, *Lamium purpureum*, *Euphorbia cyparissias*, *Agropyron repens* and *Capsella bursa-pastoris* were found in growths of oilseed rape. *Viola arvensis* was the most numerously species here, 5.34 pcs.m^{-2} in average.

Weed species as *Viola arvensis*, *Veronica hederifolia*, *Galium aparine*, *Veronica persica*, *Stellaria media*, *Matricaria recutita*, *Polygonum aviculare*, *Rumex obtusifolius*, *Brassica napus* ssp.*napus*, *Geranium pusillum*, *Lamium purpureum* and *Apera spica-venti* were identified in growths of winter wheat. *Viola arvensis* was the most occurred weed species, found in 18.04 pcs.m^{-2} in average.

Viola arvensis, *Brassica napus* ssp.*napus*, *Rumex obtusifolius*, *Lamium purpureum*, *Fallopia convolvulus*, *Chenopodium album*, *Stellaria media*, *Galium aparine*, *Veronica persica*, pet'our maloúborný, *Thlaspi arvense* and *Galeopsis tetrahit* were determined in spring barley growths. *Viola arvensis* was again the most occurred weed species in average of incidence 11.8 pcs.m^{-2}.

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