
WEED SPECIES DIVERSITY AND CROP ROTATION

Dvořáčková G., Neischl A., Winkler J.

Department of Agrosystems and Bioclimatology, Faculty of Agronomy, Mendel University in Brno, Zemedelska 1, 613 00 Brno, Czech Republic

E-mail: xdvo53@node.mendelu.cz

ABSTRACT

The aim of this work is to evaluate weed species diversity in spring barley on every variant of crop rotation. Evaluation was made on the field experiment in Žabčice. There were used three variants of crop rotations. Reached results were evaluated by CCA (Canonical Correspondence Analysis). On variant with monoculture of spring barley were mainly: *Avena fatua*, *Stellaria media*, *Cirsium arvense*, *Microrrhinum minus*, *Silene noctiflora*, *Fallopia convolvulus*, *Sonchus oleraceus*, *Persicaria lapathifolia*. On the second variant with Norfolk crop rotation appeared species: *Viola arvensis*, *Lamium amplexicaule*, *Polygonum aviculare*, *Trifolium pretense*. The third group of weeds appeared mainly on the variant where was used the 5th crop rotation and there were: *Chenopodium album*, *Thlaspi arvense*, *Fumaria officinalis*, *Carthamus tinctorius*.

Key words: spring barely, species diversity, crop rotation, weeds

Acknowledgments: The results in paper are output of project of Internal Grant Agency, FA MENDELU, No. TP 10/2013 “Study of some factors affecting implementation of the biological potential of agricultural crops”.

INTRODUCTION

The species diversity equals to the community species variety. Máchal A. (2006) sees the species diversity from the two perspectives as species bountifulness – estimated by the share of the all the species and total the volume of all individual plants also as a balanced share of individual plants within present species.

The species diversity covers all the present species on Earth. The variety could be defined by two approaches. The first represents group of individuals morfologically, physically, biochemically different form the other group. The second approach represents the group of crossbreeding individuals (Primack R.B. et al. 2001). The species diversity depends on the species bountifulness. Howereve, the only numbers of present varieties in community is unbalanced level of the species variety (Moravec J., Jenk J. 1994). Community diversity is set by the numbers of species, and biotic and abiotic factors which defines its surviving (Kolektiv 2012).

In Czech Republic there is a high density of the weed species. Chloupek O. et al. (2005) highlights the dropping level of the weed species during the last decades. There is a growing number of weed species adapting to a new agro ecological farming conditions.

MATERIAL AND METHODS

The trial site is located at cadastral area of the Žabčice village. The village is located at corn production region, barley subtype, at altitude of 184 m. The average temperature in 30 years observation is 9.2 Celsius, precipitation is below average- 483.3 mm total sum.

The trial evaluation was carried out at spring barley crops, farmed at three crop trials with different crop rotation.

The first trial is the long-term monoculture of spring barley, set in 1970. The parcel size 5.3 m x 7.0 m. two tilling approaches were used, ploughing 0.22 m deep, the second minimalization variant, disc tools 0.12 m deep. These two methods are named as traditional and minimalizational monoculture (Krejčíř J. 1996).

The second crop rotation trial was set by Norfolk cropping method, established in 1970, partially rearranged in 2002. The size of individual parcels 5.3m x 7.0 m. Cropping as follows: trefoil, winter wheat, corn, spring barley. Two tilling approaches applied, the traditional and the minimalizational

The third field trial was set as farming without animal production in drier conditions, established in 2004, Parcel size 21.0 x 19.5 m. Selected crops: corn, spring barley, safflower , winter wheat, winter wheat, with two soil tilling approaches. Traditional and minimalizational followed by shallow tillage. The first variety traditional soil tilling, the second minimalizational soil processing followed by shallow tilling.

From 2nd to 4th May the spring barley crop weed infestation has been observed and evaluated, just before the herbicides application. Numerical method has been used, individual weed plants per square meter, each variety with 24 repetitions. Weed terminology by (Kubát K. 2002) To determine each weed species influencing factors, present at each plot trial, multivolume ecological analysis has been used. The best analysis selection was driven by *Lengths of Gradient* determined by DCA (*Detrended Correspondence Analysis*) and by CCA (*Canonical Correspondence Analysis*). The 499 permutations were calculated by Monte Carlo probability test Data were processed with Canoco 4.0.software (Ter Braak C. J.F. 1998).

RESULT AND DISCUSSION

The results of the CCA analysis, evaluating the crop rotation impact on weed presence reached significant level of importance at $\alpha = 0.002$, for each canonical axis. By CCA analysis (Fig. 1) it is possible to sort the weeds into four variants.

The first with monoculture cropping confirmed weed presence of: *Avena fatua*, *Stellaria media*, *Cirsium arvense*, *Carduus acanthoides*, *Microrrhinum minus*, *Stachys palustris*, *Silene noctiflora*, *Fallopia convolvulus*, *Sonchus oleraceus*, *Persicaria lapathifolia*.

The second variant with Norfolk cropping method represent the weeds : *Anagallis arvensis*, *Viola arvensis*, *Lamium amplexicaule*, *Polygonum aviculare*, *Papaver rhoeas*, *Malva neglecta*, *Capsella bursa – pastoris*, *Artemisia vulgaris*, *Trifolium pretense*, *Tripleurospermum inodorum*.

The third variant with fifth crops cropping scheme shown presence of: *Chenopodium hybridum*, *Chenopodium album*, *Thlaspi arvense*, *Euphorbia helioscopia*, *Fumaria officinalis*, *Carthamus tinctorius*.

The fourth weeds group was affected by various factors: *Veronica persica*, *Veronica polita*.

Repetitive farming of cereals at one site leads into harmful gradations and higher weed infestation (Dvořák J., Smutný V. 2011). The theory has proven itself, at monoculture of spring barley there was the highest rate of weeds. The average number of individuals at monocultural variety with traditional tilling was 14.6 individuals per sq. meter. At monocultural variety with minimalization tilling approach was 20.5 individuals per sq. meter. Particularly higher presence of weeds such *Galium aparine*, *Silene noctiflora*, *Microrrhinum minus*, *Fallopia convolvulus*, *Avena fatua*, *Lamium amplexicaule*.

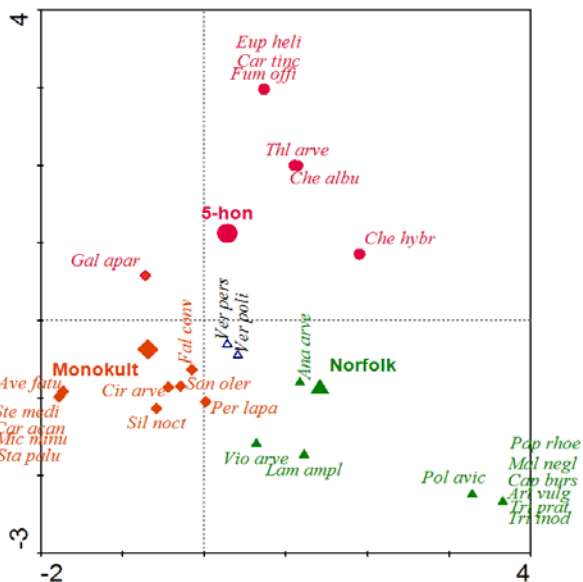


Fig. 1 How the cropping methods impact to weeds presence.

The legend : The influence of cropping methods: 5-hon -The five-crops cropping method, Norfolk-Norfolk cropping method Monokult-Monocultural cropping method The weed species: *Ana arve* (*Anagallis arvensis*), *Art vulg* (*Artemisia vulgaris*), *Ave fatu* (*Avena fatua*), *Cap burs* (*Capsella bursa-pastoris*), *Car tinc* (*Carthamus tinctorius*), *Car Acan* (*Carduus acanthoides*), *Cir arve* (*Cirsium arvense*), *Eup heli* (*Euphorbia helioscopia*), *Fal conv* (*Fallopia convolvulus*), *Fum offic* (*Fumaria officinalis*), *Gal apar* (*Galium sarine*), *Che albu* (*Chenopodium album*), *Che hybr* (*Chenopodium hybridum*), *Lam ampl* (*Lamium amplexicaule*), *Mal negl* (*Malva neglecta*), *Mic minu* (*Microrrhinum minus*), *Pap Rhode* (*Papaver rhoeas*), *Per lapa* (*Persicaria lapathifolia*), *Pol avic* (*Polygonum aviculare*), *Sil noct* (*Silene noctiflora*), *Son oler* (*Sonchus oleraceus*), *Sta palu* (*Stachys palustris*), *Ste medi* (*Stellaria media*), *Thl arve* (*Thlaspi arvense*), *Tri prat* (*Trifolium pratense*), *Tri inod* (*Tripleurospermum inodorum*), *Ver pers* (*Veronica persica*), *Ver poli* (*Veronica polita*), *Vio arve* (*Viola arvensis*).

At the cropping variants with higher share of cereals (monocultural, five crops) there is declining weed diversity. The narrow spectrum of farming crops by Chancellor R.J. (1979) results into domination of particular weed species

At the first trial plot, with spring barley monoculture, the average number of weed species was 16, the five crops cropping method result into 12 weed species. Highest number of weed was present at Norfolk cropping method with 17.5 weed species.

Repetitive farming of cereals is convenient for *Galium aparine* a *Silene noctiflora*.

Spring barley at Norfolk cropping method results in the lowest weed intensity with presence of weed varieties such *Lamium amplexicaule*, *Silene noctiflora*, *Trifolium pratense* a *Polygonum aviculare*. The five crops cropping method is represented by *Galium aparine*, *Chenopodium album* a *Thlaspi arvense*. The Norfolk cropping method develops wider weed spectrum with lower negative effect on farmed crops.

CONCLUSIONS

The weed diversity differs with the cropping method used. Dominant weed species at spring barley monoculture are *Galium aparine*, *Silene noctiflora* a *Microrrhinum minus*. The Norfolk cropping method results into dominance of *Trifolium pratense* a *Lamium amplexicaule* a *Lamium amplexicaule*. *Chenopodium album*, *Galium aparine* a *Thlaspi arvense* were dominant at the five crops cropping method cereals farming at one site develop higher share of particular weed species.

REFERENCES

- DVOŘÁK, J., SMUTNÝ, V., 2003: *Herbologie – Integrovaná ochrana proti plevelům*. Skriptum MZLU v Brně. 186 s. ISBN 80-7157-732-4.
- CHANCELLOR, R.J., 1979: The long term effects of herbicides on weed populations. *Annual Applied Biology*. Vol. 91: 141-144.
- CHLOUPEK, O., PROCHÁZKOVÁ, B., HRUDOVÁ, E., 2005: *Pěstování a kvalita rostlin*, 1. vyd. Brno, Mendelova zemědělská a lesnická univerzita v Brně, 181 s. ISBN 80-7157-897-5.
- KOLEKTIV, 2012: *Diverzita*. Encyklopedie online [cit. 2012-03-09]. Dostupné na: <<http://cs.wikipedia.org/wiki/Diverzita>>
- KREJČÍŘ J., 1996: Koncepce a metodika dlouhodobého stacionárního polního pokusu v Žabčicích a problematika jeho hodnocení. Sborník referátů z odborné konference: Význam a perspektivy dlouhodobých polních pokusů v České republice. str. 43-48, Brno.
- KUBÁT, K., 2002: *Klíč ke květeně České republiky*. Academia. Praha. 928 s. ISBN 80-200-0836-5.

MÁCHAL, A., 2006: *Malý ekologický a environmentální slovníček*, 4. vyd. Brno, Rezekvítek, 56 s. ISBN 80-86626-08-3.

MORAVEC, J., JENÍK, J., 1994: *Složení a struktura rostlinného společenstva*. In: Moravec J., *Fytocenologie*, 1. vyd. Praha, Academia, 403 s. ISBN 80-200-0128-X.

PRIMACK, R.B., KINDLMANN, P., JERSÁKOVÁ, J., 2001: *Biologické principy ochrany přírody*, 1. vyd. Praha, Portál s.r.o., 352 s. ISBN: 80-7178-552-0.

TER BRAAK, C.J.F., 1998: *CANOCO – A FORTRAN, program for canonical community ordination by [partial] [detrended] [canonical] correspondence analysis (version 4.0.)*. Report LWA-88-02 Agricultural Mathematics Group. Wageningen.