POSSIBILITIES OF BIOPREPARATION USES FOR DISEASE CONTROL IN CONSERVATION AGRICULTURE*

M. Vach[1], J. Hýsek[2], M. Javůrek[1]

Crop Research Institute, [1]Department of Crop Growing Technologies, [2]Department of Mycology, Prague, Czech Republic

To ascertain the influence of microorganisms from biopreparations (Supresivit, Polyversum and Ibefungin) on the quantitative and qualitative production characteristics of winter wheat and different soil tillage technologies were employed for stand establishment (conventional with ploughing, minimum tillage with straw incorporation, and no tillage). The experiments in luvisol were drawn-up as a rotation of three crops: pea, winter wheat, and spring barley. We verified the impacts of the chosen microrganisms (*Trichoderma harzianum* in Supresivit, *Pythium oligandrum* in Polyversum, *Bacillus subtilis* in Ibefungin) on both the qualitative and quantitative parameters of winter wheat and spring barley. There were seven different treatments of winter wheat and seven of spring barley including checks. The highest yield of winter wheat (8.05 $t.ha^{-1}$) was recorded with the conventional treatment. If the conventional treatment is considered as 100%, then the yield from parcels under the minimum tillage treatment was 97.3% and the yield under the no tillage treatment was 98.1%. Comparable to winter wheat, the highest yields of spring barley were reached after application of Supresivit with ammonium sulphate, when compared with fertilized controls without biofungicides. Laboratory analyses showed the protein content in spring barley grains ranged from 9.6 to 12.5%. Values between 10.7–11.2% are those optimal for the brewing industry. Our results document that these preparations could influence favourably the health state of field crops in conservation soil-tillage systems.

conservation soil tillage; winter wheat; spring barley; biopreparations; plant protection

INTRODUCTION

There is no doubt of the benefits of conservation soil tillage technologies which have caused quite a considerable change in farming practices. However, some problems still persist, such as the effects of conservation soil tillage technologies through yield reduction or production quality deterioration. One of these is plant disease transfer to the next crop by straw and the post-harvest residues in crop rotation systems. This situation causes a higher probability of infection, and demands more intensive disease control. Consequently, growing technology costs increase, due to the higher number of fungicide treatments. The aim of our study was to contribute to the enhancement of crop production in conservation growing systems and increases to the soil quality by means of the effectiveness of biopreparations against soil-borne phytopathogenic fungi. Available applications of soil tillage technologies, in combination with biopreparations, are shown with a view to their variants for given site conditions and preconditions, as well as for demands of crops. The study was done on the two main cereals in Czech agriculture – winter wheat and spring barley; and the biopreparations were used as the concomitant application of mineral nitrogen fertilizer with biopreparations. Our hypothesis was based upon the presumption that fungi, especially of the genus *Fusarium*, should have been suppressed by the bioagents within the biopreparations, simultaneously with other mycoparasitic soil fungi. Consequently, the biopreparations should have a positive effect on the health of the studied crops and on a decrease in the level of pathogenic fungi infestations. Good health within a crop stand should lead to good yield, less cost, and a higher production profitability (Javůrek et al., 2005). Tambong et al. (2005) was interested in similar problems. He studied populations of *Pythium* in compacted and non-compacted soils by the PCR method. *Pythium* numbers increased with soil compaction. Debode et al. (2005) found the mechanisms of *Verticilium* control in soil, by means of microbial antagonists, which were supported by crop residues and lignin incorporation. These reports demonstrate the possibilities of inhibition of soil-borne diseases by non-chemical methods. Weber et al. (2001) studied different ways of soil management for wheat, oats and barley cultivation and their infestation by cereal base diseases. They have come to the similar conclusions which are presented in this paper.

MATERIAL AND METHODS

Data were gathered from four-years of field experiments which was established in a sugar beet production-type luvisol medium-heavy soil. This experiment was established as the rotation of three crops: pea, winter wheat, and spring barley. The means of stand establishment were used as follows (only in winter wheat):

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a) conventional tillage technology with ploughing
b) no tillage technology (i.e. direct drilling into untilled soil covered with mulch)
c) minimum tillage technology (i.e. sowing into shallow tilled soil with chopped straw and post harvest residues incorporated).

Ebi was the variety of winter wheat used. In the same site, the field experiment with spring barley (cvs. Akcent, Tolar) were established; but by conventional technology only. The aim in both field experiments were to assess the impact of different biopreparations on plant health and the subsequent effects on grain yield, stability of yield components and quality parameters of winter wheat and spring barley production.

We verified the impacts of the microorganisms chosen, contained in the biopreparations used: *Trichoderma harzianum* in Supresivit*, Pythium oligandrum* in Polyversum and *Bacillus subtilis* in Ibefungin. On the contrary with winter wheat – two varieties of spring barley was established only with classic way of technology. The above-mentioned microorganisms were applied as a seed-treatment and as a mixture with nitrogen fertilizer. The biopreparations (containing microorganisms) were mixed with ANL (ammonium nitrate with limestone) for winter wheat fertilization, and with ammonium sulphate (AS) for spring barley fertilization.

Variants of winter wheat were as follows:
1. Control with seed-treatment with Celest Extra
2. Celest Extra + fertilizer fungi (ANL + 3 g Polyversum $.kg^{-1}$ of fertilizer)
3. Celest Extra + fertilizer fungi (ANL + 10 ml Ibefungin $.kg^{-1}$ of fertilizer)
4. Celest Extra + fertilizer fungi (ANL + 1 g Supresivit $.kg^{-1}$ of fertilizer)
5. Seed-treatment with 3 g Polyversum $.kg^{-1}$ of the seed
6. Seed-treatment with 10 ml Ibefungin $.kg^{-1}$ of the seed
7. Seed-treatment with 1 g Supresivit $.kg^{-1}$ of the seed

All plots were fertilized in single dose of 100 kg N per ha (divided into 3 doses 40+30+30). With respect to the research on winter wheat, we assessed several qualitative parameters (nitrogen compounds content, volume weight, sedimentation test, test of the viscosity, falling number). The dose of Celest Extra was 1.5 ml/kg of the seed. Three different methods of stand establishment were used only for winter wheat. For statistical evaluation we used the method of the lowest significant difference before the evaluation of single factors.

Variants of spring barley were as follows:
1. Fertilization with AS (30 kg $N.ha^{-1}$ before sowing) + seed-treatment with Celest Extra
2. The same as in var. 1 + seed-treatment with 3 g Polyversum $.kg^{-1}$ of the seed
3. The same as in var. 1 + seed-treatment with 10 ml Ibefungin $.kg^{-1}$ of the seed
4. The same as in var. 1 + seed-treatment with 1 g Supresivit $.kg^{-1}$ of the seed
5. Mixture of AS with Polyversum (3 g $.kg^{-1}$ of fertilizer)
6. Mixture of AS with Ibefungin (10 ml $.kg^{-1}$ of fertilizer)
7. Mixture of AS with Supresivit (1 g $.kg^{-1}$ of fertilizer)

The dose of Celest Extra was the same like in winter wheat. The seed treatment with Celest Extra was proved in the first case and after that the treatment with the microorganisms of biopreparations was done. All parcels (2–7) were fertilized with ammonium sulphate at a dose of 30 kg $N.ha^{-1}$. During the vegetation period, plant health (infestation with fungi-septorioses, helminthosporioses, fusarioses, rusts, smuts, powdery mildew) was evaluated with classic microscopic methods and microfungi occurrences in the soil (*Fusarium, Drechslera*) were evaluated; and after the harvest, yields at individual plots were recorded. The fungi in the soil were determinated quantitatively. The composition of soil mycoflora was evaluated by the cultivation of soil extracts (5 g per 500 ml of distilled water) – 1 ml on malt extract agar. The Petri dishes were cultivated before 20 ^{o}C – 10 days and after that the determination of fungi was done.

RESULTS

The four-year results of grain yields of winter wheat, grown under three different methods of stand establishment, with different depths and intensity of soil tillage, are shown in Table 1 and Fig. 1. The highest yield (8.05 $t.ha^{-1}$) was found in the conventional variant. Yield differences were also found among different tillage technologies. If the conventional variant is 100%, then the yield in the no tillage variant (2) was 98.1% and the yield in minimum tillage (3) was 97.3%.

Except for the influence of soil tillage, there was recorded no effect of the biofungicides on grain yields and health state of plants. The highest increase of yield was in variant 5 (combination ammonium nitrate & limestone with biofungicide Supresivit), comparing with control variant 2 (without biofungicides).

The weight of 1000 kernels was very similar and ranged from 48.9 to 51.3 g. Volume weight of the grain of winter wheat was highest with the conventional soil technology (depending on biofungicides 775.2–795.6 $g.l^{-1}$), and the lowest with direct drilling into untilled soil (depending on biofungicides, as well 741.2–783.8 $g.l^{-1}$).

In the Fig. 1 it is visible lower yield of the control with fertilization in comparison with the variants of biopreparations and fertilizer mixtures and seed treatment with biopreparations (about 4%).

Within the framework of the research on winter wheat, we assessed some qualitative parameters (content nitrogen matter, volume weight, sedimentation test, viscosity test, falling number). On the basis of our three-year experiment, it is clearly visible that in those variants with reduced or no soil tillage was found an increased level of nitrogen matter (14.27%), in comparison with the conventional preparation of the soil (13.15%). Similar results were found with the content of gluten (conventional technology 33.1%; no tillage 38.0%; shallow tillage 36.8%).

Table 1. The grain yields of winter wheat from evaluated variants (4 year average)

Variant		Ways of stand establishment					
		1 [x]		2 [xx]		3 [xxx]	
		($t.ha^{-1}$)	(%)	($t.ha^{-1}$)	(%)	($t.ha^{-1}$)	(%)
1.	control – Celest Extra, ANL	7.64	100.0	7.50	100.0	7.44	100.0
2.	ANL + Polyversum	7.88	103.1	7.71	102.8	7.67	103.1
3.	ANL + Ibefungin	7.94	103.9	7.81	104.1	7.68	103.2
4.	ANL + Supresivit	8.05	105.4	7.94	105.9	7.86	105.6
5.	seed + Polyversum	7.99	104.6	7.73	103.1	7.73	103.9
6.	seed + Ibefungin	7.85	102.7	7.74	103.2	7.66	103.0
7.	seed + Supresivit	8.00	104.7	7.86	104.8	7.83	105.2
Mean grain yield		7.91		7.76		7.70	
The effect of biopreparates			104.1		104.0		104.0
The effect of stand establishment		100 %		98.1%		97.3%	

[x)] Methods of stand establishment for winter wheat:
1. Conventional tillage
2. No tillage – direct sowing into untilled soil, covered with mulch
3. Minimum tillage – sowing into shallow tilled soil, with chopped of pre-crop straw incorporated

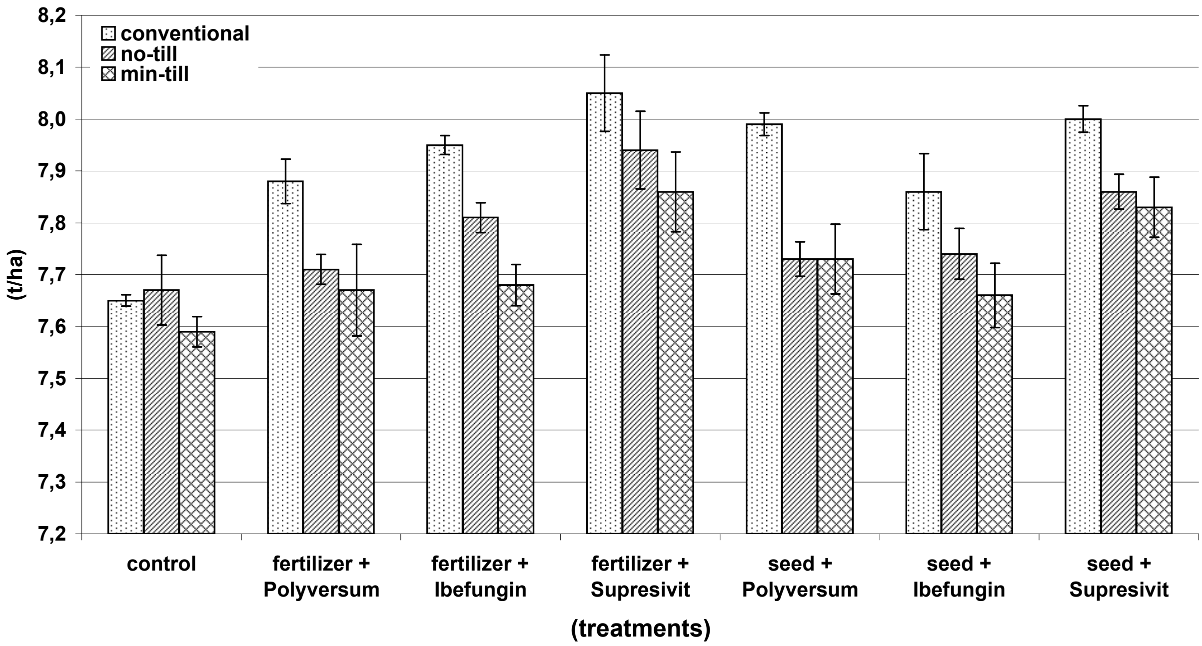

Fig. 1. The influence of soil tillage and biopreparations applied on grain yield of winter wheat (average of years 2004–2007)

Minimum conclusive difference
For grain yield; devided by biopreparations
* identifies significantly different pairs. Homogenous sub-groups are in vertical columns.

Group	Cases	Average	1	2	3	4	5	6	7
Control (1)	48	7.5260		*	*	*	*	*	*
Seed + Ibefungin (2)	48	7.7504	*					*	*
Fertilizer + Polyversum (3)	48	7.7515	*					*	*
Fertilizer + Ibefungin (4)	48	7.8075	*						*
Seed + Polyversum (5)	48	7.8160	*						
Seed+Supresivit (6)	48	7.8969	*	*	*				
Fertilizer + Supresivit (7)	48	7.9502	*	*	*	*|			

Minimum difference: 0.152

For grain yield; devided by soil tillage
* identifies significantly different pairs. Homogenous sub-groups are in vertical columns.

Group	Cases	Average	Min-till	No-till	Conventional tillage
Minimum tillage	112	7.6935			*
No-tillage	112	7.7537			*
Conventional tillage	112	7.9094	*	*	

Minimum difference: 0.083

Table 2. The mean number of fungi in the soil and on plant surface in the experiments with winter wheat

Variant	Soil 2004–2007	Plant surface 2004–2007
1.	*Drechslera* sp. ++	septoriosis 20%
	Fusarium poae +	helminthosporiosis 15%
	Fusarium solani +	rusts 15%
	Fusarium graminearum +	bunts 15%
	Fusarium oxysporum +	
2.	*Drechslera* sp. +	septoriosis 8 %
	Fusarium poae +	helminthosporiosis 8 %
	Fusarium graminearum +	rusts 7%
	Fusarium oxysporum ++	bunts 6%
3.	*Drechslera* sp. +	septoriosis 7 %
	Fusarium poae +	helminthosporiosis 6 %
	Fusarium tricinctum +	rusts 6%
	Fusarium oxysporum +	bunts 7%
4.	*Drechslera* sp. +	septoriosis 9%
	Fusarium oxysporum +	helminthosporiosis 8%
	Fusarium oxysporum +	rusts 8%
	Fusarium tricinctum +	bunts 8%
5.	*Drechslera* sp. +	septoriosis 7%
	Fusarium poae +	helminthosporiosis 6%
	Fusarium poae +	rusts 8%
	Fusarium tricinctum +	bunts 5%
6.	*Drechslera* sp. +	septoriosis 8%
	Fusarium oxysporum +	helminthosporiosis 5%
		rusts 6%
		bunts 7%
7.	*Fusarium oxysporum* +	septoriosis 8%
	Drechslera sp. +	helminthosporiosis 6%
	Fusarium oxysporum +	rusts 6%
		bunts 5%

Explanatory notes: + weak infestation (to 10%), ++ stronger infestation (to 20%)

Other parameters for winter wheat were not significantly influenced by different types of stand establishments.

In Fig. 2 average yield results of two varieties of spring barley under conventional soil tillage from years 2003 to 2006 are shown. Analogous to winter wheat, the highest yield of spring barley was achieved by application of the biofungicide Supresivit with ammonium sulphate (AS) in comparison with the fertilized control (without biofungicides).

DISCUSSION

We evaluated the spectrum of phytopathogenic fungi from all variants of field trials in the soil and also on the surface of plants and harvested grain of winter wheat. We found out the lower number of fungi of the genus *Fusarium,* exclude the species, which number irregularly varied. Big significance appeared in the reduction of the occurrence of phytopathogenic fungi of the genera *Drechslera, Fusarium, Pseudocercosporella* and *Septoria* maintaining

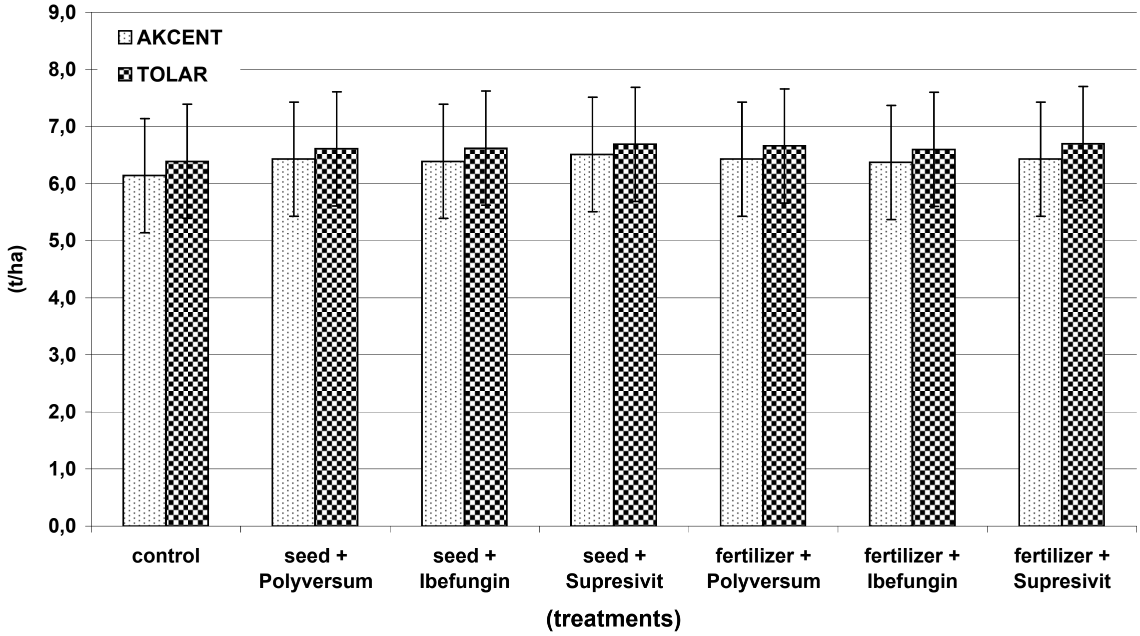

Fig. 2. The influence of biopreparations on grain yield of spring barley (average of years 2004–2006)

Minimum conclusive difference

For grain yield; devided by biopreparations

* identifies significantly different pairs. Homogenous sub-groups are in vertical columns.

Group	Cases	Average	1	2	3	4	5	6	7
Control (1)	32	6.2641						*	*
Fertilizer + Ibefungin (2)	32	6.4803							
Seed + Ibefungin (3)	32	6.5075							
Seed + Polyversum (4)	32	6.5166							
Fertilizer + Polyversum (5)	32	6.5422							
Fertilizer + Supresivit (6)	32	6.5644	*						
Seed + Supresivit (7)	32	6.5966	*						

Minimum difference: 0.3000

For grain yield; devided by variations

* identifies significantly different pairs. Homogenous sub-groups are in vertical columns.

Group	Cases	Average	Akcent	Tolar
Akcent	112	6.3833		*
Tolar	112	6.6086	*	

Minimum difference: 0.158

their infection potential on plant roots and in the soil in the form of conidia and mycelium which cause plant disease of the roots. Namely the genus *Fusarium* survives on plant residues in the soil and it is strong depressed by antagonistic fungi and bacteria. These results were gained on the base of month analysis of the soil (the evaluation of the spectrum of soil fungi). Weber et al. (2001) stood also that like in our experiments the genus *Fusarium* (*F. equiseti, F. culmorum*) occurred to a considerably lower degree in ploughless treatment. In our experiments also the genus *Fusarium* was in lower number. Our statement that in the variant of direct sowing was evaluated higher number of the genus *Fusarium* was based on our experiments with soil samples (the number of the genus *Fusarium* was about 15–20% in the comparison with control – the proves under the microscope).

During the assessed period we found out that in case of spring barley the spectrum was influenced by application of the biofungicides. On the beginning of cultivation the occurrence of *Fusarium* in soil was minimal and fungi like *Paecilomyces* spp. and *Penicillium* spp. were prevailing and represented about 75% of all spectrum. After that the number of *Fusarium* increased, but it was suppressed by the microorganisms from the biopreparations applied. As a result of it the infestation of spring barley with pathogenic fungi was not high.

Our results with biofungicides document that these preparations could have a significant influence upon field crop stand health in the protection of soil tillage technologies, where the risk of infection is far higher than in conventional ploughing plant production systems.

Table 3. The composition of soil mycoflora on the end of the experiment with spring barley

Variant	The composition on the end of the experiments
Control, ammonium sulphate + Celest Extra	*Fusarium graminearum* 33%, *Fusarium oxysporum* 36%, *Rhizoctonia solani* 3%, *Epicoccum nigrum* 3%, *Penicillium* sp. 30%, *Acremonium* sp. 10%, *Scopulariopsis candida* 10%, *Trichoderma* sp. 10%
Ammonium sulphate + Polyversum	*Fusarium graminearum* 16%, *Fusarium culmorum* 3%, *Fusarium oxysporum* 40%, *Drechslera sorokiniana* 3%, *Verticillium albo-atrum* 3%, *Penicillium* sp. 30%, *Acremonium* sp. 3%, *Aspergillus* sp. 3%
Ammonium sulphate + Ibefungin	*Fusarium oxysporum* 3%, *Verticillium albo-atrum* 3%, *Penicillium* sp. 40%, *Mucor* sp. 3%
Ammonium sulphate + Supresivit	*Fusarium graminearum* 6%, *Fusarium culmorum* 3%, *Fusarium oxysporum* 53%, *Fusarium* sp. 16%, *Penicillium* sp. 53%, *Mucor* sp. 3%
Fertilizer + Polyversum	*Fusarium graminearum* 13%, *Fusarium oxysporum* 26%, *Fusarium* sp. 13%, *Epicoccum nigrum* 6%, *Penicillium* sp. 33%, *Paecilomyces* sp. 3%, *Aspergillus* sp. 6%, *Trichoderma* sp. 3%
Fertilizer + Ibefungin	*Fusarium graminearum* 6%, *Fusarium oxysporum* 53%, *Fusarium culmorum* 3%, *Fusarium tricinctum* 6%, *Fusarium* sp. 3%, *Epicoccum nigrum* 3%, *Penicillium* sp. 23%, *Acremonium* sp. 6%, *Scopulariopsis candida* 3%
Fertilizer + Supresivit	*Fusarium graminearum* 6%, *Fusarium culmorum* 3%, *Fusarium tricinctum* 3%, *Fusarium oxysporum* 50%, *Fusarium sambucinum* 3%, *Verticillium albo-atrum* 6%, *Penicillium* sp. 63%, *Aspergillus* sp. 3%, *Acremonium* sp. 3%, *Gliocladium* sp. 3%

The application of the microorganisms from the biopreparations (Supresivit, Polyversum and Ibefungin) caused suppression of fungi of the genus *Fusarium*. There is currently only little known about this topic. Different methods of soil tillage technologies specifically influenced the composition of soil mycoflora. In the variant with direct drilling, the largest number of the genus *Fusarium* was found. On the basis of results, we conclude that the effect of the mixture of antagonistic fungi or bacteria contents, in the form of seed-treatment (or with the mineral fertilizer ANL), can favourably influence the yields on both winter wheat and spring barley. Aside from the different methods of stand establishment of winter wheat, it is possible to explain the yield effects, after the use of biopreparations for suppression of soil-borne phytopathogenic microorganisms (namely, micromycetes infestate the roots of plants). Reductions in the occurrence of fungi of the genus *Fusarium* and *Rhizoctonia* were shown to be very important for the maintenance of their soil infection potential, in the form of conidia and mycelium, which are on plant roots, then invade the roots and cause the disease (H ý s e k et al., 2005). Decreases of severity were found after natural infection with the phytopathogenic fungi *Pyrenophora* and *Septoria* – their species caused less leaf area damaging than in the control.

From agriculture research results it is known and from farming practice it is confirmed that the methods of reduced soil tillage, especially no tillage technology, bring inconsiderable economic benefits (time for crop stand establishment shortening, direct cost, fuel consumption and labour cost decrease etc.). In some cases, these advantages and savings are neutralized by higher requirements of fungicides due to the higher occurrence of plant diseases. Utilization of biofungicides, which are able to suppress the impacts of some significant pathogenic fungi, could improve the economic balance of conservation soil tillage and field crop growing technologies.

CONCLUSIONS

Four-year results with the application of chosen biofungicides to winter wheat in conditions of conventional, minimal, and no-till methods of stand establishment, as well as to spring barley growing under conventional tillage, demonstrate the favourable influence of those preparations on the health of treated stands.

Better health of the plants (of both cereals) effected higher grain yields in treated variants; of winter wheat on average by 3.8%, and of spring barley by 4.0%, compared to the control treatments.

For winter wheat, the highest yield effect was found with the combination of ANL + Supresivit (+ 5.9% compared to control); and for spring barley with the combination seed treatment by Supresivit (+ 6.4%), and with the combination of AS fertilizer with Supresivit (+ 5.4%). Differences among treated variants and control were only statistically significant in one year of our research period. Differences among treated variants, mutually, were insignificant.

Utilization of efficacious biofungicides could partially substitute for expensive chemical disease control and consequently could improve the economic balance, especially of conservation tillage technologies where the infection probability was far higher through organic matter being shallowly incorporated or left on soil surface.

REFERENCES

DEBODE, J. – DE BACKER, G. – PANNECOUCKE, J. – HÖFTE, M.: Mechanisms involved in the control of *Verticillium* with microbial antagonists, crop residues and lignin incorporation in soil. In: Proc. Symp. on Crop Protection, Gent, Belgium, May 10, 2005, p. 8.

HÝSEK, J. – VACH, M. – JAVŮREK, M.: Biological protection of main cereals against fungal specific diseases. In: Proc. Symp. on Crop Protection, Gent, Belgium, May 10, 2005, p. 123.

JAVŮREK, M. – VACH, M. – STRAŠIL, Z.: Assessing conventional and soil protection cropping from production, economic and energetic standpoint in the Czech conditions. In: Proc. ISTRO Conf. Soil – Agriculture, Environment, Landscape, Brno, 2005, pp. 17–23.

TAMBONG, J. T. – BARASUBIYE, T. – GREGORICH, E. G. – MCLAUGHLIN, N. B. – LEVESQUE, C. A. (2005). A molecular study on the effect of soil compaction on the ecology of *Pythium* communities. In: Proc. Symp. on Crop Protection, Gent, Belgium, May 10, 2005, p. 3.

WEBER – HRYNCZUK – RUNOWSKA-HRYNCZUK, KITA (2001). Influence of the Mode of Tillage on Diseases of Culm Base in some Winter Wheat varieties, Oats and Spring Wheat. J. Phytopathol., 149, 2001 (3–4): 185–188.

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Možnosti využití biopreparátů v ochraně proti chorobám v půdoochranném zemědělství.

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Ve čtyřletém polním pokusu v Praze-Ruzyni (luvisol, jílovitohlinitá půda) byly u obilnin sledovány a vyhodnoceny rozdílné technologie založení porostů v kombinaci s použitím různých forem aplikace biopreparátů. U ozimé pšenice bylo kromě konvenčního způsobu založení porostů použito i přímé setí do nezpracované půdy a také setí do mělce zpracované půdy se zapravenou rozdrcenou slámou předplodiny. Jarní ječmen byl založen pouze na variantě s konvenčním zpracováním půdy. U obou obilnin bylo použito dvou rozdílných způsobů aplikace biopreparátů Supresivit (*Trichoderma harzianum*), Polyversum (*Pythium oligandrum*) a Ibefungin (*Bacillus subtilis*). Bylo sledováno a vyhodnoceno působení těchto biopreparátů homogenizovaných jednak s osivem (ošetření osiva před setím jako mořidlo), jednak ve směsi s minerálním hnojivem (u ozimé pšenice ledek amonnovápenatý, u jarního ječmene síran amonný) na produkci a kvalitativní parametry zrna.

Nejvyšší výnosy zrna ozimé pšenice v průměru sledovaných let (8,05 $t.ha^{-1}$) a současně i nejvyšší přírůstky výnosů vzhledem k variantě hnojené a ošetřené pouze kontrolním přípravkem Celest Extra byly dosaženy na parcelách s biopreparátem Supresivit (ve směsi s hnojivem LAV) v konvenční variantě. Statisticky neprůkazně nižší výnosy zrna ozimé pšenice byly dosaženy na variantách s přímým výsevem do nezpracované půdy (98,1 %) a při setí do mělce zpracované půdy (97,3 %) oproti získané produkci na konvenční variantě. U jarního ječmene bylo dosaženo nejvyššího výnosu zrna u odrůdy Tolar po aplikaci Supresivitu (v kombinaci se síranem amonným i jako mořidlo ve směsi s osivem) v porovnání s hnojenou kontrolou, ale bez biopreparátů. Obsah proteinu v zrně jarního ječmene se na základě laboratorních analýz pohyboval od 9,6 % do 12,5 %, účinek aplikace biopreparátů se neprokázal.

Naše výsledky potvrdily, že vybrané biopreparáty mohou příznivě ovlivňovat zdravotní stav ozimé pšenice i za podmínek pěstování v půdoochranných systémech, kde je vyšší infekční tlak houbových chorob v důsledku vyššího výskytu rozdrcené slámy a posklizňových zbytků předplodin.

půdoochranné technologie; pšenice ozimá; ječmen jarní; biopreparáty; ochrana rostlin

Contact Address:

Ing. Milan V a c h , CSc., Výzkumný ústav rostlinné výroby, v.v.i., Oddělení pěstebních technologií, Drnovská 507, 161 06 Praha-Ruzyně, Česká republika, tel.: +420 233 022 248, e-mail: vach@vurv.cz