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EFFECT OF ORGANIC SYSTEM ON SPRING BARLEY STEM BASE HEALTH IN COMPARISON WITH INTEGRATED AND CONVENTIONAL FARMING

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Abstract: Stem base health of spring barley cultivated under organic, integrated and conventional systems and fungal communities were studied. A worst plant health status was observed in the organic system. The macroscopic and subsequent mycological analyses revealed the occurrence of *Bipolaris sorokiniana* and *Fusarium* spp. The incidence of *B. sorokiniana* on stem bases was clearly dependent on a farming system, and the highest incidence of this pathogen was observed in the organic system. Also, in that system, *Fusarium* spp. were isolated more numerously in the beginning of tillering, but in dough stage *B. sorokiniana* was the most prevalent pathogen, and *Fusarium* spp. were more numerous in integrated and conventional systems. It is worth to note that organic conditions could be favourable to *Gliocladium* spp. Because of growing interest in ecology, excluding the use of pesticides and increasing popularity of biological disease control, these antagonistic fungi could be useful in organic systems.

Key words: spring barley, stem base diseases, fungi, organic farming, *Bipolaris sorokiniana*, *Fusarium* spp.

INTRODUCTION

At present, organic farming has become increasingly popular. Care about the natural environment, economical and ethical aspects and consciousness of consumers drives this change into farming practice. In modern plant production, the health status of products has become a very important issue. It is commonly known that in conventional farming simplified crop rotation as well as the use of fertilizers and pesticides cause unfavourable changes in plant and animal species communities and result in soil erosion. Chemical methods of disease, pathogen and weed control have

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had many opponents for years. A major objection against them is their negative effect on the environment and ecosystem. Self-regulating characteristics of organisms in natural communities are lost when humans modify them through the destruction of community interactions. It has been reported that soil contamination with plant protection chemicals results in a decrease of biological activity and disturbs the biological balance between parasitic and non-parasitic, often antagonistic microorganisms and natural enemies of pests and disease factors. The aim of organic and integrated farming is to imitate natural ecosystems and, in such a way stimulate a beneficial phytosanitary situation. It is one of the priorities because pathogenic fungi are a serious problem where pesticide application is prohibited or limited (Prior 1992; Lampkin 1994; Tamis and van der Brink 1999; Le Guillou and Scharpe 2000; Rigby and Caceres 2001; Anonymous 2004). Besides the common opinion those aspects of organic and integrated system are advantageous, information about phytosanitary situation is rare as well as plant health as mycological analyses of fungal communities.

The aim of presented studies was to evaluate the health status and fungal communities on spring barley stem bases in organic, integrated and conventional systems.

MATERIALS AND METHODS

The studies were carried out in 1999–2003 on the Institute of Soil Science and Plant Cultivation experimental fields at Osiny near Pulawy in South-Eastern Poland. The research material were stem bases of spring barley, cv. Rudzik. Crops in the integrated and conventional systems were chemically protected and fertilized. The details connected with agricultural measures were described by Baturo (2002).

One field measuring 0.25 ha was investigated every year in each system. This area was divided into four plots. Macroscopic evaluation of stem base health status and mycological analyses were carried out at two crop stages: at the beginning of tillering and at dough maturity. Plants were sampled in four replications: at the first date 50 plants, and at the second date 25 plants, randomly from each plot in every system.

At both crop stages disease symptoms on stem bases were evaluated using 0–5 scale from 0 (healthy stem bases) to 5 (stem bases completely rotted). The level of infestation was transformed to a disease index (DI) according to the formula of Townsend and Heuberger (Wenzel 1948). Obtained data were analyzed statistically by ANOVA and Tukey's test.

Every year up to 30 plants with disease symptoms were taken for mycological analysis from a joint sample. Yet, there were cases, with less than 30 plants with disease symptoms, so isolation of fungi was performed from all diseased plants. Details concerning plant numbers taken for mycological analysis from each joint sample in every year are shown in tables 3 and 4. Mycological analyses were carried out to determine pathogenic and non-pathogenic fungi. Stem base fragments were washed for 40 minutes under running tap water followed by rinsing three times with sterile water. After washing, stem base fragments were placed on PDA medium at pH 5.5. In 1999–2001 stem base fragment surfaces were not disinfected. In 2002–2003, the fragments washed in tap water were additionally disinfected for 15 seconds in 1% $AgNO_3$. In the first three years of the studies material was not disinfected to determine all fungal communities connected and not connected with deeper layers of stem base cells. In next two years stem base fragments were disinfected to remove fungi occurring on stem base surface only. In every case, six 0.5 cm-long fragments of stem bases were put in one dish. Petri dishes containing the experimental material were incubated 6–7 days at 23°C. Fungal colonies were transferred into test tubes with PDA medium then placed in Petri dishes with Czapek Dox, PDA or SNA mediums and identified according to mycological keys.

RESULTS

Stem bases were infected more significantly in the organic system at both crop growth stages (Table 1, 2). Mean DI at the beginning of tillering in the organic, integrated and conventional systems were 8.5%, 1.9% and 1.3%, respectively. At dough maturity, mean DI was also the highest in the organic system (32.8%), however, in contrast to the previous stage, the lowest health status was stated in the integrated system (DI = 22.6%). Although there were some exceptions, a similar DI was stated at dough maturity in all farming systems in 1999. In 2003, DI in the organic and integrated systems were similar and the highest level of infestation was in the conventional system. Overall, it can be concluded that plant health was alike in integrated and conventional systems.

Table 1. Disease index of stem bases at the beginning of tillering [DI %]

Farming system	1999	2000	2001	2002	2003	Mean value (1999–2003)
Organic	5.3 a	10.5 a	9.4 a	6.8 a	10.7 a	8.5 a
Integrated	0.9 b	1.4 b	1.8 b	1.6 b	4.0 b	1.9 b
Conventional	0.8 b	1.1 b	0.6 b	1.5 b	2.4 c	1.3 c
X_{mean}	2.3	4.3	3.9	3.3	5.7	3.9
LSD (0.05)	0.74	1.07	2.28	1.08	1.42	0.27

Values in the same column followed by different letters are significantly different

Table 2. Disease index of stem bases at dough maturity [DI %]

Farming system	1999	2000	2001	2002	2003	Mean value (1999–2003)
Organic	37.2 a	37.2 a	36.0 a	30.4 a	23.0 b	32.8 a
Integrated	35.0 a	21.6 b	6.0 c	27.0 b	23.4 b	22.6 c
Conventional	35.2 a	24.6 b	10.2 b	28.6 b	33.8 a	26.5 b
X_{mean}	35.8	27.8	17.4	28.7	26.7	27.3
LSD (0.05)	4.49	4.05	2.85	3.35	5.27	1.00

Values in the same column followed by different letters are significantly different

At the beginning of crop tillering in 1999–2001, 114 colonies from 90 stem bases were isolated in the organic system, 55 colonies from 41 stems in the integrated system and 33 colonies from 30 stems in the conventional system. In 2002–2003, when material was disinfected, 58 colonies from 60 stem bases, 46 from 44, and 35 from 35 were isolated, respectively. Disinfection did not affect general tendencies and correlations between farming systems, but affected the number of main fungi (Table 3). Pathogenic species were represented by *Bipolaris sorokiniana* and *Fusarium* spp, e.g. *F. avenaceum* and *F. culmorum*. *B. sorokiniana* was more prevalent in the organic system, where it was isolated in each of the five years, as well from non-disinfected as disinfected stem bases. Its mean share in total fungal community was a 34.2% on non-disinfected fragments in 1999–2001 and 15.5% in case of disinfected stem base fragments in 2002–2003. In contrast, in the integrated and conventional systems it was isolated in lower intensity than in the organic system and from non-disinfected fragments only, at 18.2% and 12.1%, respectively. From disinfected material *Fusarium* spp. were isolated more numerously than *B. sorokiniana*. The share of total *Fusarium* spp. in the total number of fungi isolated during five years, was high (over 42%) in the organic, integrated and conventional systems. A dominating species was *F. avenaceum*. It case of non-disinfected material it comprised 16.7% of isolates in organic system, 9.1% in integrated and 6.1% in conventional system and from disinfected material 27.6%, 30.4% and 37.1% respectively. Also *F. culmorum*, *F. oxysporum* and *F. solani* constitued high per cent of isolated fungi. *Rhizoctonia* spp. were isolated relatively often, mainly, from non-disinfected stem bases, especially in the conventional system (12.1%). In organic system it was stated in low per cent but also on disinfected material. *Gliocladium* spp. were observed and, what should be emphasized, in higher intensity in the organic and integrated systems than in the conventional one. *Trichoderma* spp. were isolated in all systems, although some inclinations to higher incidence were evident in the integrated and conventional systems. The conventional system was favourable to *Aspergillus niger* development that was stated on non-disinfected material and *Penicillium* spp. was isolated mainly from disinfected plant fragments.

At dough maturity in 1999–2001, 114 colonies from 90 plants were isolated in the organic system, 92 colonies from 74 plants in integrated and 102 colonies from 90 plants in conventional one. In 2002–2003, 66 colonies from 60 stem bases, 44 from 60 and 64 from 60 were obtained. Also in that stage, disinfection of research material did not affect the general tendencies and correlations between farming systems, but it affected the number of main fungi (Table 4). Tendencies observed in the earlier stage were maintained and disease factors identified during macroscopic evaluation as *Bipolaris sorokiniana* and *Fusarium* spp., this was confirmed by microscopic analysis. The prevalence of *B. sorokiniana* was observed in organic system where it was isolated in all five years of the study, representing 43.0% of all isolates on non-disinfected stem bases and 15.2% on disinfected ones. In the conventional system it was isolated less numerously as well from non-disinfected (10.1%) and disinfected (4.7%) material and in the integrated system from non-disinfected stem bases only (21.7%). Similarly to the previous stage, from disinfected material, *Fusarium* spp. were isolated more numerously than *B. sorokiniana*. At that stage differences in share of some *Fusarium* spp., reported as potentially pathogenic for cereals, were present in three systems and their prevalence was revealed in the conventional system. Together *Fusarium avenaceum* and *F. culmorum* comprised 18.6% in case of non-disinfected material in 1999–2001

Table 3. Fungi isolated from stem bases of spring barley at the beginning of tillering stage [%]

Fungus	Organic system		Integrated system		Conventional system	
	no disin-fection	disin-fected	no disin-fection	disin-fected	no disin-fection	disin-fected
	1999–2001	2002–2003	1999–2001	2002–2003	1999–2001	2002–2003
Alternaria alternata (Fr.) Keissler	–	–	–	4.3	–	–
Aspergillus niger van Tieghem	1.8	–	1.8	–	12.1	–
Bipolaris sorokiniana (Sacc. in Sorok) Shoem.	34.2	15.5	18.2	–	12.1	–
Epicoccum nigrum Link	0.9	5.2	–	–	–	–
Fusarium avenaceum (Corda ex Fr.) Sacc.	16.7	27.6	9.1	30.4	6.1	37.1
Fusarium culmorum (W.G.Smith) Sacc.	1.8	1.7	1.8	4.3	12.1	2.9
Fusarium equiseti (Corda) Sacc.	0.9	3.5	–	–	–	–
Fusarium graminearum Schwabe	2.6	–	–	4.3	–	–
Fusarium oxysporum Schlecht.	16.7	5.2	18.2	10.9	12.1	–
Fusarium solani (Mart.) Sacc.	3.5	13.8	18.2	17.4	12.1	5.7
Fusarium sporotrichioides Sherb.	–	6.9	–	–	–	5.7
Fusarium tricinctum Corda	–	–	5.5	–	6.1	2.9
Gliocladium catenulatum Gilman et Abbott	0.9	1.7	3.6	–	–	–
Gliocladium roseum (Link) Thom	5.3	8.6	7.3	13.0	3.0	5.7
Gymnoascus reesii Baranetzky	–	–	3.6	–	–	–
Idriella bolleyi (Sprague) von Arx	3.5	–	–	–	9.1	–
Microdochium nivale	2.6	–	–	–	–	–
Monocillium sp.	–	–	1.8	–	–	–
Mucor spp.	–	–	–	–	3.0	–
Penicillium spp.	–	6.9	–	2.2	3.0	25.7
Pythium spp.	–	–	3.6	–		2.9
Rhizoctonia spp.	2.6	1.7	3.6	–	12.1	–
Rhizopus nigricans Ehrenberg	2.6	–	–	–	3.0	–
Trichoderma album Preuss	–	–	–	–	3.0	–
Trichoderma harzianum Rifai	0.9	–	–	–	–	–
Trichoderma koningi Oudemans	0.9	1.7	1.8	–	–	–
Trichoderma viride Pers. ex S.F. Gray	0.9	–	1.8	8.7	–	11.4
nonsporulating fungi	0.9	–	–	4.3	–	–
Total number of colonies	114	58	55	46	33	35
Total number of analysed plants with infested stem bases taken	90	60	41	44	30	35

Table 4. Fungi isolated from stem bases of spring barley at dough stage [%]

Fungus	Organic system		Integrated system		Conventional system	
	no disin-fection	disin-fected	no disin-fection	disin-fected	no disin-fection	disin-fected
	1999–2001	2002–2003	1999–2001	2002–2003	1999–2001	2002–2003
Absidia glauca Hagem	–	–	1.1	–	–	–
Alternaria alternata (Fr.) Keissler	–	–	1.1	2.3	–	1.6
Aspergillus niger van Tieghem	–	–	9.8	–	1.0	–
Bipolaris sorokiniana (Sacc. in Sorok) Shoem.	43.0	15.2	21.7	–	10.1	4.7
Cylindrocarpon radicicola Wollenweber	–	–	–	–	1.0	–
Fusarium avenaceum (Corda ex Fr.) Sacc.	3.5	9.1	7.6	9.1	12.7	10.9
Fusarium culmorum (W.G.Smith) Sacc.	2.6	–	9.8	6.8	5.9	25.0
Fusarium equiseti (Corda) Sacc.	2.6	16.7	1.1	–	8.8	3.1
Fusarium graminearum Schwabe	0.9	4.5	5.4	4.5	4.9	6.3
Fusarium oxysporum Schlecht.	4.4	–	1.1	13.6	6.9	15.6
Fusarium poae (Peck.) Wollenweber	0.9	1.5	1.1	–	7.8	–
Fusarium reticulatum Mont.	0.9	–	–	–	–	–
Fusarium solani (Mart.) Sacc.	3.5	21.2	4.3	15.9	–	9.4
Fusarium sporotrichioides Sherb.	–	1.5	–	2.3	–	1.6
Fusarium spp.	5.3	–	–	–	5.9	–
Gliocladium roseum (Link) Thom	17.5	–	5.4	–	6.9	–
Gymnoascus reesii Baranetzky	–	1.5	–	2.3	–	1.6
Idriella bolleyi (Sprague) von Arx	5.3	15.2	3.3	–	4.9	–
Mucor spp.	2.6	–	13.0	9.1	10.1	17.2
Penicillium spp.	1.8	1.5	2.2	15.9	2.9	–
Periconia macrospinosa Lefebvre and A.G. Johnson	–	1.5	–	2.3	–	–
Phoma spp.	–	–	2.2	–	–	–
Rhizoctonia spp.	2.6	3.0	4.3	–	4.9	–
Rhizopus nigricans Ehrenberg	–	1.5	–	–	2.0	–
Spicaria violacea Abbott	–	–	1.1	–	–	–
Trichoderma koningi Oudemans	1.8	1.5	–	–	2.0	–
Trichoderma viride Pers. ex S.F. Gray	–	1.5	1.1	9.1	–	–
Zygorrhynchus sp.	–	–	1.1	–	–	–
nonsporulating fungi	0.9	1.5	2.2	6.8	–	3.1
Total number of colonies	114	66	92	44	102	64
Total number of analysed plants with infested stem bases taken	90	60	74	60	90	60

and 35.9% in case of disinfected material in 2002–2003. In the organic and integrated systems, 6.1%, 9.1% and 17.4%, 15.9%, respectively, *F. graminearum*, *F. oxysporum* and *F. solani* were also isolated relatively numerously. *Rhizoctonia* spp. were isolated in all systems from non- disinfected material and only in the organic system from disinfected fragments of stem bases. Also *Idriella bolleyi* constitued the highest per cent on disinfected material from the organic system (15.2%). High per cent share in the integrated and conventional systems was noted in case of *Mucor* spp. The integrated system was also favourable for *Penicillium* spp. development. These fungi were isolated less often in the organic system. *Gliocladium roseum* was observed in all systems but clear differences between farming systems were not stated. However, it is worth to note that *G. roseum* was isolated numerously (17.5%) from non-disinfected material in the organic system. *Trichoderma* spp., at the former stage was isolated occasionally in all systems, but in a higher number in the integrated system.

DISCUSSION

The results presented in this paper allow to make suggestions and assumptions about the attitude towards plant health status according to farming system.

There is a common opinion that organic system, due to high soil fertility and high level of organic matter that enhance natural biocontrol of pathogens, effects a relatively high plant health and lowers the incidence of pathogens (Prior 1992; Grünwald et al. 2000). Results obtained here do not confirm a healthier status of spring barley stem bases in organic system. Moreover, barley cultivated in the organic system was infected in higher levels than plants cultivated in the integrated and conventional systems. Further, the impact of organic system on health status is not clear. Baturo et al. (2002) reported that barley roots in organic systems were healthier in comparison to conventional systems. Besides the mentioned divergences, *B. sorokiniana*, as well in case of roots as stem bases, played the main role in infection in the organic farm. *B. sorokiniana* is considered the main disease factor of barley and is transferred with grain (Christensen 1963; Łacicowa 1990; Knudsen et al. 1995; Baturo 2002). It causes foliar spot blotch, root and stem base rot, and black point on grains, as well as head blight and seedling blight. Severe infection can be followed by drastic yield decrease or the infected plants dry out without producing any seed (Eng-Chong Pua et al. 1985; Łacicowa and Pięta 1993; Kumar et al. 2002). Studies carried out by Baturo (2002) showed that heads and grain produced in organic systems can be intensively infected by *B. sorokiniana* This pathogen was also more numerously isolated from leaves in the organic farm (Baturo and Łukanowski 2001). It is a direct confirmation that plant health and conditions during vegetation season have an effect on mycological yield quality that is connected to health of sowing material, so important in organic system due to prohibition of chemical grain treatment.

Results of studies carried out on spring barley and winter wheat (Łukanowski and Sadowski 2002; Baturo et al. 2004) showed that *Fusarium* spp. do not cause more serious problems in organic systems than in conventional and integrated ones. Furthermore, grain obtained in organic systems can be less infected by *Fusarium* spp. It is advantageous in the nutritional aspect because of their abilities to produce mycotoxins. However, Champeil et al. (2004) found no clear relationship between disease severity and levels of contamination with mycotoxins. Mycotoxin production is dependent mainly both on well-defined ranges of temperature and other favourable environmental conditions (Chełkowski 1994; Bottalico and Perrone 2002). Obtained results that did not show favourable for *Fusarium* spp. conditions in the organic system did not confirm suggestions of Trewavas (2001), who claimed that food produced in the organic process may be more exposed to contamination by toxins (mycotoxins) than conventional food, where anti-fungal chemical agents are applied. FAO data (Anonymous 2000) indicated that there is no evidence that organic food is more prone to mycotoxin contamination. Overmore, there is some evidence that levels of mentioned toxic substances may be, in some cases, increased by the application of fungicides, in spite of reducing fungal population (Milus and Parsons 1994). Fungicides do not protect plants fully and on the same level against different pathogens.

Studies conducted by Platz et al. (1999) showed that chemical treatment of sowing material efficiently limits *B. sorokiniana* development. It shows that such treatment of sowing material effected a lower infection of stem bases by this pathogen in integrated and conventional systems. According to Amein (1988) seed treatment is only partially able to limit plant infection. The higher intensity of *Fusarium* spp. on barley stem bases in the conventional and integrated systems confirms that using chemically treated grain does not guarantee healthy crop plants. *Fusarium* spp. are worth recognizing because they are considered as ones of the most important cereal pathogens causing seedling damage and diseases of roots, stem bases, heads and grain. The most important, also isolated in this study, are *F. avenaceum, F. culmorum, F. graminearum*, *F. equiseti, F poae*, *F. solani* (Mathre 1987; Mańka 1989). Barley stem base threat comprises of three main diseases: eyespot, sharp eyespot and brown foot rot caused predominantly by *F. culmorum* and *F. avenaceum*, numerously isolated in this study, are associated with the mentioned symptoms (Turner et al. 1999). Also, *F. oxysporum* were isolated in significant numbers. According to Armstrong and Armstrong (1981), this species is important because of its ability to cause diseases of economically important plants, but, non-pathogenic strains, that could be important as biocontrol agents can not be forgotten (Postma and Rattink 1992; Alabouvette 1993).

Besides the mentioned serious barley pathogens, *Rhizoctonia* spp. isolated especially in the conventional system, are also considered by Łacicowa and Pięta (1993) as pathogens of spring barley. *Rhizoctonia* spp. are serious not only as a direct disease factor and have the ability to grow rapidly in plant tissues but also are connected to certain host-plants, show high tolerance to environmental factors, can persist as saprotrophs on plant residues or in the soil as sclerotia for a long time while most of pathogens die during one or two vegetation seasons (Smiley and Uddin 1993).

Also other fungi, commonly observed almost everywhere, were isolated here from stem bases e.g. genus *Alternaria, Aspergillus, Cylindrocarpon, Gliocladium, Mucor, Penicillium, Rhizopus* and *Trichoderma*.

Idriella bolleyi isolated numerously at dough stage in organic system was found in great numbers on lower-culm tissue of wheat, apart from *B. sorokiniana* and the *Fusarium* spp. by Kane et al. (1987) and Fernandez and Jefferson (2004). It is considered as a cause of decay and anthracnose (Smiley et al. 1994), but also as one of potential biocontrol agents for take-all (Lascaris and Deacon 1991). Duczek (1997) investigated the advantageous effect of *I. bolleyi* in case of seed treatment against common root rot of barley caused by *B. sorokiniana*. Knudsen et al. (1995) found that isolates of the fungi *I. bolleyi* and *G. roseum* inoculated on barley grain acted as antagonists towards

B. sorokiniana. Furthermore, *I. bolleyi* inoculated on barley seeds were shown to cause systemic induced resistance in plants to subsequent infection with *B. sorokiniana* (Liljeroth and Bryngelson 2002). Thus, it is also worth to take the interest in that fungus.

Obtained results revealed some interdependence between the most serious pathogens: the more *B. sorokiniana* the less *Fusarium* spp. generally was observed. Yet Ledingham (1942, in Bateman and Kwaśna 1999 behalf) showed a mutual effect of *B. sorokiniana* and *Fusarium* spp. in infected wheat. He revealed that intensity of root rot can be lower also in case of infection by *F. culmorum* and *B. sorokiniana* in comparison to infection only by one pathogen. However, it was also noticed that in some conditions *F. culmorum* can stimulate *B. sorokiniana* activity. Those studies showed that pathogen cooperation depends on environmental factors balance. Flieβbach and Mäder (2000) claimed that organic farming is favourable to soil microorganisms and can stimulate their development. There is also a common opinion about self-regulation mechanisms of organic agro-ecosystems. Results of the studies presented here show that mentioned self-regulation is a problematic issue. It could be only formulated that a relatively high incidence of saprotrophic fungi in that system could have an effect on significantly lower numbers of *Fusarium* spp. and the lack of *B. sorokiniana*. According to Knudsen et al. (1995) and Jensen et al. (2000), saprothropic *G. roseum* shows potential as a biological control agent against seed-borne diseases on cereals caused by *Fusarium* spp. and *B. sorokiniana*. In the presented study *G. roseum* was more numerously isolated in organic system and this suggests advantageous effect of organic conditions for *Gliocladium* spp. development. Baturo (2003) showed in organic farm rhizosphere less *Fusarium* spp. incidence and more isolates of *Gliocladium* spp. and *Trichoderma* spp. considered as saprothropic and antagonistic (Teperi et al. 1998; Diamond and Cooke 2003). However, Knudsen et al. (1999) tested the effect of organic management on the incidence of stem base rot of cereals caused by *F. culmorum* and found no correlation between microbial activity and disease suppression in organic system. However such effect was observed by Dal Bello et al. (2003), who observed antagonistic effect of soil rhizosphere microorganisms on *B. sorokiniana.* Results of the studies presented here showed low intensity of *Fusarium* spp., especially *F. avenaceum* and *F. culmorum* in organic farm, that could be the effect of *G. roseum* isolated in high intensity in that season. Thus, results presented in this paper could give only some assumptions. It cannot be directly stated that only organic management is favourable to saprotrophic fungi, which can limit pathogen development, as suggested by Campbell (1989), especially *B. sorokiniana* and *Fusarium* spp.

CONCLUSIONS

1. *B. sorokiniana* could be a serious threat in organic production of spring barley and affect negatively plant health.
2. Plant infection by *Fusarium* spp. during cropping season is not a bigger problem in organic system in comparison with integrated and conventional systems and probably could affect advantageously grain health and their contamination with mycotoxins.
3. Due to prohibition of pesticide application in organic system, searching for alternative methods of disease control is required.

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POLISH SUMMARY

ZDROWOTNOŚĆ PODSTAWY ŹDŹBŁA JĘCZMIENIA JAREGO W EKOLOGICZNYM, INTEGROWANYM I KONWENCJONALNYM SYSTEMIE UPRAWY

Badano zdrowotność oraz skład populacji grzybów zasiedlających podstawy źdźbła jęczmienia jarego uprawianego w ekologicznym, integrowanym i konwencjonalnym systemie uprawy. Najsilniejsze porażenie roślin przez *Bipolaris sorokiniana* i grzyby z rodzaju *Fusarium* stwierdzono w uprawie ekologicznej. Występowanie *B. sorokiniana* na podstawach źdźbła było wyraźnie uzależnione od systemu uprawy i wyraźnie silniejsze w systemie ekologicznym. Również w tym systemie, w fazie początku krzewienia, izolowano liczniej, w porównaniu z pozostałymi dwoma, *Fusarium* spp., jednak w fazie dojrzałości woskowej przeważającym patogenem był *B. sorokiniana*, a *Fusarium* spp. stwierdzono głównie w systemie integrowanym i konwencjonalnym. Na uwagę zasługuje fakt, że grzyby z rodzaju *Gliocladium*, znane z właściwości antagonistycznych w stosunku do patogenów, wystąpiły liczniej w systemie ekologicznym. Może to być istotne ze względu na wzrastające zainteresowanie ekologią, zaniechaniem stosowania pestycydów i coraz popularniejszą biologiczną walką z patogenami.