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THE INFLUENCE OF THE CROP FARMING SYSTEM ON THE HEALTH VALUE OF SPRING BARLEY UNDER THE MOUNTAIN CONDITIONS OF THE AREA OF BESKID NISKI

Summary

It was the goal of this paper to compare the intensity of occurrence of fungal diseases on the leaves, ears and the base of the culm in spring barley in case of pure and mixed sowing using the conventional and organic method under the mountain conditions of the area of Beskid Niski in southern Poland. The research was conducted in the years 2013-2014 at the Mountain Experimental Station in Czyrna Niżna, located in the western part of the range of Beskid Niski. The conducted research had indicated varied intensity of the emergence of fungal diseases of spring barley depending on the studied factors. Spring barley grown using the organic system was characterised by a significant reduction in the intensity of prevalence of barley scald (Rhynchosporium secalis), fusarium ear blight (Fusarium spp.) and fusarium foot rot (Fusarium spp.). At the same time, this growth system had shown an increase in the intensity of barley stripe (Pyrenophora graminea) and barley net blotch (Pyrenophora teres). Under the prevailing natural circumstances, in all analysed zones of the hill side, the growing system did not have a significant influence on the index of infection of the culm foot by Oculimacula spp. The growth of barley in a two-species mix with oat had materially reduced the intensity of fusarium ear blight (Fusarium spp.) and fusarium foot rot (Fusarium spp.). A three-species mix, in turn, had significantly reduced the development of Oculimacula spp., the causal agents of eyespot.
***Key words**: spring barley, traditional crop growth, organic crop growth, fungal diseases*

WPŁYW SYSTEMU GOSPODAROWANIA NA ZDROWOTNOŚĆ JĘCZMIENIA JAREGO W WARUNKACH GÓRSKICH BESKIDU NISKIEGO

Streszczenie

Celem pracy było porównanie nasilenia występowania chorób grzybowych na liściach, kłosach i podstawie źdźbła jęczmienia jarego w siewie czystym i mieszanym uprawianym metodą konwencjonalną i ekologiczną w warunkach górskich Beskidu Niskiego. Badania prowadzono w latach 2013-2014 w Górskiej Stacji Doświadczalnej znajdującej się w miejscowości Czyrna Niżna, położonej w zachodniej części Beskidu Niskiego. Przeprowadzone badania wykazały zróżnicowanie nasilenia występowania chorób grzybowych jęczmienia jarego w zależności od badanych czynników. Jęczmień jary uprawiany metodą ekologiczną odznaczał się istotnym spadkiem nasilenia występowania rynchosporiozy (Rhynchosporium secalis), fuzariozy kłosa (Fusarium spp.) i fuzaryjnej zgorzeli podstawy źdźbła (Fusarium spp.). Jednocześnie w tym systemie gospodarowania odnotowano wzrost nasilenia występowania pasiastości liści (Pyrenophora graminea) oraz plamistości siatkowej liści jęczmienia (Pyrenophora teres). W zaistniałych warunkach przyrodniczych, we wszystkich badanych strefach stoku system gospodarowania nie miał istotnego wpływu na indeks porażenia podstawy źdźbła przez Oculimacula spp. Uprawa jęczmienia w mieszance dwugatunkowej z owsem istotnie ograniczyła nasilenie fuzariozy kłosa (Fusarium spp.) i fuzaryjnej zgorzeli podstawy źdźbła (Fusarium spp.). Z kolei mieszanka trójgatunkowa istotnie ograniczyła rozwój Oculimacula spp. sprawców łamliwości źdźbła.
***Słowa kluczowe**: jęczmień jary, uprawa konwencjonalna, uprawa ekologiczna, choroby grzybowe*

1. Introduction

During its vegetation period, barley is attacked in particular by diseases such as: barley stripe (*Pyrenophora graminea*) and barley net blotch (*Pyrenophora teres*), barley scald (*Rhynchosporium secalis*), fusarium ear blight (*Fusarium* spp.), fusarium foot rot (Fusarium *spp.*) and eyespot (*Oculimacula* spp.) [1, 2]. The spread of these diseases depends mainly on the course of weather conditions and the growing technique used. In the organic system, it is forbidden to utilise chemical fungicides, which increases the risk of these diseases, and this, in consequence, leads to the reduction of seed quality. Hence, a correct growing technique, as a preventive measure, plays a particularly important role in plant protection especially in this production system, and forms the basis of arriving at an appropriate quality seed [2, 5, 6].

The use of mixtures is one of the growth techniques that limit the development of diseases in the crop. Mixed material to be sown describes mixtures of corns of various species of cereal crops and legumes, as well as varieties within a single species. Plants grown in mixes exploit better habitat properties, they adapt better to changing ambient conditions, undergo weaker competition and allelopathy, thanks to which they grow better than if they were sown in pure sowing. Various studies have confirmed the fact that two- and three-species crop mixes are much more competitive against weeds, are less susceptible to pathogens and vermin as well as adverse habitat conditions [2, 3, 6].

The effectiveness of inter-species mixes and their usability for limiting infections of spring crop by disease-causing fungus were also tested by Tratwal and Nadziak [8]. However, research on the subject conducted in the

mountainous conditions is lacking.

The goal of the present paper was to compare intensity of prevalence of disease-causing fungus on the leaves, ears and culm base of spring barley in case of pure and mixed sowing using the traditional and organic method under the mountain conditions of the area of Beskid Niski in southern Poland.

2. Material and methods

Field research was conducted in the years 2013-2014 at the Mountain Experimental Station in the locality of Czyrna Niżna by Krynica, located in the western part of the Beskid Niski mountain range. The experiments were conducted using soil in the 12th mountain oat and potato complex. This were two-factorial experiments set up using the random block method in three repetitions. The first experimental factor concerned the crop production system (conventional, organic), the second – the mode of sowing (pure sowing – spring barley; two-species mixed sowing - spring barley + oat and spring barley + spring triticale; three-species mixed sowing – spring barley + oat + spring triticale). The study was conducted on a hillside with the following inclination values: 10% (lower hillside zone), 12.6% (central hillside zone) and 16.6 % (upper hillside zone).

The potato was the forecrop for spring barley and the crop mixes in both production systems (conventional and organic). The farming system was typical and compliant with the growing requirements for these crops. The experiment spanning the conventional growing of spring barley used the following mineral fertilisers K_2O 92 kg·ha^{-1}, P_2O_5 104 kg·ha^{-1} and N 90 kg·ha^{-1} (30 kg before sowing and 60 kg·ha^{-1} before earing). Before sowing, the seeds were fortified with Vitavax 200 FS (s. a. carboxin, thiram) at 300 ml per 100 kg of seeds. In the vegetation period, barley was protected against weed using the herbicide Granstar 75 WG (s. a. tribenuron-methyl) at 24 g ha. The organic production method, in turn, foresaw the sowing of unfortified seeds. In this system, no synthetic fertilisation was used and no methods of protection of spring barley against agrophages were applied.

The sowing of the seeds in both systems was done in the second decade of April, with a separation of 11 cm between the rows. Spring barley (Boss cultivar) in the pure mix was sown at 170 kg·ha^{-1} (410 pcs.·m^2), in a two-species mix at 85 kg·ha^{-1} (205 pcs.·m^2) of spring barley, 110 kg·ha^{-1} (325 pcs.·m^2) of hulled oat (Borowiak cultivar), and spring triticale (Milewo cultivar) 100 kg·ha^{-1} (284 pcs.·m^2). The three-species mix was: 52 kg·ha^{-1} (125 pcs.·m^2) of spring barley, 67 kg·ha^{-1} (198 pcs.·m^2) of oat and 61 kg·ha^{-1} (173 pcs.·m^2) of spring triticale.

At the initial milk maturity of spring barley seeds (BBH 73), an evaluation was conducted of the health condition of the leaves, the ear and the culm base on 25 randomly picked plants from each field. The evaluation of intensity of diseases on the leaves and ears was conducted based on a nine-level scale, with level one denoting full resistance, and level nine – full susceptibility. The culm base was evaluated on a six-level scale, with zero denoting a healthy culm (without symptoms), and five denoting a culm base completely taken over by the disease [7].

The research results were presented as an infection index [9], subject to a variance analysis. The significance of differences between the mean values was compared using the Tukey´s test at $\alpha = 0.05$.

3. Results and discussion

The weather conditions in the study period were varied (tab. 1). The vegetative season of the year 2013 was characterised by insufficient humidity and a higher mean air temperature values as compared to the year 2014 and in the long term (1961 - 1990). This shortage of humidity accompanied the plants throughout the entire vegetative period, save for May and June. In the year 2014, however, the precipitation total from April to August was closer to the long-term values. However, shortages of water were recorded in April and June. Despite the fact that in both these years, the distribution of precipitation was uneven, one could summarise that the vegetative season of 2013 was dryer and warmer, with the one for the year 2014 being more humid and slightly cooler. The emerged weather conditions in the Beskid Niski mountain range in the years 2013-2014 significantly differentiated the intensity of prevalence of fungal diseases on spring barley (tab. 2). In own studies in the year 2014, a significant increase of the intensity of prevalence of all observed fungal diseases of barley was observed. In the analysed year, particularly significant growth was registered in the case of fusarium foot rot (*Fusarium* spp.). The weather conditions of the year 2013, in turn, reduced the development of fusarium ear blight and diseases of the culm base most significantly.

Table.1. Weather conditions in the research period measured at the Czyrna Niżna weather station, against the long-term values

Tab.1. Warunki pogodowe w okresie prowadzonych badań zmierzone w Stacji Czyrna Niżna na tle wielolecia

Years	Months					Total
	IV	V	VI	VII	VIII	
	Precipitation (mm)					
2013	24.70	118.0	202.40	33.10	32.90	411.10
2014	51.10	137.80	58.30	134.40	113.60	495.20
1961-1990 (multiyears)	62.00	99.60	118.60	111.20	91.00	482.40
	Mean temperatures (°C)					Średnia
2013	7.20	13.10	15.50	18.10	17.70	14.32
2014	8.50	12.60	14.40	18.70	16.20	14.08
1961-1990 (multiyears)	6.20	11.50	14.20	16.00	14.80	12.54

Source: own work / Źródło: opracowanie własne

Table 2. Mean infection index (ip%) for spring barley by disease-causing fungus in the years 2013-2014

Tab. 2. Średni indeks porażenia (ip%) jęczmienia jarego przez grzyby chorobotwórcze w latach 2013-2014

Diseases name	Years		$LSD_{0,05}$
	2013	2014	
Leaf stripe (*Peronophora graminea*)	20.42	38.30	2.25
Net blotch (*Peronophora teres*)	32.55	36.19	2.27
Rhynchosporiosis (*Rhynchosporium secalis*)	23.39	35.38	2.99
Fusarium head blight (*Fusarium spp.*)	9.61	33.68	3.02
Fusarium foot rot (Fusarium spp.)	28.19	51.11	3.89
Eyespot (*Oculimacula* spp.)	14.68	19.69	3.23

Source: own work / Źródło: opracowanie własne

In the mountainous conditions of the Beskid Niski range, the leaves of spring barley had shown an increased intensity of prevalence of leaf stripe (*P. graminea*), barley

net blotch (*P. teres*) and barley scald (*R. secalis*). The greatest intensity of these diseases was recorded in the sown pure barley (tab. 3, 4, 5).

Based on the obtained results, it can be determined that the production system and mode of sowing significantly influenced the prevalence of barley stripe in spring barley (*P. graminea*) in the lower (inclined at 10%) and middle part of the hillside (inclined at 12.6%) (tab. 3). The production of barley using the organic system had contributed to a significant increase in barley stripe (*P. graminea*) prevalence. A similar tendency was observed in the upper part of the hillside, inclined at 16.6%. The mode of sowing also modified the prevalence of this disease. The production of spring barley in the three-species mix significantly reduced the development of barley stripe *(P. graminea*) in both production systems (conventional and organic).

Barley net blotch (*P. teres*), in turn, save for the middle part, inclined at 12.6%, was not significantly dependent on the production mode (tab. 4). Korbas et al. [2] and Kurowski et al. [5] believe the same, indicating that the production system does not significantly contribute to the differentiation of infection of barley by the fungus causing barley net blotch. Despite this, similarly to the case of barley stripe *(P. graminea*), the tendency of increase in barley net blotch (*P. teres*) in the organic barley production system was observed. Irrespective of the production system, a significant reduction in barley net blotch on spring barley leaves produced in a two-species mix with oat, and in a three-species mix (spring barley + spring triticale + oat) was observed only in the lower and upper part of the hillside. Similar results of own research were achieved by Michalski et al. [6], Kurowski et al. [4] and Kostrzewa [3]. In their opinion, crop sown in mixes is characterised by better health.

Own research had shown that the presence of barley leaf scald *(R. secalis)* in all analysed hillside zones depended on the production system (tab. 5). Organically grown barley was characterised by a significantly lower index of leaf infection by *R. secalis* than in the traditional system. Different results were obtained by Korbas et al. [2] and Kurowski et al. [5]. In own research, a good effect of protection of barley against this disease was provided by mixed sowing, which significantly reduced the development of *R. secalis*. The highest intensity of barley scald (*R. secalis*) was observed when barley was sown as the sole crop. In the three-species mix, in turn, a significant reduction in the leaf infection index by *R. secalis* was recorded both in the lower (inclined at 10%), middle (inclined at 12.6%) and upper (inclined at 16.6%) zones of the hillside. Similar results were obtained by Kurowski et al. [4] indicating that mixed sowing reduces the development of *R. secalis* on spring barley leaves.

In own research on the barley ears we noticed the presence of fusarium ear blight (*Fusarium* spp.). The farming system significantly modified the prevalence of this disease in the lower and upper zones of the hillside (tab. 6). The infection of the ears by the *Fusarium* spp. fungus was higher in the traditional system. The obtained own research results did not confirm the effects found by Korbasa et al. [2], who recorded an increase in the infection of the barley ears in organic production. Own research had shown that both barley production systems (conventional and organic) show an influence of the mode of sowing on the prevalence of fusarium ear blight *(Fusarium* spp.). The lowest infection rate of spring barley ears by *Fusarium* spp. was registered in the two-species mix with oat. This reaction was recorded for all analysed hillside zones.

Table 3. Infection index (ip %) of spring barley leaves by *P. graminea* (barley stripe) in the conventional and organic farming systems

Tab. 3. Indeks porażenia (ip %) liści jęczmienia jarego przez P. graminea (pasiastość liści) w systemie konwencjonalnym i ekologicznym

Hillside zones	Mode of sowing	Farming system		Mean	$LSD_{0,05}$
		conventional	organic		
Upper	Spring barley	24.08	36.90	30.49	4.26
	Spring barley + oat	31.27	34.28	32.77	
	Spring barley + spring triticale	22.63	29.60	26.11	
	Spring barley + oat + spring triticale	20.20	26.30	23.25	
Mean		24.55	31.77	-	
$LSD_{0,05}$		2.26		-	
$LSD_{0,05}$: farming system x mode of sowing = 4.52					
Middle	Spring barley	24.66	36.35	30.50	3.03
	Spring barley + oat	27.68	31.75	29.71	
	Spring barley + spring triticale	35.40	29.04	32.22	
	Spring barley + oat + spring triticale	28.54	27.77	28.15	
Mean		29.07	31.23	-	
$LSD_{0,05}$		1.61		-	
$LSD_{0,05}$: farming system x mode of sowing = 3.22					
Lower	Spring barley	24.61	32.07	28.34	n.s.
	Spring barley + oat	34.04	31.89	32.96	
	Spring barley + spring triticale	28.48	30,38	29.43	
	Spring barley + oat + spring triticale	25.71	29.86	27.79	
Mean		28.21	31.05	-	
$LSD_{0,05}$		n.s.		-	
$LSD_{0,05}$: farming system x mode of sowing = n.s.					

n.s. – not significant difference

Source: own work / Źródło: opracowanie własne

Table. 4. Infection index (ip %) of spring barley leaves by *P. teres* (net blotch) in the conventional and organic farming systems

Tab. 4. Indeks porażenia (ip %) liści jęczmienia jarego przez P. teres (plamistość siatkowa liści) w systemie konwencjonalnym i ekologicznym

Hillside zones	Mode of sowing	Farming system		Mean	$LSD_{0,05}$
		conventional	organic		
Upper	Spring barley	30.23	41.12	35.67	4.83
	Spring barley + oat	37.60	12.65	31.13	
	Spring barley + spring triticale	34.83	35.58	35.20	
	Spring barley + oat + spring triticale	26.88	35.00	30.94	
Mean		32.38	34.09	-	
$LSD_{0,05}$		n.s.		-	
$LSD_{0,05}$: farming system x mode of sowing = 5.13					
Midlle	Spring barley	36.50	35.92	36.21	n.s.
	Spring barley + oat	35.62	40.54	38.08	
	Spring barley + spring triticale	39.45	33.34	36.40	
	Spring barley + oat + spring triticale	27.33	39.82	33.58	
Mean		34.72	37.41		
$LSD_{0,05}$		2.41		-	
$LSD_{0,05}$: farming system x mode of sowing = 4.94					
Lower	Spring barley	36.56	37.70	37.13	8.18
	Spring barley + oat	27.41	35.95	31.68	
	Spring barley + spring triticale	37.97	37.62	37.79	
	Spring barley + oat + spring triticale	25.19	32.03	28.61	
Mean		31.78	35.82		
$LSD_{0,05}$		n.s.		-	
$LSD_{0,05}$: farming system x mode of sowing = n.s.					

n.s. – not significant difference

Source: own work / Źródło: opracowanie własne

Table 5. Infection index (ip %) of spring barley leaves by *R. secalis* (barley leaf scald) in the conventional and organic farming systems

Tab. 5.Indeks porażenia (ip %) liści jęczmienia jarego przez R. secalis (rynchosporioza liści) w systemie konwencjonalnym i ekologicznym

Hillside zones	Mode of sowing	Farming system		Mean	$LSD_{0,05}$
		conventional	organic		
Upper	Spring barley	43.32	42.78	43.05	4.71
	Spring barley + oat	30.45	36.30	33.38	
	Spring barley + spring triticale	32.90	25.18	29.04	
	Spring barley + oat + spring triticale	34.35	24.35	29.35	
Mean		35.26	32.15		
$LSD_{0,05}$		2.50			
$LSD_{0,05}$: farming system x mode of sowing = 5.10					
Midlle	Spring barley	37.92	34.38	36.15	7.00
	Spring barley + oat	29.29	27.04	28.16	
	Spring barley + spring triticale	32.89	18.69	25.79	
	Spring barley + oat + spring triticale	26.49	16.28	21.39	
Mean		31.65	24.09		
$LSD_{0,05}$		3.72		-	
$LSD_{0,05}$: farming system x mode of sowing = 4.26					
Lower	Spring barley	32.59	30.42	31.51	5.22
	Spring barley + oat	31.20	22.62	26.91	
	Spring barley + spring triticale	29.09	23.72	26.40	
	Spring barley + oat + spring triticale	21.91	21.07	21.49	
Mean		28.70	24.46		
$LSD_{0,05}$		2.77		-	
$LSD_{0,05}$: farming system x mode of sowing = n.s.					

n.s. – not significant difference

Source: own work / Źródło: opracowanie własne

Table. 6. Infection index (ip %) of spring barley ears by *Fusarium spp*. (fusarium ear blight) in the conventional and organic farming systems

Tab. 6. Indeks porażenia (ip %) kłosa jęczmienia jarego przez Fusarium spp. (fuzarioza kłosa) w systemie konwencjonalnym i ekologicznym

Hillside zones	Mode of sowing	Farming system		Mean	LSD $_{0,05}$
		conventional	organic		
Upper	Spring barley	30.42	20.78	25.60	6.10
	Spring barley + oat	18.89	14.72	16.81	
	Spring barley + spring triticale	21.63	20.36	21.00	
	Spring barley + oat + spring triticale	19.80	16.72	18.26	
Mean		22.68	18.15	-	
LSD $_{0,05}$		3.24		-	
$LSD_{0,05}$: farming system x mode of sowing = n.s.					
Midlle	Spring barley	25.79	21.67	23.73	n.s.
	Spring barley + oat	27.06	24.63	25.84	
	Spring barley + spring triticale	23.57	26.86	25.22	
	Spring barley + oat + spring triticale	20.17	27.98	24.07	
Mean		24.15	25.28	-	
LSD $_{0,05}$		n.s.		-	
$LSD_{0,05}$: farming system x mode of sowing = 4.467					
Lower	Spring barley	27.24	21.24	24.24	6.56
	Spring barley + oat	17.00	11.66	14.33	
	Spring barley + spring triticale	26.28	19.99	23.13	
	Spring barley + oat + spring triticale	21.61	18.49	20.05	
Mean		23.03	17.85	-	
LSD $_{0,05}$		3.48		-	
$LSD_{0,05}$: farming system x mode of sowing = n.s.					

n.s. – not significant difference *Source: own work / Źródło: opracowanie własne*

Table 7. Infection index (ip %) of spring barley culm base by *Fusarium* spp. (fusarium foot rot) in the conventional and organic farming systems

Tab. 7. Indeks porażenia (ip %) podstawy źdźbła jęczmienia jarego przez Fusarium spp. (fuzaryjna zgorzel podstawy źdźbła) w systemie konwencjonalnym i ekologicznym

Hillside zones	Mode of sowing	Farming system		Mean	$LSD_{0,05}$
		conventional	organic		
Upper	Spring barley	42.33	41.16	41.74	7.08
	Spring barley + oat	31.36	33.37	32.36	
	Spring barley + spring triticale	47.66	36.33	42.00	
	Spring barley + oat + spring triticale	35.00	35.37	35.18	
Mean		39.09	36.56	-	
LSD $_{0,05}$		n.s.		-	
$LSD_{0,05}$: farming system x mode of sowing = n.s.					
Midlle	Spring barley	55.34	46.01	50.68	6.91
	Spring barley + oat	34.72	32.03	33.38	
	Spring barley + spring triticale	49.32	40.07	44.70	
	Spring barley + oat + spring triticale	40.33	42.34	41.34	
Mean		44.93	40.11		
LSD $_{0,05}$		3.67		-	
$LSD_{0,05}$: farming system x mode of sowing = 7.34					
Lower	Spring barley	52.99	42.99	47.99	8.00
	Spring barley + oat	30.69	32.97	31.83	
	Spring barley + spring triticale	45.00	38.21	41.61	
	Spring barley + oat + spring triticale	32.67	33.32	33.00	
Średnia		40.34	36.87	-	
NIR $_{0,05}$		n.s.		-	
$LSD_{0,05}$: farming system x mode of sowing = 8.50					

n.s. – not significant difference *Source: own work / Źródło: opracowanie własne*

The conducted own research in the mountainous conditions had shown that the culm base was dominated by fusarium foot rot (*Fusarium* spp.). The infection index for the culm base by the fungus *Fusarium* spp. was significantly dependent on the farming system solely in the middle part of the hillside, inclined at 12.6% (tab. 7). The growth of barley using the organic mode significantly reduced the development of fusarium foot rot (*Fusarium* spp.). In the other hillside zones, a similar tendency was recorded. The results of Korbas et al. [2] are similar. Own research had shown that similarly to the case of fusarium ear blight (*Fusarium* spp.), the mode of production also significantly modified the prevalence of this disease. The two-species mix with oat had shown a significant reduction in the development of fusarium foot rot in spring barley (*Fusarium* spp.). The obtained results confirm the research of Kurowski et al. [4].

Table 8. Infection index (ip %) of spring barley culm base by *Oculimacula* spp. (eyespot) in the conventional and organic farming systems

Tab. 8. Indeks porażenia (ip %) podstawy źdźbła jęczmienia jarego przez Oculimacula spp. (łamliwość źdźbła) w systemie konwencjonalnym i ekologicznym

Hillside zones	Mode of sowing	Farming system		Mean	$LSD_{0,05}$
		conventional	organic		
Upper	Spring barley	34.82	19.67	27.25	10.27
	Spring barley + oat	20.66	16.00	18.33	
	Spring barley + spring triticale	3.69	10.00	7.34	
	Spring barley + oat + spring triticale	7.68	13.00	10.34	
Mean		16.72	14.91	-	
$LSD_{0,05}$		n.s.		-	
$LSD_{0,05}$: farming system x mode of sowing = 10.91					
Midlle	Spring barley	25.65	30.00	27.83	8.90
	Spring barley + oat	20.38	20.01	20.19	
	Spring barley + spring triticale	18.65	4.33	11.49	
	Spring barley + oat + spring triticale	10.66	8.69	9.67	
Mean		18.83	15.76		
$LSD_{0,05}$		n.s.		-	
$LSD_{0,05}$: farming system x mode of sowing = 9.45					
Lower	Spring barley	21.45	31.83	26.64	9.34
	Spring barley + oat	15.00	28.00	21.50	
	Spring barley + spring triticale	24.33	4.00	14.17	
	Spring barley + oat + spring triticale	18,67	4.33	11.50	
Mean		19.86	17.04		
$LSD_{0,05}$		n.s.		-	
$LSD_{0,05}$: farming system x mode of sowing = 9.92					

n.s. – not significant difference *Source: own work / Źródło: opracowanie własne*

Out of all the observed fungal diseases, spring barley was least attacked by eyespot (*Oculimacula* spp.). Own research had shown that the infection index of the culm base by *Oculimacula* spp. did not significantly depend on the production system (tab. 8). Despite this, a tendency was recorded of the reduction in development of the analysed disease for the production of barley using the organic method. Kurowski et al. [5] is of a similar opinion. In case of this disease as well, the inhibiting influence of crop mixes on the infection index for the culm base by (*Oculimacula* spp.) was recorded. Kurowski et al. [4] conclude similarly. In the analysed hillside zones, the culm base of spring barley was characterised by a significantly reduced infection index by *Oculimacula* spp. in particular in the three-species mix (spring barley + oat + spring triticale).

4. Conclusion

The conducted research, under the mountain conditions of the Beskid Niski range, had shown a differentiation in the intensity of prevalence of fungal diseases for spring barley depending on the farming system, hill inclination and mode of sowing. Spring barley produced using the organic system was characterised by a significant reduction in the intensity of prevalence of barley scald (*R. secalis*), fusarium ear blight (*Fusarium* spp.) and fusarium foot rot (*Fusarium* spp.). At the same time, this production system saw an increase in the prevalence of barley stripe and barley net blotch. Under the prevailing natural conditions, in all analysed hillside zones, the production system did not significantly influence the infection index of the culm base by *Oculimacula* spp. The growth of barley in a two-species mix with oat had significantly reduced the intensity of fusarium ear blight (Fusarium spp.) and fusarium foot rot (Fusarium spp.). The three-species mix, in turn, had significantly reduced the development of *Oculimacula* spp. the agents of eyespot.

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