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OCCURRENCE OF DISEASES ON TRITICALE AND BARLEY PLANTS GROWN IN PURE STANDS AND THEIR MIXTURES

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Abstract. Spring triticale 'Migo', and spring barley 'Maresi' grown in pure stand and in their mixtures were used in field experiment. Disease occurrence, number of culms and heads as well as yield were assessed. Powdery mildew and scald of barley and *Septoria* leaf blotch of triticale occurred in lower degree in mixtures than in pure stands, but only in the years with weather conditions favourable for the diseases development. *Fusarium* stem rot and eyespot of both plant species as well as net blotch of barley occurred in similar degree in all treatments or even in some mixtures in higher degree than in pure stands.

Key words: diseases, triticale, barley, mixtures

I. INTRODUCTION

Cultivar mixtures of one plant species and mixtures of different plant species are used for decreasing the risk of yield losses due to the biotic and abiotic stresses (Dubin 1993; Gacek and Nadziak 1988; Garrett and Mundt 1999; Gołębniak et al. 1994).

The aim of the work was to compare an occurrence of diseases on triticale and barley plants cultivated in pure stands and in their mixtures. Number of culms and heads per 1 m^2 as well as yield of the plants were also assessed.

II. MATERIALS AND METHODS

Field experiment was carried out in split-plot design in four replications on clay sandy soil in the years 1997-1999. Size of each plot was 14.4 m^2. Winter wheat was the forecrop. Spring triticale 'Migo' and spring barley 'Maresi' were cultivated in pure stands and in mixtures of 75% or 25% of spring triticale, and respectively of 25% or 75% of spring barley. The occurrence of the plant diseases was assessed in the third decade of June. 40 plants in pure stands, and 20 plants of each species from all plots were evaluated. Six degree scale (1: < 1%; 2: 1-5 %; 3: 5-10 %; 4: 10-25%; 5: 25-50%; 6: > 50% of infected area) was used for evaluation of *Septoria* leaf blotch of triticale, net blotch of barley, powdery mildew, scald of barley, and three degree scale (1: < 25%; 2: 25-50%; 3: > 50% of stem circumference) for assessment of *Fusarium* stem rot as well as eyespot occurrence (Gołębniak et al. 1994). Analyse of variance was done to establish the significance of differences.

The highest mean temperatures were from April to June in 1998, and the lowest in 1997 (Tab. 1). The highest precipitations were in May and July in 1997, and in April and June in 1999. In the warmest 1998 year precipitations higher than the norm was found only in June.

Table 1

Weather conditions during vegetation period in 1997-1999

Months	Temperature °C				Precipitations			
	perennial means mm	deviations from perennial means			perennial means mm	percentage of the norm		
		1997	1998	1999		1997	1998	1999
April	7.6	–2.1	2.8	2.0	32.5	123	94	226
May	13.1	–0.2	1.8	0.5	52.7	128	57	106
June	16.4	0.6	1.1	0.1	58.7	81	137	150
July	18.1	0.0	–0.4	2.5	72.2	246	85	49

III. RESULTS

The following plant diseases occurred in the experiment: *Septoria* leaf blotch [*Phaeosphaeria nodorum* (E. Müller) Hedjaroude] on triticale, net blotch [*Pyrenophora teres* (Died.) Drechsler], powdery mildew [*Erysiphe graminis* DC.], and scald [*Rhynchosporium secalis* (Dud.) J. Davis] on barley whereas *Fusarium* stem rot as well as eyespot [*Tapesia yallundae* Wallwork] on both plant species.

Septoria leaf blotch of triticale was determined in all three treatments. The highest % of infected plants was estimated in 1999, and the lowest in 1997 (Tab. 2). The lowest significant occurrence of the disease in mixture of triticale 75% and barley 25% in comparison with two other treatments was found only in 1998.

Fusarium stem rot occurred in all three years, but the highest number of infected plants was estimated in 1998 (Tab. 3). The disease occurrence was similar in all treatments in 1997 as well as in 1999. In 1998 Fusarium stem rot infection was lower in pure stands than in mixtures.

Small number of plants of triticale infected by *Tapesia yallundae* Wallwork was found in 1997 and 1998 (Tab. 4). Similar, low infection level was estimated on barley plants in all three years (Tab. 4). In 1999 the disease occurred on high number of plants of triticale, and significant difference was found between mixtures of 75% and 25% of the triticale.

Table 2

Occurrence of Septoria leaf blotch on spring triticale cultivated in pure stand and in mixtures

Treatment	1997		1998		1999	
	$\%^{v,y}$	$\bar{x}^{y}$	$\%^{z}$	$\bar{x}^{y}$	$\%^{y}$	$\bar{x}^{y}$
Triticale (T) 100%	17	1.3	65 b	1.6	80	2.2
T 75% + Barley (B) 25%	16	1.3	60 a	1.2	86	2.4
T 25% + B 75%	8	1.1	67 b	1.1	82	2.0

v – percentage of infected plants
x – average of infection degree
y – values are not significantly different at 0.05 level
z – in columns means followed by the same letters are not significantly different at 0.05 level

Table 3

Occurrence of Fusarium stem rot on spring triticale and spring barley cultivated in pure stand and in mixtures

Estimation of	Treatment	1997		1998		1999	
		%[y]	$\bar{x}^y$	%[z]	$\bar{x}^y$	%[y]	$\bar{x}^y$
Triticale	Triticale (T) 100%	7.0	1.0	30 a	1.2	13	1.5
	T 75% + Barley (B) 25%	9.0	1.1	39 b	1.4	14	1.4
	T 25% + B 75%	11.5	1.0	39 b	1.2	15	1.6
Barley	Barley (B) 100%	6.0	1.0	41 b	1.7	17	1.7
	B 75% + T 25%	9.0	1.0	48 c	1.6	18	1.5
	B 25% + T 75%	6.0	1.2	46 c	1.7	13	1.5

Explanations see Table 2

Table 4

Occurrence of eyespot on spring triticale and spring barley cultivated in pure stand and in mixtures

Estimation of	Treatment	1997		1998		1999	
		%[y]	$\bar{x}^y$	%[y]	$\bar{x}^y$	%[z]	$\bar{x}^y$
Triticale	Triticale (T) 100%	1.0	1.3	2.0	1.5	28 bc	1.7 c
	T 75% + Barley (B) 25%	1.0	1.0	1.0	2.0	34 c	1.5 bc
	T 25% + B 75%	2.5	1.1	3.0	1.8	25 b	1.5 bc
Barley	Barley (B) 100%	2.0	1.0	1.0	1.2	2.0 a	1.3 ab
	B 75% + T 25%	3.0	1.2	1.0	1.0	2.0 a	1.4 b
	B 25% + T 75%	2.0	1.1	0.0	–	2.0 a	1.1 a

Explanations see Table 2

Table 5

Occurrence of net blotch on barley cultivated in pure stand and in mixtures

Treatment	1997		1998		1999	
	%[z]	$\bar{x}^y$	%[z]	$\bar{x}^y$	%[y]	$\bar{x}^y$
Barley (B) 100%	52 a	1.4	59 a	1.6	78	2.2
B 75% + Triticale (T) 25%	62 b	1.7	57 a	1.4	65	1.9
B 25% + T 75%	56 a	1.7	67 b	1.7	65	1.9

Explanations see Table 2

Net blotch of barley occurred on high number of plants in all three years (Tab. 5). The disease occurrence was similar in all treatments (1999) or higher in particular mixtures than in pure stand (1997, 1998).

Powdery mildew occurred on high number of barley plants in 1997 and 1999 (Tab. 6). The disease occurrence was smaller in mixtures than in pure stand in both the years.

Scald of barley occurred on considerable high number of plants only in 1999 (Tab. 7). However number of infected plants was smaller in mixtures than in pure stand in this year.

Number of culms in barley pure stand and in mixture of triticale 25% and barley 75% was higher than in triticale pure stand and in mixture of triticale 75% and barley 25% (Tab. 8).

Table 6

Occurrence of powdery mildew on barley cultivated in pure stand and in mixtures

Treatment	1997		1998		1999	
	%[z]	$\bar{x}$[y]	%[y]	$\bar{x}$[y]	%[z]	$\bar{x}$[y]
Barley (B) 100%	17 b	1.2	1	1.0	31 b	2.0 b
B 75% + Triticale (T) 25%	8 a	1.1	1	1.5	20 ab	1.6 a
B 25% + T 75%	5 a	1.2	2	1.0	15 a	1.6 a

Explanations see Table 2

Table 7

Occurrence of scald on barley cultivated in pure stand and in mixtures

Treatment	1997		1998		1999	
	%[y]	$\bar{x}$[y]	%[y]	$\bar{x}$[y]	%[z]	$\bar{x}$[y]
Barley (B) 100%	3	1.0	2	2.0	10 b	1.7 ab
B 75% + Triticale (T) 25%	2	1.8	1	1.0	4 ab	1.0 a
B 25% + T 75%	2	1.7	1	1.2	2 a	1.8 b

Explanations see Table 2

Table 8

Number of culms of triticale, and barley in pure stands as well as in mixtures per 1 m^2 at harvesting time

Treatment	Years			Average
	1997	1998	1999	
Triticale (T) 100%	508	485	491	495
T 75% + Barley (B) 25%	533*	501	529	515
	(379 + 154)**	(308 + 188)	(389 + 140)	(359 +156)
T 25% + B 75%	746	639	693	686
	(76 + 670)	(83 + 556)	(194 + 499)	(117 + 569)
B 100%	835	599	888	774
LSD (P = 0.05)	134.4	83.8	70.6	109.5

* – triticale and barley in total; ** – triticale and barley respectively

Table 9

Number of heads of triticale, and barley in pure stands as well as in mixtures per 1 m^2 at harvesting time

Treatment	Years			Average
	1997	1998	1999	
Triticale (T) 100%	439	441	460	447
T 75% + Barley (B) 25%	504	441	478	461
	(347 + 157)	(279 + 161)	(361 + 117)	(329 +132)
T 25% + B 75%	672	565	555	596
	(76 + 596)	(79 + 486)	(149 + 403)	(101 + 495)
B 100%	788	506	828	707
LSD (P = 0.05)	134.0	78.3	63.1	118.9

Table 10

Yield of grain of triticale and barley and their mixtures

Treatment	Years of grain (dt/ha)			Average
	1997	1998	1999	
Triticale (T) 100 %	52.1	46.0	55.5	51.2
T 75 % + Barley (B) 25 %	50.1	42.5	56.1	49.6
T 25 % + B 75 %	50.6	40.1	60.7	50.5
B 100 %	51.6	37.4	59.9	49.6
LSD	d.n.s.	4.64	5.93	d.n.s.

d.n.s. – difference not significant

Proportions of heads in particular treatments were similar to proportions of culms (Tab. 9). However the number of heads was smaller than the number of culms.

Yield of grain in pure stand depended on the year (Tab. 10). The yield of triticale was higher than the yield of barley in 1998, but in contrast the yield of barley was higher than the yield of triticale in 1999. In 1997 the yield of both species was similar. As far as the yield of mixtures was considered it was concluded that the yield depended on the composition of the mixture.

IV. DISCUSSION

In our experiment in 1998 number of plants of triticale infected by *Septoria* leaf blotch was only smaller in one mixture than in pure stand. Lack of differences in *Septoria* infection of triticale cultivated in pure stand and in mixtures of wheat or barley was also observed in other experiments (Gołębniak et al. 1994; Michalski et al. 1996; Weber et al. 1999).

Number of plants of triticale and of barley with symptoms of *Fusarium* stem rot and eyespot was similar in mixtures or even higher in mixtures than in pure stands. In other experiments the diseases of barley cultivated in mixtures occurred less often in mixtures than in pure stands (Kurowski et al. 1998; Vilich-Meller 1992).

The infection of net blotch on barley cultivated in mixtures was similar or even higher than in pure stand. However Jørgensen et al. (1998) observed lower barley net blotch occurrence in mixtures than in pure stand.

Out of three years of our experiment powdery mildew was observed on high number of barley plants in two years, and scald in one year. Also the number of infected plants grown in mixtures was smaller than in pure stand. Occurrence of powdery mildew on barley is very often noted on smaller number of plants in mixtures than in pure stands (Błażej and Błażej 1998; Czembor and Gacek 1987; Gacek et al. 1999). In 1998 powdery mildew occurred on very small number of plants. The year was characterised by relatively high temperature, low rainfalls and small number of culms and heads per 1 m^2. In our experiment and others (Błażej and Błażej 1998) occurrence of barley scald was smaller in mixtures than in pure stand.

The results of the experiments indicate that the diseases occurrence on triticale and barley cultivated in mixtures in comparison with their pure stands depends on the kind of disease and the level of plant infection. While powdery mildew and scald of barley occurred on 10 or higher number of plants in pure stand the number of barley infected plants and sometimes the degree of their infection were smaller in mixtures than in pure stand.

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V. LITERATURE

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WYSTĘPOWANIE CHORÓB NA ROŚLINACH PSZENŻYTA I JĘCZMIENIA W SIEWIE CZYSTYM ORAZ W MIESZANKACH

STRESZCZENIE

W doświadczeniu polowym użyto pszenżyto jare 'Migo' i jęczmień jary 'Maresi' w siewie czystym i w mieszankach. W doświadczeniu tym oceniano występowanie chorób, liczby źdźbeł i kłosów oraz plon ziarna. W latach z warunkami pogodowymi sprzyjającymi rozwojowi mączniaka i rynchosporiozy jęczmienia, a także septoriozy pszenżyta choroby te występowały w mniejszym stopniu w mieszankach niż w siewie czystym. Fuzaryjna zgorzel podstawy źdźbła i łamliwość źdźbła na obydwu gatunkach oraz plamistość siatkowa na jęczmieniu występowały w podobnym stopniu we wszystkich kombinacjach lub nawet w niektórych mieszankach w większym stopniu niż w siewie czystym.