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SUSCEPTIBILITY OF MICROIRRIGATED GERMAN ASPARAGUS CULTIVARS TO INFECTION BY PATHOGENS

Dariusz Pańka, Roman Rolbiecki, Natalia Musiał, Małgorzata Jeske
UTP University of Science and Technology in Bydgoszcz

Summary

Asparagus infection with numerous pathogens very often decreases yield of spears. Efficient protection of asparagus plantation can be very difficult and sometimes even unavailable due to lack of effective plant protection agents to control of some pathogens. The choose of cultivar and field before the establishment of plantation are crucial in such cases. Irrigation has also a very considerable impact on asparagus yielding. It can influenced the diseases development too. The aim of the research was to evaluate the susceptibility of microirrigated, three German asparagus cultivars to the plants infection by pathogens.The field experiment was settled in 1998 at KruszynKrajenski near Bydgoszcz on a sandy soil. The first factor was microirrigation used in variants: W_1 – non-irrigated plots (control), W_2 – drip-irrigated plots, W_3 – microsprinkler-irrigated plots. Irrigation doses were adequate for amount and distribution of rain-precipitation and were found out by tensiometers, too. They amounted to 195 and 113 mm for micro-sprinkler and drip irrigation, respectively. The second factor were three German cultivars of asparagus: 'Ap', 'Gr' and 'SchwetzigerMeisterschuss', grown for blanched spears. Plant healthiness observations were carried out in the first 4 harvest years (2000-2004). Occurrence of root and stem rot (*Fusarium oxysporum* f.sp. *asparagi*, *F. culmorum*), asparagus rust (*Puccinia asparagi*), grey mould (*Botrytis cinerea*) and *Stemphylium* leaf spot (*Stemphylium vesicarium*) were evaluated. Percentage of infected plants on the plot and degree of plant infection were estimated at the end of the vegetation period. There was a variability of cultivars infection with pathogens. The most severe disease symptoms were observed on the 'Schwetziger

Meisterschuss'.Cultivars 'Ap' and 'Gr' were significantly lower infested. Microirrigation affected a development of asparagus diseases too. Analysis of mean values showed that irrigation of asparagus increased *P. asparagi* occurrence and decreased *Stemphylium* leaf spot development.

Key words: Asparagus, microirrigation, diseases, cultivars

INTRODUCTION

Asparagus infection with numerous pathogens very often decreases yield of spears. *Fusarium oxysporum* f.sp. *asparagi*, *F. culmorum, F. moniliforme*, *Puccinia asparagi,Botrytis cinerea* and *Stemphylium vesicarium* are considered as the most dangerous (Hausbeck*et al.,* 1999; Johnson and Lunden, 1992). Efficient protection of asparagus plantation can be very difficult and sometimes even unavailable due to lack of effective plant protection agents to control of some pathogens. The choose of cultivar and field before the establishment of plantation are crucial in such cases. Proper plant management e.g. irrigation, fertilization, cultivation have essential meaning too. Irrigation has a very considerable impact on asparagus yielding .It can also influenced the diseases development. The aim of the research was to evaluate the susceptibility of microirrigated, three German asparagus cultivars to the plants infection by pathogens.

MATERIALS AND METHODS

The field experiment was settled in 1998 at Kruszyn Krajeński near Bydgoszcz on a sandy soil. The water reserve to 1 m depth of soil at field capacity was 87 mm and the available water 67 mm. Experiment was conducted as a two-factorial "split-plot" system with four replications and 14,4 m^2 plot's area. The first factor was post harvest microirrigation used in variants: W_1 – non-irrigated plots (control), W_2 – drip-irrigated plots, W_3 – microsprinkler-irrigated plots. Irrigation doses were adequate for amount and distribution of rain-precipitation and were found out by tensiometers, too. They amounted to 195 and 113 mm for micro-sprinkler and drip irrigation, respectively. The second factor were three German cultivars of asparagus: 'Ap', 'Gr' and 'Schwetziger Meisterschuss', grown for blanched spears. Plant healthiness observations were carried out in the first 4 years of harvest (2000-2003). Occurrence of asparagus rust (*Puccinia asparagi*) and *Stemphylium* leaf spot (*Stemphylium vesicarium*) was evaluated. Fifty stems from each plot were chosen for the evaluation, at the end of the vegetation period. The infection was estimated according to a 9-degree scale where: 0=healthy plants, 1=up to 5% of disease symptoms on plant, 2=from 6% to 15% of disease symptoms on plant, 3=16% to 25% of disease symptoms on plant, 4=26% to

35% of disease symptoms, 5=36% to 45% of disease symptoms, 6=46% to 60% of disease symptoms, 7=61% to 80% of disease symptoms, 8=above 80% plant's surface with disease symptoms.

Infection degrees were transformed into infection indexes (II) according to Townsend and Heuberger formula (Wenzel, 1948). Obtained data were statistically analyzed using analysis of variance. Means were compared with Tukey's test.

RESULTS AND DISCUSSION

Various cultivars of asparagus were characterized by different susceptibility on infestation by *P. asparagi* and *S. vesicarium*. The most severe symptoms of rust and *Stemphylium* leaf spot were observed on the 'Schwetziger Meisterschuss' cultivar (Table 1, 2). Cultivars 'Ap' and 'Gr' were significantly lower infested. The infestation index in consecutive years reached up to 21,6% and 33,1% for rust and *Stemphylium* leaf spot respectively. 'Schwetziger Meisterschuss' was the most susceptible, but the infestation index not exceed 26,2% for the rust, and 34,4% for *Stemphylium* leaf spot. Investigated cultivars may be characterized by mean susceptibility to examined pathogens. There is a high variability in cultivars resistance to diseases (Benson, 2002; Broadhurst, 1996; Knaflewski, 1996).

Irrigation variants influenced the pathogens development. The rust development was stimulated, but *Stemphylium* leaf spot was restricted by investigated irrigation variants.

Infection of cultivars was different in particular years of the study. The highest infection with rust and significant differentiation of the infection was observed in 2000. This year was characterized by moderate rainfall and slightly higher temperatures as compared to long-term values (Table 3, 4). Differentiation of the infection did not occur in remaining years. Significant influence of irrigation on rust symptoms occurrence in 2001 was also noted. Plants in control plots (without irrigation) were significantly lower infested with *P. asparagi* in comparison to irrigated treatments. Analysis of mean values from the studied years showed that irrigation of asparagus was favorable for *P. asparagi* development. It is probably associated with the plants exposure on the drought stress. *Puccinia asparagi* infects the plant by stomata, which are closed in such conditions. Probably, infection process with pathogen is restricted as a result of this situation.

Both factors, cultivar and irrigation variant, influenced significantly on the *Stemphylium* leaf spot occurrence. In 2001 and 2002 'Schwetziger Meisterschuss' cultivar was significantly more infected. Those years were characterized by high index of precipitation. Especially, the highest degree of infestation was

recorded in 2001, the coldest year in research period. Those conditions are particularly suitable for *S. vesicarium* development (Hausbeck*et al*. 1999).

Table 1. Occurrence of rust on asparagus cultivars (Infection index in %). Kruszyn Krajeński 2000 – 2003.

Year Rok	Cultivar (A) Odmiana (A)	Type of irrigation (B) – Sposób nawadniania (B)			Mean Średnia
		W_0[1]	W_1	W_2	
2000	'Ap'	17.7	20.7	20.9	19.8
	'Gr'	17.0	21.2	21.6	19.9
	'Schwetziger Meisterschuss'	22.0	25.7	26.2	24.6
	Mean – Średnia	18.9	22.6	22.9	
$LSD_{\alpha=0.05}$ A=1.31; B=2.14;AxB=3.15; BxA=3.71					
2001	'Ap'	3.69	6.81	6.62	5.71
	'Gr'	4.56	6.69	6.94	6.06
	'Schwetziger Meisterschuss'	5.81	8.59	8.31	7.57
	Mean – Średnia	4.69	7.36	7.29	
$LSD_{\alpha=0.05}$ A=n.s.[2]; B=1.33;AxB=n.s.; BxA=2.31					
2002	'Ap'	1.25	1.31	1.37	1.31
	'Gr'	1.50	2.37	1.50	1.79
	'Schwetziger Meisterschuss'	1.50	2.62	3.00	2.37
	Mean – Średnia	1.42	2.10	1.96	
$LSD_{\alpha=0.05}$ A=n.s.; B=n.s.; AxB=n.s.; BxA=n.s.					
2003	'Ap'	3.25	4.94	3.69	3.96
	'Gr'	3.94	4.00	4.31	4.08
	'Schwetziger Meisterschuss'	4.25	4.81	4.81	4.62
	Mean – Średnia	3.81	4.58	4.27	
$LSD_{\alpha=0.05}$ A=n.s.; B=n.s.; AxB=n.s.; BxA=n.s.					
2000-2003	'Ap'	6.47	8.45	8.14	7.69
	'Gr'	6.75	8.56	8.59	7.97
	'Schwetziger Meisterschuss'	8.39	10.44	10.60	9.80
	Mean – Średnia	7.20	9.15	9.10	
$LSD_{\alpha=0.05}$ A=0.75; B=0.28;AxB=0.81; BxA=0.48					

[1] W_0 – non-irrigatedplots – poletka bez nawadniania, W_1 – drip-irrigatedplots – poletka nawadniane kroplowo, W_2 – micro-sprinkler-irrigatedplots – poletka z mikrozraszaniem

[2] n.s. – not significant difference – różnica statystycznie nieistotna

Source: own research data; Źródło – wyniki własne

Table 2. Occurrence of purple spot on asparagus cultivars (Infection index in %). Kruszyn Krajeński 2000 – 2003.

Year Rok	Cultivar (A) Odmiana (A)	Type of irrigation (B) – Sposób nawadniania (B)			Mean Średnia
		W_0[1]	W_1	W_2	
2000	'Ap'	1.62	1.68	1.75	1.68
	'Gr'	1.62	1.75	1.68	1.68
	'Schwetziger Meisterschuss'	3.06	2.56	2.25	2.62
	Mean – Średnia	2.10	2.00	1.90	
$LSD_{\alpha=0.05}$ A=n.s.[2]; B=n.s.; AxB=n.s.; BxA=n.s.					
2001	'Ap'	33.1	25.2	28.6	29.0
	'Gr'	31.1	27.1	30.9	29.7
	'Schwetziger Meisterschuss'	34.4	33.7	34.4	34.2
	Mean – Średnia	32.9	28.7	31.3	
$LSD_{\alpha=0.05}$ A=n.s.; B=n.s.; AxB=7.49.; BxA=n.s.					
2002	'Ap'	13.5	11.9	11.6	12.3
	'Gr'	13.1	10.2	11.2	11.5
	'Schwetziger Meisterschuss'	14.6	14.9	13.3	14.3
	Mean – Średnia	13.7	12.3	12.0	
$LSD_{\alpha=0.05}$ A=1.78; B=n.s.;AxB=3.71; BxA=n.s.					
2003	'Ap'	0.31	0	0.50	0.27
	'Gr'	0.25	0.44	0	0.23
	'Schwetziger Meisterschuss'	0.56	0.31	0.56	0.48
	Mean – Średnia	0.37	0.25	0.35	
$LSD_{\alpha=0.05}$ A=n.s.; B=n.s.; AxB=n.s.; BxA=n.s.					
2000-2003	'Ap'	12.1	9.7	10.6	10.8
	'Gr'	11.5	9.9	11.0	10.8
	'Schwetziger Meisterschuss'	13.2	12.9	12.6	12.9
	Mean – Średnia	12.3	10.8	11.4	
$LSD_{\alpha=0.05}$ A=1.43.; B=0.50;AxB=1.52; BxA=0.86					

[1] W_0 – non-irrigatedplots – poletka bez nawadniania, W_1 – drip-irrigatedplots – poletka nawadniane kroplowo, W_2 – micro-sprinkler-irrigatedplots – poletka z mikrozraszaniem

[2] n.s. – not significant difference – różnica statystycznie nieistotna

Source: own research data; Źródło – wyniki własne

Mean analysis from years showed restricted influence of irrigation on *Stemphylium* leaf spot development. The combination of drip irrigation was

characterized by weakest disease symptoms, but high infestation was recorded in non-irrigated combination.

It is of high importance to conduct more complex experiments to prove those relations.

Table 3. The average air temperature during the research years. Kruszyn Krajeński 2000 – 2003.

Months Miesiące	Airtemperature [°C] – Temperatura powietrza [°C]					
	2000	2001	2002	2003	1999-2004	1971-2000
April Kwiecień	11,0	7,0	7,5	6,4	8,1	7,5
May Maj	14,5	13,1	15,7	14,4	14,0	13,2
June Czerwiec	16,7	14,3	16,3	17,6	16,3	16,2
July Lipiec	15,7	19,3	18,9	19,2	18,6	18,0
August Sierpień	17,3	18,3	19,9	18,4	18,3	17,7
September Wrzesień	11,7	11,2	12,9	13,6	13,0	13,1
April (Kwiecień) – September (Wrzesień)	14,5	14,0	15,2	14,9	14,7	14,3

CONCLUSIONS

1. Researched German asparagus cultivars are infected by *Puccinia asparagi* and *Stemphylium vesicarium*
2. The ‘Schwetziger Meisterschuss’ asparagus cultivar was the most susceptible to infection by *Stemphylium* leaf spot and ‘Ap’ and ‘Gr’ cultivars were the least susceptible.
3. Microirrigation decreases occurrence of *Puccinia asparagi* on the asparagus summer stalks.

Table 4. Precipitation distribution during the research years. Kruszyn Krajeński 2000 – 2003.

Months Miesiące	Total precipitation [mm]– Suma opadów [mm]					
	2000	2001	2002	2003	2000-2003	1971-2000
April Kwiecień	16	45	13	13,3	21,8	28
May Maj	19	30	50	12,1	27,8	40
June Czerwiec	36	49	44	34,3	40,8	56
July Lipiec	58	106	108	88,8	90,2	65
August Sierpień	37	27	41	17,8	30,7	51
September Wrzesień	50	117	45	11,2	55,8	50
Sum Suma	216	374	301	177,5	267,1	284

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Dr hab. Ing. Dariusz Pańka, Dr. Ing. Małgorzata Jeske, Mgr Ing. Natalia Musiał
Division of Molecular Phytophatology
20 Kordecki Str., 85-255 Bydgoszcz
panka@utp.edu.pl

Dr hab. Ing. Roman Rolbiecki
Department of Land Reclamation and Agrometeorology
6 Bernardynska str., 85-029 Bydgoszcz
rolbr@utp.edu.pl
UTP University of Science and Technology in Bydgoszcz

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