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EFFECT OF THE SOLID WASTE LANDFILL IN TARNOW ON THE HEALTHINESS OF SPRING WHEAT

WPŁYW SKŁADOWISKA ODPADÓW KOMUNALNYCH W TARNOWIE NA ZDROWOTNOŚĆ PSZENICY JAREJ

Abstract: Present work aimed at investigating the degree of spring wheat infection by fungal pathogens in the immediate vicinity of the landfill. The field experiment was conducted in 2006 and 2007 in Tarnow. During vegetation period leaf and ear infection with phytopathogenic fungi was assessed on a 9-degree scale. Both in 2006 and 2007 spring wheat was most strongly attacked by *Erysiphe graminis* on plots located in zone I on the southern, eastern and northern side of the landfill. Leaves and ears infestation by *Septoria nodorum* was lowest on plots located in zone II on the western side of the landfill. Index of *Puccinia recondita* infection was low. Cultivation of spring wheat close to active sector favours stronger plant infection by *Erysiphe graminis* and *Septoria nodorum*.

Keywords: municipal landfill site, fungal diseases, spring wheat

As municipal landfill sites affect their natural environment [1] they pose an important economic and social problem. Moreover, the areas adjoining landfills are exposed to microbiological or chemical pollution, which leads to degradation of conditions of agricultural production. Dispersal of gaseous, dust and microbial pollutants in the atmosphere may pose a hazard not only to plants and animals but also to human life and health [2, 3].

Agricultural activity is often conducted in the vicinity of municipal landfill sites. Landfill sites may disturb the balance in the environment eg through change of habitat conditions, which is visible as a sudden increase in population of pests. Fungal disease development depends on many abiotic factors such as climatic conditions and agrotechnical factors [4, 5]. Also other factors, such as industrial or traffic pollution

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may influence plants infection by phytopathogenic fungi [6, 7]. Municipal landfill sites also emit numerous pollutants which may directly affect plant pathogenic organisms but this effect has not been fully investigated yet. Phytopathogenic fungi developing on wheat inhibit its growth and as a result decrease the yield and worsen seed quality [4].

The present research aimed to investigate the occurrence of spring wheat infection by fungal pathogens in the area immediately adjoining a municipal landfill site.

Material and methods

The field experiment was conducted in 2006 and 2007 in Tarnow. The solid waste landfill site in Tarnow, around which the studies were carried out, is located in the northern city quarter. Observations were conducted on experimental plots located in the immediate vicinity of the landfill. The experimental points were set up on each side of the landfill in two zones: below 250 m and 250–500 m from its boundaries. Labelling of experimental plots is presented in Table 1. Spring wheat was cultivated on 20 m^2 plot. Spring wheat, Zura c.v. was seeded in 2006 in the second decade of April and in 2007 in the third decade of March. Tillage was carried out according to the rules of agrotechnics on all plots.

Table 1

Soil sampling sites in the vicinity of the municipal landfill site in Tarnow

Point	Localization of points with respect to landfill site	
	Direction	Zone [m]
W I	West	below 250
W II	West	250–500
N I	North	below 250
N II	North	250–500
E I	East	below 250
E II	East	250–500
S I	South	below 250
S II	South	250–500

Wind distribution in the area of Tarnow city is as follows: north winds – 6 %, north-east winds – 7.1 %, east winds – 16.7 %, south-east winds – 4.8 %, south winds – 14.8 %, south-west winds – 7.4 %, west winds – 22.6 %, north-west winds – 8.8 % and calm air – 11.8 %. Measurements of emission and composition of biogas were conducted in places where plants where cultivated. The measurements were carried out using al device for measuring landfill gas composition – Polytector II G 750(Germany). The contents of biogas components in the air surrounding the landfill are presented in Table 2. The lowest methane concentrations occurred in zone II on the eastern, northern and western side of the landfill.

Table 2

Mean value of biogas components in the air surrounding the municipal landfill site in Tarnow (from April 2006 to October 2007)

Indicator	Unit	Measuring point							
		S I	S II	E I	E II	N I	N II	W I	W II
Methane (CH_4)	ppm	0.9	0.4	0.7	0.5	0.5	0.0	0.0	0.0
Hydrogen sulfide H_2S	ppm	Not registered							
Carbon dioxide (CO_2)	%	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.04
Oxygen (O_2)	%	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9

Leaf and ear infection with *Erysiphe graminis, Puccinia recondita* f. sp. *Tritici* and *Septoria nodorum* were assessed on a 9-degree scale: 9 – 0–5 %, 8 – 6–15 %, 7 – 16–25 %, 6 – 26–40 %, 5 – 41–60 %, 4 – 61–75 %, 3 – 76–85 %, 2 – 86–95 %, 1 – 96–100 % damages [8]. The results were verified statistically using Statistica programme. Three factor ANOVA was conducted, Newman-Keuls critical intervals were computed and the value of the final step was used for means differentiation at significance level $p < 0.05$.

Results and discussion

The obtained results revealed that at earing maturity spring wheat leaves were more strongly attacked by *Erysiphe graminis* in zone I than in zone II (Table 3). The decreased plant infection by *Erysiphe graminis* was found on plots located on the western side of the landfill. At grain milk maturity plants infestation by *Erysiphe graminis* was the highest on plots located in the I zone on the eastern and southern site of landfill.

Table 3

Mean index of spring wheat infection by *Erysiphe graminis*

Direction (a)	Index of leaves infection [9 °] at earring maturity						
	Year (c)						
	2006		2007		Mean 2006–2007		
	Zone (b)						Mean
	I	II	I	II	I	II	
South	8.48	8.70	8.14	8.41	8.31	8.56	8.43
East	8.44	8.69	7.94	8.38	8.19	8.54	8.36
North	8.43	8.56	8.02	8.50	8.23	8.53	8.38
West	8.60	8.64	8.36	8.55	8.48	8.60	8.54
Mean	8.57		8.29		8.30	8.55	
$LSD_{p<0.05}$; a – 0.094, b – 0.050, c – 0.050, a × b × c – 0.257							

Table 3 contd.

Direction (a)	Index of leaves infection [9 °] at grain milk maturity						
	Year (c)						
	2006		2007		Mean 2006–2007		
	Zone (b)						Mean
	I	II	I	II	I	II	
South	8.65	8.84	8.42	8.74	8.54	8.79	8.66
East	8.62	8.82	8.49	8.80	8.56	8.81	8.68
North	8.56	8.84	8.56	8.78	8.56	8.81	8.69
West	8.88	8.85	8.74	8.71	8.81	8.78	8.80
Mean	8.76		8.66		8.62		8.80
$LSD_{p<0.05}$; a – 0.061, b – 0.032, c – 0.032, a × b × c – 0.167							

Plants infestation by *Puccinia recondite* was similar on all plots, irrespective of their location with respect to the landfill (Table 4).

Table 4

Mean index of spring wheat infection by *Puccinia recondita* f. sp. *tritici*

Direction (a)	Index of leaves infection [9 °]						
	Year (c)						
	2006		2007		Mean 2006–2007		
	Zone (b)						Mean
	I	II	I	II	I	II	
South	8.77	8.92	8.46	8.93	8.62	8.93	8.77
East	8.49	8.66	8.43	8.72	8.46	8.69	8.58
North	8.54	8.73	8.49	8.51	8.52	8.62	8.57
West	8.93	8.92	8.9	8.73	8.92	8.83	8.87
Mean	8.75		8.65		8.63	8.77	
$LSD_{p<0.05}$; no significant difference							

Spring wheat leaves were more strongly attacked by *Septoria nodorum* than ears (Table 5). Among compared plots the highest plant leaves infestation was observed in zone I on eastern and northern site of landfill. The plots on these sites were placed closest to the active sector. Obviously lower plants infestation by phyto-pathogenic fungi was observed on plots situated at a long distance from the active landfill sector.

Table 5

Mean index of leaves and ears of spring wheat infection by *Septoria nodorum*

Direction (a)	Index of leaves infection [9 °]						
	Year (c)						
	2006		2007		Mean 2006–2007		
	Zone (b)						Mean
	I	II	I	II	I	II	
South	8.14	8.46	8.10	8.33	8.12	8.40	8.26
East	8.05	8.04	7.75	7.89	7.90	7.97	7.93
North	8.36	8.41	7.72	8.40	8.04	8.41	8.22
West	8.43	8.44	8.27	8.36	8.35	8.40	8.38
Mean	8.29		8.10		8.10	8.29	
$LSD_{p<0.05}$; a – 0.085, b – 0.045, c – 0.045, a × b × c – 0.234							
Direction (a)	Index of ears infection [9 °]						
	Year (c)						
	2006		2007		Mean 2006–2007		
	Zone (b)						Mean
	I	II	I	II	I	II	
South	8.25	8.57	8.29	8.45	8.27	8.51	8.39
East	8.28	8.31	8.17	8.30	8.23	8.31	8.27
North	8.18	8.17	8.12	8.24	8.15	8.21	8.18
West	8.54	8.60	8.23	8.55	8.39	8.58	8.48
Mean	8.36		8.29		8.26	8.40	
$LSD_{p<0.05}$; a – 0.077, b – 0.041, c – 0.041, a × b × c – 0.211							

The gaseous (methane) and microbiological pollutants originates on municipal waste landfill sites and moves to the adjoining terrains with air currents. The plots situated on the eastern and northern side of the landfill in zone I are most exposed to the emission from the landfill. The highest methane concentrations were registered on these plots. It is connected with east wind prevailing in this area. Other authors also found that pollution may negatively affect plant healthiness [6, 7]. According to Stompor-Chrzan [6] ears of winter wheat were attacked more intensively by *Septoria nodorum* when cultivars were grown near the Nitrogen Plant. On the other hand, *Erysiphe graminis* infection was more intensive on control plantation. The obtained results evidence that pollutants originating from municipal landfill site may have stimulating effect on the course of some fungal disease development on spring wheat.

Conclusions

Spring wheat leaves and ears infections by phytopathogenic fungi depended on the localization of plots with respect to the landfill. Plants growing in the immediate vicinity of the active landfill sector were most strongly attacked by *Erysiphe graminis* and *Septoria nodorum*.

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WPŁYW SKŁADOWISKA ODPADÓW KOMUNALNYCH W TARNOWIE NA ZDROWOTNOŚĆ PSZENICY JAREJ

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Abstrakt: Celem pracy było zbadanie stopnia porażenia pszenicy jarej przez patogeny grzybowe w strefie bezpośrednio przylegającej do składowiska odpadów komunalnych. Badania przeprowadzono w 2006 i 2007 roku w Tarnowie. W okresie wegetacji prowadzono obserwacje występowania objawów chorobowych powodowanych przez patogeny grzybowe. Stopień porażenia roślin oceniano w skali 9°. Zarówno w 2006, jak i 2007 r. najsilniej porażone przez mączniaka rośliny pszenicy jarej obserwowano na poletkach znajdujących się w I strefie po południowej, wschodniej i północnej stronie składowiska. Objawy porażenia liści i plew roślin przez septoriozę obserwowano w najmniejszym nasileniu na poletkach po zachodniej stronie w II strefie. Stopień porażenia liści przez rdzę brunatną był niewielki. Uprawa pszenicy jarej w pobliżu czynnego sektora skaldowska sprzyjała silniejszemu porażeniu roślin przez mączniaka i septoriozę.

Słowa kluczowe: składowisko odpadów komunalnych, choroby grzybowe, pszenica jara