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**HARMFULNESS OF BIRDS IN ARABLE CROPS
IN THE IMMEDIATE VICINITY
OF THE SOLID WASTE LANDFILL SITE IN TARNOW**

**SZKODLIWOŚĆ PTAKÓW W UPRAWACH ROLNICZYCH
W BEZPOŚREDNIM SĄSIEDZTWIE
SKŁADOWISKA ODPADÓW STAŁYCH W TARNOWIE**

Abstract: Analyses of damage caused by birds in arable crops were conducted in the neighbourhood of the municipal waste landfill site in Tarnow. Birds were the most numerous on plots in the immediate neighbourhood of the active landfill sector. They were flying to the plots with sprouting horse bean plants causing partial damage or total destruction of the plants. Losses caused by birds may be considerable, in some case even the whole plantation was destroyed. Cultivation of plants which constitute attractive food for birds is burdened with great risk in the vicinity of municipal landfill sites.

Keywords: birds, municipal landfill site, damages

Municipal landfill sites affect their natural environment [1] and conditions of agricultural production causing among others deterioration of soil quality and value of agricultural products [2]. Various microbiological and chemical pollutants [3, 4] as well as waste, eg plastic bags may move with the air to the areas adjoining landfills. The landfill sites as such may be also a habitat for many organisms or a place where they exist temporarily to find food.

Large amounts of organic waste is brought to municipal landfill sites and it may constitute food for various animal species, including rodents and birds. Many bird species come to landfills. Some are present there mainly in winter when food is hard to find elsewhere. However, many species are relatively permanent occupants of such places. Municipal waste landfill sites are most often visited by ravens and gulls. Birds are an important element of both natural environments and agrocenoses [5], yet birds

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scavenging on landfills may pose a hazard to eg airplanes, the natural environment and for arable crops [6]. It should be remembered that many bird species significantly diminish insect pest populations. However, some bird species may themselves pose a hazard to cultivated crops [7]. Crops are the most threatened by birds at the sprouting and maturing stages. Birds cause the most serious damage in orchards, eg in the maturing stage of sour cherries or cherries. Maize sown areas during sprouting are most endangered among the arable crops. Damage caused by birds may also appear in horse bean or cereals.

The present paper aimed at identification of bird harmfulness in horse bean plantations localized in the zone immediately adjoining a municipal landfill site.

Material and methods

The studies were conducted in 2006 and 2007 in Tarnow Krzyz on the solid waste landfill site. The landfill area is surrounded by ploughlands, wasteland and forest. Observations were conducted on experimental sites located in the immediate neighbourhood of the landfill. The points were set up on each side of the landfill in two zones: below 250 m and 250–500 m from its boundaries. The labelling of the observations points was presented in Table 1. On each site spring wheat, potatoes and horse bean were cultivated. A single plot area was 20 m². The experiment was set up in four replications. The work presents the results of bird harmfulness on horse bean plots.

Table 1

Plots located in the vicinity of the municipal waste landfill site in 2006 i 2007

Observaion point	Localization of plots in reference 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
Z	Reclaimed sector	0

The degree of damage done by birds was assessed during sprouting. On the horse bean plot observations were conducted three times: at the beginning of sprouting, at full sprouting and a week later. On each plot a 1m x 1m area was designed using a wooden frame and the number of sprouted plants and plants damaged by birds was counted in this area. The extent of plant damage was also assessed on a three degree scale: 0 – undamaged plants, 1 – damaged but not uprooted plant, 3 – wholly uprooted plants.

Traces of bird feeding on sprouted horse bean are characteristic and easy to distinguish from damage caused by other animals.

Observations of birds feeding on the experimental plots were also conducted once during full sprouting of horse bean plants. Birds feeding on the plots were counted using binoculars at some distance so as not to frighten them off. The birds were counted three times a day, ie in the morning (between 6.00 and 8.00), at noon (between 12.00 and 14.00) and in the evening (between 17.00 and 19.00). The total number of observed birds was given as a result without differentiating their species affiliation.

The results were verified statistically using the Statistica programme and ANOVA analysis was conducted. Newman-Keuls critical intervals were computed and the value of the last step served for differentiating means at the significance level $p < 0.05$.

Results and discussion

Damage caused by wild animals may pose a serious hazard to profitability of agricultural or garden production [7]. Conducted research confirms that birds may to a considerable degree damage agronomic plants. Arable crops are particularly exposed to bird feeding during sprouting. Life conditions are advantageous for some bird species on municipal wastes landfill sites, which provide an important source of food. Birds may gather on landfill sites or in their vicinity in very large flocks. During the period when they do not scavenge on the landfill they fly to the adjoining areas and may cause damage to arable crops.

The extent of horse bean damage due to birds depended on the place of cultivation with respect to the active landfill sector (Table 2), because birds gather on the active sector or in its vicinity. The largest number of damaged plants was observed on the plots located on the eastern and northern side of the landfill and in the reclaimed sector area. The plots on these sites were placed closest to the active sector. Sprouted horse bean plants were particularly severely damaged on the plots located in the area of the reclaimed sector (Table 3). In 2006 birds damaged all germinating and sprouting plants. In 2007 losses caused by birds were smaller and on the most exposed site almost 60 % of sprouting plants were damaged.

Table 2

Damage of horse bean plants [%] caused by birds in the zone of the effect of the solid waste landfill in Tarnow

Date development stage	Percent of damaged plants on plots									LSD _{p < 0.05}
	objects									
	S		E		N		W		Z	
	I	II	I	II	I	II	I	II		
2006										
Beginning of sprouting	0.0	0.0	7.0	6.0	6.0	7.0	0.0	0.0	8.0	5.69
Full sprouting	0.0	0.0	19.0	14.0	16.0	14.0	4.0	2.0	20.0	6.84
Full 7 days after sprouting	0.0	0.0	40.0	23.0	30.0	20.0	4.0	2.0	100	7.99

Table 2 contd.

Date development stage	Percent of damaged plants on plots									LSD _{p < 0.05}
	objects									
	S		E		N		W		Z	
	I	II	I	II	I	II	I	II		
2007										
Beginning of sprouting	0.0	0.0	12.0	4.0	15.0	6.0	0.0	0.0	21.0	6.53
Full sprouting	0.0	0.0	24.0	24.0	32.0	26.0	0.0	0.0	37.0	8.25
Full 7 days after sprouting	0.0	0.0	49.0	35.0	51.0	41.0	0.0	0.0	59.0	8.41

Table 3

Degree [%] of horse bean plant damage due to birds in the zone of the effect
of the solid waste landfill in Tarnow

Date/development stage	Degree of plant damage on plots									LSD _{p < 0.05}
	objects									
	S		E		N		W		Z	
	I	II	I	II	I	II	I	II		
2006										
Beginning of sprouting	0.0	0.0	0.08	0.06	0.07	0.10	0.0	0.0	0.11	0.073
Full sprouting	0.0	0.0	0.23	0.15	0.19	0.16	0.04	0.02	0.3	0.102
Full 7 days after sprouting	0.0	0.0	0.50	0.24	0.40	0.24	0.04	0.02	1.68	0.131
2007										
Beginning of sprouting	0.0	0.0	0.12	0.04	0.15	0.06	0.0	0.0	0.21	0.065
Full sprouting	0.0	0.0	0.33	0.34	0.47	0.38	0.0	0.0	0.56	0.130
Full 7 days after sprouting	0.0	0.0	0.66	0.47	0.78	0.57	0.0	0.0	0.85	0.187

The observations evidenced numerous bird feeding on sprouted horse bean plants (Table 4). The largest number of birds were spotted on the plots on the eastern and northern side of the landfill and on the plot located on the reclaimed part, which was also next to the active sector. During the day the number of birds on individual sites changed, which was associated not only with activity of birds but also the operating personnel on the landfill. People and machines moving on the landfill frightened off birds, which, however, very quickly returned.

Solid waste landfills may also indirectly affect arable crops, among others favouring numerous bird gathering. Municipal landfill sites are eagerly visited by birds due to large share of organic waste in the total waste mass deposited on the landfill. A low level of waste sorting in Poland leads to fast filling up active landfills. An excessive quantity of organic wastes, which could have been composted, find their way to landfills as unsorted mixed municipal wastes. Birds not only scavenge on the food remnants deposited on the landfill but also spread refuse beyond the landfill boundaries.

Table 4

Bird predation on sprouted horse bean plants in the zone of the effect of the solid waste landfill in Tarnow

Date	Number of birds [heads/plot]								
	objects								
	S		E		N		W		Z
	I	II	I	II	I	II	I	II	
2006									
Morning	0.0	0.0	5	1.25	6.75	8.25	0.0	0.0	8.5
Noon	0.0	0.0	5.25	7.75	0.5	1	0.0	0.0	0
Evening	0.0	0.0	6.5	4.25	4.75	5	0.0	0.0	15.8
2007									
Morning	0.0	0.0	9.25	6.5	10.5	8.75	0.0	0.0	7.75
Noon	0.0	0.0	10	10.5	12.3	8	0.0	0.0	7.25
Evening	0.0	0.0	0	0	6.5	5.75	0.0	0.0	5

Numerous birds gathered on the landfill site in Tarnow often sat on the plots with sprouting horse bean plants, sometimes causing total destruction of the whole plantation. The plantation localisation with respect to the active sector, where the birds gathered was also important. The longer the distance from the active sector, the lesser the exposure to damage caused by birds. The plots close to the active sectors are exposed to damage and should be protected against birds by means of suitable frightening devices, such as seed dressings or wire nets [6]. Birds may be also scarred off municipal landfills by eg birds of prey.

Conclusions

1. Close localization of the municipal landfill site favours gathering of birds on arable crops.
2. During plant sprouting birds may cause very serious injuries to horse bean plants.
3. Plantations of crops exposed to damage due to birds should be established far from active municipal landfills or protected against damage.

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SZKODLIWOŚĆ PTAKÓW W UPRAWACH ROLNICZYCH W BEZPOŚREDNIM SĄSIĘDZTWIE SKŁADOWISKA ODPADÓW STAŁYCH W TARNOWIE

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Abstrakt: Badania nad szkodami powodowanymi przez ptaki w uprawach rolniczych przeprowadzono w sąsiedztwie składowiska odpadów komunalnych w Tarnowie. Ptaki występowały najliczniej na poletkach znajdujących się w bezpośrednim sąsiedztwie czynnego sektora składowiska. Ze składowiska przelatywały na poletka ze wschodzącymi roślinami bobiku, powodując częściowe uszkodzenie rośliny lub całkowite jej zniszczenie. Straty powodowane przez ptaki mogą być bardzo duże, w niektórych przypadkach doszło do całkowitego zniszczenia uprawy. Uprawa roślin, które są atrakcyjnym pokarmem dla ptaków, jest obciążona dużym ryzykiem w pobliżu składowisk odpadów komunalnych.

Słowa kluczowe: ptaki, składowisko odpadów komunalnych, uszkodzenia