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The influence of pig housing on environment

SUMMARY

The studies carried out sought to comprehensibly assess the potential threats to the natural environment caused by various pig-breeding technologies applied in Poland. Achieving this objective necessitated making measurements and comparisons between the scale of gas emissions from housing systems used for various technological groups of pigs as well as finding the content and losses of nutrients during the collecting of animal faeces and the storing of natural fertilisers.

The experimental material included pigs of all technological groups as well as natural fertilisers obtained during their keeping. The studies involved 108 milking sows, hybrids between Polish large white x Polish landrace breeds with their piglets, 1,800 piglets, hybrids between Polish large white x Polish landrace x Pietrain x Duroc breeds, 900 weaners, hybrids of the same breeds as piglets, and 450 pregnant sows, hybrids between Polish landrace x Polish large white breeds. The examinations were repeated three times which made a total of 3,258 examined individuals. The pigs were kept in the litter, deep litter, straw flow, on the slats, and partly slats systems. The studies of solid fertilisers used 5 tonnes of material on each of three manure plates for a given technological group. The studies were completed three times. A total of 270 tonnes of farmyard manure was used. In the studies of natural liquid fertilisers: slurry and liquid manure, tanks of 3 m^3 capacity were used, three such tanks for each technological group. Also this part of the study was performed three times which made a total of 216 m^3 of slurry and liquid manure. The studies on animals were performed in six microclimatic chambers with full controls and a computerised environment control system. Studies on fertilisers were done with the use of wind tunnels with a constant flow of air mass.

In gas emissions, 168 compounds were found. The great majority of them belonged to so-called odorants. The second group consisted of greenhouse gases with carbon dioxide, water vapour, nitrogen oxides, and methane. Also measured were ammonia and hydrogen sulfide. Statistically significant differences were found between the quantities of released gases depending on the housing system applied. The lowest emissions were found in the straw flow, and partly slats housing systems.

From the viewpoint of releasing nitrogen compounds from natural fertilisers, the highest environmental load was found for the slurry. It had the highest nitrogen content among all the components studied prevalently in ammonium form. The liquid fertilisers, including liquid manure had the highest loads of phosphorus and potassium The amounts of these nutrients released to the environment in the process of leaching out were the highest in the case of farmyard manure.

Table 1.

Level of gas emissions from basic housing systems of various technological pig groups (kg/year/head).

Group/ Gases	Housing system					
	Litter	**Slope floor - Self cleaning**	**Deep litter**	**Slats**	**Partly - slats**	**SEM**
Sows with piglets						
- H_2O_2	6132,94a			6571,59b	6324,21c	39,19
- CO_2	4550,70a			5130,64b	4651,47c	50,63
- NH_3	5,92aA			9,43Bb	5,41Ac	0,50
- H_2S	0,202A			0,530B	0,247C	0,03
- CH_4	4,92Aa			6,21bB	3,93Ac	0,19
- NO_x	0,214a			0,230b	0,198c	0,01
Weaners						
- H_2O_2	583,32a	578,28b	648,59c	656,07d	620,73b	7,02
- CO_2	344,10a	328,17a	402.62b	364,32a	332,03a	5,57
- NH_3	1,20Aa	0,62Bb	1,67Ac	2,03Cd	0,91Bd	0,11
- H_2S	0,042Aa	0,037Aa	0,047Aa	0,142Bb	0,077Ac	0,007
- CH_4	0,61aA	0,42aA	1,53bB	0,97cD	0,54Aa	0,08
- NO_x	0,032	0,020	0,038	0,029	0,024	0,002
Fattening pigs						
- H_2O_2	728,45Aa	799,64b	1068cB	803,47b	783,04a	20,01
- CO_2	773,89a	728,91b	818,34c	797,89ac	748,60ab	7,47
- NH_3	2,93a	2,31b	3,67c	5,24d	2,89a	0,29
- H_2S	0,091A	0,084A	0,108B	0,322D	0,129AB	0,02
- CH_4	1,91a	1,64a	2,5b	2,25b	1,83a	0,07
- NO_x	0,054a	0,043a	0,071b	0,048a	0,039a	0,003
Pregnant sows						

- H_2O_2	1035,70a	1023,64a	1228,51b	1163,70b	1074,41a	14,69
- CO_2	1243,73a	1051,30b	1387,36c	1310,08c	1132,06b	25,04
- NH_3	3,73aA	3,42bA	5,01B	7,45C	3,89aA	0,24
- H_2S	0,169A	0,145A	0,234B	0,728C	0,259B	0,04
- CH_4	3,42A	2,88A	4,60B	4,15C	3,26A	0,12
- NO_x	0,128aA	0,097bA	0,163cB	0,116aA	0,084bA	0,02

ab – statistically significant differences ($P \leq 0,05$); AB – statistically highly significant differences ($P \leq 0,01$)

Table 2.

Level of gas emissions from waste managing places (kg/t).

Gases	Solid waste						Liquid waste								SEM
	Manure - fattening pigs	Deep litter - fattening pigs	Manure - weaners	Manure – pregnant sows	Deep litter – pregnant sows	Manure – sows with piglets	Sllury – fattening pigs	Liquid manure - fattening pigs	Sllury - weaners	Liquid manure - weaners	Sllury - pregnant sows	Liquid manure - pregnant sows	Sllury - sows with piglets	Liquid manure - sows with piglets	
NH_3	1,73aA	4,39bB	1,44cA	1,76aA	3,47dAB	2,76eAB	4,91fB	5,17gB	2,53eAB	2,93hAB	3,04hAB	3,30dAB	3,87iAB	3,40dAB	0,14
NO_x	0,19aA	0,49bB	0,15cA	0,19aA	0,36dC	0,30dC	0,69eD	0,82fE	0,42bB	0,53gB	0,38dC	0,62eD	0,59gB	0,40bB	0,02
CH_4	6,93aA	10,92bB	9,59cB	8,73dAB	15,64eC	9,35cB	18,18fD	25,06gE	32,03hF	39,42iG	29,97jH	37,45kGI	25,73lE	35,38mI	1,35
H_2S	0,89aA	2,11bB	0,97cA	0.82aA	2,21bB	1,25dA	7,25eC	6,97eC	6,43fC	5,95gC	4,83hC	4,31iCD	5,43jC	5,04kC	0,28
NMVOC	44,10aA	67,79bB	61,10cB	68,87bB	75,63dB	57,80eA	10,00fC	13,82gC	16,28hCD	24,80iD	14,73jC	19,71kCD	13,63gC	17,08lCD	2,90

ab – statistically significant differences (P≤0,05); AB – statistically highly significant differences (P≤0,01)

Table 3.

Loss organic fertilizers content during storage (%).

Item	Solid waste						Liquid waste								SEM
	Manure - fattening pigs	Deep litter -fattening pigs	Manure - weaners	Manure – pregnant sows	Deep litter – pregnant sows	Manure – sows with piglets	Sllury – fattening pigs	Liquid manure - fattening pigs	Sllury - weaners	Liquid manure - weaners	Sllury - pregnant sows	Liquid manure - pregnant sows	Sllury - sows with piglets	Liquid manure - sows with piglets	
Dry matter	-13,04aA	-29,27bB	-12,67cA	-12,46cA	-25,08dC	-11,74eA	6,53fD	15,08gE	4,75hD	11,40iE	4,56hD	13,19jE	5,50kD	12,54lE	0,81
N-total	10,63aA	24,06bB	12,45cA	12,75dA	23,11eB	15,71fC	5,97gD	-6,45hE	4,34iD	-5,15jE	5,11kD	-5,92lE	5,56mD	-4,77nE	0,78
N-NH_4	49,44aA	65,56bB	56,82cC	37,82dD	47,06eA	48,48fA	3,17gE	-8,17hF	3,46iE	-3,16jG	5,37kE	-8,64lF	-2,14mG	-12,11nH	2,79
P_2O_5	10,17aA	12,29bAB	12,83cAB	14,78dBC	15,65eC	14,36fBC	0,66gD	-14,57hE	0,70gD	-18,18iF	0,46jD	-8,33kG	0,38jD	-12,88lD	0,75
K_2O	16,45aA	17,76bAB	19,83cB	20,65dB	23,23eC	16,36aA	0,28fD	-18,39gE	0,36fD	-20,25hE	0,26fD	-24,51iF	0,01jG	-17,80kE	1,10
C	12,55aA	22,89bB	16,79cC	17,64dC	27,60eD	16,87cC	11,48fA	16,36gC	12,90hA	17,94iC	12,76aA	16,51gC	11,70hA	16,76cC	0,53
N-NO_3	25,45aA	10,91bB	13,47cC	17,30dD	18,05eD	40,30F	9,87fB	23,40gA	12,05hBC	9,06iB	11,79jBC	22,55kA	10,23lB	17,19mD	0,99

ab – statistically significant differences (P≤0,05); AB – statistically highly significant differences (P≤0,01)