

Strategies for minimizing dust in straw-based-systems for pigs



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Introduction

Dust can cause respiratory diseases (Keck, 2010) and contribute to negative environmental impacts as a carrier substance for emissions (Schneidemesser, 2016). Reducing dust and improving the bedding are therefore necessary optimizations in littered pig houses in terms of health, emissions and immissions.

Methods

To determine the reduction potential of dust an investigation took place from 07/2021 to 03/2023 with two Grimm 11-C Aerosol-Spectrometers and multi-day measurement series in a functionally separated and low-emission housing system “NatureLine” for 850 fattening pigs. A “Strohmatic Welfare” system (dedusting of straw and automatic littering) with a daily bedding quantity of 100 g straw per animal and the additional dosage of 0,06-0,08 l rapeseed oil per 25 pigs/d using a low-pressure system “AirCleaner” in each lying area was used. The measuring interval of dust was every 60 seconds over 24h hours a day. After sampling data for year-round effects a 15-day-lasting investigation of different variants was done.



Fig. 1 Aerosol-Spectrometer 11-C

Results

With overall 28 measuring days there was a significant difference between summer (167 223 count values) and autumn (361 341 count values, $p=0.037$) as well as differences concerning littered/partly perforated areas.

Tab. 1 Analysis of year-round and location-based effects

	mean value in parts/l	median in parts/l	size share in % of mean value		
Littered lying area (inside)			PM ₁₀	PM _{2,5}	PM ₁
summer 2021	167 223	163 989	99,91	99,06	98,22
autumn 2021	361 341	392 831	99,66	97,70	96,08
winter 2022	256 636	256 636	99,41	92,84	88,26
spring 2022	290 101	307 357	99,59	98,82	95,34
Partly perforated activity area (outside)					
winter 2022	175 828	214 524	99,93	99,42	98,88
spring 2022	286 226	292 920	99,90	99,47	99,17



Fig. 2 Low-pressure system „AirCleaner“



Fig. 3 „Strohmatic Welfare“ system for chopping, dedusting and littering

8.640 measurement data per tested variant showed following results: By spraying oil and fully technisation of bedding process variant 1 achieved a significant difference to variant 2 with a reduction of 48,33% ($p=0.023$) as well as a reduction of 51,49% compared to manual bedding without oil spraying (variant 3). There was no significant difference between variants 2-5.

Discussion

The values of reducing dust allow conclusions about the effectiveness with seasonal trends of straw dedusting. Particle counts tended to be higher in fall/winter (reduced air rate, air moisture) with statistical significance. The number of dust particles are influenced by the activity of the pigs as well as the frequency and type of littering. Manual bedding with non dedusted and unshortened straw showed similar dust concentrations but less absorbing and lying comfort for the pigs.

Conclusion

The best available and innovative technology for reducing dust and quality defects in litter is a combination of dedusting and automation of bedding as well as the spraying of oily substances.

Tab. 2 Statistical analysis of different variants (Kruskal-Wallis/Bonf.)

variant	mean value in parts/l	pairwise comparison	Sig.	mod. Sig. ^a
1	165 797			
2	320 921	1,0-2,0	.002	.023
3	341 821	1,0-3,0	.026	.258
4	304 734	1,0-4,0	.028	.280
5	263 061	1,0-5,0	.088	.882

1 = Strohmatic Welfare + oil spraying (2x/d)
2 = Strohmatic Welfare (2x/d) without oil spraying
3 = manual bedding (1x/d) without oil spraying
4 = manual bedding (1x/d) + oil spraying (2x/d)
5 = Strohmatic Welfare (2x/d) without dedusting without oil spraying

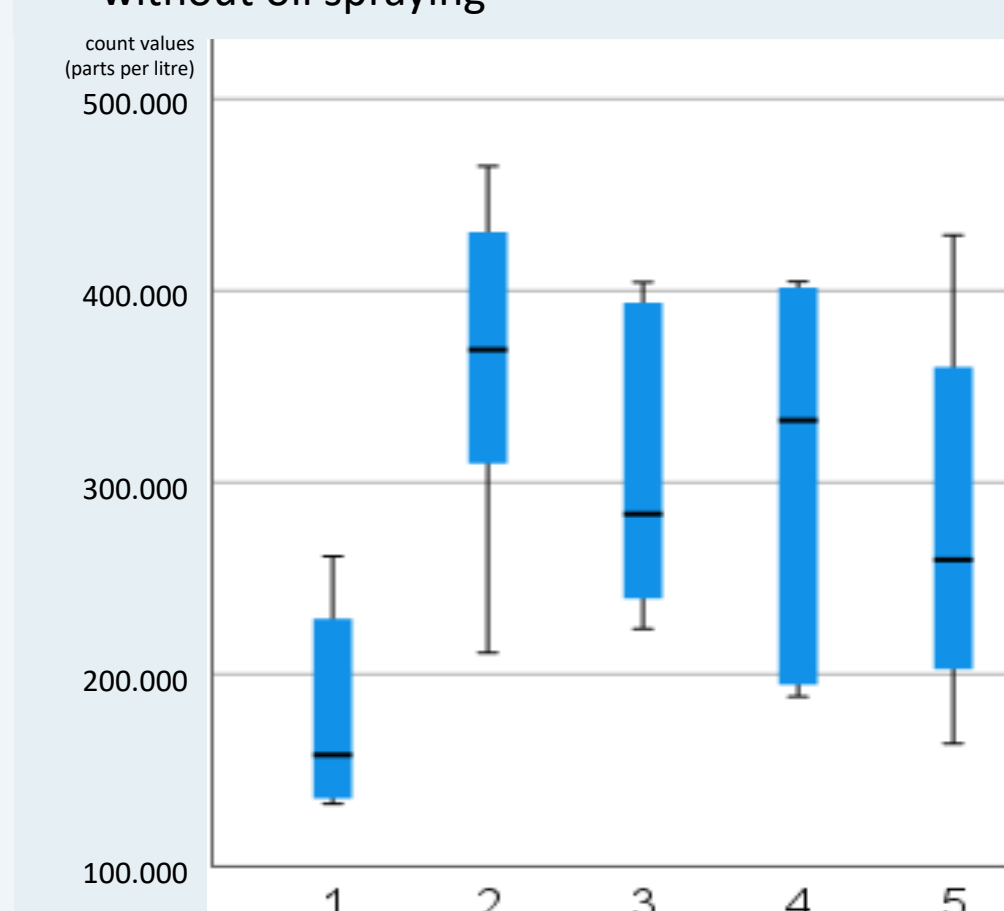


Fig. 4 Boxplots (median, quartiles) of different variants (SPSS)