Dust generation and microbiological air quality with different bedding materials in a horse stable

C. Herholz[1], L. Wicki[1], J. Siegwart[1], P. Küng[2], A. Burren[1]

[1] Berne University of Applies Science, School of Agricultural, Forest and Food Sciences HAFL, [2] MUUTU AG, CH-Berne

Introduction

- ✓ The stable climate is of paramount importance to the respiratory health of horses
- ✓ Four bedding systems were compared with respect to the amount of airborne particular matter (PM2,5 & PM10) and to the microbiological air quality (colony forming units per cubic meter, CFU/m³)

Materials & Methods

Dust

- ✓ 2 sensors SDS011
- ✓ PM 2.5 & PM 10 (µg/m³)
- ✓ 50cm & 120 cm height from the ground (Fig. 1)

Bedding systems tested

- ✓ deep straw mattress
- ✓ daily cleaned straw
- ✓ soft wood granulate
- ✓ Bio-compost

10 days each bedding

Microbiological air quality

- ✓ air sampling system (MBASS30v3, Holbach GmbH, Germany (Fig. 2)
- ✓ three samplings day 1,5,10 (D1, D5 et D10)
- ✓ total bacteria, CFU/m³
- ✓ mold spores, CFU/m³:
- ✓ total actinomycetes, CFU/m³:
- ✓ proportion of thermophilic actinomycetes, CFU/m³

✓ Air temperature & humidity & the work in the barn were considered in the statistical analysis (R Core Team 2019, level of significance $p<0.05$)

Results

Dust

- ✓ PM 2.5 (50 cm = 4.3 – 6.7 µg/m³ , 120 cm = 5.4 – 8.5 µg/m³), lowest deep straw mattress / soft wood granulate, highest daily cleaned straw
- ✓ PM 10 (50 cm = 17.7 – 29.1 µg/m³ , 120 cm = 22.3 –23.7 µg/m³), lowest deep straw mattress / Bio-compost, highest soft wood granulate
- ✓ The differences between the bedding materials were considered significant ($p<0.001$), except for PM10 between soft wood granulate & bio-compost ($p>0.05$)

Microbiological air quality

- ✓ The results are presented in table 1 and fig. 4-6

Correlations

- ✓ Airborne particular matter (PM 2.5 and PM 10) & microbiological air quality were not correlated (r = 0.01)
- ✓ Microbiological air quality & temperature were strongly correlated (r= 0.87)

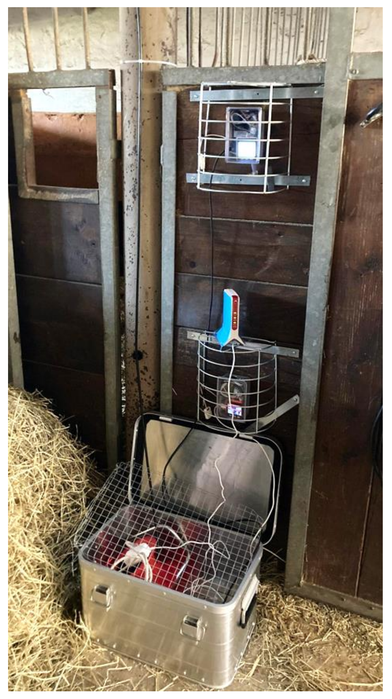

Fig 1 Dust SD011 sensors 50 cm and 120 cm in the box

Fig. 2: Air sampling system (MBASS30v3, Holbach GmbH)

Bedding	Test day	total bacteria CFU/m³	mold spores CFU/m³	Total actinomycetes CFU/m³	Part thermophilic actinomycetes CFU/m³	Average stable T(°C) and rel. humidity (%)
Deep straw mattress	D1	3333	1665	999	103	6°C 40 %
	D5	6666	1998	1665	247	
	D10	2997	1665	1332	120	
Daily cleaned straw	D1	6660	2000	1000	160	11°C 50 %
	D5	13320	16650	3330	666	
	D10	16650	19980	3330	666	
Soft wood granulate	D1	1665	3330	253	40	11 °C 57 %
	D5	2331	3330	333	154	
	D10	6660	9990	999	333	
Bio-compost	D1	16650	19980	3330	333	18 °C 65 %
	D5	20000	30000	3330	666	
	D10	26640	66600	6660	1332	

Tab. 1: Microbiological air quality for different beddings and ambient temperature, humidity.

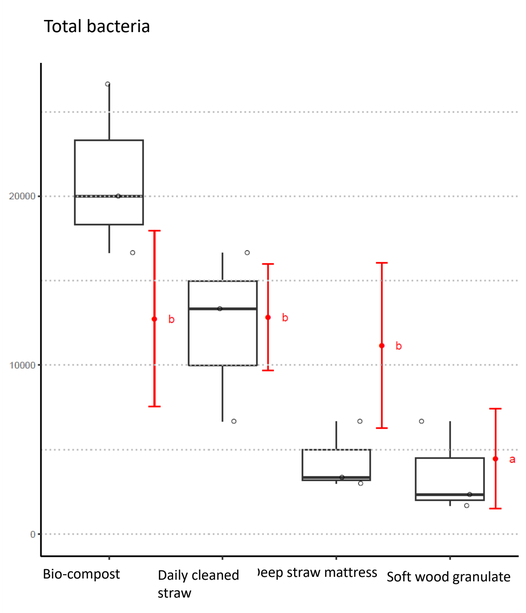

Fig. 4: Total bacteria in the air (CFU/m³) per bedding

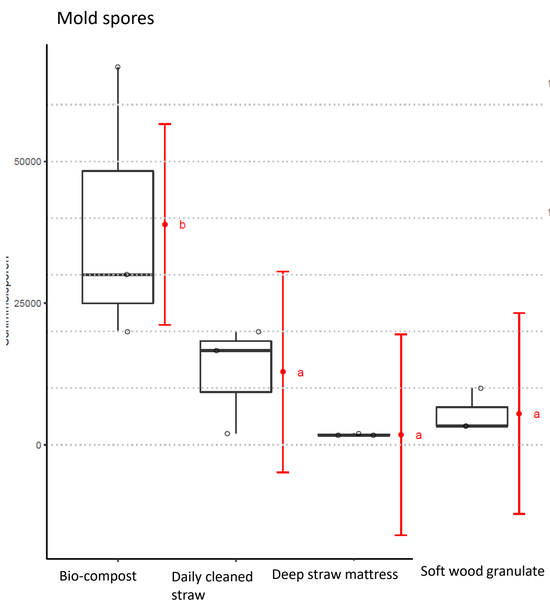

Fig. 5: Mold spores in the air (CFU/m³) per bedding

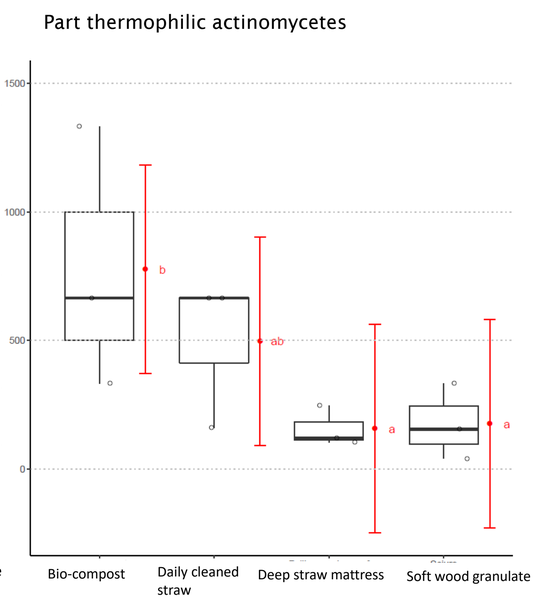

Fig. 6: Part thermophilic actinomycetes in the air (CFU/m³) per bedding

Conclusions

- ✓ Dust concentrations for PM 2.5 and PM 10 were below the recommended maximum exposure limits/day for all types of bedding PM 2.5 < 10 µg/m3 and for PM 10 < 30 µg/m3, (Labie *et al.*, 2019)
- ✓ In this study, airborne germ levels (CFU/m³) did not exceed recommendations for stables, regardless of the litter used (bibliographic sources on request).
- ✓ The temperature and management of bedding and stables have a strong influence on dust and airborne germ levels
- ✓ Low dust concentrations do not automatically mean that the microbiological air quality is not problematic

Berner Fachhochschule
Haute école spécialisée bernoise
Bern University of Applied Sciences

School of Agricultural, Forest and Food Sciences HAFL