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Animal Production Science

Supplementary Material

Effect of bedding application and air change rates on environmental ammonia concentrations for intensively housed beef cattle

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Supplemental Material

Supplemenary material 1. Daily pad surface condition scores

Moisture appearance

1. Dry and dusty
2. Dry and crumbly
3. Firm
4. Tacky and moist
5. Pugging
6. High moisture
7. Sloopy
8. Flooded

Area covered by moisture

1. No wet area (0%)
2. Small wet patches (< 10% of the area)
3. Large wet patches (≥10%

Moisture source

1. High humidity
2. Water trough spill
3. Waterline leak
4. Cattle playing with water
5. Urine

Estimated pad depth

1. No pad (0 cm)
2. 1 to 5 cm
3. 6 to 10 cm
4. 11 to 15 cm
5. 16 to 20 cm
6. > 20 cm

Table S1. Air ammonia (NH3) concentrations (predicted mean ± s.e.m) by bedding application rate (BAR) and air changes per hour (ACH)

Air NH_3 Concentration (mg/m^3)	Bedding Rate (% ASEL)			ACH (no. per hour)		
	0	**50**	**100**	**20 (low)**	**35 (medium)**	**52 (high)**
Top (2.3 m above the pad)						
Concentration (mean ± s.e.m; mg/m^3)	3.53 ± 0.18	3.34 ± 0.18	3.49 ± 0.18	4.05 ± 0.184	3.21 ± 0.18	3.09 ± 0.18
Difference	Reference category	-0.19	-0.05	Reference category	-0.84	-0.96
95% CI of the difference		-0.70 ─ 0.32	-0.55 ─ 0.46		-1.35 ─ -0.33	-1.47 ─ -0.45
P-value		0.461	0.854		0.001	< 0.001
Middle (1.8 m above the pad)						
Concentration (mean ± s.e.m; mg/m^3)	4.28 ± 0.24	4.19 ± 0.24	4.38 ± 0.24	5.41 ± 0.24	3.79 ± 0.24	3.66 ± 0.24
Difference	Reference category	-0.09	0.09	Reference category	-1.62	-1.75
95% CI of the difference		-0.76 ─ 0.57	-0.56 ─ 0.76		-2.23 ─ -0.96	-2.41 ─ -1.08
P-value		0.785	0.571		<0.001	< 0.001
Bottom (0.3 m above the pad)						
Concentration (mean ± s.e.m; mg/m^3)	3.52 ± 0.18	3.30 ± 0.18	3.42 ± 0.18	4.14 ± 0.18	3.12 ± 0.18	2.99 ± 0.18
Difference	Reference category	-0.22	-0.11	Reference category	-1.02	-1.16
95% CI of the difference		-0.72 ─ 0.28	-0.61 ─ 0.40		-1.53 ─ -0.52	-1.66 ─ -0.66
P-value		0.380	0.681		<0.001	< 0.001

Table S2. Frequency of the presumed sources of moisture

Moisture Source	Frequency	Percent (%)
High humidity + water trough spill	2	1.76
Water trough spill	22	19.4
Water trough spill + cattle playing with water +urine	25	22.1
Water trough spill + cattle playing with water	9	7.96
Water trough spill + urine	20	17.6
Waterline leak + cattle playing with water +urine	1	0.88
Waterline leak + urine	1	0.88
Cattle playing with water +urine	8	7.07
Urine	25	22.1

Table S3. Pad properties (predicted mean ± s.e.m) by bedding application rate (BAR) and air changes per hour (ACH) on day 7 of each run

Pad Properties	Bedding Rate (% ASEL)			ACH (no. per hour)		
	0	**50**	**100**	**20.25 (low)**	**34.72 (medium)**	**52.08 (high)**
Pad pH						
mean ± s.e.m	7.92 ± 0.04	7.69 ± 0.04	7.59 ± 0.04	7.69 ± 0.04	7.78 ± 0.04	7.72 ± 0.04
Difference	Reference category	-0.23	0.33	Reference category	0.10	0.03
95% CI		-0.32 ─ -0.13	-0.43 ─ -0.22		-0.01 ─ 0.19	-0.07 ─ 0.13
P-value		< 0.001	< 0.001		0.067	0.568
Pad moisture (%)						
mean ± s.e.m	80.34 ± 0.60	78.6 ± 0.60	75.3 ± 0.60	79.3 ± 0.60	77.4 ± 0.60	77.5 ± 0.60
Difference	Reference category	-1.68	-5.00	Reference category	-1.92	-1.76
95% CI		-3.34 ─ -0.03	-6.65 ─ -3.35		--3.58 ─ -0.27	-3.42 ─ -0.11
P-value		0.046	< 0.001		0.023	0.037
Pad bulk density (kg/m^3)						
mean ± s.e.m	990.0 ± 26.5	1002.3 ± 26.5	1040.7 ± 26.4	997.2 ± 28.5	1002.1 ± 28.4	1033.8 ± 28.4
Difference	Reference category	12.2	50.6	Reference category	4.95	36.5
95% CI		-57.4 to 82.1	-19.0 ─o 120.4		-72.1 ─ 82.8	-43.7 to 116.8
P-value		0.730	0.154		0.901	0.372
Pad NH_4^+ concentration (mg/g pad)-wet basis						
mean ± s.e.m	1.18 ± 0.041[a]	1.01 ± 0.0.041[b]	0.95 ± 0.041[b]	1.04 ± 0.041	1.05 ± 0.041	1.06 ± 0.041
Difference	Reference category	-0.16	-0.22	Reference category	0.01	0.02
95% CI		0.05 ─ 0.28	0.11 ─ 0.34		0.13 ─ 0.16	-0.13 ─ 0.18
P-value		0.004	< 0.001		0.885	0.776
Total pad NH_4^+ mass (g/chamber)-wet basis						
mean ± s.e.m	89.6 ± 8.21	101.2 ± 8.21	91.0 ± 8.21	100.4 ± 8.21	87.3 ± 8.21	94.8 ± 8.21
Difference	Reference category	12.32	1.45	Reference category	-12.4	-5.31
95% CI		-7.25 ─ 31.9	-18.0 ─ 21.0		-37.0 ─ 12.2	-31.7 ─ 21.1
P-value		0.217	0.880		0.322	0.692

Table S4. Pearson's correlation between pad properties on day 7 of each run

Pad Property	Statistics		
	Person coefficient	95% CI	*P* Value
Pad pH			
Pad moisture (%)	0.099	-0.091 to 0.283	0.304
Pad bulk density (kg/m^3)	0.027	-0.163 to 0.215	0.781
Pad NH_4 concentration (mg/g pad)-wet basis	0.132	-0.059 to 0.313	0.175
Total pad NH_4 mass (g/chamber)-wet basis	-0.208	0.020 to 0.382	0.031
Pad moisture (%)			
Pad bulk density (kg/m^3)	-0.383	0.020 to 0.534	< 0.001
Pad NH_4 concentration (mg/g pad)-wet basis	0.051	-0.140 to 0.237	0.604
Total pad NH_4 mass (g/chamber)-wet basis	0.228	0.040 to 0.399	0.018
Pad bulk density (kg/m^3)			
Pad NH_4 concentration (mg/g pad)-wet basis	0.053	-0.138 to 0.239	0.589
Total pad NH_4 mass (g/chamber)-wet basis	0.050	-0.140 to 0.237	0.607
Pad NH_4 concentration (mg/g pad)-wet basis			
Total pad NH_4 mass (g/chamber)-wet basis	0.612	0.478 to 0.718	< 0.001