

Supplementary Material

Mitigation of gaseous emissions from stored swine manure with biochar: effect of dose and reapplication on a pilot-scale

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Supplementary Figures and Tables

Table S1: Mitigation of NH₃ emissions utilizing different treatments with HAP biochar. Different letters indicate statistical significance.

Treatment	Letters	Least Square Mean	Standard Error	Lower 95%	Upper 95%
Control	A	128	7.2	114	142
2 kg/m ²	B	95	7.2	81	109
4 kg/m ²	B	97	7.2	83	112
2 kg/m ² with reapplication	B	75	7.2	61	89

Table S2: Mitigation of skatole peak area counts (PAC) utilizing different treatments of HAP biochar. A surrogate abundance of indole is represented by (PAC), i.e., peak area counts for indole in the headspace above manure measured by SPME and analyzed by GC-MS. PACs are arbitrary units of MS detector response.

Treatment	Letters	Least Square Mean	Standard Error	Lower 95%	Upper 95%
Control	A	227,858	25,594	177,027	278,690
2 kg/m ²	B	131,396	25,594	80,564	182,228
4 kg/m ²	B	114,118	25,594	63,286	164,949
2 kg/m ² with reapplication	B	39,713	25,594	-11,119	90,545

Table S3: Mitigation of indole peak area counts (PAC) utilizing different treatments of HAP biochar. A surrogate abundance of indole is represented by (PAC), i.e., peak area counts for indole in the headspace above manure measured by SPME and analyzed by GC-MS. PACs are arbitrary units of MS detector response.

Treatment	Letters	Least Square Mean	Standard Error	Lower 95%	Upper 95%
Control	A	4,680	866	2,961	6,399
2 kg/m ²	AB	2,904	866	1,185	4,623
4 kg/m ²	AB	2,991	866	1,272	4,710
2 kg/m ² with reapplication	B	1,018	866	-701	2,738

Table S4: Mitigation of phenol peak area counts (PAC) utilizing different treatments of HAP biochar. A surrogate abundance of indole is represented by (PAC), i.e., peak area counts for indole in the headspace above manure measured by SPME and analyzed by GC-MS. PACs are arbitrary units of MS detector response.

Treatment	Letters	Least Square Mean	Standard Error	Lower 95%	Upper 95%
Control	A	302,851	56,763	190,115	415,586
2 kg/m ²	AB	216,538	56,763	103,803	329,274
4 kg/m ²	AB	136,187	56,763	23,451	248,923
2 kg/m ² with reapplication	B	27,534	56,763	-85,202	140,269

Table S5: Mitigation of p-cresol peak area counts (PAC) utilizing different treatments of HAP biochar. A surrogate abundance of indole is represented by (PAC), i.e., peak area counts for indole in the headspace above manure measured by SPME and analyzed by GC-MS. PACs are arbitrary units of MS detector response.

Treatment	Letters	Least Square Mean	Standard Error	Lower 95%	Upper 95%
Control	AB	761,873	218,426	328,061	1,195,685
2 kg/m ²	AB	519,930	218,426	86,118	953,742
4 kg/m ²	A	1,062,317	218,426	628,505	1,496,129
2 kg/m ² with reapplication	B	185,951	218,426	-247,861	619,763

Table S6: Mitigation of 4-ethyl phenol peak area counts (PAC) utilizing different treatments of HAP biochar. A surrogate abundance of indole is represented by (PAC), i.e., peak area counts for indole in the headspace above manure measured by SPME and analyzed by GC-MS. PACs are arbitrary units of MS detector response.

Treatment	Letters	Least Square Mean	Standard Error	Lower 95%	Upper 95%
Control	A	160,294	26,364	107,932	212,656
2 kg/m ²	AB	104,543	26,364	52,181	156,905
4 kg/m ²	A	142,947	26,364	90,585	195,309
2 kg/m ² with reapplication	B	37,254	26,364	-15,108	89,616

Table S7: Mitigation of odor concentrations (OU/m³) utilizing different treatments with HAP biochar.

Treatment	Letters	Least Square Mean	Standard Error	Lower 95%	Upper 95%
Control	A	3,102	331	2,445	3,759
2 kg/m ²	A	2,756	331	2,099	3,412
4 kg/m ²	A	2,971	331	2,315	3,628
2 kg/m ² with reapplication	A	2,425	331	1,769	3,082

Table S8: Mitigation of CO₂ emissions utilizing different treatments of HAP biochar.

Treatment	Letters	Least Square Mean	Standard Error	Lower 95%	Upper 95%
Control	A	2,090	72	1,947	2,233
2 kg/m ²	A	2,084	72	1,941	2,227
4 kg/m ²	A	2,113	72	1,970	2,256
2 kg/m ² with reapplication	A	2,047	72	1,904	2,190

Table S9: Mitigation of CH₄ emissions utilizing different treatments of HAP biochar.

Treatment	Letters	Least Square Mean	Standard Error	Lower 95%	Upper 95%
Control	A	347	69	210	483
2 kg/m ²	A	397	69	261	534
4 kg/m ²	A	401	69	265	538
2 kg/m ² with reapplication	A	506	69	370	643

Table S10: Mitigation of N₂O emissions utilizing different treatments of HAP biochar.

Treatment	Letters	Least Square Mean	Standard Error	Lower 95%	Upper 95%
Control	A	0.9	0.1	0.8	1.0
2 kg/m ²	A	0.9	0.1	0.8	1.0
4 kg/m ²	A	0.8	0.1	0.7	1.0
2 kg/m ² with reapplication	A	0.8	0.1	0.7	0.9

Supplementary Figures

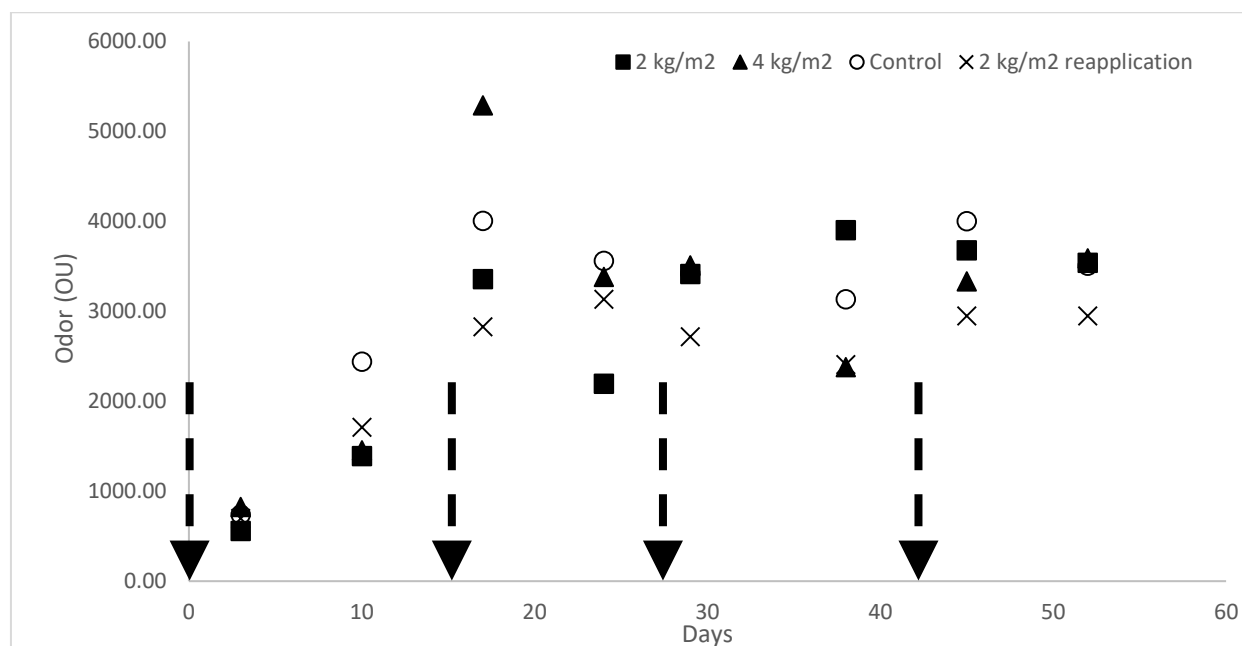


Figure S1: Mitigation of odor emissions from swine manure treated with biochar – effects of one-time dose (2 & 4 kg/m²) and 2 kg/m² bi-weekly reapplication. Vertical arrows represent the application or reapplication of biochar and manure to storage simulators. Each data point represents the mean of (n=3) measurements.

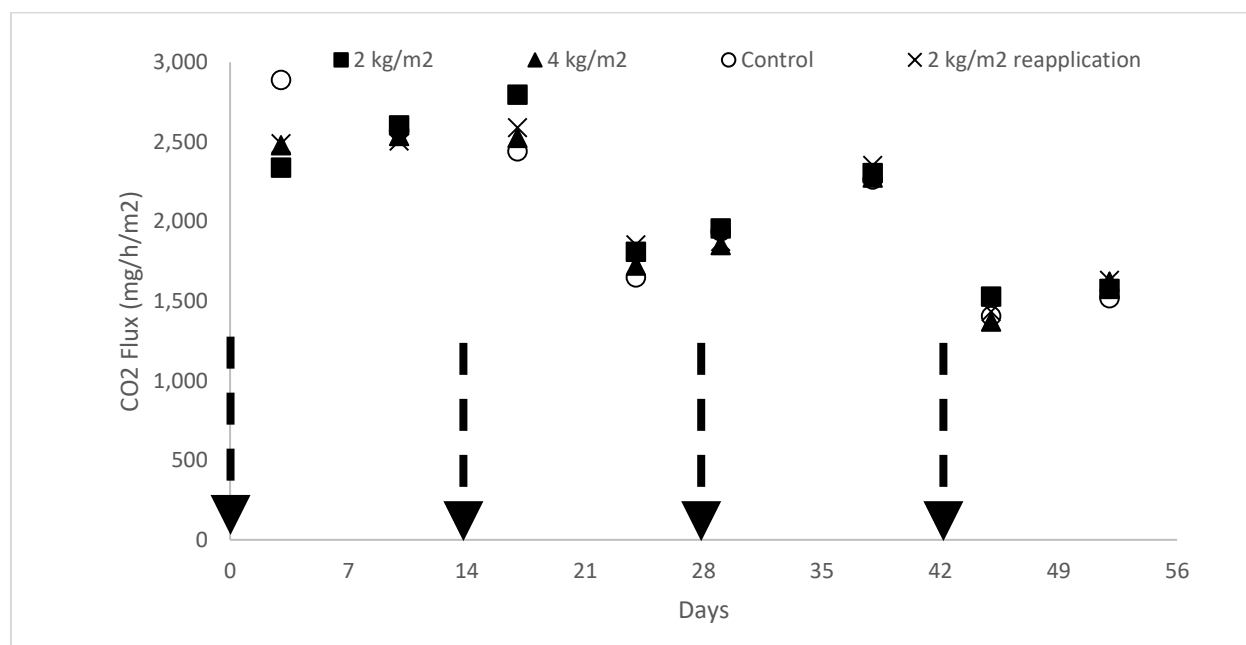


Figure S2: Mitigation of CO₂ emissions from swine manure treated with biochar – effects of one-time dose (2 & 4 kg/m²) and 2 kg/m² bi-weekly reapplication. Vertical arrows represent the application or reapplication of biochar and manure to storage simulators. Each data point represents the mean of (n=3) measurements.

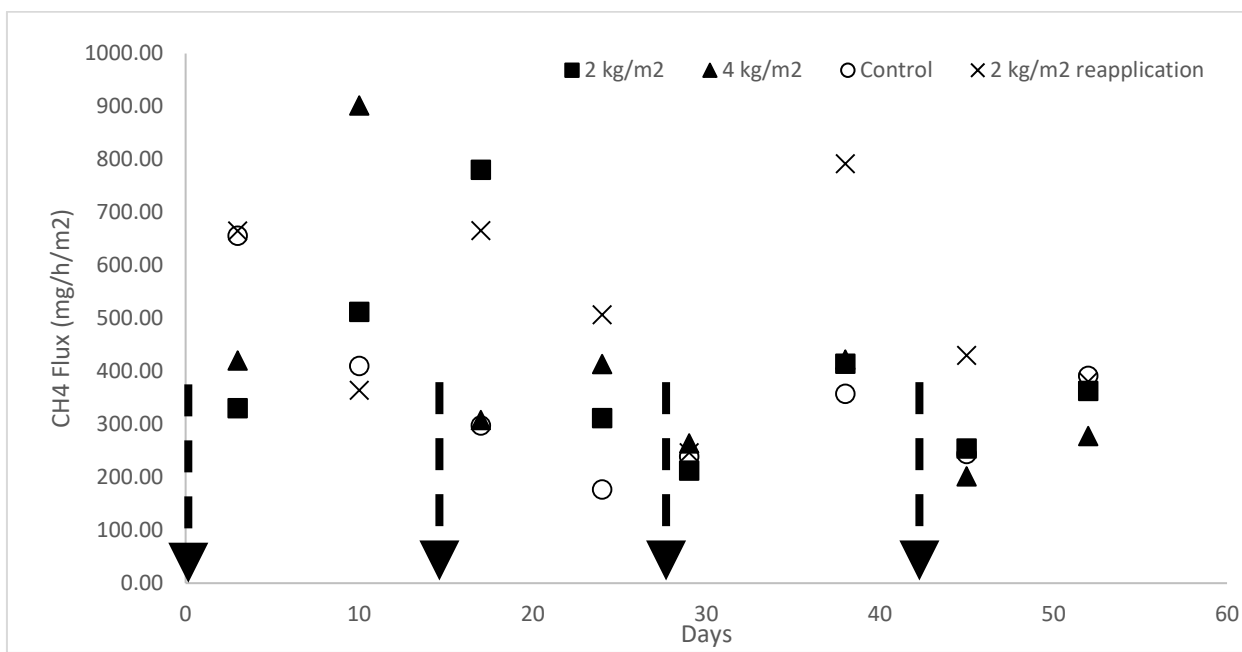


Figure S3: Mitigation of CH₄ emissions from swine manure treated with biochar – effects of one-time dose (2 & 4 kg/m²) and 2 kg/m² bi-weekly reapplication. Vertical arrows represent the application or reapplication of biochar and manure to storage simulators. Each data point represents the mean of (n=3) measurements.

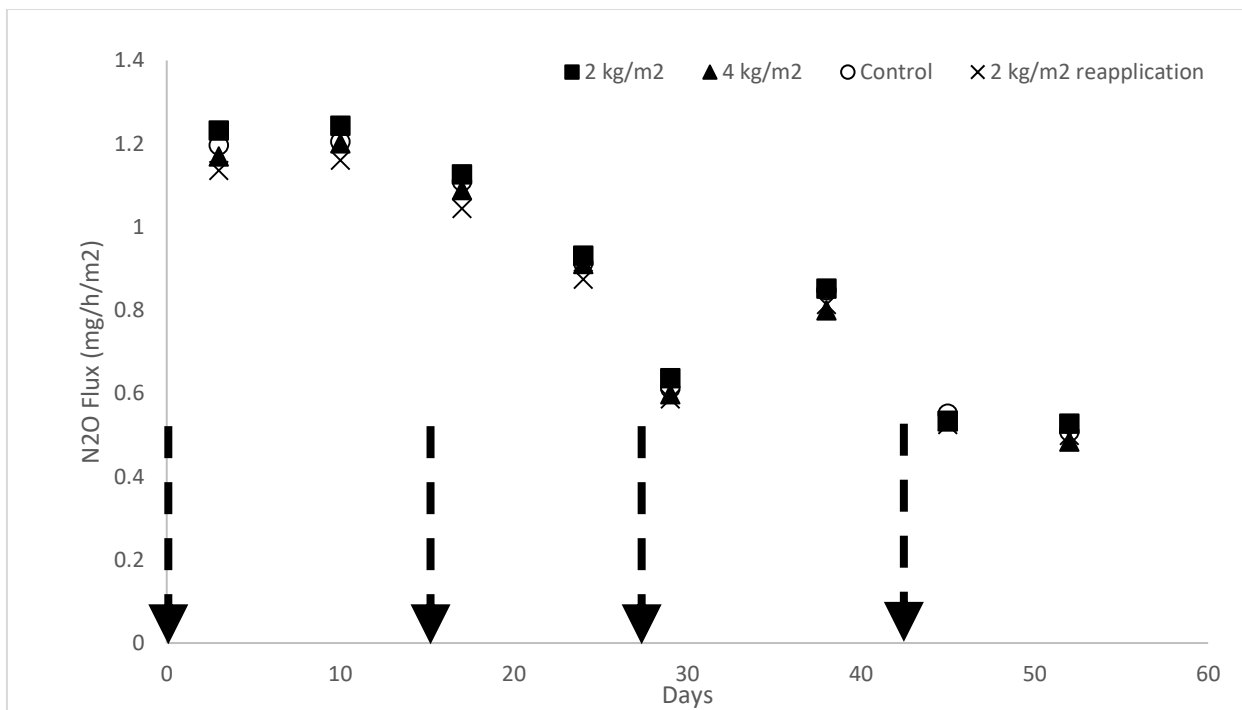


Figure S4: Mitigation of N₂O emissions from swine manure treated with biochar – effects of one-time dose (2 & 4 kg/m²) and 2 kg/m² bi-weekly reapplication. Vertical arrows represent the application or reapplication of biochar and manure to storage simulators. Each data point represents the mean of (n=3) measurements.