

Supplementary Information for

**Semi-Permeable Membrane Covering Reduces Gaseous Emissions and Promotes
Mineral-N Retention during Swine Manure Composting**

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Supplementary Figures

Figure S1. Experiment-wide effects of treatment, composting day, and their interaction on physicochemical properties. Each variable was analyzed using a linear mixed-effects model with treatment, sampling day, and their interaction as fixed effects and replicate pile as a random intercept ($n = 3$ piles per treatment). Cells show the F and P values from the corresponding model-effect tests, and color intensity represents $-\log_{10}(P)$, capped at 12 for visualization.

Figure S2. Supplementary indicators of physicochemical change and compost maturity during AC and MCAC. (A) Changes in total carbon (TC) during composting. Points and solid lines represent treatment means, and error bars represent SD ($n = 3$ replicate piles). Asterisks indicate significant differences between AC and MCAC at the same sampling date based on one-way ANOVA (* $P < 0.05$, ** $P < 0.01$, and *** $P < 0.001$). (B) Germination index (GI) of the final compost on day 35. Boxplots are overlaid with the three pile-level observations for each treatment. The grey dashed line indicates a GI of 80%. The P value indicates the day-35 comparison between AC and MCAC based on one-way ANOVA.

Figure S3. Succession of the top 20 abundant genera during AC and MCAC. Colors represent genus-wise z scores calculated from log-transformed mean relative abundance [$\ln(1 + \text{relative abundance} \times 10^6)$] across the ten treatment-by-day combinations. Genera are ordered by their overall mean relative abundance. Symbols in MCAC cells indicate differences between AC and MCAC at the corresponding sampling date based on one-way ANOVA using three replicate piles per treatment (*, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.001$). A dagger (†) indicates that the comparison remained significant after Benjamini–Hochberg adjustment across the 20 genus-level tests within that sampling date ($q < 0.05$); this adjustment was treated as a sensitivity analysis.

Figure S1

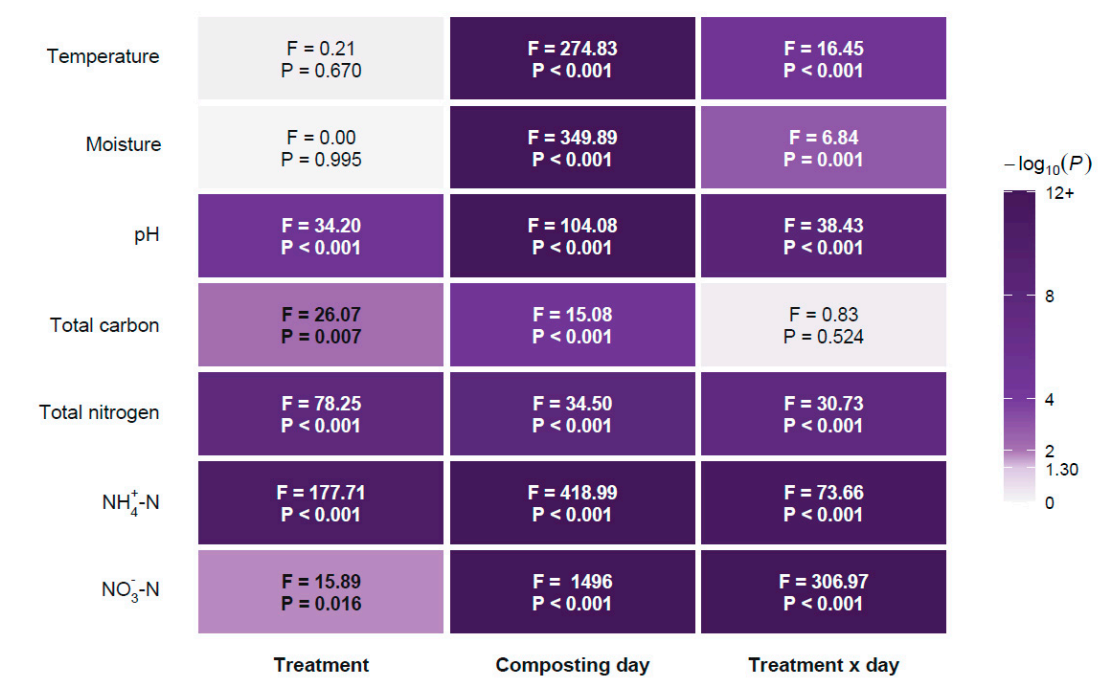


Figure S2

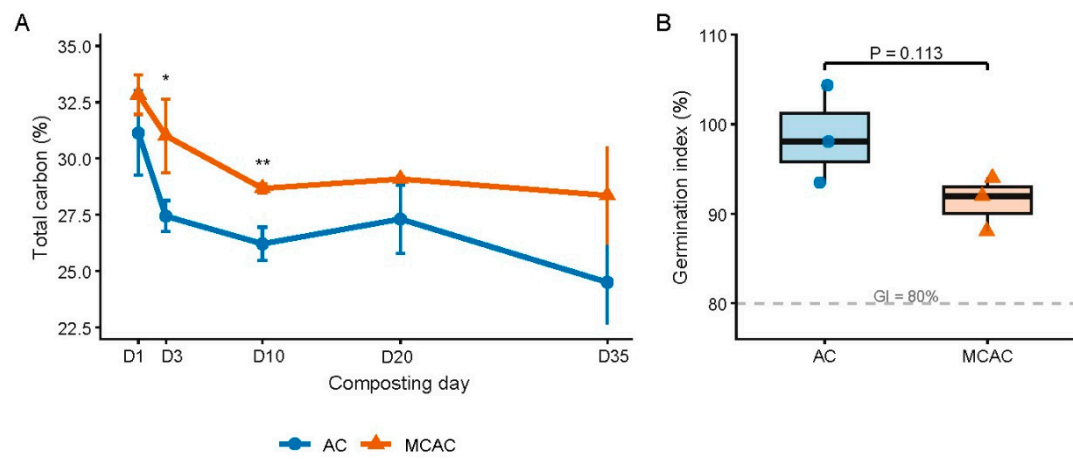


Figure S3

