**SUPPLEMENTARY MATERIAL**

PERFORMANCE OF DIGESTATE AS A CONTAMINANT BIOSORBENT AND PLANT GROWTH PROMOTER BEFORE AND AFTER COMPOSTING AND VERMICOMPOSTING

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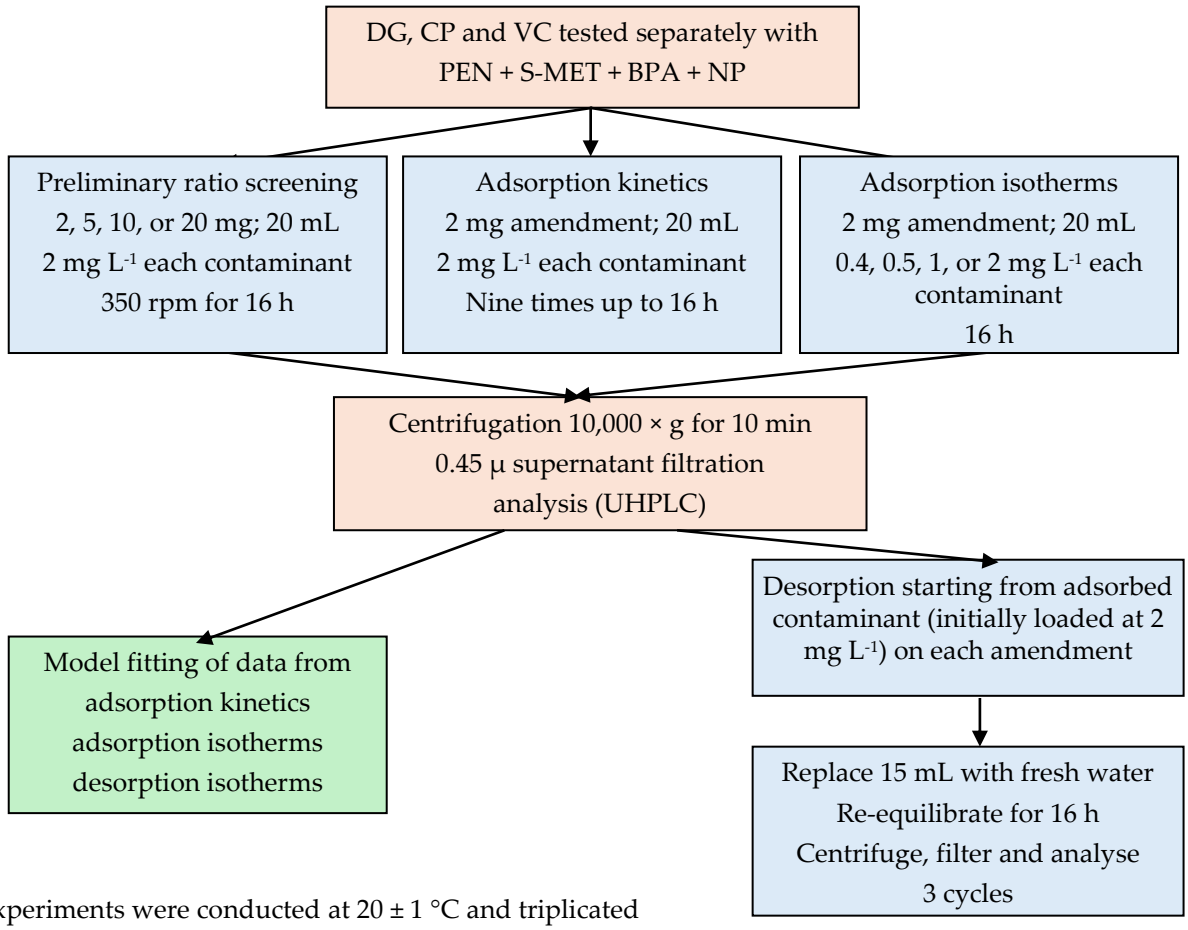
## Materials

**Table S1.** Major physicochemical properties of the Calcari-Fluvic Cambisol soil selected for filling the microcosms[a].

| Soil variable | Value |
|---|---|
| Sand (g $kg^{-1}$) | 324 |
| Silt (g $kg^{-1}$) | 651 |
| Clay (g $kg^{-1}$) | 25 |
| Texture (according to USDA) | Silt loam |
| $pH_{CaCl2}$ | 7.15 |
| Total $CaCO_3$ (g $kg^{-1}$) | 52.6 |
| Active $CaCO_3$ (g $kg^{-1}$) | 13.3 |
| $EC_{1:2}$ (µS $cm^{-1}$) | 291.50 |
| TOC (g $kg^{-1}$) | 28.83 |
| TN (g $kg^{-1}$) | 2.19 |
| C/N | 13.2 |
| CEC ($cmol_{(+)}$ $kg^{-1}$) | 20.4 |
| $Ca^{2+}$ (mg $kg^{-1}$) | 3100 |
| $Mg^{2+}$ (mg $kg^{-1}$) | 390 |
| $K^{+}$ (mg $kg^{-1}$) | 564 |
| $Na^{+}$ (mg $kg^{-1}$) | 52 |
| Ca/Mg | 4.8 |
| Mg/K | 2.2 |
| Base saturation (%) | 99.6 |

[a] From Pittarello et al. (2025). EC: electrical conductivity; TOC: total organic carbon; TN: total nitrogen; CEC: cation exchange capacity.




All experiments were conducted at 20 ± 1 °C and triplicated

**Figure S1.** Experimental workflow

## Adsorption Models

*Adsorption kinetics*

The kinetic parameters of both models (Table S2) were estimated by nonlinear regression using the Solver add-in in Microsoft Excel® and a trial-and-error optimisation procedure, following the method described by Ho et al. (2006). Accordance between the experimental data and each model was assessed using the correlation coefficient, r, calculated as:

$$r = \sqrt{\frac{\sum(q_t m - \overline{q_t})^2}{\sum(q_t m - \overline{q_t})^2 + \sum(q_t m - q_t)^2}}$$

where $q_t m$ (mg g$^{-1}$) is the model-predicted amount of compound adsorbed at time $t$, $qt$ (mg g$^{-1}$) is the experimentally determined adsorbed amount at the same time, and $\overline{q_t}$ is the mean of all experimental $q_t$ values.

*Adsorption isotherms*

The parameters of the Freundlich ($K_F$ and $1/n$), Langmuir ($b$ and $K_L$), and Temkin ($A_T$ and $b_T$) models (Table S2) were determined by nonlinear regression, following the same procedure adopted for the adsorption kinetics study. This approach minimised the sum of squared residuals (SSR) between the experimental and model-predicted values. Model adequacy was estimated using both the correlation coefficient, r, and the SSR values. The linear Henry model was also applied to determine the organic carbon-normalised partition coefficient, $K_{OC}$ (L g$^{-1}$), calculated as:

$$K_{OC} = \frac{(Kd \times 100)}{\%OC}$$

where OC (%) is the organic carbon content of the adsorbent, expressed as a percentage.

**Table S2.** Sorption models considered in this study.

| Model | Equation | Parameters |
|---|---|---|
| Adsorption kinetics | | |
| Pseudo-first order | $q_t = q_e (1 - exp^{-k1t})$ | $q_e$ and $q_t$ are the amount of solute adsorbed per unit mass of the adsorbent (mg $g^{-1}$) at equilibrium and at time $t$, respectively; $k_1$ ($h^{-1}$) and $k_2$ (g $mg^{-1}$ $h^{-1}$) are the rate constants of sorption |
| Pseudo-second order | $q_t = \frac{q_e^2 k_2 t}{1 + k_2 q_e t}$ | |
| Adsorption isotherm | | |
| Freundlich | $q_e = K_F C_e^{1/n}$ | $q_e$ (mg $g^{-1}$) is the amount of solute adsorbed per unit mass of the adsorbent at equilibrium; $C_e$ (mg $L^{-1}$) is the equilibrium concentration of the sorbate in solution; $1/n$ indicates the degree of nonlinearity between solution concentration and amount adsorbed; $n$ is the sorption intensity; $K_F$ (L $g^{-1}$) is the Freundlich adsorption constant; $b$ (mg $g^{-1}$) is the maximum monolayer adsorption; $K_L$ (mL $mg^{-1}$) is the Langmuir constant expressing the energy of adsorption; $Kd$ (L $g^{-1}$) is the distribution coefficient; $A_T$ is the Temkin isotherm equilibrium binding constant (mL $mg^{-1}$); $b_T$ (J $mol^{-1}$) expresses the enthalpy of adsorption and is calculated from $B = RT/b_T$, where $T$ is the absolute temperature (K) and $R$ is the universal gas constant (8.314 J $mol^{-1}$ $K^{-1}$) |
| Langmuir | $q_e = (K_L C_e b)/(1 + K_L C_e)$ | |
| Henry | $q_e = Kd\ C_e$ | |
| Temkin | $qe = B\ ln(A_T\ C_e)$ | |

**References**


Pittarello, M.; Rodinò, M.T.; Sidari, R.; Panuccio, M.R.; Cozzi, F.; Branca, V.; Petrovičová, B.; Gelsomino, A. Employment of biodegradable, short-life mulching film on high-density cropping lettuce in a Mediterranean environment: Potentials and prospects. *Agriculture* **2025**, *15*, 1219. https://doi.org/10.3390/agriculture15111219

Ho, Y.S. Second-order kinetic model for the sorption of cadmium onto tree fern: A comparison of linear and non-linear methods. Water Res. 2006, 40, 119–125. https://doi.org/10.1016/j.watres.2005.10.040