

## **Supplementary data**

### **Quantifying CO<sub>2</sub> emissions and carbon sequestration from digestate-amended soil using natural <sup>13</sup>C abundance as a tracer**

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**Table S1.** Additional soil physicochemical properties.

		Loamy sand (S <sub>0.6</sub> )	Sand (S <sub>0.1</sub> )
Ca	g kg <sup>-1</sup>	2.2 ± 0.1	0.9 ± 0.2
Mg	g kg <sup>-1</sup>	0.0 ± 0.8	1.1 ± 1.1
Na	g kg <sup>-1</sup>	1.1 ± 1.1	2.9 ± 0.6
K	g kg <sup>-1</sup>	9.6 ± 0.9	9.3 ± 0.6
P	g kg <sup>-1</sup>	0.6 ± 0.0	0.1 ± 0.0
S	g kg <sup>-1</sup>	0.1 ± 0.0	0.0 ± 0.0
Al	mg kg <sup>-1</sup>	7337 ± 158	9399 ± 1046
Cd	mg kg <sup>-1</sup>	0 ± 0	0 ± 0
Cu	mg kg <sup>-1</sup>	0 ± 0	0 ± 0
Fe	mg kg <sup>-1</sup>	6250 ± 222	7756 ± 1085
Zn	mg kg <sup>-1</sup>	0 ± 0	0 ± 0
OM	g kg <sup>-1</sup>	19.6 ± 0.1	9.4 ± 0.1
Lignin	g kg <sup>-1</sup>	10.4	/
Cellulose	g kg <sup>-1</sup>	38.84	/

Ca = calcium; Mg = magnesium; Na = sodium; K = potassium; P = phosphorus; S = sulphur; Al = aluminium; Cd = cadmium; Cu = copper; Fe = iron; Zn = zinc; OM = organic matter.

**Table S2.** Additional physicochemical properties of the exogenous organic matter materials. Results are expressed on dry matter basis.

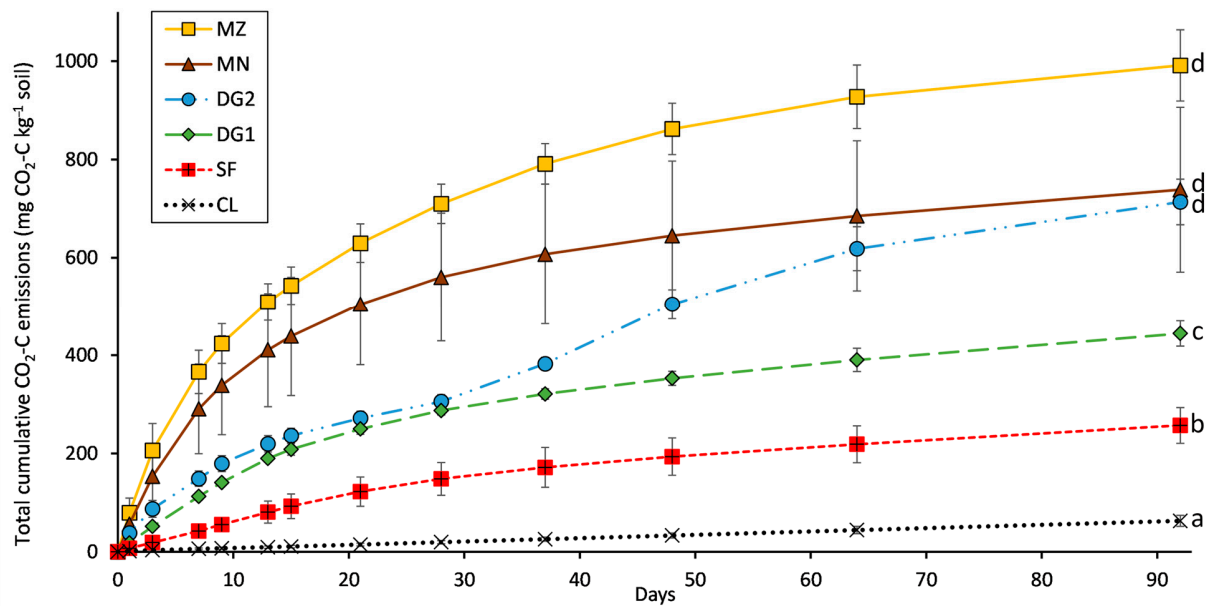
		MZ	MN	SF	DG1	DG2
P	g kg <sup>-1</sup>	1.6 ± 0.1	6.1 ± 0.3	8.5 ± 0.2	7.1 ± 0.2	7.3 ± 0.1
K	g kg <sup>-1</sup>	25.2 ± 0.8	28.1 ± 0.6	67.2 ± 1.6	58.0 ± 3.4	66.2 ± 1.1
Mg	g kg <sup>-1</sup>	1.9 ± 0.0	4.1 ± 0.2	6.0 ± 0.2	5.3 ± 0.1	3.5 ± 0.1
Ca	g kg <sup>-1</sup>	4.2 ± 0.1	9.2 ± 0.5	13.7 ± 0.4	11.8 ± 0.2	12.0 ± 0.1
S	g kg <sup>-1</sup>	1.6 ± 0.0	3.5 ± 0.0	4.8 ± 0.0	4.1 ± 0.0	4.9 ± 0.1
Na	g kg <sup>-1</sup>	1.4 ± 0.8	4.9 ± 0.3	2.1 ± 0.7	3.3 ± 0.9	1.2 ± 0.2
Al	mg kg <sup>-1</sup>	331 ± 17	1646 ± 175	285 ± 29	264 ± 24	292 ± 6
Cd	mg kg <sup>-1</sup>	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Cu	mg kg <sup>-1</sup>	7 ± 0	37 ± 2	22 ± 0	17 ± 1	19 ± 1
Fe	mg kg <sup>-1</sup>	271 ± 14	1410 ± 25	1227 ± 75	995 ± 137	2180 ± 161
Zn	mg kg <sup>-1</sup>	38 ± 4	144 ± 5	93 ± 5	71 ± 2	124 ± 3

Ca = calcium; Mg = magnesium; Na = sodium; K = potassium; P = phosphorus; S = sulphur; Al = aluminium; Cd = cadmium; Cu = copper; Fe = iron; Zn = zinc. MZ: maize; MN: manure; DG1 and DG2: digestate; SF: the solid fraction of digestate.

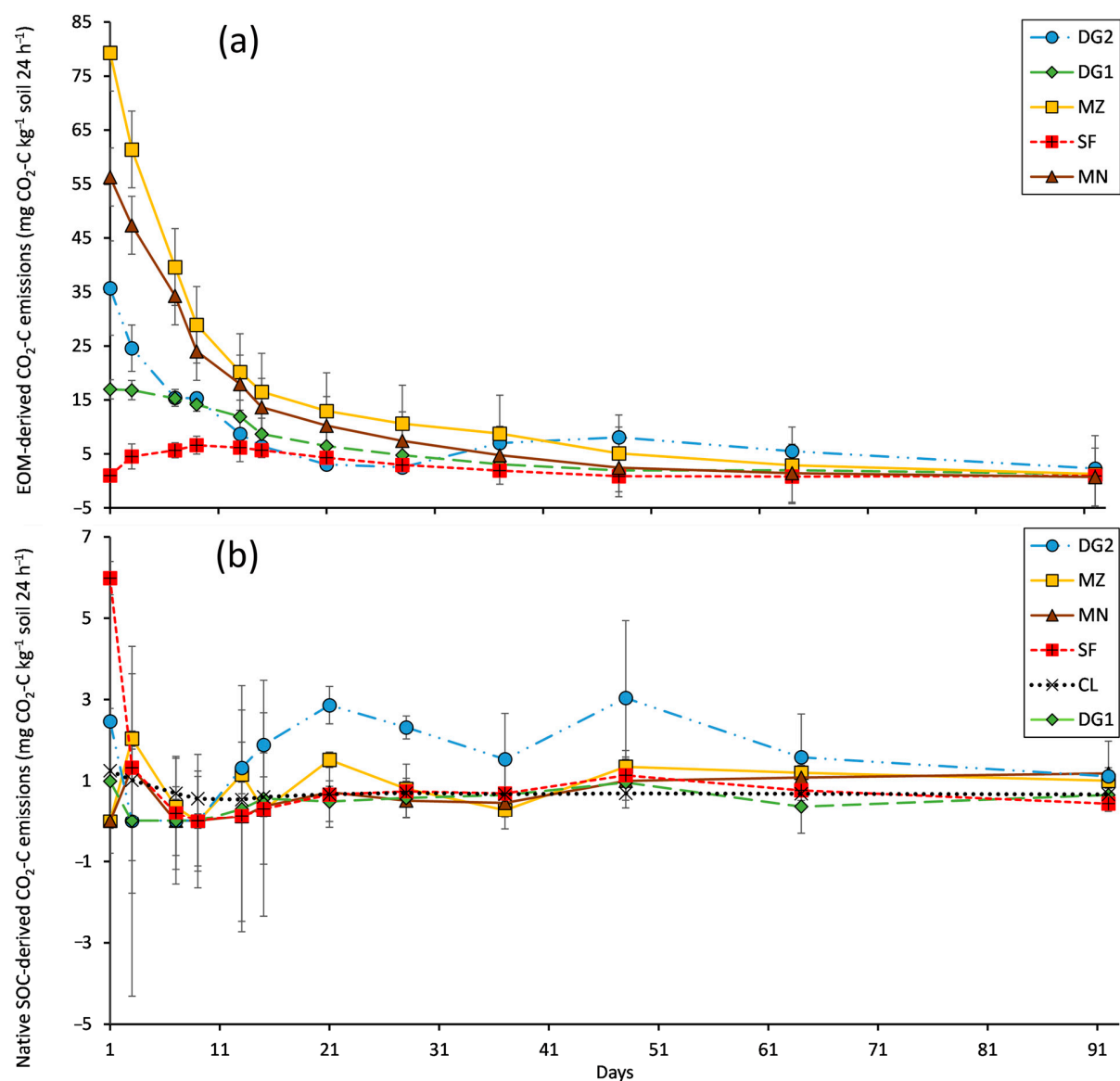
**Table S3.** Main parameters of the 2<sup>nd</sup> order kinetic model.

	MZ	MN	SF	DG1	DG2
$C_A$	58.26720856	43.014201	15.535273	28.349099	48.943676
$k_2a(1 - a)$	0.001245794	0.0020867	0.0017778	0.0016602	0.0004737
$R^2$	0.998685	0.999129	0.988552	0.998359	0.966804
$p$	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001

$C_A$  = the amount of mineralised C;  $k_2$  = the second-order mineralisation rate;  $a$  = the amount of mineralised C-substrate that becomes part of the microbial biomass;  $R^2$  = coefficient of determination. MZ: maize; MN: manure; DG1 and DG2: digestate; SF: the solid fraction of digestate.



**Figure S1.** Evolution of the total cumulative CO<sub>2</sub>-C from the soil treatments over 92 days. MZ: maize; MN: manure; DG1 and DG2: digestate; SF: the solid fraction of digestate; CL: control soil with no addition of fertiliser.



**Figure S2.** Emissions from (a) the EOM-derived CO<sub>2</sub>-C and (b) SOC-derived CO<sub>2</sub>-C expressed as mg CO<sub>2</sub>-C kg<sup>-1</sup> soil 24 h<sup>-1</sup> over 92 days. MZ: maize; MN: manure; DG1 and DG2: digestate; SF: the solid fraction of digestate; CL: control soil with no addition of fertiliser.

**Table S4.** Exogenous organic matter and soil-derived CO<sub>2</sub>-C on last day (92) expressed as mg CO<sub>2</sub>-C kg<sup>-1</sup> soil 24 h<sup>-1</sup>.

	EOM-derived (mg CO <sub>2</sub> -C kg <sup>-1</sup> soil 24 h <sup>-1</sup> )	Soil-derived
CL	/	0.67 <sup>a</sup>
MZ	1.27 <sup>a</sup>	1.01 <sup>a</sup>
MN	0.71 <sup>a</sup>	1.18 <sup>a</sup>
SF	0.94 <sup>a</sup>	0.44 <sup>a</sup>
DG1	1.27 <sup>a</sup>	0.65 <sup>a</sup>
DG2	2.29 <sup>a</sup>	1.11 <sup>a</sup>

MZ: maize; MN: manure; DG1 and DG2: digestate; SF: the solid fraction of digestate; CL: control soil with no addition of fertiliser. Treatments with the same letters are not statistically different according to Tukey's HSD test (significance level of 0.05).

**Table S5.** Amounts of N added with each treatment on first day of experiment.

	N input on day 0 (mg kg <sup>-1</sup> soil)				
	NH <sub>4</sub> <sup>+</sup> -N	NO <sub>3</sub> <sup>-</sup> -N	N <sub>min</sub>	TN	N <sub>org</sub>
MZ	4.64	3.92	8.56	90.61	82.05
MN	85.27	0.00	85.27	194.18	108.91
SF	10.43	0.00	10.43	142.17	131.74
DG1	86.67	0.00	86.67	242.39	155.72
DG2	190.03	0.00	190.03	396.58	206.55

TN = total nitrogen; NH<sub>4</sub><sup>+</sup>-N = ammonium nitrogen; NO<sub>3</sub><sup>-</sup>-N = nitrate nitrogen; N<sub>min</sub> = the mineral N taken as the sum of NH<sub>4</sub><sup>+</sup>-N and NO<sub>3</sub><sup>-</sup>-N; N<sub>org</sub> = organic nitrogen.

**Table S6.** Amounts of residual N measured in the soil cores on last day of experiment.

	Residual mineral N on day 92 (mg kg <sup>-1</sup> soil)			
	NH <sub>4</sub> <sup>+</sup> -N	NO <sub>3</sub> <sup>-</sup> -N	N <sub>min</sub>	N <sub>min</sub> (subtracting CL)
CL	2.04	25.55	27.59	/
MZ	1.04	25.01	26.04	-1.54
MN	0.52	98.21	98.73	71.14
SF	0.46	36.89	37.35	9.76
DG1	0.40	136.09	136.49	108.91
DG2	0.39	174.20	174.58	147.00

NH<sub>4</sub><sup>+</sup>-N = ammonium nitrogen; NO<sub>3</sub><sup>-</sup>-N = nitrate nitrogen; N<sub>min</sub> = the mineral N taken as the sum of NH<sub>4</sub><sup>+</sup>-N and NO<sub>3</sub><sup>-</sup>-N.

**Table S7.** Main results of Pearson's correlations.

	Priming	TOC <sub>min-EOM</sub>	DOC/NH <sub>4</sub> <sup>+</sup> -N	DOC/TOC	NH <sub>4</sub> <sup>+</sup> -N <sub>added</sub>	Lignin	Cellulose	pH <sub>D92</sub>	MinN <sub>residual</sub>	pH <sub>EOM</sub>
Priming	1									
TOC <sub>min-EOM</sub>	0.431	1								
DOC/NH <sub>4</sub> <sup>+</sup> -N	0.003	0.673	1							
DOC/TOC	0.092	0.431	-0.004	1						
NH <sub>4</sub> <sup>+</sup> -N <sub>added</sub>	0.691	0.068	-0.578	0.494	1					
Lignin	0.064	-0.706	-0.990**	-0.027	0.606	1				
Cellulose	0.637	0.713	-0.001	0.354	0.554	-0.052	1			
pH <sub>D92</sub>	-0.530	-0.208	0.468	-0.752	-0.941*	-0.469	-0.574	1		
MinN <sub>residual</sub>	0.469	-0.054	-0.645	0.632	0.956*	0.663	0.390	-0.963**	1	
pH <sub>EOM</sub>	-0.275	-0.874	-0.831	-0.504	0.084	0.824	-0.325	0.097	0.125	1

\*\*. Correlation is significant at the 0.01 level (2-tailed).

\*. Correlation is significant at the 0.05 level (2-tailed).