Supplementary Online Material

Medium-term effects of corn biochar addition on soil biota activities and functions in a temperate soil cropped to corn

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Table S1. Mean annual values for the physicochemical measurements in the different plots and treatments, all expressed on a dry weight basis.

Biochar t/ha	**Plot**	**Sand** %	**Silt** %	**Clay** %	**Moisture** %	**pH**	**EC** μScm^{-1}	**SOC** %	**P-PO4** $mg\ kg^{-1}$	**Cl** $mg\ kg^{-1}$	**N-NO2** $mg\ kg^{-1}$	**N-NO3** $mg\ kg^{-1}$	**N-NH4** $mg\ kg^{-1}$	**S-SO4** $mg\ kg^{-1}$
0	4	61.5	20.3	18.2	16.3	6.9	73.1	1.7	1.5	13.7	0.7	22.9	8.3	27.5
	8	62.2	20.2	17.6	16.1	6.9	64.5	1.6	1.2	16.3	1.2	19.5	9.7	43.0
	16	56.1	19.3	24.6	17.5	7.1	69.9	1.7	0.8	18.3	0.9	7.9	1.4	80.2
3 (1 per year)	11	62.7	19.4	17.9	17.4	7.1	72.4	1.8	1.9	22.3	0.9	9.1	9.3	138.9
	18	56.9	23.9	19.2	19.2	7.2	77.1	2.2	1.4	40.2	0.6	16.4	2.0	59.3
	31	59.5	24.8	15.7	19.7	7.1	71.7	2.4	1.0	22.4	0.2	7.6	0.9	114.4
3	6	68.7	16.7	14.7	17.0	7.0	64.8	2.2	1.6	14.3	0.9	14.6	8.5	41.0
	10	62.8	21.1	16.1	19.0	7.0	69.8	2.0	1.7	10.7	0.9	12.6	8.9	75.7
	35	56.3	26.0	17.7	19.6	7.1	79.1	2.5	2.5	19.2	1.1	7.8	0.2	137.4
12	1	60.0	22.0	18	15.0	7.1	66.2	1.7	4.3	29.2	2.5	7.1	13.1	130.2
	13	63.4	20.9	15.7	16.8	7.1	71.3	2.3	3.0	12.8	0.9	13.9	9.5	95.5
	29	58.3	18.7	22.9	21.8	7.1	90.4	2.5	1.3	22.4	0.6	15.3	0.4	115.4
30	14	63.1	15.3	21.6	17.8	7.1	70.1	1.7	1.3	21.5	1.1	11.8	9.8	89.1
	27	59.1	22.9	18	22.7	7.2	58.8	2.8	1.0	29.9	1.0	9.7	1.3	26.6
	36	58.2	25.0	16.9	20.9	7.2	82.4	2.8	2.5	19.0	1.4	8.5	0.4	136.2

Table S2. Generalized linear models with best goodness of fit (lowest AICc) of microbial measurements using explanatory variables from the summer sampling, when those microbial measurements were carried out. All the parameters are significant in itself in the model except those indicated as (ns).

Response variable	**Explanatory variable coefficients**								
	intercept	*moisture*	*sand*	*loam*	*clay*	*SOC.summer*	*NO_3.summer*	*AICc*	*r^2*
logMCB	1.315	0.068						-10.6	0.56
BAS	-229.2		2.287	2.317	2.316			-13.9	0.62
CMC	0.440						-0.006 (ns)	-19.5	0.14
qCO2	0.017	0.0004	-0.0001			0.0008(ns)		-178.8	0.68

Table S3. Pairwise Pearson correlation coefficients of the biological responses assessed. Fauna feeding rates correspond to the mean of the summer and fall values. Significant relationships are indicated by coefficients highlighted in bold and asterisks indicating the significance (*=p≤0.05, **=p≤0.01); n=15.

	Biochar rate	Fauna feedingrate (quantitative)	Fauna feedingrate (qualitative)	Decomposition (2mm-mesh)	Decomposition (0.1mm-mesh)	BAS	CMC	logMCB	qCO2	PO4 mineralization	Cl mineralization	NO2+NO3 mineralization	SO4 mineralization	NH4 mineralization	CO2 mineralization
Biochar rate	1.00														
Fauna feeding (quantitative)	0.42	1.00													
Fauna feeding (qualitative)	0.43	**0.97****	1.00												
Decomposition (2mm-mesh)	0.06	0.23	0.17	1.00											
Decomposition (0.1mm-mesh)	0.36	0.03	0.05	**0.69****	1.00										
BAS	0.23	-0.28	-0.27	-0.15	0.09	1.00									
CMC	0.06	-0.14	-0.18	**-0.23**	-0.19	**0.69****	1.00								
logMCB	0.50	0.07	0.03	**0.59***	0.44	0.30	0.09	1.00							
qCO2	-0.27	-0.17	-0.15	**-0.71****	-0.42	0.06	0.16	**-0.84****	1.00						
PO_4mineralization	-0.08	-0.17	-0.13	-0.27	-0.24	-0.19	0.22	-0.16	0.10	1.00					
Cl mineralization	-0.43	0.01	0.00	-0.03	-0.43	-0.01	0.36	0.03	-0.04	0.06	1.00				
NO_2+NO_3mineralization	**0.52***	0.23	0.16	-0.09	0.09	-0.07	-0.16	0.05	0.25	-0.14	-0.36	1.00			
SO_4mineralization	-0.42	0.16	0.16	0.31	-0.06	-0.12	0.24	0.08	-0.19	0.24	**0.77****	-0.37	1.00		
NH_4mineralization	0.51	0.13	0.04	0.35	0.21	-0.12	-0.21	**0.72****	**-0.54***	-0.09	-0.05	0.48	-0.06	1.00	
CO_2mineralization	0.38	-0.22	-0.23	0.15	0.18	**0.56***	0.39	**0.60***	-0.39	-0.10	0.02	0.18	-0.15	0.22	1.00

Table S4. Generalized linear models for fauna feeding rates, for the total values and those at different depths at the two sampling times (summer and fall), expressed as rate. All the parameters are significant in itself in the model except those indicated as (n.s.).Unacceptable models (with no significant parameters in itself included) are indicated as n.a.

Sampling	Response variable	Depth (mm)	Explanatory variable coefficients												
			intercept	*biochar*	*logMCB*	*sand*	*loam*	*clay*	*SOC*	*PO4*	*NO2*	*NO3*	*Cl*	AICc	r^2
Summer	Qualitativefeedingrate	*total*	-142.98			1.435	1.421	1.444						-40.8	0.71
		0-30	-200.77			2.010	2.036	1.996						-21.7	0.55
		30-60	-0.55		0.322				0.127	-0.702				-22.3	0.54
		60-80	-176.93			1.776	1.757	1.782						-31.4	0.77
	Quantitativefeedingrate	*total*	-115.64			1.159	1.152	1.168						-34.3	0.55
		0-30	-156.11			1.561	1.558	1.584						-22.8	0.52
		30-60	0.412								-0.0841			-29.5	0.28
		60-80	-137.47			1.380	1.365	1.384						25.5	0.58
Fall	Qualitativefeedingrate	*total*	1.06	0.004(n.s.)			-0.023							-21.8	0.53
		0-30	1.281	0.003(n.s.)			-0.028							-33.4	0.69
		30-60	1.076				-0.034						0.005	-19.1	0.58
		60-80	n.a.												
	Quantitativefeedingrate	*total*	0.906	0.005			-0.021							-26.3	
		0-30	1.243				-0.027					-0.00914		-28.9	
		30-60	0.953	0.007			-0.027							-20.5	
		60-80	n.a.												

Table S5. Generalized linear models for litter decomposition, expressed as percent, derived using as explanatory variables the soil properties values measured in the fall sampling.

Response variable	**Explanatory variable coefficients**								
	intercept	*biochar*	*logMCB*	*clay*	*pH*	*SOC*	*Cl*	*AICc*	r^2
2-mmmesh litterbags	-1.235	0.002			0.259		-0.002	-62.7	0.72
0.16-mmmesh litterbags	0.179		0.063	0.007		0.044		-65.2	0.74

Table S6. Generalized linear models for litter mineralization rates, expressed as mg $kg^{-1} \cdot day^{-1}$, using as explanatory variables those collected on the summer sampling, when this assay was carried out. All the parameters are significantin itselfin the model except those indicated as (ns).

Response variable	**Explanatory variable coefficients**								
	intercept	*logMCB*	*moisture*	*loam*	*pH.summer*	*PO4.summer*	*Cl.summer*	*AIC*	*r2*
P-PO4	0.099		-0.005				-0.003	-74.2	0.46
Cl	9.645				-1.379	0.796		-24.1	0.76
N-NO2+NO3	0.039	-0.029(ns)				0.093		-55.8	0.38
N-NH4	-0.084	0.024				0.051		-103.7	0.70
S-SO4	1.321				-0.204			-61.9	0.57
C-CO2	-0.163	0.038		0.002(ns)				-84.3	0.51

Figure S1. Mean soil soluble ion content in summer (black bars) and fall (white bars), together with the standard deviation (n=3 plots). Asterisks indicate significant differences in the values measured in the biochar-amended plots compared to control plots (0 t ha^{-1}).