Supporting Information: Organic carbon content in arable soil – aeration matters by Colombi et al.

Number of Supplemental Tables: 6
Number of Supplemental Figures: 3

Supplemental Table S1: Effects of management system (M), clay content and soil moisture at sampling (Θ) on soil physical properties at different soil depths analysed with analysis of covariance (ANCOVA). **, * and ° denotes significant effects at p < 0.01, < 0.05 and < 0.1, respectively (n=10).

Soil property	Ψ [hPa]	Depth [cm]	M	Clay [%]	Θ [g g^{-1}]
ε [m^3 m^{-3}]		12.5	**	**	
		37.5	*	**	
εa [m^3 m^{-3}]	30	12.5	**	p = 0.62	
		37.5	p = 0.76	*	
	100	12.5	**	p = 0.31	
		37.5	p = 0.80	*	
Dp/D0 [-]	30	12.5	p = 0.13	p = 0.23	
		37.5	p = 0.38	p = 0.11	
	100	12.5	*	p = 0.13	
		37.5	p = 0.70	p = 0.15	
log10 (Ka [μm^2])	30	12.5	*	°	
		37.5	p = 0.68	p = 0.24	
	100	12.5	**	*	
		37.5	p = 0.62	p = 0.13	
WHC [g g^{-1}]	100	12.5	**	**	
		37.5	**	**	
Z [MPa]		12.5	*	p = 0.64	p = 0.16
		37.5	p = 0.13	p = 0.10	p = 0.75

Abbreviations: ε = total porosity, εa = air-filled porosity, Dp/D0 = gas diffusion coefficient, Ka = air permeability, WHC = water holding capacity, Z = soil penetration resistance, Ψ = soil matric suction

Supplemental Table S2: Effects of management system (M) and clay content on soil organic carbon content, microbial biomass and microbial respiration at different soil depths analysed with analysis of covariance (ANCOVA). **, * and ° denotes significant effects at p < 0.01, < 0.05 and < 0.1, respectively (n=10).

Soil property	Depth [cm]	M	Clay [%]
SOC [g C kg^{-1} soil]	12.5	°	**
	37.5	°	**
micC [mg C kg^{-1} soil]	12.5	*	**
	37.5	°	**
Resp [µg CO_2–C g^{-1} soil h^{-1}]	12.5	p = 0.18	*
	37.5	p = 0.27	**

Abbreviations: SOC = soil organic carbon content, micC = soil microbial carbon, Resp = microbial respiration

Supplemental Table S3: Summary statistics of multiple linear regression models to explain gas diffusion coefficients, air permeability and air-filled porosity as a function of soil organic carbon content and clay content (Eq. 4). **, * and ° indicates significant regression coefficients at $p < 0.01$, $p < 0.05$ and $p < 0.1$, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Response variable	Depth [cm]	Ψ [hPa]	SOC [g kg $^{-1}$ soil]	Clay [%]	Int	R^2
Dp/D0	-12.5 cm	30	0.0008**	-0.0009**	0.0208**	0.39
		100	0.0014**	-0.0017**	0.0419**	0.42
	-37.5 cm	30	0.0003*	-0.0003**	0.0130**	0.27
		100	0.0005*	-0.0005*	0.0204**	0.23
Ka [μm^2]	-12.5 cm	30	1.445**	-1.497*	37.17**	0.25
		100	3.152**	-4.049**	104.8**	0.31
	-37.5 cm	30	1.863**	-1.245**	22.56**	0.50
		100	2.309**	-1.761**	38.06**	0.39
εa [$cm^3\ cm^{-3}$]	-12.5 cm	30	0.154 ns	-0.140 ns	15.70**	0.10
		100	0.204*	-0.211°	19.15**	0.15
	-37.5 cm	30	0.110 ns	-0.235**	15.66**	0.25
		100	0.129 ns	-0.282**	18.38**	0.29

Abbreviations: Dp/D0 = gas diffusion coefficient, Ka = air permeability, εa = air-filled porosity, Ψ = soil matric suction, SOC = soil organic carbon content, Clay = clay content, Int = intercept

Supplemental Table S4: Summary statistics of multiple linear regression models to explain water holding capacity and soil penetration resistance as a function of soil organic carbon content and clay content (Eq. 4). ** and ° indicates significant regression coefficients at $p < 0.01$ and $p < 0.1$, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Response variable	Depth [cm]	SOC [g kg $^{-1}$ soil]	Clay [%]	Int	R^2
WHC [$g\ g^{-1}$]	-12.5 cm	0.0035**	0.0039**	0.135**	0.73
	-37.5 cm	0.0030**	0.0046**	0.079**	0.75
Z [MPa]	-12.5 cm	-0.029°	0.028 ns	1.254**	0.12
	-37.5 cm	-0.025 ns	0.036 ns	1.840**	0.09

Abbreviations: WHC = water holding capacity, Z = soil penetration resistance SOC = soil organic carbon content, Clay = clay content, Int = intercept

Supplemental Table S5: Summary statistics of multiple linear regression models to explain microbial biomass as a function of gas diffusivity and clay content, and air permeability and clay content (Eq. 3). Gas diffusivity and air permeability were measured at matric suction of 30 hPa. **, * and ° indicates significant regression coefficients at p < 0.01, p < 0.05 and p < 0.1, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

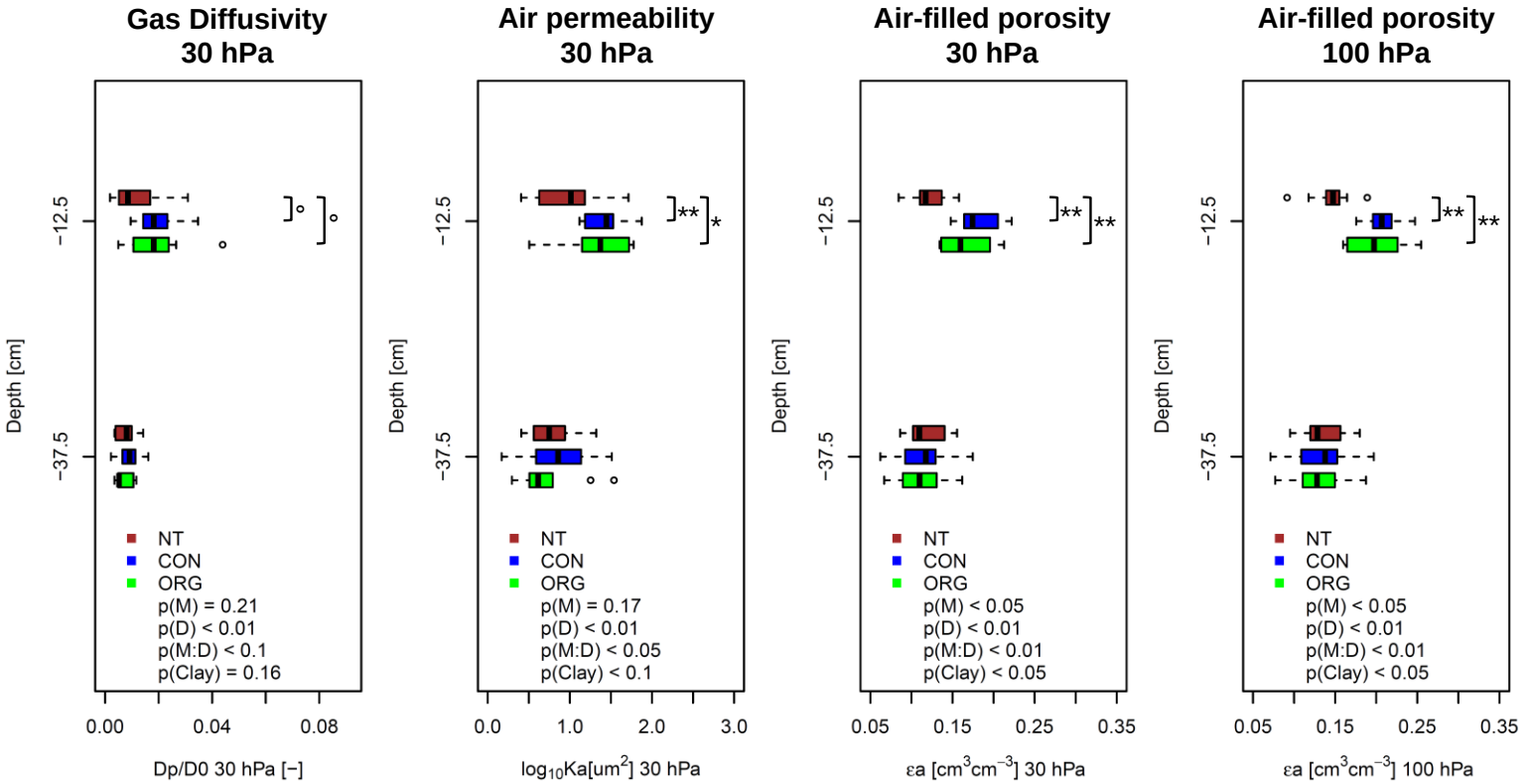
Response variable	Depth [cm]	Dp/D0 [-]	Clay [%]	Int	R^2
micC [mg C kg^{-1} soil]	-12.5 cm	13312**	31.07**	-245.1 ns	0.56
	-37.5 cm	17664°	22.66**	-339.4*	0.48
		Ka [μm^2]	**Clay [%]**	**Int**	**R^2**
	-12.5 cm	5.622*	29.78**	-175.3 ns	0.54
	-37.5 cm	4.535*	19.91**	-198.3°	0.49

Abbreviations: micC = soil microbial carbon, Dp/D0 = gas diffusion coefficient, Ka = air permeability, Clay = clay content, Int = intercept

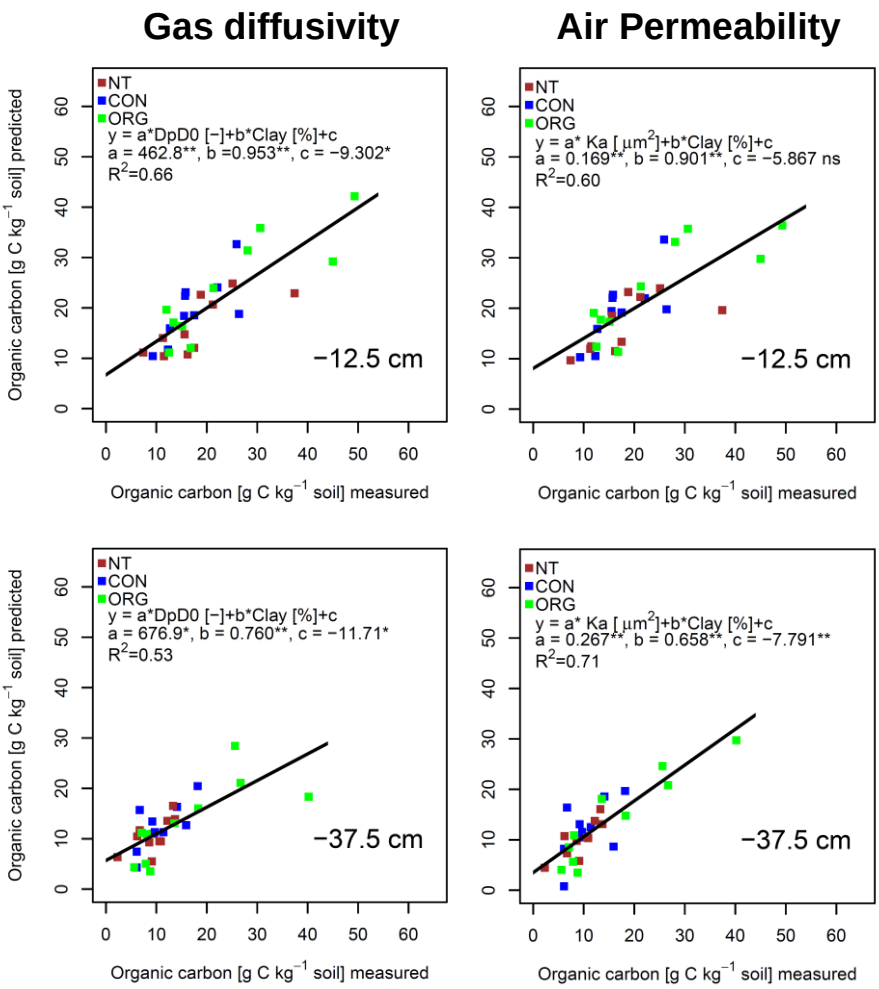
Supplemental Table S6: Summary statistics of multiple linear regression models to explain microbial biomass as a function of air-filled porosity and clay content (Eq. 3). **, * and ° indicates significant regression coefficients at p < 0.01, p < 0.05 and p < 0.1, respectively. R^2 represents multiple r-squared.

Response variable	Depth [cm]	Ψ [hPa]	εa [cm^3 cm^{-3}]	Clay [%]	Int	R^2
micC [mg C kg^{-1} soil]	-12.5 cm	30	30.09*	28.56**	-436.7°	0.52
		100	31.21*	29.44**	-563.0*	0.54
	-37.5 cm	30	25.37°	23.90**	-513.3*	0.48
		100	23.35°	24.36**	-544.3*	0.48

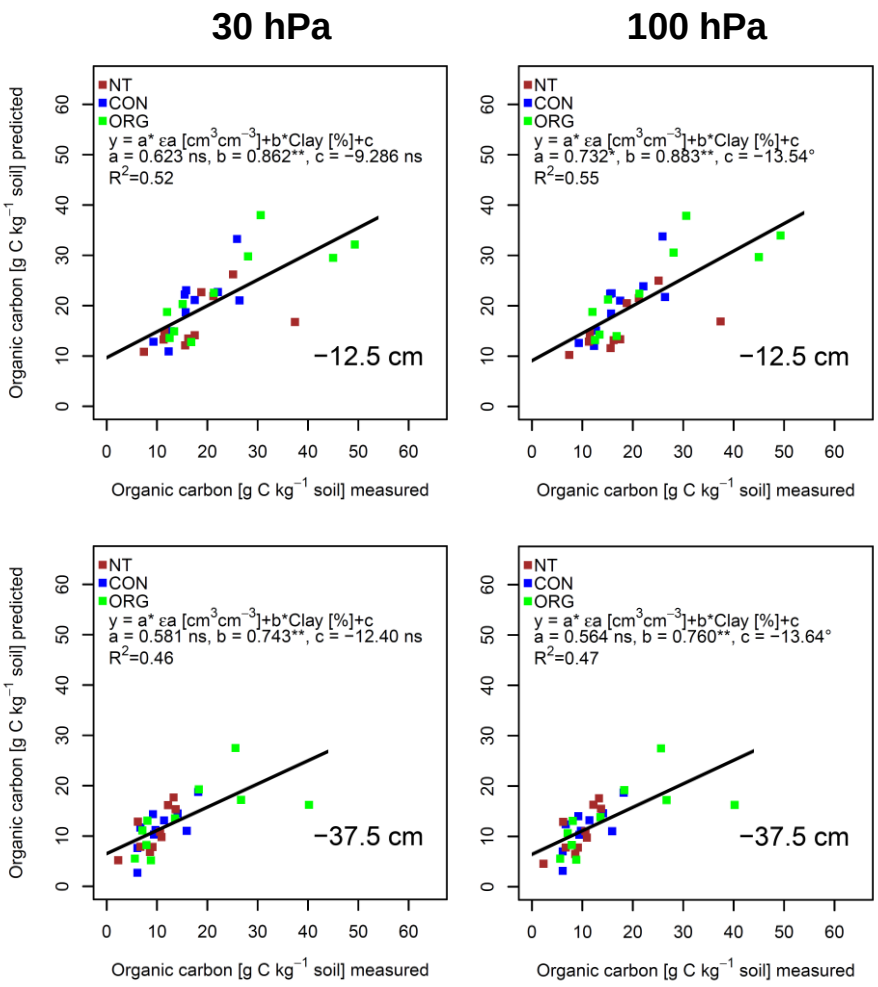
Abbreviations: micC = soil microbial carbon, Ψ = soil matric suction, εa = air-filled porosity, Clay = clay content, Int = intercept



Supplemental Figure S1: Effects of soil management (M), sampling depth (D), their interaction (M:D) and clay content (Clay) on gas diffusivity and air permeability at 100 hPa and air-filled porosity at 30 and 100 hPa matric suction and water holding capacity analysed with linear mixed models (Eq. 2) followed by analysis of covariance. NT (red), CON (blue) and ORG (green) denote no-till, conventional and organic management system, respectively. **, * and ° indicate significant differences between management systems at individual depths using least significant difference tests at $p < 0.01$, $p < 0.05$ and $p < 0.1$, respectively (n = 10).



Supplemental Figure S2: Multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of gas diffusion coefficients (Dp/D0 [-]) and air permeability (Ka) measured at 30 hPa matric suction and clay content (Clay [%]). NT (red), CON (blue) and ORG (green) denote no-till, conventional and organic management system, respectively. ** and * indicates significant regression coefficients at p < 0.01 and p < 0.05, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.



Supplemental Figure S3: Multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of air-filled porosity (εa [cm^3 cm^{-3}]) measured at 30 hPa and 100 hPa matric suction and clay content (Clay [%]). NT (red), CON (blue) and ORG (green) denote no-till, conventional and organic management system, respectively. **, * and ° indicates significant regression coefficients at $p < 0.01$, $p < 0.05$ and $p < 0.1$, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.