Supplement of SOIL, 5, 91–105, 2019
https://doi.org/10.5194/soil-5-91-2019-supplement

SOIL Open Access EGU

Supplement of

On-farm study reveals positive relationship between gas transport capacity and organic carbon content in arable soil

Tino Colombi et al.

Correspondence to: Tino Colombi (tino.colombi@slu.se)

Supplemental Table S1: Summary statistics of multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of gas diffusivity and clay content in the management systems with and without regular tillage. ** and * indicate significant regression coefficients at p < 0.01 and p < 0.05, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Management	Ψ [hPa]	Depth [cm]	Dp/D0 [-]	Clay [%]	Int	R^2
CON & ORG	30	-12.5 cm	434.0*	1.001**	-10.94 ns	0.71
		-37.5 cm	756.5 ns	0.758**	-11.68 ns	0.52
	100	-12.5 cm	309.6**	1.054**	-15.65*	0.74
		-37.5 cm	349.5 ns	0.728**	-9.766 ns	0.50
NT	30	-12.5 cm	744.0*	0.954*	-10.79 ns	0.66
		-37.5 cm	318.2 ns	0.538*	-5.165 ns	0.48
	100	-12.5 cm	420.8*	0.996*	-12.34 ns	0.68
		-37.5 cm	349.7 ns	0.606*	-8.421 ns	0.63

Abbreviations: CON is conventional, ORG is organic, NT is no-till, Ψ is soil matric suction, Dp/D0 is gas diffusion coefficient, Clay is clay content, Int is intercept

Supplemental Table S2: Summary statistics of multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of air permeability and clay content in the management systems with and without regular tillage. ** and * indicate significant regression coefficients at p < 0.01 and p < 0.05, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Management	Ψ [hPa]	Depth [cm]	Ka [µm^2]	Clay [%]	Int	R^2
CON & ORG	30	-12.5 cm	0.159 ns	0.965**	-7.740 ns	0.65
		-37.5 cm	0.263**	0.664**	-7.464 ns	0.70
	100	-12.5 cm	0.095*	1.054**	-12.48 ns	0.68
		-37.5 cm	0.160**	0.707**	-8.363 ns	0.62
NT	30	-12.5 cm	0.281 ns	0.827 ns	-4.881 ns	0.51
		-37.5 cm	0.224*	0.529**	-5.196 ns	0.67
	100	-12.5 cm	0.146*	1.004**	-9.671 ns	0.55
		-37.5 cm	0.160*	0.543**	-5.732 ns	0.70

Abbreviations: CON is conventional, ORG is organic, NT is no-till, Ψ is soil matric suction, Ka is air permeability, Clay is clay content, Int is intercept

Supplemental Table S3: Summary statistics of multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of air-filled porosity and clay content in the management systems with and without regular tillage. ** and * indicate significant regression coefficients at $p < 0.01$ and $p < 0.05$, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Management	Ψ [hPa]	Depth [cm]	εa [cm^3 cm^{-3}]	Clay [%]	Int	R^2
CON & ORG	30	-12.5 cm	0.730 ns	0.951**	-14.02 ns	0.60
		-37.5 cm	0.638 ns	0.788**	-13.30 ns	0.46
	100	-12.5 cm	1.110 ns	0.979**	-24.61 ns	0.65
		-37.5 cm	0.630 ns	0.815**	-15.05 ns	0.46
NT	30	-12.5 cm	2.164 ns	0.742 ns	-23.53 ns	0.46
		-37.5 cm	0.759*	0.431*	-9.209 ns	0.67
	100	-12.5 cm	2.253 ns	0.992*	-35.69 ns	0.51
		-37.5 cm	0.737*	0.418*	-9.974 ns	0.70

Abbreviations: CON is conventional, ORG is organic, NT is no-till, Ψ is soil matric suction, εa is air-filled porosity, Clay is clay content, Int is intercept

Supplemental Table S4: Summary statistics of multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of water holding capacity and clay content in the management systems with and without regular tillage. ** and * indicate significant regression coefficients at $p < 0.01$ and $p < 0.05$, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Management	Depth [cm]	WHC [g^1 g^{-1}]	Clay [%]	Int	R^2
CON & ORG	-12.5 cm	108.2**	0.176 ns	-16.98**	0.77
	-37.5 cm	97.16*	-0.022 ns	-9.018 ns	0.57
NT	-12.5 cm	123.2 ns	-0.122 ns	-10.83 ns	0.28
	-37.5 cm	21.33 ns	0.345 ns	-2.640 ns	0.42

Abbreviations: CON is conventional, ORG is organic, NT is no-till, WHC is water holding capcity, Clay is clay content, Int is intercept

Supplemental Table S5: Summary statistics of multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of gas diffusivity, clay content and sampling time. ** and * indicate significant regression coefficients at p < 0.01 and p < 0.05, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Ψ [hPa]	Depth [cm]	Dp/D0 [-]	Clay [%]	Date	Int	R^2
30	-12.5 cm	424.3**	0.933**	-0.080 ns	4.304 ns	0.67
	-37.5 cm	592.9 ns	0.744**	-0.062 ns	-0.944 ns	0.54
100	-12.5 cm	256.9**	0.956**	-0.070 ns	0.802 ns	0.69
	-37.5 cm	339.5*	0.717**	-0.083 ns	3.132 ns	0.55

Abbreviations: Ψ is soil matric suction, Dp/D0 is gas diffusion coefficient, Clay is clay content, Date is day of the year when samples were taken, Int is intercept

Supplemental Table S6: Summary statistics of multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of air permeability, clay content and sampling time. ** and * indicate significant regression coefficients at p < 0.01 and p < 0.05, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Ψ [hPa]	Depth [cm]	Ka [μm^2]	Clay [%]	Date	Int	R^2
30	-12.5 cm	0.145*	0.879**	-0.101 ns	12.23 ns	0.62
	-37.5 cm	0.293**	0.658**	-0.102 ns	-5.776 ns	0.71
100	-12.5 cm	0.075*	0.947**	-0.077 ns	4.799 ns	0.62
	-37.5 cm	0.158**	0.689**	-0.039 ns	-2.178 ns	0.65

Abbreviations: Ψ is soil matric suction, Ka is air permeability, Clay is clay content, Date is day of the year when samples were taken, Int is intercept

Supplemental Table S7: Summary statistics of multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of air-filled porosity, clay content and sampling time. ** indicates significant regression coefficients at p < 0.01, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Ψ [hPa]	Depth [cm]	εa [$cm^3\ cm^{-3}$]	Clay [%]	Date	Int	R^2
30	-12.5 cm	0.501 ns	0.837**	-0.168 ns	19.39 ns	0.56
	-37.5 cm	0.510 ns	0.728**	-0.114 ns	6.698 ns	0.50
100	-12.5 cm	0.639 ns	0.857**	-0.163 ns	14.29 ns	0.59
	-37.5 cm	0.506 ns	0.746**	-0.115 ns	5.476 ns	0.50

Abbreviations: Ψ is soil matric suction, εa is air-filled porosity, Clay is clay content, Date is day of the year when samples were taken, Int is intercept

Supplemental Table S8: Summary statistics of multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of water holding capacity, clay content and sampling time. ** indicates significant regression coefficients at p < 0.01, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Depth [cm]	WHC [g g^{-1}]	Clay [%]	Date	Int	R^2
-12.5 cm	85.72**	0.249 ns	-0.129 ns	9.380 ns	0.66
-37.5 cm	84.98**	0.091 ns	-0.137 ns	12.18 ns	0.62

Abbreviations: WHC is water holding capacity, Clay is clay content, Date is day of the year when samples were taken, Int is intercept

Supplemental Table S9: Summary statistics of multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of clay content and exogenous organic matter input estimated as described by Büchi et al. (2019). ** indicates significant regression coefficients at p < 0.01, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Depth [cm]	Clay [%]	OC Inp [kg C ha^{-1} y^{-1}]	Int	R^2
-12.5 cm	0.831**	0.008 ns	-4.520 ns	0.52
-37.5 cm	0.636**	0.003 ns	-5.267 ns	0.44

Abbreviations: Clay is clay content, OC Inp is Exogenous organic carbon input, Int is intercept

Supplemental Table S10: Summary statistics of multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function gas diffusivity, clay content and exogenous organic matter input estimated as described by Büchi et al. (2019). ** and * indicate significant regression coefficients at p < 0.01 and p < 0.05, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Ψ [hPa]	Depth [cm]	Dp/D0 [-]	Clay [%]	OC Inp [kg C ha^{-1} y^{-1}]	Int	R^2
30	-12.5 cm	429.2**	0.927**	0.003 ns	-9.957*	0.67
	-37.5 cm	853.3**	0.776**	0.001 ns	-13.81**	0.58
100	-12.5 cm	258.0**	0.946**	0.003 ns	-12.05*	0.69
	-37.5 cm	487.9**	0.740**	0.003 ns	-1.218*	0.58

Abbreviations: Ψ is soil matric suction, Dp/D0 is gas diffusion coefficient, Clay is clay content, OC Inp is Exogenous organic carbon input, Int is intercept

Supplemental Table S11: Summary statistics of multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of air permeability, clay content and exogenous organic matter input estimated as described by Büchi et al. (2019). ** and * indicate significant regression coefficients at p < 0.01 and p < 0.05, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Ψ [hPa]	Depth [cm]	Ka [μm^2]	Clay [%]	OC Inp [kg C ha^{-1} y^{-1}]	Int	R^2
30	-12.5 cm	0.156*	0.872**	0.005 ns	-7.739 ns	0.61
	-37.5 cm	0.308**	0.652**	-0.001 ns	-6.931*	0.77
100	-12.5 cm	0.077*	0.933**	0.005 ns	-10.02 ns	0.63
	-37.5 cm	0.212**	0.693**	-0.001 ns	-8.385*	0.73

Abbreviations: Ψ is soil matric suction, Ka is air permeability, Clay is clay content, OC Inp is Exogenous organic carbon input, Int is intercept

Supplemental Table S12: Summary statistics of multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of air-filled porosity, clay content and exogenous organic matter input estimated as described by Büchi et al. (2019). ** indicates significant regression coefficients at p < 0.01, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

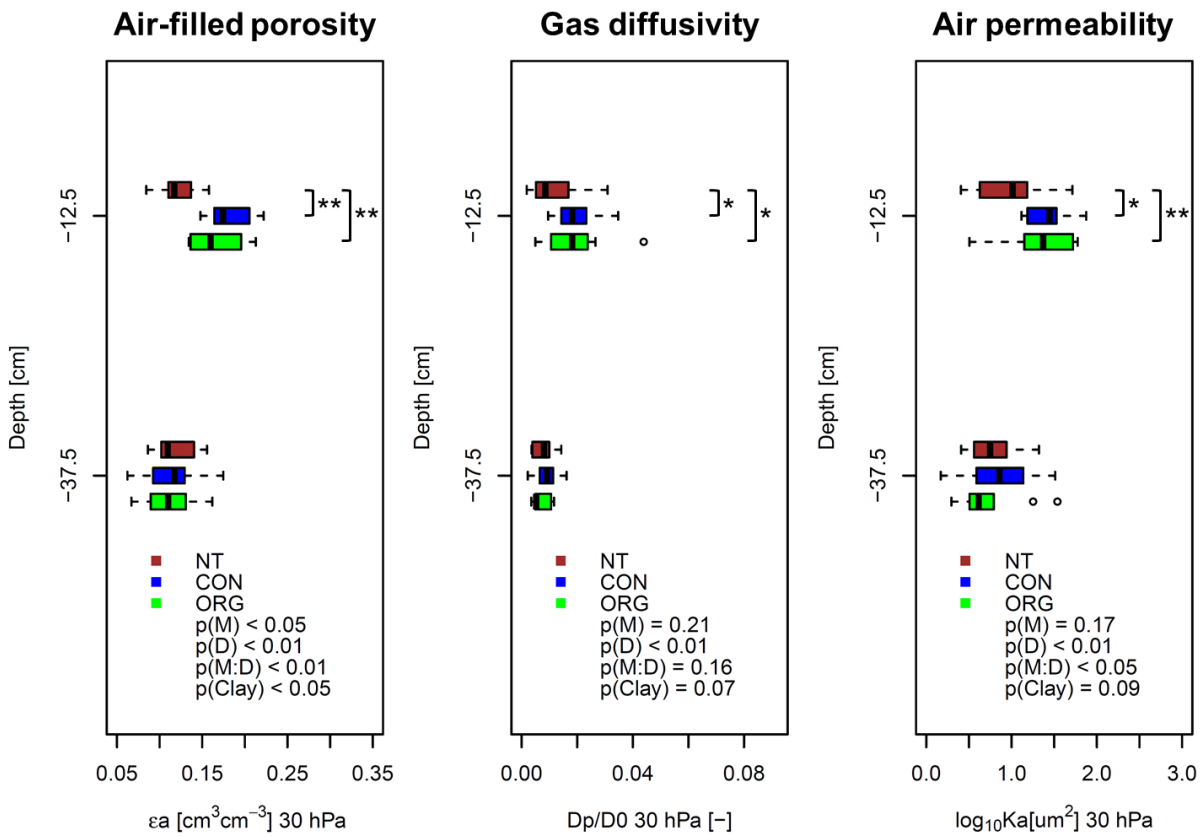
Ψ [hPa]	Depth [cm]	εa [cm^3 cm^{-3}]	Clay [%]	OC Inp [kg C ha^{-1} y^{-1}]	Int	R^2
30	-12.5 cm	0.407 ns	0.838**	0.006 ns	-9.710 ns	0.54
	-37.5 cm	0.576 ns	0.731**	0.003 ns	-13.63 ns	0.48
100	-12.5 cm	0.564 ns	0.855**	0.006 ns	-13.69 ns	0.57
	-37.5 cm	0.607 ns	0.757**	0.003 ns	-15.74 ns	0.49

Abbreviations: Ψ is soil matric suction, εa is air-filled porosity, Clay is clay content, OC Inp is Exogenous organic carbon input, Int is intercept

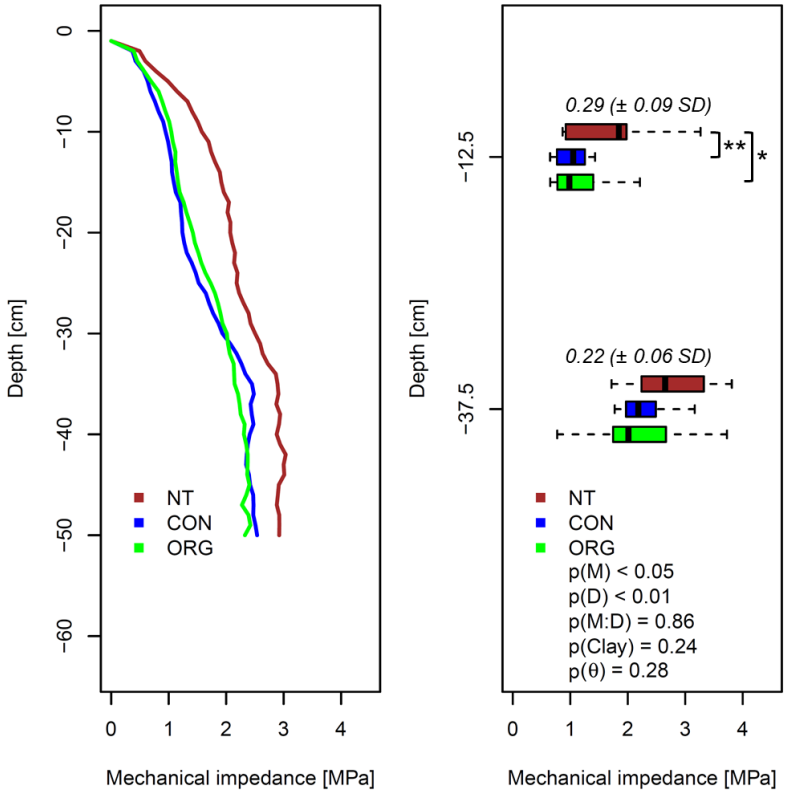
Supplemental Table S13: Summary statistics of multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of water holding capacity, clay content and exogenous organic matter input estimated as described by Büchi et al. (2019). ** indicates significant regression coefficients at p < 0.01, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

Depth [cm]	WHC [g g^{-1}]	Clay [%]	OC Inp [kg C ha^{-1} y^{-1}]	Int	R^2
-12.5 cm	87.58**	0.226 ns	0.006 ns	-14.95**	0.67
-37.5 cm	86.37**	0.072 ns	0.004 ns	-11.95**	0.60

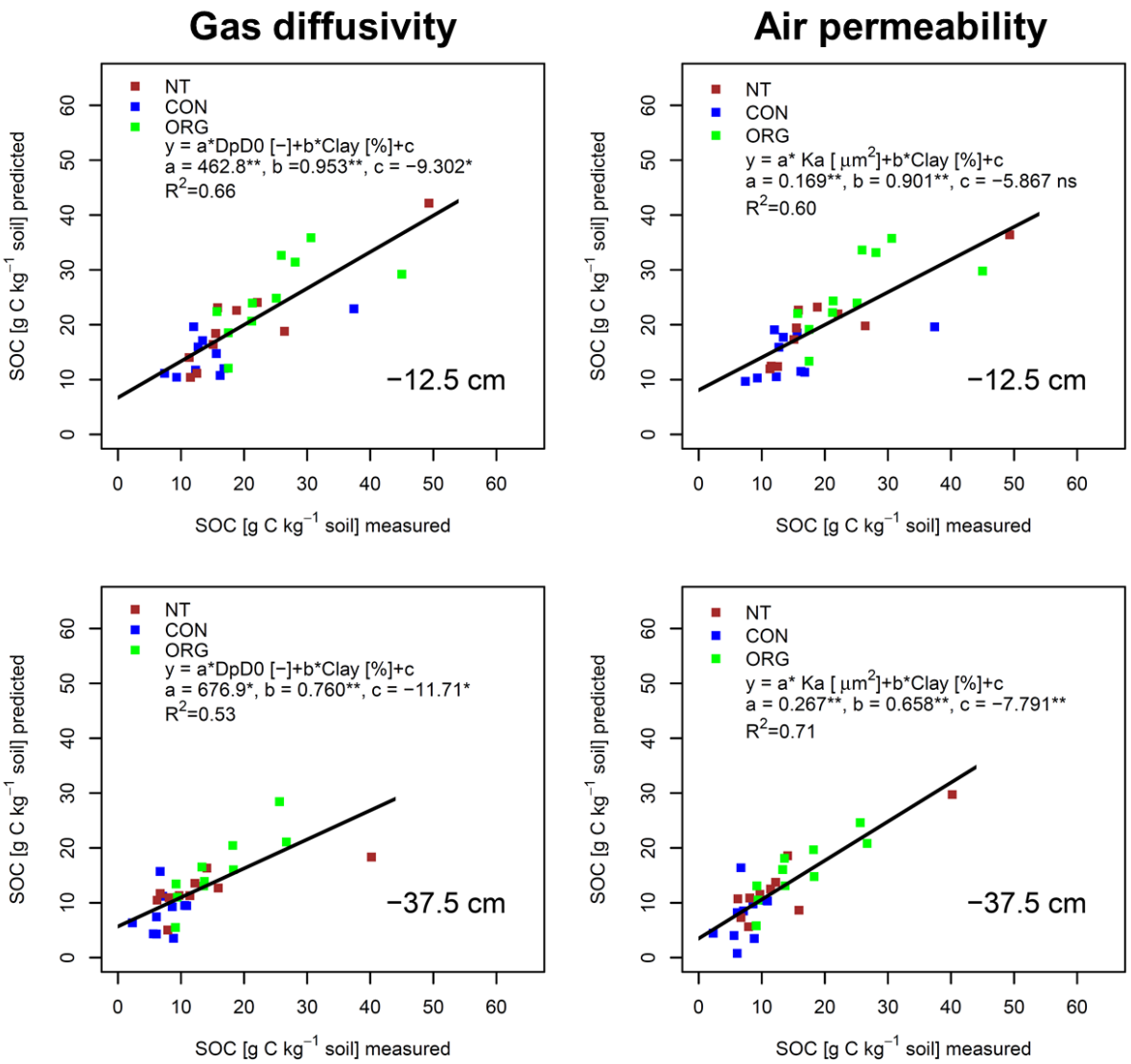
Abbreviations: WHC is water holding capacity, Clay is clay content, OC Inp is Exogenous organic carbon input, Int is intercept



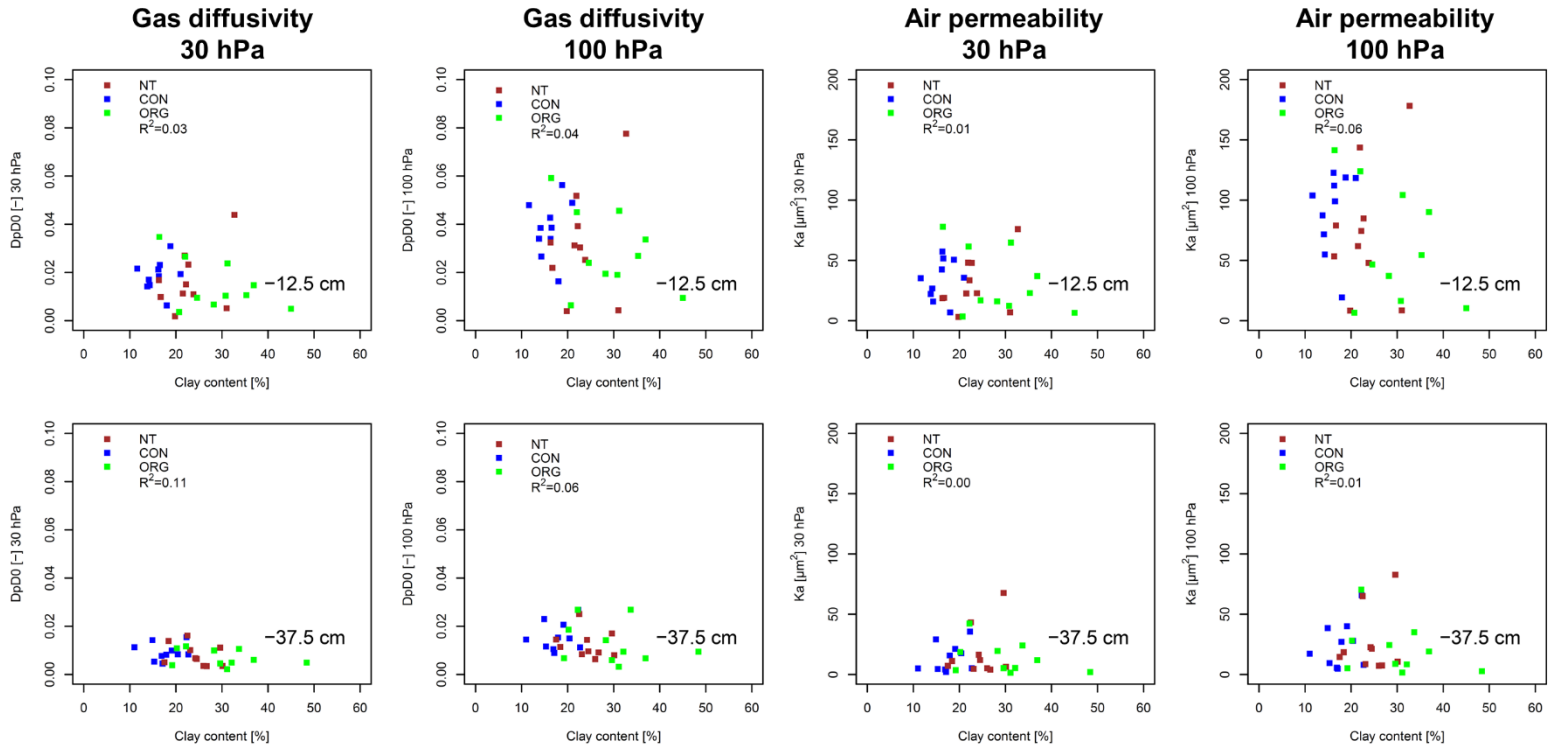
Supplemental Figure S1: Effects of soil management (M), sampling depth (D), their interaction (M:D) and clay content (Clay) on air-filled porosity, gas diffusivity and air permeability at 30 hPa analysed with linear mixed models (Eq. 2) followed by analysis of covariance. NT (red), CON (blue) and ORG (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 $p < 0.01$ and $p < 0.05$, respectively (n = 10).



Supplemental Figure S2: Effects of soil management (M), sampling depth (D), their interaction (M:D), clay content (Clay) and gravimetric water content at sampling (θ) on soil penetration resistance 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 and p < 0.05, respectively (n = 10). Numbers in italic denote overall mean gravimetric water content (± standard deviation) at the time of measurement.

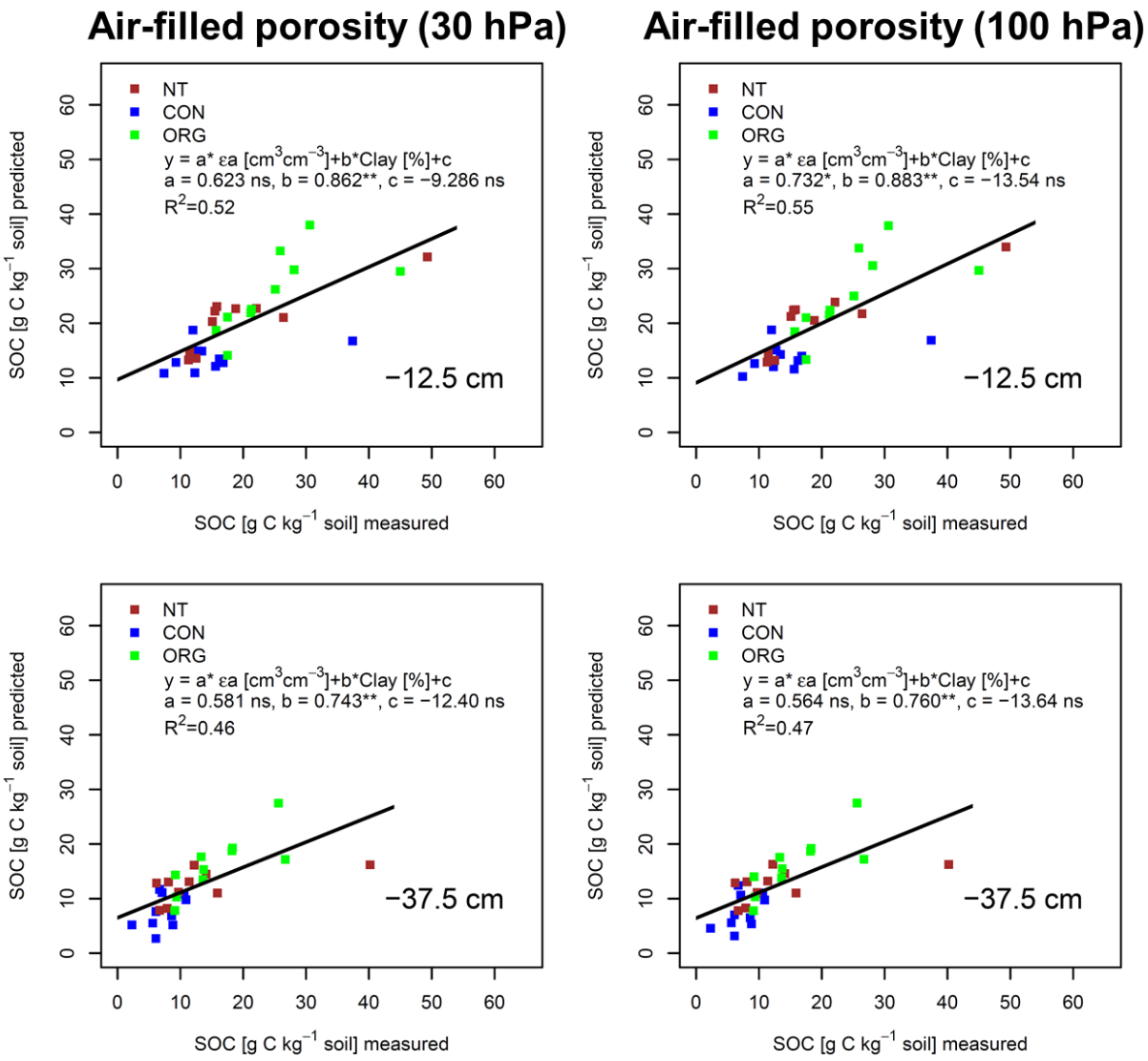


Supplemental Figure S3: Multiple linear regression models (Eq. 3) to explain soil organic carbon content as a function of gas diffusion coefficients (Dp/D0 [-]) and air permeability (Ka [µm^2]) measured at 30 hPa matric suction and clay content (Clay [%]). NT (red), CON (blue) and ORG (green) denote no-till, conventional and organic management system, respectively. ** and * indicate significant regression coefficients at $p < 0.01$ and $p < 0.05$, respectively, ns indicates nonsignificant regression coefficients. R^2 represents multiple r-squared.

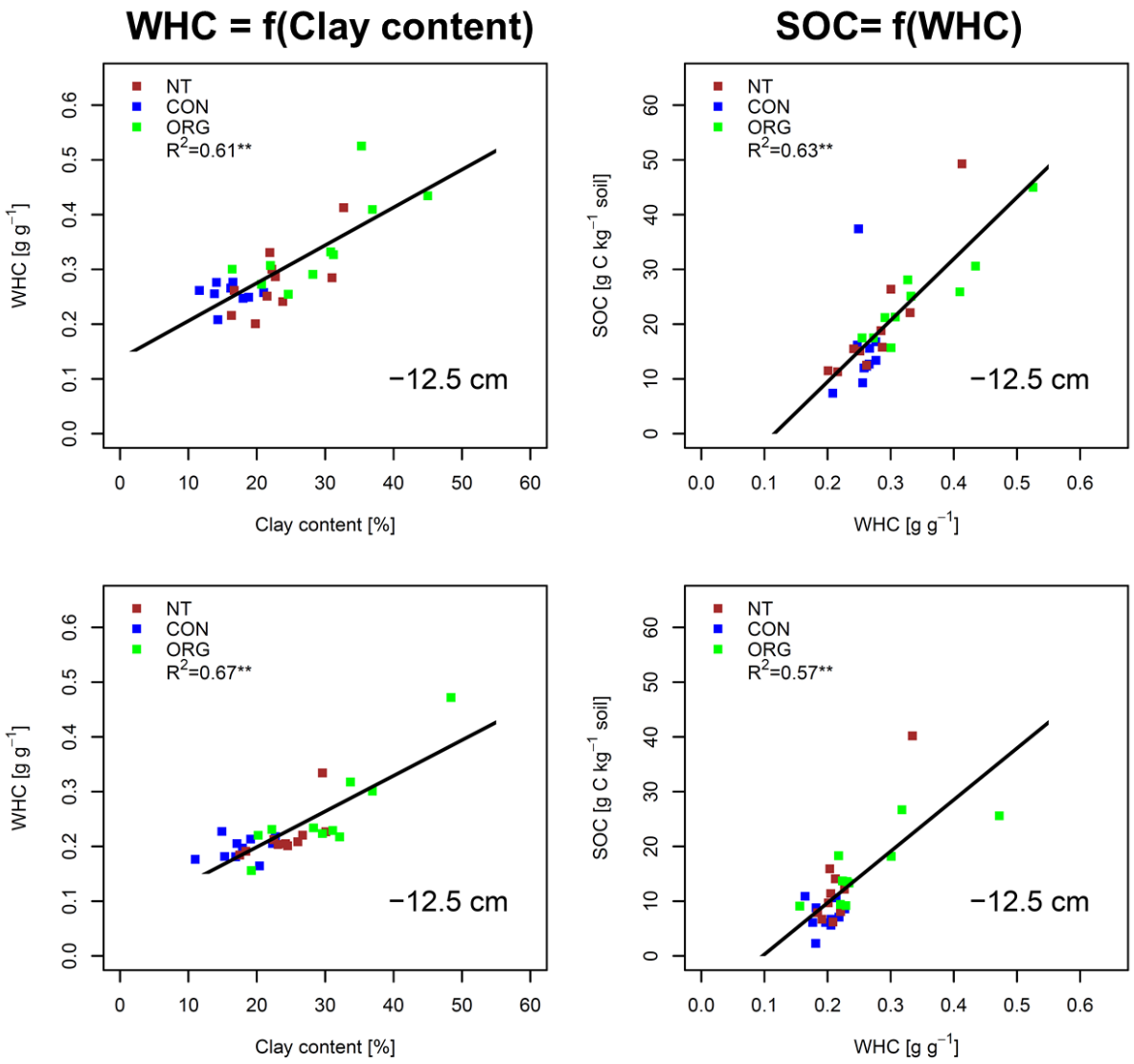


Supplemental Figure S4: Linear regressions between clay content and gas diffusion coefficients (Dp/D0 [-]) and air permeability (Ka [µm^2]), respectively. NT (red), CON (blue) and ORG (green) denote no-till, conventional and organic management system, respectively. R^2 represents multiple r-squared.

5



Supplemental Figure S5: 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 * indicate 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 S6: Linear regressions between clay content and water holding capacity (WHC [g^3 g^{-3}]), and between water holding capacity and soil organic carbon content (SOC [g C kg^{-1} soil]). NT (red), CON (blue) and ORG (green) denote no-till, conventional and organic management system, respectively. ** denotes significant regressions at $p < 0.01$ and R^2 represents multiple r-squared.