

Supplementary Materials for

Soil drying shapes rhizosheath properties and their link with maize yields across different soils

in “Plant and Soil”

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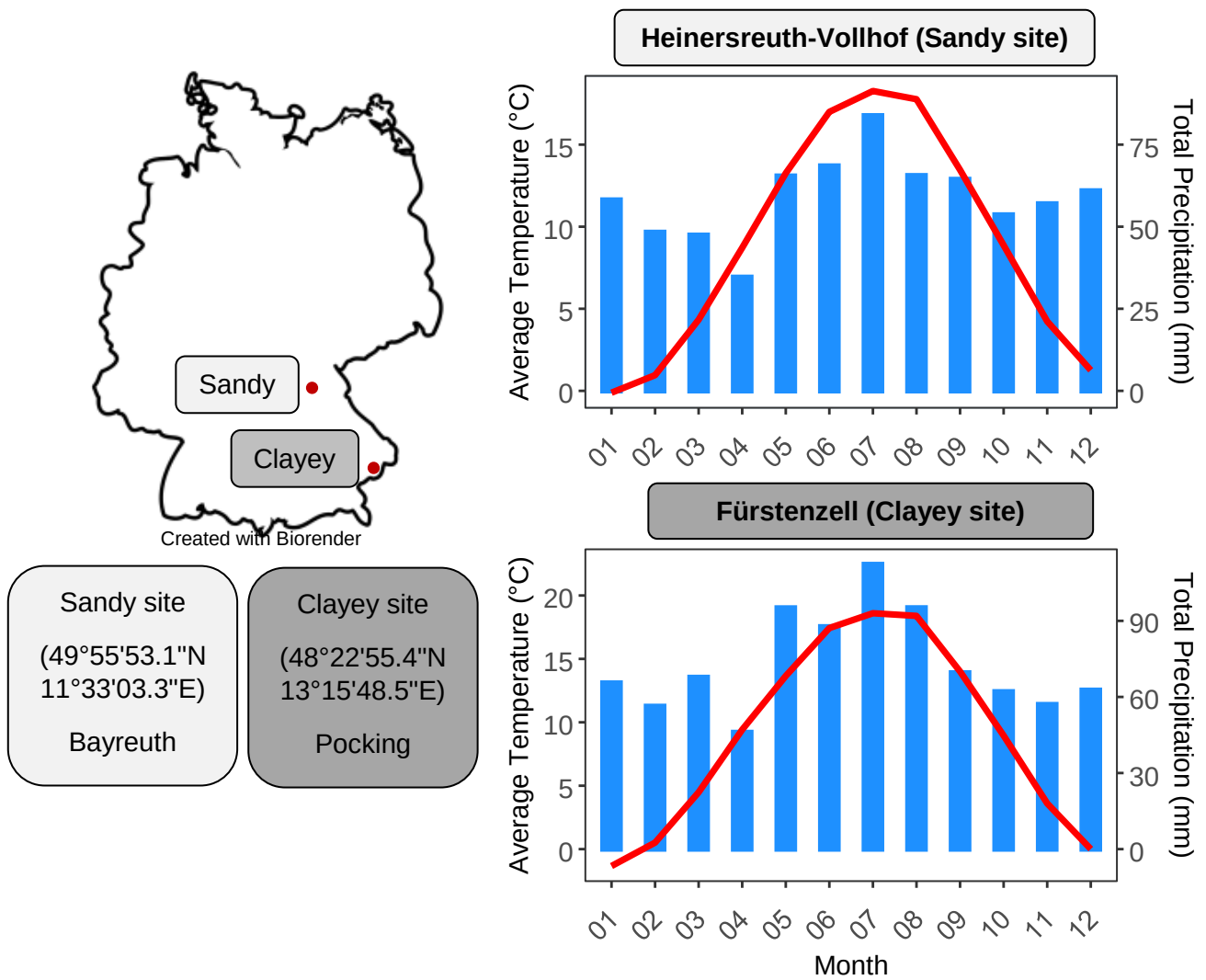


Fig S1 Location and climate diagrams of both field sites. Data from 1997 to 2021 were obtained from Meteostat for the nearest weather stations with at least 25 years of records: Fürstenzell (19.44 km from the clayey site) and Heinersreuth-Vollhof (4.8 km from the sandy site).

Table S1 Overview of investigated maize varieties. Agricultural purpose distinguishes between grain maize (GM) and silage maize (SM). Open-pollinated varieties are abbreviated as type OPV. The abbreviated countries of origin refer to Austria (AT), Germany (DE), and Switzerland (CH), while year indicates the year of registration. Status distinguishes between varieties listed in the German Descriptive Variety Lists 2024 (Listed), which is a prerequisite for commercial trade; varieties declared as conservation varieties in the German Descriptive Variety Lists 2024 (CV); varieties notified by the German Federal Plant Variety Office as organic heterogeneous material (OHM; commercially traded); and varieties provided by genebanks as plant genetic resources (Gen).

Variety	Type	Agricultural purpose	Maturity	Country of origin	Year	Status	Breeder
Almito	OPV	SM/GM	Medium	DE	2016	OHM	Dottenfelderhof
Alpenfex	Landrace	GM	Medium	AT; DE	<1945	CV	LfL
Benedictio KWS	Hybrid	SM	Medium	DE	2016	Listed	KWS
Braunes Schindelmeiser	Landrace	GM	Early	DE	< 1945	Gen	IPK
Gelber Bad. Landmais	Landrace	SM	Medium	DE	< 1945	Listed	IPK
Liberator	Hybrid	GM	Medium	DE	2015	Listed	Deutsche Saatveredelung AG
LuigiCS	Hybrid	GM	Medium	DE	2010	Listed	Caussade Semences
Pautzfelder	Landrace	GM	Early	DE	< 1945	Gen	IPK
Pfarrkirchner	Landrace	GM	Early	DE	< 1945	Gen	IPK
PM Serveza	Hybrid	GM	Early	DE	2018	Listed	BayWa
Rheintaler Ribel	Landrace	GM	Early	CH	< 1945	Gen	IPK
Weihenstephaner2	OPV	GM	Late	DE	2016	OHM	LfL

LfL: Bavarian State Research Center for Agriculture, IPK: Leibniz Institute of Plant Genetics and Crop Plant Research

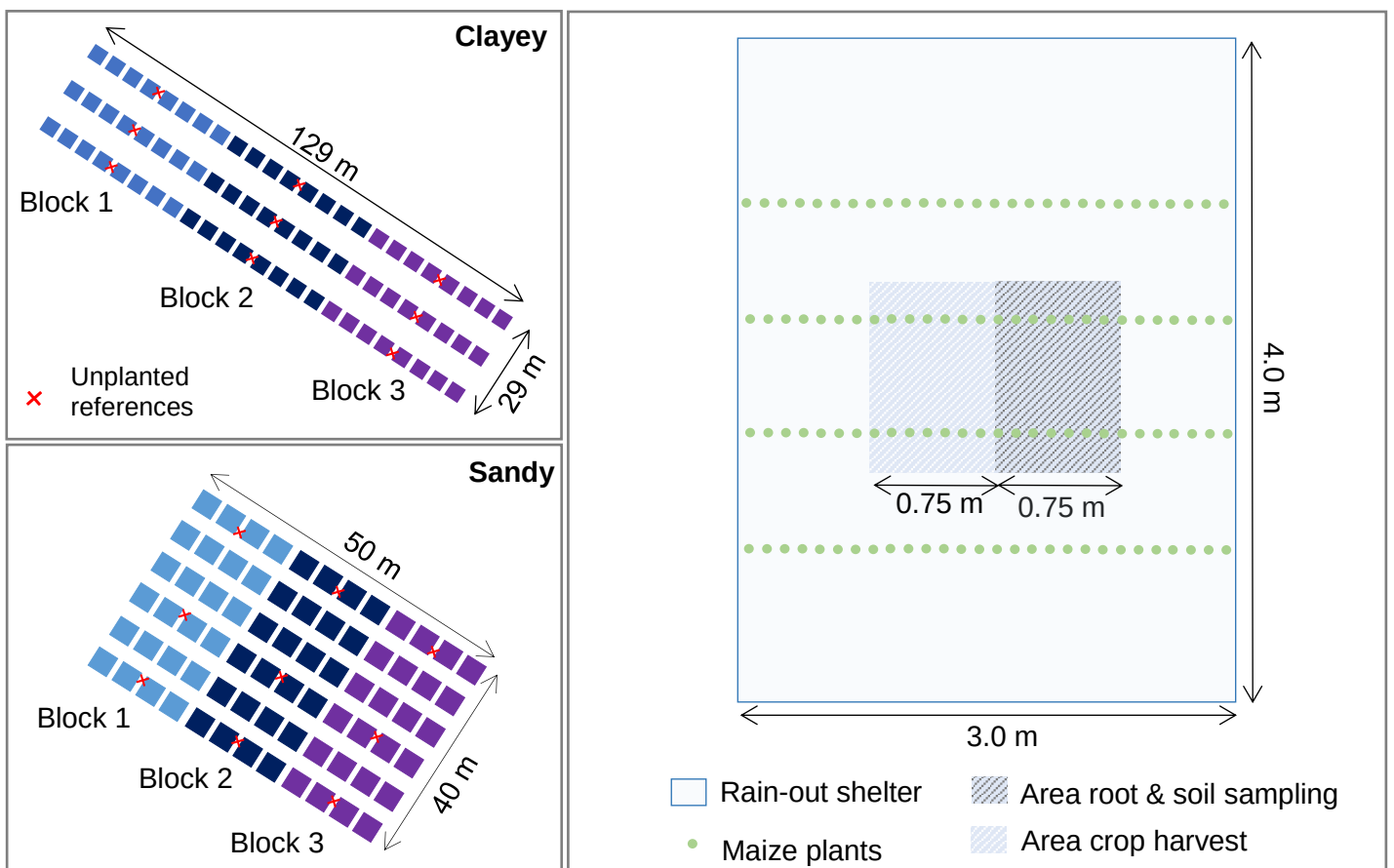


Fig S2 Image of the Rain-Out Shelter design, sketches of the plot arrangement at both field sites, and layout of the individual plots with dimensions and marking of core areas sampled during root and soil sampling or crop harvest, respectively. At the clayey site, blocks were organized to cover a topographic gradient, while blocks at the sandy site capture a gradient in soil texture and a depth gradient of stagnic subsoil properties

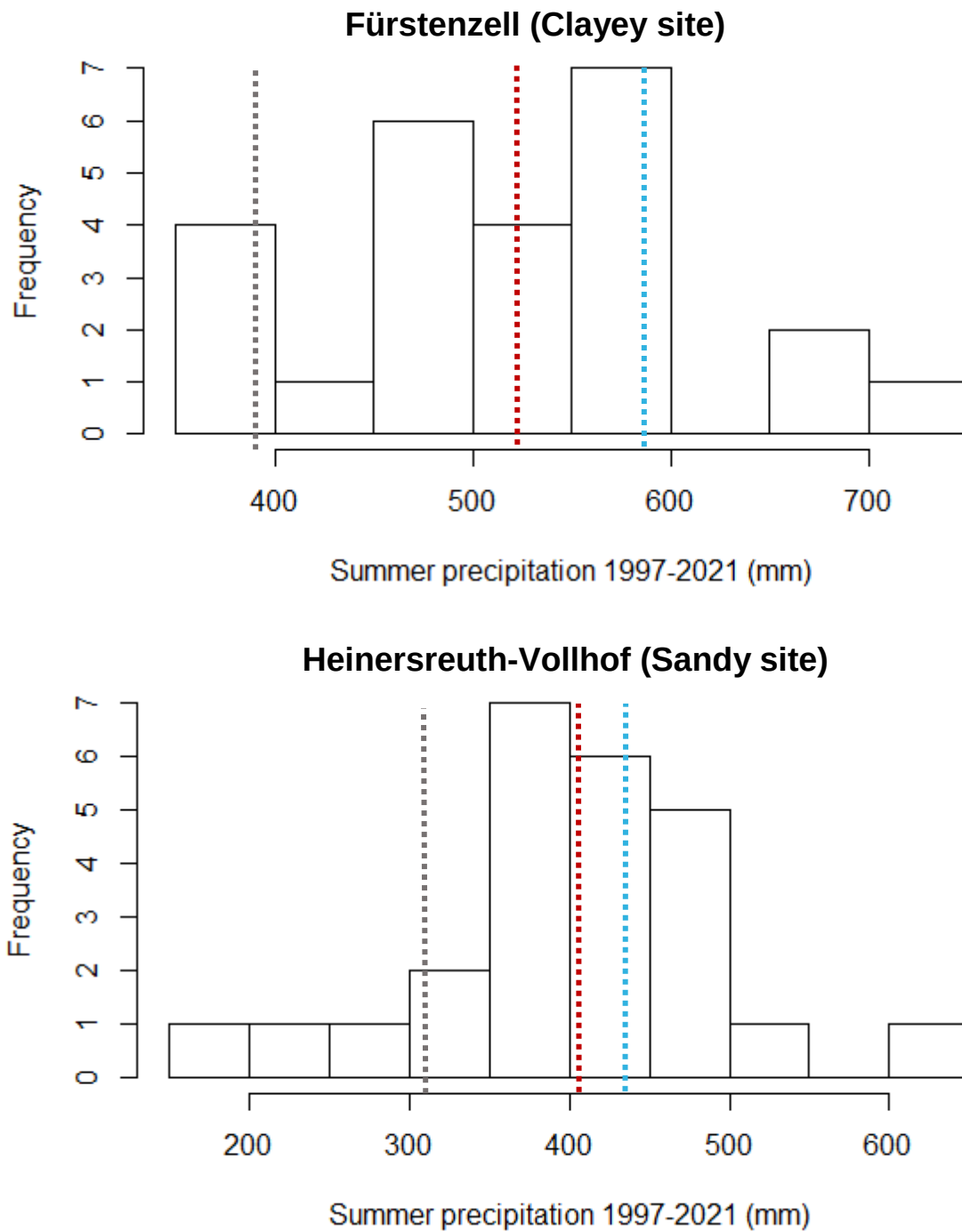


Fig S3 Comparison of cumulative summer precipitation (May-October) in the experimental treatments with the site-specific summer precipitation over the period 1997-2021. The histogram shows the frequency distribution of summer precipitation in the given period. The blue line represents the amount of ambient precipitation in unsheltered plots, the grey line shows the calculated summer precipitation in sheltered plots (60% reduction on days when shelters were in place), while the red line indicates the average summer precipitation 1997-2021. Data were obtained from Meteostat for the nearest weather stations with at least 25 years of records: Fürstenzell (19.44 km from the clayey site) and Heinersreuth-Vollhof (4.8 km from the sandy site)

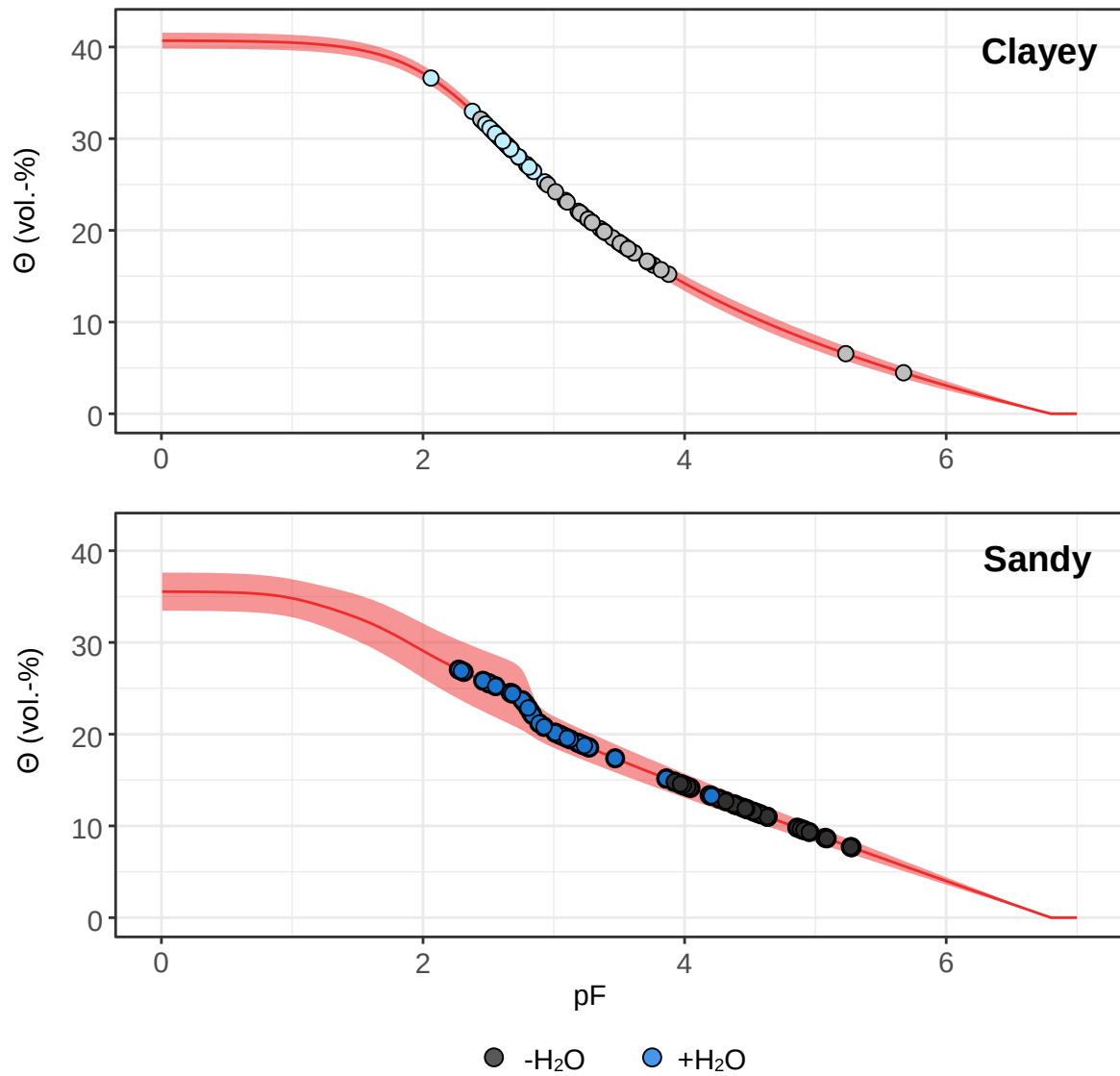


Fig S4 Soil water contents (θ) at rhizosheath sampling in the experimental plots under ambient (+H₂O) or reduced precipitation (-H₂O) and the corresponding soil water potentials derived from the soil water retention curves of the clayey and sandy field sites (HYPROP2, METER Environment, Munich, Germany). Data by courtesy of T. Köhler

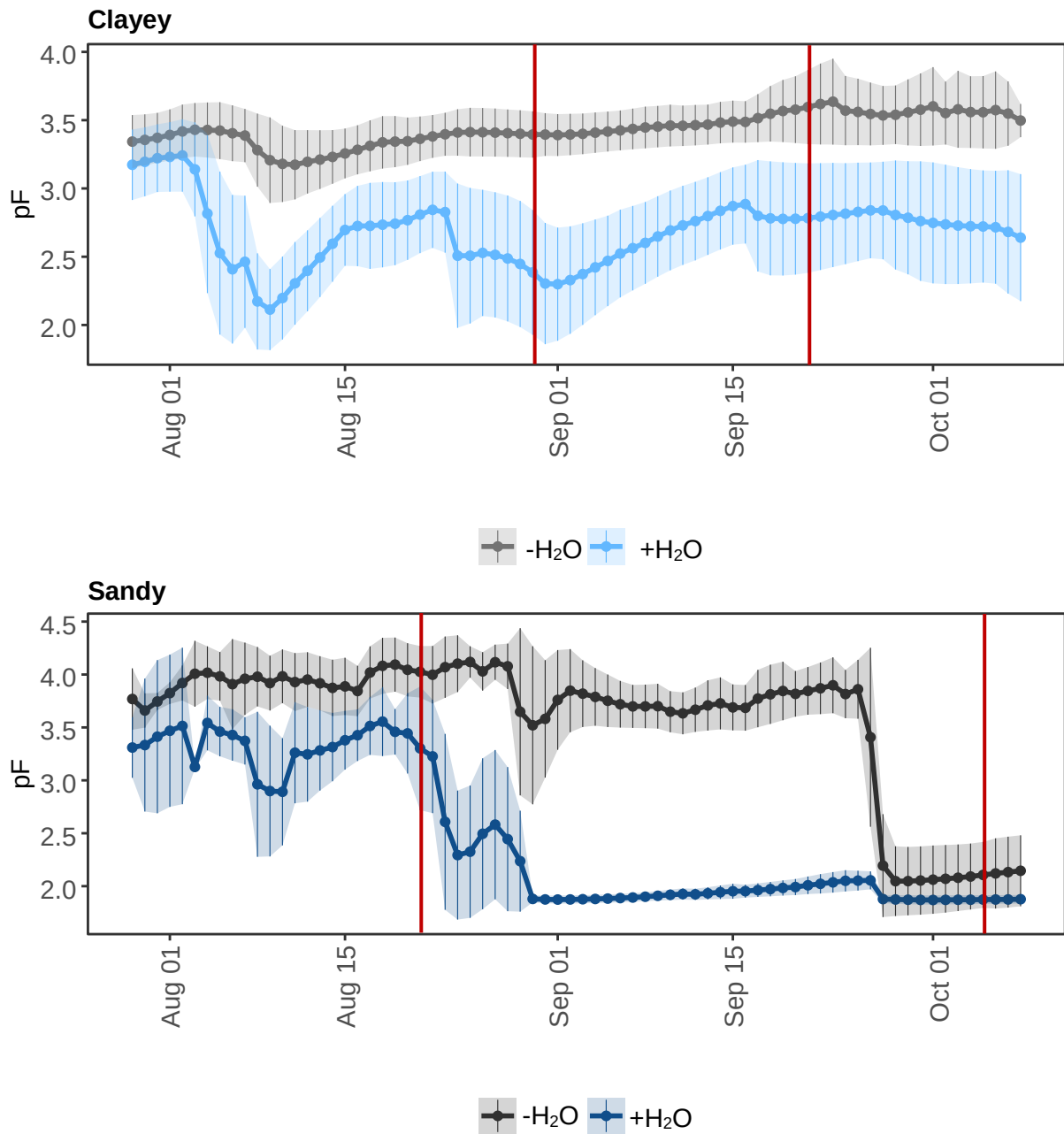


Fig S5 Temporal development of soil water potentials at 30 cm depth on the clayey and sandy field sites. Soil water potentials were averaged across plots of the same precipitation treatment, with values displayed as mean $\pm$ standard deviation. The red lines indicate the start of root/soil sampling and crop harvest at the two field sites. Data by courtesy of T. Köhler

Table S2 ANOVA models testing differences in physicochemical soil properties and their interaction with precipitation reduction among maize varieties. Models included maize variety, plot blocking, precipitation level, and the interaction between variety and precipitation level as fixed effects. Significant P-values are highlighted in bold. When the interaction between precipitation and maize variety (V x W) was significant ($p < .05$), effects of precipitation reduction were tested within each variety using estimated marginal means conditioned on variety (package emmeans, Fig S10, S13-16). Data that violated the assumption of homoscedasticity (Levene's test, $p < .05$) or exhibited non-normal residuals (Lilliefors test of normality, $p < .05$) were transformed by square root or log transformation. If residuals remained non-normal after transformations, ANOVA with aligned rank-transformed (ART) data was performed to preserve the interaction structure (package ARTool). In cases where ART-ANOVA was applied, sum of squares and intercept values are not provided, due to the rank-based testing. Additionally, plot blocking was excluded from these models to meet the requirement of a full interaction structure. *V x W (Interaction Variety x Watering), SS III (Type III sum of squares), df (degrees of freedom).*

Clayey Site					
		SS III	df	F	p
Specific rhizosheath (mg soil cm ⁻¹ root)	Intercept	27.0381	1	258.33	<.001
	Watering	2.7840	1	26.60	<.001
	Variety	1.2394	11	1.08	.402
	Block	0.0224	2	0.11	.899
	V x W	2.3010	11	2.00	.053
	Error	4.5006	43		
Normalized rhizosheath (g soil g ⁻¹ root)	Intercept	172.786	1	1731.18	<.001
	Watering	2.291	1	22.95	<.001
	Variety	1.671	11	1.52	.158
	Block	0.107	2	0.54	.588
	V x W	1.497	11	1.36	.224
	Error	4.392	44		
Total rhizosheath (g rhizosheath kg ⁻¹ soil)	Intercept	1013.49	1	424.22	<.001
	Watering	37.85	1	15.84	<.001
	Variety	48.19	11	1.83	.078
	Block	0.69	2	0.14	.866
	V x W	33.29	11	1.27	.276
	Error	102.73	43		
Bulk C (mgC g ⁻¹ soil)	Intercept	13830.1	1	26891.01	<.001
	Watering	2.7	1	5.34	.025
	Variety	9.8	11	1.74	.094
	Block	6.7	2	6.51	.003
	V x W	5.5	11	0.98	.477
	Error	23.7	46		

Sandy site					
		SS III	df	F	p
Specific rhizosheath (mg soil cm ⁻¹ root)	Intercept	6.8349	1	201.33	<.001
	Watering	0.1180	1	3.48	.069
	Variety	0.6109	11	1.64	.124
	Block	0.2250	2	3.31	.046
	V x W	0.2046	11	0.55	.859
	Error	1.4258	42		
Normalized rhizosheath (g soil g ⁻¹ root)	Intercept	727.49	1	634.78	<.001
	Watering	17.07	1	14.89	<.001
	Variety	14.86	11	1.18	.329
	Block	1.17	2	0.51	.604
	V x W	11.92	11	0.95	.508
	Error	49.28	43		
Total rhizosheath (g rhizosheath kg ⁻¹ soil)	Intercept	1576.89	1	371.095	<.001
	Watering	21.75	1	5.118	.030
	Variety	36.77	11	0.787	.651
	Block	1.72	2	0.203	.817
	V x W	25.81	11	0.552	.854
	Error	157.22	37		
Bulk C (mgC g ⁻¹ soil)	Intercept	NA	NA	NA	NA
	Watering	NA	1	0.957	.333
	Variety	NA	11	0.553	.856
	Block	NA	NA	NA	NA
	V x W	NA	11	1.074	.402
	Error	NA	48		

Clayey Site					
		SS III	df	F	p
Bulk N (mgN g ⁻¹ soil)	Intercept	150.787	1	47920.48	<.001
	Watering	0.009	1	2.96	.092
	Variety	0.052	11	1.50	.164
	Block	0.069	2	10.94	<.001
	V x W	0.047	11	1.35	.229
	Error	0.145	46		
Bulk C:N	Intercept	6601.7	1	93120.67	<.001
	Watering	0.3	1	3.84	.056
	Variety	1.1	11	1.40	.207
	Block	1.9	2	13.45	<.001
	V x W	0.3	11	0.37	0.963
	Error	3.3	46		
Net C change (mgC kg ⁻¹ soil)	Intercept	1611.18	1	165.37	<.001
	Watering	1.55	1	0.16	.692
	Variety	146.18	11	1.36	.225
	Block	99.58	2	5.11	.010
	V x W	29.63	11	0.28	.987
	Error	418.96	43		
Net N change (mgN kg ⁻¹ soil)	Intercept	0.451	1	8.10	.007
	Watering	0.097	1	1.74	.194
	Variety	0.668	11	1.09	.391
	Block	1.002	2	9.00	<.001
	V x W	0.605	11	0.99	.473
	Error	2.394	43		

Sandy site					
		SS III	df	F	p
Bulk N (mgN g ⁻¹ soil)	Intercept	NA	NA	NA	NA
	Watering	NA	1	0.031	.860
	Variety	NA	11	0.519	.880
	Block	NA	NA	NA	NA
	V x W	NA	11	1.392	.208
	Error	NA	48		
Bulk C:N	Intercept	8172.6	1	147390	<.001
	Watering	0.7	1	12.715	<.001
	Variety	0.6	11	1.047	.423
	Block	0.8	2	7.046	.002
	V x W	1.2	11	1.945	0.058
	Error	2.6	46		
Net C change (mgC kg ⁻¹ soil)	Intercept	937.14	1	1139.30	<.001
	Watering	0.30	1	0.367	.548
	Variety	8.71	11	0.963	.496
	Block	2.35	2	1.430	.252
	V x W	12.90	11	1.425	.203
	Error	30.43	37		
Net N change (mgN kg ⁻¹ soil)	Intercept	2.455	1	6.893	.013
	Watering	0.066	1	0.185	.670
	Variety	3.656	11	0.933	.521
	Block	0.417	2	0.585	.562
	V x W	5.520	11	1.409	.210
	Error	13.178	37		

V x W: Interaction Variety x Watering, SS III: Type III sum of squares, df: Degrees of freedom

Clayey site																	
Source		>1000 µm				1000 – 250 µm				250 – 53 µm				<53 µm			
		SS III	df	F	p	SS III	df	F	p	SS III	df	F	p	SS III	df	F	p
Mass-%	Intercept	43451	1	545.451	<.001	134063	1	5111.130	<.001	29501.9	1	1112.037	<.001	10439.0	1	504.571	<.001
	Watering	353	1	4.434	.041	1058	1	40.337	<.001	442.1	1	16.664	<.001	917.8	1	44.363	<.001
	Variety	405	11	0.463	.917	374	11	1.296	.257	95.7	11	0.328	.975	131.5	11	0.578	.837
	Block	236	2	1.484	.237	132	2	2.518	.092	16.0	2	0.302	.741	8.0	2	0.193	.825
	V x W	904	11	1.031	.436	184	11	0.637	.788	226.0	11	0.775	.663	257.8	11	1.133	.359
	Error	3664	46			1207	46			1220.4	46			951.7	46		
C (mgC g ⁻¹ Fraction)	Intercept	14809.3	1	10099.320	<.001	14610.2	1	13906.442	<.001	14506.3	1	14293.857	<.001	9451.3	1	15434.194	<.001
	Watering	0.6	1	0.436	.512	12.4	1	11.835	.001	40.7	1	40.062	<.001	10.4	1	17.040	<.001
	Variety	23.2	11	1.436	.190	16.4	11	1.422	.196	26.4	11	2.365	.021	4.2	11	0.621	.801
	Block	12.6	2	4.303	.019	11.8	2	5.625	.007	2.6	2	1.301	.282	6.4	2	5.212	.009
	V x W	15.7	11	0.972	.485	9.1	11	0.786	.652	37.0	11	3.315	.002	9.5	11	1.409	.201
	Error	67.5	46			48.3	46			46.7	46			28.2	46		
N (mgN g ⁻¹ Fraction)	Intercept	149.040	1	26116.676	<.001	151.685	1	32479.583	<.001	152.324	1	28253.244	<.001	NA	NA	NA	NA
	Watering	0.001	1	0.234	.631	0.036	1	7.757	.008	0.240	1	44.474	<.001	NA	1	29.600	<.001
	Variety	0.080	11	1.276	.268	0.054	11	1.045	.425	0.177	11	2.979	.005	NA	11	0.344	.971
	Block	0.108	2	9.468	<.001	0.066	2	7.054	.002	0.069	2	6.436	.003	NA	NA	NA	NA
	V x W	0.063	11	1.011	.452	0.050	11	0.968	.488	0.257	11	4.341	<.001	NA	11	0.989	.469
	Error	0.263	46			0.215	46			0.248	46			NA	48		
C:N	Intercept	7148.0	1	18994.006	<.001	6921.8	1	49956.510	<.001	6838.9	1	57617.020	<.001	4229.0	1	10763.117	<.001
	Watering	0.1	1	0.235	.631	1.3	1	9.525	.003	1.3	1	10.614	.002	4.0	1	10.292	.002
	Variety	3.9	11	0.939	.513	1.5	11	0.985	.474	1.1	11	0.862	.582	3.5	11	0.799	.640
	Block	1.0	2	1.273	.290	3.5	2	12.763	<.001	1.8	2	7.782	.001	0.8	2	1.075	.350
	V x W	3.3	11	0.808	.632	0.9	11	0.615	.807	1.3	11	1.031	.436	2.9	11	0.677	.753
	Error	17.3	46			6.4	46			5.5	46			18.1	46		
C (mgC g ⁻¹ soil)	Intercept	874.89	1	620.656	<.001	2692.98	1	5422.634	<.001	607.53	1	948.067	<.001	2.9786	1	20.315	<.001
	Watering	6.69	1	4.743	.035	10.07	1	20.274	<.001	18.42	1	28.750	<.001	5.0944	1	34.746	<.001
	Variety	11.28	11	0.728	.707	4.56	11	0.835	.607	2.18	11	0.309	.980	1.4301	11	0.887	.560
	Block	1.63	2	0.577	.565	9.16	2	9.219	<.001	0.66	2	0.513	.602	0.0263	2	0.090	.915
	V x W	16.67	11	1.075	.401	4.04	11	0.740	.695	7.56	11	1.072	.404	1.5843	11	0.982	.476
	Error	64.84	46			22.84	46			29.48	46			6.7446	46		

V x W: Interaction Variety x Watering, SS III: Type III sum of squares, df: Degrees of freedom

Clayey site																	
		>1000 μm				1000 – 250 μm				250 – 53 μm				<53 μm			
	Source	SS III	df	F	p	SS III	df	F	p	SS III	df	F	p	SS III	df	F	p
N (mgN g ⁻¹ soil)	Intercept	8.9204	1	569.209	<.001	28.1035	1	5323.989	<.001	6.3374	1	1003.954	<.001	12.0344	1	2715.046	<.001
	Watering	0.0722	1	4.608	.037	0.1537	1	29.118	<.001	0.1650	1	26.142	<.001	0.1713	1	38.657	<.001
	Variety	0.1070	11	0.621	.801	0.0522	11	0.899	.549	0.0180	11	0.259	.990	0.0404	11	0.830	.612
	Block	0.0240	2	0.765	.471	0.0747	2	7.073	.002	0.0060	2	0.472	.627	0.0017	2	0.197	.822
	V x W	0.1891	11	1.097	.385	0.0357	11	0.614	.807	0.0724	11	1.042	.427	0.0566	11	1.160	.340
	Error	0.7209	46			0.2428	46			0.2904	46			0.2039	46		
Sandy site																	
		>1000 μm				1000 – 250 μm				250 – 53 μm				<53 μm			
	Source	SS III	df	F	p	SS III	df	F	p	SS III	df	F	p	SS III	df	F	p
Mass-%	Intercept	84135	1	1957.446	<.001	206293	1	8052.703	<.001	7640.6	1	1675.675	<.001	284.328	1	1303.018	<.001
	Watering	27	1	0.632	.431	31	1	1.206	.278	0.0	1	0.003	.958	0.213	1	0.974	.329
	Variety	519	11	1.099	.384	352	11	1.249	.284	59.4	11	1.185	.323	5.436	11	2.265	.026
	Block	363	2	4.222	.021	93	2	1.823	.173	66.0	2	7.242	.002	1.923	2	4.406	.018
	V x W	567	11	1.199	.315	284	11	1.008	.454	113.0	11	2.253	.027	5.232	11	2.180	.033
	Error	1977	46			1178	46			209.7	46			10.038	46		
C (mgC g ⁻¹ Fraction)	Intercept	7312.0	1	2331.406	<.001	323.03	1	15985.069	<.001	NA	NA	NA	NA	79624	1	2867.787	<.001
	Watering	0.8	1	0.248	.621	0.04	1	1.920	.173	NA	1	3.533	.066	238	1	8.585	.005
	Variety	23.7	11	0.688	.743	0.23	11	1.054	.418	NA	11	0.836	.606	349	11	1.144	.351
	Block	7.0	2	1.120	.335	0.06	2	1.559	.221	NA	NA	NA	NA	107	2	1.918	.158
	V x W	30.1	11	0.873	.572	0.34	11	1.550	.147	NA	11	1.988	.051	551	11	1.805	.081
	Error	144.3	46			0.93	46			NA	48			1277	46		
N (mgN g ⁻¹ Fraction)	Intercept	59.541	1	2308.602	<.001	4.9662	1	262.995	<.001	160.907	1	9915.261	<.001	1076.13	1	4099.769	<.001
	Watering	0.007	1	0.283	.597	0.0168	1	0.887	.351	0.002	1	0.102	.751	0.37	1	1.395	.244
	Variety	0.188	11	0.664	.764	0.2407	11	1.159	.341	0.121	11	0.677	.753	3.37	11	1.169	.335
	Block	0.014	2	0.266	.768	0.0576	2	1.525	.228	0.102	2	3.139	.053	0.88	2	1.673	.199
	V x W	0.232	11	0.818	.622	0.3341	11	1.608	.128	0.303	11	1.700	.104	5.69	11	1.971	.054
	Error	1.186	46			0.8686	46			0.746	46			12.07	46		

V x W: Interaction Variety x Watering, SS III: Type III sum of squares, df: Degrees of freedom

Sandy site																	
		>1000 μm				1000 – 250 μm				250 – 53 μm				<53 μm			
	Source	SS III	df	F	p	SS III	df	F	p	SS III	df	F	p	SS III	df	F	p
C:N	Intercept	8852.1	1	48454.901	<.001	8425.7	1	115220	<.001	7783.8	1	79688.359	<.001	5352.4	1	6793.944	<.001
	Watering	0.0	1	0.141	.709	0.5	1	7.430	.009	3.6	1	36.437	<.001	5.7	1	7.226	.010
	Variety	2.6	11	1.278	.267	0.6	11	0.738	.697	1.1	11	0.997	.463	7.4	11	0.856	.588
	Block	2.7	2	7.353	.002	1.4	2	9.368	<.001	0.3	2	1.740	.187	2.2	2	1.425	.251
	V x W	3.3	11	1.620	.125	0.9	11	1.103	.381	1.9	11	1.781	.086	8.2	11	0.946	.507
	Error	8.4	46			3.4	46			4.5	46			36.2	46		
C (mgC g ⁻¹ soil)	Intercept	873.46	1	789.807	<.001	1450.38	1	2781.106	<.001	185.099	1	1520.514	<.001	30.0842	1	1601.755	<.001
	Watering	0.53	1	0.476	.494	2.17	1	4.154	.047	0.059	1	0.485	.490	0.0297	1	1.580	.215
	Variety	9.89	11	0.813	.627	8.38	11	1.461	.179	1.478	11	1.104	.380	0.5211	11	2.522	.014
	Block	1.13	2	0.511	.603	2.02	2	1.933	.156	3.011	2	12.368	<.001	0.1165	2	3.100	.055
	V x W	9.13	11	.750	.686	5.56	11	0.970	.486	3.043	11	2.273	.026	0.3278	11	1.587	.135
	Error	50.87	46			23.99	46			5.600	46			0.8640	46		
N (mgN g ⁻¹ soil)	Intercept	7.1261	1	798.173	<.001	12.3936	1	2630.586	<.001	1.71770	1	1460.064	<.001	0.40509	1	2315.720	<.001
	Watering	0.0051	1	0.567	.455	0.0122	1	2.597	.114	0.00004	1	0.032	.859	0.00002	1	0.108	.743
	Variety	0.0784	11	0.798	.641	0.0748	11	1.443	.187	0.01366	11	1.056	.416	0.00670	11	3.483	.001
	Block	0.0175	2	0.982	.382	0.0119	2	1.260	.293	0.02495	2	10.602	<.001	0.00148	2	4.230	.021
	V x W	0.0691	11	0.703	.729	0.0490	11	0.946	.507	0.03072	11	2.374	.020	0.00361	11	1.878	.068
	Error	0.4107	46			0.2167	46			0.05412	46			0.00805	46		

V x W: Interaction Variety x Watering, SS III: Type III sum of squares, df: Degrees of freedom

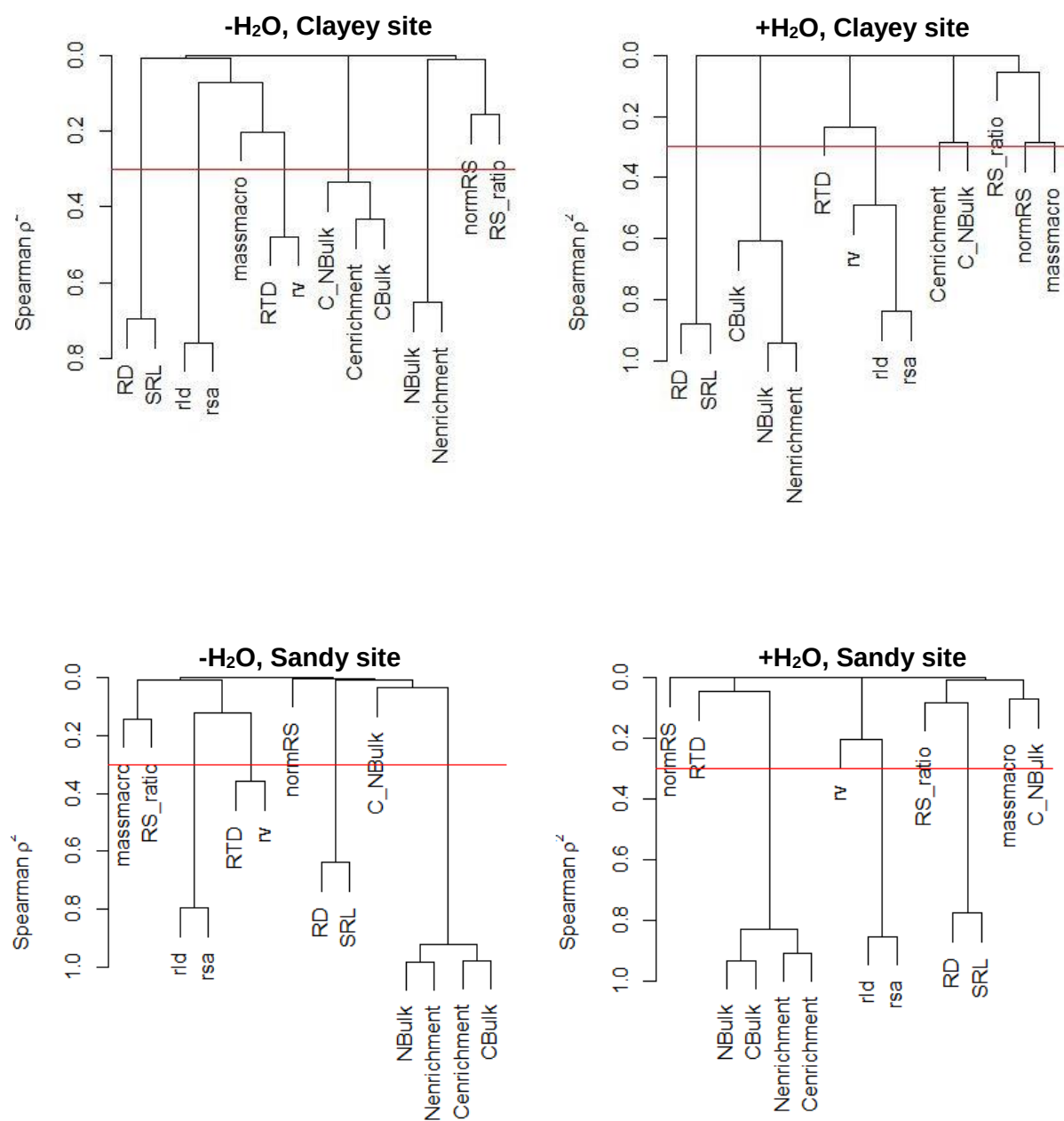


Fig S6 Hierarchical variable clustering to assess multicollinearity among multiple regression predictors at each site (clayey or sandy) and under each precipitation treatment (reduced (-H₂O) or ambient precipitation (+H₂O)). The dendrogram shows the results of hierarchical variable clustering of rhizosheath and root properties considered as potential predictors for the multiple regression analyses. The red line indicates the cut-off to select non-redundant predictors ($\rho^2 < 0.3$). normRS (normalized rhizosheath; g soil g⁻¹ roots), massmacro (mass contribution of aggregate fraction > 250 μ m; mass-%), C_NBulk (bulk C:N ratio rhizosheath soil; -), CBulk (bulk carbon content; mgC g⁻¹ soil), NBulk (bulk nitrogen content; mgC g⁻¹ soil), RS_ratio (indicator root: shoot ratio; mg roots kg⁻¹ soil g⁻¹ shoot), Cenrichment (C enrichment per unit soil mass in planted samples compared to the unplanted reference; mgC kg⁻¹ soil), Nenrichment (N enrichment per unit soil mass in planted samples compared to the unplanted reference; mgN kg⁻¹ soil), RTD (root tissue density; mg cm⁻³), RD (mean root diameter; mm), SRL (specific root length; m g⁻¹), rld (root length density; mm cm⁻³ soil), rsa (root surface area; mm²), rv (root volume; mm³)

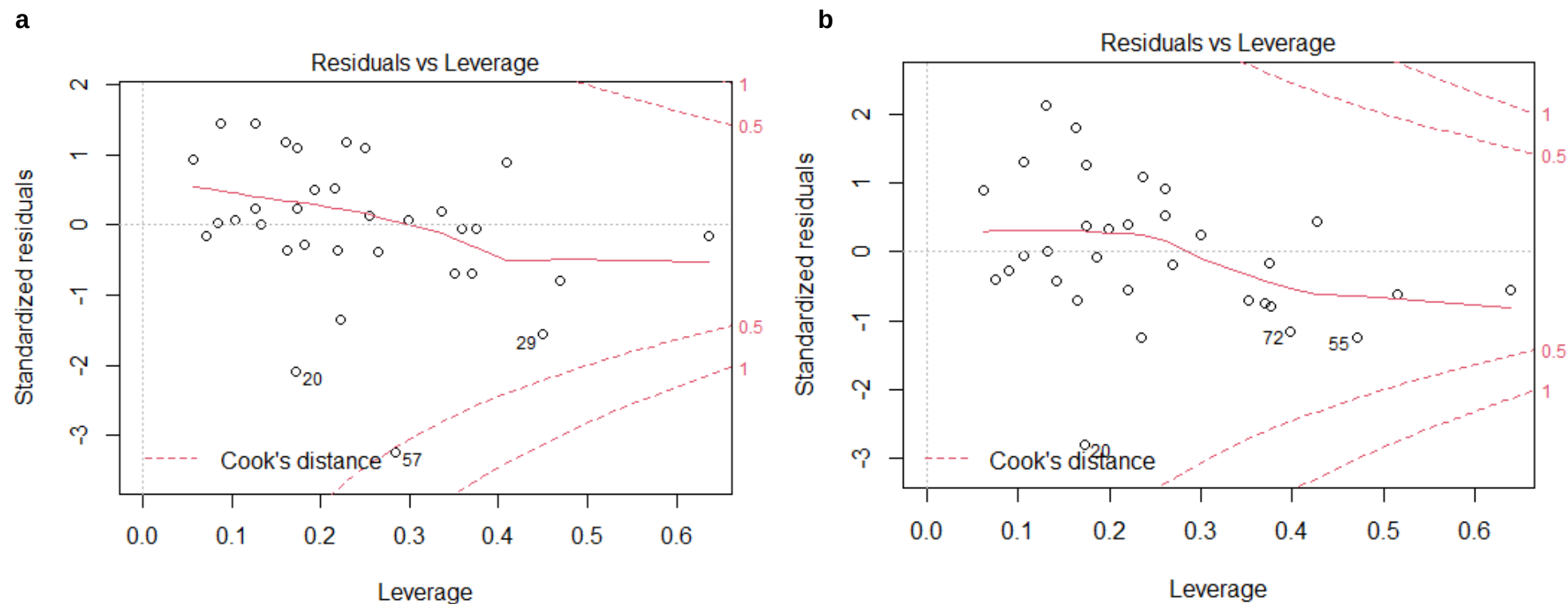


Fig S7 Diagnostic plots indicating Cook's distance for the multiple regression model prior to best subset variable selection, with aboveground biomass at the clayey site under ambient precipitation as the response variable. Model diagnostics are displayed (a) for the entire dataset, with point 57 (ID 309) identified as an influential data point with Cook's distance > 0.5, and (b) for the model after excluding ID 309

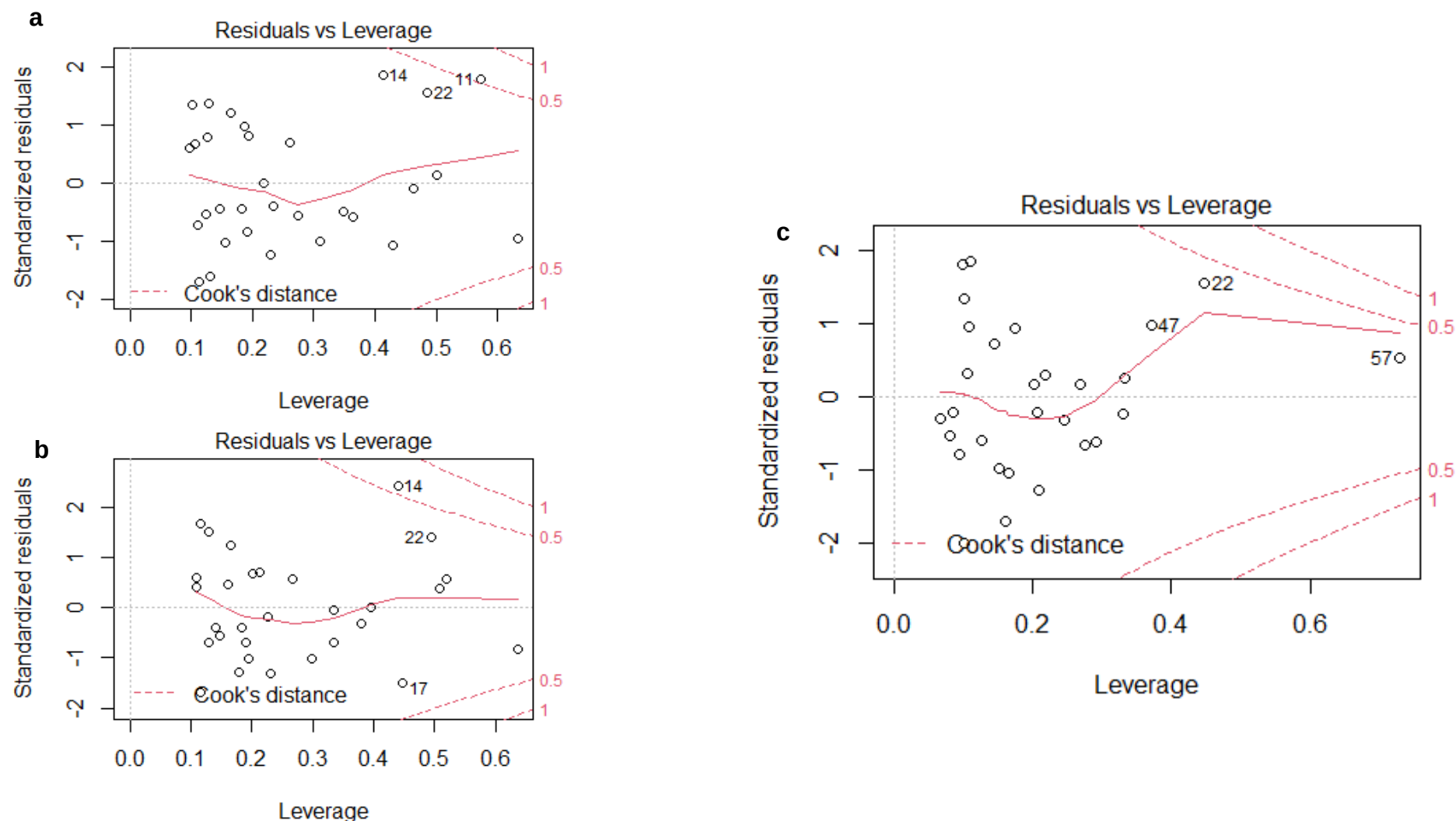


Fig S8 Diagnostic plots indicating Cook's distance for the multiple regression model prior to best subset variable selection, with aboveground biomass at the sandy site under ambient precipitation as the response variable. Model diagnostics are displayed (a) based on the entire dataset, with point 11 (ID 111) identified as an influential data point with Cook's distance > 0.5, (b) after excluding ID 111, with point 14 (ID 144) identified as an influential data point with Cook's distance > 0.5, and (c) after excluding ID 111 and 144

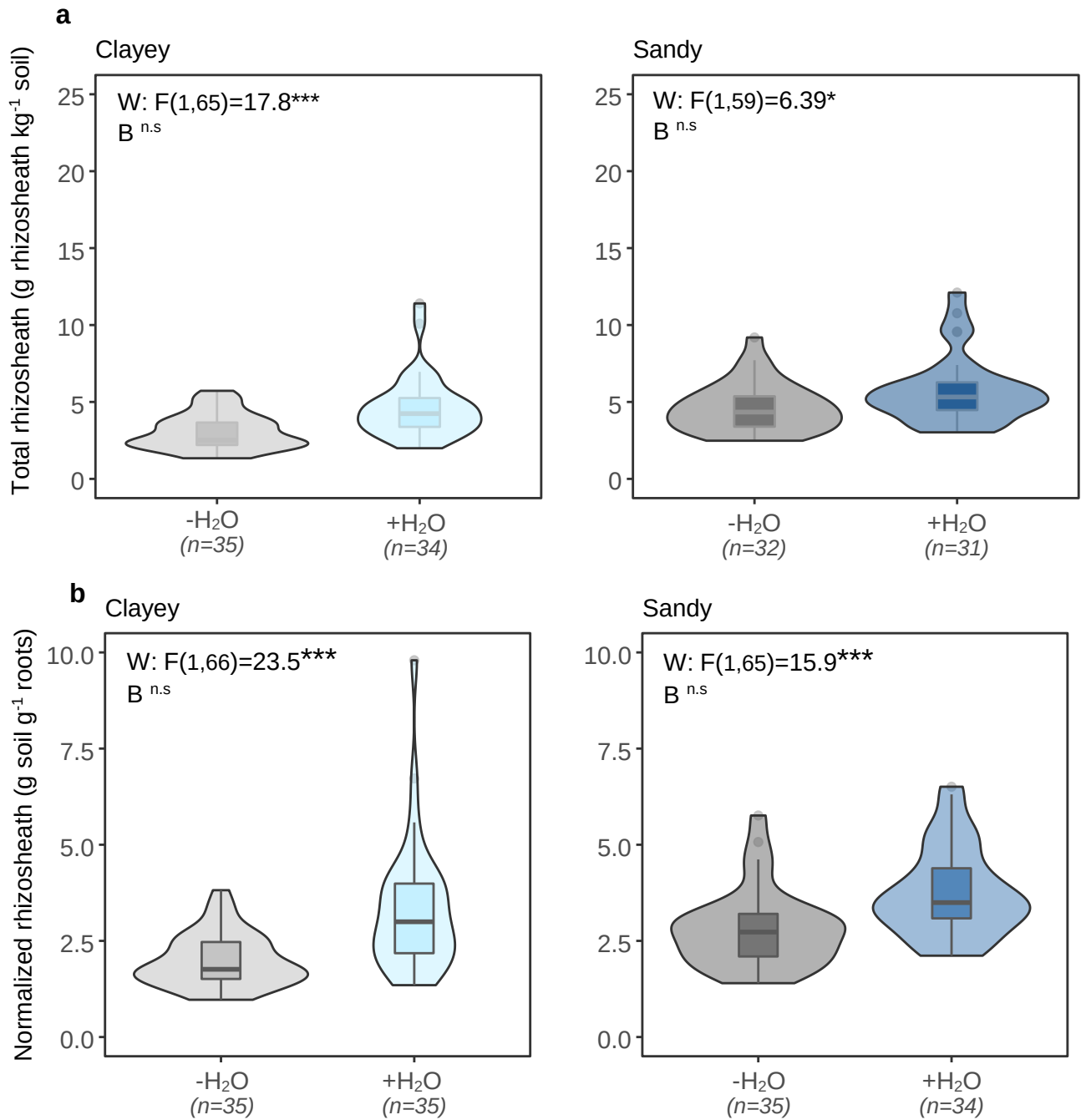


Fig S9 Total rhizosheath mass per soil weight (a) and normalized rhizosheath mass (b) under reduced (-H₂O) and ambient precipitation (+H₂O) at the clayey and sandy field site. Effects of watering (W) and blocking (B) on rhizosheath parameters are indicated by ANOVA results. *n*: Number of replicates

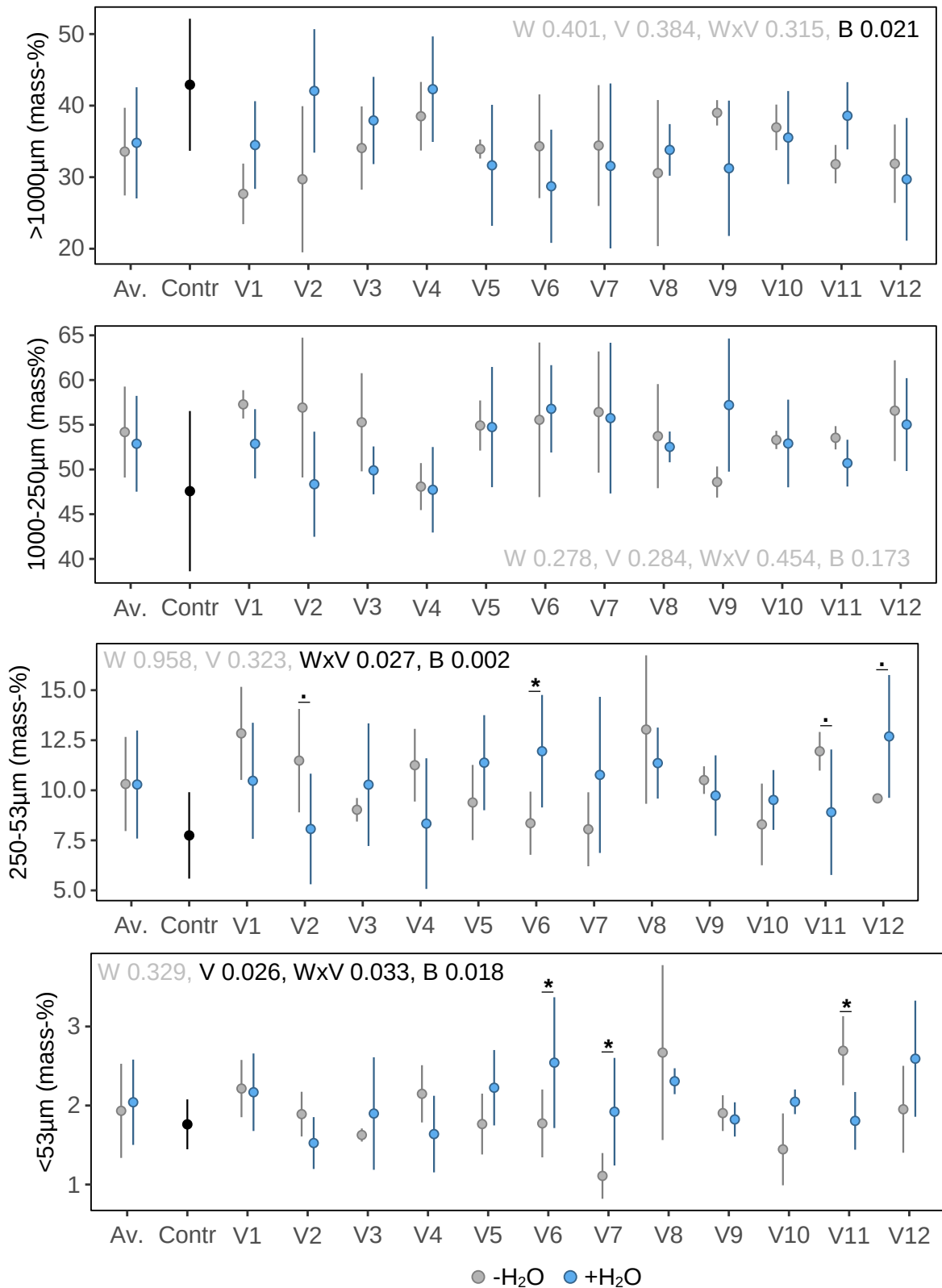


Fig S10 Mass distribution of aggregate size fractions in the unplanted control soil (Contr.), in the rhizosheath of individual maize varieties, and averaged across all rhizosheath samples (Av.) under reduced (-H₂O) and ambient precipitation (+H₂O) at the **sandy site** (mean ± SD). Effects of watering (W), variety (V), their interaction (WxV), and plot blocking (B) on the mass contribution of individual aggregate fractions are indicated by ANOVA p-values, with significant effects highlighted in bold. In the case of a significant Watering x Variety interaction, varieties that showed a significant effect of precipitation reduction on the mass contribution of the corresponding aggregate size fraction are indicated (· p < 0.1, * p < 0.05), based on estimated marginal means conditioned on variety. Varieties V1: *Almito*, V2: *Alpenfex*, V3: *Benedictio KWS*, V4: *Braunes Schindelmeiser*, V5: *Gelber Bad. Landmais*, V6: *Liberator*, V7: *LuigiCS*, V8: *Pautzfelder*, V9: *Pfarrkirchner*, V10: *PM Serveza*, V11: *Rheintaler Ribel*, V12: *Weihenstephaner2*.

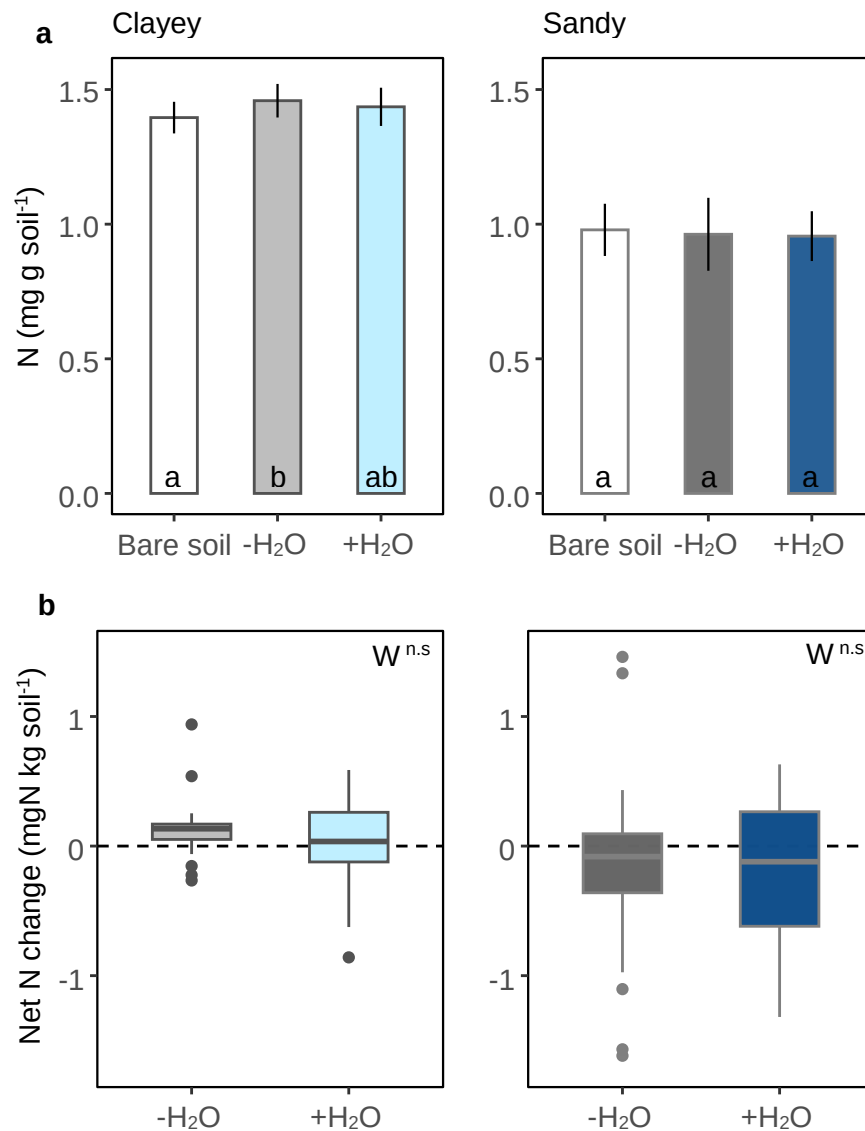


Fig S11 Nitrogen (N) contents (a) in the unplanted reference soil (Bare soil, n=9) and the rhizosphere (n=36) under reduced (-H₂O) or ambient precipitation (+H₂O) are presented as mean $\pm$ standard deviation for both sites. Letters indicate significant differences in N contents between treatments of the same site according to applied post-hoc tests. The net change in N in planted samples compared to the unplanted reference (b) is displayed for the clayey (-H₂O: n=35, +H₂O: n=34) and sandy site (-H₂O: n=32, +H₂O: n=31). Effects of precipitation (W) and blocking (B) on net N change at each site are indicated by Kruskal-Wallis test results

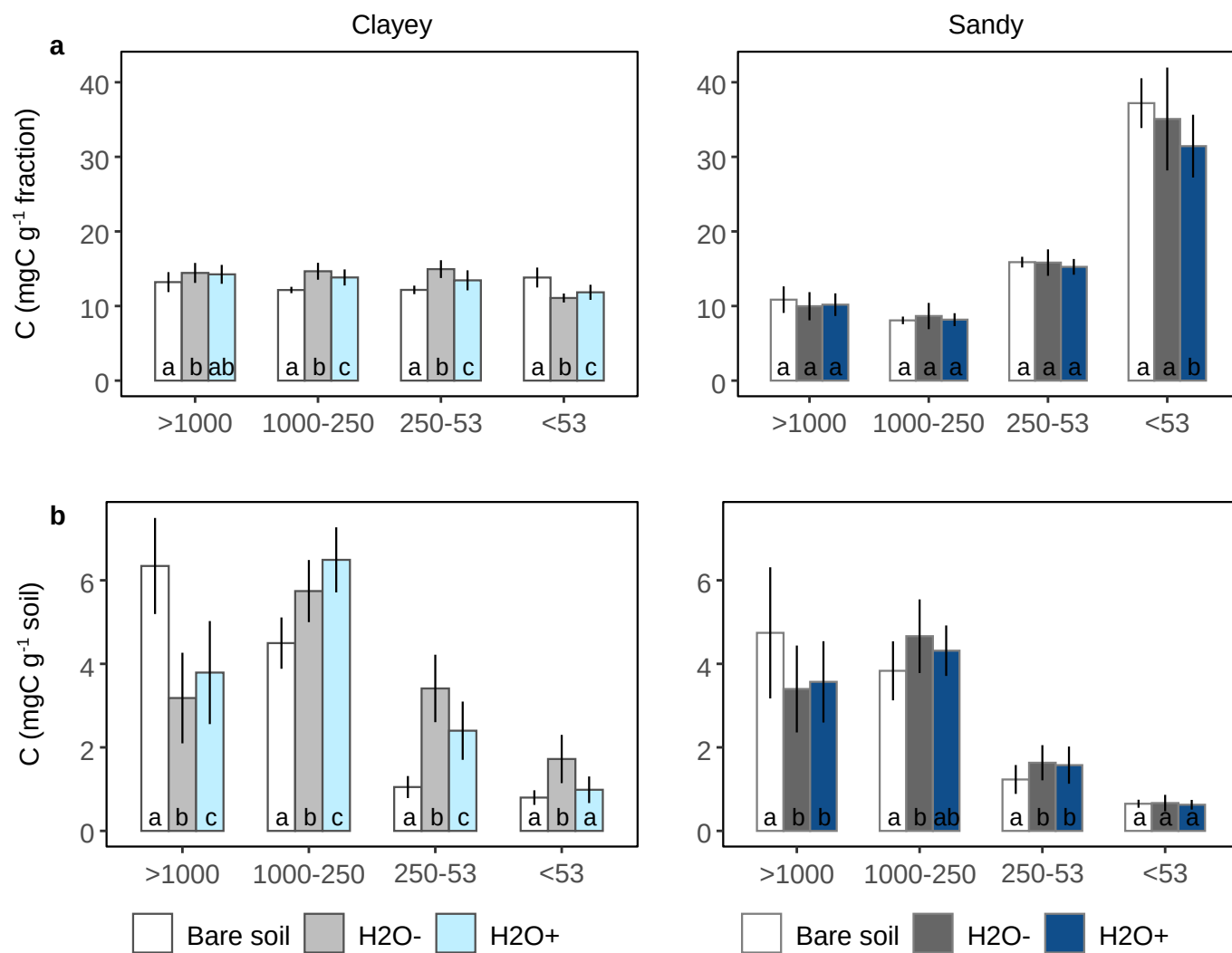


Fig S12 Carbon (C) contents within fractions (a) and aggregate-associated C contents (b) in the unplanted reference soil (Bare soil, n=9) and the rhizosheath (n=36) under reduced (-H₂O) and ambient precipitation (+H₂O). All values are displayed as mean ± standard deviation. Letters indicate significant differences between treatments within the same aggregate fraction of one site

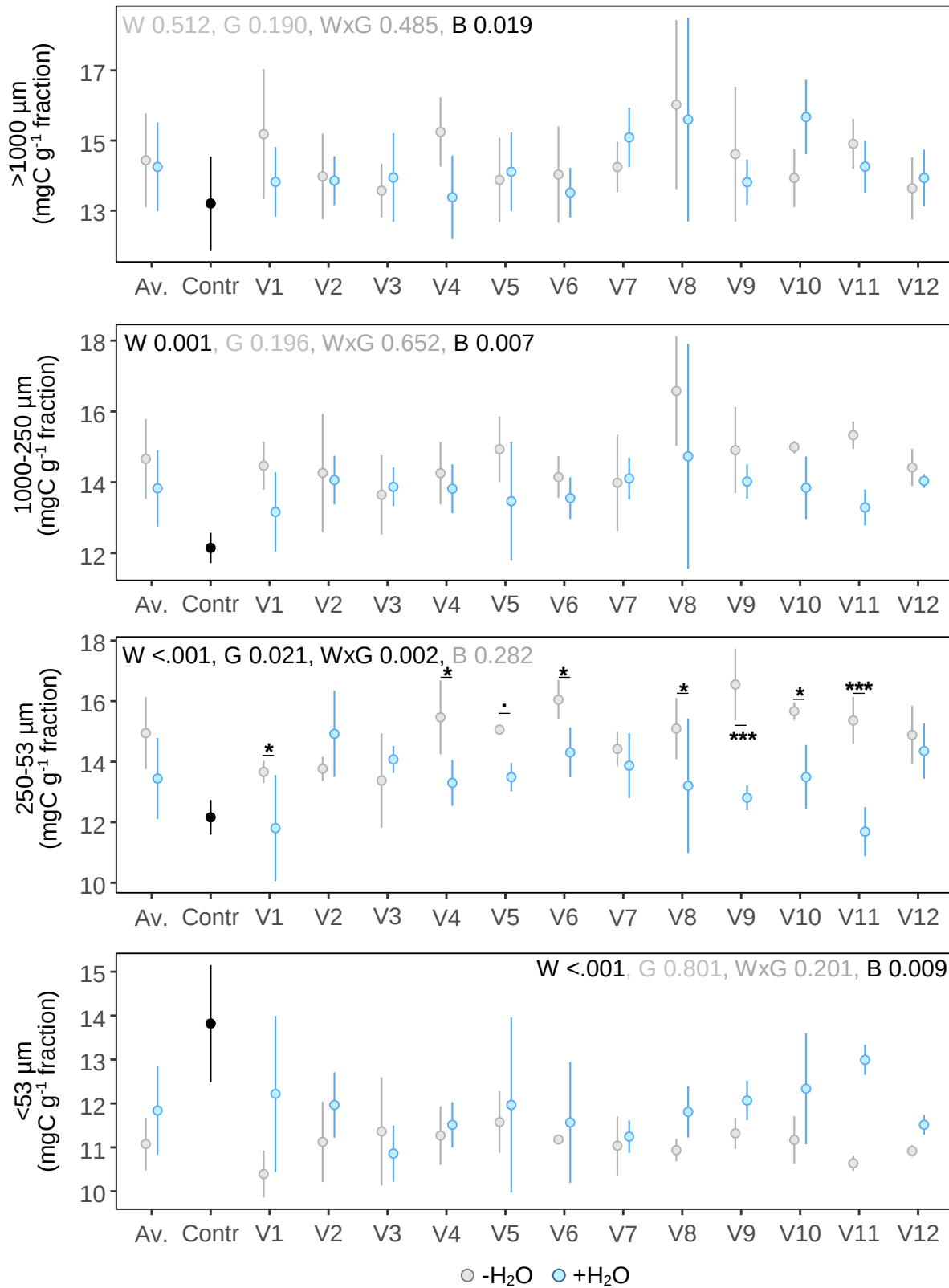


Fig S13 Carbon (C) contents within aggregate fractions in the unplanted control soil (Contr.), in the rhizosheath of individual maize varieties, and averaged across all rhizosheath samples (Av.) under reduced (-H₂O) and ambient precipitation (+H₂O) at the **clayey site** (mean $\pm$ SD). Effects of watering (W), variety (V), their interaction (WxV), and plot blocking (B) on the C contents of individual aggregate fractions are indicated by ANOVA p-values, with significant effects highlighted in bold. In the case of a significant Watering x Variety interaction, varieties that showed a significant effect of precipitation reduction on the C content of the corresponding aggregate size fraction are indicated ($p < 0.1$, $*p < 0.05$, $**p < 0.01$, $***p < 0.001$), based on estimated marginal means conditioned on variety. Varieties V1: Almito, V2: Alpenfex, V3: Benedictio KWS, V4: Braunes Schindelmeiser, V5: Gelber Bad. Landmais, V6: Liberator, V7: LuigiCS, V8: Pautzfelder, V9: Pfarrkirchner, V10: PM Serveza, V11: Rheintaler Ribel, V12: Weihenstephaner2.

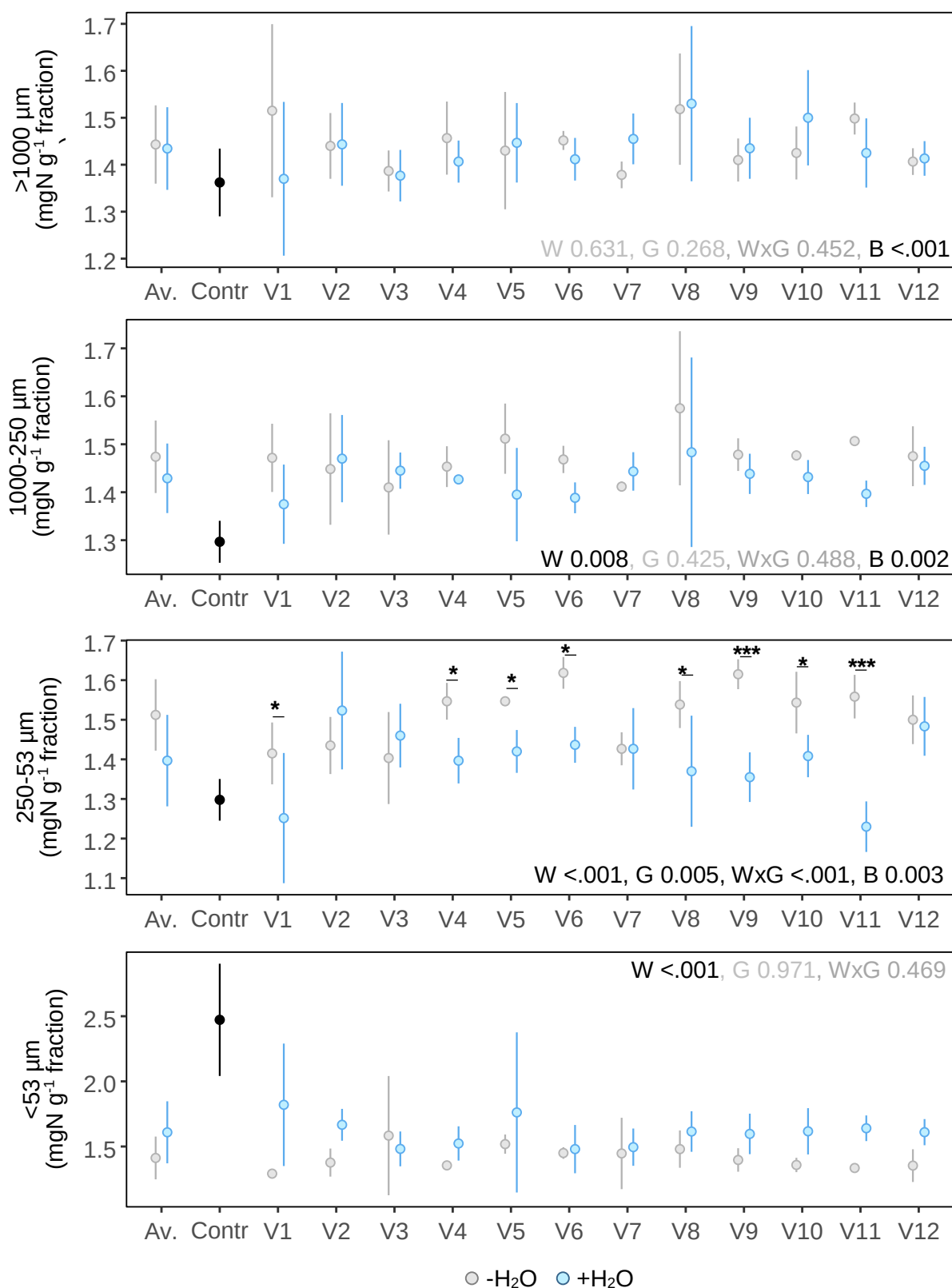


Fig S14 Nitrogen (N) contents within aggregate fractions in the unplanted control soil (Contr.), in the rhizosphere of individual maize varieties, and averaged across all rhizosphere samples (Av.) under reduced (-H₂O) and ambient precipitation (+H₂O) at the **clayey site** (mean $\pm$ SD). Effects of watering (W), variety (V), their interaction (WxV), and plot blocking (B) on the N contents of individual aggregate fractions are indicated by ANOVA p-values, with significant effects highlighted in bold. In the case of a significant Watering x Variety interaction, varieties that showed a significant effect of precipitation reduction on the N content of the corresponding aggregate size fraction are indicated ($p < 0.1$, $*p < 0.05$, $**p < 0.01$, $***p < 0.001$), based on estimated marginal means conditioned on variety. Varieties V1: *Almito*, V2: *Alpenfex*, V3: *Benedictio KWS*, V4: *Braunes Schindelmeiser*, V5: *Gelber Bad. Landmais*, V6: *Liberator*, V7: *LuigiCS*, V8: *Pautzfelder*, V9: *Pfarrkirchner*, V10: *PM Serveza*, V11: *Rheintaler Ribel*, V12: *Weihenstephaner2*.

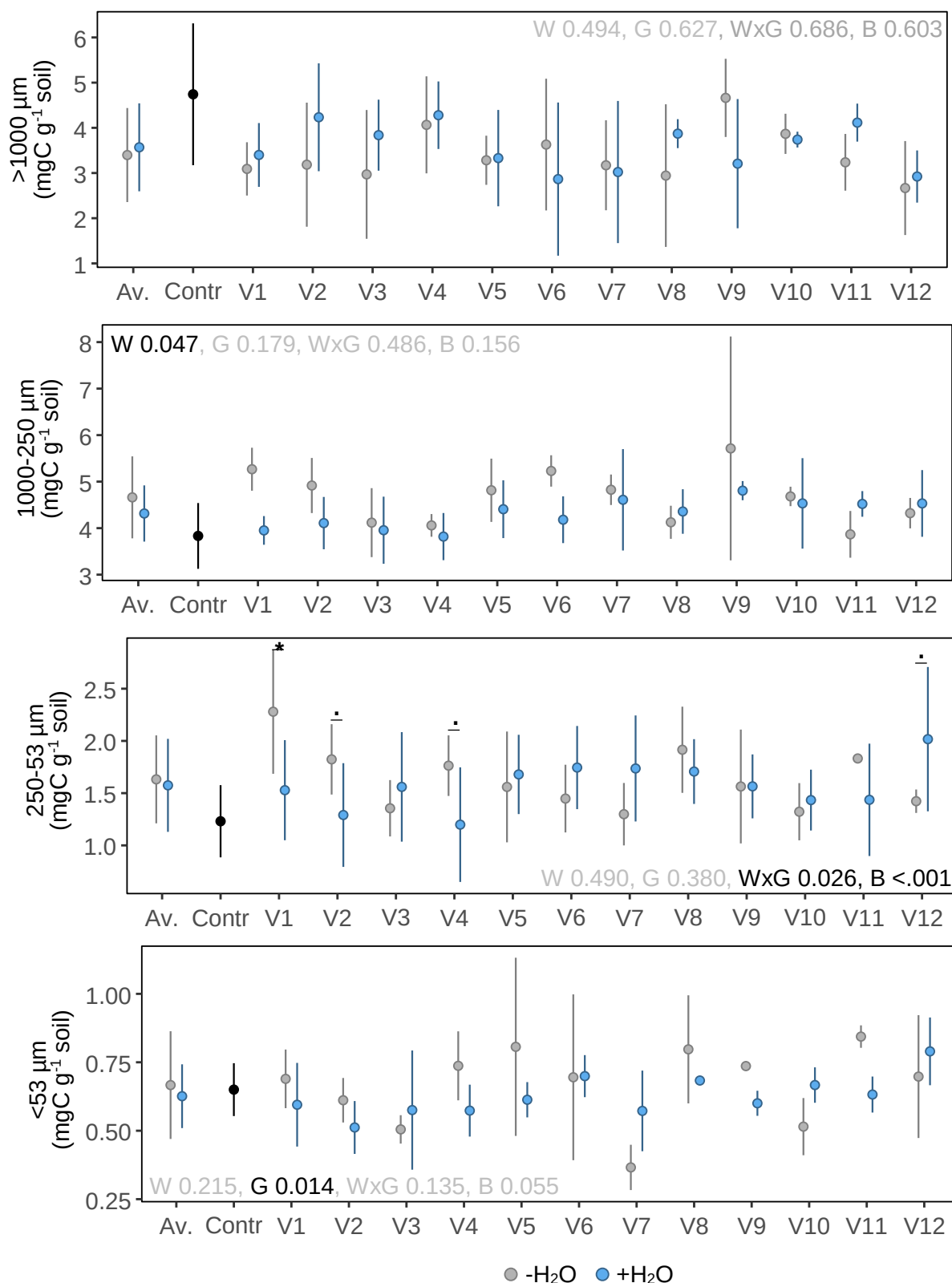


Fig S15 Aggregate-associated carbon (C) contents in the unplanted control soil (Contr.), in the rhizosphere of individual maize varieties, and averaged across all rhizosphere samples (Av.) under reduced (-H₂O) and ambient precipitation (+H₂O) at the **sandy site** (mean $\pm$ SD). Effects of watering (W), variety (V), their interaction (WxV), and plot blocking (B) on aggregate-associated C contents are indicated by ANOVA p-values, with significant effects highlighted in bold. In the case of a significant Watering x Variety interaction, varieties that showed a significant effect of precipitation reduction on the aggregate-associated carbon content of the corresponding aggregate size fraction are indicated (.p < 0.1, *p < 0.05, **p < 0.01, ***p < 0.001), based on estimated marginal means conditioned on variety. Varieties V1: *Almito*, V2: *Alpenfex*, V3: *Benedictio KWS*, V4: *Braunes Schindelmeiser*, V5: *Gelber Bad. Landmais*, V6: *Liberator*, V7: *LuigiCS*, V8: *Pautzfelder*, V9: *Pfarrkirchner*, V10: *PM Serveza*, V11: *Rheintaler Ribel*, V12: *Weihenstephaner2*.

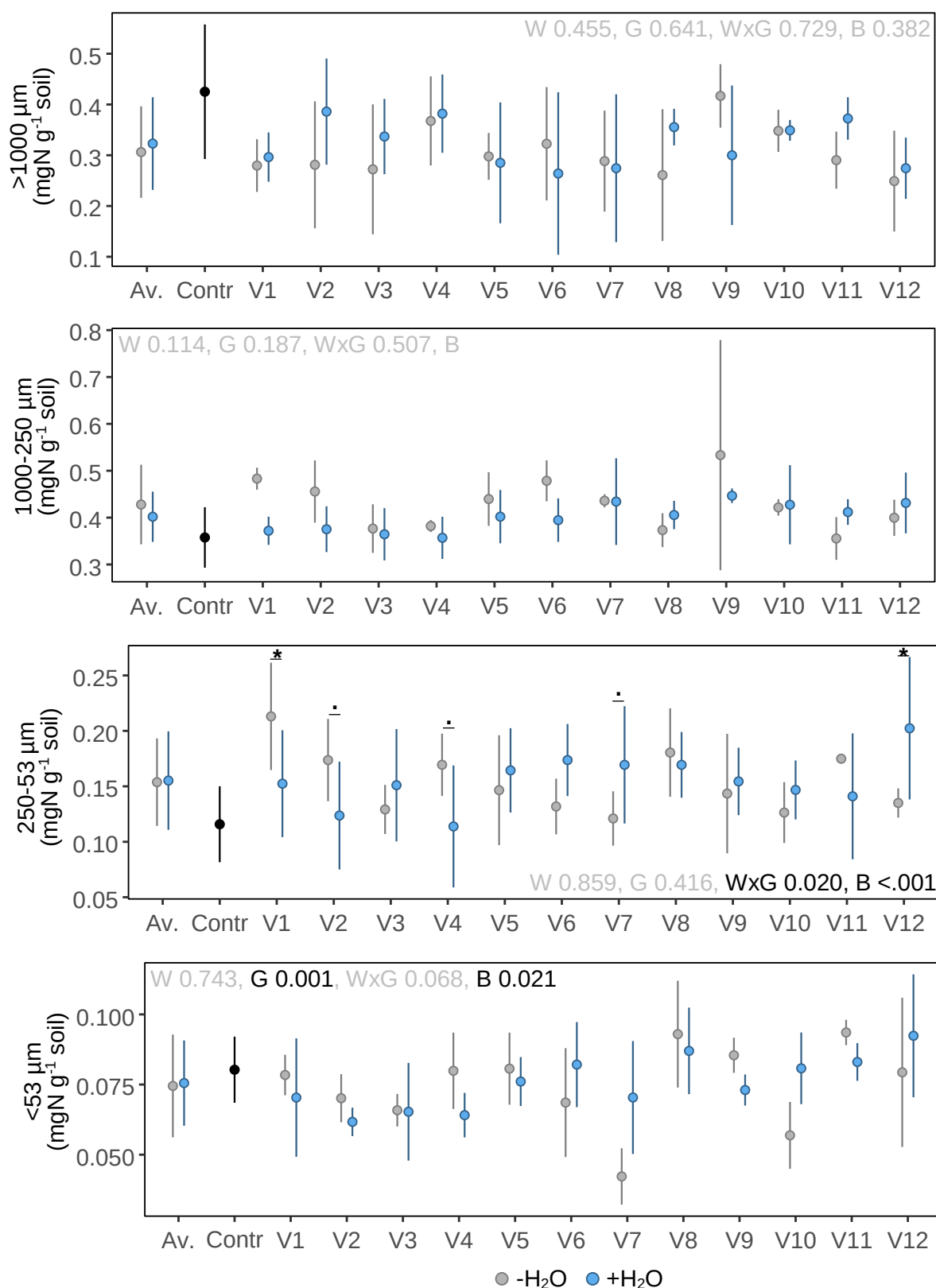


Fig S16 Aggregate-associated nitrogen (N) contents in the unplanted control soil (Contr.), in the rhizosheath of individual maize varieties, and averaged across rhizosheath samples (Av.) under reduced (-H₂O) and ambient precipitation (+H₂O) at the **sandy site** (mean $\pm$ SD). Effects of watering (W), variety (V), their interaction (WxV), and plot blocking (B) on aggregate-associated N contents are indicated by ANOVA p-values, with significant effects highlighted in bold. In the case of a significant Watering x Variety interaction, varieties that showed a significant effect of precipitation reduction on the aggregate-associated N content of the corresponding aggregate size fraction are indicated ($p < 0.1$, $*p < 0.05$, $**p < 0.01$, $***p < 0.001$), based on estimated marginal means conditioned on variety. Varieties V1: Almito, V2: Alpenfex, V3: Benedictio KWS, V4: Braunes Schindelmeiser, V5: Gelber Bad. Landmais, V6: Liberator, V7: LuigiCS, V8: Pautzfelder, V9: Pfarrkirchner, V10: PM Serveza, V11: Rheintaler Ribel, V12: Weihenstephaner2.

Table S3 Yield and functional root traits under ambient (+H₂O) and reduced precipitation (-H₂O). Letters indicate significant differences between precipitation treatments within the same parameter at one site according to Kruskal-Wallis or ANOVA results. R:S (indicator root: shoot ratio), RTD (root tissue density), RD (mean root diameter), RLD (root length density). Data by courtesy of S. Tung and A. J. Wild

	Clayey		Sandy	
	-H ₂ O	+H ₂ O	-H ₂ O	+H ₂ O
Above-ground biomass dry matter (t*ha ⁻¹)	22.75 ± 6.81 ^a	24.50 ± 8.00 ^a	10.75 ± 3.33 ^A	11.06 ± 3.75 ^A
Grain yield (t*ha ⁻¹)	11.08 ± 4.63 ^a	11.81 ± 5.32 ^a	5.26 ± 2.49 ^A	5.37 ± 2.67 ^A
R:S (mg roots kg ⁻¹ soil g ⁻¹ shoot)	8.81 ± 3.21 ^a	7.55 ± 2.11 ^b	22.14 ± 8.17 ^A	22.65 ± 11.89 ^A
RTD (mg cm ⁻³)	69.84 ± 18.37 ^a	67.36 ± 15.45 ^a	80.05 ± 14.85 ^A	73.46 ± 15.67 ^A
RD (mm)	0.43 ± 0.09 ^a	0.49 ± 0.09 ^b	0.29 ± 0.04 ^A	0.30 ± 0.06 ^A
RLD (mm cm ⁻³ soil)	61.45 ± 24.43 ^a	49.46 ± 27.59 ^b	126.06 ± 39.04 ^A	143.80 ± 56.52 ^A
SRL (m g ⁻¹)	57.47 ± 25.31 ^a	46.79 ± 20.07 ^a	108.75 ± 33.95 ^A	127.27 ± 47.42 ^A

Table S4 Multiple regression models describing yield performance as a function of root and rhizosheath properties. Models were conducted separately for grain yield (t ha^{-1}) and aboveground biomass dry matter (biomass; t ha^{-1}) at each site (clayey or sandy) and under each precipitation treatment (reduced ($-\text{H}_2\text{O}$) or ambient ($+\text{H}_2\text{O}$)). Standardized regression coefficients (β), their standard errors (se), t- and p-values are presented for soil and root traits identified as relevant to the corresponding yield parameter by best subset selection. RS_{norm} (normalized rhizosheath; g soil g^{-1} roots), $>250\mu\text{m}$ (mass contribution of aggregate fraction $> 250 \mu\text{m}$; mass-%), C_{Bulk} (bulk carbon content; mgC g^{-1} soil), R/S (indicator root: shoot ratio; mg roots kg^{-1} soil g^{-1} shoot), RTD (root tissue density; mg cm^{-3}), RD (mean root diameter; mm), RLD (root length density; mm cm^{-3} soil). For each model, the overall F-value, the corresponding degrees of freedom in parentheses, and the p-value are provided, along with the number of complete cases (n) considered in the model calculation

Grain Yield, $-\text{H}_2\text{O}$, Clayey site				
Predictor	β	se	t-value	p
Intercept	11.09	0.65	17.17	<0.001
R/S	-1.78	0.84	-2.14	0.041
RD	1.82	0.71	2.58	0.015
C_{Bulk}	-1.41	0.86	-1.65	0.110
F(3,30)=8.301, p<0.001, n=34				
Aboveground biomass dry matter, $-\text{H}_2\text{O}$, Clayey site				
Predictor	β	se	t-value	p
Intercept	22.90	0.85	27.00	<0.001
RS_{norm}	-1.06	0.92	-1.15	0.258
R/S	-1.68	1.15	-1.47	0.154
RD	4.09	0.94	4.37	0.000
C_{Bulk}	-2.13	1.15	-1.85	0.074
F(4,29)=9.316, p<0.001, n=34				
Grain Yield, $+\text{H}_2\text{O}$, Clayey site				
Predictor	β	se	t-value	p
Intercept	12.02	0.73	16.36	<0.001
$>250 \mu\text{m}$	2.31	0.93	2.49	0.019
RS_{norm}	-2.06	1.09	-1.89	0.070
R/S	-1.47	0.84	-1.76	0.090
RTD	-1.24	0.84	-1.48	0.150
RLD	1.79	0.84	2.14	0.042
F(5,28)=3.887, p=0.008, n=34				

Aboveground biomass dry matter, +H ₂ O, Clayey site				
Predictor	β	se	t-value	p
Intercept	25.21	1.00	25.19	<0.001
>250 μm	3.20	1.23	2.60	0.015
RS _{norm}	-3.58	1.20	-2.97	0.006
RTD	-1.78	1.15	-1.55	0.132
C _{Bulk}	-1.90	1.14	-1.67	0.106
RLD	3.68	1.14	3.22	0.003
F(5,27)=5.468, p=0.001, n=33				
Grain Yield, -H ₂ O, Sandy site				
Predictor	β	se	t-value	p
Intercept	5.15	0.38	13.49	<0.001
>250 μm	1.14	0.39	2.90	0.007
RS _{norm}	-0.64	0.41	-1.57	0.129
R/S	-0.57	0.42	-1.36	0.186
C _{Bulk}	-0.42	0.40	-1.06	0.298
F(4,26)=4.496, p=0.007, n=31				
Aboveground biomass dry matter, -H ₂ O, Sandy site				
Predictor	β	se	t-value	p
Intercept	10.62	0.50	21.31	<0.001
>250 μm	1.32	0.51	2.58	0.016
RS _{norm}	-0.82	0.53	-1.55	0.134
R/S	-0.91	0.55	-1.67	0.107
C _{Bulk}	-0.79	0.52	-1.53	0.138
F(4,26)=4.788, p=0.005, n=31				
Grain Yield, +H ₂ O, Sandy site				
Predictor	β	se	t-value	p
Intercept	5.18	0.45	11.62	<0.001
R/S	-0.54	0.47	-1.15	0.262
RD	-1.03	0.53	-1.96	0.061
RLD	-1.49	0.56	-2.68	0.012
F(3,27)=2.788, p=0.060, n=31				
Aboveground biomass dry matter, +H ₂ O, Sandy site				
Predictor	β	se	t-value	p
Intercept	10.29	0.61	16.97	<0.001
>250 μm	1.29	0.76	1.70	0.103
R/S	-1.44	0.66	-2.17	0.040
RD	-1.05	0.80	-1.31	0.204
RTD	-1.44	0.93	-1.56	0.133
RLD	-1.35	0.83	-1.62	0.118
F(5,23)=2.021, p=0.114, n=29				