

Table S1 Four different soil managements NK, NPK, CONMIN and BIODYN were applied on the DEMO (fertilization DEMONstration experiment, Reckenholz) and DOK (Dynamic, organic and conventional managements, Therwil) long-term fields and corresponding soil parameters were measured before sowing. (a) N_{tot} : total nitrogen, N_{org} : organic nitrogen, N_{min} : mineralisable nitrogen. NK: N and K fertilization, NPK: N, P and K fertilization, CON: CONMIN (conventional mineral fertilization) and BIO: BIODYN (biodynamic). In the “Input” section the amount of complex compounds amended on soil is specified and the resulting amount of P and K is symbolized by the arrow. (b) Measurements were performed on the DEMO and DOK fields subjected to four different soil managements (NK, NPK, CONMIN, and BIODYN). pH H_2O : pH in aqueous solution, pH $CaCl_2$: pH in salt solution, C_{org} : organic carbon, N: total nitrogen, C/N: carbon/nitrogen ratio, POXC: labile organic carbon, sand content, silt content, clay content, LM: large macro-aggregates (> 2000 μm), SM: small macro-aggregates (250 - 2000 μm), μA : micro-aggregates (53 - 250 μm), S+C: silt and clay fraction (< 53 μm), CEC: cation exchange capacity, BS: base saturation, Mno: Mn(III)oxide content, Feo: short-range ordered Fe(III) oxide content, Fed: total FeIII oxide content, Mg: magnesium, K: potassium, Ca: calcium, P: phosphorus, Mn: manganese, Fe: iron, Cu: copper, Zn: zinc, Na: sodium, Mo: molybdenum, Al: aluminum, KW: aqua regia extractable elements). Mean and standard deviation (n = 6, for C_{org} , N, C/N, POXC; n = 12, for LM, SM, and μA ; and n = 4 for S+C).

(a)

	DEMO NK	DEMO NPK	DOK CONMIN	DOK BIODYN
Fertilization scheme				
Farmyard manure (FYM)	-	-	-	30 m ³ /ha (autumn 2016) Composted FYM + slurry (Jauche)
Mineral	N: ammonium sulphate (21% N, 24% S) / ammonium nitrate K: potassium sulphate (50% K ₂ O, 18% S) P: triple superphosphate (46% P ₂ O ₅ , 12% Ca) Mg: Granumag (10% MgSO ₄ , 19% MgCO ₃)	N: ammonium sulphate (21% N, 24% S) / ammonium nitrate (27% N) K: potassium sulphate (50% K ₂ O, 18% S) P: triple superphosphate (46% P ₂ O ₅ , 12% Ca) Mg: Granumag (10% MgSO ₄ , 19% MgCO ₃)	Synthetic (NPK) according to Swiss fertilization ordination	-
Input				
Dry matter	-	-	-	1020 kg/ha
Organic matter	-	-	-	720 kg/ha
N_{tot}	N_{min} in soil: 90 kg N/ha (02.06.17) Ammonium sulphate: 55 kg N/ha (13.06.17) Ammonium nitrate: 45 kg/ha (22.06.17)	N_{min} in soil: 90 kg N/ha (02.06.17) Ammonium sulphate: 55 kg N/ha (13.06.17) Ammonium nitrate: 45 kg/ha (22.06.17)	40 kg N/ha (15.06.17) Calcium ammonium nitrate-20%	32 kg/ha
N_{org}	-	-	-	19 kg/ha
P	0 kg P ₂ O ₅ /ha → 0 kg P/ha	75 kg P ₂ O ₅ /ha → 33 kg P/ha	Not added in 2017	10 kg/ha
K	240 kg K ₂ O/ha → 200 kg K/ha	240 kg K ₂ O/ha → 200 kg K/ha	Not added in 2017	69 kg/ha
Ca / CaO	-	No special Ca and lime fertilizer (12% Ca in triple superphosphate)	26 kg/ha Calcium ammonium nitrate-13%	30 kg/ha
Mg	-	20 kg Mg/ha	9 kg/ha Calcium ammonium nitrate-4.5%	11 kg/ha
S	Parts N and K fertilizer	Parts N and K fertilizer	-	-
Plant protection scheme				
Weed control	Mechanical (no herbicides due to sensitivity of the inbred lines)	Mechanical (no herbicides due to sensitivity of the inbred lines)	Mechanical and herbicides	Mechanical
Disease control	-	-	Chemical (damage threshold)	Indirect methods
Insect control	Trichogramma (European corn borer)	Trichogramma (European corn borer)	Chemical (damage threshold)	Plant extracts, biocontrol
Special treatments	-	-	Plant growth regulators	Biodynamic preparations
Irrigation	-	-	20L/m ² (19.06.17)	20L/m ² (19.06.17)

(b)

		DEMO (Reckenholz)			DOK (Therwil)					
		NK fertilization		NPK fertilization	Mineral conventional fertilization (CONMIN)			Biodynamic fertilization (BIODYN)		
		NK		NPK	CONMIN-1	CONMIN-2	CONMIN-3	BIODYN-1	BIODYN-2	BIODYN-3
pH	pH_H2O	-	5.97 ± 0.13	6.85 ± 0.13	6.36 ± 0.11	5.91 ± 0.16	6.81 ± 0.14	6.93 ± 0.27	7.08 ± 0.15	7.02 ± 0.20
	pH_CaCl2	-	5.15 ± 0.17	5.94 ± 0.14	5.53 ± 0.20	4.86 ± 0.13	5.74 ± 0.16	5.95 ± 0.30	6.04 ± 0.15	6.02 ± 0.18
Organic matter	Corg	(g/Kg)	11.49 ± 0.65	15.51 ± 0.35	14.66 ± 0.29	12.90 ± 0.48	18.29 ± 0.50	17.26 ± 0.85	17.65 ± 0.49	22.36 ± 0.52
	N	(g/Kg)	1.68 ± 0.10	2.16 ± 0.06	1.98 ± 0.06	1.73 ± 0.09	2.40 ± 0.06	2.18 ± 0.07	2.25 ± 0.09	2.83 ± 0.08
	C/N	-	6.82 ± 0.21	7.19 ± 0.11	7.42 ± 0.26	7.46 ± 0.23	7.64 ± 0.15	7.91 ± 0.17	7.85 ± 0.18	7.91 ± 0.18
	POXC	(mg/Kg)	207.46 ± 31.36	404.28 ± 28.52	451.83 ± 38.48	263.37 ± 20.42	423.11 ± 48.06	488.61 ± 42.72	525.21 ± 26.44	577.32 ± 35.26
Particle size distribution	Sand	(g/Kg)	450.77 ± 10.43	390.45 ± 8.95	53.21 ± 1.66	54.67 ± 1.98	30.18 ± 4.79	55.37 ± 1.47	53.23 ± 2.55	24.83 ± 1.09
	Silt	(g/Kg)	433.48 ± 8.25	485.38 ± 6.21	833.82 ± 5.56	840.14 ± 2.10	822.77 ± 3.36	840.01 ± 1.19	836.73 ± 3.29	830.24 ± 1.28
	Clay	(g/Kg)	115.75 ± 2.34	124.17 ± 2.81	112.97 ± 4.78	105.19 ± 3.20	147.05 ± 2.92	104.63 ± 1.51	110.04 ± 4.17	144.93 ± 0.99
Soil aggregation	LM	%	14.05 ± 4.31	16.83 ± 4.33	6.34 ± 4.40	2.31 ± 1.82	8.62 ± 5.07	4.63 ± 1.76	2.95 ± 1.05	10.97 ± 4.76
	SM	%	42.22 ± 5.38	48.17 ± 2.47	50.03 ± 5.43	41.60 ± 4.52	39.98 ± 4.00	46.49 ± 2.43	55.35 ± 8.00	49.88 ± 6.03
	µA	%	38.25 ± 3.85	30.25 ± 2.61	29.58 ± 8.89	38.10 ± 3.98	37.37 ± 5.51	30.08 ± 1.47	26.74 ± 6.56	27.48 ± 7.79
	S+C	%	5.48 ± 1.18	4.74 ± 0.39	13.97 ± 1.12	17.93 ± 3.71	14.02 ± 1.74	18.80 ± 0.56	14.96 ± 2.37	11.60 ± 3.02
Nutrient retention	CEC	(cmol/Kg)	14.42 ± 2.21	16.58 ± 0.99	12.71 ± 0.30	9.69 ± 0.31	19.69 ± 0.33	13.67 ± 0.82	14.91 ± 0.29	20.62 ± 0.23
	BS	%	76.21 ± 14.12	94.78 ± 4.54	105.16 ± 5.40	102.92 ± 4.43	95.06 ± 1.36	103.58 ± 4.40	104.04 ± 3.19	96.91 ± 2.81
Oxides	Mno	(g/Kg)	0.39 ± 0.03	0.46 ± 0.02	0.44 ± 0.05	0.41 ± 0.03	0.40 ± 0.01	0.40 ± 0.04	0.46 ± 0.09	0.37 ± 0.02
	Feo	(g/Kg)	2.18 ± 0.09	2.29 ± 0.06	2.51 ± 0.10	2.27 ± 0.03	3.10 ± 0.07	2.33 ± 0.08	2.63 ± 0.10	3.13 ± 0.09
	Fed	(g/Kg)	8.44 ± 0.23	9.38 ± 0.21	8.11 ± 0.28	7.08 ± 0.12	10.88 ± 0.29	7.12 ± 0.21	7.83 ± 0.07	10.36 ± 0.56
Plant available nutrients	Mg	(mg/Kg)	11.13 ± 4.05	16.83 ± 1.99	15.94 ± 2.15	14.58 ± 0.70	16.78 ± 2.09	19.24 ± 4.48	20.35 ± 2.69	22.71 ± 2.88
	K	(mg/Kg)	10.77 ± 5.10	6.10 ± 1.01	15.77 ± 4.81	17.47 ± 6.39	7.72 ± 2.52	17.43 ± 5.98	18.65 ± 6.02	11.32 ± 2.20
	Ca	(mg/Kg)	57.63 ± 19.13	142.56 ± 23.09	102.86 ± 9.64	70.90 ± 5.98	149.71 ± 24.88	157.55 ± 34.14	163.57 ± 15.79	181.18 ± 19.27
	P	(mg/Kg)	0.95 ± 0.48	1.32 ± 0.21	2.20 ± 0.43	2.20 ± 0.52	1.27 ± 0.29	2.97 ± 0.89	3.05 ± 0.74	2.68 ± 0.27
	Mn	(mg/Kg)	1.98 ± 0.67	1.41 ± 0.20	2.01 ± 0.33	3.18 ± 0.49	1.67 ± 0.23	1.58 ± 0.26	1.25 ± 0.15	1.10 ± 0.15
	Fe	(mg/Kg)	17.65 ± 12.67	2.31 ± 1.05	8.32 ± 1.93	11.67 ± 2.34	1.79 ± 0.94	2.34 ± 0.91	3.53 ± 1.53	2.59 ± 1.15
	Cu	(mg/Kg)	0.11 ± 0.04	0.13 ± 0.02	0.13 ± 0.01	0.14 ± 0.01	0.09 ± 0.01	0.11 ± 0.01	0.11 ± 0.01	0.12 ± 0.01
	Zn	(mg/Kg)	0.08 ± 0.05	0.02 ± 0.01	0.06 ± 0.01	0.09 ± 0.02	0.02 ± 0.00	0.04 ± 0.01	0.04 ± 0.01	0.04 ± 0.01
	Na	(mg/Kg)	5.90 ± 2.05	6.36 ± 0.97	7.77 ± 1.60	6.25 ± 1.48	7.91 ± 1.87	8.18 ± 1.25	8.49 ± 2.01	11.88 ± 2.85
	Mo	(mg/Kg)	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
	aqua-regia extractable elements	Mg_KW	(mg/Kg)	4263.90 ± 59.22	5191.82 ± 111.83	3593.33 ± 140.11	3322.90 ± 83.40	5089.09 ± 178.40	3189.94 ± 70.09	3607.76 ± 84.46
K_KW		(mg/Kg)	4873.71 ± 176.11	5883.75 ± 219.21	4449.99 ± 274.39	4175.58 ± 303.73	6349.11 ± 193.15	4072.33 ± 82.48	4577.32 ± 148.38	6168.40 ± 222.35
Ca_KW		(mg/Kg)	2090.19 ± 160.41	2958.86 ± 148.25	3192.51 ± 120.60	2625.98 ± 162.90	3608.36 ± 139.05	3049.04 ± 142.90	3356.22 ± 64.81	3718.40 ± 156.35
P_KW		(mg/Kg)	341.50 ± 17.93	487.43 ± 18.57	451.37 ± 29.85	441.48 ± 21.92	536.92 ± 21.95	422.11 ± 21.24	482.49 ± 14.36	571.17 ± 15.91
Mn_KW		(mg/Kg)	653.38 ± 23.73	720.00 ± 34.93	748.49 ± 70.75	653.20 ± 43.78	673.54 ± 19.72	717.00 ± 58.12	680.30 ± 66.39	623.08 ± 25.63
Fe_KW		(mg/Kg)	18750.89 ± 224.77	21163.55 ± 408.08	18515.74 ± 677.35	17016.41 ± 436.30	24757.01 ± 890.56	16778.96 ± 442.74	18430.64 ± 449.81	24335.84 ± 901.78
Cu_KW		(mg/Kg)	21.50 ± 0.64	33.02 ± 0.80	19.23 ± 0.96	19.57 ± 1.47	24.93 ± 0.80	17.18 ± 0.53	18.16 ± 0.56	25.07 ± 1.11
Zn_KW		(mg/Kg)	46.49 ± 2.18	53.34 ± 1.44	50.70 ± 1.55	45.30 ± 1.39	65.33 ± 2.10	49.18 ± 1.37	53.38 ± 1.47	69.97 ± 2.38
Al_KW		(mg/Kg)	23817.27 ± 491.56	26869.82 ± 741.26	20926.41 ± 706.91	19208.92 ± 713.04	30127.89 ± 1047.27	18802.24 ± 494.79	20757.97 ± 402.32	29226.33 ± 1044.54
Mo_KW		(mg/Kg)	0.74 ± 0.03	0.78 ± 0.04	0.40 ± 0.02	0.36 ± 0.04	0.43 ± 0.02	0.41 ± 0.02	0.46 ± 0.02	0.52 ± 0.04