

Supplementary file

Table S1. Soil analysis data. Topsoil mineral N, plant available soil P and K (PCAL and KCAL) extracted with a calcium-acetate-lactate extract in kg ha⁻¹ and topsoil pH value for the seven treatments and four sampling dates in 2019 at the long-term fertilizer experiment Dikopshof (taken from Yi et al. 2020 [44]).

Sampling date	NPKCa+m+s	NPKCa	_PKCa	N_KCa	NP_Ca	NPK_	no fertilization
Mineral N							
May, 16	80.9	22.8	10.1	76.5	74.0	109.5	13.5
June, 13	32.5	9.4	5.2	18.8	26.6	36.2	20.7
July, 10	4.5	6.8	3.1	2.7	3.4	18.2	6.8
September, 10	4.9	4.1	1.8	4.0	8.1	3.6	3.2
PCAL							
May, 16	392	142	168	30	90	57	18
June, 13	344	158	182	36	88	67	35
July, 10	369	84	166	34	61	82	47
September, 10	292	147	147	28	91	65	18
KCAL							
May, 16	655	219	228	226	121	162	108
June, 13	563	211	243	198	100	144	126
July, 10	531	275	239	216	117	137	122
September, 10	576	462	320	285	84	117	76
pH value							
May, 16	6.4	6.5	6.9	6.4	6.6	5.5	5.8
June, 13	6.5	6.8	7.0	6.7	6.8	5.8	5.6
July, 10	6.7	6.3	6.9	6.4	6.8	5.8	5.5
September, 10	6.5	6.6	6.8	6.7	6.7	5.5	5.7

Table S2. Number of analyzed replicates per sampling date and treatment for LAI, DM root, DM shoot, Root morphology (total root length, root diameter) and link basic connectivity. For link basic connectivity, the replicates correspond to segments of one sample per treatment and per sampling date.

sampling date	LAI				DM root				DM shoot				SRL				Root morphology				Link basic connectivity			
	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
NPKCa+m+s	5	5	4	1	5	5	4	1	5	5	4	1	3	3	5	4	3	3	3	5	5	3	3	3
NPKCa	6	5	5	1	6	5	5	1	6	5	5	1	4	3	6	5	5	3	3	6	6	1	3	3
_PKCa	5	5	5	1	5	5	5	1	5	5	5	1	5	3	5	5	3	3	3	5	5	3	3	2
N_KCa	5	6	5	1	5	6	5	1	5	6	5	1	4	2	5	4	4	3	3	5	5	4	3	3
NP_Ca	5	5	5	1	5	5	5	1	5	5	5	1	4	3	6	5	3	3	3	6	6	4	3	3
NPK_	5	5	4	1	5	5	4	1	5	5	4	1	5	2	6	5	3	2	2	6	6	3	3	2
no fertilization	5	6	5	1	5	6	5	1	5	6	5	1	5	3	5	4	4	3	3	5	5	3	3	3

Table S3. Means of shoot and root C, N, P, K parameters as well as shoot C/N ratio and root C/N ratio.

Sampling date	NPKCa+m+s	NPK_	_PKCa	N_KCa	NP_Ca	NPKCa	no fertilization
shoot N (%)							
June, 13	4.41	4.03	4.83	4.71	4.69	4.66	4.6
July, 10	2.05	2.72	3.03	3.13	3.18	2.89	3.32
September, 10	2.57	1.89	2.82	2.11	2.22	1.99	1.88
shoot C (%)							
June, 13	36.38	37.08	36.87	37.1	37.06	36.64	39.04
July, 10	39.56	38.82	40.87	39.29	40.67	39.75	41.45
September, 10	33.96	32.89	37.47	35.2	36.28	34.6	32.56
shoot C/N ratio							
June, 13	8.24	7.9	9.2	7.87	7.64	7.86	8.48
July, 10	27.1	12.78	14.25	12.54	13.47	13.78	12.5
September, 10	13.23	16.31	17.41	16.7	13.29	17.36	17.33
root C/N ratio							
June, 13	18.83	20.02	26.25	18.52	18.6	18.33	21.76
July, 10	29.74	51.76	65.55	45.03	55.31	50.22	56.97
September, 10	44.7	48.04	77.9	45.11	43.38	43.56	63.55
root C (%)							
June, 13	41.1	42.83	42.31	41.84	42.68	43.03	42.44
July, 10	35.91	43.6	42.9	43.53	43.52	44.04	43.72
September, 10	50.15	50.95	47.01	49.5	47.46	50.2	49.03
root N (%)							
June, 13	2.23	2.14	1.61	2.26	2.3	2.35	1.95
July, 10	1.47	0.842	0.65	0.97	0.787	0.88	0.77
September, 10	1.12	1.06	0.6	1.1	1.09	1.15	0.77
shoot N (%)							
June, 13	4.41	4.69	4.03	4.71	4.83	4.66	4.6
July, 10	2.05	3.18	2.72	3.13	3.03	2.89	3.32
September, 10	2.57	2.22	1.89	2.11	2.82	1.99	1.88
shoot P (%)							
June, 13	0.37	0.41	0.4	0.35	0.43	0.42	0.37
July, 10	0.2	0.26	0.19	0.16	0.21	0.24	0.21
September, 10	0.18	0.15	0.18	0.1	0.14	0.13	0.09
shoot K (%)							
June, 13	10.13	8.37	7.12	7.89	5.49	8.15	4.76
July, 10	9.16	6.34	4.29	5.61	3.7	5.58	3.18
September, 10	6.62	3.61	0.75	2.88	2.92	3.67	1.68
root P (%)							
June, 13	0.35	0.37	0.39	0.3	0.34	0.37	0.3
July, 10	0.21	0.19	0.12	0.1	0.17	0.21	0.11
September, 10	0.16	0.09	0.12	0.06	0.14	0.15	0.07
root K (%)							
June, 13	4.26	2.82	2.38	3.79	2.78	4.01	2.54
July, 10	2	1.1	0.66	1.18	0.72	1.12	0.79
September, 10	1.41	0.65	0.44	0.76	0.86	0.88	0.52

Table S4. Share of interior root length (II, in %) exterior-interior (EI, in %) and exterior (EE, in %) of total root length (II, EI and EE) for the seven treatments and three sampling dates in 2019 at the long-term fertilizer experiment Dikopshof.

Sampling date	NPKCa+m+s	NPKCa	_PKCa	N_KCa	NP_Ca	NPK_	no fertilization
Share of interior (II) root length of total root length (%)							
May, 16	70.0	63.1	65.3	56.5	59.4	64.6	64.8
June, 13	60.7	58.0	60.7	55.1	59.9	57.5	62.2
September, 10	65.6	67.0	66.8	70.4	68.9	66.4	61.7
Share of exterior-interior (EI) root length of total root length (%)							
May, 16	20.6	24.9	18.8	27.1	26.5	20.8	26.7
June, 13	26.8	25.0	21.7	32.9	27.8	26.6	26.5
September, 10	20.7	19.7	20.4	17.1	19.1	21.3	23.8
Share of exterior-exterior (EE) root length of total root length (%)							
May, 16	9.4	12.0	15.9	16.5	14.1	14.6	8.5
June, 13	12.5	17.0	17.6	12.1	12.3	15.9	11.4
September, 10	13.7	13.3	12.8	12.5	12.0	12.3	14.4

Table S5. Number of interior (II), exterior-interior (EI) and exterior-exterior (EE) links per cm root length for the seven treatments and three sampling dates in 2019 at the long-term fertilizer experiment Dikopshof.

Sampling date	NPKCa+m+s	NPKCa	_PKCa	N_KCa	NP_Ca	NPK_	no fertilization
Number of interior (II) links per cm root length							
May, 16	3.5	3.6	1.9	2.1	1.9	2.8	2.9
June, 13	2.8	3.1	3.0	2.8	2.8	2.5	2.7
September, 10	5.8	6.0	6.6	6.2	7.1	6.6	5.7
Number of exterior-interior (EI) links per cm root length							
May, 16	0.6	0.8	0.5	0.6	0.7	0.5	0.7
June, 13	0.9	1.0	0.9	1.0	0.9	0.8	0.9
September, 10	1.3	1.3	1.3	1.2	1.3	1.5	1.3
Number of exterior-exterior (EE) links per cm root length							
May, 16	0.3	0.4	0.4	0.3	0.3	0.3	0.2
June, 13	0.5	0.7	0.7	0.5	0.5	0.4	0.5
September, 10	0.9	0.8	0.8	0.7	0.8	0.9	0.9