Table S1. δ13C signatures and N partitioning of the previous year leaves/needles sorted by site, season and ID. For each component, i.e., δ13C total N, soluble protein N, amino acid N, and structural N, a linear mixed model was fitted. Backward elimination of non-significant effects by the principle of marginality was found to generate the best model fit. Mean, standard deviation (s.d.), and significant differences (dif) are displayed. Differences are to be read as follows: Capital letters indicate differences between the same ID and site, but at different seasons; lowercase letters indicate differences between different IDs, but at the same season and site; hashtags and asterisks indicate differences between different sites, but same ID and season. Sharing the same letter/symbol indicates no significant difference at $p \leq 0.05$.

Leaves (previous)			δ13C [‰]			total N [mg/g DW]			protein N [mg/g DW]			amino acid N [mg/g DW]			structural N [mg/g DW]		
ID	Time	Site	mean	s.d.	dif	mean	s.d.	dif	mean	s.d.	dif	mean	s.d.	dif	mean	s.d.	dif
pure beech	Spring	Conventwald	–27.19	0.95	A#a	23.18	2.10	A#a	2.57	0.84	A#a	0.34	0.27	A#a	20.27	2.13	A#a
mixed beech	Spring	Conventwald	–26.09	0.57	A#a	22.32	2.04	A#a	1.41	0.92	A#ab	0.20	0.03	A#a	20.71	2.02	A#a
mixed fir	Spring	Conventwald	–26.11	0.72	A#*a	11.67	1.49	A#b	0.27	0.09	A#b	0.45	0.30	A#a	10.95	1.19	A#b
pure beech	Summer	Conventwald	–28.77	0.97	B#a	22.36	3.04	A#a	9.55	2.73	B#a	0.61	0.10	B#a	12.20	5.02	B#a
mixed beech	Summer	Conventwald	–28.05	0.67	B#a	19.57	3.29	A#a	8.36	3.43	B#a	0.65	0.10	B#a	10.56	4.84	B#a
mixed fir	Summer	Conventwald	–27.35	0.47	B#*a	13.40	2.56	A#b	0.34	0.34	A#b	0.56	0.43	A#a	12.51	2.22	A#a
pure beech	Fall	Conventwald	–28.43	1.30	B#a	22.16	3.26	A#a	9.82	2.35	B#a	0.57	0.11	B#a	11.77	4.45	B#a
mixed beech	Fall	Conventwald	–27.66	1.05	B#a	20.54	2.18	A#a	7.75	3.48	B#a	0.60	0.15	B#a	12.19	3.67	B#*a
mixed fir	Fall	Conventwald	–27.73	0.35	B#*a	13.68	2.25	A#b	0.49	0.39	A#b	0.55	0.43	A#a	12.64	2.06	A#a
pure beech	Spring	Freiamt	–26.97	1.17	A#a	21.96	2.43	A#a	3.54	1.33	A#a	0.58	0.28	A*a	17.84	2.90	A#a
mixed beech	Spring	Freiamt	–27.71	0.89	A#a	24.31	3.26	A#a	4.73	1.11	A*a	0.38	0.14	A#*a	19.19	3.25	A#a
mixed fir	Spring	Freiamt	–27.29	1.06	A#a	12.03	1.50	A#b	0.67	0.34	A#b	0.40	0.15	A#a	10.96	1.40	A#b
pure beech	Summer	Freiamt	–28.15	1.13	B#a	23.65	2.25	A#a	9.50	3.20	B#a	0.61	0.09	A#a	13.54	3.57	B#a
mixed beech	Summer	Freiamt	–29.80	0.95	B#a	27.97	4.34	A*a	12.23	2.71	B#a	0.62	0.09	A#a	15.12	5.72	A#a
mixed fir	Summer	Freiamt	–28.47	0.85	B#a	14.54	2.59	B#b	0.60	1.00	A#b	0.47	0.10	A#a	13.48	2.81	A#a
pure beech	Fall	Freiamt	–28.12	1.17	B#a	22.60	3.06	A#a	8.00	2.84	B#a	0.59	0.08	A#a	14.01	2.22	AB#a
mixed beech	Fall	Freiamt	–28.93	0.52	B#a	25.88	2.71	A*a	9.37	2.23	AB#*a	0.59	0.17	A#a	15.92	3.58	A#a
mixed fir	Fall	Freiamt	–28.17	0.99	B#a	14.91	1.35	B#b	0.49	0.27	A#b	0.56	0.29	A#a	13.86	1.35	A#a
pure beech	Spring	Croatia	–26.93	0.84	A#a	22.03	1.71	A#a	1.73	1.62	A#a	0.36	0.18	A#*a	19.94	2.39	A#a
mixed beech	Spring	Croatia	–26.52	0.69	A#ab	24.47	2.15	A#a	2.29	1.63	A#*a	0.52	0.18	A*a	21.66	2.08	A#a
mixed fir	Spring	Croatia	–25.58	1.27	A*b	10.77	0.49	A#b	0.40	0.16	A#a	0.37	0.06	A#a	10.00	0.60	A#b
pure beech	Summer	Croatia	–28.61	0.81	B#a	21.49	3.90	A#a	9.61	2.41	B#a	0.57	0.06	B#a	11.32	3.95	B#a
mixed beech	Summer	Croatia	–28.48	1.19	B#ab	24.89	2.15	A*a	8.13	1.83	B#a	0.67	0.13	A#a	16.09	3.35	A#a
mixed fir	Summer	Croatia	–27.15	0.51	B*b	15.44	2.49	A#b	0.36	0.21	A#b	0.49	0.06	A#a	14.61	2.47	A#a
pure beech	Fall	Croatia	–28.03	1.28	B#a	20.57	1.89	A#a	9.57	3.82	B#a	0.49	0.07	AB#a	10.39	3.47	B#a
mixed beech	Fall	Croatia	–27.87	0.94	B#ab	25.81	3.09	A#*b	17.54	4.33	C*b	0.67	0.13	A#a	7.87	4.78	B*a
mixed fir	Fall	Croatia	–25.98	0.99	B*b	13.74	1.87	A#c	0.67	0.35	A#c	0.45	0.09	A#a	12.62	1.96	A#a

Table S2. δ13C signatures and N partitioning of the current year leaves/needles sorted by site, season and ID. For each component, i.e., δ13C total N, soluble protein N, amino acid N, and structural N, a linear mixed model was fitted. Backward elimination of non–significant effects by the principle of marginality was found to generate the best model fit. Mean, standard deviation (s.d.), and significant differences (dif) are displayed. Differences are to be read as follows: Capital letters indicate differences between the same ID and site, but at different seasons; lowercase letters indicate differences between different IDs, but at the same season and site; hashtags and asterisks indicate differences between different sites, but same ID and season. Sharing the same letter/symbol indicates no significant difference at $p \leq 0.05$.

Leaves (current)			δ13C [‰]			total N [mg/g DW]			protein N [mg/g DW]			amino acid N [mg/g DW]			structural N [mg/g DW]		
ID	Time	Site	mean	s.d.	dif	mean	s.d.	dif	mean	s.d.	dif	mean	s.d.	dif	mean	s.d.	dif
pure beech	Spring	Conventwald	–27.19	0.95	A#a	23.18	2.10	A#a	2.57	0.84	A#*a	0.34	0.27	A#a	20.27	2.13	A#a
mixed beech	Spring	Conventwald	–26.09	0.57	A#a	22.32	2.04	A#a	1.41	0.92	A#a	0.20	0.03	A#a	20.71	2.02	A#a
mixed fir	Spring	Conventwald	–27.17	0.93	A#*a	14.53	1.75	A#*b	0.33	0.30	A#b	0.23	0.04	A#a	13.97	2.03	A#a
pure beech	Summer	Conventwald	–28.77	0.97	B#a	22.36	3.04	A#a	9.55	2.73	B#a	0.61	0.10	B#a	12.20	5.02	B#a
mixed beech	Summer	Conventwald	–28.05	0.67	B#a	19.57	3.29	A#a	8.36	3.43	B#a	0.65	0.10	B#a	10.56	4.84	B#a
mixed fir	Summer	Conventwald	–28.07	0.25	B#*a	10.88	2.19	A#b	0.14	0.09	A#b	0.40	0.11	B#a	10.97	1.68	A#a
pure beech	Fall	Conventwald	–28.43	1.30	B#a	22.16	3.26	A#a	9.82	2.35	B#a	0.57	0.11	B#a	11.77	4.45	B#a
mixed beech	Fall	Conventwald	–27.66	1.05	B#a	20.54	2.18	A#a	7.75	3.48	B#a	0.60	0.15	B#a	12.19	3.67	B#*a
mixed fir	Fall	Conventwald	–28.17	0.58	B#*a	12.15	3.68	A#b	0.40	0.33	A#b	0.56	0.43	B#a	11.20	3.43	A#a
pure beech	Spring	Freiamt	–26.97	1.17	A#a	21.96	2.43	A#a	3.54	1.33	A#a	0.58	0.28	A*a	17.84	2.90	A#a
mixed beech	Spring	Freiamt	–27.71	0.89	A#a	24.31	3.26	A#a	4.73	1.11	A*a	0.38	0.14	A*a	19.19	3.25	A#a
mixed fir	Spring	Freiamt	–27.65	1.12	A#a	19.30	3.79	A#a	0.25	0.16	A#b	0.39	0.12	A*a	18.66	3.85	A#a
pure beech	Summer	Freiamt	–28.15	1.13	B#a	23.65	2.25	A#a	9.50	3.20	B#a	0.61	0.09	A#a	13.54	3.57	B#a
mixed beech	Summer	Freiamt	–29.80	0.95	B#a	27.97	4.34	A*a	12.23	2.71	A#a	0.62	0.09	A#ab	15.12	5.72	A#a
mixed fir	Summer	Freiamt	–29.46	0.97	B#a	12.23	1.28	B#b	0.28	0.22	A#b	0.43	0.14	A#b	11.52	1.34	B#a
pure beech	Fall	Freiamt	–28.12	1.17	B#a	22.60	3.06	A#a	8.00	2.84	B#a	0.59	0.08	A#a	14.01	2.22	AB#a
mixed beech	Fall	Freiamt	–28.93	0.52	B#a	25.88	2.71	A#a	9.37	2.23	A#a	0.59	0.17	A#a	15.92	3.58	A#a
mixed fir	Fall	Freiamt	–28.74	1.26	B#a	12.59	2.05	B#b	0.35	0.25	A#b	0.34	0.06	A#b	11.90	2.06	B#a
pure beech	Spring	Croatia	–26.93	0.84	A#a	22.03	1.71	A#a	1.73	1.62	A*a	0.36	0.18	A#*a	19.94	2.39	A#a
mixed beech	Spring	Croatia	–26.52	0.69	A#ab	24.47	2.15	A#a	2.29	1.63	A#*a	0.52	0.18	A*a	21.66	2.08	A#a
mixed fir	Spring	Croatia	–26.14	1.14	A*b	13.48	1.01	A*b	0.28	0.08	A#b	0.29	0.07	A#*a	12.91	1.06	A#b
pure beech	Summer	Croatia	–28.61	0.81	B#a	21.49	3.90	A#a	9.61	2.41	B#a	0.57	0.06	B#ab	11.32	3.95	B#a
mixed beech	Summer	Croatia	–28.48	1.19	B#ab	24.89	2.15	A#*a	8.13	1.83	B#a	0.67	0.13	B#a	16.09	3.35	A#a
mixed fir	Summer	Croatia	–26.40	0.94	B*b	12.42	1.85	A#b	0.18	0.15	A#b	0.43	0.06	A#b	11.80	1.86	A#a
pure beech	Fall	Croatia	–28.03	1.28	B#a	20.57	1.89	A#a	9.57	3.82	B#a	0.49	0.07	AB#ab	10.39	3.47	B#a
mixed beech	Fall	Croatia	–27.87	0.94	B#ab	25.81	3.09	A#b	17.54	4.33	B#a	0.67	0.13	B#a	7.87	4.78	B*a
mixed fir	Fall	Croatia	–25.95	1.06	B*b	12.62	1.53	A#c	0.36	0.23	A#b	0.32	0.13	A#b	11.93	1.46	A#a

Table S3. δ13C signatures and N partitioning of the roots sorted by site, season and ID. For each component, i.e., δ13C total N, soluble protein N, amino acid N, and structural N, a linear mixed model was fitted. Backward elimination of non-significant effects by the principle of marginality was found to generate the best model fit. Mean, standard deviation (s.d.), and significant differences (dif) are displayed. Differences are to be read as follows: Capital letters indicate differences between the same ID and site, but at different seasons; lowercase letters indicate differences between different IDs, but at the same season and site; hashtags and asterisks indicate differences between different sites, but same ID and season. Sharing the same letter/symbol indicates no significant difference at $p \leq 0.05$.

Roots			δ13C [‰]			total N [mg/g DW]			protein N [mg/g DW]			amino acid N [mg/g DW]			structural N [mg/g DW]		
ID	Time	Site	mean	s.d.	dif	mean	s.d.	dif	mean	s.d.	dif	mean	s.d.	dif	mean	s.d.	dif
pure beech	Spring	Conventwald	–26.68	0.80	A#*a	17.81	4.54	A#a	0.33	0.17	A#a	0.49	0.16	A#*a	17.02	4.37	A#a
mixed beech	Spring	Conventwald	–26.31	0.44	A#a	17.45	2.94	A#a	0.33	0.16	A#a	0.24	0.06	A#a	16.88	2.78	A#a
mixed fir	Spring	Conventwald	–26.45	0.71	A#a	16.99	3.60	A#a	0.27	0.11	A#a	0.37	0.20	A#a	16.34	3.38	A#a
pure beech	Summer	Conventwald	–25.88	0.83	B#*a	13.22	3.36	B#*a	4.34	2.95	B#a	0.67	0.48	B#*a	8.21	2.13	B#a
mixed beech	Summer	Conventwald	–25.05	0.69	B#a	15.01	3.05	A#a	4.51	1.66	B#a	0.59	0.36	B#a	9.92	1.51	B#a
mixed fir	Summer	Conventwald	–24.95	0.88	B#a	15.58	2.64	A#a	5.51	1.67	B#a	0.87	0.38	B#a	9.20	1.74	B#a
pure beech	Fall	Conventwald	–26.04	1.10	B#*a	13.96	3.32	B#*a	4.21	3.36	B#a	0.67	0.43	B#*a	9.09	2.91	B#a
mixed beech	Fall	Conventwald	–25.04	0.91	B#a	15.21	2.78	A#a	4.56	2.11	B#a	0.74	0.29	B#a	9.90	1.49	B#a
mixed fir	Fall	Conventwald	–24.88	1.02	B#a	15.97	3.09	A#a	6.24	2.16	B#a	0.93	0.49	B#a	8.81	1.16	B#a
pure beech	Spring	Freiamt	–28.18	1.09	A#a	12.93	4.71	A*a	0.41	0.10	A#a	0.55	0.35	A#a	11.97	4.39	A*a
mixed beech	Spring	Freiamt	–28.86	0.76	A*a	10.28	3.29	A*a	0.37	0.05	A#a	0.37	0.12	A#a	9.55	3.30	A*a
mixed fir	Spring	Freiamt	–27.96	1.18	A*a	13.33	2.56	A#a	0.38	0.08	A#a	0.48	0.21	A#a	12.47	2.53	A*a
pure beech	Summer	Freiamt	–26.83	0.76	B#a	16.31	2.64	AB#a	4.26	1.04	B#a	1.38	1.14	B#a	10.68	2.10	A#a
mixed beech	Summer	Freiamt	–27.75	0.63	B*a	12.80	2.88	AB#a	4.00	1.48	B#a	0.89	0.63	B#a	7.90	2.19	A#a
mixed fir	Summer	Freiamt	–26.67	0.62	B*a	14.28	3.17	A#a	3.27	1.52	B#*a	1.27	0.70	B#a	9.75	3.16	A#a
pure beech	Fall	Freiamt	–26.45	0.35	B#a	18.26	2.30	B#a	4.26	1.04	B#a	1.00	0.31	B#a	13.01	2.20	A*a
mixed beech	Fall	Freiamt	–27.63	0.43	B*a	16.03	3.28	B#a	4.00	1.48	B#a	0.94	0.62	B#a	11.09	3.06	A#a
mixed fir	Fall	Freiamt	–26.72	0.71	B*a	14.33	2.23	A#a	3.27	1.52	B#a	0.93	0.27	B#a	10.13	2.13	A#a
pure beech	Spring	Croatia	–26.84	0.58	A*a	13.08	2.71	A*a	0.23	0.07	A#a	0.24	0.08	A*a	12.61	2.77	A*a
mixed beech	Spring	Croatia	–26.54	0.70	A#a	16.71	2.48	A#a	0.24	0.08	A#a	0.38	0.07	A#a	16.09	2.56	A#a
mixed fir	Spring	Croatia	–26.98	1.03	A*a	14.57	2.64	A#a	0.26	0.05	A#a	0.34	0.12	A#a	13.97	2.53	A#*a
pure beech	Summer	Croatia	–25.63	0.56	B*a	11.03	1.34	AB*a	1.89	0.43	B*a	0.46	0.19	B*a	8.68	1.16	B#a
mixed beech	Summer	Croatia	–26.23	1.11	B#a	13.66	1.04	AB#a	1.79	0.43	B#a	0.74	0.39	B#a	11.13	1.05	B#a
mixed fir	Summer	Croatia	–26.55	0.93	B#*a	13.61	1.76	A#a	1.81	0.27	B*a	0.62	0.31	B#a	11.18	1.69	B#a
pure beech	Fall	Croatia	–25.72	0.58	B*a	9.61	1.02	B*a	3.63	0.66	C#a	0.38	0.12	B*a	5.60	1.12	C#a
mixed beech	Fall	Croatia	–25.79	1.21	B#a	11.65	0.98	B#a	3.52	0.78	C#a	0.84	0.34	B#a	7.29	1.21	C#a

mixed fir	Fall	Croatia	–25.58	0.87	B#*a	11.58	0.96	A#a	3.27	0.38	C#a	0.68	0.12	B#a	7.62	1.02	C#a

Table S4. Net N uptake capacities of beech and fir roots sorted by site, N source, season and ID. For N uptake a linear mixed model was fitted. Backward elimination of non-significant effects by the principle of marginality was found to generate the best model fit. Mean N uptake and standard deviation (s.d.) are displayed. Significant differences in N uptake capacity (dif) are to be read as follows: Capital letters indicate differences between different N sources, but same ID and site; lowercase letters indicate differences between IDs at the same site and N source; hashtags and asterisks indicate differences between sites, but the same IDs and N sources. Sharing the same letter/symbol indicates no significant difference at $p \leq 0.05$.

				N Uptake		
ID	Time	N Source	Site	Mean	Stdev	dif
pure beech	Spring	A	Conventwald	264.11	260.01	A#a
mixed beech	Spring	A	Conventwald	138.81	78.23	A#a
mixed fir	Spring	A	Conventwald	113.80	91.23	A#a
pure beech	Spring	G	Conventwald	92.12	43.19	A#*a
mixed beech	Spring	G	Conventwald	64.61	48.74	A#a
mixed fir	Spring	G	Conventwald	53.32	28.14	A#a
pure beech	Spring	NH4	Conventwald	12.09	3.49	B#*a
mixed beech	Spring	NH4	Conventwald	8.53	5.49	B#a
mixed fir	Spring	NH4	Conventwald	13.19	11.11	B#a
pure beech	Spring	NO3	Conventwald	19.05	12.82	B#*a
mixed beech	Spring	NO3	Conventwald	11.99	9.35	B#a
mixed fir	Spring	NO3	Conventwald	15.09	5.69	AB#a
pure beech	Spring	A	Freiamt	105.24	24.05	A#a
mixed beech	Spring	A	Freiamt	122.99	36.86	A#a
mixed fir	Spring	A	Freiamt	173.95	168.43	A#a
pure beech	Spring	G	Freiamt	40.30	15.32	B#a
mixed beech	Spring	G	Freiamt	47.38	20.35	A#a
mixed fir	Spring	G	Freiamt	48.97	22.78	B#a
pure beech	Spring	NH4	Freiamt	5.07	3.70	C#a
mixed beech	Spring	NH4	Freiamt	10.24	8.20	B#a
mixed fir	Spring	NH4	Freiamt	7.28	3.03	C#a
pure beech	Spring	NO3	Freiamt	5.38	3.43	C#a
mixed beech	Spring	NO3	Freiamt	4.68	1.48	B#a
mixed fir	Spring	NO3	Freiamt	6.81	5.83	C#a
pure beech	Spring	A	Croatia	217.57	73.49	A#a
mixed beech	Spring	A	Croatia	148.32	84.78	A#a
mixed fir	Spring	A	Croatia	127.68	20.04	A#a
pure beech	Spring	G	Croatia	142.84	74.07	A*a
mixed beech	Spring	G	Croatia	95.89	38.78	A#a
mixed fir	Spring	G	Croatia	80.10	14.24	A#a
pure beech	Spring	NH4	Croatia	21.93	8.65	B*a
mixed beech	Spring	NH4	Croatia	10.22	7.10	B#a
mixed fir	Spring	NH4	Croatia	8.46	6.17	B#a
pure beech	Spring	NO3	Croatia	37.88	18.39	B*a
mixed beech	Spring	NO3	Croatia	15.09	4.87	B#a
mixed fir	Spring	NO3	Croatia	13.77	4.70	B#a
pure beech	Summer	A	Conventwald	167.32	48.24	A#a
mixed beech	Summer	A	Conventwald	253.93	40.65	A#a
mixed fir	Summer	A	Conventwald	171.20	62.10	A#a
pure beech	Summer	G	Conventwald	56.42	30.01	B#a
mixed beech	Summer	G	Conventwald	26.31	20.84	B#a
mixed fir	Summer	G	Conventwald	26.19	15.76	B#a
pure beech	Summer	NH4	Conventwald	9.80	5.77	C#a
mixed beech	Summer	NH4	Conventwald	6.12	2.89	BC#a

mixed fir	Summer	NH4	Conventwald	4.41	1.87	C#a
pure beech	Summer	NO3	Conventwald	3.18	1.92	D#a
mixed beech	Summer	NO3	Conventwald	6.26	6.25	C#a
mixed fir	Summer	NO3	Conventwald	4.48	3.80	C#a
pure beech	Summer	A	Freiamt	159.41	32.84	A#a
mixed beech	Summer	A	Freiamt	155.37	24.39	A#a
mixed fir	Summer	A	Freiamt	94.30	42.12	A#a
pure beech	Summer	G	Freiamt	44.21	22.46	B#a
mixed beech	Summer	G	Freiamt	47.00	18.21	A#a
mixed fir	Summer	G	Freiamt	37.85	23.59	A#a
pure beech	Summer	NH4	Freiamt	6.45	4.44	C#a
mixed beech	Summer	NH4	Freiamt	8.06	3.60	B#a
mixed fir	Summer	NH4	Freiamt	8.04	7.00	B#a
pure beech	Summer	NO3	Freiamt	3.36	1.92	C#a
mixed beech	Summer	NO3	Freiamt	2.46	1.40	B#a
mixed fir	Summer	NO3	Freiamt	6.33	4.84	B#a
pure beech	Summer	A	Croatia	239.74	126.41	A#a
mixed beech	Summer	A	Croatia	195.37	87.66	A#a
mixed fir	Summer	A	Croatia	139.52	42.81	A#a
pure beech	Summer	G	Croatia	60.82	33.99	B#a
mixed beech	Summer	G	Croatia	47.79	42.36	B#a
mixed fir	Summer	G	Croatia	38.45	20.63	B#a
pure beech	Summer	NH4	Croatia	8.45	3.97	C#a
mixed beech	Summer	NH4	Croatia	9.68	7.82	C#a
mixed fir	Summer	NH4	Croatia	7.79	2.75	C#a
pure beech	Summer	NO3	Croatia	6.56	4.67	C#a
mixed beech	Summer	NO3	Croatia	8.08	5.14	C#a
mixed fir	Summer	NO3	Croatia	7.28	11.41	C#a
pure beech	Fall	A	Conventwald	162.62	52.27	A#a
mixed beech	Fall	A	Conventwald	243.81	52.00	A#a
mixed fir	Fall	A	Conventwald	197.93	39.39	A#a
pure beech	Fall	G	Conventwald	63.27	24.91	A#a
mixed beech	Fall	G	Conventwald	35.04	16.01	B#a
mixed fir	Fall	G	Conventwald	32.74	19.07	B#a
pure beech	Fall	NH4	Conventwald	10.20	5.35	B#a
mixed beech	Fall	NH4	Conventwald	7.03	0.62	BC#a
mixed fir	Fall	NH4	Conventwald	4.92	1.41	C#a
pure beech	Fall	NO3	Conventwald	4.37	2.13	B#a
mixed beech	Fall	NO3	Conventwald	4.27	2.45	C#a
mixed fir	Fall	NO3	Conventwald	3.90	3.83	C#a
pure beech	Fall	A	Freiamt	121.18	60.77	A#a
mixed beech	Fall	A	Freiamt	127.63	37.95	A#a
mixed fir	Fall	A	Freiamt	99.40	31.29	A#a
pure beech	Fall	G	Freiamt	19.56	11.86	B*a
mixed beech	Fall	G	Freiamt	27.27	18.29	B#a
mixed fir	Fall	G	Freiamt	22.64	11.33	B#a
pure beech	Fall	NH4	Freiamt	7.26	5.05	C#a
mixed beech	Fall	NH4	Freiamt	6.74	1.71	BC#a
mixed fir	Fall	NH4	Freiamt	5.72	3.47	C#a
pure beech	Fall	NO3	Freiamt	21.12	55.42	C#a
mixed beech	Fall	NO3	Freiamt	5.77	2.94	C#a
mixed fir	Fall	NO3	Freiamt	2.82	2.57	C#a
pure beech	Fall	A	Croatia	189.33	40.11	A#a

mixed beech	Fall	A	Croatia	185.87	72.92	A#a
mixed fir	Fall	A	Croatia	187.74	48.49	A#a
pure beech	Fall	G	Croatia	72.78	34.20	B#a
mixed beech	Fall	G	Croatia	52.91	24.09	A#a
mixed fir	Fall	G	Croatia	58.61	22.44	A#a
pure beech	Fall	NH4	Croatia	12.38	6.33	C#a
mixed beech	Fall	NH4	Croatia	9.38	2.55	B#a
mixed fir	Fall	NH4	Croatia	6.89	1.93	B#a
pure beech	Fall	NO3	Croatia	11.15	9.39	C#a
mixed beech	Fall	NO3	Croatia	8.04	6.21	B#a
mixed fir	Fall	NO3	Croatia	6.59	4.74	B#a

Table S5. Basic climate, vegetation, and soil properties of the investigated field sites. *DBH*: diameter at breast height, *MAAT*: mean annual air temperature, *SOC*: soil organic carbon, *TN*: soil total nitrogen. The CO site has a long research history (e.g., Puhlmann and von Wilpert 2009; von Wilpert et al. 1996; von Wilpert 2008); current soil data (texture, SOC, TN, and soil type) were kindly provided by the University of Freiburg: Chair of soil ecology, Lang and Krüger (personal communication). The vegetation data were kindly provided by the forest administrations ''Breisgau-Hochschwarzwald'' (for CO), ''Emmendingen'' (for EM), and via personal communication with the forest administration in Gospic regarding the Croatian site (CR), respectively.

Site	Gospić, (CR) Croatia	Freiamt, (EM) Germany	Conventwald, (CO) Germany
Elevation (m asl)	800-900	400	700
MAAT (°C) (period)	7.5 (1987–2010)	9.6 (1987–2014)	7.3 (1971–2001)
Annual precipitation (mm) (period)	2230 (1987–2010)	1100 (1987–2014)	1777 (1971–2001)
Vegetation composition (pure/mixed) (%)	Beech: 57/38 Silver-fir: 40/50 others: 3/12	Beech: 70 Silver fir: 15 Larch: 15	Beech: 60/35 Silver fir: 10/35 Spruce: 40/5 Douglas fir: 0/10 Larch:0/5
Stand age (pure/mixed) (a)	30–40/70–90	40–60	67–102/120
Growth rate (dbh of beech/silver-fir) (m a^{-1})	0.0085/0.0053	0.0062/0.0074	0.0048/0.0055
Tree height (pure/mixed) (average) (m)	15/25	24	29
Soil parent material	Limestone	Sandstone	Paragneiss
Soil type (depth to parent material)	Chromic Cambisol (45cm)	Dystric Cambisol (100cm)	Hyperdystric Skeletic Folic Cambisol (60–100cm)
Soil texture	silty clay	sandy loam	loam
SOC (mg g^{-1}) (depth cm) organic layer	451 ± 48 (organic layer)	433 ± 65 (organic layer)	446 ± 90 (organic layer)
SOC Ah	138 ± 50 (0–5)	25 ± 8 (0–15)	114 ± 48.6 (0–23)
SOC Bv1	48 ± 21 (5–25)	7 ± 3 (15–40)	45 ± 14.7 (23–48)
SOC Bv2	33 ± 15 (25–45)	3 ± 2 (40–100)	13 ± 9 (48–92)
TN Litter (mg g^{-1}) (depth cm) organic layer	15.8 ± 2.8 (organic layer)	14.9 ± 3 (organic layer)	16 ± 3.5 (organic layer)
TN Ah	8.2 ± 2.2 (0–5)	1.4 ± 0.5 (0–15)	5.1 ± 2.4 (0–23)
TN Bv1	3.2 ± 0.9 (5–25)	0.5 ± 0.1 (15–40)	2 ± 0.5 (23–48)
TN Bv2	2.4 ± 0.8 (25–45)	0.5 ± 0.1 (40–100)	0.76 ± 0.3 (48–92)
Inorganic N Litter (mg kg^{-1})	25.7 ± 13 (a)	24.7 ± 8.8 (a)	11.1 ± 4.7 (a)
Inorganic N Ah	6.8 ± 1.9 (b)	5.2 ± 2.8 (b)	4.1 ± 1.9 (b)
Inorganic N Bv	3.1 ± 1.7 (b)	1.9 ± 0.5 (b)	2.4 ± 1.1 (b)
C:N ratio Ah (depth cm)	17 ± 3 (0–5)	17 (0–15)	22 (0–23)
C:N ratio Bv1	17 ± 9 (5–25)	12 (15–40)	23 (23–48)
C:N ratio Bv2	16 ± 8 (25–45)	7 (40–100)	17 (48–92)
SOC stocks profile (kg C m^{-2})	18 ± 6 (45cm)	9 (100cm)	66 (100cm)
TN stocks profile	1.2 ± 0.3	0.8 (100cm)	3.1 (100cm)

(kg N m^{-2})	(45cm)		
Field capacity Ah (depth cm)	33 vol% (5)	20 vol% (0–15)	16 vol% (0–23)
Field capacity Bv1	n.a.	17 vol% (15–40)	23.5 vol% (23–48)
Field capacity Bv2	32 vol% (40)	17 vol% (40–100)	17 vol% (48–92)

Table S6. Correlation between pure beech plant parameters and soil parameters in fall. Leaf total N (LNT [mg g^{-1} DW]), Leaf protein N (LNP [mg g^{-1} DW]), Leaf amino acid N (LNAS [mg g^{-1} DW]), Leaf structural N (LNS [mg g^{-1} DW]), roots total N (RNT [mg g^{-1} DW]), roots amino acid N (RNAS [mg g^{-1} DW]), and roots structural N (RNS [mg g^{-1} DW]) are correlated with three soil depths' (i.e., Litter, Ah, Bv) total N (TN [mg g^{-1}]), soil inorganic N (Nmin [mg kg^{-1}]), and organic carbon (SOC [mg g^{-1}]). Correlation coefficient is Spearman's rho (ϱ) followed by asterisks depicting corresponding p-values: $p < 0.0001$ "****"; $p < 0.001$ "***"; $p < 0.01$ "**"; $p < 0.05$ "*".

Fall BB	LNT	LNP	LNAS	LNS	RNT	RNP	RNAS	RNS	LC13	R13C	TN.Litter	TN.Ah	TN.Bv	SOC.Litter	SOC.Ah	SOC.Bv
LNT																
LNP	0.16															
LNAS	0.1	0.15														
LNS	0.60***	–0.62****	–0.04													
RNT	0.46**	–0.28	0.35*	0.51**												
RNP	0.47**	–0.16	0.3	0.42*	0.29											
RNAS	0.49**	–0.21	0.32	0.46**	0.86****	0.45**										
RNS	0.25	–0.22	0.23	0.34*	0.87****	–0.07	0.66****									
LC13	–0.13	0.41*	–0.1	–0.43*	–0.12	–0.36*	–0.13	0.05								
R13C	–0.15	0.03	–0.35*	–0.15	–0.3	–0.17	–0.38*	–0.33	0.2							
TN.Litter	–0.11	0.23	–0.12	–0.32	–0.48**	–0.27	–0.52**	–0.51**	–0.04	0.40*						
TN.Ah	–0.14	0.23	–0.13	–0.37*	–0.47**	–0.26	–0.52**	–0.51**	–0.01	0.40*	0.97****					
TN.Bv	–0.15	0.17	–0.13	–0.34	–0.40*	–0.28	–0.42*	–0.46**	–0.07	0.43*	0.93****	0.96****				
SOC.Litter	–0.14	0.22	–0.12	–0.33	–0.47**	–0.28	–0.48**	–0.51**	–0.04	0.39*	0.99****	0.95****	0.94****			
SOC.Ah	–0.14	0.23	–0.13	–0.37*	–0.47**	–0.26	–0.52**	–0.51**	–0.01	0.40*	0.97****	1.00****	0.96****	0.95****		
SOC.Bv	–0.15	0.17	–0.13	–0.34	–0.40*	–0.28	–0.42*	–0.46**	–0.07	0.43*	0.93****	0.96****	1.00****	0.94****	0.96****	
Nmin.Litter	–0.29	0.04	–0.38*	–0.12	–0.47**	–0.03	–0.37*	–0.39*	0.14	0.15	–0.40*	–0.40*	–0.40*	–0.40*	–0.40*	–0.40*
Nmin.Ah	–0.29	0.04	–0.38*	–0.12	–0.47**	–0.03	–0.37*	–0.39*	0.14	0.15	–0.40*	–0.40*	–0.40*	–0.40*	–0.40*	–0.40*
Nmin.Bv	–0.39*	0.25	–0.45**	–0.44**	–0.85****	–0.3	–0.79****	–0.82****	0.09	0.53**	0.59***	0.59***	0.59***	0.59***	0.59***	0.59***

Table S7. Correlation between mixed beech plant parameters and soil parameters in fall. Leaf total N (LNT [mg g^{-1} DW]), leaf protein N (LNP [mg g^{-1} DW]), leaf amino acid N (LNAS [mg g^{-1} DW]), leaf structural N (LNS [mg g^{-1} DW]), root total N (RNT [mg g^{-1} DW]), root amino acid N (RNAS [mg g^{-1} DW]), and root structural N (RNS [mg g^{-1} DW]) are correlated with three soil depths' (i.e., litter, Ah, Bv) total N (TN [mg g^{-1}]), soil inorganic N (Nmin [mg kg^{-1}]), and organic carbon (SOC [mg g^{-1}]). Correlation coefficient is Spearman's rho (ϱ) followed by asterisks depicting corresponding p-values: $p < 0.0001$ "****"; $p < 0.001$ "***"; $p < 0.01$ "**"; $p < 0.05$ "*".

Fall BF	LNT	LNP	LNAS	LNS	RNT	RNP	RNAS	RNS	LC13	R13C	TN.Litter	TN.Ah	TN.Bv	SOC.Litter	SOC.Ah	SOC.Bv
LNT																
LNP	0.47															
LNAS	0.32	0.23														
LNS	0.39	–0.53*	–0.09													
RNT	–0.14	–0.46	0.25	0.36												
RNP	–0.08	0.01	0.33	–0.07	0.39											
RNAS	0.06	0.1	0.14	–0.12	0.37	0.17										
RNS	–0.18	–0.56*	0.01	0.42	0.82****	–0.1	0.18									
LC13	–0.25	–0.13	–0.15	–0.11	–0.33	–0.2	–0.15	–0.24								
R13C	–0.24	0.16	0.25	–0.42	–0.36	0.12	–0.2	–0.43	0.35							
TN.Litter	–0.60*	–0.25	0	–0.32	–0.1	–0.01	–0.1	–0.1	0.51*	0.78***						
TN.Ah	–0.58*	–0.24	0.06	–0.3	–0.03	0.04	–0.04	–0.05	0.47	0.74***	0.98****					
TN.Bv	–0.58*	–0.24	0.06	–0.3	–0.03	0.04	–0.04	–0.05	0.47	0.74***	0.98****	1.00****				
SOC.Litter	–0.61**	–0.23	–0.01	–0.39	–0.12	0.07	–0.13	–0.18	0.59*	0.75***	0.96****	0.93****	0.93****			
SOC.Ah	–0.57*	–0.22	0.1	–0.31	0	0.1	–0.01	–0.05	0.47	0.71**	0.96****	0.99****	0.99****	0.92****		
SOC.Bv	–0.58*	–0.24	0.06	–0.3	–0.03	0.04	–0.04	–0.05	0.47	0.74***	0.98****	1.00****	1.00****	0.93****	0.99****	
Nmin.Litter	0.64**	0.79***	0.22	–0.18	–0.45	–0.09	0.11	–0.47	–0.08	–0.1	–0.53*	–0.53*	–0.53*	–0.53*	–0.53*	–0.53*
Nmin.Ah	0.02	–0.54*	–0.27	0.57*	0.52*	0	–0.03	0.59*	–0.52*	–0.71**	–0.53*	–0.53*	–0.53*	–0.53*	–0.53*	–0.53*
Nmin.Bv	–0.64**	–0.79***	–0.22	0.18	0.45	0.09	–0.11	0.47	0.08	0.1	0.53*	0.53*	0.53*	0.53*	0.53*	0.53*

Table S8. Correlation between N uptake capacities of pure and mixed beech stands in fall. N uptake capacities are depicted as the name of the N source arginine, glutamine, ammonium, and nitrate, respectively, and are correlated with three soil depths' (i.e., litter, Ah, Bv) total N (TN [mg g^{-1}]), soil inorganic N (Nmin [mg kg^{-1}]), and organic carbon (SOC [mg g^{-1}]). Correlation coefficient is Spearman's rho (ϱ) followed by asterisks depicting corresponding p-values: $p < 0.0001$ "****"; $p < 0.001$ "***"; $p < 0.01$ "**"; $p < 0.05$ "*".

Fall BB	Arginine	Glutamine	Ammonium	Nitrate
Argine				
Glutamine	0.28			
Ammmonium	0.38*	0.45**		
Nitrate	0.17	0.15	0.35*	
TN.Litter	0.3	0.65****	0.29	–0.09
TN.Ah	0.35*	0.65****	0.32	–0.08
TN.Bv	0.35*	0.62****	0.35*	–0.03
SOC.Litter	0.26	0.63****	0.28	–0.08
SOC.Ah	0.35*	0.65****	0.32	–0.08
SOC.Bv	0.35*	0.62****	0.35*	–0.03
Nmin.Litter	0.19	0.14	0.15	0.28
Nmin.Ah	0.19	0.14	0.15	0.28
Nmin.Bv	0.48**	0.72****	0.43**	0.19
Fall BF	Arginine	Glutamine	Ammonium	Nitrate
Argine				
Glutamine	0.1			
Ammmonium	0.16	0.68**		
Nitrate	–0.02	–0.18	–0.05	
TN.Litter	0.65**	0.1	0.06	0
TN.Ah	0.70**	0.12	0.02	–0.05
TN.Bv	0.70**	0.12	0.02	–0.05
SOC.Litter	0.64**	0.13	0.11	–0.02
SOC.Ah	0.71**	0.13	0.02	–0.06
SOC.Bv	0.70**	0.12	0.02	–0.05
Nmin.Litter	–0.34	0.33	0.42	0.12
Nmin.Ah	–0.34	–0.46	–0.49*	–0.08
Nmin.Bv	0.34	–0.33	–0.42	–0.12

Table S9. Packages used in statistical analysis in R.

Package	URL package/ citation package
nlme	Pinheiro J, Bates D, DebRoy S, Sarkar D and R Core Team (2017). _nlme: Linear and Nonlinear Mixed Effects Models_. R package version 3.1–131, URL: https://CRAN.R-project.org/package=nlme
lsmeans	Russell V. Lenth (2016). Least-Squares Means: The R Package lsmeans. Journal of Statistical Software, 69(1), 1–33. doi:10.18637/jss.v069.i01
car	John Fox and Sanford Weisberg (2011). An {R} Companion to Applied Regression, Second Edition. Thousand Oaks CA: Sage. URL:http://socserv.socsci.mcmaster.ca/jfox/Books/Companion
MASS	Venables, W. N. & Ripley, B. D. (2002) Modern Applied Statistics with S. Fourth Edition. Springer, New York. ISBN 0-387-95457-0
rcompanion	Salvatore Mangiafico (2018). rcompanion: Functions to Support Extension Education Program Evaluation. R package version 1.11.3. https://CRAN.R-project.org/package=rcompanion
multcompView	Spencer Graves, Hans-Peter Piepho and Luciano Selzer with help from Sundar Dorai-Raj (2015). multcompView: Visualizations of Paired Comparisons. R package version 0.1-7. https://CRAN.R-project.org/package=multcompView
xtable	David B. Dahl (2016). xtable: Export Tables to LaTeX or HTML. R package version 1.8-2. https://CRAN.R-project.org/package=xtable
Hmisc	Frank E Harrell Jr, with contributions from Charles Dupont and many others. (2018). Hmisc: Harrell Miscellaneous. R package version 4.1–1. https://CRAN.R-project.org/package=Hmisc
ggplot2	H. Wickham. ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York, 2009.
lattice	Sarkar, Deepayan (2008) Lattice: Multivariate Data Visualization with R. Springer, New York. ISBN 978-0-387-75968-5
pgirmess	Patrick Giraudoux (2017). pgirmess: Data Analysis in Ecology. R package version 1.6.7. https://CRAN.R-project.org/package=pgirmess