Supplementary Materials:

Table S1. Comparisons[1] of adjusted means of growth variables of two-year-old white spruce (WS 2+0) and one-year-old black spruce (BS, 1+0) seedlings between sampling date at the beginning (mid-January 2010) and end of winter (mid-March 2010) in response to different freezing temperatures

Shoot dry mass (mg)		**Mid-January 2010**												**Mid-March 2010**									
		4°C			**-4°C**			**-12°C**			**-20˚C**			**4°C**			**-4°C**			**-12°C**			**-20˚C**		
	WS 2+0	8414	±352	a[1]	8723	±352	a	9126	±352	a	9035	±352	a	9774	±352	a	9853	±352	a	9598	±352	a	6189	±352	a
	BS 1+0	377	±27	bc	439	±27	ab	412	±27	ab	389	±27	abc	509	±27	a	479	±27	ab	424	±27	ab	281	±27	c
Dry mass of new roots (mg)		**Mid-January 2010**												**Mid-March 2010**									
		4°C			**-4°C**			**-12°C**			**-20˚C**			**4°C**			**-4°C**			**-12°C**			**-20˚C**		
	WS 2+0	112	±13	a	103	±13	ab	115	±13	a	48	±13	bc	106	±13	a	121	±13	a	75	±13	ab	1	±13	c
		Mid-January 2010												**Mid-March 2010**									
	BS 1+0				28				±2	a							16				±2	b			
		4°C			**-4°C**			**-12°C**			**-20˚C**														
		32	±3	a	26	±3	ab	16	±3	bc	14	±3	c												
Total root dry mass (mg)		**4°C**			**-4°C**			**-12°C**			**-20˚C**														
	WS 2+0	2197	±82	a	2298	±82	a	2251	±82	a	1697	±82	b												
		Mid-January 2010												**Mid-March 2010**									
		4°C			**-4°C**			**-12°C**			**-20˚C**			**4°C**			**-4°C**			**-12°C**			**-20˚C**		
	BS 1+0	131	±7	ab	135	±7	ab	129	±7	ab	133	±7	ab	145	±7	a	134	±7	ab	111	±7	bc	87	±7	c
Total dry mass of seedling (mg)		**Mid-January 2010**												**Mid-March 2010**									
		4°C			**-4°C**			**-12°C**			**-20˚C**			**4°C**			**-4°C**			**-12°C**			**-20˚C**		
	WS 2+0	10632	±430	a	10974	±430	a	11397	±430	a	10971	±430	a	11950	±430	a	12197	±430	a	11829	±430	a	7648	±430	b
	BS 1+0	508	±33	ab	574	±33	a	541	±33	a	522	±33	ab	653	±33	a	613	±33	a	535	±33	a	368	±33	b

[1] Comparisons are made only when the probabilities are significant. For more details, see Table 6.

[2] Horizontally, the adjusted means (±standard error) followed by distinct letters show significant differences at the threshold =5%.

Table S2. Observed probabilities (*p*-values) and degrees of freedom of the fixed effects related to the different treatments[1] applied before freezing on mineral nutrient concentrations (%) and contents (mg) of different parts (shoot, root and whole seedling) of two-year-old white spruce (WS, 2+0) and one-year-old black spruce (BS, 1+0)

Shoot nutrient concentration (%) and content (mg)																						
			N (%)				**P (%)**				**K (%)**				**Ca (%)**				**Mg (%)**			
Source of			**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**	
variation	**dln[2]**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	
Treatment	6	21	0.7715	15.2	**0.0462**	21	0.6034	21	0.4650	21	0.4652	21	**0.0156**	21	0.0857	21	**0.0249**	21	0.5408	15.1	**0.0196**	
			N (mg)				**P (mg)**				**K (mg)**				**Ca (mg)**				**Mg (mg)**			
			WS 2+0		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**	
	dln	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	
Treatment	6	21	0.8463	21	0.6018	21	0.4563	21	0.4742	14.6	0.1878	21	0.1799	21	0.4067	21	0.0672	21	0.9133	21	0.7748	
Whole seedling nutrient concentration (%) and content (mg)																						
			N (%)				**P (%)**				**K (%)**				**Ca (%)**				**Mg (%)**			
			WS 2+0		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**	
	dln	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	
Treatment	6	21	0.6083	14.5	0.2735	21	0.5441	21	0.1263	21	0.6523	21	**0.0034**	21	0.0709	21	0.1348	21	0.5644	14.6	0.1052	
			N (mg)				**P (mg)**				**K (mg)**				**Ca (mg)**				**Mg (mg)**			
			WS 2+0		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**	
	dln	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	
Treatment	6	21	0.8547	21	0.1673	21	0.6135	21	**0.0023**	14.6	0.4949	21	**0.0141**	21	0.5274	21	**0.0478**	21	0.9624	21	0.1303	
Root nutrient concentration (%) and content (mg)																						
			N (%)				**P (%)**				**K (%)**				**Ca (%)**				**Mg (%)**			
			WS 2+0		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**	
	dln	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	
Treatment	6	14.6	0.4031	13.4	0.1600	21	0.7028	21	**<.0001**	15.4	0.0740	21	**<.0001**	21	**0.0016**	21	**0.0055**	21	0.1683	13.1	**0.0003**	
			N (mg)				**P (mg)**				**K (mg)**				**Ca (mg)**				**Mg (mg)**			
			WS 2+0		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**		**WS 2+0**		**BS 1+0**	
	dln	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	**dld**	**Pr > F**	
Treatment	6	21	0.8553	21	**0.0002**	21	0.7582	21	**<.0001**	15.8	0.7424	21	**<.0001**	21	0.4159	21	**0.0007**	21	0.7368	9.3	**0.0059**	

[1] Mineral nutrition analyses were carried out according to the seven treatments: sampling in autumn as a Control to the initial state of mineral nutrition; mid-January (TR1, TR2 and TR3) and mid-March (TR1, TR2 and TR3).

- Treatment 1 (TR1): Control seedlings were kept in a cold room at 4°C in the dark conditions to get closer to natural conditions because the seedlings under a good depth of snow do not receive light.
- Treatment 2 (TR2): Seedlings placed for 1 day in a greenhouse at 10°C (day and night) and at the natural photoperiod of the season.
- Treatment 3 (TR3): Seedlings placed for 3 days in a greenhouse at 10°C (day and night) and at the natural photoperiod of the season.

[2] dln: degrees of freedom of numerator; dld: degrees of freedom of denominator.

Table S3. Comparison[1] of adjusted means between differents treatments[1] before freezing related to mineral nutrient concentrations (%) and contents (mg) of different parts (shoot, root and whole seedling) of two-year-old white spruce (WS, 2+0) and one-year-old black spruce (BS, 1+0)

		Shoot nutrient concentration (%) and content (mg)						
		Control in automn	Mid-January (1 day)	Mid-January (3 days)	Mid-January (Control)	Mid-March (1 day)	Mid-March (3 days)	Mid-March (Control)
N (%)	WS 2+0	2.06 ±0.07 a	2.02 ±0.07 a	1.94 ±0.07 a	2.01 ±0.07 a	2.03 ±0.07 a	1.93 ±0.07 a	2.06 ±0.07 a
	BS 1+0	1.99 ±0.05 a	1.76 ±0.05 a	1.96 ±0.05 a	1.90 ±0.05 a	1.87 ±0.05 a	1.85 ±0.05 a	1.81 ±0.05 a
P (%)	WS 2+0	0.20 ±0.01 a	0.20 ±0.01 a	0.19 ±0.01 a	0.20 ±0.01 a	0.19 ±0.01 a	0.20 ±0.01 a	0.21 ±0.01 a
	BS 1+0	0.29 ±0.01 a	0.27 ±0.01 a	0.28 ±0.01 a	0.27 ±0.01 a	0.27 ±0.01 a	0.27 ±0.01 a	0.27 ±0.01 a
K (%)	WS 2+0	0.59 ±0.02 a	0.57 ±0.02 a	0.59 ±0.02 a	0.55 ±0.02 a	0.55 ±0.02 a	0.58 ±0.02 a	0.57 ±0.02 a
	BS 1+0	0.84 ±0.02 a	0.82 ±0.02 ab	0.77 ±0.02 ab	0.76 ±0.02 b	0.80 ±0.02 ab	0.84 ±0.02 ab	0.79 ±0.02 ab
Ca (%)	WS 2+0	0.23 ±0.01 a	0.23 ±0.01 a	0.22 ±0.01 a	0.23 ±0.01 a	0.26 ±0.01 a	0.24 ±0.01 a	0.26 ±0.01 a
	BS 1+0	0.19 ±0.01 a	0.17 ±0.01 a	0.18 ±0.01 a	0.19 ±0.01 a	0.21 ±0.01 a	0.21 ±0.01 a	0.21 ±0.01 a
Mg (%)	WS 2+0	0.14 ±0.00 a	0.14 ±0.00 a	0.13 ±0.00 a	0.15 ±0.00 a	0.14 ±0.00 a	0.14 ±0.00 a	0.14 ±0.00 a
	BS 1+0	0.14 ±0.00 a	0.13 ±0.00 a	0.13 ±0.00 a	0.14 ±0.00 a	0.14 ±0.00 a	0.14 ±0.00 a	0.14 ±0.00 a
N (mg)	WS 2+0	147.5 ±8.44 a	151.3 ±8.44 a	141.7 ±8.44 a	136.2 ±8.44 a	139.4 ±8.44 a	137.3 ±8.44 a	145.2 ±8.44 a
	BS 1+0	4.53 ±0.22 a	4.63 ±0.22 a	5.03 ±0.22 a	4.42 ±0.22 a	4.66 ±0.22 a	4.56 ±0.22 a	4.66 ±0.22 a
P (mg)	WS 2+0	14.53 ±0.61 a	14.83 ±0.61 a	14.00 ±0.61 a	13.39 ±0.61 a	13.17 ±0.61 a	14.21 ±0.61 a	14.45 ±0.61 a
	BS 1+0	0.65 ±0.03 a	0.71 ±0.03 a	0.71 ±0.03 a	0.63 ±0.03 a	0.68 ±0.03 a	0.68 ±0.03 a	0.68 ±0.03 a
K (mg)	WS 2+0	41.95 ±1.78 a	42.27 ±1.78 a	42.64 ±1.78 a	37.25 ±1.78 a	37.41 ±1.78 a	41.33 ±1.78 a	40.23 ±1.78 a
	BS 1+0	1.92 ±0.09 a	2.14 ±0.09 a	1.96 ±0.09 a	1.77 ±0.09 a	2.01 ±0.09 a	2.07 ±0.09 a	2.04 ±0.09 a
Ca (mg)	WS 2+0	16.33 ±0.98 a	17.29 ±0.98 a	15.88 ±0.98 a	15.57 ±0.98 a	17.96 ±0.98 a	16.76 ±0.98 a	18.25 ±0.98 a
	BS 1+0	0.43 ±0.02 a	0.46 ±0.02 a	0.46 ±0.02 a	0.45 ±0.02 a	0.52 ±0.02 a	0.51 ±0.02 a	0.53 ±0.02 a
Mg (mg)	WS 2+0	10.17 ±0.54 a	10.22 ±0.54 a	9.66 ±0.54 a	9.93 ±0.54 a	9.42 ±0.54 a	9.98 ±0.54 a	9.55 ±0.54 a
	BS 1+0	0.33 ±0.02 a	0.35 ±0.02 a	0.33 ±0.02 a	0.33 ±0.02 a	0.36 ±0.02 a	0.35 ±0.02 a	0.35 ±0.02 a
		Whole seedling nutrient concentration (%) and content (mg)						
		Control in automn	Mid-January (1 day)	Mid-January (3 days)	Mid-January (Control)	Mid-March (1 day)	Mid-March (3 days)	Mid-March (Control)
N (%)	WS 2+0	2.08 ±0.05 a	2.01 ±0.05 a	1.98 ±0.05 a	2.03 ±0.05 a	2.04 ±0.05 a	1.96 ±0.05 a	2.08 ±0.05 a
	BS 1+0	2.01 ±0.05 a	1.92 ±0.05 a	2.08 ±0.05 a	2.04 ±0.05 a	1.99 ±0.05 a	1.99 ±0.05 a	1.94 ±0.05 a
P (%)	WS 2+0	0.22 ±0.01 a	0.21 ±0.01 a	0.20 ±0.01 a	0.21 ±0.01 a	0.20 ±0.01 a	0.21 ±0.01 a	0.22 ±0.01 a
	BS 1+0	0.31 ±0.01 a	0.33 ±0.01 a	0.32 ±0.01 a	0.33 ±0.01 a	0.33 ±0.01 a	0.34 ±0.01 a	0.33 ±0.01 a
K (%)	WS 2+0	0.57 ±0.01 a	0.54 ±0.01 a	0.56 ±0.01 a	0.54 ±0.01 a	0.54 ±0.01 a	0.55 ±0.01 a	0.55 ±0.01 a
	BS 1+0	0.82 ±0.01 ab	0.86 ±0.01 a	0.79 ±0.01 b	0.80 ±0.01 b	0.83 ±0.01 ab	0.87 ±0.01 a	0.83 ±0.01 ab
Ca (%)	WS 2+0	0.24 ±0.01 a	0.23 ±0.01 a	0.22 ±0.01 a	0.23 ±0.01 a	0.26 ±0.01 a	0.24 ±0.01 a	0.25 ±0.01 a
	BS 1+0	0.18 ±0.01 a	0.18 ±0.01 a	0.18 ±0.01 a	0.19 ±0.01 a	0.20 ±0.01 a	0.20 ±0.01 a	0.20 ±0.01 a
Mg (%)	WS 2+0	0.15 ±0.01 a	0.14 ±0.01 a	0.14 ±0.01 a	0.15 ±0.01 a	0.14 ±0.01 a	0.15 ±0.01 a	0.15 ±0.01 a
	BS 1+0	0.16 ±0.00 a	0.16 ±0.00 a	0.16 ±0.00 a	0.17 ±0.00 a	0.16 ±0.00 a	0.16 ±0.00 a	0.16 ±0.00 a
N (mg)	WS 2+0	191.0 ±9.69 a	192.1 ±9.69 a	181.3 ±9.69 a	175.1 ±9.69 a	182.9 ±9.69 a	179.2 ±9.69 a	187.5 ±9.69 a
	BS 1+0	6.26 ±0.31 a	7.09 ±0.31 a	7.58 ±0.31 a	6.81 ±0.31 a	7.12 ±0.31 a	7.04 ±0.31 a	7.12 ±0.31 a
P (mg)	WS 2+0	19.81 ±0.82 a	19.74 ±0.82 a	18.57 ±0.82 a	18.04 ±0.82 a	18.27 ±0.82 a	19.34 ±0.82 a	19.34 ±0.82 a
	BS 1+0	0.96 ±0.04 b	1.22 ±0.04 a	1.17 ±0.04 a	1.08 ±0.04 ab	1.19 ±0.04 a	1.20 ±0.04 a	1.20 ±0.04 a
K (mg)	WS 2+0	52.37 ±2.24 a	51.59 ±2.24 a	51.61 ±2.24 a	46.61 ±2.24 a	48.13 ±2.24 a	50.50 ±2.24 a	49.76 ±2.24 a
	BS 1+0	2.54 ±0.12 b	3.18 ±0.12 a	2.88 ±0.12 ab	2.67 ±0.12 ab	2.98 ±0.12 ab	3.07 ±0.12 ab	3.06 ±0.12 ab
Ca (mg)	WS 2+0	21.91 ±1.34 a	21.84 ±1.34 a	20.30 ±1.34 a	20.14 ±1.34 a	23.59 ±1.34 a	21.78 ±1.34 a	22.95 ±1.34 a
	BS 1+0	0.57 ±0.03 b	0.66 ±0.03 ab	0.66 ±0.03 ab	0.65 ±0.03 ab	0.70 ±0.03 ab	0.69 ±0.03 ab	0.72 ±0.03 a
Mg (mg)	WS 2+0	13.91 ±0.87 a	13.64 ±0.87 a	12.65 ±0.87 a	13.17 ±0.87 a	12.95 ±0.87 a	13.35 ±0.87 a	13.33 ±0.87 a
	BS 1+0	0.49 ±0.03 a	0.60 ±0.03 a	0.56 ±0.03 a	0.56 ±0.03 a	0.58 ±0.03 a	0.58 ±0.03 a	0.58 ±0.03 a

		Root nutrient concentration (%) and content (mg)																			
		Control in automn			Mid-January (1 day)			Mid-January (3 days)			Mid-January (Control)			Mid-March (1 day)			Mid-March (3 days)			Mid-March (Control)		
N (%)	**WS 2+0**	2.16	±0.08	a	1.96	±0.08	a	2.13	±0.08	a	2.12	±0.08	a	2.1	±0.08	a	2.08	±0.08	a	2.17	±0.08	a
	BS 1+0	2.07	±0.07	a	2.31	±0.07	a	2.37	±0.07	a	2.37	±0.07	a	2.29	±0.07	a	2.33	±0.07	a	2.23	±0.07	a
P (%)	**WS 2+0**	0.26	±0.01	a	0.24	±0.01	a	0.25	±0.01	a	0.25	±0.01	a	0.25	±0.01	a	0.26	±0.01	a	0.25	±0.01	a
	BS 1+0	0.37	±0.01	c	0.48	±0.01	ab	0.43	±0.01	b	0.45	±0.01	ab	0.48	±0.01	ab	0.49	±0.01	a	0.47	±0.01	ab
K (%)	**WS 2+0**	0.52	±0.02	a	0.45	±0.02	a	0.48	±0.02	a	0.5	±0.02	a	0.51	±0.02	a	0.46	±0.02	a	0.49	±0.02	a
	BS 1+0	0.74	±0.02	c	0.98	±0.02	a	0.86	±0.02	b	0.9	±0.02	ab	0.91	±0.02	ab	0.94	±0.02	ab	0.92	±0.02	ab
Ca (%)	**WS 2+0**	0.28	±0.01	a	0.22	±0.01	c	0.24	±0.01	bc	0.24	±0.01	abc	0.27	±0.01	ab	0.25	±0.01	abc	0.24	±0.01	abc
	BS 1+0	0.16	±0.01	b	0.19	±0.01	ab	0.18	±0.01	ab	0.2	±0.01	a	0.17	±0.01	ab	0.17	±0.01	b	0.17	±0.01	ab
Mg (%)	**WS 2+0**	0.18	±0.01	a	0.16	±0.01	a	0.16	±0.01	a	0.17	±0.01	a	0.17	±0.01	a	0.17	±0.01	a	0.19	±0.01	a
	BS 1+0	0.20	±0.00	c	0.24	±0.00	a	0.22	±0.00	bc	0.23	±0.00	ab	0.21	±0.00	c	0.21	±0.00	bc	0.21	±0.00	bc
N (mg)	**WS 2+0**	43.5	±2.76	a	40.85	±2.76	a	39.56	±2.76	a	38.91	±2.76	a	43.45	±2.76	a	41.87	±2.76	a	42.25	±2.76	a
	BS 1+0	1.73	±0.10	b	2.46	±0.10	a	2.54	±0.10	a	2.39	±0.10	a	2.46	±0.10	a	2.48	±0.10	a	2.46	±0.10	a
P (mg)	**WS 2+0**	5.28	±0.35	a	4.92	±0.35	a	4.57	±0.35	a	4.66	±0.35	a	5.1	±0.35	a	5.14	±0.35	a	4.88	±0.35	a
	BS 1+0	0.31	±0.02	b	0.51	±0.02	a	0.46	±0.02	a	0.45	±0.02	a	0.51	±0.02	a	0.52	±0.02	a	0.52	±0.02	a
K (mg)	**WS 2+0**	10.42	±0.87	a	9.33	±0.87	a	8.97	±0.87	a	9.37	±0.87	a	10.71	±0.87	a	9.17	±0.87	a	9.53	±0.87	a
	BS 1+0	0.62	±0.04	b	1.04	±0.04	a	0.92	±0.04	a	0.9	±0.04	a	0.98	±0.04	a	1	±0.04	a	1.02	±0.04	a
Ca (mg)	**WS 2+0**	5.58	±0.49	a	4.55	±0.49	a	4.42	±0.49	a	4.57	±0.49	a	5.63	±0.49	a	5.02	±0.49	a	4.7	±0.49	a
	BS 1+0	0.14	±0.01	b	0.2	±0.01	a	0.2	±0.01	a	0.2	±0.01	a	0.18	±0.01	a	0.18	±0.01	a	0.19	±0.01	a
Mg (mg)	**WS 2+0**	3.74	±0.36	a	3.42	±0.36	a	2.99	±0.36	a	3.24	±0.36	a	3.53	±0.36	a	3.37	±0.36	a	3.78	±0.36	a
	BS 1+0	0.16	±0.01	b	0.26	±0.01	a	0.23	±0.01	a	0.23	±0.01	a	0.22	±0.01	a	0.22	±0.01	a	0.23	±0.01	a

[1] Mineral nutrition analyses were carried out according to the seven treatments: sampling in autumn as a Control to the initial state of mineral nutrition; mid-January (TR1, TR2 and TR3) and mid-March (TR1, TR2 and TR3).

- Treatment 1 (TR1): Control seedlings were kept in a cold room at 4°C in the dark conditions to get closer to natural conditions because the seedlings under a good depth of snow do not receive light.
- Treatment 2 (TR2): Seedlings placed for 1 day in a greenhouse at 10°C (day and night) and at the natural photoperiod of the season.
- Treatment 3 (TR3): Seedlings placed for 3 days in a greenhouse at 10°C (day and night) and at the natural photoperiod of the season.

[2] Horizontally, the adjusted means (±standard error) for each species followed by distinct letters show significant differences at the threshold α=5%.