

## Supplementary Material

**Tab. S1** - An overview of a program “typical autumn with decreasing temperature” (Treatment 1), that was run in growth chamber 1 with S!MPATI software.

Week	Day	Sunrise	Sunset	Daylength (hours)	Nightlength (hours)	Light (%)	Temp. (°C)				Humidity (%)
							07.00 - 10.00	10.00 - 14.00	14.00 - 19.00	19.00 - 07.00	
1	1	07:00	19:00	12	12	70	8 to 10	10 to 14	14 to 10	10 to 8	80
	2	07:00	19:00	12	12	70	8 to 10	10 to 14	14 to 10	10 to 8	80
	3	07:00	19:00	12	12	70	8 to 10	10 to 14	14 to 10	10 to 8	80
	4	07:00	19:00	12	12	70	8 to 10	10 to 14	14 to 10	10 to 8	80
	5	07:00	19:00	12	12	70	8 to 10	10 to 14	14 to 10	10 to 8	80
	6	07:00	19:00	12	12	70	8 to 10	10 to 14	14 to 10	10 to 8	80
	7	07:00	19:00	12	12	70	8 to 10	10 to 14	14 to 10	10 to 8	80
2	8	07:30	18:30	11	13	60	7 to 9	9 to 12	12 to 9	9 to 7	80
	9	07:30	18:30	11	13	60	7 to 9	9 to 12	12 to 9	9 to 7	80
	10	07:30	18:30	11	13	60	7 to 9	9 to 12	12 to 9	9 to 7	80
	11	07:30	18:30	11	13	60	7 to 9	9 to 12	12 to 9	9 to 7	80
	12	07:30	18:30	11	13	60	7 to 9	9 to 12	12 to 9	9 to 7	80
	13	07:30	18:30	11	13	60	7 to 9	9 to 12	12 to 9	9 to 7	80
	14	07:30	18:30	11	13	60	7 to 9	9 to 12	12 to 9	9 to 7	80
3	15	08:00	18:00	10	14	50	6 to 8	8 to 10	10 to 8	8 to 6	80
	16	08:00	18:00	10	14	50	6 to 8	8 to 10	10 to 8	8 to 6	80
	17	08:00	18:00	10	14	50	6 to 8	8 to 10	10 to 8	8 to 6	80
	18	08:00	18:00	10	14	50	6 to 8	8 to 10	10 to 8	8 to 6	80
	19	08:00	18:00	10	14	50	6 to 8	8 to 10	10 to 8	8 to 6	80
	20	08:00	18:00	10	14	50	6 to 8	8 to 10	10 to 8	8 to 6	80
	21	08:00	18:00	10	14	50	6 to 8	8 to 10	10 to 8	8 to 6	80
4	22	08:30	17:30	9	15	40	4 to 5	5 to 7	7 to 5	5 to 4	80
	23	08:30	17:30	9	15	40	4 to 5	5 to 7	7 to 5	5 to 4	80
	24	08:30	17:30	9	15	40	4 to 5	5 to 7	7 to 5	5 to 4	80
	25	08:30	17:30	9	15	40	4 to 5	5 to 7	7 to 5	5 to 4	80
	26	08:30	17:30	9	15	40	4 to 5	5 to 7	7 to 5	5 to 4	80
	27	08:30	17:30	9	15	40	4 to 5	5 to 7	7 to 5	5 to 4	80
	28	08:30	17:30	9	15	40	4 to 5	5 to 7	7 to 5	5 to 4	80

**Tab. S2** - An overview of a program “atypical autumn with fluctuating temperature” (Treatment 2), that was run in growth chamber 2 with SIMPATI software.

Week	Day	Sunrise	Sunset	Daylength (hours)	Nightlength (hours)	Light (%)	Temp. (°C)				Humidity (%)
							07.00 - 10.00	10.00 - 14.00	14.00 - 19.00	19.00 - 07.00	
1	1	07:00	19:00	12	12	70	7 to 9	9 to 11	11 to 9	9 to 7	80
	2	07:00	19:00	12	12	70	7 to 9	9 to 11	11 to 9	9 to 7	80
	3	07:00	19:00	12	12	70	7 to 9	9 to 11	11 to 9	9 to 7	80
	4	07:00	19:00	12	12	70	7 to 9	9 to 11	11 to 9	9 to 7	80
	5	07:00	19:00	12	12	70	7 to 9	9 to 11	11 to 9	9 to 7	80
	6	07:00	19:00	12	12	70	7 to 9	9 to 11	11 to 9	9 to 7	80
	7	07:00	19:00	12	12	70	7 to 9	9 to 11	11 to 9	9 to 7	80
2	8	07:30	18:30	11	13	60	9 to 12	12 to 15	15 to 10	10 to 9	80
	9	07:30	18:30	11	13	60	9 to 12	12 to 15	15 to 10	10 to 9	80
	10	07:30	18:30	11	13	60	9 to 12	12 to 15	15 to 10	10 to 9	80
	11	07:30	18:30	11	13	60	9 to 12	12 to 15	15 to 10	10 to 9	80
	12	07:30	18:30	11	13	60	9 to 12	12 to 15	15 to 10	10 to 9	80
	13	07:30	18:30	11	13	60	9 to 12	12 to 15	15 to 10	10 to 9	80
	14	07:30	18:30	11	13	60	9 to 12	12 to 15	15 to 10	10 to 9	80
3	15	08:00	18:00	10	14	50	4 to 6	6 to 7	7 to 6	6 to 4	80
	16	08:00	18:00	10	14	50	4 to 6	6 to 7	7 to 6	6 to 4	80
	17	08:00	18:00	10	14	50	4 to 6	6 to 7	7 to 6	6 to 4	80
	18	08:00	18:00	10	14	50	4 to 6	6 to 7	7 to 6	6 to 4	80
	19	08:00	18:00	10	14	50	4 to 6	6 to 7	7 to 6	6 to 4	80
	20	08:00	18:00	10	14	50	4 to 6	6 to 7	7 to 6	6 to 4	80
	21	08:00	18:00	10	14	50	4 to 6	6 to 7	7 to 6	6 to 4	80
4	22	08:30	17:30	9	15	40	4 to 5	5 to 11	11 to 5	5 to 4	80
	23	08:30	17:30	9	15	40	4 to 5	5 to 11	11 to 5	5 to 4	80
	24	08:30	17:30	9	15	40	4 to 5	5 to 11	11 to 5	5 to 4	80
	25	08:30	17:30	9	15	40	4 to 5	5 to 11	11 to 5	5 to 4	80
	26	08:30	17:30	9	15	40	4 to 5	5 to 11	11 to 5	5 to 4	80
	27	08:30	17:30	9	15	40	4 to 5	5 to 11	11 to 5	5 to 4	80
	28	08:30	17:30	9	15	40	4 to 5	5 to 11	11 to 5	5 to 4	80

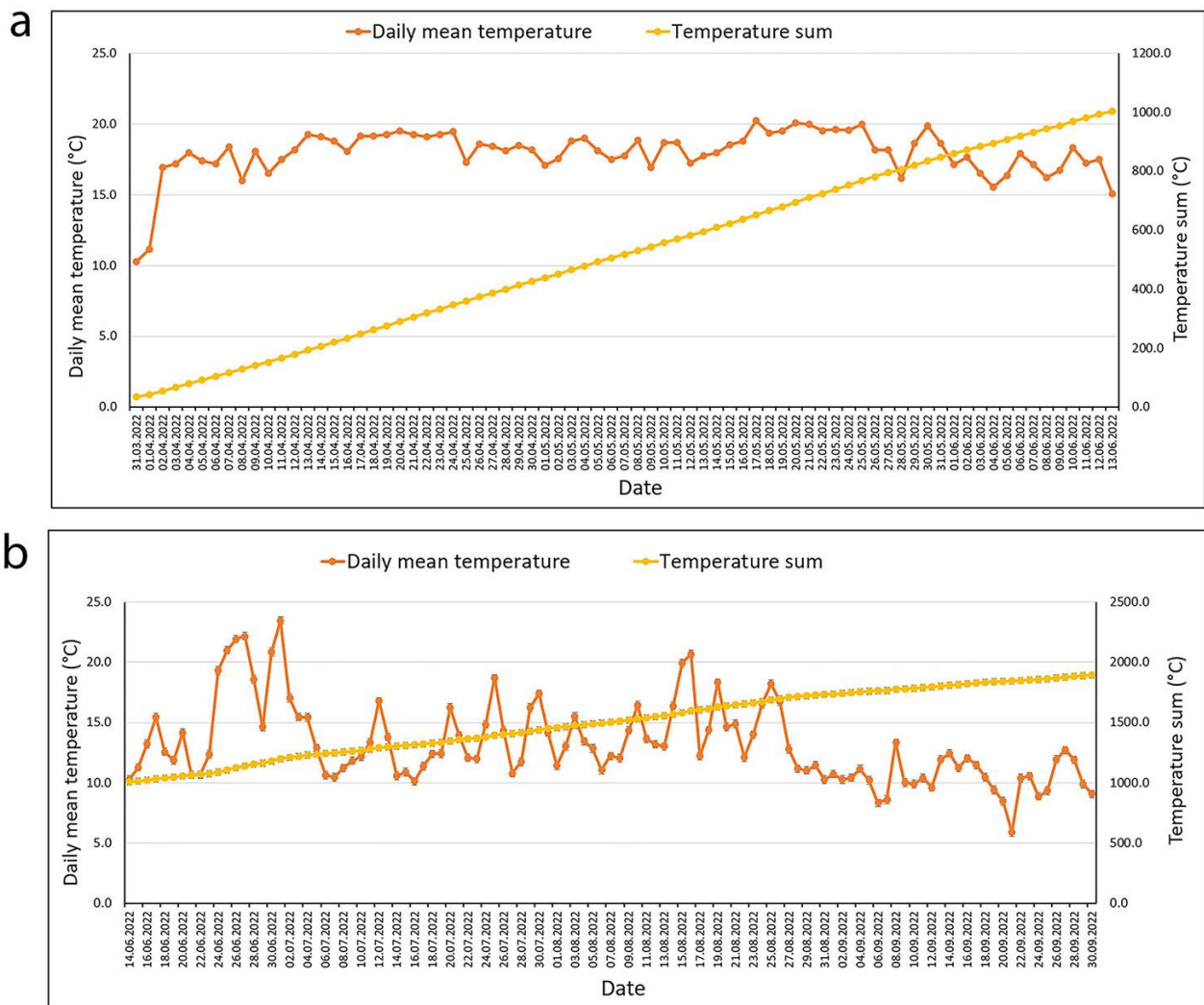
**Tab. S3** - The average, minimum and maximum temperatures (°C) that were recorded on each date for treatments 1 and 2.

Date	Treatment 1 (Growth chamber 1)			Treatment 2 (Growth chamber 2)			Week
	Average	Min.	Max.	Average	Min.	Max.	
2022-09-30	9.4	6.3	21.8	9.4	5.2	19.9	
2022-10-01	10.6	8.0	13.6	8.8	6.6	11.1	
2022-10-02	10.1	7.6	14.1	8.8	6.7	11	
2022-10-03	10.1	7.6	14.1	8.8	6.8	11.1	Week1
2022-10-04	10.1	7.5	14.1	8.8	6.9	11	
2022-10-05	10.1	7.6	14.1	8.8	6.6	11.1	
2022-10-06	10.1	7.3	14.1	8.8	6.6	11.2	
2022-10-07	9.8	6.8	14.1	9.8	5.8	15	
2022-10-08	8.9	7.0	12.1	10.9	8	15	
2022-10-09	8.9	7.0	12.1	10.9	8	15	
2022-10-10	8.9	7.0	12.1	10.9	7.6	15	
2022-10-11	8.9	7.0	12.1	10.9	7.6	15.1	Week2
2022-10-12	8.9	7.0	12.1	10.9	7.6	15	
2022-10-13	8.9	7.0	12.1	10.9	7.6	15	
2022-10-14	7.9	5.7	12.1	8.6	3.3	15	
2022-10-15	6.0	5.9	6.4	4	3.9	4.3	Issues S!MPATI software
2022-10-16	6.0	5.9	6.1	4	3.9	4.1	
2022-10-17	6.0	5.9	6.0	4	3.9	4.1	
2022-10-18	7.1	5.9	12.1	5.1	4	11.6	
2022-10-19	7.8	6.0	10.6	5.6	4	6.9	
2022-10-20	7.8	6.0	10.6	5.6	4	6.9	
2022-10-21	7.8	6.0	10.6	5.6	4	6.9	Week3
2022-10-22	7.7	6.0	10.6	5.6	1	6.9	
2022-10-23	7.8	6.0	10.6	5.6	4	7.3	
2022-10-24	7.7	6.0	10.6	5.6	4	6.8	
2022-10-25	6.6	4.1	8.6	6.1	4	11.2	
2022-10-26	5.1	3.9	12.6	5.8	4	11.2	
2022-10-27	5.1	4.0	7.0	5.8	4	11.2	
2022-10-28	5.1	4.0	7.0	5.8	4	11.2	Week4
2022-10-29	5.1	4.0	7.1	5.8	4	11.2	
2022-10-30	5.1	4.0	7.0	5.8	4	11.2	
2022-10-31	5.1	4.0	7.0	5.8	4	11.2	
2022-11-01	6.4	3.4	18.1	6.4	3.9	16.9	
2022-11-02	5.1	3.4	7.6	5.8	3.6	11.2	Week5
2022-11-03	5.1	3.1	8.8	5.8	4	11.2	
2022-11-04	5.1	4.0	7.0	5.8	4	11.2	

Ahuja I, Fløistad IS, Grande PO, Tyldum JM, Edvardsen OM, Steffenrem A (2026). **Frost hardening in seedlings of four provenances of Norway spruce in response to simulated autumn conditions with decreasing and fluctuating temperatures**  
iForest – Biogeosciences and Forestry – doi: [10.3832/ifor5041-019](https://doi.org/10.3832/ifor5041-019)

Date	Treatment 1 (Growth chamber 1)			Treatment 2 (Growth chamber 2)			Week
	Average	Min.	Max.	Average	Min.	Max.	
2022-11-05	5.1	3.9	7.1	5.8	4	11.2	
2022-11-06	5.1	4.0	7.0	5.8	4	11.2	
2022-11-07	5.3	3.9	10.8	6.5	4.2	11.2	
2022-11-08	5.1	2.8	9.9	5.9	3	11.4	
2022-11-09	5.1	4.0	7.1	5.8	4	11.2	
2022-11-10	5.1	3.2	9.4	5.8	3.5	11.2	
2022-11-11	5.1	2.9	7.1	5.8	3.5	11.3	Week6
2022-11-12	5.1	4.0	7.1	5.8	4	11.2	
2022-11-13	5.1	4.0	7.0	5.8	4	11.2	
2022-11-14	5.1	3.8	7.1	5.8	3.9	11.2	
2022-11-15	5.1	4.0	7.1	5.8	4	11.2	
2022-11-16	5.1	4.0	8.9	5.8	4	11.2	
2022-11-17	5.1	4.0	7.0	5.8	4	11.2	Week7
2022-11-18	5.1	4.0	7.0	5.8	4	11.2	
2022-11-19	4.7	3.8	6.4	3.8	0.7	8.6	
	348.2			347.2			

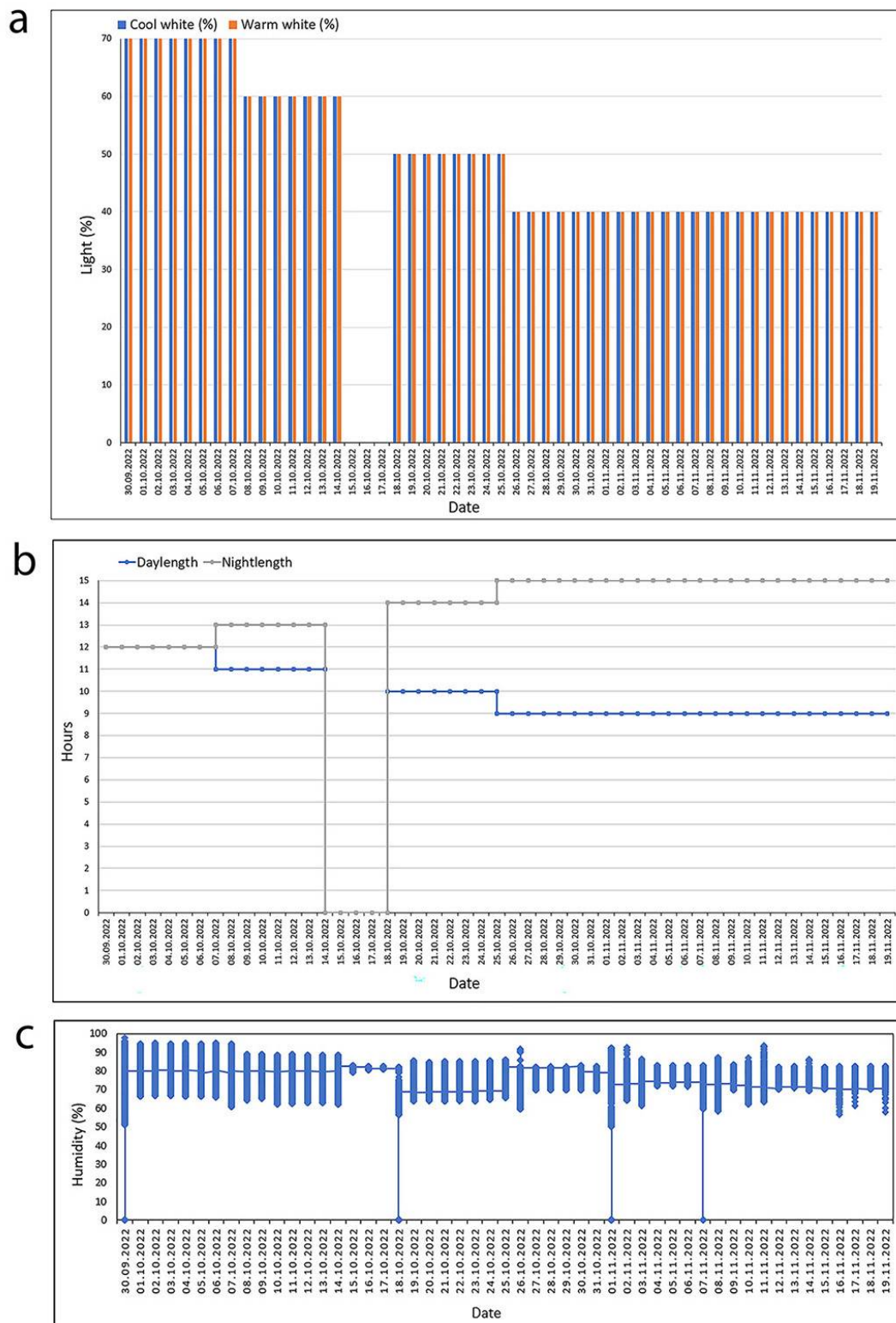
**Fig. S1** - Air temperature (daily mean and sum) (°C), registered at the greenhouse and the outside area (31 May to 30 September), SPMN Kvatninga. A. In the greenhouse from 31 May to 13 June, B. In the outside area from 14 June to 30 September.



**Fig. S2** - The day/night cycles of temperature (°C) (30 September – 19 November) that were registered in two growth chambers by running programs for Treatments 1 and 2 (Tab. S2 and Tab. S3) with the S!MPATI software. A. The temperature cycles (30 September – 19 November) for climate chamber 1 where program for Treatment 1 was run, B. The temperature cycle for climate chamber 2 where program for Treatment 2 was run. Due to some issues with the S!MPATI software between 14-17 October, there was no day/night cycle, and the program was restarted on 18 October.



**Fig. S3** - The day/night cycles of light, photoperiod, and humidity conditions that were registered in two climate chambers (30 September – 19 November) by running specific programs for Treatments 1 and 2 (Tab. S2 and Tab. S3) with the SIMPATI software. A. Light (%): Cool white and warm white, B. Photoperiod (hours): day length and night length, and C. humidity (%).



**Fig. S4** - The temperature cycle of the freezing test that was conducted at -25 °C in a programmable freezer.

