

THE EFFECTS OF TIMING OF SOIL FROST THAWING ON SCOTS PINE

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Background

Spring is stressful for trees in boreal zone: Soil is frozen, light irradiance is considerable and diurnal air temperature may vary between -20 and 20°C. Foliar damage may occur and varies from slight to severe. The aim was to study the effects of delayed soil frost thawing on Scots pine, and to determine a threshold temperature parameter for tolerance of the stress.

Material and methods

The experiment took place in the root lab, 'Joensuu dasotrons' (Fig. 1). Sixteen 5-years-old Scots pine seedlings were used in four treatments which started during the second artificial dasotron-winter when soil in the root containers was frozen. Air conditions changed from 'winter' (4°C, photoperiod 6/18h day/night, photon flux density 200 µmol/m²s) to 'summer' (20/15°C, photoperiod 18/6h, RH 70/80% day/night respectively, 400 µmol/m²s) at the same time but the soil thawing took place at different times by treatments (Fig. 2A).

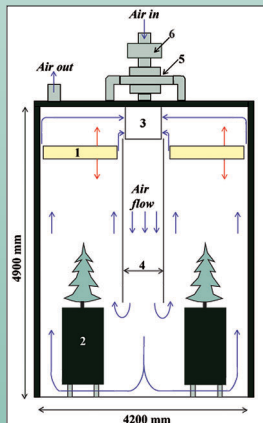


Fig. 1. Schematic cross-section of a dasotron. 1) Movable lamp canopy, 2) pot, 3) evaporator, 4) roller blinds, 5) dehumidifier, and 6) filter

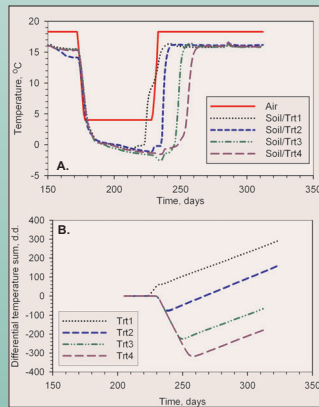


Fig 2. A. Daily mean air and soil (organic layer) temperature during the experiment. B. The difference in the temperature sum between soil and air that is calculated according to the threshold of 0°C and 5°C for daily mean temperature respectively.

Measurements

- Soil and air temperature and soil moisture content
- Survival and biomass allocation
- Phenology
- Chlorophyll fluorescence (Fv/Fm) of needles
- Chlorophyll a and b content of needles
- Electrical impedance of needles

Results

- All the seedlings in Trt1 and Trt2 and one seedling in Trt3 survived the soil thawing treatments (Fig. 3).
- Initiation of shoot and needle elongation and cessation of shoot elongation differed between Trt1 and Trt2 (Table 1).
- The stress induced by the Trt3 and Trt4 was observed in the Fv/Fm-ratio, chlorophyll a/b -ratio and extracellular resistance (Fig. 4).

Table 1. The air temperature sum (d.d) for different phenological events by treatments.

Trt	Initiation of shoot elongation	Cessation of shoot elongation	Initiation of needle elongation
1	186 _a	416 _c	443 _e
2	253 _b	500 _d	486 _f
3	dns	-	dns
4	dns	-	dns

dns = did not start. Different letters indicate a significant difference at $p < 0.05$

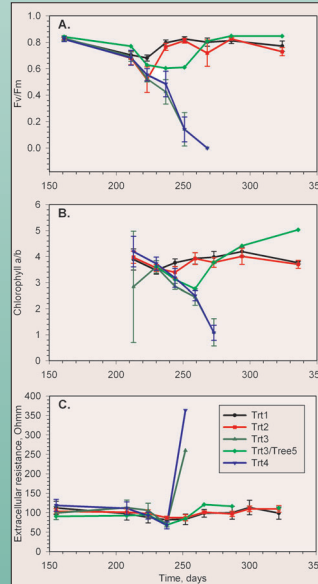


Fig 4. Chlorophyll fluorescence Fv/Fm (A), chlorophyll a/b -ratio (B) and extracellular resistance (C) of the needles during the experiment.

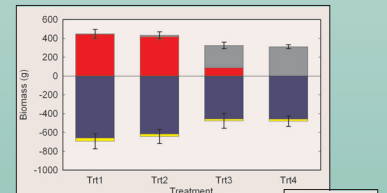


Fig. 3. The air temperature sum (d.d) for different phenological events by treatments.

Conclusions

- A threshold for the tolerance of stress due to the delayed soil thawing existed between Trt2 and Trt3
- The difference in temperature sum between soil and air reached the minimum of -70 and -220d.d. for Trt2 and Trt3 respectively (Fig. 2B).
- Further studies are needed to test if the threshold corresponds the situation in field.