Artificial top soil drought hardly affects water use of *Picea abies* and *Larix decidua* saplings at treeline in the Austrian Alps

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Background

Increased temperatures and more severe drought are predicted for the upcoming decades.

Methods

Therefore, at treeline in the Central Tyrolean Alps, Austria,we installed a transparent roof construction around three *Picea abies* and three *Larix decidua* saplings to prevent precipitation from reaching the soil surface. Three additional saplings from each species served as controls in the absence of any manipulation. Sap flow density (Qs) of all the study saplings and environmental parameters were monitored throughout three growing seasons.

Roofing significantly reduced soil water content (SWC) in 5 - 10 cm soil depth (Table 1) while soil temperature was not affected.

Table 1

SWC % vol	2016	2017	2018
Control	35	32	30
Roofed	27	15	16

Results

Three years of rain exclusion did not significantly modify the response of Qs to SWC in 5 - 10 cm soil depth and evaporative demand. While Qs and SWC were unrelated, Qs increased with increasing PHAR and VPD (Figure 1).

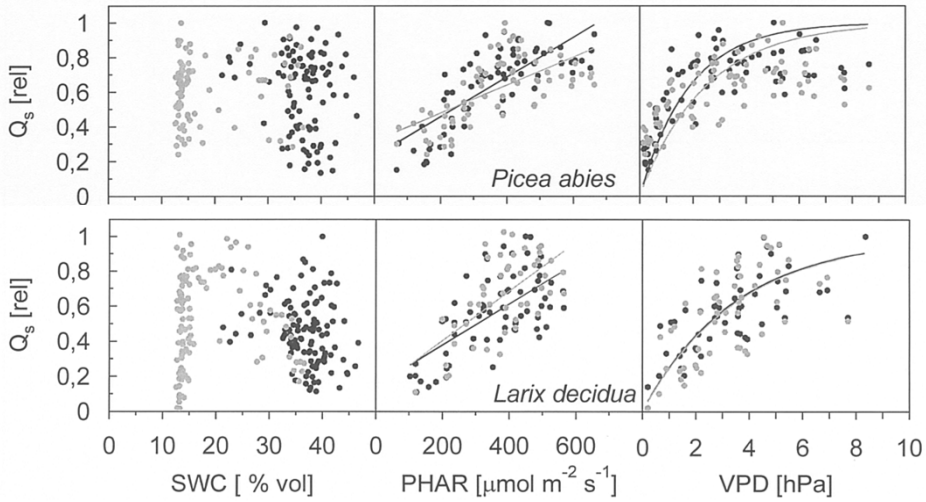

Figure 1 Symbols control (black) rain exclusion treatment (grey)

In contrast to normalized Qs, normalized canopy conductance (gc) declined with increasing VPD, and was not affected by the rainout treatment (Figure 2).

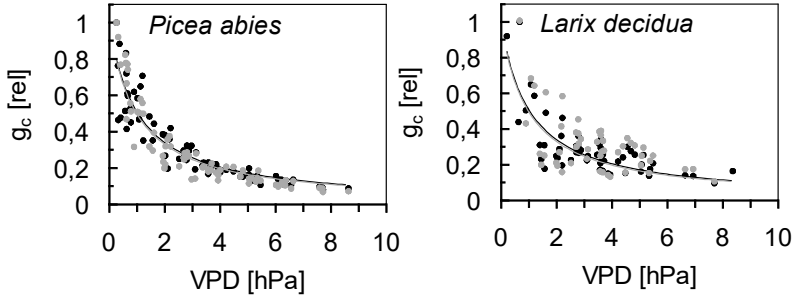

Figure 2 Symbols control (black) rain exclusion treatment (grey)

Conclusions

- The lack of a significant Qs - SWC correlation in *P. abies* and *L. decidua* saplings at our study site indicates sufficient water supply
- Whole tree water loss primarily depends on evaporative demand.
- Our findings suggest a great tolerance of saplings of both tree species to limited top soil SWC at treeline.
- This is because at treeline, small young trees are less coupled to the atmosphere and experience different environmental conditions as compared to adult trees, which are well coupled to the atmosphere.

Recommendation

- It therefore remains to be investigated whether the surprisingly high drought resistance of saplings of the two conifer species at the treeline also holds for mature trees.