

STOMATAL REGULATION IN FIELD-GROWN DOUGLAS-FIR.

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1. INTRODUCTION

Stomatal aperture is important in regulating CO₂ and H₂O exchange between leaf and environment. Knowledge of stomatal regulation under various ambient conditions is important for models in which uptake of gaseous air pollutants is estimated. Needles high and low in the tree crown are subject to different ambient conditions and may also differ in stomatal regulation (1). Therefore, stomatal behaviour was studied on current-year and one-year-old needles high (sun adapted) and low (shade adapted) in the tree crown. Between May and September in 1992 and 1993 2 trees were climbed every 2 weeks to measure gas exchange with a portable gas exchange unit (ADC, LCA-2). Transpiration rate (E), stomatal conductance (gs) and meteorological data were measured. Afterward the shoot was cut and the shoot water potential (P) was measured directly at the forest floor, using a pressure bomb.

2. RESULTS

In general the gs and E of needles high in the crown was higher compared with needles low in the crown. No difference was found in gs and E between current-year and one-year old needles. High in the crown stomatal closure was only found under low light conditions. No relation was evident between gs and PAR. A clear relation was found between E and gs: E increased with increasing gs, but the slope was highly dependent on VPD (fig 1). At high VPD, transpiration was more sensitive to changes in gs. This was also found for one-year-old needles and needles low in the crown. E was also more sensitive to changes in gs at low P values (more negative) (fig 2). P decreased (became more negative) with increasing transpiration to reach a minimum at ca -17 Bar,

while E still increased (fig 3). Evidently low P values did not induce stomatal closure, as sometimes reported in literature (2) Needles low in the crown showed much the same relation between E and P, although E did not exceed 1000 $\mu\text{Mol H}_2\text{O/m}^2\cdot\text{s}$.

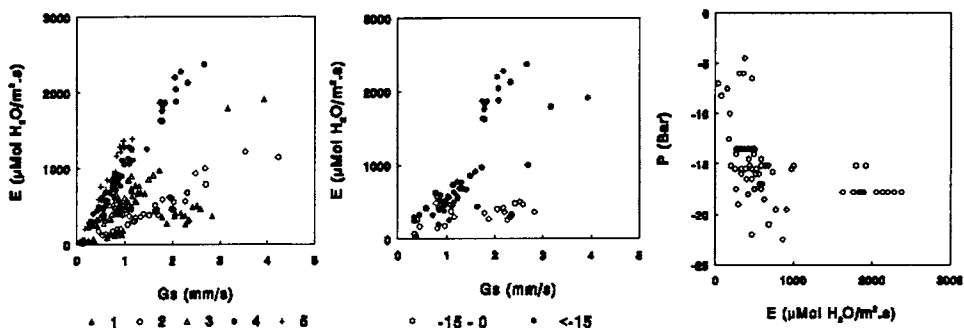


Figure 1

Figure 2

Figure 3

Figure 1: The relation between gs and E under different VPD-ranges of current-year needles high in the tree crown. (VPD (Pa): 1<500; 2=500-1000; 3=1000-2000; 4=2000-3000; 5>3000).

Figure 2: The relation between gs and E under different P ranges of current-year needles high in the tree crown. (P (Bar): >-15 and <-15).

Figure 3: The relation between E and P of current-year needles high in the tree crown.

3. CONCLUSIONS

- 1 Transpiration rates were more sensitive to gs at high VPD ranges, and low shoot water potentials.
- 2 Under these conditions, shoot water potentials did not induce stomatal closure, high or low in the crown.
- 3 No differences were found in stomatal regulation between needles high and low in the crown and between current-year and one-year-old needles.

4. REFERENCES

- 1 W. Jans and E. Steingröver. IBN, Wageningen, The Netherlands, Dorschkamp Report 695, 1992.
- 2 C. Tan and T. Black. Boundary-Layer Meteorology 10 (1976).