



Simple relations for different stomatal control mechanisms link partially drying soil and transpiration

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Stomata can close to regulate plant water loss under unfavourable water availability. This closure can be triggered by hydraulic ('H') and/or chemical signals ('C', 'H+C'). By combining plant hydraulic relations with a model for stomatal conductance, including chemical signalling, our aim was to derive a simple relation that links soil water availability, expressed as the fraction of roots in dry soil, to transpiration.

We used the detailed mechanistic soil-root water flow model R-SWMS to verify this relation. Virtual split root experiments were simulated, comparing horizontally and vertically split domains with varying fractions of roots in dry soil and comparing different strengths of stomatal regulation by chemical and hydraulic signals.

Transpiration predicted by the relation was in good agreement with numerical simulations. Under certain conditions H+C control leads to isohydric plant behaviour, which means that stomata close to keep leaf water potential constant after reaching a certain level. C control on the other hand exerts anisohydric behaviour, meaning that stomata remain fully open during changes in leaf water potential. For C control the relation between transpiration reduction and fraction of roots in dry soil becomes independent of transpiration rate whereas H+C control results in stronger reduction for higher transpiration rates.

Simple relations that link effective soil and leaf water potential can describe different stomatal control resulting in contrasting behaviour.