The multidimensionality of plant drought stress: The relative importance of edaphic and atmospheric drought

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Abstract

Drought threatens plant growth and related ecosystem services. The emergence of plant drought stress under edaphic drought is well studied, whilst the importance of atmospheric drought only recently gained momentum. Yet, little is known about the interaction and relative contribution of edaphic and atmospheric drought on the emergence of plant drought stress. We conducted a gradient experiment, fully crossing gravimetric water content (GWC: field capacity-permanent wilting point) and vapour pressure deficit (VPD: 1-2.25kPa) using five wheat varieties from three species (*Triticum monococcum*, *T. durum* & *T. aestivum*). We quantified the emergence of plant drought stress on molecular (ABA), cellular (stomatal conductance), organ (leaf water potential) and stand level (evapotranspiration). Plant drought stress increased with decreasing GWC across all organisational levels. This effect was magnified non-linearly by VPD after passing a critical threshold of soil water availability. At around 20% GWC plants lost their ability to regulate leaf water potential via stomata regulation, followed by the emergence of hydraulic dysfunction. The emergence of plant drought stress is characterized by changing relative contributions of soil vs. atmosphere and their non-linear interaction. This highly non-linear response, consequently, is likely to abruptly alter plant-related ecosystem services in a drying world.

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