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Ecological stoichiometry reveals variation in phosphorus and nitrogen responses to warming and drought across mycorrhizal partners

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Ecological stoichiometry provides a valuable framework to understand functional variation among organisms, particularly with respect to responses to stress. Trophic dynamics are an important element of this framework, although symbiotic interactions are poorly integrated. Here, we assessed concentrations and ratios of carbon ([C]), nitrogen ([N]) and phosphorus ([P]) in tissues of lucerne (Medicago sativa) and their associated arbuscular mycorrhizal (AM) fungi growing under ambient or extreme (high temperature and/or low soil moisture) environmental conditions. In general, the AM fungal mycelium was depleted in [C] by 50% and [N] by 46% but enriched in [P] by more than six times when compared to plant shoots and roots. Warming and moisture limitation resulted in further increases in [P] and reduced C:P and N:P ratios in all tissues, while AM fungal [N] and C:N responses were muted and decoupled from those in plant tissues. Using high-throughput DNA sequencing and joint species distribution modelling, we were also able to link compositional shifts in AM fungal communities in roots and soil to variation in hyphal chemistry. As such, this work provides insight into the ecological strategies of AM fungi associated with an important pasture legume (among many other species); some potential consequences for carbon and nutrient exchange between soil, fungal and plant pools; and how these interactions are impacted by climate extremes.