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Root Responses to Altered Ecosystem N/P Stoichiometry in a Mediterranean Tree-Grass Ecosystem

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Biological components of the soil system (plant roots, fungi, microbes) may respond to biogeochemical drivers (e.g. nutrient status, water availability, C availability) in dissimilar ways due to differing scales, activities and access to resources. Understanding individual components and their phenology in the soil system is therefore critical to interpret overall fluxes. In seasonally dry systems, plants balance belowground investment with other growth and maintenance in life strategies where water limitations (in dry periods), nutrient limitations (in wet periods) and temperature/light limitations (in winter) interact, varying the need to invest in gaining these three resources throughout the year. Additionally, root growth may also be desynchronized with overall nutrient demand due to the ability to take up nutrients outside of seasonal periods of demand for storage and subsequent reallocation.

We examined root responses to an ecosystem level stoichiometry (+N / +N+P) manipulation experiment at a highly instrumented site in a strongly seasonal semi-arid tree-grass ('dehesa') system (Majadas del Tietar, Spain). We are interested in whether root growth and phenology is affected by differing demand for nutrients/water both between sites and at tree and grass-dominated subsites. Many non-invasive, ecosystem-scale methods to measure changes in biogeochemical cycling focus only on integrated whole-system fluxes or above-ground change and it is difficult to extract a root signal. However, local soil respiration fluxes and root growth introduces a variety of method-dependent artefacts and drawbacks necessitating multiple approaches and careful interpretation. Therefore, in coordination with indirect measurements (subcanopy fluxes via eddy covariance, soil respiration chambers) we are using direct soil coring, ingrowth cores and repeatable measurements from custom-built minirhizotron systems to attempt to assess site-level variation in root biomass and phenology. In this presentation, we show initial results from manual minirhizotron measurements and direct root biomass measurements at Majadas del Tietar indicating that +N and +N+P additions are driving increased root biomass, primarily in areas of open grassland rather than under canopies. We interpret differences in root observations within the context of water, nutrient availability, whole plant and site-level trends.