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* Marañon et al., 2020: **Variation in morphological and chemical traits of Mediterranean tree roots: linkage with leaf traits and soil conditions**:

In general, roots and leaves were functionally coordinated, although most of the trace elements showed strong root-leaf discordance. The soil conditions interacted with the fine root traits in feedback processes. The ability of tree roots to accumulate trace elements and to reduce their translocation to leaves is a desirable trait for the phytoremediation of metalcontaminated soils.

Understanding the variations in the root traits of trees will help us to predict both the responses of forests to global changes, including soil contamination, and the provision of soilbased ecosystem services.

most of the trait variation was concentrated in a two-dimensional spectrum of plant

form and function: plant size and leaf economics spectrum (LES) (Díaz et al. 2016). The LES reflects the trade-off between resource acquisition and resource conservation. At one end of the spectrum, there are species with high photosynthetic and respiration rates,

high nitrogen (N) and phosphorus (P) concentrations, low leaf mass per area (LMA) and low leaf longevity. At the other end of the spectrum, there are species with the opposite traits (Wright et al.2004).

* El articulo trata sobre la plasticidad a través de los rasgos funcionales, en este caso habla específicamente de la importancia de las raíces y sus adaptaciones al medio, muchas veces adaptables en función de la fertilidad o física del suelo, o hasta de las relaciones microbiológicas con micorrizas. Eso em recuerda como los agricultores de alguna forma escogen no apenas los suelos, sino las épocas de plantio, en el caso de la mandioca en Ipixuna, don Lucio comentaba como la maniva había que plantarla en verano, en el suelo mas arcilloso para que la batata engordase, creciese buscando agua…

Resource acquisition is coupled and linked among plant organs. Thus, fast acquisition and processing of water and nutrients by roots would require fast acquisition and processing of carbon (C) by leaves (Reich 2014).

However, other studies did not find correlations between leaf and root traits, suggesting that trade-offs in different organs operate independently and that the leaf-root coordination may depend on specific limiting factors in each habitat (Tjoelker et al. 2005; Kembel and Cahill2011; Fortunel et al.2012).

**Relación entre rasgos funcionales vs nutrientes (NIR) vs clima**

Contrasting leaf habits in trees - that is, evergreen versus deciduous - are usually associated with different functional traits. For example, deciduous species are characterised by acquisitive traits such as lower LMA, higher rates of photosynthesis and respiration, and higher nutrient concentrations, in comparison to evergreen species, which tend to exhibit more-conservative traits (Wright et al. 2004; Villar et al. 2006;delaRiva et al.2018b). However, few studies have investigated the differences in root traits between evergreen and deciduous trees; for example, Martinez et al. (2002) did not find differences in root C or N concentrations between deciduous and evergreen species of Quercus.

**El grado de simbiosis o la afinidad entre los simbiontes como rasgo funcional de la raíz? Eso puede ser mensurado? Seria un rasgo cualitativo? Cuantitavivo?**

Besides unravelling the RES, another research challenge is to understand how different drivers of global change impact a suite of root traits, and to predict their cascading effects on soil-based ecosystem processes (Bardgett et al.2014). Root traits are plastic and respond to physical soil limitations, the heterogeneous distribution of soil water and nutrients and biotic interactions (Bardgett et al. 2014).

**En el artículo, los autores presentan las diferentes hipótesis que los rasgos funcionales de las raíces y sus relaciones con los rasgos funcionales aéreos se pueden comportar frente a los diferentes elementos que presentaron los suelos biorremediados a lo largo de un periodo de tiempo largo.**

**Hay que describir las principales medias climáticas como precipitación media, ETo, Temperatura media, máxima (mes) y mínima (mes), en lo referente al suelo también deben ser colocadas informaciones de la localización y el tipo y la formación de cada suelo.**

Differences in leaf habit (deciduous versus evergreen) will be mirrored by root traits variation, if there is coordination between plant organs. Effectively, deciduous trees presented significantly higher values of the acquisitive root trait SRL, and lower values of the conservative RMA, RDMC and RDI, compared to evergreen species. The concentrations of nutrients (K, P, Ca, Mg and S) were higher in the roots of deciduous trees than in those of evergreen trees; although, there was no significant difference for C or N. The accumulation of some essential (Fe, B and Zn) and non-essential (As, Pb and Sr) trace elements was also higher in the roots of deciduous trees (Table S4)

**Hubo diferencias en la concentración de muchos de los elementos químicos entre las raíces y hojas de los diferentes grupos de árboles (caducos/peremnes).**

**No entiendo lo que significa Leaf Economic Spectrum, de igual modo en raíces**

The relative coordination between the root and leaf traits was also reflected by the positive correlations between some of the 24 analogous traits (Table 1), and by the significant linear correlation between the scores of the first axes of their respective PCAs (Fig. 4). In particular, the analogous morpho-functional traits RMA and LMA were highly correlated (r = 0.55, p= 0.001). Among the chemical elements, the root-leaf correlation was significant for C, the nutrients P, Ca and Mg, the trace elements Ba and Sr, and the isotope δ13C. There was no significant root-leaf correlation for the concentrations of the other 14 elements and δ15N.

**Esto es interesante, las variaciones ocurridas en las hojas, ocurrían en loas raíces.**

There were significant differences among the tree species for only seven of the 21 variables tested in the soil underneath the trees: soil pH and available concentrations of S and some trace elements (B, Mn, Ba and Co) (Table S5).

The soil pH was correlated significantly and negatively with RMA, RDMC and RTD, and positively with SRL; no correlation was found with RDI.

The main trend in variation observed for the root traits of this study supports the root economics spectrum (RES) hypothesis. Trees with lighter roots, lower RMA and richer in N, K and P (like those of the deciduous Fraxinus and Celtisspecies) would maximise soil resource acquisition. Contrastingly, trees with denser roots, higher RDMC and lower concentrations of nutrients (like evergreen Pinus and Quercusspecies) would exhibit a resource conservation strategy. These results support the existence of a suite of correlated plant (roots and leaves) traits associated with the trade-off between resource conservation and fast growth, known as the“plant economics spectrum”(Freschet et al. 2010; Reich2014;delaRivaetal.2018a).

The key morphological traits RMA and SRL, which are indicators of the root uptake potential, correlated with other morphological traits and with some major nutrients (P, K, Ca and Mg), which supports the uptake function of these traits.

**El articulo relaciona parámetros morfológicos con nutricionales (dinámicas y contenido de nutrientes en los diferentes tejidos como hojas y raíces) todo eso relacionándolo junto al suelo y las diferentes especies para definir conceptos de rasgos funcionales mas específicamente en las raíces, o sea que la planta consigue adaptarse (modificarse) con cierta capacidad de plasticidad para optimizar el uso de los recursos lo que se define como Espectro económico de las hojas o de las raíces.**

Among the root traits which confer improved tolerance to elevated metal concentrations in soils is the ability to bind trace elements to root cell walls and accumulate them belowground; in this way, roots may be barriers impeding the uptake of potentially toxic elements and their translocation to the leaves (Lambers et al. 2008;Zhaoetal.2016). This additional root dimension that confers metal tolerance may be very important for plant fitness in metal-rich environments, like the study site.

**Esto es superinteresante pues fundamenta un mecanismo por el cual las plantas consigues desarrollar métodos de sobrevivencia y tolerancia a ambientes hostiles se adaptando a las limitaciones del medio, en este caso la presencia de elementos tóxicos los cuales impiden de entrar en los tejidos y los acumulan en la superficie de las raíces.**

Fast plant growth depends on the coordination of roots and leaves, with the former providing enough water and nutrients supply to maintain acquisitive leaves with high

photosynthetic rates and high evaporative demand (Reich 2014). In general, we found that the main root variation trend (PCA axis 1) was significantly correlated with the corresponding leaf variation trend (Fig.4), supporting the existence of a plant economics spectrum (Pérez-Ramos et al. 2012;delaRivaetal.2016b, 2018a).

In particular, we found significant correlations between morphological root traits (RMA and RDMC) and the analogous leaf traits (LMA and LMDC), supporting such root-leaf coordination, as reported in other studies (Holdaway et al.2011;delaRivaetal. 2018a).

Nutritional differences among tree species result from the functional diversity in mechanisms of nutrient uptake from soil, nutrient requirements and long-term nutrient use efficiency (Lambers et al.2008). The coordinated variability in P, Ca and Mg concentrations between roots and leaves indicates that these nutrients are under biological control, due to their importance for plant growth (Newman and Hart2006;Gengetal. 2014;Zhaoetal.2016)

In contrast, most of the trace elements had a strong discordance between their concentrations in roots and leaves. The excess uptake of non-limiting elements

seems poorly regulated by plants, and therefore they exhibit high variability (Ladanai et al.2010). Plants tend to accumulate trace elements in roots, binding them to

cell walls as a detoxification mechanism (Domínguez et al.2009; Kabata-Pendias 2011;Zhaoetal.2016).

However, some tree species have a selective uptake and transport of certain trace elements, accumulating them in leaf tissues. Notable examples are the accumulation

of Cd and Zn inPopulusleaves (Madejón et al. 2004) and the accumulation of Mn in Quercusleaves (Madejón et al. 2006), but not in their roots (Fig. S4)

**Aquí tenemos información directa para poder discutir los contenidos de nutrientes en las hojas de la encina, mas concretamente de Mn en el estudio de Madejón 2006**

In soils contaminated by trace elements, the adequate selection of plant species for phytostabilization is essential. One of the main criteria is that the selected tree species control the mobility of the trace elements, keeping their root to shoot translocation factors as low as possible, to avoid toxicity risks in the trophic web (Mendez and Maier2008; Bolan et al. 2011; Madejón et al.2018b)