New Phytologist

Meetings

Think globally, research locally: emerging opportunities for mycorrhizal research in South America

First international mycorrhizal meeting in South America, 'Mycorrhizal symbiosis in the southern cone of South America', Valdivia, Chile, 6–9 March 2017

More than 20 years ago David Read highlighted the ideal relationship between dominant vegetation and plant mycorrhizal types; he divided the world into major biomes and hypothesized that mycorrhizal symbioses modulate biome dynamics through soil-nutrient processes (Read, 1991). This idea has been accepted and further developed theoretically in the northern hemisphere (Read & Perez-Moreno, 2003), but conversely, no clear further development has been made in the southern hemisphere, and in particular in South America, despite its contrasting patterns of mycorrhizal association with forests dominated by arbuscular mycorrhizal (AM) gymnosperms and angiosperms, or ectomycorrhizal (ECM) *Nothofagus* spp. (Fontenla *et al.*, 1998; Palfner, 2001). These South American mycorrhizal patterns, linked to its unique geology, climate and biogeographic history (McGlone *et al.*, 2016; Goymer, 2017), have already provided interesting insights into mycorrhizal research, such as the discovery of new mycorrhizal associations (Bidartondo *et al.*, 2002), or regional differences in the distribution of mycorrhizal fungi (Tedersoo *et al.*, 2014; Davison *et al.*, 2015).

In the last decade, the development of molecular and macro-ecological approaches has boosted mycorrhizal research globally (Chagnon *et al.*, 2016), which is allowing comparisons to be made among northern and southern hemisphere patterns. However, global initiatives have been initiated in the northern hemisphere, and might lack the integration of local southern perspectives into the global context. As a consequence, the sampling effort among northern and southern regions is far from balanced (Fig. 1), further highlighting the need for more mycorrhizal research in under-studied regions, such as South America (Goymer, 2017). The first international mycorrhizal meeting in South America, 'Mycorrhizal symbiosis in the southern cone of South America', took place in Valdivia, Chile, 6–9 March 2017, and has been a key step towards this goal (Fig. 2). The meeting gathered 70 South American and European mycorrhizal researchers from eight countries (Argentina, Brazil, Chile, Estonia, Germany, Spain, United Kingdom and Uruguay) and 26 institutions, including universities, research centers, companies, foundations and public entities (https://mycorrhyzal.wordpress.com/).

The topics addressed in the meeting fit broadly under two themes: ecology of mycorrhizas and mycorrhizal applications, representing timely research directions both in the region and globally.

Mycorrhizal fungi and plant invasions in South America

The scattered knowledge on mycorrhizal ecology in South America dictates that more basic research needs to be done to describe mycorrhizal fungal diversity and community structure from natural, agricultural and degraded environments. Results presented at this meeting regarding these areas either using field inventories, DNA-based approaches or both, are a valuable contribution to understand mycorrhizal fungal diversity across the globe, to discover new fungal species and lineages (Tedersoo & Smith, 2013), and to assess plant or fungal community changes and invasions in the future. Woody plant invasion is in fact one of the current threats to South American highly diverse ecosystems, mainly due to its soil-properties altering effect, hydrology, ground cover, and its impact on animal and soil communities (Simberloff *et al.*, 2010). Belowground biotic interactions are being increasingly recognized as having a major role in the expansion of invasive plant species, in particular trees from the *Pinaceae* family (Simberloff *et al.*, 2010; Nuñez & Dickie, 2014). To date, the causes and mechanisms of their expansion are globally unknown but are expected to be complex, including multiple interactions among native and nonnative flora, AM and ECM fungi (Nuñez & Dickie, 2014; Hayward *et al.*, 2015). For instance, Nahuel Policelli (Universidad Nacional de Comahue, Argentina) showed in a glasshouse experiment that seedlings of nonnative *Pinus contorta* and native *Nothofagus antartica* performed similarly with nonnative and native ECM fungi, indicating that *P. contorta* is able to switch its mycorrhizal fungal partners. Similarly, but in natural conditions, María Eugenia Salgado Salomón (Centro de Investigación y Extensión Forestal Andino Patagónico, Esquel, Argentina) analyzed the interaction between native *Nothofagus* spp. and nonnative dual mycorrhizal species *Pseudotsuga menziesii*. She also found that both groups of plant species can share their mycorrhizal fungi, and that the dual mycorrhizal nature of *P. menziesii* may be behind the successful establishment of these nonnative seedlings. Whether the belowground symbiosis interactions favor or limit the plant invasion, or even enhance plant–fungal co-invasion, is unknown, but it seems to be taxon- and context-specific (Hayward *et al.*, 2015; Gazol *et al.*, 2016). Future advances ensure promising mycorrhizal research distinguishing mycorrhizal fungal communities with strong and weak invasive abilities, with clear applications to forest management and conservation.

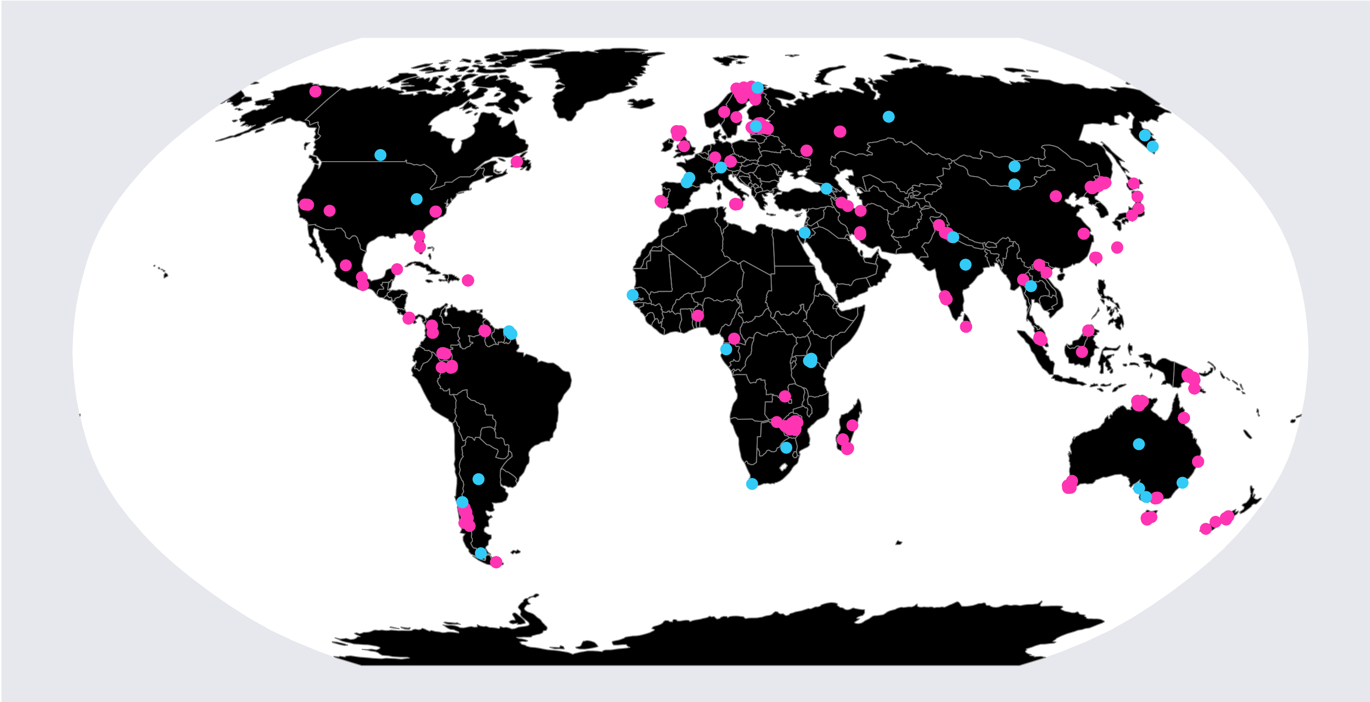

Fig. 1 The last two global studies exploring the diversity of mycorrhizal fungi, with large sampling gaps in rich biodiversity regions, such as South America. Pink dots correspond to sampling sites from Tedersoo *et al.* (2014) and blue dots from Davison *et al.* (2015).

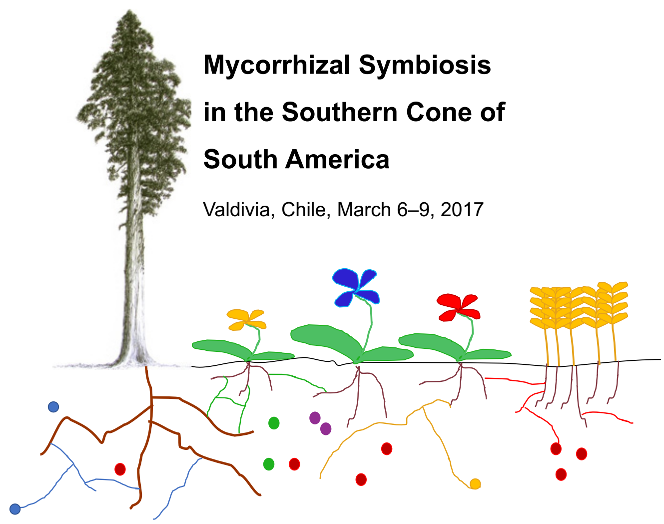

Fig. 2 Meeting logo.

Mycorrhizas and South America's food production systems

There is an increasing demand for sustainable solutions to food production and amelioration of environmental problems, where mycorrhizal fungi again may play a key role. Several research teams presented their results on the development of strategies to use mycorrhizas to enhance sustainability and productivity in agricultural systems.

Agricultural crops such as fruits (including wine grapes), cereals and vegetables, developed in volcanic areas, are important economic motors in southern South America. Among the advances towards increasing crop productivity is the use of mycorrhizal fungal symbionts to ameliorate the stressful conditions of crop plants in volcanic soil (Andosols). Andosols are characterized by low pH, high exchangeable aluminum (Al) content (Al phytotoxicity), and low levels of plant available phosphorus (P) (Borie *et al.*, 2010; Seguel *et al.*, 2013). Several mechanisms related to AM activities and fungal communities have been identified as drivers of Al-phytotoxicity amelioration and available P-deficiency tolerance in crop production (Borie *et al.*, 2010; Seguel *et al.*, 2013). To know and describe such effective AM fungal assemblages would be the first step towards an improvement of plant performance and crop productivity, linked with a potential significant decrease of the use of agrochemicals (Säle *et al.*, 2015). In this context, Paula Aguilera (Universidad de la Frontera, Temuco, Chile) showed high host-specificity in the AM fungi from Al-tolerant cultivars compared to Al-sensitive cultivars in four cereal plant species (Aguilera *et al.*, 2017). Similarly, in a previous experiment, Paula Aguilera and coworkers showed how the AM fungal communities of six winter wheat cultivars differ (Aguilera *et al.*, 2014), reinforcing the idea of high host-specificity also among cultivars within the same cereal crop. Future work could identify, extract and produce inocula with arbuscular fungal species with low host specificity, while optimizing plant performance for compatible crops in similar limiting soil conditions.

Future directions

The seed has been planted, and the first South American mycorrhizal meeting has provided clear examples of active and innovative mycorrhizal research in basic and applied questions of

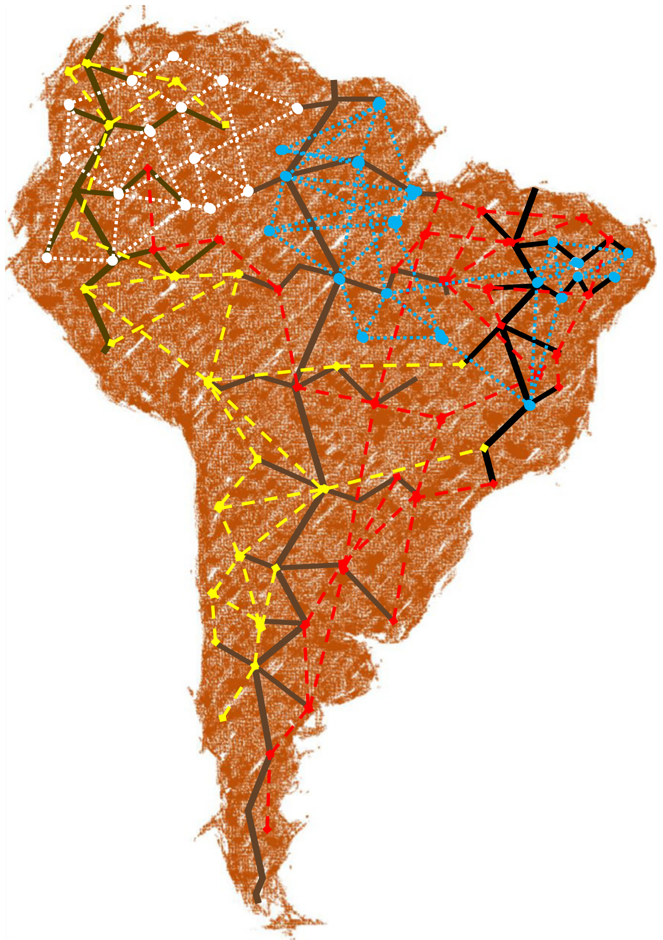

Fig. 3 Logo of the South American Mycorrhizal Research Network (https://southmycorrhizas.org/), launched just after the meeting.

local importance and global relevance. The meeting also reflected the presence of strong teams in South American mycorrhizal research with an emerging research generation facing large gaps in mycorrhizal knowledge. The last session of the meeting gathered them together with other enthusiastic researchers to discuss future local and global strategies to fill the knowledge gaps. As a consequence of the inspiring discussions held during the meeting, the South American Mycorrhizal Research Network was formed (Fig. 3; https://southmycorrhizas.org/). This network will serve as a platform for communication among researchers and practitioners within and outside South America, fostering mycorrhizal research, economical applications and public outreach. We hope that after this first seed, many South-American mycorrhizal research meetings will come, with the shared need to face local and regional conditions, while providing insights to classic questions as well as new challenges to mycorrhizal research.

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