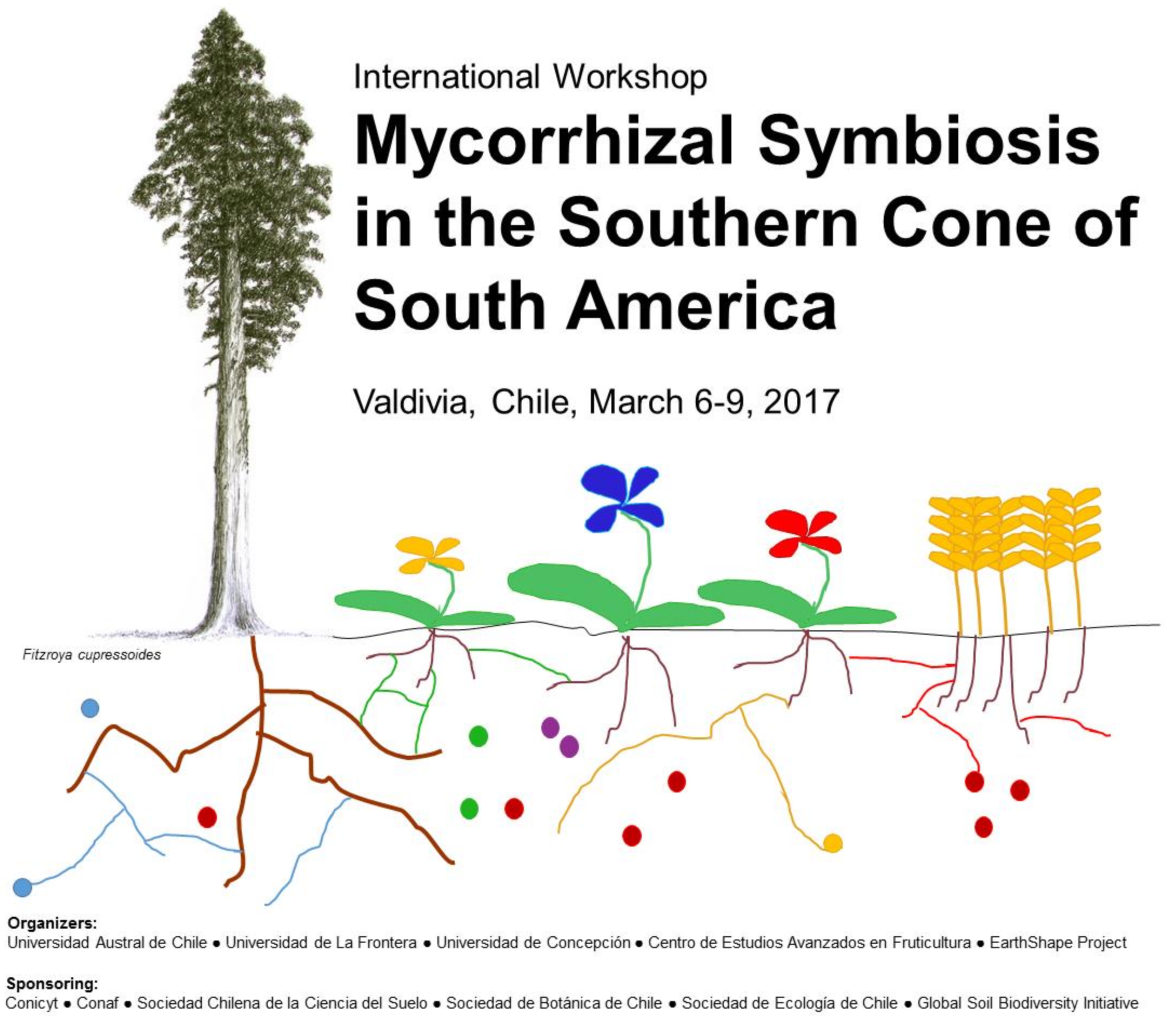
ABSTRACTS BOOK



https://mycorrhyzal.wordpress.com/

Content

Abstract book edited by: César Marín.

About the workshop

Aim:

This workshop is aimed at establishing the status of knowledge of mycorrhizal symbiosis in the Southern Cone of South America. It is also aimed at facilitating collaboration between researchers, students, and the mycorrhizal scientific community of Argentina, Chile, and other countries.

Activities:

The four-day workshop will be held at the Universidad Austral de Chile. Three days will be devoted to indoor meetings, and one day will consist of outdoor fieldwork in regional forests. Each day will include keynote lectures and participant oral and poster sessions.

Call for Contributions Special Issue of the *Journal of Soil Science and Plant Nutrition***:**

The participants are invited to submit their abstracts and extended paper submission (both in english) for a special issue of *Journal of Soil Science and Plant Nutrition* (http://jsspn.ufro.cl/, impact Factor 1.6). The deadline for paper submissions is 10th April 2016. Unpublished, original and high-quality works presented either in an oral or poster format in the Mycorrhizal Symbiosis in the Southern Cone of South America workshop, are invited to be submitted at this Special Issue of the Journal of Soil Science and Plant Nutrition (http://cl.submission.scielo.org/).

Venue and schedule:

The workshop will be held at the DAE building, Universidad Austral de Chile, Valdivia, Chile, between March 6th and March 9th, 2017. The workshop includes a field excursion to Puyehue National Park.

Photography exhibition:

In collaboration with Fundación Fungi, a fungal Photography exhibition would be held during the Workshop.
Exhibition title: *What few stop to look at/Lo que pocos se detienen a mirar*.

Contact: César Marín (cesar.marin@postgrado.uach.cl).

Overview:

The Southern Cone of South America sustains old-growth temperate rainforests that account for more than half of the southern hemisphere's temperate rainforests. These forests represent a biogeographic island housing a high degree of endemism that was facilitated by Pleistocene glaciations and postglacial climatic fluctuations. Several factors contribute to the concept that these forests are unique, isolated islands; specifically, they have extreme environmental, edaphic, and orographic conditions that are enhanced by earthquakes and volcanic activity. Furthermore, the soil of these forests has particular characteristics such as a high retention of organic matter and low plant available phosphate. Additionally, Patagonian temperate rainforests are characterized by low levels of atmospheric pollution, and since the Holocene the floristic composition has been stable.

Southern South American temperate rainforests are located within the Chilean Coastal Range and the Andes Range, two mountain systems that have contrasting geological histories. The Coastal Range bedrock is highly weathered with important oceanic atmospheric nutrient influence. In contrast, young volcanic ash deposits and weathered basaltic volcanic scoria are found in steep slopes of the Andes Range, which mostly contribute to nutrient input dynamics. Glaciations in Southern South America have strongly influenced current plant species distributions, delimiting refuge areas for plants adapted to warmer climates. The Coastal Range, in turn, has similarly influenced the vegetation resulting in high plant diversity at the family level and isolated monotypic genera. Three main floristic types are found in temperate rainforests of the Southern Cone of South America: conifer-dominated forests, e.g. *Fitzroya cupressoides*, angiosperm dominated forests *Nothofagus* spp., and Valdivian forests.

There are various different types of mycorrhizal associations in these forests. In Nothofagus forests, ectomycorrhizal (EM) forms are the dominant and arbuscular mycorrhizal (AM) associations are found with subordinate plants. Overall, however, soil fungal communities have been poorly studied in North-Patagonian temperate rainforests. The first mycorrhizal studies in Chile determined the mycorrhizal dominance of conifer trees and Nothofagus species as well as the mycotrophic status of the vascular flora of several forests types. Some recent molecular studies have been focused on the study of soil fungi assemblages in North-Patagonia, specifically EM fungi in Chilean and Argentinean Nothofagus forests. Recent global studies have also included Chilean and Argentinean coniferous forests, comparing all fungal associations and specifically AM fungal communities.

Disturbances in forest ecosystems alter the interaction between biotic components and biogeochemical processes. In Chile and Argentina, different natural and anthropogenic induced disturbances are responsible for temporal and permanent land use changes that have respective impacts on local ecosystems. Forestry plantations are significant components of Chilean and Argentinean landscapes and economies. Deforestation and agricultural expansion are the most evident processes of anthropogenic land cover changes in Southern South America. During the last century, a large fraction of the Nothofagus forests in this region has been cleared for agriculture. Anthropogenic activities such as transport, industry, and agriculture have been increasing in this region and thus could substantially alter the atmospheric N load and subsequently N deposition.

Arbuscular mycorrhizal (AM) associations play a key role in the sustainability of terrestrial ecosystems, in particular those presenting limitations for the establishment and subsequent growth of plants involved in commercial activities. In Chile, more than 50% of arable soils originate from volcanic ashes, which poses constraints to crop production. In general, these soils have a low pH, high exchangeable aluminum content, and low levels of available P. Given these conditions, the maintenance of AM fungal propagules via the use cultural management practices and biotechnological advances could be a successful way to maximize the positive effects of fungal symbiosis on plant growth.

Workshop´ excursions:

Workshop Dinner on a Catamaran in the Valdivia River.

We are pleased to welcome our participants to join the workshop dinner on the 8th of March. To participate in the dinner on the Catamaran Marqués de Mancera, you must make a reservation on the first day of the workshop (March 6th). The dinner on the river surrounding the Teja Island will be a nice end to the workshop, allowing personal interaction with key lecturers and senior scientists. The reservation costs is $5.000 CLP.

Excursion to Puyehue National Park.

Webpage: http://www.parquepuyehue.cl/

Previous registration for the excursion should be included with the general registration, before 06.02.2017. The cost is $10.000 CLP.

Puyehue National Park is located in the Andes mountains of the Los Ríos and Los Lagos regions of Chile. The park is 75 km east of Osorno, en route to Argentina. The park's protected area encompasses 1070 km^2 and includes recreational areas such as a ski resort and hot springs. Hiking activities in the park start from the Aguas

Calientes sector, which is the main administrative zone of the environmental authority (CONAF).

The park is dominated by a chain of volcanos known as the Cordón Caulle-Antillanca group; this chain includes several volcanos close to each other, including the Puyehue volcano. The park is divided into three main areas: Aguas Calientes, Anticura, and Antillanca. Aguas Calientes features natural thermal baths and hiking trails. Anticura features a variety of attractions including: the Puyehue volcano, the El Puma sightseeing point, the Cordón Caulle and associated hot springs, a strawberry field called the Pampa de Frutilla, a waterfall of an inlet of the Golgol river called the Salto de la Princesa, and an 800-year-old forest of *Nothofagus* trees. The Antillanca area features the Raihuén crater, Mirador hill, the Las Gaviotas river, as well as Rupanco Lake, and skiing facilities.

The climate in Puyehue is classified as rainy temperate. The annual precipitation (rain and snow) sums 7000 mm, with snow cover from June to November. The annual mean temperature is 4.5 °C. The Puyehue volcano is 2240 m.a.s.l. During the earthquake in 1960 (the strongest earthquake ever recorded), the volcano top collapsed, turning a large chunk of dense, humid evergreen forest into a stark landscape of sand dunes and lava rivers. The last eruption occurred in 2011. The volcanic soils of the park are classified as Mesic, Umbric Vitrandept. The material consists of andesitic basaltic tuff, scoria and sand of different particle sizes.

The native temperate rainforests of southern Chile have extraordinary genetic, phytogeographic, and ecological significance. The dominant vegetation type in the park is old-growth evergreen forest. This exuberant forest is made of various layers and houses a rich composition of endemic species. At low altitudes, the forest contain “coigüe” (*Nothofagus dombeyi*) and “ulmo” (*Eucryphia cordifolia*), including some *N. dombeyi* specimens that reach up to 40 m in height, accompanied of “olivillo” (*Aextoxicon punctatum*) and “tineo” (*Weinmannia trichosperma*). The underbrush has abundant bushes and bamboos (*Chusquea* spp.), ferns, mosses and lichens. At higher altitudes, “coigüe” (*Nothofagus dombeyi*) and “tepa” (*Laureliopsis philipiana*) can be found along with the conifer tree “mañío” (*Saxegothaea conspicua*), which usually is the dominant species. Near the treeline (1200 m.a.s.l.) there are pure forests of “coigües de Magallanes” (*Nothofagus betuloides*) with a dense underbrush composed of *Chusquea quila* and “lenga” (*Nothofagus pumilio*). Another interesting and highly specific vegetation type includes the so called *“mallines*”, which are bushes areas covered with the thick moss *Sphangnum sp*., bush layers, “ñirre” (*Nothofagus antarctica*), and “ciprés de las Guaitecas” (*Pilgerodendron uviferum*).

Among mammals in Puyehue National Park are the puma (*Puma concolo*r), the gray fox (*Pseudalopex griseus*), the “quique” (*Galictis cuja*) or ferret, the “Coipo” (*Myocastor coypus*), the “güiña” (*Felis guigna*) or wild cat, and the “chingue” (*Conepatus chinga*) or skunk. Birds often observed in the park include the torrent duck (*Merganetta armata*), the Magellanic woodpecker (*Campephilus magellanicus*), the Chilean pigeon (*Patagioenas araucana*), the hued-hued (*Pteroptochos tarnii*) and the condor (*Vultur gryphus).*

Organizers and sponsoring institutions

Institutions Involved: Universidad Austral de Chile, Universidad de La Frontera, Universidad de Concepción, Centro de Estudios Avanzados en Fruticultura, EarthShape Project (DFG).

Organization Committee: Roberto Godoy, César Marín, Paula Aguilera, Patricia Silva, Pablo Sandoval, Giuliana Furci.

Special thanks to:

Macrohongos de Chile: http://micobiota.cl/
Fundación Fungi: http://www.ffungi.org/

Scientific Committee:

Chile: Götz Palfner (UDEC), Fernando Borie (UFRO), Alex Seguel (UFRO), Felipe Aburto (UDEC).
Argentina: Eduardo Nouhra (U-Córdoba), Mónica Lugo (U-San Luis), Natalia V. Fernández (U-Comahue).
Estonia: Maarja Öpik (U-Tartu).
Germany: Jens Boy (U-Hannover).

Collaborators: Leandro Paulino, Francisco Matus, Pablo Cornejo, Francisco Nájera, Kirstin Übernickel, Diana Wall, Mónica Barrientos, Natalí Hurtado, Suany Quesada, Liz Huamaní, Richard Cadenillas, Luis Amador.

Funding:
• Universidad Austral de Chile: Dirección de Investigación y Desarrollo, Facultad de Ciencias, Escuela de Graduados Facultad de Ciencias, Doctorado en Ciencias mención Ecología y Evolución, Doctorado en Ciencias mención Microbiología, Magíster en Ciencias mención Microbiología.
• Universidad de La Frontera: PhD Programe in Natural Resources Sciences and Bioren.
• Universidad de Concepción.
• Centro de Estudios Avanzados en Fruticultura.
• EarthShape Project (DFG).

Sponsoring Institutions:

- Conicyt – Fondecyt.
- Conaf – Snaspe.
- Sociedad Chilena Ciencias del Suelo.
- Sociedad de Botánica de Chile.
- Sociedad de Ecología de Chile.
- Global Soil Biodiversity Initiative- GSBI.

Origin of participants:

ARGENTINA: Universidad Nacional de Córdoba, Universidad Nacional de la Patagonia, Universidad Nacional de La Plata, Universidad Nacional de San Luís, Universidad Nacional del Comahue, Instituto Multidisciplinario de Investigaciones Biológicas.

BRAZIL: Evangelical School of Goianésia.

CHILE: Universidad Austral de Chile, Universidad Católica de Chile, Universidad Católica del Maule, Universidad de Chile, Universidad de Concepción, Universidad de La Frontera, Universidad Técnica Federico Santa María, Universidad Mayor, CEAF, ECORES, Fundación Fungi, Concha y Toro, Celeo Redes Ltda. Chile.

ESTONIA: University of Tartu.

GERMANY: University of Hannover.

SPAIN: Symborg.

UNITED KINDGOM: University of Edimburgh, Royal Botanic Garden of Edimburgh.

URUGUAY: Universidad de La República.

Key lectures

The following researchers will participate with key lectures:

- **Álvaro G. Gutiérrez**

Talk title: "Temperate rainforests of southern South America under a changing climate: present and future"

Dr. Álvaro G. Gutiérrez is as a forest ecologist whose main research interests are in the dynamics and impacts of global change and biogeography of temperate rainforests. He is a full Professor at the Universidad de Chile, Santiago, Chile. He obtained his PhD at the Technical University of Munich and in the Hemholtz Centre for Environmental Research (UFZ-Leipzig), Germany. He did postdoc at the Swiss Institute of Technology (ETH-Zurich).

- **Andrea C. Premoli**

Talk title: "Forests of the south: biogeographic history in complex landscapes"

Dr. Andrea Premoli has a PhD in biology from Colorado University, USA, and her research centers in population genetics and evolution of plant species in temperate rainforests of South America. She is a full Professor at the Universidad Nacional del Comahue-Inbioma-Conicet, San Carlos de Bariloche, Argentina.

- **Götz Palfner**

Talk title: "Rolf Singer´s ectotroph in Southamerica revisited"

Dr. Götz Palfner is a biologist specialized in mycology with a Dr. rer. nat. degree from Ludwig-Maximilians-Universität München, Germany. He has more than 20 years of experience in research of diversity, ecology, and distribution of ectomycorrhizal fungi in Chile. Since 2006, he has been an associate professor at the Universidad de Concepción, Chile.

- **Fernando Borie**

Talk title: "Mycorrhizal aluminum phosphorus interactions in volcanic soils of Chile". Talk by Pablo Cornejo.

Dr. Fernando Borie holds a Doctorate in Sciences from the Universidad de Granada, Spain, and his main research areas include soil microbiology, the role of arbuscular mycorrhizal symbiosis in plant phosphorus uptake efficiency, and aluminum tolerance in plants. He is a full Professor in the Departamento de Ciencias Químicas y Recursos Naturales, Facultad de Ingeniería y Ciencias, Universidad de La Frontera, Temuco, Chile.

- **Maarja Öpik**

Talk title: "Biodiversity of arbuscular mycorrhizal fungi: from species recognition to understanding the patterns"

Dr. Maarja Öpik has a PhD in Botany and Ecology from the University of Tartu and is a Senior Research Fellow in Plant Ecology in the same institution. Her main research topics include the molecular detection and identification of arbuscular mycorrhizal (AM) fungi, biotic and abiotic factors affecting AM distribution from local to global scales, and functional diversity and land-use change effects on AM.

- **C. Guillermo Bueno**

Talk title: "Plant mycorrhizal traits: approaches at macroecological, plant community and species level"

Dr. Guillermo Bueno has a PhD in Ecology from the University of Zaragoza, Spain and is currently a postdoc in the University of Tartu, Estonia. His main line of research in this institution is aiming to understand the patterns and distribution of plant mycorrhizal traits at large scales and how the degree of mycorrhization in plant communities is related to edaphic and diversity community properties.

- **Jens Boy**

Talk title: "From fringe science to applicability – perspectives of mycorrhiza-induced biogenic weathering in ecology and food production"

How ecosystems develop, what makes them functioning as perfect as they do, and how we could protect them by taking advantage of the processes offered by their plethora of functional traits is the research interest of Dr. Jens Boy (University of Hannover, Germany). A biologist and functional ecologist by training, his journeyman years across several Universities and research fields made him a biogeochemist with a soft spot for every topic sitting between two stools.

Program

The program is numbered per the presentation type: Key lectures (KL; KL1 – KL7), oral sessions (O; O1 – O14), and poster sessions (P; P1 – P28). Please consult your presentation number either in the abstract or author index.

March 6

Time	March 6
8:30-9:00	Registration
9:00-9:40	
9:40-10:00	Welcome, instructions
10:00-10:20	**KL1 - Álvaro G. Gutiérrez: Temperate rainforests of southern South America under a changing climate: present and future.**
10:20-10:40	
10:40-11:00	
11:00-11:20	O1: Arbuscular Mycorrhiza and intensive agriculture, *Glomus iranicum var tenuihypharum var. nova*. An study case.
11:20-11:40	O2: Mycorrhizal arbuscular native fungi for sustainable Viticulture in Chile.
11:40-12:00	O3: Effect of *Funneliformis mosseae* on volatile terpenes in Carbernet Sauvignon.
12:00-14:00	Lunch break
14:00-15:00	**KL2 - Andrea C. Premoli: Forests of the south: biogeographic history in complex landscapes.**
15:00-15:20	Coffee break
15:20-15:40	O4: Belowground invasions: Effects of non-native ectomycorrhizal communities on non-native and native tree species.
15:40-16:00	O5: What happens to the mycorrhizal communities of native and exotic seedlings when *Pseudotsuga menziesii* invades Nothofagaceae forests in Patagonia, Argentina?
16:00-16:20	Poster session 1 (all posters; P1 – P28)
16:20-16:40	
16:40-17:00	
17:00-17:30	
17:30-19:00	Inauguration activities

March 7

Time	March 7
9:00-9:40	**KL3 - Götz Palfner: Rolf Singer´s ectotroph in Southamerica revisited.**
9:40-10:00	
10:00-10:20	Coffee break
10:20-10:40	O6: Factors affecting arbuscular mycorrhizal fungi of Chilean temperate rainforest, and an update on their Chilean diversity patterns.
10:40-11:00	O7: Seeing things for the first time: molecular diversity of arbuscular mycorrhizal fungi in sclerophyllous forests of the Chilean matorral.
11:00-11:20	O8: Shared phylogeography of *Arachnitis uniflora* and its mycorrhizal fungi.
11:20-11:40	O9: Habitat description of *Butyriboletus loyo* and *Ramaria spp.* in temperate forests of Paillaco, Los Ríos Region, Chile.
11:40-12:00	O10: Adaptation of the traditional arbuscular mycorrhizal staining technique for its study in bryophytes.
12:00-14:00	Lunch break
14:00-15:00	**KL4 - Fernando Borie and Pablo Cornejo: Mycorrhizal aluminum phosphorus interactions in volcanic soils of Chile.**
15:00-15:20	Coffee break
15:20-15:40	**KL5 - Maarja Öpik: Biodiversity of arbuscular mycorrhizal fungi: from species recognition to understanding the patterns.**
15:40-16:00	
16:00-16:20	
16:20-16:40	O11: Nutrients affect fungal growth and the establishment of mycorrhizal associations in orchid mycorrhizas.
16:40-17:00	O12: Rock ´eating´ fungi: biogenic weathering in temperate rainforests of South Chile.
17:00-17:30	Coffee break
17:30-19:00	Poster session 2 (all posters; P1 – P28)

March 8

Time	March 8
9:00-9:40	**KL6 – C. Guillermo Bueno: Plant mycorrhizal traits: approaches at macroecological, plant community and species level.**
9:40-10:00	
10:00-10:20	Coffee break
10:20-10:40	**KL7 - Jens Boy: From fringe science to applicability – perspectives of mycorrhiza-induced biogenic weathering in ecology and food production.**
10:40-11:00	
11:00-11:20	
11:20-11:40	O13: Fungal diversity of Llancahue watershed and socio-ecological approaches of fungus collectors of Lomas del Sol, Valdivia, Chile.
11:40-12:00	O14: Mycorrhizas in natural environments and bioregions of South America: "write a book" is the next challenge for South American mycorrhizologists!
12:00-14:00	Lunch break
14:00-15:00	Group discussion: round table, future research (or workshops?), how to publish. Closure.
15:00-15:20	
15:20-15:40	
15:40-16:00	
16:00-16:20	Workshop dinner at Catamarán around Teja Island (optional).
16:20-16:40	
16:40-17:00	
17:00-17:30	
17:30-19:00	

March 9

Excursion to Puyehue National Park, full day (optional).

Key lectures abstracts (KL)

KL1: Temperate rainforests of southern South America under a changing climate: present and future.

Gutiérrez, A.G.[1]
[1]Departamento de Ciencias Ambientales y Recursos Naturales Renovables, Facultad de Ciencias Agronómicas, Universidad de Chile, Chile. E-mail: bosqueciencia@gmail.com

Concern about climate change has increased the interest in how forests of the world may vary in their responses to climate change and contribute differently in mitigation strategies. Currently, extreme climatic events are more common and reports of consequent forest changes are widespread. Although comparatively with other forests biomes the surface of temperate rainforests (TRF) is low, these forests have unique characteristics that emphasize their global relevance in sustaining a unique biodiversity and maintaining large amounts of carbon in their biomass. Still, uncertainties remain on the patterns of forest responses to climate change operating locally in some TRF regions, such as southern South America (37°45'-47°30'S, SSA). In the same region, large tracks of unlogged primary forests exit allowing the study of changes in natural processes in response to climate change. This talk is focused on the issues discusses above. Also, I will synthetize the state of knowledge about climate change impacts on temperate rainforests from SSA. To foster research focused on reducing uncertainties regarding their functioning under a changing climate, I will 1) describe the current state of forests in SSA mainly focused on old-growth forests, 2) revise the past and future trends in climate in the region, 3) discuss current impacts and responses of SSA forests potentially associated to climate change, and 4) discuss future impacts of climate change on TRF in this region.

KL2: Forests of the south: biogeographic history in complex landscapes.

Premoli, A.C.[1]
[1]Universidad Nacional del Comahue, CONICET, Argentina. E-mail: andrea.premoli@gmail.com

The physical setting of Patagonia consists of heterogeneous landscapes along steep environmental gradients occurring even at short spatial distances. Trees and shrubs of subgenus *Nothofagus* are widely distributed in Patagonia and were used to analyze variations in the physical environment along different time scales that affect their genetic makeup and thus to study past, present, and future evolutionary potential. We combined distinct molecular markers as well as modeling and experimental approaches. Conserved DNA sequences of the chloroplast (cpDNA)

were used to analyze past responses related to the influence of geologic forces in all five species of the subgenus: the evergreen *Nothofagus betuloides*, *N. dombeyi*, and *N. nitida* and the deciduous *N. antarctica* and *N. pumilio*. They are commonly found in pure stands although they can also coexist in sympatry/parapatry where hybrids can be produced. Concordant geographic cpDNA patterns suggested a shared evolutionary history maintained by cycles of hybridization/introgression. Variation in biparentally inherited markers on the two widespread most deciduous species, yet ecologically distinct, showed that the habitat restricted *N. pumilio* yielded an impoverished gene pool probably related to genetic bottlenecks suffered along its range. This is in contrast to the high genetic diversity found in the *N. antarctica* that inhabits diverse habitat types. Ecological genetic studies showed that the spatial distribution of genotypes at short spatial scales depended on the regeneration strategy of species (seeders vs. resprouters) and type of disturbance, postfire stands yielded a more homogeneous genetic structure while mature stands undergoing gap-phase regeneration were genetically structured. Common garden and reciprocal transplant experiments of *N. pumilio* from contrasting elevations showed that ecomorphological traits have a genetic basis which may limit potential responses under climate change. The southern tip of South America varies in climates and history that result in a combination of adaptive and plastic responses of plants.

KL3: Rolf Singer´s ectotroph in South America revisited.

Palfner, G.[1]
[1]Universidad de Concepción, Chile. E-mail: goetz.palfner@gmail.com

Around 1960, Rolf Singer, one of the most influential pioneers of modern mycology, developed a new, integrative perspective for studying ectomycorrhizal symbiosis: he united aspects of myco- and phytosociology, biogeography, co-evolution and ecological aspects of mycorrhizal partners, creating the concept of the ectotroph. This term stands for a functional unit formed by a woody phytobiont and its guild of mycobionts and can be used to classify forest ecosystems on both, regional and global scale, essentially based on their type of mycotrophy. South American *Nothofagus* forests were the most important model systems for Singer while working on this approach. Although quite modern from today´s point of view, Singer´s ectotroph never gained much attention or wider application in a time when functional diversity of mycorrhizal symbiosis in forests, especially of the southern hemisphere, was still underrated and mainstream research focussed on physiological aspects.
Today, more than 50 years later, it is worth to revisit the concept of the South American ectotroph, in order to estimate its relevance for our current understanding of mycorrhizal symbiosis in this ecoregion but also to look at new knowledge which

may either confirm or update Singer´s original observations. In this context, we refer to aspects of mycorrhizal fungal diversity and distribution, ecological function of some species and specific interactions between certain mycobionts and their phytobionts, especially in the Chilean *Nothofagus* area.
We acknowledge the financial support by Universidad de Concepción (Vicerrectoría de Investigación y Desarrollo).

KL4: Mycorrhizal-aluminum-phosphorus interactions in volcanic soils of Southern Chile.

Borie, F.[1], Cornejo, P.[1]
[1]Center of Amelioration and Sustainability of Volcanic Soils, BIOREN-UFRO, Universidad de la Frontera, Chile. E-mail: Fernando.borie@ufrontera.cl

Chilean agricultural land cover approximately 15 million of hectares with 5.5 million of arable land from which fifty to sixty percent are covered by volcanic soils where the bulk of forests, cereals and livestock production is developed. Variable charge, low pH, high phosphate adsorption capacity and high levels of soil organic matter highly humified are the main prominent attributes regulating its chemical reactions. Chilean Andisols have some special characteristics which demonstrate the complexity of the overall biogeochemical cycles in such habitats, like: a) great stabilization of indigenous or exogenous organic matter produced by its strong interactions with soil mineral matrix, b) high rates of microbial synthesis of humic-type macromolecules, c) high enzymatic activities and, d) high activity of mycorrhizal fungi in both, agricultural and forest soils. The high P fixation capacity together with high stable macromolecules formation including humus-P complexes make difficult to microorganisms to mineralize C and P from this compounds. Therefore, farmers must yearly apply significant amounts of fertilizer for an adequate plant growth but P is accumulated in the soil under different pools of varying lability. In the last 25 years, our research group have focused their efforts in deep in in the potential reutilization of P accumulated as well as to decrease P application. In this regard, the first step was to study the chemical P forms found in these soils and their lability for subsequently to deep on the mechanisms developed by plants there growing to mimic them for developing technological alternatives involving microbial inoculants mainly based on selected mycorrhizal strains obtained from our diversity studies. Results of this studies will be further discussed.

KL5: Biodiversity of arbuscular mycorrhizal fungi: from species recognition to understanding the patterns.

Öpik, M.[1]
[1]University of Tartu, Estonia. E-mail: maarja.opik@ut.ee

Understanding about the global biodiversity of Glomeromycotina (arbuscular mycorrhizal fungi, AMF) and its patterns has considerably improved in recent years. Remarkable number of new species has been recently described, and higher taxonomic rearrangements made. Hand in hand with the taxonomic novelties, molecular ecologists continuously discover large numbers of novel DNA-based taxa, thus creating the need to clarify DNA sequence-based ways for appropriate taxon recognition in this group of fungi and beyond. I will summarise recent the conceptual advancements in AMF taxon recognition and the empirical evidence of what the species of AMF might be.

Evidence on low global scale endemism of AMF and environmental and spatial factors shaping the diversity patterns at local scale raise further questions on the roles of factors that may influence AMF communities at different spatial scales: rate of speciation, dispersal properties, abiotic and biotic filtering. I will summarise the current understanding of diversity patterns of AMF and drivers of these patterns at various spatial scales. Specifically, I'll focus on AMF community assembly in time, and in relation to different land use types.

I will conclude by summarising the knowledge on functional groups of AMF and how this knowledge feeds back to taxonomical (species recognition) and (macro)ecological (biodiversity patterns) understanding about this enigmatic group of organisms.

KL6: Plant mycorrhizal traits: approaches at species, community and macroecological level.

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Mycorrhizal symbiosis is involved in crucial processes for plant fitness and survival, such as plant nutrition and tolerance to abiotic and biotic stresses. This symbiosis varies among plant species and environmental conditions, ultimately affecting plant realized niches and the structure and functioning of plant communities and ecosystems. In the last decades, evidence about different aspects of mycorrhizal symbiosis has accumulated for a large number of plant species, along with georeferenced plant distribution, vegetation plot databases and digital maps of environmental variables. The availability of all this information has laid the ground for new approaches in mycorrhizal research. Using mycorrhizal characteristics, it is possible to reveal the prevalence and potential influence of different mycorrhizal symbioses at different organization levels and geographic scales. Using traits such as plant mycorrhizal type, whether a plant species forms arbuscular (AM), ecto- (ECM), ericoid (ERM) mycorrhiza or is non- (NM) mycorrhizal, plant mycorrhizal status, whether mycorrhizal fungi always (obligate, OM) or sometimes (facultative, FM) colonize the roots of a particular plant species, or plant mycorrhizal flexibility, whether a plant species can grow both with and without mycorrhizal symbiosis, can improve our understanding of the role and the relevance of this symbiosis. In this talk, I will briefly introduce the most relevant plant mycorrhizal traits and present some promising approaches aiming to understand the impact of mycorrhizal symbiosis in plant realized niches, plant communities and along large environmental gradients.

KL7: From fringe science to applicability – perspectives of mycorrhiza-induced biogenic weathering in ecology and food production.

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Peak phosphorus, climate change, super weeds, famines, or poisoned groundwater- a lot is going terribly wrong with modern agriculture. One major reason for this is its incapacity to take advantage of natural processes developed in co-evolution by plants and symbionts to ensure their nutrition and wellbeing under natural conditions. Here, we evaluate the biogeochemical processes performed by mycorrhizae in systemic studies performed in pristine ecosystems in order to understand what might be the key mechanisms in tomorrow’s food production. One of these mechanisms is biogenic weathering from bedrock, which helps to gain nutrients, re-establish nutritional self-sustainability and deduces CO2 from the atmosphere- latter for much longer as you probably think. But there are also functional nutrient niching, regain of nutrients from organo-mineral complexes (also a problem in e.g. Chilean Andosols) or resilience by market-theory driven functional diversity to name, if it comes to other potential chances to change the game. This biogeochemical journey to rock-eating fungi and beyond takes you as well to exotic places like Antarctica or the subtropical forests of New Caledonia, as to Chilean national parks at your doorstep, all in the hope to convince that some important paths towards food security have to be trodden under the canopy of pristine environments.

Oral sessions (O)

O1: Arbuscular Mycorrhiza and intensive agriculture, *Glomus iranicum var tenuihypharum var. nova***. An study case.**

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The aim of guaranteeing a high productive potential, the intensive agriculture is characterized using genetically more productive varieties, a high consumption of chemical inputs and water in general, which inevitably leads to an unbalance of the original composition of the soils, contributing to a contrasted microbial decreasing, which it at the end, accelerates his own degradation with greats negative consequences on the yield of the crops. At present, there is greater environmental awareness that is expressed through new legislation, limiting the limits of substances allowed in crops, which makes necessary new strategies to ensure the maintenance of agricultural profitability.

Arbuscular mycorrhizae (AM) are mutual associations between fungi of Phyllum Glomeromycota and most plants, and can be a very useful tool within this strategy. In fact, this symbiosis promotes not only direct benefits on plant nutrition through increases in soil exploration, root system, increased nutrient uptake through the hyphae and roots, but also ensures, temporary storage of nutrients in fungal biomass avoiding its leaching, as well as a stimulation of the rhizosphere microflora, which stabilizes the biological activity of the soils, achieving a greater productive development.

Notwithstanding the knowledge of these benefits, their use in intensive farming systems has been ineffective, probably due to the use of species with low tolerance to high concentrations of nutrients in to the soil solution, especially the phosphate ion, poor soil adaptation and / or mycorrhizal functioning that can be very intense, demanding high costs of carbon, marking the threshold of parasitism as is the case of some strains of *Rhizophagus irregularis* and / or *Glomus intraradices* that produce abundant spores inside the roots, obstructing the nutrients flow at the expense of a greater energy cost for the plant.

The selection of a species of mycorrhizal fungus in intensive agriculture is not an easy task, as it is necessary to think about the above described to achieve an adequate profitability, in view of the high required nutritional salts applied under these conditions. For all the above the objective of this work is to show the results of the study of an AMF, *Glomus iranicum var tenuihypharum*, its adaptability and functionality in different intensive farming systems.

Glomus iranicum var tenuihypharum var. nova, was selected from a group of species due to its wide range of tolerance to soil pH ranging from 5 to 9.5, and to high concentrations of Mg, Ca and Mn and salinity (Gomez-Bellot et al, 2014). This species produces abundant extramatrical mycelium, exploring a large volume of soil, its reproductive form, generates spores on the outside of the root, which allows an adequate transport of nutrients inside the roots to the plant and tolerates high concentrations of salts, as well, which guarantees a complete adaptation to the fertilization protocols (Fernandez et al, 2014). The application of this strain promotes a notable positive effect on the water situation of the plants. Its application increases the profitability of the fruit, in the specific case of table grapes, continuous increases have been achieved from 12-45%, for more than three years in the total production in the varieties, Red Globe, Crimson, Napoleon, etc. (Nicolas et al., 2014). It promotes the quality of the fruit, increasing the length, the weight of the clusters, and a greater uniformity of color and degrees Brix.

In horticultural crops, it promotes significant increases in physiological activity (better water status and gas exchange) and productivity (10-15%) of the treated plants, grown both in the greenhouse and in the open field. (Vicente-Sanchez, 2014). Increases and induces changes in the root architecture from the stimulation of lateral roots, favoring a greater absorption in Melon plants.

Studies in peppers under greenhouse have not only achieved a greater productive increase (1 kg per m2), but also an important control of the endogenous hormonal expression of the plants, increasing at the beginning of the culture the expression of auxin (indole acetic acid) for a greater root production and mycorrhizal colonization, a greater expression of gibberellins and cytokinin in favor of a greater foliar and productive development from the 50 days of cultivation and a significant decrease of abscisic acid in favor of more juvenile plants towards the end of the cycle . (Alcobendas et al, 2015). Currently this species is the active compound of four products, MycoUp, MycoUp Activ, Resid HC and Resid MG, which covers crops grown under a localized irrigation system, seed coating, direct seeding and is contained in two international patents as a biostimulant and bionematicide.

O2: Mycorrhizal arbuscular native fungi for sustainable Viticulture in Chile.

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Viticulture is a sector in Chile of great economic importance it includes a vine area of 211.000 ha, wine production of 10 Mhl, and US $1.515 million in wine exports., Chilean viticulture has to adapt to new challenges as they arise such as pest management, which includes pesticide reduction, and climate change, which results in increased droughts. Nevertheless, these challenges need to be addressed with sustainable solutions. Viticulture adaptation can benefit from arbuscular mycorrhiza,

a plant–fungus symbiosis. The following study analyses the potential of mycorrhizal arbuscular native fungi for sustainable viticulture in Chile. The major points of this study are the following: (1) the unique characteristics of Chilean viticulture. (2) The ecosystem benefits of arbuscular mycorrhiza for grapevine production. (3) Vineyard agricultural practices impact on sustainability.

O3: Effect of *Funneliformis mosseae* on volatile terpenes in Carbernet Sauvignon.

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Arbuscular mycorrhizal fungi (AMF) form symbiotic associations with most terrestrial plants, generating physiological and molecular changes that improve growth and plant fitness. Arbuscular mycorrhizae stimulate certain volatile compounds, such as terpenes, which have been related to defense against pathogens. These volatile compounds affect the aroma, which is important in agronomic crops where the organoleptic characteristics are relevant. In vine cultures, multiple factors can influence aromatic compounds. The set of factors that determine the characteristic aromas in the vine and, therefore, in the wine, are known as terroir. However, the effect of AMF on the composition of volatile terpenes in vine has not been studied. The concept of terroir by definition includes these microorganisms, but the role it plays still remains unknown. The objective of this work is to determine the effect of the AMF on volatile terpenes in *Vitis vinifera*. Cabernet Sauvignon plants obtained from in vitro culture were acclimatized in a greenhouse in sterilized peat and inoculated with *Funneliformis mosseae*. Measurements of volatile terpenes were performed on foliar tissue at 23 weeks. The results show that mycorrhizal plants have an increase of up to 185% of aroma-related terpenes in vines, such as nerol, citronerol, geraniol and β-ionone. This study demonstrates that mycorrhizal fungi influence volatile terpenes on vines, translocating their effect to foliar tissue, which could induce a change in the profile of volatile terpenes in the fruit.
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O4: Belowground invasions: Effects of non-native ectomycorrhizal communities on non-native and native tree species.

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Increasing evidence shows that belowground interactions are key in determining invasive plants success or failure. However, less is known about the changes that plant invasion produce in local soil biota and how non-native and native plants are affected. We measured the effect of exotic ectomycorrhizal fungi (EMF) on native communities in two ecosystems in southern Chile (Malalcahuello and Coyhaique). To determine how EMF community changes across the invasion and whether fungal species can switch hosts, we used the non-native invasive *Pinus contorta* and the dominant native *Nothofagus antarctica* as focal species. We sampled root tips from both species in stands with increasing pine density. We then used ITS-RFLP and sequencing to identify fungal species. To further analyse plant-fungal interactions, we conducted a greenhouse experiment. We took soil cores from native and invaded stands and planted seeds from the native and the invasive plants. We also planted a native non-mycorrhizal plant (*Embothrium coccineum*) to control for changes in abiotic soil conditions and we used sterilized soil as general control. Preliminary results from the DNA analyses showed a predominance of non-native suilloid fungi in field samples, which have been previously described as decisive for pine invasion. In the greenhouse experiment, native and exotic plants showed similar growth and root colonization percentage in all treatments, but a higher shoot/root ratio in both soil origins compared with sterile soil in which they grew less and invested more biomass in roots. Hence, the role of belowground mutualists seems crucial for both the native and the invasive plant, even in the presence of soil pathogens. Despite similar plants growth, invasive fungal community might be replacing native ECM species. Future molecular analysis will determine the possibility of novel interactions, together with a wide-ranging understanding of the role of ECM species in plant invasions and their belowground impact.

O5: What happens to the mycorrhizal communities of native and exotic seedlings when *Pseudotsuga menziesii* invades Nothofagaceae forests in Patagonia, Argentina?

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Mycorrhizae associations are vital for Nothofagaceae forests and *P. menziesii* plantations' establishment and development. In Patagonia, *P. menziesii* is being planted close or within native forests, showing an aggressive invasion behaviour. We studied the mycorrhizal status of seedlings along six Nothofagaceae+*P.menziesii* invasion matrices to investigate their role in this process. Our results present evidence that *P. menziesii* invasion of Nothofagaceae forests occurs with the co-invasion of their mycorrhizal partners. Also, soil environments located beyond invading conifers seedlings have shown to hold ectomycorrhizal (EM) inoculum capable to associate with incoming new plants. We have evidence that *P. menziesii* invasion could produce maladaptation of native EM communities. Most of the EM species detected for all forests types correspond to genera reported as pioneers, commonly present in disturbed sites and previously reported in invaded matrices. Undoubtedly, these pioneer genera are a co-adjuvant factor in *P. menziesii* seedling invasion. *Hebeloma mesophaeum*, a *Wilcoxina sp.* (early-stage and common *P. menziesii*'s EMs) and a Pyronemataceae sp. (widely associated with Nothofagaceae spp.) were found shared by P. menziesii and Nothofagaceae spp. Interestingly, and contrary to our expectations, *Hebeloma hiemale* and *Wilcoxina sp.*, common mycorrhizal partners for *P. menziesii* in Patagonia although not registered from Nothofagus forest, were found associated with *N. antarctica*, this is the first report for both fungal species. *Pseudotsuga menziesii* seedling seems to have the ability to form different AM colonization types (Paris-, Arum- Both-, Intermediate-type) depending on sites conditions. Significant high presence of Intermediate-type was found in seedling grown in invaded soils, where the colonization was less abundance. The presence of different mutual association gives *P. menziesii* a strong ability for seedlings establishment. The nursery mycorrhizal effect has been observed consistently in different environments, therefore, this fact should be considered in the design, site selection and invasion management of fast growing exotic plantations in Patagonia.

O6: Factors affecting arbuscular mycorrhizal fungi of Chilean temperate rainforest, and an update on their Chilean diversity patterns.

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While arbuscular mycorrhizal (AM) fungi has been mainly registered on Chilean agroecosystems, there is a gap of knowledge regarding AM fungal diversity on Chilean temperate rainforests. AM fungal communities of these forests could be affected by several factors: the mountain systems of Chile (Coast or Andes Mountains), the mycorrhizal dominance of the forest (either ectomycorrhizal -EM- or AM), edaphic factors and altitude. We tested the effects of mountain system, mycorrhizal dominance, edaphic chemistry and altitude on AM fungal diversity, and update the AM fungi species list of Chilean ecosystems. We described 7,120 AM fungal spores, belonging to 14 species, comprised on 41 soil samples and 14 plots located on Coast and Andes Mountains and EM and AM forests of Southern Chile. Mountain system and mycorrhizal dominance affected the AM fungal community composition, although no its richness or abundance. Soil plant available P, Ca, Mg and Na were the edaphic variables structuring AM fungal community composition. There was no relationship between altitude and AM fungal richness, at high altitudes there was higher abundance. Finally, we updated the AM species list and ecosystem presence on Chilean ecosystems, to a total of 59 species, many of which were previously registered exclusively in agroecosystems.
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O7: Seeing things for the first time: molecular diversity of arbuscular mycorrhizal fungi in sclerophyllous forests of the Chilean matorral.

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Arbuscular mycorrhizal fungi (AMF) are a group of fungi that forms an obligated symbiosis with more than 80% of terrestrial plant. This symbiosis allows the fungi the uptake of carbon from the plant, while the plant improves their performance due to the fungi. Also, it is widely recognized that AMF plays a key role in diversity, distribution and abundance of plant species. To understand this, it is necessary to known the ecological aspects of AMF at local and global scale and recently some are emerging. Nevertheless, there are still scarce records of some continents, ecosystems and habitats. One of the places with scarce records on ecological parameters of AMF is South America, especially mediterranean climates and their habitats (e.g. sclerophyll forest). Chile, particularly the central zone, is characterized for being one of the five regions of mediterranean climate in the world, which has a high diversity of native plants, with restricted distributions. This type of climate is heavily endangered by human activities and in order to preserve this area is necessary to know all the relevant aspects of this type of climatic zone, including the ecology of soil microorganism, as the AMF. However, there is no information regarding diversity and distribution of AMF associated to those plants and the factors that might be regulating those ecological aspects.
In this presentation, we will show preliminary results of a project in which is aimed to describe, for the very first time, patterns of molecular diversity and distribution of AMF present in the soil and in the roots of plants of a sclerophyll forest in the central zone of Chile and how those ecological patterns are affected by host plant species, soil physicochemical factors and seasons of the year.

O8: Shared phylogeography of *Arachnitis uniflora* and its mycorrhizal fungi.

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Arachnitis uniflora Phil. (Corsiaceae) is a mycoheterotrophic plant; it is unable to assimilate carbon and depends on mycorrhizal fungi to obtain nutrients from autotrophic plants. Arachnitis grows mainly along the Andean-Patagonian forests of Argentina and Chile, in south-central Bolivia and in the Malvinas Islands. Morphological and molecular studies showed that the fungi involved belong to the Glomeromycotina but have intracellular structures different from those of typical arbuscular mycorrhizas. Another noticeable feature is the presence of plant propagules in the roots containing Glomeromycotina and potentially favouring the maintenance of the symbiosis.

We studied the genetic variability of *A. uniflora* and its mycorrhizal fungi using molecular markers along the plant's geographic range. We found that *A. uniflora* associates with three families - Glomeraceae, Claroideoglomeraceae and Acaulosporaceae - the first present in every plant, while the others are rare and appear to be facultative. Molecular dating revealed that the origin of Arachnitis coincided with the diversification of Glomeromycotina in the Oligocene-Miocene. The Andes uplift and the Great Patagonian Glaciation shaped the diversification of *A. uniflora* and we found four common geographic barriers latitudinally structured. Both plants and fungi have three overlapping hot spots of genetic diversity related to Pleistocene glacial refuges where genetic diversity was maintained.

O9: Habitat description of *Butyriboletus loyo* and *Ramaria spp.* in temperate forests of Paillaco, Los Ríos Region, Chile.

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It is described the habitat of the edible ectomycorrhizal fungis *Butyriboletus loyo* ("loyo") and *Ramaria* spp. ("changle"), inside temperate forests of Paillaco, Los Ríos Region, Chile. Sites where selected where peasants annually harvest the sporocarps. There were selected 14 harvesting sites, 7 for each species that were described through floristic inventories, geomorphologic attributes and soil samples. Most of the sites showed signs of anthropic intervention. All the sites had a mineral-organic horizon, the organic composed by litter and raw organic material (3.1-3.7 cm deep), and the mineral corresponding to the A horizon, reddish and clayey. Both, loyo and changle habitats, were located in hillsides and had a similar slope of 19-25%. The total species inventoried were 82. The most frequent trees in all the sites were *Eucryphia cordifolia* (10/14), *N. dombeyi* (8/14), *N. obliqua* (8/14), *Laureliopsis philipiana* (7/14), *Luma apiculata* (7/14) and *Aextoxicon punctatum* (6/14). The most frequent shrubs in all the sites were *Chusquea valdiviensis* (11/14), *Gaultheria mucronata* (10/14) and *Ugni molinae* (10/14). The most frequent species in the lower strata was the fern *Blechnum hastatum*, (14/14), the vine *Boquila trifoliolata* (13/14), the bromeliad *Greigia sphacelata* (11/14), the vine *Lapageria rosea* (10/14) and, the soil covers *Nertera granadensis* (8/14) and *Viola portalesia* (8/14). The main difference observed in the floristic inventory is the dominance of *Nothofagus obliqua* in loyo habitats, and *Nothofagus dombeyi* in changle habitats. It was common the introduced grass and herbs species in loyo sites, typically founded in ruderal areas, like *Agrostis capillaris* (6/7); *Anthoxanthum odoratum* (3/7); *Digitalis purpurea* (5/7); *Holcus lanatus* (4/7); *Lotus pedunculatus* (3/7); *Luzula campestris* (4/7) and *Prunella vulgaris* (3/7). While changle occupy better conserved habitats, with high levels of plant species endemism like *Amomyrtus meli* (4/7); *Myrceugenyia pinifolia* (1/7), *Rhamnus diffusus* (1/7) *Sarmientas scandens* (1/7), *Lomatia dentata* (2/7) and *Fuchsia magellanica* (1/7).

O10: Adaptation of the traditional arbuscular mycorrhizal staining technique for its study in bryophytes.

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The most accepted traditional method for staining arbuscular mycorrhiza (AM) in vascular plants is the one proposed by Phillips & Hayman (1970). This method consists in fixing the root samples in FAA; later, clarifying them with 10% potassium hydroxide (KOH) (60 minutes, 90 °C); acidifying them with diluted hydrochloric acid (HCl); and staining with 0.05% Trypan-blue in lactophenol (5 minutes, room temperature). In particular, for the study of AM in plants included in bryophytes (s.l.), Anthocerophyta, Bryophyta (s.s.) and Marchantiophyta, some authors have introduced some modifications to this technique. For example, for Anthocerophyta, Schüßler (2000) clarifies the sample with 10% KOH (10 minutes, 121 °C) and acidifies with 3.7% HCl; for Bryophyta (s.s.), Zhang & Guo (2007) fix the material with 50% ethanol, clarify with 10% KOH (20 minutes, 90 °C), acidify with lactic acid (3 minutes, room temperature) and stain with 0.5% acid fuchsin (20 minutes, 92 °C); and for Marchantiophyta, Silvani et al. (2012) clarify with 15% KOH (48 hrs, 25 °C), acidify with 4% HCl and stain with trypan-blue in 0.1% lactic acid. Even though all these protocols stain AM hyphae, their main disadvantage is related to the result of maceration of the material by over-softening or completely destroying plant cells due to the high temperatures used, the reagents high concentrations or the long-time exposure of the material to the chemicals. In order to optimize the results for the observation of arbuscular fungi in this group of plants, a new modification is presented to the techniques proposed above, using 70% ethanol to fix and as a first clarifier, 1% KOH (20 minutes, 80 °C) as a second clarifier; 1% HCl (10 minutes, 50 °C) as an acidifier and 0.05% Trypan-blue (20 minutes, 60 °C) for dyeing.
This work was funded by CONICET and UNComahue.

O11: Nutrients affect fungal growth and the establishment of mycorrhizal associations in orchid mycorrhizas.

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One of the questions in the study of mycorrhizas is about the evolution of specialization, referred to the diversity of fungal partners with which a plant interacts. It has been observed that environmental conditions can affect the diversity and composition of mycorrhizal fungi associated with plants. One of these conditions are soil nutrients, especially nitrogen and phosphorus availability. In a past study we observed that soil N and P were negatively correlated with diversity of mycorrhizal fungi associated with the orchid *Bipinnula fimbriata,* and also that soil P affected fungal composition. Nevertheless, it was not clear if this was due to different fungal choices from plants, or different fungal performances under different soil nutrients content. To evaluate this, we study the effect of nutrients on fungal growth and then how this affects the establishment of the mycorrhizal association. We selected four OTUs of Ceratobasidiaceae and four OTUs of Tulasnellaceae from fungi isolated from *B.fimbriata*, and measured their growth under four nutrient treatments (OMA, OMA+P, OMA+N and OMA+N+P). Then we placed *B. fimbriata* seeds with the eight fungal OTUs under the same four treatments and recorded the seed development monthly. We observed that nutrients affect the growth of most fungal OTUs, independently of the family, and that this effect was related with seed germination. In higher nutrients media, only a two OTUs could germinate seeds, the other 6 promoted seed germination only under low nutrient media. Our results are suggesting that nutrients affect fungi which in turn affect the establishment of the mycorrhizal association; a less number of the fungal OTUs germinate seeds under high nutrients, which could be an explanation to the mycorrhizal specialization under high nutrient availability.

O12: Rock ´eating´ fungi: biogenic weathering in temperate rainforests of South Chile.

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Coniferous and *Nothofagus* Nor-Patagonia forests exhibit biogeographic isolation, given their edaphic and climatic conditions. In these restrictive conditions, mycorrhizae have a vital role in biogeochemical cycles. A general pattern of vascular flora in temperate rainforests of south Chile, indicates arbuscular mycorrhiza dominance in Pteridophytes, Gymnosperms and Angiosperms. Ectomycorrhizas are unique to the *Nothofagus* genus. Bioweathering is the physicochemical process by which rocks are directly or indirectly degraded by biota. In old forests, bioweathering would be performed mainly by mycorrhizal hyphae, as they have energy from photosynthesis and can access weatherable surfaces. An inverse relationship between the edaphic bioavailability of nutrients and the degree of bioweathering is expected, since the latter is energetically costly, as it involves processes of chelation, complexolysis, redoxolysis, metal precipitation and thigmotropism. These processes involve release essential nutrients in plant nutrition (P, Ca, K, Mg, Al). This study suggests that bioweathering is relevant in environmentally restrictive scenarios. A bioweathering experiment in P.N. Puyehue and P.N. Tolhuaca (south Chile) is reported, with the first results of exposure of test minerals *in situ* (muscovite, biotite). We found an inverse relationship between soil nutritional status and bioweathering degree (calculated as the percentage of test mineral colonized by hyphae, after one year, through confocal laser microscopy). We found that bioweathering is greater in ectomycorrhizal *Nothofagus* forests than in arbuscular mycorrhizal coniferous forests. We present a first assessment of fungal communities obtained by meta-genomics.

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O13: Fungal diversity of Llancahue watershed and socio-ecological approaches of fungus collectors of Lomas del Sol, Valdivia, Chile.

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Fungi are a cosmopolitan group of organisms with more than 1.5 million species around the world of which only about 5% are known. Fungal biota plays a fundamental role for the productivity and stability of agroecosystems because they are important for the phosphate nutrition of plants. Also, they establish a mutualistic symbiosis with most of terrestrial plants and this type of mycorrhiza is by far the most important worldwide. To know the fungal diversity and to understand the perceptions of the fungus collectors of the Lomas del Sol community (Llancahue, Valdivia) we establish a baseline of fungal diversity and its ecosystemic relationship in this area.
The Llancahue watershed (1270 ha) provides important ecosystem services to the local human population, including biodiversity protection, a park for recreation, clean water, as well as an average 60% of the water supply for the city of Valdivia. Within this watershed is a native temperate forest fragment (ca. 700 ha) in a natural reserve, which is the nearest such natural reserve to the city of Valdivia. It represents part of a biodiversity hotspot and a threatened ecosystem.
The methodology consisted of outings on the ground during the different seasons of the year, in which the recorded species were collected and determined. To know the perception of the collectors of the Lomas de Sol community, an in-depth interview was conducted.
Preliminary results show a high diversity of forest-associated fungi species (35 species, classified as 6 mycorrhizae, 27 saprophytic and 2 parasites), which include species such as *Amanita rubencens*, *Cortinarius* sp, *Boletus loyo*, *Ramaria flava*, among others. In addition, the results of the interviews allowed us to know the perceptions of the collectors, regarding the local consumption and its ecosystemic relationships with the fungi.
Acknowledgments: Proyecto Vinculación con el Medio (JJN), Universidad Austral de Chile.

O14: Mycorrhizas in natural environments and bioregions of South America: "write a book" is the next challenge for South American mycorrhizologists!

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Throughout South America there are numerous and varied biogeographic regions with their own and exclusive biotic and abiotic characteristics which delimit particular natural environments integrated by very characteristic ecosystems with unique biological and underground communities. In South America, each bioregion within its own ecosystems housed animals, plants, fungi and microorganisms along with their biological interactions, including mycorrhizas. South American mycorrhizologists have investigated these symbioses in our precious / appreciated natural ecosystems for decades, providing data on Venezuelan Great Savannah, Andes, Puna, Chaco, Caatinga, Monte, Mata Atlantica, Marginal Forest, the coastal Medanales, Patagonia, Yungas, Rainforest, Andean-Patagonian Forests, Antarctic section, etc. In these environments, different mycorrhizal associations (arbuscular / ericoid / orchidoid / ectomycorrhizal / mycoheterotrophic) have been analyzed in herbaceous plants, shrubs and trees. Mycorrhizal associations were studied from different researching points of view (biodiversity, biological invasions, biotic / abiotic disturbances, altitudinal variations, seasonal changes, land uses, etc.). Metaphorically, we have as "children" our data / information on mycorrhizas in many natural ecosystems in South America; "trees" are already planted, but we could still plant them mycorrhized! and now we should "write a book". The purpose of this presentation is, through the synthesis of information on mycorrhizas from South American natural environments, to summon the authors / mycorrhizologists and motivate us to write the book!

Poster sessions (P)

P1: Impact of the invasive tree *Ligustrum lucidum* on arbuscular mycorrhizal fungi communities in *Celtis tala* forests of Buenos Aires, Argentina.

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The presence of invasive plants has been identified as a soil disturbance factor, often conditioning the structure and function of soil microorganisms. *Ligustrum lucidum* W.T. Aiton has been reported as an invasive tree in several regions of the world, and despite it has been registered as a mycotrophic specie, the effect produced on the structure of AMF communities has never been assessed. The native dry forest dominated by *Celtis tala* Gill. ex Planch. and *Scutia buxifolia* Reiss. constitutes the main woodland community of the eastern plain in Buenos Aires province, Argentina. We hypothesize that L. lucidum modifies the structure of AMF community in C. tala forests, influencing the establishment and growth of native plants that are dependent on these mutualisms. The studied area is located in Reserva de Biosfera Parque Costero del Sur MAB-UNESCO (35°11' S, 57°17' W). Soil samples were collected along transects with increasing presence of L. lucidum in the forest structure. Thirty-two AMF species were identified, belonging to six families. Higher AMF spore density, species richness and diversity were observed in the invaded forest when compared to the native forest. Species abundances differed for both the native and invaded areas. The abundance of Glomeraceae increased with invasion while Gigasporaceae decreased with the increment of *L. lucidum*. Although experimental manipulations are required to assess functional consequences, the observed patterns indicate that the presence of invasive *L. lucidum* might affect the AMF community composition, probably conditioning the establishment of native plants.

P2: Mycorrhizal activity in conventional and organic vineyard from five representative wine regions of Chile.

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Chile produces wine, which is recognized around the world, furthermore, its isolated geographic characteristics have favoured the creation of a viticulture with a unique terroir. In this report, we will describe for the first time the presence and colonization of arbuscular mycorrhizal fungi (AMF) associated with grapevine. AMF were studied in *Vitis vinifera* roots and rhizosphere soil in five vineyards located in the north, centre and south of Chile, covering an area of approximately 750 km. AMF presence on roots of grapevines was analysed by observing fungal root colonization and typical structures. The AMF colonization of these grapevines roots was consistent along the whole of these five regions, at 5 to 45 % of fine roots. The potential of inoculum of AMF communities on the roots of these grapevines showed that AMF associated in trap culture seems to be relatively stable. It is observed that AMF structures change seasonally probably due to the variation of root colonizing species of the vine plants. Some of the changes in the presence of AMF were attributed to environmental factors (plant-available P) and location of the vineyard, although the latter could also have been influenced by an unmeasured environmental factor. The management of the vineyards directly affects the formation of arbuscular mycorrhiza, for an organic or biodynamic management encourages the development of a healthy community of microorganisms in the rhizosphere. It can be observed how the native arbuscular mycorrhizal communities have a great potential, in plants inoculated with mycorrhizae shown in positive results like an increase in the length of roots and plants, as well as in the number of leaves.

P3: Aluminum tolerance breeding influence on arbuscular mycorrhizal fungal communities associated to cereals.

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In Chile, cereals cultivation is mainly in volcanic soils with pH values typically between 4.5-5.5 and high levels of exchangeable aluminum (Al) and low P availability. In this context, arbuscular mycorrhizal fungi (AMF) provide or enhance protection against this environmental stress. The aim of this study was to investigate the impact of the selection of cereal plants Al-tolerant on AMF community structure and diversity associated to four cereals species. This breeding program has been developed since 1980. Rhizosphere soils from cereals (*Avena sativa*, *Hordeum vulgare*, *Triticum durum*, x. *Tritico secale* Wittmack, *Secale cereale* and *T. aestivum*) were collected from field plots in South- Central Chile. In addition, two Al-tolerant cereals (Crac wheat cultivar and rye) were analyzed as controls. AMF identification and taxonomy was performed based on spore morphological analyses. Colonization and glomalin related soil protein (GRSP) was also evaluated. In general, up to 80% of root colonization in all cereal was found. Extraradical mycelium reached levels close to 3 m g-1of soil in the rhizosphere of *S. cereale*, *A. sativa* and *H. vulgare* selected under Al stress. While, GRSP values were statistically similar among selected or not selected genotypes under Al stress, this trend was not observed in *H. vulgare*, where a difference of 20 µg GRSP g-1 of soil was found. Moreover, large differences in AMF spore densities were observed, being 340 spores in 100 g soil the lowest and 1,900 the highest one, in non-Al tolerant *H. vulgare* and Al tolerant x. *Tritico secale* Wittmack, respectively. From a total of 10,000 AM fungal spores, 21 AMF species were identified, belonging to three classes, six orders, and eight families. The alpha diversity was higher in Al tolerant *T. durum* and almost similar to *T. aestivum*. Evenness index was significantly higher in Al tolerant *H. vulgare*. As conclusion, the use of target AMF species and cereals obtained under Al stress could be determinant factors for the appropriate AMF community establishment, potential inoculation assays and agricultural practices, especially oriented to soils with high Al levels.

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P4: Interactive effect of stabilized wheat straw compost and arbuscular mycorrhizal fungi on the biochemical properties of a soil contaminated with Cu and As.

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Application of stabilized compost on metal contaminated soils might be a useful tool for the decreasing of toxic elements. It is well known that arbuscular mycorrhizal fungi (AMF) improve the establishment of plants under negative conditions, thus, the interaction between both factors with the presence of vegetal species can be an effective alternative of phytoremediation of contaminated soils. In this study, we evaluated the interactive effect of the application of stabilized wheat straw composts (SWSC) together the inoculation of diverse strains of arbuscular mycorrhizal fungal on the biochemical properties and AMF parameters of a Cu and As contaminated soil as basis to improve phytoremediation strategies. It was made an experiment under greenhouse conditions using mesocosms with plants of *Imperata condensata* and *Oenothera picensis* (two plants of each) in a Cu/As contaminated soil which was maintained under these conditions by two years. Biochemical properties of soil and AMF parameters were evaluated in the following treatments: 1) SWSC with *Trametes versicolor* and iron oxide; 2) SWSC with *T. versicolor* and aluminium oxide; 3) SWSC with *T. versicolor* and an allophanic soil; 4) SWSC with *T. versicolor*; and 5) soil without amendment. For each treatment, it was evaluated the AMF inoculation effect of *Claroideoglomus claroideum* (CC), native AMF (Nat), CC+Nat and without inoculation. The activity of acid phosphatase, β-glucosidase and the fluorescein diacetate hydrolysis did not show an effect by the AMF inoculation, however, it was observed a significant effect because the interaction between the AMF inoculation and the SWSC addition, decreasing the enzymatic activity in those treatments without both elements, this trend supports the joint use of amendments and AMF as a strategy for the phytoremediation programs of contaminated soils. This research was supported by FONDECYT Chile (Grant 1120890) and DIUFRO (Grant PIA16-0005). H. Aponte thanks to Doctoral Fellowship Program CONICYT.

P5: Root colonization by arbuscular mycorrhizal fungi in different planting configuration of *Quillaja saponaria* in a degraded Mediterranean forest.

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The development of proper tools for a successful ecosystem restoration is crucial. In this sense, mycorrhizal fungi, appears as a mechanism that significantly improves the process of restoration in degraded ecosystems. Specifically, arbuscular mycorrhizal fungi (AMF), significantly improves soil properties, above and belowground diversity and the survival, growth and establishment of seedlings in soils with water and nutrient stress. Also, it has been found that they promote plant succession and prevent the invasion of alien species. All this features, place AMF as an appealing tool for restoration ecology. Despite of all this information, the role of AMF in restoration field experiments is poorly understood. This research aim to understand whether the planting configuration of plantlets of *Quillaja saponaria*, either next to an old mother tree or alone in the field, has an influence in the percentage of root colonization of AMF in a degraded field. To assess this, we explored the percentage of root colonization of AMF in both configurations and we test whether this has an influence with survival and growth of the plantlets.

P6: Effects of mycorrhizal inoculants on growth and root architecture of two wheat cultivars with contrasting phosphorus acquisition efficiency.

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Wheat (*Triticum aestivum* L.) yields higher than the national average is achieved in southern Chile. However, these yields are only possible through application of high doses of P fertilizer and around of 80% of P is accumulated in soil as residual P. Arbuscular mycorrhizal (AM) symbiosis is known to improve P acquisition under low P availability, however some cereals - especially wheat - are believed to not respond significantly to colonization. The present study aimed to evaluate the response on

plant growth and root development of two wheat cultivars with contrasting P acquisition efficiency colonized by two mycorrhizal species. Seeds of ´Crac` (P efficient cv) and ´Tukan` (P no efficient cv, according to previous screening) were pre-germinated for 3 days and then transferred to plastic pots with a mixture of sand and vermiculite (1:1). Mycorrhizal inoculum of *Claroideoglomus claroideum* and *Rhizoglomus intraradices* were mixed with the substrate before planting (20% v/v). Plants were grown for 33 days and watered every day to field conditions with Taylor and Foy nutrient solution with low P (10 µM). At harvest, soil samples were taken to measure organic acid and acid phosphatase exudation. Roots and shoot were excised and samples were cutted to measure AM colonization. The remaining roots were analyzed with winRHIZO software and then dried at 65º C. Mycorrhizal colonization by *C. claroideum* significantly reduced root growth, length, area and number of forks in ´Tukan, while *R. intraradices* increased the same parameters. Both AM inoculum improved shoot growth in ´Tukan´, being Y.Y. the most effective. Our preliminary results suggest that mycorrhizal symbiosis can contribute to P acquisition and to enhance growth in less efficient cultivars. The efficiency attributed to ´Crac´ may not be related to mycorrhizal symbiosis, as it did not significantly affect development. This data also supports the idea of functional diversity, however P, organic acid and phosphatase concentration, need to be measured to support our findings.
We fully acknowledge the financial support of the FONDECYT 11160385 grant (A. Seguel) from Comisión Nacional de Investigación Científica y Tecnológica (CONICYT) Chile and the support granted by CONICYT scholarship.

P7: Forest management of native shrublands: an approach to mycorrhizal colonization.

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Shrublands have high productive capacity. In Patagonia, more than 70% of these native environments are exploited for livestock and timber extraction. The alteration of soils and vegetation affect the richness and composition of edaphic fungal communities, including mycorrhizal fungi which are one of the most abundant fungal groups in soil. In the Andean-Patagonian forests, about 70% of the plant species have mycorrhizas. Our aim was to analyze in a native shrubland the effect of two management practices on the mycorrhizal colonization of the dominant species *Nothofagus antarctica*. Eight experimental plots were established in three sites of a native shrubland combining: thinning intensity (basal area removed 70, 50, 30 and 0%) and implantation of six native tree species (with and without implantation). One year after these management practices were implemented, roots were collected from three adult individuals of *N. antarctica* established prior to management. The percentage of ectomycorrhizal colonization was quantified. Data were analyzed with multilevel models inference using the AICc value to select the best-fit model. All individuals presented ectomycorrhizas, the percentages oscillated from 74 to 92% and were similar to the values registered in other Nothofagus species in the Patagonian region. The best-fit model was that considered the thinning, implantation, and the interaction between both, however these variables had no significant effect in mycorrhizal colonization. This could due to the dependence of these plants to this relationship to facilitate the nutrient capture, mainly phosphorus, or that the time elapsed from the implementation of the management to the sampling is not sufficient enough to evidence changes in the colonization. Continue with this work, analyzing the effect of the management in short and medium time scale and supplement these data with other researches in the same plot design is important for setting up guidelines for sustainable forest management in native shrublands.

P8: Differences in symbiotic germination between rare orchids and common orchids of the genus *Bipinnula*.

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Understanding the causes of the rarity in orchids is very important for their conservation. Orchid seeds are very small and lack of energetic reserves, so they require to associate with mycorrhizal fungi to germinate. This requirement has been postulated as a possible limitation for orchid distribution, especially for those orchids that present specialist mycorrhizal associations. In a previous study on the orchid genus Bipinnula, we observed that the widely-distributed species *B. fimbriata* and *B. plumosa* were associated with a significant higher diversity of mycorrhizal fungi than the very restricted orchids *B. volckmannii* and *B. apinnula*, which associate with only a single OTU from the fungal family Ceratobasidiaceae.

In this work, we aim to evaluate if this specialization observed in the field was reflected in seed germination, to evaluate if the rarity of these two orchid species could be related with mycorrhizal specialization. For this we compared symbiotic germination between the two rare orchids and the common *B. fimbriata*. We placed

seeds of the three species in OMA agar, with fungi of the family Ceratobasidiaceae and Tulasnellaceae which were isolated from roots of these orchids. The development of seeds was monitored monthly. We observed that in the same time period, common orchids reached stages of development much more advanced than rare orchids, which showed higher development with Tulasnella than with Ceratobasidium, contrary to what we expected as Ceratobasidium was the fungus isolated in their own roots.

Our results suggest that the rarity in these orchids could be related with their difficult to germinate, as their germination was slow with general fungus and with the fungus isolated in their own roots. Nevertheless, due to the slow germination of rare orchid seeds, more time it is needed to draw more definitive conclusions about their mycorrhizal specialization.

P9: Morphological study of sporocarpic Glomeromycotina species from Patagonian Nothofagaceae forests (Argentina-Chile).

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Fungi are an important component of temperate forest soil communities. Arbuscular mycorrhizal fungi (AMF) that form hypogeous sporocarps have been studied primarily in the Northern Hemisphere and very little is known about the diversity of these fungi in the Southern Hemisphere. Although the *Nothofagaceae* forests of Patagonia in Argentina and Chile tend to be dominated by ectomycorrhizal fungi, there is evidence that *Nothofagaceae* also form arbuscular mycorrhizal associations as well. During recent expeditions to collect fungi associated with *Nothofagaceae* trees in Argentina and Chile, we encountered several morphologically distinct species of sporocarpic Glomeromycotina. Here we examine and morphologically describe several rare, sporocarpic species that do not match the descriptions of any known species and are apparently new to science. All these fungi produce glomoid spores and have been found only one time. Only one sporocarpic species of Glomeromycotina, *Glomus fuegianum* (Speg.) Trappe & Gerd. has been previously documented from the Tierra del Fuego Archipielago. This study provides preliminary data on three additional new species, suggesting that the diversity of this group of fungi is likely much higher than previously thought in southern South America.

P10: Contribution of inoculation with arbuscular mycorrhizal fungi to the bioremediation of a copper polluted soil using *Oenothera picensis*.

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Bradford-reactive soil protein (BRSP) fraction includes the glomalin, a glycoprotein produced by arbuscular mycorrhizal (AM) fungi able to bind some metals, like copper (Cu), which could promote bioremediation of Cu-polluted soils. This study aimed to analyse the Cu-binding capacity of BRSP in *Oenothera picensis* inoculated or not with AM fungi. *O. picensis* plants were established in a Cu contaminated soil sterilized and i) uninoculated (-M) or inoculated with ii) native AM fungal propagules (+M), or iii) a *Claroideoglomus claroideum* (CC) strain isolated from non-contaminated soil. In each case, five Cu supply levels were applied to the soil (basal level 497.3 mg Cu kg-1): 0 (T1); 75 (T2); 150 (T3); 225 (T4) and 300 mg Cu kg-1 (T5). A high BRSP accumulation in AM inoculated treatments, especially with CC, was observed. A higher Cu-bound-to-BRSP content was found at increasing Cu concentrations, representing up to 20-22% of total Cu in the soil. Moreover, a higher root Cu concentration in +M was observed. These results suggest a high Cu binding capacity by BRSP, which is a relevant aspect to consider in the design of bioremediation programs together with the selection of endemic metallophytes and AM fungal strains able to produce glomalin in high quantities.
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P11: Arbuscular micorrhytic fungi in soils cultivated with different varieties of sugar cane under organic and conventional production system.

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Arbuscular mycorrhizal fungi (AMF) have the potential to promote plant development and soil aggregation. Organic production systems directly influence the edaphic

microbiota and among them, the AMFs stand out. The objective of this work was to evaluate the occurrence, number of spores in the soil, mycorrhizal colonization rate, easily extractable glomalin and mycorrhizal fungi associated with sugarcane under organic and conventional production systems. The experimental design was completely randomized, in a subplot scheme, with five replications. The plots were composed of two production systems: conventional and organic; the sub-plots were the sugarcane varieties: CTC 4, IACSP 94-2101 and IACSP 95-5000. The rate of mycorrhizal colonization was determined by the method of Phillips & Hayman (1970) and Giovannetti & Mosse (1980). The spore density values were determined by the method of Gerdemann & Nicolson (1963). For the determination of easily extractable glomalin the method of Wright and Upadhyaya (1996) was used. The identification of the AMF species was made from the morphological characteristics (Invam, 2014). Thirteen species of AMF were identified in the soil under production systems and sugarcane varieties: *Acaulospora laevis, A. scrobiculata, A. tuberculata, A. spinosa, Archeospora leptoticha, Glomus clavisporum, G. lamellosum, G. Tortuosum, G. microaggregatum, G. macrocarpum, Gigaspora sp, Scutellospora persica* and *S. pellucida*. There was no effect of sugarcane varieties on the number of spores and levels of glomalin in the soil. The conventional system presented statistically lower values of mycorrhizal colonization rate compared to the organic system. The varieties cultivated under conventional planting systems presented greater diversity of AMF, where twelve of the thirteen species identified were present. Acknowledgments: Fapeg and AEE.

P12: Approaching diversity of Agaricales *sensu lato* in Cerro El Roble *Nothofagus macrocarpa* forest (Región de Valparaiso, Chile).

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Nothofagus (Nothofagaceae) dominates as the only strictly ectomycorrhizal tree genus in natural temperate forests in Southern South America. In Chile, ten Nothofagus species are distributed between the regions of Valparaiso and Magallanes, where the area of *N. macrocarpa* marks the northern limit, ranging between (33°-35°S approx.). In this region, natural forests have been strongly reduced and deteriorated by fires and timber cutting. As fungi play important specific roles in the trees´ life cycle and, more generally, in nutrient cycling in forest ecosystem, it is important to know fungal diversity in stands of endemic tree species like *N. macrocarpa* in order to understand better its ecology and biotic requirements in conservation and restoration programs. It has been documented that *Nothofagus* forms mycorrhizal symbiosis with 47% of the approx. 300 fungal species belonging to the Agaricales *s.l.* which are known in Chile. This group includes Russulales, Boletales and Agaricales *sensu stricto,* but so far, there is very little information about the associated fungal community at the northern distributional limit of *Nothofagus* in the Mediterranean climate zone.

The principal aim of this study is to contribute basic information about diversity of Agaricales *s.l.* for forest at the Cerro El Roble Locality (Región de Valparaiso), dominated by *N. macrocarpa*.

Field research at Cerro El Roble during 2016 yielded 26 Agaricales *s.l.* species, where five species correspond to ectomycorrhizal fungi, mainly belonging to the genera *Cortinarius*, *Laccaria* and *Hebeloma*.

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P13: Ectomycorrhizal sporocarp occurrence in *Pinus radiata* D. Don stands of different age.

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The occurrence of ectomycorrhizal sporocarps in 18 stations on six stands of *Pinus radiata* were studied. In July 2005 stands of *P. radiata* of different age (i.e., 5 to 18 years) located in the Coastal range of the Maule Region in Central Chile were selected to perform mycological observations in 100 m^2 stations (2 x 50 m). Sporocarps of ectomycorrhizal fungi were systematically identified and counted in all stations. The data on the ectomycorrhizal species were characterised by the total numbers of sporocarps. Canopy coverture (%) and soil relative humidity (%) were also measured in each six stands. A total of 112 carpophores were found: 80 in juvenile stands (age 14 to 18) and 32 in young stands (i.e., younger than 6). *Amanita toxica* and *Russula sardonia* were the most common ectomycorrhizal fungi associated with juvenile stands of *P. radiata*, while in young stands the species *A. toxica* and *Suillius luteus* were the most frequent. On the other hand, canopy coverture was similar between juvenile and young stands (68 and 67%, respectively), while soil relative humidity was different (29 and 45%, respectively). Although these results are based on only 2 months of research, the low number of *S. luteus* and *Lactarius deliciosus* sporocarps (two edible species associated to *P. radiata* plantations) induces to think of a decrease in production of carpophores instead of a change in ectomycorrhizal community, as underlined by increasing presence of local harvesters. As *S. luteus* and *L. deliciosus* seems not to need a dense canopy but an open and sunny wood habitat, we advocate that to maintain and/or increase its productivity, in order to meet the increasing demand, management guidelines for local harvesters must be developed and strictly implemented. This research was granted by Fundación para la Innovación Agraria (Grant FIA-PI-C-2004-2-F-014).

P14: Effects of land-use change on the structure and function of soil fungal communities in a Chilean temperate rainforest.

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By lowering the production and decomposition of soil organic matter and litter input, land-use changes are predicted to decrease soil fungal diversity. Though, this has been poorly studied at the functional level. Thus, a fungal biodiversity decrease, both for saprotrophic and mycorrhizal fungi can be expected with increasing disturbance. This study aimed to establish the effects of land-use change on taxonomical and functional diversity of southern Andean soil fungi. We assessed the fungal communities close to the surface (1 cm soil depth) and in the topsoil (10 cm) in nearby plots under a gradient of anthropogenic disturbance (under pristine forest, removed overstory, and clear-cut conditions). We identified 1733 fungal OTUs by 454-pyrosequencing from which 401 were assigned to a fungal guild. While we found a higher taxonomic richness in plots being cut clear they had a higher share of plant pathogen fungi, and a lower share of saprotrophic- and ectomycorrhizal fungi as compared to the other treatments. The directly opposed pattern was found under pristine forests. Species richness of fungi itself does not seem to reflect ecosystem health. Thus, the lower taxonomic diversity founded on the pristine forest is compensated by higher diversity of fungal guilds directly involved in nutrient-cycling.
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P15: Effects of fertilization on mycorrhizal colonization.

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Mycorrhizas are symbiotic associations between fungi and plants and are present in 92% of terrestrial plant families, these associations are influenced by abiotic factors such as soil conditions. In the mycorrhizal association plant delivers Carbon to the fungus and the fungus nutrients (N and P) to the plant, therefore when plants are limited by nutrients, it's been suggested that they will allocate more carbon to fungi in order to maximize nutrient uptake, and this could increase the abundance and diversity of fungi in roots. In natural populations of *Bipinnula fimbriata*, a Chilean orchid, it has been observed a positive relationship between mycorrhizal colonization and Phosphorus availability, therefore an increase in soil phosphorus is expected to increase the mycorrhizal colonization. Soil Nitrogen in turn, showed no relationship with colonization but a negative correlation with fungal diversity. In this study, we analyzed the effect of fertilization on mycorrhizal colonization of *B. fimbriata*. We performed a field experiment in Zapallar, that consisted of the application of fertilizers in an extensive population of this orchid. We established 40 plots to which we applied 4 treatments (N, P, NP and control, 10 plots each), soil and roots samples were taken pre-and post-fertilization to analyzed mycorrhizal colonization. Additionally, we measured the number of flowers, fruits, rosettes and inflorescences and height of inflorences, to evaluate the response in the aerial part of the plant. We observed that percentage of colonization decrease with P fertilization in soils, which could be explained by a lower allocation of C to fungi or to a lower abundance of fungi in soils with higher P. In contrast, no relationship was observed with N fertilization. Aerial parts of the plant were no significantly affected by fertilization of N and P.

P16: Soil fungal assemblages in Chilean temperate rainforests: effects of geological history, forest mycorrhizal dominance, and altitude on taxonomical, functional, and phylogenetic diversity.

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Chilean temperate rainforests, located in two mountain systems (Andes and Coast) with contrasting geological histories, feature three vegetation types: *Nothofagus* spp. forests (dominated by ectomycorrhizal (EM) trees), Valdivian and coniferous forests (dominated by arbuscular mycorrhizal (AM) trees). By soil resource partitioning/competition, the dominant trees mycorrhizal type, or 'mycorrhizal dominance', likely affects other non-mycorrhizal fungal guilds. This study aimed to test the effects of mountain system, mycorrhizal dominance, edaphic conditions, and altitude on soil fungal taxonomic, functional, and phylogenetic diversity. Here we describe soil fungal communities of temperate rainforests using ITS2 Illumina sequencing. There was a significant effect of mountain system on the community composition of all, saprotrophic, EM, and AM fungi. In addition to affecting the community composition of all, saprotrophic, and EM fungi, mycorrhizal dominance affected EM and AM phylogenetic diversity. Redox potential, C, N, plant available P, Ca, K and Mg were the edaphic variables that significantly affected all fungi community composition. The composition of saprotrophs and AM fungi were affected by similar edaphic variables while EM composition was affected by pH and K. Only AM richness was lower at higher altitudes. Saprotroph and EM abundances were negatively related. Overall, mycorrhizal dominance significantly affected non-mycorrhizal soil fungal guilds. Funding: CONICYT 21150047, DFG BO 3741 3-1, Fondecyt 1141060.

P17: Mix inoculation of native mycorrhiza and yeast on different *Populus* species growing in greenhouse condition.

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In Argentina, there is an increasing interest on improving *Populus* sp. production for large scale plantation. *Populus* trees present both arbuscular mycorrhiza and ectomycorrhiza colonization. Manipulation of mycorrhizal colonization could be an important tool to enhance plant production. The aim of the present study was to evaluate the effect of two native yeasts on mycorrhizal colonization of *Populus trichocarpa* and *P. nigra* produced under greenhouse condition. One year old, 30 cm cuttings were planted in pots containing sterile peat, clean sand and native soil (1:1:2). Yeast inoculation was performed in two steps: submerging the cutting in cell-suspension for 8 h before planting and spreading cell-suspension on cutting base after 20 days. Native soil from steppe was used as mycorrhizal inoculum. Chlorophyll contains was measure as evaluation of plant health. Ectomycorrhizal presence was evaluated by observation of fresh roots; and the percentage of arbuscular mycorrhizal colonization was evaluated on roots stain with tryphan blue. All plants were healthy with similar level of chlorophyll. No ectomycorrhizal colonization was observed on any plant. Colonization by dark septate entophytes was observed as microsclerotia and hyphae in less than 10% of the roots. Vesicular-arbucular mycorrhizal colonization was observed in both tree species, with average root colonization over 50%. Two distinguishing patterns of colonization were observed: colonization by thick hyphae showing arbuscules, terminal vesicles and intracellular coil structures; and colonization by fine hyphae with intercalar swollen and arbuscules. One of the yeast inoculated enhance mycorrhizal colonization, but statistical differences to control treatment were not significant. The lack of ectomycorrhizal colonization could be attributed to plant age, but it has to be further investigated. The present work is a pioneer and innovative research for poplar production in Argentina. Greenhouse trials like the present one, allow the selection of mycorrhization-helper microorganisms for future field experimentation.

P18: An experimental approach: ectomycorrhizas in a *Nothofagus pumilio* forest affected by the Puyehue Cordón Caulle´s volcanic ashes (tephra).

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The 2011 Puyehue Cordón Caulle´s eruption affected large areas of *Nothofagus pumilio* forests where tephra deposition buried all the understory vegetation, forming a brand-new substrate for plants and microorganisms. After this disturb, there are natural regeneration of *N.pumilio* seedlings growing in the tephra. *N.pumilio* normally have a high proportion of colonization of ectomycorrhizas (EM) (adults ≥70%). The aim was to study how tephra deposition influences *N.pumlio´*s EM colonization and seedling development. In a forest with high tephra deposition (>40cm), ten pots were placed in the tephra and filled with their forest soil, obtained under the tephra. It was selected *N.pumilio* seedlings growing in the tephra, two were transplanted into each pot (soil seedlings) and ten remained growing in the tephra. After one year, it was sampled roots from five adults and ten seedlings from each substrate. In all the individuals, it was analyzed EM colonization and richness, and seedlings morphometric measures: length and diameter of the stem, epicotyl and root. All the individuals presented EM. The EM colonization and richness were not statistically different between soil seedlings and adults (75% and 70%; 3,8 and 6,0 ectomorfotypes/individual, respectively) and were higher than tephra seedlings (50%; 1.3). This difference may be due to the fact that soil seedlings and adults were in direct contact with the soil (native inoculum). No differences were found in the morphometric measures between soil/tephra seedlings, suggesting that, in the short term, seedling growth was not influenced by the different substrates. The tephra not only allowed the germination and survival of seedlings, but also possessed EM infective capacity, although it appeared to be lower than soil. After a high impact disturbance, the re-establishment of the native inoculum in the tephra and the mycorrhizal capacity of *N.pumilio* seedlings seems to be an important process for the forest regeneration.

P19: Arbuscular mycorrhizal fungi in fire-altered *Araucaria araucana* forests and their relationship with biogeochemical patterns.

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Arbuscular mycorrhizal fungi (AMF) dominate the mycotrophic stratum in temperate forest ecosystems of American Southern cone. In these environments, forest fires are common disturbance events and may affect symbiotic AMF associations, as well as alter biogeochemical processes and N bioavailability. The AMF response to a catastrophic fire disturbance in plant communities with *Araucaria araucana* K Koch., may partly explain the ability of these ecosystems to resist massive events. A study of AMF spores in a volcanic soil, altered by a forest fire in Tolhuaca National Park, Chile (38º S, 72º W), was carried out with morphological and biomass measurements of *A. araucana* seedlings under greenhouse experiment, as well as rates of AMF colonization in roots and the quantification of total N content and 15N isotopic ratio in soil, plants and fungi, affected by fire as compared to unburned forest soil.
Fire-resistant AMF spores were observed and morphological and biomass development of seedlings were affected by the use of burned soil in comparison with unaltered soils. The frequency and intensity of AMF colonization in the roots were higher in the unaltered soil and were related to the morphological development of seedlings. The natural abundance of 15N (delta-$_{15}$N) increased significantly in the soil and plant profile from burned area, but was not evident for the AMF compared to other functional groups of fungi. The resistance and persistence of AMF in the soil altered by fire in relation to the changes in N biogeochemical patterns, indicate a potential pathway of ecological resilience of those threatened communities, favoring the recovery of forest ecosystems after a catastrophic event.
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P20: Arbuscular mycorrhizas in Uruguayan grasslands: long-term effects of P fertilization.

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Natural grassland (NG) is the dominant ecosystem of Uruguay, it covers 64% of the territory and it supports livestock, one of the main economic activities of the country. Arbuscular mycorrhizas (AM) are particularly relevant in grasslands; however, studies of mycorrhiza associations are scarce in Uruguay. Our objectives were to evaluate the impacts of P fertilization on: 1) the AM status and nutrient contents of dominant grass species; 2) the AM diversity of two native grasses. We evaluated a long-term experiment, where P fertilization and legume introduction on native grassland caused changes in botanical composition. Fertilized plots were invaded by *Cynodon dactylon*, *Lolium multiflorum* and *Gaudinia fragilis*, and reduced the abundance of native perennial grasses. We hypothesize that these changes could be related to the mycorrhizal dependency of native species. In the experiment, established in 1996, the treatments were: 1) natural grassland (NG) without fertilization; 2) improved oversown grassland (IPlow) fertilized annually with 30 kg ha^{-1} of P_2O_5; 3) improved oversown grassland (IPhigh) fertilized annually with 60 kg ha^{-1} of P_2O_5. During 2011 and 2012 we seasonally collected plants and soil to evaluate: mycorrhizal colonization, soil available P, leaf P and N contents, diversity and abundance of AM spores (using morphological techniques) in the rhizosphere of *Paspalum dilatatum* and *Coelorhachis selloana* and AM diversity in their roots (using the T-RFLP technique). P soil contents were three and five times higher in IPlow and IPhigh treatments than in NG. Native and invasive species presented higher leaf P concentration in fertilized plots. Leaf N presented low values in all species and no differences among treatments. In fertilized plots, native species presented less colonization of coils and arbuscules than in NG in the four seasons. *C. dactylon* (invasive weed) showed high levels of root micorrization in all plots, but less coils and arbuscules compared to native species. The increase in available P did not affect the diversity of AM in the roots of any of the two native grasses.

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P21: Land use and cover changes: winners and losers in the Arbuscular Mycorrhizal Fungi soil community of Argentinean Arid Chaco.

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The Argentinean Arid Chaco in the last 150 years had simultaneously suffered two highly transformative processes: a reduction in the native forests area to incorporate new agricultural lands and an increase in the area of implanted pastures for livestock over natural grasslands. Arbuscular Mycorrhizal Fungi (AMF) are obligate symbionts of the 80% of the terrestrial plants and improve their ability to acquire nutrients, mainly Phosphorus. In general AMF abundance and effectiveness with respect to root colonization and plant growth promotion are declining upon agricultural intensification. However, little is known about the effect of management practices on the species diversity and community structure of AMF. Our objective was to analize the HMA diversity changes in the different management and land use units, considering the Native Forest as the pristine situation and along a gradient of diverse land uses units, to determinate which species are favored, and those that are disadvantages against the management and land uses changes. The following land use systems were selected: Native forest, Shrublands, Nopals Agriculture, Fruit trees, Fallow lands, *Alfalfa* meadows and Implanted grasslands. AMF spores were counted and identified both for samples taken directly from field sites. Preliminary results indicate that Annual Crops and Pastures are more diverse than Native forests and that this diversity would seem to be related to the intensity of use and management.
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P22: Change in total glomalin content related to soil proteins after a wildfire in an Andisol of *Araucaria araucana* forests of south-central Chile.

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In high-altitude montane forests, the vascular plants undergo mycorrhizal symbiosis with mycorrhizal fungi as a strategy to face extreme soil and climate conditions. In this study, glomalin content related to soil proteins (GRSP) was studied, an insoluble glycoprotein produced by hyphae of arbuscular mycorrhizal fungi and deposited on the soil, four years after a wildfire of variable severity, in *Araucaria araucana* forest in south-central Chile (38° S). For the previously stated, the aim proposed was to determine the content of this glycoprotein as well as to evaluate and relate the composition of soil organic matter to the content of this glycoprotein. Samples were collected at different depths (0-5, 5-10, 10-20 and 20-30 cm, respectively) from areas presenting various fire severities (low, medium and high) and an unburned soil area (control soil). Furthermore, composition and structure of soil organic matter was studied by Nuclear Magnetic Resonance Spectroscopy of ^{13}C (NMR ^{13}C). As main results, total GRSP concentration showed significant differences between the burned soil and the control soil. A significant correlation between the composition of the organic matter and GRSP was found. The high concentration of GRSP obtained in burned forests could answer to an ecological-evolutionary strategy from the *Araucaria araucana* forest in their adaptation to both a soil with low nutrient availability and to periodical fire catastrophic events; suggesting their key role in the recovery of these ecosystems and should be considered in restoration programs.
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P23: Common ectomycorrhizal macrofungi (Agaricales s.l.) in the Los Ruiles National Forest Reserve, Maule Region, Chile.

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The Los Ruiles National Forest Reserve in the Cauquenes Province, Maule Region, is the most important protected area of the regionally endemic *Nothofagus alessandrii*, the most endangered Nothofagus species in Chile. In the reserve, N. alessandrii grows mixed with other obligatorily ectomycorrizal *Nothofagus spp*. such as *Nothofagus dombeyi* and *Nothofagus glauca*, which all have become increasingly rare in the coastal cordillera of Southern Central Chile, due to large-scale elimination of native forest as a consequence of replacement by exotic tree plantations, crop fields and cattle pastures or, more recently, of extensive forest fires enhanced by longer draught periods and higher summer temperatures.

In order to develop long-term strategies of conservation and restoration of this highly fragmented and endangered forest type, it is important to know its mycorrhizal fungal community which is essential in the trees´ life cycle. Ectomycorrhizal fungi with conspicuous, epigeous fruiting bodies (Agaricales s.l. and related groups), specifically associated to Nothofagus in natural Chilean forests, are relatively easy to observe and therefore an appropriate base for preliminary inventories of mycorrhizal fungal diversity.

We present a list of common species of ectomycorrhizal basidiomycetes, based on field inventories performed between 2007 and 2014 in the Los Ruiles Natural Reserve. Most of this species belong to the Cortinariaceae, but *Amanita spp.*, *Boletus spp.*, *Ramaria spp.* and *Russula spp.*, among others, are also important elements of the community of fungal symbionts.

The high proportion of endemic mycorrhizal fungi underlines the urgent need of a more integrative approach of conservation and reforestation programs which does not only consider the tree species, but it's an associated mycobiota as well.

This study was supported by the National Forest Corporation CONAF, especially by project 65/2012 “Bases para definir estrategias y prácticas de manejo sustentable del bosque nativo, usando el estado de conservación de líquenes, algas y hongos superiores”.

P24: Mycorrhizal status of three native plants species that grow in the high Andean ecosystem of Atacama Desert, Tarapacá region – Chile.

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Plant association with soil microorganisms promote growth and generate better response to abiotic stress. Specifically, the arbuscular mycorrhizal fungi (AMF) as one of the most important biotic components in environments with water limitations. This study analyzed the mycorrhizal status of representative species of the high Andean ecosystems of the Region of Tarapaca, (3749-4134 m s.n.m.). This ecosystem is characterized by the water stress conditions with an arid climate and low development saline soils. It is for these conditions that roots and rhizosphere soil samples were taken, *Parastrephia lucida*, *Deyeuxia curvula* and *Festuca crysophylla*, were collected. In laboratory, the percentage of AM colonization by the gridline intercept method (Giovannetti & Mosse 1980), after rinsing in a 10% (w/v) KOH solution and staining with 0.05% (w/v) trypan blue in lactic acid, was determined. For the rhizospheric soil, spore density, by the wet sieving and decanting method in a 70% sucrose solution (w/v) (Gerdemann & Nicolson 1963), was determined. The measurement of mycelium length in the soil was carried out according to Borie et al. (2000) and total Glomalin-related soil protein (T-GRSP) was determited according to Wright and Upadhyaya (1998). The results show high mycorrhizal plants rates (from 13.6 to 73.6%), fungal mycelium densities of 0.22 to 7.83 g m^{-1}, spores densities between 101 and 6624 per 100 g soil, and T-GRSP contents varied between 0.2 and 3.48 mg $g^{-1,}$ under natural conditions. The pH of soils values between 7.8 to 9.1 and salinity levels to 6000 dS m^{-1}. These results suggest a high dependence of these plant species for the establishment of mycorrhizal symbiosis under limiting soil conditions, in which they are growing, a factor that should be considered in revegetation plans that consider these highly vulnerable plant species.

P25: Agaricoid, secotioid and hypogeous ectomycorrhizal fungi associated with the endangered *Nothofagus alessandrii* Espinosa in Central Chile.

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Nothofagus alessandrii Espinosa (ruil) is a threatened, endemic tree of the Mediterranean zone of Chile. The restoration of this species is a priority task and calls for a better understanding of ectomycorrhizal fungi that can significantly affect plant growth and patterns of succession after a disturbance. In an effort to obtain basic knowledge of the ectomycorrhizal fungi associated to *N*. *alessandrii*, two study sites in the coastal range of the Maule Region were selected, viz: Los Ruiles National Reserve, which is managed by the Corporación Nacional Forestal and El Desprecio, a private reserve owned by the forest company Forestal Mininco S.A. Both sites were visited during 2006-2008, following significant precipitation events, and monitoring of fungal sporocarps was performed, with special emphasis in secotioid and hypogeous species. A total of 26 ectomycorrhizal fungi species were found; 20 species in the National Reserve and 6 in the private area. Cortinariales, Russulales and Boletales comprise 77% of the species diversity discovered. Of the 26 species found, 65.3, 30.7 and 3.8% were epigeous, secotioid and hypogeous, respectively. The most frequent species at both sites were *Amanita diemii*, *Boletus loyo*, *Cortinarius austroturmalis, Hysterangium carneoroseum* and an unidentified secotioid russuloid species, while *Porpoloma sejunctum*, *Thaxterogaster magellanicus* and an unidentified secotioid cortinarioid species were less frequent. Ectomycorrizal fungi are essential elements in the tree life cycle and especially secotiod and hypogeous mycobionts are supposed to be best adapted to water stress which is an increasing problem in the Mediterranean climate of the study zone, especially in the context of climate change. Our preliminary results show the urgent need for better knowledge of the ectomychorrizal fungi associated to *N*. *alessandrii*, especially for future programs of efficient reforestation. We thank Corporación Nacional Forestal and Forestal Mininico S.A., for provide access to the collecting sites.

P26: Influence of arbuscular mycorrhizal colonization on three wheat genotypes differing in Al-tolerance when growing at a phytotoxic Al level.

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The aim of this study was to test the effect of arbuscular mycorrhizal (AM) colonization on three wheat genotypes differing in Al tolerance when subjected to a high phytotoxic Al level and to investigate the AM influence on some root and rhizosphere parameters. Al tolerant (‘Porfiado’) and sensitive (‘Tukan’) local *Triticum aestivum* L. (wheat) genotypes were used. Additionally, the gold-standard Al-tolerant wheat genotype ‘Atlas 66’ was assayed as a reference treatment. The experiment was carried out using a soilless substrate inoculated or not with native populations of AM fungi and supplied or not with 200 µM Al. In general, the wheat response to Al levels in the medium depends on plant cultivars and to the AM colonization. On other hand, the increase P concentration and decrease Al uptake were influenced by AM activity but these processes cannot be generalized. High Al concentration triggered the extraradical mycelium development able to retain Al and this ability differed between wheat cultivars. Al-sensitive wheat cultivar “Tukan” significantly increased the glomalin production suggesting the important role of AM extraradical mycelium in Al detoxification. In this sense, AM symbiosis produced a strategy to tolerate Al-toxicity and specifically the AM colonization would mitigate Al toxicity by mechanisms as extraradical mycelium production and P acquisition from the rhizosphere soil.

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P27: Seasonal dynamic of arbuscular mycorrhizal fungi spores of sclerophyllous forests of the Chilean matorral.

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The temporal changes of arbuscular mycorrhizal fungi (AMF) present in soils of sclerophyllous forests of the Chilean matorral are not known. The seasonal dynamic of AMF spores on this soils were examined together with the factors that influence the changes. AMF spores' abundance was studied in two sclerophyllous forest: (1) south facing slope and (2) north facing slope and during the four climatic seasons. Significant differences in the number of spores were found among seasons and between the two forests. The highest numbers of spores were observed during the dry and warm season, with a decrease during the cold and rainy season. This results shows, as for other habitats, that seasonality does affect abundance of AMF spores in soils of sclerophyllous forests of the Chilean matorral.

P28: Evaluation of abundance and diversity of arbuscular mycorrhizal spores in *Austrocedrus chilensis* forests affected by wildfire in Patagonia, Argentina.

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During February of 2015, near to Cholila (Chubut, Argentina) an extreme behaviour wildfire occurred, leaving 27,101 ha burned. Approximately 5700 ha of this area corresponded to pure and mixed *Austrocedrus chilensis* forests. The symbiosis between arbuscular mycorrhizal (AM) fungi and *A. chilensis* has been established and has great ecological importance for the species regeneration. Therefore, is important to determine AM spore bank state in post-fire underground in order to understand the evolution of these stands and to properly manage their restoration. This study was carried out in three sites with *A. chilensis* forest near to Las Horquetas (Cholila, Chubut) where three treatments were selected: unburned forests, forests moderately affected, and forests severely affected by fire, with the aim of determine and compare the abundance and diversity of AM spores in soil affected by different fire severities. Five composite soil samples were taken in each

treatment and site, at the first 15 cm of soil profile; AM spores were extracted with the wet sieving-sucrose gradient method, quantified and classified according to morphological characteristics in binocular stereomicroscope. Arbuscular mycorrhizal spores were significantly more abundant in moderate fire treatment (258 spores/100 g dry soils). It was possible to identify 6 different morpho-species present in all treatments, two of them (*Glomus*-like) being the most abundant. Evenness declined significantly in moderate severity treatment (E_I=0.68; E_{A-V}=0.74, $p<0.0001$, respectively). The spore bank in unburned soil (85 spores/100 g dry soils) did not significantly differ with the high severely treatment (121 spores/100 g dry soils). Thinking in restoration strategies, it has to be considered that wildfire would also cause the extramatrical mycelium loss, although some stimulus occurs in moderately affected soil that increased spores' abundance. Moderately burned areas have better chances of natural restoration considering the abundant AM spores bank, while artificial inoculation has to be considered for severely affected areas.

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