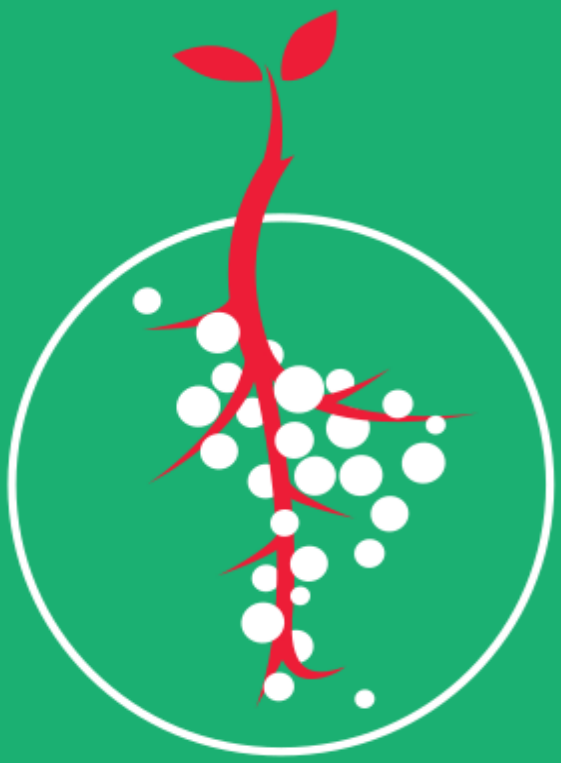
II INTERNATIONAL SYMPOSIUM



MYCORRHIZAL SYMBIOSIS

IN SOUTH AMERICA

ABSTRACTS BOOK

II International Symposium
Mycorrhizal Symbiosis in South America

March 6th - 8th, 2019
San Carlos de Bariloche, Argentina

AIMS OF THE MEETING

In its second edition, the Symposium Mycorrhizal Symbiosis in South America aims to promote the research of the symbiosis between fungi and plants with special emphasis on the advances and applications in South America. The need for this meeting arises from the South American potential in the subject, which involves various areas of biology such as ecology, taxonomy, physiology and molecular biology, with a positive impact for industry and production at a regional level. The meeting will promote interdisciplinary actions between experts, stakeholders and producers, and it will establish and strengthen academic, scientific and technical networks, generating novel alternatives of sustainable production.

En su segunda edición, el Simposio Simbiosis Micorrícica en Sudamérica tiene como objetivo promover la investigación de la simbiosis entre hongos y plantas, con especial énfasis en los avances y aplicaciones en Sudamérica. La necesidad de esta reunión surge del potencial sudamericano en el tema, que aborda diversas áreas de la biología como la ecología, la taxonomía, la fisiología y la biología molecular, con un impacto positivo en la industria y la producción a nivel regional. La reunión promoverá acciones interdisciplinares entre expertos, partes interesadas y productores. Así mismo establecerá y fortalecerá redes académicas, científicas y técnicas, generando nuevas alternativas de producción sustentable.

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Pioneer in the research, conservation and promotion of Fungi found in Chile, this organization forms part of a solid global mycological network and holds one of Chile's largest collections of fungal photography, a growing collection of biological specimens and spores, and an important mycological library, as well as over 17 years of field experience consolidated in the people who work with them

https://www.ffungi.org/

LOGO CONTEST

During the first months of 2018 the Organizing Committee called for a national logo contest to represent this II International Symposium Mycorrhizal Symbiosis in South America. In March 2018 a special committee formed by students, designers, former researchers and specialists in science popularization decided to give the first and second prizes to the following participants:

1st Prize (100 USD, book and regional gift)
Javier Curros Cámara – Architect and Designer
http://ousia.com.ar/about/

2nd Prize (50 USD, regional gift)
Walter Policelli – Licenciado in Communication Science and Designer
http://www.walpok.com/website/

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Facundo Fioroni, Matías Soto, Verónica Bella, Ana Laura Guardamagni, Natalia Joelson

Grad students
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Natalia Gobran - CCT Patagonia Norte, CONICET

Musicalization and sound
Sebastián Olarte

Work partners

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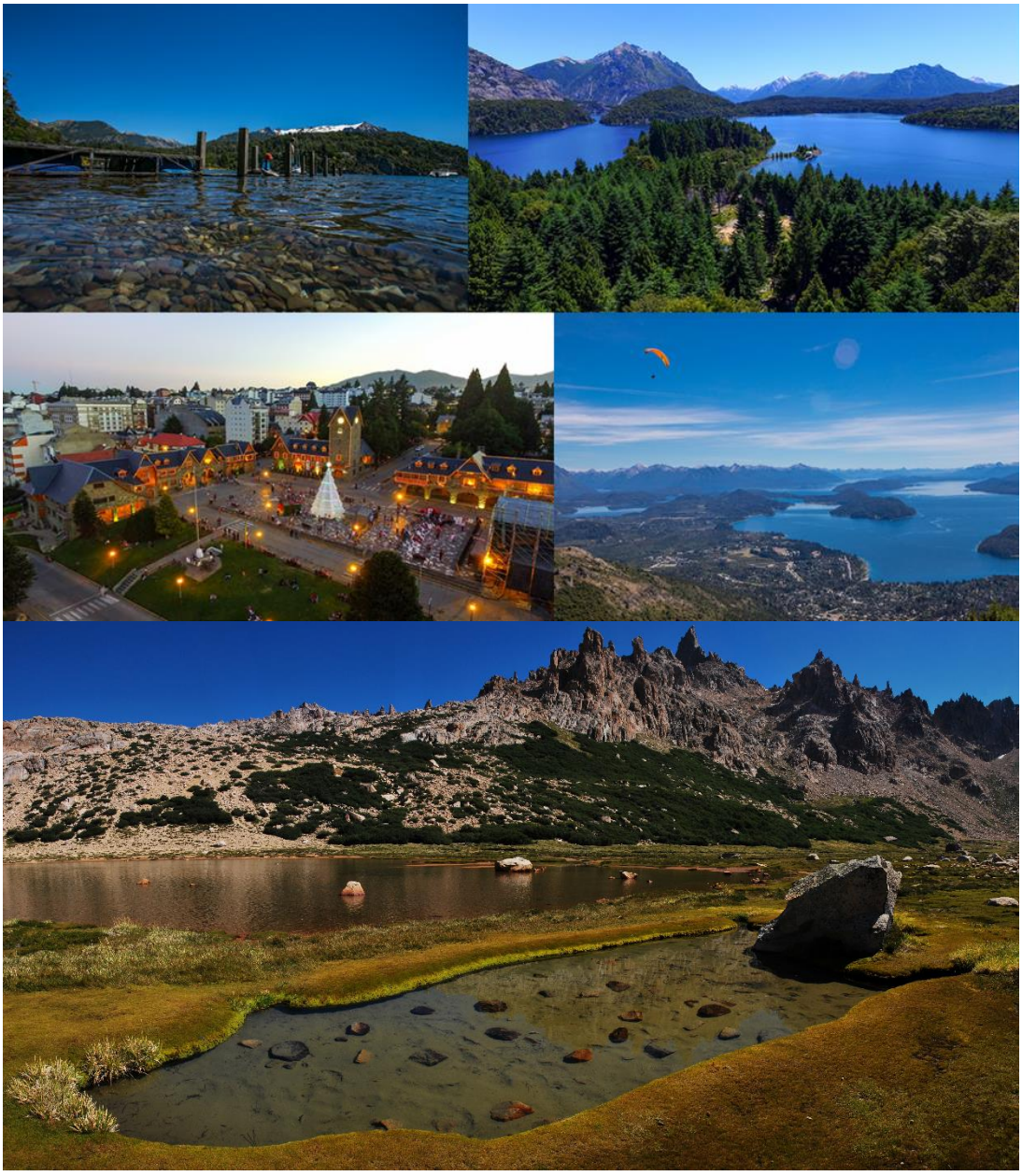
Dr. Miriam Gobbi for her wonderful handicrafts

THE CITY OF BARILOCHE

The symposium will be held in the beautiful city of Bariloche, Río Negro, Argentina. Bariloche is a world-class destination full of unique sceneries and it is well known for its incredible natural beauty, food, and local culture. In this city, you can enjoy a variety of different activities, ranging from outdoor adventures to cultural events and restaurants with typical Patagonian meals. Recognized for its delicious chocolates and the rise of craft breweries, some of them made with a native yeast, Bariloche has a lot to offer to all kind of visitors. Hope you enjoy the city!

You can visit the Bariloche´s Tourism website for more information: https://www.barilocheturismo.gob.ar/.



II International Symposium: Mycorrhizal Symbiosis in South America
PROGRAM SCHEDULE

1st DAY	WEDNESDAY 6th Ecology, environment and society			
8.15 – 8.45	*Registration*			
8.45 – 9.00	*Opening Ceremony*			
9.00 – 9.45	**KEY LECTURE**		**Dr. Kabir Peay (Stanford University, USA)**	**K01: Ectomycorrhizal fungi as keystone species**
9.45 – 10.15	**DEBATE**		**Moderator: Dr. Roberto Godoy (Universidad Austral, Chile)**	**Mycorrhizal Ecology in South America: weaknesses and strengths**
10.15 – 10.30	*Coffee break*			
10.30 – 11.35	**ORAL SESSION I**	**Invited speaker:**	**Dr. Guillermo Bueno (University of Tartu, Estonia)**	**OI01: Different estimations of plant mycorrhizal traits: limitations, suggestions and challenges**
		Selected speakers:	M. I. Mujica, M. F. Pérez, G. Burin and T. Quental	OS01: Seed plant families with diverse mycorrhizal states have higher diversification rates
			C. I. Nunes, J. L. García Massini, I. H. Escapa and D. Guido	OS02: Structurally preserved arbuscular mycorrhizae from the middle Jurassic of Patagonia, Argentina
			C. Marín, J. Boy, M. Öpik and R. Godoy	OS03: Biogeochemical and ecological drivers of fungal biogenic weathering in Patagonian temperate rainforests
11.35 – 11.45	Break			
11.45 – 12.35	**ORAL SESSION II**	**Invited speaker:**	**Dr. María Julia Mazzarino (Universidad Nacional de Buenos Aires, Universidad Nacional de Río Negro - CONICET)**	**OI02: Mycorrhiza and nutrient limitation in woody species of the Argentinian Andean-Patagonian Region**
		Selected speakers:	D. Moguilevsky, A. Carron, N. V. Fernández, J. Puntieri, P. Cornejo and S. B. Fontenla	OS04: Natural forest succession after a volcanic eruption: mycorrhizal and fungal communities related to seedling regeneration
			D. Torres	OS05: Fungi Foundation: Let's save the mushrooms!
12.35 – 14.15	LUNCH			
14.15 – 14.55	**CONFERENCE**		**Dr. François Teste (IMASL, CONICET – Universidad Nacional de San Luis, Argentina)**	**C01: Dual-mycorrhizal plant functional responses following shifts in soil nutrient availability during ecosystem development**
14.55 – 15.25	**ORAL SESSION III**	**Selected speakers:**	M. Renton and F. P. Teste	OS06: Evolutionary dynamics of dispersal during co-invasion of trees and their mycorrhizal symbionts and pathogens

			N. Policelli, T. R. Horton, T. D. Bruns, A. Pauchard and M. A. Nuñez	**OS07: Belowground Invasions: Co-invasion of pine trees and their ectomycorrhizal fungi**
15.25 – 15.35	Break			
15.35 – 16.40	**WORKSHOP**		**Moderators: Dr. Natalia Fernández (IPATEC, CONICET - Universidad del Comahue, Argentina) and Dr. Carolina Barroetaveña (CIEFAP, CONICET, Argentina)**	
16.40 – 17.00	***Coffee break***			
17.00 – 17.35	**E-POSTER SESSION I**		**EP01 - EP07**	*Please, see the attached table*
17.35 – 17.45	Break			
17.45 – 18.20	**E-POSTER SESSION I**		**EP08 - EP13 + EP41**	*Please, see the attached table*

2nd DAY	**THURSDAY 7th** **Biodiversity and physiology**			
8.15 – 8.45	***Registration***			
9.00 – 9.45	**KEY LECTURE**		**Dr. Marc André Selosse (Sorbonne Universites, France)**	**K02: Advances in ecology of Tuber melanosporum: from mating strategy to hidden endophytic behaviour**
9.45 – 10.15	**DEBATE**		**Moderator: Dr. Cesar Marin (Instituto de Ciencias Agronómicas y Veterinarias, Universidad de O'Higgins, Chile)**	**Novel tools and methods for the study of mycorrhizal fungi**
10.15 – 10.30	***Coffee break***			
10.30 – 11.35	**ORAL SESSION IV**	**Invited speaker:**	**Dr. Agustín Grimoldi, (IFEVA-CONICET, Facultad de Agronomía, Argentina)**	**OI03: Mycorrhizal effects on plants recovering from defoliation**
		Selected speakers:	F. Pezzani, G. Parodi, F. Lezama and A. del Pino	OS08: Opposite responses to P fertilization in native grasses: improvement of plant nutrient content and performance and detriment for mycorrhizal colonization
			M. V. Scorza, M. Statello, V. A. Silvani, R. P. Colombo, S. Fracchia and A. M. Godeas	OS09: *In vitro* evaluation of the tolerance of arbuscular mycorrhizal fungi (AMF) isolated from alkaline-saline soils at different pH and salinity ranges in their pre-symbiotic states
			F. Magurno, M. Malicka, K. Posta , G. Wozniak, E. Lumini and Z. Piotrowska-Seget	OS10: Glomalin gene as molecular marker for functional diversity of arbuscular mycorrhizal fungi in soil
11.35 – 11.45	Break			
11.45 – 12.35	**ORAL SESSION V**	**Invited speaker:**	**Dr. Camille Truong (Universidad Autónoma de México, México)**	**OI04: The role of ectomycorrhizal fungi for nitrogen cycling in Southern Patagonia**

		Selected speakers:	A. Carteron, F. Cichonski and E. Laliberté N. V. Fernández, P. Marchelli and S. Fontenla	OS11: Ectomycorrhizal-dominated temperate forests show faster decomposition of soil organic matter than neighbouring arbuscular mycorrhizal-dominated forests OS12: From the nursery to the field: a story about mycorrhizal fungal communities associated with *Nothofagus alpina* (raulí)
12.35 – 14.15	LUNCH			
14.15 – 14.55	**CONFERENCE**		**Dr. Matthew Smith (University of Florida, USA)**	**C02: The biogeography and diversity of ectomycorrhizal fungi across different biomes in South America**
14.55 – 15.25	**ORAL SESSION VI**	**Selected speakers:**	F. Kuhar J. Duchicela, J. Bever and V. Bala Chaudhary	OS13: Morphological basiodome diversification associated to changes to the ectomycorrhizal lifestyle in Southern Gondwana landmassess OS14: A neotropical database of plant response to mycorrhizal fungi, expanding MycoDB
15.25 – 15.35	Break			
15.35 – 16.40	**WORKSHOP**		**Moderators: Dr. Paula Aguilera (Universidad de La Frontera, Temuco, Chile) and Dr. Dr. Francisco Kuhar (IMBIV, CONICET - Universidad Nacional de Córdoba, Argentina)**	
16.40 – 17.00	***Coffee break***			
17.00 – 17.35	**E-POSTER SESSION II**		**EP014 - EP19**	*Please, see the attached table*
17.35 – 17.45	Break			
17.45 – 18.20	**E-POSTER SESSION II**		**EP20 - EP27**	*Please, see the attached table*

3RD DAY	**FRIDAY 8th** **Sustainable development and management**		
8.15 – 8.45	***Registration***		
8.45 – 9.00	**CONFERENCE**	**Dr. Laura Mendez (ECyC, IPEHCS - CONICET - Universidad Nacional del Comahue, Argentina)**	**C03: Women and days: Female roles in historical perspective**
9.00 – 9.40	**CONFERENCE**	**Dr. Luis Gabriel Wall (CONICET and Universidad Nacional de Quilmes, Argentina)**	**C04: New paradigms in agricultural soil microbiology**
9.45 – 10.15	**DEBATE**	**Moderator: Dr. Cecilia Mestre (IPATEC, CONICET - Universidad del Comahue, Argentina)**	**Insights in management and sustainable production involving mycorrhizal fungi**
10.15 – 10.30	***Coffee break***		

10.30 – 11.35	**ORAL SESSION VII**	**Invited speaker:**	**Assoc. Prof. Miroslav Vosátka (Institute of Botany Czech Academy Sciences, Pruhonice, Czech Republic)**	**OI05: Perspectives of Mycorrhizal Fungi Applications in Agriculture and Forestry**
		Selected speakers:	M. Ruscitti, C. Arango, S. Garita, V. Bernardo and J. Ripodas	OS16: Use of arbuscular mycorrhizae for phytoparasitic nematodes control and growth promotion in pepper plants
			J. F. Sandoval, P. Nizo, E. León, E. Gutiérrez, A. Rodriguez and E. Torres	OS17: Effect of AMF native communities and rootstock genotypes on physiology of cocoa plants grown on Cd enriched Andean soil
			P. Aguilera and G. Villalobos	OS18: Bioproductos Myconativa Ltda
11.35 – 11.45	Break			
11.45 – 12.40	**ORAL SESSION VIII**	**Invited speaker:**	**Dr. Martin Nuñez (INIBIOMA, CONICET- Universidad del Comahue, Argentina)**	**OI06: Ectomycorrhizal fungi and pine invasions: lessons from Isla Victoria, Nahuel Huapi National Park**
		Selected speaker:	A. I. Carron, L. A. Garibaldi and S. Fontenla	OS19: Forest management and seasonal effects on the diversity and ecological function of soil fungi in a Northwestern Patagonian shrubland
		Invited speaker:	**Dr. Lucas Garibaldi (IRNAD, CONICET - Universidad de Río Negro, Argentina)**	**OI07: Sustainable management of the native mixed forest: aerial and belowground interactions between plants and insects**
12.40 – 14.15	LUNCH			
14.15 – 14.55	**CONFERENCE**		**Dr. Maarja Öpik (University of Tartu, Estonia)**	**C05: Arbuscular mycorrhizal fungi under the pressures of environmental change**
14.55 – 15.25	**ORAL SESSION IX**	**Selected speakers:**	M.E. Avila, F. Montesdeoca, M. Orellana, K. Pacheco, F. Borie, P. Cornejo, N. Becerra, Y. Cerda and P. Aguilera	OS20: Arbuscular mycorrhizal fungi in a Mollisol from the Andean Region of Ecuador
			B. S. Ventura, E. Meyer, J. A. Scarsanella, K. G. Anjos, M. B. Agudelo and P. E. Lovato	OS21: Soil chemical attributes, but not plant genotypes, affect mycorrhizal root colonization in on-farm grown maize landraces, conventional, and genetically modified hybridsin Santa Catarina, Southern Brazil
15.25 – 15.50	***Coffee break***			
15.50 – 16.20	**E-POSTER SESSION III**		**EP28 - EP33**	*Please, see the attached table*
16.20 – 16.30	Break			
16.30 – 17.05	**E-POSTER SESSION III**		**EP34 - EP40**	*Please, see the attached table*
17.05 – 18.15	**WORKSHOP**		**Moderators: Dr. Sonia Fontenla (Universidad del Comahue and IPATEC, Argentina) and Pablo Cornejo Rivas (Universidad de La Frontera, Temuco, Chile)**	
18.10 – 18.20	***Closing ceremony***			
18.30 – … …	***Mythical mountain experience with patagonian dinner***			

II International Symposium: Mycorrhizal Symbiosis in South America
E-POSTERS PROGRAM

WEDNESDAY 6th Ecology, environment and society					
Time	**Session**	**Code**	**Authors**	**Title**	**Presenting time**
17.00 – 17.35	E-POSTER SESSION I	EP01	E. J. Trevenen, F. P. Teste, E. Veneklaas, M. Doborowolski, L. Mucina and M. Renton	Simulating the effect of plant-soil feedbacks on the diversity and resilience of plant communities	17.00 - 17.05
		EP02	F. Kuhar, P. López Bernal, M. Rajchenberg and C. Barroetaveña	Analysis of the ectomycorrhizal community associated with Nothofagus pumilio seedlings in central Patagonia, Argentina.	17.05 - 17.10
		EP03	R. Godoy and C. Marín	Mycorrhizal studies in temperate rainforests of southern Chile	17.10 - 17.15
		EP04	P. Silva-Flores, C. G. Bueno and G. Palfner	Biogeography of plant mycorrhizal traits along a South American latitudinal gradient in Chile	17.15 - 17.20
		EP05	N. Becerra, P. Aguilera, P. Ojeda-González, O. A. Martínez, C. Marín, Y. Cerda and R. Godoy	Analyzing the shift of diversity of arbuscular mycorrhizal fungi in a vegetational gradient of Araucaria araucana – Nothofagus spp., Nahuelbuta National Park, Chile.	17.20 - 17.25
		EP06	P. Silva-Flores, C. G. Bueno, T. Jairus, M. Vasar, J. Neira, G. Palfner and M. Öpik	Factors that determine the molecular arbuscular mycorrhizal fungal community in the sclerophyllous forests of the Mediterranean Chilean matorral	17.25 - 17.30
		EP07	D. Chávez, G. Rivas, Á. Machuca and P. Cornejo	Current mycorrhizal state of the Araucaria araucana in conserved areas affected by forest fire and mycotrophic capacity of native inocula	17.30 - 17.35
17.35 - 17.45				Break	
17.45 - 18.20	E-POSTER SESSION I	EP08	C. Santander, S. García and P. Cornejo	Arbuscular Mycorrhizal status of representative plant species growing in different ecoregions of the Atacama Desert, Tarapaca Region	17.45 - 17.50
		EP09	P. F. A. Ferreira, L. C. Silva, H. A. R. Martinez, C. A. J. Nascimento, K. A. L. Ferreira, M. E. Detert, C. P. Nobre and C. Gehring	Arbuscular mycorrhizal fungi community composition in two subsequent dry seasons in sabiá (Mimosa caesalpiniifolia) plantations in Central Maranhão State, eastern periphery of Amazonia	17.50 - 17.55
		EP10	J. K. Romero, N. Becerra, P. Cornejo, F. Borie, R. Godoy, C. Marín, Y. Cerda, O. A. Martínez and	Arbuscular mycorrhizal fungi associated to cereal roots growing under aluminum saturation	17.55 - 18.00
		EP11	B. Luis, M. Toro, K. Ogata and D. Zuñiga	Arbuscular mycorrhizae tolerant to cadmium to improve Cocoa plantations	18.00 - 18.05
		EP12	M. Statello, M. V. Scorza, R. P. Colombo, E. De la Fournière, V. A. Silvani, M. E. Benavidez, A. Scotti, A.M. Godeas and M. Debray	MicroPIXE technique to understand the distribution of copper during arbuscular mycorrhizal symbiosis	18.05 - 18.10

		EP13	C. Marín, T. Grebenc and C. G. Bueno	**An overview of South American mycorrhizal research: thematic and geographical gaps, local and global networking, and suggested directions**	18.10 - 18.15
		EP41	C. Stuardo, FUNDACIÓN FUNGI	**Sustainable harvest of wild edible fungi**	18.15 - 18.20

THURSDAY 7th Biodiversity and physiology					
17.00 – 17.35	**E-POSTER SESSION II**	**EP14**	A. Mello, F. Radhouani, E. Zampieri, F. Guasmi and A. Ferchichi	**β-tubulin gene as a complementary molecular marker for desert truffle identification**	17.00 - 17.05
		EP15	M. Statello, M. V. Scorza, V. A. Silvani, R. P. Colombo, T. En Lo, M. Recchi, M. A. Rodríguez and A. M. Godeas	**Evaluation of interactions between an Arbuscular Mycorrhizal Fungus and a strain of *Trichoderma* sp. as potential bioinoculants**	17.05 - 17.10
		EP16	C. P. Peña-Venegas, T. W. Kuyper, J. Davison, T. Jairus, M. Vasar, T. J. Stomph, P. C. Struik and M. Öpik	**Root colonization and arbuscular mycorrhizal fungal richness in roots of sweet and bitter cassava varieties**	17.10 - 17.15
		EP17	L. C. Silva, P. F. A. Ferreira, H. A. R. Martinez, C. A. J. Nascimento, C. P. Nobre, and C. Gehring	**Diversity of arbuscular mycorrhizal fungi and seasonality in dunes of Carimã and São Marcos Beaches – Maranhão State, Brazil**	17.15 - 17.20
		EP18	M. A. Lugo, R. E. Ontivero, L. V. Risio Allione, V. Bianciotto and E. Lumini	**A first snapshot on arbuscular mycorrhizal fungi in soils of different crops farming in the Puna**	17.20 - 17.25
		EP19	R. E. Ontivero, L. V. Risio Allione and M. A. Lugo	**Spores abundance and diversity of arbuscular mycorrhizal fungi in the Caldenal Forest, Argentina**	17.25 - 17.30
		EP20	A. C. Cottet and M. I. Messuti	**A new report of a fungal association in *Targonia* L. (Marchantiophyta)**	17.30 - 17.35
17.35 - 17.45				Break	
17.45 - 18.10	**E-POSTER SESSION II**	**EP21**	M. V. Scorza, V. A. Silvani, M. Pérgola, M. Statello, R. P. Colombo, A. E. Martinez and A. M. Godeas	**Banco de Glomeromycota In-vitro (BGIV): an *in vitro* collection of arbuscular mycorrhizal fungi from Argentina**	17.45 - 17.50
		EP22	A. F. N. Almeida, J. A. Scarsanella, K. G. Anjos and P. E. Lovato	**Arbuscular mycorrhizal fungal spore diversity and density in sand dunes disturbed by fire or *Pinus* spp. invasion in Santa Catarina Island, Brazil**	17.50 - 17.55
		EP23	M. B. Pildain, S. B. Visnovsky and C. Barroetaveña	**Diversity of the exotic ectomycorrhizal fungus *Rhizopogon* in Patagonia, Argentina**	17.55 - 18.00
		EP24	M. B. Pildain, P. Marchelli, M. M. Azpillicueta, A. De Errasti, C. Starik and C. Barroetaveña	**Low genetic structure of the introduced edible ectomychorrizal fungi *Suillus luteus* in pines afforestation of Patagonia, Argentina**	18.00 - 18.05
		EP26	M. J. Dibán and L. F. Hinojosa	**Forest type effect on ectomycorrhizal diversity: differences in fruiting patterns between a juvenile and a mature *Nothofagus* forests in La Araucanía Region, southern Chile**	18.05 - 18.10

FRIDAY 8th Sustainable development and management					
17.00 – 17.35	**E-POSTER SESSION III**	**EP28**	H. Aponte, W. Herrera, L. Milagros, I. Hernández and L. Fajardo	**Effect of arbuscular mycorrhizal fungi on the bioremediation potential of *Brachiaria humidicola* in soils contaminated with hydrocarbons**	17.00 - 17.05
		EP29	M. Mogrovejo, V. Luna and M. Garcés Ruiz	**Phytoremediation of hydrocarbon-contaminated substrate using *Lolium multiflorum* associated with *Rhizophagus irregularis* or an AMF native inoculum isolated from the Ecuadorian Amazon**	17.05 - 17.10
		EP30	C. Santander, A. Ruiz, S. García and P. Cornejo	**Efficiency of two AMF inocula to improve saline stress tolerance in lettuce plants by changes of antioxidant defense mechanisms**	17.10 - 17.15
		EP31	M. C. Mestre, M. Boenel, V. Bella and S. Fontenla	**Halotolerant endophytic bacteria enhance arbuscular mycorrhizal colonization in poplar production under greenhouse condition**	17.15 - 17.20
		EP32	Y. Cerda, N. Becerra, P. Cornejo, F. Borie, R. Godoy, C. Marín, A. Contreras, A. Altamirano and P. Aguilera	**Diversity of arbuscular mycorrhizal fungi in agricultural systems in acidic andisols**	17.20 - 17.25
		EP33	M. Llamuca, J. Hernández, C. Delavaux and J. Duchicela	**Comparative study of guava (*Psidium guajava*) and cocoa (*Theobroma cacao L.)* rhizosphere microbiota under different management: an ongoing project**	17.25 - 17.30
		EP34	J. Toro and M. Arteaga	**Evaluation of arbuscular mycorrhizal fungi in an agroforestry system with coffee in Jaen – Perú**	17.30 - 17.35
17.35 - 17.45				Break	
17.45 - 18.15	**E-POSTER SESSION III**	**EP35**	C. A. J. Nascimento, E. M. Pinheiro, P. F. A. Ferreira, L. C. Silva, C. Gehring, C. P. Nobre and J. R. G. Araújo	**Arbuscular mycorrhizal fungi and the development of saplings of acerola (*Malpighia emarginata* d. C.) derived from herbaceous cuttings**	17.45 - 17.50
		EP36	B. S. Ventura, E. Meyer, J. A. Scarsanella, K. G. Anjos, A. S. Vieira and P. E. Lovato	**Arbuscular mycorrhizas and plant growth in maize landraces and commercial hybridsused in Western Santa Catarina, Brazil**	17.50 - 17.55
		EP37	P. Campos, N. Aguilera, F. Borie, P. Cornejo and A. Seguel	**Phosphorus acquisition traits of two wheat cultivars colonized by indigenous AMF**	17.55 - 18.00
		EP38	M. Boenel, N. Robredo, S. Fontenla and M. C. Mestre	**Arbuscular mycorrhizae and two Patagonian yeasts co-inoculation effects on tomato production under greenhouse conditions**	18.00 - 18.05
		EP39	W. Castañeda, M. Toro, A. Solorzano and D. Zuñiga	**Initial approaches on the use of biochar as substrate in greenhouse experiments with arbuscular mycorrhizae and Phisalys peruviana L.**	18.05 - 18.10
		EP40	E. Furrazola, Y. Torres-Arias, G. Bernal, J. Hernández and J. Duchicela	**Management impacts on Mycorrhizal fungal presence in *Solanum tuberosum* in Ecuador**	18.10 - 18.15

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E-POSTERS

Day 1

Ecology, environment and society

KEYNOTE I: Dr. Kabir Peay

9 – 9.45 am

K01

Ectomycorrhizal fungi as keystone species

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Because interactions between plants and microbial organisms, such as mycorrhizal fungi, can influence species diversity and rates of nutrient cycling, how plants shape microbial communities is fundamental to understanding the structure of ecosystems. Despite this, the spatial and temporal scales over which plants influence microbial communities is poorly understood, particularly whether past abiotic or biotic legacies strongly constrain microbial community development. We examined biogeochemical cycling and microbial community structure in a coastal landscape where historical patterns of vegetation transition between plants with different mycorrhizal associations after a large fire in 1995 are well known, allowing us to account for past abiotic and biotic conditions. We found that alternative states in microbial community structure and ecosystem processes emerged under different plant species, regardless of past conditions. Greenhouse studies further demonstrated that these differences arise from direct plant selection of fungi and bacteria, with selection stronger in roots compared with soils, especially for bacteria. Despite these effects, minimal overlap between seedling and field microbial communities indicates that the effects of initial plant selection are not stable, rather plant selection initiated alternative successional trajectories after the fire. Using data from a guild where we have abundant natural history information - ectomycorrhizal fungi - we show that greenhouse communities are dominated by ruderal taxa that are also common in the field after the fire, and that these ruderal mycorrhizal fungi strongly alter spatial patterns in plant-soil feedback, enabling invasion and transformation of soils previously occupied by heterospecific plants, thus potentially acting as keystone mutualists.

Keywords: *microbial community structure, vegetation transition, plant-soil feedback*

ORAL SESSION I

10.30 – 11.35 am

INVITED SPEAKER: Dr. Guillermo Bueno

10.30 – 10.50 am

OI01

Different estimations of plant mycorrhizal traits: limitations, suggestions and challenges

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While the use of plant mycorrhizal traits are increasing, as we are addressing more questions about the role of mycorrhiza in communities, ecosystems and whole regions, more efficient ways of trait estimation are needed. In this talk I want to answer three general questions: 1) How plant mycorrhizal traits can be estimated? Does the method of estimation matters? And which can be the best approach for different data availability? Based on a recent comparison of the two main methods of plant mycorrhizal trait estimation for more than 1300 European species, i.e. the empirical and taxonomic approaches, I will introduce the conceptual differences of both methods and its potential consequences. While the empirical approach is a species-based method of systematic collection of mycorrhizal traits from published sources, the taxonomic approach is based on an expert extrapolation from few mycorrhizal observations to complete plant genus or plant family. The coverage, uncertainty and potential biases of both methods differed and should be considered in each case. Overall, the empirical approach represents a more stable and sound approach when the plant mycorrhizal information covers a representative proportion of the flora under study. In contrast, the taxonomic approach may be useful in scenarios with scarce mycorrhizal information, and may represent a transient approach in our way to develop a deeper phylogenetic understanding of the plant and mycorrhizal fungus relationship.

Keywords: *mycorrhizal trait estimation, empirical approach, taxonomic approach*

10.50 – 11.05 am

OS01

Seed plant families with diverse mycorrhizal states have higher diversification rates

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One crucial innovation in plant evolution was the association with soil fungi during land colonization. Today, this symbiotic interaction is present in most of plants species and can be

classified in four types: Arbuscular (AM), Ecto (EM), Orchid (OM) and Ericoid Mycorrhiza (ER). Since the AM ancestral state, some plants lineages have switched partner (EM, OM and ER) or lost the association (NM). Evolutionary transitions to a novel mycorrhizal state (MS) might allow plant linages to access new resources, enhancing diversification rates. However, some clades are not restricted to one MS, and this variability might promote diversification. In this study we address the relationship between MS and plant diversification rates of seed plant families. For this, we compiled a database for ~6200 seed plant species and their mycorrhizal partners. We first assign a single MS to each plant family, then calculated the heterogeneity of MS and estimate their diversification rates using the method-of-moments. Families with mixed MS had the highest diversification rates and there was a positive relationship between heterogeneity of MS and diversification rates. These results support the hypothesis that MS plasticity promotes diversification and highlight the importance of the association with soil fungi for the diversification of plants.

Keywords: *diversification rates, mycorrhizal states, seed plants*

11.05 – 11.20 am
OS02
Structurally preserved arbuscular mycorrhizae from the middle Jurassic of Patagonia, Argentina

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Arbuscular mycorrhizae are one of the most ecologically and economically important symbiotic associations in modern terrestrial ecosystems, and are believed to have driven colonization of land by plants. Knowledge of the evolution of arbuscular mycorrhizae based on the fossil record is incomplete, which is mostly because of the low preservation potential they have in most sedimentary deposits. Arbuscular mycorrhizae have only been detected as petrifications and permineralizations, such as in settings where plant tissues, along with their fungal partners, became impregnated by mineral saturated water (i.e., in distal environments of a hot spring system). The oldest unequivocal evidence of arbuscular mycorrhizae is from the Rhynie chert in Scotland (Upper Devonian); less than a dozen additional examples are recorded from the Phanerozoic. Mesozoic records of in situ arbuscular mycorrhizal associations, however, are still scarce. Herein, the first example of in situ permineralized arbuscular mycorrhizae from the Jurassic is described. This is preserved in cherts from La Matilde Formation in the Bahia Laura Group, Deseado Massif (Santa Cruz Province, Argentina), which are the only known fossiliferous geothermal deposits from the Mesozoic. These fossil geothermal systems are characterized by lagerstätten style preservation of the fossil assemblages (e.g., bacteria, protists, fungi, plants, algae, arthropods, mollusks). The fossil remains described herein consist of small diarch roots bearing small nodules infected with coenocytic hyphae that form coils and develop into arbuscule-

like fine ramifications that occupy the lumen of cortical cells around the vascular cylinder. Additionally, several glomoid spores subtended by coenocytic hyphae have been observed directly associated with root nodules and young diarch roots. This is one of the very few examples of structurally preserved arbuscular mycorrhizal associations and the second known example of AM fungi associated with root nodules. Based on comparison with modern examples and the presence of abundant leafy twigs and wood of the Podocarpaceae and Araucariaceae, the mycorrhizal nodules most likely engaged members of Araucariales conifers. The presence of these nodules can be argued as having been ecologically significant for the distribution of these conifers in the geothermally influenced ecosystems.

Keywords: *fossil AM associations, Mesozoic, geothermal environments*

11.20- 11.35 am
OS03

Biogeochemical and ecological drivers of fungal biogenic weathering in Patagonian temperate rainforests

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Biogenic weathering is the process by which rocks are directly or indirectly degraded by biota, process mainly performed by mycorrhizal hyphae, as they have energy from photosynthesis and can access weatherable surfaces. An inverse relationship between the soil nutrient status and the degree of biogenic weathering is expected, since the latter is energetically costly. North-Patagonian temperate rainforests are located within two mountain systems (Andes and Coast mountains), whit different geological history, soils and biogeochemistry. Coast mountains soils are more physically and chemically weathered than most of the Andes. These forests have three types of vegetation with two mycorrhizal dominance types: *Nothofagus* spp. forest (dominated by ectomycorrhizal trees, EM), Valdivian and native coniferous forests (dominated by arbuscular mycorrhizal trees, AM). There is little information about the biogeochemical and ecological factors influencing biogenic weathering in these forests. Specifically, we wanted to answer three questions: what is the relationship between physicochemical weathering and biogenic weathering?, what is the relationship between the forest nutrient economy and biogenic weathering?, and finally, which mycorrhizal types are more efficient at biogenic weathering? To answer these questions we selected 13 plots in five national parks at the south of Chile -both EM and AM forests in both Andes and Coast mountains, where we installed test minerals in situ, which after a year of exposure were analyzed through confocal laser microscopy. We also measured the ecosystem nutrient economy: soil chemical analysis, roots and leaves nutrients, and with a resin system we measured the forests' nutrient input by precipitation and its leaching. Using Illumina sequencing of the fungal ITS2 region we determined the whole soil fungal

communities. Biogenic weathering was most significant in the middle age stands. We found an inverse relationship between soil nutrient availability and the degree of biogenic weathering. These results were dependent on: the nutrient inputs, i.e. some nutrients were sufficiently supplied by precipitation, and the dominant mycorrhizal type of the forest, as EM-dominated forests always were more efficient at biogenic weathering than AM-dominated forests. In conclusion, mycorrhizal biogenic weathering is an important form of nutrient input to the ecosystems, and as such, should be taken into account in future nutrient modeling.
Keywords: *bioweathering, patagonian forests, soil formation*

ORAL SESSION II
11.45 – 12.35 am

INVITED SPEAKER: Dr. María Julia Mazzarino
11.45 – 12.05

OI02
Mycorrhizal infection and nutrient limitation in woody species of the Argentinian Andean-Patagonian Region
M. J. Mazzarino[1, 2]

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According to some indicators of nutrient limitation, most woody species of the region are limited by N in mature forests: have foliar N/P ratio lower than 14-16, are N-proficient and P-non-proficient, and have high N- and low P-resorption efficiency. The lack of P limitation despite volcanic soils of low P availability is probably related to the high percentage of infection with ectomycorrhizae (Ecto) and arbuscular mycorrhizae (AM), suggesting that both types of mycorrhizae contribute to P acquisition. Thus, from 10 tree species studied in the region (*Nothofagus dombeyi*, *N. pumilio*, *N. antarctica*, *N. alpina*, *N. obliqua*, *Lomatia hirsuta*, *Maytenus boaria*, *Fitzroya cupressoides*, *Austrocedrus chilensis* and *Araucaria araucana*) only *L. hirsuta*, a non-mycorrhizal Proteaceae with cluster roots, is limited by P. The effects of nutrient addition in indicators of nutrient limitation, plant growth and mycorrhizal infection were studied in seedlings of two *Nothofagus* species of high economic value, *N. alpina* and *N. obliqua*, both associated with Ecto. Although they are closely related and occur in habitats with similar abiotic conditions, each species has a distinctive imprint on soil properties, especially those related to N and P availability, which are lower under *N. alpina*. Seedlings were grown in soils characteristic of each species during two years and fertilized with three levels of N, with or without the concurrent application of a single P rate. Results confirmed that both species were limited by N: increasing N rates resulted in increased plant growth, and a shift to N-non-proficient plants and N-P co-limitation (foliar N/P = 14-16). Effects on growth were more marked in *N. obliqua*, and were accompanied by lower

Ecto infection and mass allocation to roots. Conversely, these variables were maintained in *N. alpina*, where adding N without P revealed that P can become a secondary-limiting nutrient at high N rates. Interestingly, under low light availability (5-8% vs 60% PAR) no changes were observed in the responses of the shade-tolerant *N. alpina*, while in the shade-intolerant *N. obliqua*, root biomass was strongly reduced. This led to a marked drop in P-uptake capacity and induced a shift to P limitation (P proficiency and foliar N/P > 16), while increasing the mass allocation to roots and Ecto-infection. On the contrary, N uptake was much less affected. Results clearly suggest that Ecto can especially contribute to P acquisition.

Keywords: *mycorrhizas and P acquisition*, *N fertilization*, *foliar N/P*

12.05 – 12.20 pm
OS04

Natural forest succession after a volcanic eruption: mycorrhizal and fungal communities related to seedling regeneration

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The 2011 Puyehue Cordón Caulle´s eruption affected large areas of *Nothofagus pumilio* (lenga) forests. In some places a 50 cm thick tephra layer buried the understory vegetation and provided a brand new substrate for plants and microorganisms. After the eruption, abundant seedling regeneration of *N. pumilio* took place, but there is no information about its ectomycorrhizal behaviour and the importance of this symbiosis for this natural process. The ectomycorrhizal (EM) symbiosis is present in all *Nothofagus* species, and colonization rates in mature *N. pumilio* trees are in general ≥70%. Our objective was to analyse how tephra influenced *N. pumlio´*s EM colonization, seedling development and root fungal communities over time. In 2013, in a forest with high tephra deposition we buried 15 pots into the tephra layer, which were filled with soil obtained from under the tephra. Two six-month-old seedlings that were growing in the tephra were transplanted into each pot ("soil seedlings", SS) and nearby seedlings remained growing in the tephra ("tephra seedlings", TS). One, four and five years after the experiment was established (2014, 2017 and 2018) we collected seedlings from both substrates (SS and TS) in addition to roots from adult trees. We analysed several morphometric measures of the seedlings and EM abundance in seedlings and adults. For studying the composition of different rhizosphere fungal communities we performed several Denaturing Gradient Gel Electrophoresis (DGGE). Total DNA was extracted from the rhizosphere and nested PCRs were carried out, using different sets of primers for analysing three different fungal communities, Total Fungi (ITS1F-ITS4),

Ascomycetes (ITS1F-ITS4A) and Basidiomycetes (ITS1F-ITS4B). All the individuals had EM. The first year (2014), EM colonization was lower in TS (49%) than in SS and adults (75% and 70%, respectively). In 2017 and 2018 the EM colonization was similar between all samples (63-86%). For the morphometric measures, in the first year, no differences were found between TS and SS, but in 2017 SS were bigger than TS, and in 2018 SS seedlings were smaller than TS. For the three fungal communities analyzed, in 2014 there was a clear separation between TS and SS, but in 2017 they were more similar to each other. These results suggest that tephra is becoming an appropriate substrate for *N. pumilio* development. Tephra allows the germination and survival of *N. pumilio* seedlings, has EM infective capacity, and favours root colonization over time. After a high-impact disturbance, the re-establishment of the native inoculum in tephra and the occurrence of EM in *N. pumilio* seedlings seem to be important factors for the forest regeneration.
Keywords: *volcanic eruption, ectomycorrhizas, N. pumilio regeneration*

12.20 – 12.35 pm
OS05
Fungi Foundation: Let's save the mushrooms!
D. Torres[1]

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* Email: dtorres@ffungi.org

Forests are fundamental to the survival and well-being of life on the planet. In these ecosystems we find multiple environmental, social and economic functions. Fungi, edible and medicinal species have been part of how we have developed as a society. The ancestral relationship with these organisms proves a close relationship since ancient times. Currently, fungi are part of the livelihood of hundreds of people who, during autumn and spring, collect edible species, generating income for their families. With all the current environmental threats and man's pressure on the ecosystems, it becomes necessary to respond urgently protecting the species. The concept of sustainable collection has been defined as the set of measures and anticipated practices to conserve the viable populations of species in their natural environments and to avoid the deterioration of the conditions that allow the evolution and continuity of the natural habitat. This is why it is necessary to emphasize the current importance of the implementation and development of these techniques as methods of economic optimization, fostering a fair social environment.
Keywords: *edible fungi, ancestral relationship, social environment*

CONFERENCE I: Dr. François P. Teste

2.15 – 2.55 pm

C01

Dual-mycorrhizal plant functional responses following shifts in soil nutrient availability during ecosystem development

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The majority of terrestrial plants form root symbioses with arbuscular mycorrhizal (AM) fungi to enhance nutrient (particularly phosphorus, P) acquisition. However, some of these plant species also form dual symbioses involving ectomycorrhizal (ECM) fungi. The factors driving plants to form dual-mycorrhizal symbioses is poorly understood. It has been suggested that these plants show plasticity in root symbioses to optimize nutrient acquisition depending on the type and strength of soil nutrient limitation (e.g., N vs. P). Alternatively, the degree of investment or "preference" in particular root symbioses might simply reflect differences in inoculum potential among soils of contrasting nutrient availability, reflecting adaptations of root symbionts to different edaphic conditions. To better understand the ecology of dual-mycorrhizal plants, we grew two co-occurring plant species forming AM and ECM (*Acacia rostellifera* and *Melaleuca systena*) symbioses in soils of increasing age and contrasting nutrient availability from an Australian long-term soil chronosequence. Specifically, we aimed to disentangle the relative importance of abiotic factors (e.g., soil nutrient availability) and biotic factors (e.g., soil inoculum potential) in determining root colonization patterns and functional outcomes of these multiple root symbioses. For both plant species, we found clear hump-shaped plant growth patterns along the strong gradient in soil nutrient availability, with peak growth in intermediate-aged soils, while high levels of mycorrhizal colonization by the "preferred" root symbionts were maintained across all soils. We found large increases (540%) in foliar manganese concentrations with increasing soil age and declining P availability, suggesting that plants may be relying on the release of carboxylates to help acquire P in the most P-impoverished soils. Finally, we found that soil abiotic properties, such as strong differences in soil nutrient availability, are generally more important than soil inoculum potential in explaining these shifts in our plant and root responses. Our study suggests that plants capable of forming dual-mycorrhiza root symbioses show plasticity in their nutrient-acquisition strategies following shifts in soil nutrients during long-term ecosystem development, yet maintain a preference for certain root symbionts despite changes in soil microbial inoculum.

Keywords: *ecosystem development and retrogression, foliar manganese, nitrogen and phosphorus limitation, nutrient-acquisition strategies, poor and deficient soil, root traits*

ORAL SESSION III

2.55 – 3.25 pm

2.55 – 3.10 pm
OS06
Evolutionary dynamics of dispersal during co-invasion of trees and their mycorrhizal symbionts and pathogens

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Most invasive trees depend closely on mycorrhizal symbionts to provide required resources, and thus their invasive success depends on the dispersal of these symbionts as well as their own dispersal. Invasive trees may also be negatively impacted by pathogenic fungi in their natural range, and thus benefit from 'enemy release' if they spread into new areas faster than these pathogenic fungi. Previous empirical and theoretical work has shown that the dispersal characteristics of organisms can undergo selection pressure and evolution during the course of an invasion or colonization of new areas, but the evolutionary dynamics of dispersal during co-invasion has not been considered. In this work, we use spatially-explicit eco-evolutionary simulation modelling to investigate how the dispersal characteristics of trees and their mycorrhizal symbionts and pathogens evolve over the course of a tree invasion. We find that the selection pressures manifesting during the invasion cause the dispersal characteristics of the different organisms to vary across time and space in complex and interdependent ways that are influenced by human management. For example, dispersal ability of the three organisms increases over time and is higher at the fronts of an invasion, but managing trees through removal of outliers decreases the rate at which increased dispersal ability evolves.
Keywords: *ectomycorrhizal fungi, seed and spore dispersal, tree invasion*

3.10 – 3.25
OS07
Belowground Invasions: Co-invasion of pine trees and their ectomycorrhizal fungi

N. Policelli[1,*], T. R. Horton[2], T. D. Bruns[3], A. Pauchard[4] and M. A. Nuñez[1]

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Belowground biota is known to drive the invasion of non-native plant species, however, it is unclear whether the identity of belowground organisms or its mere presence are determinant of the invasion process, and the impact that non-native belowground biota may have on native species. Pine invasions in the Southern Hemisphere are an ideal system to study these two questions as the invasion is not possible without the co-introduction of ectomycorrhizal fungi (EMF). To evaluate if the presence of any compatible fungi was enough for pines to invade or if the identity of the EMF matters, we conducted a global systematic review of the literature. We found that only one group of EMF, suilloid fungi, is able to act as a global driver of pine invasions. We identified the main ecological traits of suilloid fungi that may explain their key role at pine invasions related to their long-distance dispersal capacity and exploration type, their capacity to generate a resistant spore bank, and their rapid colonization of roots. Knowing that not only pines but also their associated symbionts have invasive traits, we asked whether non-native invasive EMF could be replacing native EMF communities and how that would affect the growth of native ectomycorrhizal plant species. We also evaluated the possibility of crossed colonization between hosts and EMF (native vs non-native). In a greenhouse experiment we planted native *Nothofagus* species and non-native invasive *Pinus contorta* in soil from stands where invasive pine trees were highly abundant (invaded soil) and from stands were pine trees were absent and *Nothofagus* was the dominant tree species (uninvaded soil). We also collected root tips of both species from the field along a pine invasion gradient over a *Nothofagus* forest. We evaluated the identity of the EMF species associated with the roots using RFLP and sequencing. We found that both host species (*Nothofagus* and *P. contorta*) grew equally well in both soil types (invaded and uninvaded) with a high percentage of root colonization. We did not find cross-colonization. *Suillus luteus* was predominantly driving the invasion of pines together with a few less dominant EMF species. *Nothofagus* was able to associate with native EMF, predominantly *Cortinarius* sp., in both soil types. We obtained similar results for field root tips. Together, our results show that the identity of mycorrhizal fungi and their functional traits, rather than simply the presence of compatible fungi and their diversity, are key to the understanding of plant invasion processes and their success or failure. For plant species invasion, belowground biota can both drive the invasion into non-invaded native forests and enhance restoration possibilities of previously invaded habitats.
Keywords: *invasive species, plant–soil feedback*, *Suillus*

E-POSTER SESSION I

5.00 – 6.30 pm

5.00 – 5.05 pm
EP01

Simulating the effect of plant-soil feedbacks on the diversity and resilience of plant communities

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Plant Soil Feedbacks (PSFs) are plant-induced changes to the biotic/abiotic conditions of the soil that positively or negatively impact plant growth. The magnitude and direction (positive or negative) of this impact on plant growth is likely to depend on the species involved. For example, the pathogens associated with one species may also have a negative effect on another species. Mycorrhiza associated with one plant species may facilitate access to nutrients that are then more available to another plant species, and also afford some protection against the pathogens associated with yet another plant species. In plant communities, such feedbacks create complex interaction networks that have been shown to play a key role in promoting and maintaining high levels of diversity within plant communities. There is mounting evidence that diversity loss leads to reduced resilience, which can be defined as an ecosystem's ability to recover following disturbance, or its ability to resist the effects of disturbance completely. As they can promote diversity, PSFs may also positively influence the resilience of a community, but to our knowledge this relationship has never directly been empirically or theoretically explored. Therefore, we explored the effects of different PSF interaction networks on community resilience across several disturbance regimes, using a spatially-explicit stochastic cellular automata simulation model. The PSF interaction networks were hypothetical model systems, each consisting of 100 species, but designed to highlight different feedback types – including different combinations of positive and negative conspecific and heterospecific interactions, as well as equivalent systems with no interactions. We found that plant-soil feedback scenarios could influence the resilience of a community undergoing disturbance, and that particular interaction networks prove more resilient than others.

Keywords: *community dynamics, interaction networks, heterospecific interactions*

5.05 – 5.10 pm
EP02

Analysis of the ectomycorrhizal community associated with *Nothofagus pumilio* seedlings in central Patagonia, Argentina.

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Lenga (*Nothofagus pumilio*) is present throughout the distribution of the Patagonian Andes forests, and has undergone significant degradation process mainly caused by forest fires, cattle grazing and logging, as it is one of the most valuable timber species. There is considerable evidence that the ectomycorrhizal (ECM) community associated with forest tree species changes during their development, but the mycobiota associated with Lenga in its early stages is largely unknown, although constitutes crucial information for nursery ECM inoculation management. The aims of this work were to study the ectomycorrhizal mycobiota associated to lenga seedlings, and to characterize their ECM community. The complete systems of 600 seedlings from three locations in Chubut province were analyzed for two consecutive years with spring and autumn samplings, selecting sapling patches with plants less than 30 cm height. Ectomycorrhizal morphotypes were characterized and molecularly identified by comparing the ITS sequences with a database produced in the framework of this study from sporomes collected in the plots and from other collections. It was found that the most frequent morphotypes correspond to *Inocybe geophilomorpha* (Inocybaceae), *Descolea antarctica* and *Descolea brunnea* (Bolbitiaceae), three species of the genus *Cortinarius* (Cortinariaceae), *Tomentella tenuissima* and *Tomentella* sp. (Thelephoraceae), and the ascomycetes *Cenococcum geophilum* (Gloniaceae) and *Aleurina argentina* (Pyronemataceae). The highest abundances correspond to *I. geophilomorpha*, *C. geophilum*, *S. brunneus* and two species of *Cortinarius*. No sporocarps of the species identified in the studied plots were found, suggesting that the abundance of ectomycorrhizal morphotypes would not be related to fructification frequency. Molecular data allowed identifying, in addition, the presence of species of the genera *Tricholoma*, *Laccaria*, *Rickenella* and *Hysterangium*. Differences in morphoytpes relative frequency were detected between sites but not between seasons and year. These data will allow to select appropriate mycobionts for nursery seedlings inoculations considering sites variations, in order to improve seedlings survival and growth in restoration actions.

Keywords: *Descolea, molecular identification, Tomentella*

5.10 - 5.15 pm
EP03
Mycorrhizal studies in temperate rainforests of southern Chile
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Old-growth temperate rainforests, located at the Patagonian and Valdivian regions of southern Chile and Argentina, represent unique ecosystems in South America. These forests are characterized by a large amount of precipitation, with very little to none atmospheric pollution, and a flora derived from Gondwanian elements. The mycorrhizal traits of the dominant flora of these ecosystems are also exceptional: the angiosperm *Nothofagus* spp. associates with ectomycorrhizal (EM) fungi, while the native conifer species associate with arbuscular mycorrhizal (AM) fungi, an opposite pattern to that of the northern hemisphere. On this conference we present an overview of the mycorrhizal type of 245 vascular plant species, where 187 species were associated with AM fungi, seven with EM fungi, 14 with other mycorrhizal types, and 37 plant species were non-mycorrhizal. On these old-growth temperate rainforests, we also show the role of mycorrhizal fungi on crucial ecosystem processes, as biogenic weathering, and its potential use as ecological restoration tools for the re-establishment of native flora. Specifically, we found that the co-inoculation of two EM fungi species significantly increases the growth of *Nothofagus* spp. when compared to singular inoculations. On these temperate rainforests, mycorrhizal fungi play key roles on nutrient cycling, maintenance of biodiversity, and ecosystem productivity.
Keywords: *Conifers, Nothofagus, Old-growth forest*

5.15 – 5.20 pm
EP04
Biogeography of plant mycorrhizal traits along a South American latitudinal gradient in Chile
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Mycorrhizal symbiosis is a key relationship between most plants and certain groups of soil fungi. This interaction depends on the plant and taxa involved, describing four main plant mycorrhizal types: arbuscular mycorrhiza (AM), orchid mycorrhiza (OrM), ericoid mycorrhiza (ErM) and ectomycorrhiza (EcM). Besides, the frequency of occurrence of mycorrhizal symbiosis for each plant species (plant mycorrhizal status) will determine whether plants are always (obligately mycorrhizal; OM), sometimes (facultatively mycorrhizal; FM), or never (non-mycorrhizal plants; NM) colonized by mycorrhizal fungi. The mycorrhizal type (MT) and the mycorrhizal status (MS) are two plant mycorrhizal traits related to nutrient cycling, plant interactions and ecosystem

processes. Therefore, studying their large-scale patterns can provide independent insights on ecological processes within and across biomes. Despite its relevance, there is no previous study about plant mycorrhizal traits along large gradients in the southern hemisphere. The aim of this study is to analyze the patterns of distribution of plant MT and MS in the Southern Hemisphere, specifically along a large continental gradient in Chile. Specifically, we have considered all plants species in the region, across most prominent biome types (Desert, Mediterranean and Temperate) and in relation to plant species distribution (native or endemic) and plant life forms (tree, shrub, sub-shrub, and annual, biennial or perennial herb). Our results showed that AM type was more frequent, in all latitudes, biomes and among plant distributions and life forms. The proportion of AM plant species decreases towards higher latitudes, while the other plant mycorrhizal types increases. Very few NM plant species were found, with highest proportions within biennial herbs. Regarding the plant distributions, endemic plants showed higher proportion of mycorrhizal symbiosis association than native ones, with a majority of obligate relationships. Finally, the relative proportion of EcM plants was highest within trees, where most trees showed OM status. Major gaps of empirical information on MT and MS can be found at lower and intermediate latitudes, in Desert and Mediterranean biomes and in species within families with dual species, such as Salicaceae. More empirical plant mycorrhizal data are needed in order to confirm and describe general patterns of mycorrhizal traits, and to understand their ecological role within the biomes and ecosystems of the Southern hemisphere.

Keywords: *distribution, mycorrhizal status, mycorrhizal type*

5.20 – 5.25
EP05

Analyzing the shift of diversity of arbuscular mycorrhizal fungi in a vegetational gradient of *Araucaria araucana* – *Nothofagus* spp., Nahuelbuta National Park, Chile.

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Given its pristine character, the temperate rain forests of central-southern Chile constitute model ecosystems for the study of mycorrhizal symbiosis and its functioning. In temperate forests of Chile, *Nothofagus* spp., species are associated with ectomycorrhizal fungi, while native conifers are associated with arbuscular mycorrhizal fungi (AMF). The objective of this study was to determine the effect of the structure and forest composition and the edaphic chemistry, on the composition and diversity of AMF, in a vegetational gradient *A. araucana* - *Nothofagus* spp., in the Nahuelbuta National Park. The floristic characterization was carried out, and the dasometric parameters, soil chemistry, and mycorrhizal colonization were estimated in roots of *Alstroemeria*

presliana, a native and common species along the vegetation gradient. In addition, morphological analysis of spores of soil and molecular analysis (PCR-DGGE) was carried out from rhizospheric soil, the richness and abundance of AMF were determined, analyzing their diversity through various statistical methods of management and community. The results show that there are significant differences in the structure and composition of the forest among the representative selected areas, through the selected vegetation gradient. There are no significant differences in the results of edaphic chemical variables between the areas of the vegetational gradient. The percentage of mycorrhizal colonization in *Alstroemeria presliana* is a good indicator (over 60%) and there are significant differences in the diversity of AMF in the soil, associated with the composition of the forest in the study areas through the vegetational gradient. We conclude that the structure and composition of the forest, in addition to the chemistry of the soil, affects the richness, abundance and composition of the AMF community.

Keywords: *Alstroemeria presliana, dasometric parameters, forest composition*

5.25 – 5.30 pm
EP06

Factors that determine the molecular arbuscular mycorrhizal fungal community in the sclerophyllous forests of the Mediterranean Chilean matorral

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Arbuscular mycorrhizal fungi (AMF) form a mutualistic relationship with 71% of the known plant species. This relationship called arbuscular mycorrhiza (AM), positively and directly influences plants and AMF fitness and have an indirect effect on diversity and community composition of both integrant of the association. The Chilean matorral is a biodiversity hotspot and AMF have the potential to be used for restoration purposes, however they have been overlooked on this ecosystem and consequently ecological patterns are unknown, hampering the application in conservation initiatives. On this study it was analyzed the effect of AMF compartment (root or soil sample type), host plant species, season and physico-chemical soil factors on AMF diversity and community composition in two sites of a representative sclerophyllous forest. The results show a strong regulation of AMF community, by AMF compartment (root or soil) and host plant species but not by season. Also, pH and SOM resulted to shape AMF communities overall, however other soil factors affected differentially each site. Moreover, 173 Virtual taxa (VT) were found, where 20 are new and exclusive for this ecosystem. VT from the genera *Glomus*, *Claroideoglomus* and *Paraglomus* were the most abundant. Those genera, together with *Acaulospora*, *Archeospora*, *Ambispora* and *Diversispora* were also frequent and abundant in at least one AMF compartment or host plant species. This study represents the first for this ecosystem in the Chilean matorral and the findings supports the idea of an AMF soil pool, relatively stable during the year, with plant

species filtering the AMF from soil to form an AM with several species that are shared between all plant species, but with a few that are specific for each plant. These results are a useful starting point for restoration purposes, and should be considered as a reference natural system.
Keywords: *Illumina MiSeq, Mediterranean-type ecosystem, restoration*

5.30 – 5.35 pm
EP07
Current mycorrhizal state of the *Araucaria araucana* in conserved areas affected by forest fire and mycotrophic capacity of native inocula
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Araucaria araucana is a species currently classified as “Endangered” by the International Union for Conservation of Nature (IUCN), mainly because in the Andes and Coastal Mountain Ranges in Chile its population is severely fragmented. There has been a continuous reduction of its area of occupation due to a series of debilitating factors, including fires, deforestation and overgrazing. The aim of this study was to examine the mycorrhizal state of *A. araucana* in conserved areas affected by forest fires in the Nahuelbuta (NNP conserved), Tolhuaca (TNP conserved and burned), Conguillio (CNP conserved) National Parks and China Muerta National Reserve (CHMNR conserved and burned), and evaluate the potential of soil as inocula in trap plants. To do this, random samples were taken from soil and roots of the different study sites. Roots were washed and stored in ethanol 70 % and then subjected to bleaching and staining. Soil samples were stored at 4 °C for subsequent chemical and enzymatic analysis and for in vivo assays with trap plants for 12 weeks. The results indicated that the percentage of mycorrhization (arbuscular mycorrhizas AM) did not present significant differences among the conserved sites, reaching on average 70 % of mycorrhization. However, when samples corresponding to the conserved and affected sectors of the same study site were compared, the percentage of mycorrhization drops significantly in burned sites. In CHMNR and Tolhuaca AM colonization values decreased 31 % and 36.3 %, respectively. The site with the lowest pH values, greatest content of organic matter and organic carbon (%) was NNP, which was statistically different from all the evaluated sites. NNP presented the greatest activity of β-glucosidase, while conserved NNP, CHMNR and TNP had the greatest activity of β-glucosaminidase and the burned sectors of CHMNR and TNP had the greatest phosphatase activity. In relation to P content, there were no significant differences between the sites studied and its content was considered below (compared to other studies conducted in *A. araucana*) what is indicated for the high dependency of the association with arbuscular fungi for the capture of nutrients from the soil. The trap plants presented greater mycorrhization with the inoculum from burned soils**.**
Keywords: *arbuscular mycorrhizal fungi, enzymatic activity, native inocula*

5.45 – 5.50 pm
EP08

Arbuscular Mycorrhizal status of representative plant species growing in different ecoregions of the Atacama Desert, Tarapaca Region

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The symbiosis formed between plant roots and arbuscular mycorrhizal (AM) fungi has great interest because of its influence on ecosystem processes and its role in determining plant diversity in natural plant communities. The objective of this study was to characterize the AM status of native flora representative species in different bioclimatic areas of the Atacama Desert, Tarapaca Region. To accomplish this objective, rhizosphere soil was sampled from three ecoregions of Atacama Desert: i) desertic, ii) pre-Puna, and iii) Puna ecoregions. Chemical parameters such as pH, electrical conductivity, organic matter, and soluble cations were analyzed in all soil samples. The percentage of AM colonization was determined in roots by the gridline intercept method and stained with trypan blue. Spore density, mycelium length, and total Glomalin-related soil protein (T-GRSP) were determined in rhizosphere soil. The 48 plant species sampled showed AM fungal propagules. The results showed high rates of AM colonization (from 12 to 87%), fungal mycelium densities of 0.13 to 20 m g-1, spore densities between 43 and 8,500 per 100 g of soil, and T-GRSP contents varied between 0.7 and 9 mg g-1, under natural conditions. The highest spore density and length of mycelium in rhizosphere soils were associated with *Baccharis scandens*, *Werneria pinnatifida*, *Deyeuxia curvula*, and *Festuca orthophylla*. The electrical conductivity and soluble cations were positively related with spore density and mycelium length. These results showed high plant dependence for mycorrhizal symbiosis under the limiting soil and climate conditions where the plants are growing. In the same way, AM fungal propagules seem to be playing an important role in coping with salt stress through the accumulation of toxic ions in fungal structures that deserve to be deeply studied.

Keywords: *enzymatic activity, phenolic compounds, salt stress*

5.50 – 5.55 pm
EP09

Arbuscular mycorrhizal fungi community composition in two subsequent dry seasons in sabiá (*Mimosa caesalpiniifolia*) plantations in Central Maranhão State, eastern periphery of Amazonia

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Frequent fires and shortening fallow-periods in traditional shifting cultivation cause severe land degradation, low productivity and rural poverty throughout Amazonia. Agroforestry plantations with the native and vigourous legume tree sabiá (Mimosa caesalpiniifolia Benth.) have been proposed as a management-option to face this socioecological crisis. This study evaluates in two consecutive dry seasons (November 2015 and 2016), Glomerospore species composition and diversity in two sabiá-plantations (1 and 4 yrs old), and two paired same-age spontaneous secondary forest regrowth sites in Pirapemas county, central Maranhão, eastern periphery of Amazonia. In each site, we randomly collected three composite 0-20 cm soil samples, resulting in 24 samples in each dry season. We extracted glomerospores from 50 grams of soil, counted and identified using morphological characteristics. We identified a total of 48 AMF species (representing 28% of Brazil´s and 14% of worldwide known AMF species richness), distributed in seven families and 11 genera; Glomus and Acaulospora dominated species richness with 16 and 14 species respectively. Total species richness varied slightly between 2015 (37) and 2016 (30) dry seasons. The four-years-old spontaneous secondary forest regrowth site presented higher species richness followed by sabia-plantations areas (S1 e S2) and the one-year-old spontaneous secondary forest regrowth (CAP1) with lowest number os species. The higher Shannon índex was detected in CAP4, in both dry seasons. *Glomus glomerulatum* was the only species with ocurrence in all sites and over both study years. Our results indicate that both the dry period and leguminous tree sabia influence on AMF diversity and spore production.

Keywords: *Glomeromycota, degraded lands, native legume tree*

5.55 – 6.00 pm
EP10

Arbuscular mycorrhizal fungi associated to cereal roots growing under aluminum saturation

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In Chile, national surface destined to cereals species during season 2018 corresponded to 514,290 ha. Cereals production is mainly composed by wheat, oats and barley, which concentrate principally in Bío Bío and La Araucanía region. In general, cereals production is established in Andisols, characterized by having pH values normally between 4.5 and 5.5 and they presenting high levels of exchangeable Aluminum (Al). Andisols have undesirable properties, such as high phosphorus adsorption capacity (P) and high levels of Al3+, Mn2+ and H+ ions. These soil conditions generate a significant decrease in the growth of plants, which see their capacity for water and nutrient absorption very reduced. In this context, several studies have shown that arbuscular mycorrhizal fungi (AMF) favors the biological adaptation of plants that live under

conditions of abiotic stress, highlighting heavy metals and also Al. Therefore, the objective of this work was to analyze the AMF communities associated with roots of wheat, oats and barley plants growing in the presence of Al by molecular tools. An assay was established in mesocosms (100 * 100 * 20 cm) containing sand / vermiculite in a 1:1 ratio where the AMF inoculum was applied from acid soils and two levels of saturation were studied by Al. The species that were cultivated they were maintained under controlled conditions of humidity and temperature, considering the agronomic management similar to that carried out under field conditions. Root sampling was considered in four phenological stages. AMF colonization in roots was determined. AMF diversity was determined from samples of genomic DNA extracted from roots by means of molecular analysis (PCR-DGGE). In addition, statistical analyzes of community and ordination were carried out. A greater diversity was observed associated with barley cultivation in conditions of greater saturation by Al and with respect to phenological scale, greater diversity was observed in the tillering phase. The genetic diversity existing in the AMF communities is conditioned by the established cereal species, existing predominant species in the colonized root.
Keywords: *AMF colonization, breeding, diversity*

6.00 – 6.05 pm
EP11
Arbuscular mycorrhizae tolerant to cadmium to improve Cocoa plantations
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In recent years, Peru has become an important exporter of cocoa (*Theobroma cacao* L.); for this reason, producing organic cocoa is significant for farmers. Cocoa plantations grow in acid soils with medium content of organic matter and phosphorus. Although Cd content in soil are below accepted levels established by the Environmental Quality Standards, certain cocoa varieties could bioaccumulate it in leaves and seeds. Arbuscular mycorrhizae (AM) have the ability to alleviate the toxicity of Cd in the plant by phytoextraction and/or phytostabilization. In order to use arbuscular mycorrhizae in cocoa plantations with the aim of alleviating Cd content, a diagnosis of the presence of AM symbiosis in organic plantations of San Martín with several cocoa varieties was made. Cocoa plants showed 21% of AM colonization in average; rhizospheric soil had 251 Glomeromycota spores in 100 g of soil, predominating genera from Gigasporaceae family. Rhizospheric soil samples were placed in traps pots with *Brachiaria decumbens* as host plant, to reproduce Glomeromycota spores and obtaining inocula of native fungi. Glomalin contain (8.2 mg/g dry soil) and extraradical mycelium of Glomeromycota fungi could be related with the capacity of these fungi to alleviate toxicity of Cd in plant. Currently, this is being corroborated in greenhouse trials. Glomeromycota diversity was assesed, showing differences between plantations, being 6 the highest number of morphotypes detected. Our results indicate that arbuscular mycorrhizal fungi were present in the three cocoa fields, which will be used for the formulation of biofertilizers. The potentiality of arbuscular mycorrhizae in alleviating Cd toxicity in peruvian cocoa plantations management is discussed.
Keywords: *Glomeromycota fungi, rhizosphere, phytoremediation*

6.05 – 6.10 pm
EP12

MicroPIXE technique to understand the distribution of copper during arbuscular mycorrhizal symbiosis

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Soil tends to strongly retain heavy metals (HM) in their colloids and accumulate them. Edaphic contamination by HM compounds not only implies a detriment on the provided ecosystem services but also a risk for the environment and the health of living beings. The most common soil decontamination techniques involve high costs and environmental alterations. In this context, bioremediation methods are most appropriate as they stimulate the processes that naturally occur in soil. Among them, phytoremediation is a sustainable alternative. The vast majority of plant species are able to associate with arbuscular mycorrhizal fungi (AMF). This association plays a key role in the maintenance of functionality and diversity of ecosystems, and it also improves the survival and tolerance of plants to adverse conditions, enhances edaphic structure and increase the volume of explored soil, through the formation of hyphal networks. For this, it is considered that the AMF increase the efficiency of the bioremediation processes by adsorbing or absorbing the HM through the hyphal network or translocating it towards the host plant. The microPIXE technique allows to know the HM accumulation and distribution patterns in plants and microorganisms, being a valuable tool in studying where HM accumulate during the arbuscular mycorrhizal symbiosis. This work aims to use this technique to quantify and to map the location of copper (Cu), a very common toxic element, by using the in vitro culture system of transformed carrot roots associated to the AM fungal strain GC3 (Banco de Glomeromycota in vitro- BGIV). In order to understand the role of AMF in the rhizosphere of plants growing in soils with high content of Cu. In vitro experiments were performed in divided petri plates containing transformed carrot roots colonized by GC3 at one side (root compartment: RC), and sterile soil, artificially contaminated, or not, with 300 ppm of Cu (treatments: Cu+ and Cu-) at the other side, where only hyphae could access (hyphal compartment: HC). After three months, root, mycelia, spores and intraradical vesicules from the RC and HC were sampled at both treatments. Different accumulation patterns were observed between treatments. Cu was only detected in vesicules and roots of Cu+ treatment. P, Zn, Mn and Ca were strongly associated to every AMF structures. These results show an accumulation of HM in the fungal intraradical tissue during the symbiotic association and not in the plant itself.

Keywords: *biorremediation, heavy metal, in vitro*

6.10 – 6.15 pm
EP13

An overview of South American mycorrhizal research: thematic and geographical gaps, local and global networking, and suggested directions

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Over the last three decades, developments on molecular methods, statistical and modeling tools, and on macroecological concepts, have led to a notable advancement on mycorrhizal research. However, this advanced has been biased against the southern hemisphere, particularly South America. While the most complex ecosystems and many biodiversity hotspots are located in this continent, the initiative and resources to investigate them are mostly coming from the north. This situation leads to develop northern perspectives on the southern areas, enlarging the gap between the research needs for sustainable local development and the improvement of global mycorrhizal ecological models. By comparing the scientific production between South America and Europe from 1975 to 2018, we identified several trends and gaps in our continent research. While Europe produced 1927 articles, most of which studied the effect of anthropogenic constrains in the mycorrhizal symbiosis, South America, despite its larger size, produced 797 articles over the same period, most of which studied the biodiversity and community structure of mycorrhizal fungi. In both continents, two spikes of research are identified: on the early 1990's, coinciding with the development of accessible molecular methods as well as macroecological mycorrhizal theories, and over the last decade, coinciding with the 'omics' era. In South America, the mycorrhizal scientific production is mostly concentrated in the southern part of the continent (south of Brazil, and Patagonian ecosystems), with some production in the northern Andes. Thus, entire countries or ecosystems have little to no mycorrhizal research. On those better known areas, we suggest to start looking at other crucial topics to understand the mycorrhizal symbiosis: its rhizospheric interactions, how affects and its affected by biogeochemical cycles, and, as in Europe, the effects of anthropogenic pressure. Finally, we suggest three directions to overcome the constraints of mycorrhizal research in our continent: first, to strengthen local collaboration (i.e. by means of the South American Mycorrhizal Research Network); second, to integrate our researchers and research needs to global efforts for monitoring soil biodiversity and functions (i.e. Soil BON) -as these efforts have identified the same gaps as us; and third, to promote the exchange of graduate students, whom should be on the front row of this enterprise.

Keywords: *north-south integration, soil ecosystem functions, South American Mycorrhizal Research Network*

6.15 – 6.20 pm
EP41
Sustainable harvest of wild edible fungi
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During the summer of 2017, the central-southern zone of Chile was affected by huge forest fires. In Empedrado, located in the Maule Region, more than 200 families harvest wild edible fungi. The harvest of wild edible fungi is one of the oldest trades registered by the FAO. In 2017 the forest fires burned 90 % of the pine plantations which provided these families with the ectomycorrhyzal fungi they live from. These plantations were the main income sources of the community. The species of edible fungi in this kind of implanted forests are mycorrhizal and the main species are: *Suillus luteus*, *Suillus granulatus* and *Lactarius deliciosus*. Under the pressure of the fires, the harvesters had to find a way to recover their main source of income, this is how in the second period of 2017 they created a Cooperative Association. Their objective is to restore and improve the commercialization of wild edible mushrooms associated to implanted forests. In the framework of this initiative workshops with the local people were organized and it was possible to teach and reinforce concepts on sustainable collection techniques also paving the way towards the formalization of this livelihood in order to turn this activity into a profitable and sustainable source of income. In addition, a guide of sustainable harvest was elaborated and the post-fire local funga was assessed.
Keywords: *Cooperative Association, commercialization of wild edible mushrooms, profitable and sustainable fungi harvest*

Day 2

Biodiversity and physiology

KEYNOTE II: Dr. Marc-André Selosse

9 – 9.45 am

K02

Advances in ecology of *Tuber melanosporum*: from mating strategy to hidden endophytic behaviour

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The ectomycorrhizal Black Truffle (*Tuber melanosporum* Vittad.) spontaneously grows in open woodlands, either spontaneous (= natural) or planted, and gets nutrients from its hosts. Its presence in soil is marked by a zone where plant exhibit reduced growth and density, the so-called *brûlé*. Our researches in Southern France questioned the biology and ecology of the Black Truffle in natural or planted environments, in order to understand some aspects of Black Truffle vegetative life and reproductive development. We aimed at coming back to the basic ecology of this species, having in mind to unravel factors limiting the production of this prized fungus. Barcoding of ectomycorrhizal communities confirms that the Black Truffle is a pioneer, successional symbiont, which is quite specific to *Quercus* spp. in the investigated shrub ecosystems with sparse trees preceding canopy closure, and which disappears from mature forests. It profits from disturbance, and the abandonment of fields and forest exploitation (i.e. anthropic disturbances) in Southern Europe may have driven the reported rarefaction of this fungus. The Black Truffle forms ectomycorrhizae, but we found in addition molecular evidence that roots from various herbaceous plant species of the brûlé, arbuscular mycorrhizal or non-mycorrhizal, also harbor Black Truffle. Beyond molecular barcoding, Fluorescent In Situ Hybridization suggests a loose colonization as a root endophyte, that is without formation of ectomycorrhizaa. Although the exact interaction remains unclear, this shows that the exact niche of the Black Truffle remains to be more accurately delineated, with a large potential for endophytism. We suspect from our analyses that an endophytic ability is perhaps also occurring in some other ectomycorrhizal fungi. In the case of the Black Truffle, endophytism in herbaceous plant may explain the determinism of the *brûlé by* an exploitation of plants: indeed, our unpublished mesocosm analyses suggest that this fungus extracts nitrogen and phosphorous from herbaceous plants. The interaction with herbaceous plant also features a fungus living open forest ecosystems, where canopy is not closed, leaving space for herbaceous plants. Although hermaphrodite, the Black Truffle is self-sterile due to incompatibilities controlled by a mating-type gene with two alleles (+ and -): its meiotic spores are formed in ascocarps supported by one (maternal) parent after fertilization by a second (paternal) parent. We confirm statistically the previously suspected existence, both in natural and planted populations, of segregated patches of maternal individuals with identical mating types (i.e. exclusively + or -), which colonize ectomycorrhizal and roots of herbaceous hosts. This mating type segregation is poorly understood but it may result from vegetative incompatibilities, genetically linked to the mating type, that may create patches of kin individuals sharing not only the same mating type, but a given

allele of vegetative incompatibility genes located nearby. Microsatellite analyses also confirm the previously observed strong isolation by distance among maternal individuals, probably due to local deposition of spores from same ascocarp(s) by animal dispersers, and to an important soil spore bank that are genetically related to locally sporulating parents. Diploid zygotic ascocarps are highly inbred (although to a lesser extent in planted truffle-grounds), supporting very limited spatial dispersal of paternal gametes. Paternal mycelia were never found on investigated roots, i.e. neither ectomycorrhizas nor roots of herbaceous plants; moreover, although maternal mycelia persist over years and can cover large (metric) areas, paternal mycelia are small and annual. Thus, we hypothesize that male function is operated by germlings from the spore bank. This means that some spores would be recruited for a gametic function, i.e. for mating with established mycelia but without further vegetative development after germination. We also show that, due to segregated patches of mating types, individuals from one of the mating types can locally behave only as maternal contributors, while individuals from the other mating type are restricted to a paternal contribution (and thus to a spatially and temporally limited development). Thus, although potentially hermaphrodite, the Black Truffle displays a functional dioecism.

Keywords: *Black Truffle, molecular barcoding, mating type, endophytism*

ORAL SESSION IV

10.30 – 11.35 am

INVITED SPEAKER: Dr. Agustin Grimoldi

10.30 – 10.50 am

OI03

Mycorrhizal effects on plants recovering from defoliation

A. A. Grimoldi[1,*] and R. A. Cavagnaro[1]

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In grasslands, the symbiotic association between arbuscular mycorrhizal fungi (AMF) and plant roots (i.e. mycorrhiza) is a widespread phenomenon. Fungi support plant growth in return for photosynthetic C from the host plant. But, forage plants are subject to periodic removal of leaf tissue, which may strongly decrease C availability for plant recovery from defoliation. I will show a set of experiments about the effects of mycorrhizal symbiosis and phosphorus availability on the growth and post-defoliation recovery of forage grasses (an increasing range of mycorrhizal affinity: *Lolium perenne* < *Agropyron elongatum* < the tropical species *Brachiaria brizantha*). In non-defoliated plants, the result of the interaction was clearly positive as relative growth rate of mycorrhizal plants was significantly higher as a result of improved phosphorus nutrition. A carbon economy analysis revealed that AMF enhanced relative respiration rate of the root-soil system by 16%, being the total C drain for growth and respiration of the AMF estimated at ≤ 8% of daily

gross photosynthesis. This was the C-cost of mycorrhiza in non-defoliated plants. The enhancement of respiration rate induced by AMF was not reduced when plants were subjected to defoliation, being fructans (the main C-reserve compound in grasses) in leaf sheaths depleted by the combination of defoliation and mycorrhiza. Although, in temperate grasses (as *L. perenne* and *A. elongatum*), mycorrhizae still promoted plant recovery from defoliation at low P supply. But remarkably, at high P supply, defoliation decreased arbuscules, biomass and tillers, denoting a trade-off between symbionts. Contrarily, in the tropical species *B. brizantha*, the presence of mycorrhizae did not affect recovery from defoliation at any P supply. In summary, the net result of AMF-symbioses in defoliated grasses resulted to be different depending on plant species affinity and soil phosphorus availability.

Keywords: *forage grasses, post-defoliation recovery, P availability and C-cost*

10.50 – 11.05 am
OS08

Opposite responses to P fertilization in native grasses: improvement of plant nutrient content and performance and detriment for mycorrhizal colonization

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Natural grasslands cover more than 60% of Uruguayan territory and are highly relevant for extensive livestock production. P fertilization and legume addition are common practices in these grasslands to improve forage quality and production. Long-term experimental data shows that these practices can drastically modify community diversity and composition and negatively affect mycorrhizal colonization of native grasses. The objective of the present study was to evaluate the impacts of contrasting P fertilization practices (long and short-term application) on two dominant native grasses. We carried out a glasshouse experiment with plants that we brought from a long-term field experiment. Treatments in the glasshouse were: 1) plants from natural grassland plots (NG) without fertilization; 2) plants from long-term fertilized plots (FP) fertilized annually since 1996, and 3) plants from NG plots that we fertilized them in the glasshouse (NG+P). During two months, we evaluated plant performance (tiller production, leaf appearance and leaf elongation rate). At harvest, we evaluated arbuscular mycorrhizal (AM) colonization, soil and leaf N and P contents and biomass allocation to aerial and subterranean structures and to reproductive organs. Plants from NG showed the highest presence of mycorrhizal colonization (more than 70%). NG+P plants presented less than 50% of AM colonization while FP plants showed less than 40%. AM fungi structures were also negatively affected by P: we only observed arbuscules in plants from NG. Although mycorrhizal colonization of the plants was negatively affected due to P increments, P leaf content was 70% higher both in plants from the long term experiment and from the NG+P treatment. At the end of the experiment P available soil was three time higher in the FP treatment (11,7 mg kg^{-1}) than in the NG one (3,8 mg kg^{-1}), while in the NG+P treatment was 7,7 mg kg^{-1}. N leaf content was only higher in plants from the long-term experiment (FP) and did not show any difference between plants that were fertilized in the glasshouse from plants of the NG. Plants from FP plots and NG+P allocated more biomass to aerial structures than plants that were not fertilized.

Our results show that P fertilization effects on mycorrhizal, P leaf content and some plant attributes can be observed in few months. The very low P available soil concentration present in NG of Uruguay (less than 5 mg kg^{-1}) could be limiting not only plant growth but also mycorrhizal interaction.

Keywords: *Coelorhachis selloana, Paspalum dilatatum, Uruguayan grasslands*

11.05 – 11.20 am
OS09

***In vitro* evaluation of the tolerance of arbuscular mycorrhizal fungi (AMF) isolated from alkaline-saline soils at different pH and salinity ranges in their pre-symbiotic states**

M. V. Scorza[1,*], M. Statello[1], V. A. Silvani[1], R. P. Colombo[1], S. Fracchia[2] and A. M. Godeas[1]

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The Laguna Brava Provincial Reserve is located northwest of the province of La Rioja and is formed by a series of high Andean lakes exposed to extreme environmental factors: high incidence of UV radiation, low rainfall, low oxygen pressure, high salinity and concentration of heavy metals, alkaline pHs, and oligotrophy. These types of extreme ecosystems are fundamental for the conservation of microorganisms with phenotypes and genotypes with particular adaptations, which would not be found in others environments. The soils of the margins of the lagoons are naturally enriched with salts and heavy metals, and have AMF associated with the scarce vegetation. The aims of this work was to select three species of AMF isolated from high-Andean lagoons of the "Laguna Brava" and to evaluate the effect and tolerance on spore germination and hyphal development of these species according to different ranges of pH and salinity. For that, spores or sporocarps of *Funneliformis mosseae*, *Entrophospora infrequens* and *Funneliformis* sp. were incubated in gellified medium with different salt concentrations (NaCl) or different pH ranges. Percentage of germination, viability of ungerminated spores, hyphal length and number of hyphal tips of germinated spores were registered. The germination of the spores and their hyphal development in the three species varied according to the pH values. At acidic pH, none AMF germinated despite the high percentage of viable spores. At alkaline pH, there was a high percentage of germination and pre-symbiotic development in spores of *E. infrequens* and *Funneliformis* sp., observing an increase in length and hyphal branching at pH 8 and pH 10, respectively. Salinity negatively affected the germination and pre-symbiotic development of spores of *E. infrequens* and *Funneliformis* sp., but not their viability. As the salinity increased, the length and the hyphal branches of the germinated spores decreased in both species. The strain of *F. mosseae* showed almost no germination under the different conditions of pH and salinity despite its high viability, indicating a probable dormancy in its spores. Salinity tolerant strains with optimal growth characteristics under alkaline conditions could be selected for the formulation of a bio-inoculant based on AMF applicable to alkaline-saline soils.

Keywords: *extreme ecosystems, Funneliformis sp., Entrophospora infrequens*

11.20- 11.35 am
OS10
Glomalin gene as molecular marker for functional diversity of arbuscular mycorrhizal fungi in soil

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Arbuscular mycorrhizal fungi are ubiquitous plant symbionts playing an important role in terrestrial ecosystems functioning. Among the ecological services provided, the process of soil aggregation is hypothesized to be partially mediated by glomalin, an immunoreactive glycoprotein released by AM fungi into soil during hyphal turnover and after the death of the fungus in the soil. The protein is characterized by abundant production, apparent recalcitrance and hydrophobic properties. Although glomalin has been identified as a putative homolog of heat shock protein 60, the use of expressed fungal genes encoding glomalin as a marker for functional AMF diversity was never exploited. The present work describes the first attempt to identify the glomalin gene in several AMF species, verify its reliability as gene marker for the identification and discrimination of AMF, and test the possibility to detect its expression in soil. We designed a specific functional and phylogenetic PCR primers set able to amplify many known lineages of AMF glomalin gene. We demonstrated its applicability to create a new reference glomalin sequence dataset for comparative sequence analyses. We showed that the glomalin-related gene could be a valuable marker for AMF detection in soil representing a promising resource for further investigations on glomalin-based AMF community analyses under field condition.
Keywords: *AMF, glomalin-related gene, sequences dataset*

ORAL SESSION V
11.45 – 12.35 am

INVITED SPEAKER: Dr. Camille Truong
11.45 – 12.05

OI04
The role of ectomycorrhizal fungi for nitrogen cycling in Southern Patagonia

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The ecological role of ectomycorrhizal (ECM) associations for carbon and nitrogen cycles has been demonstrated in boreal forests, but these processes have been little studied in the Southern Hemisphere. In southern Patagonia, the ECM tree *Nothofagus pumilio* forms continuous mono-specific forests across a wide elevation gradient (100-800 m). These conditions offer a unique opportunity to elucidate ecological functions of soil fungi in situ while eliminating the effects of having multiple lineages of unrelated host plants. Previous studies showed that, despite this wide range of soil and climatic conditions, *N. pumilio* is not limited in nutrients and even acts as a nitrogen (N) "sink". We investigated how edaphic variables and elevation affected the diversity and functions of soil fungi, using meta-genomic sequencing of ITS1 rDNA and extra-cellular soil enzyme activities involved in carbohydrate degradation and nutrient mobilization. We also recorded soil properties as well as N mineralization rate and N microbial biomass. Strong shifts in fungal community composition across elevation were mediated primarily by soil pH, with the most species-rich fungal families occurring within a narrow pH range. In contrast, enzyme activities were minimally influenced by elevation, but correlated with the composition of organic matter, especially total carbon. The activity of leucine aminopeptidase (involved in N cycling) correlated positively with ECM fungi, while a high N microbial biomass and both low N mineralization and N availability were measured. Our results suggest that soil fungi in *N. pumilio* forests are functionally similar across elevations and that these diverse communities help maintain nutrient mobilization across the elevation gradient. In particular, ECM fungi seem to play a preponderant role for N cycling, similarly to the organic N economy that have been described in boreal forests.

Keywords: *ecosystem functioning, nutrient cycling, climate change*

12.05 – 12.20 pm
OS11

Ectomycorrhizal-dominated temperate forests show faster decomposition of soil organic matter than neighbouring arbuscular mycorrhizal-dominated forests

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Soil microorganisms play a crucial role in nutrient cycling and carbon (C) storage. Among them, arbuscular mycorrhizal (AM) and ectomycorrhizal (EcM) fungi contribute greatly to soil organic matter degradation but differ in their effects due to distinct enzymatic activities. Ectomycorrhizal fungi have been suggested to promote carbon sequestration by slowing down litter decomposition, due to the competition with free-living saprotrophs for organic nutrients (i.e. the “Gadgil effect” hypothesis). On the other hand, AM fungi may indirectly stabilize soil organic matter by promoting microbial products and soil aggregation (i.e. the microbial efficiency-matrix stabilization hypothesis). We simultaneously tested these two hypotheses by comparing the soil organic matter decomposition in adjacent patches of temperate forests dominated by AM or EcM trees in Québec, Canada. Over one year, we followed decomposition of the three organic horizons (L, F, H) using a reciprocal transplant design experiment. Litterbags were composed of different

mesh size that allow (40 µm) or exclude (1 µm) ingrowth of fungal hyphae. We estimated differences in mass loss, carbon and nitrogen content using mixed linear models. After one year, litterbags from EcM-dominated patches showed higher mass loss (23.1% *vs* 22.3% for AM-dominated, *p-value* = 0.042). The exclusion of mycorrhizal fungi slowed down the decomposition in patches dominated by AM, but also in EcM patches, contrary to the Gadgil effect expectations. These results suggest that soil microbial communities, including mycorrhizal fungi but particularly EcM fungi, actually promote decomposition of organic matter. This experiment needs be extended in time and replicated in different ecosystems, for the results to be better supported. Nonetheless, our study emphasizes that mycorrhizas should be taken into account to increase our capacity to predict ecosystem functioning and ecosystem response to climate change.
Key words: *american beech, carbon sequestration, sugar maple*

12.20 – 12.35 pm
OS12
From the nursery to the field: a story about mycorrhizal fungal communities associated with *Nothofagus alpina* (raulí)
N. V. Fernández[1,2,*], P. Marchelli[3] and S. Fontenla[1]

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Due to its high timber quality and ecological importance, *Nothofagus alpina* (raulí) is currently included in conservation and domestication programs, in which ectomycorrhizas (EcM) play an important role. The aim of this work was to analyze the abundance and diversity of EcM associated with *N. alpina* in: 1) nursery cultivated seedlings, 2) domesticated specimens established under a native forest or 3) under a *Pinus* plantation, and 4) naturally established plants. The occurrence of arbuscular mycorrhizas (AM) was also investigated. EcM colonization was estimated according to Grand and Harvey, and diversity of EcM fungi (EcMF) was assessed by morphotyping and subsequent sequencing. First, a 2-year trial was conducted following the conditions used for domestication programs. Seedlings were grown in the forest nursery under two different practices: greenhouse (2 years) and greenhouse (1 year) + flowerbed (1 year). It was observed that they naturally developed EcM 6-12 months after germination. The most abundant EcMF were *Tomentella ellisii* (Basidiomycota) and an unidentified ascomycetous fungi. However, the abundance and diversity of EcMF varied between the cultivation techniques. Seedlings grown in the greenhouse had higher colonization rates than those transplanted into the flowerbed, but the last were colonized by a higher diversity of EcMF. With respect to the domesticated specimens subsequently established in the field, we observed that the abundance and diversity of EcMF were significantly higher in the individuals stablished in the native forest than in those located in the *Pinus* plantation. In the native forest, EcMF communities were similar between the domesticated *N. alpina* specimens and the naturally established plants. Most of the EcMF were basidiomycetes, belonging mainly to the Cortinariaceae and Tricholomataceae.

Significant differences regarding plant age (seedlings/young plants/mature trees), seasonality (autumn/spring) and forest management (occurrence/type) were also observed and will be discussed. Common fungal species were not found between the native forest and the *Pinus* plantation, or between these environments and the nursery. AM were not present within *N. alpina* roots. These results improve our understanding of the key factors affecting EcMF communities associated with *Nothofagus* under nursery and natural conditions. This information is relevant not only from an ecological point of view, but also from an applied perspective because it can be used for improving conservation and domestication programs.

Key words: *ectomycorrhizas and arbuscular mycorrhizas, conservation and domestication programs, Cortinariaceae and Tricholomataceae*

CONFERENCE II: Dr. Matthew Smith

2.15 – 2.55 pm

C02

The biogeography and diversity of ectomycorrhizal fungi across different biomes in South America

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The biodiversity patterns of plants and animals are well studied but analogous patterns in fungi and other microbes are only beginning to emerge with a combination of increased sampling and molecular analyses. The biota of South America has been strongly influenced by historical continental movements (e.g. the “Gondwanan breakup” and “Great American Interchange”), but biogeographical effects from these events have not been fully studied from a microbial perspective. During the last two decades multiple research groups have begun to elucidate the diversity and community structure of ectomycorrhizal fungi across different habitats in South America. Their studies have revealed distinct patterns across the different forest types and regions of the continent. In this talk I will provide an overview and synthesis of the biogeography and diversity of ectomycorrhizal fungi of South America with a focus on the most well studied systems in the northern tropical regions (the Guiana Shield) and the temperate southern region (Patagonia). I will underscore the importance of a synergistic approach that combines both classic, specimen-based systematics and metagenomics-based ecology studies. I will provide examples of newly emerging biogeographic patterns that have been discovered recently based on phylogenetic analyses of newly-collected samples in the Guiana Shield and Patagonia. I will discuss what is known about the ectomycorrhizal fungi and host plants of the different South American biomes and also highlight questions for future research.

Keywords: *specimen-based systematics, metagenomics-based studies, biogeographic patterns*

ORAL SESSION VI

2.55 – 3.25 pm

2.55 – 3.10 pm
OS13
Morphological basiodome diversification associated to changes to the ectomycorrhizal lifestyle in Southern Gondwana landmassess

F. Kuhar[1,*]

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Ectomycorrhizal (EM) forests in landmasses derived from southern Gondwana show a unique diversity of fungal taxa associated with a few genera of trees in the families Nothofagaceae and Myrtaceae. At least two changes to the EM lifestyle are well documented in Patagonia, Australia and Zealandia and within the agaricomycotina that seem to have triggered a diversification in the form and dispersal strategies of basidiomes. One of these cases is the family Serpulaceae, where an EM clade containing the genera *Austropaxillus* and *Gymnopaxillus* shows a high diversity of basidiome morphologies in contrast with the paraphyletic parental genus *Serpula*, of exclusively corticioid basidiomes. The other case is the EM genus *Descolea*, also a southern Gondwana representative of the mostly saprotrophic family Bolbitiaciae, which displays a continuous gradient of forms ranging from primitive agaricoid basidiomes, to fully hypogeous gasteroid species. Current hypotheses explaining these patterns involve climate changes and animal dispersion. Previous results in these and other groups will be discussed as well as the possible role of the EM symbiosis as trigger of the morphologic differentiation.
Keywords: *preadaptation, constraint, biogeography, Gondwana, plasticity*

3.10 – 3.25
OS14
A neotropical database of plant response to mycorrhizal fungi, expanding MycoDB

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One of the most globally widespread and obligate symbionts of plant roots are arbuscular mycorrhizal fungi (AMF), subphylum Glomeromycotina. Mycorrhiza arises from an ancient symbiosis between fungi and plant roots which allow the fungi to receive plant-synthesized carbon while providing plants with increased nutrient and water foraging ability. These individual plant-

growth effects can underlie community assembly and drive critical ecosystem processes. In particular, the symbiosis has a leading role in soil aggregate formation and long term soil stabilization. This association evolved very early in the evolution of terrestrial plants and likely played a pivotal role in supporting ancestral plant adaptation to the terrestrial environment. The largest previous compilation of mycorrhizal response traits (MycoDB) was an important step forward in creating a common database for future meta-analyses on this globally significant symbiosis. Nonetheless, an important gap highlighted by this study was the lack of information from neotropical regions, making broad generalizations difficult. A major limitation to collecting these data is that much literature focused on the neotropics is not in English, limiting the diversity of plants represented in the database. In addition, MycoDB focused primarily on mycorrhizal response in terms of growth of the plant host. To date, numerous papers have shown that the benefits of mycorrhizal fungi to plants extend past growth to pathogen resistance, water uptake, and soil aggregation. Therefore, we propose to expand the existing database to include neotropical data from literature in Spanish and Portuguese, while also expanding the mycorrhizal traits to include a broader array of benefits. In addition, we will conduct a preliminary meta-analysis on benefits conferred by mycorrhizal fungi to plants, employing the methods suggested in the original MycoDB paper to reduce meta-analytical technique biases. Here we present MycoDB, a large database of mycorrhizal inoculation experiments, linked with plant and fungal phylogenies, to facilitate tests on the ecological and evolutionary contexts and invite researchers from the South American Mycorrhizal Research Network to join to this project proposal.

Key words: *mycorrhizal fungi, meta-analysis, mycorrhizal response database*

E-POSTER SESSION II

5.00 – 6.20 pm

5.00 – 5.05 pm

EP14

β-tubulin gene as a complementary molecular marker for desert truffle identification

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Desert truffles are hypogeous fruiting bodies which establish mycorrhizal symbiosis with various host plants, and comprise more than 20 species. Among them *Terfezia boudieri* is famous in the market for its delicate organoleptic properties. Usually the ITS marker is considered the most used DNA region for fungal barcoding. Given that a high level of intrasporocarpic variation of the nrDNA ITS is present in *Terfezia* desert truffles our goal was to assess whether β-tubulin gene could be a complementary molecular tool for resolution of phylogenetic species. ITS and β-tubulin

genes were employed on Tunisian samples. Both markers were successfull in distinguishing *Tirmania nivea* from *Terfezia bouderii* and *T. arenaria*, and in assigning the phylogenetic types to the *T. boudieri* complex. This study showed for the first time the distribution of desert truffles from north to south of Tunisia providing help in addressing programmes aimed to the cultivation of these specific desert truffles.

Keywords: *biodiversity, ecology, taxonomy*

5.05 – 5.10 pm
EP15

Evaluation of interactions between an Arbuscular Mycorrhizal Fungus and a strain of *Trichoderma* sp. as potential bioinoculants

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Microorganisms of soil can form consortium that enhance survival and fitness of the plant. Some fungi bring nutrients to its host, like the arbuscular mycorrhizal fungi (AMF), while others improve resistance to biotic or abiotic stress like *Trichoderma harzianum*. The aims of this work were to evaluate the interaction between the AMF strain GA5 and *T. harzianum* strain BF24 under in vitro and in vivo conditions, and to study the effect of the 'consortium' as bioinoculant on alfalfa (*Medicago sativa*). The in vitro system consisted on divided petri dishes with transformed carrot roots growing in MM at one side (RC) and sterile soil at the other side (SC), where only mycelia could access. The experimental design had four treatments: GA5, BF24, GA5+BF24, and control. GA5 was always inoculated at the RC, while BF24 was inoculated at SC. For the third treatment, BF24 was inoculated once hyphae of strain GA5 reached 50% of SC. After three days, glomalin-related soil proteins (GRSPs), BF24 colony-forming units (CFU), extraradical mycelium (ERM) and GA5 spores were measured. The in vivo test was carried out under semi-controlled conditions. Sterilized seeds were sown in pots with tyndallized substrate, and after one week, they were inoculated with 50 GA5 spores. After 30 days, plantlets were inoculated with 1,60E+07 CFU of BF24. Percentage of mycorrhization, GRSPs, soil enzymatic activity, MER, spores, CFU, green index of the leaves (SPAD) and biomass dry weight were registered. Under the in vitro system, the ERM development resulted significantly higher when co-inoculation of strains occurred. Spores of GA5 strain were only observed in presence of BF24, while CFU and MER were higher in presence of GA5. No significant differences in GRSPs concentration between treatments were observed. SPAD values were significantly different among control and treatments, and co-inoculated roots tended to present a greater mycorrhization. In conclusion, this consortium interacted by producing an enhance on hyphal development and spores/conidia production in both strains, and also showed positive effects on alfalfa, thus it could be considered as potential bioinoculant.

Keywords: *alfalfa, consortium, fungal inoculants*

5.10 - 5.15 pm
EP16
Root colonization and arbuscular mycorrhizal fungal richness in roots of sweet and bitter cassava varieties

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Cassava, also known as manioc (*Manihot esculenta* Crantz), is an important tropical food crops, which contributes to feeding over 800 million people in approximately 80 countries around the world. Cassava is highly dependent on and responsive to arbuscular mycorrhization. Cassava genetic diversity is very high with thousands of manioc varieties in two major groups according to their root toxicity: sweet varieties with low levels of cyanogenic compounds and bitter varieties with high levels of cyanogenic compounds. It has not been established if manioc genetic variation correlates with differences in composition or richness of arbuscular mycorrhizal (AM) fungal communities at root level. We collected roots of sweet and bitter cassava varieties cultivated in swiddens (shifting-cultivation fields) on different soils of the Colombian Amazon region to study root AM fungal colonization, AM fungal diversity and AM fungal species composition by using 454-sequencing of AM fungal SSU rRNA gene amplicons from cassava roots. When grown in the same soil, bitter and sweet cassava showed similar levels of root colonization; however, sweet cassava is also cultivated in lower, regularly inundated floodplains, and plant growing in these sites exhibited significantly lower mycorrhization. A total of 148 AM fungal virtual taxa colonized cassava roots with no difference in the number of virtual taxa among cassava varieties. AM fungal communities colonizing different cassava varieties were different even in the same field, suggesting some host plant selection for AM fungi from the soil pool. Our results help to understand how is arbuscular mycorrhization in cassava roots and have potential implications regarding AM fungal inoculation of cassava.
Key words: *Amazon, Manihot esculenta, virtual taxa*

5.15 – 5.20 pm
EP17
Diversity of arbuscular mycorrhizal fungi and seasonality in dunes of Carimã and São Marcos Beaches – Maranhão State, Brazil

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Arbuscular mycorrhizal fungi (AMF) are symbiotic microorganisms which improve plant nutrition and are key for the establishment of vegetation in degraded lands and in early stages of

succession such as coastal dunes. In such ecosystems, AMF aid in water and nutrient acquisition and in the stabilization of the dunes via plant colonization which serves as a barrier in sand dispersal. Though some research has been done on AMF in Brazilian sand dunes, the state of knowledge in Maranhão is still insufficient. This study investigates AMF diversity in four randomly selected dunes of Carimã and of São Marcos beaches each, with sampling in dry season (November/2017) and rainy season (May/2018). In each dune, we collected five composite soil samples (0-20 cm), resulting in 40 samples per season. Samples were transferred to the Arthropod and Microbiology Laboratory of Maranhão State University for subsequent spore extraction, counting and taxonomic identification. We checked data for homogeneity of variance and normality of distribution before comparing means via Tukey-test with 5% significance-level. Glomerospore density did not vary significantly between seasons, but within-season São Marcos beach had significantly higher spore density. Glomerospore density varied between 0.2 and 4.76 spores per g of soil in the dry season, and between 0.12 and 11.54 in the rainy season. We identified 37 AMF species distributed in 10 genera. This high Glomerospore diversity is likely the outcome of soil texture and chemistry, extreme temperatures and the dune vegetation. AMF species richness is high for dunes, indicative of the key role of Glomeromycota for dune vegetation establishment.

Keywords: *dunes, Glomeromycota, species richness*

5.20 – 5.25
EP18

A first snapshot on arbuscular mycorrhizal fungi in soils of different crops farming in the Puna

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Soil ecosystems and its functioning are under the threat of biodiversity lost by the increase of cultivated areas and agronomic exploitation intensity. Changes in land use alter the structure and functioning of ecosystems where biodiversity plays a vital role in the ecosystem-services (ES) provision. Arbuscular-Mycorrhizal-Fungi (AMF) are a key soil biota functional group with an important potential to contribute to crop productivity and implement of new strategies for sustainable production. The different land uses and soil types affect the AMF diversity and their function in the community. Despite the significant relationship between AMF diversity, land uses and its ES, there are very few studies focused in ES of AMF in Latin America. The Puna is an arid-high plateau where plants experience high abiotic-stresses and unique extreme distinctive environmental conditions. This work is part of CNR-CONICET Project “Ecological characterization of AMF communities as ecosystem indicators for arid and semiarid

Argentinean soils" that analyze the effects of different land uses on AMF diversity and their resilience; identify AMF species useful as indicators of ecosystem health and determinate potential ES derived from AMF diversity through a combination of molecular and morphological approaches. In this Project we sampled 6 land uses conditions including hotspots areas in Argentine Puna with different stressors. The aim of this work was to analyze in Chaupi Rodeo (Jujuy, Argentina), AMF diversity (spores total number, spore-taxa richness) in 3 crops species usually farming by people settlement: native corn, bean and native potato, under a familiar land use, without the supplements of agrochemicals but with different histories of crops rotation. Each crop species has 3 plots replicates; in each plot, 5 subsamples were taken. The total number of AMF spores/100g of dry-soil were isolated and counted for each sample under dissecting-microscope. Preliminary results indicate that AMF spores were most abundant in corn plots, followed by potato and bean. The number of AMF taxa morphologies was high and variable (20 to 4); were represented glomoid, acaulosporoid, scutellosporoid, gigasporoid, and diversisporoid morphologies, and spores were single, aggregate or forming sporocarps with peridium. The AMF diversity changes could be due to the rotation histories, with less effect of the species of crops. Molecular data on the same plots are under investigation.
Key words: *Andean highlands crops, Glomeromycotina spores abundance, land uses*

5.25 – 5.30 pm
EP19
Spores abundance and diversity of arbuscular mycorrhizal fungi in the Caldenal Forest, Argentina

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Arbuscular mycorrhizal fungi (AMF, Glomeromycota) are biotrophic mutualistic symbionts of the 80% of the terrestrial plants; AMF increase their hosts growth through its contribution to the water and nutrients absorption from soil to the plant roots. The AMF mycelia and spores are common components of the biological soil communities. The different AMF taxa vary in their edaphic and nutritional preferences, the host species ranges and the seasonal changes in sporulation features. The increase in world human population and the global demand for natural resources, have acted as an important driving force for agricultural changes in Argentina in the last 150 years. Thus, a territory of high agricultural productivity and low population, such as the Central Argentina, has changed drastically at this stage. Particularly, in Espinal ecoregion the synergy of natural and/or anthropogenic changes has modified intensely the dynamics of the xeric forests that dominated the region. Therefore, in San Luis province the *Prosopis caldenia* Burkart forests (or "Caldenales") have suffered a reduction of 12.600ha in the last 10 years. This changes probably also have affected soil community, for that reason is important to study the AMF

communities in the Caldenal Forest soils. The aim of this work was to know the abundance and diversity of AMF spores at the northern limit of the Caldenales. The sampling sites were four forests in San Luis (Argentina); at each site, soil samples were collected, packed and transported to the laboratory. The AMF spores were extracted from 100g of field soil from each sample by wet sieving followed by sucrose centrifugation and quantified using an optical microscope. Species identification was performed using the specific bibliography and the INVAM database. There were plots with spore abundance differences, the most abundant plot had almost twice the total number of spores. All plots showed similar values of Shannon-Wienner index and Simpson's Diversity index. Herbaceous stratum, shrub stratum and tree stratum diversity none have effect on spore abundance; instead, the lowest spore abundance occur in the plot with highest number of young trees. Furthermore, the lowest abundance of spores coincided with the only plot grazed by horses; the other plots were occasionally cattle grazed. Hence, in Caldén Forests these preliminary results showed that spores abundance could be influenced by different factors such as plant phenology and forest uses history.

Keywords: *biodiversity, Glomeromycota, Caldén*

5.30 – 5.35 pm
EP20

A new report of a fungal association in *Targonia* L. (Marchantiophyta)

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Several land non-vascular plants, such as bryophytes, are known to form associations with different groups of fungi. Within these, the arbuscular fungi include representatives of Glomeromycotina (arbuscular mycorrhizal, AM) and Mucoromycotina (fine endophyte, FE). Both groups have been registered living in association with liverworts (Marchantiophyta). As an example of this fungal colonization, we can mention the association established between the AM fungi and the complex liverworts of *Targionia* L. (*T. hypophyla* L.). The aim of this work was to know if the other species of this genus also distributed in Argentina, *T. stellaris* (Müll. Frib.) Hässel, form fungal associations. Collected specimens come from to northwest Argentina (Tafí del Valle, Tucumán) growing on rocky slope at c. 3000 masl. They were collected, herborized and identified using traditional techniques for the study of bryophytes. The colonization by the fungi was observed staining the gametophyte under the recently proposed technique for these plants. The thallus is dark green, dyed purple on both sides, gregariously adhered to the substrate by unicellular rhizoids. In cross-section, the dorsal surface is smooth, concave in the middle and progressively flat towards the margins with simple epidermal pores with a single ring of 6-7 thin-walled cells; air chambers in a single layer with green filaments and basal tissue that extends to three quarters of the height of the thallus. The colonization of the FE was evidenced by the presence of characteristic fungal structures. The aseptate hyphae were observed, mainly in the middle ventral portion of the thallus, the external hyphae close to the rhizoids, and the internal measure c. 3-4 µm in diameter; intracellular arbuscules with hyphae ranged from 1 to 3 µm in

diameter; vesicles were not observed. The presence of FE was restricted to the non-photosynthetic part of the plant, where the colonization percentage reaches 8% (5%-10%). In this contribution, we present the FE association with *T. stellaris*, which also constitutes the first mention of this for the genus.
Key words: *Glomeromycotina, Mucoromycotina, T. stellaris*

5.45 – 5.50 pm
EP21
Banco de Glomeromycota In-vitro (BGIV): an *in vitro* collection of arbuscular mycorrhizal fungi from Argentina
M. V. Scorza[1,*], V. A. Silvani[1], M. Pérgola[1], M. Statello[1], R. P. Colombo[1], A. E. Martinez[1] and A. M. Godeas[1]

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Due to the obligate biotrophic nature of the arbuscular mycorrhizal (AM) fungi, the traditional method to propagate them is through the inoculation of plants growing in sterile substrates under greenhouse conditions. This technique has two important disadvantages: the required space and the impossibility to isolate the pot cultures from others microorganisms. Another way to propagate AM fungi, involves the *in vitro* cultivation by using transformed roots growing in Petri plates with minimal medium. This *in vitro* technique allows the symbiosis establishment and the development of high amounts of spores and mycelia in much less space, high purity and monospecificity conditions. The *Banco de Glomeromycota in vitro* (BGIV), created in 2003 at the *Lab. Microbiología del Suelo* (FCEyN-UBA), and registered in the World Data Center of Microorganisms in 2010, seeks to multiply the germplasm of AM fungi in association with transformed carrot roots (Ri T-DNA *Daucus carota*) under *in vitro* conditions. This collection contributes to the knowledge on the biodiversity of AM fungi from agricultural or natural environments, and the ex-situ conservation of this important biological resource, thus facilitating sustainable use of their germplasms. The BGIV collection propagate and maintain native AM fungal strains isolated from different ecosystems of Argentina (Salta, Córdoba, La Rioja, Buenos Aires and C.A.B.A.). Nowadays, 40 strains of diverse species (*Rhizoglomus*, *Glomus*, *Gigaspora*, *Claroideoglomus*) are cultured and characterized by morphological and molecular techniques (SSU 18S). Recently, the *Federación Latinoamericana de Colecciones* and the *Asosiación Argentina de Microbiología* have also incorporated the BGIV to their institutions (SI-62 and SCCM 026, respectively). The BGIV has a web page (www.bgiv.com.ar) with a detailed *on line* catalogue of AM fungal strains, as well as, a gallery of photos and video, research works carried out with strains of the collection and links to other pages of interest.
Keywords: *Ex situ conservation, germplasm, monospecific culture*

5.50 – 5.55 pm
EP22
Arbuscular mycorrhizal fungal spore diversity and density in sand dunes disturbed by fire or *Pinus* spp. invasion in Santa Catarina Island, Brazil
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Mycorrhizas improve plant establishment in sand dunes, a harsh environment with high soil temperature and low nutrient and organic matter contents in the soil. Arbuscular mycorrhizal fungi (AMF) community are affected by disturbance, such as fires and plant invasions. The aim of this study was to evaluate AMF spore density in sand dunes colonized by *Gaylussacia brasiliensis* (Ericaceae) and disturbed by fire or invasion by *Pinus* spp., in comparison to adjacent undisturbed areas. Samples were taken in late spring in a conservation park in Santa Catarina Island, Brazil. In each site, soil samples were collected from the root zone of ten individuals of *G. brasiliensis*. Fungal spores were extracted by wet sieving, counted, and separated as morphotypes, based on spore morphology. An amount de 27 morphotypes were recovered from all areas. The number of AMF morphotypes did not significantly vary between the sites with invasion by *Pinus* sp. and their adjacent areas. Sites previously affected by fire had lower morphotype number, as well as their adjacent areas. The most abundant morphotype belongs to Acaulosporaceae. Total spore numbers were higher in *Pinus*-invaded sites as compared to their undisturbed adjacent areas, while fire-disturbed sites had lower spore number, not differing from their adjacent sites. In conclusion, AMF spore density was more affected by exotic plants replacing natural vegetation by than by fire disturbance.
Keywords: *dune soil, occurrence, soil fungi*

5.55 – 6.00 pm
EP23
Diversity of the exotic ectomycorrhizal fungus *Rhizopogon* in Patagonia, Argentina
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The ectomycorrhizal hypogeous genus *Rhizopogon*, with several edible species, is widely associated with the Pinaceae (mostly *Pinus* sp.), and has a global distribution resulting from the introduction of exotic trees into the Southern Hemisphere for plantation forestry. In this study, a detailed account of *Rhizopogon* in Patagonia Argentina is presented, based on integrative phylogenetic, morphological and associated *Pinus* species. The internal transcribed spacer (ITS)

and large subunit nrDNA sequences were used to discriminate the *Rhizopogon* specimens from Argentina and to examine their relationships with *Rhizopogon* species published in GenBank. Six Patagonian collections from *P. ponderosa* afforestation across different Patagonia provinces, clustered with *R. arctostaphyli*, a species within *R.* subg. *Amylopogon*; morphological features confirm its position. On the other hand, the majority of Patagonian grouped within three clades in *R.* subg. *Roseoli*: a) the most numerous group, which included collections from *P. ponderosa*, *P. contorta* and *P. radiata* clustered with Clade IIa of North American affiliation; b) the second group from *P. ponderosa* plantations was identified as Clade IIIa of European origin, which included the holotype collection of *R. mohelnensis* from Czech Republic, possibly associated with *Abies* sp. and *P. sylvestris*; and c) the third group nested within the species *R. granuloflavus* associated with *P. canariensis*, with morphological features that confirm this position. This work provides the first comprehensive report of the genetic diversity of *Rhizopogon* species including information of geographic regions and pine associations. This research could potentially be valuable for agro–forest industry in cultivation programs involving this fungus, new afforestations, gourmet product developments, while also contribute with important data for conservation biology programs, were the introduction and spread of exotic and invasive species is one of the most important problems.
Keywords: *multiplex PCR, Pinus; Rhizopogon subgenus Roseoli*

6.00 – 6.05 pm
EP24
Low genetic structure of the introduced edible ectomychorrizal fungi *Suillus luteus* in pines afforestation of Patagonia, Argentina

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Suillus luteus is a widely distributed ectomycorrhizal species associated to *Pinus* spp. with edible fruit bodies largely harvested and consumed around the world. We studied the molecular phylogenetic relationships and the genetic structure of populations of this basidiomycete in afforestations from Patagonia, Argentina. In total 110 sporocarps were collected from 11 geographically separate populations from different *Pinus* plantations located from Neuquén to Santa Cruz provinces. Collections were sequenced and genotyped at five microsatellite loci. ITS phylogenetic analyses were performed in order to ascertain the affiliation of Patagonian collections. These analyses showed that collections from Patagonia match within the *S. luteus* species, and no sub-grouping was observed related to the different origins. For the genotyping, considerable genetic diversity was found within the geographical subpopulations, but not between the geographical subpopulations. Also not statistical supported evidence for clustering of subpopulations from *Pinus* species vs. subpopulations was found; nevertheless, differences in allele frequencies in *S. luteus* collections from Santa Cruz associated to *P. sylvestris* plantations was observed. Our results suggest that the genetic structure observed in the Patagonian Andes

area reflects the recent history of introduction and expansion of *S. luteus* associated to exotics afforestation. The high value of gene flux (29) represents a genetic structure of populations and gene flow that turned out to depend of human activities by introducing species and genets on a regional scale. This study may aid not only in the knowledge of the molecular ecology of this species but also to the management of genetic resources for future inoculation programs.
Keywords: *microsatellite, Pinus ponderosa, slippery jack*

6.05 – 6.10 pm
EP26
Forest type effect on ectomycorrhizal diversity: differences in fruiting patterns between a juvenile and a mature *Nothofagus* forests in La Araucanía Region, southern Chile.
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Nothofagus is the dominant genus in southern Chile, southwestern Argentina and Patagonia forests. All *Nothofagus* species in South America are obligate ectomycorrhizal (EcM) trees, with more than 200 fungal species, being *Cortinarius* the dominant genus. In Chile, southern *Nothofagus* forests have been highly affected by human interventions, e.g., expansion of commercial plantations (*Pinus* spp., and *Eucalyptus* spp.), commercial farms, urbanization, and forest fires. Thus, the aim of this study was to assess the effect of forest type on fruiting richness and composition of EcM species. Two forests in La Araucanía Region were selected: Pucón, an early-successional forest dominated by *N. obliqua – Luma apiculata*, and Caburgua, a mature forest dominated by *N. obliqua, N. dobeyi, Gevuina avellana, and Persea Lingue.* EcM fruiting bodies were collected in four sites, covering a total area of 7.200 m^2. Also, vegetational composition and edaphic variables were measured. EcM species richness and abundance were compared between the two forests and correlated with environmental variables. We found 9 families, 10 genera and 66 EcM species in total; mature forest had the highest EcM species richness: 8 families, 8 genera and 57 EcM species, being *Cortinarius* and *Inocybe* the dominants genera with 34 and 9 species respectively, whereas 8 families, 8 genera, and 19 EcM species were collected in the juvenile forest, with *Cortinarius* as the dominant genus, comprising 10 species. Although both forests had similar abundance of fruiting bodies (334 and 312, respectively), species composition differed significantly between them. The mature forest was dominated by 12 species, representing 70% of the total number of sporocarps. *C. austroturmalis*, *C. magellanicus*, *Tricholoma fusipes*, and *Cortinarius* sp. represented 50% of the collected specimens. On the other hand, in the juvenile forest, three species represented the 70% of all collected specimens. *C. austroturmalis* and *Laccaria galerinoides* represented 50% of the total abundance. We performed a Redundancy Discriminant Analysis (RDA), where RDA 1 and RDA 2 explained 99.5% of total variance. Na, pH, plant total richness, percentage of open sky, abundance and average on host trunk radius were the most important environmental variables which explained the EcM fungal richness between families. We conclude that there are a

negatively effect on richness and composition of EcM spcies in a forest that is regenerating from its anthropic intervention, compared to a mature one.

Keywords: *fruiting bodies, ECM richness, soil edaphic*

Day 3

Sustainable development and management

CONFERENCE III: Dr. Laura Mendez

8:45 - 9:00 am

C03

Women and days: Female roles in historical perspective

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The purpose of this presentation is to invite us to think about March 8th and its significance as International Women's Day. From this ephemerid some appreciations will be debated in terms of the roles that women have played and still play in Western history, intending to notice essentialisms, cultural mandates and gender stereotypes. We are particularly interested in pointing out the relations between women, nature and culture. All from a perspective located in North Patagonia, especially through the itineraries of Mapuche women, during the last two hundred years. Finally, we will mention the current context and the challenges that we as women face individually and as part of a social group within a patriarchal society.

Keywords: *women, culture, nature, history, Mapuche*

CONFERENCE IV: Dr. Luis Wall

9:00 – 9:40 am

C04

New paradigms in agricultural soil microbiology

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At the beginning of the 20th century Louis Pasteur laid the foundations of classical microbiology, based on the cultivation of microorganisms. Microbiology ceased to be an exclusive concern in matters of health or food conservation and extended to almost all fields in Nature. Microbes were recognized as the catalysts of all the cycles of the elements in our planet. In this context, agricultural microbiology works as a catalog of curiosities that offers the possibility to isolate particular microorganism and convert them into modern additives of agriculture. However, this paradigm vanished not many years ago, after a big anomaly in bacterial counts. Biochemical tools allow us to see the new unculturable microbes and a new scenario of soil microbiology is under construction at present. The new concept of microbiome expands the complexity of the soil where any macroscopic form of life develops. Analyzing the soil microbiology at a soil microaggregates scale suggests that agricultural managements are the way of shaping soil microbiomes to improve soil quality and improve crop production and soil services without harming the environment. The

integration of soil microbiomes knowledge into the other levels of the soil food web is the future of soil science and could be one of the clues to mitigate the global climate change. Mycorrhiza, as part of the soil biology should be analyzed in terms of this new paradigms.
Keywords: *agricultural microbiology, microbiome, management and soil services*

ORAL SESSION VII

10.30 – 11.30 am

INVITED SPEAKER: Assoc. Prof. Miroslav Vosátka
10.30 – 10.50 am

OI05

Perspectives of Mycorrhizal Fungi Applications in Agriculture and Forestry

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Degradation of microbial life in the soils is due an excessive pesticide application, drought or pollution, and the inoculation with beneficial microbes becomes a part of good agriculture and forestry practice. Several major groups of beneficial soil microbes can be reintroduced into degraded soil where the native microbial populations were diminished or eliminated. These microbes can provide significant benefits to plant growth, contribute to the stress tolerance and enhance the yield. The inoculation can reduce plant mortality and stress associated with transplantation from nursery to the field. However, the main hurdle of the technology is an economic feasibility (cost-benefit ratio) of inoculation. The application of microbial inocula is economically feasible for perennial plants with the higher value where the benefits of inoculation can be calculated over a long period of plant life. For a short term crop the inoculation is usually too costly to match potential benefits. The cost of inoculation is mainly related to the mode of inocula application and to the dosage per area or per plant. Recently developed inocula applications via subsurface irrigation or seed coating show feasibility even for extensive crops like cereals. The demands of inoculum for these application is significantly lower compared to conventional broadcasting of inocula. The inocula can be combined with application of liquid biostimulants that are synergistic with the effects of microbes or at least do not influence their populations. Compilation of the results from 6 years of research both in greenhouse and open field brings the evidence on the high potential of microbial applications for numerous crops. Possible ways of the large scale implementation of mycorrhiza-based technologies are discussed based on extensive trials experience.
Keywords: *inoculation technology, mycorrhizal fungi, plant growth promoting rhizobacteria*

10.50 – 11.05 am
OS16

Use of arbuscular mycorrhizae for phytoparasitic nematodes control and growth promotion in pepper plants

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The rosary's nematode *Nacobbus aberrans* affects plant growth and development and decreases the production of numerous horticultural crops. Several investigations have shown that vesicular-arbuscular mycorrhizae could confer tolerance to pathogens through different mechanisms of action, as mycoparasitism, competition of space for nutrients, and induction of plant resistance. The objective of this work was to analyze the potential of two strains of mycorrhizal fungus (AMF) *Rhizophagus intraradices* in the control of *Nacobbus aberrans* and to evaluate the response to inoculation in pepper plants. The assay was performed under controlled conditions. Plants were inoculated at sowing with two strains of *R. intraradices*, B1 and A2. Three days after transplant (DDT) pepper plants were inoculated in half of the pots with 5000 *N. aberrans´s* eggs. At 90 DDT, the percentage of mycorrhization, chlorophyll and soluble proteins content, proline, phenolic compounds, total sugars content, root electrical conductivity and number of total eggs of the nematode were determined. The percentage of mycorrhization was 49% and 38%, for B1 and A2, respectively. The number of eggs was reduced 93% and 86% in the plants inoculated with B1 and A2 respectively, compared to the non-inoculated ones. The penetration of mobile forms of *N. aberrans* in the roots produced damages in the cell membranes that caused the electrolytes liberation, increasing the relative conductivity of the cell membranes without inoculating (24.26%) with respect to the inoculated ones (13 ,6%). In the absence of mycorrhizal fungi, parasitism by *N. aberrans* caused a decrease in the content of soluble proteins and chlorophyll, with respect to plants without parasitizing. The loss of the functionality of the infected roots in the plants induced a water stress, reflected by the accumulation of proline and total sugars, osmolytes used by plants in stress situations. At the same time, as a product of pathogenesis, phenolic compounds were accumulated. Both in plants parasitized and not parasitized by the nematode, the inoculation with mycorrhizal fungi, increased the soluble proteins and chlorophyll content, and decreased the proline, sugars and phenolic compounds contents. These results show the potential for the use of AMF in horticultural crops, both to reduce the population of *N. aberrans* as to promote the plant growth in situation of biotic stress.

Keywords: *Capsicum annuum*, *mycorrhizal symbiosis*, *Nacobbus aberrans*

11.05 – 11.20 am
OS17
Effect of AMF native communities and rootstock genotypes on physiology of cocoa plants grown on Cd enriched Andean soil
J. F. Sandoval[1,*], P. Nizo[1], E. León[1], E. Gutiérrez[2], A. Rodriguez[1] and E. Torres[1]

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Traces of cadmium (Cd) have been found in chocolates and several investigations indicate that contamination source are cacao beans produced in Cd-polluted soils. Thus, strategies that reduce uptake and Cd accumulation are necessary to fulfill the future market requirements. Arbuscular mycorrhizal fungi (AMF) have a great potential for remediation of soils contaminated with heavy metals. However, it has been found that their effect on plant Cd accumulation depends on both plant host genotype and AMF species. AMF communities isolated from soils with high Cd concentration may be adapted and thus reduce phytotoxicity in its host-plant grown in Cd polluted soils. The aim of this study is to determine the effect of native AMF community inoculation on physiological parameters and cadmium accumulation in different organs of cocoa plants grown on Cd enriched soils. Two native AMF inocula were taken from soils enriched (AMF-adapted-high Cd) and not enriched (AMF-adapted-low Cd) and multiplied on onion plant tramp for six months. Two cacao rootstock genotypes (IMC67 and CAU43) were grafted with FSV41 scion genotype and then transplanted to plastic bags with Cd enriched soil (25.7 mg kg^{-1}) and inoculated with AMF treatments (without AMF, AMF-adapted-low Cd, AMF-adapted-high Cd, commercial AMF), control plants were also grown in soil without Cd in Yacopí, Colombia. Factorial experimental design (2x4+2) with seven replications was performed. Chlorophyll fluorescence (Fv/Fm, qP, NPQ, Y(II)), plant length, leaves number and greenness were measured monthly for five months. Physicochemical soil analysis including Cd were performed before and after the treatments. In addition, plant growth (dry biomass and leaf area), basal soil respiration and Cd concentration in different organs were determined at the end of the experiment. Surprisingly, preliminary results show that toxic Zn levels were associated with Cd natural enriched soils. Inoculation with AMF-adapted-high Cd enhanced plant growth response but it depends on the rootstock genotype, finding better results with IMC67. Basal soil respiration was higher when AMF-adapted-low Cd was inoculated in Cd enriched soil which demonstrated that microbial activity was increased. Cd and Zn accumulation in both soils and plant organs are currently being measured and will be discussed in the frame of Cd mitigation in agricultural soils.
Keywords: *Cd accumulation, Cd mitigation, heavy metal*

11.20 - 11.35 am
OS18
Bioproductos Myconativa Ltda
P. Aguilera[1,*], and G. Villalobos[2]

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It is a company driven from the academy that generates bioproducts from research and at the same time provides technological services and instruction. The results of a PhD thesis allowed to transform the know-how into technology, this was possible due to the co-financing of national instruments, the sponsorship of La Frontera University and Company experimental field. As a company we seek to incorporate technologies that provide a sustainable productive management to agriculture, with emphasis on the nutritional and functional value of products provided by fruit growing, horticulture, oenology. At the same time, favors the conservation of ecosystems through ecological restoration and bioremediation. The bioproducts correspond to biofertilizers, rooting, fortifying, biostimulants that can be applied in vegetable, fruit, ornamental plants in different stages of the crop, as well as in the bioremediation and conservation of ecosystems. The basis of the bioproducts generated so far by our company, is constituted by native beneficial fungi extracted from Chilean soils that colonize the root which are called arbuscular mycorrhizal fungi (AMF). AMF contribute to biochemical fertilization. MYCONATIVA® is the first inoculant bioproduct developed in our company and has been designed based on AMF isolated from the La Araucanía region for use as an energizer of agricultural plants. It is a bio-fortifying with AMF that favors the water conduction, nutrients, stimulates the germination, emergence, rooting, flowering, biomass production and final products. Inoculated plants with MYCONATIVA® tolerate greater environmental stress and resistance to water deficit. The mycorrhizae correspond to a symbiosis between beneficial fungi and the roots of plants, the fungus increases the water, macro and micronutrient absorption capacity, increases the resistance of plants towards diseases, scientifically it has been shown that it benefits plants that live in water stress, salinity, presence of pollutants, in return the plant gives the fungus the carbonized products of photosynthesis so that they can live.

Keywords: *AMF, inoculation, innovation, technology*

ORAL SESSION VII

11.45 – 12.40 am

INVITED SPEAKER: Dr. Martín Nuñez

11.45 – 12.05

OI06

Ectomycorrhizal fungi and pine invasions: lessons from Isla Victoria, Nahuel Huapi National Park

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There is clear evidence that soil organisms play a key role in plant invasion. Here we report the current understanding of the role of ectomycorrhizal fungi in pine invasions from data obtained in the last 15 years from Isla Victoria, Nahuel Huapi National Park. Isla Victoria is a 2000 hectares

island where, at the beginning of the last century, the Argentine government started a project to introduce many tree species to see which would grow better in the region. To this end, they planted over 130 tree species from all continents but Antarctica. In this area pines are able to spread but only to areas relatively near the original plantations. With a series of greenhouse and field studies, coupled with molecular analyses, we found that appropriate fungi were missing far from the plantations (ca. 2000 m), and this absence is halting the spread of introduced trees. Co-invasion of trees and their associated fungi is happening on the island since trees associate only with nonnative ectomycorrhizal fungi. Also nonnative mammals, mainly European deer and wild boar, seem to be the main drivers of the dispersal of fungi. Feces of deer and wild boar contained spores that can inoculate Pinaceae. With detailed surveys and molecular analyses, we found that some fungal species appear to have a high dispersal ability (notably the Suilloids), and other fungal species seem to be confined to the original plantations. A few species of fungi (Suilloids) dispersed by nonnative mammals seem to be driving the pine invasion on Isla Victoria. These results highlight the importance of soil biota to explain the pattern of spread of highly invasive trees in the Pinaceae family. Without an understanding of the ecology of soil biota, it would have been difficult to understand the detailed mechanisms of the observed pattern of tree invasion.
Keywords: *biological invasion, ectomycorrhiza, Isla Victoria, Pinaceae*

12.05 – 12.20 pm
OS19
Forest management and seasonal effects on the diversity and ecological function of soil fungi in a Northwestern Patagonian shrubland

A. I. Carron[1,2,*], L. A. Garibaldi[3,4] and S. Fontenla[1]

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The shrublands of the Andean-Patagonian region present high biodiversity and provide multiple ecosystem services, being one of the ecosystems with higher forestry activities in the region. Several natural and anthropogenic factors influence the soil fungus community. These microorganisms play a central role in ecosystem functioning and interaction with different species. Our objective was to evaluate the effects of forest management and season (autumn vs. summer) in the soil fungal community and their ecological function. Eight experimental plots were established in a native shrubland combining: thinning intensity (basal area removed 70, 50, 30 and 0%) and implantation of native tree species (implanted and not implanted). A soil sample/plot was collected in autumn and summer, one year after the forest management. We determined soil community characteristics and ectomycorrhizal occurrence of a dominant native tree (*N. antarctica*). The fungal soil community analysis was performed with the Roche Sequencing using the entire ITS region of fungal nrDNA (ITS1F-ITS4). The taxonomic classification were RAPD with UNITE/QIIME database and were assigned a trophic mode using FUNGuild database. Then, a

NMDS test was performed using Bray-Curtis dissimilarity. All *N. antarctica* adults had high values of ectomycorrhizal colonization (~80%) with non-significant differences between plots. At fungal classes, only a correlation was observed between taxonomic diversity and the season. The abundance of Eurotiomycetes and Dothideomycetes (including other mycorrhizal fungi, such as *Cenococccum*) was higher in autumn, while Sordariomycetes, Tremellomycetes and Leotiomycetes abundance was higher in summer. When the trophic modes were analyzed there were no correlation between them, the season, the thinning or the implantation. The saprotrophs and sapro-simbiotrophs were the most abundant trophic mode, represented by the genera *Hygrocybe* and *Mortierella* in both seasons. After this general behavior, the pathogens and symbionts that followed them in abundance presented different trends between seasons. Autumn was associated with the pathogen mode and summer with the symbiotrophic mode, particularly represented by ectomycorrhizal fungi with greater abundance of *Cortinarius*, *Descomyces* and *Inocybe*. The results suggest that in a Patagonian shrubland seasonal factors influence fungal diversity, at the class and gender level, and ecological function. Management factors do not appear to be determinant after one year of established thinning intensity and implantation of native tree species.

Keywords: *ectomycorrhizal fungi, Nothofagus antarctica, seasons and soil characteristics*

INVITED SPEAKER: Dr. Lucas Garibaldi

12.20 – 12.40 pm

OI07

Sustainable management of the native mixed forest: aerial and belowground interactions between plants and insects

L. A. Garibaldi[1,*], J. Aguero, A. Carron, C. Coulin, M. Fernandez, I. García, A. Girotto, M. Goldenberg, S. Fontenla, M. Nacif, F. Oddi, N. Pérez-Mendez and L. van Doorn

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The loss of native forests and the services that these provide is a problem of great relevance in Argentina and worldwide. Such loss is partly due to the lack of technologies that allow producers to use the forest sustainably, both in economic and environmental terms. In Río Negro, the native mixed forest, one of the most diverse in the region (also known as tall shrubland), has been historically replaced by livestock systems or by afforestation with exotic species. In three mixed forests of Río Negro, we are evaluating the relationship between economic profitability and the environmental impact of 8 management practices. These practices result from a factorial design at the plot level (1418 m2 each), which includes 4 harvesting intensities crossed with plantation of native tree species (plots with or without plantation). At the transect level within the plot, we planted 3 origins of each of 6 native tree species (one species per transect). These practices prioritize different forest products, such as firewood and non-wood products in the unplanted plots vs. timber in the planted plots, and we expect them to have different environmental and economic impacts. We are evaluating the response of quantitative plant-insect interaction networks, both

aerial and belowground, focusing on plant-pollinator interactions, plant-leaf herbivores and plant-root herbivores. Insects are an important component of the biodiversity of Patagonian forests, which in turn can have an impact on forest productivity and timber quality as well as on non-wood products. We will evaluate leaf quality for herbivores and physical-chemical characteristics of soils that impact both plants and insects. We will relate the impact of practices on quantitative networks of plant-insect interaction with aspects of economic profitability (e.g. product quality, target market and price). From the point of view of the implementation of local and regional policies, we will provide information lacking on management technologies, economic profitability and environmental impact that will contribute to the adequate implementation of the Law 26,331 of Minimum Budgets for the Protection of Native Forests. For example, our results will contribute to the allocation of economic incentives to producers by Law 26,331 according to the economic profitability and the environmental impact of the practices proposed in their management plans. From the global and conceptual point of view, our results will be novel contributions on less explored aspects of agricultural and forestry theory, such as the simultaneous interaction of a diverse group of plants and insects and their consequences on the belowground and aerial processes.

Keywords: *ecological intensification, forest management, biodiversity, ecological interactions, ecosystem services*

CONFERENCE: Dr. Maarja Öpik

2.15 – 2.55 pm

C05

Arbuscular mycorrhizal fungi under the pressures of environmental change

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Current global environmental change has palpable influence on humans and nature alike. Soil biota, including fungi in soil and plant-symbiotic arbuscular mycorrhizal (AM) fungi are directly and indirectly influenced by changes in climate, increased frequency of extreme weather events, changed and increasing anthropogenic pressure, including loss and fragmentation of habitats as well as invasion of non-native species. The various aspects of global change influence other biota, which in turn change the biotic and abiotic environment for AM fungi. In my presentation I will address the current knowledge on how land use and its change influences AM fungal diversity and functioning. Further, I will explore how the less-studied non-nutritional functionalities of AM fungi such as drought protection matter under the conditions of fluctuating weather. I will also look into the scenarios where AM fungi can be successfully applied to improve vegetation restoration. I will conclude with looking into the most burning knowledge gaps on the way of fostering soil biota, including AM fungi, for global change mitigation and adaptation.

Keywords: *arbuscular mycorrhiza, land use, environmental change, diversity*

ORAL SESSION IX

2.55 – 3.25 pm

2.55 – 3.10 pm
OS20

Arbuscular mycorrhizal fungi in a Mollisol from the Andean Region of Ecuador

M.E. Avila[1,*], F. Montesdeoca[1], M. Orellana[1], K. Pacheco[1], F. Borie[2,3], P. Cornejo[2,3], N. Becerra[2,3], Y. Cerda[2,3] and P. Aguilera[2,3]

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Ecuador is an Andean country undergoing intensive agriculture to achieve high food productivity. Under conventional tillage, nutrients replenishment back into the soil is generally not considered due to the high cost of fertilizers for small scale local farmers. In this sense, the agricultural sustainability in this region faces high risks. Conservational agriculture, on the other hand, is a well-known alternative for enhancing soil biological activities, including those of the arbuscular mycorrhizal fungal (AMF), which increase water and nutrients transportation to the plants, and promote ecosystemic benefits. In Ecuador, a long-term comparative research study between plots with intensive tillage vs. conservative tillage has been proposed under bean-maize and bean-amaranth rotations with increasing fertilization levels. Biological, physical and chemical properties will be evaluated at harvesting time. Under this context, the objective of this preliminary study on precedent crops (grasslands, maize and potatoes), was to characterize the soil´s AMF status including glycoprotein (GRSP) concentration, which will contribute to set a data baseline for comparative coming studies about fungal symbiosis in crops. Soil samples from these mentioned precedent crops were analyzed following specific protocols for biochemical and for AMF morphological characterization. Root colonization was analyzed as well, in grasslands, maize and potatoes plots, evidencing that the AMF´s colonization percentage in spontaneous appearing plants growing in these plots occurs, and is strongly different among plant species. GRSP levels detected in soil samples ranged between 2.3-2.8 mg g^{-1}, while the identified species of AMF spores corresponded to the following families and genus: *Acaulosporaceae (Acaulospora)*, *Pacisporaceae (Pacispora)*, *Entrophosporaceae* (*Claroideoglomus, Glomus, Simiglomus*) and Paraglomeraceae (*Paraglomus*). For the long-term research project that will be assessed, our preliminary findings have great importance, because they represent the first AMF taxonomic diversity and colonization status determination in Ecuadorian plots with a combination of soil management practices. This study will strongly contribute to soil management improvement in the Andean region of Ecuador, focusing on the benefits of sustainable soil management practices for the agricultural development in this country.

Keywords: *AMF diversity, intensive and conservative tillage, glycoprotein*

3:10 – 3:25
OS21
Soil chemical attributes, but not plant genotypes, affect mycorrhizal root colonization in on-farm grown maize landraces, conventional, and genetically modified hybridsin Santa Catarina, Southern Brazil

B. S. Ventura, E. Meyer, J. A. Scarsanella, K. G. Anjos, M. B. Agudelo and P. E. Lovato

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Small farmers in Brazil grow maize (*Zea mays* L.) under diverse management systems, using various plant genotypes and different methods to control fungi, pest, and spontaneous plants. Those management techniques may affect the arbuscular mycorrhizal symbiosis. With the aim of evaluating the effects of soil chemical attributes and plant genotype on mycorrhizal colonization, soil and roots were collected in farms managed using three groups of corn genotypes: landraces (LR), conventional hybrids (CO), and genetically modified (GM) hybrids. Soil, shoots, and roots were collected in 15 farms, five from each group, in São Miguel do Oeste and neighboring municipalities. There were with five collection points in each site, for two consecutive years (2016 and 2017). Mycorrhizal colonization, soil chemical parameters, and leaf P content were determined. The data were submitted to analysis of variance and redundancy analysis (RDA) to check the relationships among physical and chemical soil variables and those related to mycorrhizas. In both harvests, root varied within the culture systems. Arbuscule frequency varied between 6-34% and 13-63%, and vesicles frequency ranged between 1-12% and 2- 40% and total root colonization ranged from 27-67% and 43-87%, in 2016 and 2017, respectively. Leaf P content did not differ among treatments in 2016, but in 2017, the TR treatment had lower values than CR, and CO. Soil chemical attributes showed to affect the mycorrhizal variables more than the maize genotype groups (landrace, conventional, or GM) emphasizing the importance of soil fertility management for the symbiosis.
Keywords: *arbuscular mycorrhizal fungi, soil phosphorus, Zea mays*

E-POSTER SESSION III

3.50 – 5.05 pm

3.50 – 3.55 pm
EP28

Effect of arbuscular mycorrhizal fungi on the bioremediation potential of *Brachiaria humidicola* in soils contaminated with hydrocarbons

H. Aponte[1,2,*], W. Herrera[1,2], L. Milagros[2], I. Hernández[3] and L. Fajardo[2]

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Soil contamination by petroleum hydrocarbons has become a worldwide environmental issue due to the extraction and transport of fossil fuels because of its high demand. There are several methods to successfully bioremediate hydrocarbon contaminated soils. For instance, plants can phytoremediate contaminated soils with petroleum hydrocarbons, and microorganism associated with the rhizosphere can also do it. Among these, the role of arbuscular mycorrhizal fungi (AMF) as petroleum-degrading microorganisms is not well understood. The current study investigated the effect of two AMF mixed inocula on the phytoremediation of Venezuelan heavy crude contaminated soil. One of the inocula comes from a native non-contaminated locality and the other one comes from contaminated soils. Previously germinated seedlings of *B. humidicola* were sown in pots with sterile soil under different treatments: i) inoculated with AMF native inoculum, ii) inoculated with AMF contaminated inoculum and iii) not inoculated (control). All these treatments were exposed to 6000 mg kg^{-1} of heavy crude contaminated soil for 6 months in a greenhouse. The results showed that there are significant differences in the survival, leaf numbers, radical length and growth of *B. humidicola* among treatments. The degradation rate of the total petroleum hydrocarbons (TPHs) of plants with native inoculum was significantly higher than the non-inoculated group and presented a degradation of 3238 mg TPHs kg^{-1} (53.77%). The results indicated that *B. humidicola* combined with this microorganism pool would be a feasible method to phytoremediate contaminated soils with petroleum hydrocarbons.
Keywords: *AMF, oil, petroleum, phytoremediation*

3.55 – 4.00 pm
EP29

Phytoremediation of hydrocarbon-contaminated substrate using *Lolium multiflorum* associated with *Rhizophagus irregularis* or an AMF native inoculum isolated from the Ecuadorian Amazon

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Arbuscular mycorrhizal fungi (AMF) are obligate symbionts with 72% of vascular plants and represent 5 to 10% of the soil microbial biomass. Several studies have demonstrated the role of AMF to improve hydrocarbon remediation. Here, the hydrocarbon phytoremediation by RyeGrass plants inoculated with AMF or not (Negative Control "NC") was determined on artificially-polluted substrate. A mixture of volcanic rock and previously sterilized compost with 5% of crude oil was used. The experiment was set up with three treatments for 34 weeks. The treatment "T" was inoculated with a native multi-spore inoculum isolated from an oil pond of the Ecuadorian Amazon; treatment "R" with a model strain *Rhizophagus irregularis* and treatment "NC", without AMF inoculum. Root colonization and count of spores revealed the establishment of the symbiotic relationship. Moreover, the substrate was analyzed to demonstrate the reduction of hydrocarbon concentration. Finally, at the end of the study, the presence of bacteria, fungi and actinomyces, as accompanying flora in the substrate of each treatment, was reported without significant difference. The AMF root colonization in treatments T and R were very low. However, spore (sps) counting increased from initial inoculum 4 sps 10 g^{-1} substrate to 115 sps $10g^{-1}$ and 64 sps $10g^{-1}$ (T, R, respectively) at the end of the study. Bioremediation ratios C17/Pristane and C18/Phytane ($p<0.01$, $p<0.01$, respectively) demonstrated treatment R as the best bioremediation trial, followed by NC. Degradation percentages of pristane and phytane ($p<0.01$, $p<0.01$, respectively) showed R and NC as the most effective for degradation. Low colonization may be due to the adverse effects of crude oil on root exudates, spore germination and formation of the symbiosis. The decrease of crude oil in treatment R agree with previous studies demonstrating the effectiveness of *R. irregularis* to enhance bioremediation. Likewise, the effectiveness of treatment NC might be due to the absence of mycorrhizal symbiosis under stress conditions. Therefore, non-mycorrhized plants focused their energy into developing under hydrocarbon conditions rather than establishing symbiosis. The low effectiveness of treatment T suggests a limited degradation activity despite the higher number of spores compared to treatment R. The use of plants previously mycorrhized for hydrocarbon-polluted soil remediation may save energy consumption in the symbiosis and ensure the effect of biodegradation.

Keywords: *bioremediation, mycorrhiza, oil ponds*

4.00 - 4.05 pm

EP30

Efficiency of two AMF inocula to improve saline stress tolerance in lettuce plants by changes of antioxidant defense mechanisms

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Arbuscular mycorrhizal fungi (AMF) establish a symbiosis with more than 80% of agricultural plants, improving water and nutrient absorption under salinity stress. In this study, the functional contribution of two arbuscular mycorrhizal strains (*Claroideoglomus claroideum* -Cc- and a

consortium of AMF isolated from saline soils -AMC-) on the growth and antioxidants compounds activity of two cultivar of lettuce (*Lactuca sativa* cv. Grand Rapids and Lollo Bionda), was evaluated under increasing salt stress conditions (0, 40 and 80 mM NaCl). The objective of the present advance was to evaluate the effect of selected AM fungal community on the growth, nutrition and the antioxidant response of lettuce plants under salinity stress conditions. At 60 days of growth symbiotic development, biomass production, oxidative damage to lipids, proline content, antioxidant enzymes and phenolic compound activity and antioxidants capacity were evaluated. The two AMF inoculum produced a high percentage of root colonization, which produced a higher growth at all levels of salinity, compared to plants non-inoculated. These results were directly related to lower oxidative damage, increased synthesis of proline, high enzyme activity and low phenolic compounds activity. Our results suggest that this improved with growth is due to the changes that produce AMF on the modulation of antioxidant defense mechanisms, increasing mainly enzyme activity and proline content, and diminishing phenolic contents. This is important due to the level of lettuce production on saline soils and the possibility to improve the crop by means of direct inoculation with efficient AMF strains.

Keywords: *enzymatic activity, phenolic compounds, salt stress*

4.05 – 4.10 pm
EP31
Halotolerant endophytic bacteria enhance arbuscular mycorrhizal colonization in poplar production under greenhouse condition

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Plant's roots harbors diverse population of microorganisms including fungi and bacteria. These microorganisms could play important roles in plant development and growth, as well as in the regulation of the endophytic populations. Poplar species present different behavior respect symbiosis, with mixed mycorrhizae or only one of them. The aim of the present study was to evaluate the effect of endophytic bacterial on growth and mycorrhizal colonization of poplars cuttings produced under greenhouse conditions. Endophytic bacteria were isolated from roots of *Populus xcanadensis* 'Guardi' (PG) in commercial plantation on saline soil, and the mycorrhizal status of these was assessed. Bacterial isolates were identified by 16S rDNA gen fragment sequencing, and auxin production and tolerance to NaCl were evaluated. These isolates were inoculated on a pot trial with PG and *P. nigra* 'Jean Pourtet' (PJP) cuttings, with soil from potential production sites. After one growing season, cuttings were harvested, growth parameters and mycorrhizal colonization were evaluated. Adults trees from the plantation were colonized by arbuscular mycorrhizae (AM, 85%) and ectomycorrhizae (80%). Two bacterial isolates were identified as *Pseudomonas* sp., belonging to the "fluorescens groups", and *Bacillus* sp.;both isolates were tolerant to NaCl (5 and 10%, respectively). Only *Pseudomonas sp.* strain showed high auxin production (2,8mM) which increased growth of PG cuttings, but with no significance difference. *Bacillus sp.* reduce shoot/root rate in PJP cutting at significant level. No ectomycorrhizal were observed on either species, but both have AM. *Bacillus sp.* inoculation of

PJP cuttings result on significant higher arbuscular colonization (75%) than control plants (69%, p=0,04). Our results revealed that adult tree growing in the commercial plantation were highly colonized by arbuscular mycorrhizae and ectomycorrizae, despite the saline condition of soils. Bacterial inoculation had different effects. *Pseudomonas* seems to improve height and biomass production on PG cuttings. *Bacillus* was able to enhance mycorrhizal colonization by natural inoculum (residing in soil used for pot trial) in PJP but not in PG. *Bacillus* isolate will be a good candidate for production assays in stressed condition due to be used as mycorrhizal-helper and to its tolerance to NaCl. Here we highlight the potential use of poplar's endophytic bacterial to enhance Populus production under saline conditions.

Keywords: *mycorrhizal-helper, Pseudomonas, Bacillus*

4.10 – 4.15 pm
EP32

Diversity of arbuscular mycorrhizal fungi in agricultural systems in acidic andisols

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In southern Chile, the crop production is predominantly established on volcanic soils. These soils have limitations for production, such as their high P-fixing capacity and high levels of exchangeable Al. To address these conditions, farmers have implemented a series of strategies, including the lime application, phosphate fertilizers, and the use of tolerant cultivars. Together with the above, the increased activity of arbuscular mycorrhizal (AM) fungi emerges as an interesting alternative because their contribution has been extensively documented in acidic soils. AM fungi also participate in Al phytotoxicity attenuation processes by reducing the Al activity of soil because they bioaccumulate the metal in its fungal structures and in the protein produced by them called glomalin. As a consequence, the availability of this phytotoxic element in the rhizosphere decreases and at the same time a greater mobility of nutrients to the plant occurs, mainly P, Ca and Mg. Several beneficial aspects of the symbiosis will be conditioned by a part to land use intensity and agricultural management, both aspects related to the sustainability and nutrients cycling and on the other hand, to the structure and composition of the AM fungal community along with functionality in promoting plants fitness to this environmental stress condition. The aim of this study was to define the agro-edaphoclimatic areas present in a homogeneous distribution of soils (series, family) that have agricultural production systems with different degrees of intensity of agronomic management and to compare AM fungi status, focused on colonization, mycelia and spore volume. In this period interviews were conducted with academics and researchers specialized in agriculture developed in the three regions in the area

of traditional crops such as cereals, fruit species, native forest ecosystems, meadows and vegetables. Within these crops, different types of agronomic management were considered, from the conventional, integrated and finally organic management. After the analysis of fungal propagules, a higher intensity of these was obtained in organic-managed soils and in systems with lower intensity of soil use. The most representative species corresponded to the following families and genus: *Acaulosporaceae (Acaulospora)*, *Pacisporaceae (Pacispora)*, Glomeraceae (*Claroideoglomus, Glomus, Simiglomus*) and Paraglomeraceae (*Paraglomus*).
Keywords: *AMF diversity, ArcGIS, soil use intensity*

4.15 – 4.20 pm
EP33
Comparative study of guava (*Psidium guajava*) and cocoa (*Theobroma cacao L.*) rhizosphere microbiota under different management: an ongoing project
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The study of the microbial communities within the plant rhizosphere is key to the understanding of their role in the growth and ecological fitness of the plant host. The rhizosphere community is complex and consists of a myriad of organisms that are interconnected in many ways, acting on each other and reacting to their environment. Two important components of the plant rhizosphere´ microbiome are the arbuscular mycorrhizal fungi (AMF) and oomycetes. This abstract presents a summary of an ongoing research project in which we will examine the community composition of AMF and oomycetes from cocoa (*Theobroma cacao*) and guava (*Psidium guajava*) crops, belonging to different provinces of Ecuador. We extracted DNA from soil and root samples of cocoa cultivated with organic or conventional management, and from wild and cultivated guava. We plan to use next generation sequencing of the ITS (oomycetes) and LSU (mycorrhizae) regions. Subsequently, we will use a bioinformatical pipeline to visualize and compare the structure of microbial communities of oomycetes and mycorrhizas. Finally, we will measure diversity (abundance and richness) using Chao, Shannon and Simpson indices to determine differences between the communities. We hypothesized that the abundance and richness of AMF and oomycetes in the soil and roots of the cultivated guavas will be lower compared to the wild guavas because fungicides are usually used in cultivated plants. Regarding cocoa, we hypothesize that the abundance and richness of AMF and oomycetes will be higher in roots and soil of cocoa grown with organic management, because no pesticides are usually used in these sites. With the results from this study, it will be possible to obtain future recommendations for the development of a sustainable agriculture together with a better understanding of the relationships between the microorganisms that are part of the rhizosphere of the crops of interest.
Key words: *arbuscular mycorrhizae, indices of diversity, oomycetes*

4.30 – 4.35 pm
EP34
Evaluation of arbuscular mycorrhizal fungi in an agroforestry system with coffee in Jaen – Perú
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The agroforestry systems with coffee, have diverse structural compositions, different levels and types of handling, which contribute to reach the sustainability of the systems of production and improve the standard of living of the population. The objective of the investigation was to determine the genders and species of mycorrhizae presents in the rhizosphere of the vegetable species comprised of *Acrocarpus fraxinifolius, Cordia alliodora, Eucalyptus saligna and Arabic Coffea var. Catuai.* It was evaluated the percentage of mycorrhizal colonization realizing colorations with trypan blue in culm of the species in study; for the quantity of spores and its identification of the genres and species it was used as the basis the size of the spores found in the samples of rhizosphere soil of every mentioned species. It was obtained as results 22 morphotypes of which 18 belong to the genre *glomus*, 2 to *aculospora* and 2 to *entrophospora*. Concluding that the biggest colonization is found in *Arabic Coffea var. catuai* with 81.70 % and the species *Acrocarpus fraxinifolius* had the highest number of spores in the rhizosphere, with, 5 100 spores in 100g of soil, the genera *Entrophospora* and *Glomus* predominate
Keywords: *agroforestry system, coffee, mycorrhizal fungi*

4.35 – 4.40 pm
EP35
Arbuscular mycorrhizal fungi and the development of saplings of acerola (*Malpighia emarginata* d. C.) derived from herbaceous cuttings
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Arbuscular mycorrhizal fungi (AMF) are beneficial microorganisms useful for the production of saplings, both in their initial growth-phase and in their establishment in the new environment after transplanting. This study evaluates the effects of inoculation with different AMF species on the saplings of the acerola bush *Malpigia emarginata* D.C. (an important fruit species) derived vegetatively from herbaceous cuttings. Saplings were grown in 500 mL tubes containing Plantmax® substrate until root formation and subsequently inoculated with three AMF species (*Gigaspora margarita*, *Claroideoglomus etunicatum* and *Glomus clarum*) as well as a combination of the three, in a completely randomized block design with ten replicates per treatment. After inoculation, saplings were grown for a further 100 days in a greenhouse. We monitored plant height every 15 days and calculate absolute and relative growth-rates. The results indicated potential for the production of *Malpigia emarginata* D.C. seedlings by cuttings inoculated with FMA

with a tendency to reduce the time for transplanting. The combination Gimarg + Claetun promoted higher rates of absolute growth and height of seedlings from herbaceous cuttings indicating their potential in the production of acerola seedlings.
Keywords: *inoculation, sapling production, vegetative propagation*

4.40 – 4.45 pm
EP36
Arbuscular mycorrhizas and plant growth in maize landraces and commercial hybridsused in Western Santa Catarina, Brazil
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Corn (*Zea mays* L.) has great social and economic importance for small farmers in Brazil, and there is a diversity micro center in Western Santa Catarina, in South Brazil. Maize, as most plants, benefits from association with microorganisms, including arbuscular mycorrhizal fungi (AMF). The effect of breeding on microbial symbiotic behavior in modern corn varieties is still controversial since previous studies have shown diverse impacts of breeding techniques on the mycorrhizal association. With the aim of evaluating mycorrhizal colonization rates, plant growth and P uptake in maize genotypes with diverse origins, a greenhouse experiment was carried out with five genotypes of maize landraces and five commercial hybrids. Taquara, Pixurum 07, Branco precoce, Lingua de Papagaio, and Amarelão are the most widely grown landraces, and Santa Helena SHS 5050, Morgan 20A55, Santa Helena SHS 5070, Prezzotto PRE 22D11, and Catarina SCS 155 are the most common hybrids in Western Santa Catarina. Plants belonging to those ten genotypes were grown in pots with non-sterile soil having low P levels. After 60 days, the plants were harvested, and height, stalk diameter, shoot (SDM), and root (RDM) dry mass, SDM/RDM ratio, root colonization, and leaf P content and accumulation were measured. All data were submitted to analysis of variance and the Tukey test at 5% was used to separate the means. Although no differences in mycorrhizal colonization occurred, maize genotypes showed diverse growth strategies in the low-P soil. The Morgan 20A55 hybrid showed the highest shoot dry matter in such conditions. That may be due to a denser root system, as compared to the other genotypes.
Keywords: *phosphorus, GM corn, Zea mays*

4.45 – 4.50 pm
EP37
Phosphorus acquisition traits of two wheat cultivars colonized by indigenous AMF
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Inorganic phosphorus (Pi) fertilizers are expected to become scarce in the near future; so, breeding for improved Pi-acquisition related root traits would decrease the need for Pi fertilizer application. This work aimed to decipher the morphological, physiological and biochemical mechanisms, and the associated arbuscular mycorrhizal fungi (AMF) community underlying the differences in Pi-acquisition efficiency (PAE) between two commercial wheat cultivars (Crac and Tukan). For that, the two cultivars were grown in rhizoboxes filled with an acidic soil with or without Pi-addition until Zadoks phenological stage 21 and the Pi-acquisition related root traits were assessed. The results showed that both cultivars presented similar mycorrhizal colonization regarding Pi treatment. However, Tukan plants showed a preferential association withone Archeospora-like specie, while Crac presented a potential clustering with one Claroideoglomus specie. Crac plants presented higher Pi-acquisition independently of Pi-addition, which was highly correlated with root parameters. In this sense, Crac plants presented a larger, thinner, more branched, and Pi-efficient root system than Tukan plants. Even though unfertilized Crac plants did not presented higher shoot growth at this phenological stage, it could comprehend an important source to sustain growth hereafter. Moreover, Crac growth responses to extra Pi supply were higher than to the observed for Tukan ones. In addition, Crac plants presented an improved oxalate exudation, especially on top roots of fertilized plants, which could be an important mechanism to enhance PAE in high Pi-fixing soils. Finally, the results obtained in the present study increased the knowledge in how differential root traits affected Pi-acquisition, and thus could comprehend a useful target for breeding programs oriented to a more sustainable use of Pi fertilizers.
Keywords: *phosphorus efficiency, P-fixing soils, root traits*

4.50 – 4.55 pm
EP38
Arbuscular mycorrhizae and two Patagonian yeasts co-inoculation effects on tomato production under greenhouse conditions
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The use of microorganisms is a valued tool in agricultural production to expand productive borders and minimize the use of fertilizers. Technological investment is also a challenges that regional

and national production needs to address. In recent years, *in-vitro* physiological characteristics associated with plant growth promotion has been described in yeasts. The tomato is one of the most important horticultural crops in Argentina. The aim of this work was to evaluate the development of tomato plants (*Lycopersicum esculentum*) inoculated with two Patagonian native yeasts and the arbuscular mycorrhizal fungus *Funneliformis mosseae* (FM) in a pot trial inside the greenhouse. The yeast isolates were selected for their ability to produce auxin-like compounds, siderophores and solubilize phosphate. Germinated seeds of tomato were transplanted to tray containing sterile commercial seedbed substrate, with or without FM inoculum. After the appearance of the first true leaves, the seedlings were inoculated with a suspension of yeasts. Forty days old seedlings roots were collected to evaluate mycorrhizal colonization and they were transplanted into pots with perlite, peat and non-sterile soil from the surrounding areas. Plant growth and symbionts behaviour were evaluated at the end of growing season. Yeast inoculation showed no significant differences on growth or production variables. Plants inoculated with FM showed significant increase of stem length and dry aerial biomass, and also in production variables: higher proportion of plants with fruit, greater number and weight of fruits. Seedlings at the time of transplant showed no mycorrhizal colonization; while at harvest time, the plants reached 28-50% of AM colonization. A significant increase was also observed by the inoculation of FM and the yeast strain identified as *Saccharomyces eubayanus*. For the production of tomato, simulating normal greenhouse production, the inclusion of FM symbionts showed beneficial effects on growth and productive variables. The inclusion of *S. eubayanus* a soil yeast, which seems to be a colonization-helper when used together with *F. mossae* inoculum. The co-inoculation of both microorganisms could be a suitable strategy to improve production in the region.

Keywords: *Funneliformis mosseae, Saccharomyces eubayanus, Lycopersicum esculentum*

4.55 – 5.00 pm
EP39

Initial approaches on the use of biochar as substrate in greenhouse experiments with arbuscular mycorrhizae and *Phisalys peruviana* L.

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Biochar is a product of the pyrolysis of residual vegetation biomass, which provides carbonized particles used for soil conditioning. In order to assess its use as substrate and support for the production of inoculants based on Glomeromycota fungi, a biochar obtained from parks vegetation in Lima (pH = 10.6, 28% MO) was used. Biochar characterization showed that the most favorable particle size for plant growth was 0.5 - 2.0 mm; mean lethal dose over *Phisalys peruviana* L. was 43.56% v / v (Probit analysis, 95% confidence limits); finally, biochar pH was adjusted to 7.0, to compare both pH conditions. Original and conditioned biochars were mixed with sand (25% v / v) in a greenhouse experiment with *P. peruviana*, inoculated or not with *R. intrarradices* (with 1388 spores / 100 g soil and rootlets with 89% arbuscular mycorrhiza colonization). Treatments were: sand without and with AM (T1 and T2); conditioned and original

biochar/sand) without (T3 and T5) and with AM (T4 and T6). After three months, plants were harvested; controls grown in sand inoculated with AM showed the highest height and biomass. Only 12.5% of plants grown in original biochar survived (T5 and T6), indicating the need to improve its chemical/physical characteristics for its potential use. Mycorrhizal colonization facilitated development and production of biomass of *P. peruviana* grown in sand + conditioned biochar (T4). The implications of the use of biochar in inoculation experiments with arbuscular mycorrhizae and/or reproduction of Glomeromycota fungi are discussed.
Key words: *biochar, arbuscular mycorrhizae (AM), Phisalys peruviana*

5.00 – 5.05 pm
EP40
Management impacts on Mycorrhizal fungal presence in *Solanum tuberosum* in Ecuador
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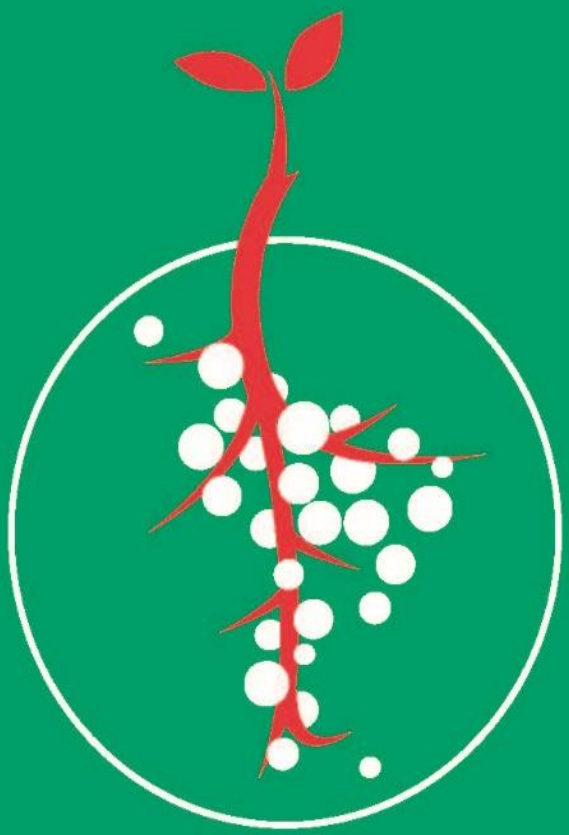
In natural communities, arbuscular mycorrhizal fungi (AMF) form largely beneficial relationships, they have a positive role in plant nutrition, pathogen protection, stress tolerance and soil structure provision that may enhance the establishment of young plants by supplying them with resources, thus making them more tolerant of environmental stress and increasing their competitive ability. The optimal utilization of arbuscular mycorrhizas is important for the maintenance and sustainability in plant production. However, changes in the chemical, physical and biological variables in the soil may affect mycorrhiza. Here, we evaluated functioning of AMF in their symbiosis with plants across plots with different soil management in Ecuador. According to the type of established agricultural system, we selected agricultural potato fields with high and low input of agrochemicals in the provinces of Cañar, Cotopaxi and Carchi, Ecuador. We extracted three composite soil samples from each of five soil sub-samples, each up to 20 cm deep. From these samples, root dry weight, root colonization, mycorrhizal visual density, external mycelium biomass, internal mycelium biomass and spore density were evaluated. The highest root colonization and mycorrhizal visual density was observed at low input agricultural potato fields with a mean value of 65.4 and 7.76%, while ecosystems with high inputs showed 51.0 and 5.13%, respectively. Root dry weight and external mycelium biomass were higher at high input agricultural potato field (7.45 and 71.22 respectively) than lower input fields (4.84 and 52.35 respectively); Spore density in plots with low inputs triplicates the values obtained for high input agriculture soils (21974 vs. 7730 spores.dm-3). Modern agriculture has been developed for high input of agrochemicals which we show here may negatively impact mycorrhizal functioning. On the other hand, ecosystems with a low input of agrochemicals showed the highest mycorrhizal variables values. Statistically significant at a value of $p< 0.05$. These results may help us improve agricultural practices to take advantage of the several benefits from AMF.
Keywords: *agrochemicals, phosphorus, potato*



II INTERNATIONAL SYMPOSIUM MYCORRHIZAL SYMBIOSIS IN SOUTH AMERICA