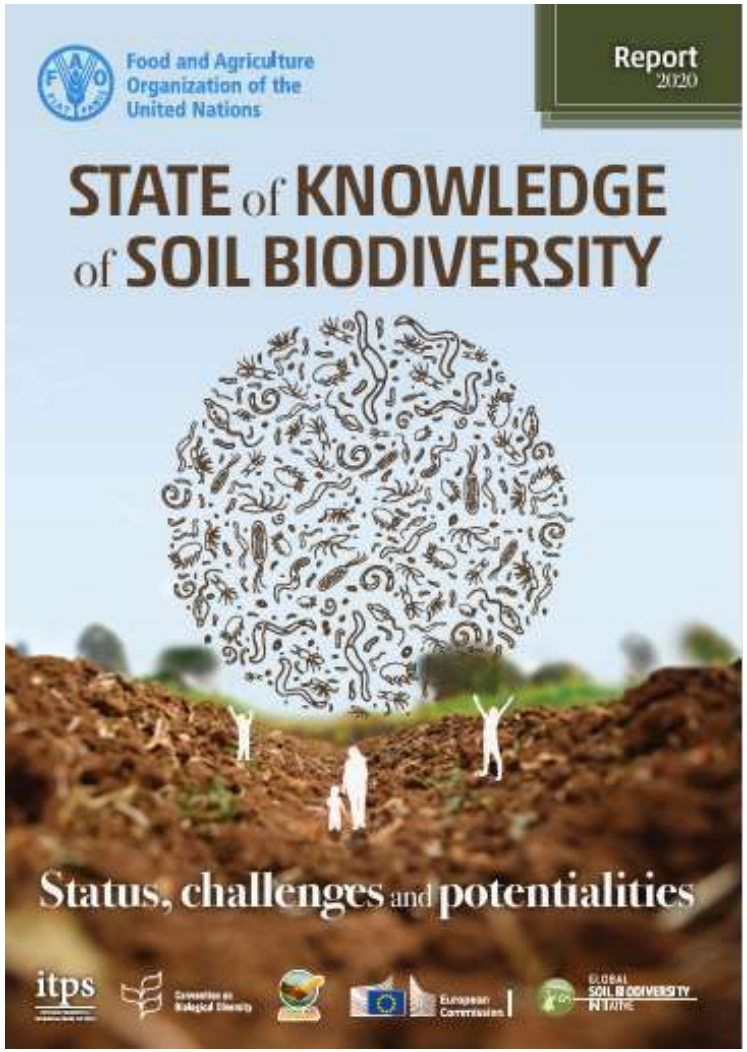
Arbuscular Mycorrhizal Fungi: Diversity, Interactions, and Their Impact on Plant Symbioses.

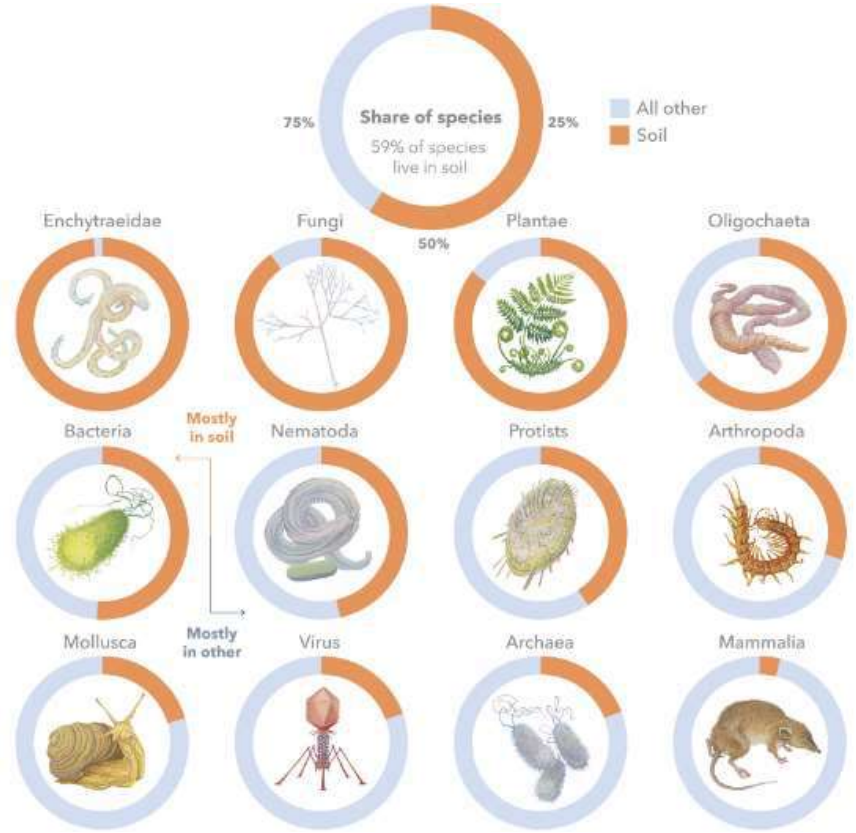
PhD. María Victoria Vignale

Researcher

Instituto de Biología Subtropical (IBS), Puerto Iguazú (CONICET-UNAM), Argentina.

Soil is the habitat of 59% of the planet's biodiversity.





PNAS RESEARCH ARTICLE | ECOLOGY

Enumerating soil biodiversity

Mark A. Anthony[a,b,1], S. Franz Bender[a,c], and Marcel G. A. van der Heijden[a,c,1]

2023

Much remains to be understood.

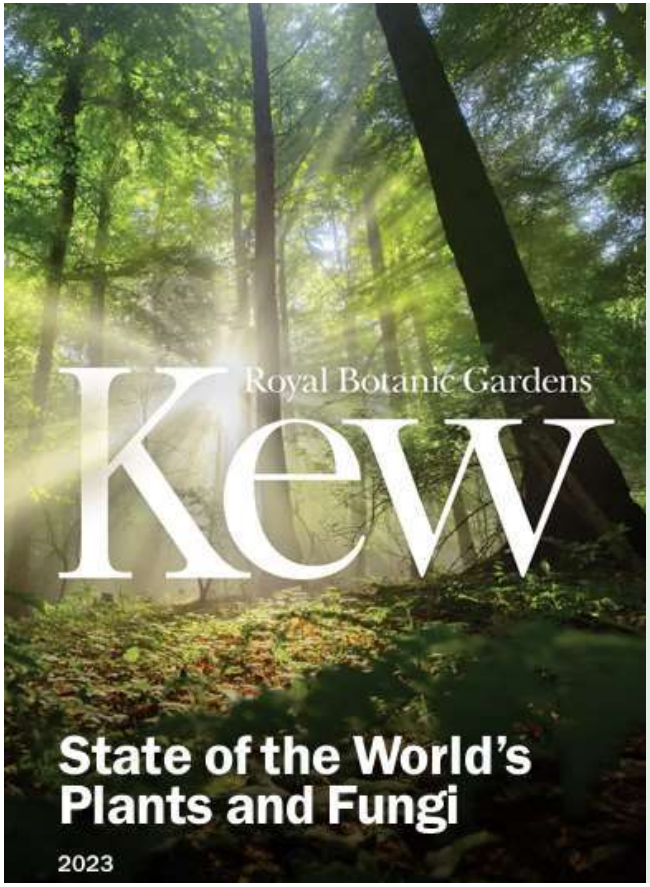
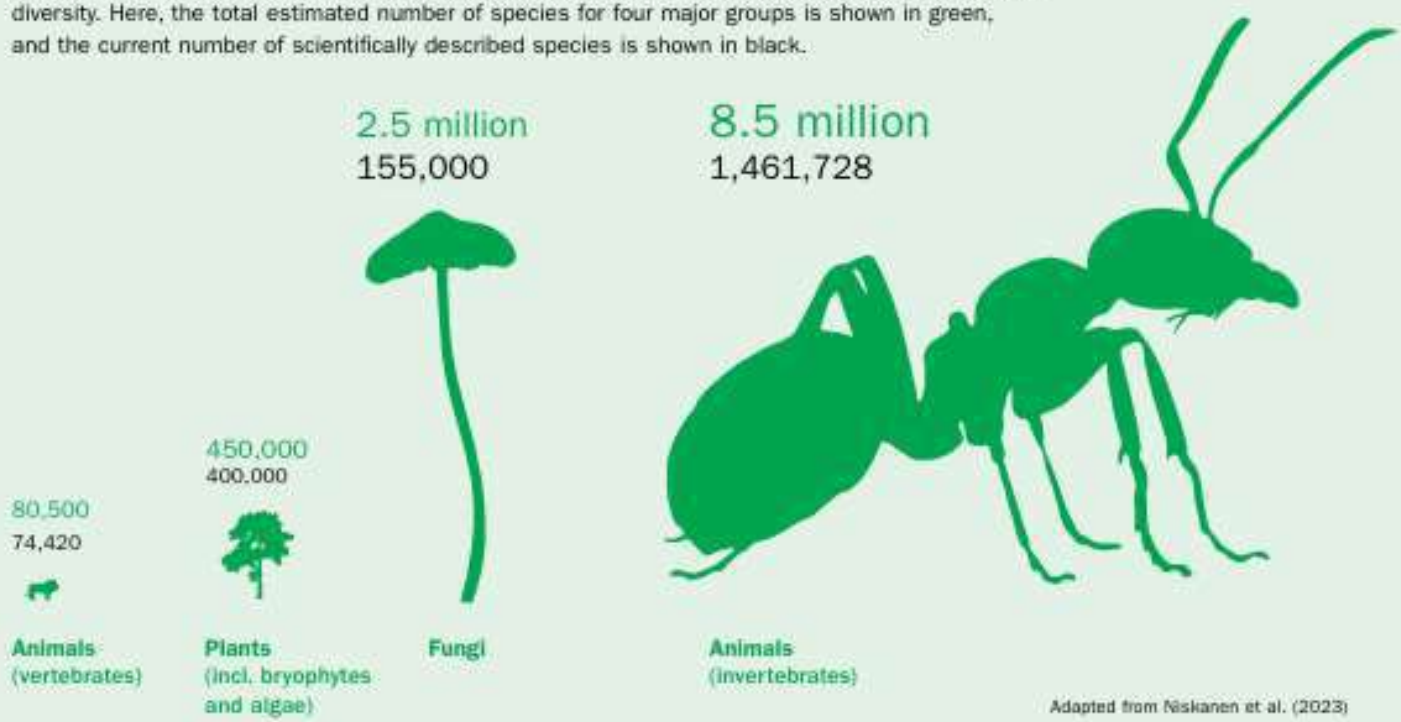
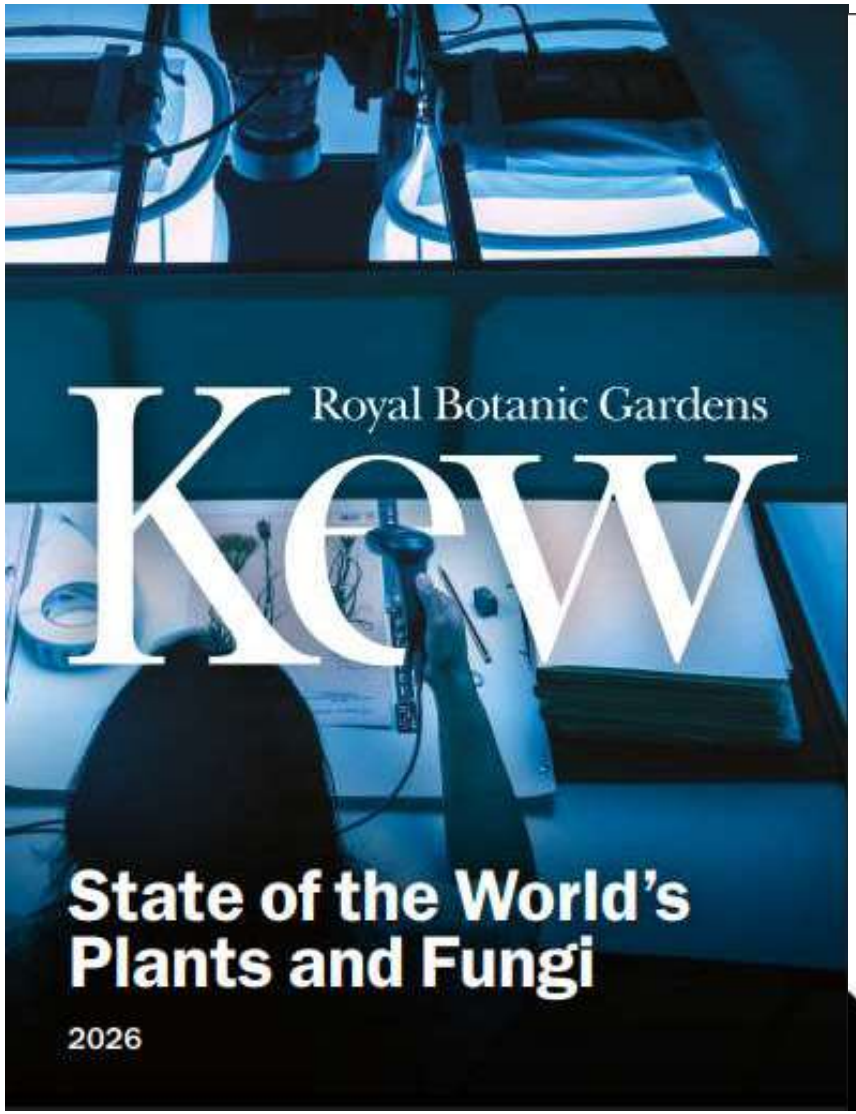


FIGURE 1: How species diversity differs between animals, plants and fungi

An updated estimate confirms fungi as second only to invertebrate animals with regards to species diversity. Here, the total estimated number of species for four major groups is shown in green, and the current number of scientifically described species is shown in black.



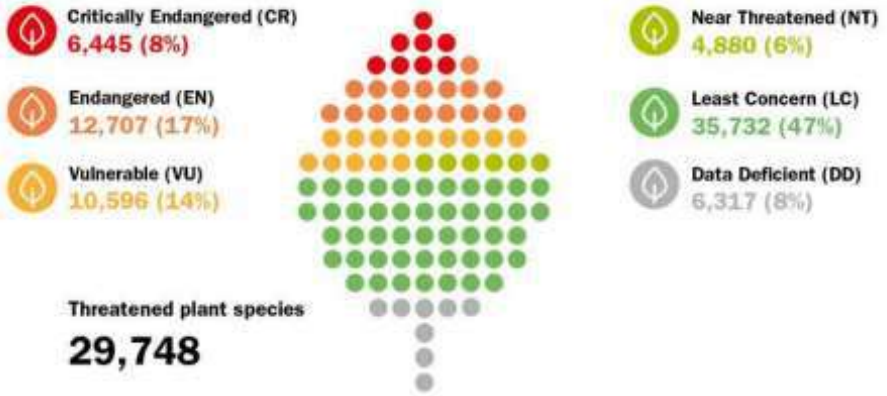
Adapted from Niskanen et al. (2023)



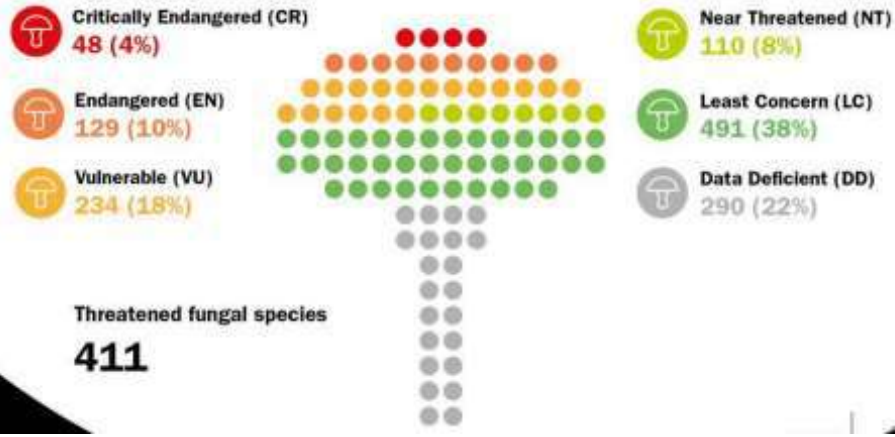
How many species are at risk?

Number of species in six of the nine IUCN Red List categories (excluding Extinct, Extinct in the Wild and Not Evaluated) and the corresponding percentages.

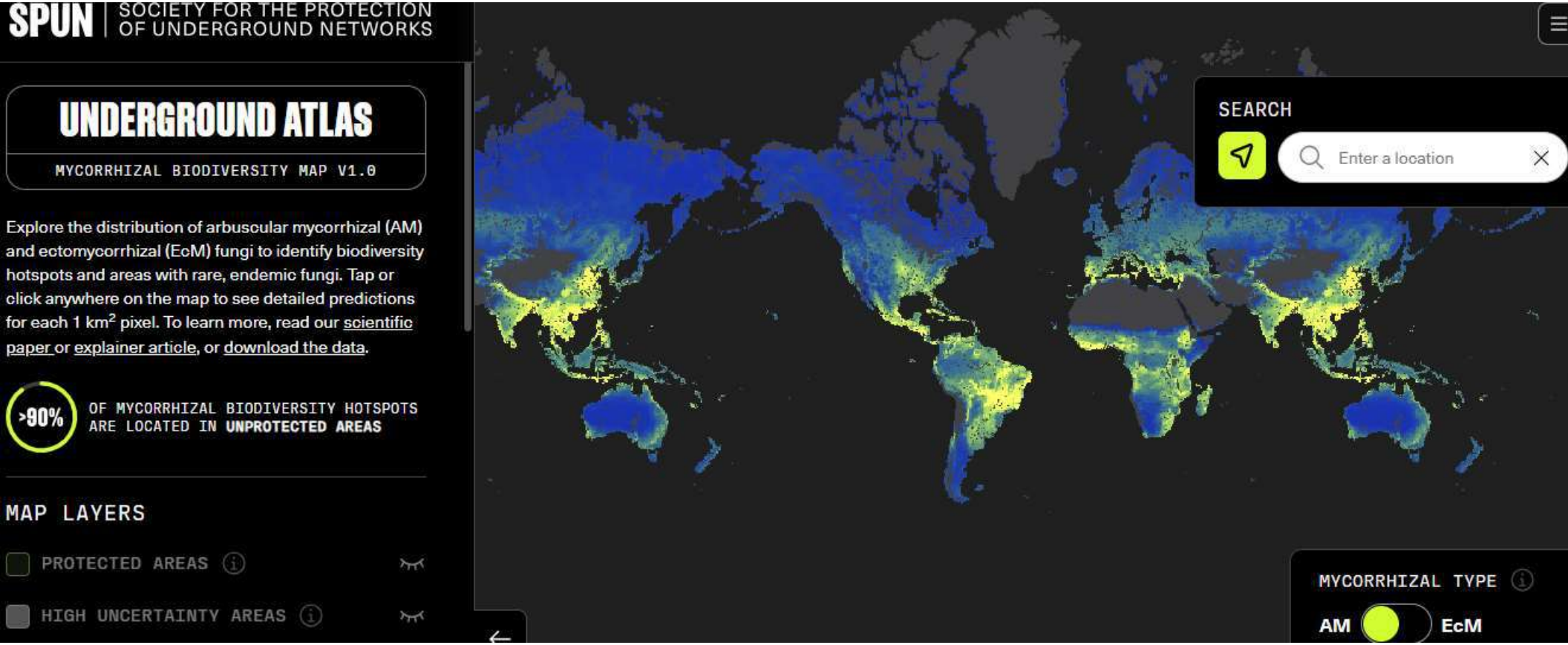
Plants



Fungi



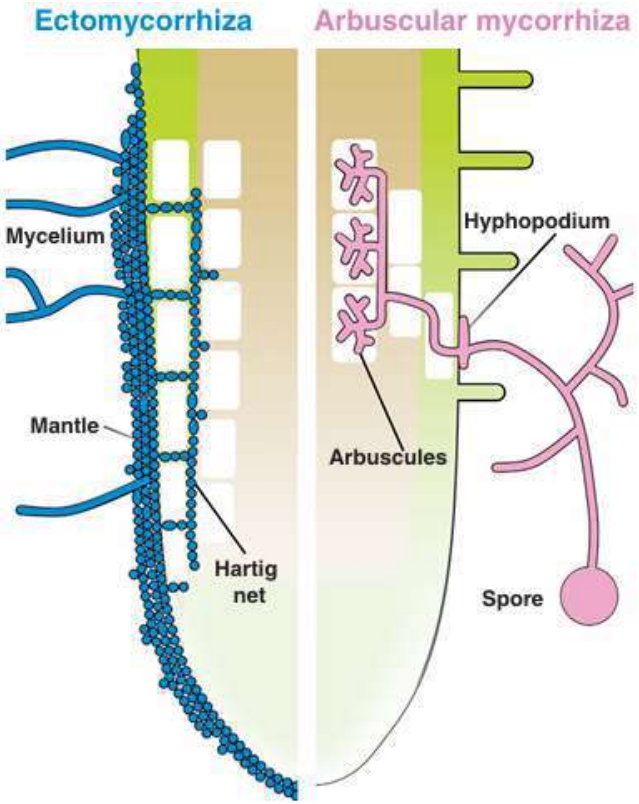
Massive underground network of fungi

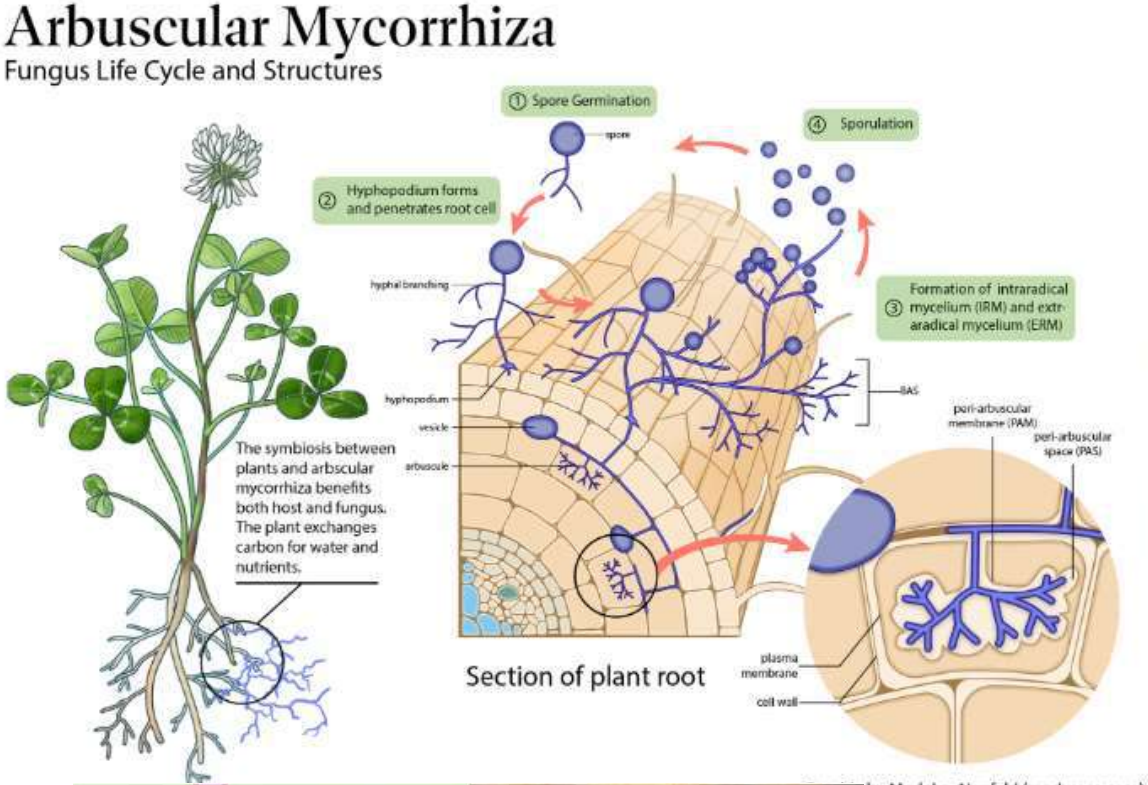


70% of belowground biodiversity hotspots remain unprotected (Guerra et al., 2022).

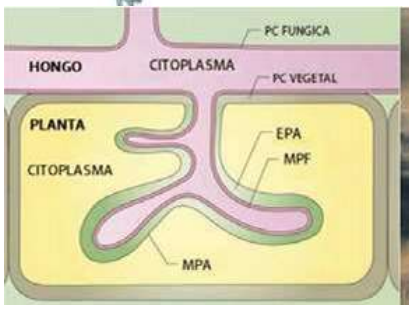

FAUNA
FLORA
FUNGA

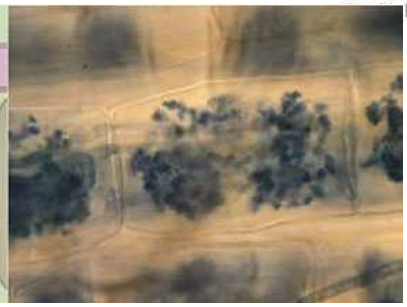
What Is a Mycorrhiza? Main types





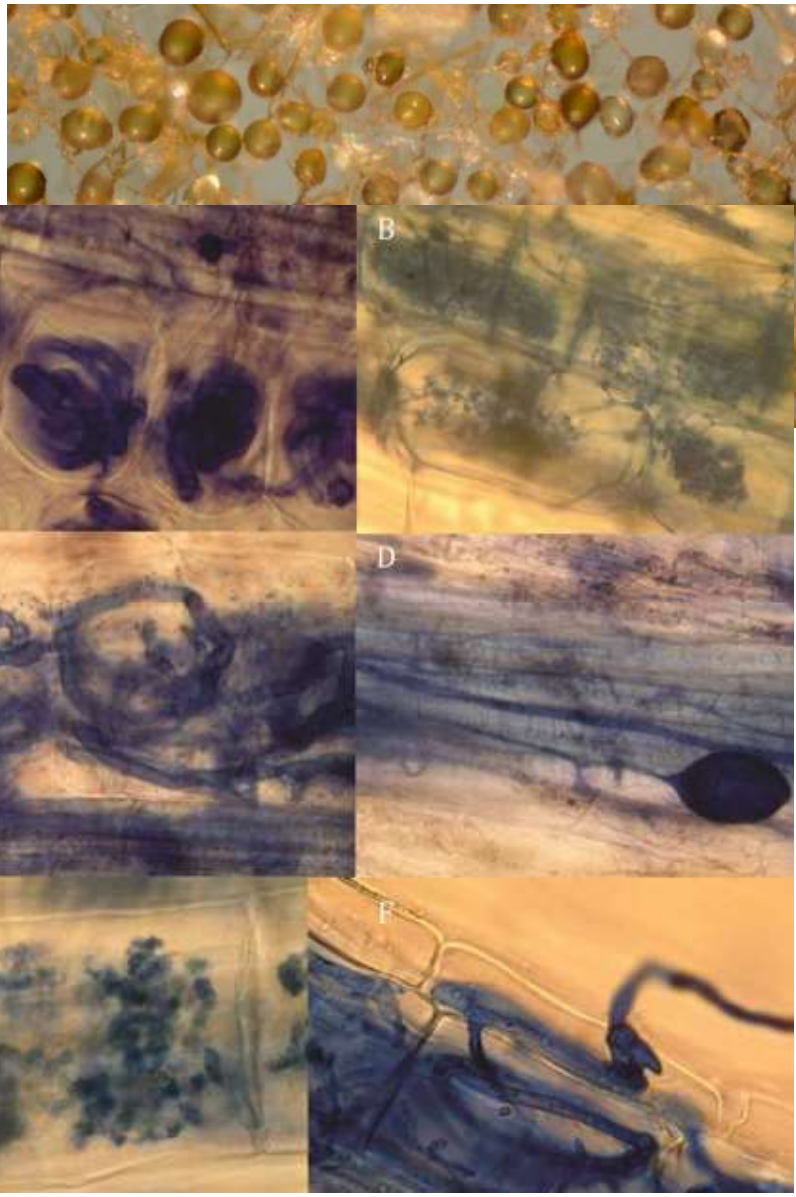
150 m years





470 m years

Arbuscular mycorrhizal fungi



- Belong to the phylum Glomeromycota
- Helped plants colonize land approximately 475 million years ago
- Obligate biotrophs
- Form associations with more than 80% of terrestrial plant species
- Around 370 species have been described morphologically (more than 1,000 molecular taxa), with high genetic and functional diversity
- Asexual reproduction (including hyphal anastomosis)
- Microscopic organisms (spores up to 0.05 mm in diameter

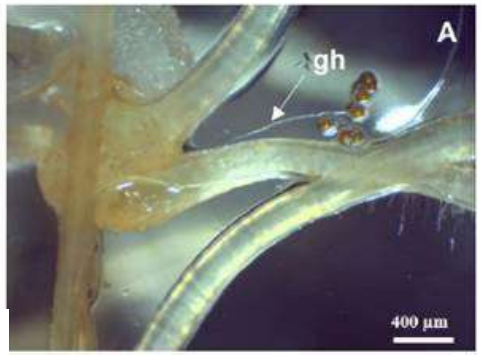
Plant Soil
DOI 10.1007/s11104-017-3173-5

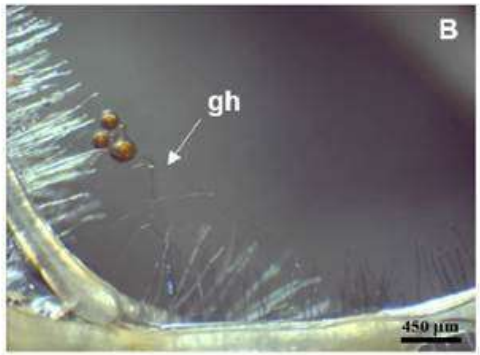
REGULAR ARTICLE

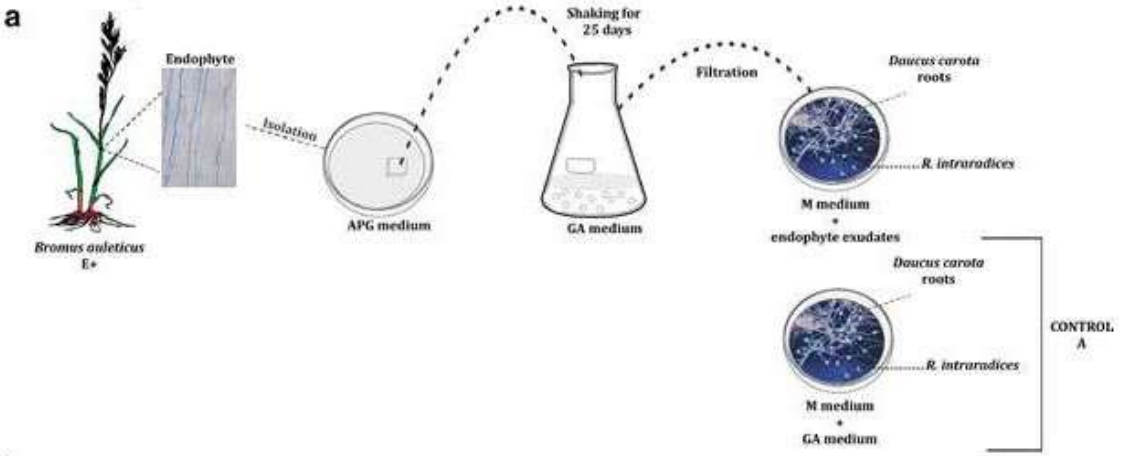
Epichloë exudates promote in vitro and in vivo arbuscular mycorrhizal fungi development and plant growth

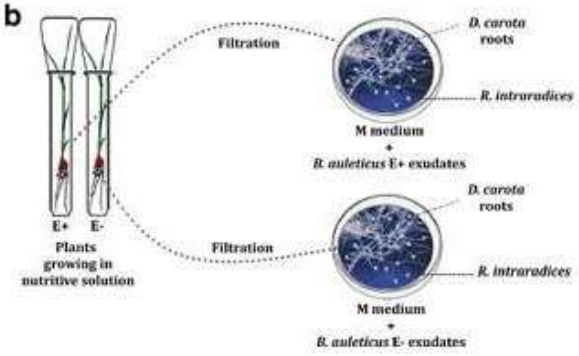
M. Victoria Vignale · Leopoldo J. Iannone · J. Martín Scervino · M. Victoria Novas

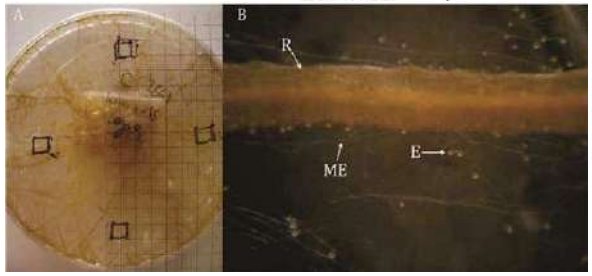
In - vitro

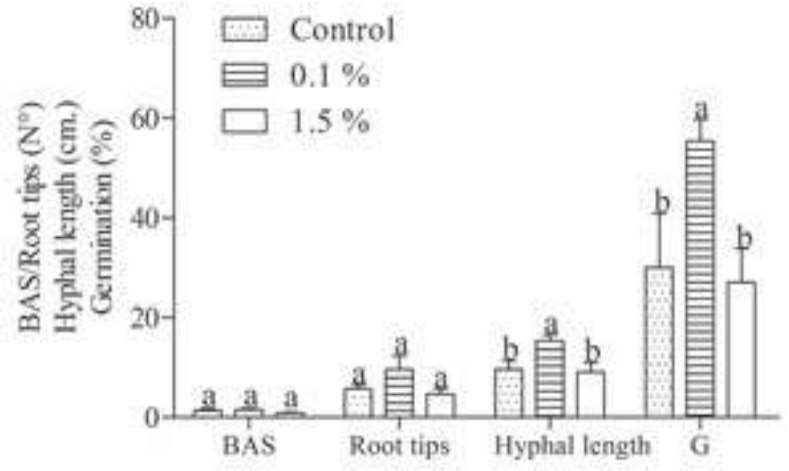


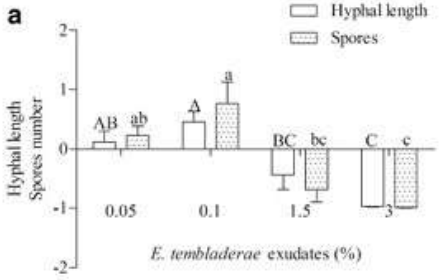


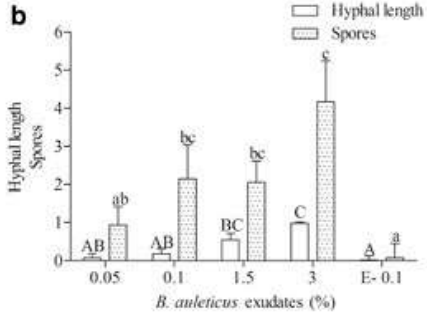




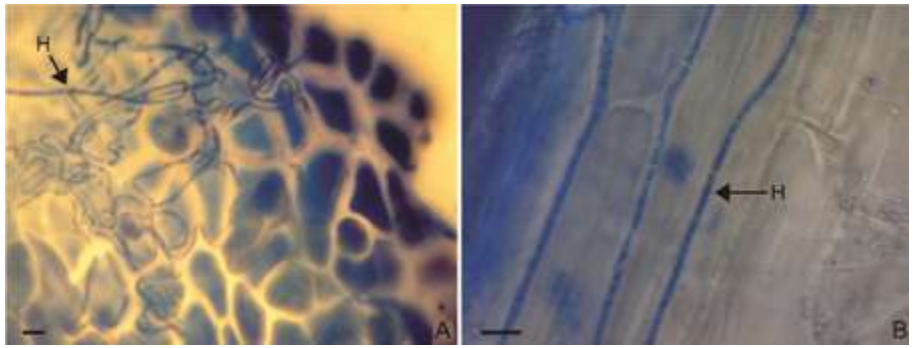


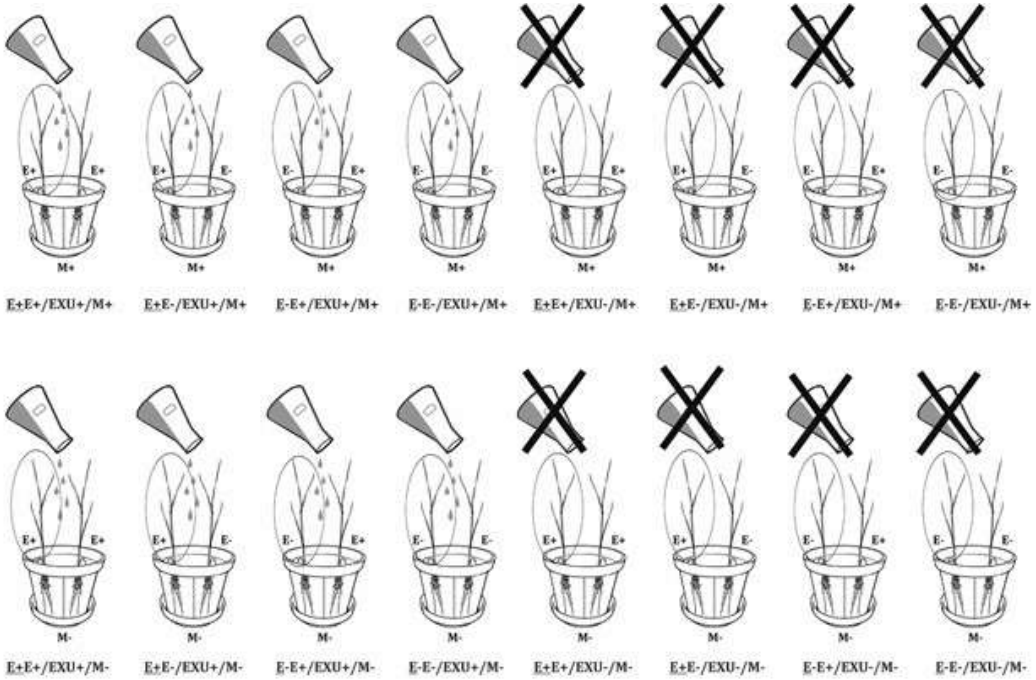


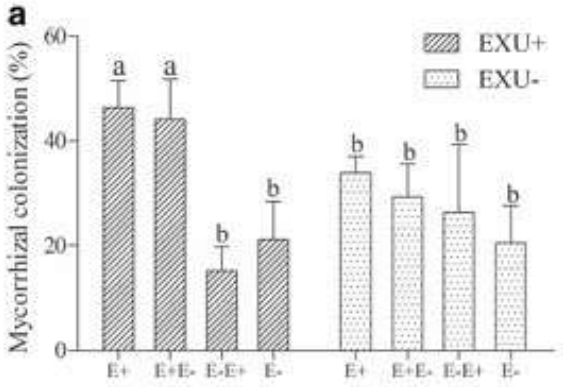




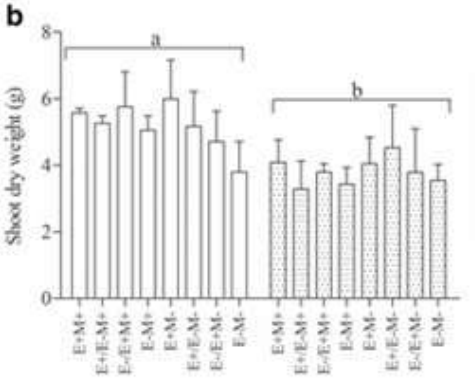
In – vivo (pots)

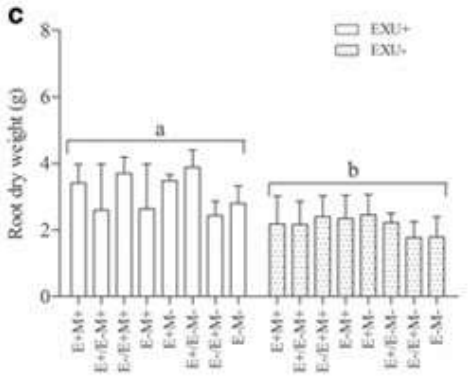






Mycorrhizal colonization and plant growth were enhanced by the endophytes and their exudates.





Fungal Ecology 45 (2020) 100916

Contents lists available at ScienceDirect

Fungal Ecology

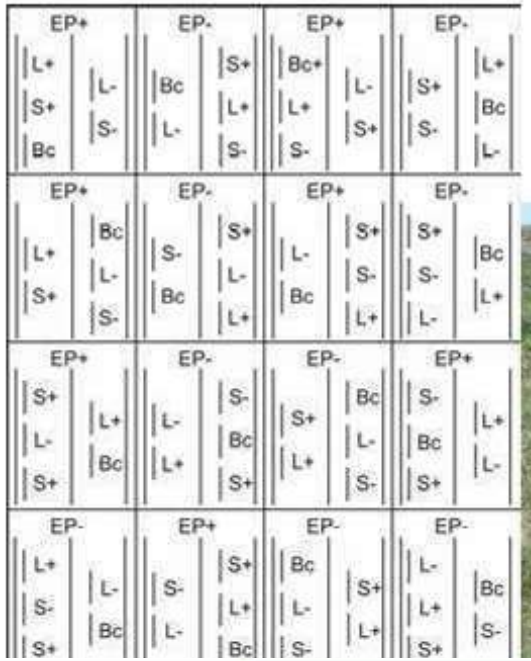
journal homepage: www.elsevier.com/locate/funeco

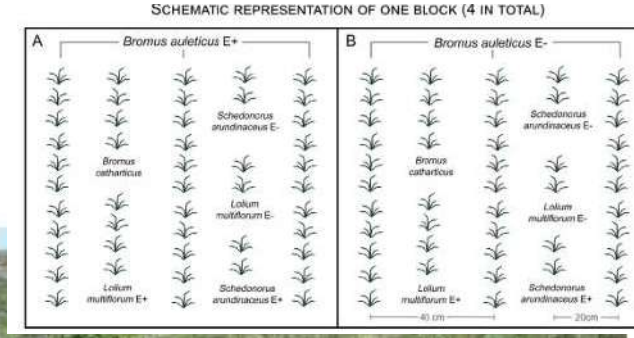
Epichloë endophytes of a wild grass promote mycorrhizal colonization of neighbor grasses

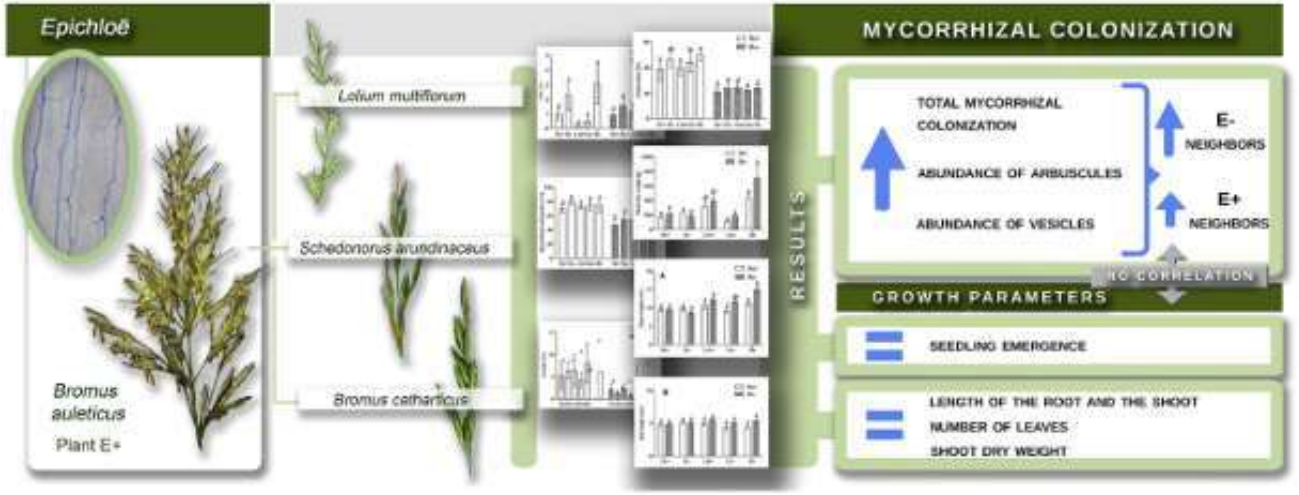
M. Victoria Vignale [a, b], Leopoldo J. Iannone [a, b, c], M. Victoria Novas [a, b, *]

Field experiment
EEA INTA C del Uruguay

Neighboring plants: three agronomically important grass species.







Rhizosphere 27 (2023) 100757

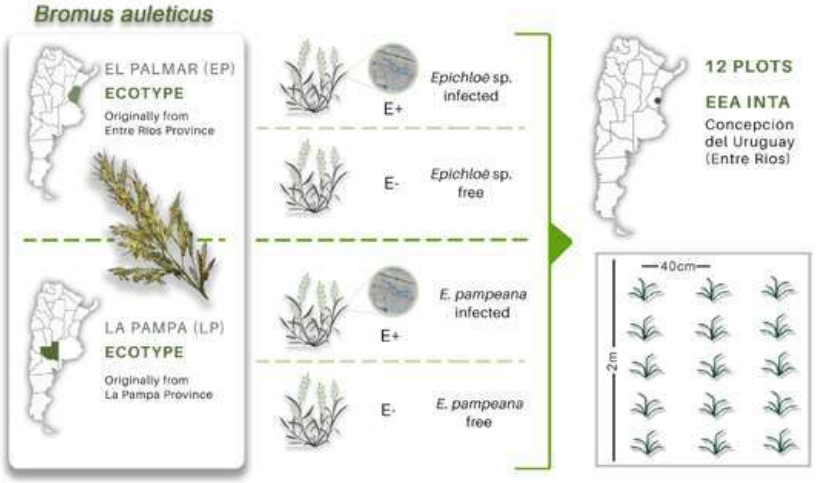
Contents lists available at ScienceDirect

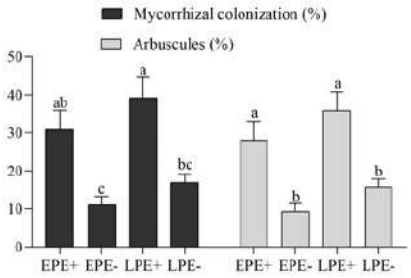
Rhizosphere

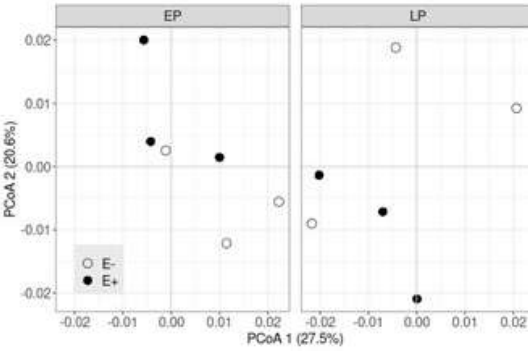
journal homepage: www.elsevier.com/locate/rhisph

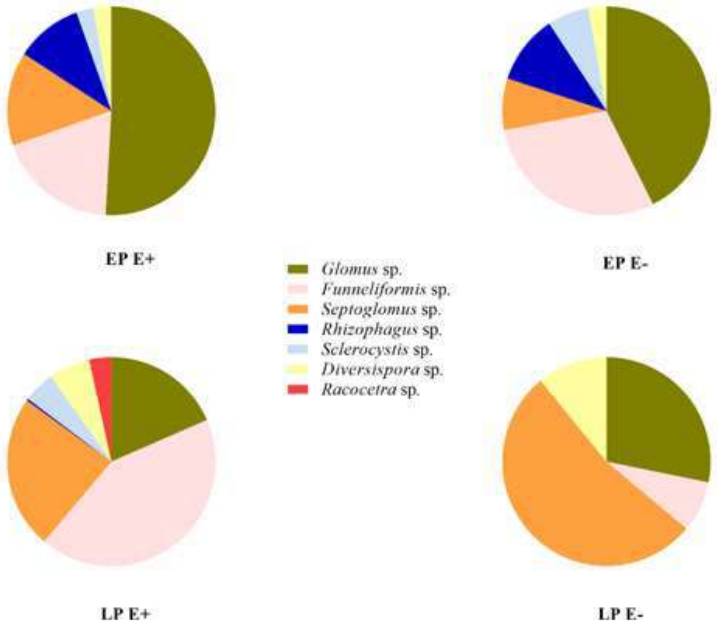
Ecotype and fungal endophyte status differentially affect soil arbuscular mycorrhizal community of the native grass Bromus auleticus

M. Victoria Vignale[a,b,1], Lucía Ortiz Rocca[c], Marcelo Soria[c,d], Leopoldo J. Iannone[a,b], M. Victoria Novas[a,b,*]









- Mycorrhizal colonization was higher in E+ plants than in E− plants.
- Differences in AMF richness and community composition were observed among ecotypes.
- No differences were detected in soil AMF communities between E+ and E− plants.

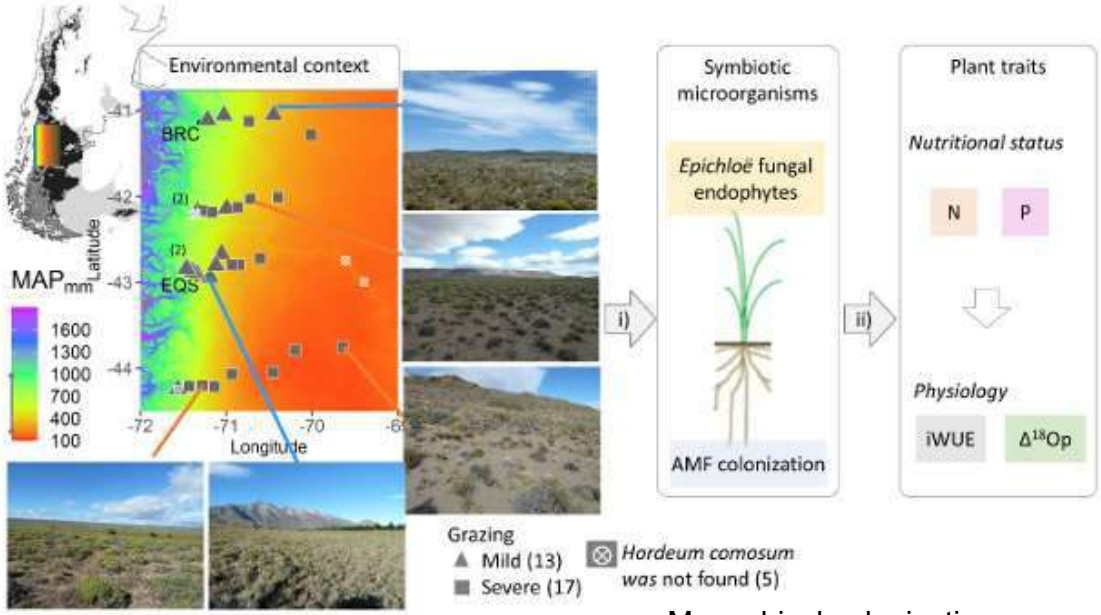
Received: 18 May 2021 | Accepted: 1 November 2021
DOI: 10.1111/1365-2435.13974

Functional Ecology

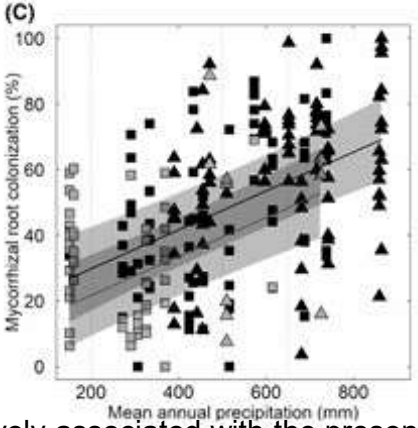
RESEARCH ARTICLE

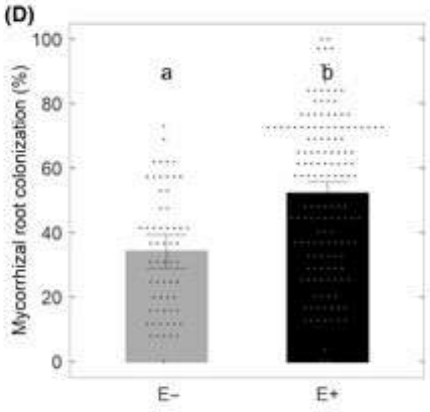
Loss of fungal symbionts at the arid limit of the distribution range in a native Patagonian grass—Resource eco-physiological relations

Cecilia Casas[1,2,3] | Pedro E. Gundel[2,4] | Eluney Deliens[1] | Leopoldo J. Iannone[5,6] | Guillermo García Martinez[7] | María V. Vignale[5,6,8] | Hans Schnyder[3]



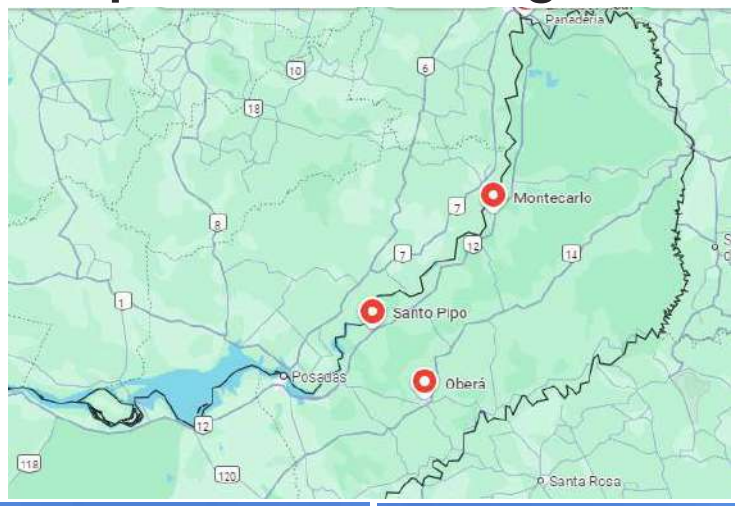
The study was highlighted as a featured paper by the prestigious journal *Nature Climate Change* (Armarego-Marriott, 2022).





- Mycorrhizal colonization was positively associated with the presence of the endophyte.
- Mycorrhizas can regulate stomatal aperture in response to environmental moisture conditions, thereby optimizing intrinsic water-use efficiency

Interaction between Arbuscular Mycorrhizas and *Trichoderma* in *Ilex paraguariensis*: Effects on Plant Development and Drought Tolerance



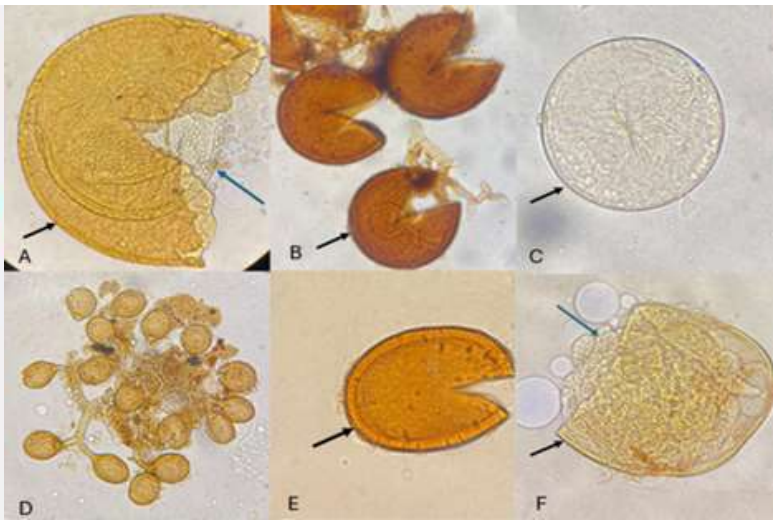
1. The diversity and colonization of arbuscular mycorrhizal fungi in yerba mate plantations are influenced by management practices.

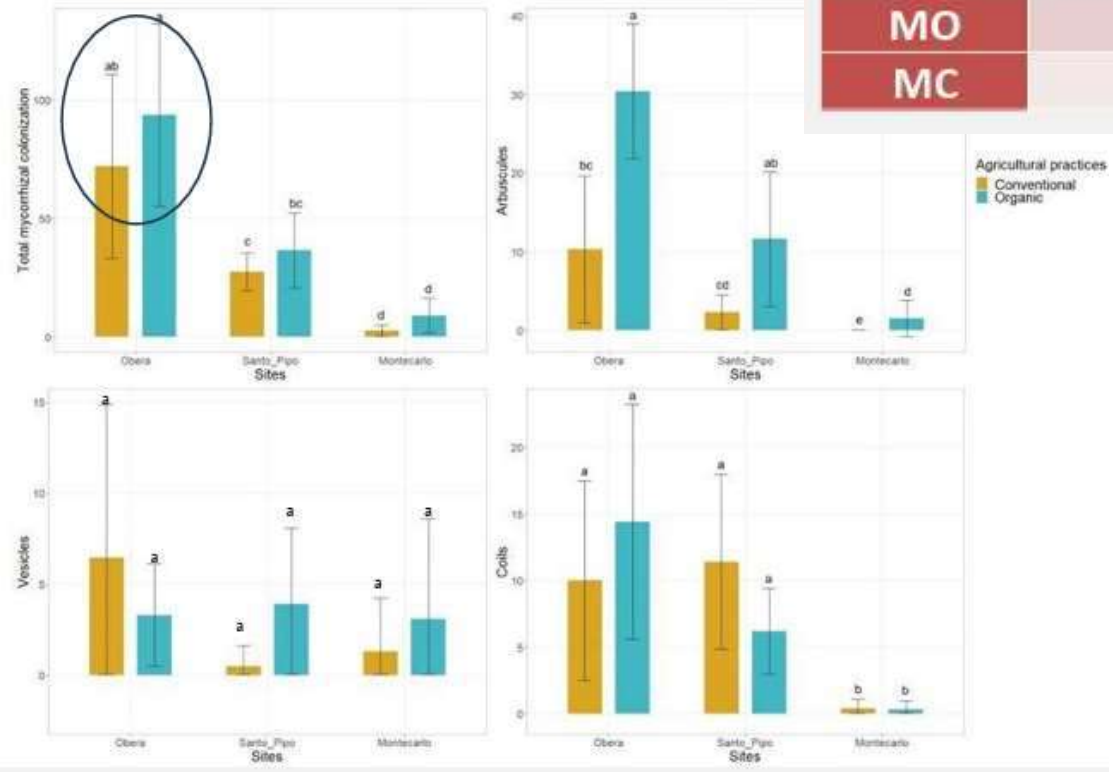
2. Co-inoculation with arbuscular mycorrhizal fungi and *Trichoderma* promotes the growth and development of *Ilex paraguariensis* seedlings.

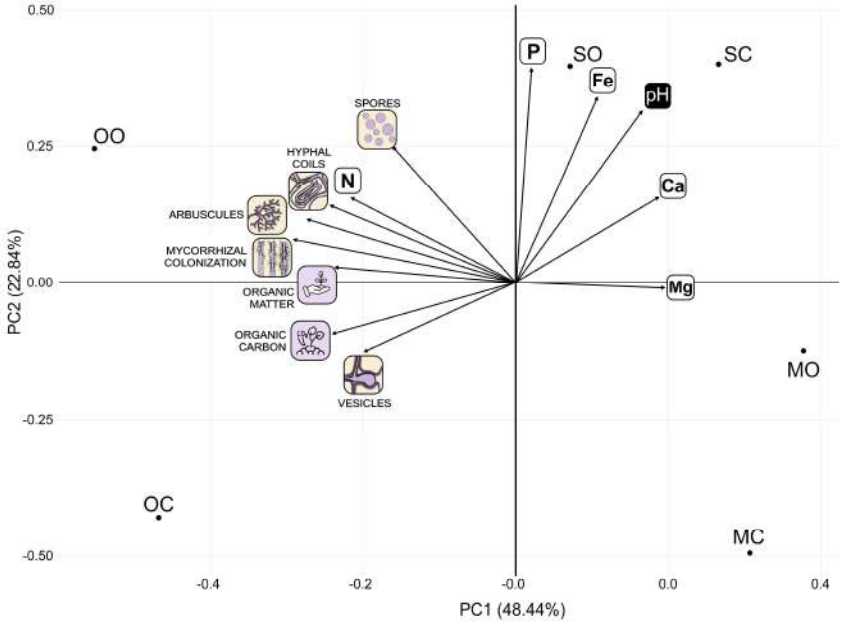
3. Co-inoculation with arbuscular mycorrhizal fungi and *Trichoderma* enhances drought tolerance in *Ilex paraguariensis* seedlings.

Sampling and characterization of arbuscular mycorrhizal fungi (AMF) from yerba mate plantations under different cultural management practices.

Sitio de muestreo	Número de esporas
OO	1450
OC	443
SO	782
SC	598
MO	671
MC	354







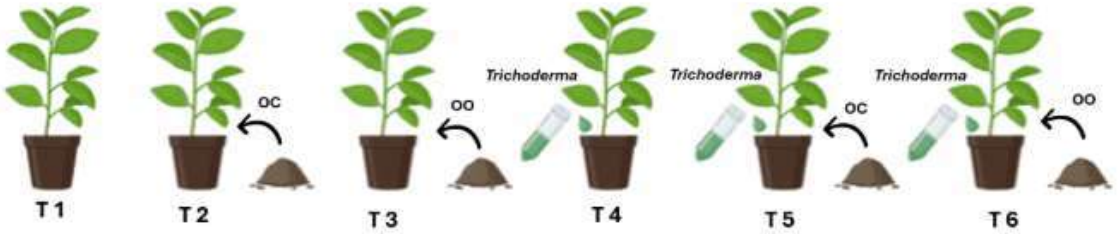
Ensayo de desarrollo de plantas juveniles de *Ilex paraguariensis* co-inoculadas con HMA y *Trichoderma*

DISEÑO EXPERIMENTAL

Se realizaron **6 tratamientos** con **20 plantas** juveniles cada uno provenientes del vivero **VyO** (Oberá, Misiones).

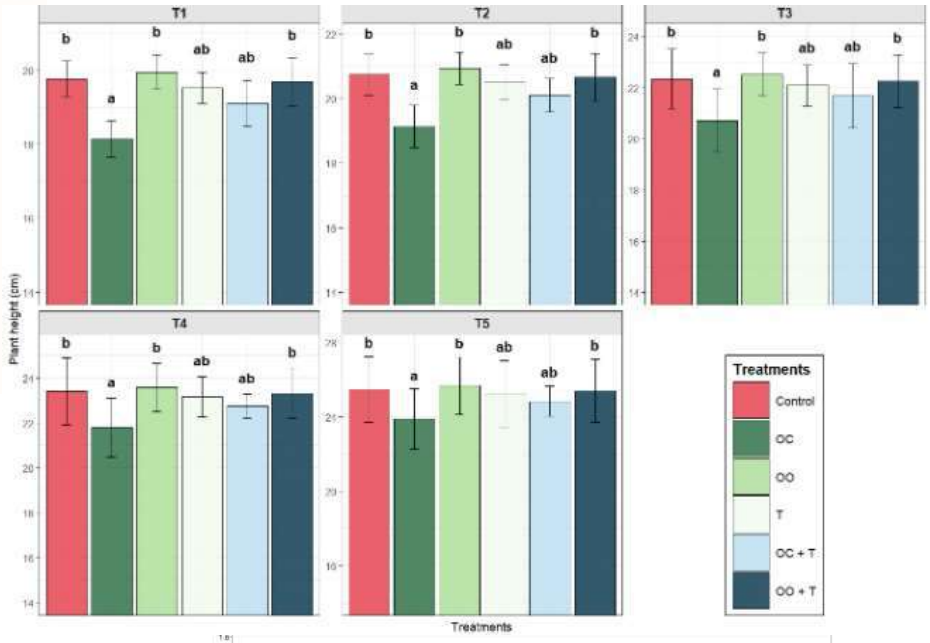
Se utilizó como inóculo **20 g de suelo** provenientes de los sitio Oberá con manejo orgánico, Oberá con manejo convencional y *Trichoderma asperelloides* LBM193.

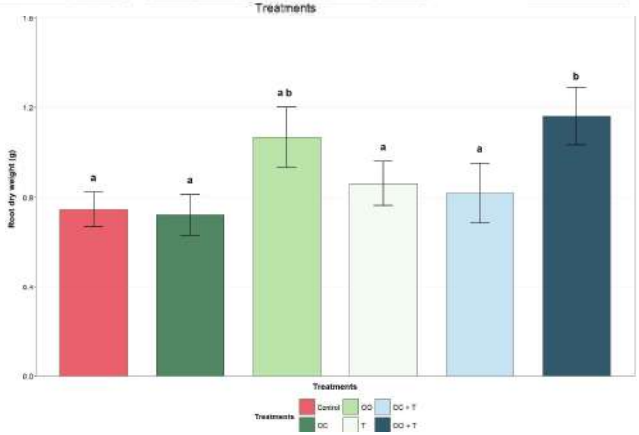
El esquema de tratamiento fue el siguiente:



Parámetros evaluados:

- ✓ Altura del vástago
- ✓ Número de hojas
- ✓ Diámetro de la planta a la altura del cuello
- ✓ Peso fresco y seco de parte aérea y radicular
- ✓ Porcentaje de micorrización en raíces
- ✓ Volumen radicular
- ✓ Contenido de clorofila





Molecular and morphological characterization and comparison between populations of AMF in yerba mate (*Ilex paraguariensis*) plantations with different types of management (Organic vs Conventional). James Bever´s Lab – University of Kansas

Objective 1

Activity 1. Extraction of DNA from soil, make library prep for Illumina sequence and analyse.

Activity 2. Spores extraction, DNA extraction from individual spores.

Activity 3. Morphological ID of spores.

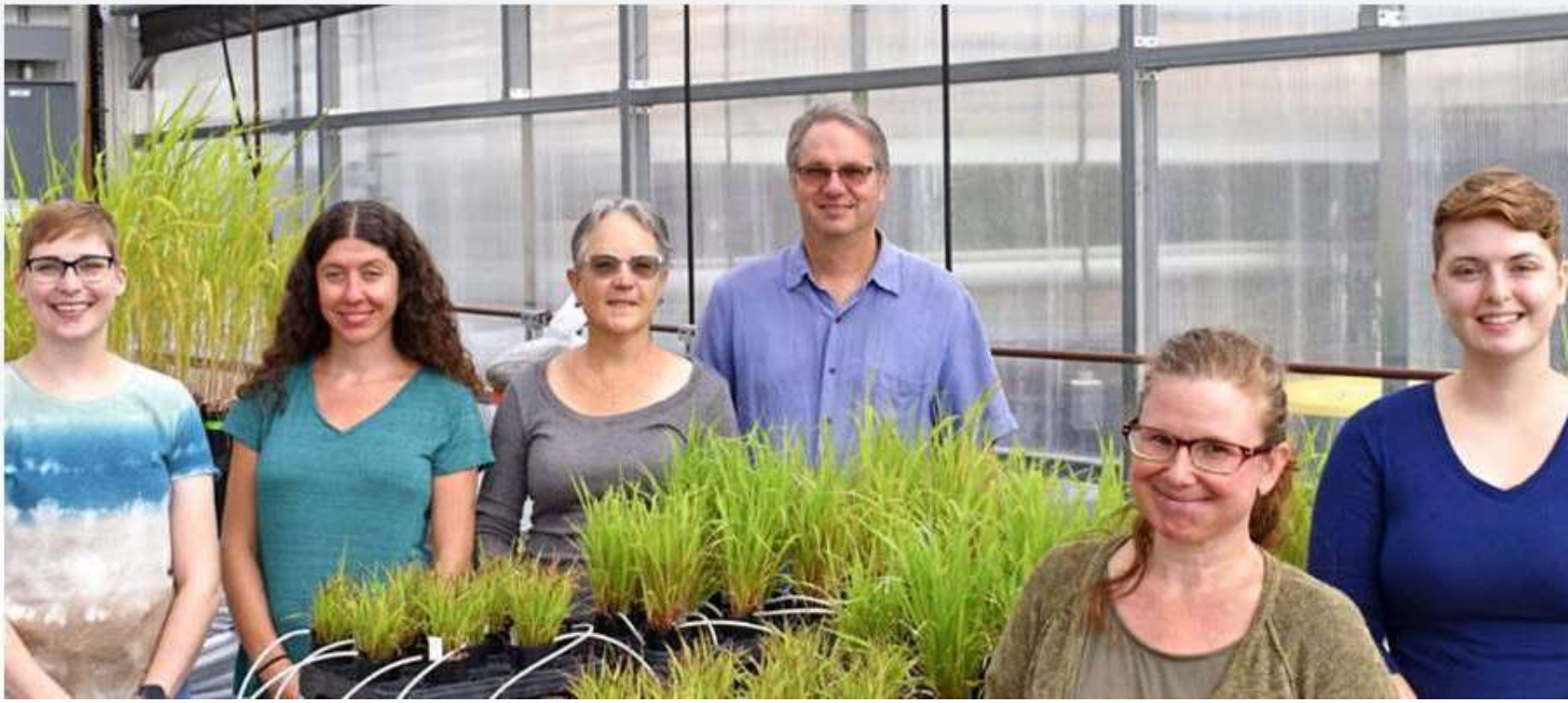
Activity 4. Trap cultures and cone-tainers with single species cultures.

Objective 2

Activity 1. Training in the development and maintenance of an AMF culture collection (INVAM)

KU | The International Collection of (Vesicular) Arbuscular Mycorrhizal Fungi

INVAM



Objective 2
Activity 1. Training in the development and maintenance of an AMF culture collection.

- **Planting**

- **Organizing**

- **Counting spores per g/soil**
- **Extraction of INVAM spores and observation of many different species**

- **Harvesting**

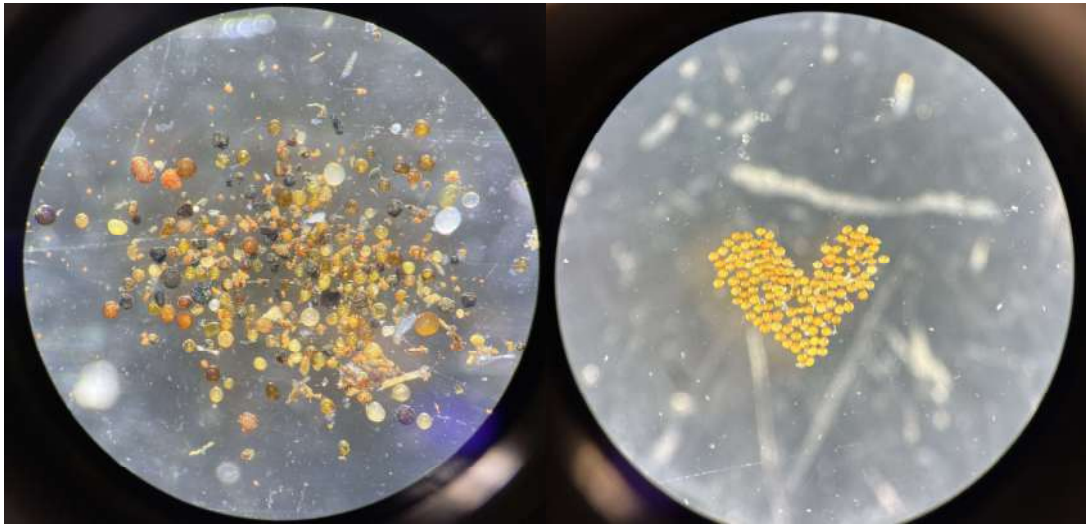
- **nursery plant maintenance**

Results

- **Objective 1**

Activity 2. Spores Extraction (slides, measurements, photographs, DNA extraction from individual spores and cultures)

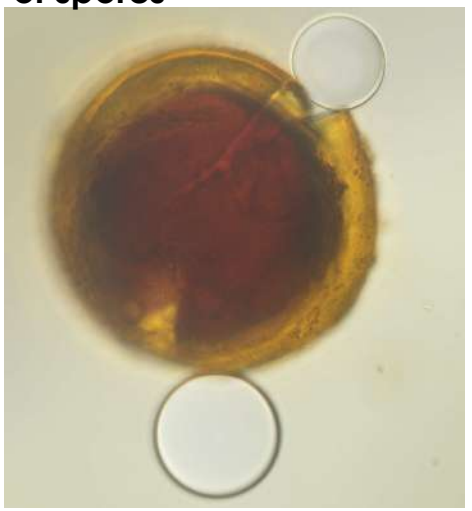
Extraction of spores

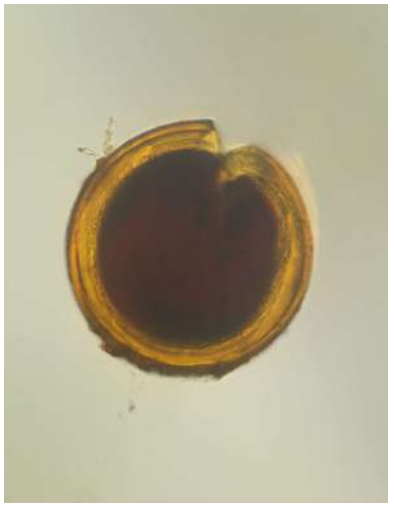


Spores

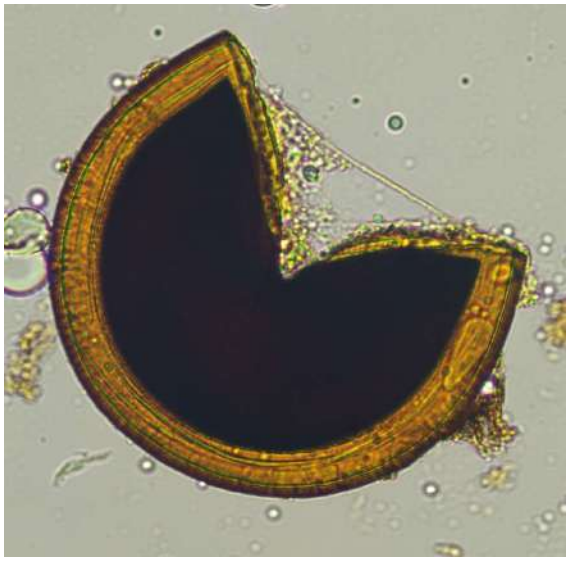
- **Objective 1**

Activity 3. Morphological ID of spores





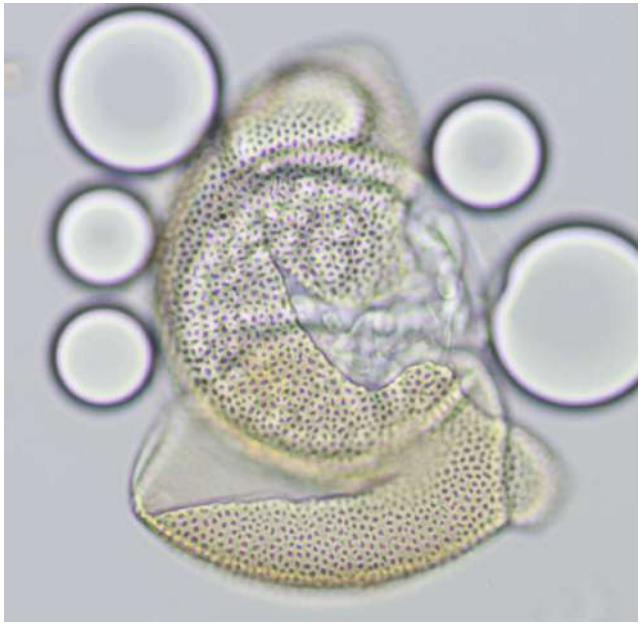
Acaulospora sp.

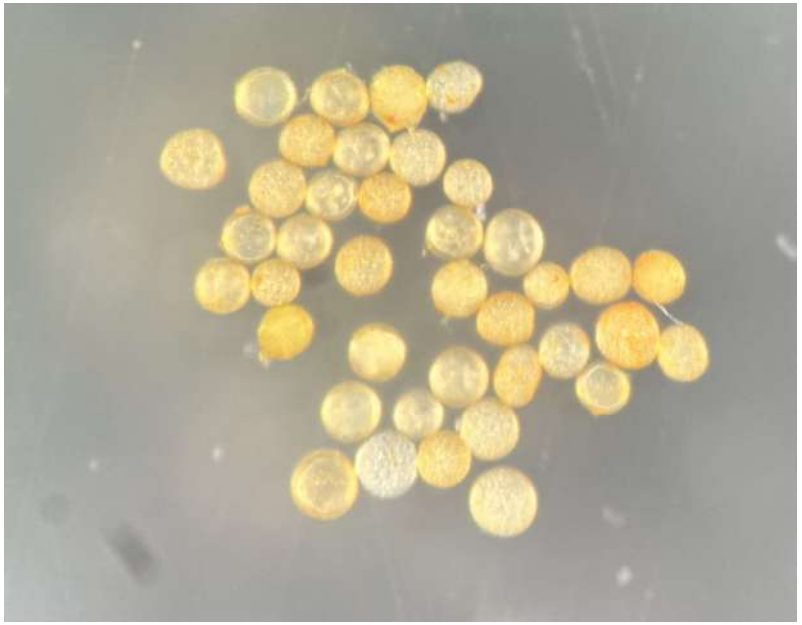


DNA EXTRACTED
We created a step-by-step protocol for extracting DNA from spores.

Spores

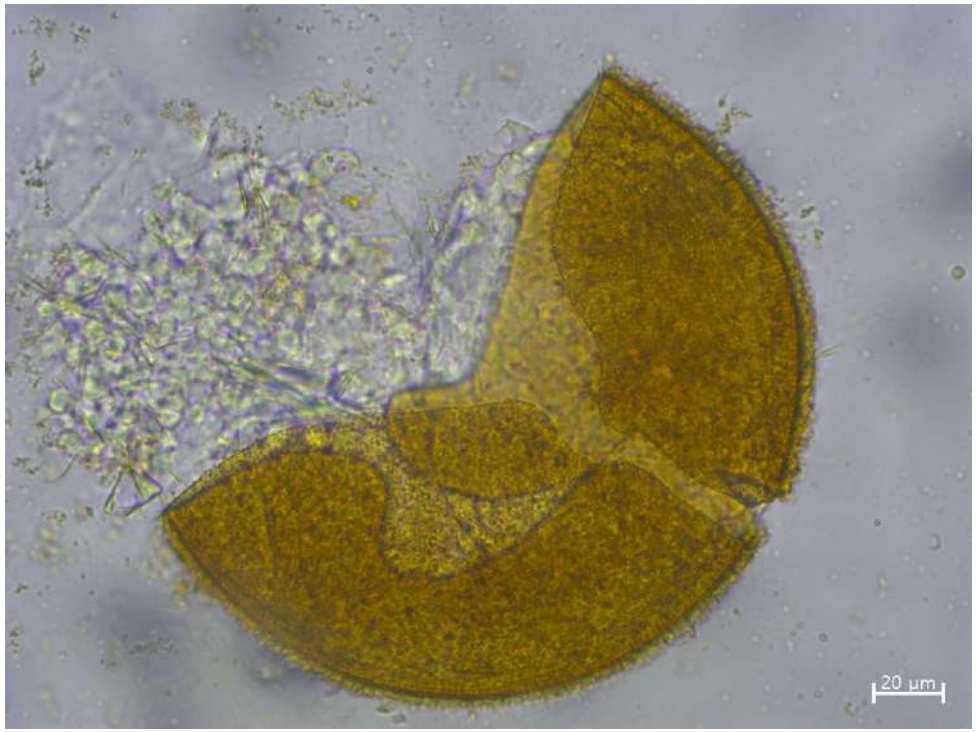
Acaulospora scrobiculata

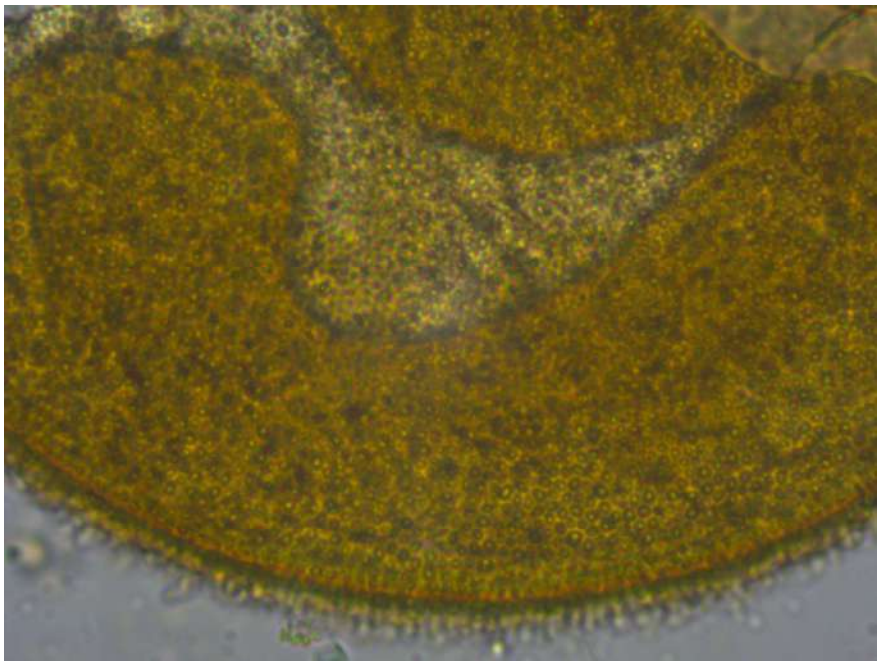




Spores

Entrophospora infrequens



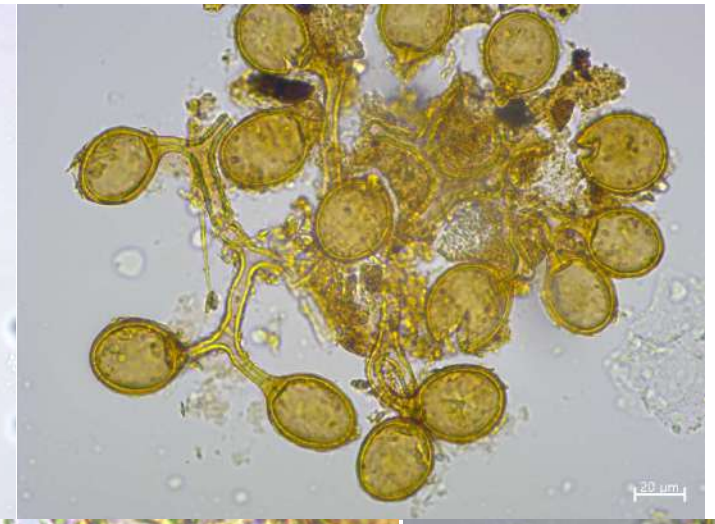


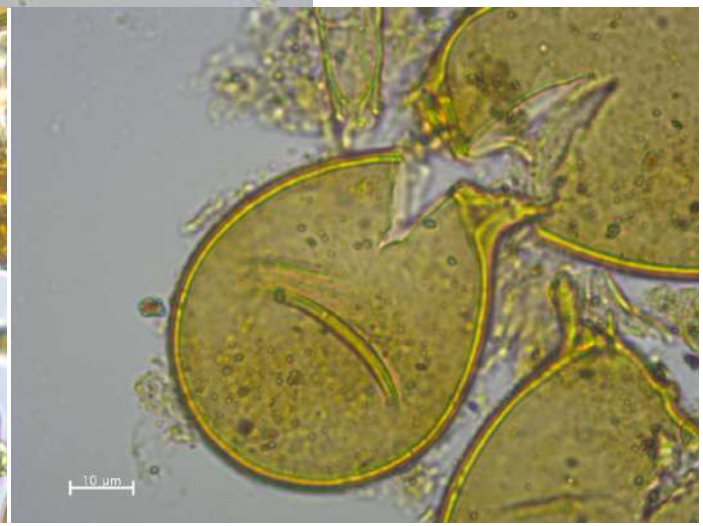
Spores/sporocarps

Glomus clavisporum

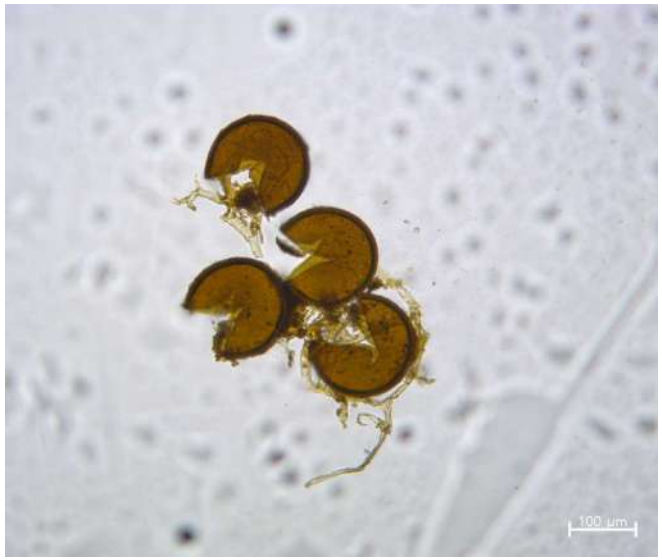
Spores/sporocarps

Sclerocystis rubiformis

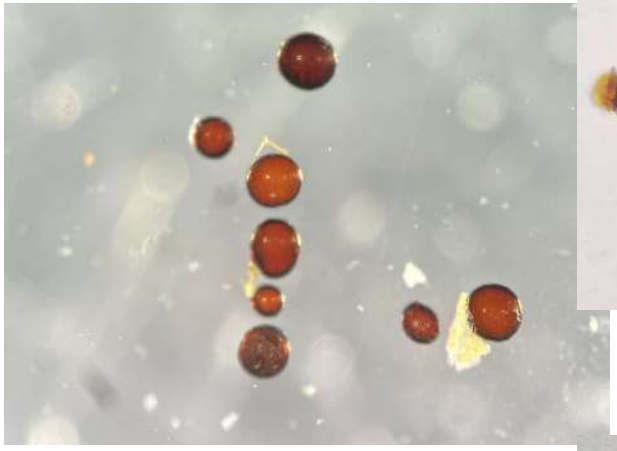




Spores/sporocarps



More spores…

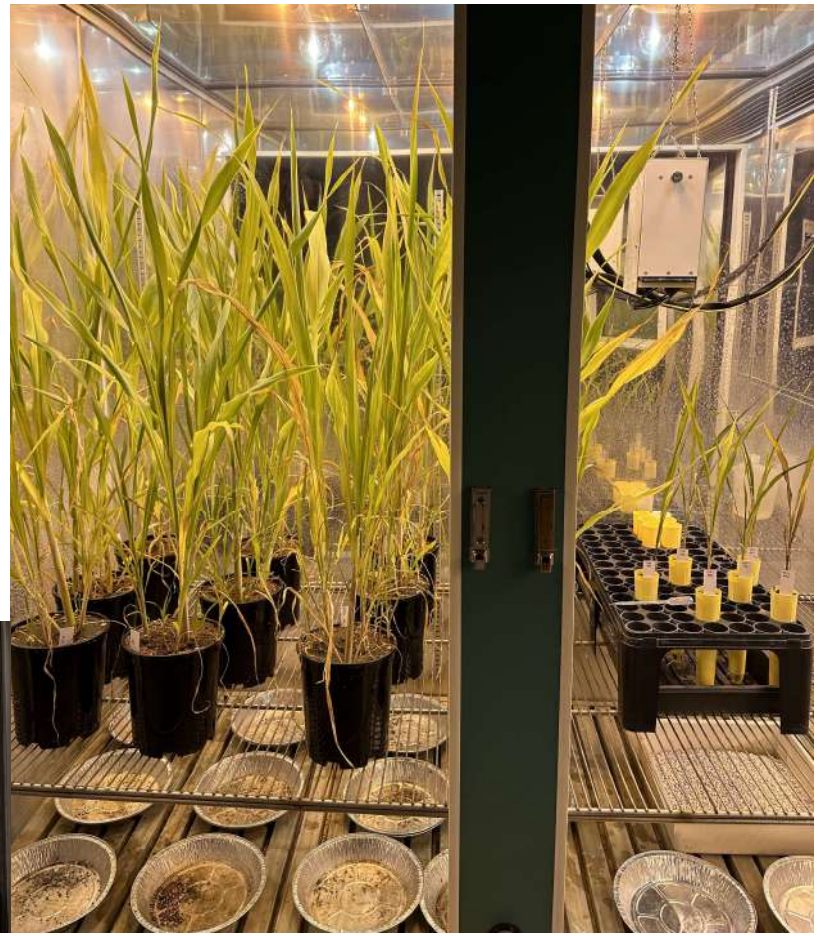


<u>In general</u>, I see more diversity in organic crops compared to conventional ones, while in conventional crops, there is a higher number of spores of the same species.
In the native forests there are few spores.

Results

- **Objective 1**

Activity 4: Trap cultures and cone-tainers with single species cultures



PROGRAM SETTING

CHAMBER 1

00.00 22 °C - 000Mmol
08.00 26 °C - 800
12.00 30 °C - 1000
20.00 26 °C - 800

70% HUMIDITY
300 ppm CO2

7/20: 12 trap cultures
8/20: Fertilization 70 ml.

4 months in 11/20

Others

Visit to the KU Experimental Station

New Roots for restauration meeting

Mushroom Foray near Topika

UPCOMING PROJECT

Mycorrhizal communities associated with ferns as indicators of successional gradients and ecological maturity in subtropical forest environments.

WOOD-INHABITING AGARICOMYCETES OF THE ARGENTINE ATLANTIC FOREST

COMMUNITY COMPOSITION AND ITS INFLUENCE IN NATURAL AND FORESTED ECOSYSTEMS

PhD STUDENT: LIC. BATISTA ADRIANA JUDIT
SUPERVISOR: PhD. NIVEIRO NICOLAS
CO-SUPERVISOR: PhD. VIGNALE MARÍA VICTORIA

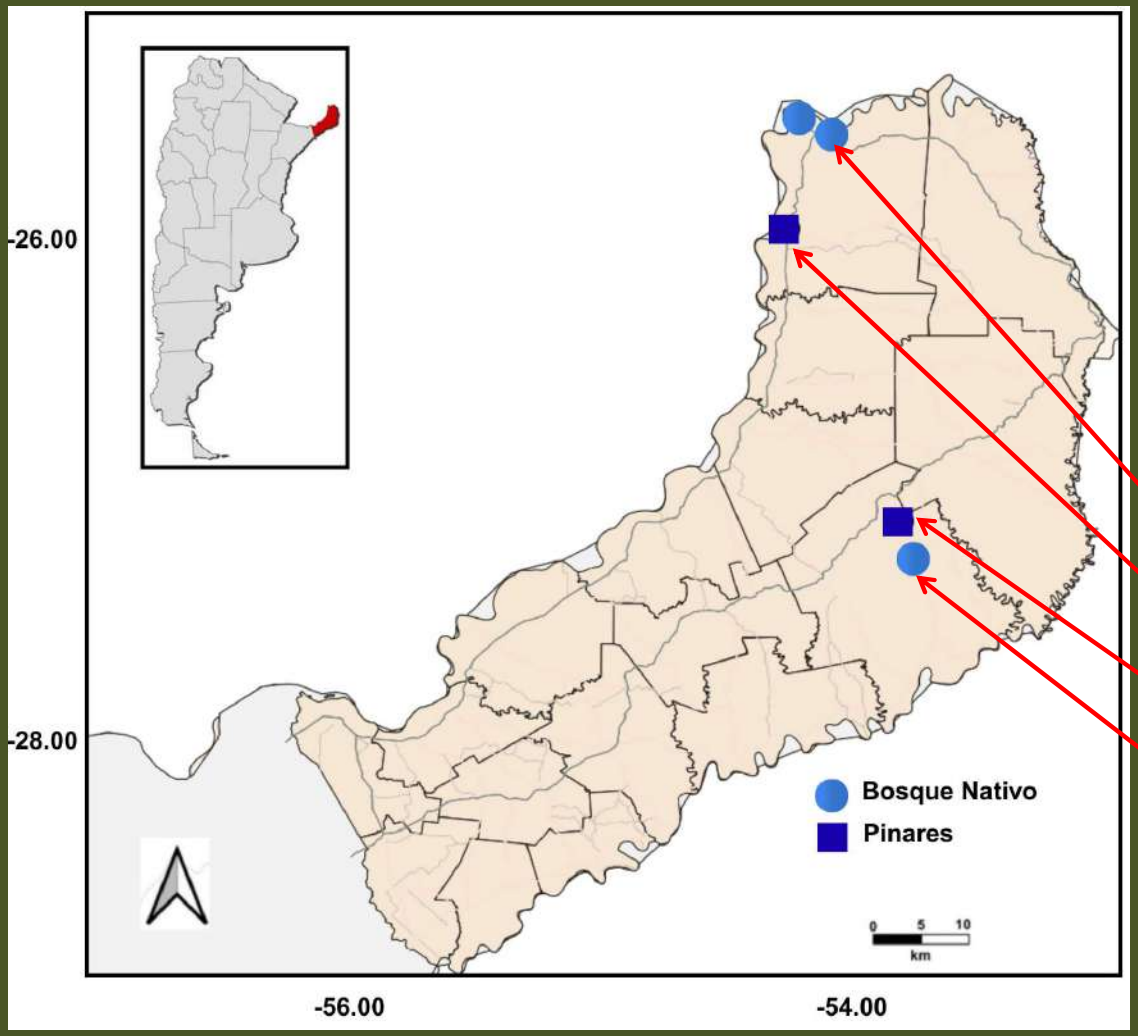
GENERAL AIM

To study wood-inhabiting Agaricomycete communities in native and forested environments of the Argentine Atlantic Forest (AAF), assessing their occurrence and ecological roles as pathogens and saprotrophs.

PARTICULAR AIMS

1. To document, identify, and describe wood-inhabiting Agaricomycete species present in native and planted environments of the Argentine Atlantic Forest.
2. To analyze and compare the composition of wood-inhabiting Agaricomycete communities in native environments of the Argentine Atlantic Forest (SAA) and pine plantations.
3. To identify the pathogenic fungal species affecting native and planted trees.
4. To analyze substrate specificity of pathogenic and saprotrophic species.

METHODOLOGY



Study Area

- Iguazú National Park
- Pine plantation
- Pine plantation
- Reserva de Usos Múltiples Guaraní

(Permanent Sampling Pots)

Autumn-Spring 2025
Autumn-Spring 2026

-

Pine plantations

Iguazú National Park

Reserva de Usos Múltiples Guaraní (RUMG)

GEO-TREES: high-accuracy ground data for satellite-derived biomass mapping

ONGOING

Argentina

MISIONES

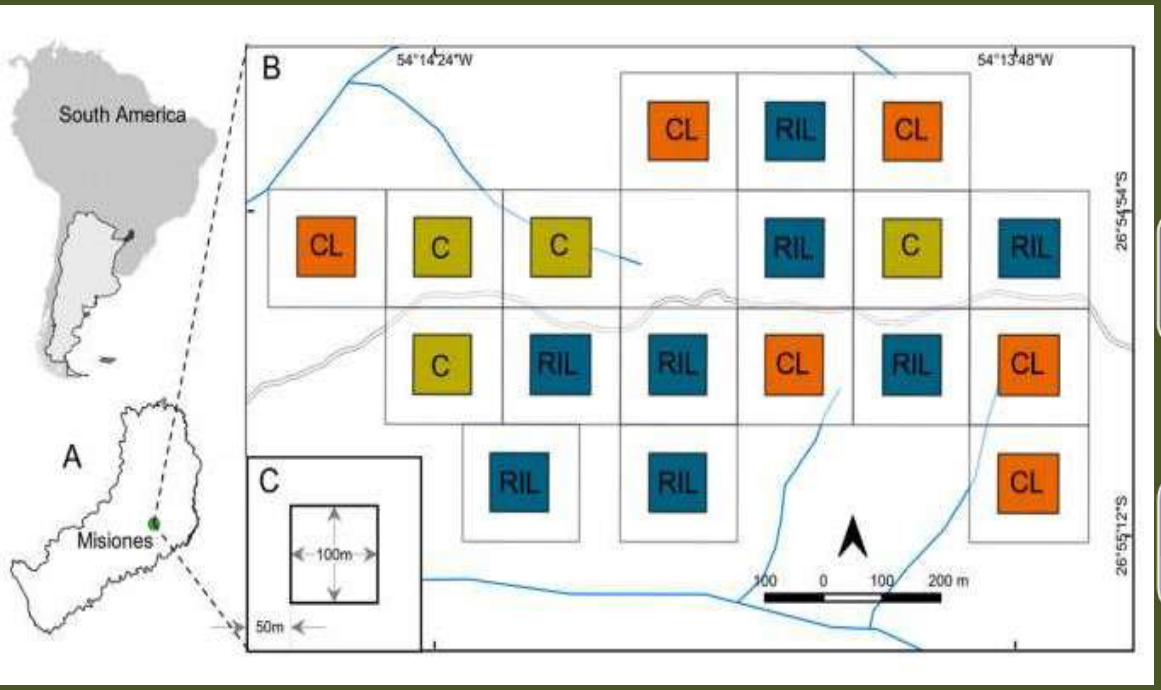
LATITUDE : -26.92 LONGITUDE : -54.23

The Misiones site is located within the Guarani Multiple Use Reserve (RUMG, Faculty of Forestry Sciences - National University of Misiones). The site includes 18 forest inventory plots, 1 ha size each with all trees, palms and lianas ≥ 10 cm included. Of these, there are 4 control plots, 8 plots with reduced-impact logging, and 6 with conventional logging (first measurement: 1998; logging date: 1999). Lowland (350-500 m a.s.l.) subtropical semideciduous forest. TmFO Site.

Completed measurements :

- Forest plot inventory
- ALS

RUMG - 30 years of monitoring data



Control

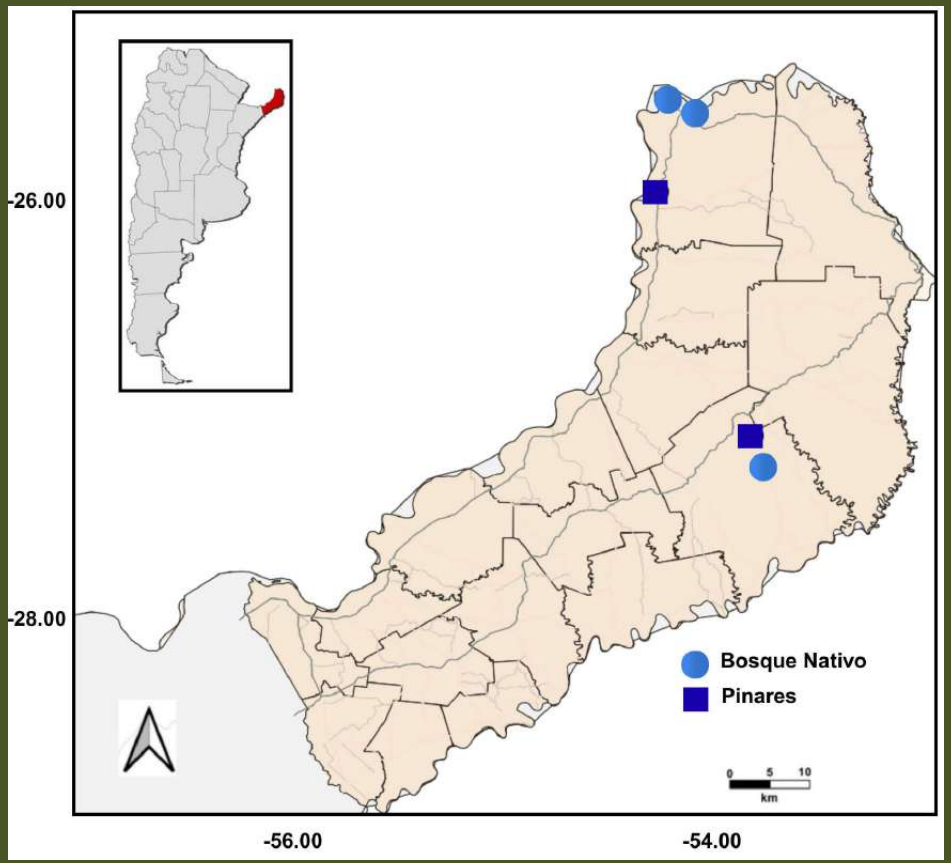
Conventionally Logged plots (CL)

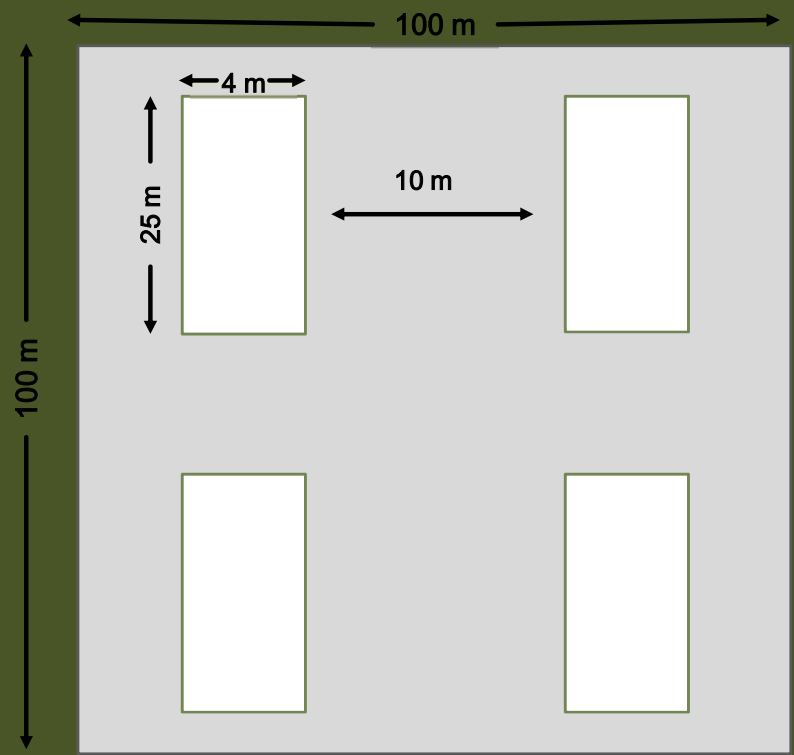
Reduced impact Logging plots (RIL)

Bedrij *et al.* 2022: Conventionally logged plots (CL), reduced-impact logging plots (RIL), control (C).

Experimental design

Modified from Gates *et al.* (2011)





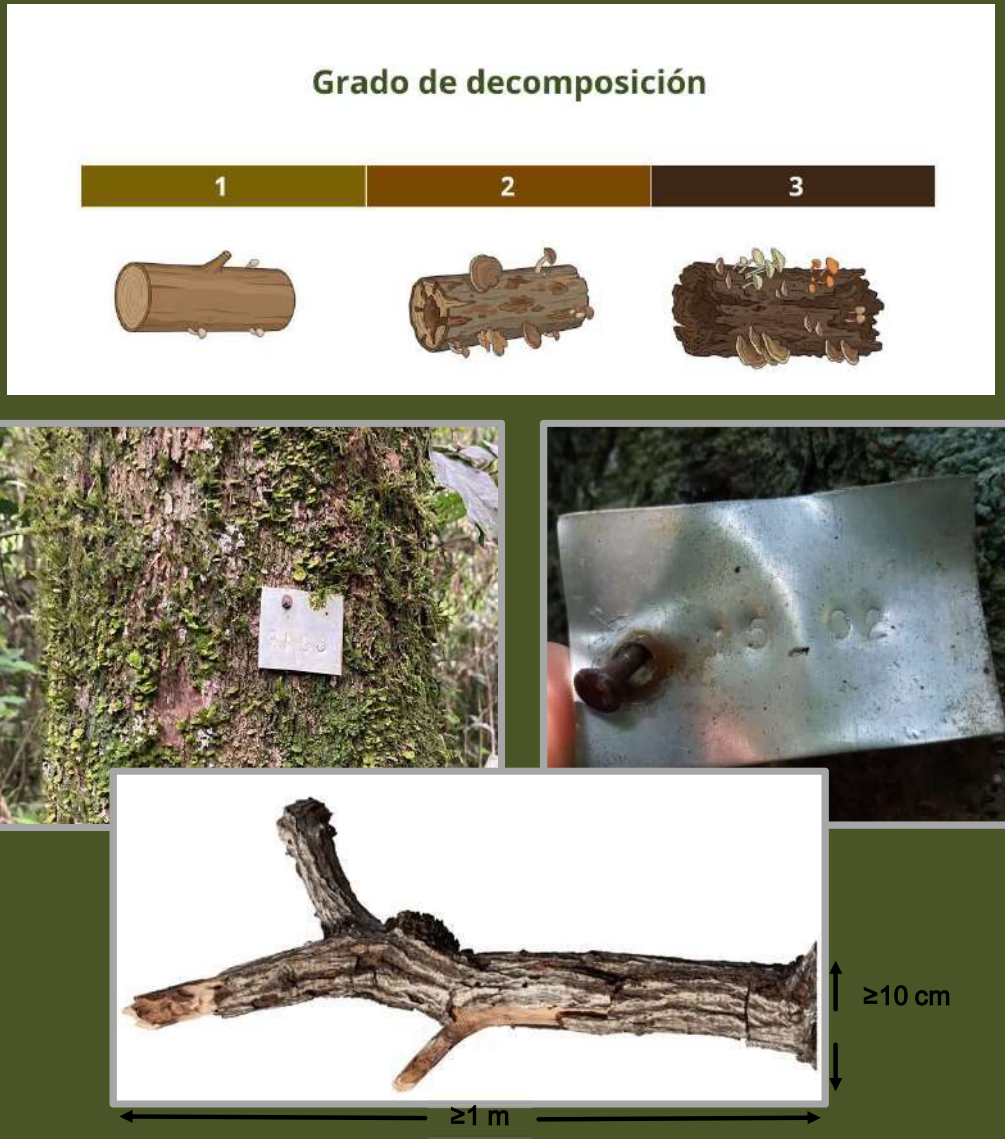
4 Plots in each area (1 ha each)

4 subplots (25 x 4 meters)

Experimental design

Huhndorf *et al.* 2004)

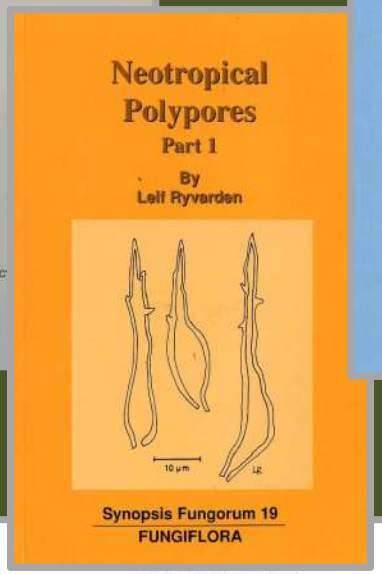
- **Decay class 1:** Newly fallen wood, generally retaining its bark.
- **Decay class 2:** Intermediate decay; bark detached; a knife can penetrate up to 2 cm into the wood without applying excessive pressure.
- **Decay class 3:** Advanced decay; a knife can penetrate the wood easily without applying much pressure, and the wood can be partially crumbled by hand.

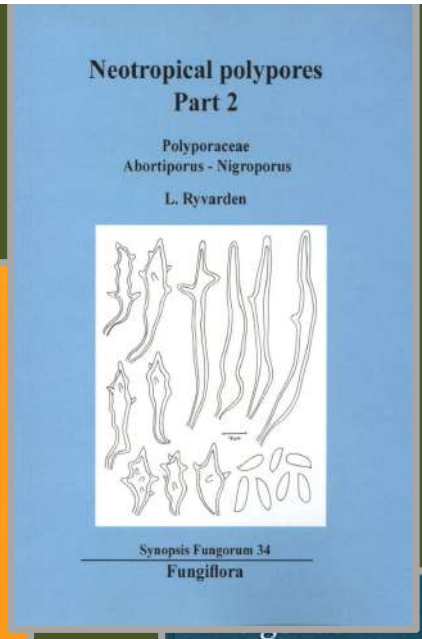


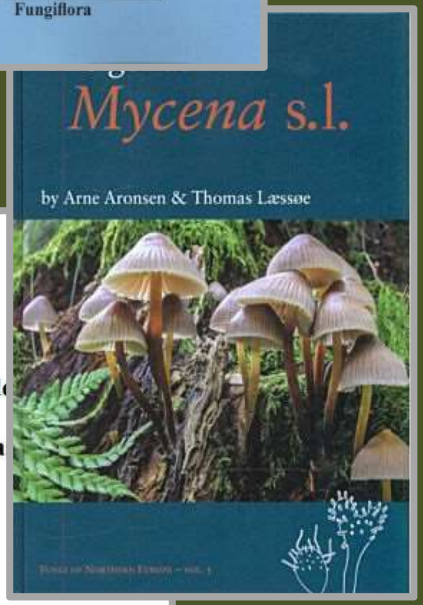
Morfological ID

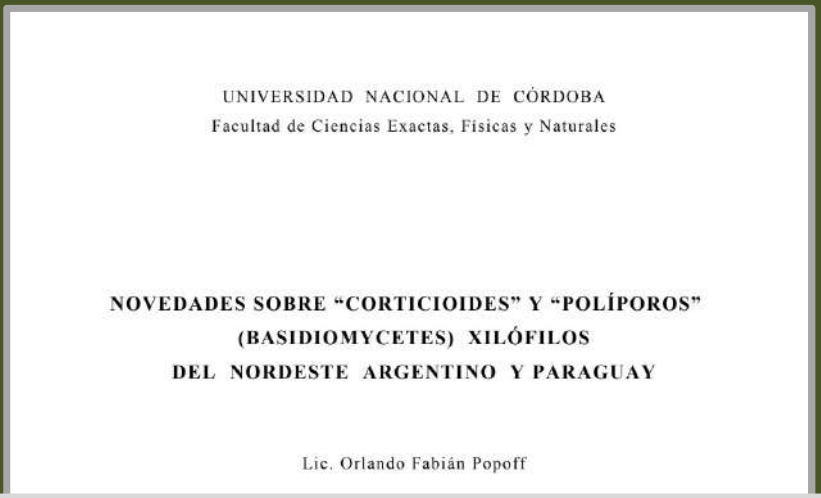
In a first step, orders and/or families were determined based on the analysis of macro- and microscopic characters of taxonomic relevance, using specialized literature.

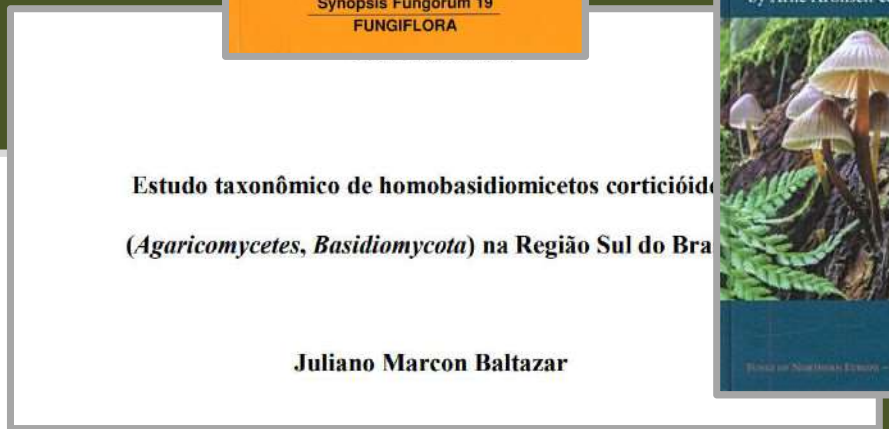
Colección BAH (Briófitos, Algas y Hongos) – Herbario CTES












61


32


139

Molecular ID

Finnish Museum of Natural History (Helsinki, Finland)
PhD. Slava Spirin
PhD. Ilya Viner

80 samples

"White corticioids"

"jelly fungi"

"black stipe polypores"

Substrate volume

All woody substrates with a diameter > 10 cm intersecting the 25 m transect.

Substrate volume

$$V = L/3 \times (A_1 + \sqrt{(A_1 \times A_2)} + A_2)$$

V = volumen de la pieza
L = longitud de la pieza
A_1 = área basal
A_2 = área distal

Tocones

Ramas caídas

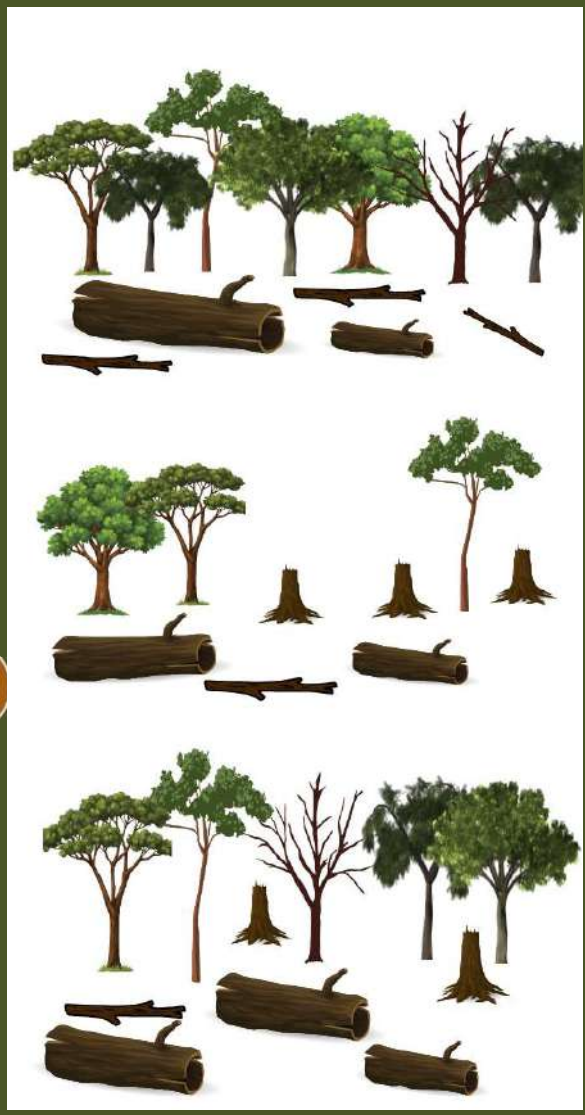
Troncos caídos

FWD = 5 - 9 CM

CWD ≥ 10 CM

Tratamiento: ID subparcela: GP_____S_____

N° pieza	Tipo	D1 ancho (cm)	D2 angosto (cm)	Longitud (m)	Descomposición (1,2,3)
1					
2					
3					
4					
5					

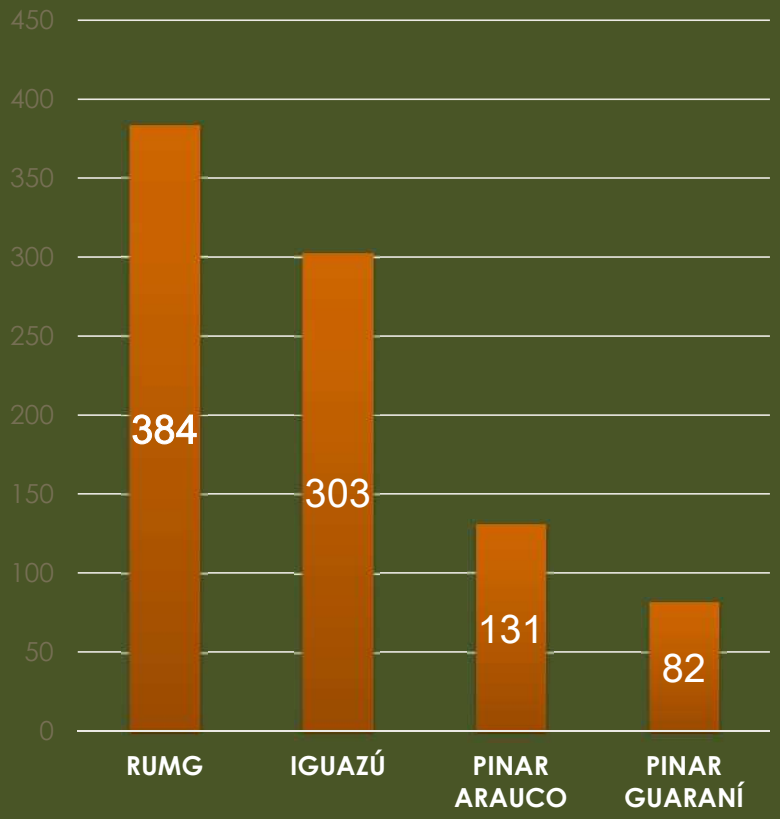


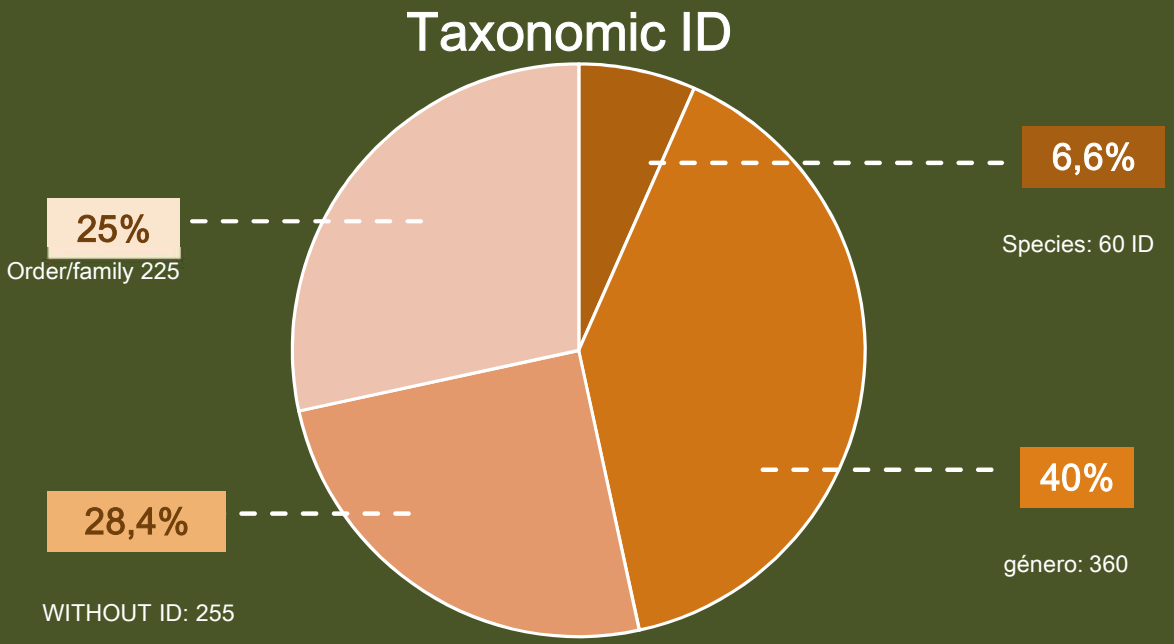
RESULTS

3 of the 4 sampling campaigns:

1. Autumn 2025
2. Spring 2025
3. Autumn 2026

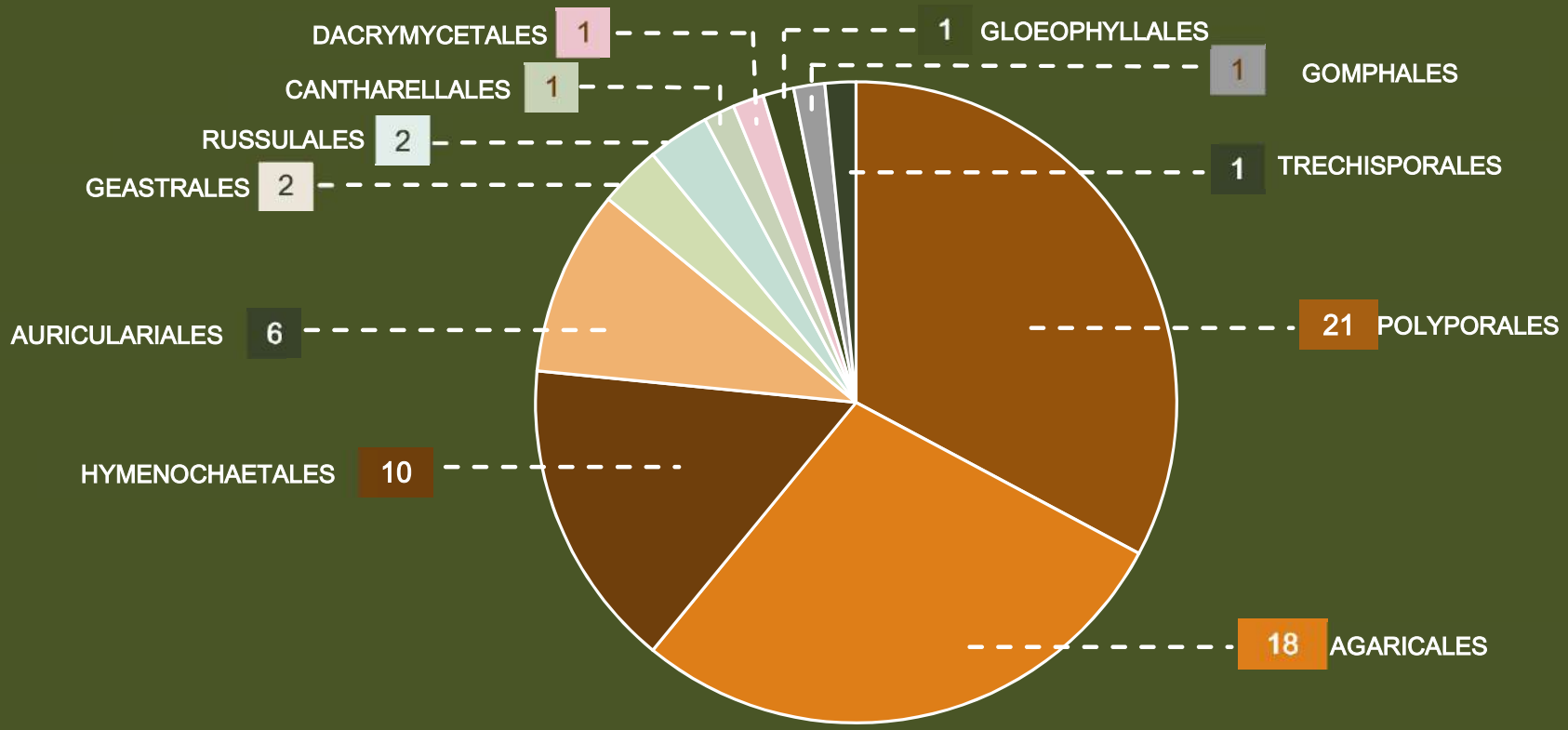
RESULTS



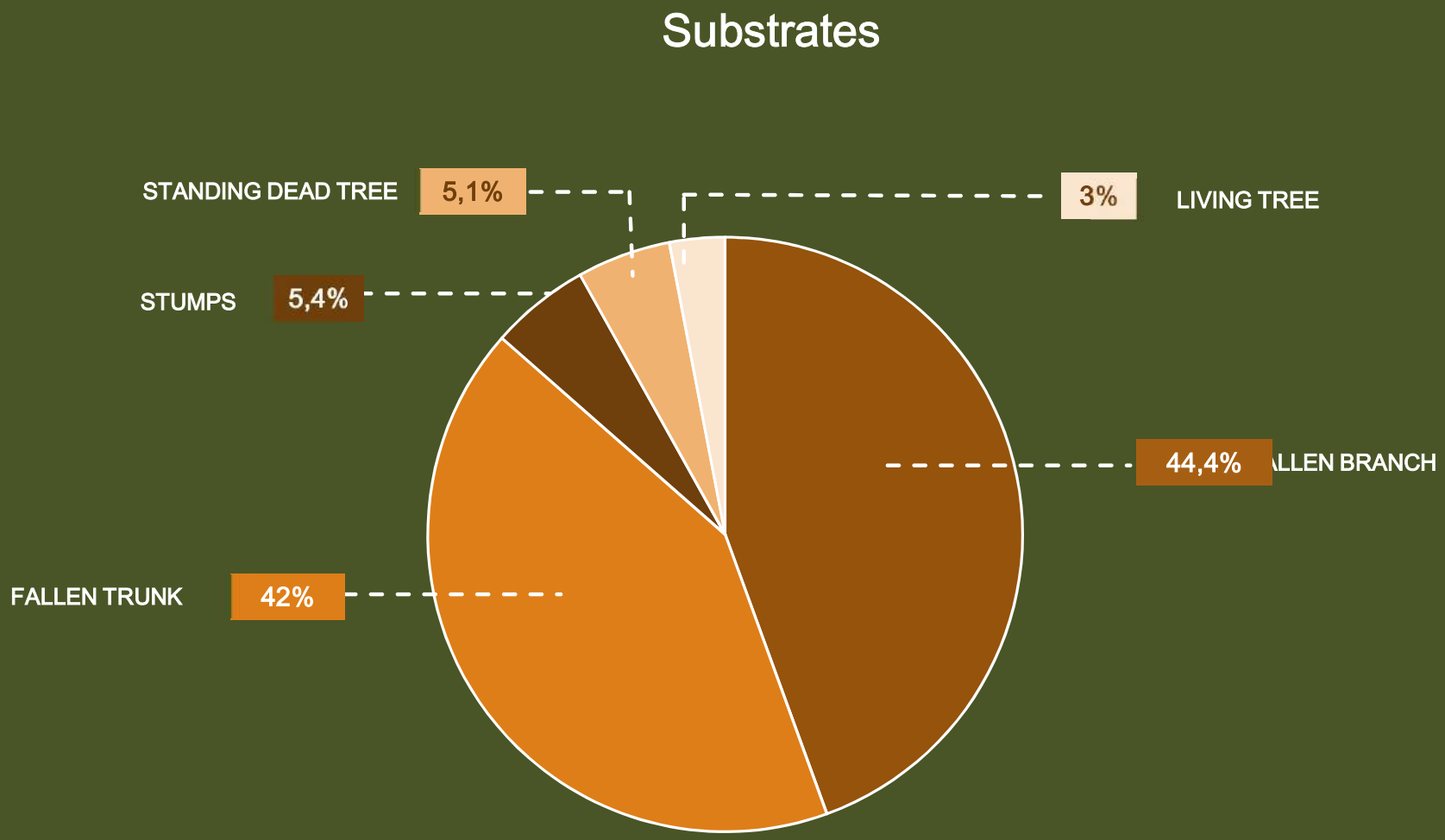


During the first year of sampling (autumn and spring 2025), 900 Agaricomycetes specimens were collected.

RESULTS


DACRYMYCETALES 1
CANTHARELLALES 1
RUSSULALES 2
GEASTRALES 2
AURICULARIALES 6
HYMENOCHAETALES 10
1 GLOEOPHYLLALES
1 GOMPHALES
1 TRECHISPORALES
21 POLYPORALES
18 AGARICALES

RESULTS


Substrates
STANDING DEAD TREE
5,1%
3%
LIVING TREE
STUMPS
5,4%
44,4%
LLEN BRANCH
FALLEN TRUNK
42%

Filoboletus grassilis

Rigidoporus crocatus

Perenniporia martius

Polyporus leprieurii s.l.

Meripilus brasiliensis

Fomes fasciatus

Inocutis jamaicensis

Elmerina santanensis

Clitocybe aff asema

Peniophorella rudis s.l.

Scytinostroma duriusculum s.l.

Hyphoderma setigerum s.l.

Ganoderma aplannatum

Galerina velutipes

Perenniporia

Hymenochaete

Leucocoprinus

Mycena paraguariensis

RESULTS

6 *Auricularia* species

A. brasiliana

A. fuscosuccinea

A. protracta

A. cornea

A. nigricans

A. tremellosa

The identity of additional specimens was confirmed *Polyporus wrightii*, *P. subelegans*, *Lyomyces boquetensis*, *Xylodon rickii*, *Phanerochaete* sp., *Steccherinum perparvulum*, *Perenniporia paraguayiensis* y *Elmeerina santanensis.*

Estudio preliminar sobre el género *Amanita* en el nordeste de Argentina

Preliminary study on the genus *Amanita* in northeastern Argentina

Vignale M. V.[1,2], Ramirez N. A.[3], Grassi E. M.[2,*], Niveiro N.[3,4]

Introducción

Materiales y Métodos

Resultados y Discusión

Referencias

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EL GÉNERO *AMANITA* (AMANITACEAE, AGARICALES, BASIDIOMYCOTA) ASOCIADO A CULTIVOS FORESTALES DE PINO EN LA MESOPOTAMIA ARGENTINA

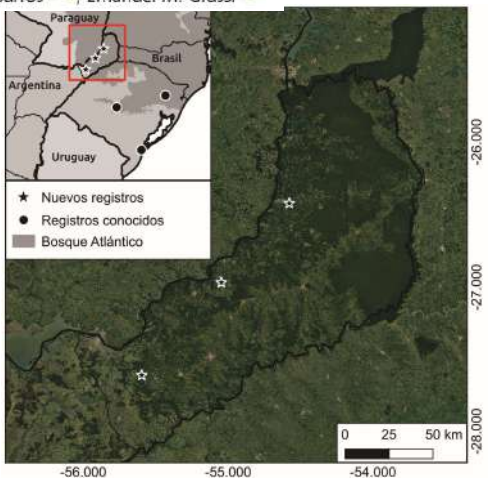
A. Judit Batista[1,2*], Alex E. Somrau[1], Natalia A. Ramirez[1,2], Emanuel M. Grassi[3], M. Victoria Vignale[3,4] & Nicolás Niveiro[1,2]

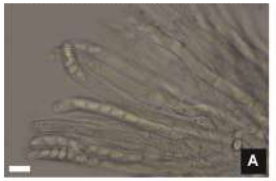
Fundación Miguel Lillo Tucumán Argentina

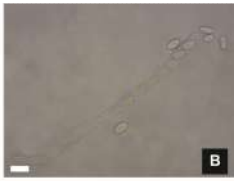
Nuevo registro de *Morchella esculenta* (Ascomycota, Pezizales) para la selva paranaense

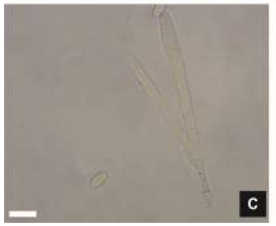
New record of *Morchella esculenta* (Ascomycota, Pezizales) for the Paranaense forest

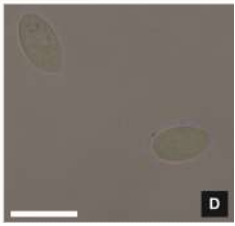
Vignale, M. Victoria[1,2*]; Felipe Sodré Mendes Barros[1,3]; Emanuel M. Grassi[1]



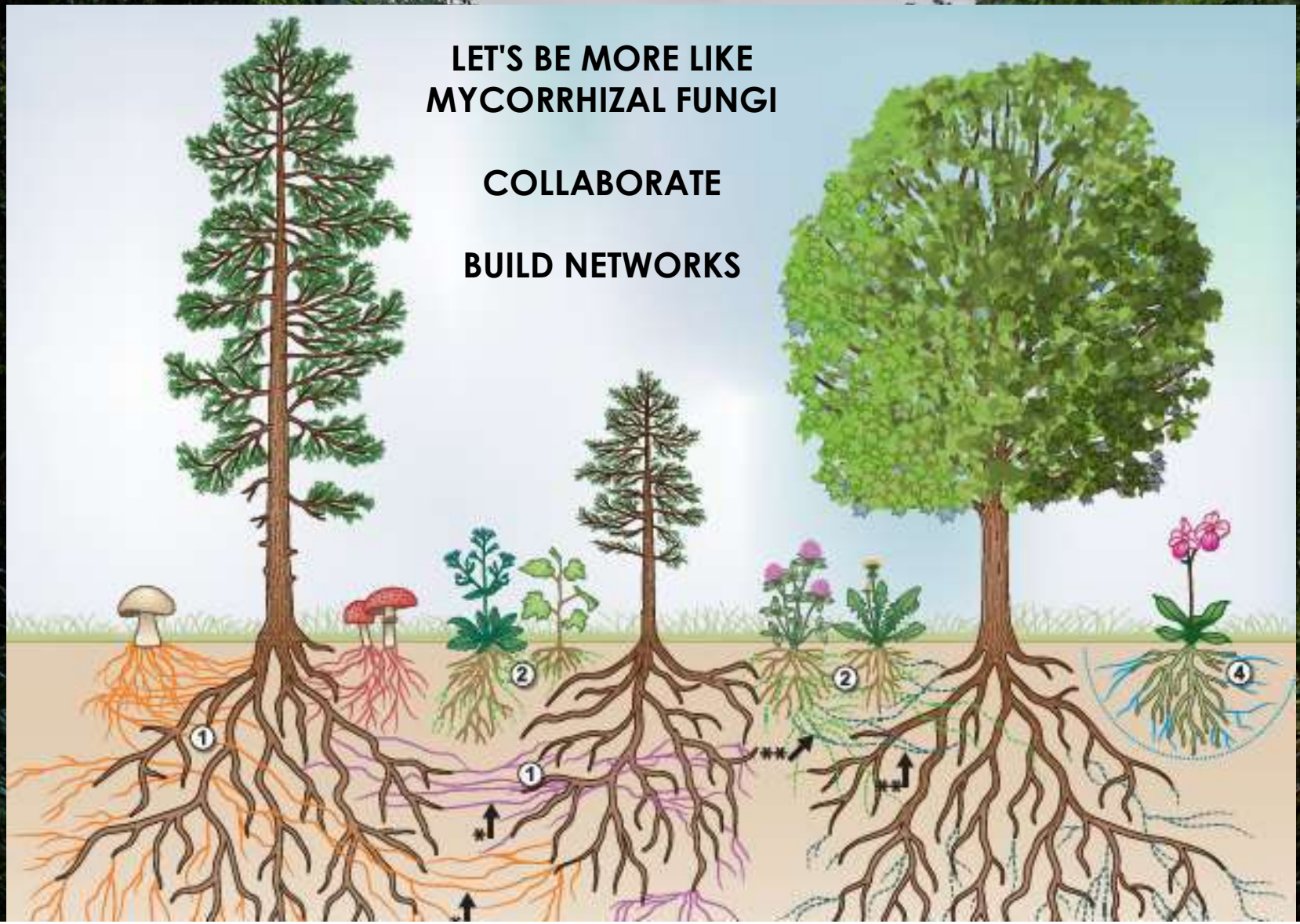








Workshops on mushroom identification and collection


LET'S BE MORE LIKE
MYCORRHIZAL FUNGI
COLLABORATE
BUILD NETWORKS
1
2
1
2
4