I Congreso Internacional de
TRUFICULTURA

1ST International Congress of
TRUFFICULTURE

2013
TERUEL
Spain
5.6.7.8 I3 I2013

www.tuber2013.com
@tuber2013

LESSONS LEARNED IN TWENTY YEARS OF MONITORING MYCORRHIZAL STATUS IN CULTIVATED TRUFFLE GROUNDS

A.M. de Miguel

Department of Environmental Biology. University of Navarra

Universidad de Navarra

6th March 2013

Why twenty years?

The starting - today

Objectives

Before production

- *Tuber melanosporum presence*
- *Truffle* replacement
- Competing *mycorrhizas: nursery contamination/ wild competition?*
- *Mycorrhization status* evolution
- Tree *suitability*
- *Effect of* agricultural practices

After production

- Orchard *and tree suitability*
- *Effect of agricultural practices*

Productive trees:

- *Mycorrhizas coexisting with the truffle*

Non productive trees

- *Competing mycorrhizas inhibiting truffle production*

Many questions/Uncertainties at the beginning

- *Who: truffle owners, ITG Agrícola, Unav. Botánica*
- *Whose and where: truffle stand owners of Navarra*
- *Which: experimental stands*
- *Why: because of the lack of information about what is happening during a long period of years*
- *What for: to know the evolution of truffled trees and orchards*
- *What, how, when and how often: mycorrhizas collected periodically in spring and autumn since 1993*
- *What more: looking for references, contacting and visiting specialists*

Methodology - *in the field*

SAMPLING OF MYCORRHYZAS

Countless samples, many days, many hours in the field, with sun, rain,...

Methodology in the laboratory

IDENTIFICATION OF MYCORRHYZAS

Many hours, days, years in the laboratory cleaning, selecting and looking mycorrhizas

Collections of:

- *Ectomycorrhizal type slides for microscopic examination*
- *Herbarium of hypogeous fungal species of truffle stands*
- *Slides, photographs and JPG pictures*

Selection of >2700 references about:

- *Tuber, truffle growing*
- *Hypogeous fungi*
- *Description of ectomycorrhizas, ecology, dynamic of ectomycorrhizal communities*

Countless authors PDF

The first results

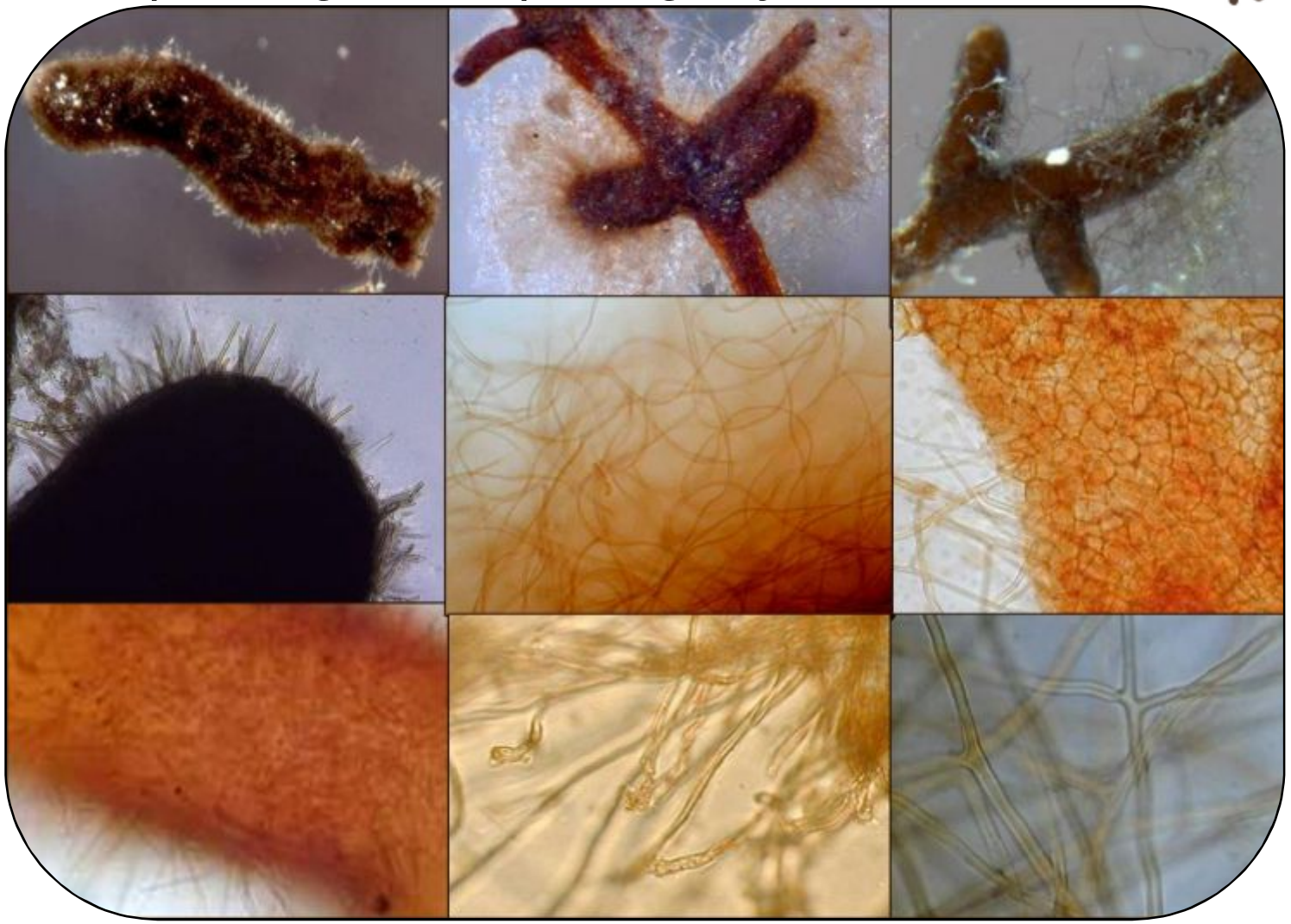
Black truffle
Tuber melanosporum

and other Tuber species
T. aestivum
T. borchii
T. brumale
T. mesentericum
T. rufum
...

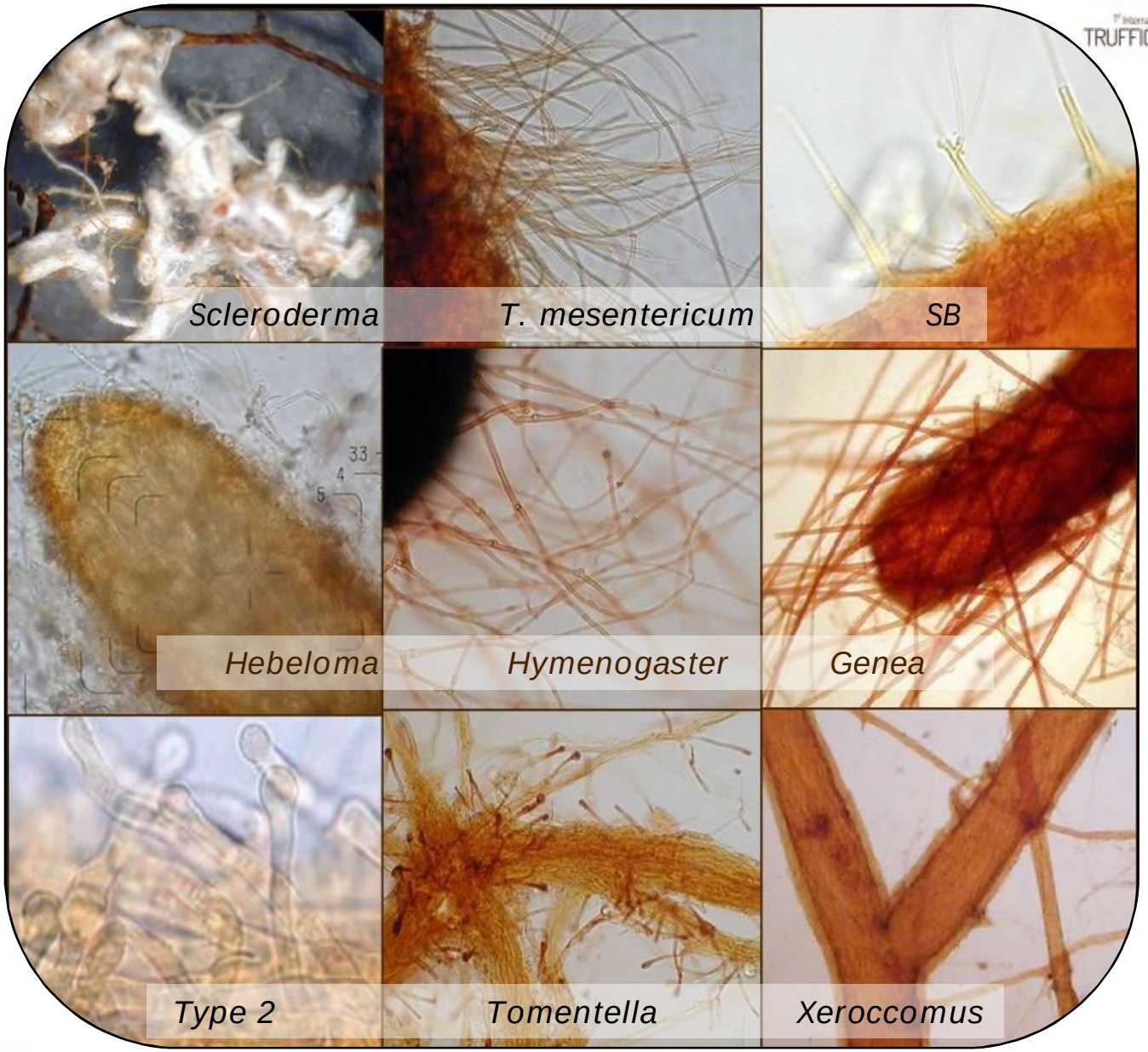
Other Fungi
Scleroderma, Hebeloma, AD, SB...

After 5 years of plantation, 12 types

The beginning: Replacing – competing mycorrhizas

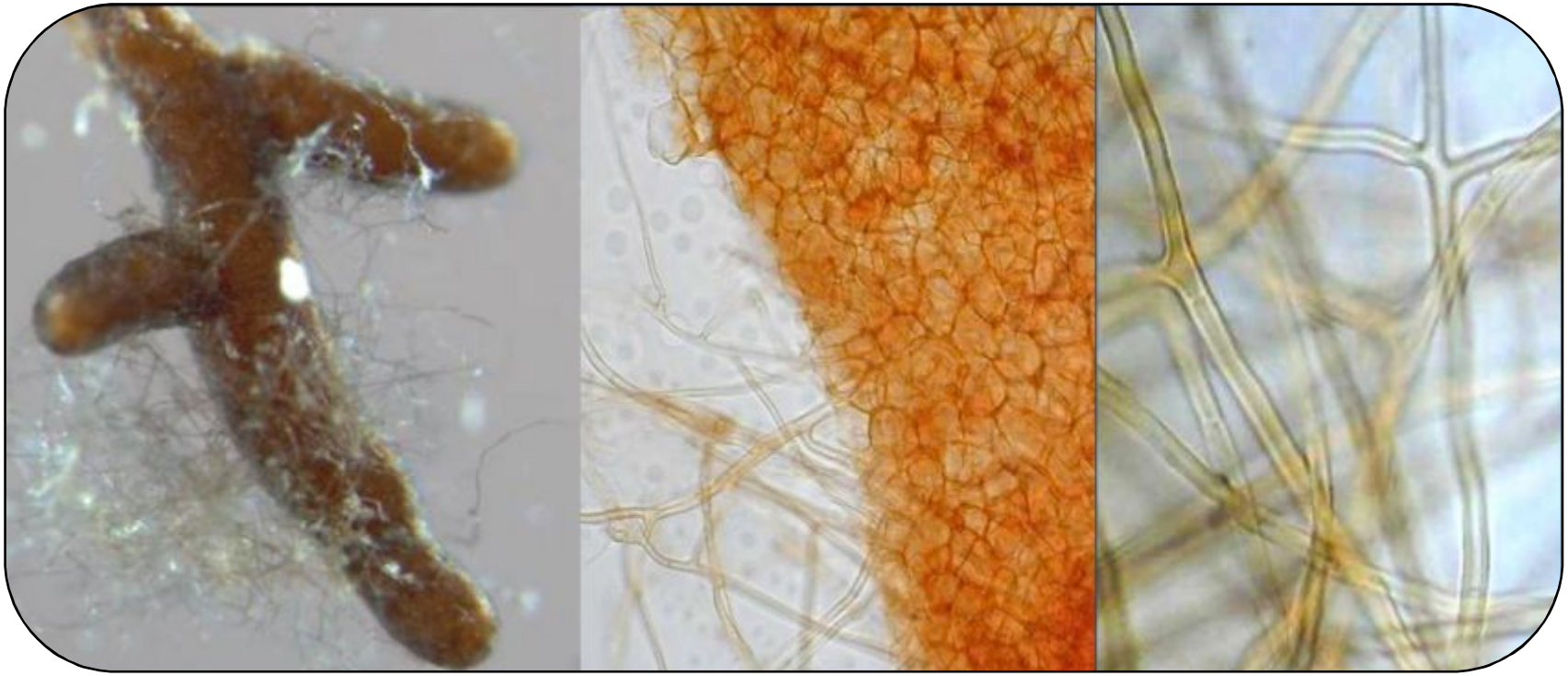


Tuber brumale *Tuber aestivum* *AD*



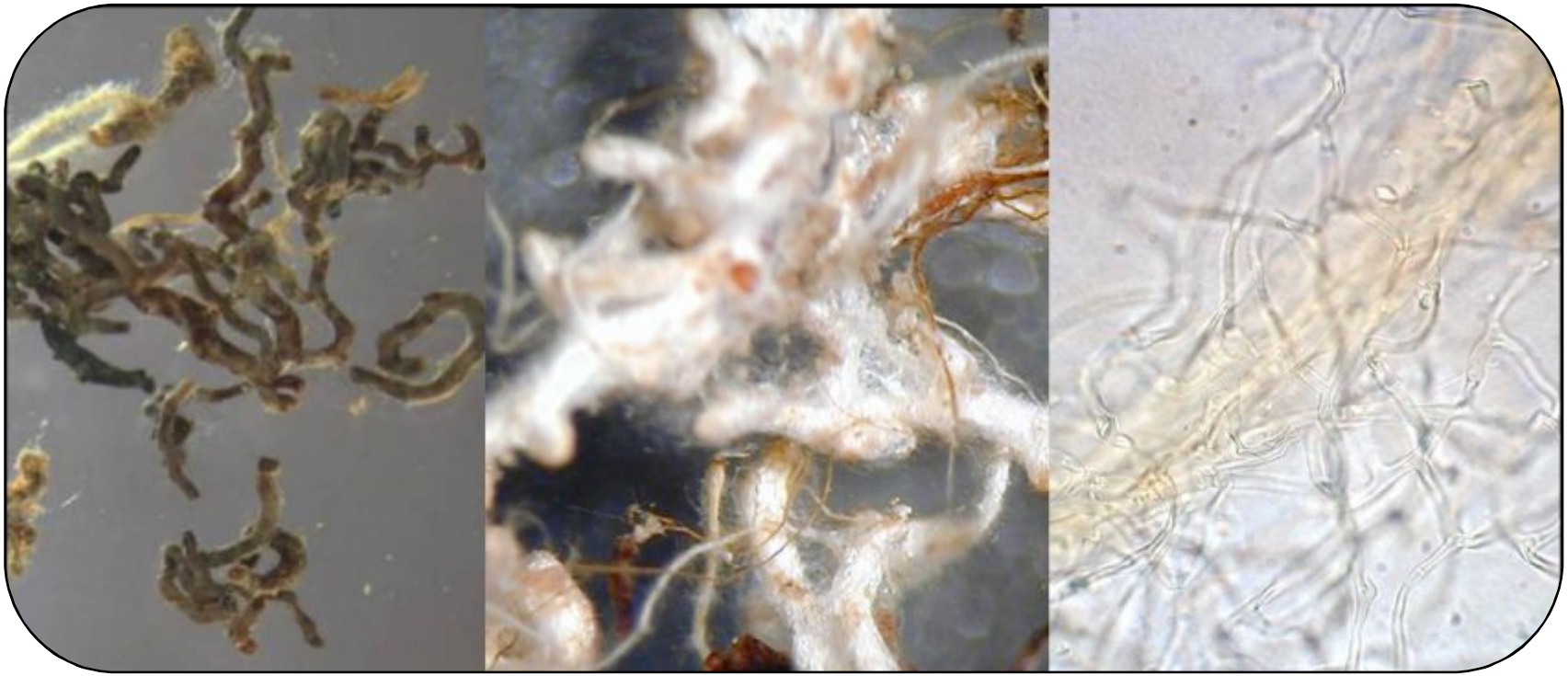
More and more:

Russula, Boletus, Lactarius, Sphaerosporella...

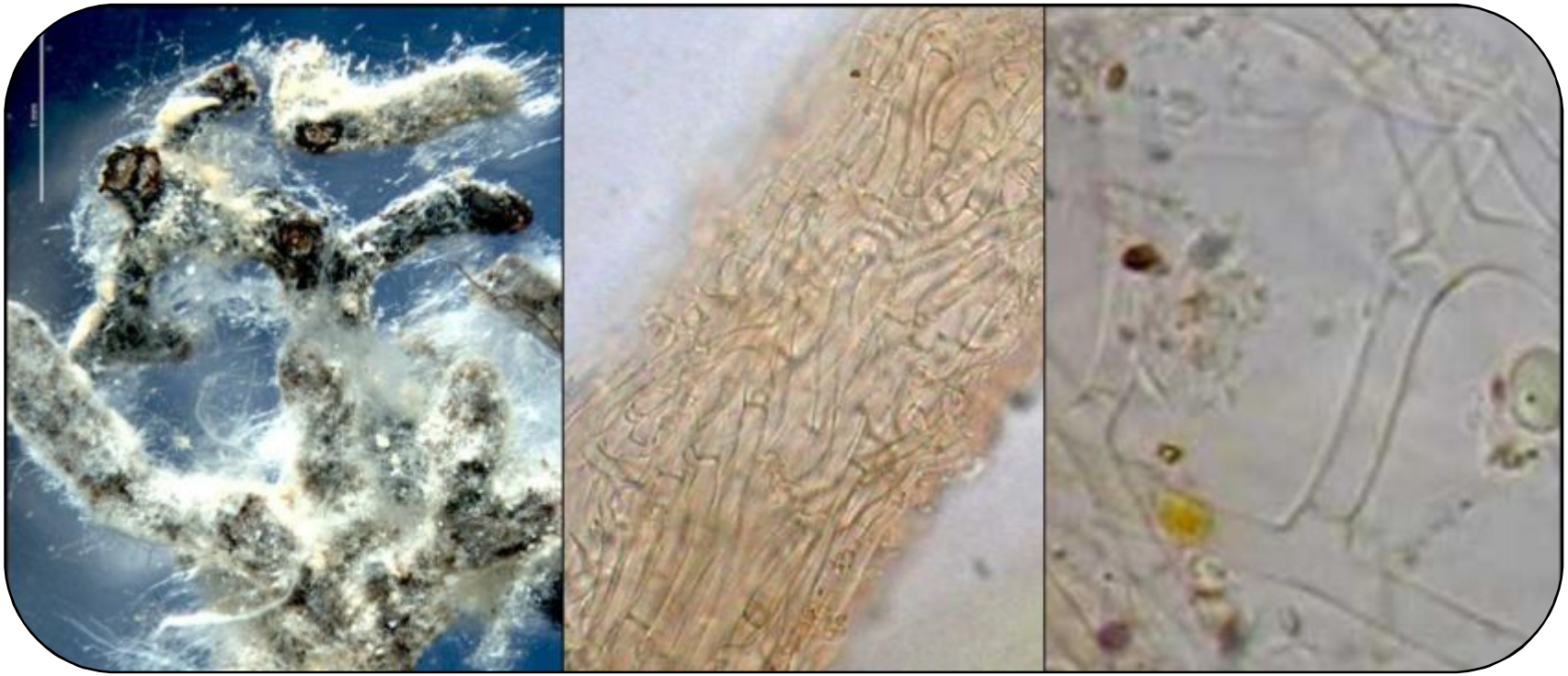


Trichophaea woolhopeia (Cooke & W. Phillips) Boud.

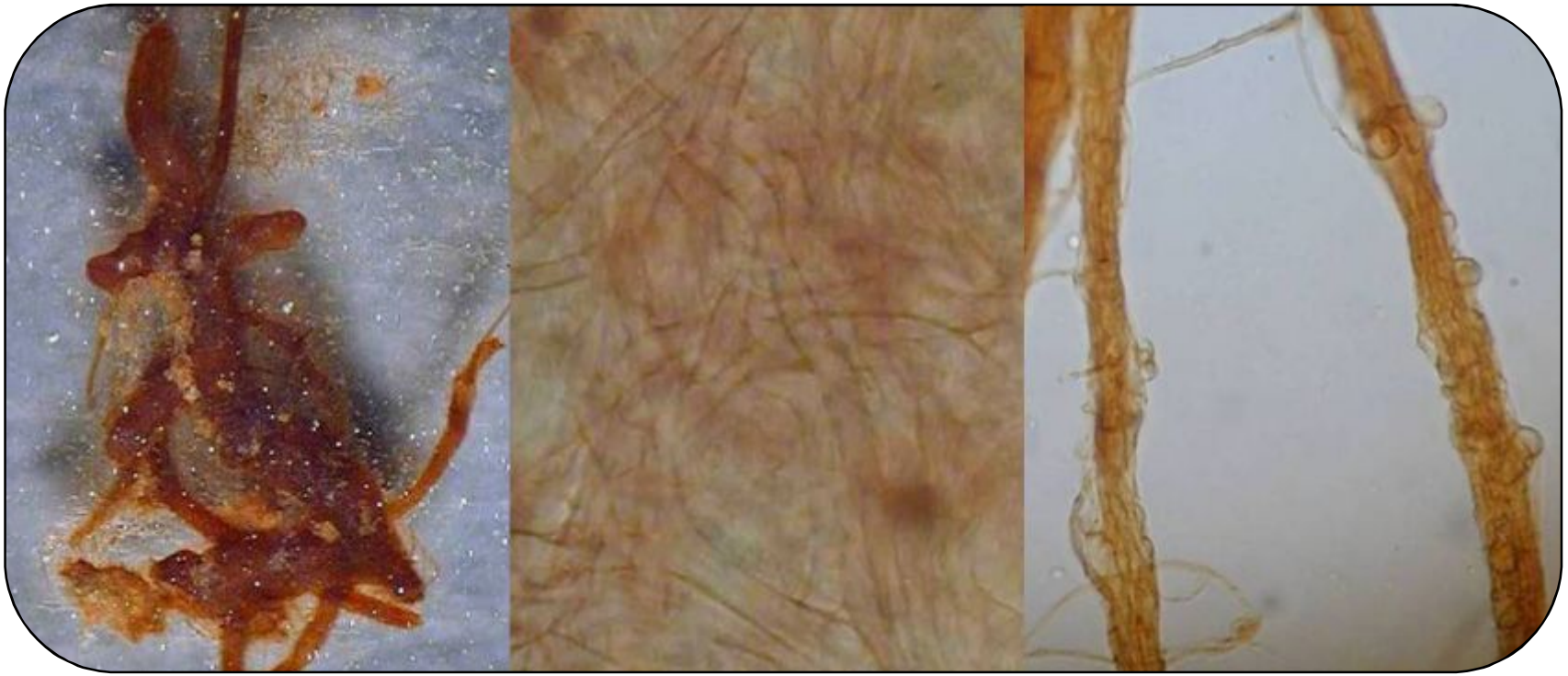
Most frequent competitor mycorrhiza in truffle plantations, mentioned in some truffle growing general manuals and many papers



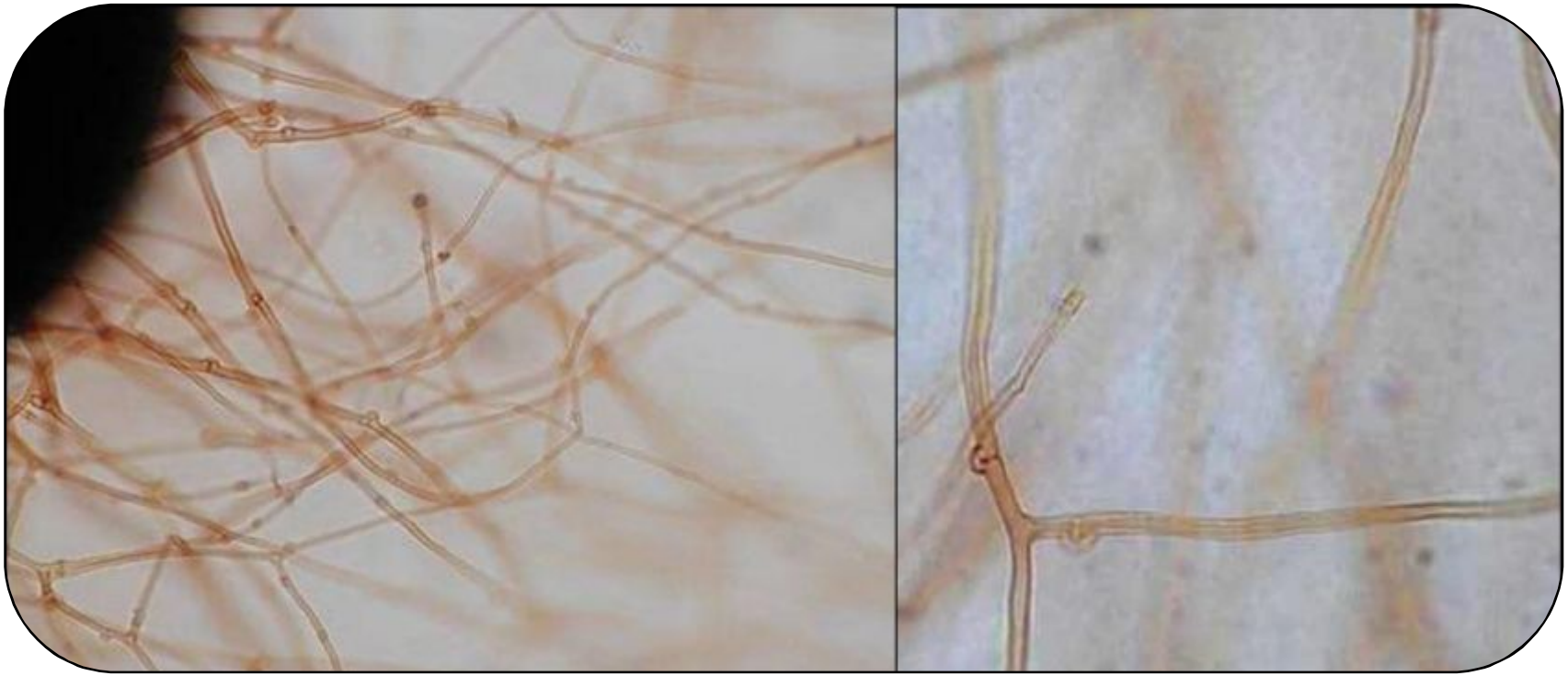
Scleroderma



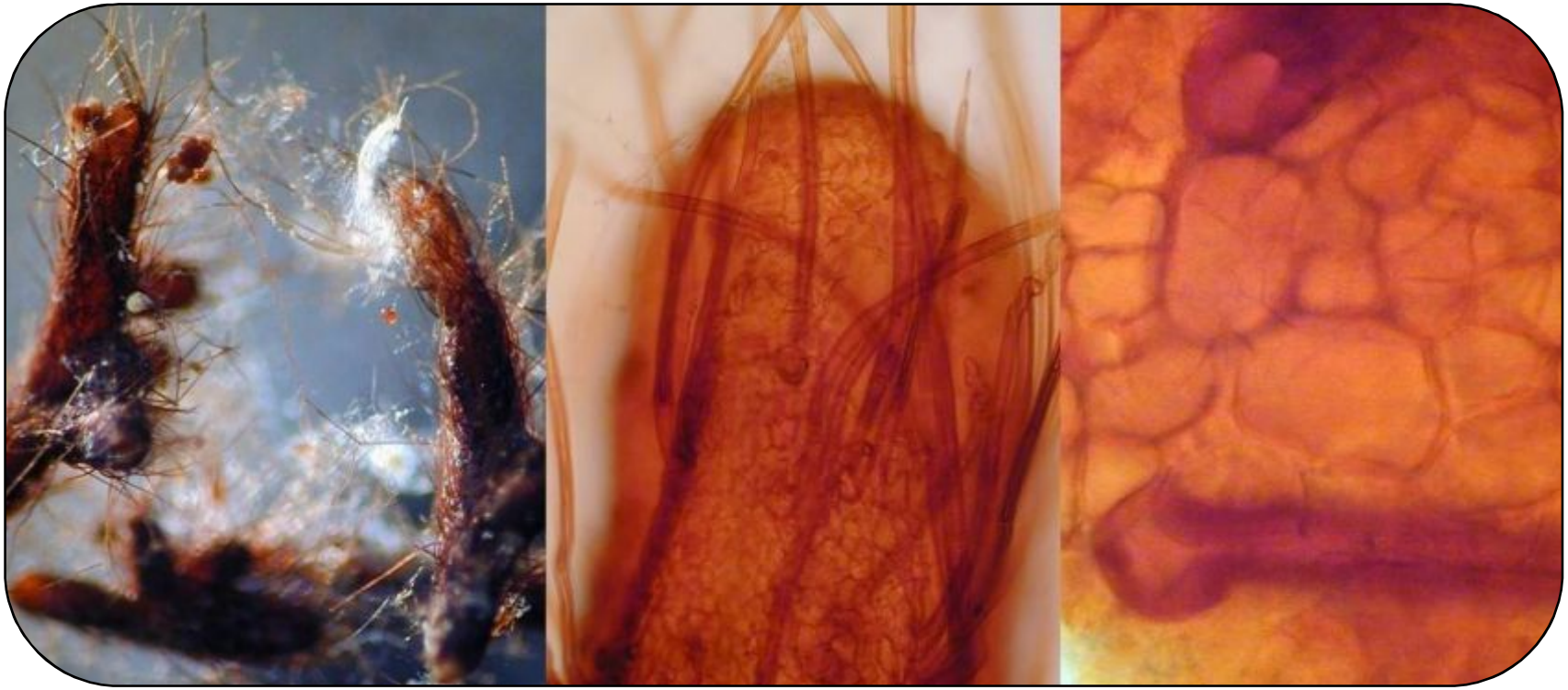
Hebeloma - Cortinarius



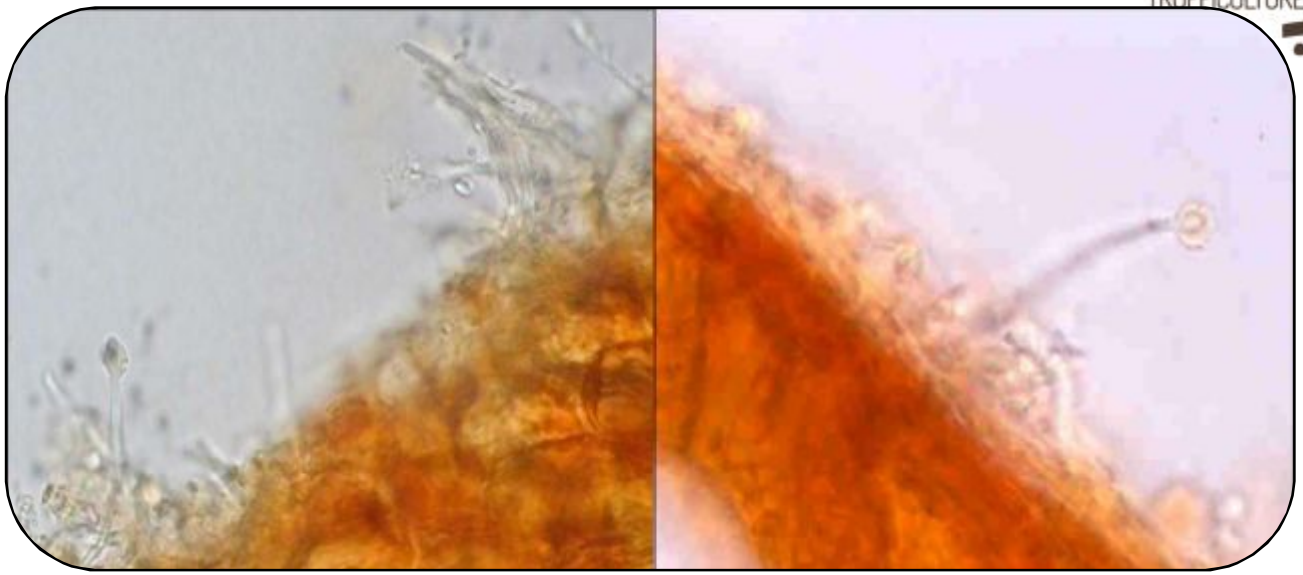
Pisolithus arhizus (Scop.) Rauschert



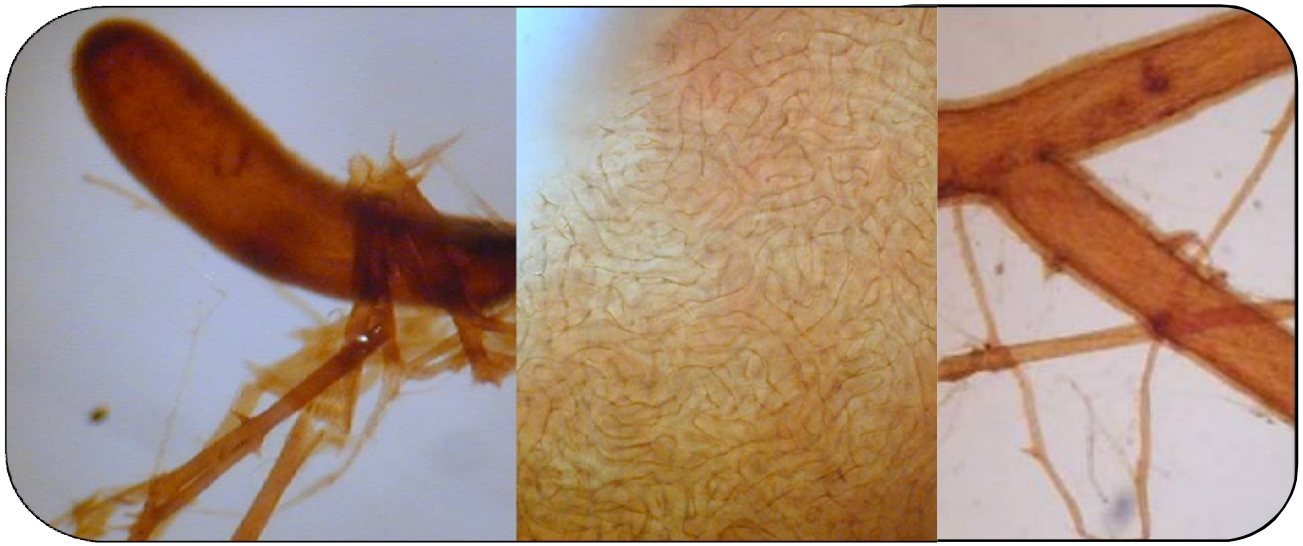
Hymenogaster



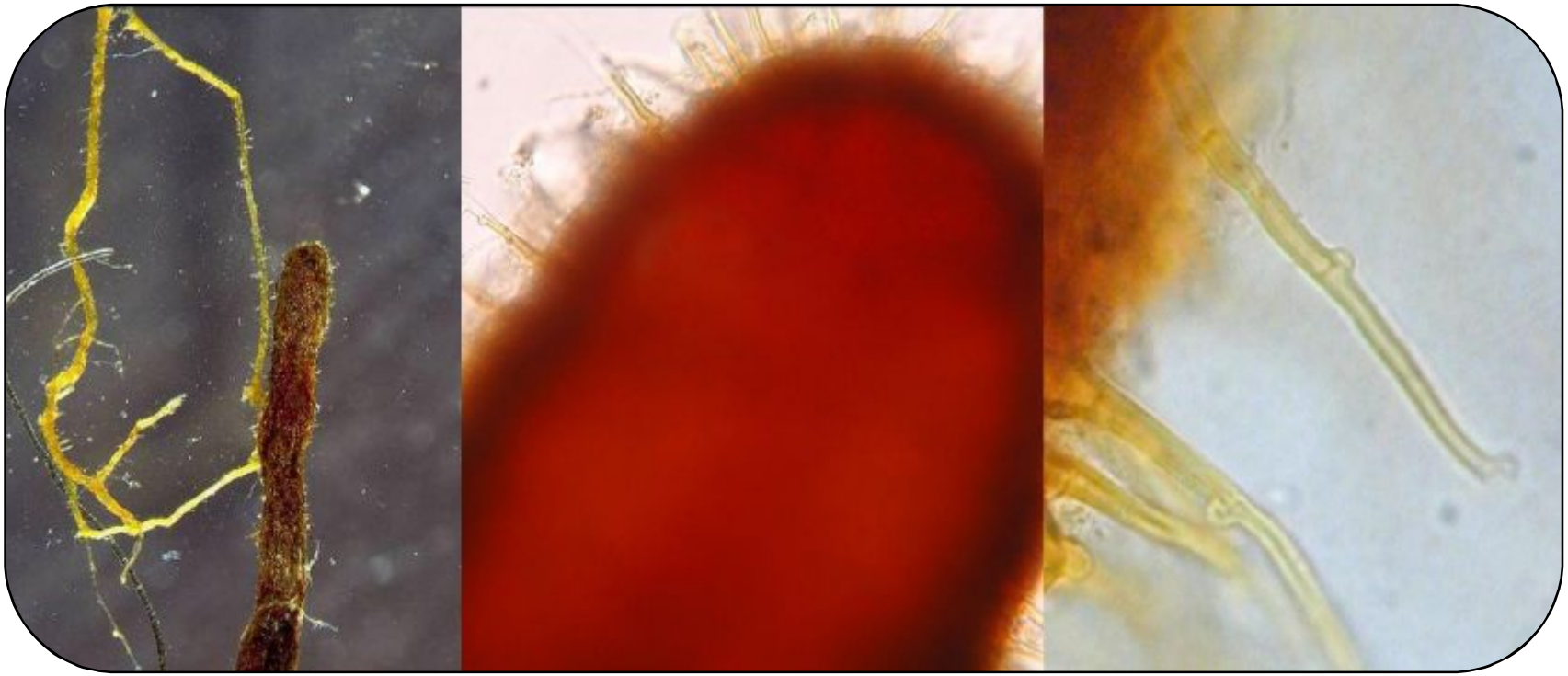
Genea verrucosa Vittad.



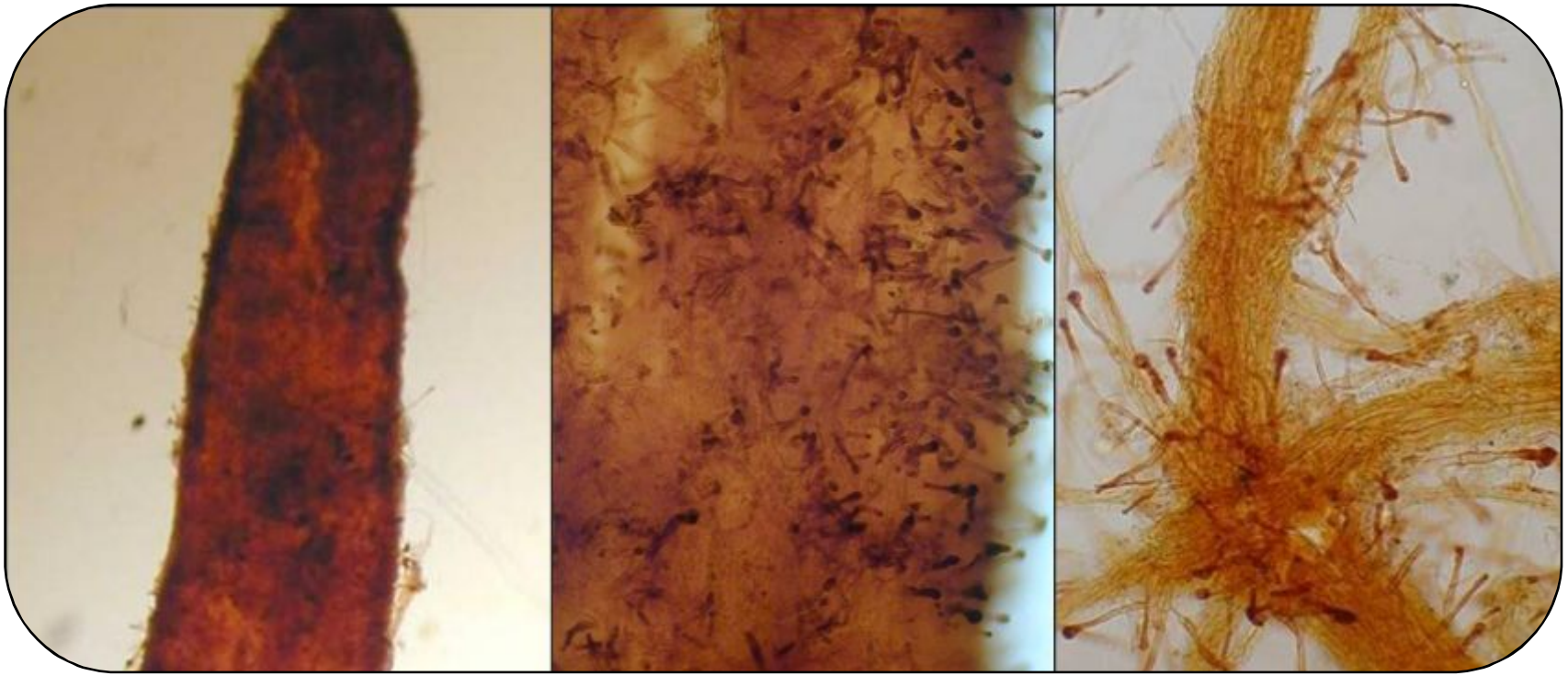
Russula



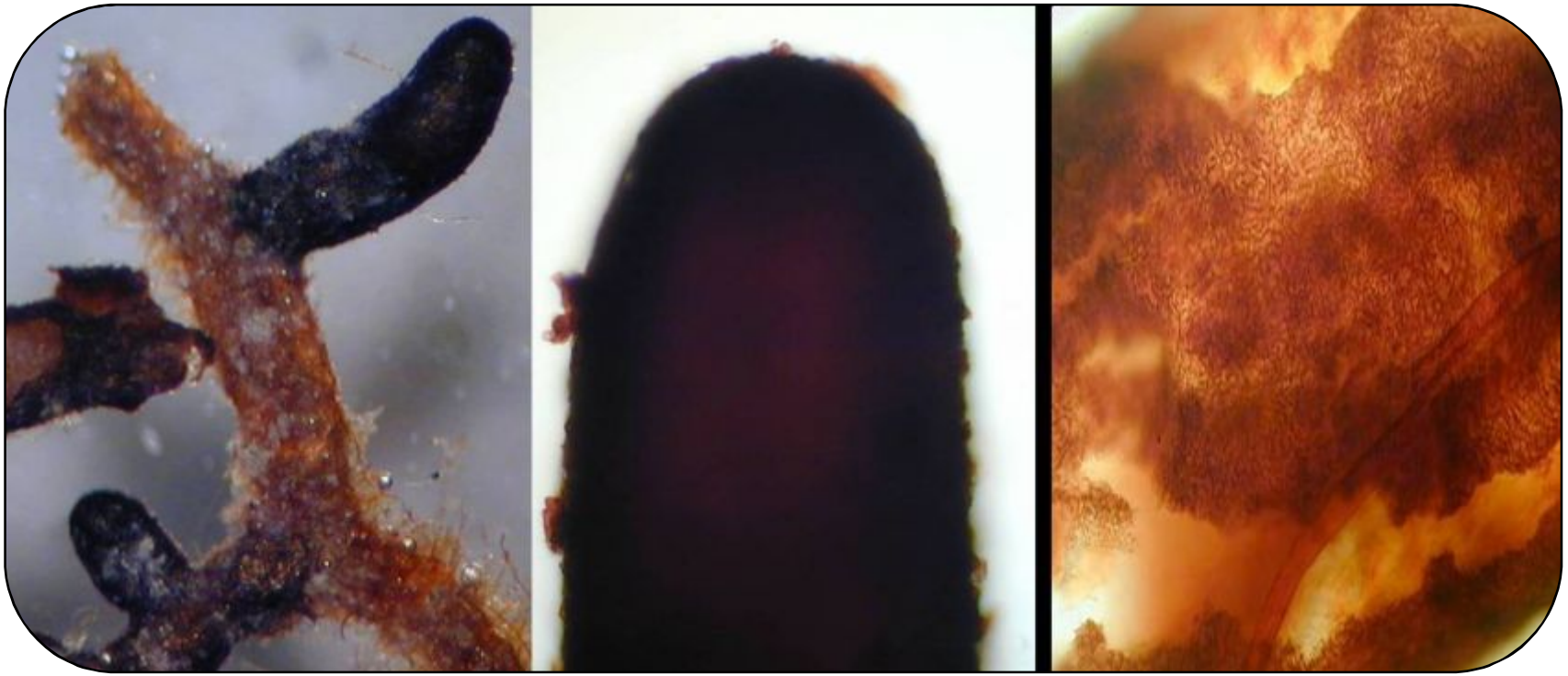
Xerocomus



Tomentella galzinii Bourdot

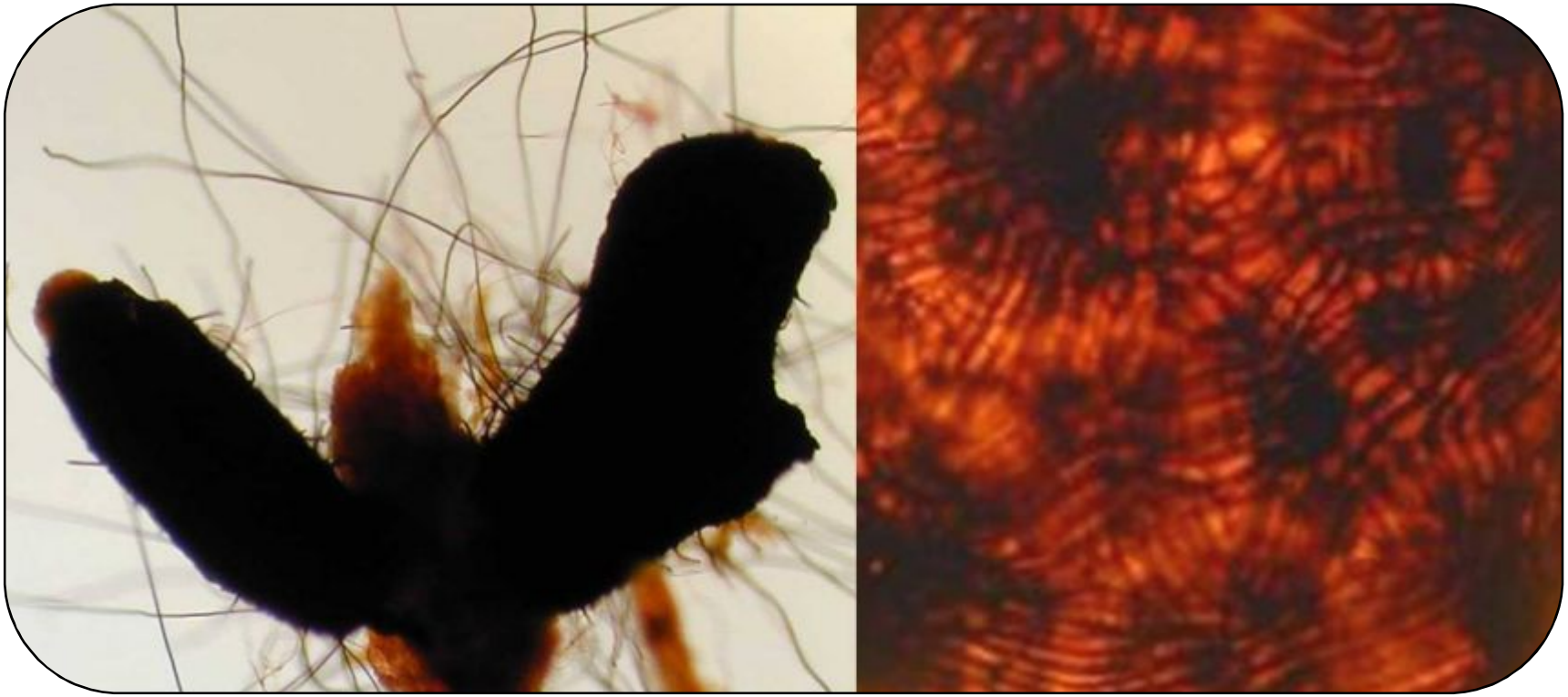


Tomentella subtestacea Bourdot & Galzin



Quercirhiza squamosa (Palfner, 1995)

2 Type (De Román, 2003) *Astraeus hygrometricus* (Pers.) Morgan



Cenococcum geophilum Fr.

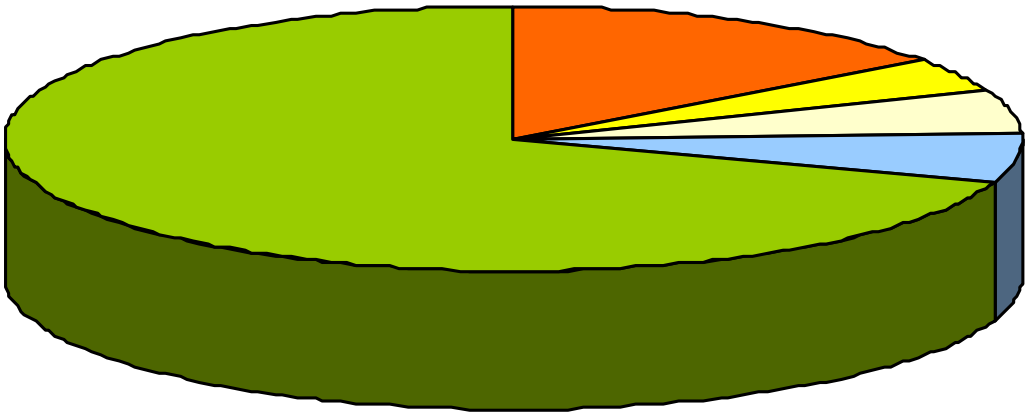
50 ECTOMYCORRHIZAL MORPHOTYPES IDENTIFIED* IN TRUFFLE STANDS** IN THE WORLD (≈70 references)

ECTOMYCORRHIZAL MORPHOTYPES ** ***T.melanosporum, T.magnatum, Taestivum, Tborchii*** stands	
Astraeus hygrometricus	*Tomentella elisei*
Basidiomycetes	*Tomentella ferruginea*
Boletus	*Tomentella galzinii (=SB; =forma 14; =Quercirhiza fibulocistidiata)*
Cantharellus tubaeformis	*Tomentella lapidum*
Cenococcum geophilum	*Tomentella lilacionogrisea*
Clavulinaceae	*Tomentella stuposa*
Cortinarius	*Tomentella subtestacea*
Genea	*Tricholoma*
Hebeloma	*Trichophaea woolhopeia (=AD; forma 2; =Quercirhiza quadratum)*
Hymenogaster vulgaris (Hymenogaster)	*Tuber aestivum*
Inocybe rufuloides (Inocybe, Inocybaceae)	*Tuber borchii (=T.albidum)*
Laccaria	*Tuber brumale*
Lactarius	*Tuber dryophilum*
Melanosgaster variegatus (Melanogaster)	*Tuber excavatum*
Pisolithus arhizus	*Tuber lyonii*
Quercirhiza cumulosa	*Tuber maculatum*
Quercirhiza squamosa	*Tuber magnatum*
Quercirhiza stellata	*Tuber melanosporum*
Russula	*Tuber mesentericum*
Scleroderma	*Tuber oligospermum*
Sebacinacea	*Tuber rapaedorum*
Sphaerosporella brunnea	*Tuber rufum*
Suillus	*Tuber uncinatum*
Thelephoraceae	*Tuber whestonense*
2 Type	*Xerocomus*
In bold: Only in our studies	Underlinde: only in EEUU

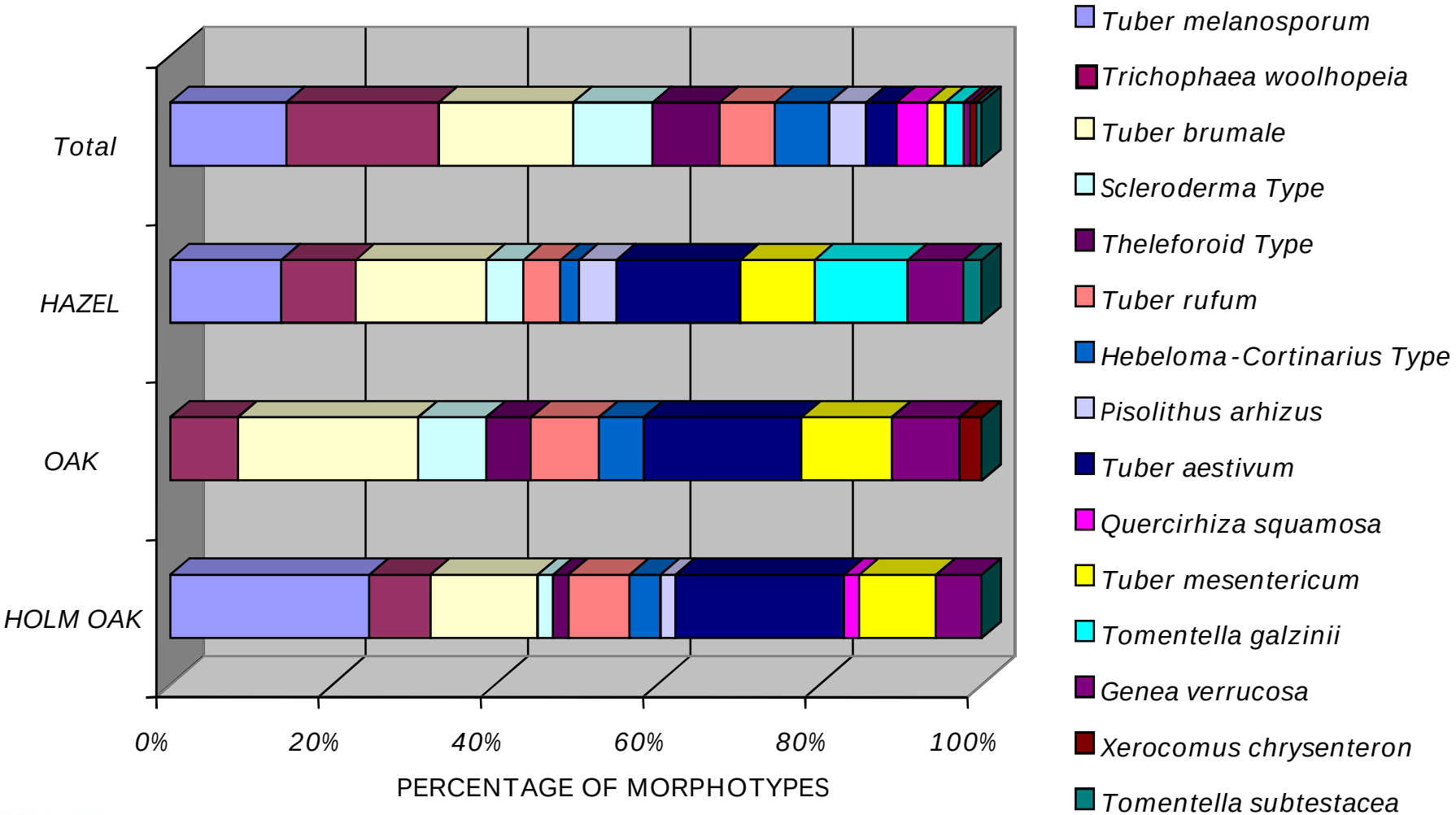
Nowadays >100 species known in truffle stands

*"Unidentified morphotypes, Formas, Unknown Mycorrhizas and Other Ectomycorrhizal species" not included in the table

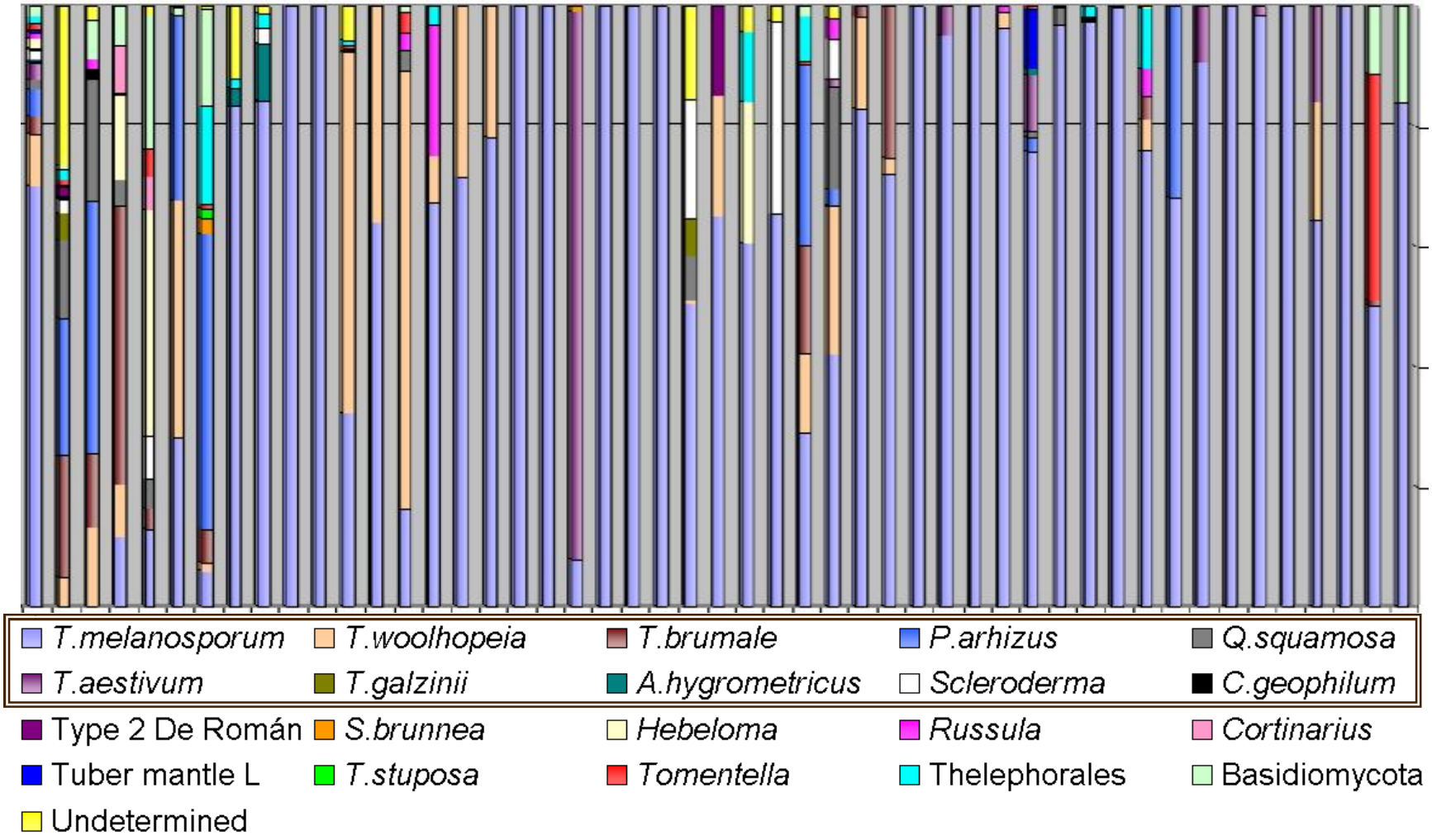
TAXONOMICAL SPECTRUM OF ECTOMYCORRHIZAL TYPES



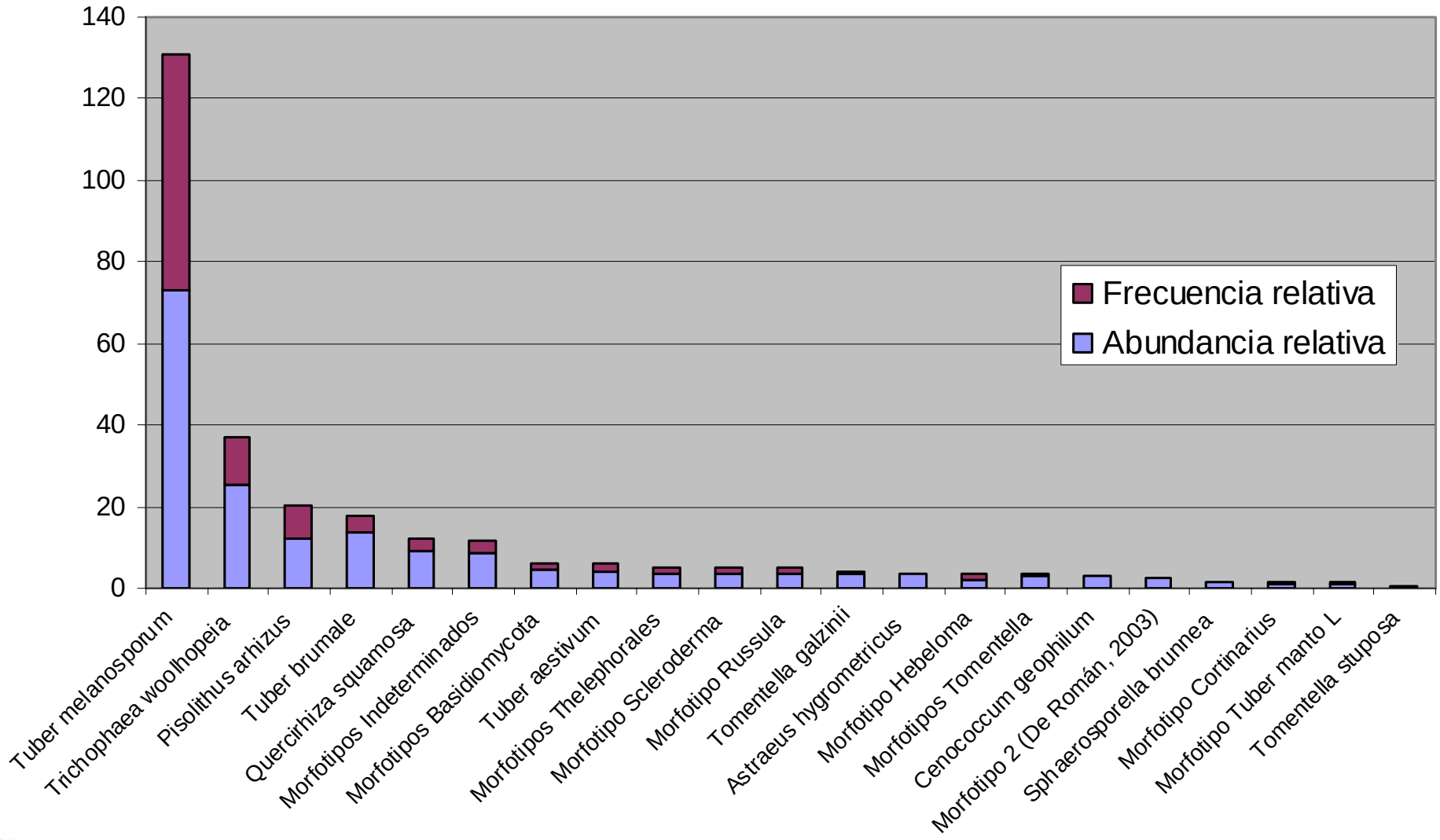
MYCORRHYZAL FRECUENCY IN BLACK TRUFFLE STANDS



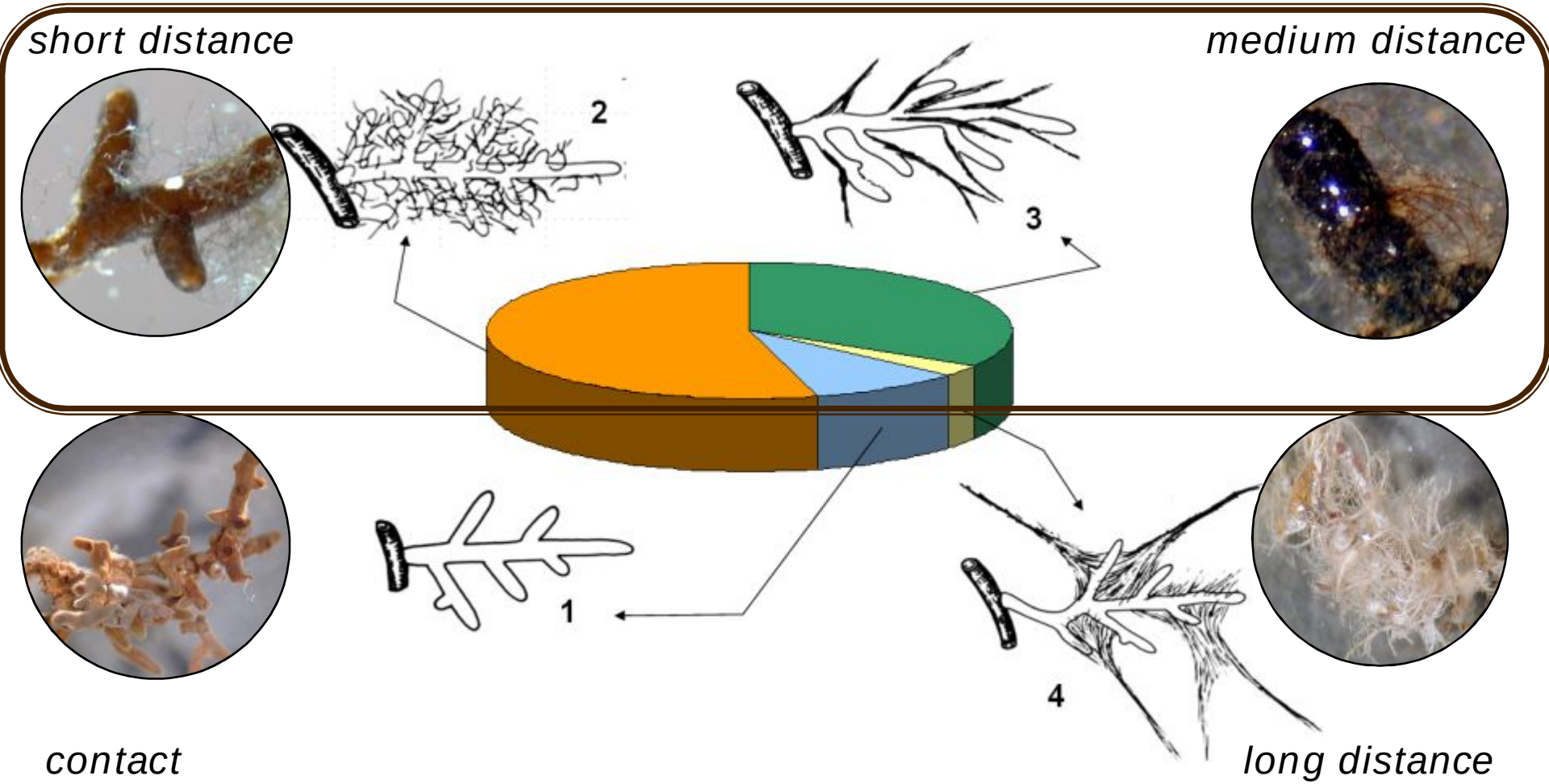
MYCORRHYZAL MORPHOTYPE PRESENCE-ABUNDANCE IN 48 TREES



IMPORTANCE VALUE *(Lamprecht, 1990)*



EXPLORATION TYPES IN TRUFFLE PLANTATIONS



Biological spectrum basis on exploration types (Agerer 2001)

CONCLUSIONS

Morphological study

- *Is possible and necessary*
- *Provides important results for* truffle growing:
  - ✓*Plant quality: need of nursery plant control*
  - ✓*Suitability of symbionts: host preference*
  - ✓*Truffle plantations management*
    - *Effect of tillage, pruning, watering, covering in the ectomycorrhizal community*
    - *Avoid forest in the vicinity*
- *Sampling method: depending on the aims*





Mycorrhizal diversity

- *Excepting unfavourable situations initially, T.melanosporum develops properly and lives together with a* mycorrhizal courtship *of species*
- *Mixed plantation is home for more diversity*
- *After twenty years, ten morphotypes, amongst a hundred morphotypes characterized, are the more frequents*
- *Until now, studies about presence or absence of certain species haven't revealed a direct influence on the production*

Ectomycorrhizal community

- *Rich and diverse*
- *35-50% Thelephoroid species*
- *Natural competition – a dynamic equilibrium*
- *Follows the same pattern as those of natural truffle productive forest, with similar morphotypes.*
- *Reveal* ectomycorrhizal courtship *of* productive *trees*

Many other lessons from truffle and mycorrhiza's colleagues

My gratituide for all of them

Thank you for your attention

Gratitudes
Universidad de Navarra
ITGA
Asociación de Truficultores de Navarra
INIA
Fundación Universidad de Navarra
Gobierno de Navarra
CICYT
GTT, CRETT, TEDER, GTMFT
Universidades y centros de investigación nacionales y extranjeros

Contact
Department of Environmental Biology, University of Navarra
C/Irunlarrea s/n. 31008, Pamplona, Navarra, Spain
amiguel@unav.es