La plante cache souvent le champignon : leçons de symbiose

Colloque Les champignons
3-4 juin 2015

La plante cache souvent le champignon

- Equipe Botanique
- Institut de Systématique, Evolution, Biodiversité (**ISYEB**, UMR 7205)
- **Muséum national d'Histoire naturelle**

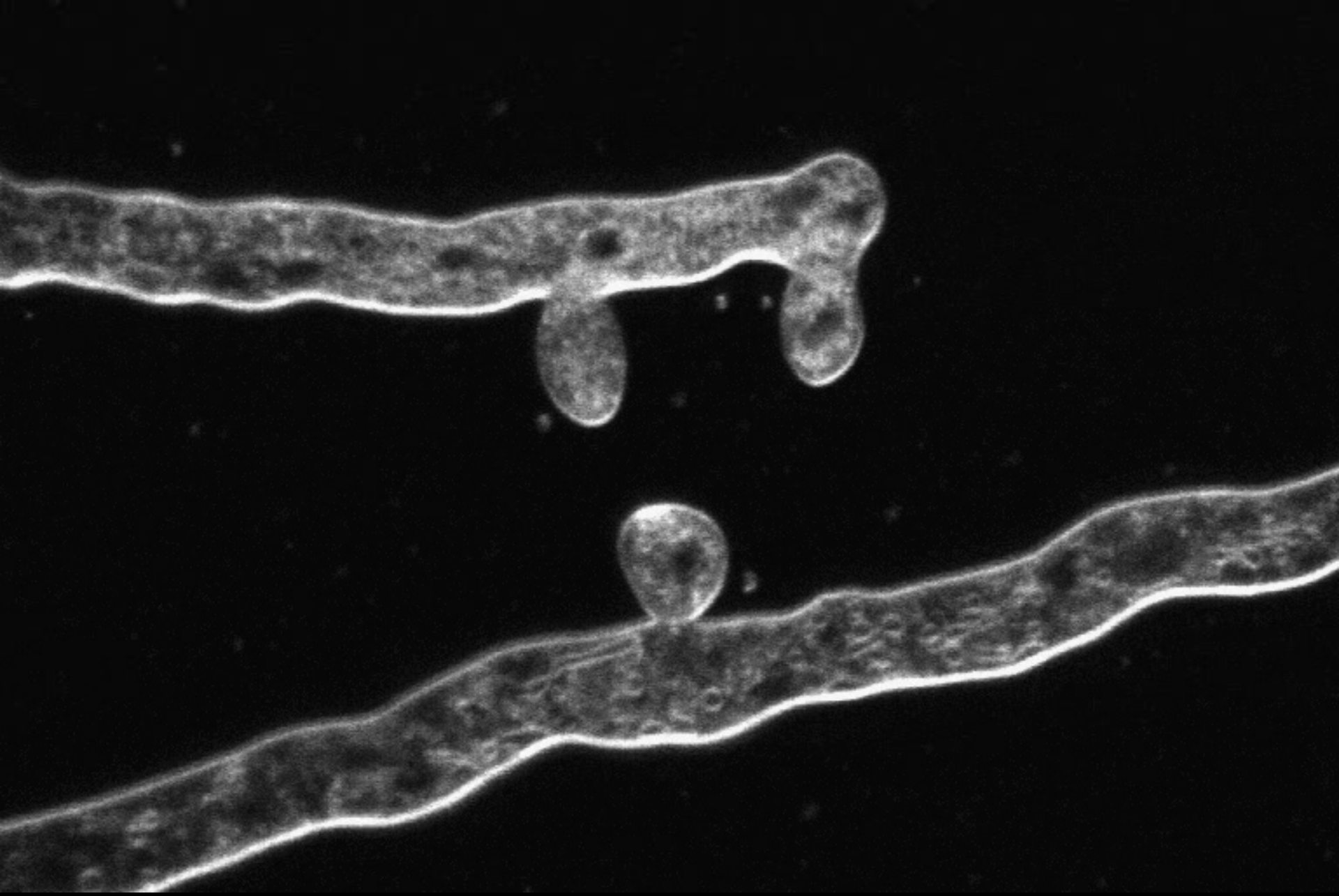
- Professeur invité aux universités de Gdansk (Pologne) & Viçosa (Brésil)
- Professeur du Muséum
- Président de la Société botanique de France

Colloque **Les champignons**
3-4 juin 2015

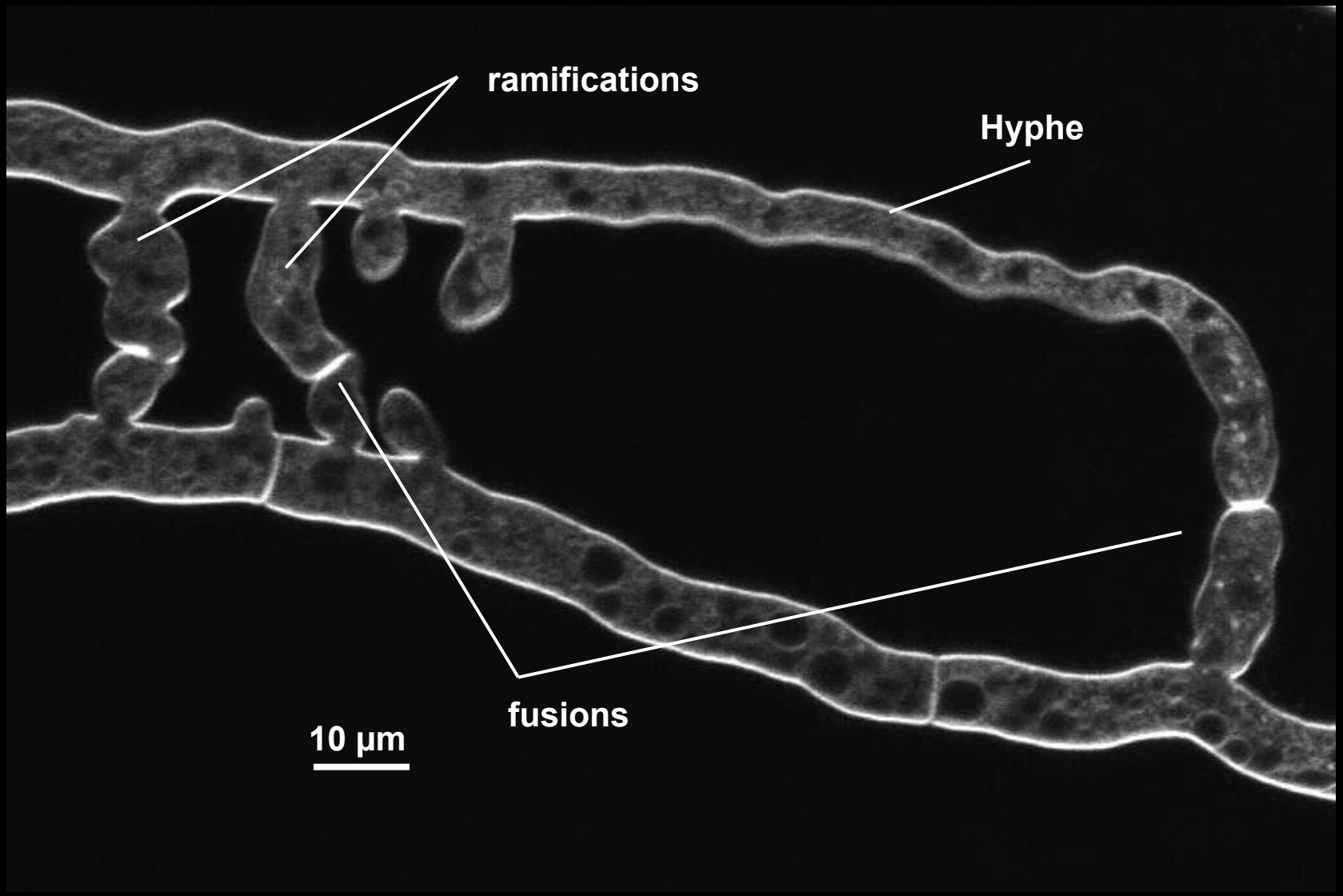
La plante cache souvent le champignon

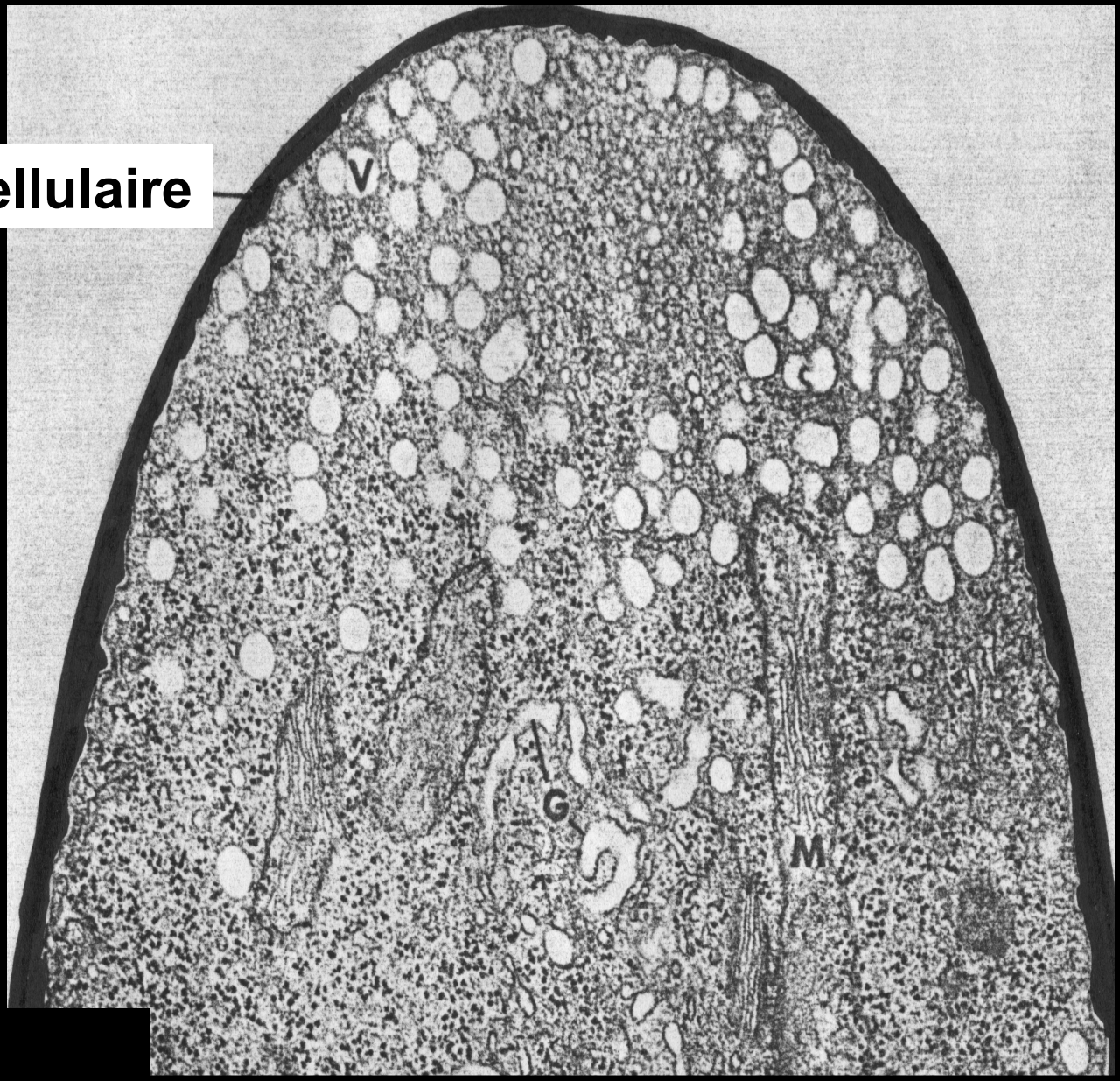
- Invisibles
- Protecteurs
- Nourriciers
- Nettoyeurs
- Sculpteurs

arte

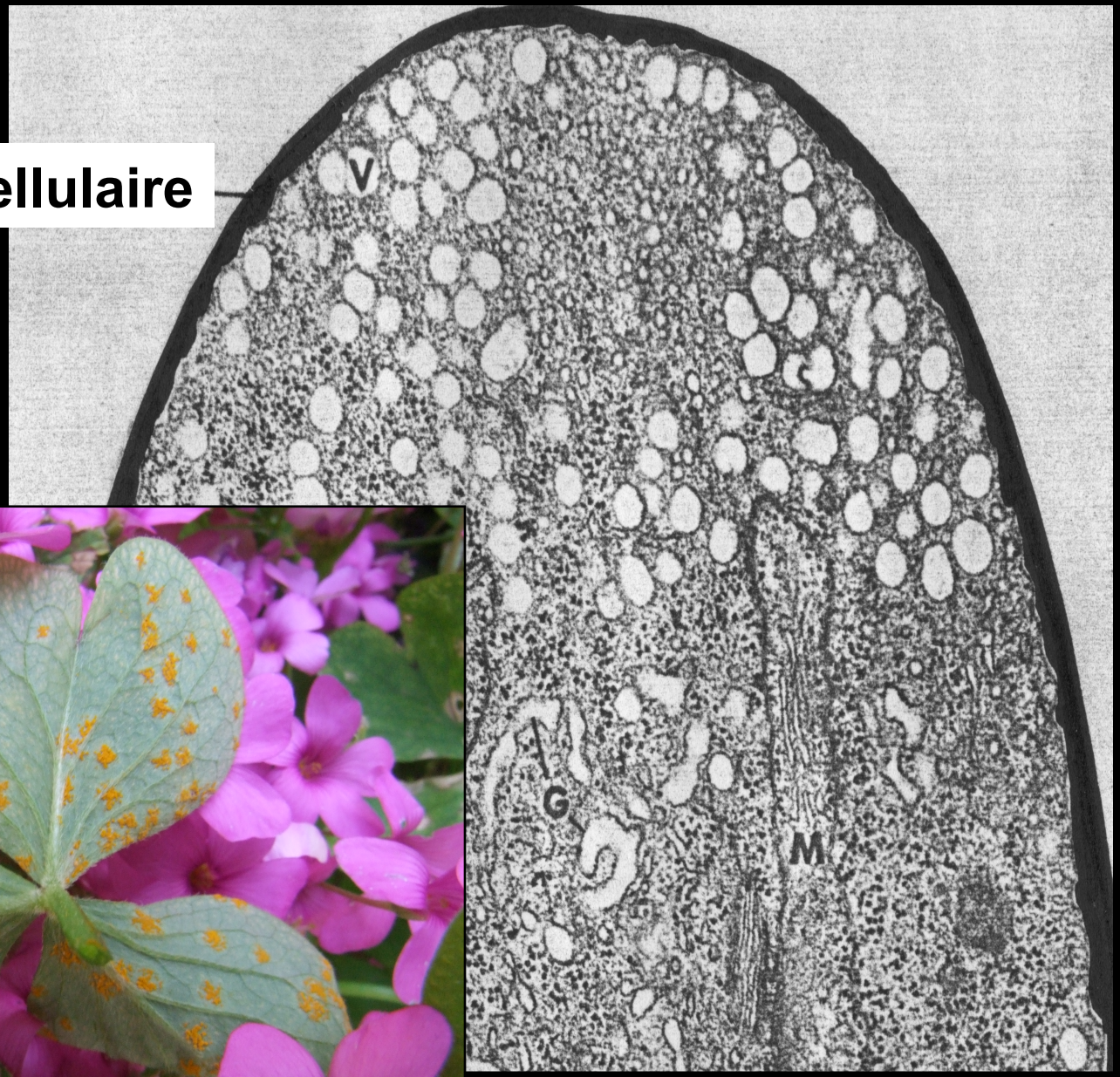


FUSION HYPHALE CHEZ *NEUROSPORA CRASSA*


ramifications
Hyphe
fusions
10 µm

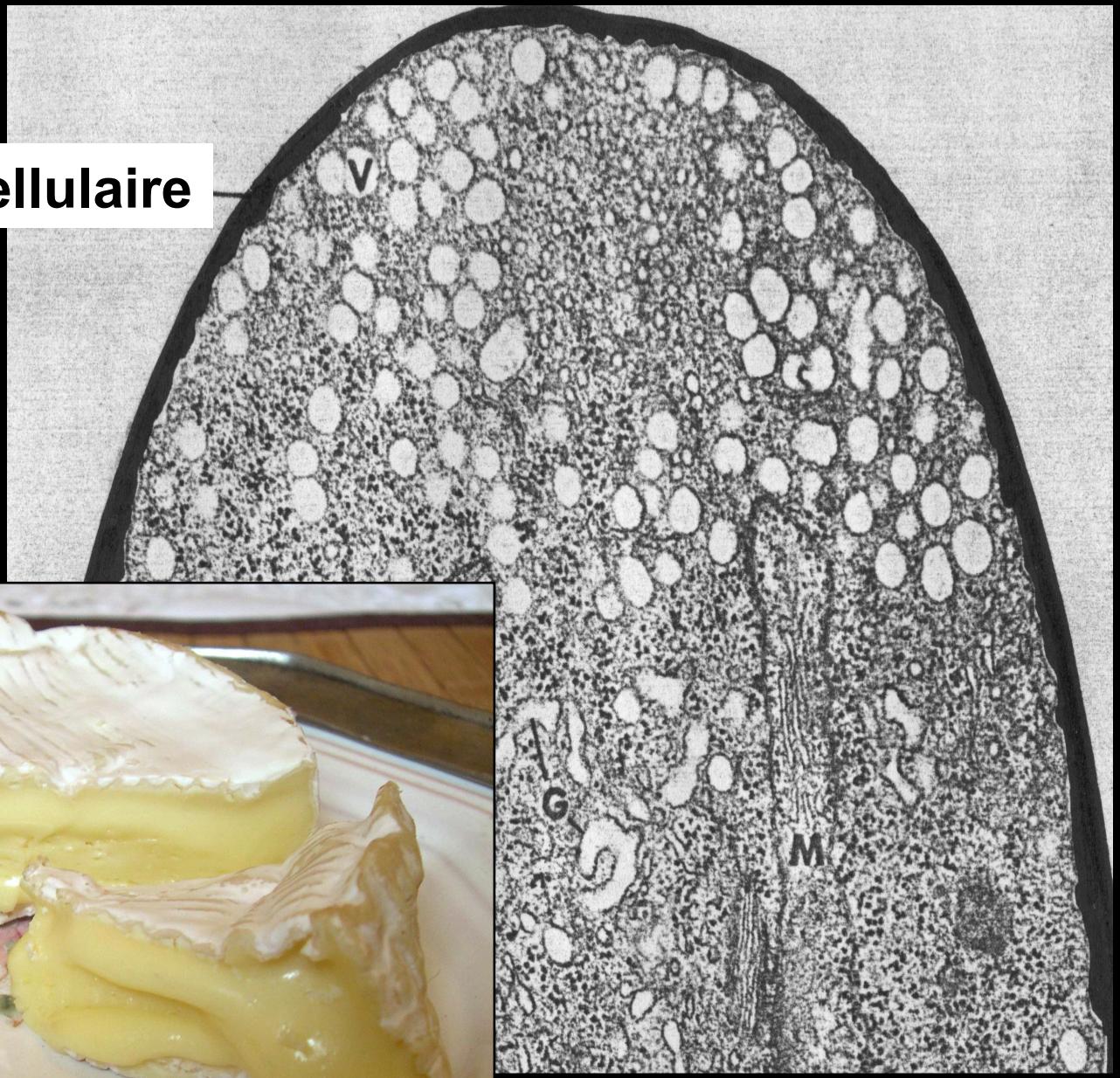

Paroi cellulaire
V
G
M

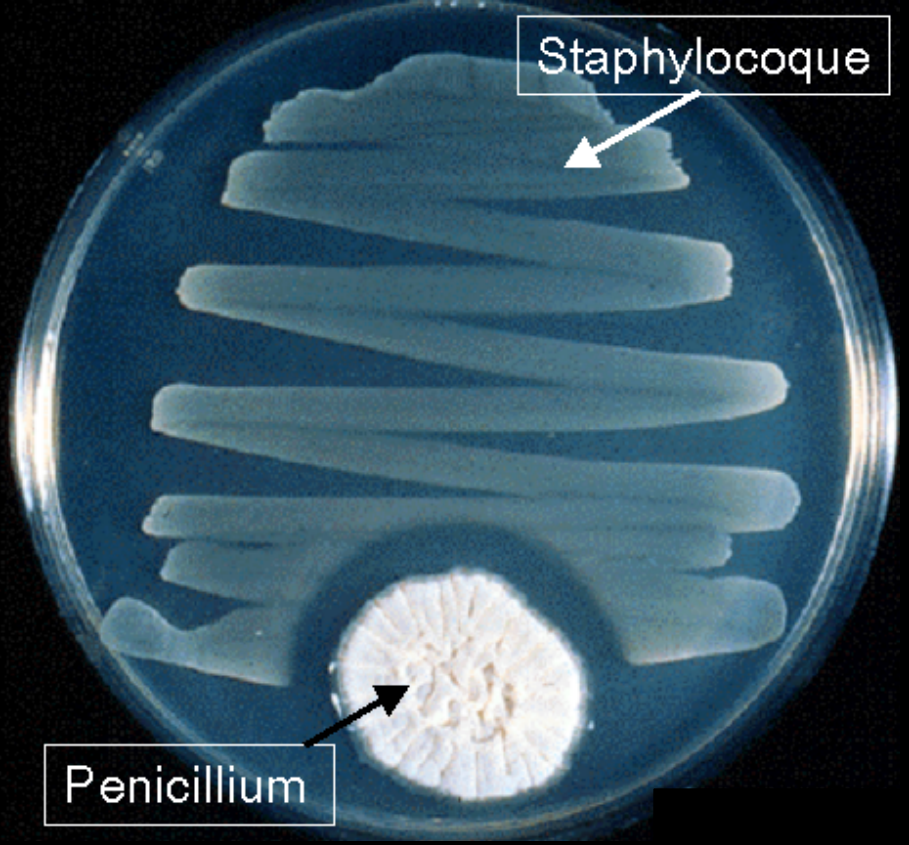
Paroi cellulaire

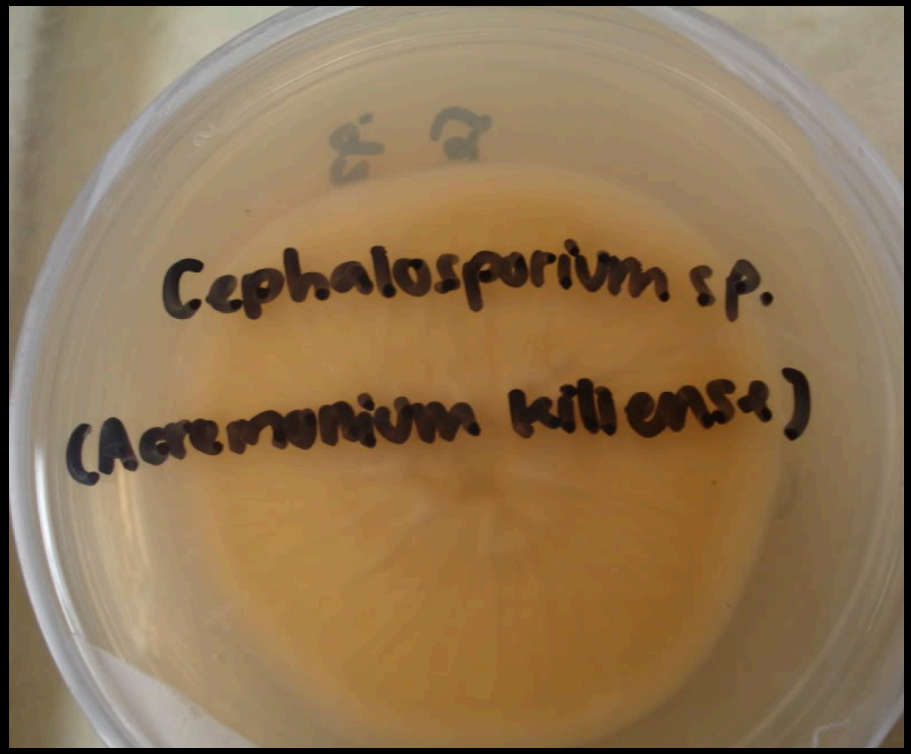


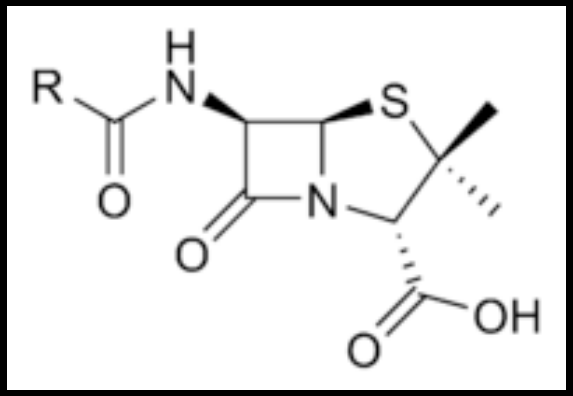
Paroi cellulaire

… et sécrétion d’exo-enzymes

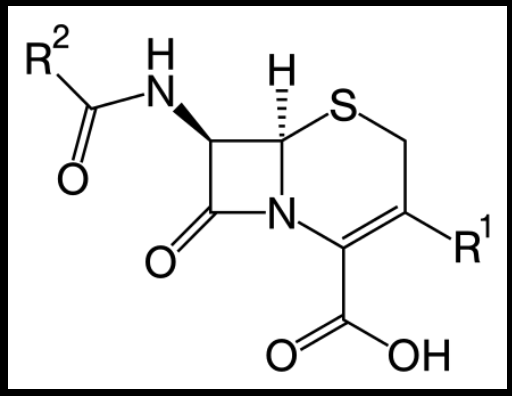








PENICILLINE



CEPHALOSPORINE

La plante cache souvent le champignon

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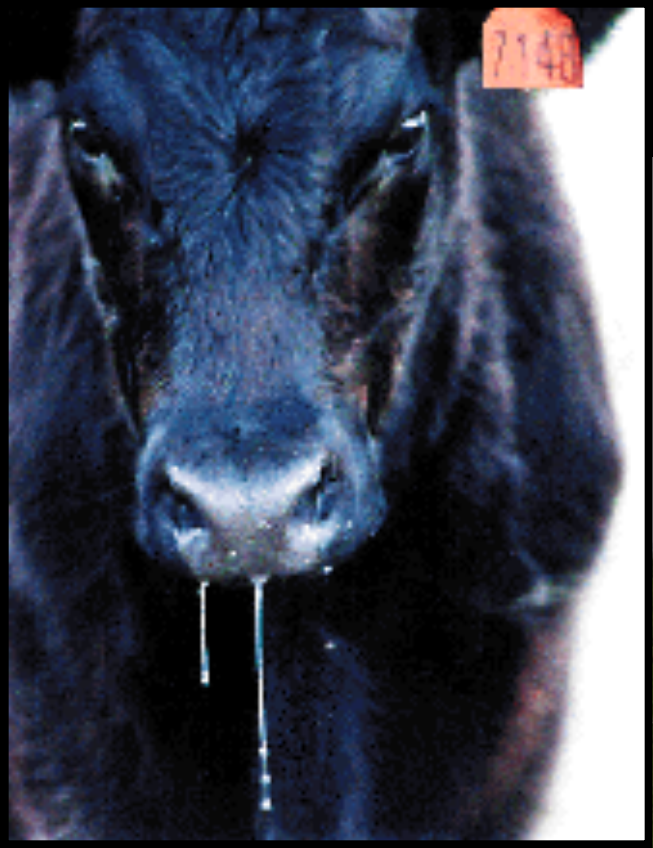
Festuca arundinacea ‘Kentucky 31’, sélectionnée en 1931-43 pour améliorer les prairies américaines…


7148

LES ENDOPHYTES PROTECTEURS

Festuca arundinacea cv. Kentucky 31, sélectionnée en 1943 pour améliorer les prairies américaines, cache un redoutable endophyte…

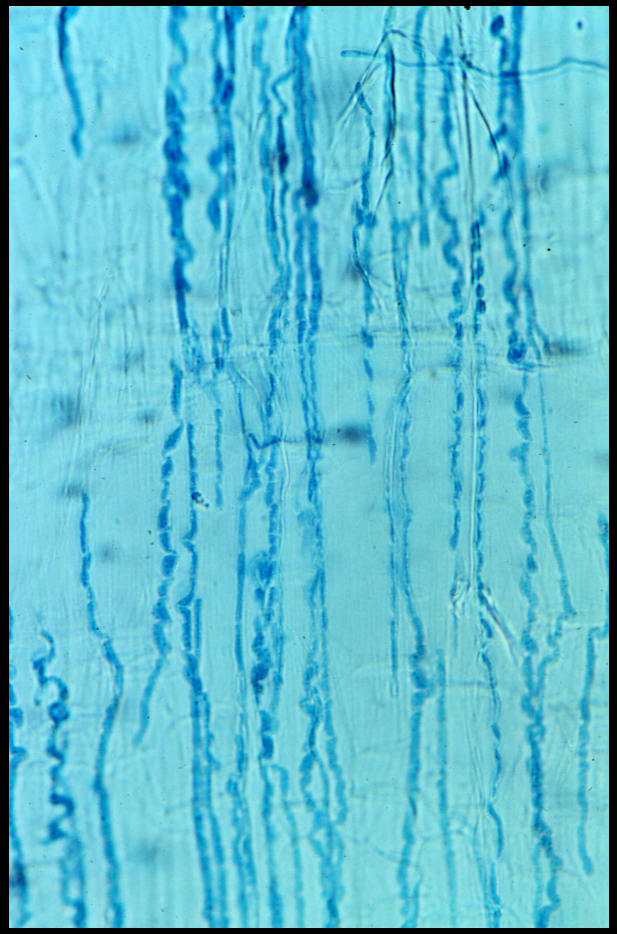
Gangrène sèche des extrémités
Réduction de croissance (- 45 kg/an)
Réduction des gestations de 34%
Réduction de la lactation de 37%

(Ball *et al.*, 1989)

- 800 millions de dollars par an aux USA
- 300 millions de dollars par an en Australie

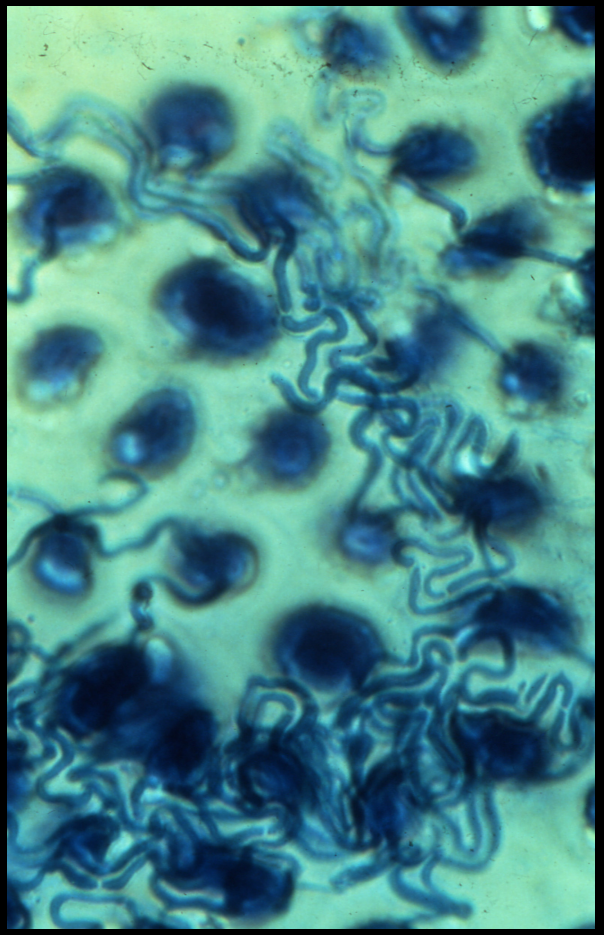
LES ENDOPHYTES PROTECTEURS

Pas de sporulation (> pas de lésions visibles) mais…



< endophytes
dans tous
les tissus…

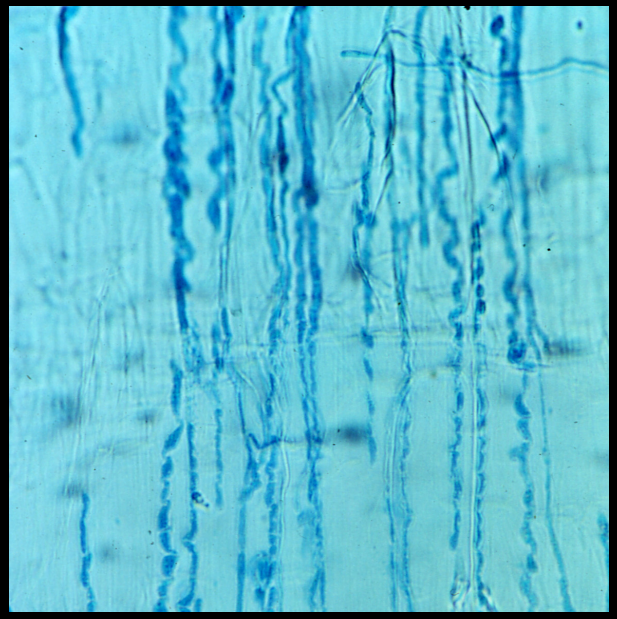
… dont
les graines >

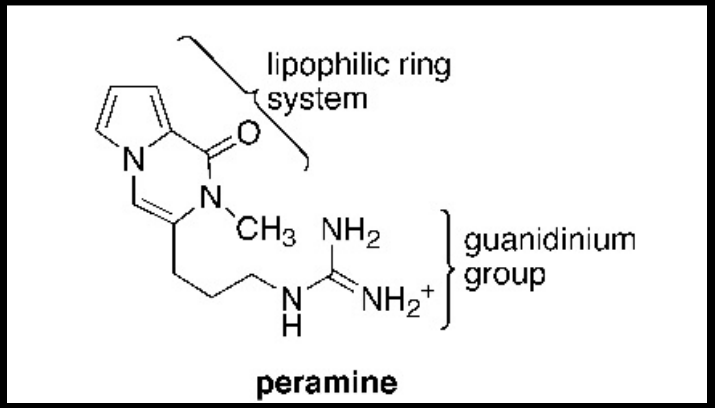


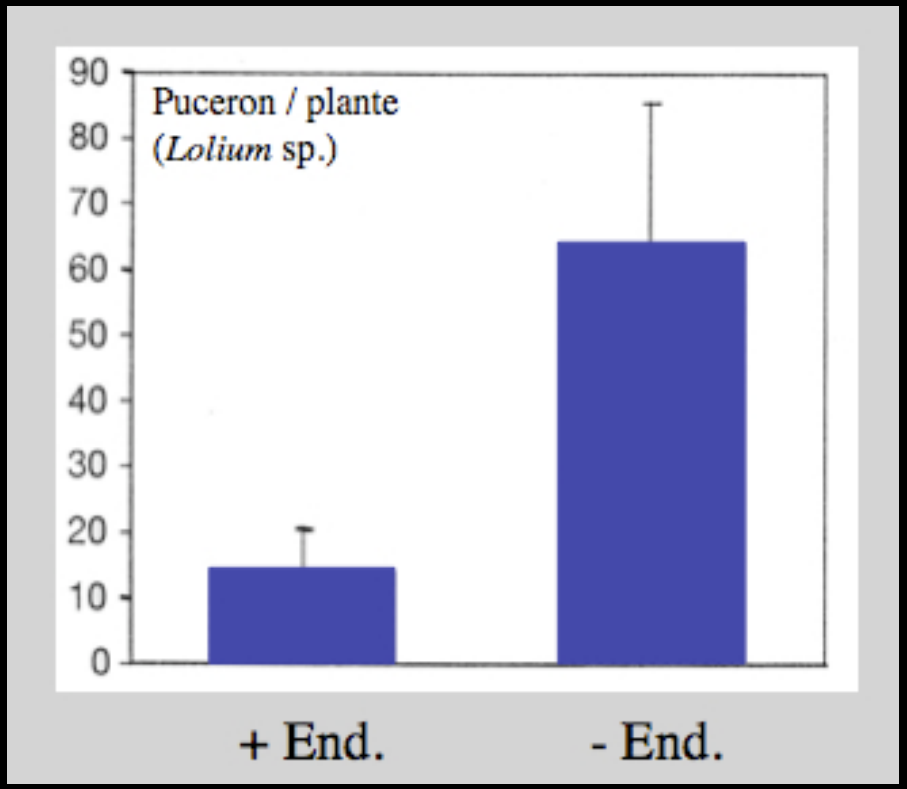
> Champignon héritable (il a été sélectionné !)

LES ENDOPHYTES PROTECTEURS

Neotyphodium (Clavicipitales) des Graminées : des producteurs d'alcaloïdes toxiques



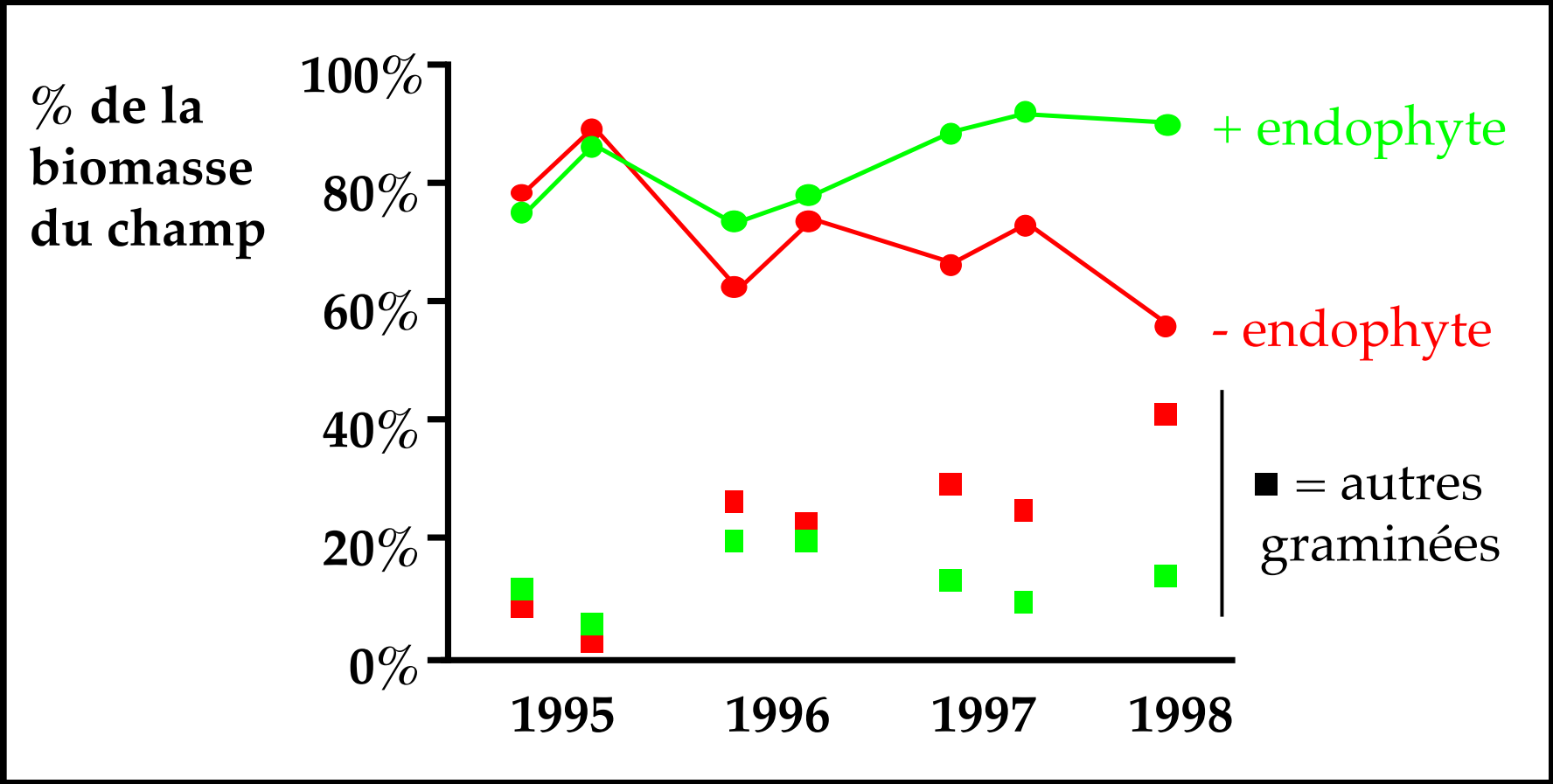




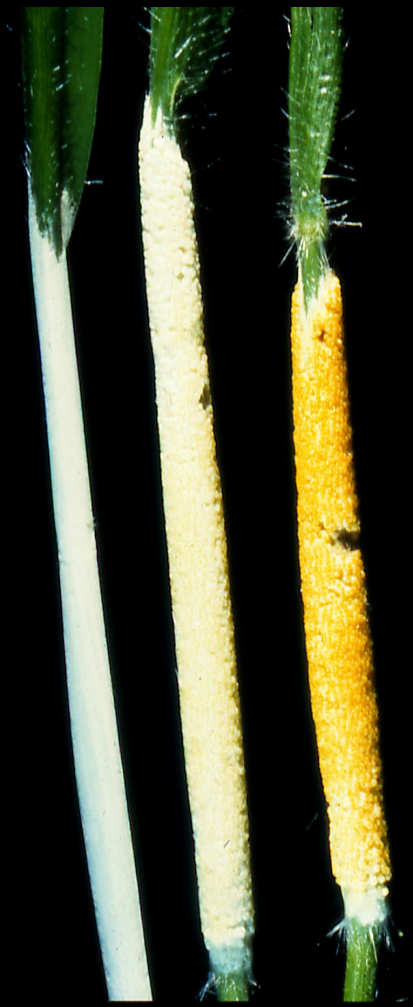
Sur *Lolium multiflorum* ; Omacini *et al.*, 2001

LES ENDOPHYTES PROTECTEURS

Kentucky 31 est aujourd'hui une peste végétale !

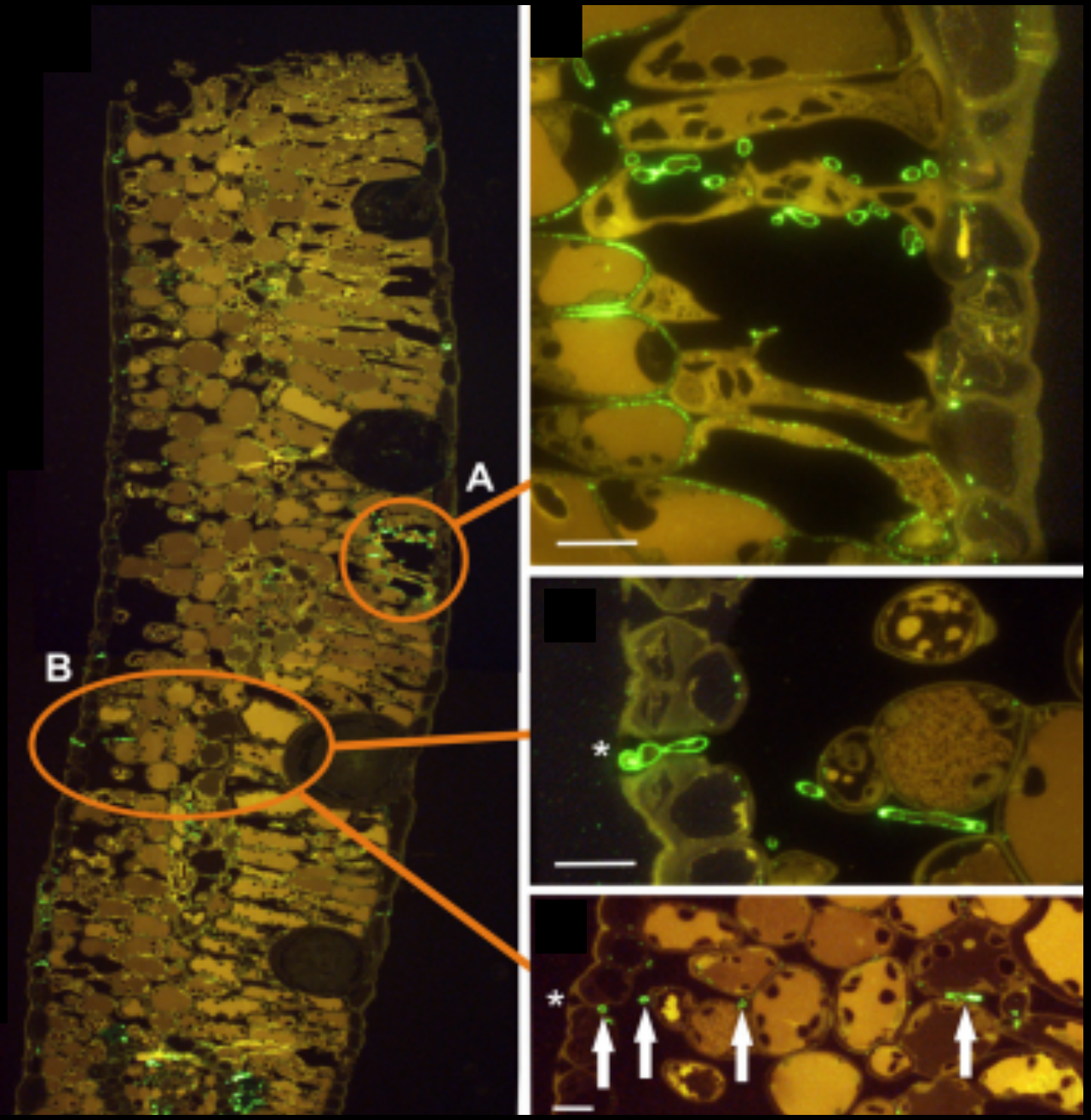


Expériences en prairie ; Clay et Holah *et al.*, 1999



Epichloe* gr. *typhina

Epichloe* gr. *typhina



Une hyper-diversité ignorée…

jusqu’à une centaine d’espèce de champignons endophytes dans une feuille en milieu tropical !

La thermotolérance de *Dichanthelium lanuginosum* aux sols volcaniques chauds

45°C

C+

C-

15g

0g

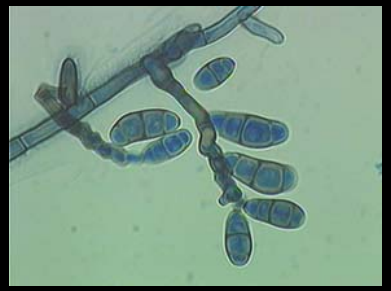
40°C

C+

C-

28g

21g



Curvularia sp.

Vue : en place *déraciné* (*Redman* et al., *2002*)

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- Invisibles
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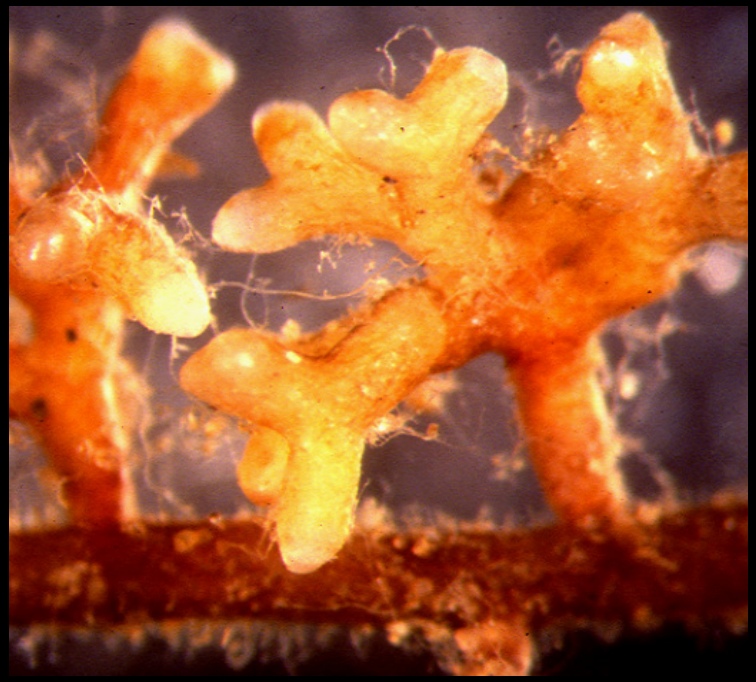
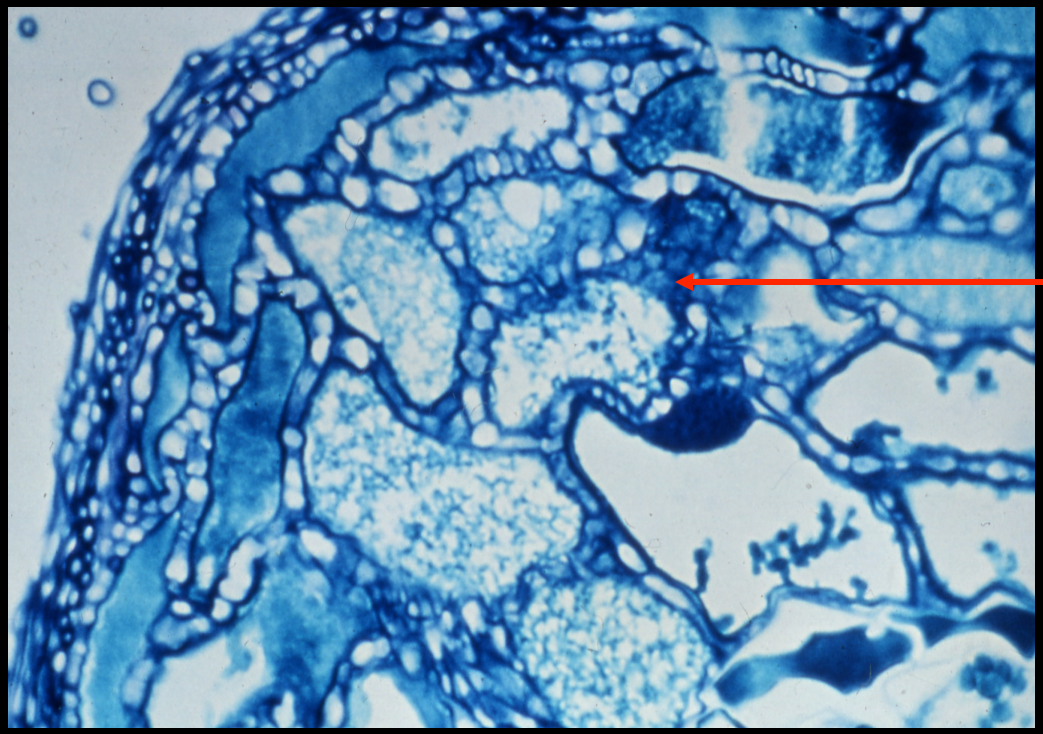
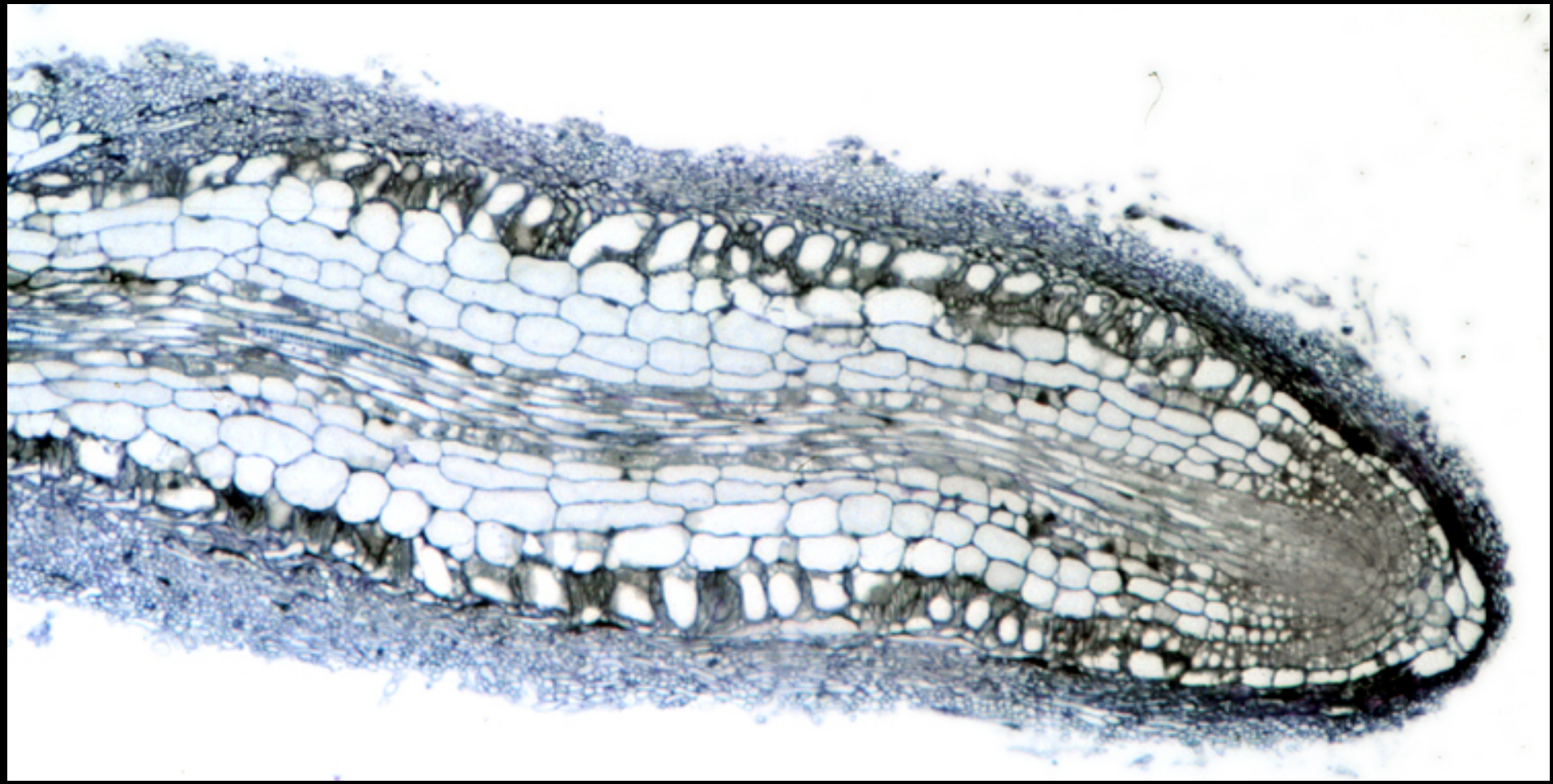
- Sculpteurs

Scleroderma cf. sinnamariense

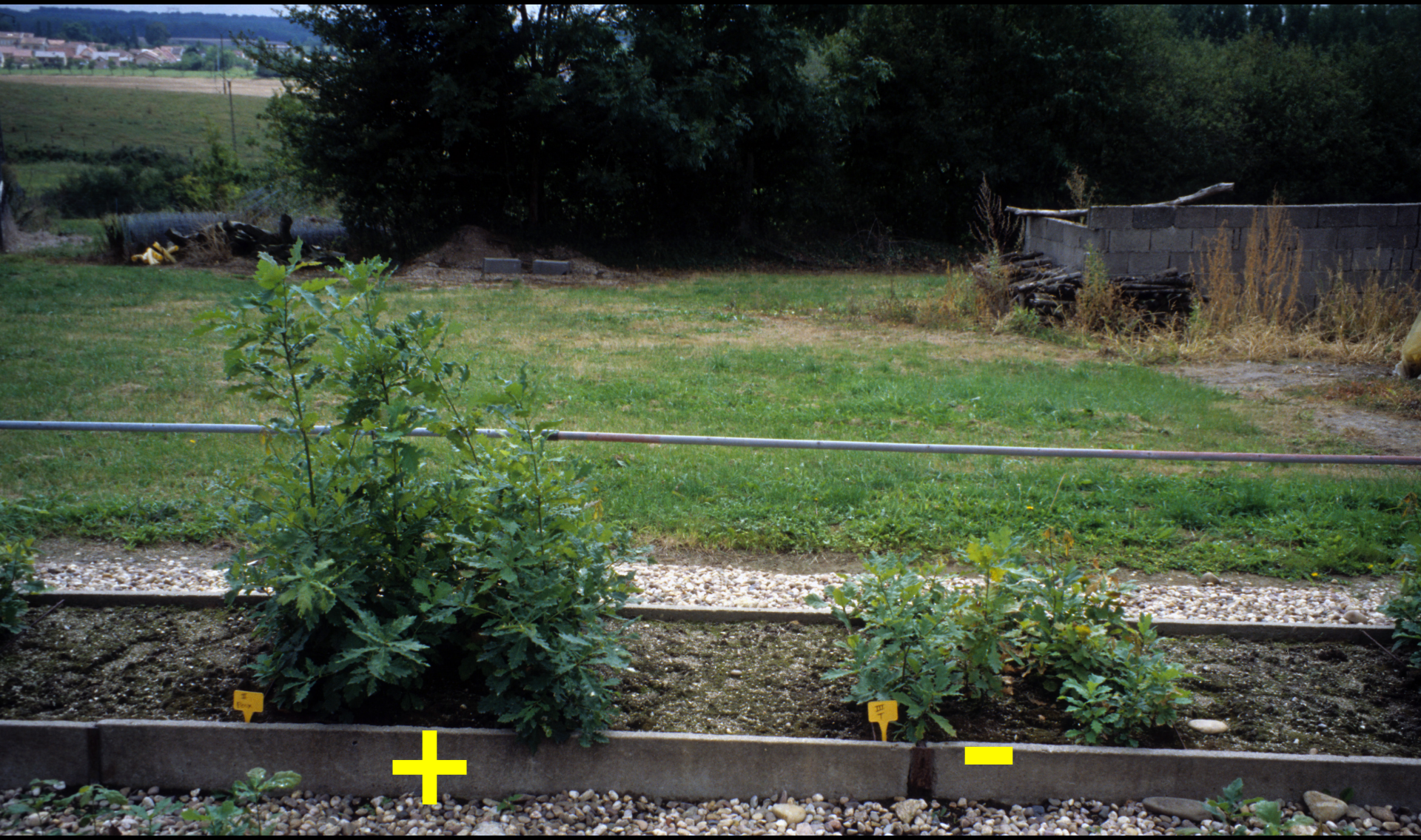
ECTOMYCORHIZE





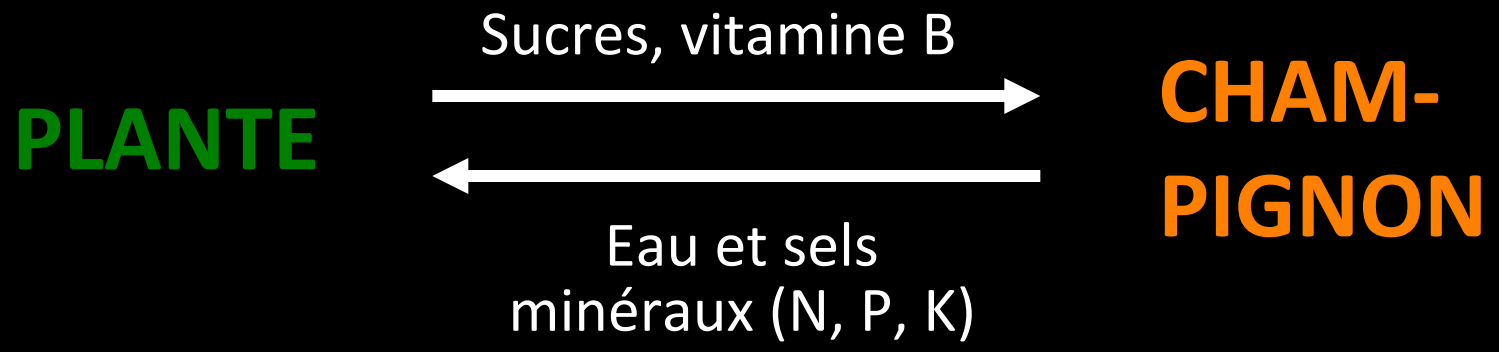


ECTOMYCORHIZE



LA MYCORHIZE, UNE SYMBIOSE

Des échanges nutritifs réciproques :

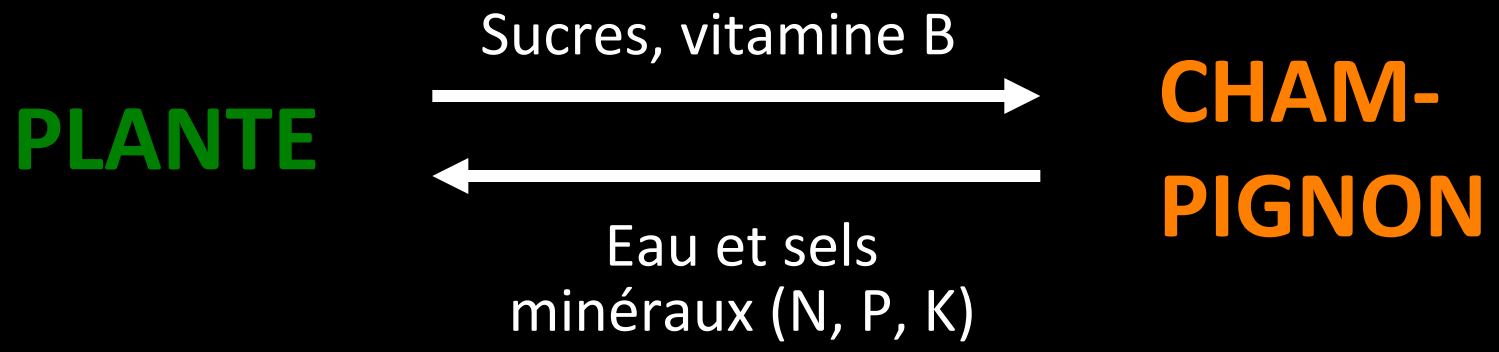


… à table, ensemble !

AZZURRA

LA MYCORHIZE, UNE SYMBIOSE

Des échanges nutritifs réciproques :



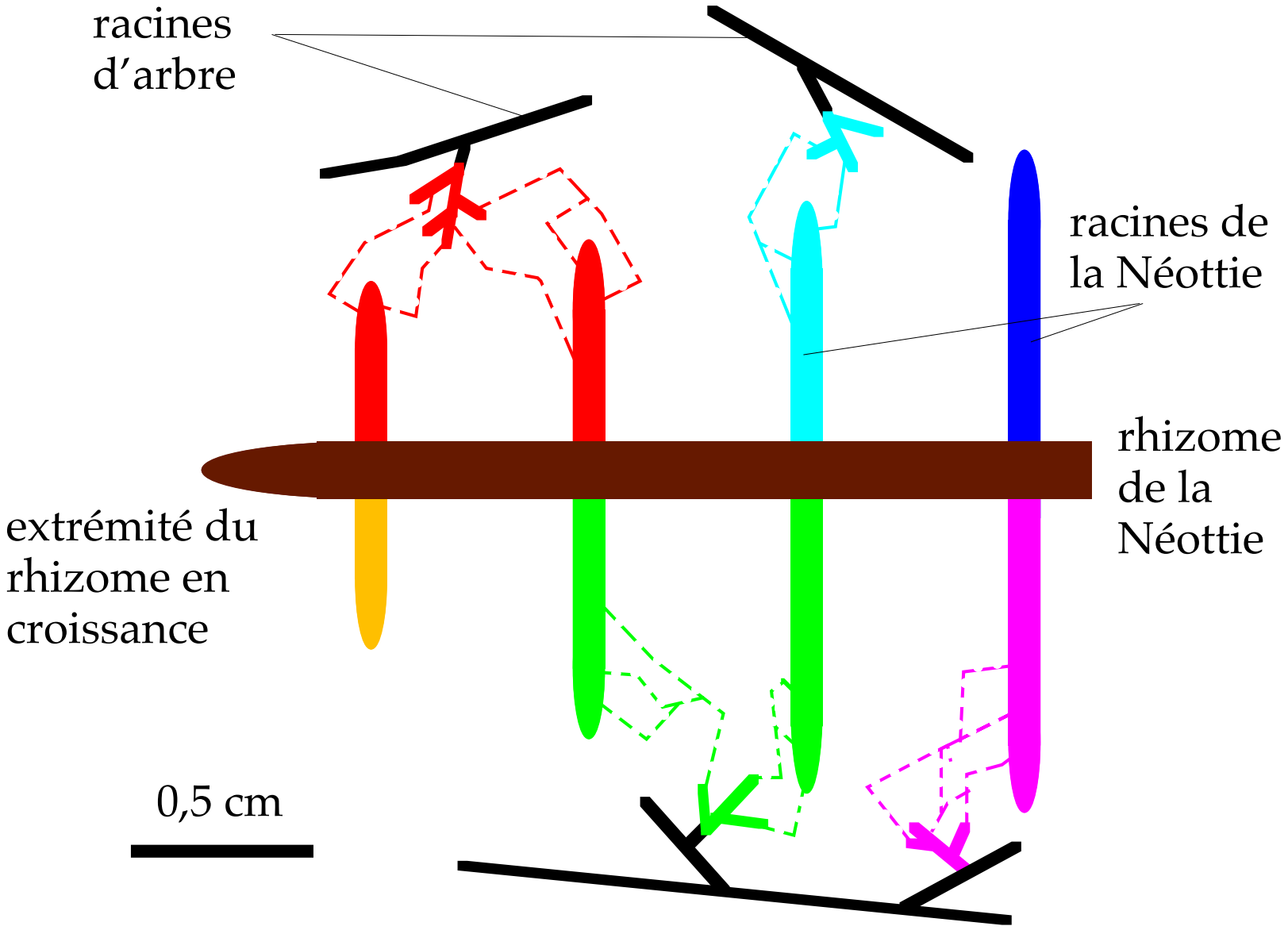
… à table, ensemble !

Neottia nidus-avis

… associé avec des *Sebacina*…
5 mm

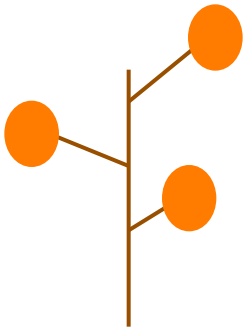
… associé avec des *Sebacina*…

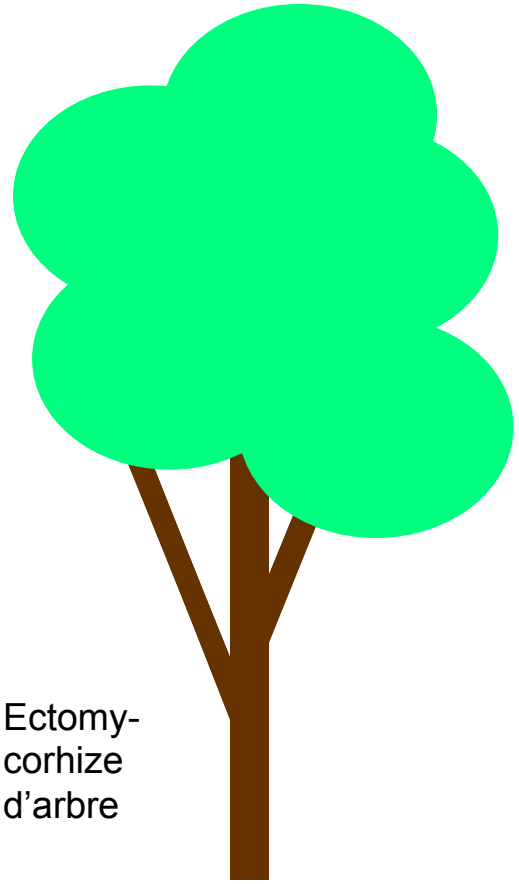
… elles-mêmes associées aux arbres voisins


racines
d'arbre
racines de
la Néottie
rhizome
de la
Néottie
extrémité du
rhizome en
croissance
0,5 cm

ARBRE

PLANTE NON CHLORO-PHYLLIENNE



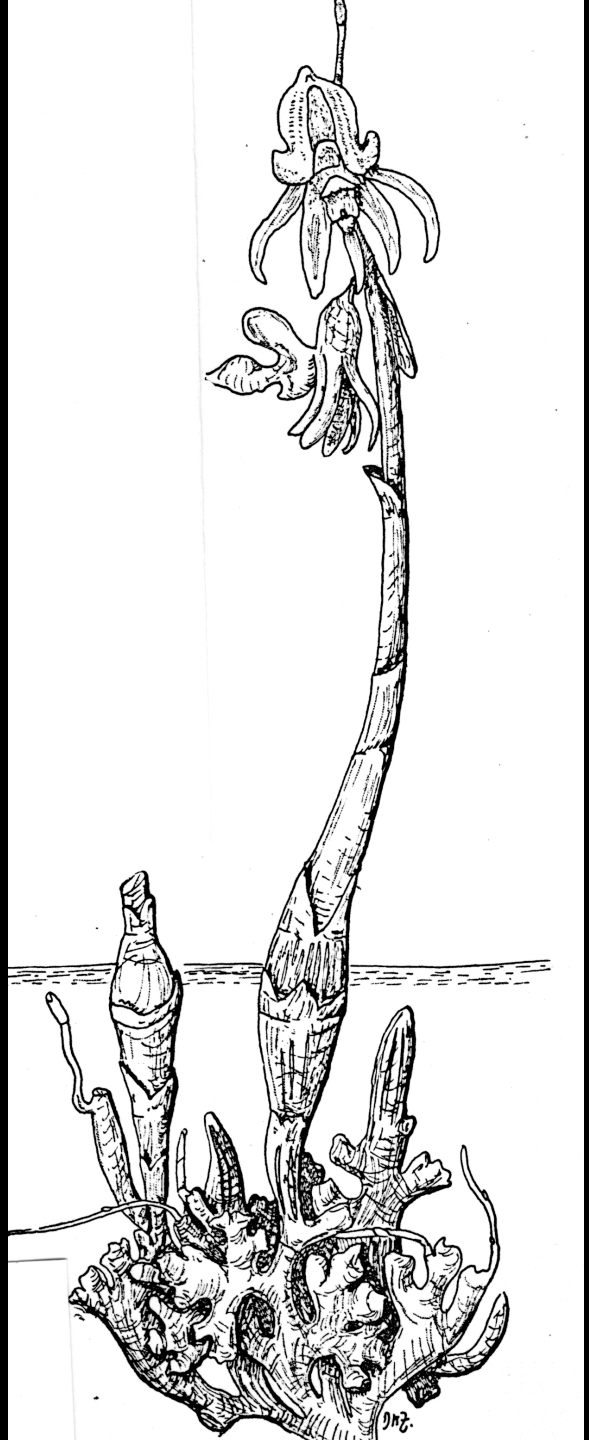


Mycorhize d'orchidée

CHAMPIGNON

Ectomy-corhize d'arbre

Flux de sucre



Epipogium aphyllum

\+ *Inocybe*

Hypopytis Monotropa

\+ *Tricholoma*

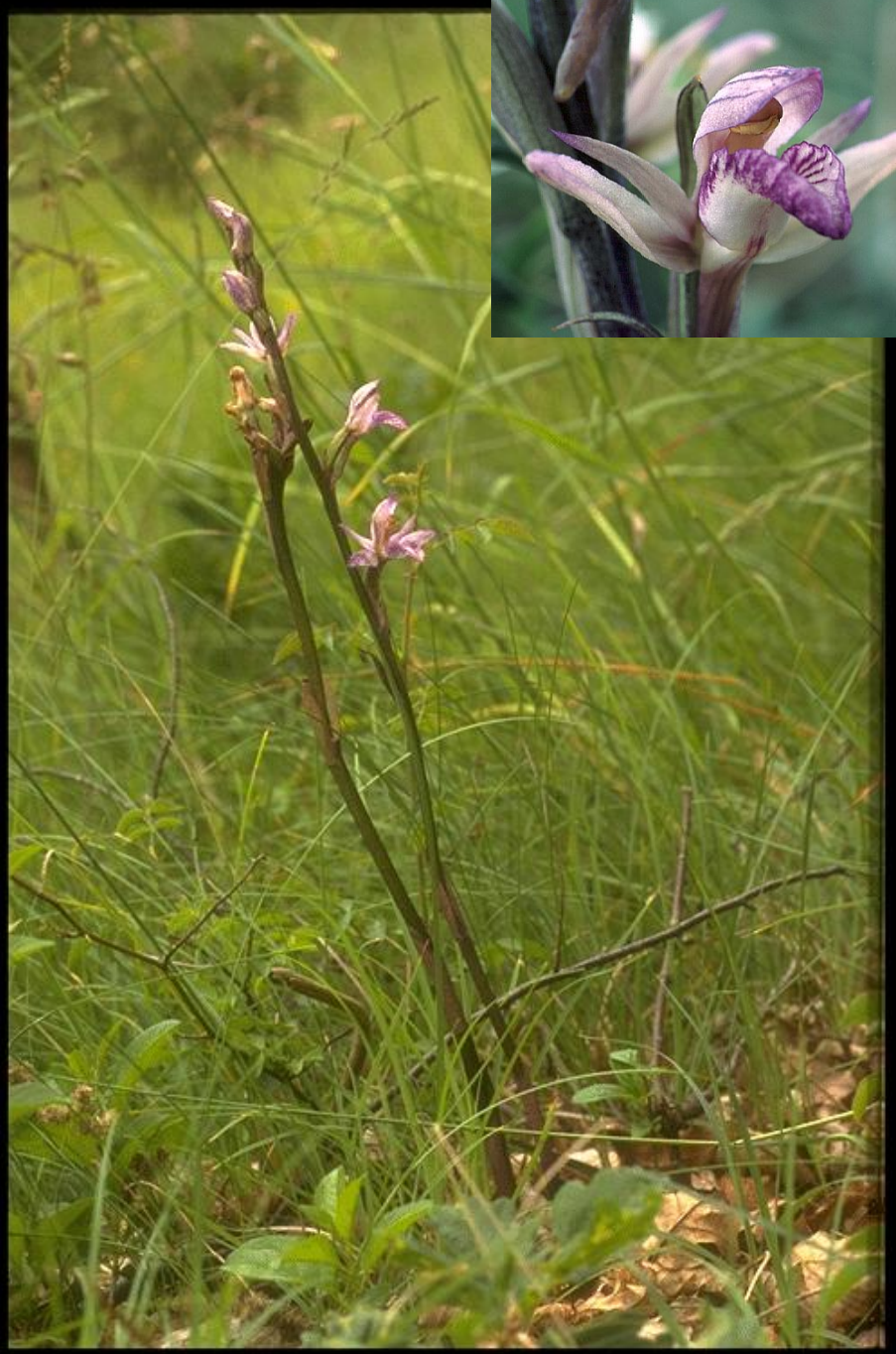
Sarcodes sanguinea
+ Rhizopogon

Voyria aphylla

Gymnosiphon sp.

Apteria aphylla

Orchidées forestières
Pyroles



Limodorum abortivum

Russula delica

Girlanda *et al.*, 2006

P. P. Pernot

Epipactis microphylla

Divers chamignons ectomycorhiziens (*Tuber* spp.)

P. P. Pernot

Lumière

PLANTE CHLORO-PHYLLIENNE

ARBRE

Mycorhize d'orchidée

CHAMPIGNON

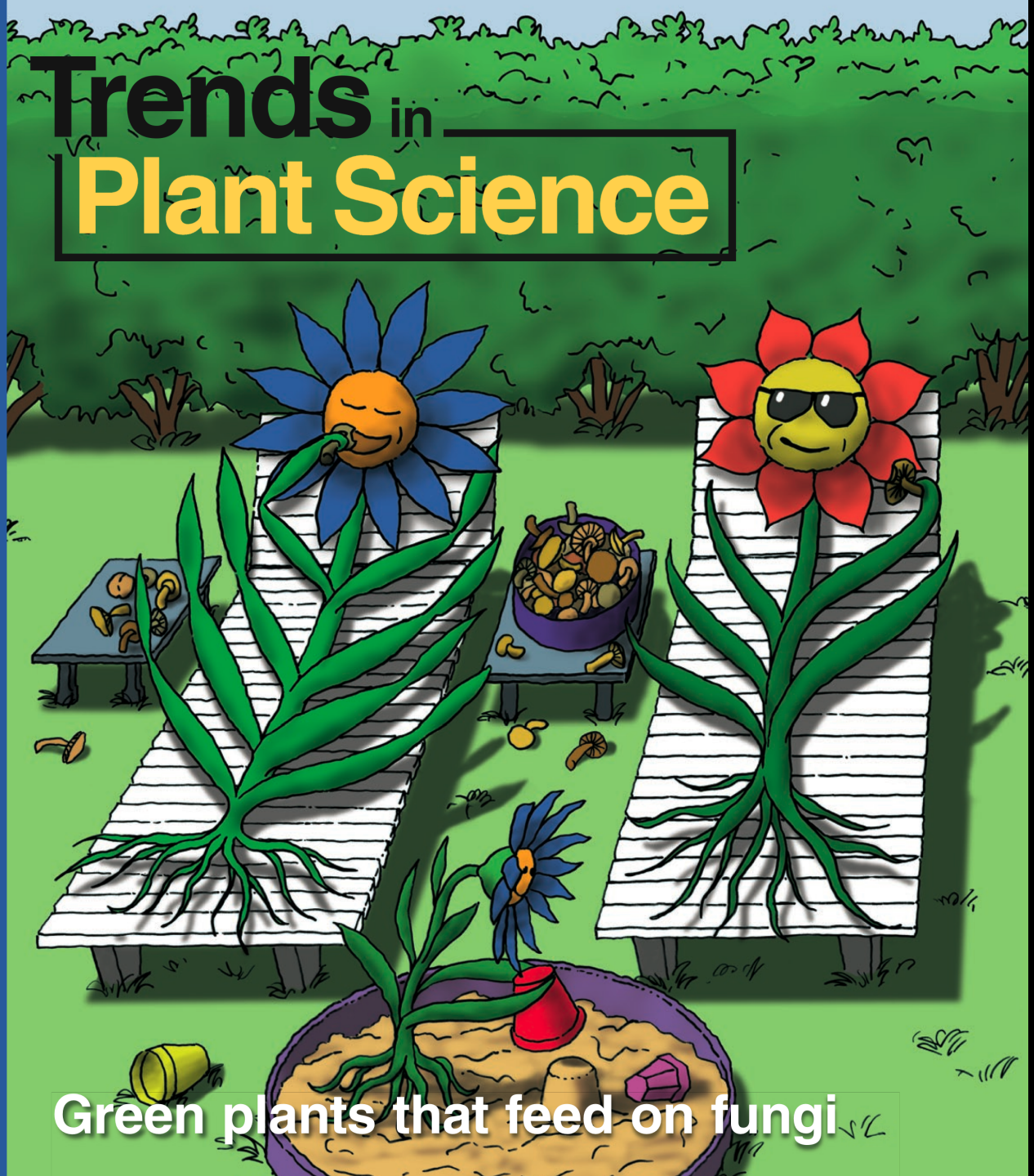
Ectomy-corhize d'arbre

Flux de sucre

Cephalanthera damasonium

Trends Plant Sci. February 2009 Vol. 14 No. 2, pp. xxx–xxx ISSN 1360-1385

Trends in Plant Science



Green plants that feed on fungi

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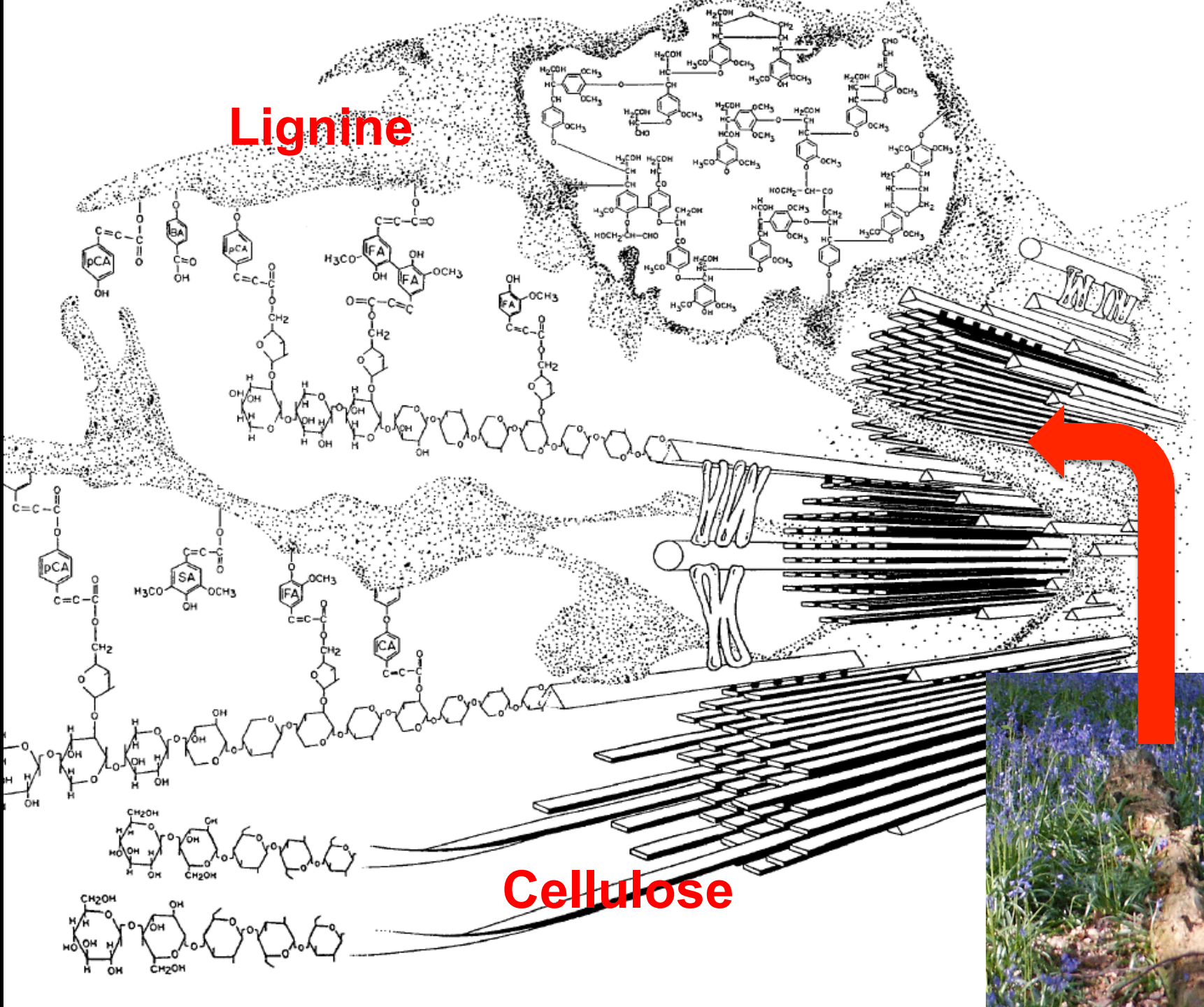
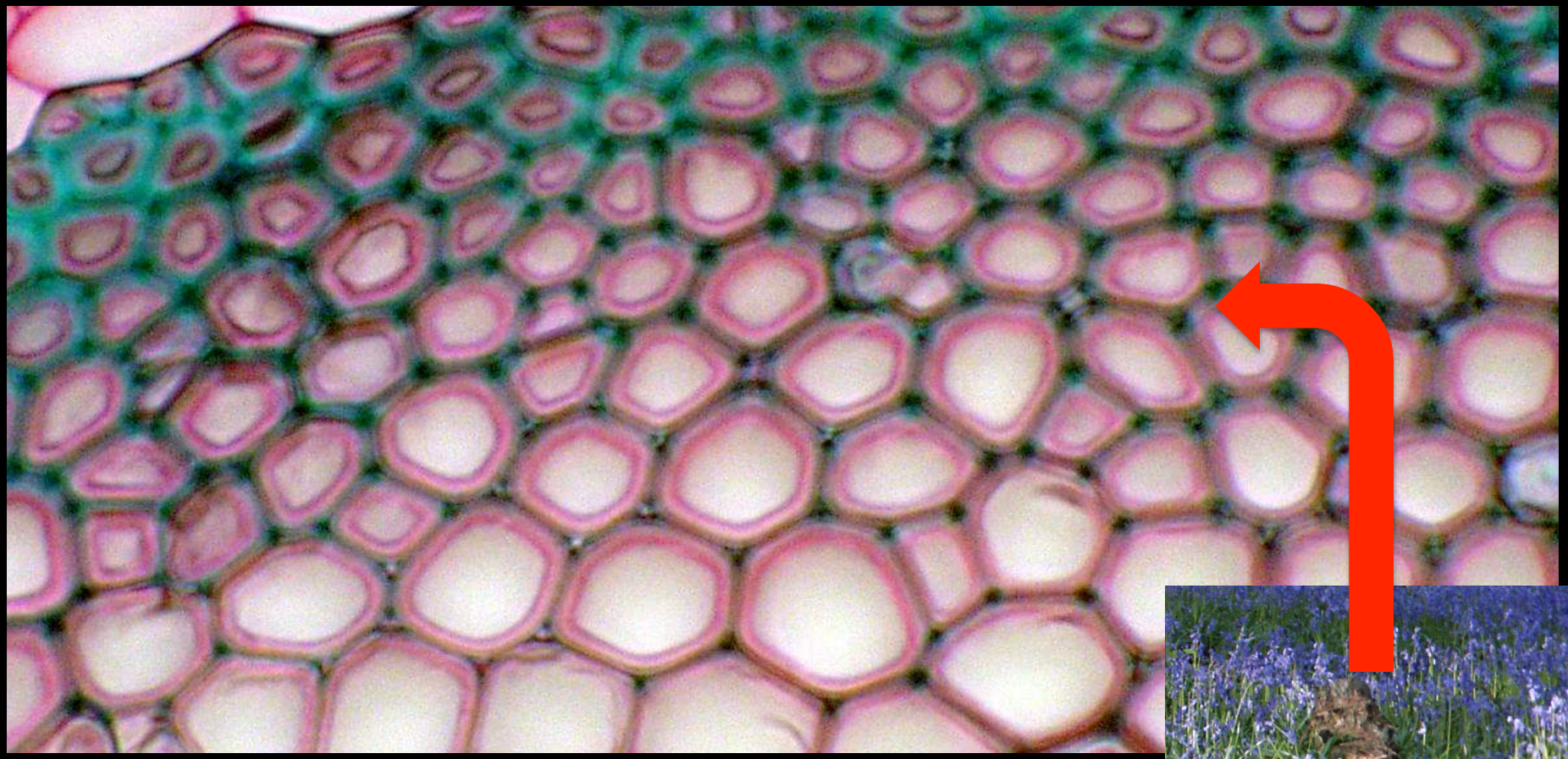
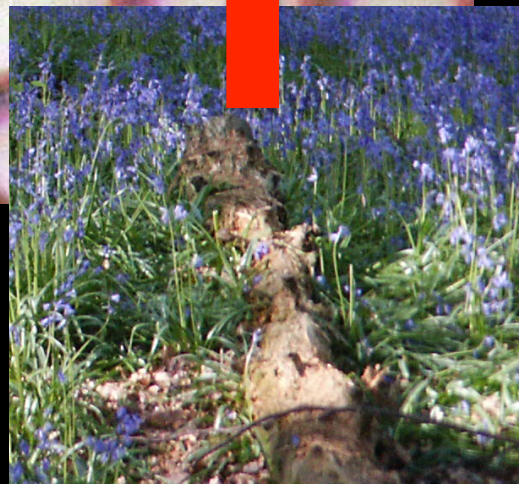

Lignine
Cellulose

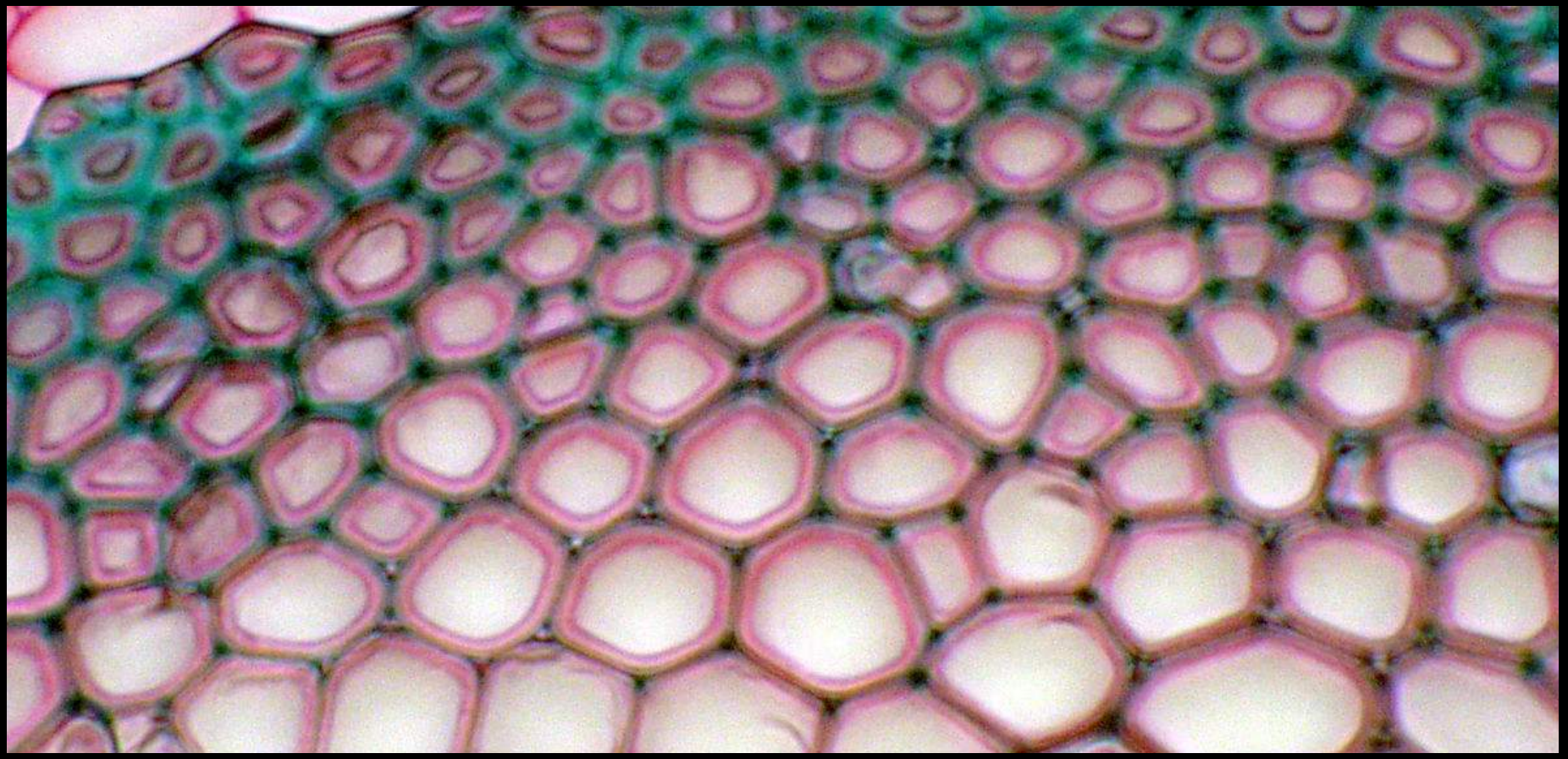
Lignine entre les cellules



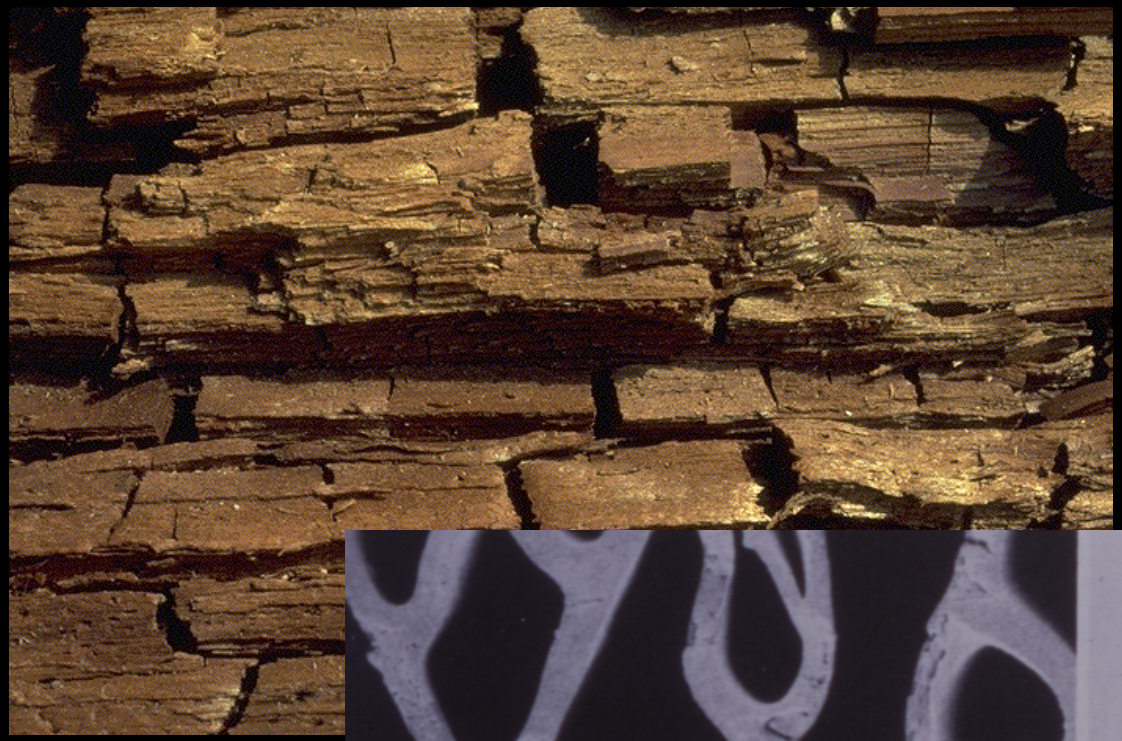


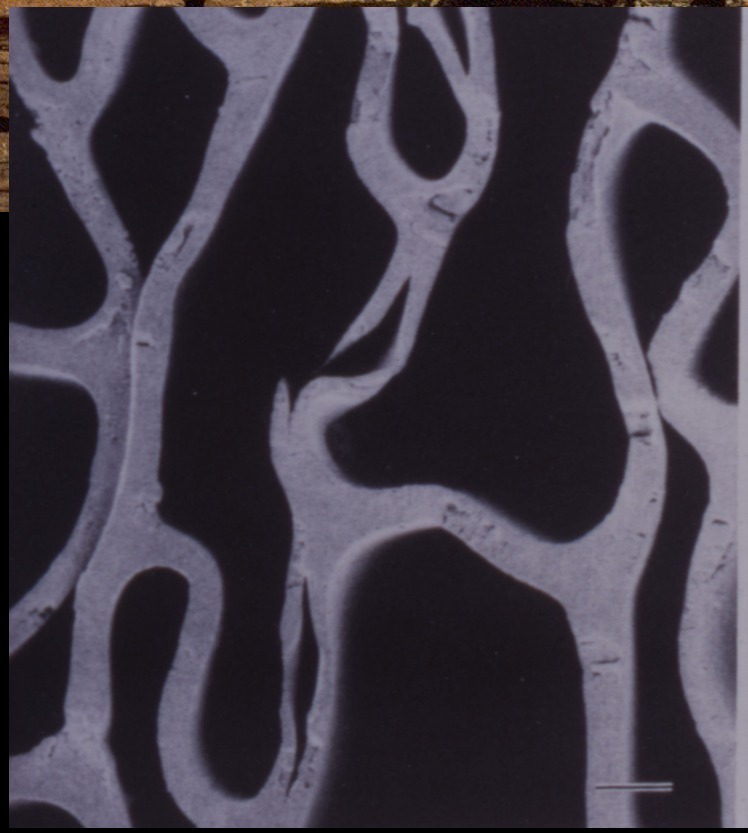
Cellulose plutôt vers l'intérieur

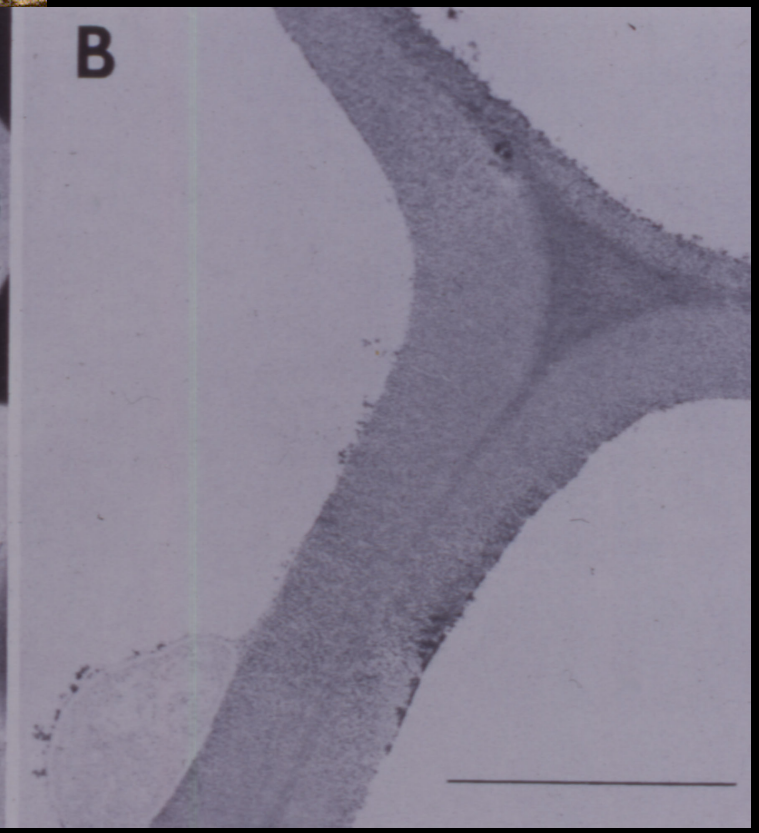
Lignine entre les cellules



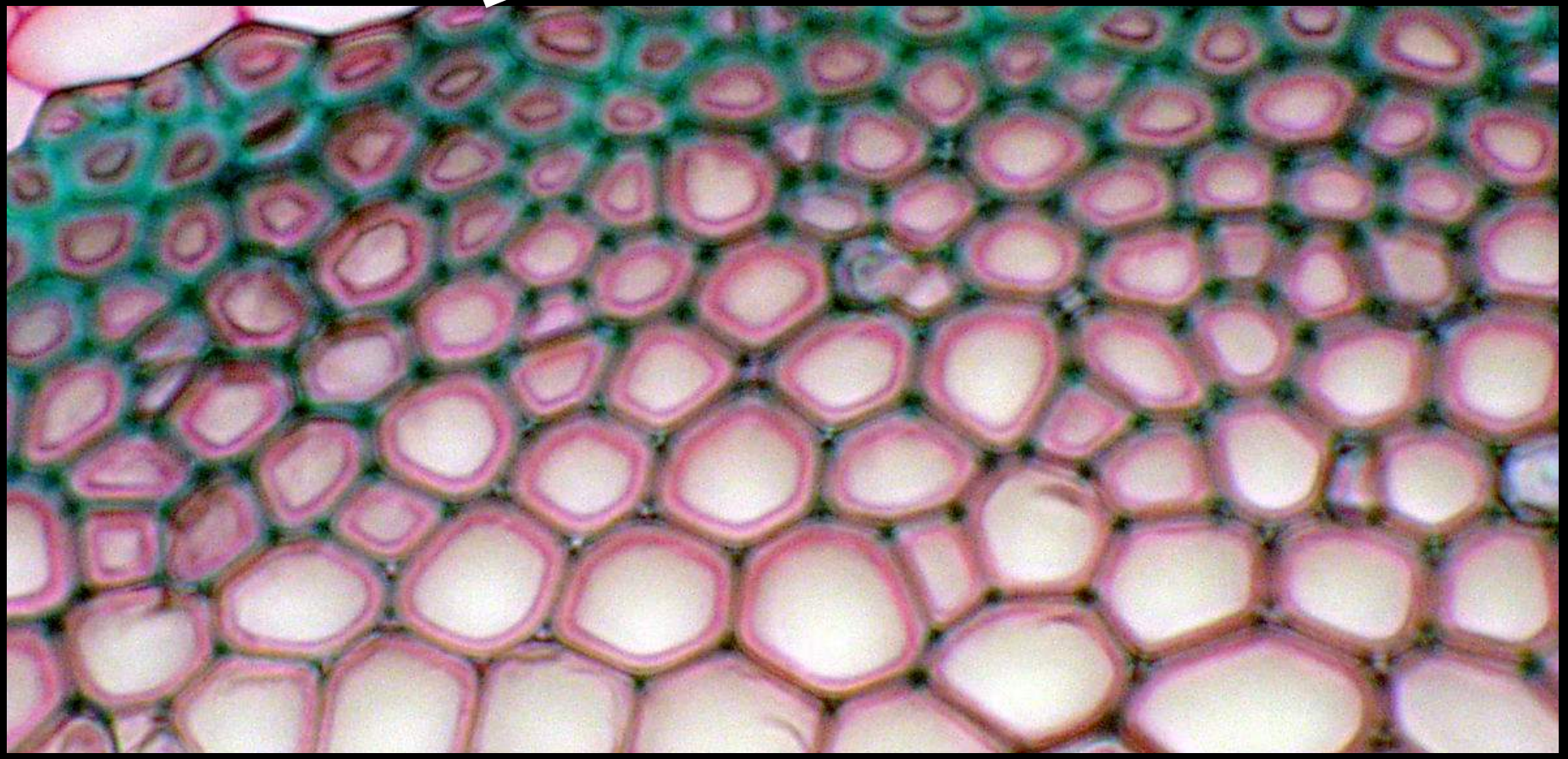
~~Cellulose plutôt~~
~~vers l'intérieur~~



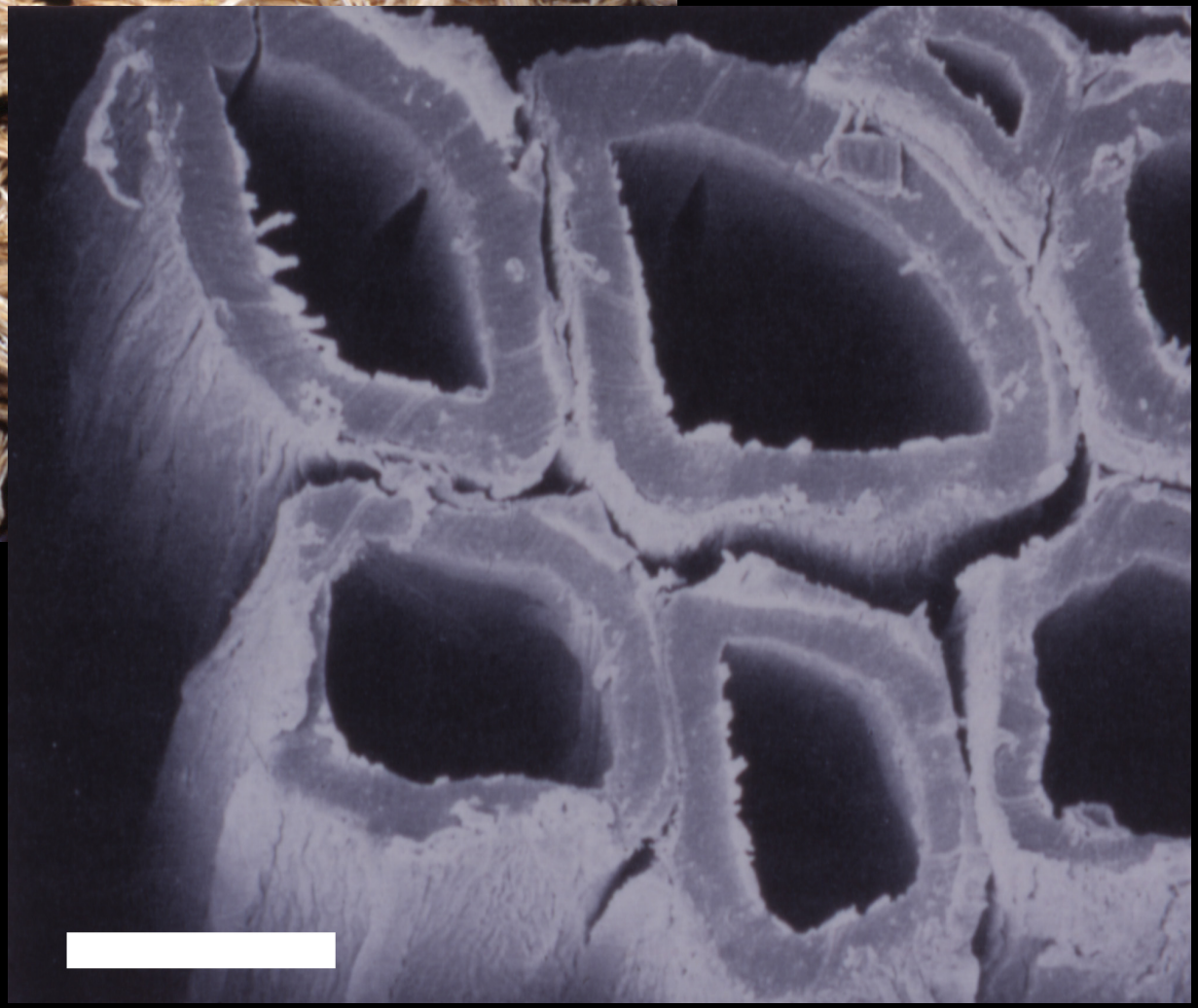



B

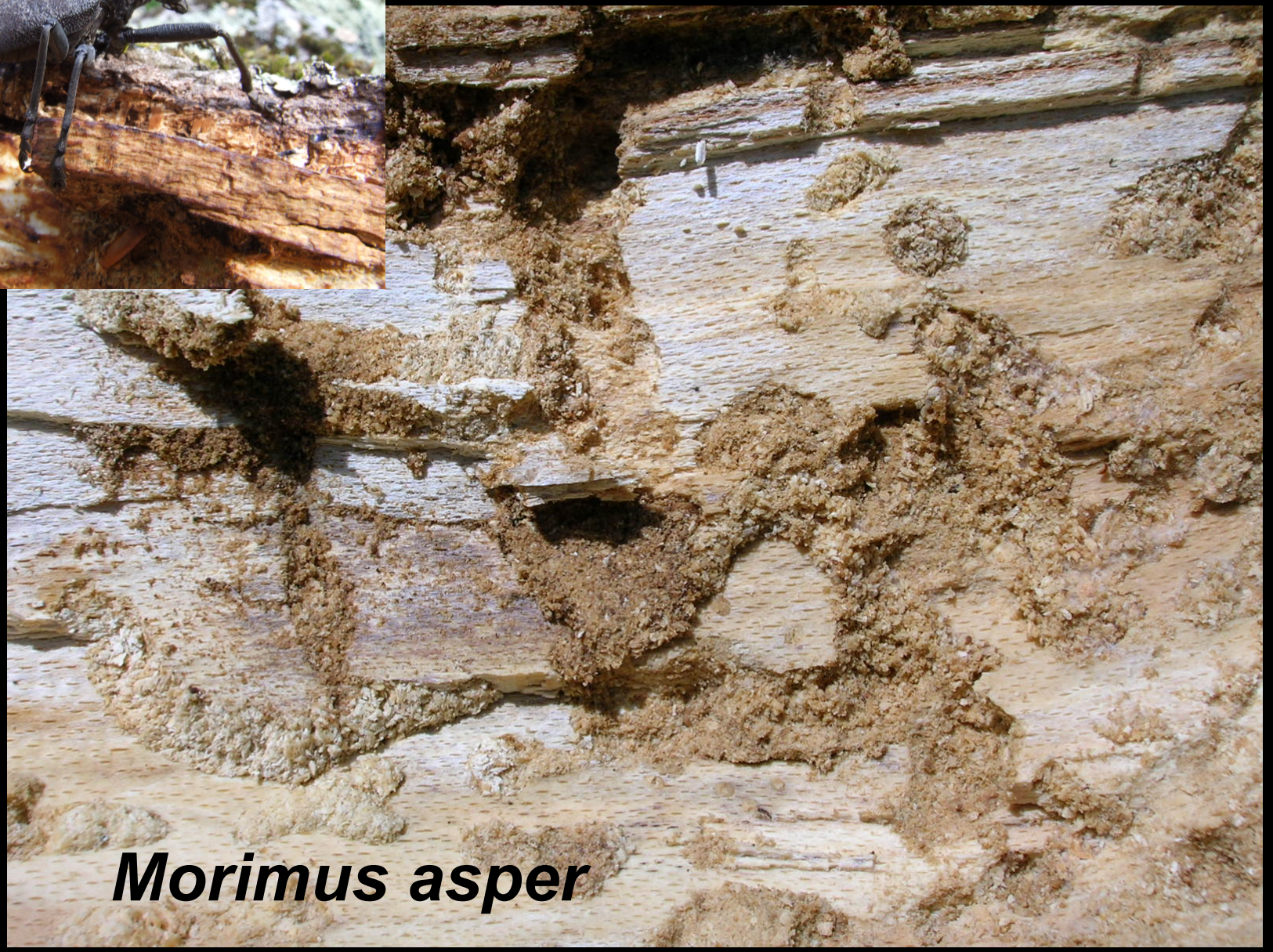
Lignine entre les cellules



Cellulose plutôt
vers l'intérieur



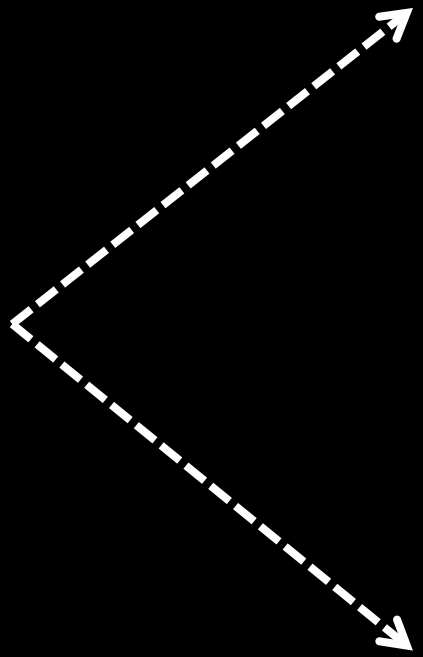
Les insectes xylophages…



Morimus asper

Pourriture brune, cubique (cellulose slt.)

Pourriture blanche, fibreuse



Champignons ectomycorhiziens

… une évolution récurrente, au moins chez les basidiomycètes

ECTOMYCORHIZE

ECTOMYCORHIZE

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Vuilleminia comedens

Pulcherricium caeruleum

ectomycorhizes

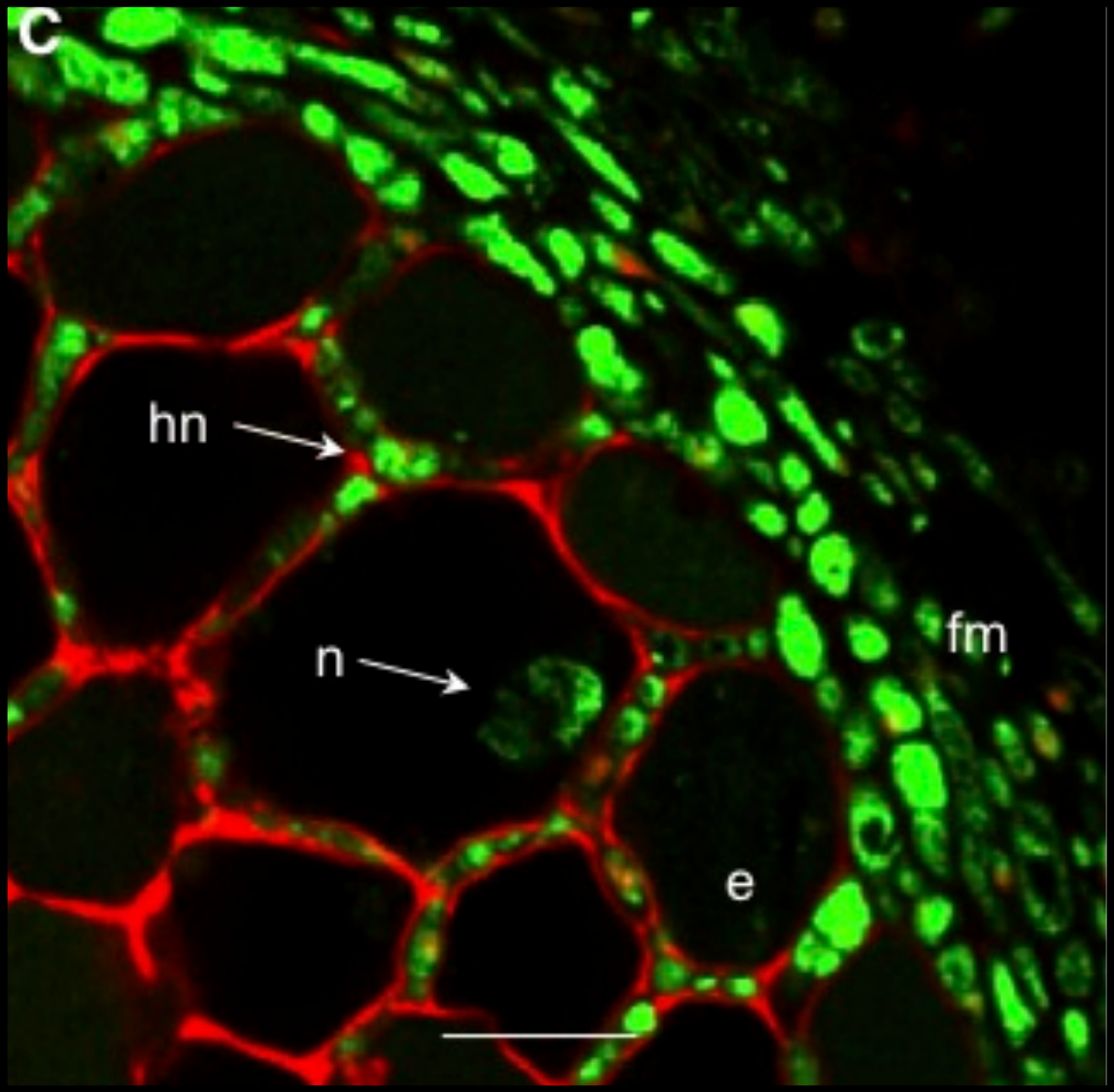
Exobasidium rhododendri

Taphrina amentorum

Melamsporella sp.

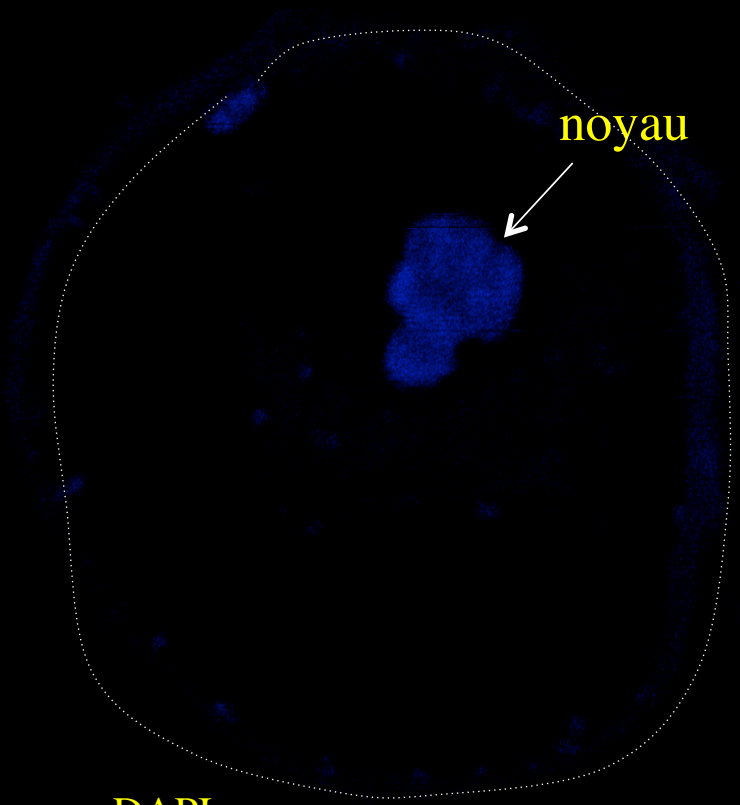
ectomycorhizes

Chez *Laccaria bicolor*, le peptide MiSSP7 entre dans le noyau des cellules racinaires !

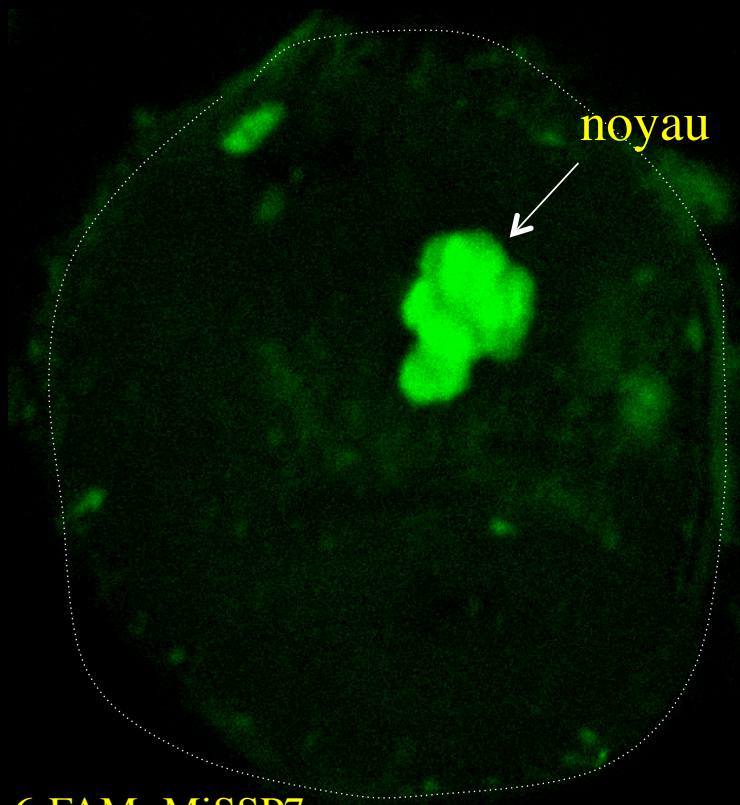


Plett et al. (2011) *Current Biology* 21, 1197-1203

Chez *Laccaria bicolor*, le peptide MiSSP7 entre dans le noyau des cellules racinaires !



+ DAPI



+ 5,6-FAM -MiSSP7

Cellules de peuplier en culture *in vitro*

Plett et al. (2011) *Current Biology* 21, 1197-1203

La plante cache souvent le champignon

- Invisibles
- Protecteurs
- Nourriciers
- Nettoyeurs
- Sculpteurs

Questions & réponses

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Partenaires du colloque

Merci aux partenaires premium

Région RhôneAlpes

Alcina