

FUNGOS

Estima-se que existam cerca de 1,5 milhão de espécies
70 000 espécies descritas
1000 – 2000 novas espécies por ano
Classificação em andamento

a grande maioria é terrestre
a grande maioria filamentosa, alguns unicelulares (leveduras)



HETEROTRÓFICOS – secretam enzimas digestivas e absorvem os produtos da digestão

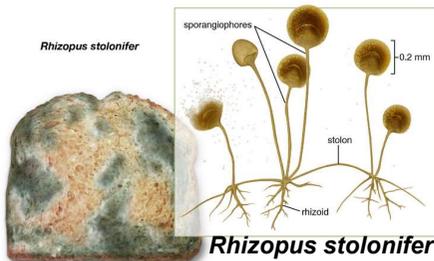
Decompositores – saprófitas (digerem matéria orgânica)

Simbiontes (formigas, plantas, algas eucarióticas, algas procarióticas, bactérias)

Parasitas

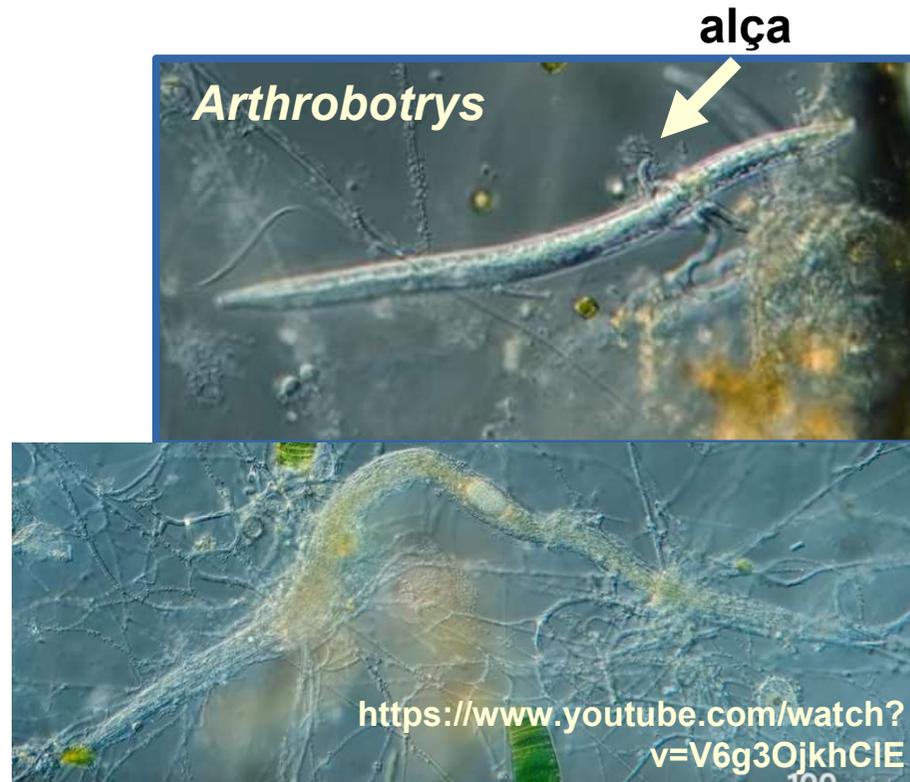
Patógenos

- plantas
- animais



Fungos predadores

- formam alças com suas hifas que contraem por estímulo
- após a captura secretam enzimas digestivas para dentro da presa



Denise Dagnino, LBT, CBB, UENF

Usos

alimentação:

- cogumelos
- fermentação
- flavorizante

médico:

- antibióticos
- imunomoduladores

industrial:

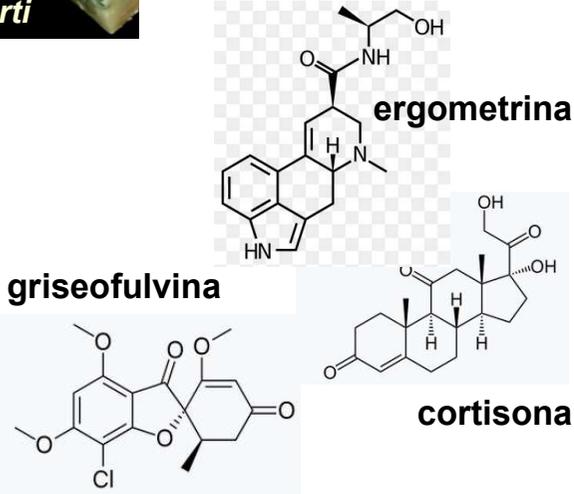
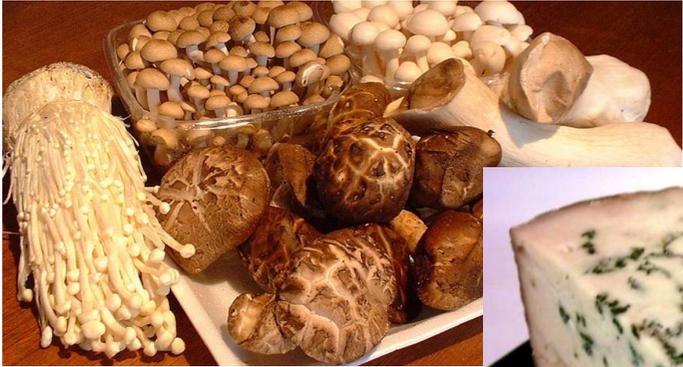
- substâncias diversas
- agrônômico

• micorrizas

• controle biológico

toxinas:

- halucinógenos



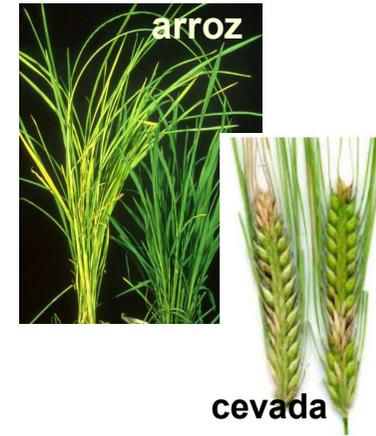
pragas:

- ambientes úmidos
- lavoura
 - patógenos
- silagem
 - toxinas

patógenos de animais:

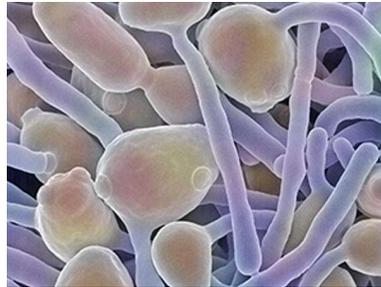
- micoses
- infecções hospitalares

plantas
infectadas
por
Gibberella



Formas de crescimento:

- unicelulares (leveduras, fermento*)
- filamentosos multicelulares (mofos)
- filamentosos multicelulares macroscópicos (cogumelos)
- mista



Candida albicans

hifas, pseudohifas e levedura



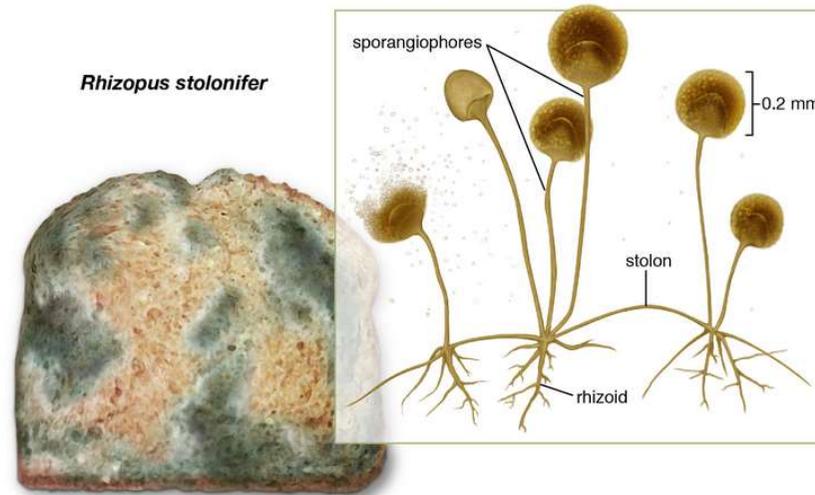
cogumelo
corpo de
frutificação



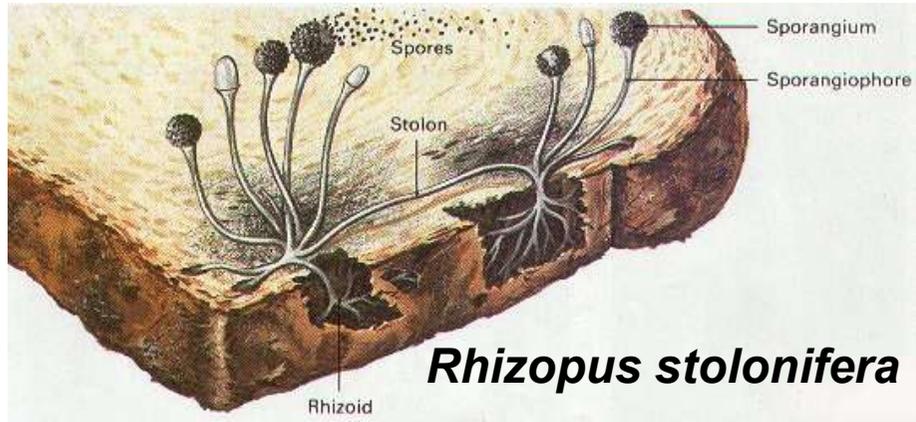
Hyphae



Rhizopus stolonifer mofo

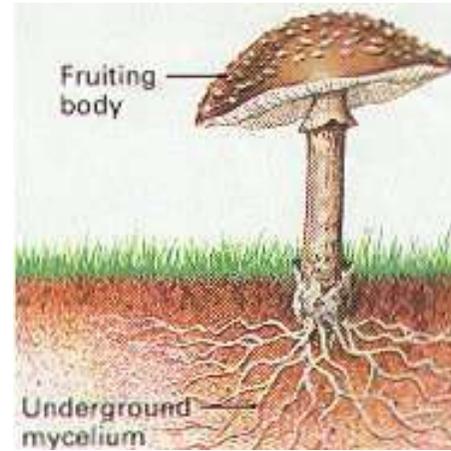


*https://www.youtube.com/watch?v=iyWtp_L0Kzc



Rhizopus stolonifera

http://www.silverfalls.k12.or.us/staff/read_shari/chapter_28_AB.htm

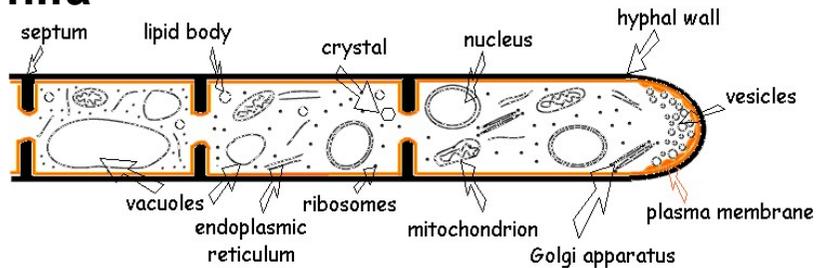


<http://www.uoguelph.ca/~gbarron>

Hifas e micélios

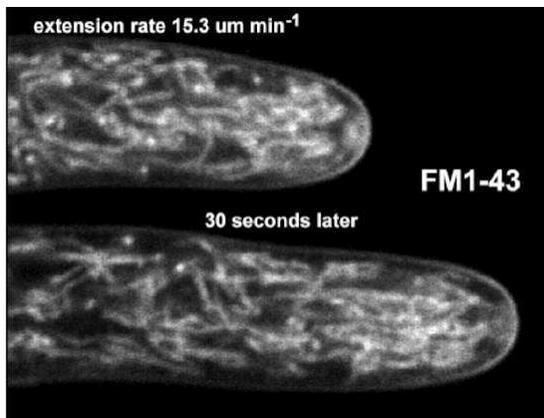
- parede celular rígida de quitina (polímero de N-acetilglicosamina)
- acúmulo de glicogênio
- crescimento e absorção de alimento principalmente na região do ápice da hifa
- umas das formas de reprodução assexuada: fragmentação das hifas

hifa



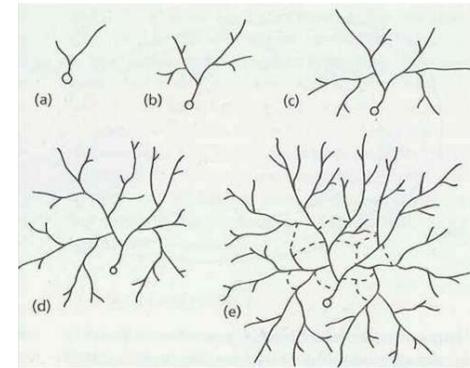
Tipos de hifas:

- septadas
- asseptadas (cenocíticas)



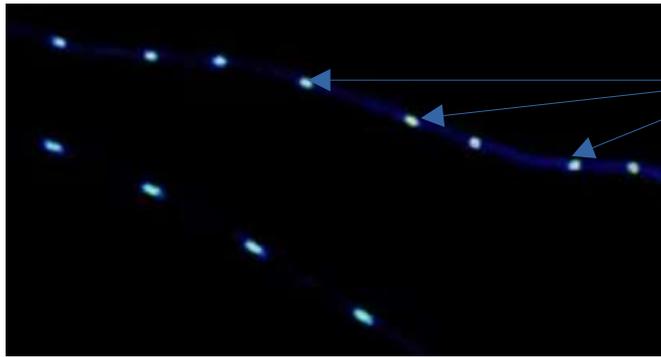
Neurospora crassa
crescimento: 1 mm/h

hifas exploram o ambiente na busca de alimento formando um micélio.



estágios de desenvolvimento de uma colônia a partir da germinação de um esporo. Linhas tracejadas representam anastomoses, próximas ao centro da colônia



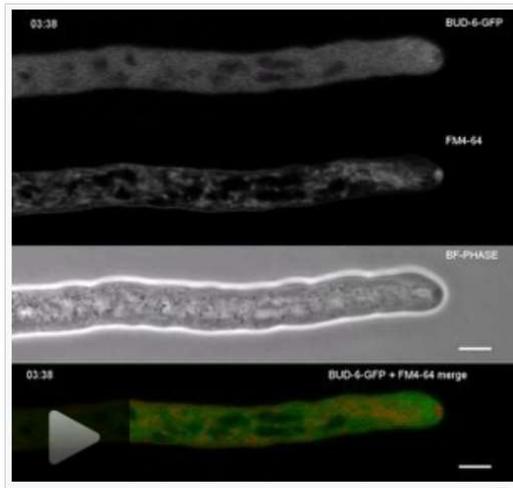
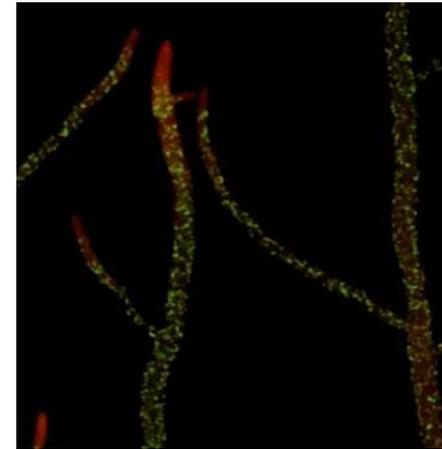


núcleos da hifa

Time-Lapse: Growing Mycelium of *Neurospora crassa* by Dr. Patrick Hickey

Canal Olympus Life Science

<https://www.youtube.com/watch?v=PbZjET6qQMk>



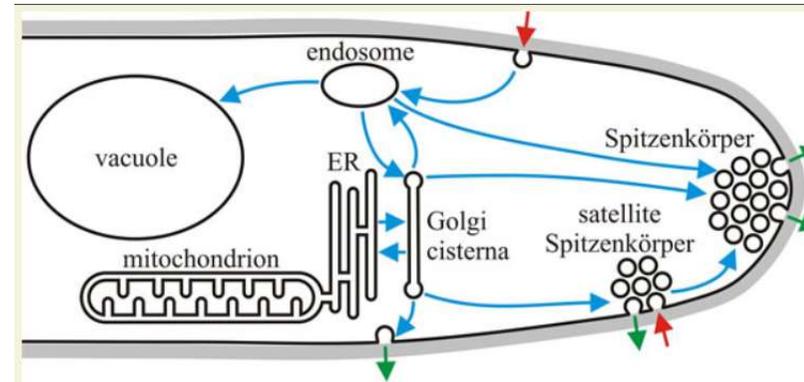
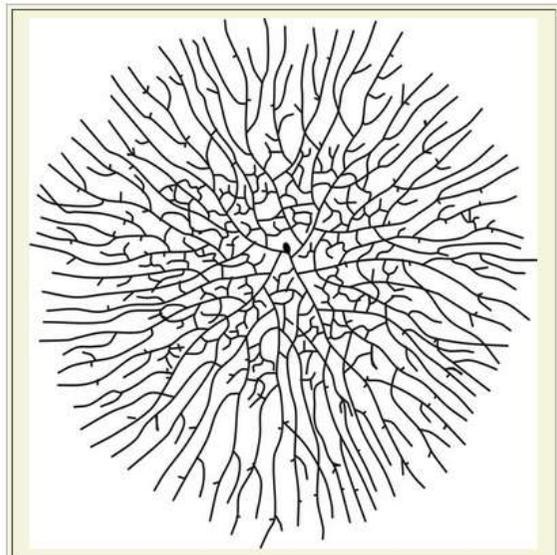
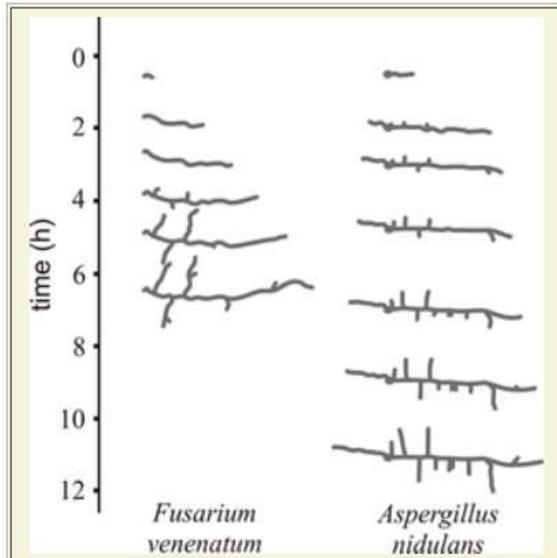
Spitzenkörper *Neurospora crassa*

<https://commons.wikimedia.org/w/index.php?title=File%3AComparative-Live-Cell-Imaging-Analyses-of-SPA-2-BUD-6-and-BNI-1-in-Neurospora-crassa-Reveal-Novel-pone.0030372.s007.ogv>

Denise Dagnino, LBT, CBB, UENF

Hifa e micélio

25°C em agar



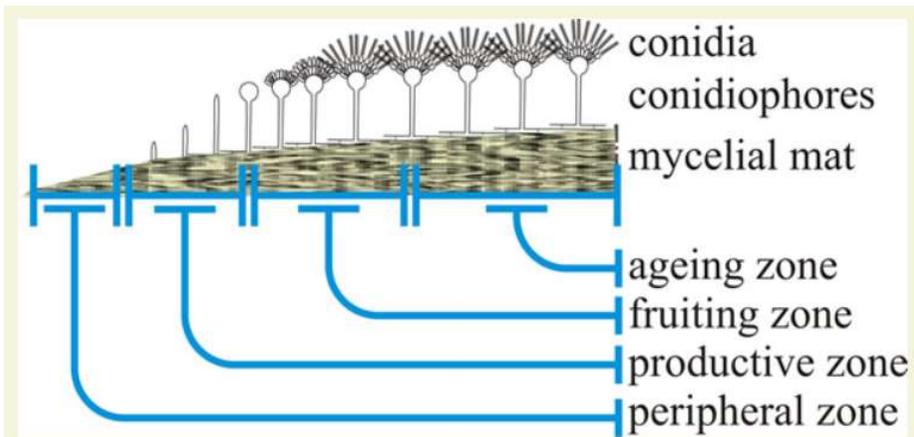
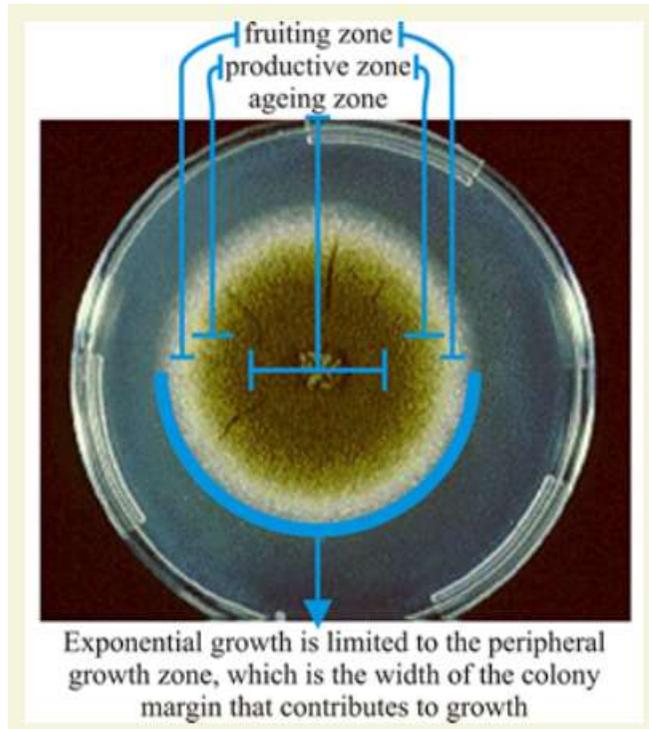
Time lapse drawings showing development of young germlings of *Fusarium venenatum* and *Aspergillus nidulans*. Note that the majority of the first-formed branches are oriented at close to 90° to the long axis of the main germ tube hypha, as new hyphal tips grow directly away from their parent hypha to explore the substratum.

A maturing fungal colony. Notice how the growing hyphae are oriented outward into uncolonised regions whilst the production of branches and hyphal fusions centrally ensures the mycelium becomes a network that efficiently exploits available substrate. *Coprinus sterquilinus*, A.H.R. Buller's, *Researches on Fungi* (Buller, 1909-1934).

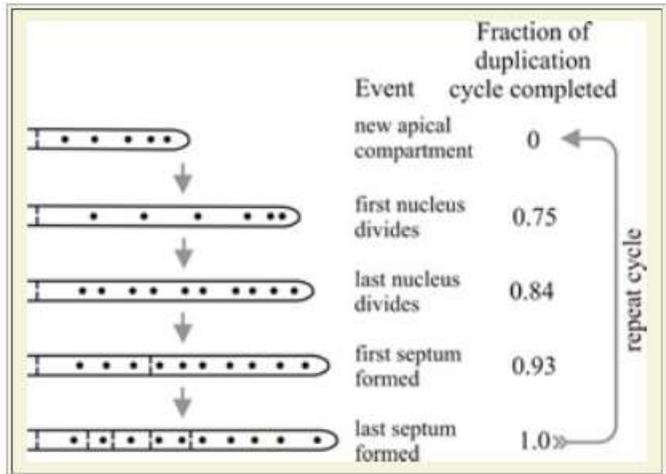
a extensão de dá nas pontas das hifas e é sustentada pelo crescimento ao longo de todo o micélio

Diferenciação no micélio

as diferentes zonas da colônia estão em estados fisiológicos específicos



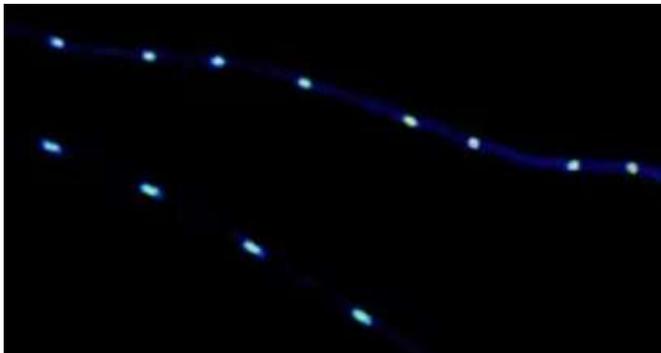
Morphological differentiation of colonies of *Aspergillus* shown in a diagrammatic radial section



etapas:

- extensão da hifa e aumento de volume/núcleo
- divisão aproximadamente síncrona de todos os núcleos
- formação de septos

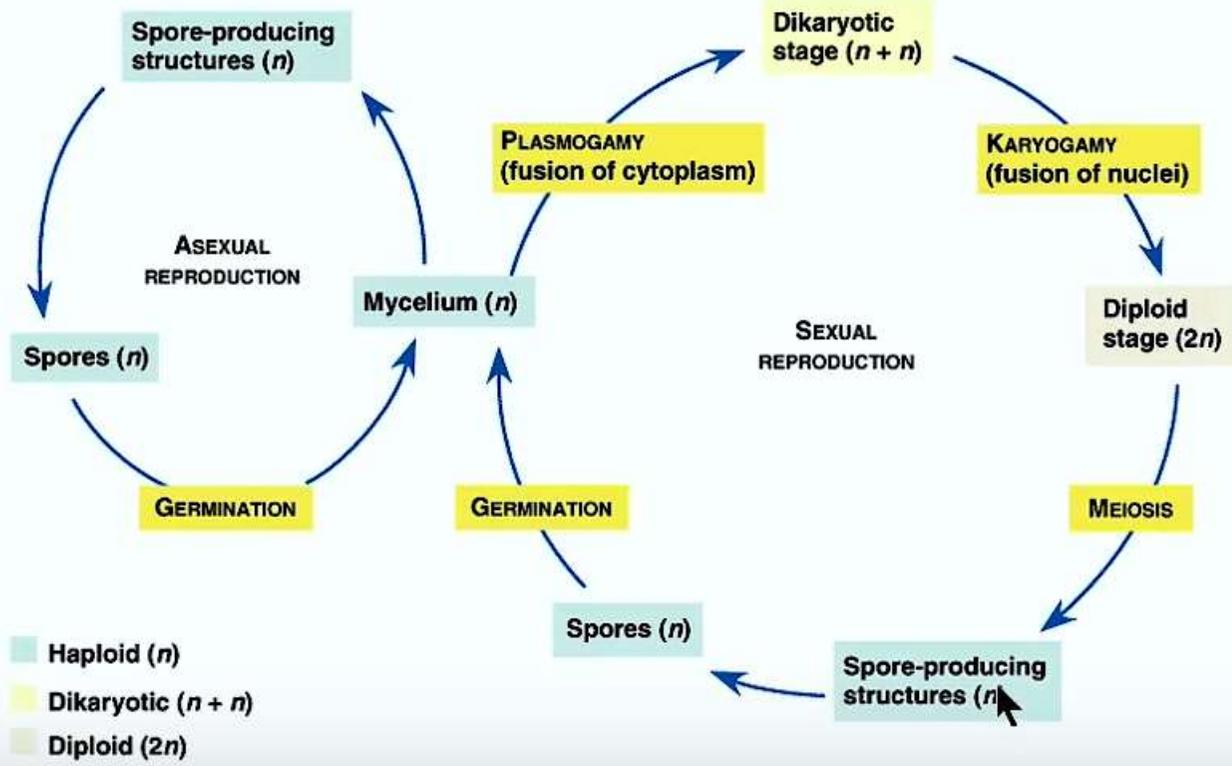
Diagrammatic representation of the **duplication cycle** in a leading hypha of *Aspergillus nidulans* extending at a linear rate on solid medium. On average, completion of a duplication cycle takes 2.1 hours.



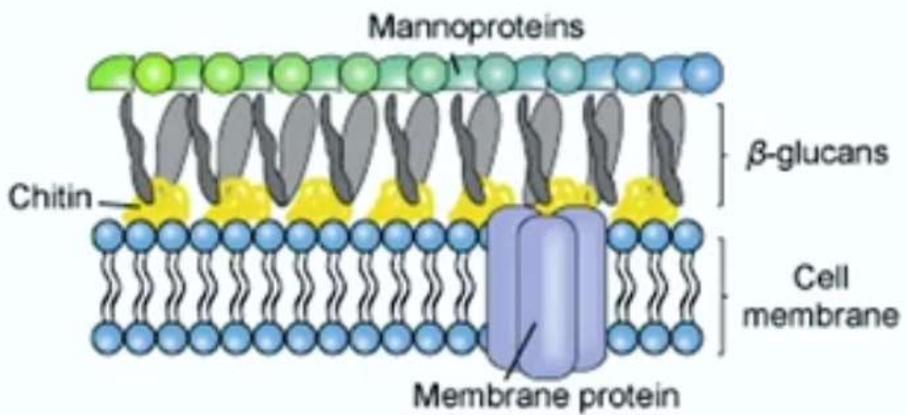
Aspergillus mitosis Timelapse by Dr. Patrick Hickey

Canal Olympus Life Science
<https://www.youtube.com/watch?v=wggx3i3cmd0>

Ciclo de vida



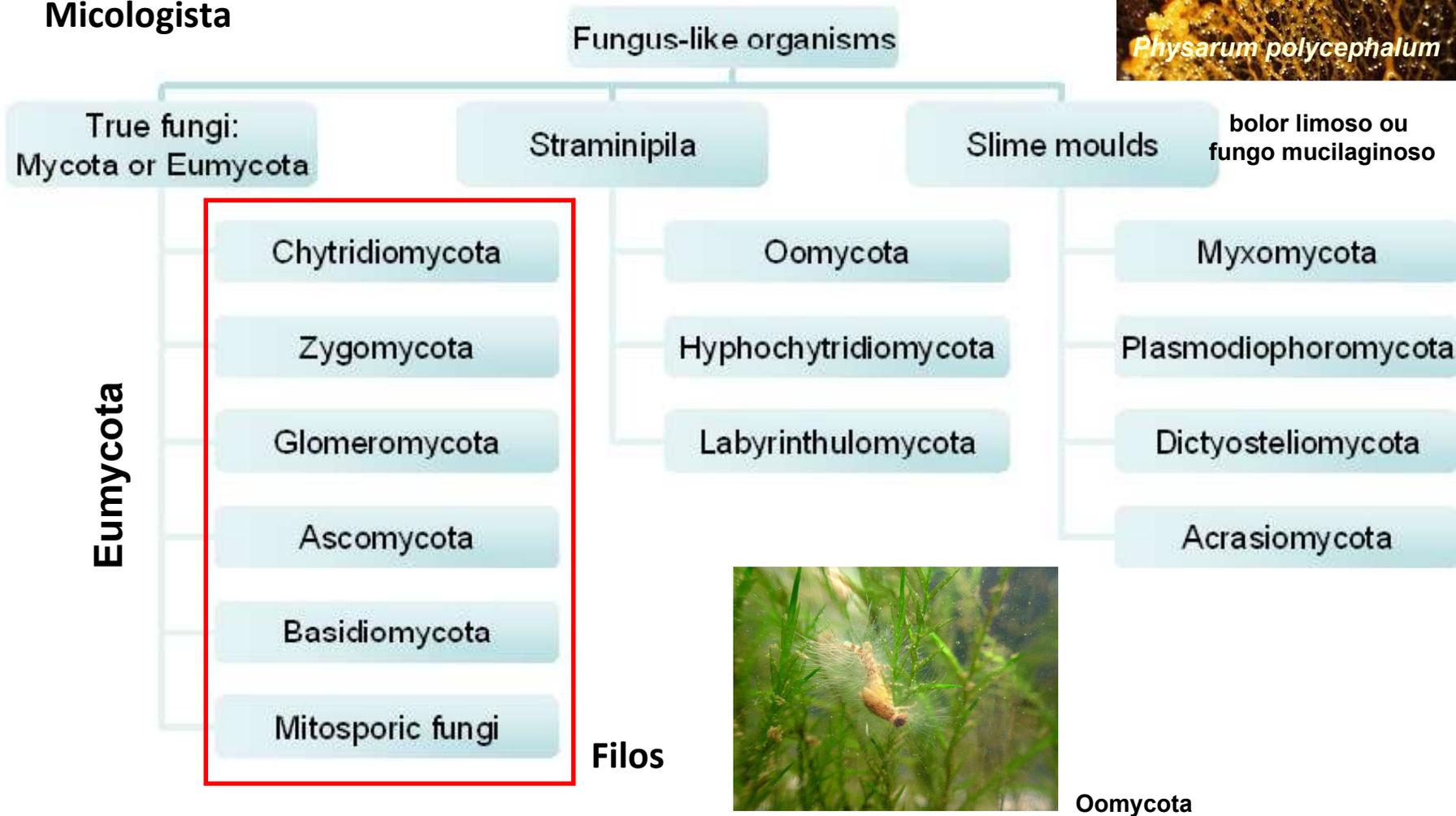
Pared celular



Classificação

histórico

Micologia
Micologista



Classificação utilizada pelo livro *Biologia Vegetal* (Raven)

Chytridiomycota

Zygomycota

Ascomycota

Basidiomycota

outros

Chytridiomycota

- produzem zoóporos
- zoósporos com flagelo único posterior
- alguns produzem gametas flagelados
- NÃO é monofilético

Filogenia molecular:

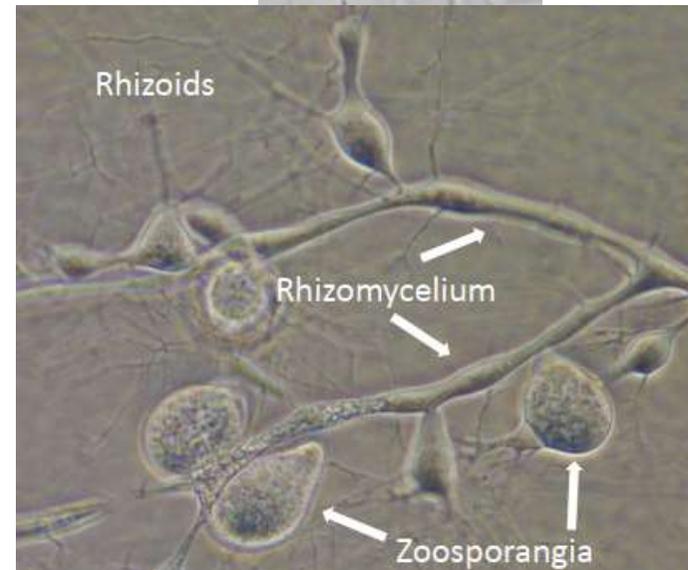
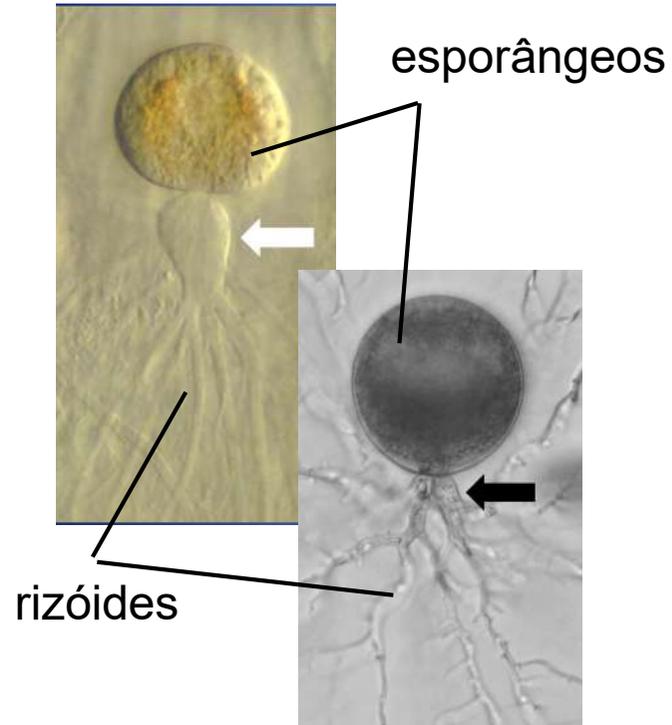
- classe Monoblepharidomycetes
- classe Chytridiomycetes

Morfologia não é indicativa de filogenia pois difere:

- no meio ambiente e em cultura
- nos diferentes meios de cultura

Hábitos:

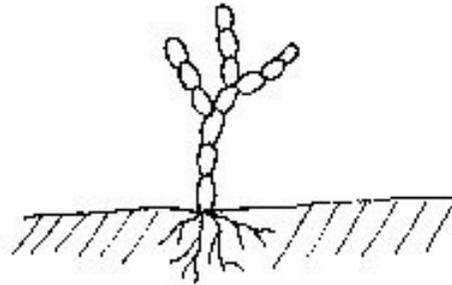
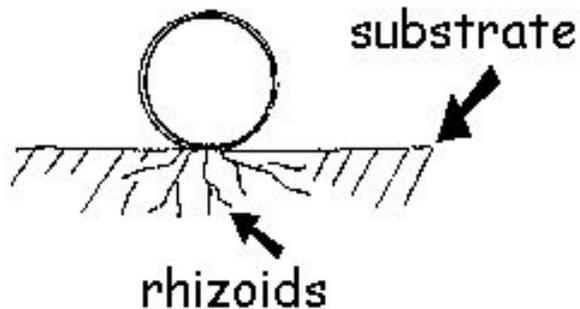
- predominantemente aquáticos
- habitam também solos
- alguns parasitas animais, plantas, protozoários
- patógenos de plantas e anfíbios



Chytridiomycota

cerca de 800 espécies
(o filo NÃO é monofilético)

formas de vida



Fungi belonging to the Chytridiomycota exist as either **single round cells** (unicellular species) or **primitively branched chains of cells**. In either case, the fungus may be anchored to its substrate by structures called RHIZOIDS

Únicos que possuem durante o ciclo de vida células flageladas!!
(gametas e zoósporos com flagelos posteriores)

ciclos de vida diversos

mais conhecido: Allomyces – alternância de gerações heteromórficas

responsáveis pela morte de
anfíbios em todo mundo
RISCO DE EXTINÇÃO de
várias espécies



<https://www.youtube.com/watch?v=7RFK9KNC8FA>

batata



Synchytrium

<https://alchetron.com/Synchytrium>

milho



*Physoderma
maydis*

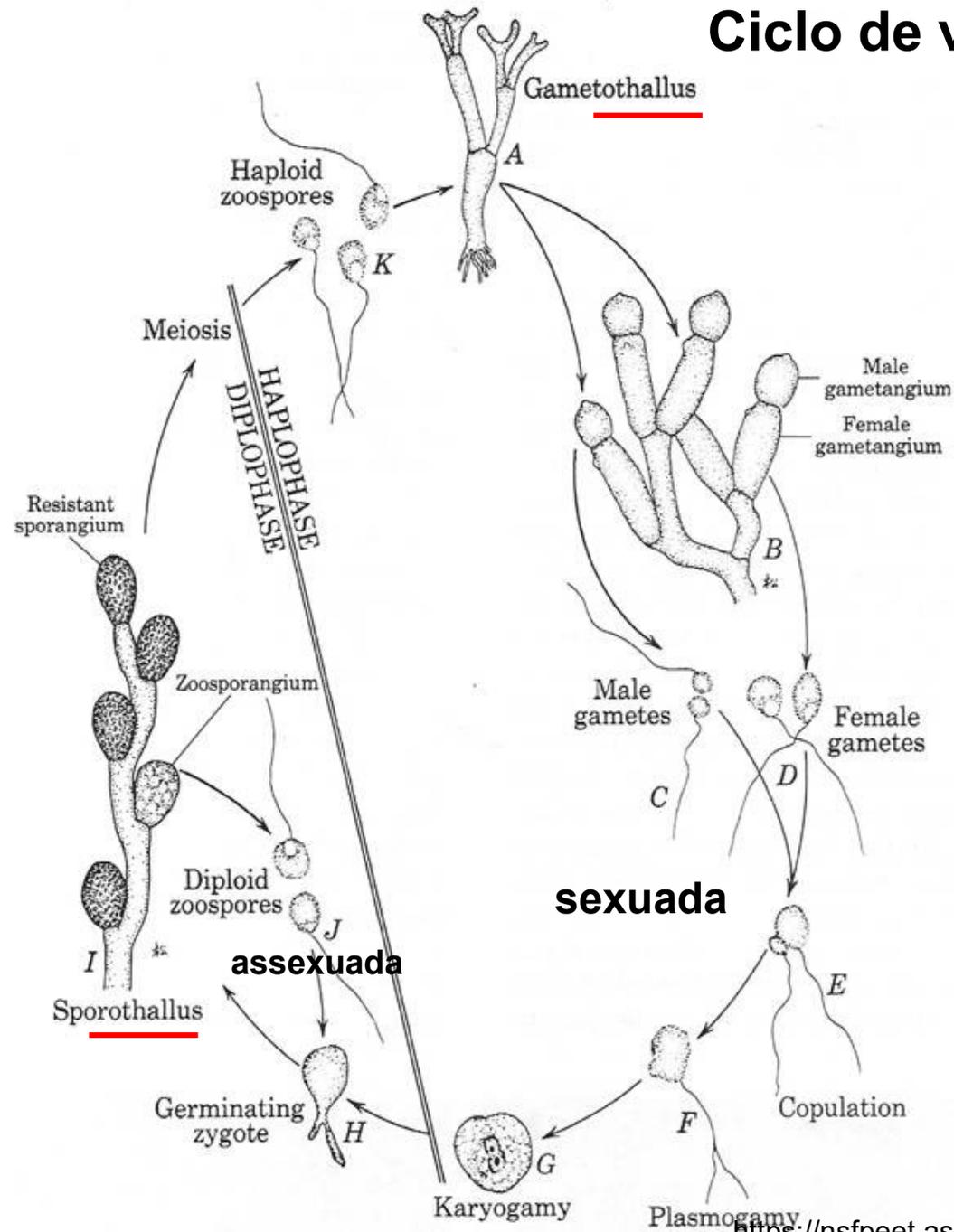
A

B

E.O.SABATO, 2014. Doenças do Milho. SOCIEDADE BRASILEIRA DE FITOPATOLOGIA (SBF)

Ciclo de vida de Blastocladiomycota

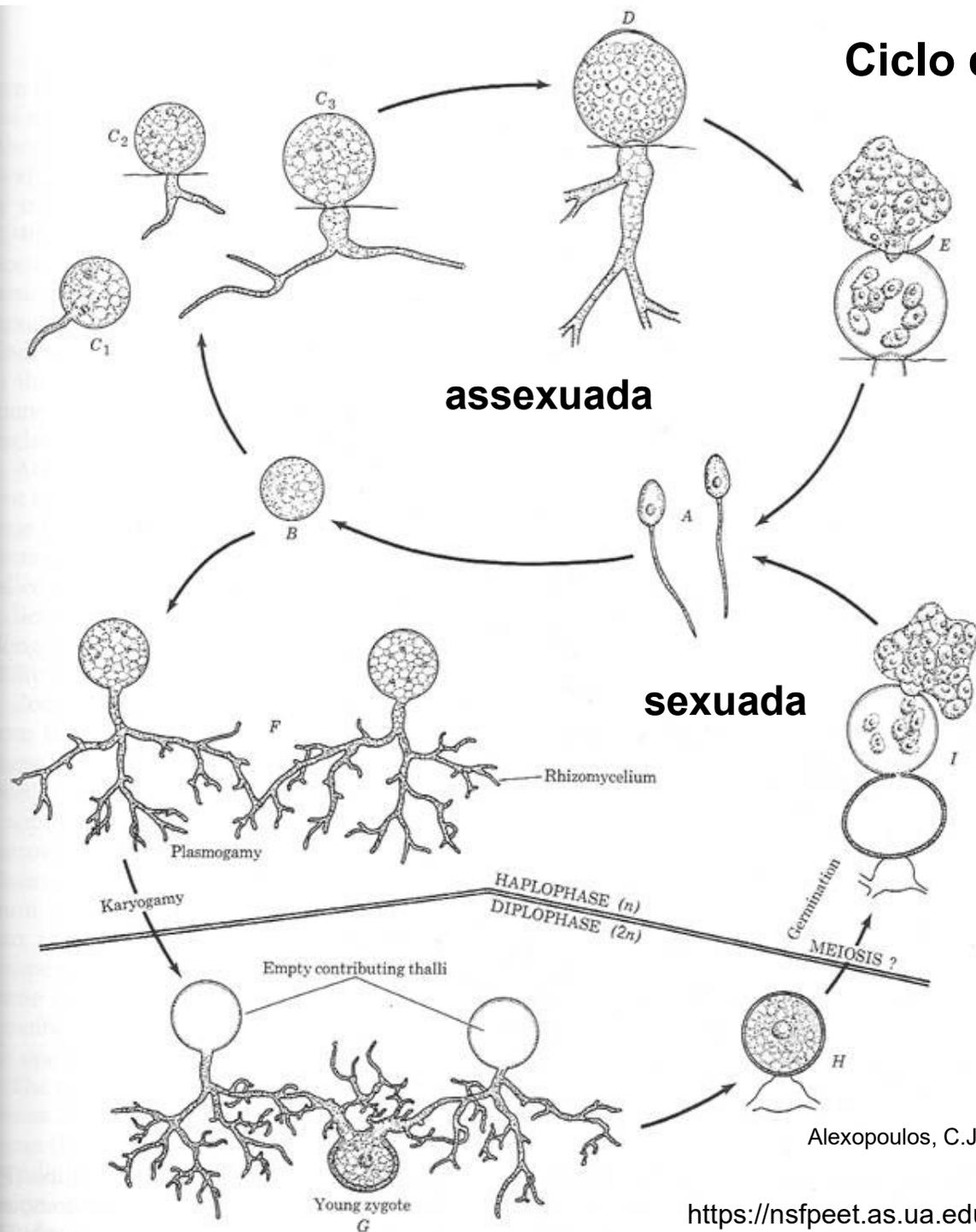
(Alexopoulos *et al.* 1996)



alternância de:
 •gametotalo
 •esporotalo

Allomyces arbuscula
 gerações formando cadeias
 ramificadas de células

Ciclo de vida de Chytridiomycetes (Alexopoulos *et al.* 1996)



assexuada

sexuada

plasmogamia

e

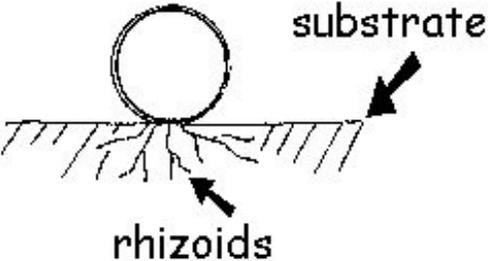
cariogamia

ocorrem em tempos diferentes

Alexopoulos, C.J., C.W. Mims, and M. Blackwell. 1996. *Introductory Mycology*. 4th edition. Wiley, NY. 868 pgs

<https://nsfpeet.as.ua.edu/Teaching%20with%20Basal%20Fungi%20lab.htm>

Germinação do zoósporo



Rabern Simmons, PEET trainee, University of Maine
Mycological Society of America Annual Meeting (2009)

Denise Dagnino, LBT, CBB, UENF

Zygomycota

o filo NÃO é monofilético

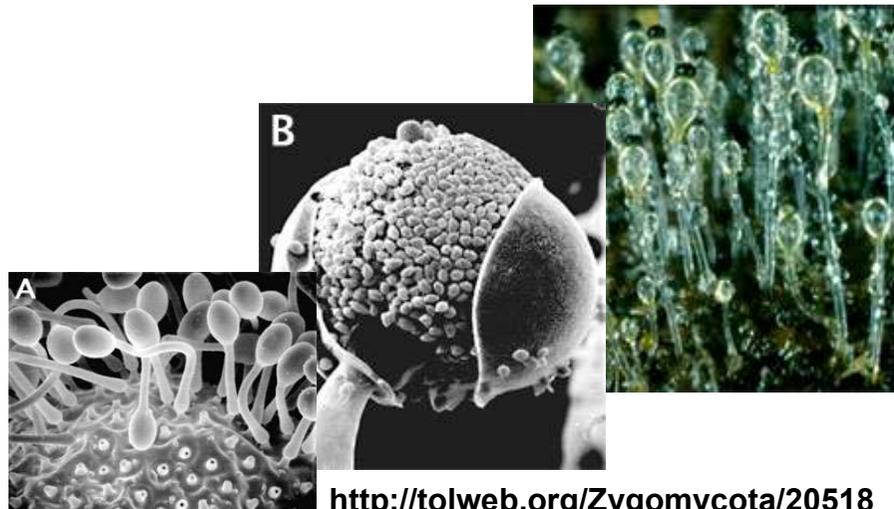
- representam cerca de 1% dos fungos (cerca de 1500 espécies)
- terrestres ou aquáticos sendo que muitos passam despercebidos
- habitam o trato intestinal de certos artrópodos
- patógenos de animais, plantas, amebas e mesmo de outro fungos
- hifas cenocíticas
- não formam corpos de frutificação



distinguidos dos demais fungos devido à formação de zigospórangios e zigósporos durante a reprodução sexuada

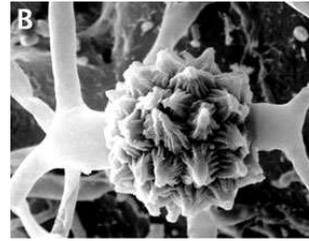
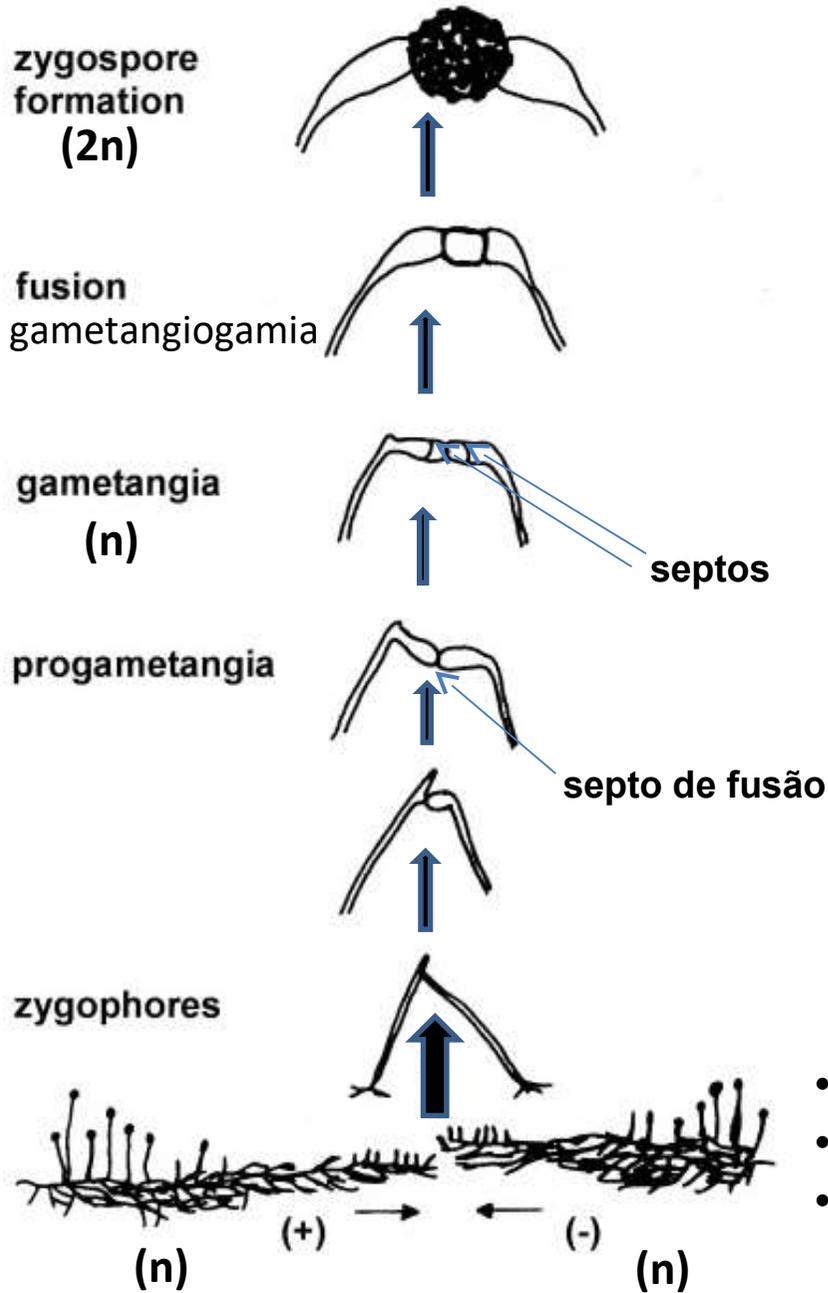
digestão de amido

Ordens mais proeminentes:
Mucorales
Entomophorales

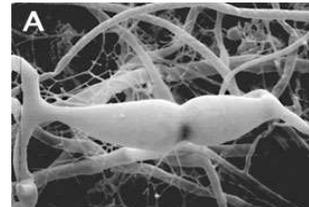
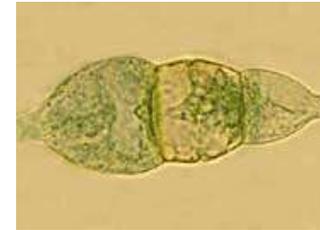
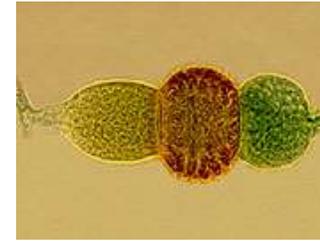


<http://tolweb.org/Zygomycota/20518>

Formação do zigósporo



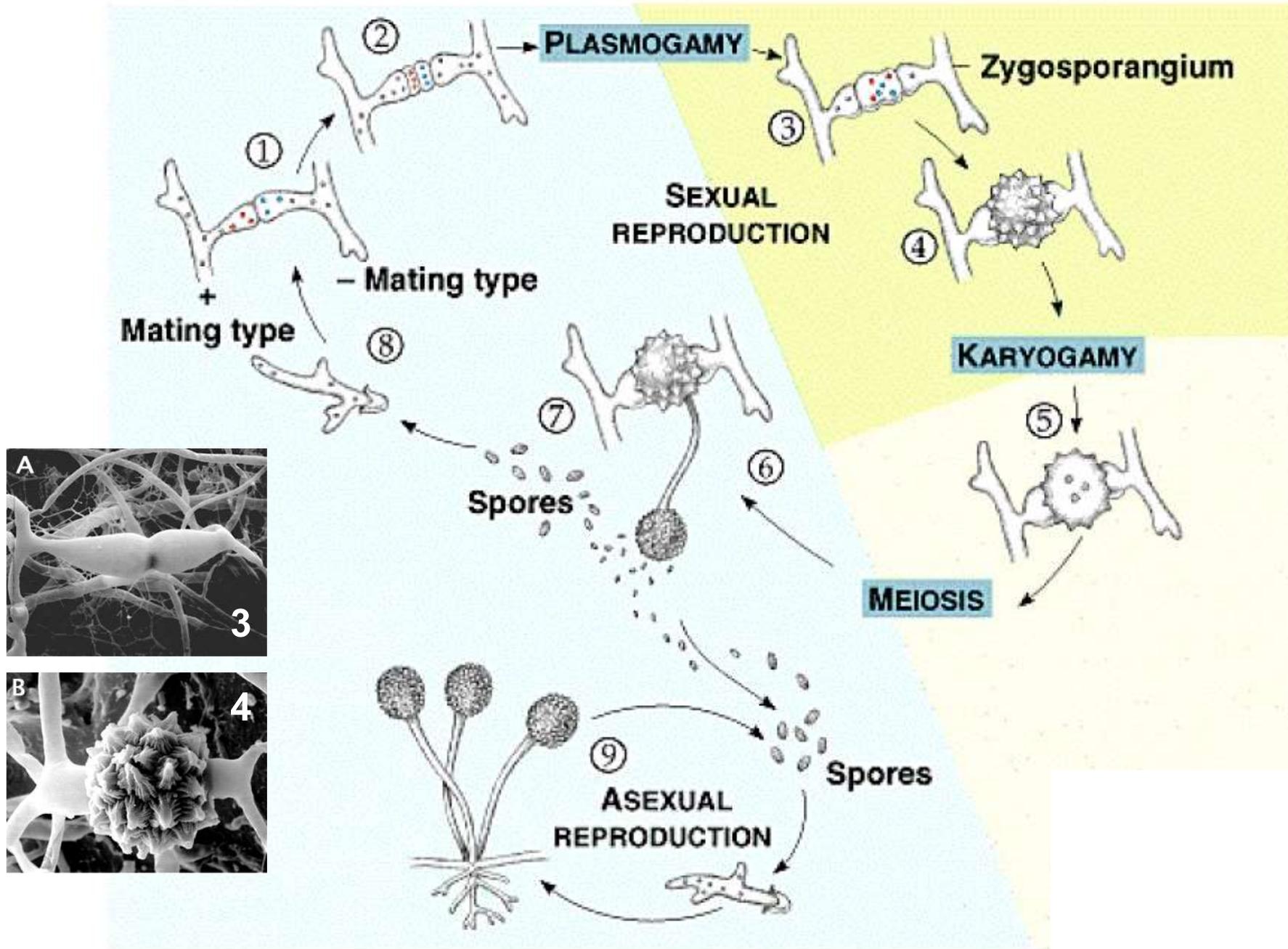
(2n)

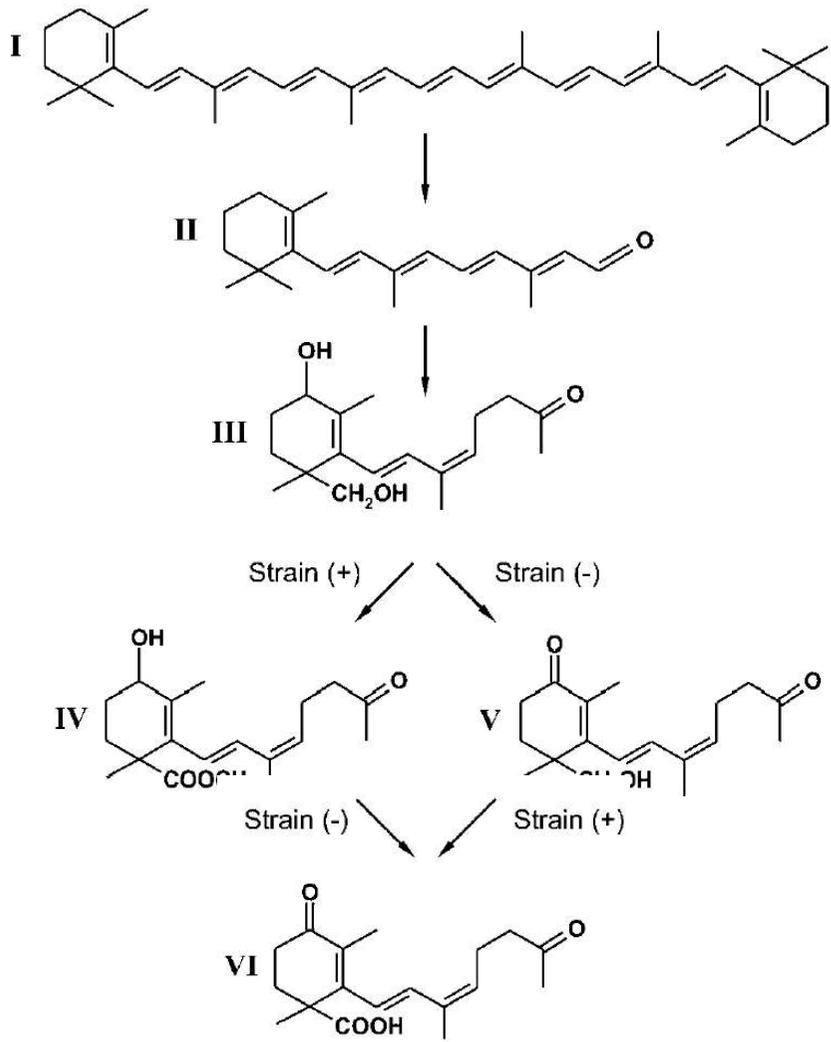


(n)

- única fase diplóide do ciclo de vida é o zigósporo
- zigósporo tem uma fase de dormência obrigatória
- meiose ocorre durante a germinação

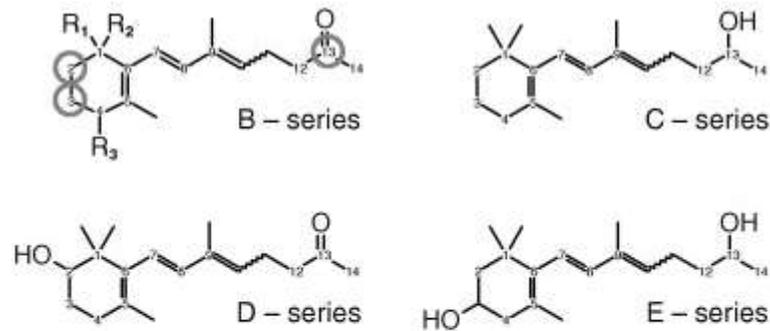
Figure 28.3 The life cycle of the zygomycete *Rhizopus*





biossíntese colaborativa do ácido trispórico com liberação de intermediários para o meio

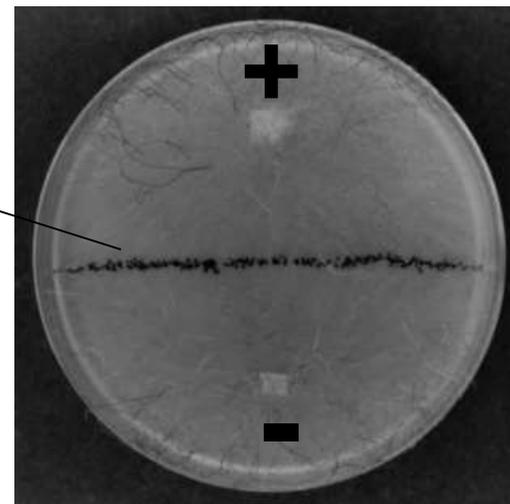
Denise Dagnino, LBT, CBB, UENF



4-dihydrotrispোরin: $R_1 = \text{CH}_3; R_2 = \text{CH}_3; R_3 = \text{OH}$
 trispোরin: $R_1 = \text{CH}_3; R_2 = \text{CH}_3; R_3 = \text{O}$
 trispোরol: $R_1 = \text{CH}_3; R_2 = \text{CH}_2\text{OH}; R_3 = \text{O}$
 trispোরic acid: $R_1 = \text{CH}_3; R_2 = \text{COOH}; R_3 = \text{O}$
 4-dihydrotrispোরic acid: $R_1 = \text{CH}_3; R_2 = \text{COOH}; R_3 = \text{OH}$
 methyltrisporate: $R_1 = \text{CH}_3; R_2 = \text{COOCH}_3; R_3 = \text{O}$
 4-dihydromethyltrisporate: $R_1 = \text{CH}_3; R_2 = \text{COOCH}_3; R_3 = \text{OH}$

trisporoides – estrutura geral

zigósporos



Schimek 2009, Phytochemistry

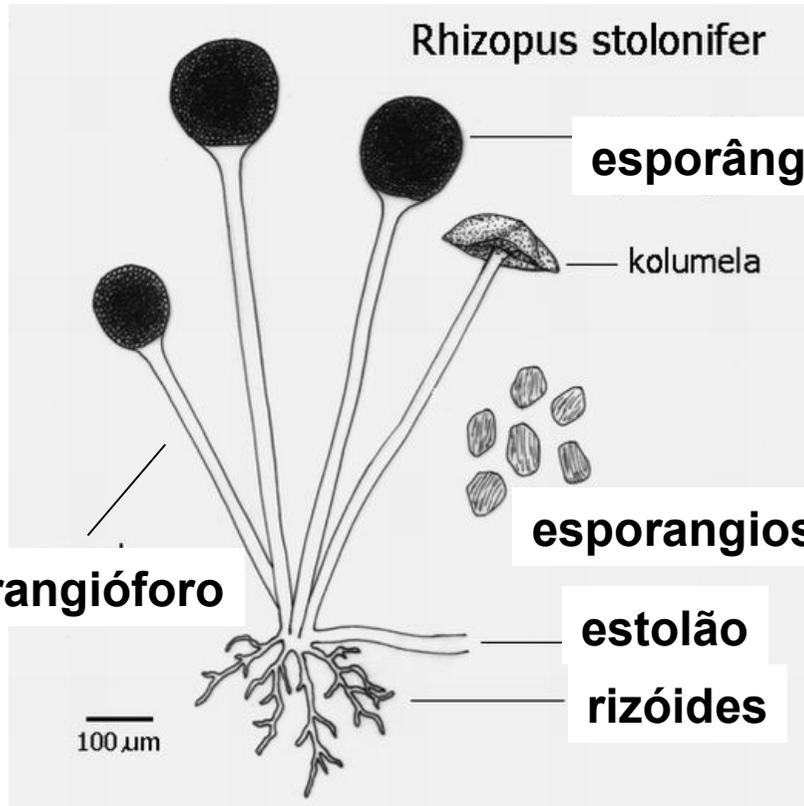
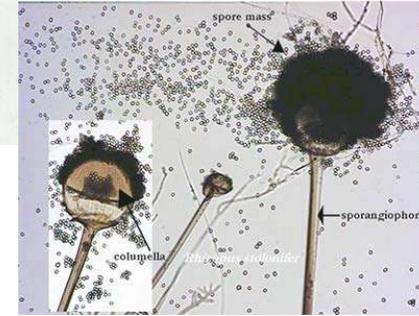
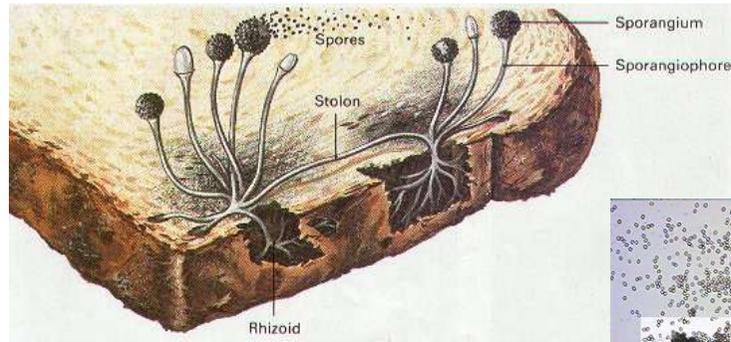
ZYGOMYCOTA

Muscorales

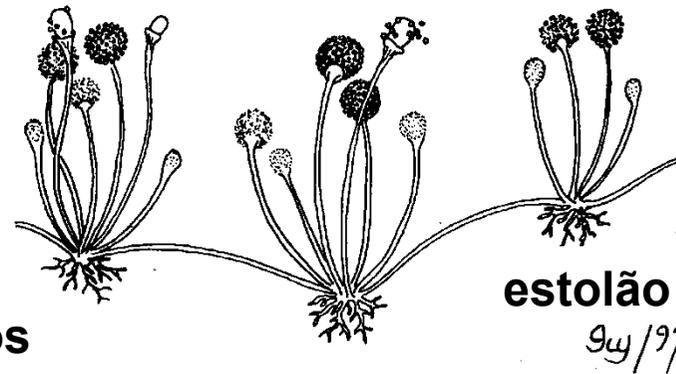
hifas cenocíticas

anastomoses raras

parede celular de quitina e quitosana



bolor no pão



Ivy Livingstone ©BIODIDAC

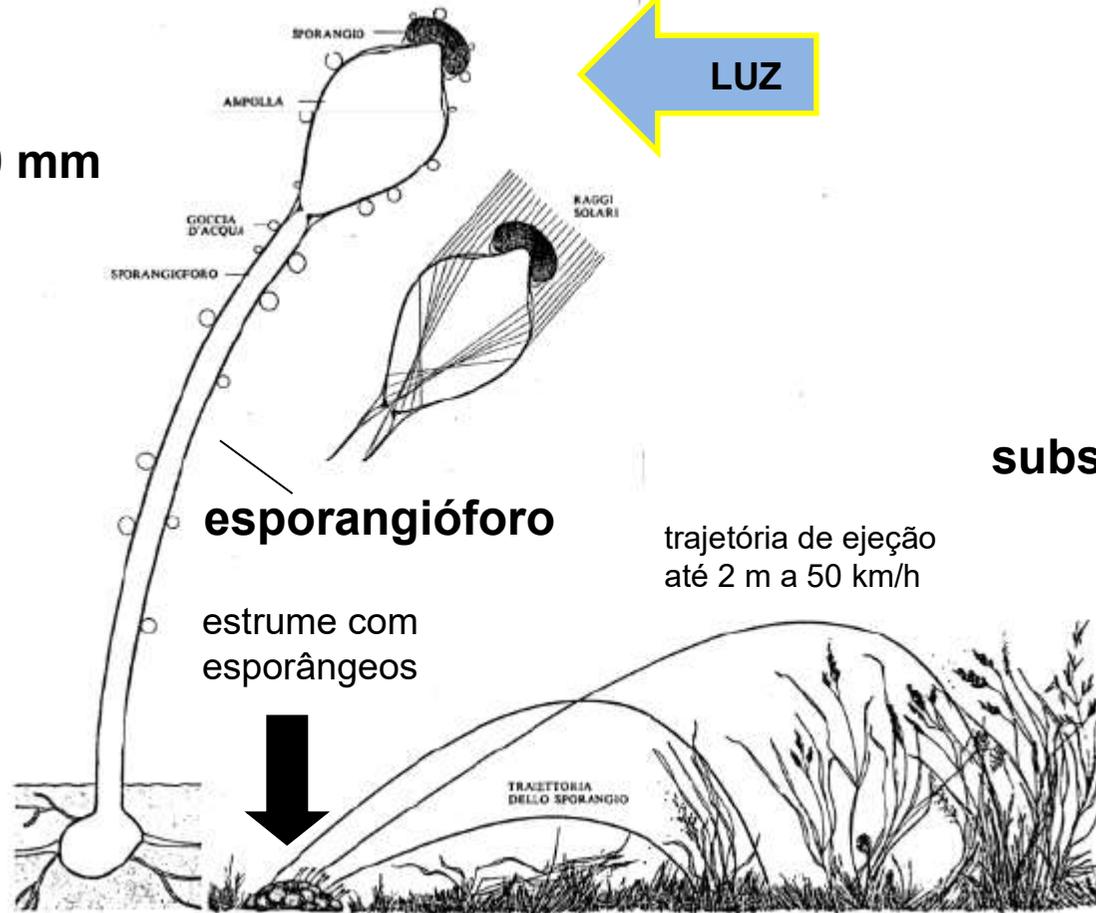
esporangiolos
e merosporângios

Pilobolus

esporângio

fototrófico positivo

5-10 mm

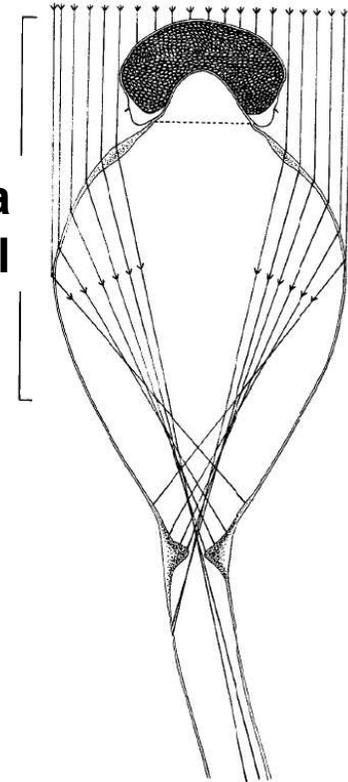


esporangióforo

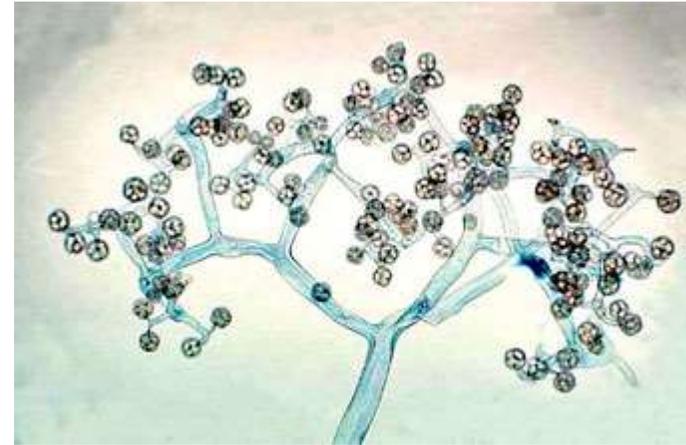
estrume com esporângios

trajetória de ejeção
até 2 m a 50 km/h

vesícula
subsporangial

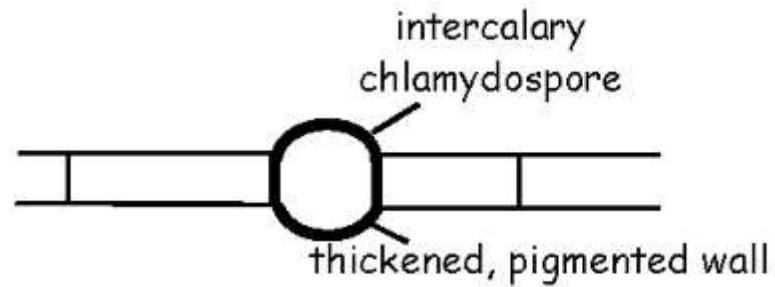
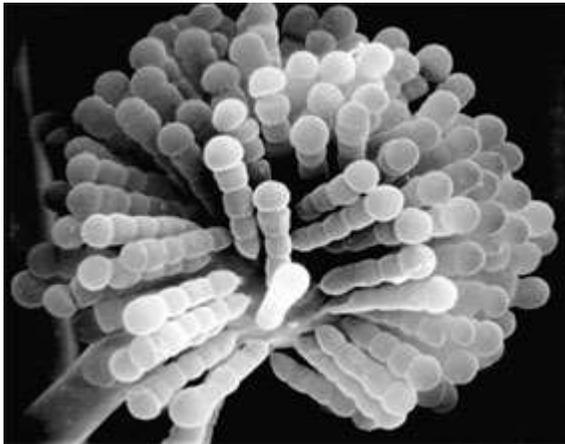


Outros tipos de esporângeos



esporângios

meroesporângios



Coleta e identificação de cogumelos

Fresno Mycology Society - <https://www.youtube.com/watch?v=xXCVgRYIT4g>

Pilobolus – velocidade de liberação dos esporos

- <https://www.youtube.com/watch?v=T8OAmcUnm4g>

- <https://www.youtube.com/watch?v=b646LTmzTu8>

Fungos da Austrália

<https://www.youtube.com/watch?v=8tGXFZmndCY>

Naturalistas – muitos musgos e samambaias nesta busca por fungos!

Mushroom wonderland: https://www.youtube.com/watch?v=H_xOEbWogU4

Comunidade de registro e identificação de seres vivos

<https://www.inaturalist.org/>

Vídeo - História e evolução: Fungus: The 3rd kingdom -

https://www.youtube.com/watch?v=ZGEdHxiWo_Y

Livro: 21st Century Guidebook to Fungi, SECOND EDITION

by David Moore, Geoffrey D. Robson and Anthony P. J. Trinci

http://www.davidmoore.org.uk/21st_Century_Guidebook_to_Fungi_PLATINUM/

index.htm