UZ LEUVEN

MYCOLOGY

Katrien Lagrou, PharmD, PhD

University Hospitals Leuven and KU Leuven, BELGIUM

UZ LEUVEN

REVIEW

MEDICAL MYCOLOGY

Hidden Killers: Human Fungal Infections

Gordon D. Brown,[1]* David W. Denning,[2]* Neil A. R. Gow,[1]* Stuart M. Levitz,[3]* Mihai G. Netea,[4]* Theodore C. White[5]*

Although fungal infections contribute substantially to human morbidity and mortality, the impact of these diseases on human health is not widely appreciated. Moreover, despite the urgent need for efficient diagnostic tests and safe and effective new drugs and vaccines, research into the pathophysiology of human fungal infections lags behind that of diseases caused by other pathogens. In this Review, we highlight the importance of fungi as human pathogens and discuss the challenges we face in combating the devastating invasive infections caused by these microorganisms, in particular in immunocompromised individuals.

WHO has no program on fungal infection

19 December 2012 Vol 4 Issue 165 165rv13

Some figures….

SUPERFICIAL infections of skin and nails:

- **Most common fungal diseases in humans, affect ~ 25% of the general population worldwide**
- **Caused primarily by dermatophytes**
- **Athlete's foot: 1 in 5 adults**
- **Ringworm of the scalp: affect 200 million individuals worldwide**
- **Onychomycosis: 10% of the general population worldwide (incidence increases with age to ~ 50% in adults ≥ 70 years**

Some figures…

MUCOSAL infections:

- **50-75% of women in their childbearing years suffer from at least one episode of vulvovaginitis; 5-8% have at least four episodes annually**
- **Nearly 10 million cases of oral thrush and 2 million cases of esophageal fungal infections annually in HIV/AIDS patients**

INVASIVE infections:

- **Incidence much lower than superficial infections but unacceptably high mortality rates**
- **Kill about 1.5 million people every year**
- **>90% of all reported fungal-related deaths results from species that belong to these four genera: *Cryptococcus*, *Candida*, *Aspergillus* and *Pneumocystis***

Disease (most common species)	Location	Estimated life-threatening infections/ year at that location*	Mortality rates (% in infected populations)*
Opportunistic invasive mycoses			
Aspergillosis (*Aspergillus fumigatus*)	Worldwide	>200,000	30–95
Candidiasis (*Candida albicans*)	Worldwide	>400,000	46–75
Cryptococcosis (*Cryptococcus neoformans*)	Worldwide	>1,000,000	20–70
Mucormycosis (*Rhizopus oryzae*)	Worldwide	>10,000	30–90
Pneumocystis (*Pneumocystis jirovecii*)	Worldwide	>400,000	20–80
Endemic dimorphic mycoses*†			
Blastomycosis (*Blastomyces dermatitidis*)	Midwestern and Atlantic United States	~3,000	<2–68
Coccidioidomycosis (*Coccidioides immitis*)	Southwestern United States	~25,000	<1–70
Histoplasmosis (*Histoplasma capsulatum*)	Midwestern United States	~25,000	28–50
Paracoccidioidomycosis (*Paracoccidioides brasiliensis*)	Brazil	~4,000	5–27
Penicilliosis (*Penicillium marneffei*)	Southeast Asia	>8,000	2–75

*Most of these figures are estimates based on available data, and the logic behind these estimates can be found in the text and in the Supplementary Materials. †Endemic dimorphic mycoses can occur at many locations throughout the world. However, data for most of those locations are severely limited. For these mycoses, we have estimated the infections per year and the mortality at a specific location, where the most data are available.

mycoses
Diagnosis, Therapy and Prophylaxis of Fungal Diseases

Supplement article

Burden of serious fungal infections in Belgium

Katrien Lagrou,[1,2] Johan Maertens,[1] Ellen Van Even[2] and David W. Denning[3]

[1]Department of Microbiology and Immunology, Catholic University Leuven, Leuven, Belgium, [2]Department of Laboratory Medicine, National Reference Center for Mycosis, University Hospitals Leuven, Leuven, Belgium and [3]National Aspergillosis Centre, University Hospital of South Manchester, Manchester Academic Health Science Centre, The University of Manchester, Manchester, UK

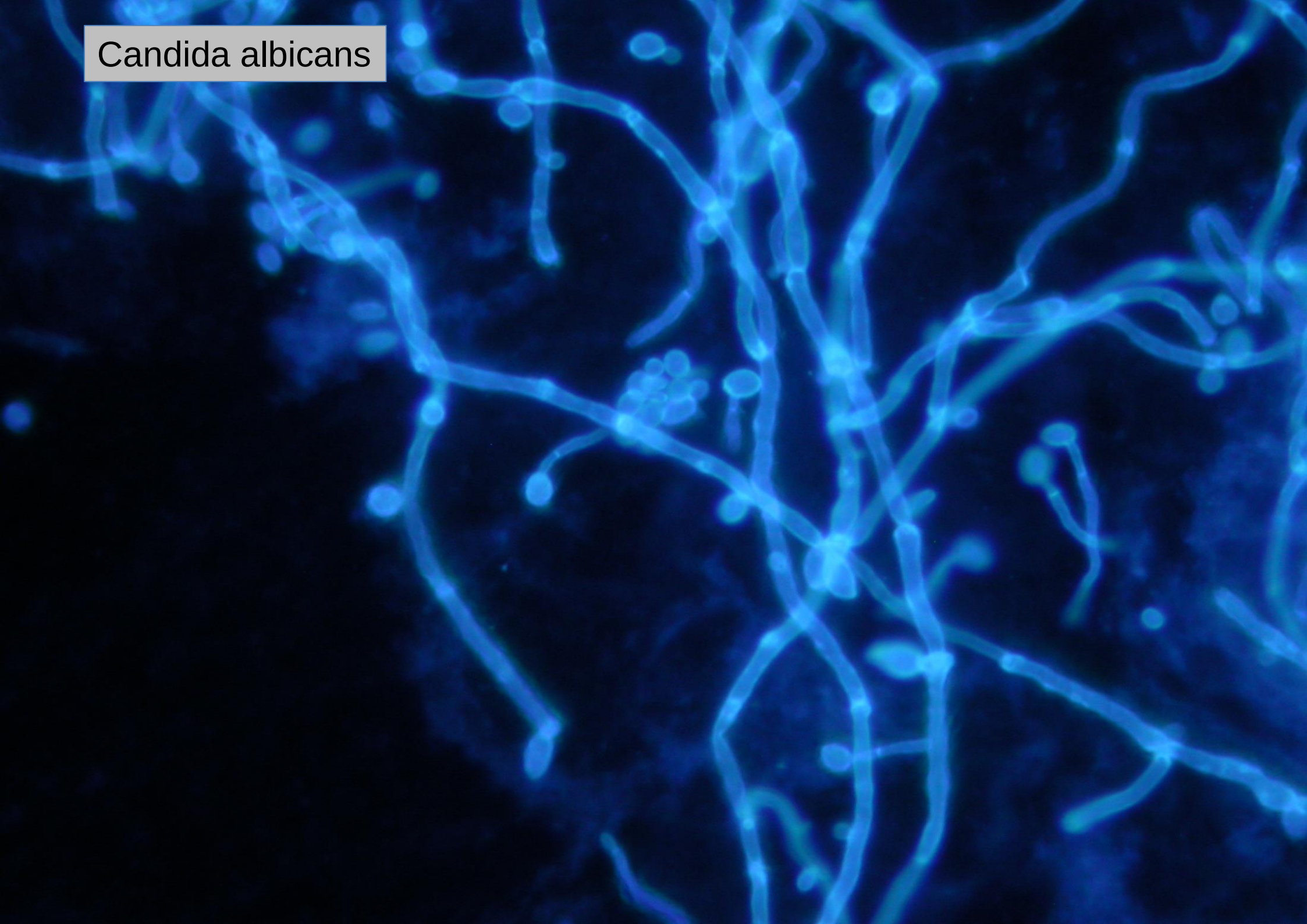
Summary

We aimed to estimate the total number of serious fungal infections occurring yearly in Belgium. The number of cryptococcal infections was retrieved from the National Reference Center for Mycosis. Populations at risk and fungal infections frequencies in these populations were used to estimate incidence or prevalence of other fungal infections. The Belgian population consists of 11.10 million people. Cryptococcal meningitis is rare. In all, 15 of the 1227 newly diagnosed HIV/AIDS cases presented with *Pneumocystis jirovecii* pneumonia. This accounts for ±14% of total PCP cases ($n = 120$). The incidence of candidaemia is estimated as 5/100 000 resulting in 555 cases and 213 deaths. A total number of 675 invasive aspergillosis cases and ≥169 deaths attributed to this infection were calculated. Chronic pulmonary aspergillosis is estimated to be prevalent in 662 cases. Allergic bronchopulmonary aspergillosis cases were estimated to be 23 119 applying a 2.5% and 15% rate in adult asthma and cystic fibrosis patients respectively. Severe asthma with fungal sensitisation cases was estimated to be 30 402. There were 174 760 women with recurrent *Candida* vaginitis assuming a 6% rate in women aged between 15 and 50. Approximately 233 000 people of the Belgian population (2.1%) are estimated to suffer from a fungal infection on a yearly basis.

FUNGI (SCHIMMELS)

YEASTS
(GISTEN)

FILAMENTOUS FUNGI/MOULDS
(FILAMENTEUZE FUNGI)

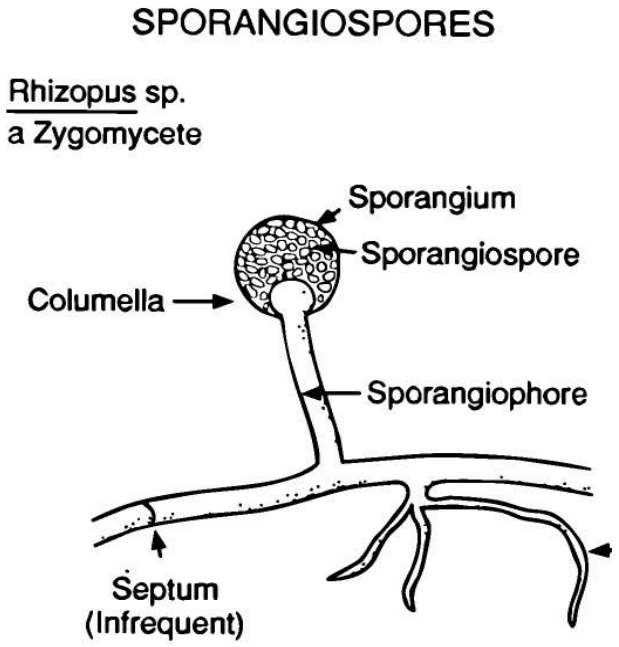

Candida albicans

Reproduction of fungi

- Many fungi go through a typical life cycle and can be found as separate independent spore-forming sexual and asexual generations with very different morphology
- Biochemical structure and physiological properties are identical
- Sexual reproduction (nuclear fusion and meiosis)
    - sexual for or **TELEOMORPH**
    - *in vitro* often difficult to achieve
    - basis for classification of fungi
- Asexual reproduction (mitosis)
    - asexual form or **ANAMORPH**
    - basis for microscopical identification

Asexual reproduction: formation of spores

Simultaneous formation in one compartment



ANAMORPH

Separate formation

Piece of mycelium which transforms

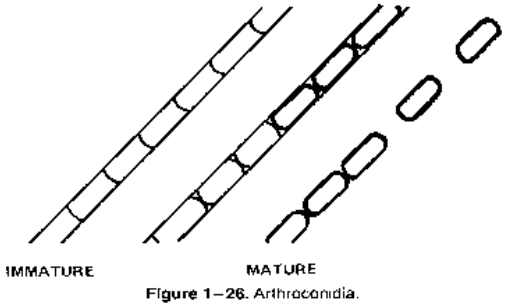
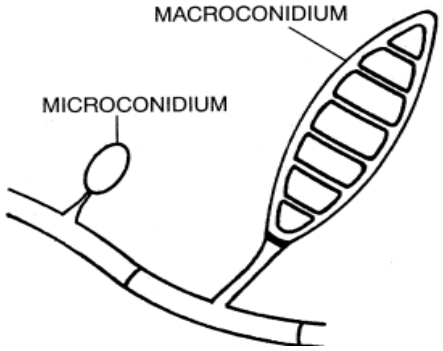


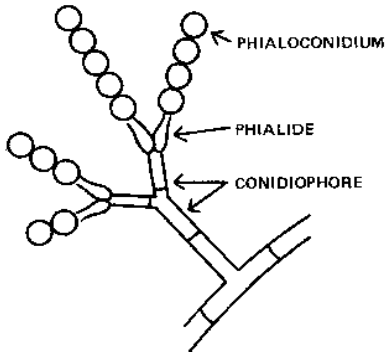
Figure 1–26. Arthroconidia.



Arthroconidia

Aleurioconidia

Sporulating cell (conidiogenous cell)

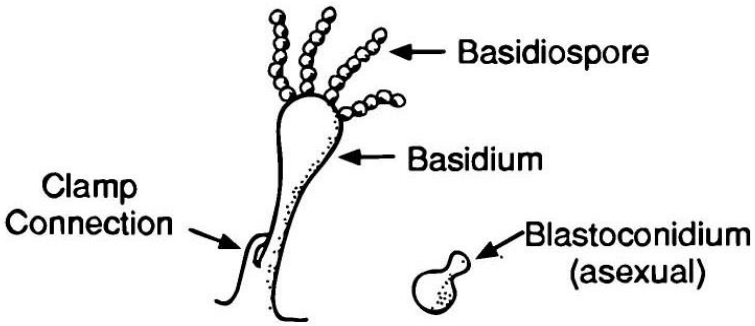


Sexual sporulation

BASIDIOMYCOTA

BASIDIOSPORES

Filobasidiella neoformans
a Basidiomycete

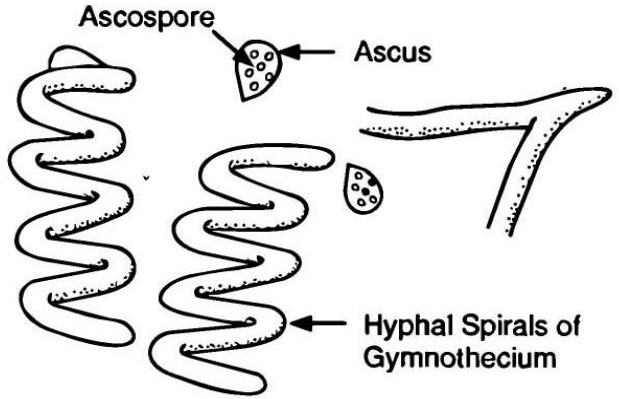


Multi-lamellar cell wall

ASCOMYCOTA

ASCOSPORES

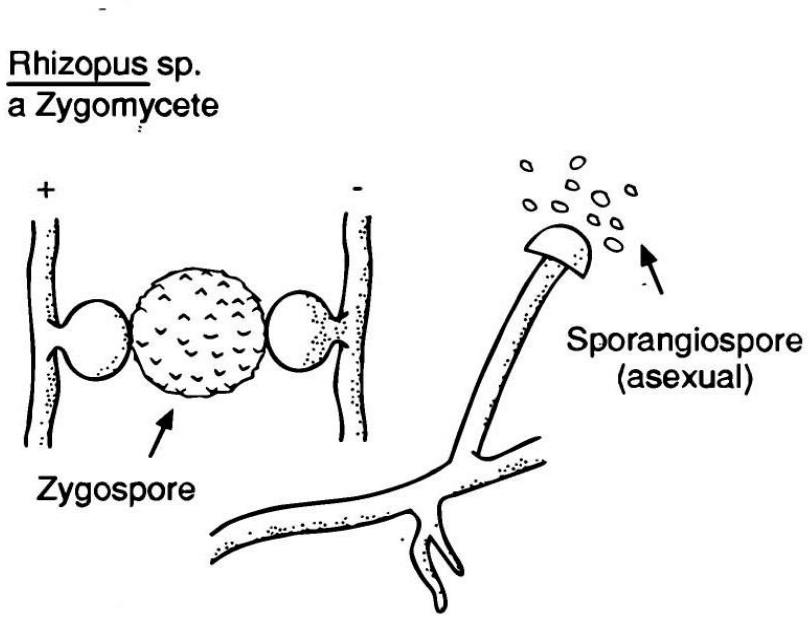
Ajellomyces dermatitidis
an Ascomycete



Cell wall with 2 layers

Sexual sporulation

MUCORALES



ANAMORPHIC FUNGI

The anamorphic fungi are an artificial assemblage of asexual stages of ascomycetes and basidiomycetes. They are classified together with asexually reproducing fungi that lack sexual structures

Identification of fungi

- Yeast:
  - Physiological characteristics
  - MALDI-TOF MS
  - Molecular techniques (sequence-analysis)

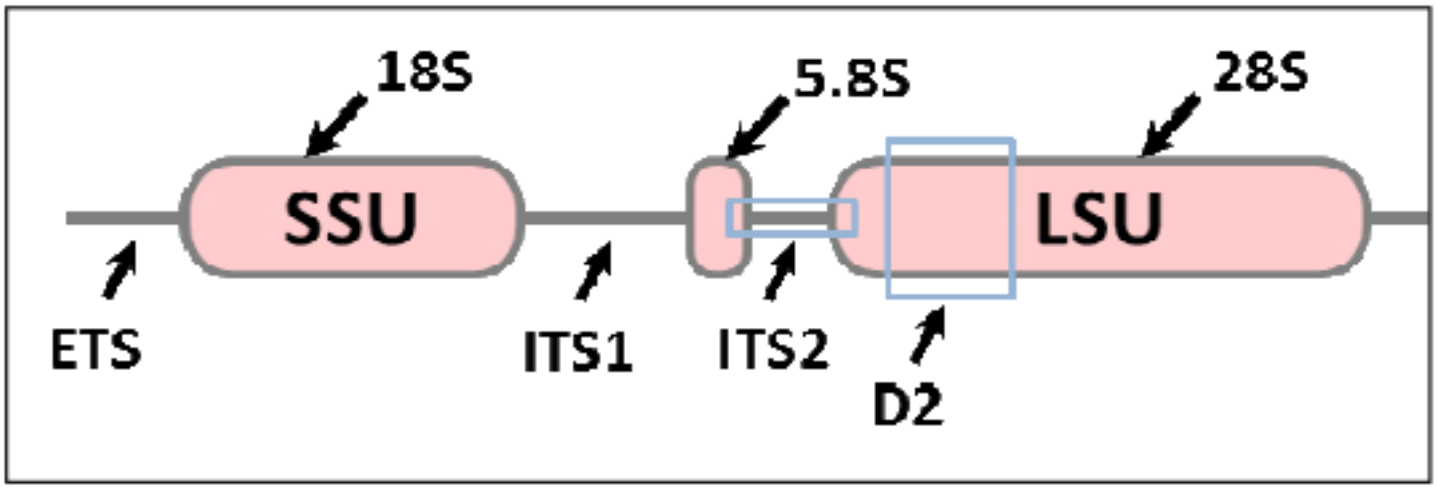
- Filamentous fungi:
  - Morphological characteristics
  - Molecular techniques (sequence-analysis)
  - (MALDI-TOF MS)

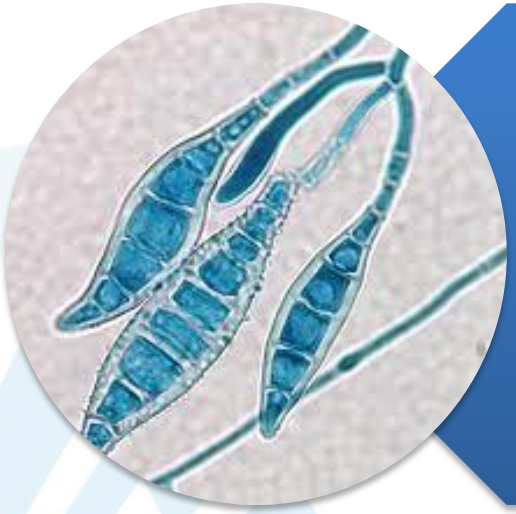
Sequence-analysis

genes coding for rRNA: target most commonly used

CBS database

http://www.cbs.knaw.nl/dermatophytes/BioloMICS.aspx





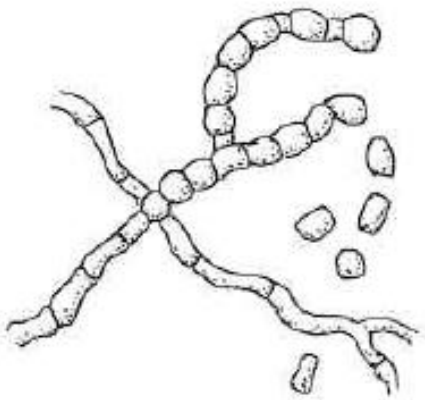
Dermatophytes

Dermatophytes: classification according to habitat

- **Geophilic species**: usually recovered from the soil but occasionally infect humans and animals
- **Zoophilic species**: organisms primarily found in animals which cause marked inflammatory reactions in humans who have contact with infected animals
  - *Microsporum canis* (cat, dog)
  - *Trichophyton verrucosum* (cattle)
  - *Trichophyton mentagrophytes* (rodents)
- **Antropophilic species**: are restricted to human hosts and produce a mild, chronic inflammation.
  - *Trichophyton interdigitale* (belongs to the *T. mentagrophytes* complex)
  - *Epidermophyton floccosum*
  - *Trichophyton rubrum*

Diagnosis of a dermatophytosis

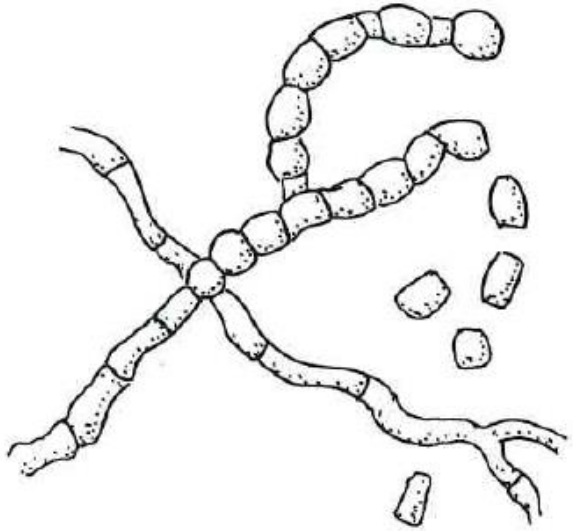
- Direct examination and culture are essential
- Correct sampling is essential
- Direct examination of samples:
  - Skin and nails:
    - KOH: 10-30%
    - Calcofluor white (Fungi-Fluor™)
  - Hair: chloral-lactofenol
    - Presence of spores?
    - Inside (endothrix) or outside (ectothrix) the hair
    - KOH breaks up hair (further examination not possible)

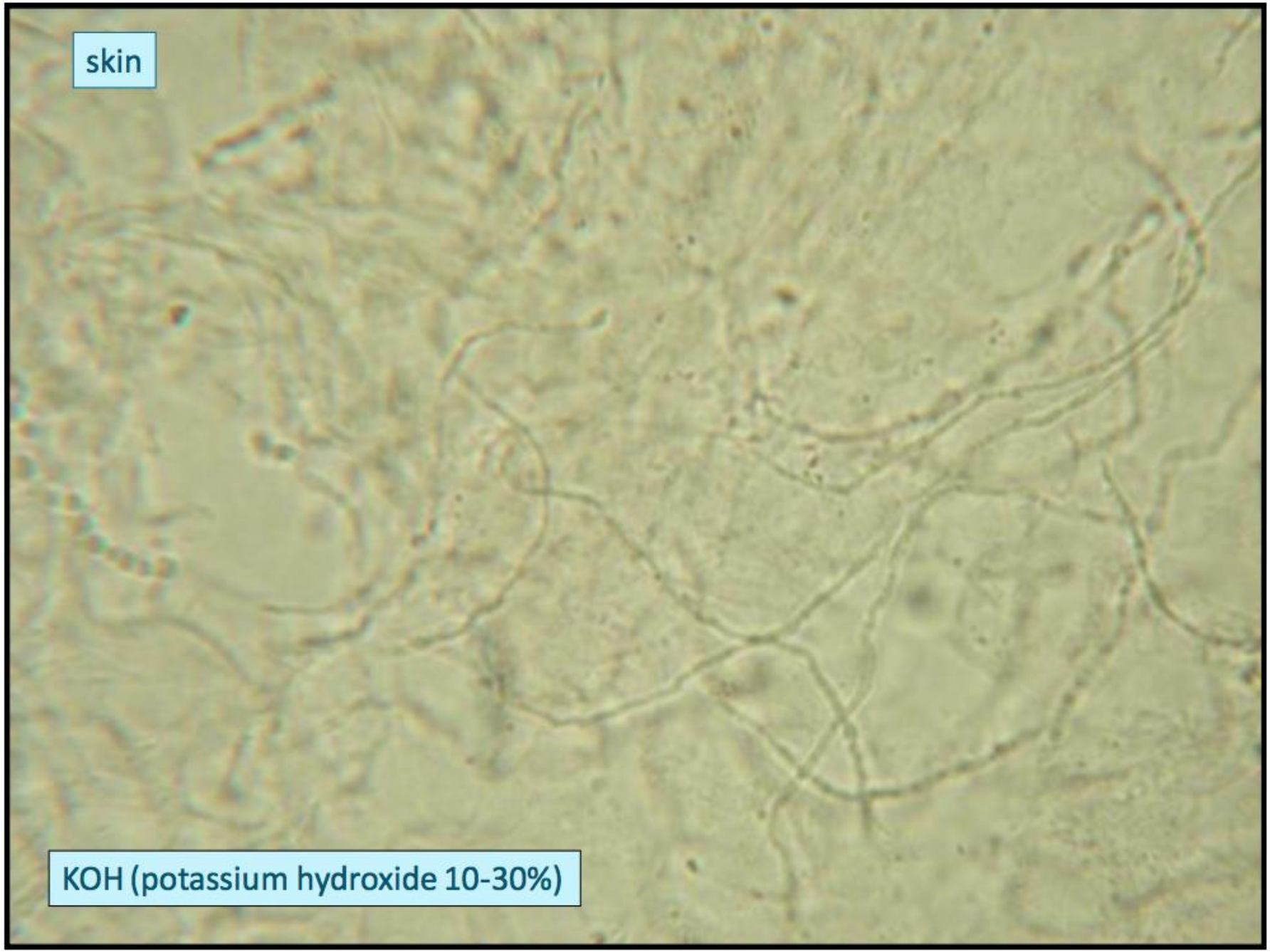


- Colorless, branched, septate hyphae
- Hyphae often break up into chains of arthroconidia
- Other conidia do not form in tissue

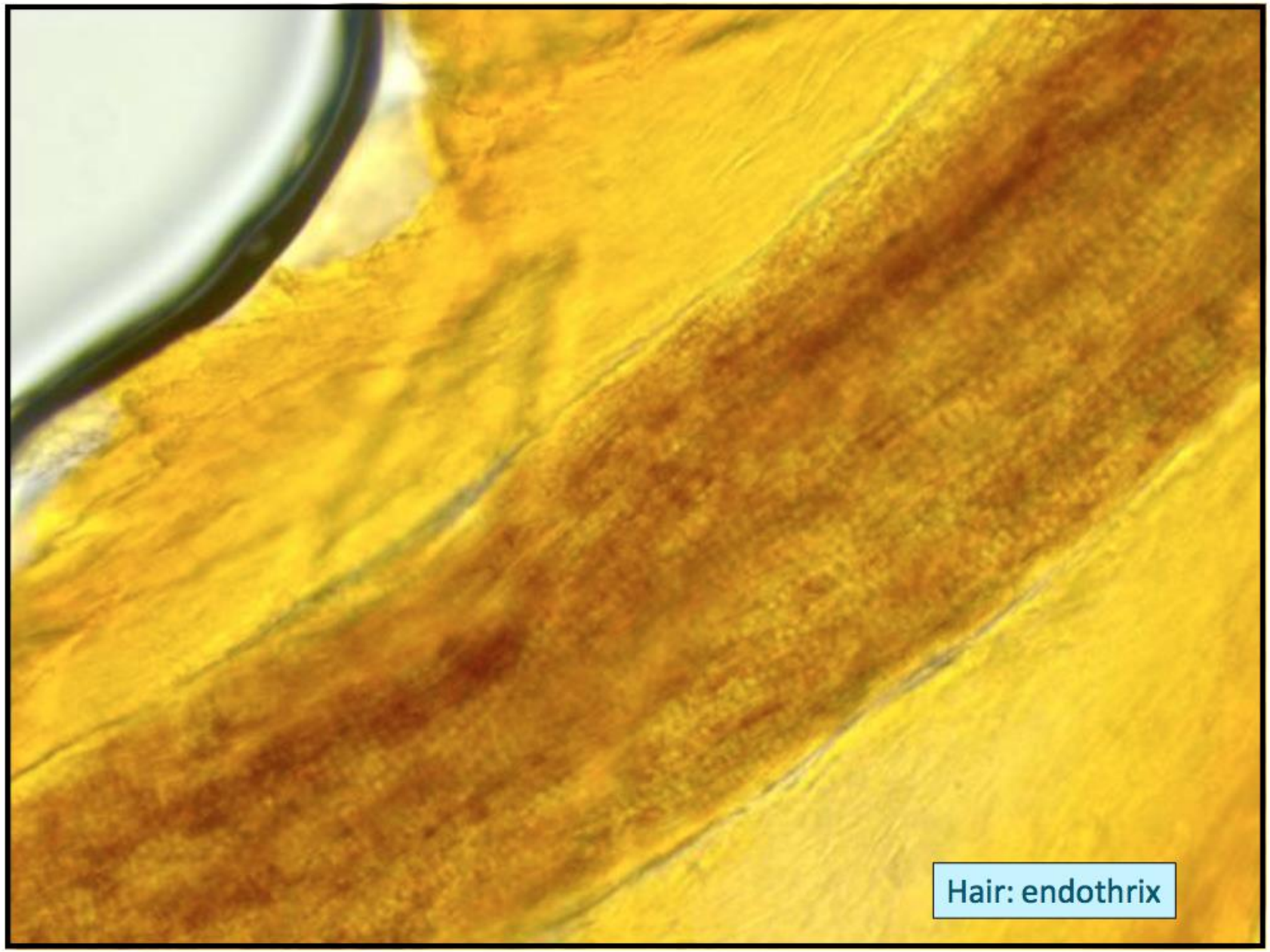
DERMATOPHYTOSIS (tinea, ringworm) (p. 42)

Dermatophytosis




skin
KOH (potassium hydroxide 10-30%)


Hair: ectothrix


Hair: endothrix

Procedure calcofluor kleuring nagels - huidschilfers

Plaats een draagglaasje in een petrischaal met absorberend papier en plaats hier de huidschilfers of nagelfragmenten (hou voldoende materiaal over voor cultuur).

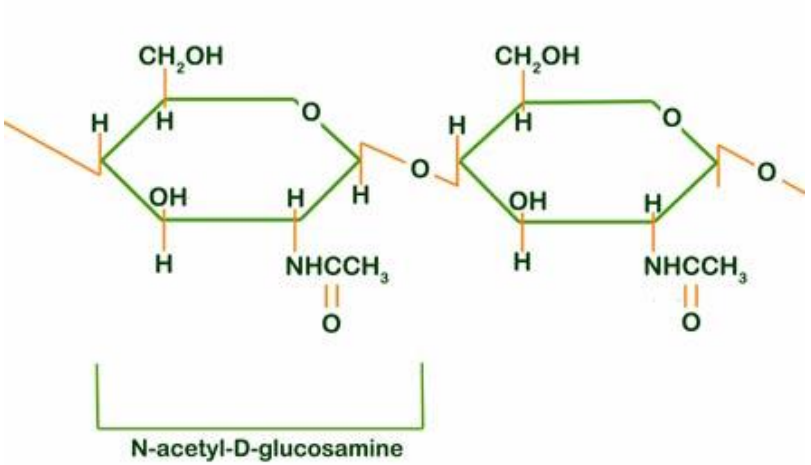
Voeg 1 tot 2 druppels KOH 30% toe zodat het materiaal volledig bedekt is.
Laat dit 20 minuten (huidschilfers) of 3-7 uur (nagels, incubatieduur afhankelijk van grootte nagelfragment) inwerken.

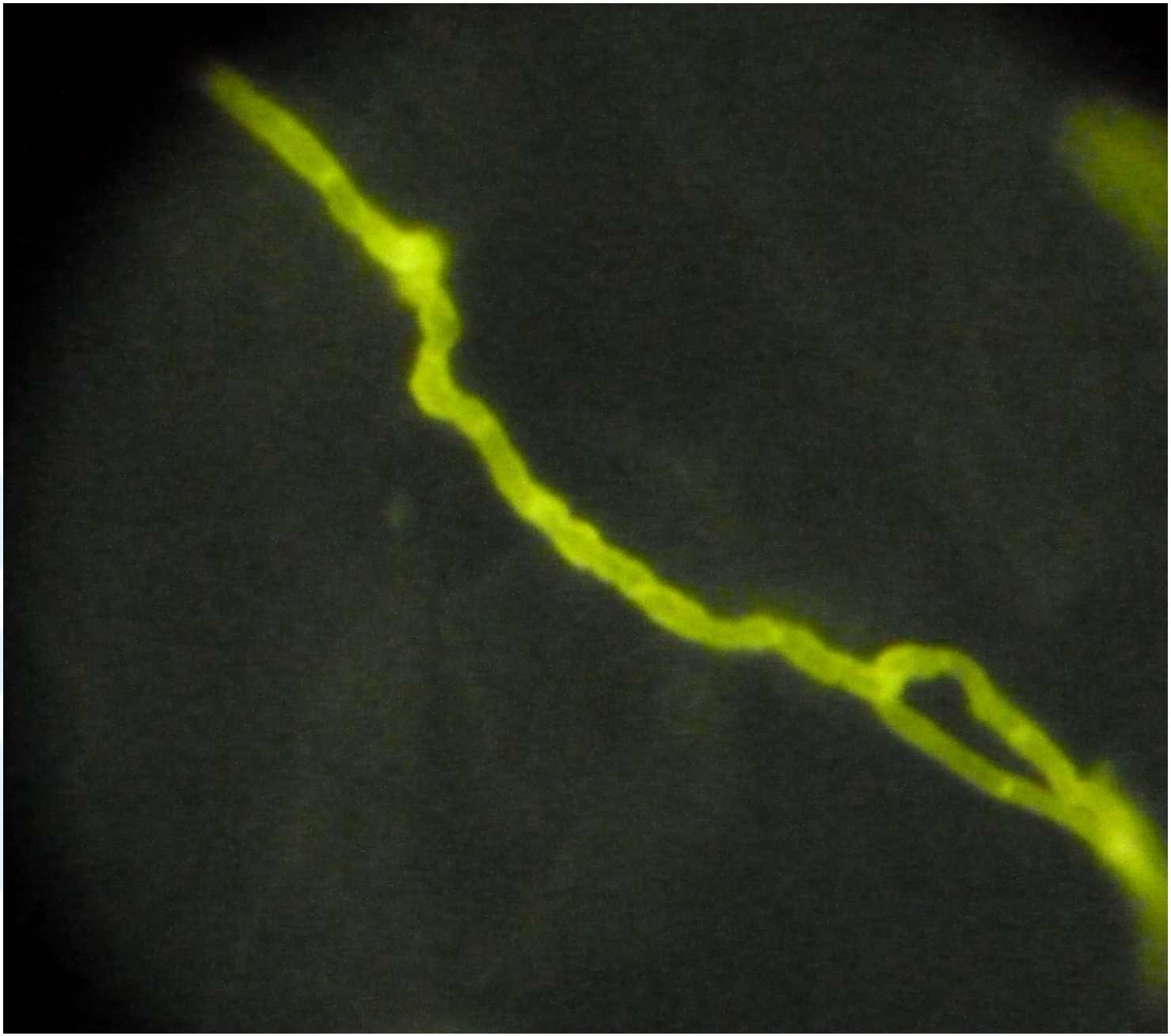
Voeg 1 tot 2 druppels van oplossing A van de Fungi-fluor™ kit toe en meng met de hoek van een dekglaasje. Plaats een dekglaasje bovenop het verweekte materiaal en duw dit plat.

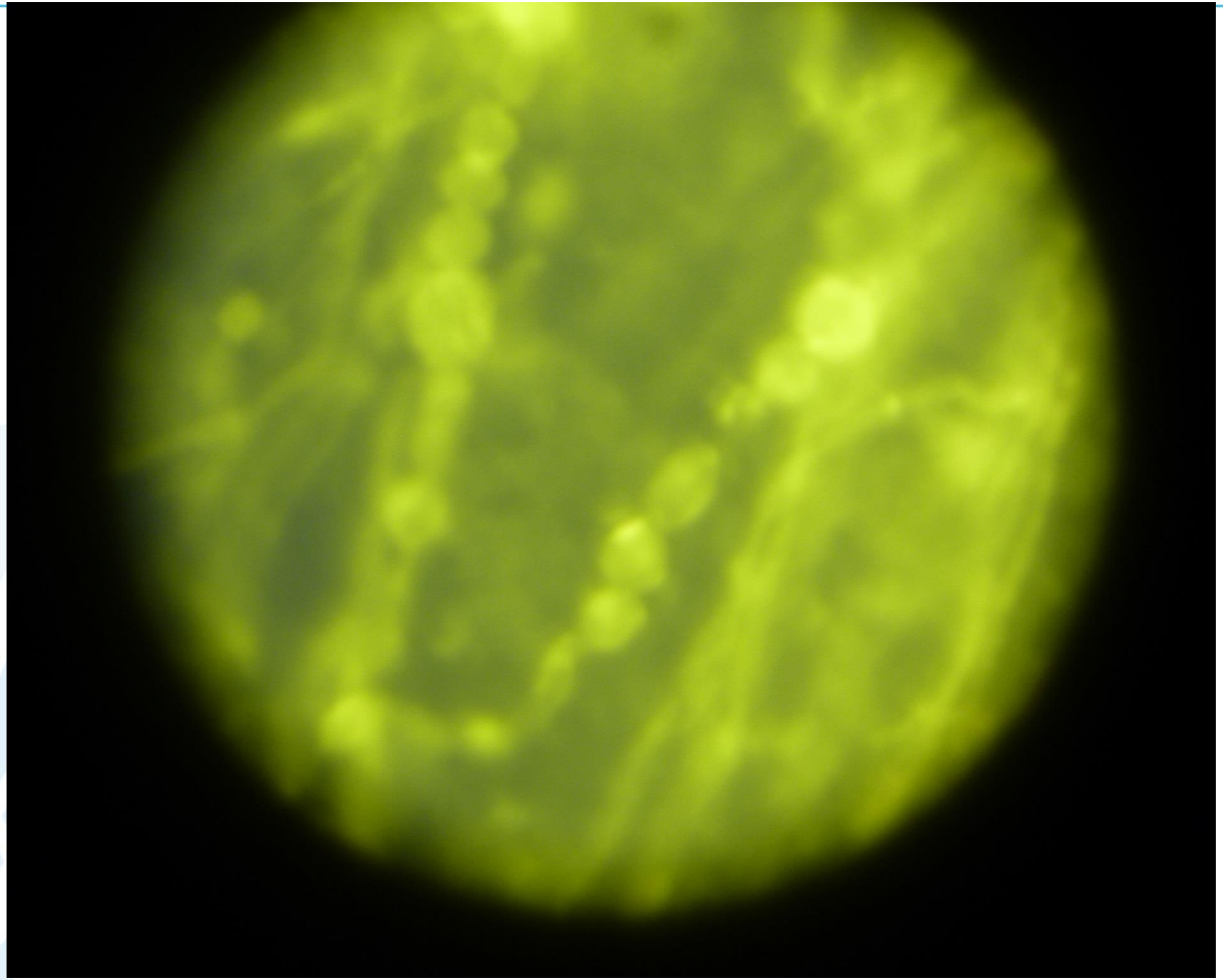
Bekijk het preparaat met de fluorescentiemicroscoop op de aanwezigheid van fungi.
Bij infectie door dermatofyten ziet men hyfen met septa en soms ook arthroconidia (tonvormige blokjes). Bij infectie door gisten ziet men ovale gistcellen.

Calcofluor white (Fungi-Fluor™)

Chitin

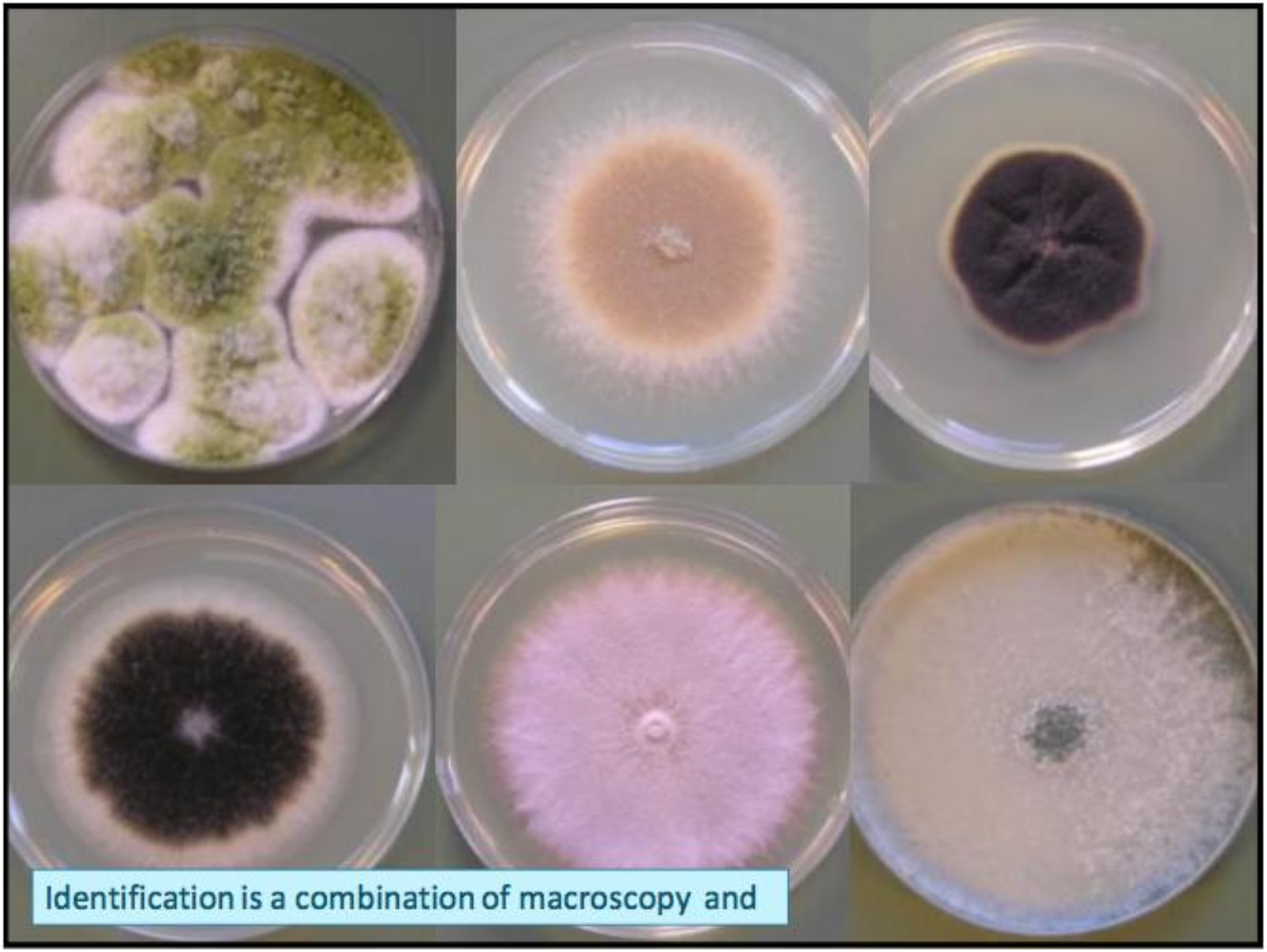


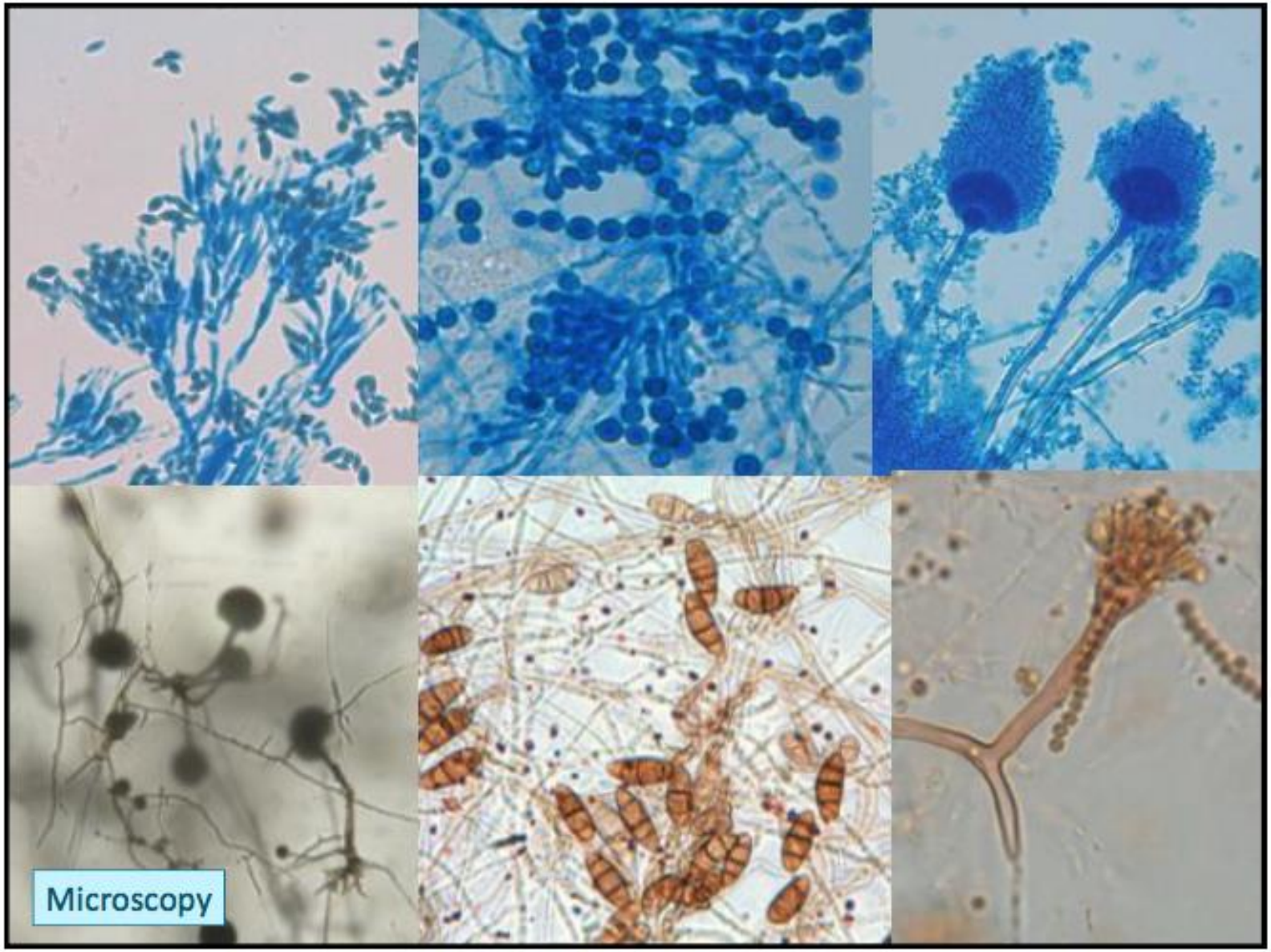




Culture

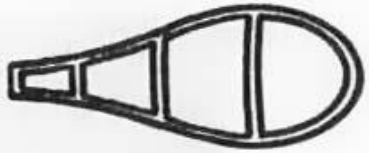
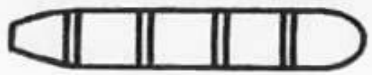
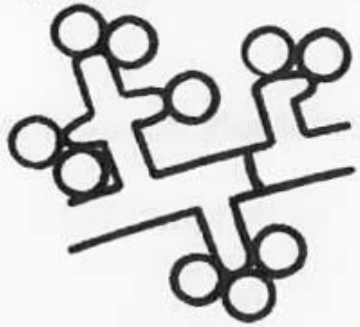
- Sabouraud (pH 6.5-6.8)
  - Chooramfenicol 0.2 mg/dl
  - Glucose 20 g
  - Peptone 10 g
  - Agar 20 g
  - Aqua dest. 1000 mL
- Verdunde sabouraud (1/10)
  - Glucose 2 g
  - Peptone 1 g


Identification is a combination of macroscopy and


Microscopy

Identification of dermatophytes: based on presence and aspect of micro- and macroconidia

MICROSCOPIC CHARACTERISTICS OF DERMATOPHYTE GENERA

	Microsporum	*Epidermophyton*	*Trichophyton*
Macroconidia:			
Quantity	Numerous	Numerous	Usually rare
Rough- /smooth-walled	Rough	Smooth	Smooth
Shape	Elliptical/spindle	Club	Pencil
Thick- /thin-walled	Thick or thin	Thin	Thin
Number of cells inside	Usually 3–7	Usually 2–4	Usually 3–8
			
Microconidia:			
Quantity	Few	Absent	Numerous or few
Shape	Club	——	Round, oval, or club
How borne	Singly	——	Singly/grapelike clusters
			

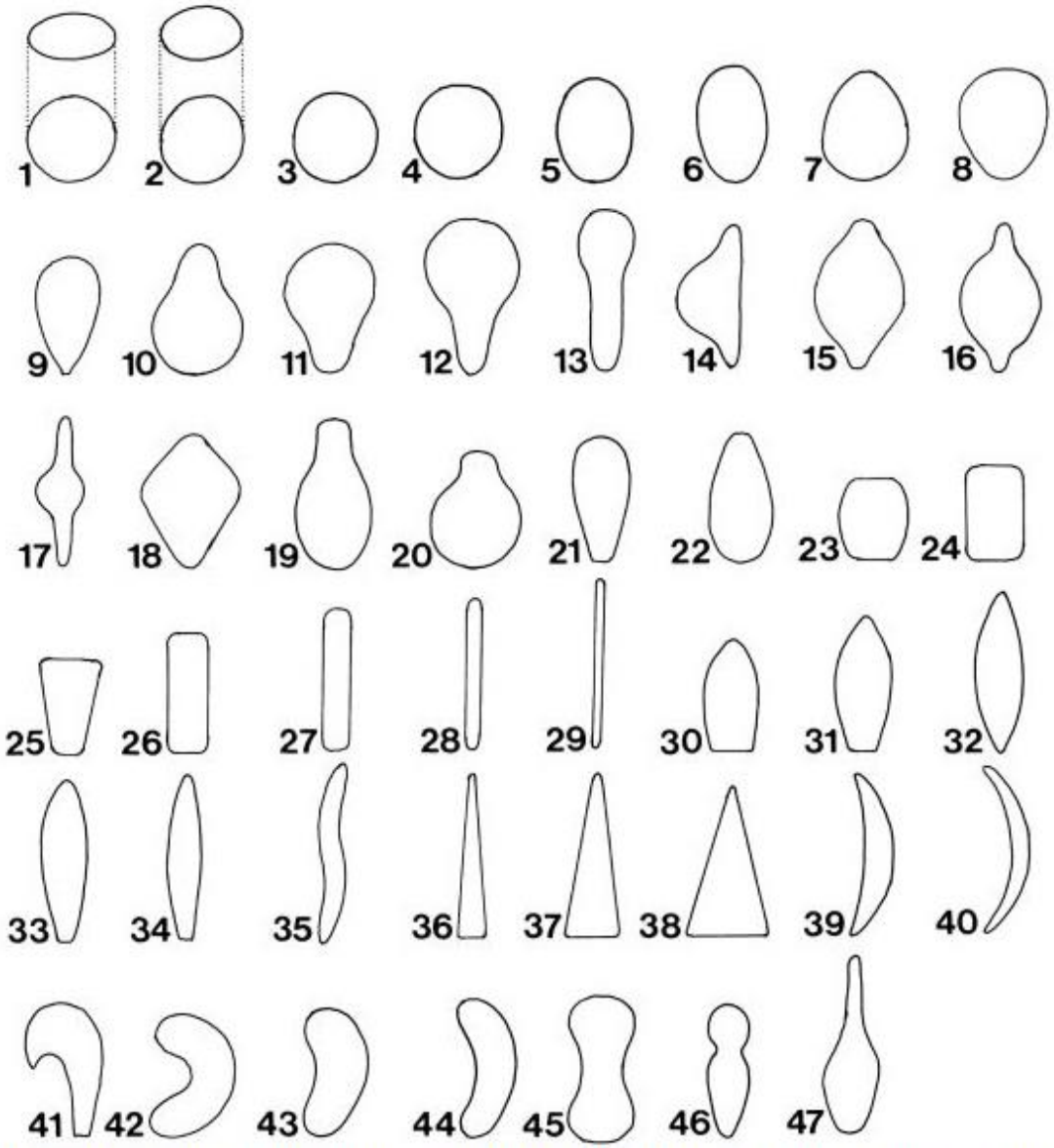
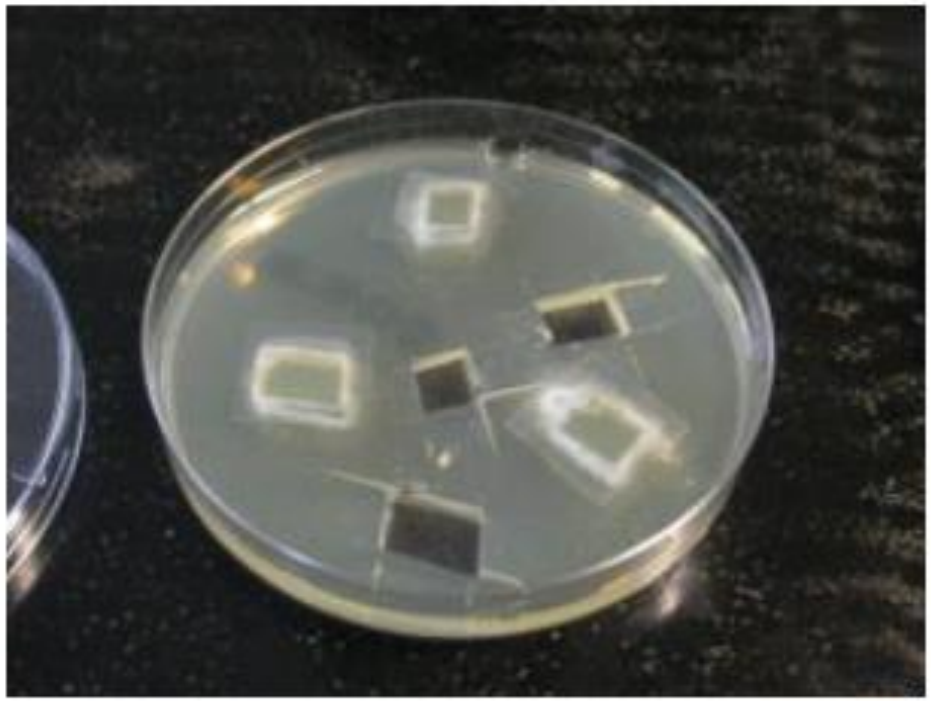


Fig. 64. Diagram of used shape terminology. 1. lenticular, lens-shaped; 2. oblate; 3. spherical; 4. subspherical; 5. broadly ellipsoidal; 6. ellipsoidal; 7. ovoidal, egg-shaped; 8. obovoidal; 9. tear-shaped; 10. obpyriform; 11. pyriform, pear-shaped; 12. tadpole-shaped; 13. spathulate, spoon-shaped; 14. cullulate, hat-shaped; 15. limoniform, lemon-shaped; 16. saturn-shaped; 17. umbonate; 18. rhomboid, kite-shaped; 19. flask-shaped; 20. ampulliform, urn-shaped; 21. clavate, club-shaped; 22. obclavate; 23. doliiform, barrel-shaped; 24. rectangular; 25. cuneiform, axeblade-shaped; 26. cylindrical; 27. bacilliform, narrow cylindrical; 28. linear, line-shaped; 29. thread-shaped; 30. bullet-shaped; 31. navicular, boat-shaped; 32. fusiform, spindle-shaped; 33. cigar-shaped; 34. lanceolate, rocket-shaped; 35. stringbean-shaped; 36. acicular; 37. subulate; 38. conical; 39. lunate, moon-shaped; 40. falcate, sickle-shaped; 41. Uncinate, hook-shaped; 42. cashewnut-shaped; 43. reniform, kidney-shaped; 44. allantoid, sausage-shaped; 45. ossiform, bone-shaped; 46. isthmoid, constricted; 47. rostrate, beaked.

Examine the fungus microscopically when the culture first begins to grow and forms conidia and again a few days later. In many instances the manner of conidiation, which is so important to identification, is obscured in old cultures.

Slide culture technique

Best method for preserving and observing the actual structure of the fungus



Adhesive tape technique

Interpretation of the result

Correlate always the culture results with the results of direct examination (DE):

- Positive DE and negative culture:
  - ✓ Diagnostic for a fungal infection, ask a new sample
  - ✓ Sample not taken at the site of active growth
  - ✓ Antifungal therapy already initiated
- Negative DE and positive culture: interpretation is dependent of the organism cultured (dermatophyte versus potential contaminant)

Correlate always the identification with the sample type

- *T. rubrum:* does not cause tinea capitis
- *E. floccosum*: does not cause tinea capitis or tinea unguinum
- *M. canis*: can infection skin, hair as well as nails

Atlas of Clinical Fungi

G.S. de Hoog, J. Guarro, J. Gené and M.J. Figueras

The ultimate benchtool for diagnostics

Version 4.0 (November 2014)

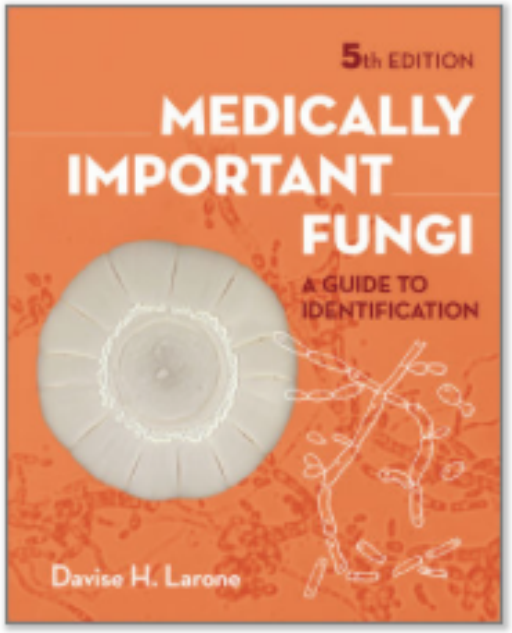
http://www.clinicalfungi.org/

Identification of Pathogenic Fungi, 2nd Edition

Colin K. Campbell, Elizabeth M. Johnson, David W. Warnock (Editor)

ISBN: 978-1-4443-3070-0

350 pages
April 2013, Wiley-Blackwell



Medically Important Fungi: A Guide to Identification, 5th Edition

Davise H. Larone

ISBN: 978-1-55581-660-5

510 pages

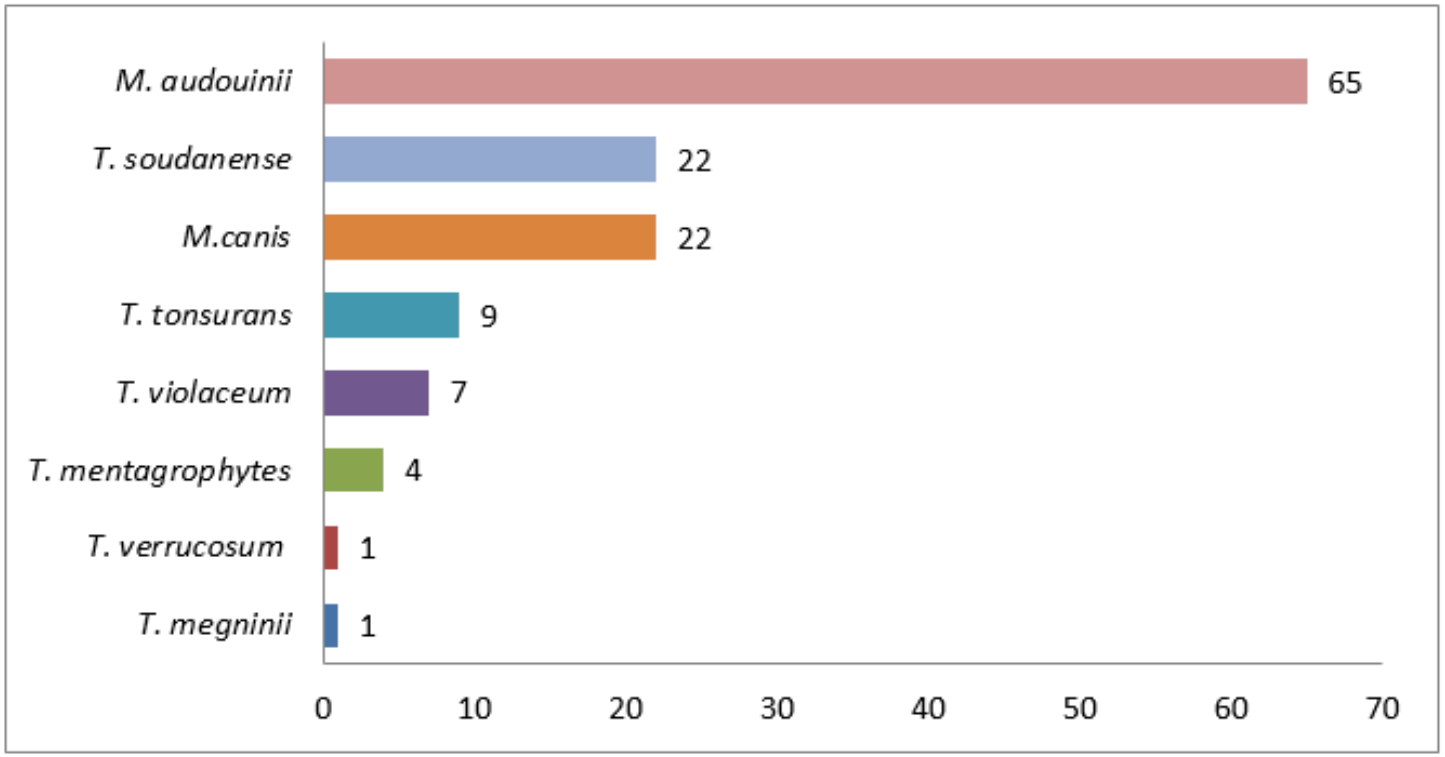


Figure 5 : Répartition des espèces de dermatophytes causant des infections du cuir chevelu en 2015

NRC Mycosis report 2015

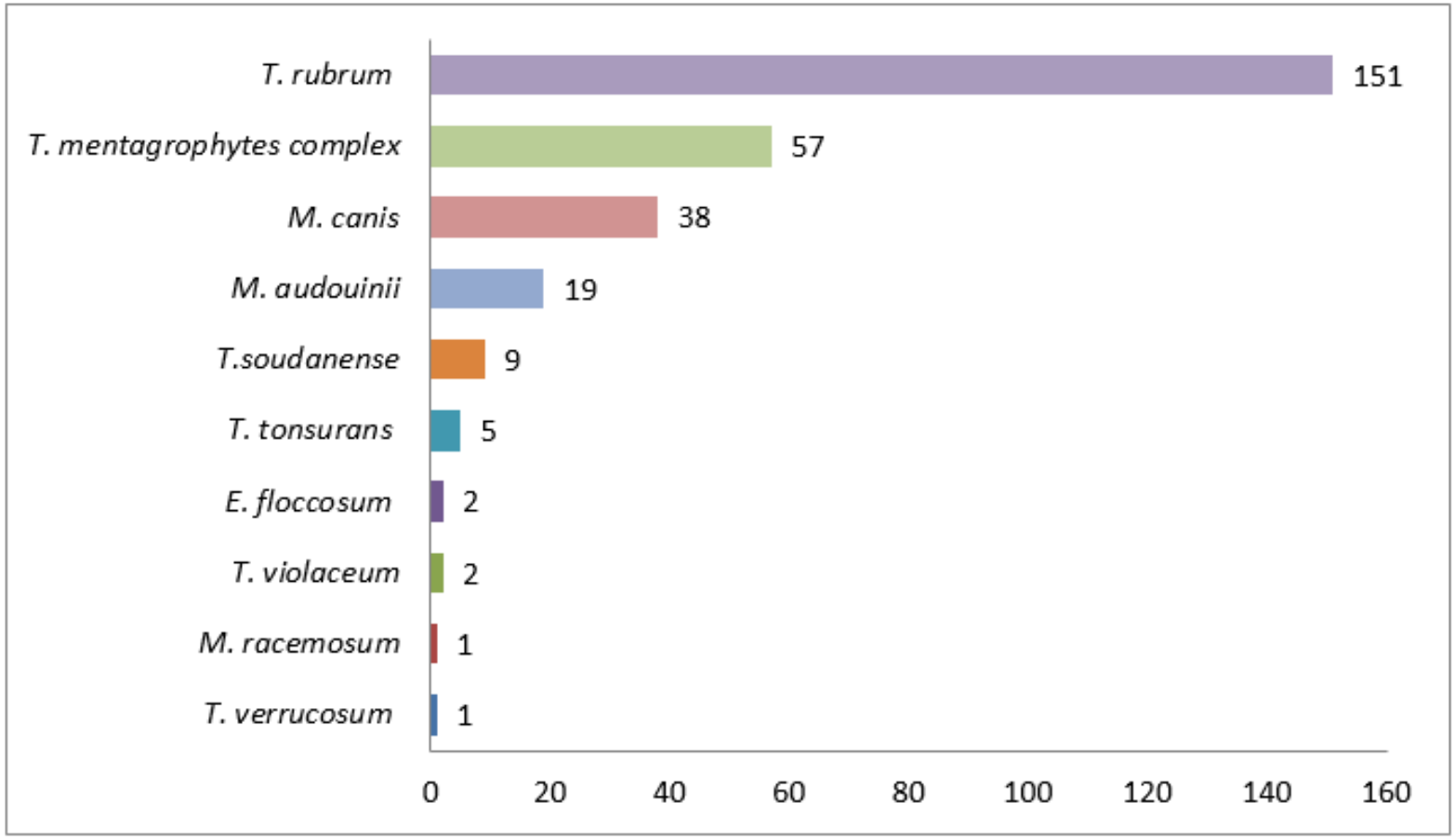


Figure 6 : Répartition des espèces de dermatophytes (en %) causant des infections de la peau en 2015.

NRC Mycosis report 2015

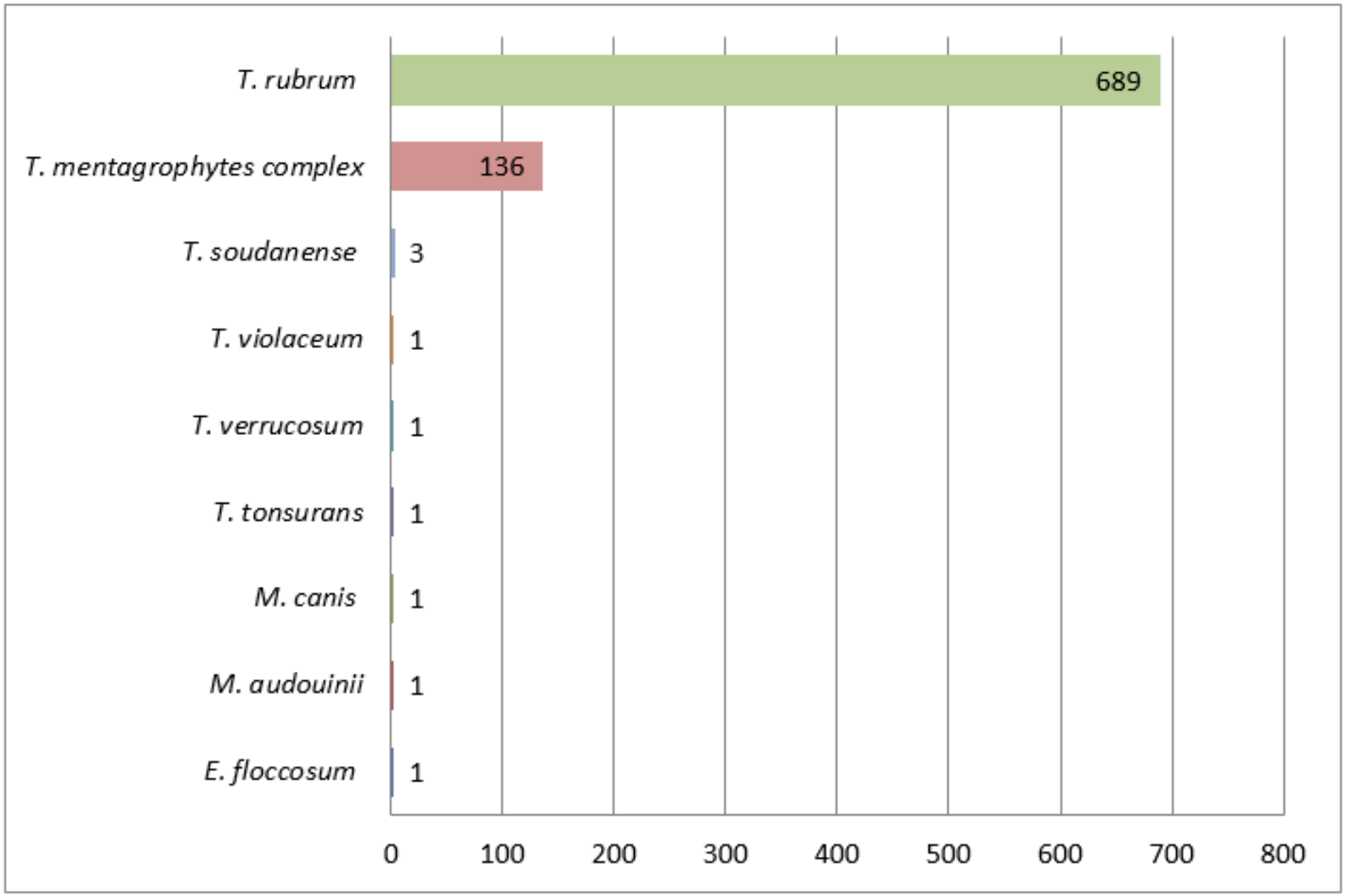
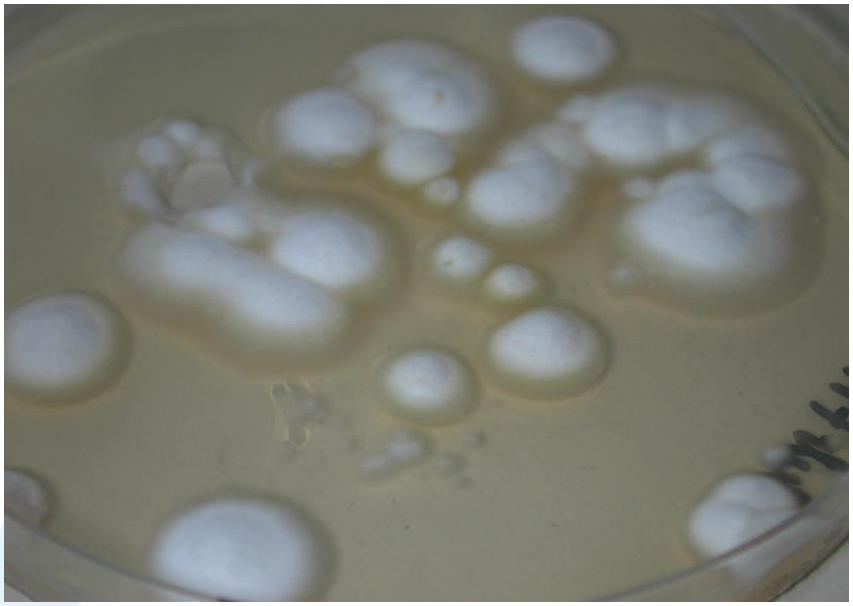
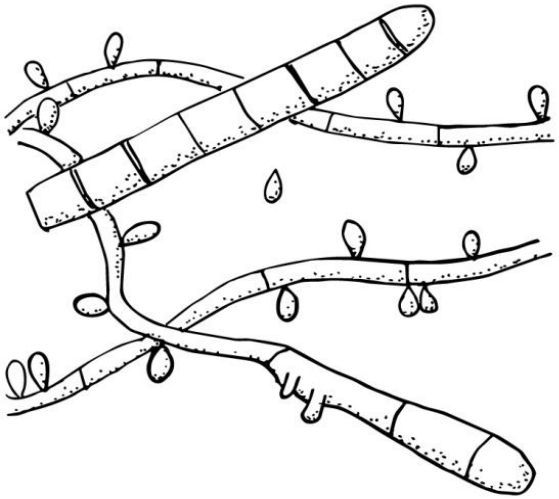


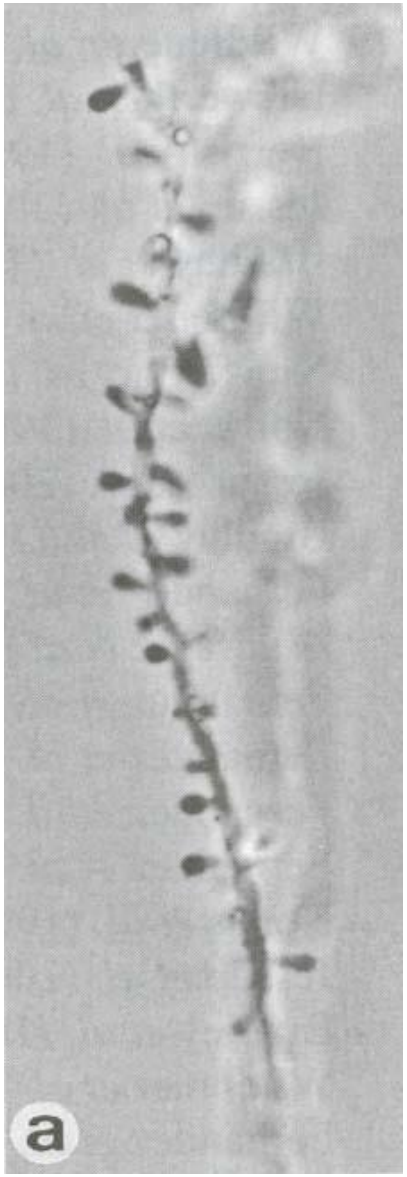
Figure 7: Répartition des espèces de dermatophytes responsables d'onychomycoses en 2015.

NRC Mycosis report 2015

Trichophyton rubrum







Specimen 1515— *Trichophyton rubrum*

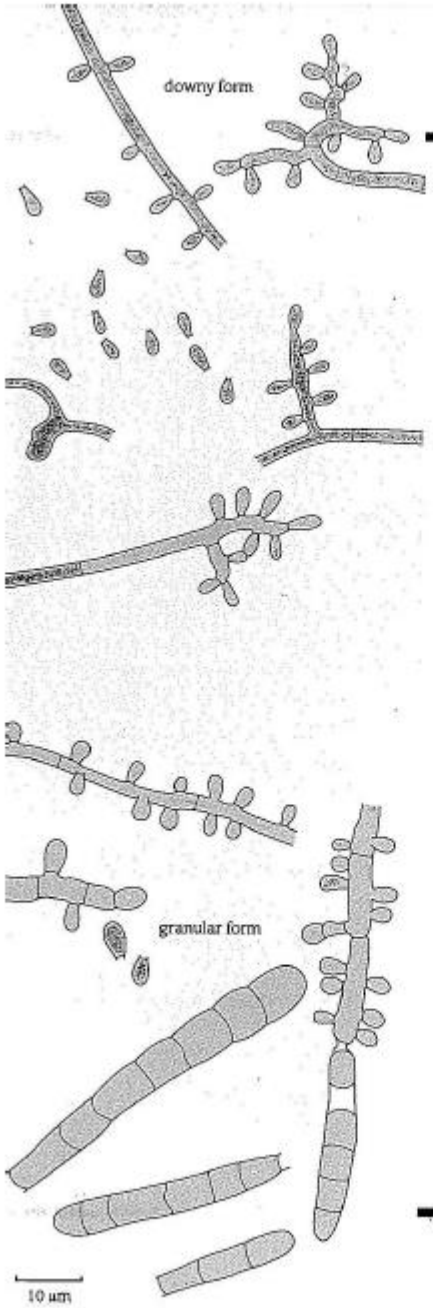
7 days incubation on Sabouraud Dextrose Agar at 30°C

Front

wit, donzig, verheven

Reverse

rood-bruin, scherp begrensde kleur



TRICHOPHYTON RUBRUM

COLONIAL APPEARANCE

at 30°C on glucose peptone agar

diameter	10-15 mm in one week
topography	domed
texture	downy to floccose
colour	white
reverse	dark red-brown with a sharply demarcated white edge

MICROSCOPIC APPEARANCE

at 30°C

predominant features	sparse microconidia; sometimes a few arthrospores
macroconidia	absent
microconidia	club-shaped; formed along the sides of the hyphae

Trichophyton mentagrophytes complex

- Ongoing discussion about the taxonomy
- The species within this complex are difficult to distinguish based on morphology alone

  - *T. mentagrophytes*: zoophilic (rodents, Guinea pig, rabbit)(rare in West-Europa)

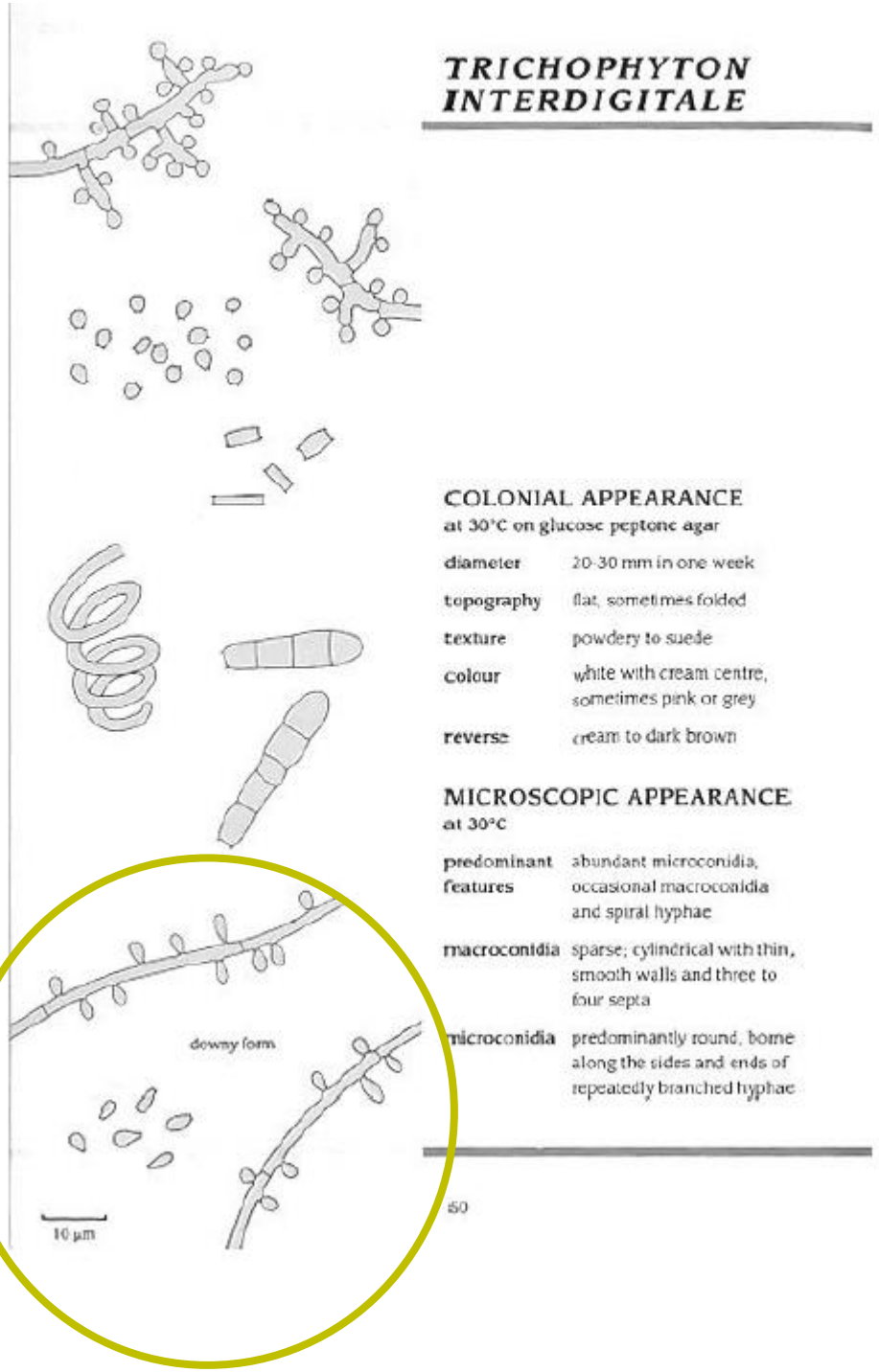
  - *T. interdigitale*: important cause of dermatophytosis (*T. rubrum* also)
    - Antropophilic lineage:
      - macr: white, floccose or yellow-orange pigment (var. nodulare)

    - Zoophilic lineage (cats, dogs, mice)
      - macr: powdery to floccose, light brown

Trichophyton interdigitale

anthropophilic

zoophilic


TRICHOPHYTON INTERDIGITALE
COLONIAL APPEARANCE
at 30°C on glucose peptone agar
diameter 20-30 mm in one week
topography flat, sometimes folded
texture powdery to suede
colour white with cream centre, sometimes pink or grey
reverse cream to dark brown
MICROSCOPIC APPEARANCE
at 30°C
predominant features abundant microconidia, occasional macroconidia and spiral hyphae
macroconidia sparse; cylindrical with thin, smooth walls and three to four septa
microconidia predominantly round, borne along the sides and ends of repeatedly branched hyphae
downy form
10 µm
50

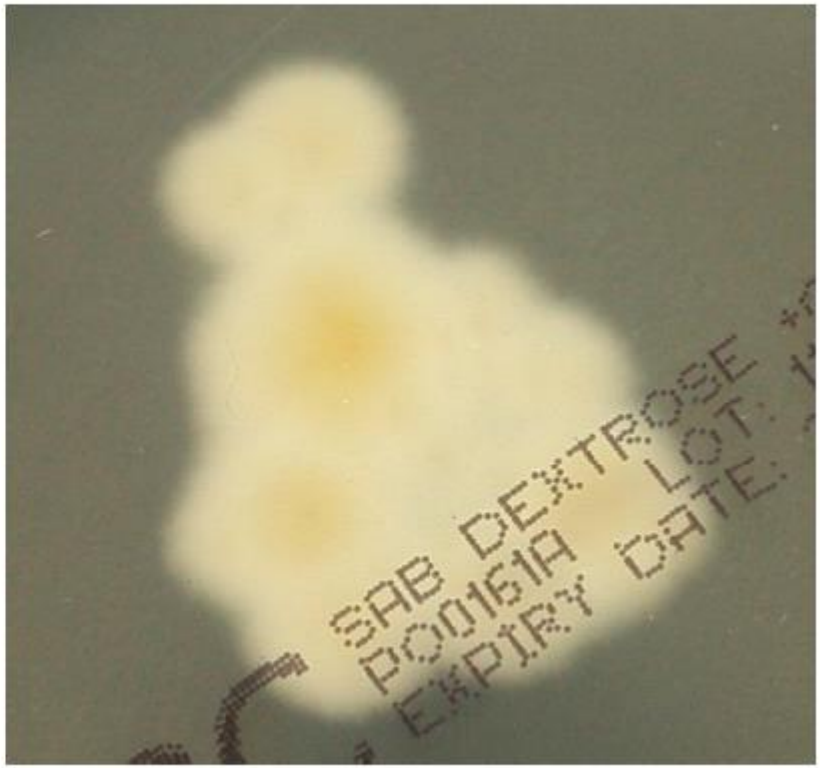
downy form

Specimen 0389 — *Trichophyton interdigitale* - downy variant

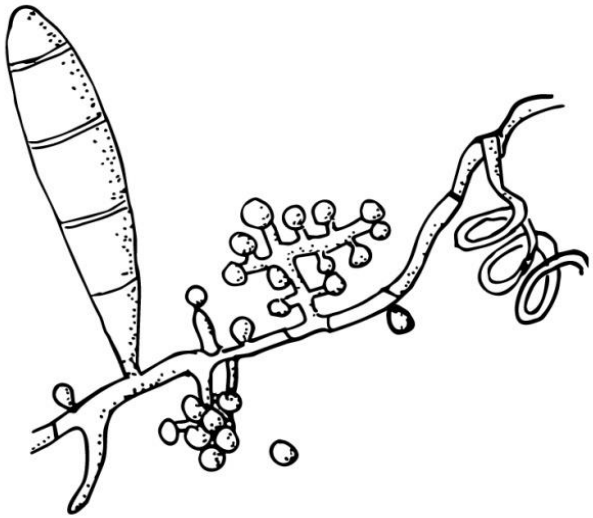
6 days incubation on Sabouraud Dextrose Agar at 30°C

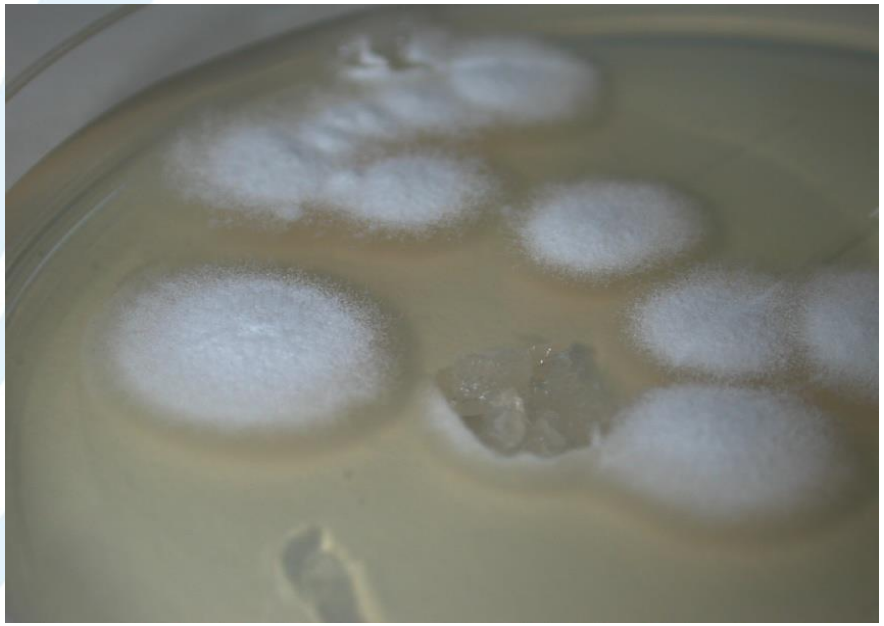
Front

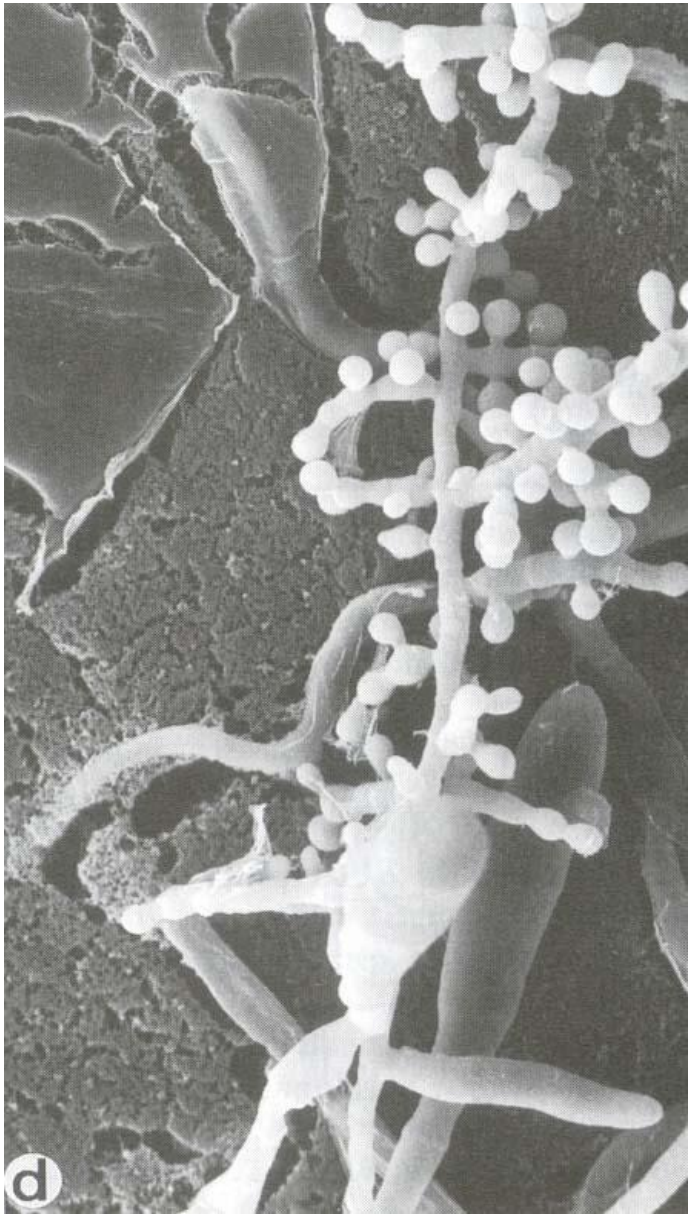
Reverse

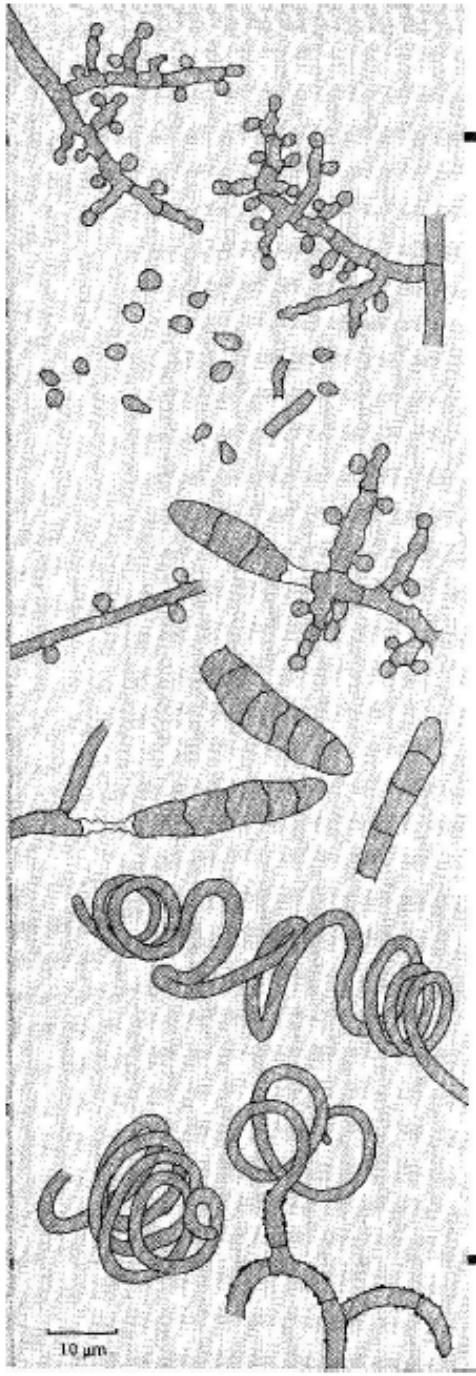


Trichophyton mentagrophytes









TRICHOPHYTON MENTAGROPHYTES

COLONIAL APPEARANCE

at 30°C on glucose peptone agar at 30°C

diameter	20-30 mm in one week
topography	flat
texture	granular to powdery
colour	white to cream, sometimes pale pink, grey or yellow
reverse	cream to dark brown, often with radiating brown striations

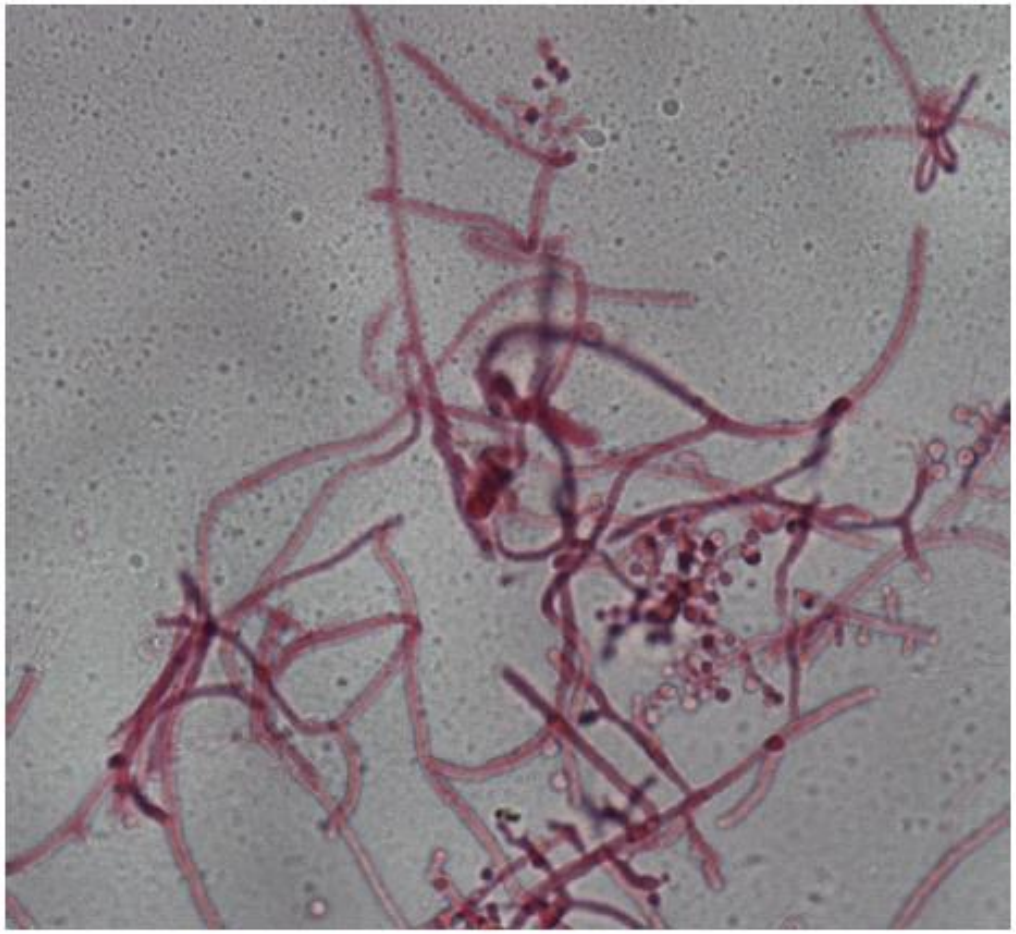
MICROSCOPIC APPEARANCE

at 30°C

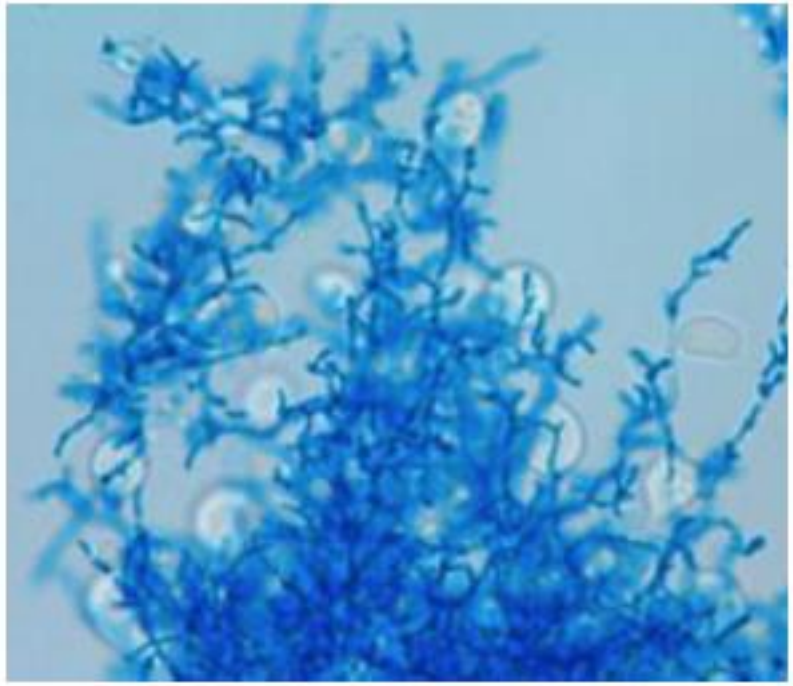
predominant features	abundant microconidia, some macroconidia, and spiral hyphae
macroconidia	*quite common; cylindrical,* 20-50 µm × 7-10 µm, with thin, smooth walls and *mostly three to four septa*
microconidia	predominantly round, borne along the sides and ends of repeatedly branched hyphae to form large clusters

Trichophyton mentagrophytes

Microscopy X 40 objective



Trichophyton violaceum



No or sporadic micro and / or macroconidia

Slow growing waxy red/violet colony.

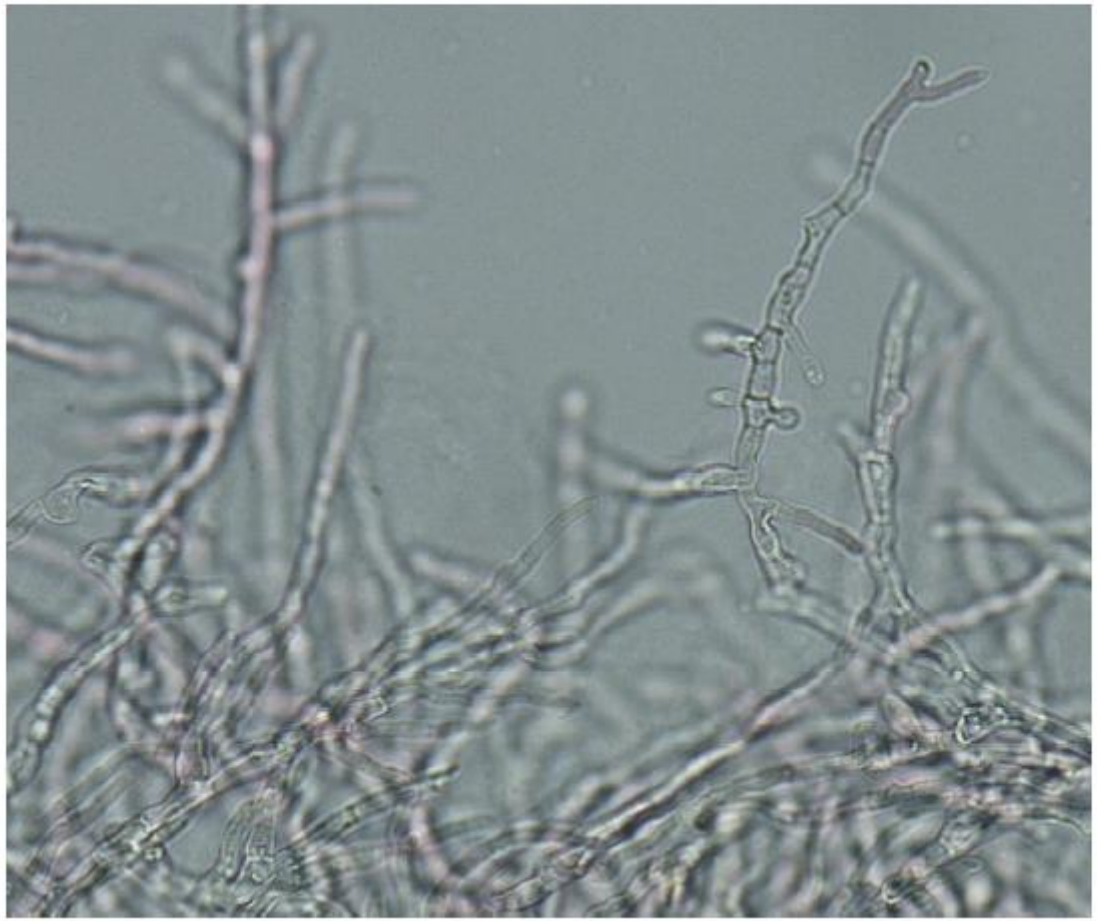
Trichophyton violaceum

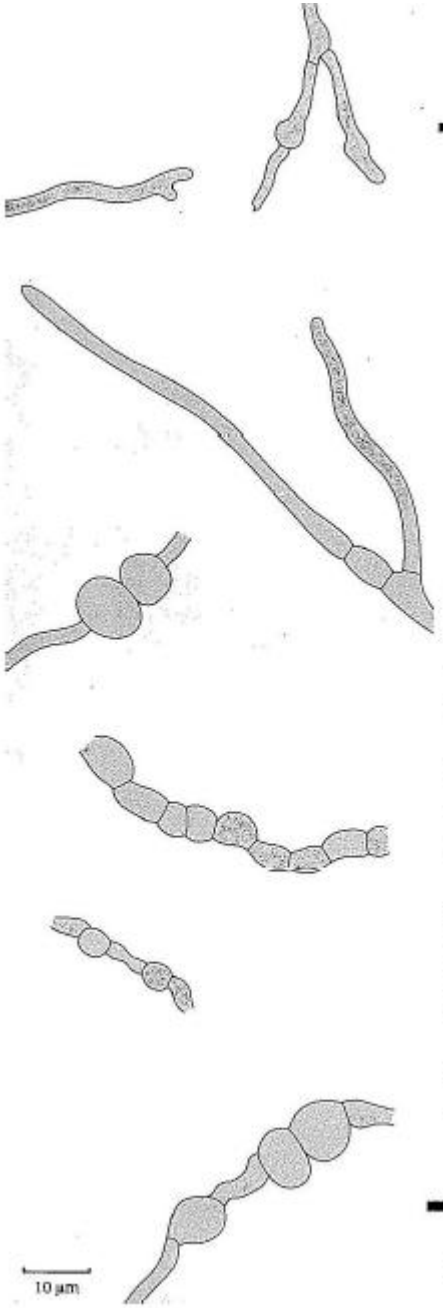
Specimen 0543 — *Trichophyton violaceum*

10 days incubation on Sabouraud Dextrose Agar at 30°C

Trichophyton violaceum

Microscopy X 40 objective





TRICHOPHYTON VIOLACEUM

COLONIAL APPEARANCE

at 30°C on glucose peptone agar

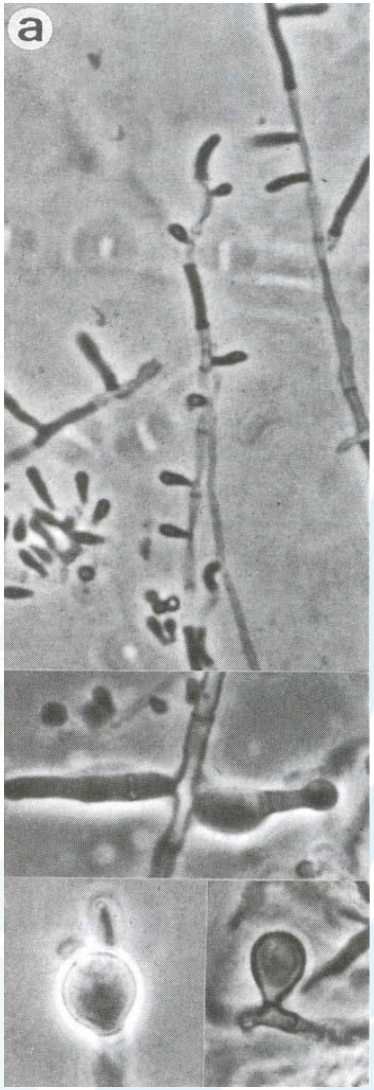
diameter	10 mm in one week
topography	irregularly wrinkled; heaped in the centre
texture	glabrous
colour	dark purple-red
reverse	dark purple-red

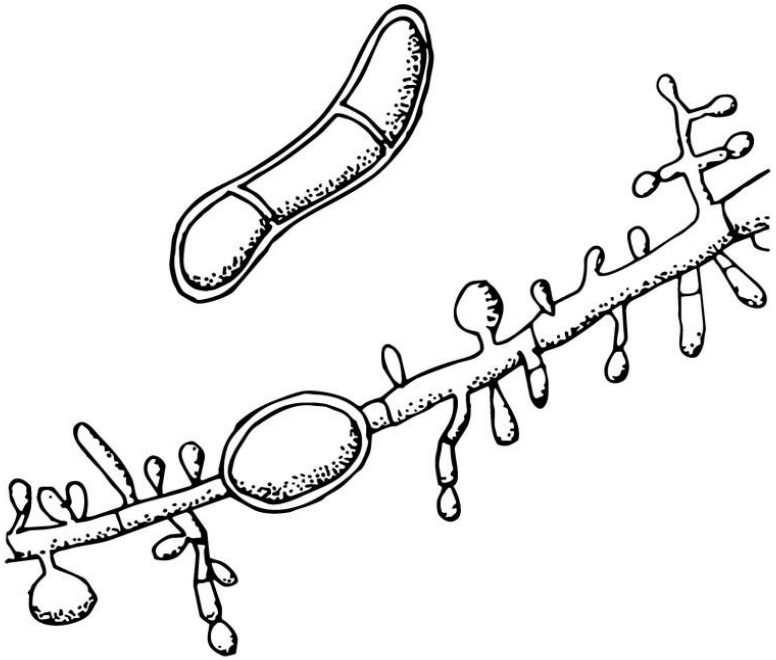
MICROSCOPIC APPEARANCE

at 30°C

predominant features	hyphal growth; chlamydospores sometimes present
macroconidia	absent
microconidia	pear-shaped; only seen on enriched media

Trichophyton tonsurans





Distribution 3017 Mycology

Specimen 0865 — *Trichophyton tonsurans*

6 days incubation on Sabouraud Dextrose Agar at 30°C

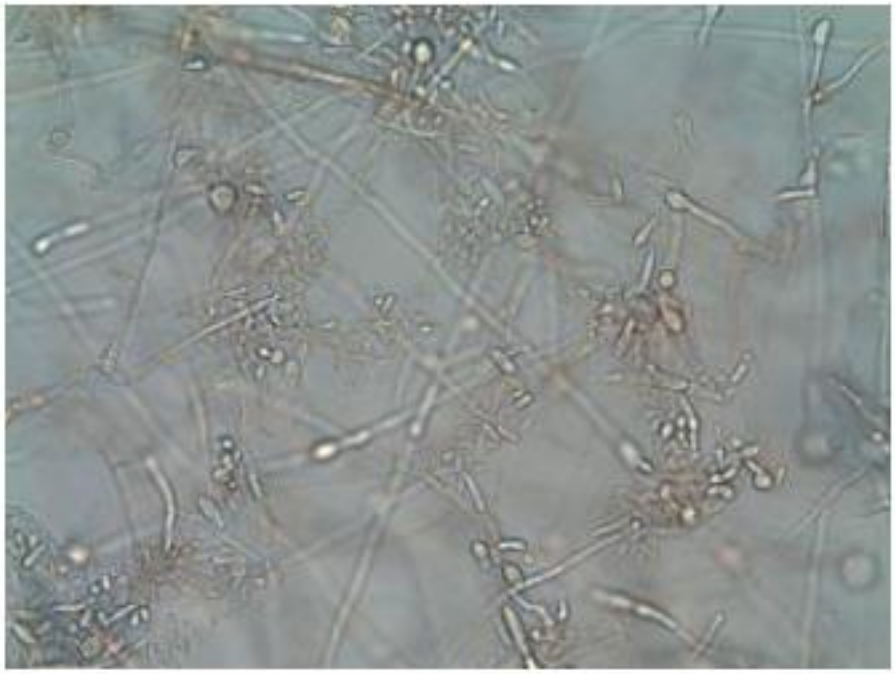
Front

poederig tot donzig

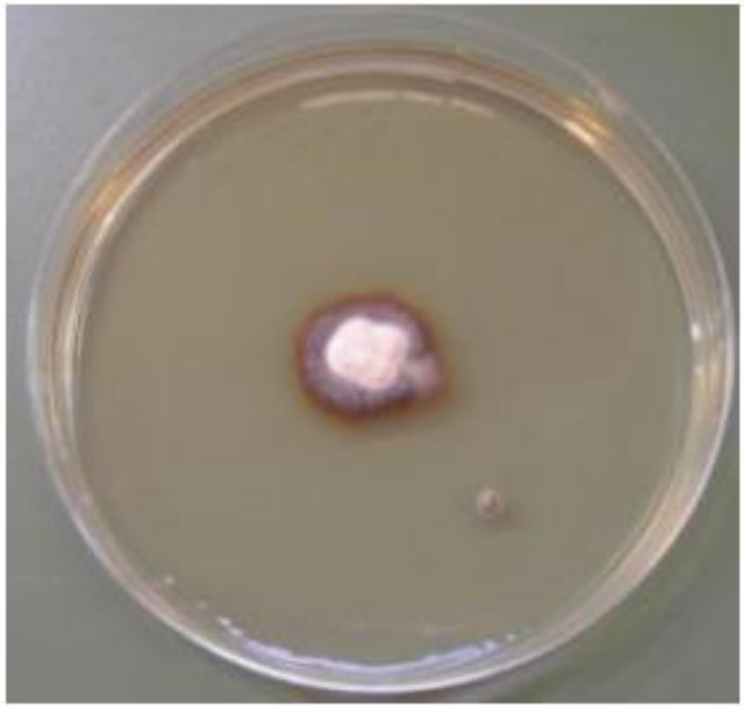
Reverse

bruin

Trichophyton tonsurans



Irregular (swollen) micoconidia teardrop shaped along the hyphae. Sometimes macroconidia and chlamydoconidia



Beige brown suede-like colony, pigment may diffuse into the agar.

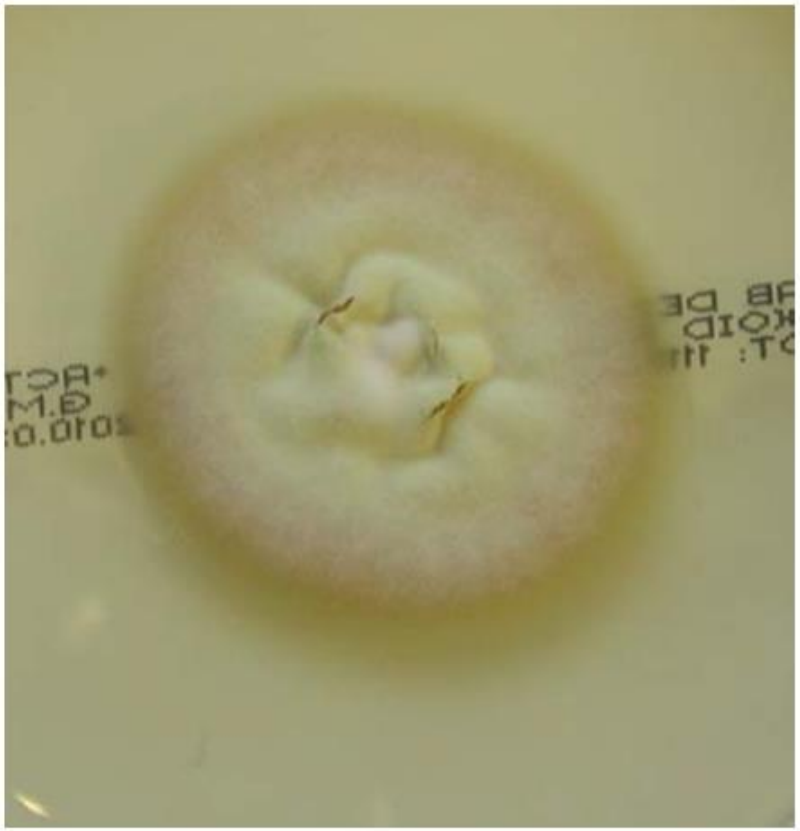
Trichophyton tonsurans

Microscopy X 40 objective

Epidermophyton floccosum

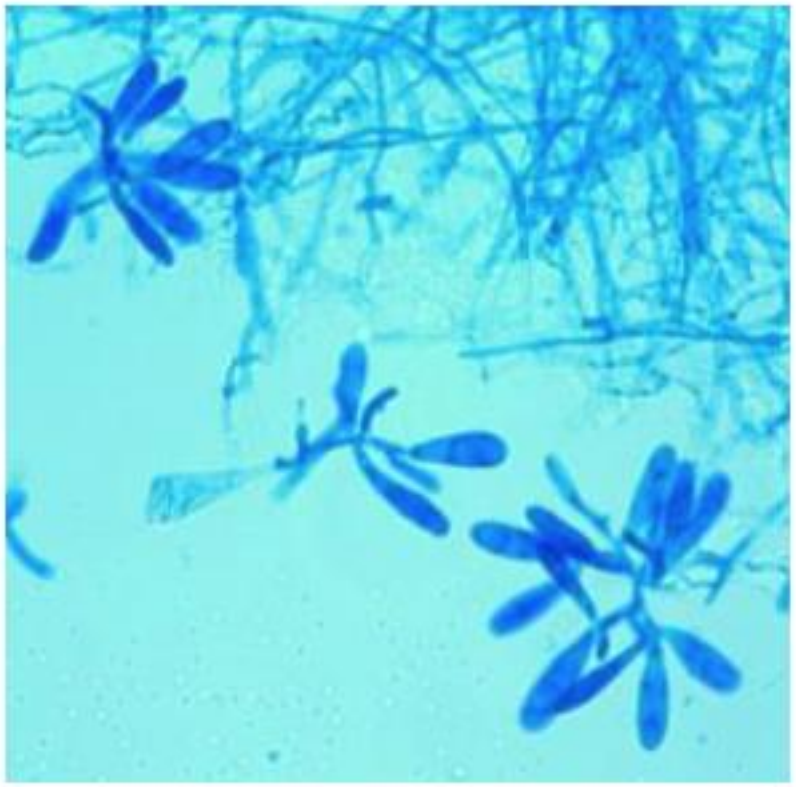
Specimen 9647 — *Epidermophyton floccosum*

10 days incubation on Sabouraud Dextrose Agar at 30°C

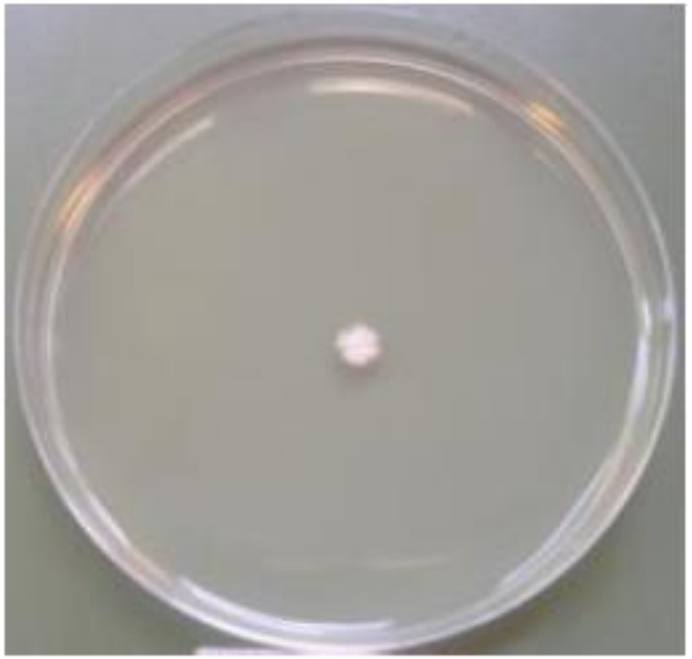


Vlak, poederig, geel tot kaki kleur

Epidermophyton floccosum



No microconidia, macroconidia club-shaped, thin smooth wall.

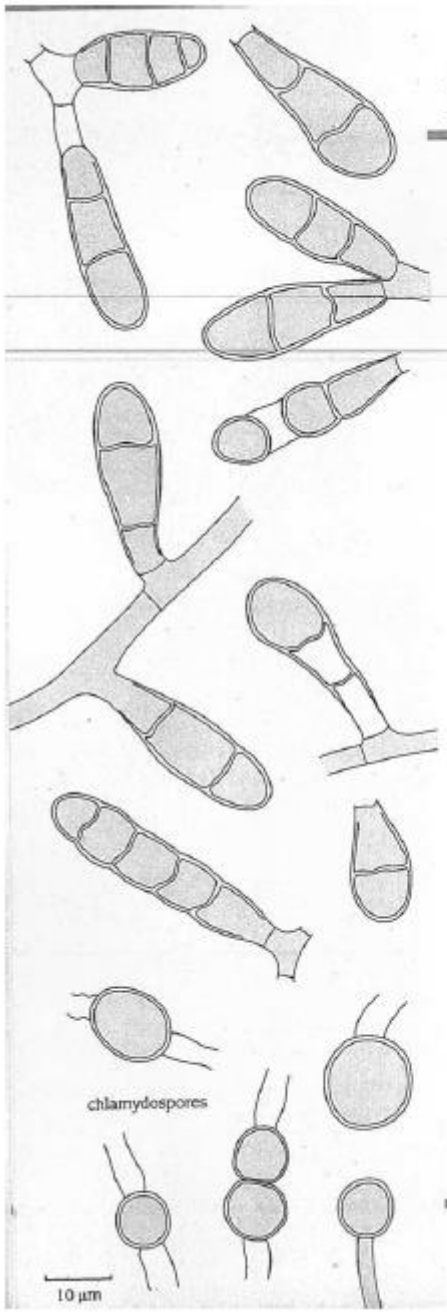


Antropophilic no Tinea capitis

Epidermophyton floccosum

Microscopy X 40 objective

Line drawing of *Epidermophyton floccosum*



EPIDERMOPHYTON FLOCCOSUM

COLONIAL APPEARANCE
at 30°C on glucose peptone agar

diameter	15 mm in one week
topography	flat, sometimes folded in the centre
texture	powdery
colour	greenish yellow to khaki, with colourless submerged edge
reverse	pale brown

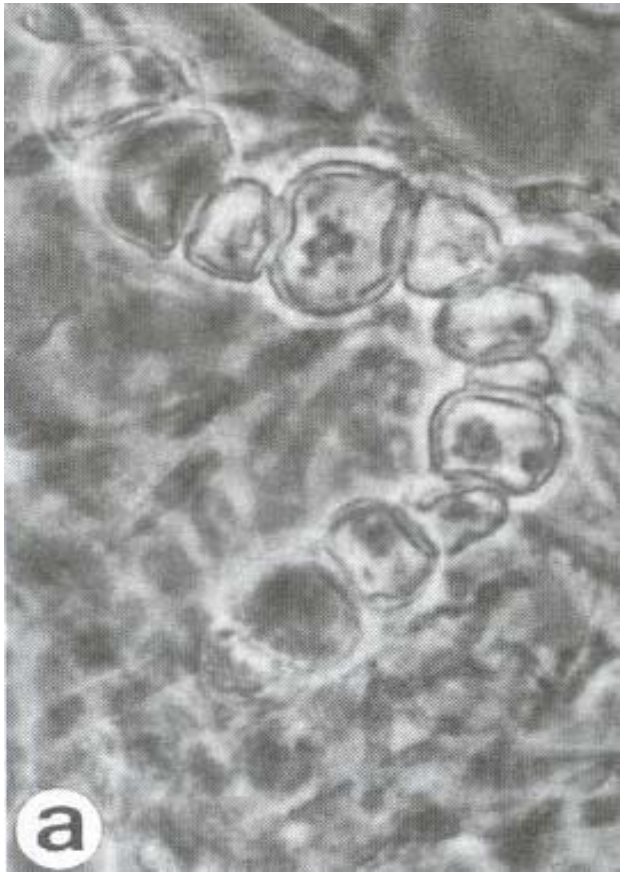
MICROSCOPIC APPEARANCE
at 30°C

predominant features	macroconidia, hyphal fragments and chlamydospores
macroconidia	oval to club-shaped, 25-45 µm × 8-10 µm, mostly with two to four septa; walls smooth and of medium thickness; often produced in clusters of two or three; soon lose cell contents
microconidia	absent

38

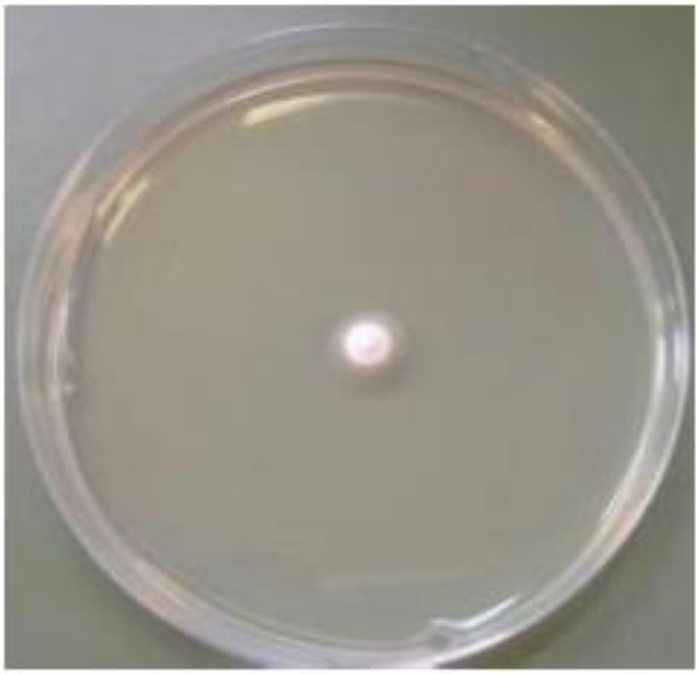
Trichophyton verrucosum

BHI, 37° C



Trichophyton verrucosum

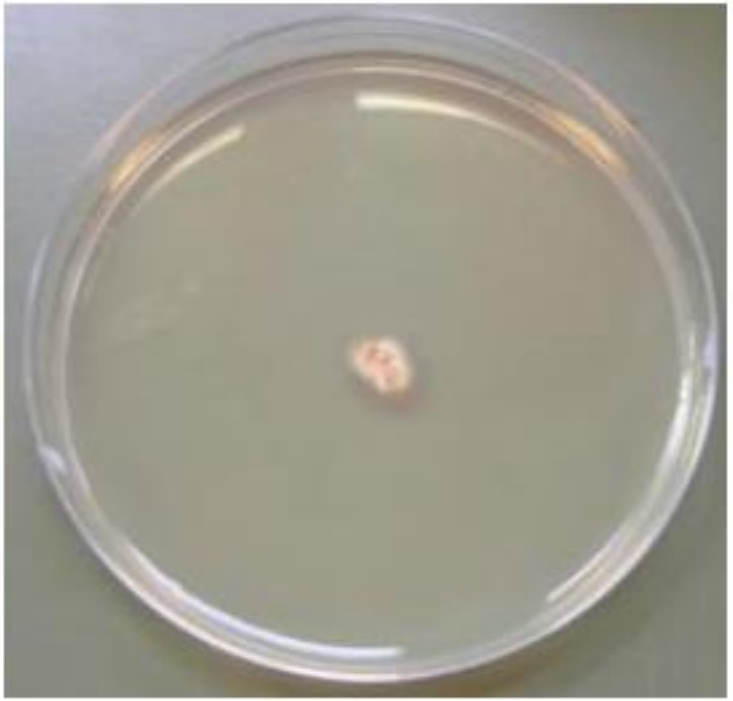
No or sporadic micro and / or macroconidia
BHI/Sab at 37°C: production of toruloïde hyphae



Slow growing, cream colored waxy colony.

Trichophyton soudanense

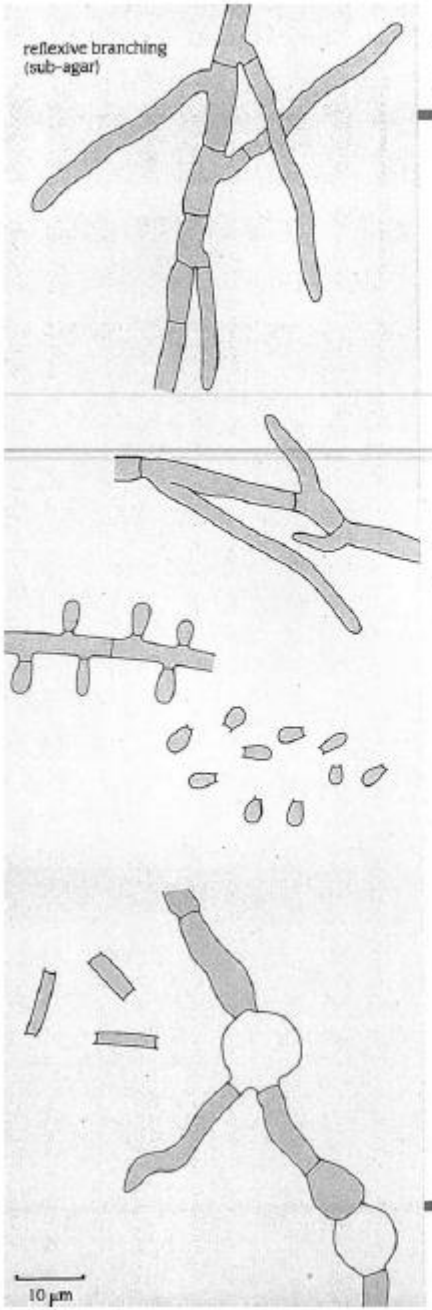
If microconidia present, regular shape.
Hyphae in the opposite direction.
"reflexive" branching.



Yellow yellow/orange colony

Diep-oranje geel, vaak met een rood centrum

Line drawing of *Trichophyton soudanense*



TRICHOPHYTON SOUDANENSE

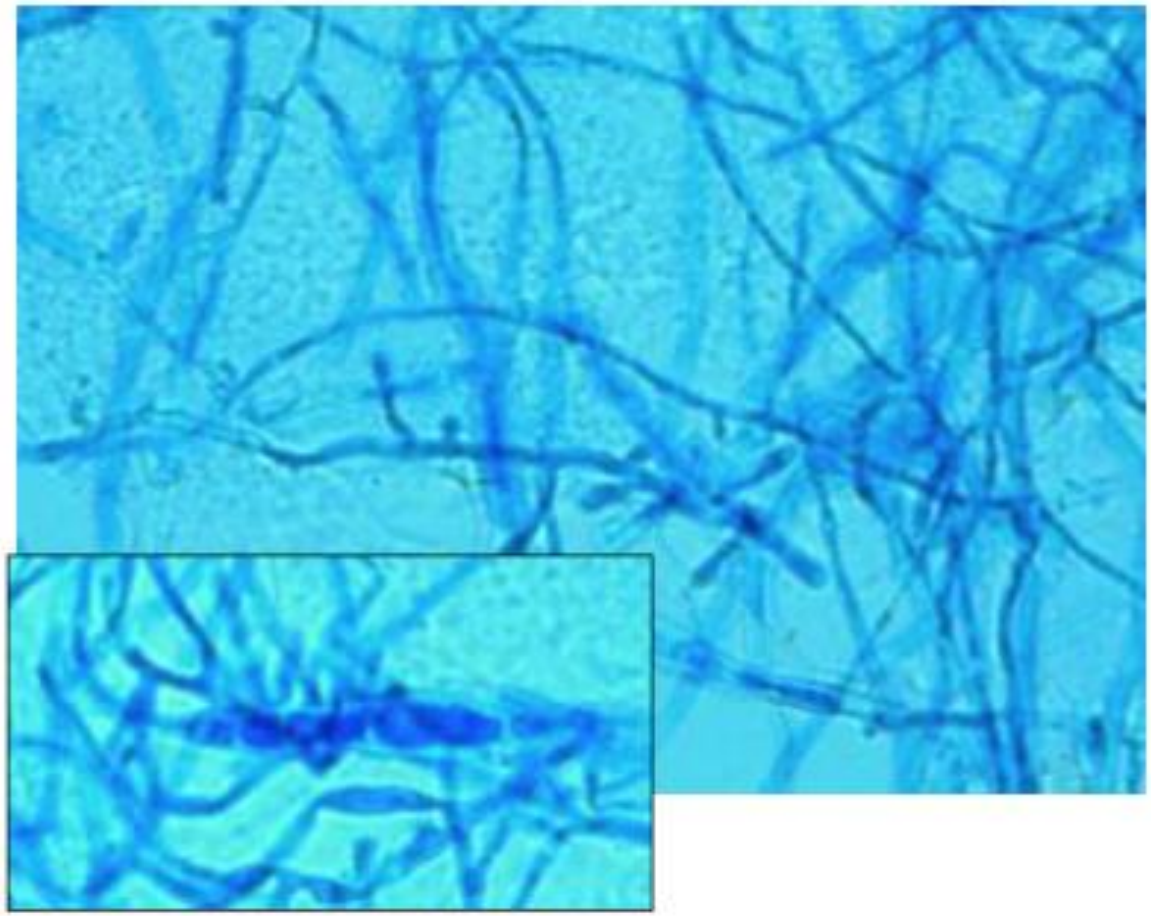
COLONIAL APPEARANCE
at 30°C on glucose peptone agar

diameter	10 mm in one week
topography	flat, with heaped, folded centre
texture	glabrous, with submerged edge
colour	deep orange-yellow, often with a reddish centre
reverse	deep orange-yellow

MICROSCOPIC APPEARANCE
at 30°C

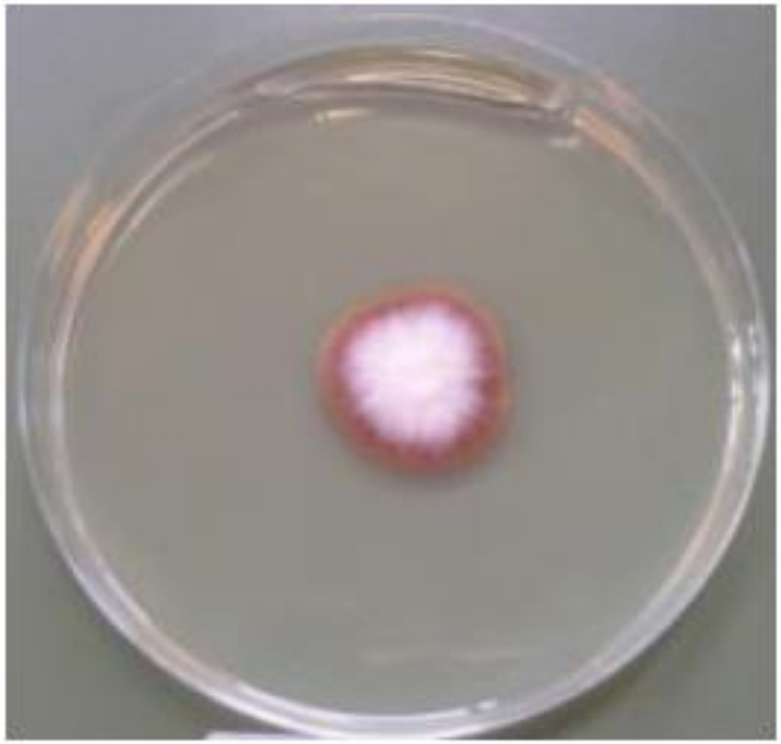
predominant features	few microconidia; reflexive branching at edge of colonies; arthrospores and chlamydospores may occur
macroconidia	absent
microconidia	large, oval, borne along the sides of the hyphae

Microsporum audouinii



Strain forms irregular macroconidia and pectinate-hyphae

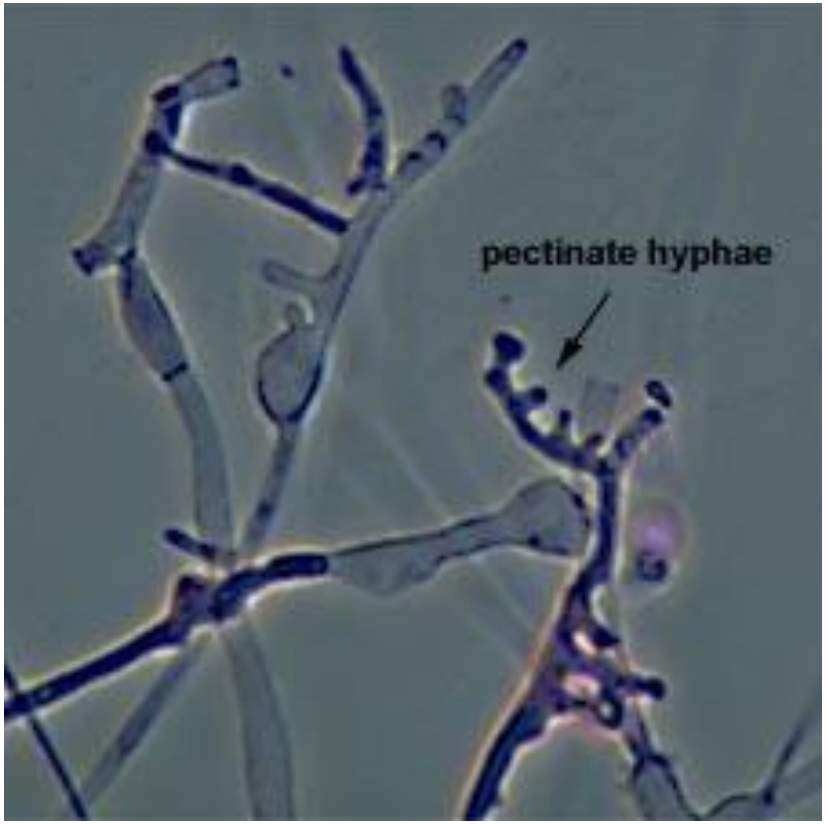
geen of weinig microconidia



Salmon colony.

reverse

Microsporum audouinii

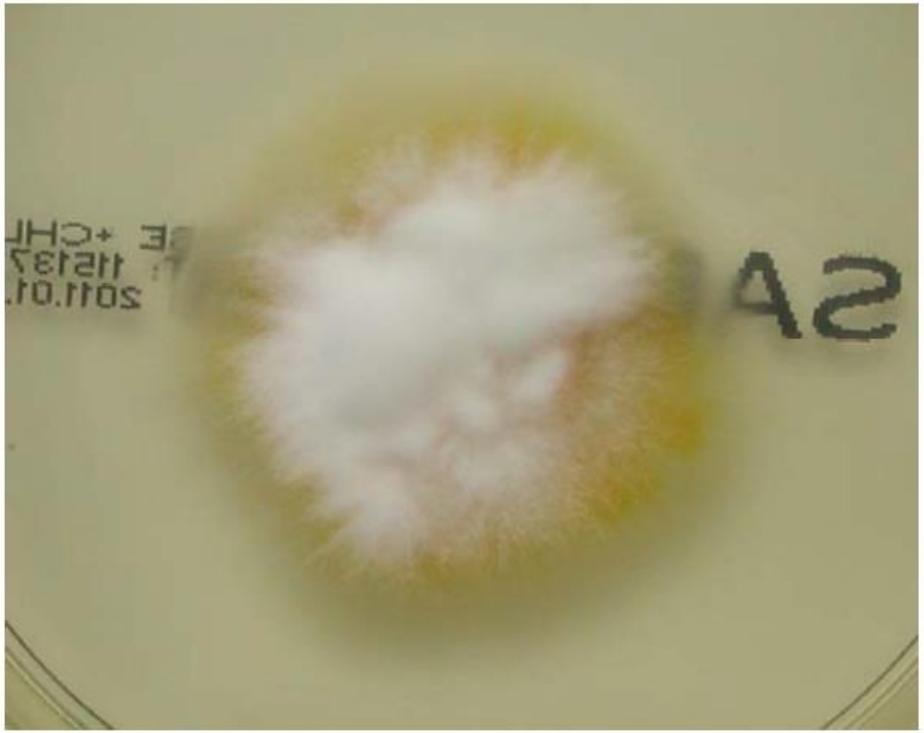


Distribution 2757 Mycology

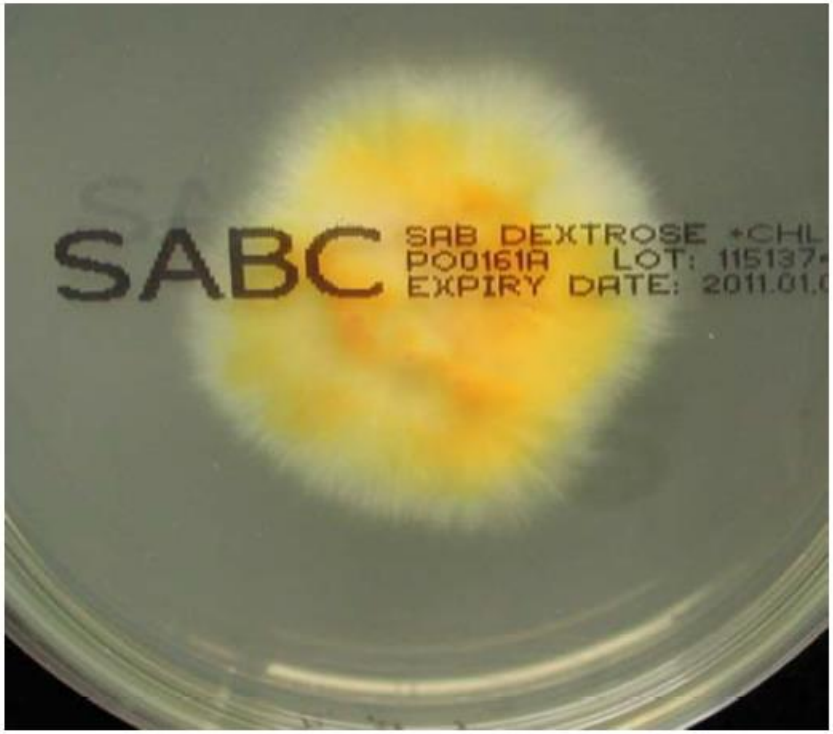
Specimen 0164 — *Microsporum canis*

7 days incubation on Sabouraud Dextrose Agar at 30°C

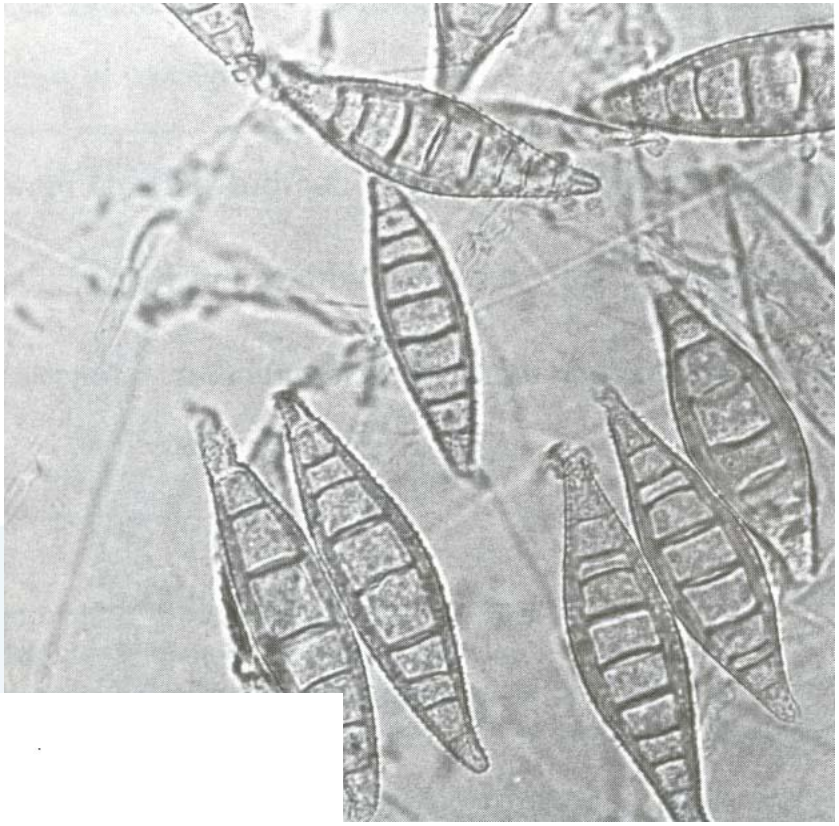
Front

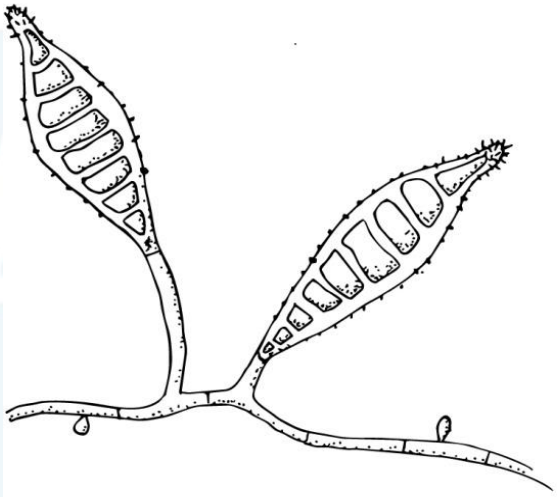


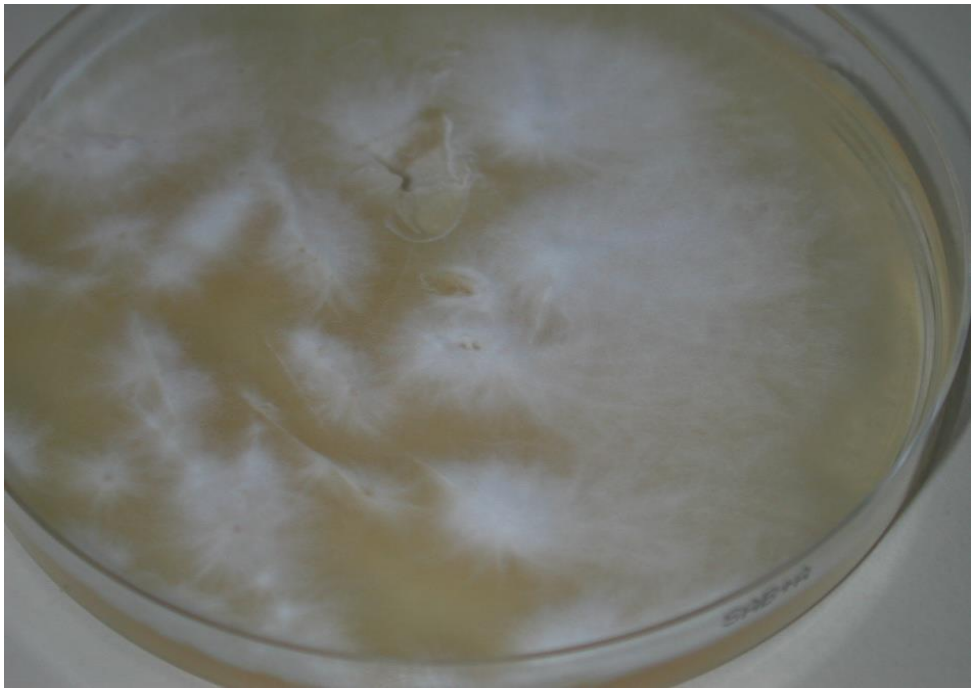
Reverse



Microsporum canis







Microsporum canis

Microscopy X 40 objective

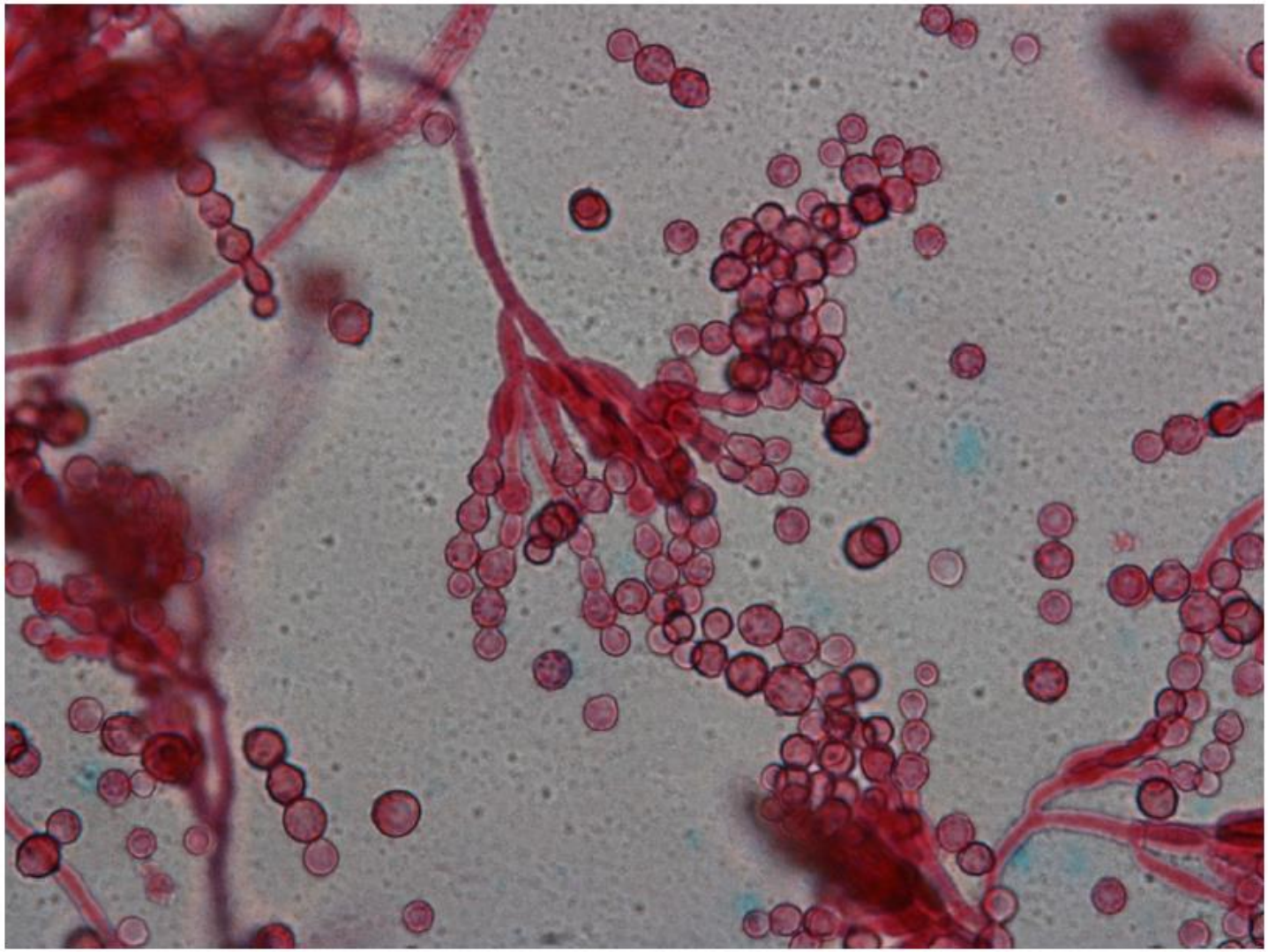
Specimen 2233— *Scopulariopsis brevicaulis*

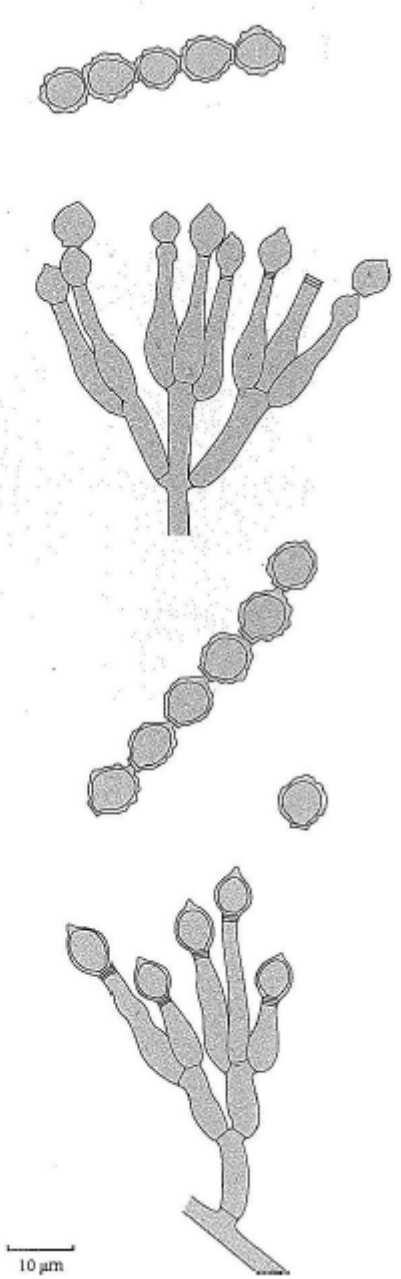
7 days incubation on Sabouraud Dextrose Agar at 30 °C

Front

Scopulariopsis brevicaulis

Microscopy x40 objective





SCOPULARIOPSIS BREVICAULIS

COLONIAL APPEARANCE

at 30°C on glucose peptone agar

diameter	50 mm in one week
topography	flat
texture	smooth, velvety to thickly granular, becoming loosely floccose
colour	pale to rich sand-brown
reverse	pale brown

MICROSCOPIC APPEARANCE

at 30°C

predominant features	chains of large, round, rough conidia; Penicillium-like conidiophores
conidiophore	short, branched heads, terminating in wide-necked, phialide-like cells which show annellations in older cultures
conidia	lemon-shaped, 6-7 µm long, with prominent flattened base, roughened

nail

Scopulariopsis brevicaulis

Neoscytalidium

Specimen 9478 — *Scytalidium dimidiatum*

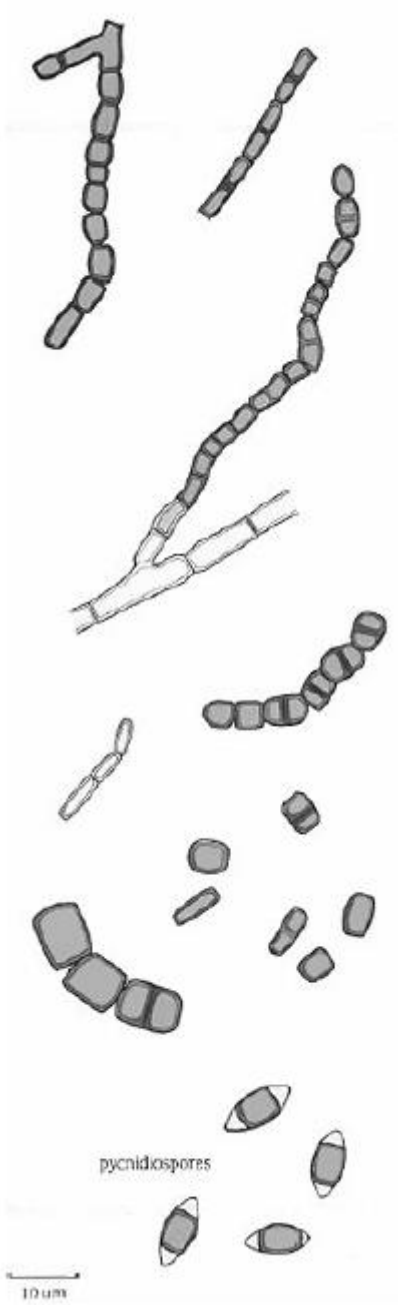
7 days incubation on Sabouraud Dextrose Agar at 30°C

Eerst wit-grijs, daarna snel donkergroen/zwart

Neoscytalidium dimidiatum

Microscopy X 40 objective

Line drawing of *Scytalidium dimidiatum*



SCYTALIDIUM DIMIDIATUM

COLONIAL APPEARANCE
at 30°C on glucose peptone agar

diameter	90 mm in three days in most strains (but see variant forms)
topography	abundant aerial growth to lid of petri dish
texture	floccose
colour	white at first, soon becoming black or dark brown
reverse	black or dark brown

MICROSCOPIC APPEARANCE
at 30°C

predominant features	brown arthrospores
arthrospores	narrow, colourless arthrospores and wider, brown-walled arthrospores are produced in abundance on the aerial mycelium; many have two cells separated by a thick septum
pycnidia	hard, black stromata about 1-2 mm across are formed on the surface of old cultures in some strains. When dissected these show multiple pycnidial cavities filled with pycnidiospores. The latter are unicellular and colourless when immature, but become three-celled with the central cell darker than the end cells. The pycnidial state is referred to *Nattrassia mangiferae*

Specimen 1516 — *Neoscytalidium dimidiatum* var. *hyalinum*

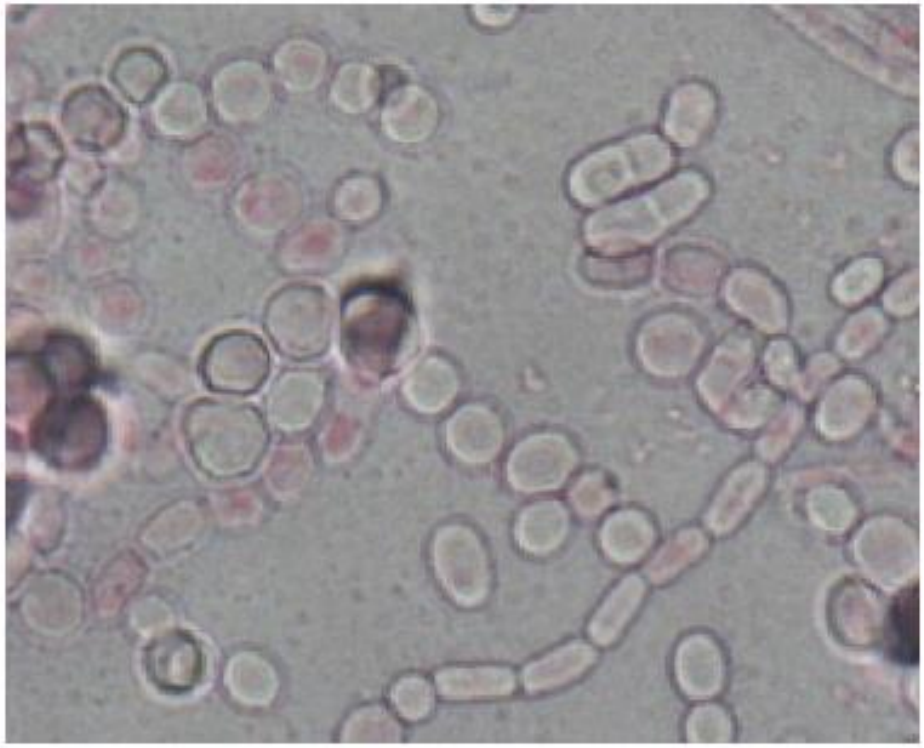
5 and 7 days incubation on Sabouraud Dextrose Agar at 30°C

Front 5 days

Front 7 days

Neoscytalidium dimidiatum var. hyalinum

Microscopy x 40 objective

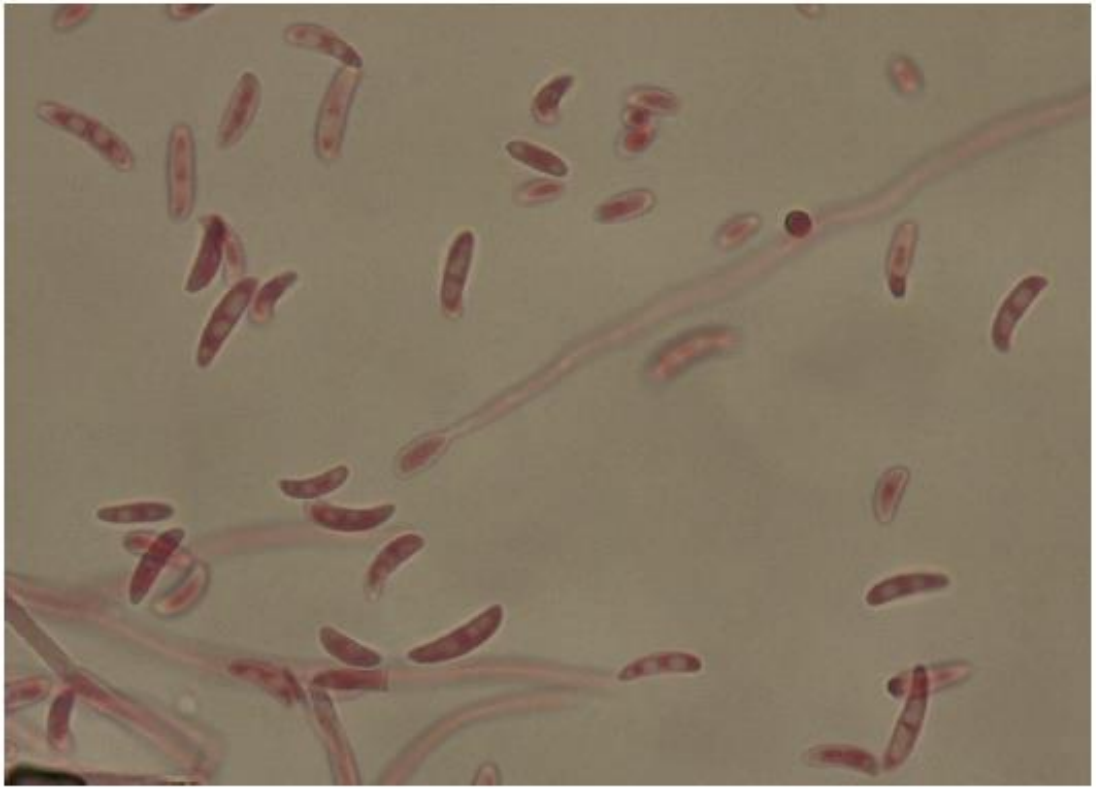


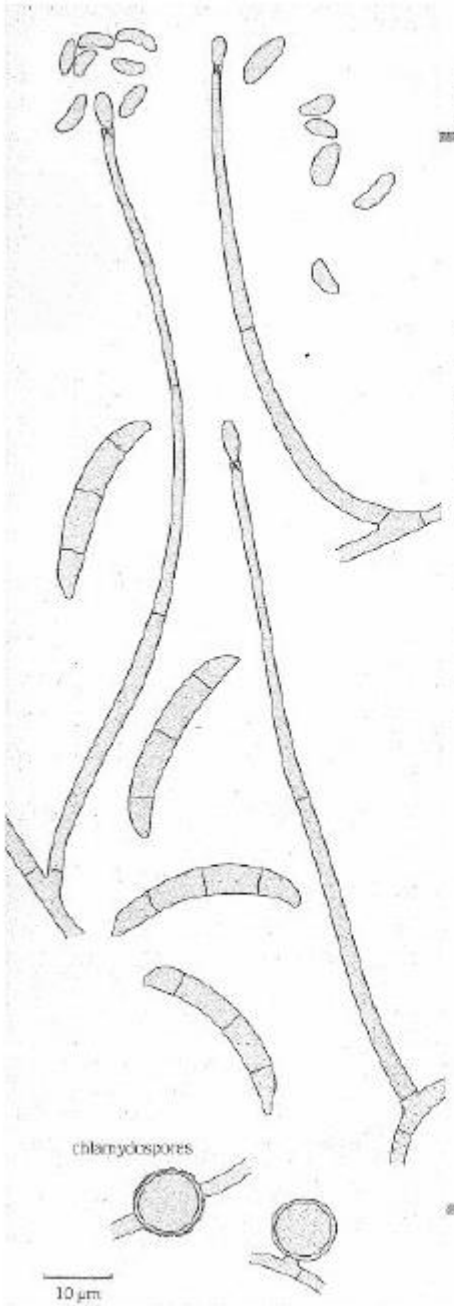
Specimen 0867 — *Fusarium solani*

5 days incubation on Sabouraud Dextrose Agar at 30°C

Fusarium solani

Microscopy X 40 objective





FUSARIUM SOLANI

COLONIAL APPEARANCE

at 30°C on glucose peptone agar

diameter	30 mm in one week
topography	flat
texture	floccose
colour	greyish-white, cream, buff or pinkish-purple
reverse	pale cream

MICROSCOPIC APPEARANCE

at 30°C

predominant features	abundant, small, oval microconidia mixed with smaller numbers of crescent-shaped macroconidia; large, round chlamydospores may be present singly or in pairs
conidiophore	long, tapering phialides with inconspicuous collarettes; difficult to distinguish from vegetative hyphae
microconidia	abundant, small, oval to kidney shaped; occasionally with one septum
macroconidia	one to five septa; crescent-shaped with a definite foot cell at one end

Validation of the DermaGenius *plus* multiplex assay, a new commercial PCR assay developped for the detection and identification of dermatophytes and *Candida* in nails

Corresponding author
mphayette@chu.ulg.ac.be

Marie-Pierre Hayette[1], Hélène Graide[1], Caroline Adjetey[1], Jorge Arrese[2], Giel Gaajetaan[3], Dennis van Tegelen[3], Tim Kampermann[3], Guus Simons[3], Gijs Dingemans[3]
[1]Department of Clinical Microbiology, [2]Deparment of Dermatopathology, University Hospital of Liege, Belgium,[3]PathoNostics B.V., Maastricht, The Netherlands

Methods

76 NAIL CLIPPINGS (from 76 patients collected at CHU Liège)

Histology
PAS staining

CULTURE
Sabouraud agar
at 28C for 21 days

IDENTIFICATION
MICROSCOPY (positive cultures)
MALDI-TOF MS (yeasts)
ITS sequencing (for confirmation)

Proteinase K
(overnight)
+ DNA purification
(EasyMag, bioMérieux)

Complete multiplex kit

- *Candida albicans*
- *Trichophyton mentagrophytes*
- *Trichophyton interdigitale*
- *Trichophyton rubrum*
- *Trichophyton tonsurans*
- *Trichophyton soudanense*
- *Trichophyton violaceum*
- *Microsporum canis*
- *Microsporum audouinii*
- *Epidermophyton floccosum*

DermaGenius®: Multiplex real-time PCR assays for the detection and identification of fungal infections of nail, hair and skin

Hayette MP et al., TIMM 2015

Onychomycosis case definition:
positive microscopy alone **or** positive culture alone with true pathogen or positive microscopy+culture of possible pathogen

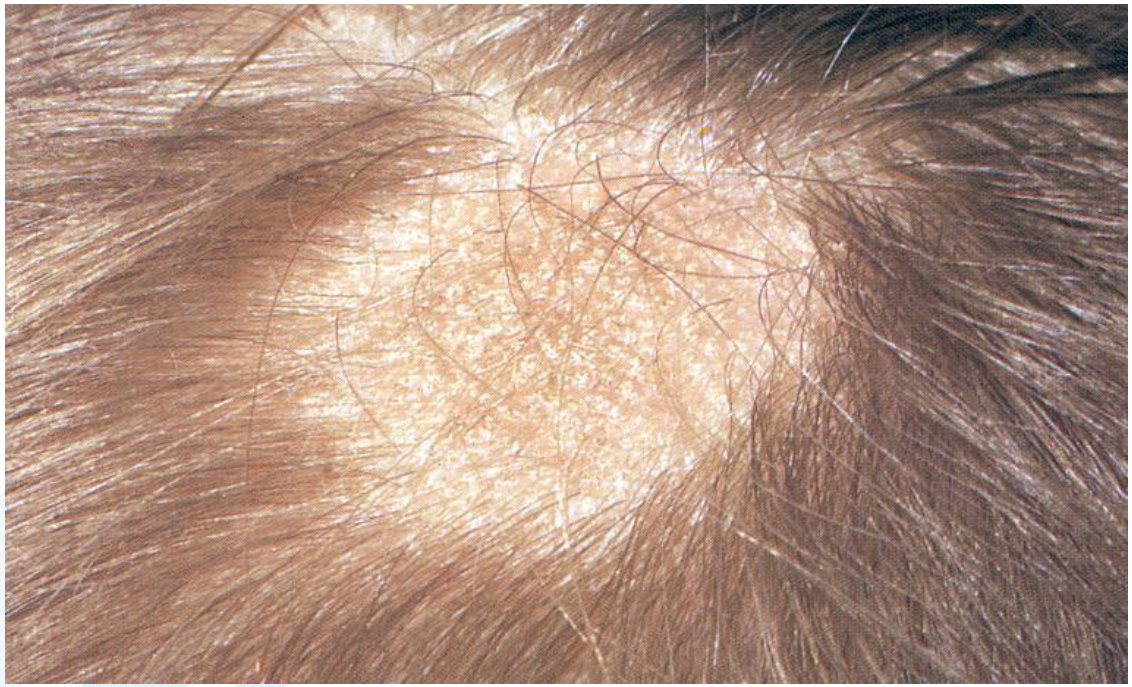
CASE DEFINITION	Microscopy POSITIVE	Culture POSITIVE (true pathogen)	Culture POSITIVE (potential pathogen, DG target+)	DG Positif
Onychomycosis (N=34, 44%)	58% (20/34)	79% (27/34)	23,5% (8/34)	85% (29/34)
Non fungal onychodystrophy (N=42, 56%)	0	0	2,3% (1/42)	30,9% (13*/42)

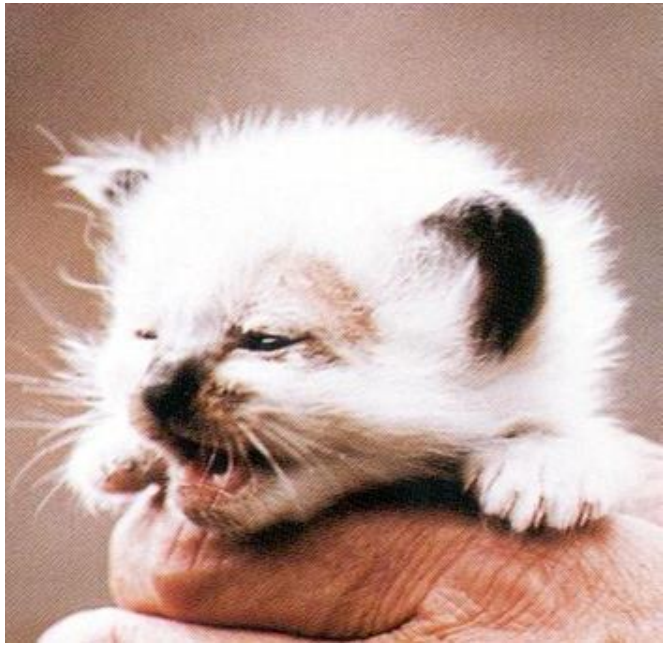
Fig 1. DermaGenius (DG) performance in cases of onychomycosis ; *DG : 9 *T. rubrum, 2T. mentagrophytes complex, 2C. parapsilosis*

Diagnosis of onychomycosis in 44% of cases based on conventional methods versus 54% based on DermaGenius.

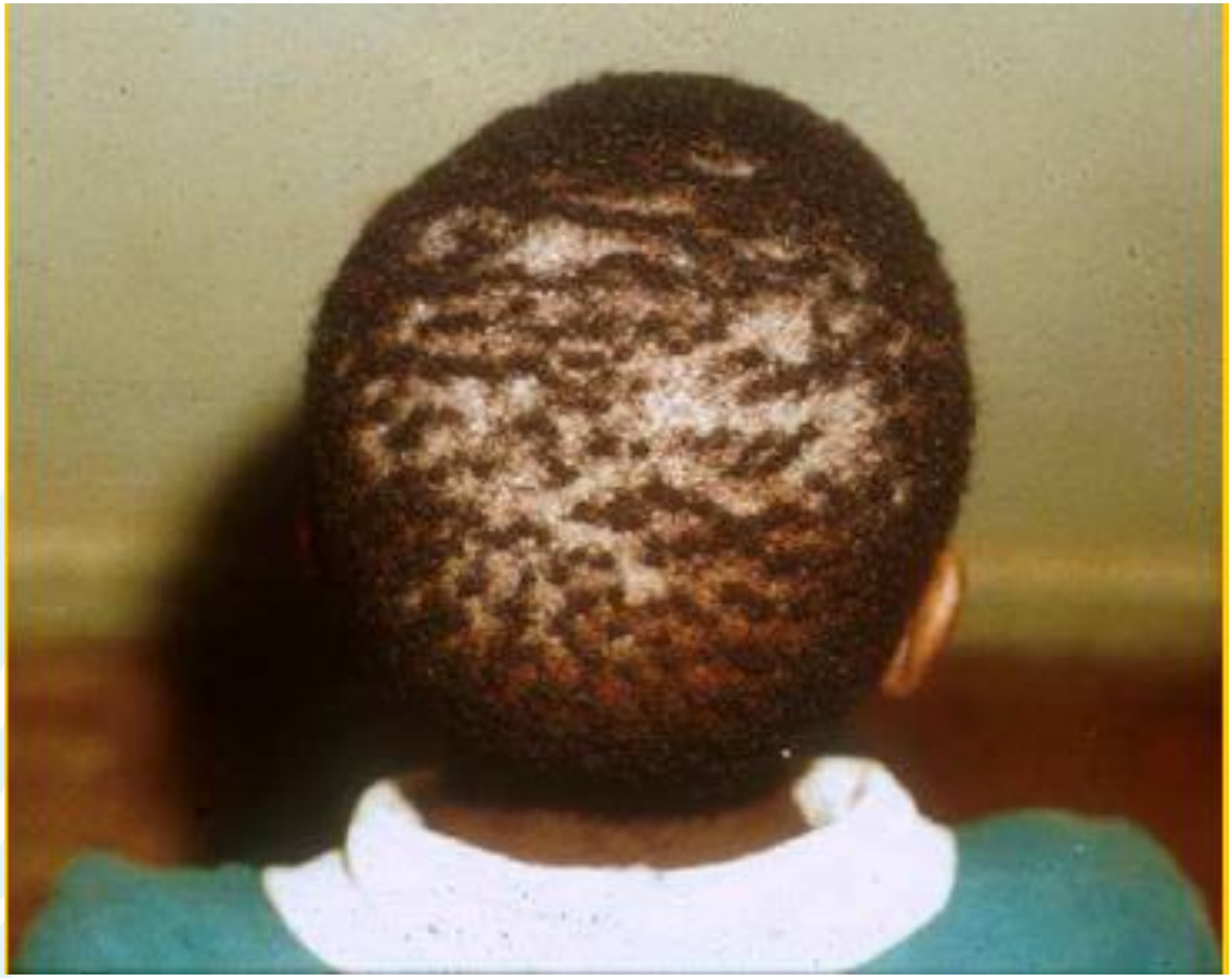
Hayette MP et al., TIMM 2015

Ectothrix tinea capitis





Endothrix tinea capitis



Favus

Tinea barbae

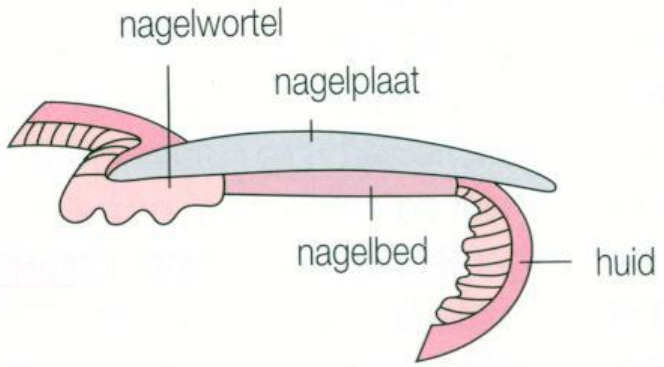
Tinea corporis

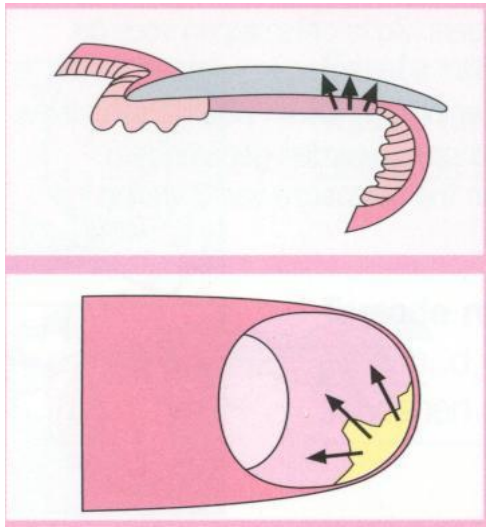
Tinea corporis

Tinea pedis (Athlete's foot)

Tinea pedis (vesicular)

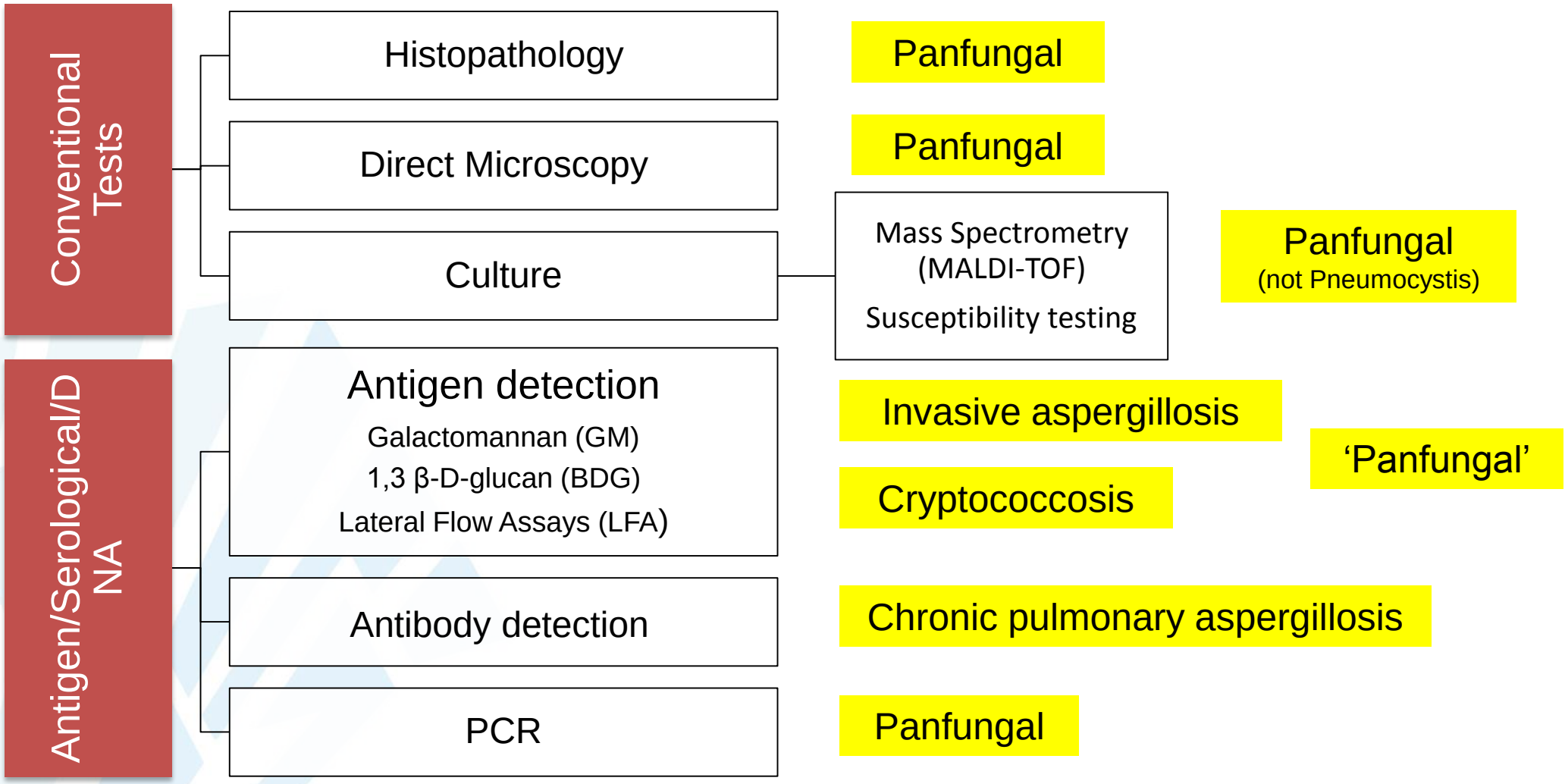
Onychomycosis



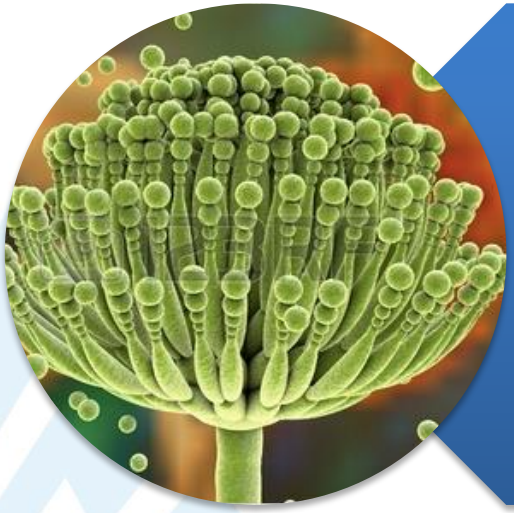


Onychomycosis

Which tests can the lab offer to you for the diagnosis of fungal infection?



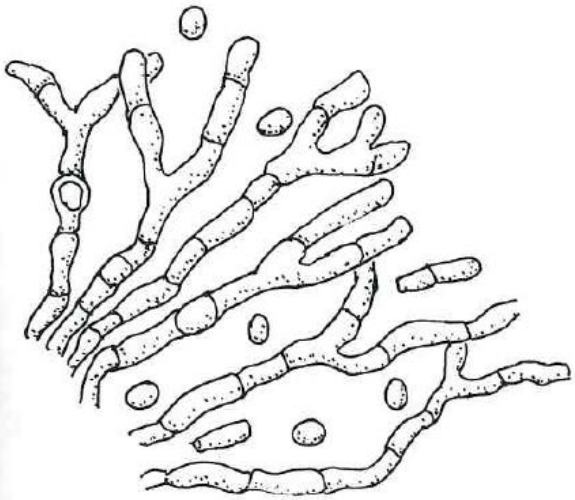
YOU WILL MISS ABOUT 50% OF INVASIVE FUNGAL INFECTIONS IF YOU RELY ONLY ON CONVENTIONAL TESTS

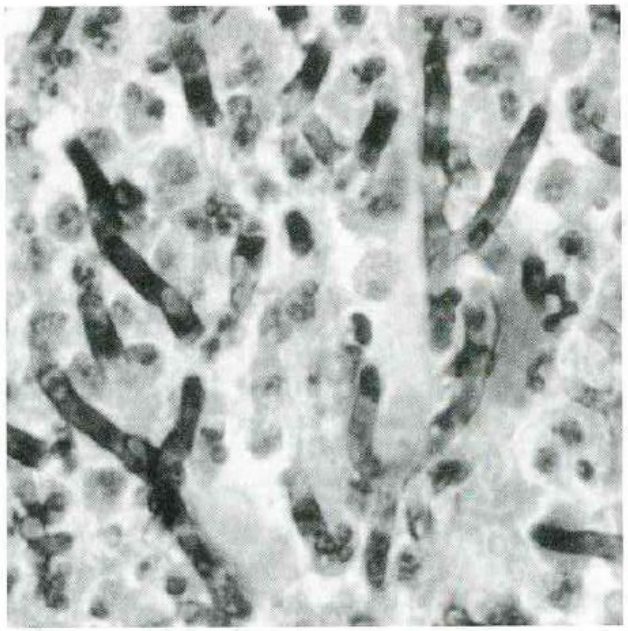


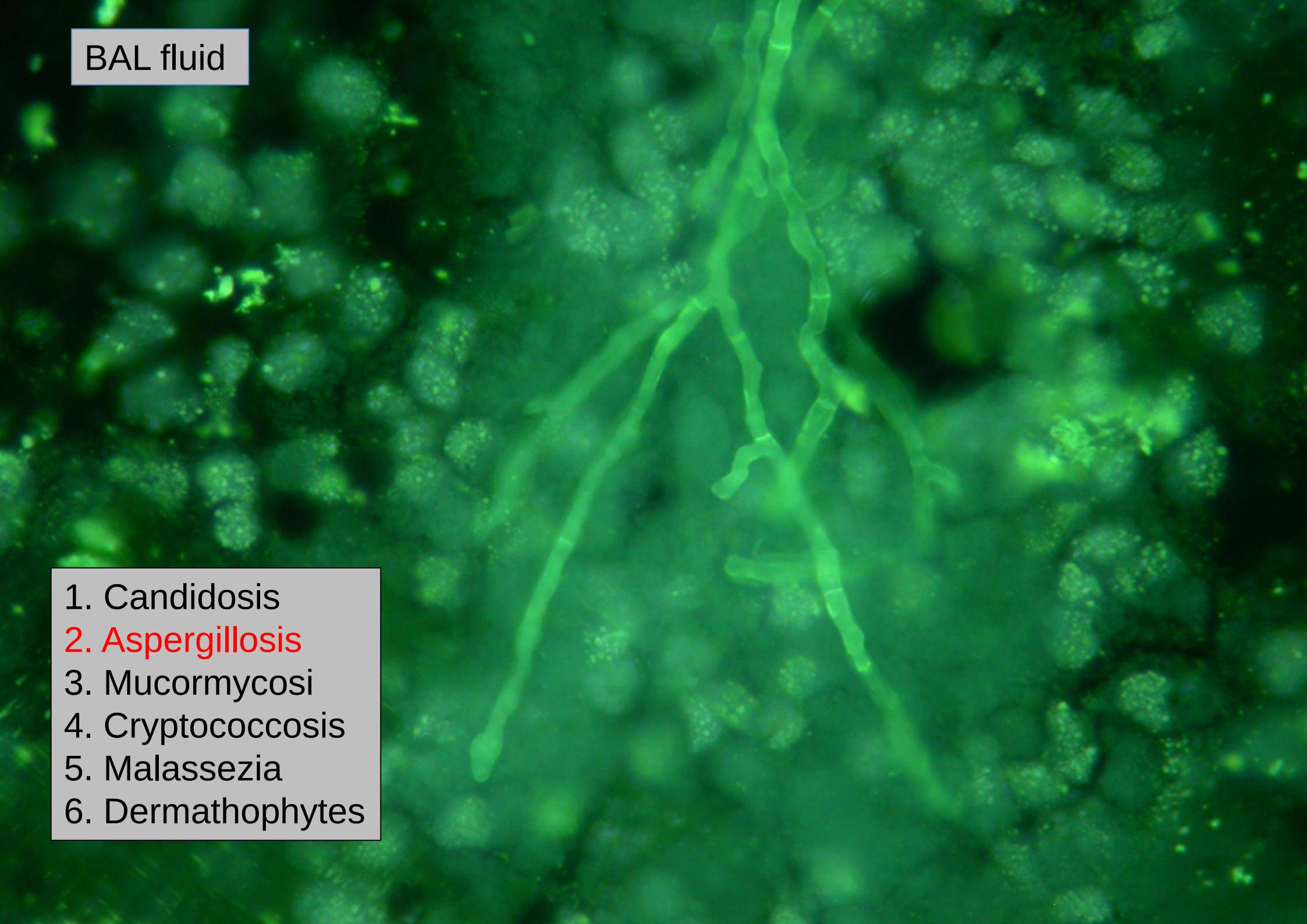
Aspergillus

Aspergillosis *(continued)*

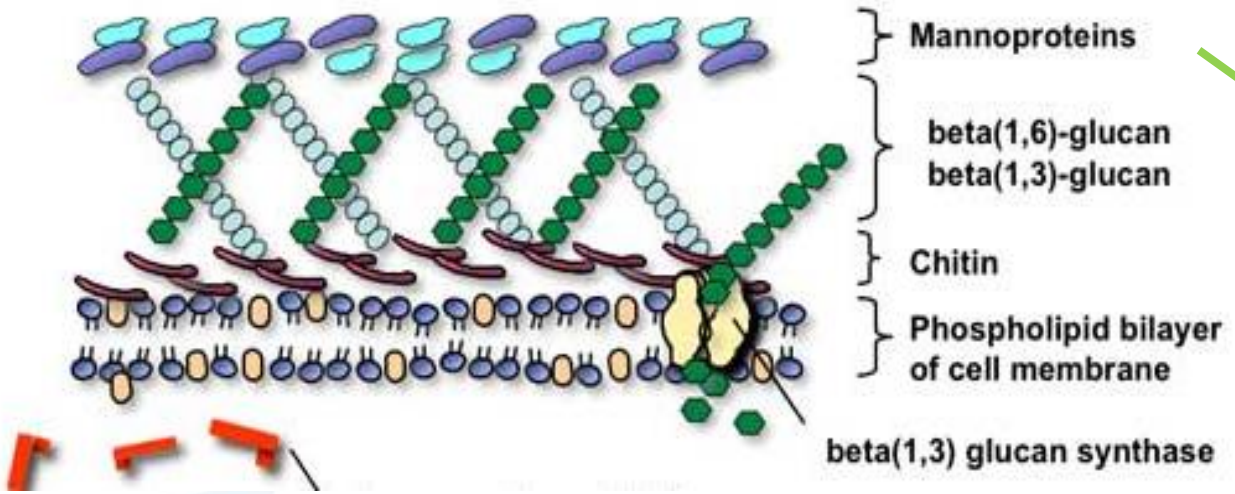
Many other fungi appear similar to the aspergilli in tissue or other clinical specimens; however, there are subtle differences. Zygomycetes have hyphae that are almost nonseptate, are commonly broader (up to 25 μm in diameter), show random branching, often appear collapsed and twisted, are irregular and nonparallel, and usually stain lighter with GMS than do the aspergilli. *Candida* spp., in addition to hyphae, form pseudohyphae (typically showing distinct constrictions at the septa) and budding yeast cells; but when the hyphae of *Aspergillus* are cut on cross section, they may be mistaken for nonbudding yeast cells. Hyphae of other opportunistic hyaline moulds may be indistinguishable from *Aspergillus* in tissue (see "Miscellaneous Hyalohyphomycoses," p. 40).

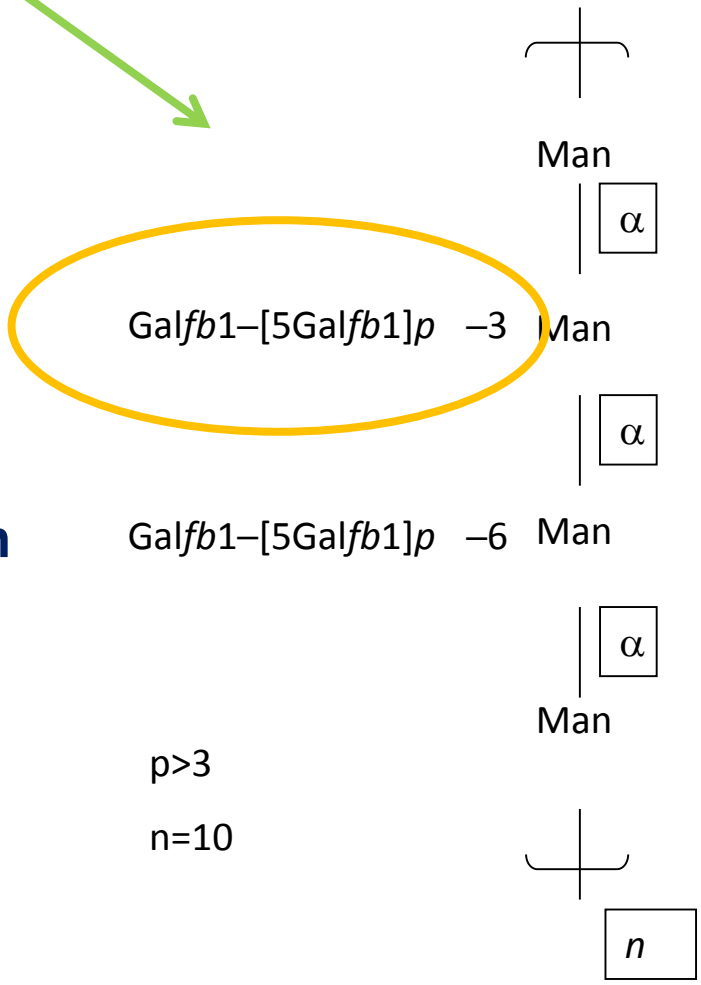





BAL fluid
1. Candidosis
2. Aspergillosis
3. Mucormycosi
4. Cryptococcosis
5. Malassezia
6. Dermathophytes

Galactomannan (GM) detection (Platelia™)





- Heat stable hetero-polysaccharide present in the cell wall of most *Aspergillus* spp., **release during growth** (cross reactivity *Penicillium*, *Paecilomyces*, *Cryptococcus, Histoplasma*)

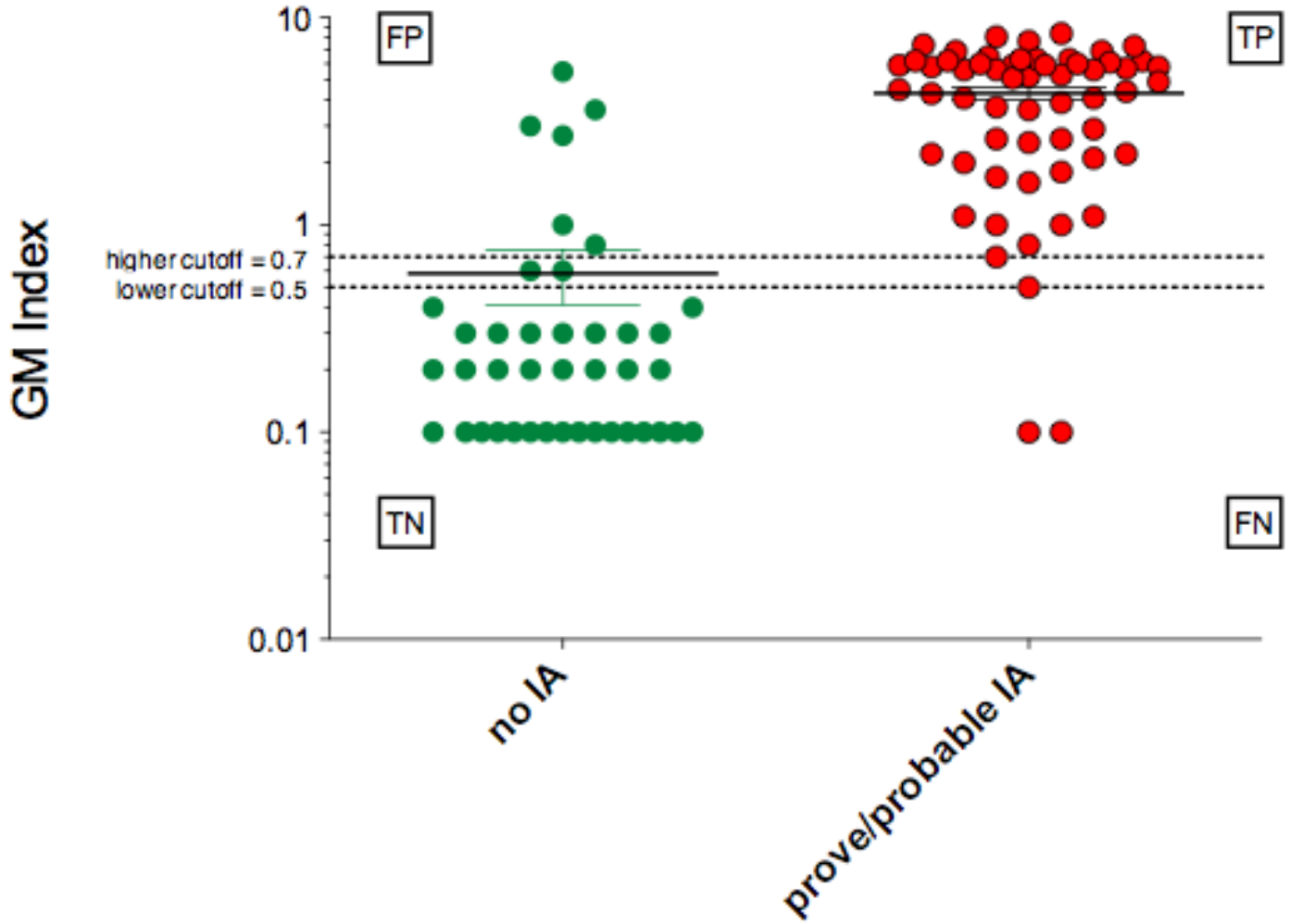
- Commercial kit: Platelia® Sandwich ELISA (BioRad)

Some issues about galactomannan detection

- Sensitivity of serum GM detection is high in neutropenic patients only
- Sensitivity of BAL GM detection is high for the broad population at risk of IA but may also be positive due to colonization
- No false positivity due to Tazocin™ administration (but cave generic formulations - compare serum with BAL values)
- Retesting the same sample may help to distinguish between true and false positive results

Mikulska M *et al.* J Antimicrob Chemother 2012,67:1746-8
Metan, G. Infection 2013, 41: 293-294.

Clear influence of neutropenia on serum GM but not on BAL GM value



Jan 2005 – Sept 2008
58 proven/probable IA
41 controls

	Neutropenic	non-Neutropenic	P-value
BAL, 1.0	100%	94.7%	0.99
Serum, 0.5	90%	36.8%	0.008

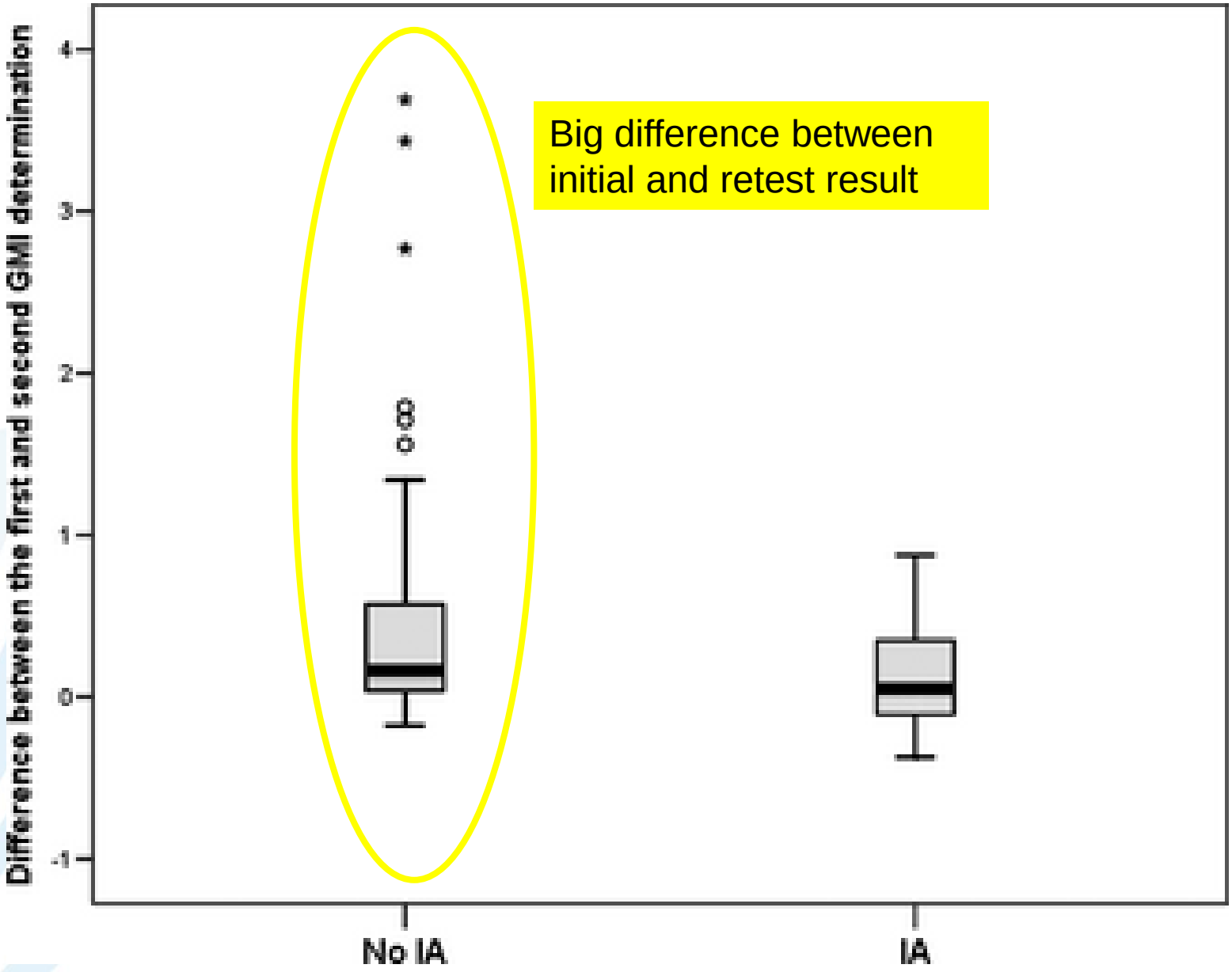
Maertens J et al., CID, 2009, 49: 1688-1693.

Galactomannan detection in blood: screening of neutropenic haematology patients

OD index cutoff value, episode classification	No. of episodes with positive results/no. of episodes tested	Sensitivity, % (95% CI)	No. of episodes with negative results/no. of episodes tested	Specificity, % (95% CI)
OD index ⩾1.5				
Proven IA	19/19	100 (85.4–100)	…	…
Probable IA	10/19	52.6 (28.9–75.5)	…	…
Overall	29/38	76.3 (59.8–88.6)	…	…
Control group	…	…	196/201	97.5 (94.3–99.2)
OD index ⩾1.0				
Proven IA	19/19	100 (85.4–100)	…	…
Probable IA	12/19	63.2 (38.4–83.7)	…	…
Overall	31/38	81.6 (65.7–92.3)	…	…
Control group	…	…	194/201	96.5 (93.0–98.6)
OD index ⩾0.5				
Proven IA	19/19	100 (85.4–100)	…	…
Probable IA	18/19	94.7 (74.0–99.9)	…	…
Overall	37/38	97.4 (86.2–99.9)	…	…
Control group	…	…	182/201	90.5 (85.6–94.2)
OD index ⩾2 × 0.5				
Proven IA	19/19	100 (85.4–100)	…	…
Probable IA	16/19	84.2 (60.4–96.6)	…	…
Overall	35/38	92.1 (78.6–98.3)	…	…
Control group	…	…	196/201	97.5 (94.3–99.2)

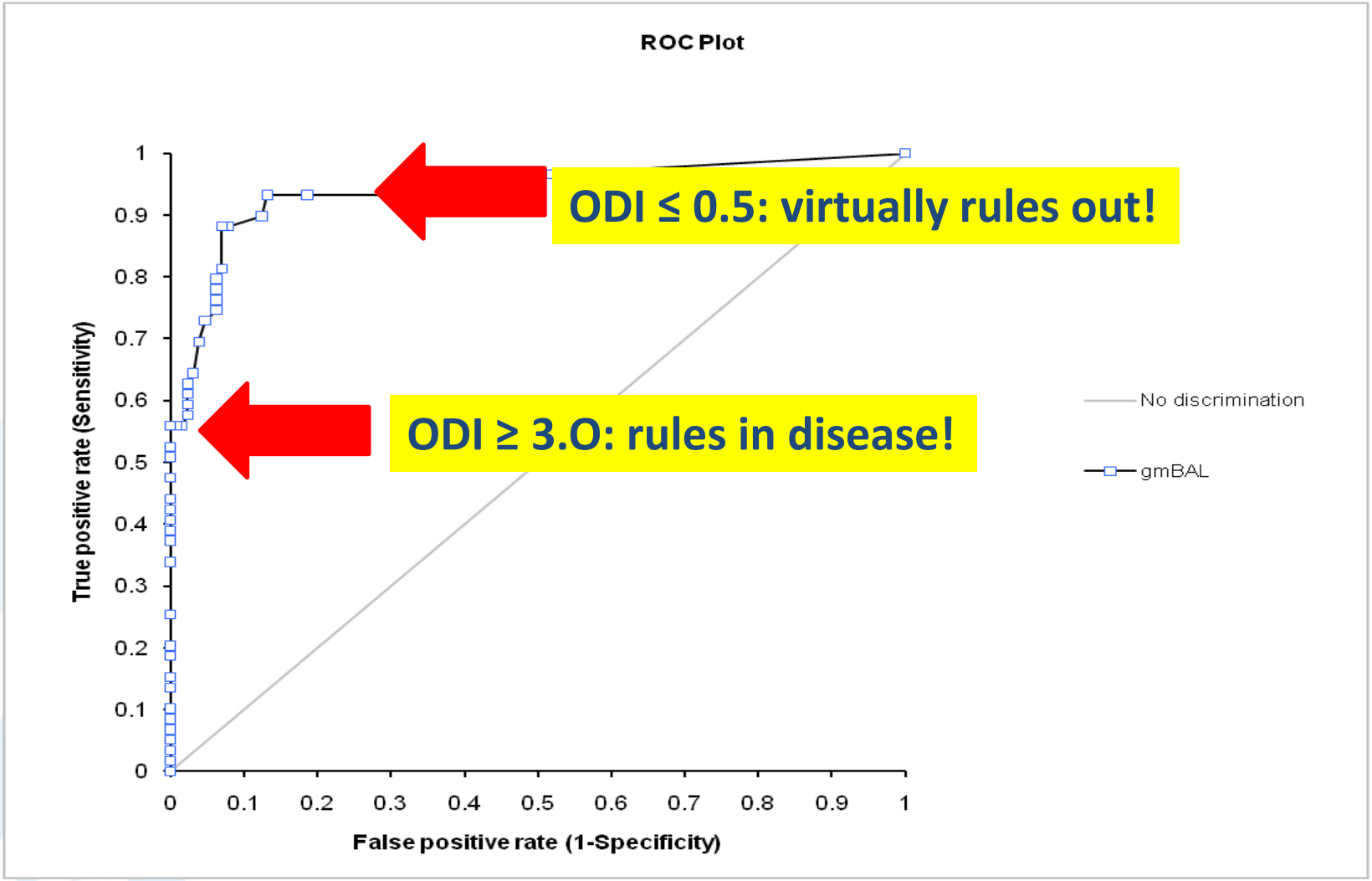
Maertens J A et al. Clin Infect Dis. 2007;44:1329-1336

False positive galactomannan results: testing the sample twice improves specificity



Furfaro E et al., Transpl Infect Dis 2012, 14:E38-9

Galactomannan detection in BAL: optical density index cut-off value



The ROC curve identified 0.8 as the most appropriate cut-off value; the area under de curve was 0.94 (95% CI, 0.90-0.98)

D'Haese J et al. J Clin Microbiol 2012; 50: 1258-1263

Mold active antifungal prophylaxis: huge impact on PPV of serum GM test!

262 unselected consecutive high-risk episodes, prospectively managed with posaconazole primary prophylaxis, biweekly serum GM testing.

Performance of serum galactomannan assay in high-risk patients receiving effective anti-mold prophylaxis

nearly 9/10 serum GM is false positive!

GM screening of all cases (incidence < 2%)	NPV 100 %	PPV 12 %
Diagnosis of IFD suspicion only (incidence >50%)	NPV 100 %	PPV 90 %

Duarte RF et al. Clin Infect Dis 2014;59:1696-702

Diagnostic performance of GM detection in CSF

Patients from Erasmus MC (The Netherlands) and UZ Leuven (Belgium), GM tested because of clinical suspicion of cerebral aspergillosis (CA) 2004-2014

4 proven CA, 13 probable CA and 27 no CA

	No. of patients		
CSF sample type	With CA	Without CA	Total
With positive GM (≥0.5/1.0/2.0)	15	1	16
With negative GM (<0.5/1.0/2.0)	2	26	28
Total	17	27	44

SENS = 88%
SPEC = 96%
NPV = 94%
PPV = 93%

GM. Chong et al., JCM 2016, 54: 428-431

1, 3 β-D-Glucan detection

- **'Panfungal'**:
  - *Aspergillus, Candida,* many other fungi  
  - **NO detection of Mucorales and *Cryptococcus***
- Several commercial kits available (different cut-off values): Fungitell™,Glucatell™ in US and Europe
- Approved for serum testing only. Lower specificity than GM detection in BAL (frequent Candida colonization of respiratory tract)
- Test not really user-friendly
- Many cause for false positivity β-lactam antibiotics
  - Hemodialysis/hemofiltration
  - Blood components: immunoglobulin preparations
  - Surgical gauzes
  - Bacterial infections

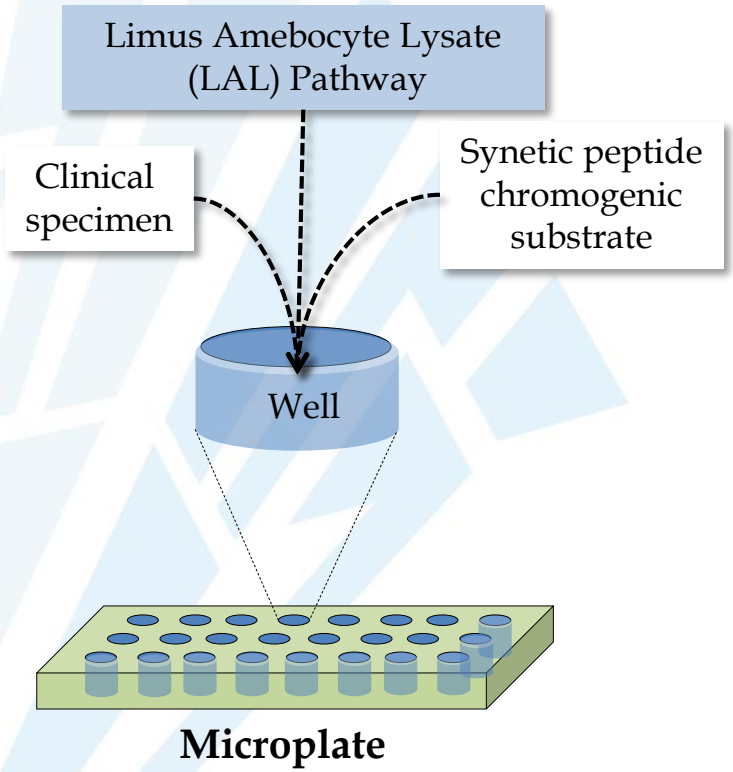
1, 3 β-D-Glucan Assay

A

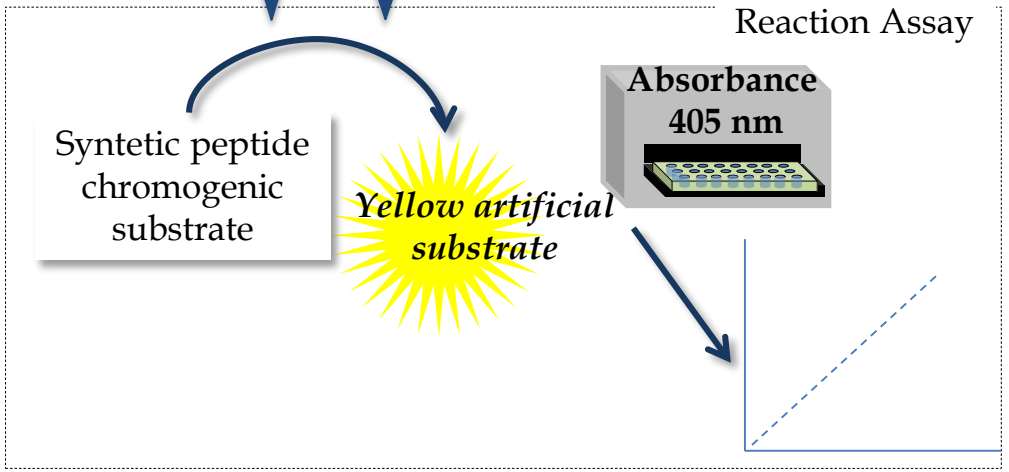
B

C

D



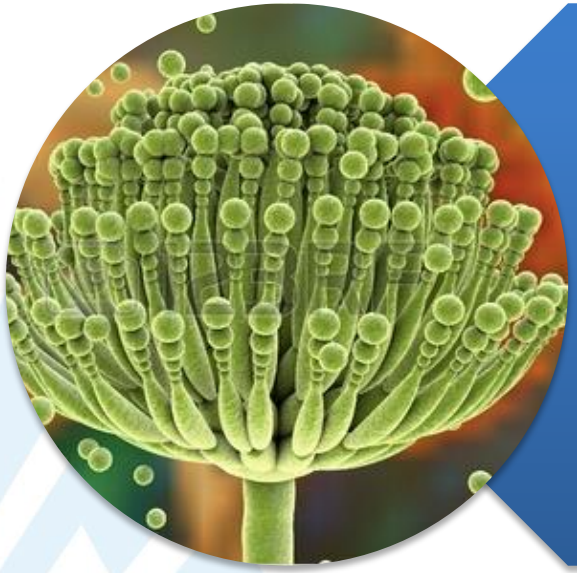
E



1-3-β-D-glucan performed by the Belgian National Reference Center for Mycosis

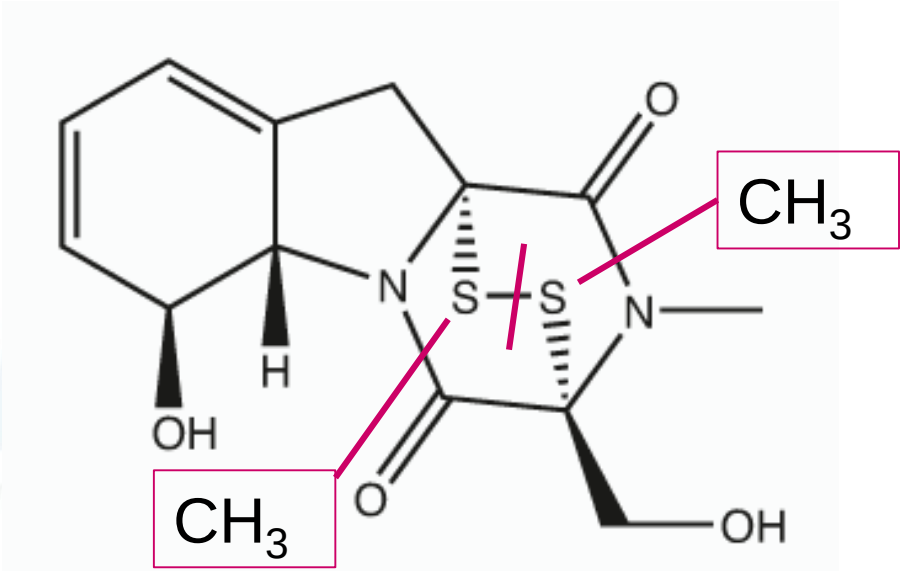
Institut	UZ Leuven/KU Leuven
Departement	Microbiologie & Immunologie
Responsable CNR	Prof. Dr. Lagrou Katrien
Addresse	Herestraat 49, B-3000 Leuven, België
Personne de contact	Prof. Dr. Lagrou Katrien
Email	mailto:katrien.lagrou@uz.kuleuven.be
Tel	016/34.70.98
Fax	016/34.79.31

- Strong suspicion of invasive fungal infection while all (other) test remain negative or inconclusive
- Inability to perform bronchoalveolar lavage in a patient with suspicion of *Pneumocystis jirovecii* pneumonia



Research on new diagnostic tests

Bis(methylthio)gliotoxin (bmGT) detection for the diagnosis of invasive aspergillosis



GLIOTOXIN

- Acts as a virulence marker: mediates immunosuppressive and proapoptotic effects
- Produced by *A. fumigatus*, *A. flavus*, *A. terreus*, *A. niger* (not *Candida*)
- Reactive compound, rapidly removed from body fluids

bmGT

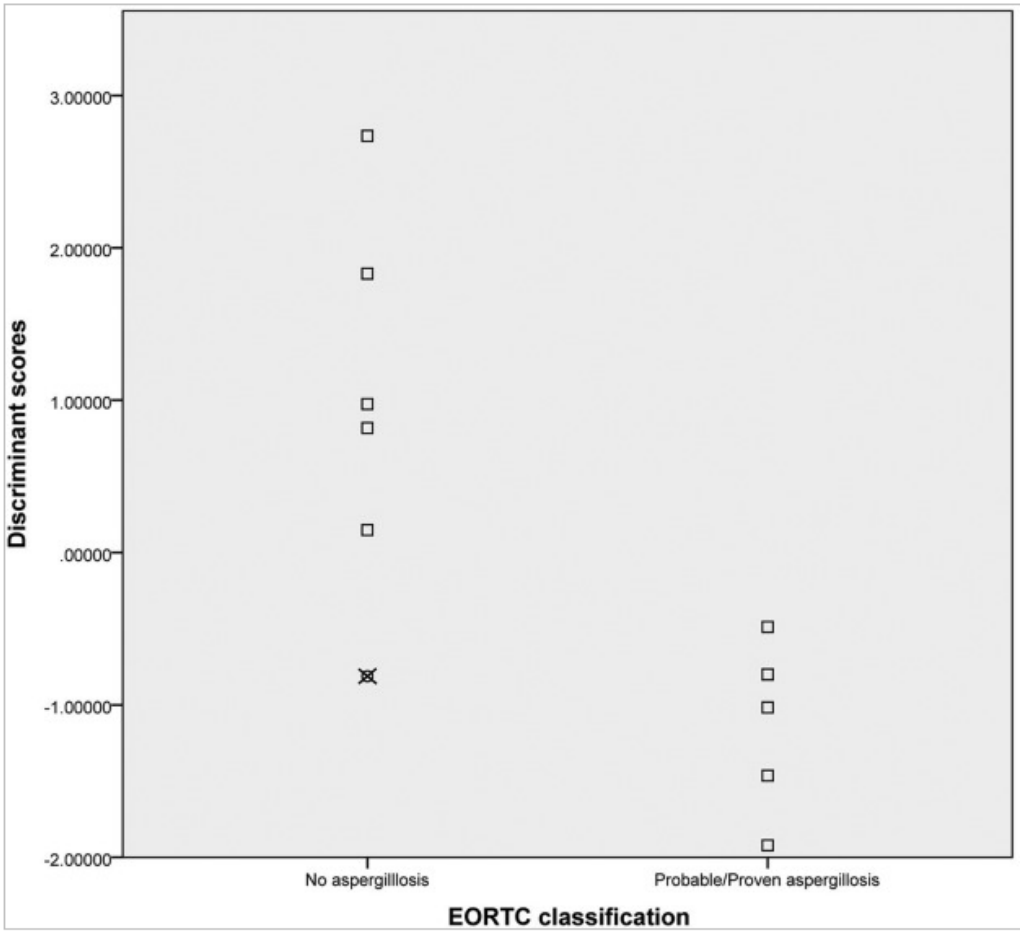
more stable inactive metabolite

Vidal-Garcia M et al, Appl Microbiol Biotechnol 2016, 100: 2327-2334

eNose technology: detection of volatile organic compound (VOC)s

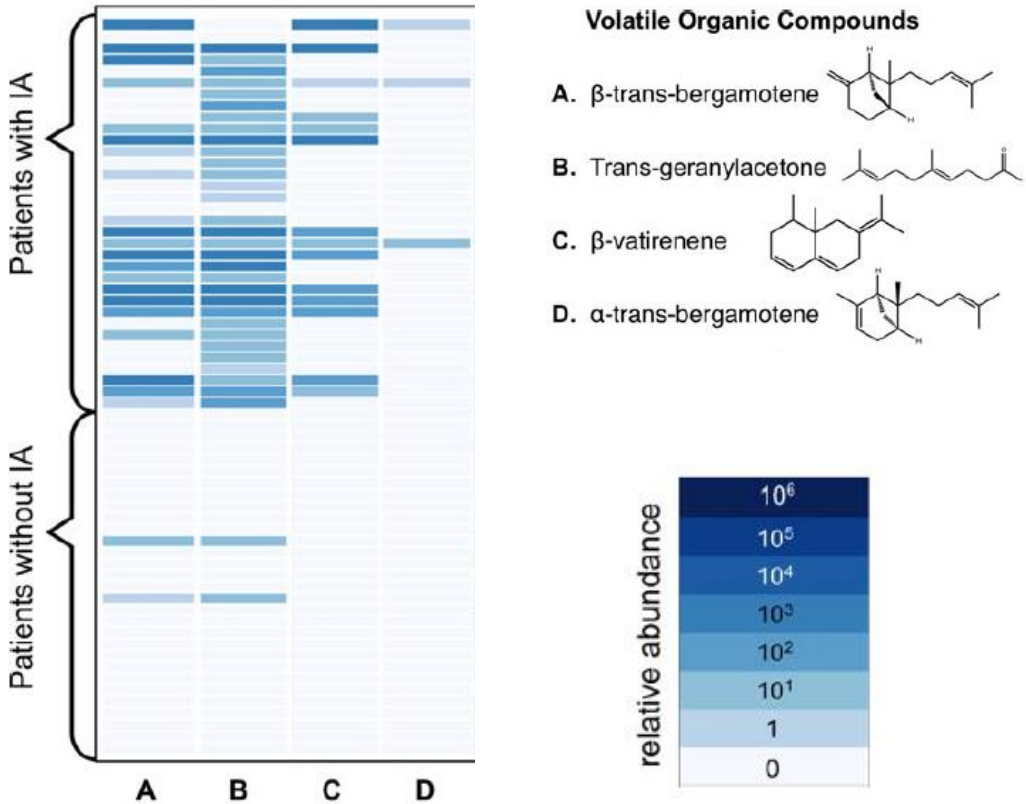
- Detection of complex mixtures of volatile organic compound (VOC)s by **pattern recognition**: sensors that react differently with individual VOCs
- Cyranose 320 (Smith Detection): 32 cross-reactive polymer sensors blended with carbon black composite and configured as an array
- Exhaled breath: up to 2000-3000 VOCs
- Several disease states can be discriminated by their composite pattern of exhaled VOCs: **'breath-print'**

eNose proof-of-principle for detection of invasive pulmonary aspergillosis



6 cases, 5 controls

Exhaled metabolite signature of *Aspergillus fumigatus* in vivo by GC-MS



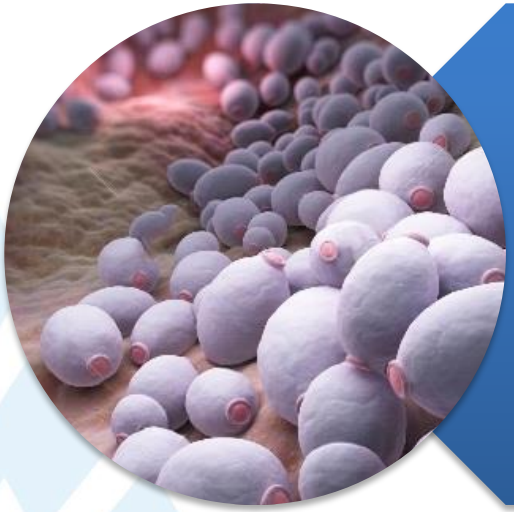
34 cases, 30 controls

de Heer K et al, JCM 2013, 51: 1490-1495

Koo S et al., CID 2014, 59: 1733-1740

Is emergence of multidrug resistance in *Candida* and *Aspergillus* a matter of concern?

Is susceptibility testing of *Candida and Aspergillus* important to guide therapy?



Candida

Drug resistant *Candida glabrata* in cancer patients

- Retrospective study
- MD Anderson Cancer Center Houston (Texas)
- March 2005-Sept 2013

146 *C. glabrata* candidemia episodes (144 patients)

30 (20.5%) fluconazole R

29/30 (96.6%) multi-azole R

Independently associated with:

- Azole preexposure (voriconazole)
- Hematological malignancy
- Mechanical ventilation

15 (10.3%) caspofungin R

Independently associated with:

- Echinocandin preexposure
- Mono/lymphocytopenica
- Total parenteral nutrition

D. Farmakiotis et al, EID 2014

Drug resistant *Candida glabrata* in cancer patients

- Retrospective study
- MD Anderson Cancer Center Houston (Texas)
- March 2005-Sept 2013

146 *C. glabrata* candidemia episodes (144 patients)

30 (20.5%) fluconazole R

15 (10.3%) caspofungin R

30% 66.6%

10 (6.8%) multidrug R

9 fluco/caspo
1 caspo/amphoB

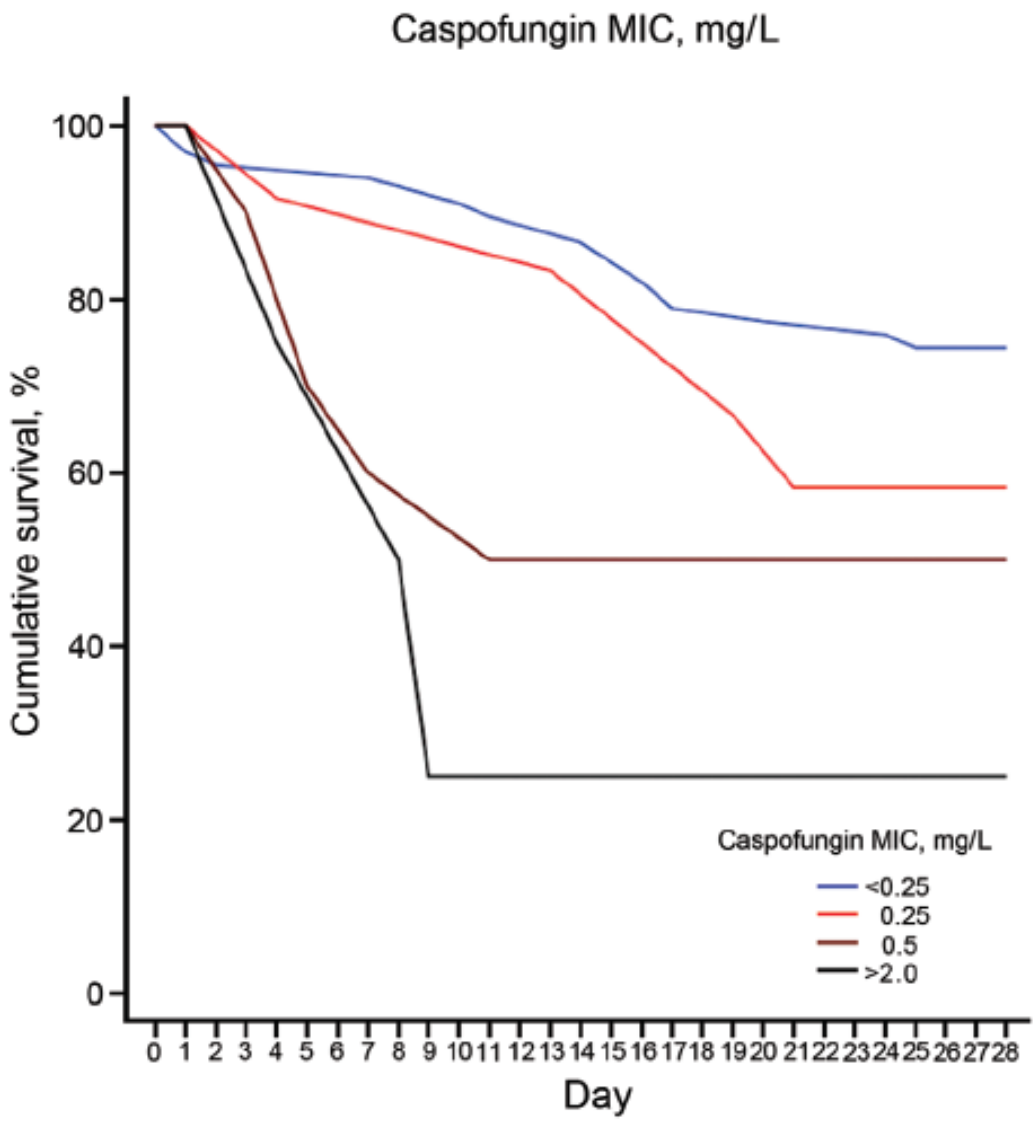
Independently associated with:

- Echinocandin preexposure
- Total parenteral nutrition

D. Farmakiotis et al, EID 2014

Drug resistant *Candida glabrata* in cancer patients

Strong correlation of all-cause mortality rates with in vitro caspofungin MICs but not with other factors classically associated with poor outcomes

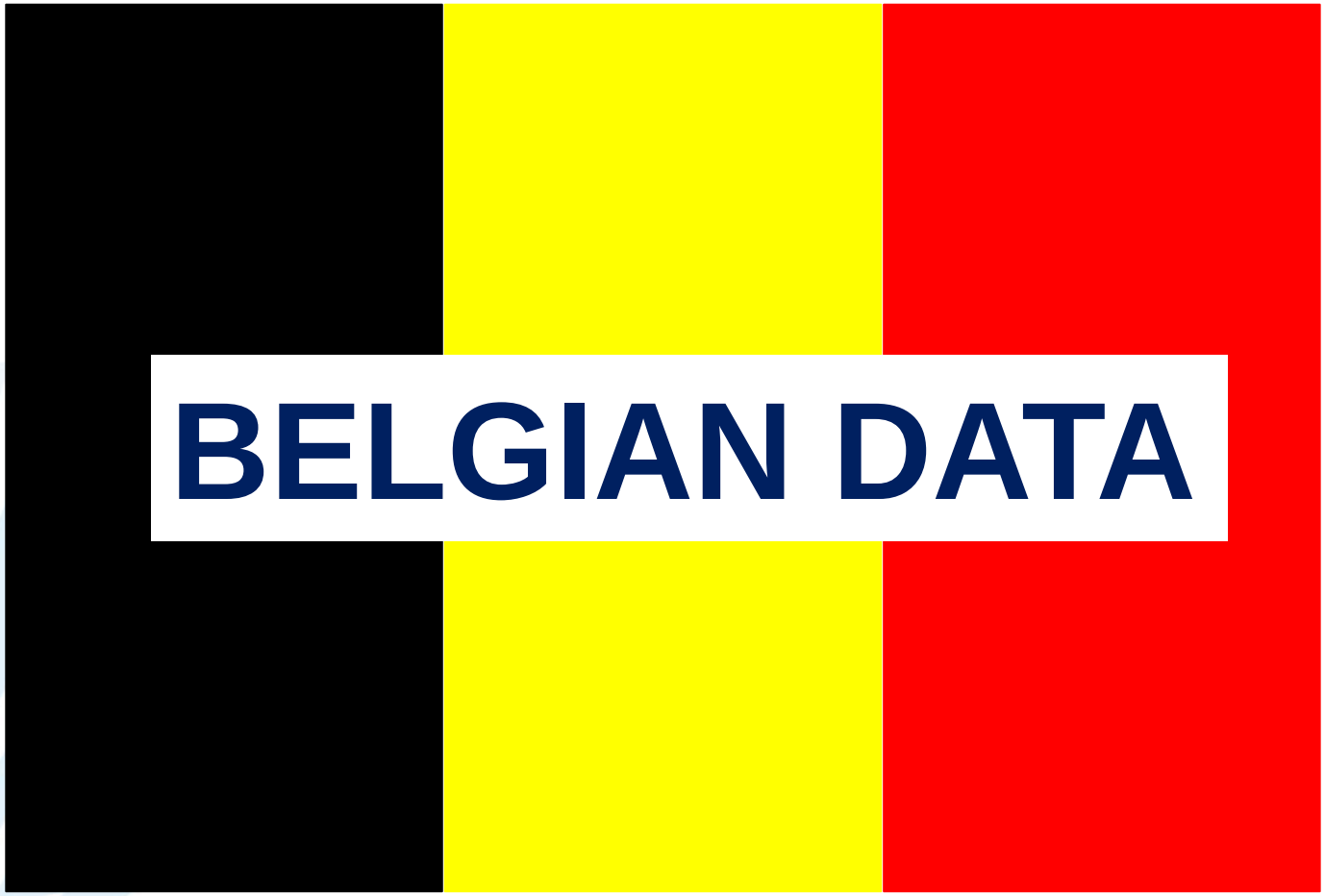


2012 intermediate susceptiblity

2012 breakpoint for R

2008 breakpoint for R

D. Farmakiotis et al, EID 2014


BELGIAN DATA

Eur J Clin Microbiol Infect Dis
DOI 10.1007/s10096-016-2841-3

ORIGINAL ARTICLE

Epidemiology and reporting of candidaemia in Belgium: a multi-centre study

C. Trouvé[1] · S. Blot[2,3] · M.-P. Hayette[4] · S. Jonckheere[5] · S. Patteet[1,9] · H. Rodriguez-Villalobos[6] · F. Symoens[7] · E. Van Wijngaerden[8] · K. Lagrou[1,9]

	FLC		VRC		POS		AND		MCF		AMB	
	% S	% R	% S	% R	% S	% R	% S	% R	% S	% R	% S	% R
C. albicans	92.7	3.9	96.1	3.9	96.6	3.4	100	0	100	0	100	0
C. glabrata	0	11.3	/*	/*	/*	/*	99.0	1.0	99.0	1.0	100	0
C. parapsilosis	94.4	5.6	94.4	5.6	97.2	2.8	0**	0**	0**	0**	100	0
C. tropicalis	75.0	20.0	80.0	20.0	80.0	20.0	100	0	/*	/*	100	0
Total	65.5	7.6	/*	/*	/*	/*	99.7	0.3	99.7	0.3	100	0

FLC: fluconazole; VRC: voriconazole; POS: posaconazole; AND: anidulafungin; MCF: micafungin; AMB: amphotericin B

*No EUCAST breakpoints available

**All strains were classified as intermediate susceptible

Published online: 17 November 2016

Drug resistance
The Observer

Millions at risk as deadly fungal infections acquire drug resistance

Researchers believe widespread use of fungicides on crops is reducing effectiveness of frontline medicines

Robin McKie Science Editor

Saturday 27 August 2016 21.00 BST

Aspergillus fumigatus, one of the most common aspergillus species to cause disease in individuals with an immunodeficiency. Photograph: Alamy

Scientists have warned that potentially deadly fungal infections are acquiring resistance to many of the medicines currently used to combat them. **More than a million people die of fungal infections every year,** including about 7,000 in the UK, and deaths are likely to increase as resistance continues to rise. **Researchers say the widespread use of fungicides on crops is one of the main causes of the rise in fungal resistance,** which mirrors the rise of resistance to antibiotics used to treat bacterial infections in humans.

“There are close parallels between bacterial and fungal resistance, though the problems we face with the latter are particularly worrying,” said Prof Adilia Warris, a co-director of the newly opened Centre for Medical Mycology at Abderdeen University.

“There are more than 20 different classes of antibacterial agents. By contrast, there are only four classes of anti-fungal agents. Our armory for dealing with deadly fungi is much smaller than the one we have for dealing with bacteria.

Doctors have recently uncovered another worrying development: outbreaks of fungal infections – mainly cryptococcus – that have appeared in previously healthy people. In one outbreak, in the northwest US, dozens of people died.

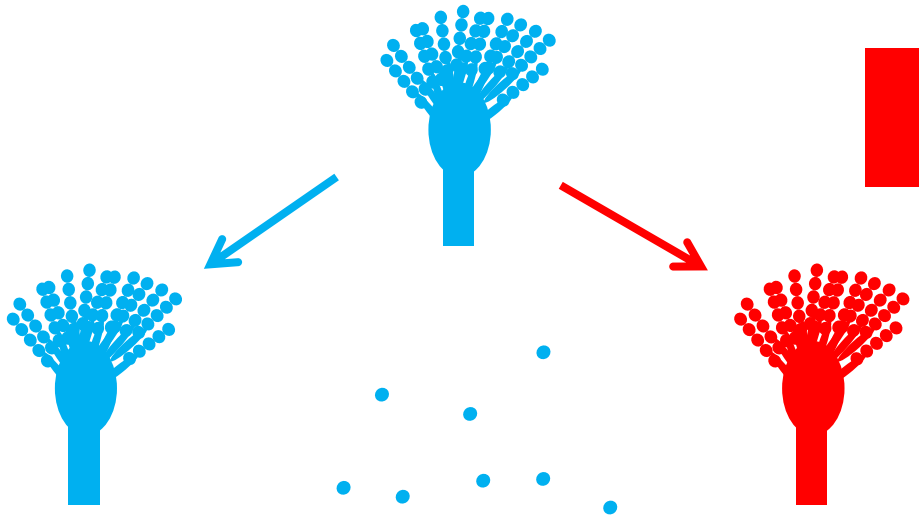
In the wake of these developments, it was decided by Britain’s Medical Research Council to open its Aberdeen mycology centre earlier this year.

It will employ experts in the field to gain new understanding of how fungi move into the human body and survive there. It will also work on the development of new drugs and tests for pinpointing specific fungi that are infecting patients.

“Fungal infections are going to be an increasing problem in coming years and we need to develop the best defences,” said Brown.

Routes of resistance development in A. fumigatus

ENVIRONMENT

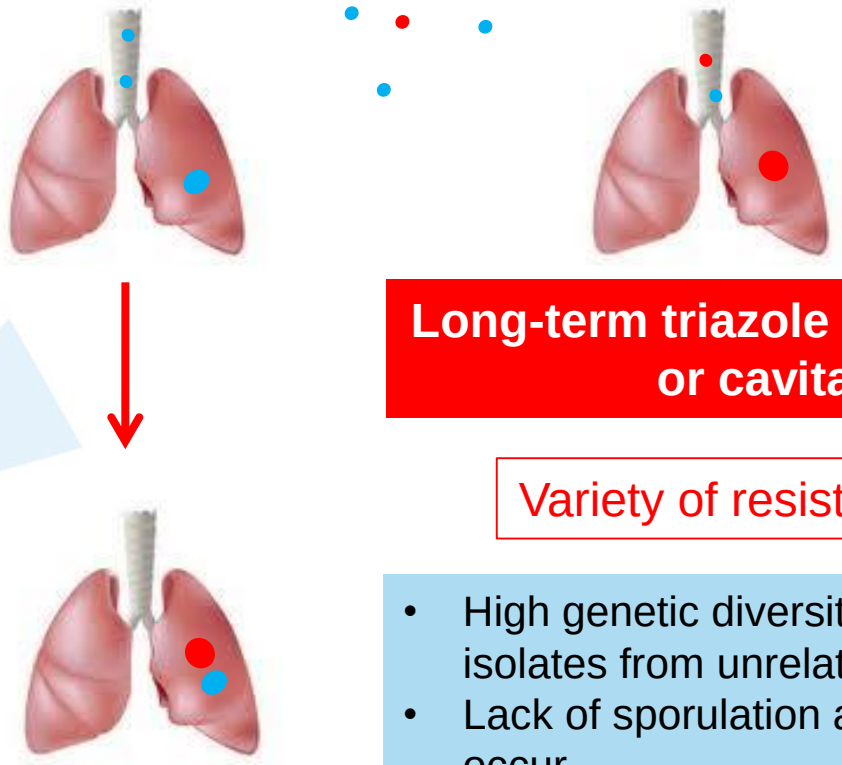


Triazole fungicides in agriculture

TR_{34}/L98H
TR_{46}/Y121F/T289A

- Patients with IA and chronic Aspergillus diseases
- Low genetic diversity between azole-resistant isolates from unrelated patients
- No apparent fitness cost

PATIENT



Long-term triazole treatment for aspergilloma or cavitary lung disease

Variety of resistance mechanisms

- High genetic diversity between azole-resistant isolates from unrelated patients
- Lack of sporulation and reduced growth rate may occur

PE Verweij et al, CID 2015, Epub ahead of print.

Global presence of azole resistance in A. fumigatus

Countries that reported the TR_{34}/L98H and TR_{46}/Y121F/T289A resistance mechanism in clinical or environmental A. fumigatus

PE Verweij et al, CID 2015, Epub ahead of print.

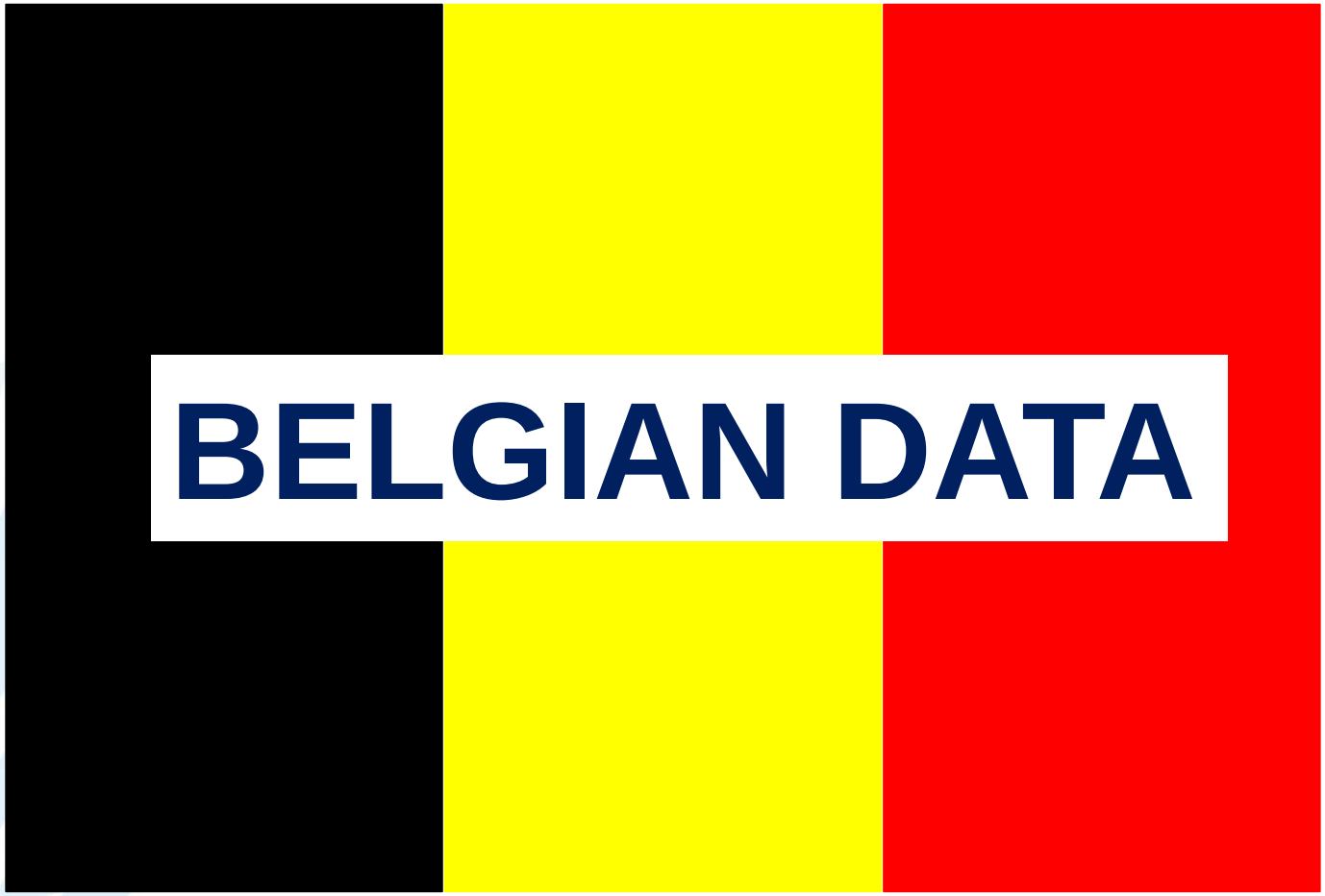
High prevalence of azole resistance in patients on the hematology ward in Utrecht

Patient characteristics						Resistance to voriconazole[a]		Resistance to itraconazole[a]		Resistance to posaconazole[a]	
Year	No. of patients	Age (years), median (range)	Male, %	Hospital ward	No. of patients (percentage of voriconazole-resistant isolates)	phenotype	no. of patient isolates (%)	phenotype	no. of patient isolates (%)	phenotype	no. of patient isolates (%)
2011	30	58.5 (10–80)	70.0	Haematology ICU	20 (50.0) 10 (0.0)	susceptible intermediate resistant	20/30 (66.7) 0 10/30 (33.3)	susceptible intermediate resistant	19/30 (63.3) 0 11/30 (36.7)	susceptible intermediate resistant	18/30 (60.0) 2/30 (6.7) 10/30 (33.3)
2012	42	63.5 (1–82)	42.9	Haematology ICU	19 (5.3) 23 (8.7)	susceptible intermediate resistant	34/42 (81.0) 5/42 (11.9) 3/42 (7.1)	susceptible intermediate resistant	36/42 (85.7) 0 6/42 (14.3)	susceptible intermediate resistant	34/42 (81.0) 3/42 (7.1) 5/42 (11.9)
2013	33	58 (9–78)	57.6	Haematology ICU	22 (18.2) 11 (0.0)	susceptible intermediate resistant	27/33 (81.8) 2/33 (6.1) 4/33 (12.1)	susceptible intermediate resistant	29/33 (87.9) 0 4/33 (12.1)	susceptible intermediate resistant	24/33 (72.7) 5/33 (15.2) 4/33 (12.1)
Total	105	60 (1–82)	55.2	Haematology ICU	61 (24.6) 44 (4.5)	susceptible intermediate resistant	81/105 (77.1) 7/105 (6.7) 17/105 (16.2)	susceptible intermediate resistant	84/105 (80.0) 0 21/105 (20.0)	susceptible intermediate resistant	76/105 (72.4) 10/105 (9.5) 19/105 (18.1)

[a]Voriconazole: resistant MIC >2 mg/L and susceptible MIC ≤1 mg/L; itraconazole: resistant MIC >2 mg/L and susceptible MIC ≤1 mg/L; posaconazole: resistant MIC >0.25 mg/L and susceptible MIC ≤0.12 mg/L.[8,9] Values between resistant and susceptible were considered intermediate.[8,9]

- 105 positive cultures collected; proven IA (5), probable IA (48) and no infection (52)
- 21/105 (20%) isolates were resistant to at least one azole
- 16/105 (15.2) isolates showed pan-azole resistance
- 16/17 (94.1%) of voriconazole resistant isolates exhibit *cyp51A* gene mutation

Fuhren et al., JAC 2015, 70: 2894-2898.


BELGIAN DATA

Belgium nationwide surveillance

	# Isolates	# Patients	Rate of azole-resistance	Prevalence of azole-resistance	Mechanism of resistance (number of patients)
Invasive aspergillosis	**134**	**122**			
A. fumigatus	115	108	5/115 (**4·4%**)	5/108 (**4·6%**)[4]	4 TR_{34}/L98H, 1 non-Cyp51A
A. niger	9	9	8/9 (89%)	8/9 (89%)	8 intrinsic (8 *A. tubingensis*)
Other species	10	10	0/10	0/10	
ABPA and bronchitis	**66**	**46**			
A. fumigatus	62	44	6/62 (**9·7%**)	4/44 (**9·1%**)	2 TR_{34}/L98H, 1 TR_{46}/Y121F/T289A, 1 non-Cyp51A mediated
A. niger	1	1	1/1	1/1	1 intrinsic (1 *A. tubingensis*)
Other	3	2	0/3	0/2	/
Chronic aspergillosis[1]	**20**	**15**			
A. fumigatus	15	13	0/15 (0%)	0/13 (0%)	/
A. niger	0	0	/	/	/
Other	5	3	0/5	0/3	/
Total	**220**	**182**			
A. fumigatus	192	164	11/192 (**5·7%**)	9/164 (**5·5%**)	6 TR_{34}/L98H, 1 TR_{46}/Y121F/T289A, 2 non-Cyp51A mediated
A. niger	10	10	9/10 (90%)	9/10 (90%)	9 intrinsic (9 *A. tubingensis*)
Other	18	15	0/18 (0%)	0/15 (0%)	/

E. Vermeulen et al., AAC 2015

Drug Resistance Updates 21–22 (2015) 30–40

Contents lists available at ScienceDirect

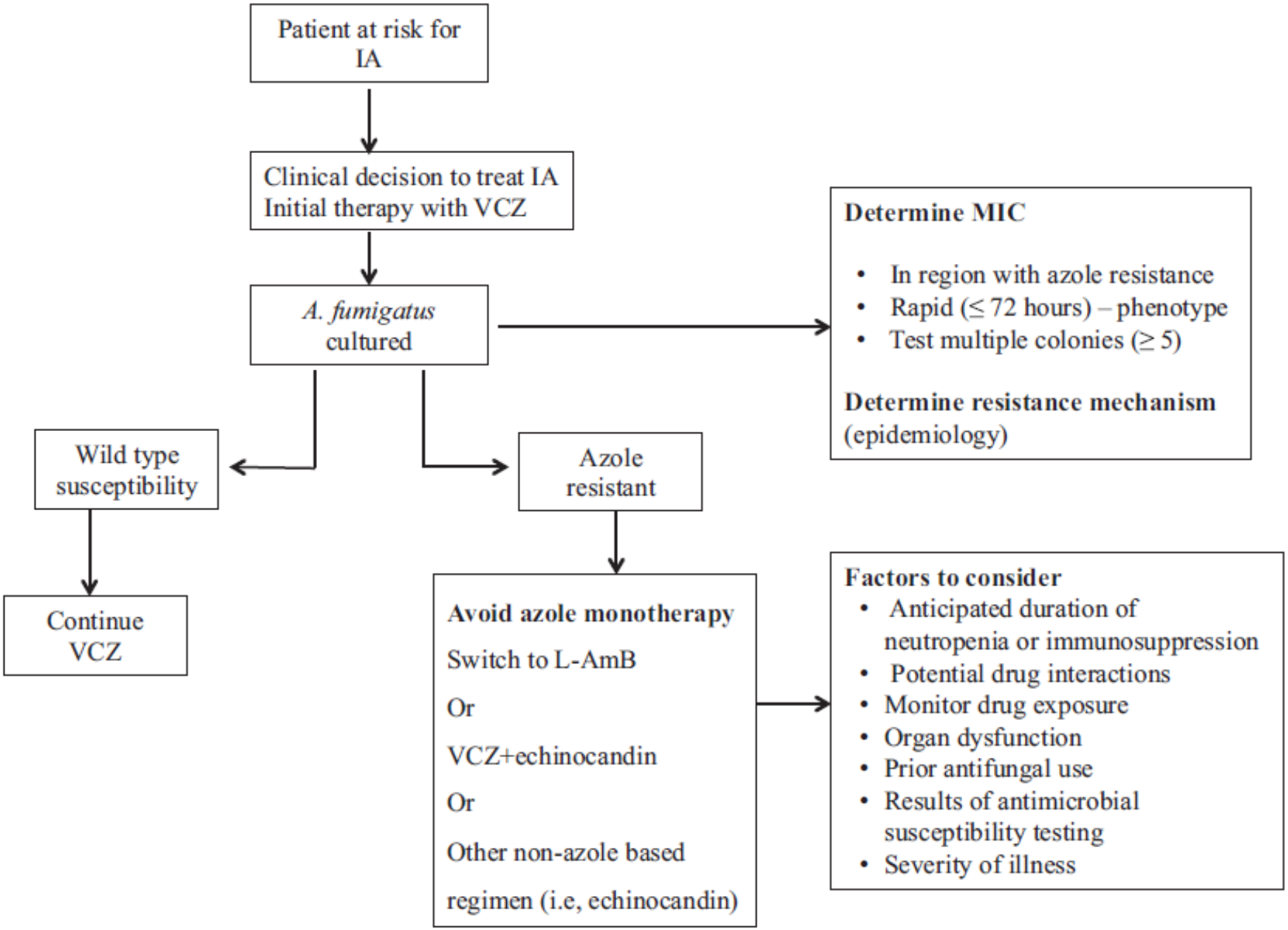
Drug Resistance Updates

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

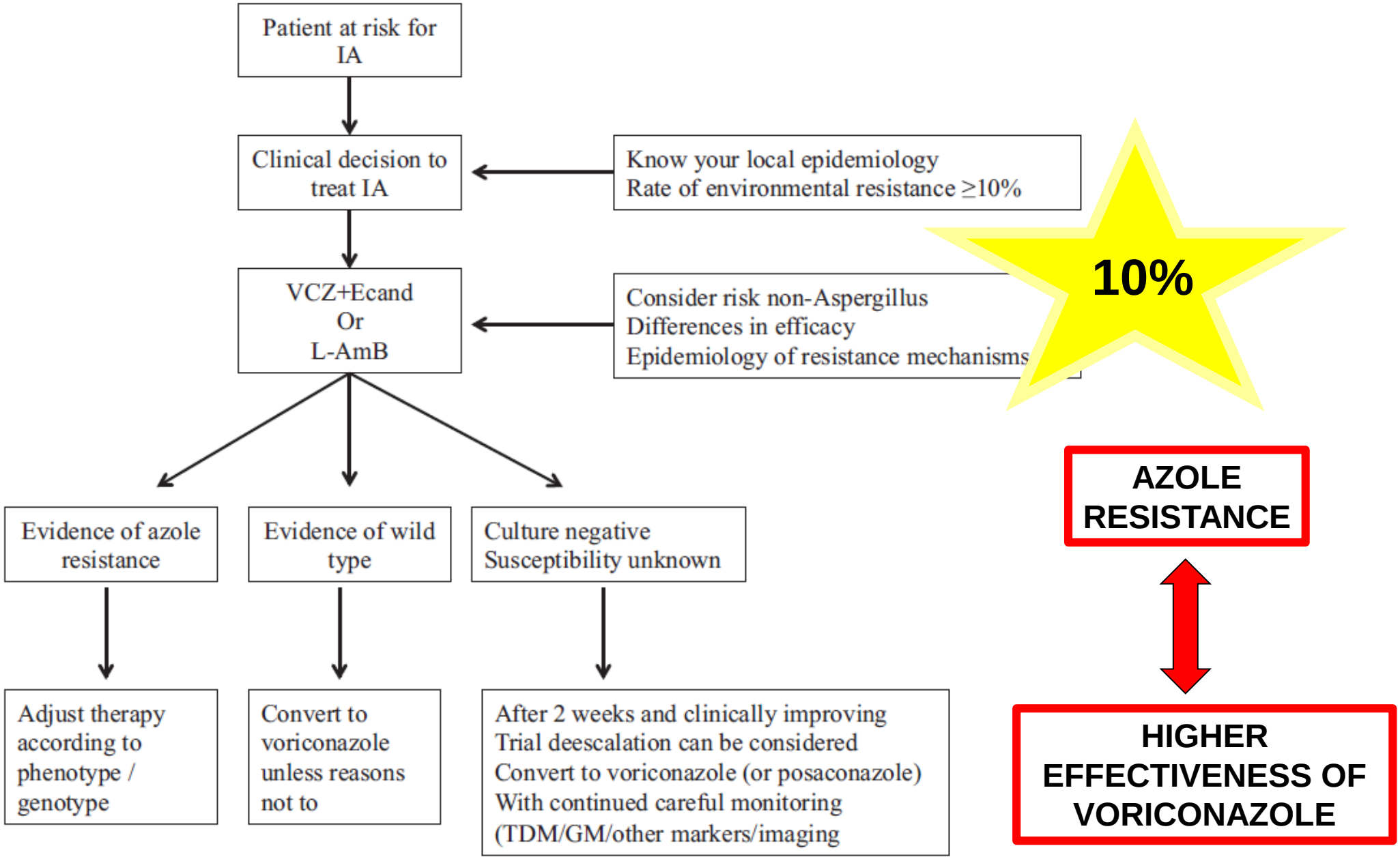
International expert opinion on the management of infection caused by azole-resistant *Aspergillus fumigatus*

Paul E. Verweij[a,*], Michelle Ananda-Rajah[b], David Andes[c], Maiken C. Arendrup[d], Roger J. Brüggemann[e], Anuradha Chowdhary[f], Oliver A. Cornely[g], David W. Denning[h], Andreas H. Groll[i], Koichi Izumikawa[j], Bart Jan Kullberg[k], Katrien Lagrou[l], Johan Maertens[m], Jacques F. Meis[a,n], Pippa Newton[h], Iain Page[h], Seyedmojtaba Seyedmousavi[a], Donald C. Sheppard[o], Claudio Viscoli[p], Adilia Warris[q], J. Peter Donnelly[r]

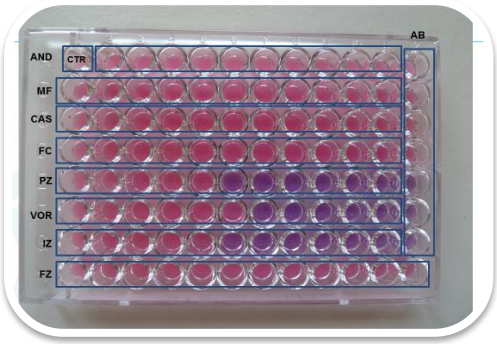
Management of patients with IA in regions with no/minimal azole resistance in the environment



Management of patients with IA in regions with ≥ 10% environment resistance



Triazole resistance detection in Aspergillus



MIC determination

- CLSI/EUCAST
- Commercial systems

Triazole resistance screening agar (VIPcheck™)

Sensitivity 97%
Specificity 98%

Molecular methods

- In house
- AsperGenius® assay

Resistance multiplex
– L98H
– Tandem repeat 34
– T289A
– Y121F

- Always perform susceptibility testing if antifungal therapy is intended – contact the lab!
- Both azole-susceptible and azole-resistant phenotypes can be simultaneously present in culture, test multiple colonies!

UZ LEUVEN

MEDICAL MYCOLOGY

Despite the multifaceted importance of medical mycology, the study of fungal infections has lagged behind that of other pathogens, and lethal mycoses continue to undo the good work done in the treatment of cancers, intensive care patients, and severely immunocompromised individuals. Public health understanding of the impact of fungal disease in both the hospital and the community is limited.

Registration

Registration before 1 May 2017. A maximum of 20 students are allowed. A minimum of 10 participants is required in order to organise the course.

Please contact Mrs. Margaretha Charlier
Email: Margaretha.charlier@uzleuven.be
Tel: +32 16 34 79 02

For more information on the course, please contact :

Dr. Ignace Surmont : Ignace.Surmont@azsintjan.be
Pr. Katrien Lagrou : katrien.lagrou@uzleuven.be
Pr. Marie-Pierre Hayette : mphayette@chu.ulg.ac.be

Specialization Course in Medical Mycology

from Monday, September 11, 2017
until Thursday, September 21, 2017
at the KU Leuven Campus Gasthuisberg

SBMHA - BVMDM

KATHOLIEKE UNIVERSITEIT LEUVEN

SBMHA - BVMDM

KATHOLIEKE UNIVERSITEIT LEUVEN

Content

Medical mycology is a domain of medical microbiology of increasing importance.
Fungi are frequently responsible for superficial mycoses but cause also lifethreatening invasive infections in patients with reduced immunity. With an ever increasing mobility of people, the importance of import fungal pathologies is also increasing. The course aims to provide insight into fungal infections, host factors, clinical pictures, diagnosis and treatment of these infections.

An important part of the course will be devoted to the acquisition of skills for the identification of fungi. The aim of the course is to enable participants to give adequate mycological advice in clinical practice. All common fungal infections will be discussed. Theoretical sessions alternate with discussion of clinical cases and pratical's.

Audience

The target audience are physicians, medical microbiologists and scientists who want to develop or expand their theoretical and practical knowledge in medical mycology.

Organisation

KU Leuven, Department of
Microbiology & Immunology

In collaboration with:
The Belgian Society for Human and Animal Mycology

Prof. Dr. P.E. Verweij, UMC St. Radboud,
Nijmegen, The Netherlands

Practical

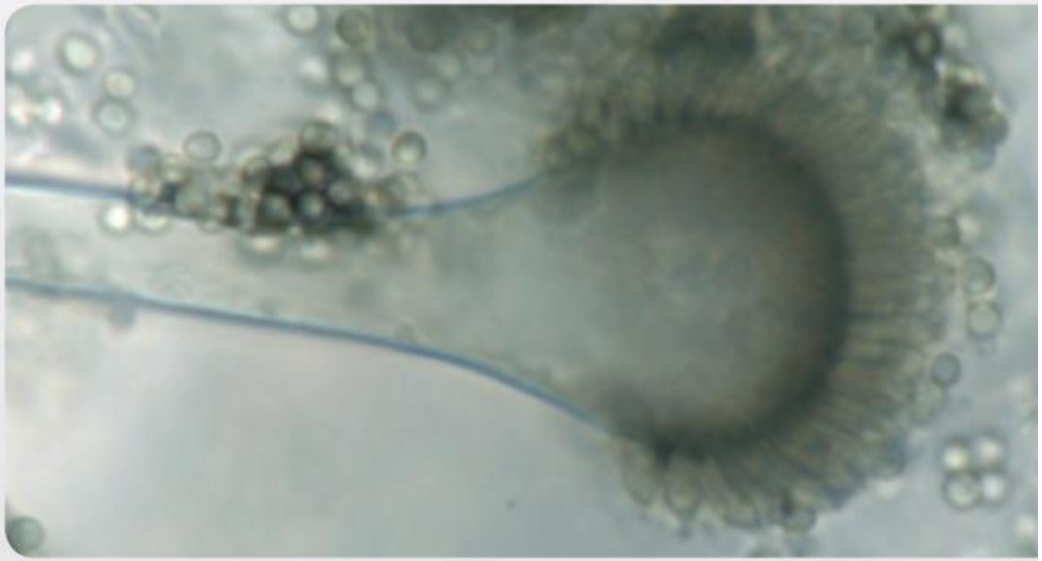
The 9-day course will be from Monday, September 11, 2017 until Thursday, September 21, 2017 at the KU Leuven Campus Gasthuisberg.

The cost of the course is 1.900 €. This includes the textbook «Medically Important Fungi: A Guide to Identification, Fifth Edition» from D. Larone, and slides.

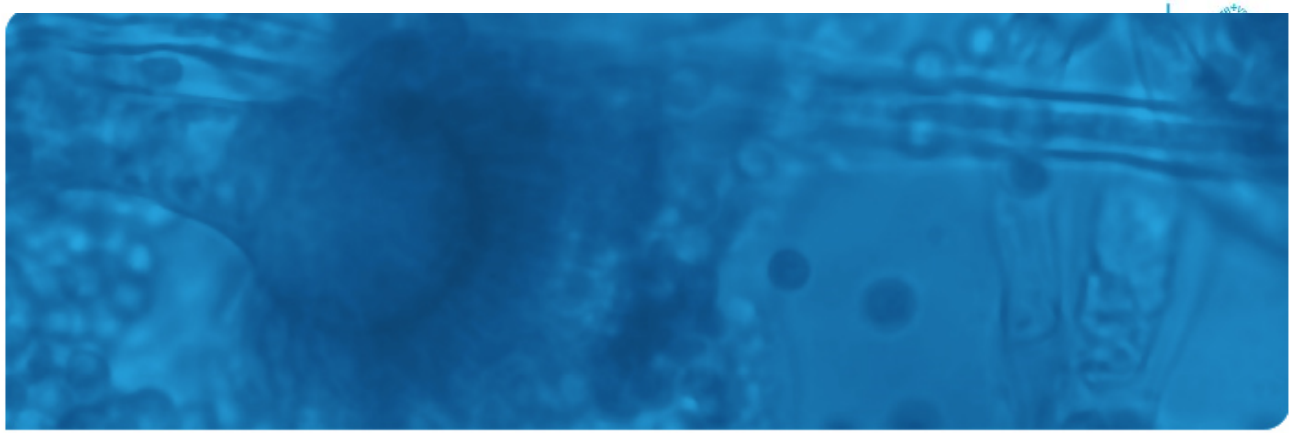
The course is given by a core team of teachers (Professor Katrien Lagrou, Dr. Ignace Surmont and Prof. M.P. Hayette) and guest speakers with expertise in a specific field of mycology. The practical sessions are supported by highly trained laboratory technologists.

The course ends with an assessment test. After passing the test, the participant receives a «**Certificate of medical mycology**».

Accreditation is sought.



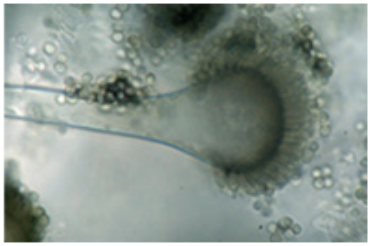
Belgian Society Human Animal Mycology



Belgian Society of Human and Animal Mycology

The **Belgian Society for Human and Animal Mycology (BSHAM)** was created in 1964 by Raymond Vanbreuseghem, physician, Professor of Parasitology at the Free University of Brussels, and Professor of Medical Mycology at the Institute of Tropical Medicine in Antwerp.

It is an VZW/ASBL concerned with pathologies induced by fungi and yeasts such as fungal allergies, mycotoxicoses, mycetism and mycoses.



BSHAM is a bilingual society with about 85 members presently.

It is directed by a Board meeting 2 or 3 times per year, most of the information being given by e-mail. A plenary administrative meeting (general meeting) is organised once a year. The annual scientific meeting takes place successively in Brussels, Flanders and Wallonia.

All BSHAM members are automatically members of the European Confederation of Medical Mycology. Many of them are also member of the **International Society for Human and Animal Mycology (ISHAM)**.

Account: IBAN BE 35 0011 2595 0637- BIC GEBABEBB

http://www.medmycol.be/