Visual session of unusual *Aspergillus* species: images and plates

J. Varga, S. Kocsubé, G. Szigeti, N. Baranyi, J. Houbraken, R. A. Samson

Aspergillus

Aspergillus terreus
conidial head

Aspergillum (holy water sprinkler)

Pietro Antonio Micheli (Nova Plantarum Genera, 1729)

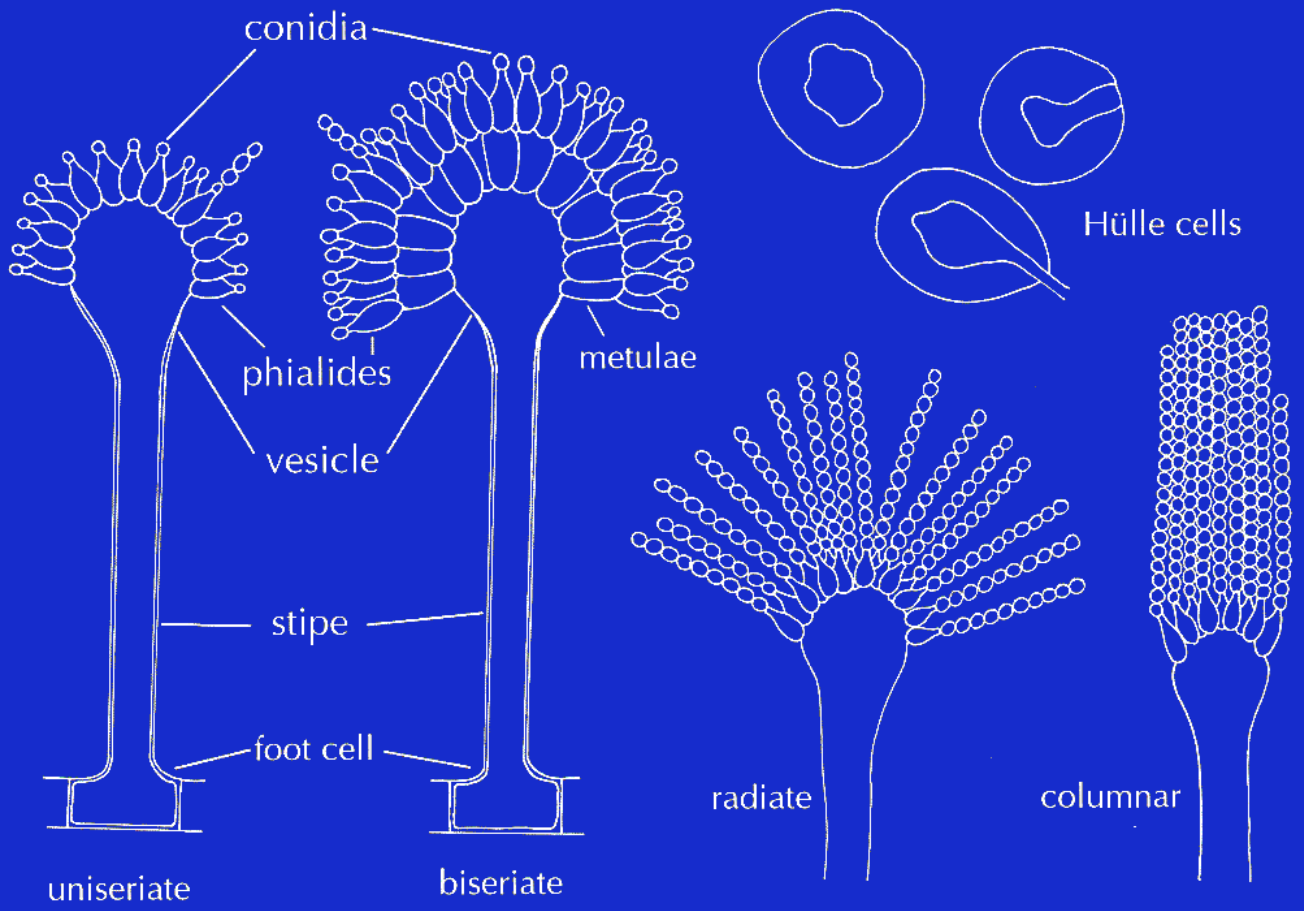
Outline of the presentation

- Overview of *Aspergillus* taxonomy & nomenclature

- Unusual/newly described Aspergilli in the clinical setting
  - Section *Fumigati*
  - Section *Flavi*
  - Section *Nigri*
  - Section *Nidulantes*
  - Section *Circumdati*
  - Other species

Aspergillus taxonomy and nomenclature

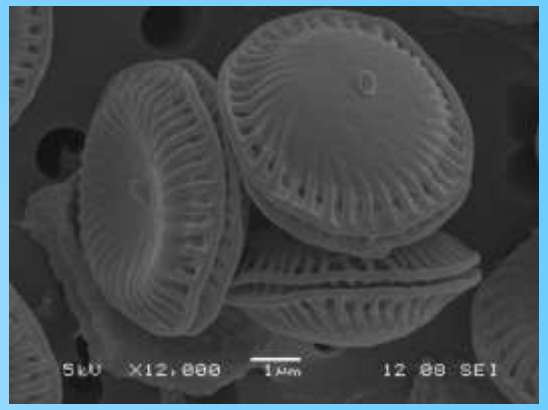
- What is *Aspergillus*?



What is *Aspergillus?*

"Aspergillus paradoxus"

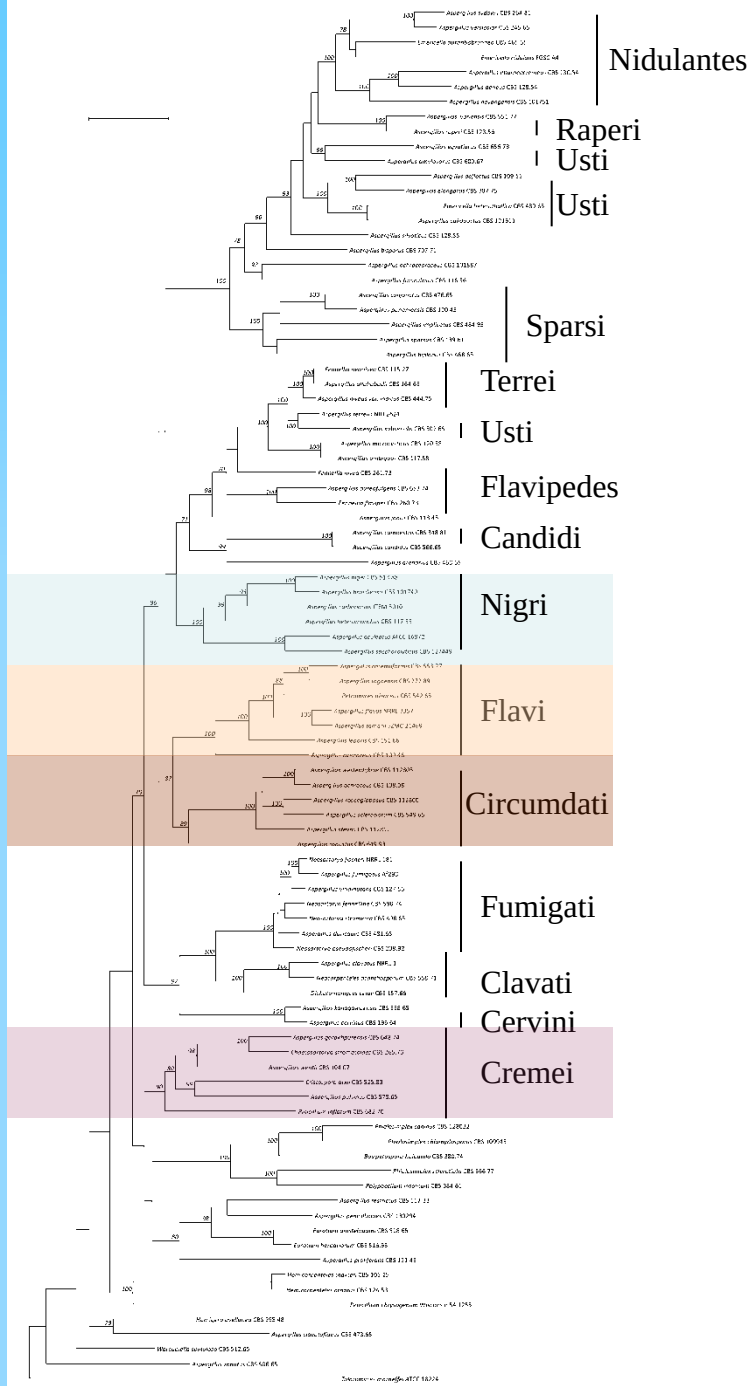
"Fennellia monodii"



"Penicillium inflatum"

Phylogenetic relationships within the *Aspergillus* genus

- type strains of 92 species were examined
- 6 genes: Acl1, MCM7, RPB1, RPB2, Tsr1, Cct8
- maximum likelihood (PhyML)



Use of dual nomenclature in Aspergilli

- Teleomorph: *Neosartorya fischeri* (Wehmer) Malloch & Cain 1972
- Anamorph: *Aspergillus fischerianus* Samson & W. Gams 1985

One fungus = One name

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Fungal nomenclature.

1. Melbourne approves a new Code

Lorelei L. Norvell

Secretary, IAPT Nomenclature Committee for Fungi,
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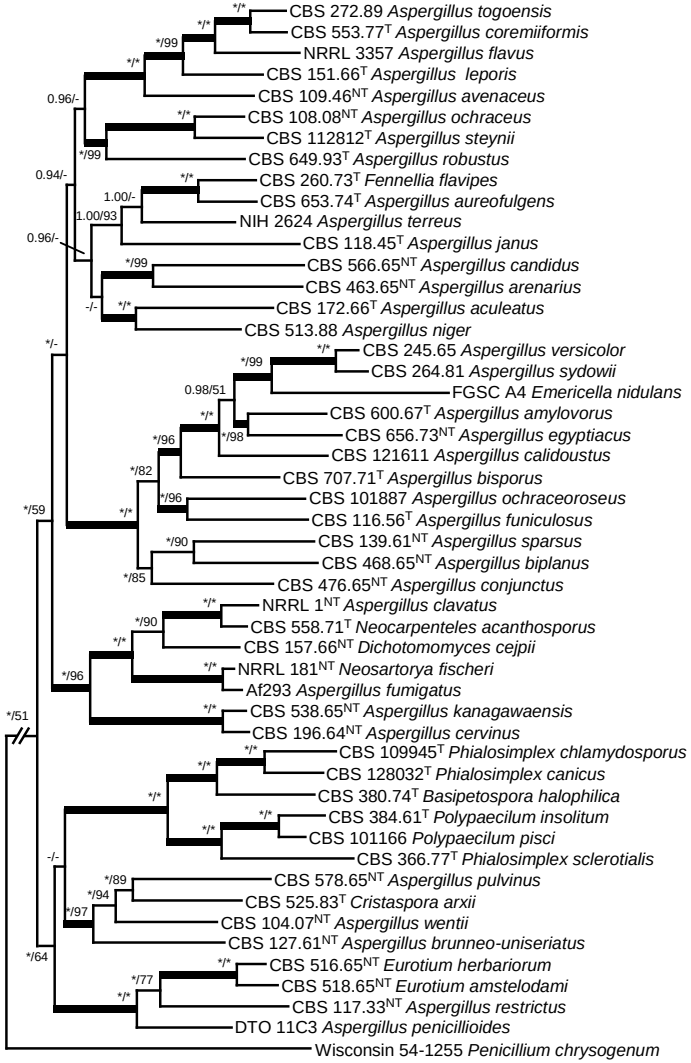
Correspondence to: *llnorvell@pnw-ms.com*

Aspergillus is largely a monophyletic genus



subgenus *Circumdati*
Incl. sections *Circumdati*, *Flavi*, *Candidi*, *Flavipedes*, *Nigri*, *Terrei*

subgenus *Nidulantes*
Incl. sections *Nidulantes*, *Usti*, *Ochraceorosei*, *Sparsi*, (*Aeni*)

subgenus *Fumigati*
Incl. sections *Fumigati*, *Clavati* and *Cervini*

Phialosimplex & *Polypaecilum*

Aspergillus section *Cremei*

subgenus *Aspergillus*
Incl. sections *Restricti*, *Aspergillus*

Possible name if the genus is kept as a unit

Aspergillus

Aspergillus

Aspergillus

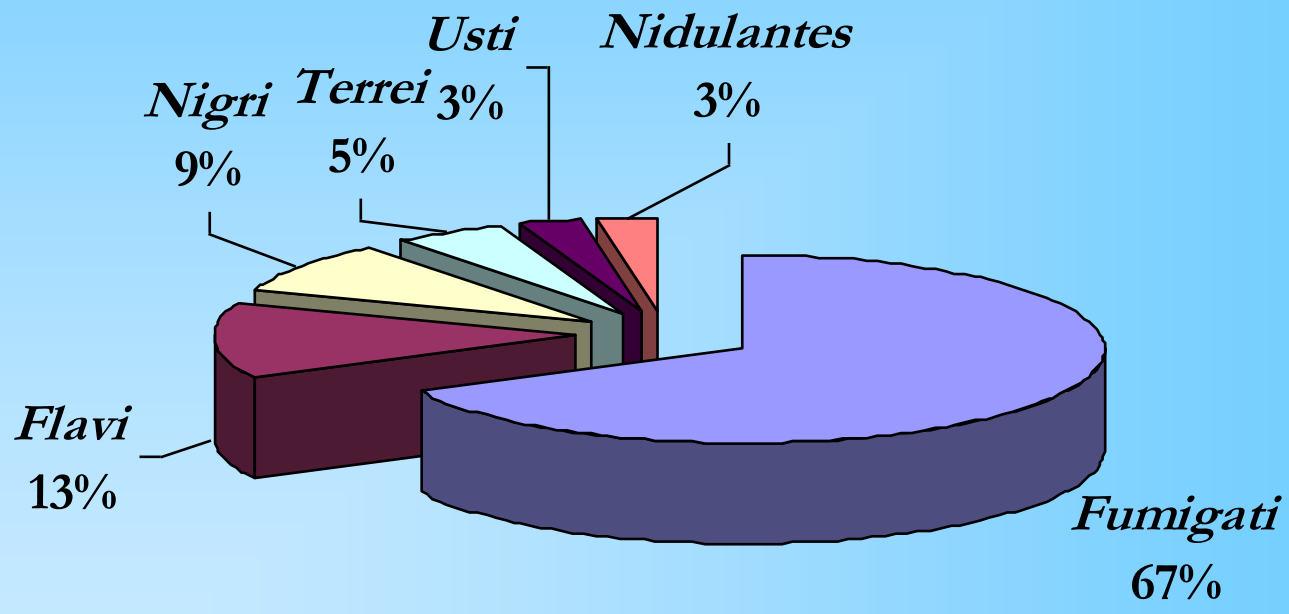
Aspergillus

Aspergillus

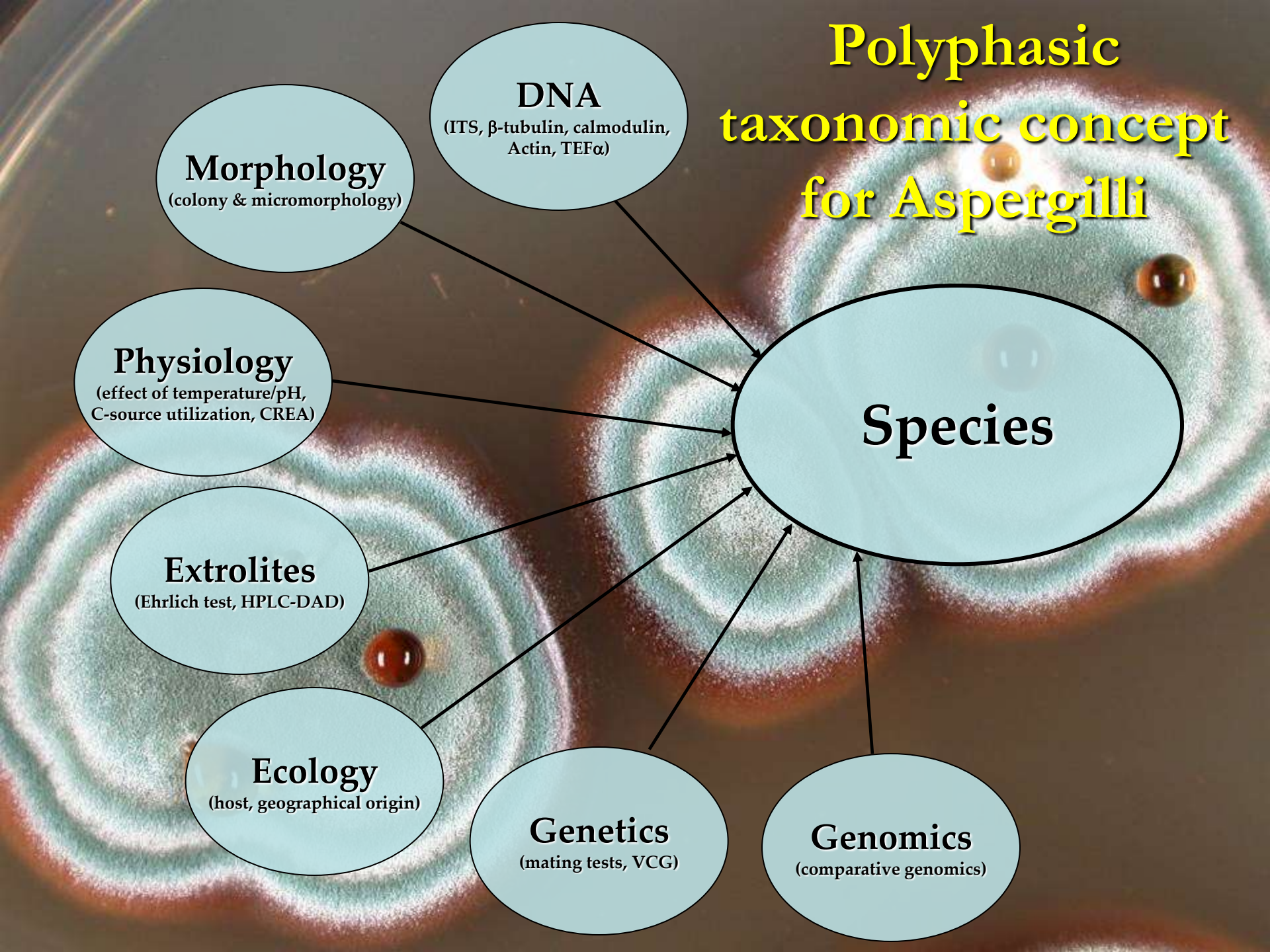
Aspergillus

SIM 70 (2011) 1-51

Distribution of *Aspergillus* sections based on sequence-based identification in the transplant associated infection surveillance network



J Clin Microbiol 2009; 47: 3138-41; 3271-75

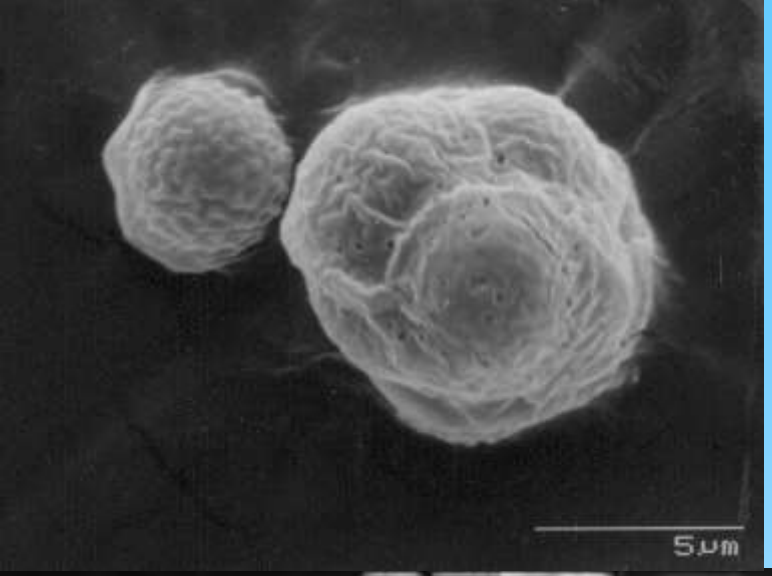

Polyphasic taxonomic concept for Aspergilli
DNA
(ITS, β-tubulin, calmodulin, Actin, TEFα)
Morphology
(colony & micromorphology)
Physiology
(effect of temperature/pH, C-source utilization, CREA)
Extrolites
(Ehrlich test, HPLC-DAD)
Ecology
(host, geographical origin)
Genetics
(mating tests, VCG)
Genomics
(comparative genomics)
Species

Species with known genome sequences

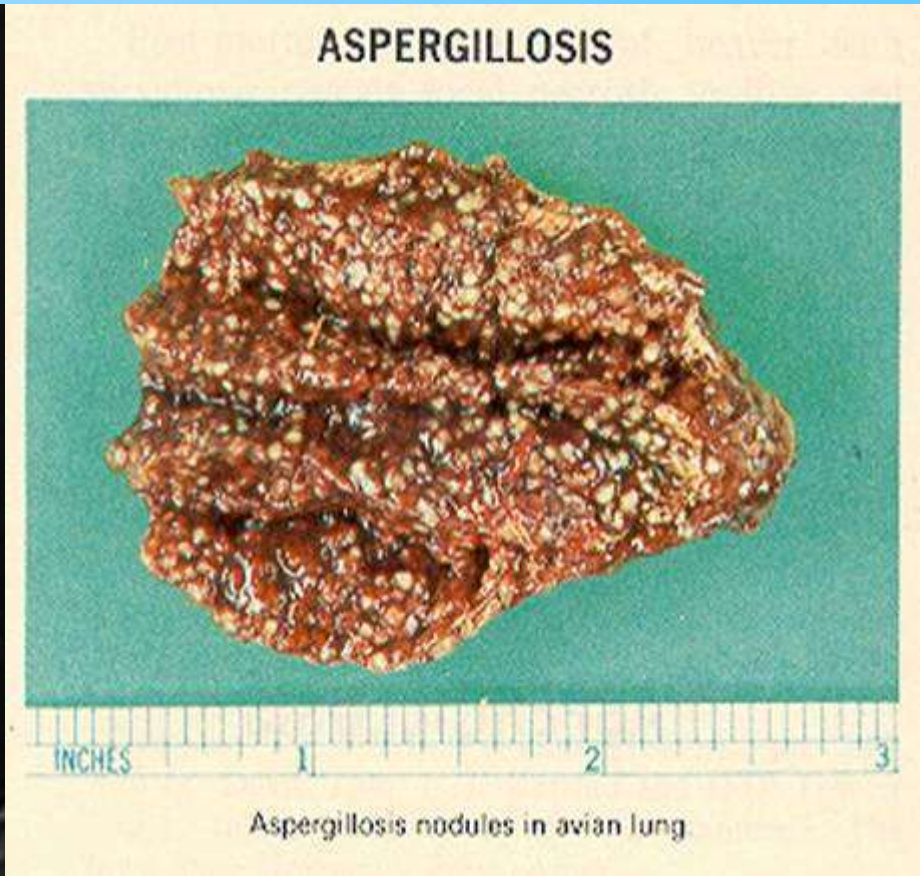
- *Aspergillus fumigatus* (3 isolates)
- *Aspergillus clavatus*
- *Aspergillus flavus*
- *Aspergillus nidulans*
- ***Aspergillus niger* (3 isolates)**
- *Aspergillus oryzae*
- *Aspergillus terreus*
- *Neosartorya fischeri*
- ***Aspergillus carbonarius***
- ***Aspergillus aculeatus***
- *Aspergillus parasiticus*
- ***Aspergillus tubingensis***

Species with genome sequencing in progress

- ***Aspergillus tubingensis***
- ***Aspergillus welwitschiae***
- ***Aspergillus brasiliensis***
- ***Aspergillus kawachii (?)***
- ***Aspergillus luchuensis***
- *Aspergillus sojae*
- *Aspergillus versicolor*
- *Aspergillus sydowii*
- *Aspergillus wentii*
- *Aspergillus glaucus*
- *Aspergillus zonatus*
- *Aspergillus cervinus*
- *Aspergillus sparsus*
- *Aspergillus penicillioides*

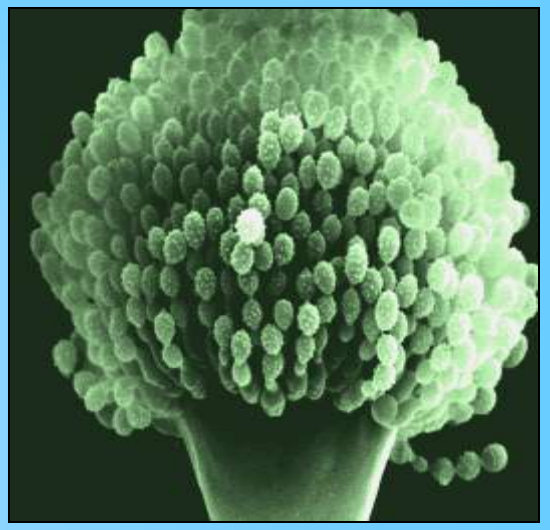


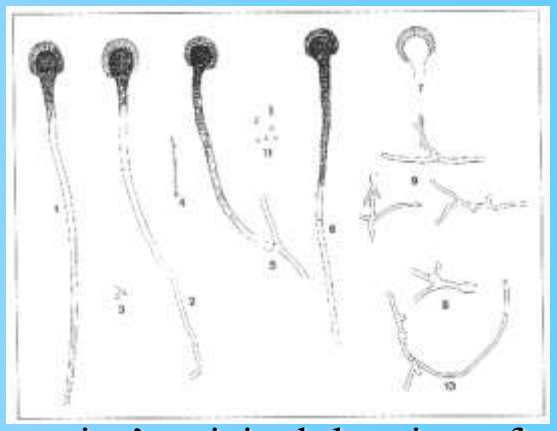
Aspergillus section *Fumigati*



Aspergillus fumigatus Fresenius 1863

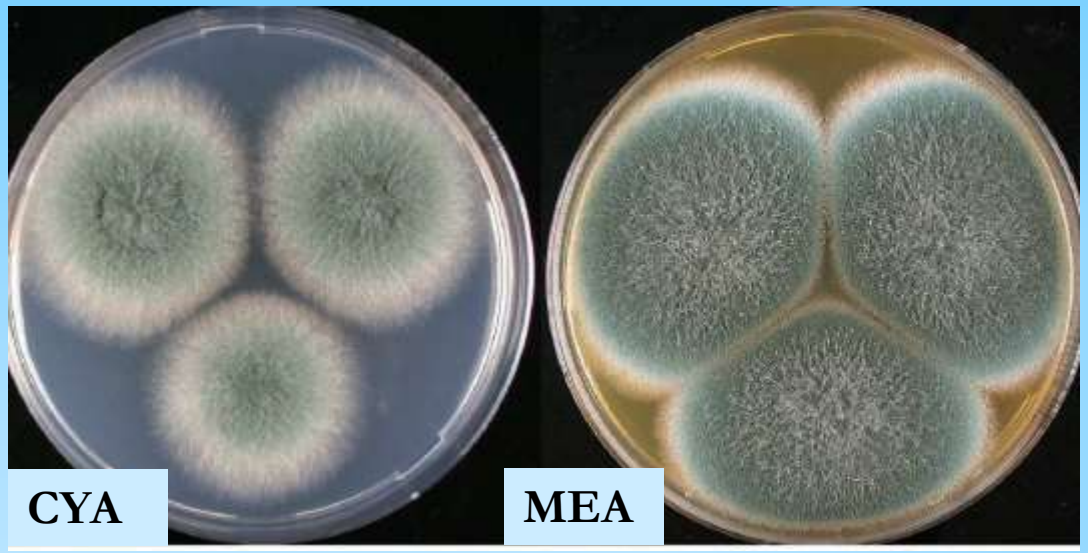
- *A. fumigatus* is the most frequent cause of IA in most medical centers
- People at risk are transplant recipients, patients with HIV/AIDS, with chronic granulomatous disease, with severe combined immunodeficiency, etc.
- ca. 350 000 patients suffer from IA worldwide according to Fungal Research Trust (2011)
- Able to grow at/above 50°C





Fresenius's original drawing of *A. fumigatus* conidial heads

Aspergillus fumigatus

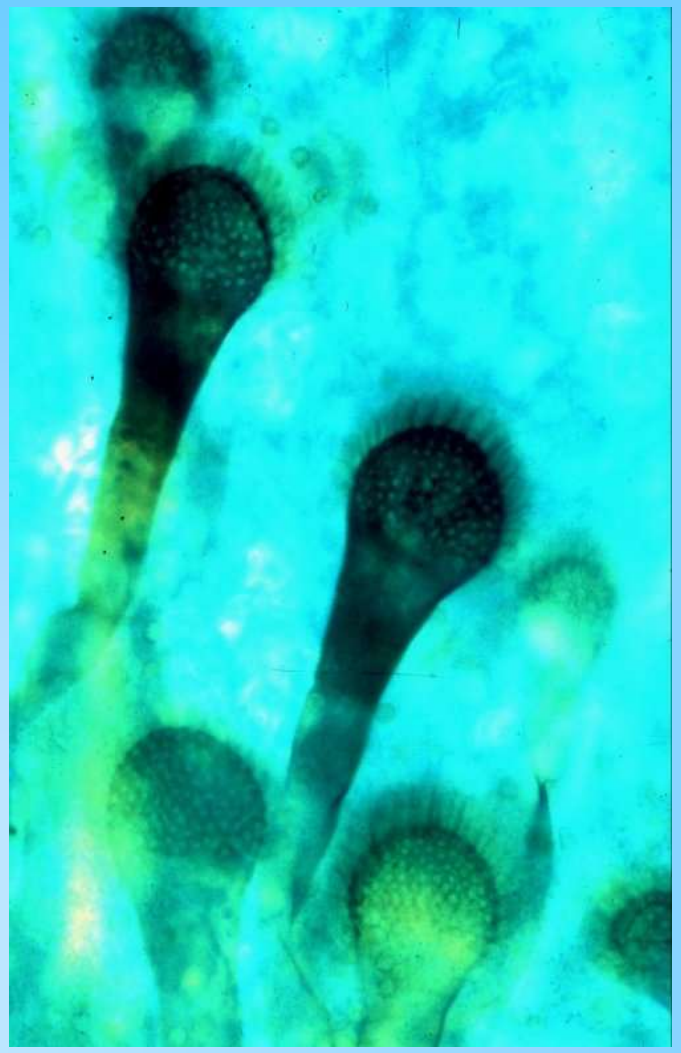


Fast-growing blue- green colonies covering the entire MEA plate in 5-7 days at 37°C

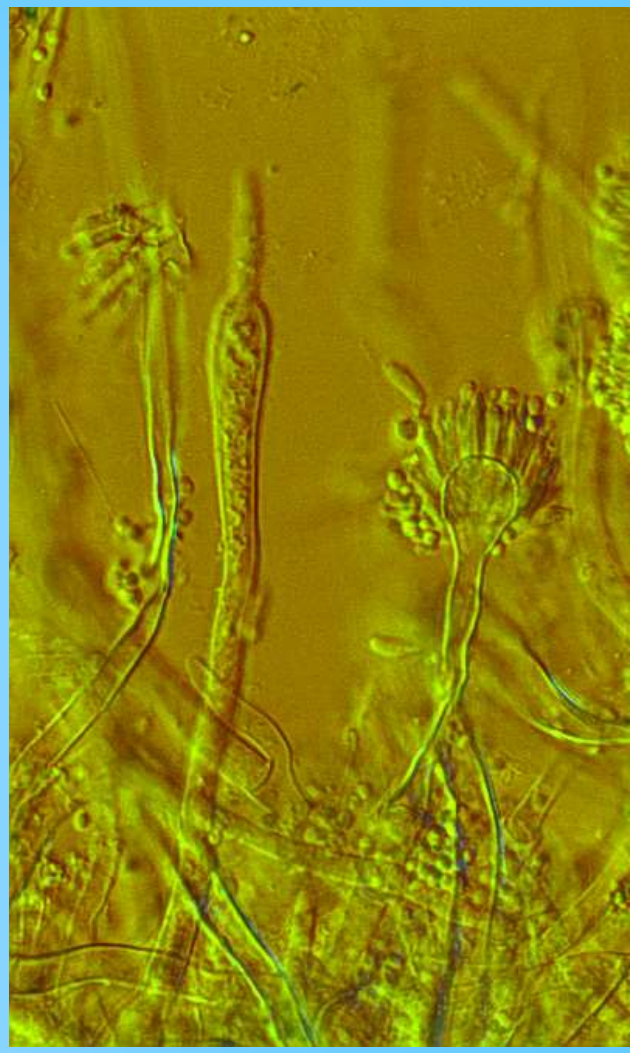
Typical columnar heads

Aspergillus fumigatus

Typical isolates



Conidiophores in sputum

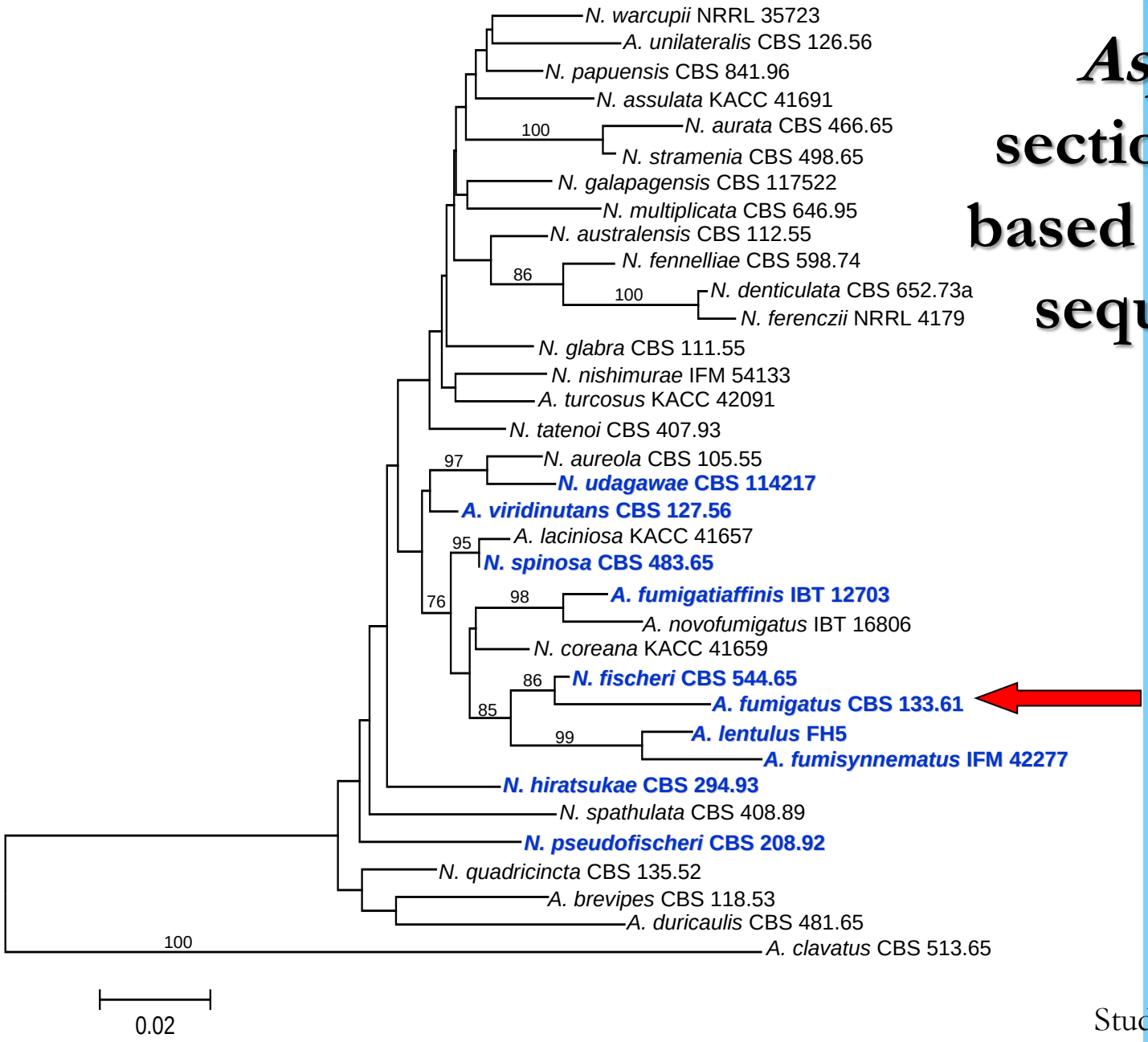


Clinical isolates

Synonyms of *A. fumigatus* described from clinical material

- *A. aviarius* Peck 1891
- *A. bronchialis* Blumentritt 1901
- *A. septatus* Sartory & Sartory 1943
- *A. fumigatus* var. *ellipticus* Raper & Fennell 1965
- *A. fumigatus* var. *minimus* Sartory 1919
- *A. phialiseptatus* Kwon-Chung 1975
- *A. neoellipticus* Kozakiewicz 1989
- *A. acolumnaris* Kozakiewicz 1989
- *A. arvii* Aho et al. 1994
- *A. syncephalis* Gueguen 1904
- *A. lignieresi* Cost. & Lucet 1905

Tree of *Aspergillus* section *Fumigati* based on β-tubulin sequence data



Stud Mycol 2007; 59: 147-203

Species identification

- Anamorphs can hardly be distinguished by morphological means
- ITS can be used to define "species complexes" (e.g. *A. fumigatus* complex, *A. niger* complex)
- If more precise identification is needed, the use sequences of parts of other genes (e.g. calmodulin, β-tubulin)

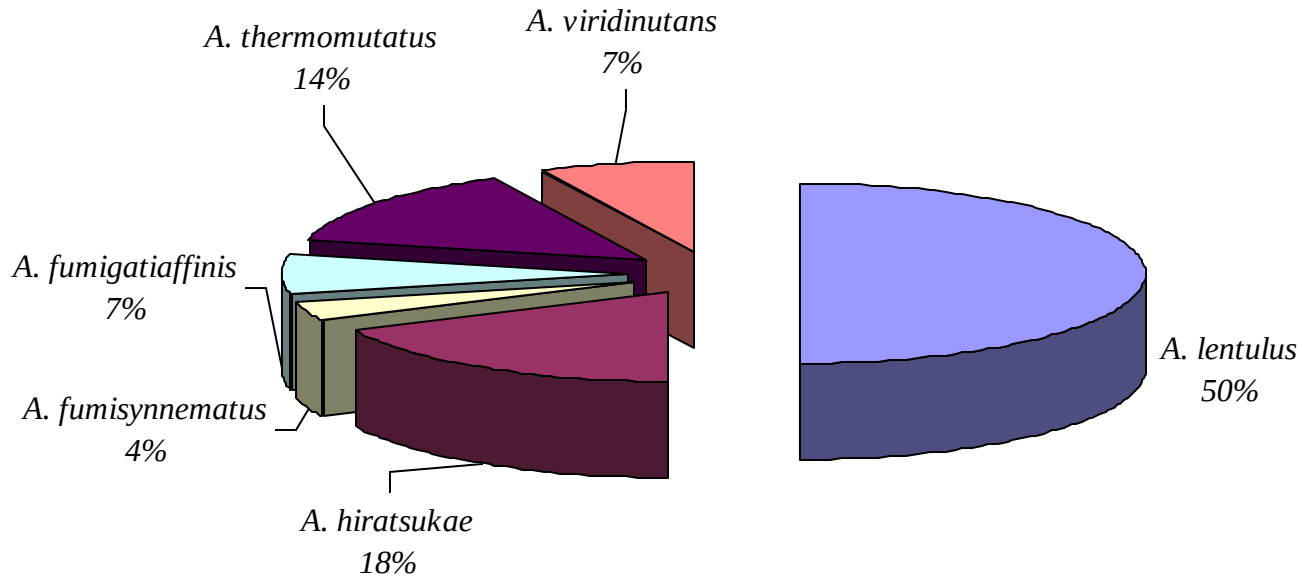
A. fumigatus

A. lentulus

A. fumisynnematus

A. fumigatiaffinis

Distribution of section *Fumigati* strains not growing at 48°C in Spain



Antimibrob Agents Chemother 2008; 52: 1244-1251

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

Sinonasal and sino-orbital aspergillosis in 23 cats: Aetiology, clinicopathological features and treatment outcomes

V.R. Barrs[a,*], C. Halliday[b], P. Martin[c], B. Wilson[a], M. Krockenberger[c], M. Gunew[d], S. Bennett[e], E. Koehlmeyer[f], A. Thompson[g], R. Fliegner[h], A. Hocking[i], S. Sleiman[b], C. O'Brien[h], J.A. Beatty[a]

[a] Valentine Charlton Cat Centre, Faculty of Veterinary Science, The University of Sydney, New South Wales 2006, Australia
[b] Centre for Infectious Diseases and Microbiology, Westmead Hospital, Westmead, New South Wales, Australia
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[d] The Cat Clinic, Mt Gravatt, Queensland 4122, Australia
[e] Department of Veterinary Clinical Sciences, Murdoch University, South Street, Murdoch, Western Australia 6150, Australia

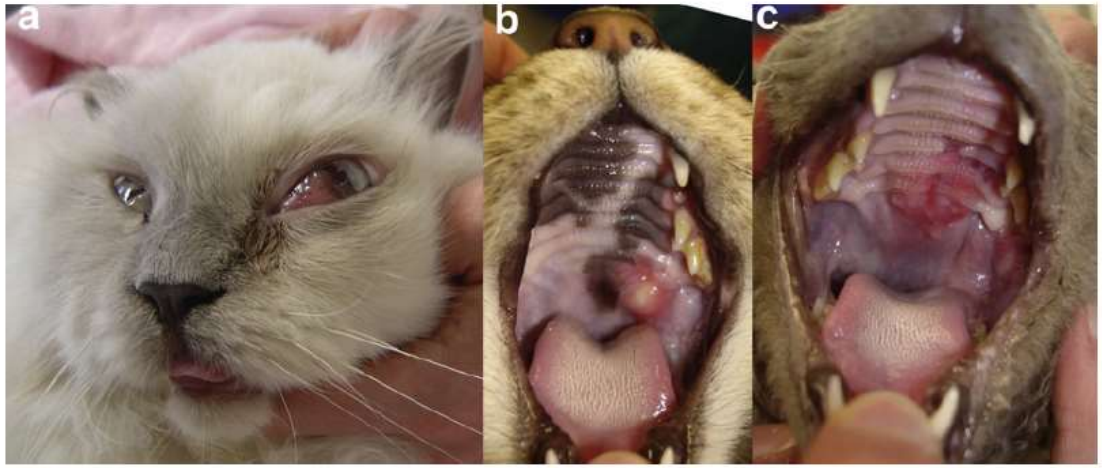


Fig. 1. Exophthalmos (a), mass in the left pterygopalatine fossa (b) and ulceration of the hard palate (c) due to retrobulbar fungal granulomas in cats with sino-orbital aspergillosis.

Feline Aspergillosis

Vanessa R. Barrs, BVSc(hons), MVetClinStud, FANZCVSc(Feline Medicine), GradCertEd (Higher Ed)*,
Jessica J. Talbot, BSc(vet)(hons)

Table 2
Etiologic agents in genus *Aspergillus* of SNA and SOA in cats

Number of Cases		Identification (Phenotypic[P]/Molecular[M])		
SNA	SOA	Subgenus	Section	Species
7	0	*Fumigati*	*Fumigati*	*A fumigatus*[M]
1	0	*Fumigati*	*Fumigati*	*A lentulus*[M]
1	1	*Fumigati*	*Fumigati*	*N pseudofischeri* (*A thermomutatus*)[M]
1	18	*Fumigati*	*Fumigati*	*A felis*[M]
0	4	*Fumigati*	*Fumigati*	*A udagawae*[M]
0	1	*Fumigati*	*Fumigati*	*A virdinutans*[M]
3	0	*Circumdati*	*Nigri*	*A niger*[P (n=2), M (n=1)]

Molecular identification is based on polymerase chain reaction and sequencing of the internal transcribed spacer and β-tubulin regions.

Abbreviations: SNA, sinonasal aspergillosis; SOA, sino-orbital aspergillosis.
Data from Refs.[9,11,12,15,16,42]; and Barrs & Talbot unpublished data, 2013.

Canine and Feline Respiratory Medicine
EDITOR
Lynelle R. Johnson

Clinical presentation of feline SOA

SOA clinical signs:

- exophthalmos
- corneal ulceration
- oral mass / ulcer
- nasal signs variably present
- paranasal soft tissue swelling
- neurological signs 15% cases

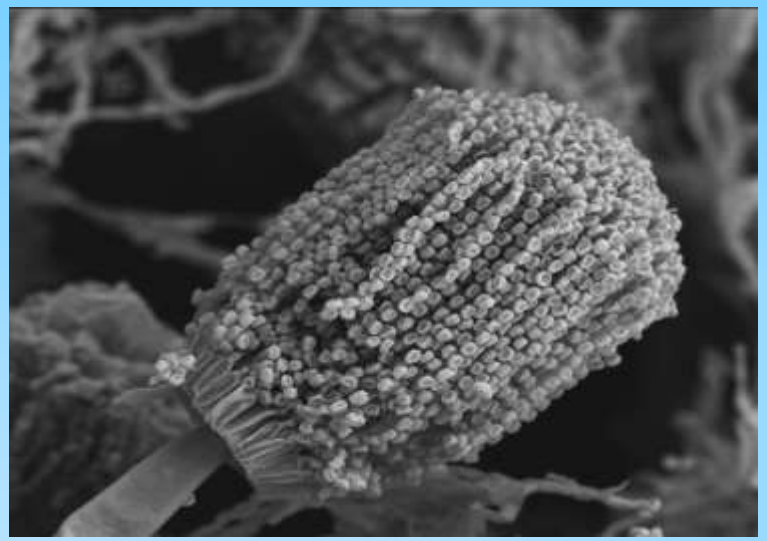
Pathogenesis - SOA

- Progression from SNA, an **invasive** mycosis

- Lysis of orbital bone most common site for spread into orbit

Aspergillus felis sp. nov.

An emerging pathogen in cats, dogs and humans



V. Barrs[1], T. van Doorn[2], P. Martin[1], J. Houbraken[2],S. Kidd[3],
M. Richardson, D. Pinheiro, J. Varga, R. A. Samson[2].

[1]Valentine Charlton Cat Centre, University of Sydney
[2]CBS-KNAW Fungal Biodiversity Centre, Utrecht
[3]Mycology Unit, W & C Hospital, Adelaide, Australia

Aspergillus felis sp. nov.

Barrs et al
PLOS One
2013

A. felis - host range & disease

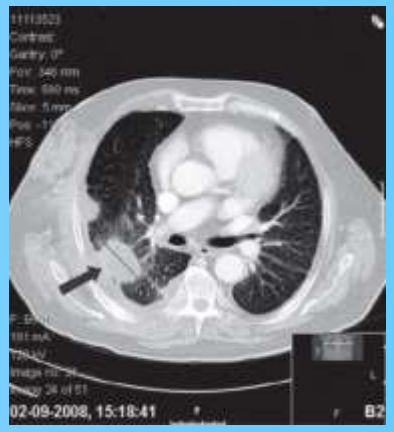
- **Dogs (n=1):**

- 9 y MN Old English Sheepdog systemic aspergillosis
- IMHA – prednisolone, cyclosporin

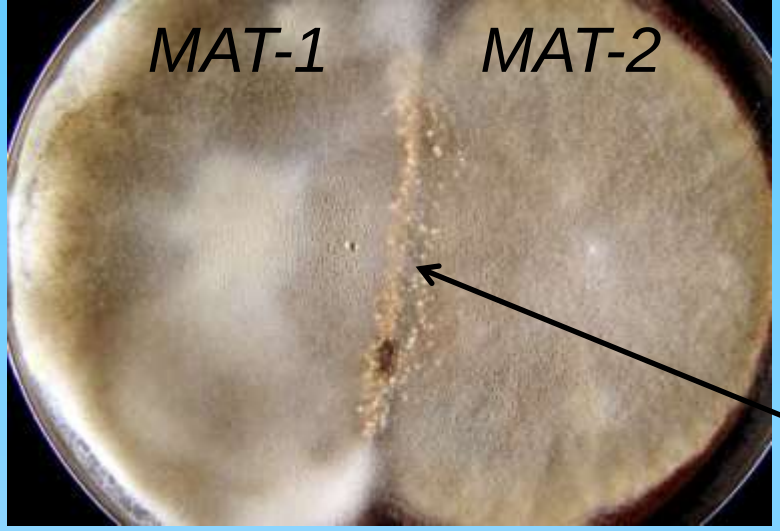
- **Humans (n=5):**

- A cause of chronic IPA - refractory to Rx (ITZ, POS,VCZ, CSF).
- Phylogenetic evidence – 4 other human isolates:

  Invasive pulmonary aspergillosis (Spain)
  Sputum (Spain)
  Nail (Spain)
  Clinical specimen (Japan)



anamorph

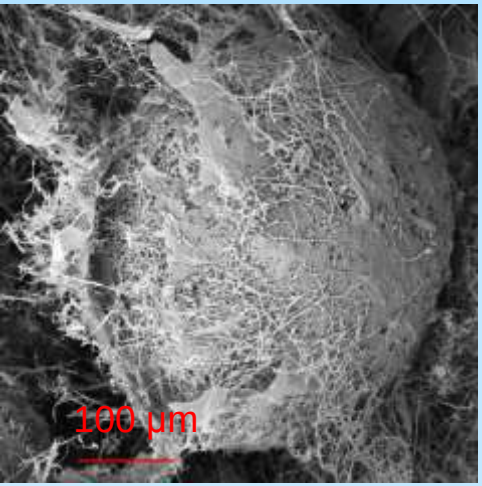


complementary mating types

cleistothecia

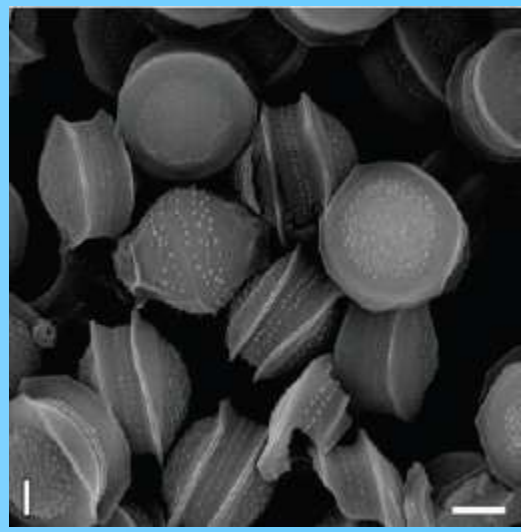
teleomorph

Heterothallic fungus

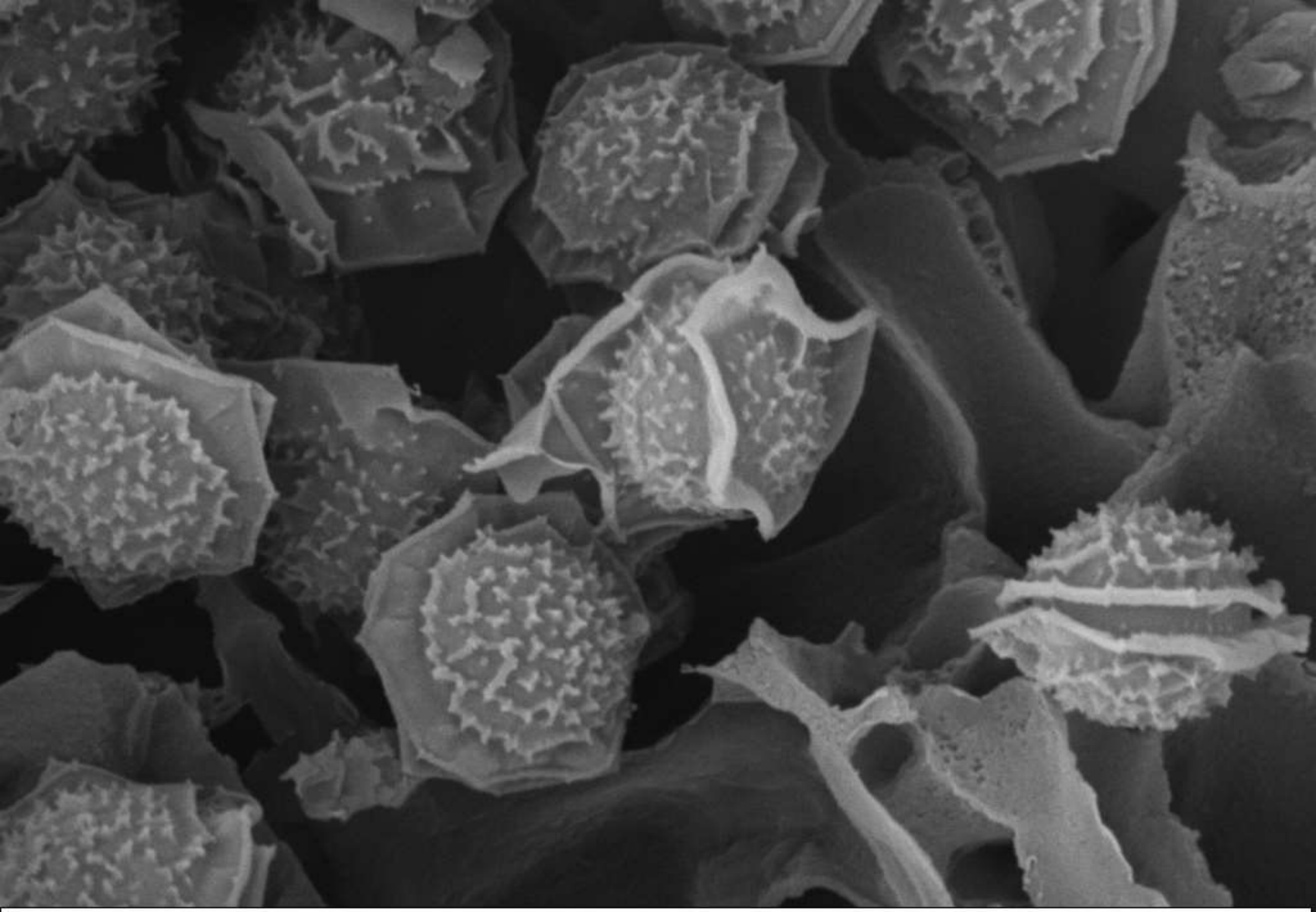


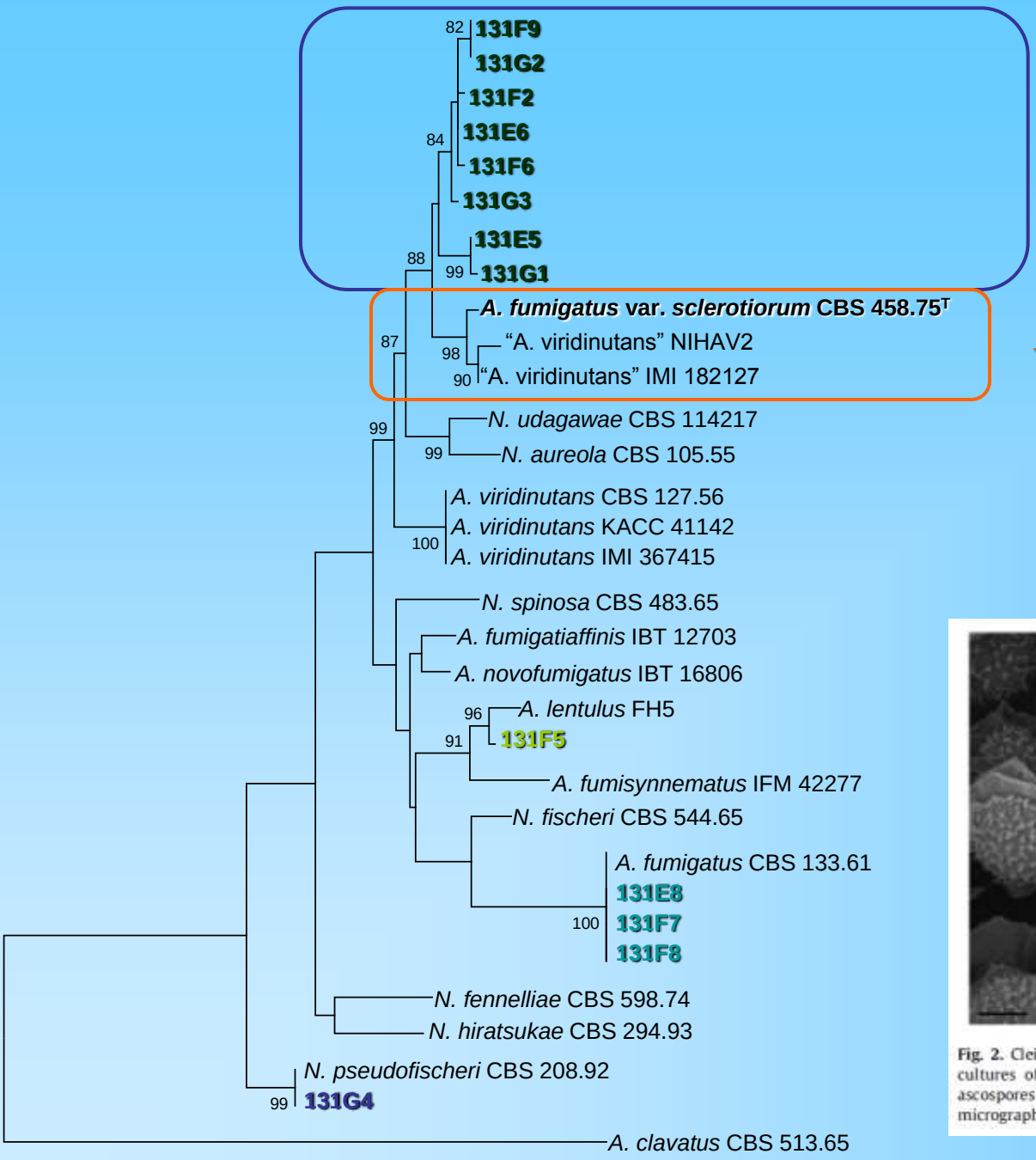
cleistothecium

8-spored asci



ascospore


2 µm*
EHT = 15.00 kV
Signal A = RBSD
Mag = 12.63 K X
WD = 17.0 mm
Photo No. = 20
Aspergillus section Fumigati
"KCee"



Aspergillus felis sp. nov.

Aspergillus sp. nov.

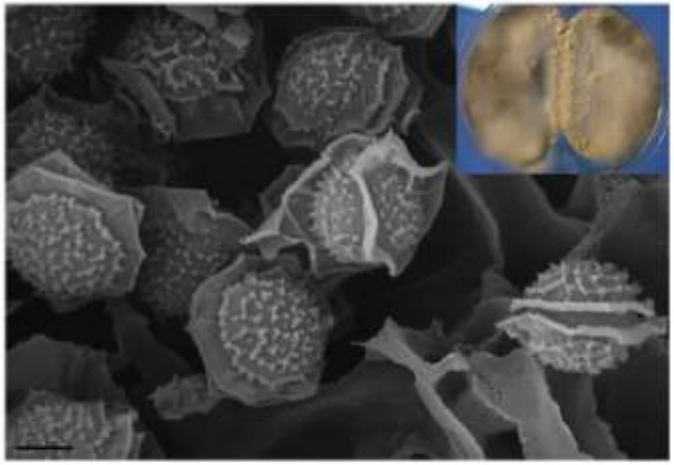


Fig. 2. Cleistothecia (small spherical structures) at the colony junction in paired cultures of *Neosartorya* spp. isolates from two cases (inset). *Neosartorya* spp. ascospores with roughened side walls and two axial crests. Scanning electron micrograph (Zeiss EVO LS15). Scale bar = 2 µm.

Chronic Invasive Aspergillosis caused by *Aspergillus viridinutans*

Donald C. Vinh,[1] Yvonne R. Shea,[1] Pamela A. Jones, Alexandra F. Freeman, Adrian Zelazny, and Steven M. Holland

Table. Antifungal drug susceptibility results of *Aspergillus viridinutans* isolates relative to *A. fumigatus* reported at 48 hours*

Isolate	Amphotericin B MIC, mg/L	Itraconazole MIC, mg/L	Voriconazole MIC, mg/L	Posaconazole MIC, mg/L	Caspofungin MEC, mg/L	Terbinafine MIC, mg/L
Patient 1	4	1	1	0.06	0.25	ND
Patient 2†	2–8	8	2–4	≤0.016–0.5	0.06–0.25	0.125–1
A. fumigatus B-5233‡	0.5	0.5	0.5	0.125	0.25	2

*MEC, minimal effective concentration; ND, not determined.
†Composite results of 3 isolates from the patient.
‡Clinical isolate from a patient with a fatal case of aspergillosis (courtesy of K. J. Kwon-Chung, National Institute of Allergy and Infectious Diseases, Bethesda, MD, USA).

Emerg Infect Dis 2009; 15: 1292-1294

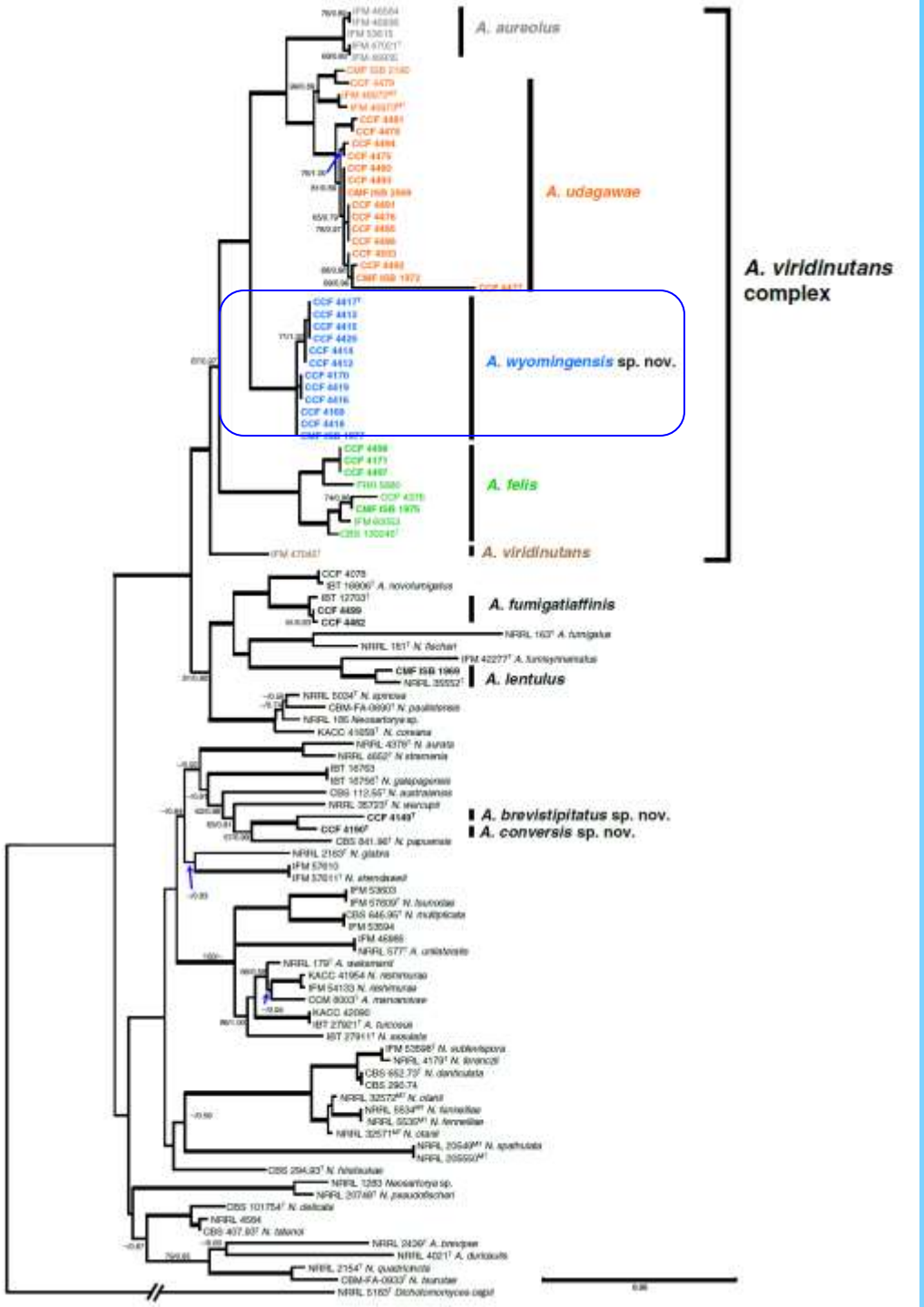
A. wyomingensis

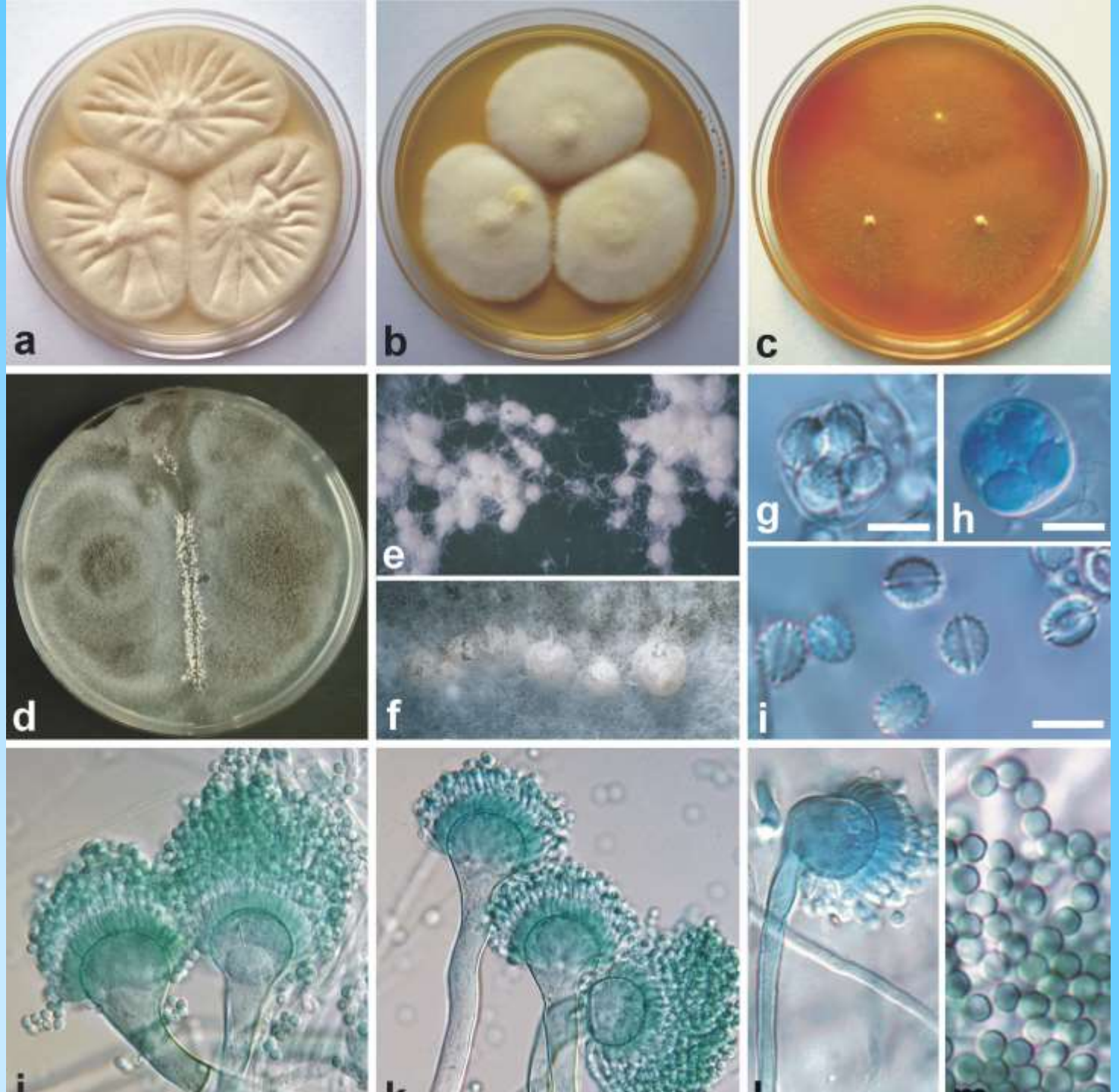
Fungal Diversity
DOI 10.1007/s13225-013-0262-5

New species in *Aspergillus* section *Fumigati* from reclamation sites in Wyoming (U.S.A.) and revision of *A. viridinutans* complex

Alena Nováková · Vit Hubka · Zuzana Dudová · Tetsuhiro Matsuzawa · Alena Kubátová · Takashi Yaguchi · Miroslav Kolařík

- Identified from an 18 month old British Short Haired cat came from Melbourne in Australia (V. Barrs, personal communication)


A. aureolus
A. udagawae
A. viridinutans complex
A. wyomingensis sp. nov.
A. felis
A. viridinutans
A. fumigatiaffinis
A. lentulus
A. brevistipitatus sp. nov.
A. conversis sp. nov.


a
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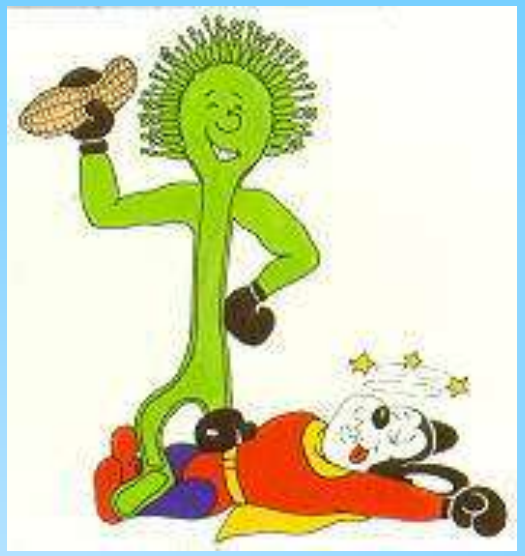
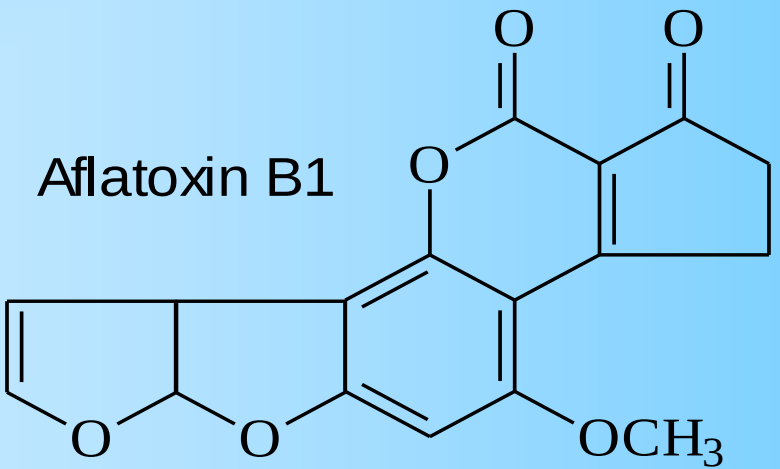
Aspergillus section *Flavi*



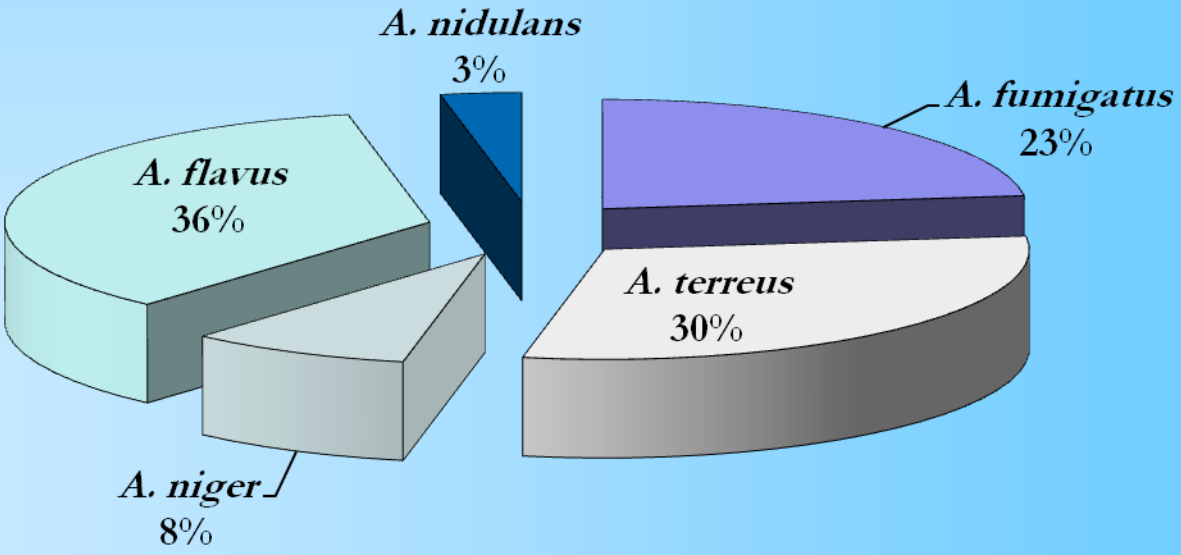
Aflatoxin B1



Aspergillus flavus

- Usually considered as the 2nd most prevalent cause of IA
- Frequently encountered in keratitis cases and as causative agent of ABPA
- Limited molecular data indicate that most clinical isolates belong to *A. flavus*, with one assigned to *A. alliaceus*

Distribution of Aspergilli from IA cases at the University of Texas (1998-2001)



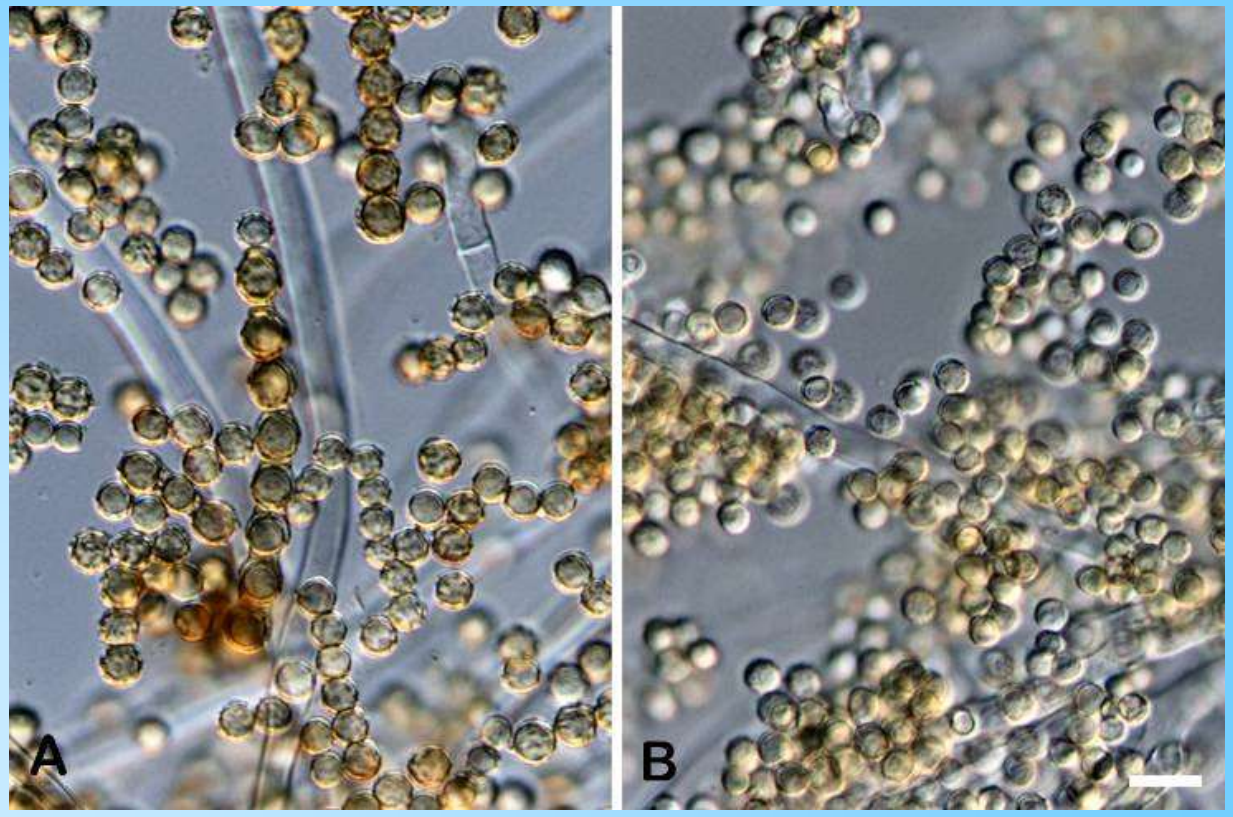
Diagn Microb Infect Dis 2003; 46: 25-28

JOURNAL OF CLINICAL MICROBIOLOGY, Oct. 2007, p. 3464–3467 Vol. 45, No. 10
0095-1137/07/$08.00+0 doi:10.1128/JCM.00920-07

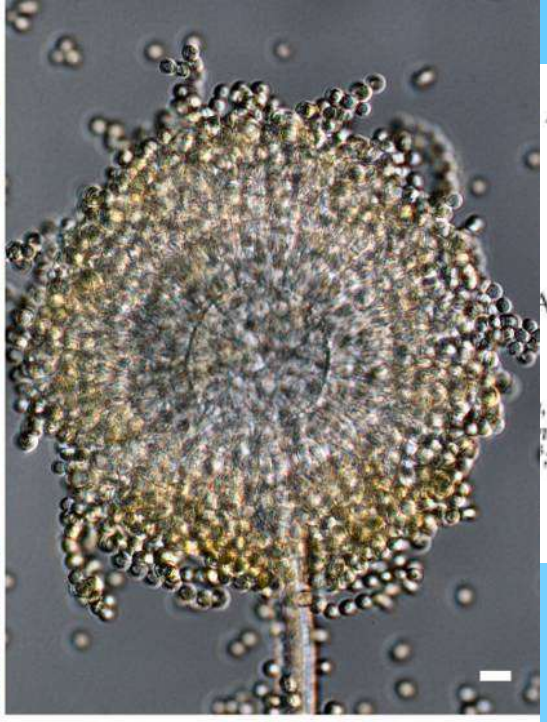
Case of Keratitis Caused by *Aspergillus tamarii*▽

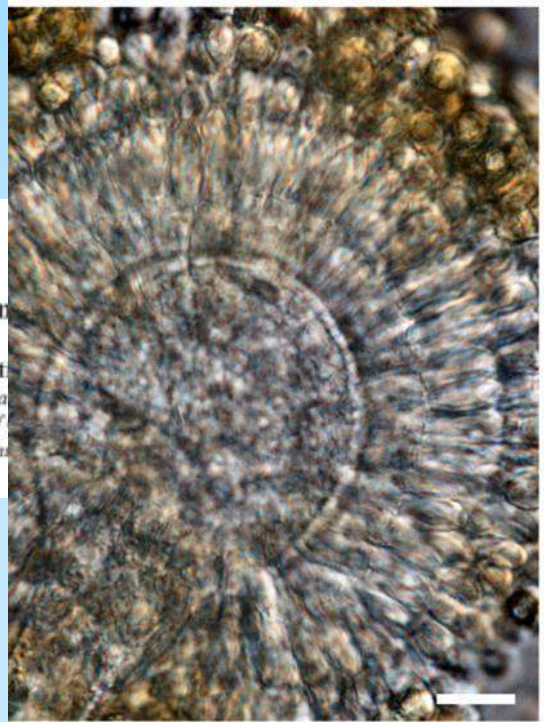
László Kredics,[1] János Varga,[1,2] Sándor Kocsubé,[1] Ilona Dóczi,[3] Robert A. Samson,[2] Revathi Rajaraman,[4] Venkatapathy Narendran,[4] Madhavan Bhaskar,[5] Csaba Vágvölgyi,[1] and Palanisamy Manikandan[4]*

Department of Microbiology, Faculty of Sciences, University of Szeged, Szeged, Hungary[1]; CBS Fungal Biodiversity Centre, Utrecht, The Netherlands[2]; Department of Clinical Microbiology and Diagnostics, Faculty of Medicine, University of Szeged, Szeged, Hungary[3]; Aravind Eye Hospital and Postgraduate Institute of Ophthalmology, Coimbatore, India[4]; and Department of Microbiology, Coimbatore Medical College, Coimbatore, India[5]



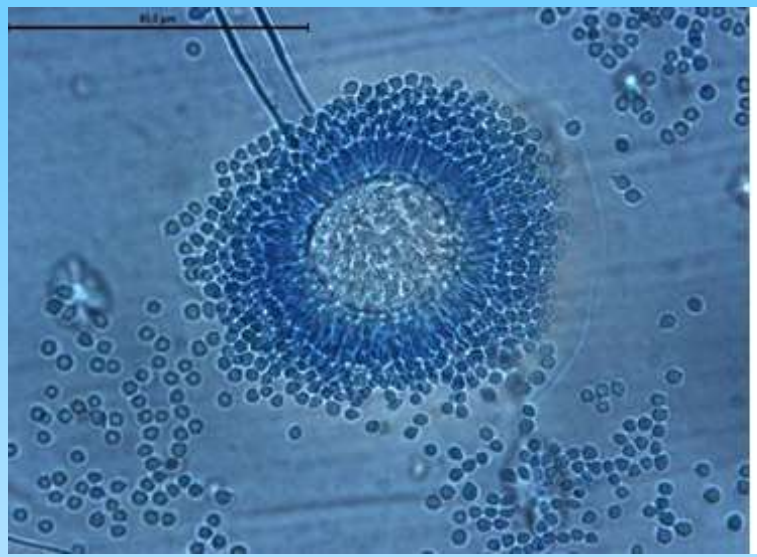
J Clin Microbiol 2007; 45: 3464-3467

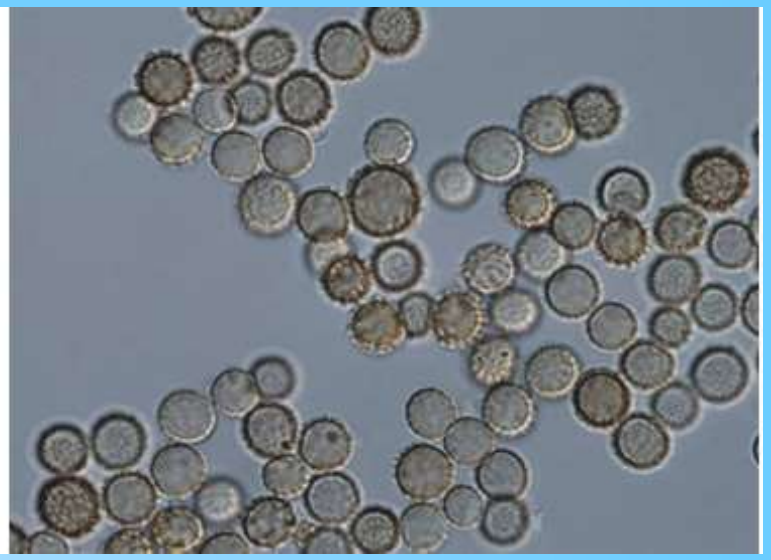


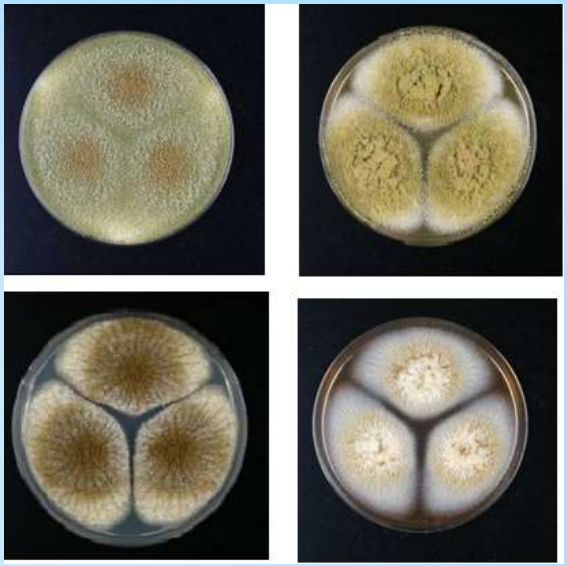


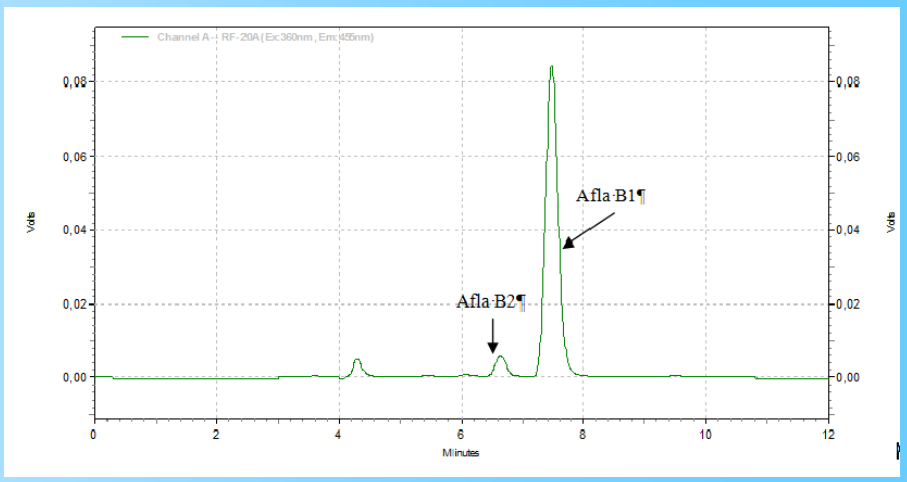
A. nomius

Aspergillus pseudotamarii has recently also been identified in a keratitis case in India









Medical Mycology Case Reports 2 (2013) 91–94

Contents lists available at ScienceDirect

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

Keratitis caused by *Aspergillus pseudotamarii*

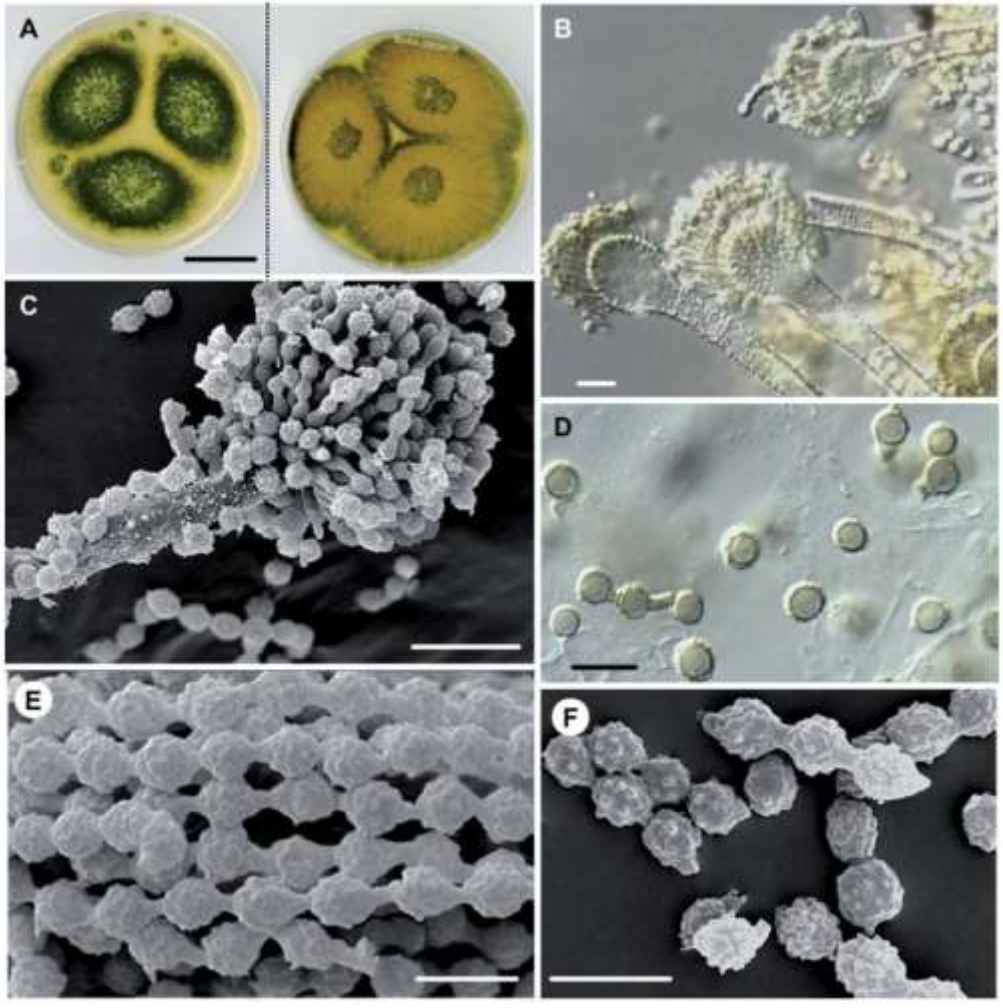
Nikolett Baranyi [a], Sándor Kocsubé [a], András Szekeres [a], Anita Raghavan [b], Venkatapathy Narendran [b], Csaba Vágvölgyi [a], Kanesan Panneer Selvam [c], Yendremban Randhir Babu Singh [b,d], László Kredics [a], János Varga [a,*], Palanisamy Manikandan [b]

[a] *Department of Microbiology, Faculty of Science and Informatics, University of Szeged, Közép fasor 52, H-6726 Szeged, Hungary*
[b] *Aravind Eye Hospital and Postgraduate Institute of Ophthalmology, Avinashi road, Coimbatore 641 014, Tamilnadu, India*
[c] *M.R. Govt. Arts College, Mannargudi, 614 001 Thiruvarur, Tamilnadu, India*
[d] *Department of Microbiology, Dr. GRD College of Science, Coimbatore, Tamilnadu, India*

Aspergillus novoparasiticus: a new clinical species of the section *Flavi*

SARAH S. GONÇALVES*, ALBERTO M. STCHIGEL†, JOSEP F. CANO†, PATRICIO C. GODOY-MARTINEZ‡, ARNALDO L. COLOMBO* & JOSEP GUARRO†

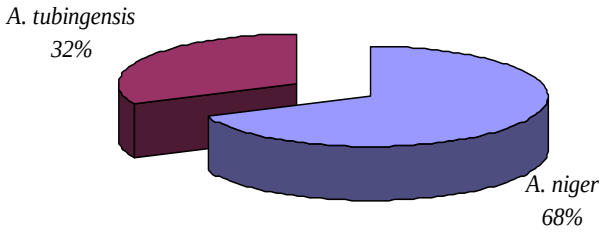
*Departamento de Medicina, Disciplina de Infectologia, Universidade Federal de São Paulo, Brazil, †Mycology Unit, Medical School, IISPV, Universitat Rovira i Virgili, Reus, Spain, and ‡Universidad Austral de Chile, Valdivia, Chile



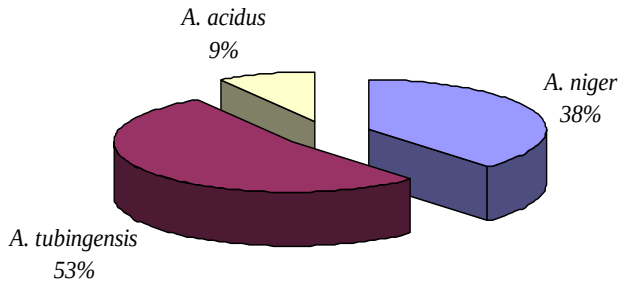
Aspergillus section *Nigri*

Species distribution of black Aspergilli from various studies

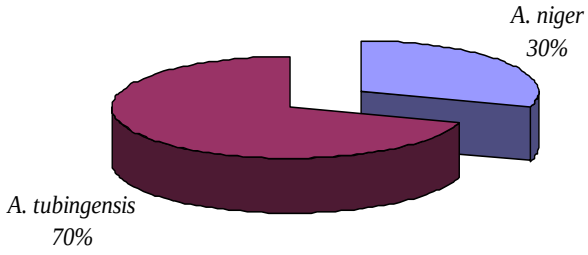
Balajee et al. 2009



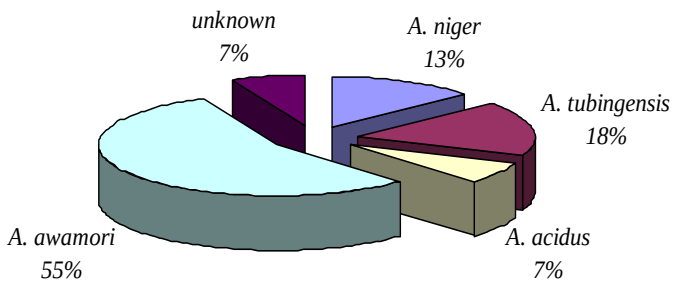
Alcazar-Fuoli et al. 2009



Hong et al. 2009

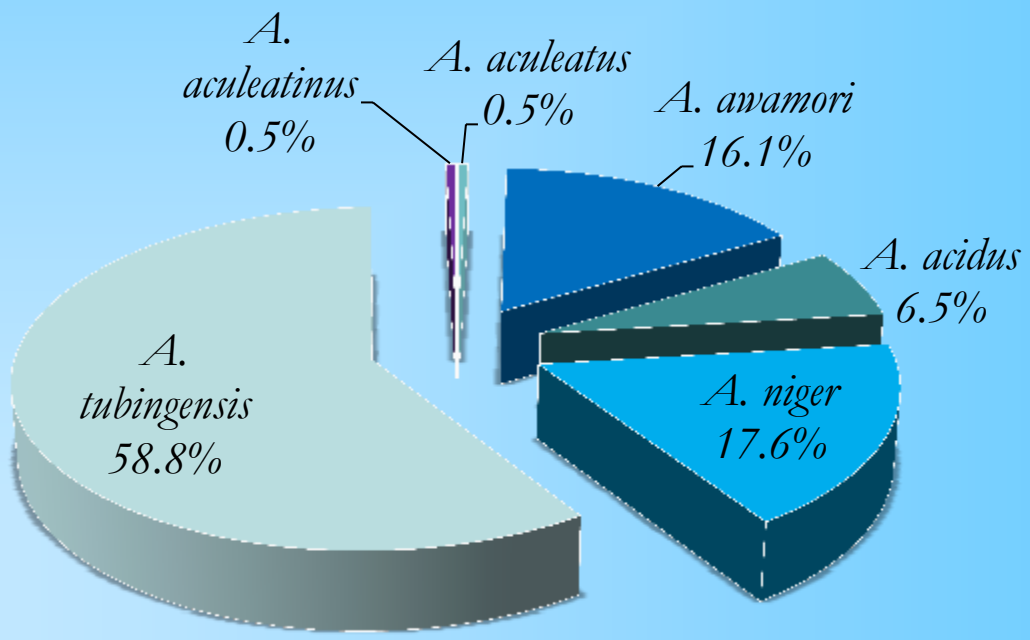


Howard et al. 2011



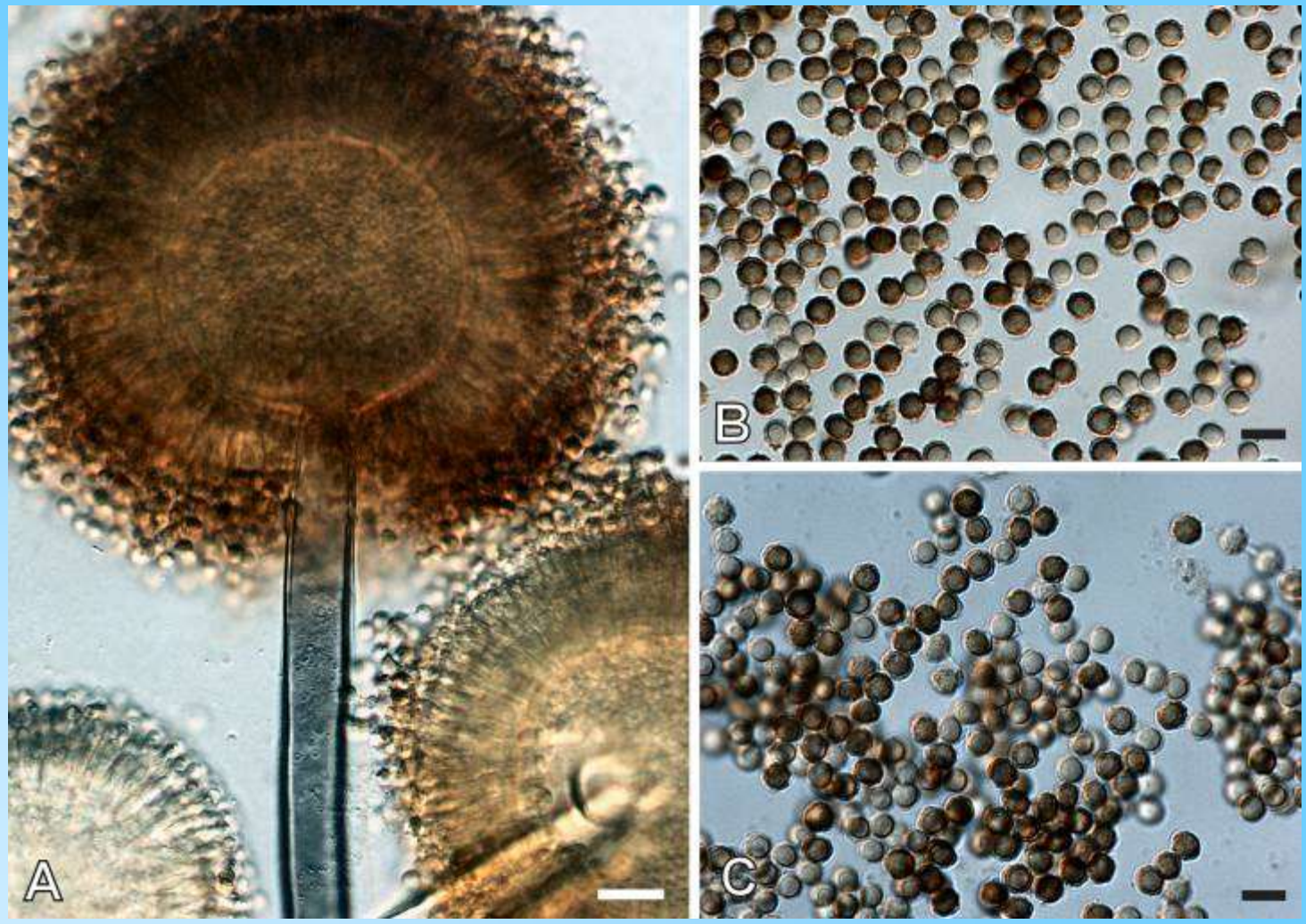
Species assignment of ca. 200 black Aspergilli came from clinical environment

Species distribution of 200 black Aspergilli



Preliminary results of antifungal susceptibility tests indicate species-specific differences (in progress)

A. tubingensis from keratitis cases



Cornea 2009; 28:951-4

Manikandan *et al. Journal of Medical Case Reports* 2010, **4**:68
http://www.jmedicalcasereports.com/content/4/1/68

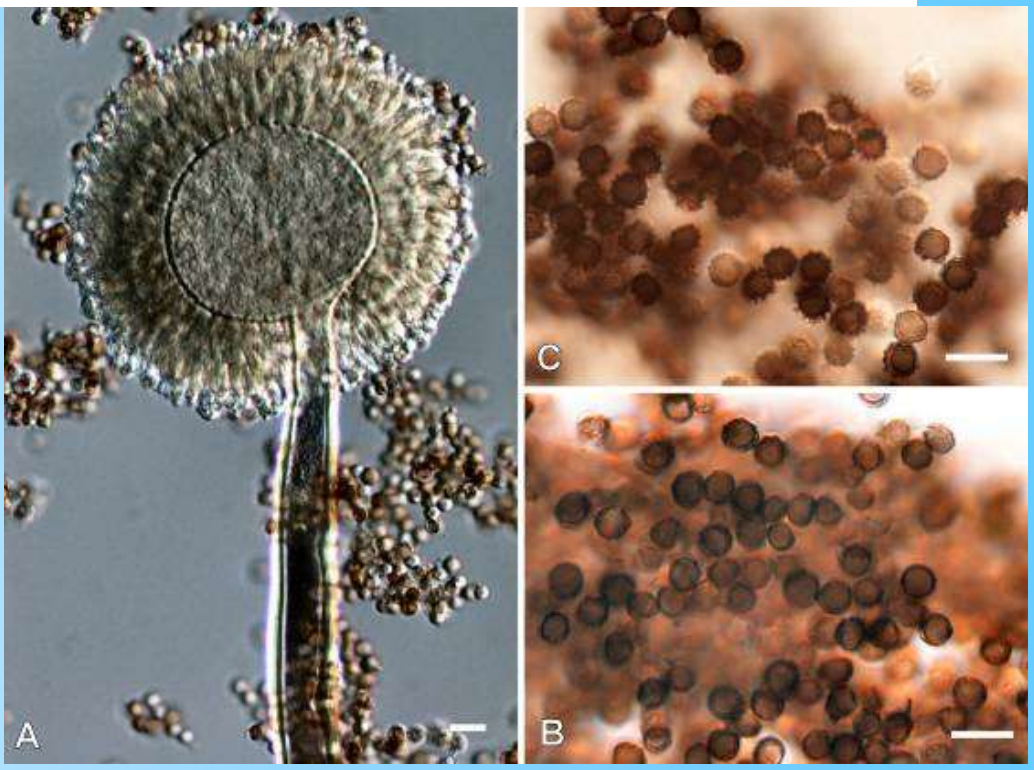
JOURNAL OF MEDICAL CASE REPORTS

CASE REPORT Open Access

Keratitis caused by the recently described new species *Aspergillus brasiliensis*: two case reports

Palanisamy Manikandan[1,5], János Varga[2,3], Sándor Kocsubé[3], Rajaraman Revathi[1], Raghavan Anita[1], Ilona Dóczi[4], Tibor Mihály Németh[3], Venkatapathy Narendran[1], Csaba Vágvölgyi[3], Madhavan Bhaskar[6], Chockaiya Manoharan[5], Robert A Samson[2], László Kredics[3*]

- The species was described in 2007 by our group
- Occurs in soil (Brazil, Australia, USA, Netherlands), on grapes (Portugal), and in human keratitis (India)



Black Aspergilli in otomycosis cases

mycoses
Diagnosis, Therapy and Prophylaxis of Fungal Diseases

Original article

Species assignment and antifungal susceptibilities of black aspergilli recovered from otomycosis cases in Iran

Gyöngyi Szigeti,[1] Ebrahim Sedaghati,[2] Ali Zarei Mahmoudabadi,[3] Ali Naseri,[4] Sándor Kocsubé,[1] Csaba Vágvölgyi[1] and János Varga[1]

[1]Department of Microbiology, Faculty of Science & Informatics, University of Szeged, Szeged, Hungary, [2]Department of Plant Protection, College of Agriculture, Vali-e-Asr University of Rafsanjan, Rafsanjan, Iran, [3]Infectious and Tropical Diseases Research Center and Department of Medical Mycology, School of Medicine, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran and [4]Department of Medical Parasitology and Mycology, Imam Reza Hospital, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

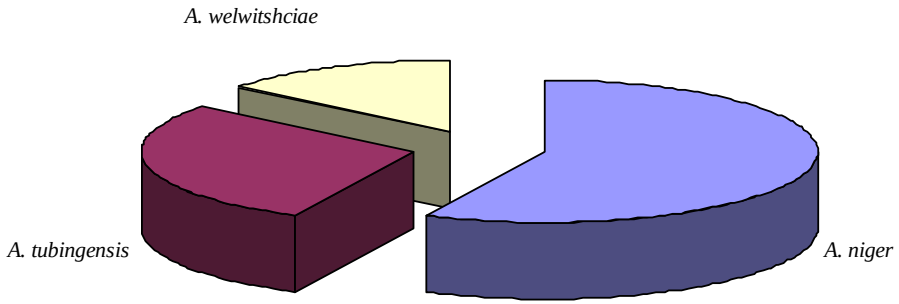
Mycopathologia
DOI 10.1007/s11046-012-9529-8

Molecular Identification and Antifungal Susceptibilities of Black *Aspergillus* Isolates from Otomycosis Cases in Hungary

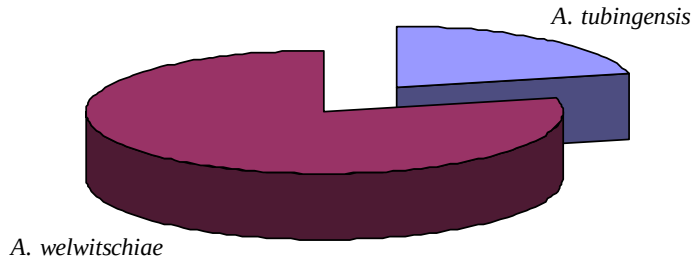
Gyöngyi Szigeti · Sándor Kocsubé · Ilona Dóczi · László Bereczki · Csaba Vágvölgyi · János Varga

Species distribution of black Aspergilli from otomycosis cases in Iran and Hungary

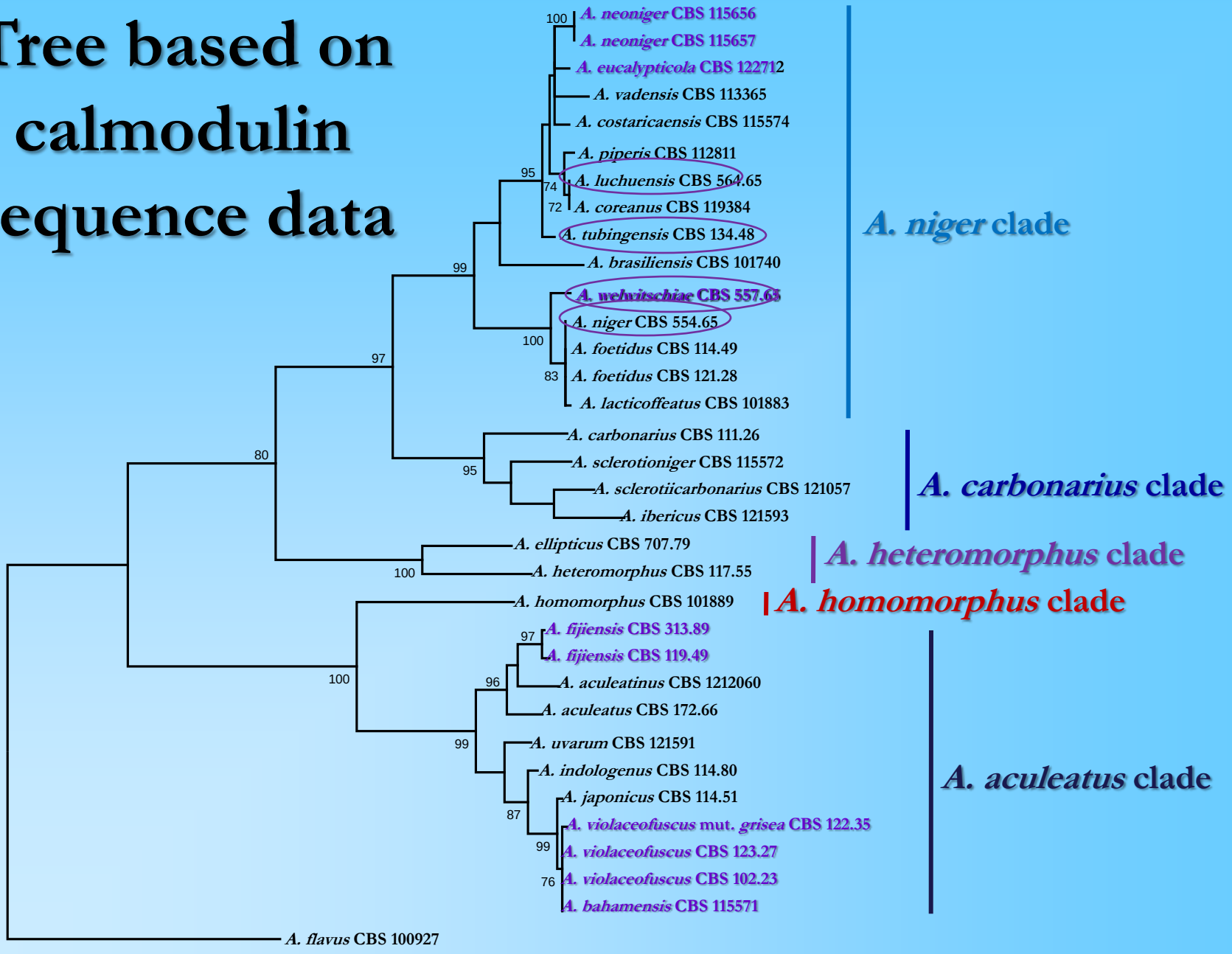
Iran



Hungary



Tree based on calmodulin sequence data



Stud Mycol 69 (2011) 1-17

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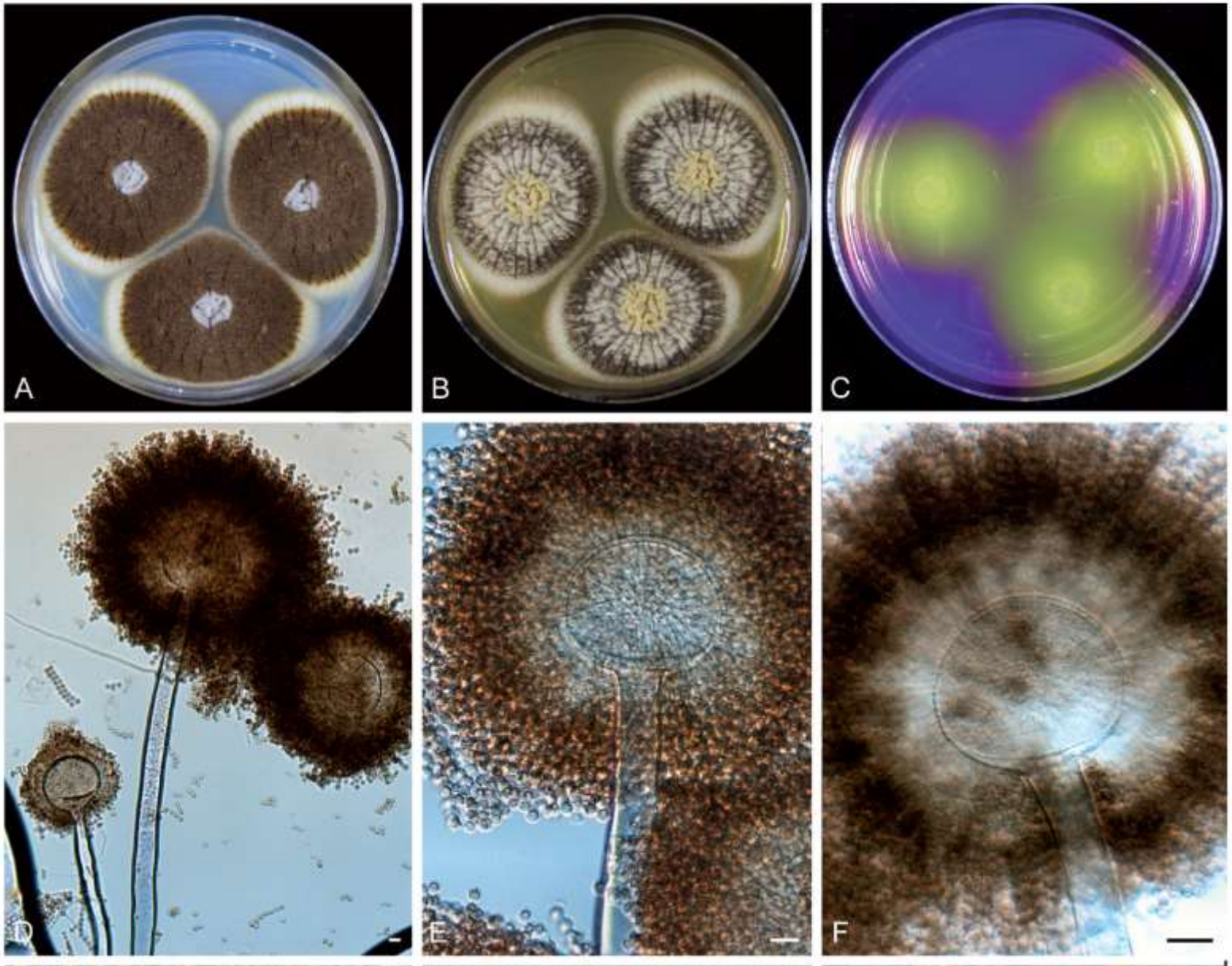
PLOS ONE

Aspergillus luchuensis, an Industrially Important Black *Asp*

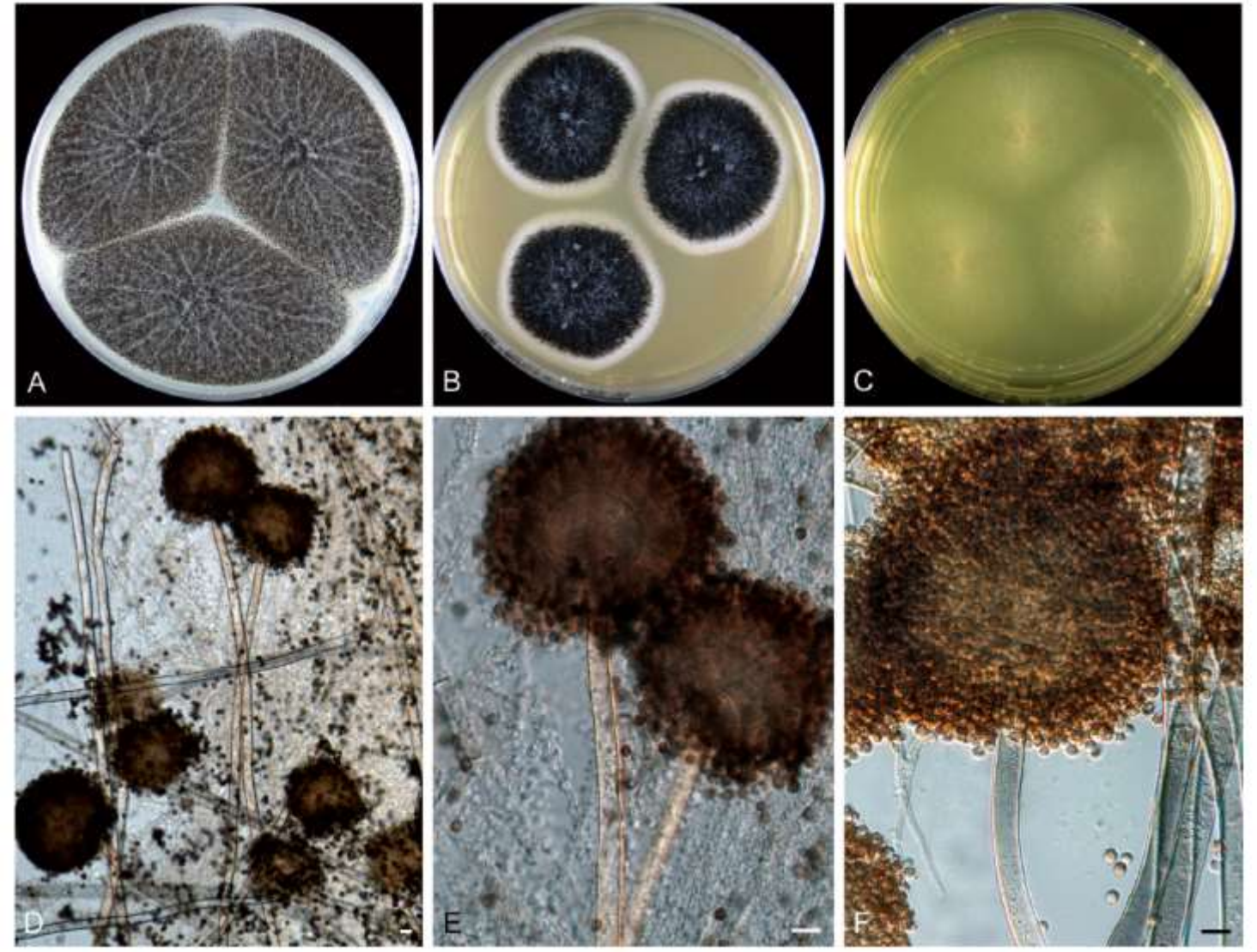
Seung

Katsuy

1 Korean A
Faculty of
Denmark,
Informatic
Higashi-Hi
8 Genome
Netherlan



A. neoniger (identified in 2 keratitis cases in India)



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Case report Open Access

Aspergillus fijiensis n. sp. isolated from bronchial washings in a human case of bronchiectasis with invasive aspergillosis: the first report

Giancarlo Perrone[1], Gaetano Stea[1], Chandana N. Kulathunga[2], Hewage Wijedasa[3] and Sarath N. Arseculeratne[3*]
*Correspondence: chubby@sltnet.lk
[1]Institute of Sciences of Food Production, National Research Council, Bari, Italy.
[2]District General Hospital, Matale, Sri Lanka.
[3]Department of Microbiology, Faculty of Medicine, University of Peradeniya, Sri Lanka.

doi:10.5598/imafungus.2012.03.02.08

IMA FUNGUS · VOLUME 3 · NO 2: 159–173

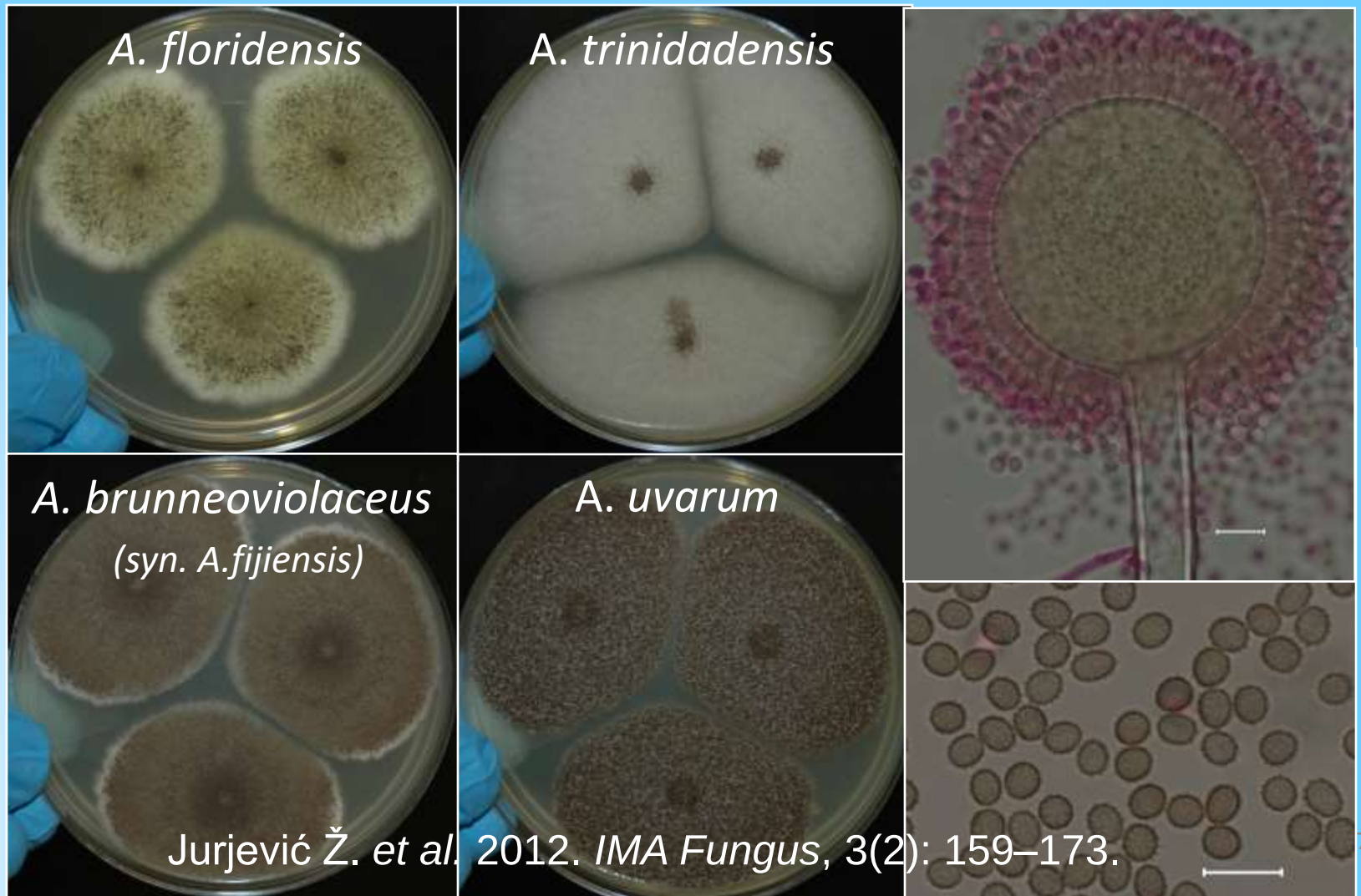
Two novel species of *Aspergillus* section *Nigri* from indoor air

Željko Jurjević[1], Stephen W. Peterson[2], Gaetano Stea[3], Michele Solfrizzo[3], János Varga[4], Vit Hubka[5], and Giancarlo Perrone[3]

[1]EMSL Analytical, Inc., 200 Route 130 North, Cinnaminson, New Jersey 08077 USA; corresponding author e-mail: zjurjevic@emsl.com
[2]Bacterial Foodborne Pathogens and Mycology Research Unit, National Center for Agricultural Utilization Research, Agricultural Research Service, U.S. Department of Agriculture, 1815 North University Street, Peoria, Illinois 61604 USA
[3]Institute of Sciences of Food Production, CNR, Via Amendola 122/O, 70126 Bari, Italy
[4]Department of Microbiology, Faculty of Sciences and Informatics, University of Szeged, Közép fasor 52, H-6726 Szeged, Hungary
[5]Department of Botany, Faculty of Science, Charles University in Prague, Benátská 2, 128 01, Praha 2, Czech Republic

A. brunneoviolaceus (=A. fijiensis)

New species of *Aspergillus* section *Nigri*



Jurjević Ž. *et al.* 2012. *IMA Fungus*, 3(2): 159–173.

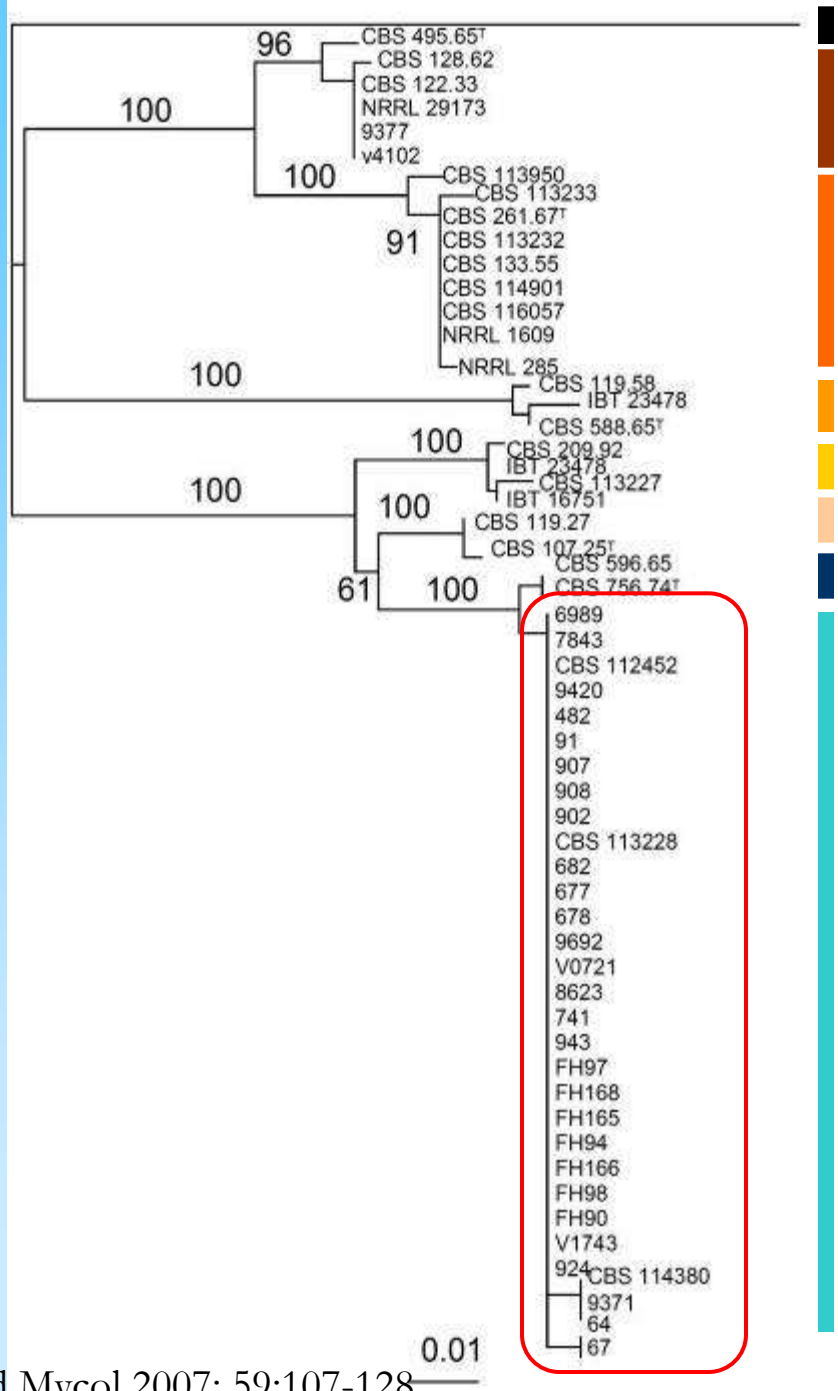
Aspergillus section *Usti*

Aspergillus calidoustus

sp. nov.

- All except one clinical "*A. ustus*" isolates belong to this species
- Relatively rare human pathogen (28-30 cases reported)
- Able to grow at >37°C
- Associated with high mortality rates, primarily due to the reduced susceptibilities to azoles

Eukaryotic Cell 2008; 7: 630-638



Stud Mycol 2007; 59:107-128

A. versicolor

A. puniceus

A. ustus

A. granulosus

A. keveii

A. insuetus

A. pseudodeflectus

Tree based on β–tubulin sequences

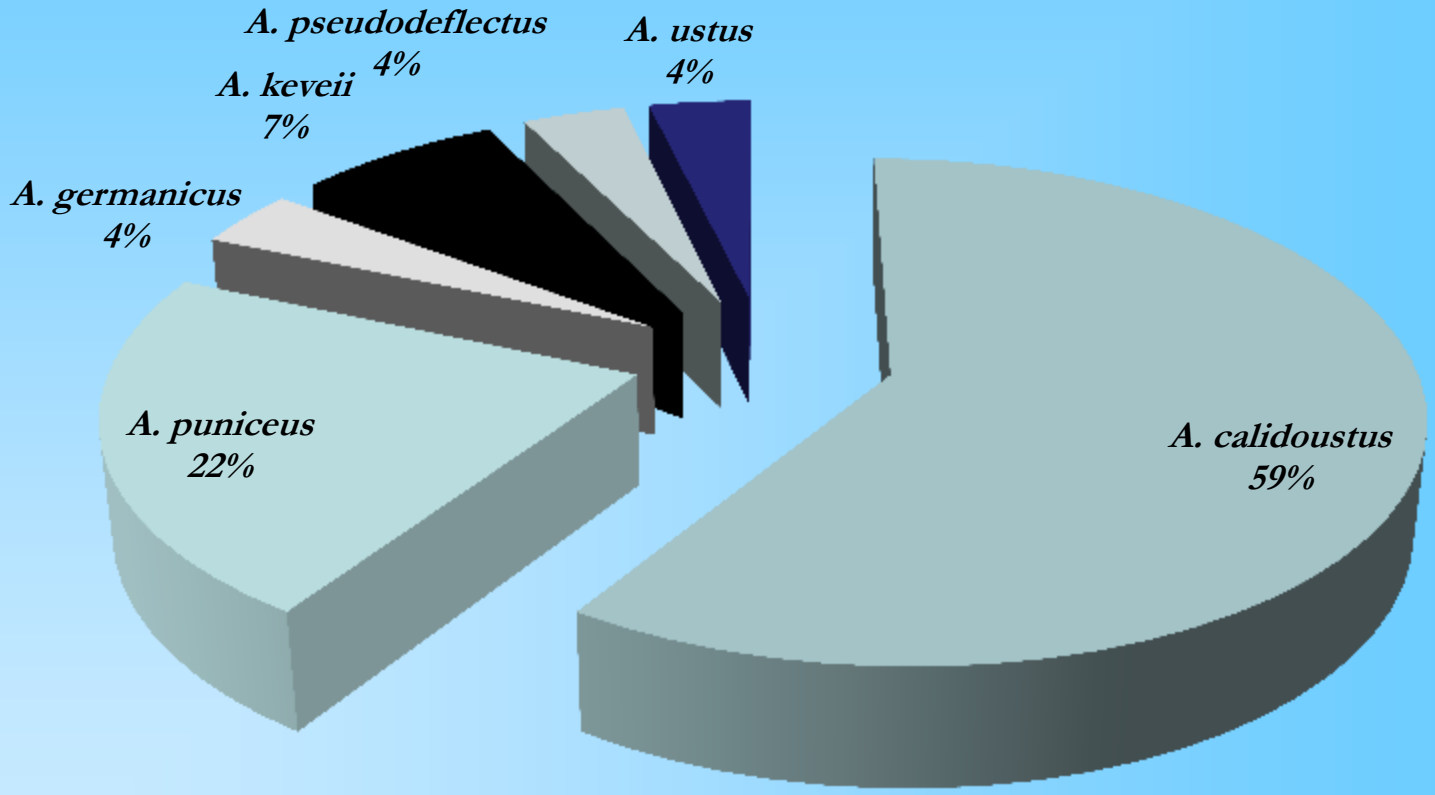
← growth at 37°C (+)

← growth at 37°C (++)

A. calidoustus ← clinical isolates; growth at 37°C (++)

Hülle-cells

Incidence of species of section *Usti* in indoor environments



Medical Mycology Month 2011, **Early Online,** 1–6

informa
healthcare

Emerging pathogen *Aspergillus calidoustus* colonizes water distribution systems

GUNHILD HAGESKAL, RALF KRISTENSEN, ROSA F. FRISTAD & IDA SKAAR

National Veterinary Institute, Section of Mycology, Sentrum, Oslo, Norway

Recent studies have changed the taxonomy of *Aspergillus* section *Usti*, and a novel species, *Aspergillus calidoustus*, has been erected. It was also demonstrated that clinical isolates previously identified as *A. ustus* actually belong to the emerging pathogen *A. calidoustus*. *Aspergillus ustus* were frequently isolated from Norwegian water systems, and due to the taxonomical progress, these waterborne strains could be identified more precisely. A MLST study including ITS, calmodulin, β-tubulin and actin sequences was conducted on 32 strains previously identified as *A. ustus*. All strains were identified as *A. calidoustus*, which was verified by physiological, biochemical and phylogenetic analyses. This is the first report of that *A. calidoustus* is able to colonize water distribution systems. In respect to the potential role of water systems as a source of nosocomial infections in patients with immunodeficiency, attention should be given to water systems in hospitals and other healthcare units, especially the heated-water installations.

Case 2: Clinical and laboratory manifestation of latent A. calidoustus *brain pseudoabcess in a patient with chronic granulomatous disease (CGD)*

A case of IA due to *A. calidoustus* affecting the brain was recorded in a 17-year-old boy with X-linked CGD. At age 17, the boy underwent allogeneic haematopoietic stem cell transplantation (HSCT). The patient was prophylaxed with posaconazole and treated in the single isolation room containing HEPA filtered air and under positive pressure. On day 39 after HSCT, the serum galactomannan index (GMI) reached a value of 1.17, but no other

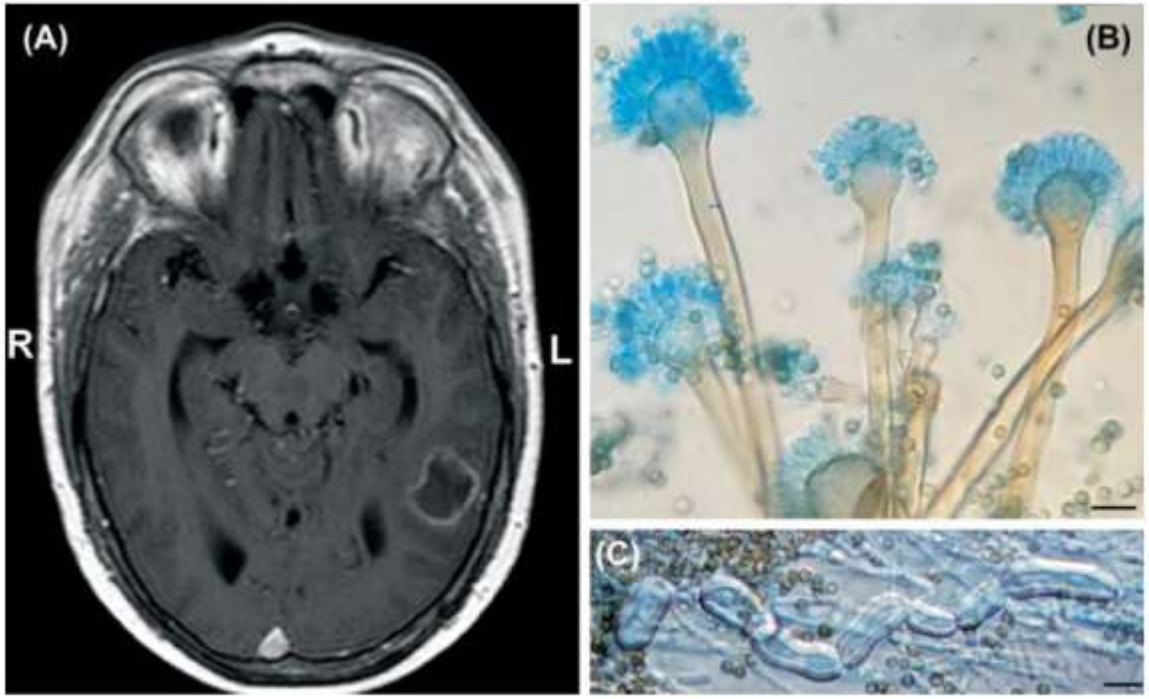
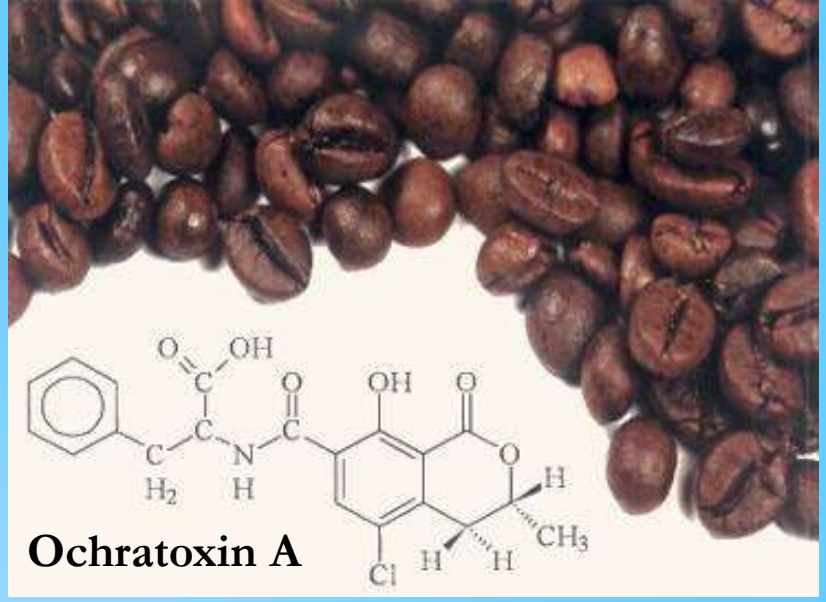
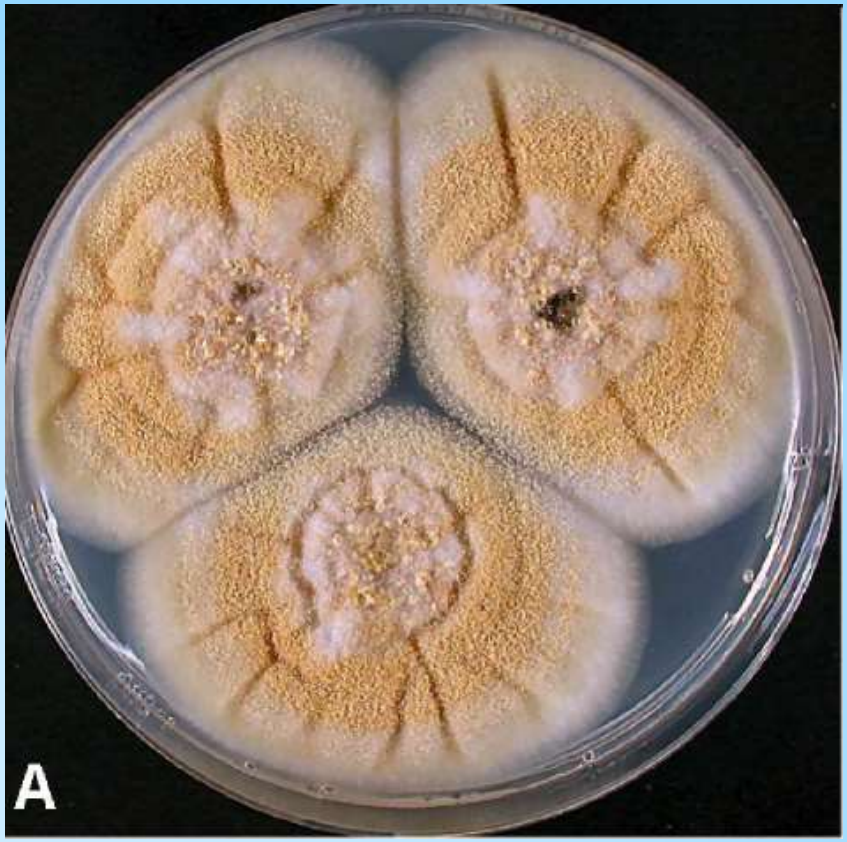


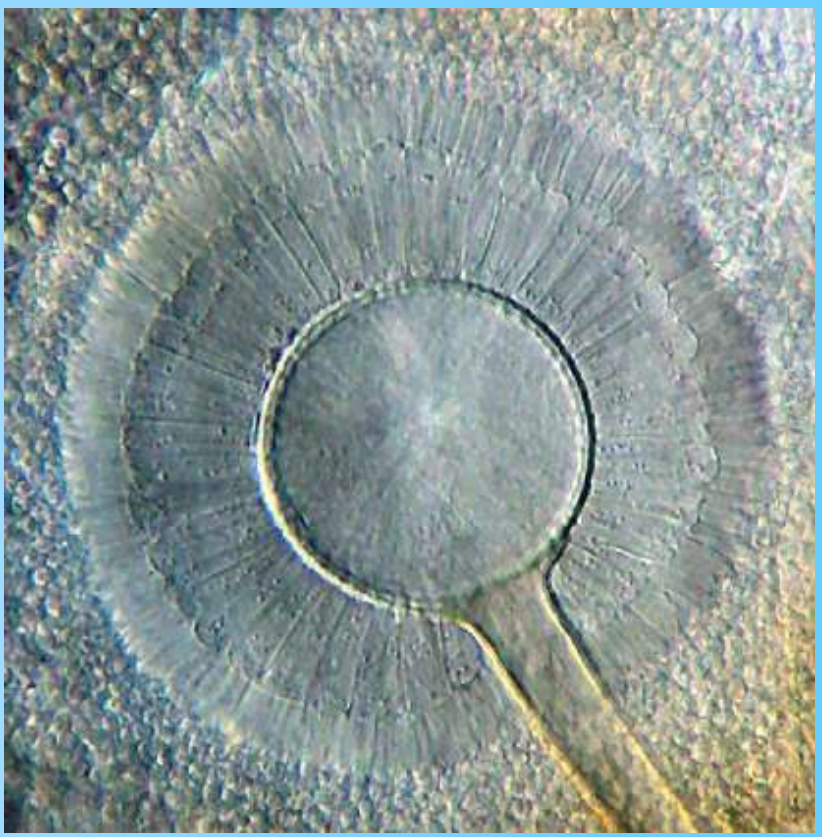
Fig. 4 An MRI of the head showing an abscess in the left temporo-occipital area (A); *Aspergillus calidoustus* CCF 3755 with brown biseriate conidiophores (B); the elongated Hülle cells (C).

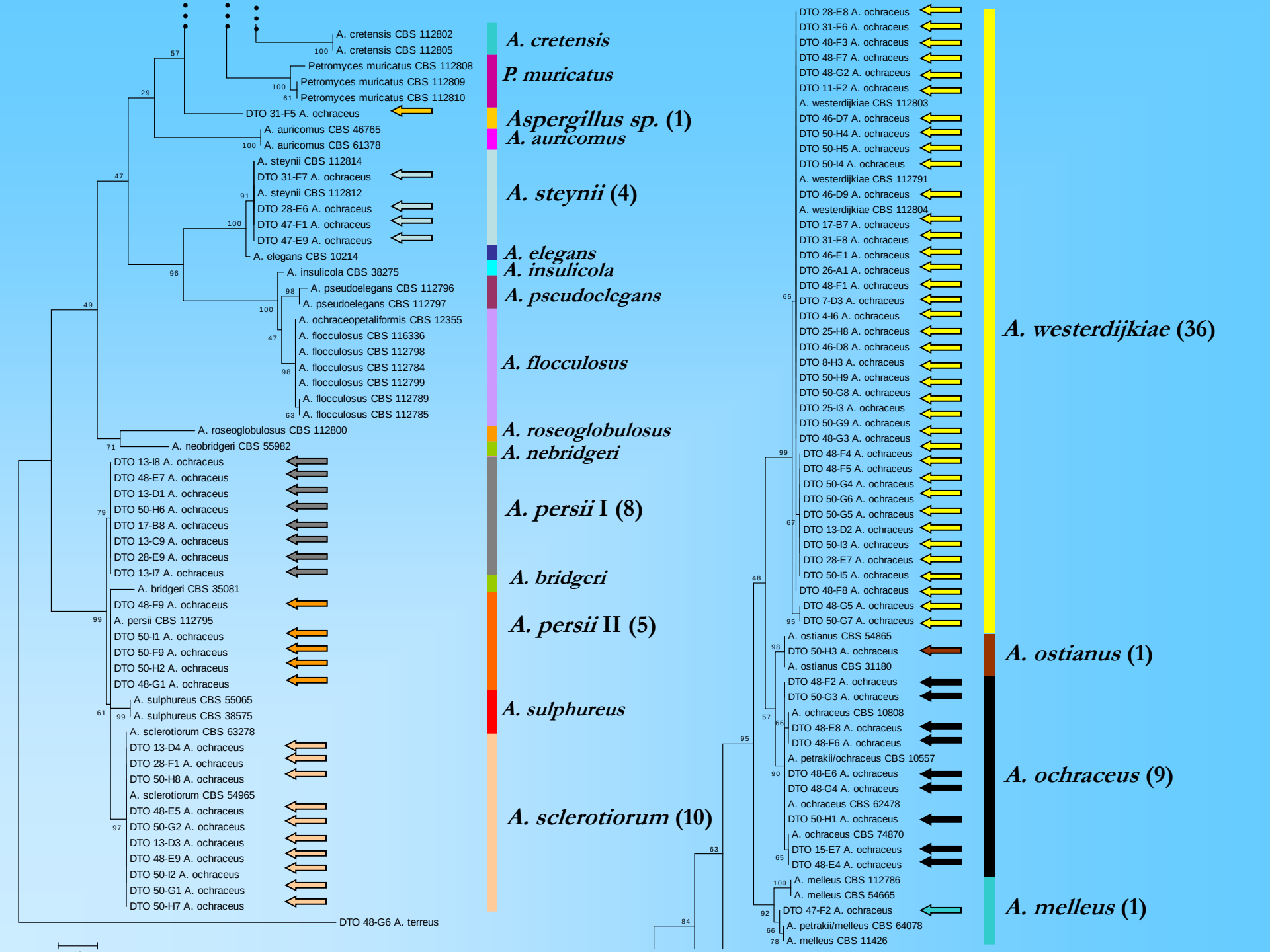
Aspergillus section *Circumdati*



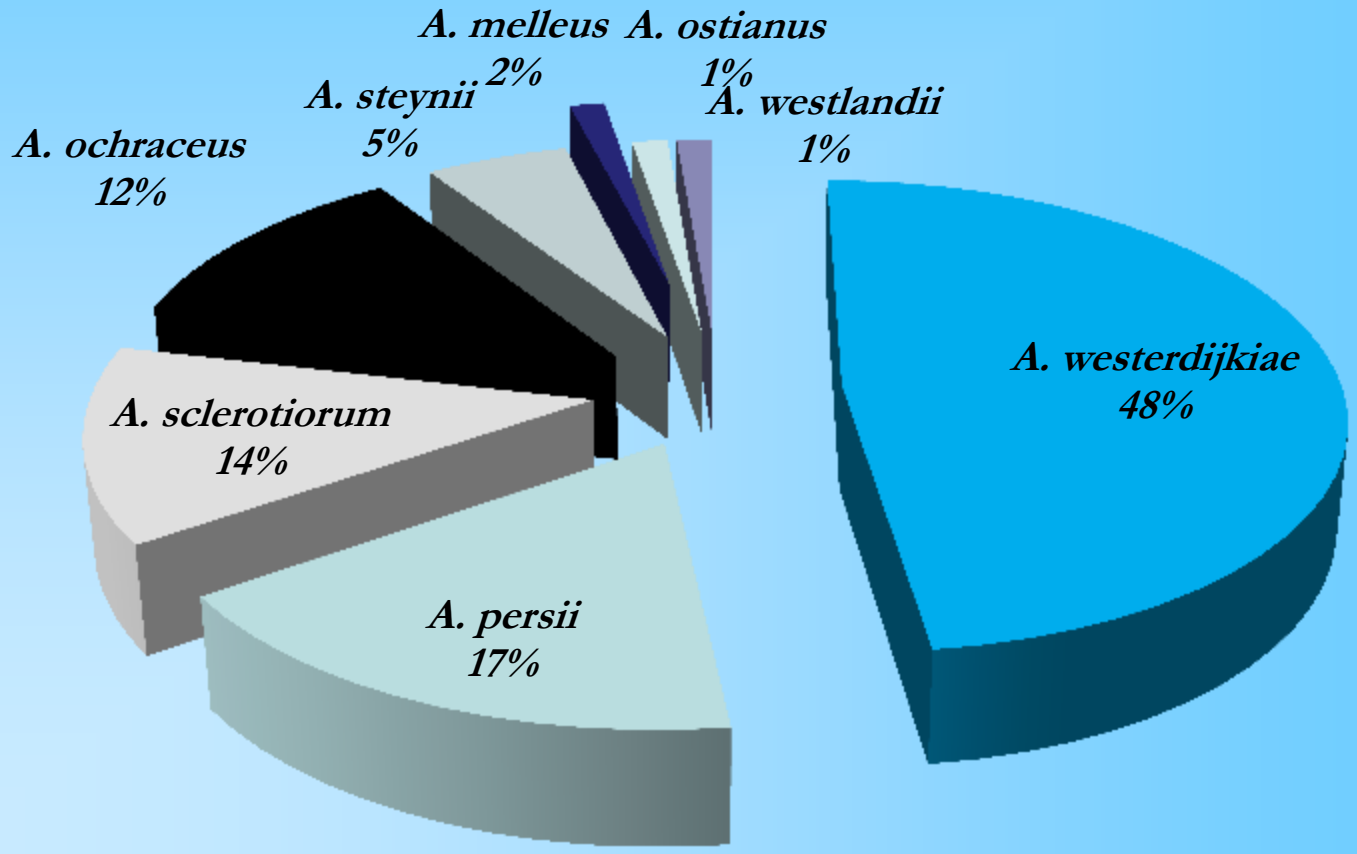
Ochratoxin A






A. cretensis CBS 112802
A. cretensis CBS 112805
Petromyces muricatus CBS 112808
Petromyces muricatus CBS 112809
Petromyces muricatus CBS 112810
DTO 31-F5 A. ochraceus
A. auricomus CBS 46765
A. auricomus CBS 61378
A. steynii CBS 112814
DTO 31-F7 A. ochraceus
A. steynii CBS 112812
DTO 28-E6 A. ochraceus
DTO 47-F1 A. ochraceus
DTO 47-E9 A. ochraceus
A. elegans CBS 10214
A. insulicola CBS 38275
A. pseudoelegans CBS 112796
A. pseudoelegans CBS 112797
A. ochraceopetaliformis CBS 12355
A. flocculosus CBS 116336
A. flocculosus CBS 112798
A. flocculosus CBS 112784
A. flocculosus CBS 112799
A. flocculosus CBS 112789
A. flocculosus CBS 112785
A. roseoglobulosus CBS 112800
A. neobridgeri CBS 55982
DTO 13-I8 A. ochraceus
DTO 48-E7 A. ochraceus
DTO 13-D1 A. ochraceus
DTO 50-H6 A. ochraceus
DTO 17-B8 A. ochraceus
DTO 13-C9 A. ochraceus
DTO 28-E9 A. ochraceus
DTO 13-I7 A. ochraceus
A. bridgeri CBS 35081
DTO 48-F9 A. ochraceus
A. persii CBS 112795
DTO 50-I1 A. ochraceus
DTO 50-F9 A. ochraceus
DTO 50-H2 A. ochraceus
DTO 48-G1 A. ochraceus
A. sulphureus CBS 55065
A. sulphureus CBS 38575
A. sclerotiorum CBS 63278
DTO 13-D4 A. ochraceus
DTO 28-F1 A. ochraceus
DTO 50-H8 A. ochraceus
A. sclerotiorum CBS 54965
DTO 48-E5 A. ochraceus
DTO 50-G2 A. ochraceus
DTO 13-D3 A. ochraceus
DTO 48-E9 A. ochraceus
DTO 50-I2 A. ochraceus
DTO 50-G1 A. ochraceus
DTO 50-H7 A. ochraceus
DTO 48-G6 A. terreus
A. cretensis
P. muricatus
Aspergillus sp. (1)
A. auricomus
A. steynii (4)
A. elegans
A. insulicola
A. pseudoelegans
A. flocculosus
A. roseoglobulosus
A. nebridgeri
A. persii I (8)
A. bridgeri
A. persii II (5)
A. sulphureus
A. sclerotiorum (10)
DTO 28-E8 A. ochraceus
DTO 31-F6 A. ochraceus
DTO 48-F3 A. ochraceus
DTO 48-F7 A. ochraceus
DTO 48-G2 A. ochraceus
DTO 11-F2 A. ochraceus
A. westerdijkiae CBS 112803
DTO 46-D7 A. ochraceus
DTO 50-H4 A. ochraceus
DTO 50-H5 A. ochraceus
DTO 50-I4 A. ochraceus
A. westerdijkiae CBS 112791
DTO 46-D9 A. ochraceus
A. westerdijkiae CBS 112804
DTO 17-B7 A. ochraceus
DTO 31-F8 A. ochraceus
DTO 46-E1 A. ochraceus
DTO 26-A1 A. ochraceus
DTO 48-F1 A. ochraceus
DTO 7-D3 A. ochraceus
DTO 4-I6 A. ochraceus
DTO 25-H8 A. ochraceus
DTO 46-D8 A. ochraceus
DTO 8-H3 A. ochraceus
DTO 50-H9 A. ochraceus
DTO 50-G8 A. ochraceus
DTO 25-I3 A. ochraceus
DTO 50-G9 A. ochraceus
DTO 48-G3 A. ochraceus
DTO 48-F4 A. ochraceus
DTO 48-F5 A. ochraceus
DTO 50-G4 A. ochraceus
DTO 50-G6 A. ochraceus
DTO 50-G5 A. ochraceus
DTO 13-D2 A. ochraceus
DTO 50-I3 A. ochraceus
DTO 28-E7 A. ochraceus
DTO 50-I5 A. ochraceus
DTO 48-F8 A. ochraceus
DTO 48-G5 A. ochraceus
DTO 50-G7 A. ochraceus
A. ostianus CBS 54865
DTO 50-H3 A. ochraceus
A. ostianus CBS 31180
DTO 48-F2 A. ochraceus
DTO 50-G3 A. ochraceus
A. ochraceus CBS 10808
DTO 48-E8 A. ochraceus
DTO 48-F6 A. ochraceus
A. petrakii/ochraceus CBS 10557
DTO 48-E6 A. ochraceus
DTO 48-G4 A. ochraceus
A. ochraceus CBS 62478
DTO 50-H1 A. ochraceus
A. ochraceus CBS 74870
DTO 15-E7 A. ochraceus
DTO 48-E4 A. ochraceus
A. melleus CBS 112786
A. melleus CBS 54665
DTO 47-F2 A. ochraceus
A. petrakii/melleus CBS 64078
A. melleus CBS 11426
A. westerdijkiae (36)
A. ostianus (1)
A. ochraceus (9)
A. melleus (1)

Incidence of species of section *Circumdati* in indoor environments



A. ochraceopetaliformis in an onychomycosis case

Medical Mycology June 2010, **48**, 656–660

informa
healthcare

A new species, *Aspergillus persii*, as an agent of onychomycosis

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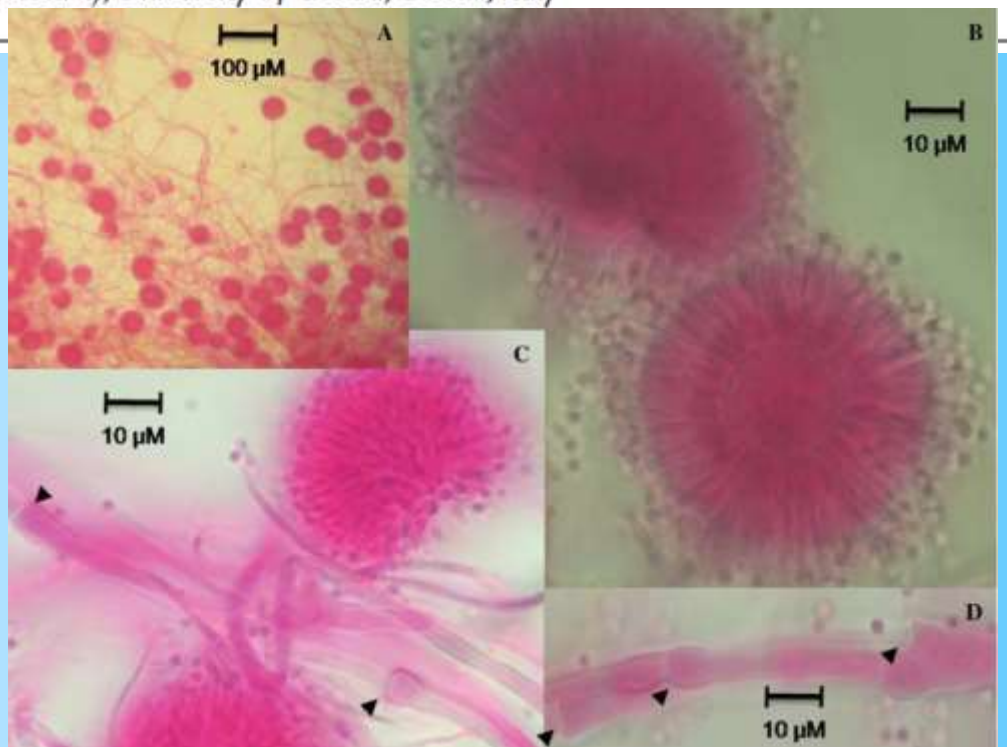

Aspergillus persii

***Aspergillus melleus* as the etiological agent of onychomycosis: the first case described in literature**

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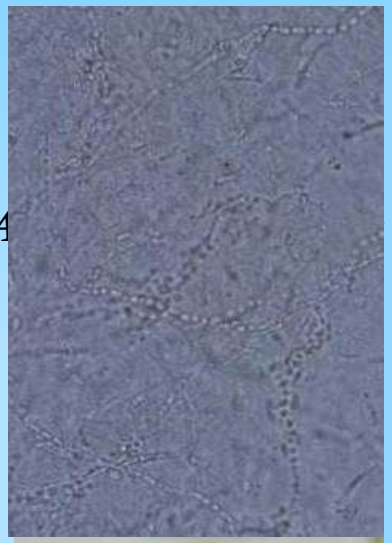
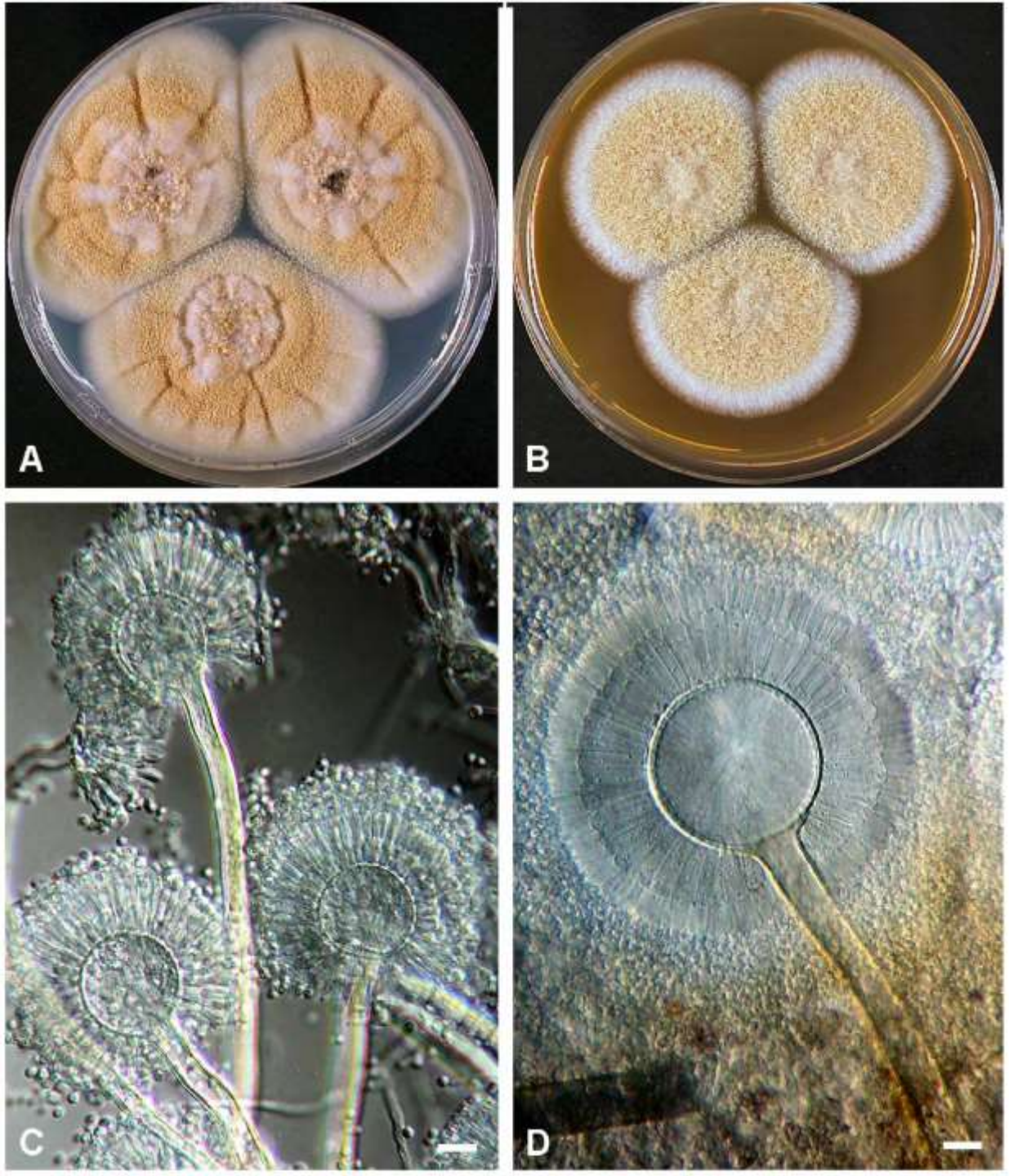
Aspergillus melleus

2007: IV finger foot dx,
57 year old, male

direct examination



A. westerdijkiae **and** ***A. insulicola*** **are also able to cause onychomycoses**



Med Mycol 50 (2013) 601

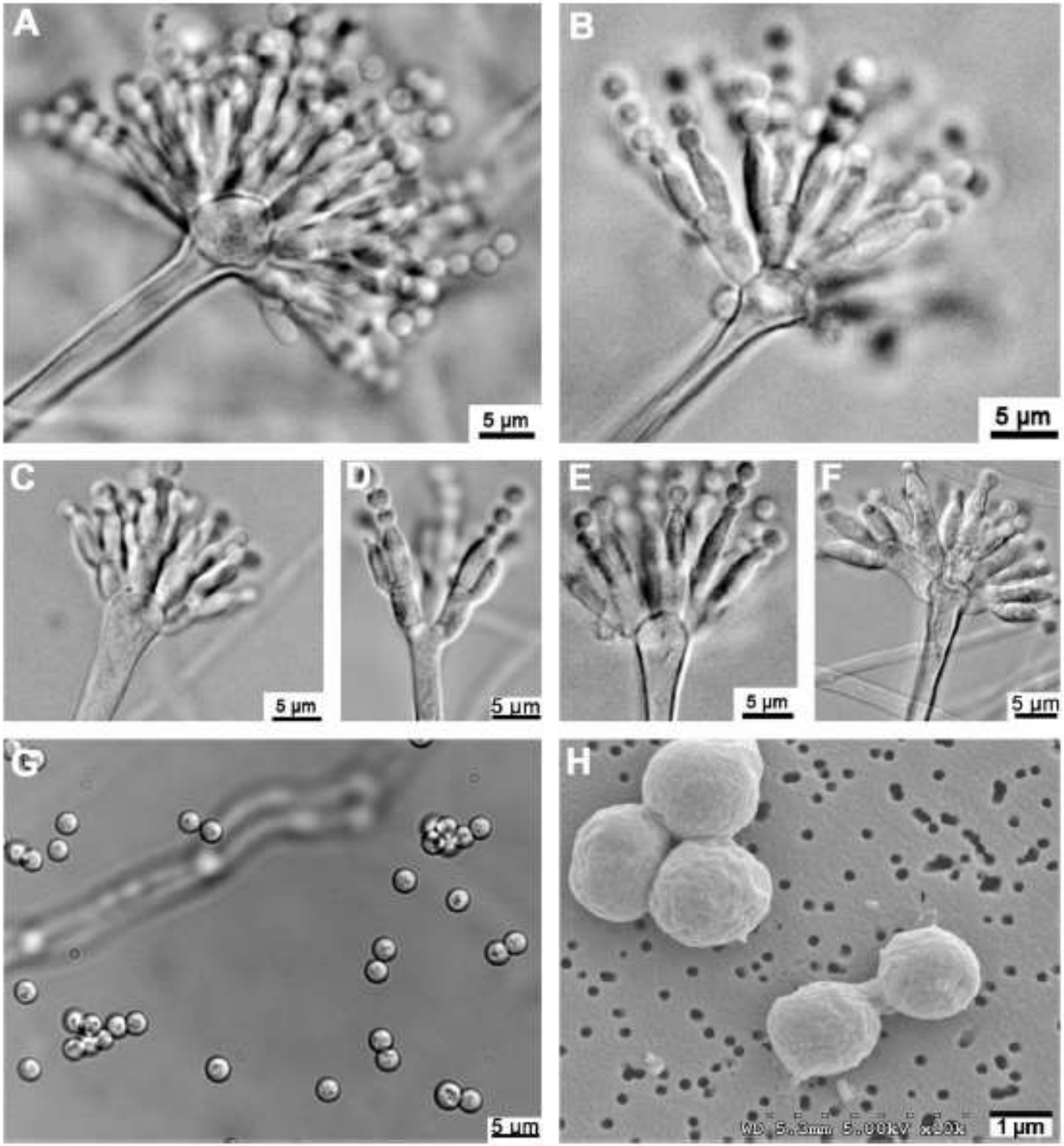
JCM
Journals.ASM.org

Aspergillus tanneri sp. nov., a New Pathogen That Causes Invasive Disease Refractory to Antifungal Therapy

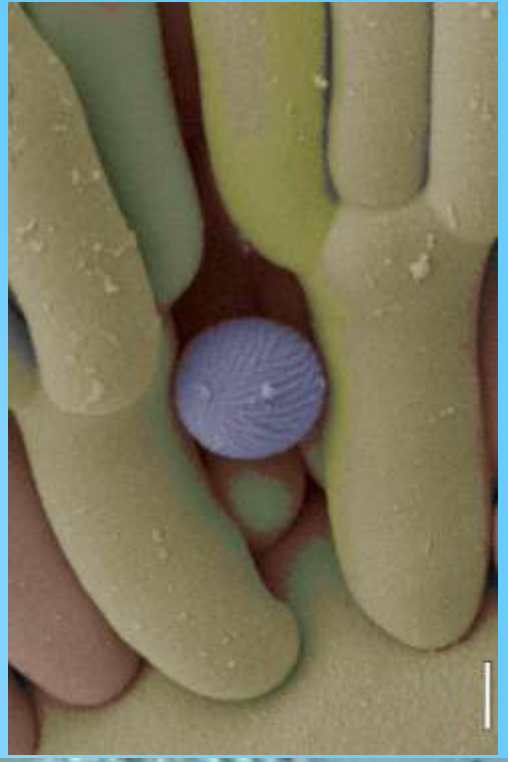
Janyce A. Sugui,[a] Stephen W. Peterson,[b] Lily P. Clark,[a] Glenn Nardone,[c] Les Folio,[d] Gregory Riedlinger,[e] Christa S. Zerbe,[f] Yvonne Shea,[g] Christina M. Henderson,[g] Adrian M. Zelazny,[g] Steven M. Holland,[f] and Kyung J. Kwon-Chung[a]

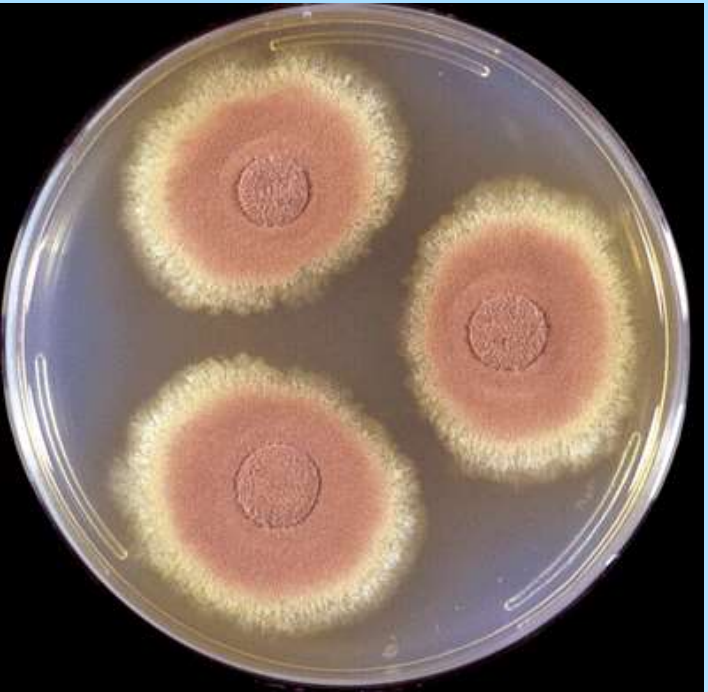
Molecular Microbiology Section, Laboratory of Clinical Infectious Diseases, NIAID, NIH, Bethesda, Maryland, USA[a]; National Center for Agricultural Utilization Research, U.S. Department of Agriculture, Peoria, Illinois, USA[b]; Research Technology Branch, NIH, Rockville, Maryland, USA[c]; Computed Tomography, Radiology and Imaging Sciences, NIH, Bethesda, Maryland, USA[d]; National Cancer Institute, Laboratory of Pathology, NIH, Bethesda, Maryland, USA[e]; Immunopathogenesis Section, Laboratory of Clinical Infectious Diseases, NIAID, NIH, Bethesda, Maryland, USA[f]; and Microbiological Service, Department of Laboratory Medicine, NIH, Bethesda, Maryland, USA[g]

The most common cause of invasive aspergillosis (IA) in patients with chronic granulomatous disease (CGD) is *Aspergillus fumigatus* followed by *A. nidulans*; other aspergilli rarely cause the disease. Here we review two clinical cases of fatal IA in CGD patients and describe a new etiologic agent of IA refractory to antifungal therapy. Unlike typical IA caused by *A. fumigatus*, the disease caused by the new species was chronic and spread from the lung to multiple adjacent organs. Mycological characteristics and the phylogenetic relationship with other aspergilli based on the sequence analysis of *Mcm7*, *RPB2*, and *Tsr1* indicated that the new species, which we named as *A. tanneri*, belongs to *Aspergillus* section *Circumdati*. The species has a higher amphotericin B, voriconazole, and itraconazole MIC and causes more chronic infection in CGD mice than *A. fumigatus*. This is the first report documenting IA in CGD patients caused by a species belonging to the *Aspergillus* section *Circumdati* that is inherently resistant to azoles and amphotericin B. Unlike the results seen with many members of *Aspergillus* section *Circumdati*, ochratoxin was not detected in filtrates of cultures grown in various media. Our phenotypic and genetic characterization of the new species and the case reports will assist future diagnosis of infection caused by *A. tanneri* and lead to more appropriate patient management.

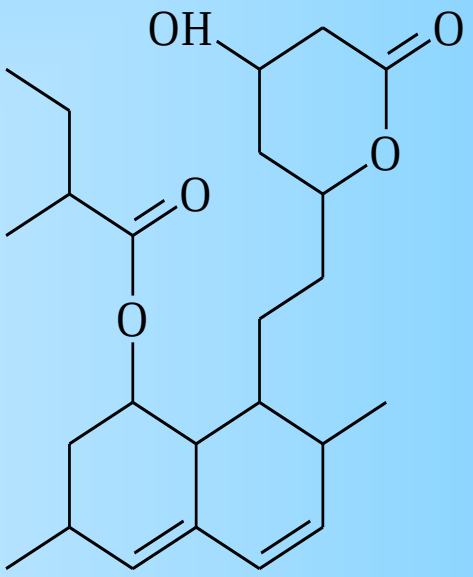

A
5 µm
B
5 µm
C
5 µm
D
5 µm
E
5 µm
F
5 µm
G
5 µm
H
1 µm

Aspergillus section *Terrei*





lovastatin

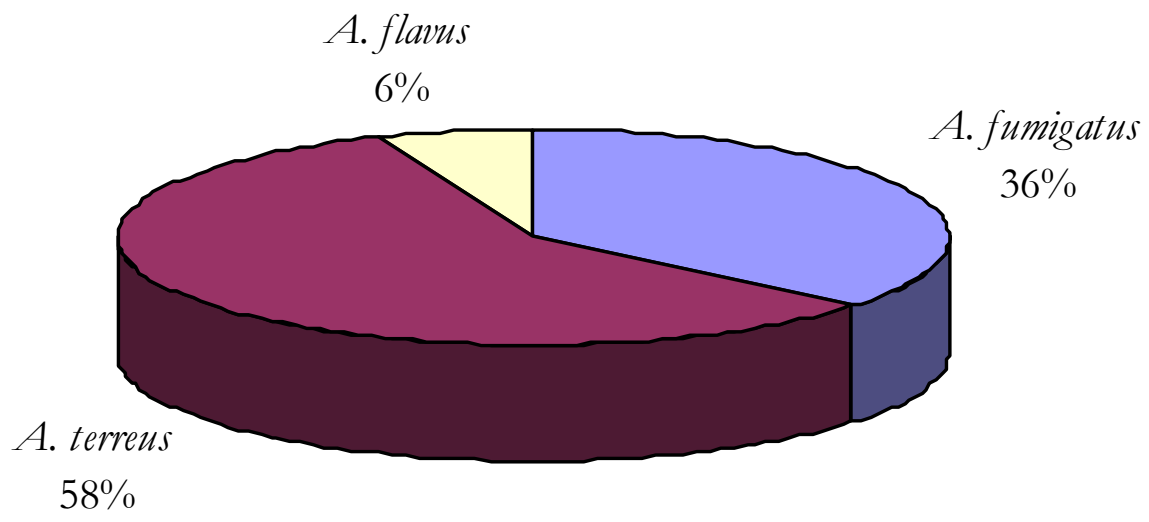


Aspergillus terreus

- 3rd most frequent cause of IA worldwide; the most frequent causative agent of IA in some medical centers (eg. Austria)
- Increased lethality of infections compared with those caused by other *Aspergillus* species
- Construction activity, soil of potted plants, and water distribution systems implicated as potential reservoirs of *A. terreus* in hospital environments
- Exhibit decreased *in vitro* susceptibilities to amphotericin B

Aspergilli in IA cases in Austria

Distribution of Aspergilli from IA cases at Innsbruck University, Austria (2003-2006)



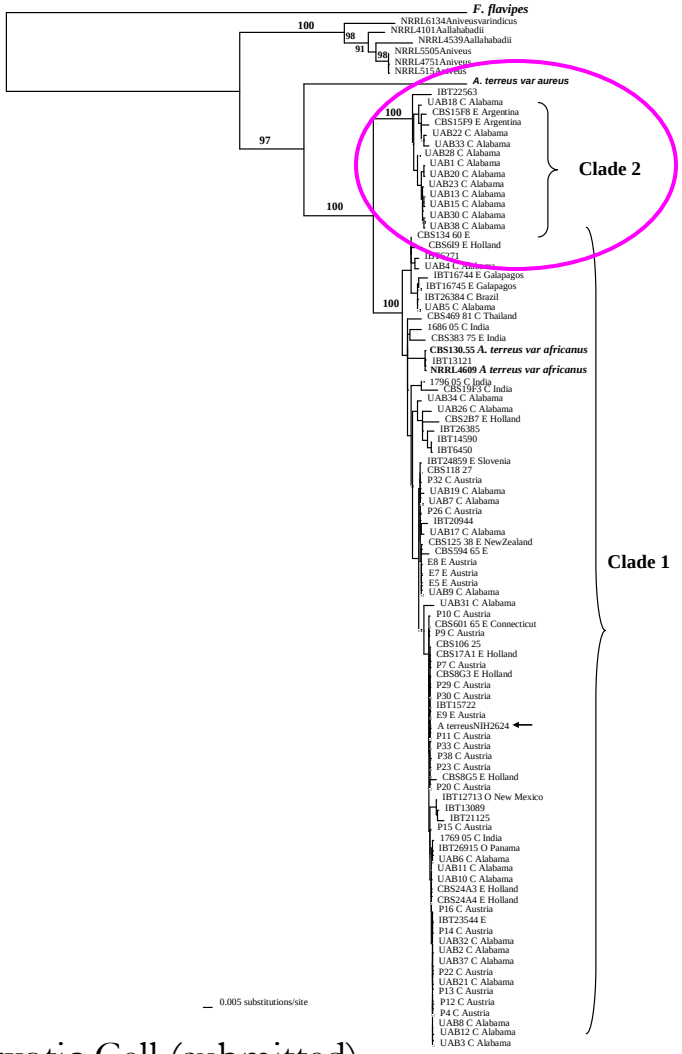
Clin Infect Dis 45 (2007) e101-e104

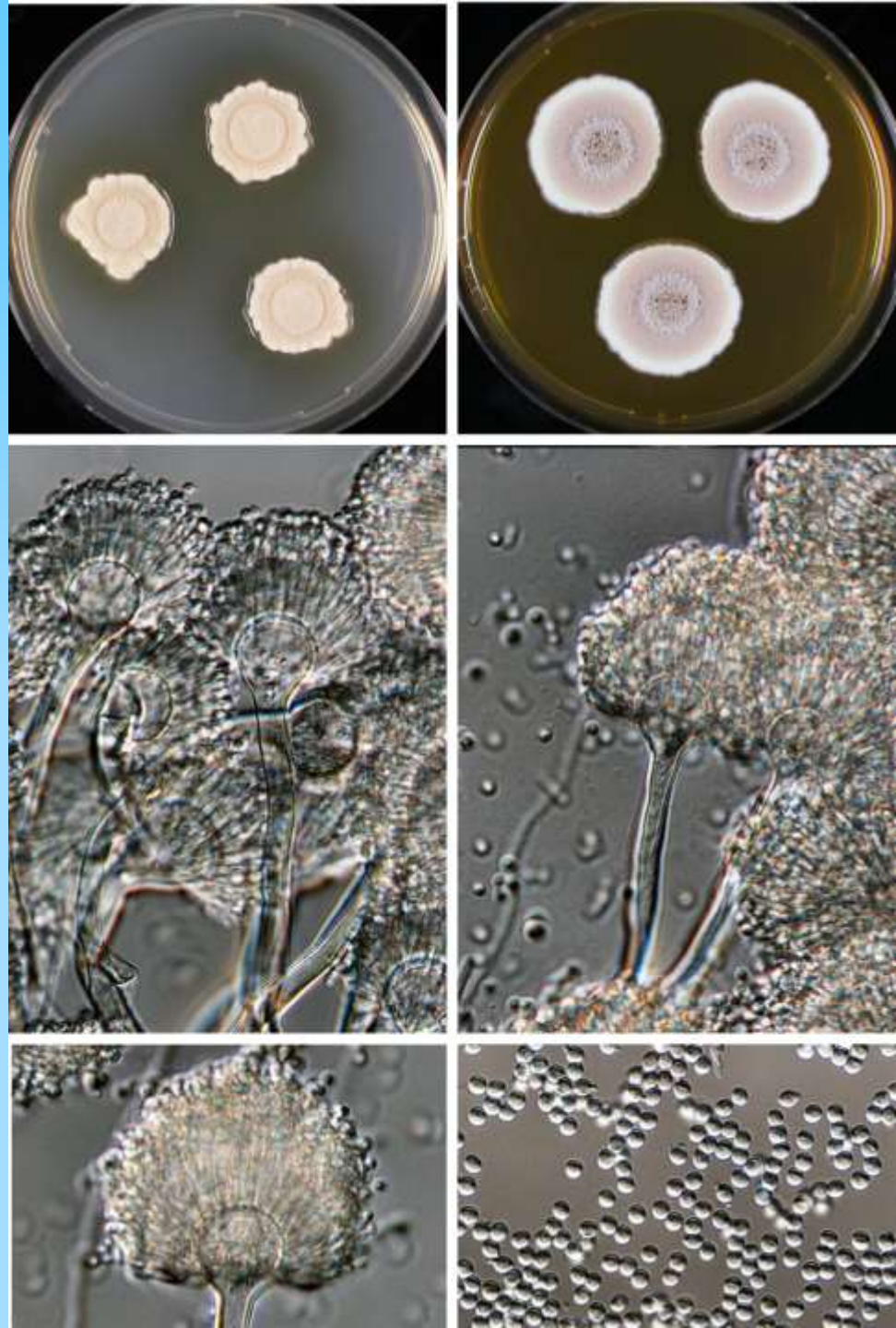
A. alabamensis sp. nov.

- Multilocus sequence analysis of large numbers of (mainly) clinical isolates revealed a new pathogenic species related to *A. terreus*
- Occurrence: USA (Alabama), Argentina
- Mostly recovered as colonizing isolates from immunocompetent populations
- Exhibit decreased *in vitro* susceptibilities to amphotericin B

A. alabamensis sp. nov.

Figure 5

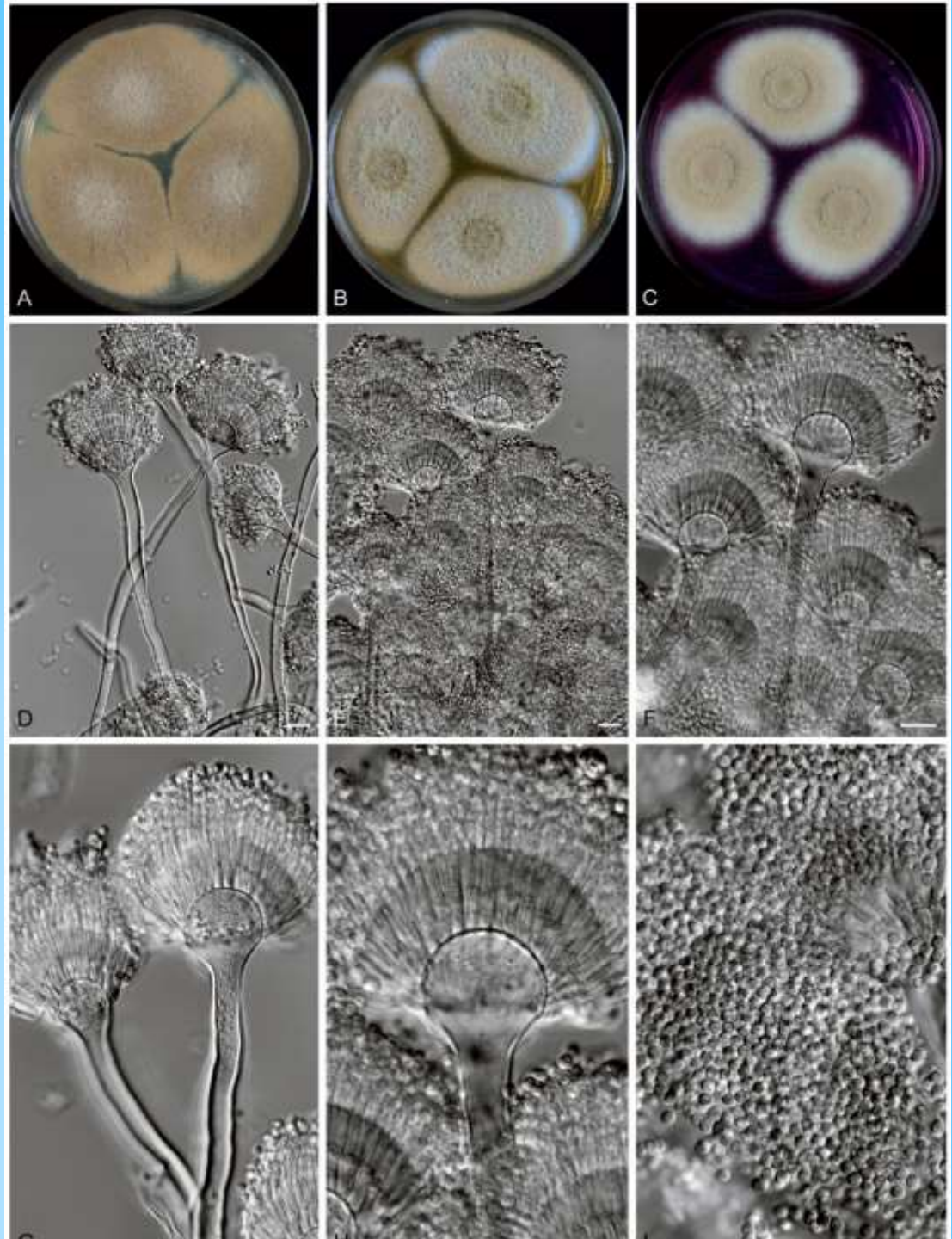




Eukaryotic Cell (submitted)

Aspergillus hortai

- Originally described in 1935 from ear infection (Brazil)
- Also identified from nail infection in the Czech Republic



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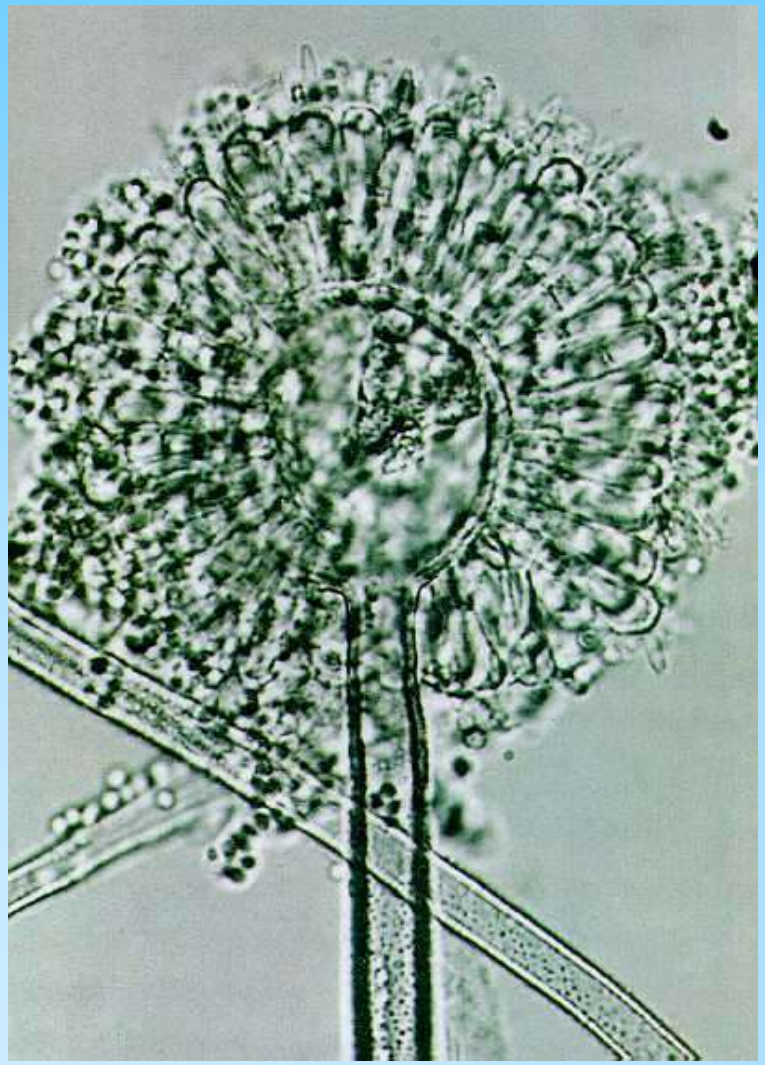
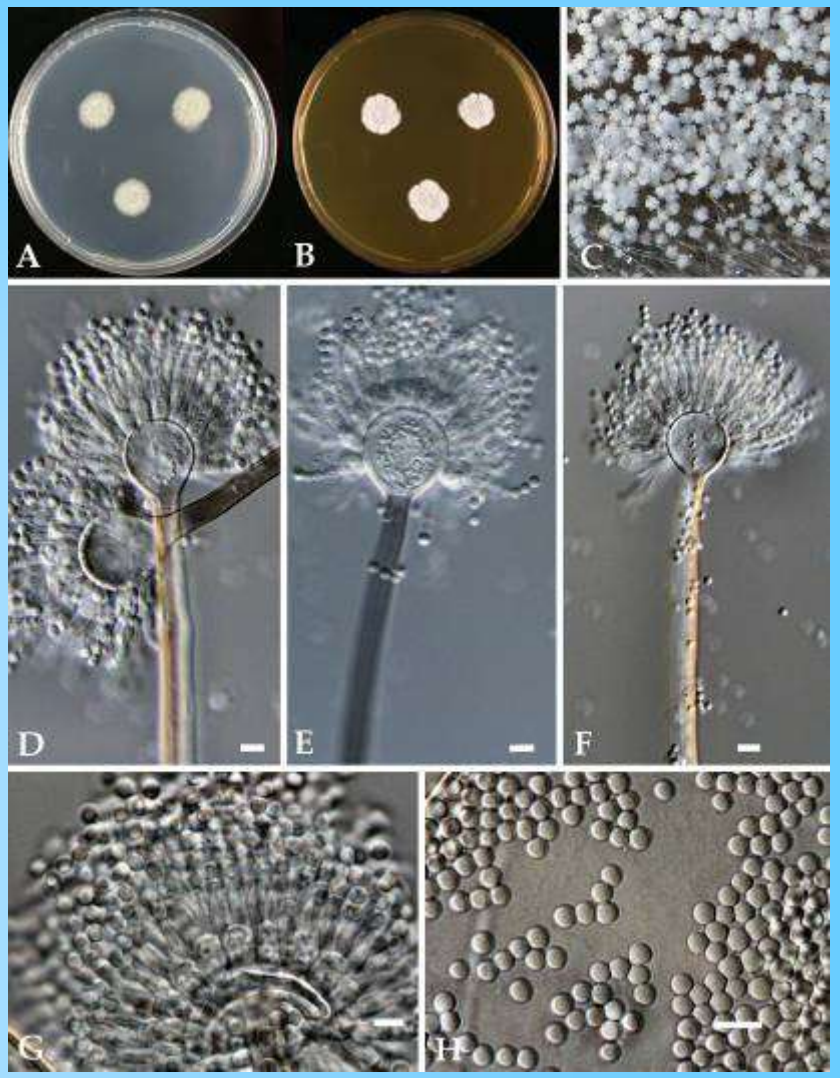
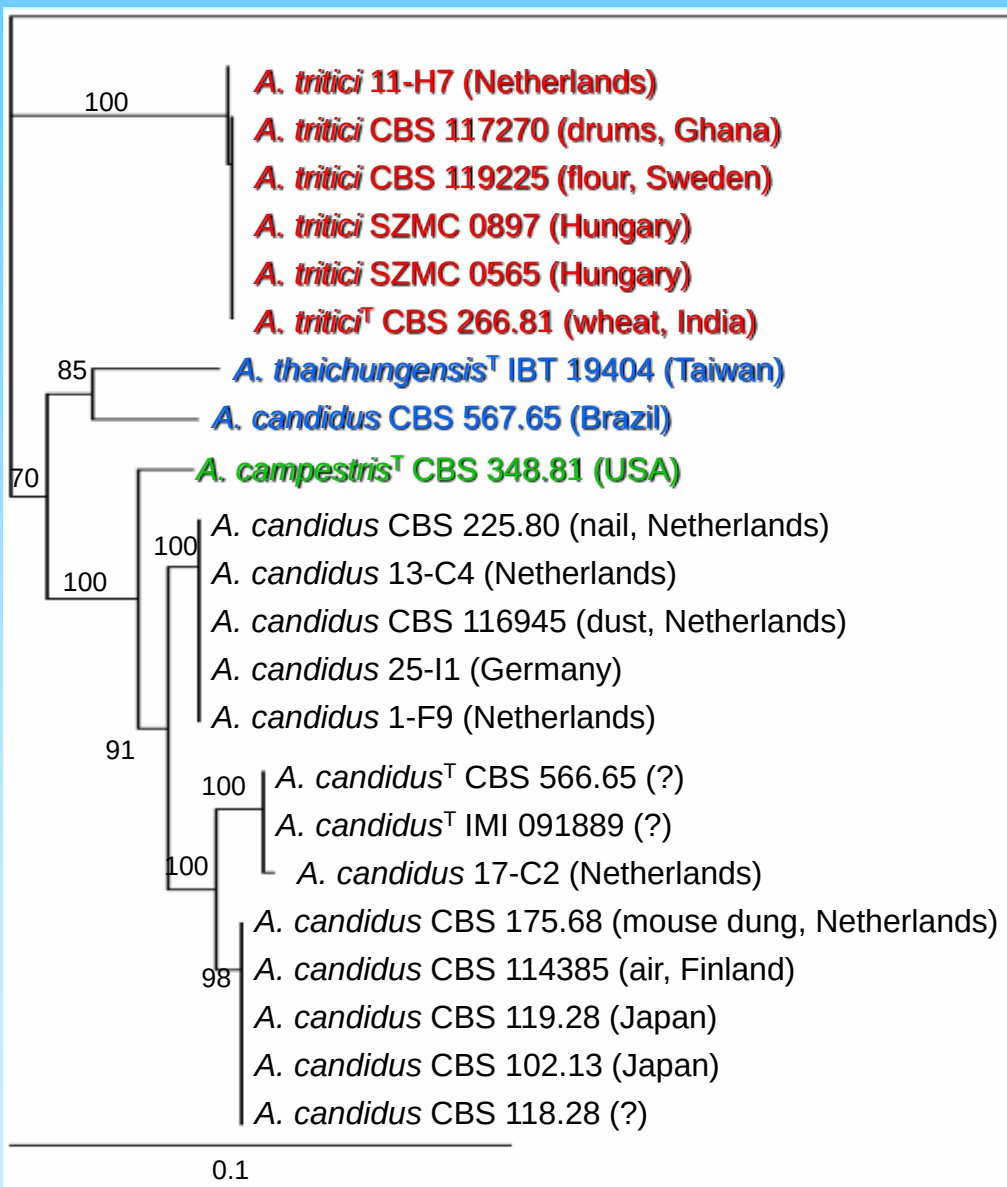
Aspergillus section *Candidi*





Neighbor-joining tree based on β-tubulin sequence data of *Aspergillus* section *Candidi*



63/497 PI char.

4 MP trees

L: 218

CI: 0.8853

RI: 0.9178

Aspergillus tritici

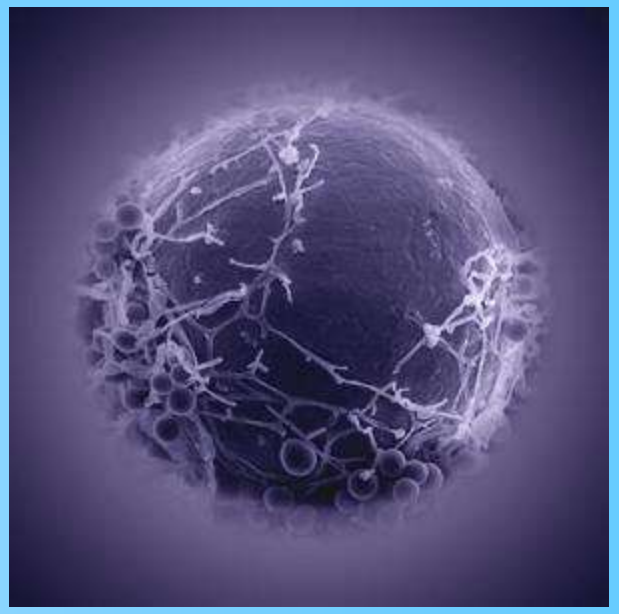
- Originally described as "*A. triticus*" by Mehrotra & Basu (1976)
- Isolates grow well at 37ºC
- More yellowish than *A. candidus*
- Some of them produce purple sclerotia
- Conidial heads radiate, wet ("slimy"), conidia roughened
- Causes onychomycoses (Hubka et al. Med. Mycol. 50: 601)

A. pragensis

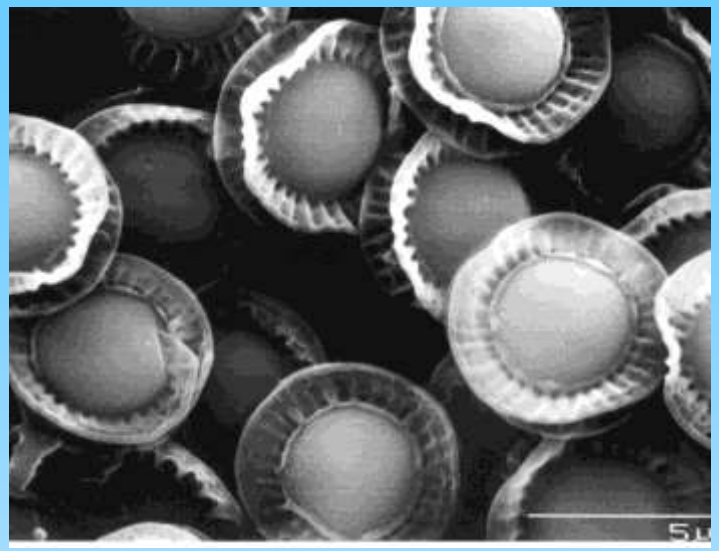
- Potential cause of nail infection in humans
- Does not grow at 37°C
- Isolated in the Czech Republic

Hubka et al. submitted

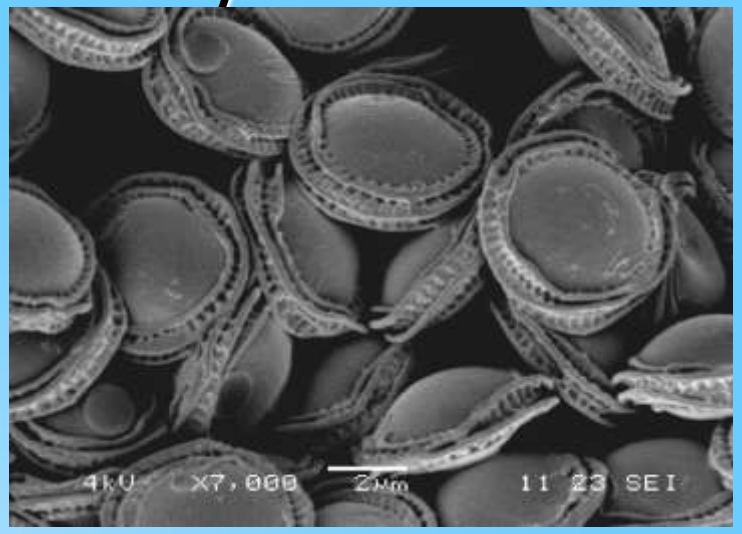
Aspergillus section *Nidulantes*



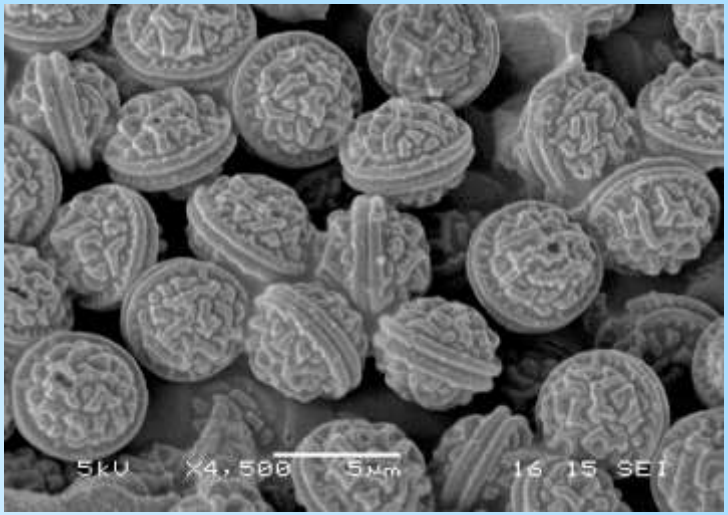
A. nidulans



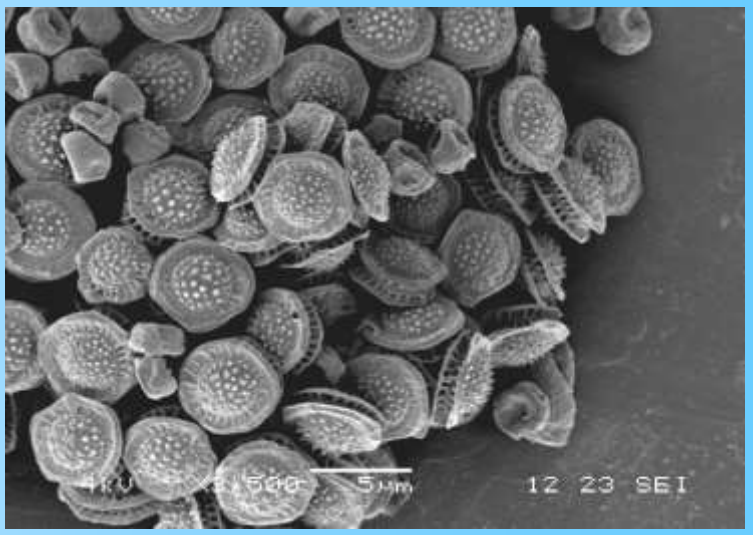
A. quadrilineata



E. rugulosa

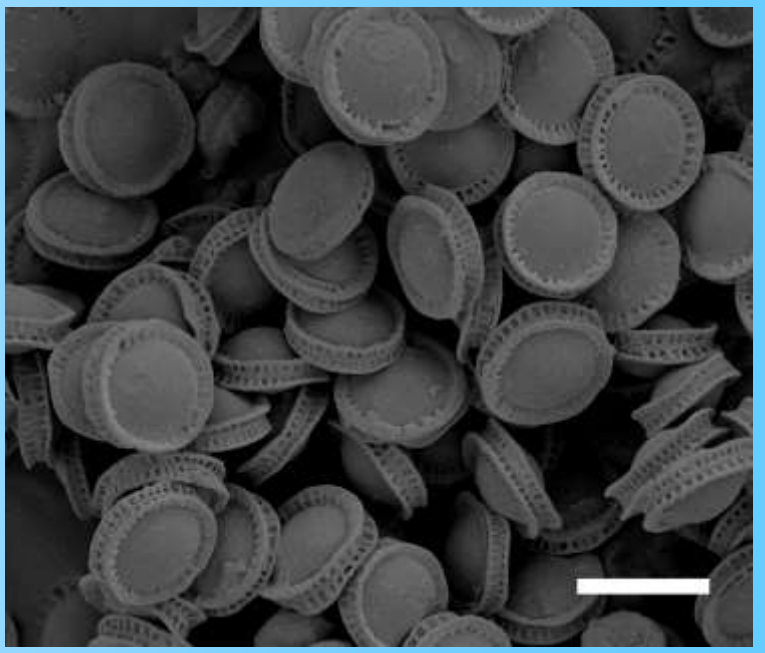


E. nidulans var. *echinulata*



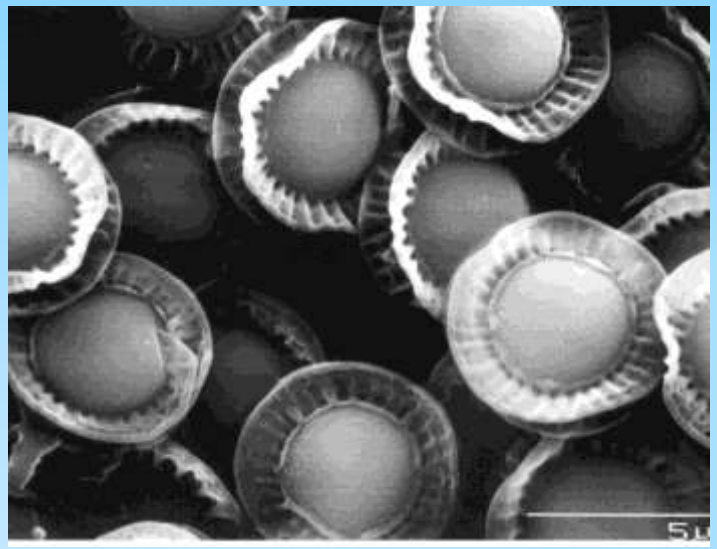
Emericella nidulans (*Aspergillus nidulans*)

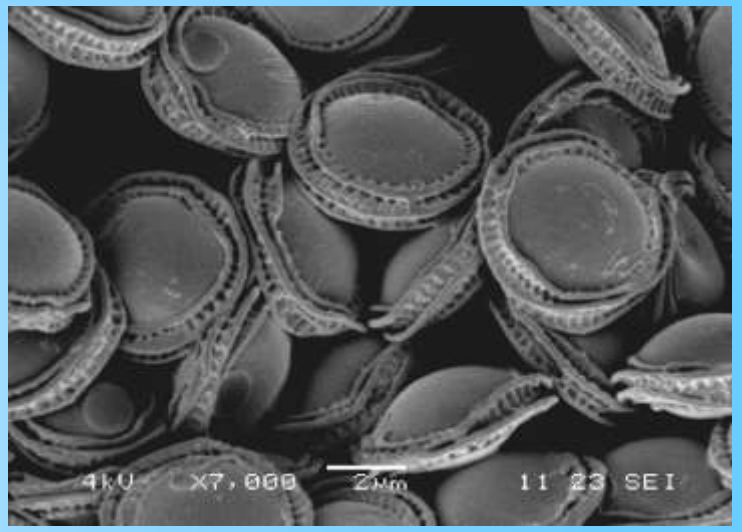
- Important model organism
- Uncommon in animals and humans
- Occurs predominantly in patients with chronic granulomatous disease (CGD)

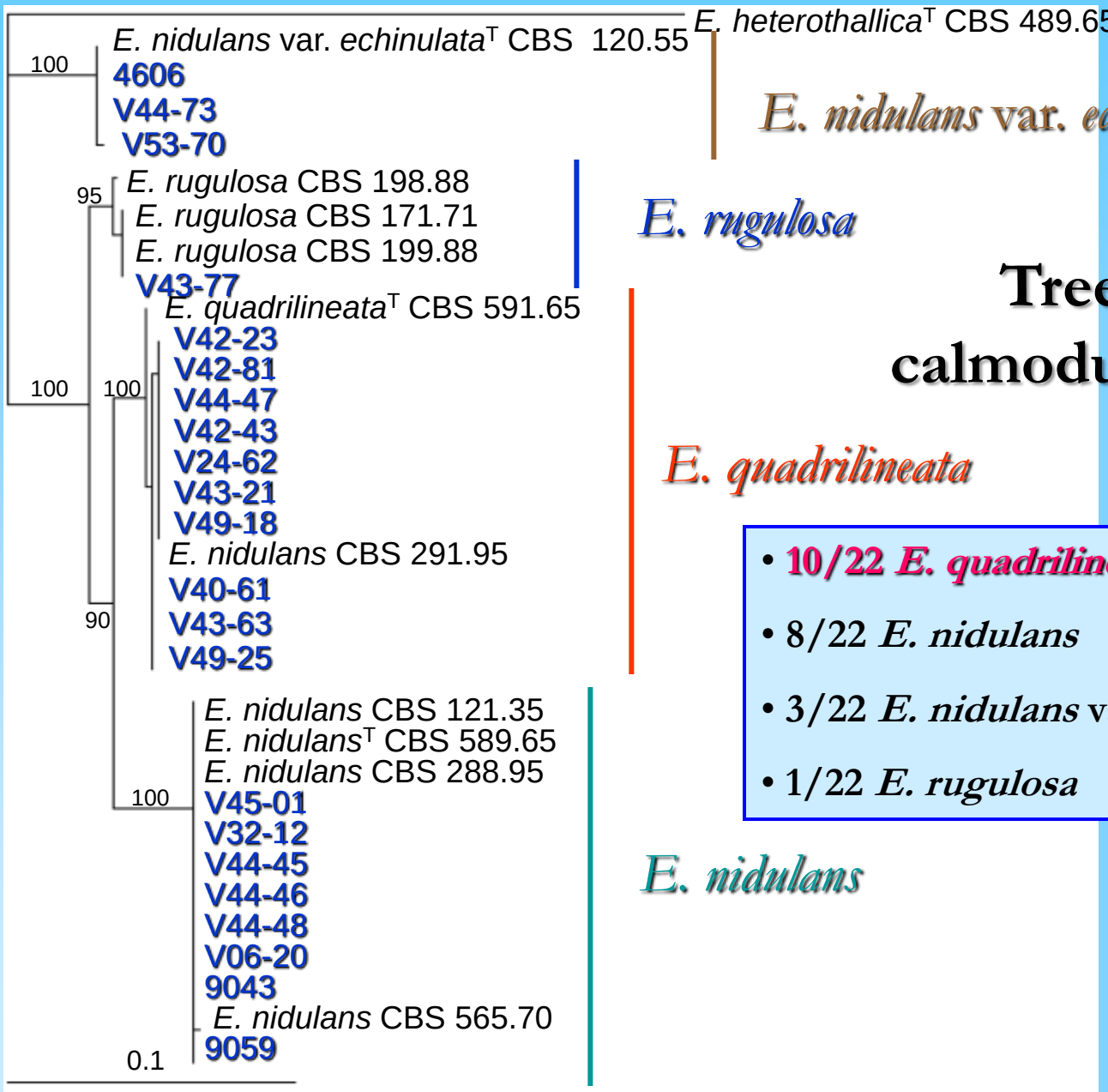


Emericella quadrilineata as Cause of Invasive Aspergillosis

Paul E. Verweij,* János Varga,†‡ Jos Houbraken,† Antonius J.M.M. Rijs,* Frans M. VerduynLunel,* Nicole M.A. Blijlevens,* Yvonne R. Shea,§ Steven M. Holland,§ Adilia Warris,* Willem J. G. Melchers,* and Robert A. Samson†





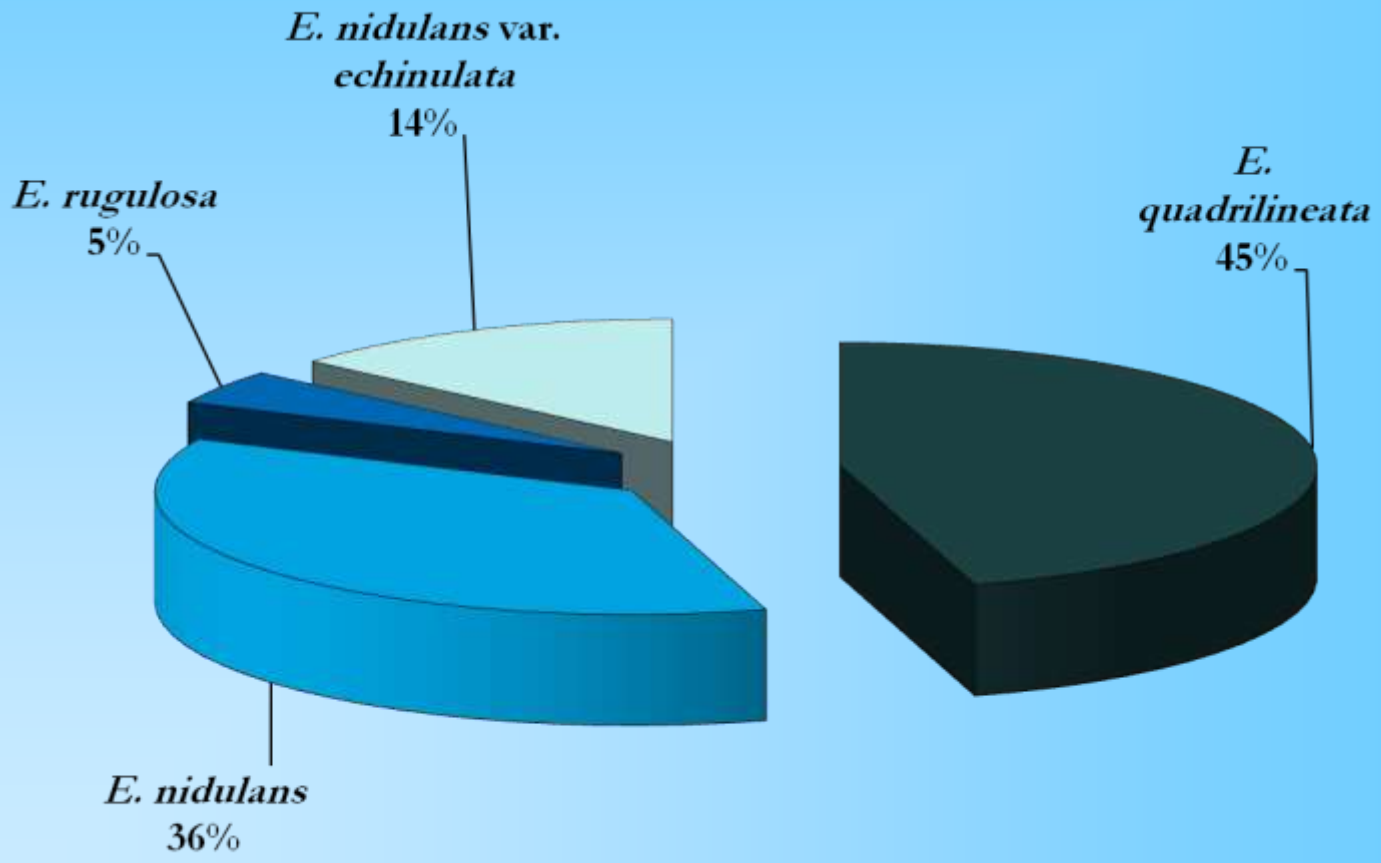


Tree based on calmodulin sequences

- **10/22 *E. quadrilineata***
- 8/22 ***E. nidulans***
- 3/22 ***E. nidulans* var. *echinulata***
- 1/22 ***E. rugulosa***

Emerg Infect Dis 2008; 14: 566-572

Incidence of *Emericella* species among the examined clinical isolates



Emerg Infect Dis 2008; 14: 566-572

Comparison of mean MICs against *E. nidulans* (n=12) and *E. quadrilineata* (n=12)

Drug	*E. nidulans*	*E. quadrilineata*	Significance
Amphotericin B	2.5	0.5	P<0.05
Itraconazole	0.07	0.13	N.S.
Voriconazole	0.26	0.39	P<0.05
Posaconazole	0.25	0.22	P<0.05
Caspofungin	0.32	1.83	P<0.05
Terbinafin	0.01	0.009	N.S.

Emerg Infect Dis 2008; 14: 566-572

Medical Mycology August 2012, **50**, 601–610

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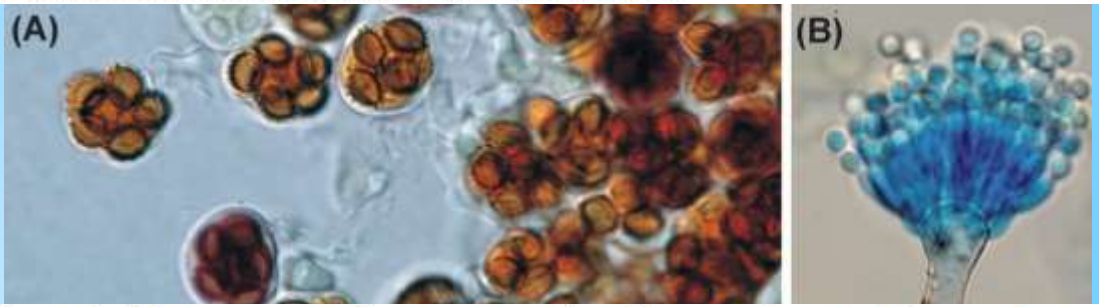
healthcare

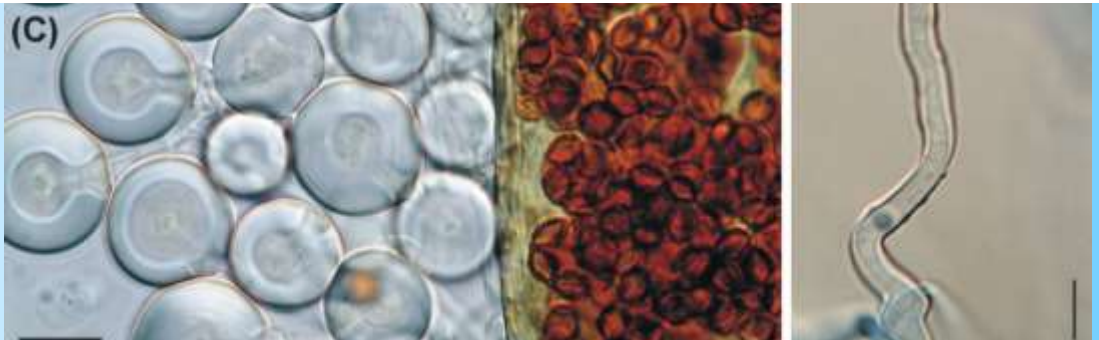
Rare and new etiological agents revealed among 178 clinical *Aspergillus* strains obtained from Czech patients and characterized by molecular sequencing

VIT HUBKA*†, ALENA KUBATOVA*, NADA MALLATOVA‡, PETR SEDLACEK§, JAN MELICHAR#**, MAGDALENA SKOREPOVA^, KAREL MENCL+, PAVLINA LYSKOVA$, BLANKA SRAMKOVA$, MILADA CHUDICKOVA†, PETR HAMAL¦ & MIROSLAV KOLARIK*†

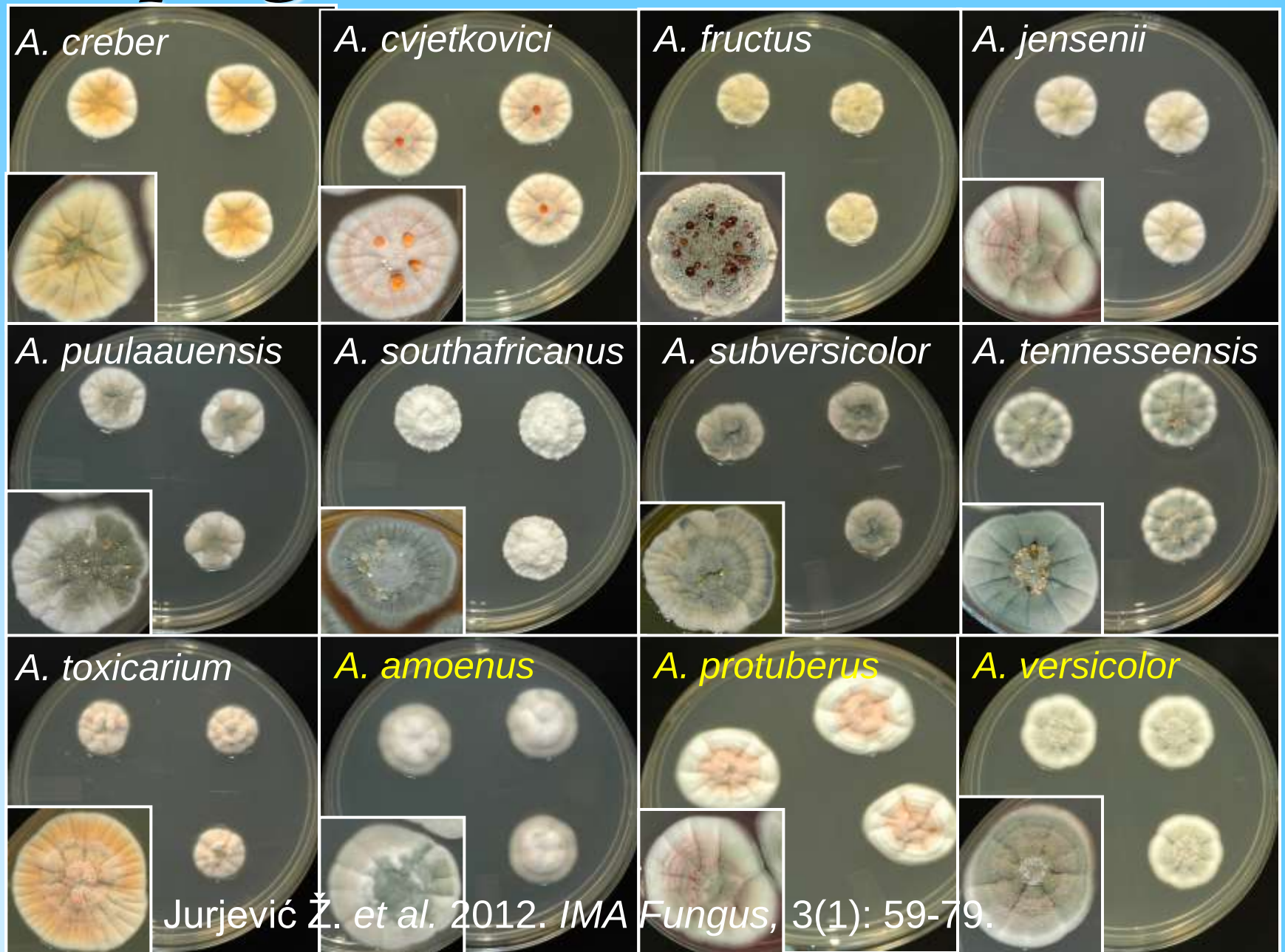
***A. rugulovalvus* (=*Emericella rugulosa*)**



Case 1: Necrotising disseminated infection due to E. rugulosa *in a premature newborn*



Aspergillus section *Versicolores*



Jurjević Ž. *et al.* 2012. *IMA Fungus*, 3(1): 59-79.

Mycotoxin Res (2013) 29:141–145
DOI 10.1007/s12550-013-0160-4

ORIGINAL PAPER

Sterigmatocystin production by nine newly described *Aspergillus* species in section *Versicolores* grown on two different media

Željko Jurjević · Stephen W. Peterson · Michele Solfrizzo · Maja Peraica

A. sydowii on gorgonian sea fans

Collaborators

- **Sándor Kocsubé, Gyöngyi Szigeti, Nikolett Baranyi,** University of Szeged, Szeged, Hungary
- **Robert A. Samson,** CBS-KNAW Fungal Biodiversity Centre, Utrecht, Netherlands
- **Jens C. Frisvad,** Technical University, Lyngby, Denmark
- **Vit Hubka, Vanessa Barrs, Zeljko Jurjevic, Mirca Zotti**

Thanks for your attention!