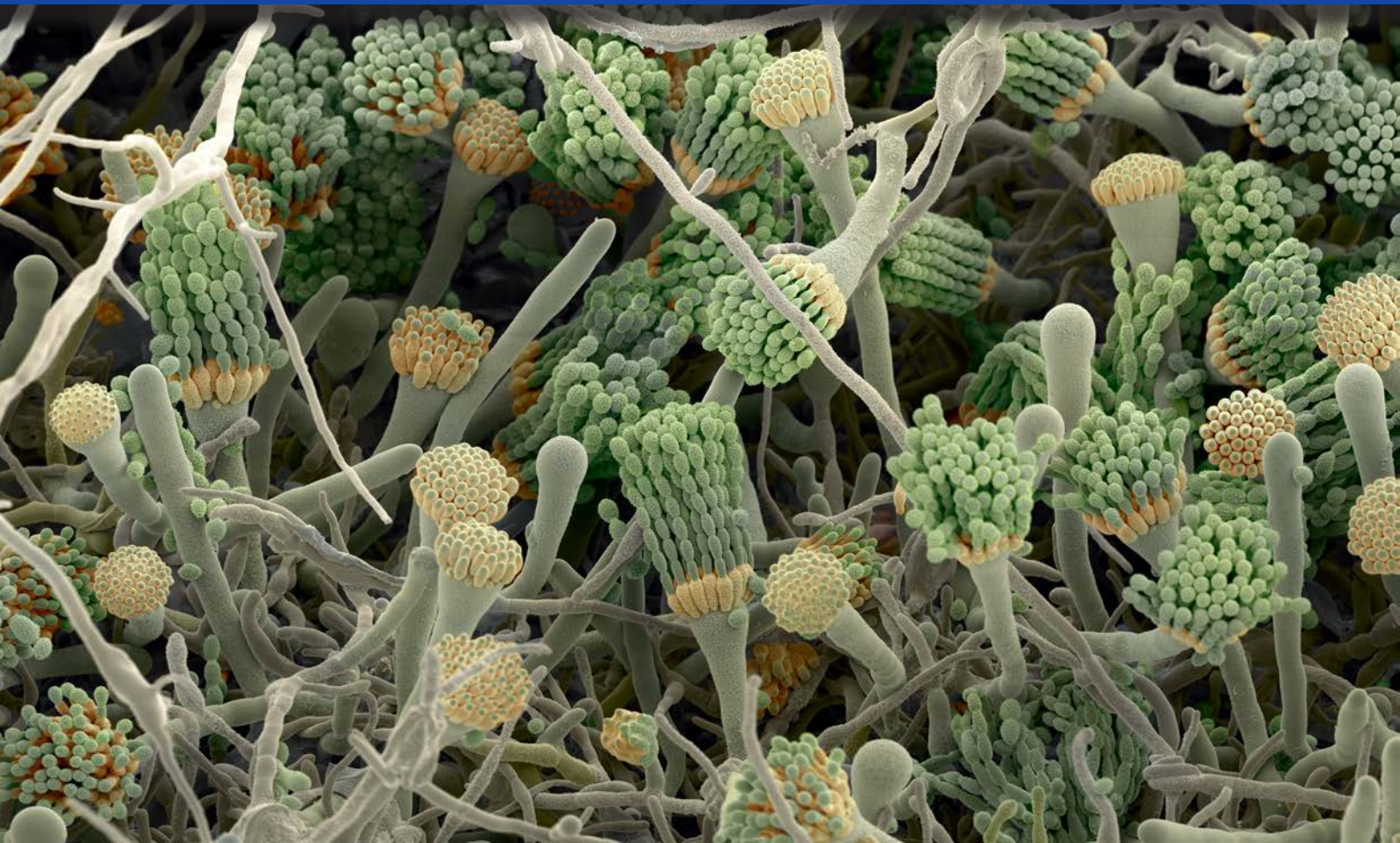




Westerdijk Fungal Biodiversity Institute

Genetic resources and bioscience services
for education, research and development





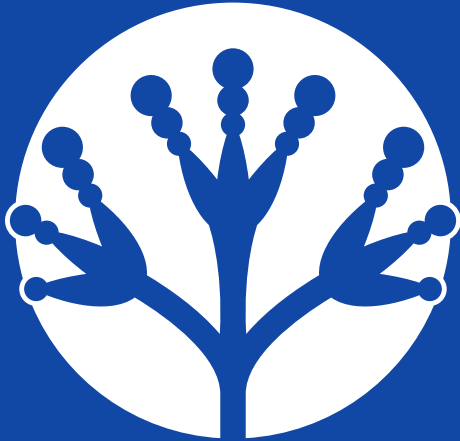
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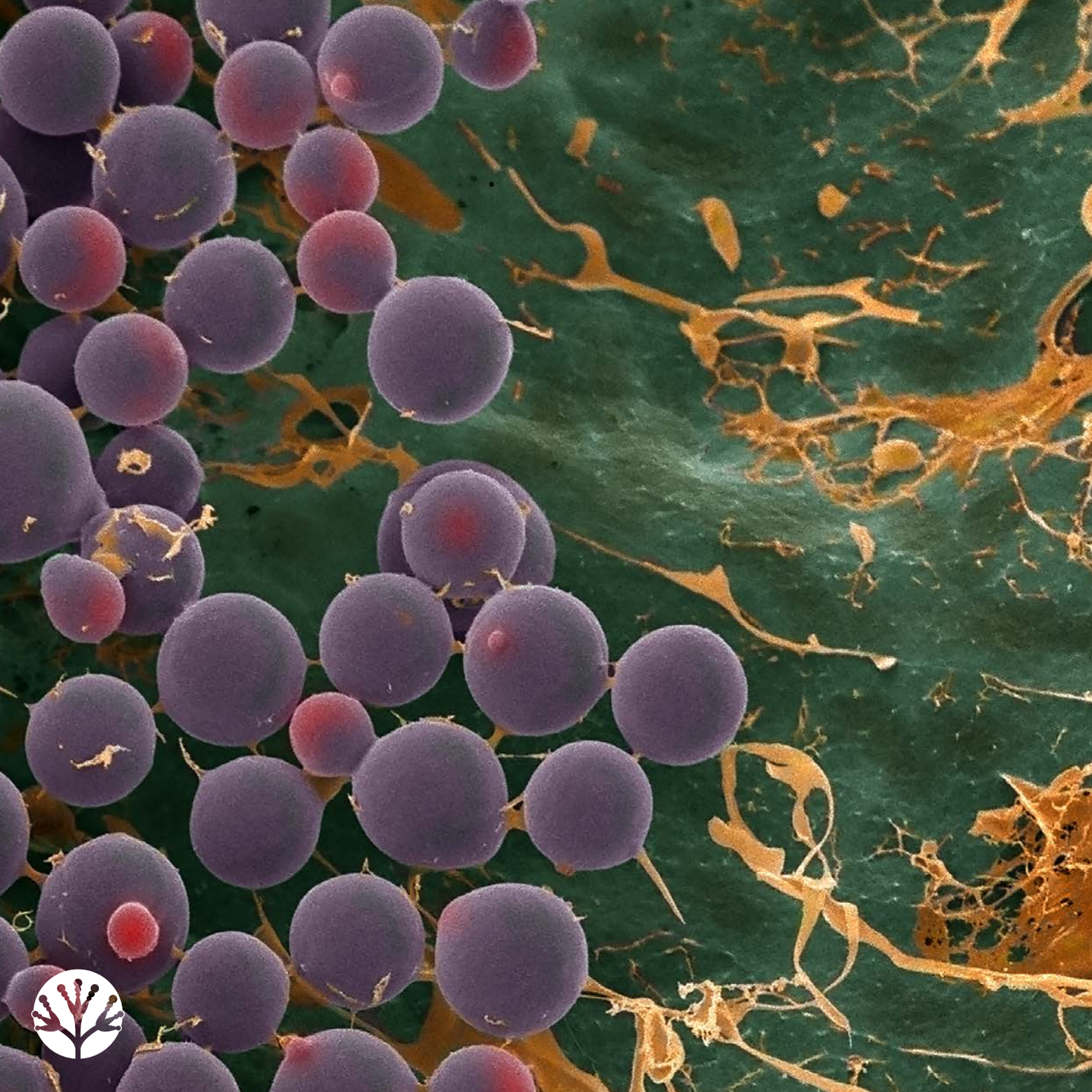
Westerdijk Fungal Biodiversity Institute
Uppsalalaan 8, 3584 CT Utrecht, The Netherlands
Phone: +31 30 2122600
Fax: +31 30 2122601
E-mail: info@wi.knaw.nl
www.wi.knaw.nl

Facebook: [@WesterdijkInstitute](https://www.facebook.com/WesterdijkInstitute)
Twitter: [@_Westerdijk_](https://twitter.com/_Westerdijk_)

COLOFON

Design: Ellen Bouma
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Cover: *Aspergillus restrictus*







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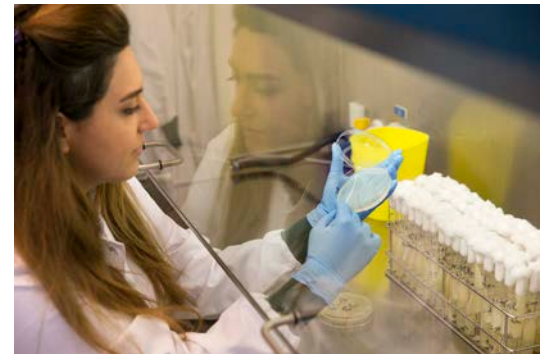


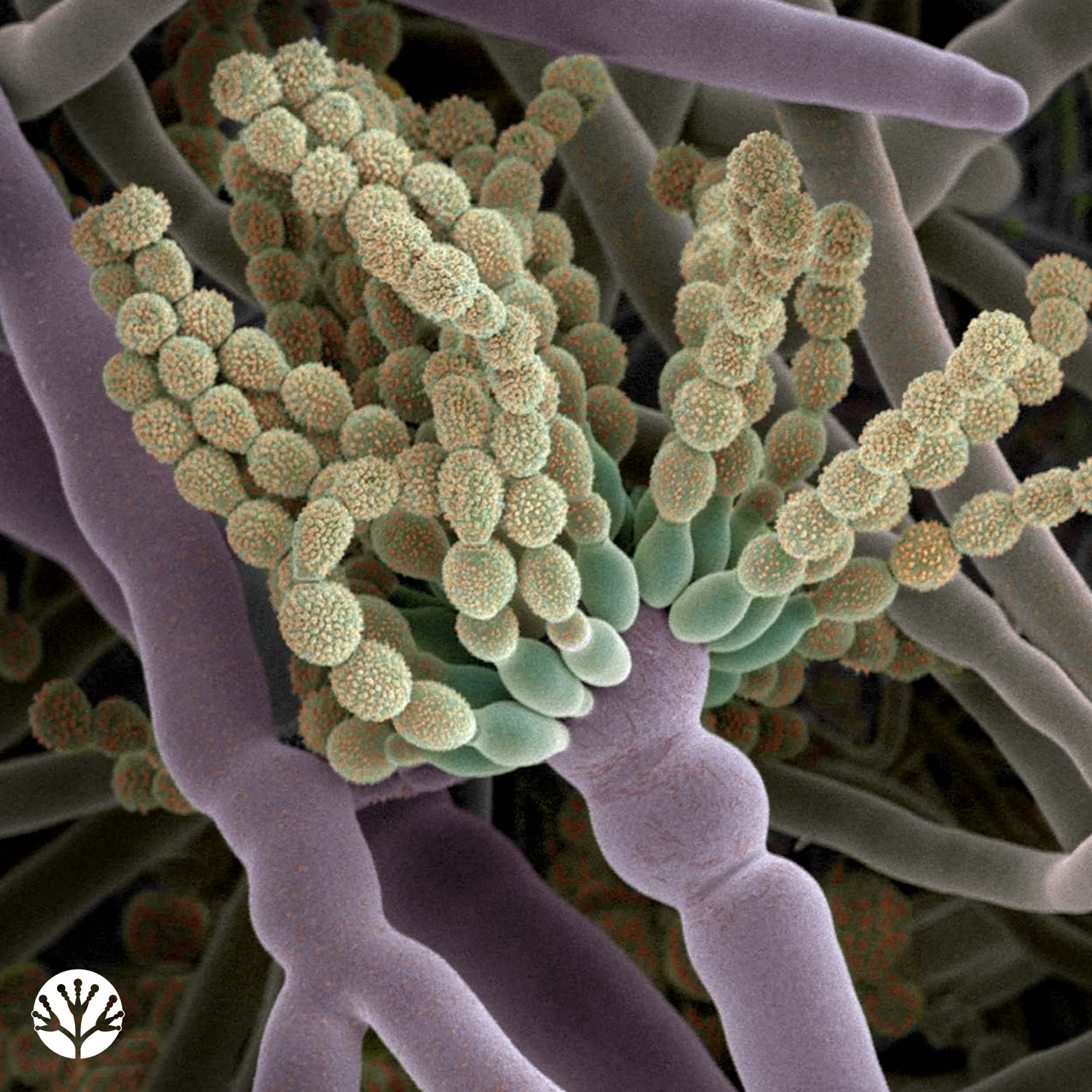
INTRODUCTION TO THE WESTERDIJK FUNGAL BIODIVERSITY INSTITUTE

Explore, Study and Preserve

The Westerdijk Fungal Biodiversity Institute (formerly CBS-KNAW Fungal Biodiversity Centre) is part of the Royal Netherlands Academy of Arts and Sciences, and is situated in Utrecht. The heart of the institute is the Biological Resource Centre (BRC) where we maintain the world-renowned CBS Biobank of living filamentous fungi and yeasts and the NCCB Biobank of bacteria. The Westerdijk Institute research groups focus on evolutionary biology, taxonomy and biodiversity of fungi and yeasts in the widest sense, aiming on three priority areas: agriculture, human health, and industry. The institute uses a broad range of biochemical, genomics and microscopy methods. It is a leader in this field, but is also an expertise centre, advising on mycological problems of a scientific, health-related or industrial nature. It offers various services including identification, applied research, consultancy, ordering of cultures and courses. The institute generates and shares scientific knowledge, and addresses key societal questions in collaboration with other scientific institutions, social partners and industries. The institute employs circa 80 personnel, among whom 28 scientists. The Westerdijk Institute is an independent laboratory and research projects are carried out on a strictly confidential basis.

Westerdijk Fungal Biodiversity Institute, Uppsalaalaan 8, 3584 CT Utrecht, The Netherlands





BIOLOGICAL RESOURCE CENTRE – CBS AND NCCB BIOBANKS FOR STRAINS OF FILAMENTOUS FUNGI, YEASTS AND BACTERIA

All BRC services are ISO 9001:2015 certified

The CBS Biobank was established as a public collection of fungi in 1904 and at present holds a very broad coverage of culturable filamentous fungi, yeasts and oomycetes. Our NCCB Biobank (Netherlands Culture Collection of Bacteria) of prokaryotes contains bacterial wild-type and mutant strains, hosts suitable for DNA research, genetically engineered plasmids, broad-host-range plasmids and phages.

From these unique resources we can offer you:

- Cultures originating from all continents (living cultures or genomic DNA extracts).
- Representatives of 19 500 species and 5 100 genera of fungi.
- Ex-type-strains of nearly all accepted species of yeasts and of many culturable filamentous fungi.
- Isolates from soil, plants (including plant pathogens), clinical sources (biological agents up to risk group 3), indoor- and extreme environments, food, and numerous other origins.
- Cultures of parasitic fungi that grow with their fungal host.

Annually around 6 000 strains are supplied to users worldwide.

Number of strains preserved in the BRC	
Filamentous fungi	73 746
Yeasts	12 890
Oomycota	1 896
Bacteria	8 720
Actinobacteria	1 473
Plasmids	563
Total	99 288
Number of Type strains	
Filamentous fungi	10 015
Oomycota	264
Yeasts	2 791
Total	13 070





PRESERVATION METHODS

The CBS and NCCB strains are preserved in a metabolically inactive state as cryopreserved and lyophilised cultures. Our optimised protocols assure the best possible conservation of unique properties and long-term vitality of the strains. In addition, strains that are recalcitrant to freeze-drying or cryopreservation are also maintained in a continuous active state by periodic transfer on agar media, which helps to guarantee their availability.

Cryopreservation

Cryogenic storage is one of the most reliable methods of long-term preservation for living cultures of fungi and yeast and our protocols can be applied to sporulating and non-sporulating cultures. Almost all strains in the biobanks are thus preserved in this manner, in polypropylene straws or commercially available plastic cryotubes. Vials are stored in the vapour phase of liquid nitrogen in Taylor Wharton K-series tanks with a unique design to allow constant mixture of cold and warmer vapour, to keep all materials effectively below $-175\text{ }^{\circ}\text{C}$ regardless of their position within the storage system. Cryopreserved materials selected for orders are always activated first and after phenotypic quality checks supplied on agar slants.

Freeze-drying

Freeze-drying or lyophilisation is another widely used method for long-term preservation.

The strains in our biobanks are freeze-dried according to optimised protocols using state-of-art programmable freeze-dryers (Christ Epsilon series). All crucial parameters are monitored for an optimal preservation of properties of the strain during drying and to maximise shelf life of the dried product. The lyophilised product needs not be activated before shipment (although this is possible on request) and can be quickly sent to customers.

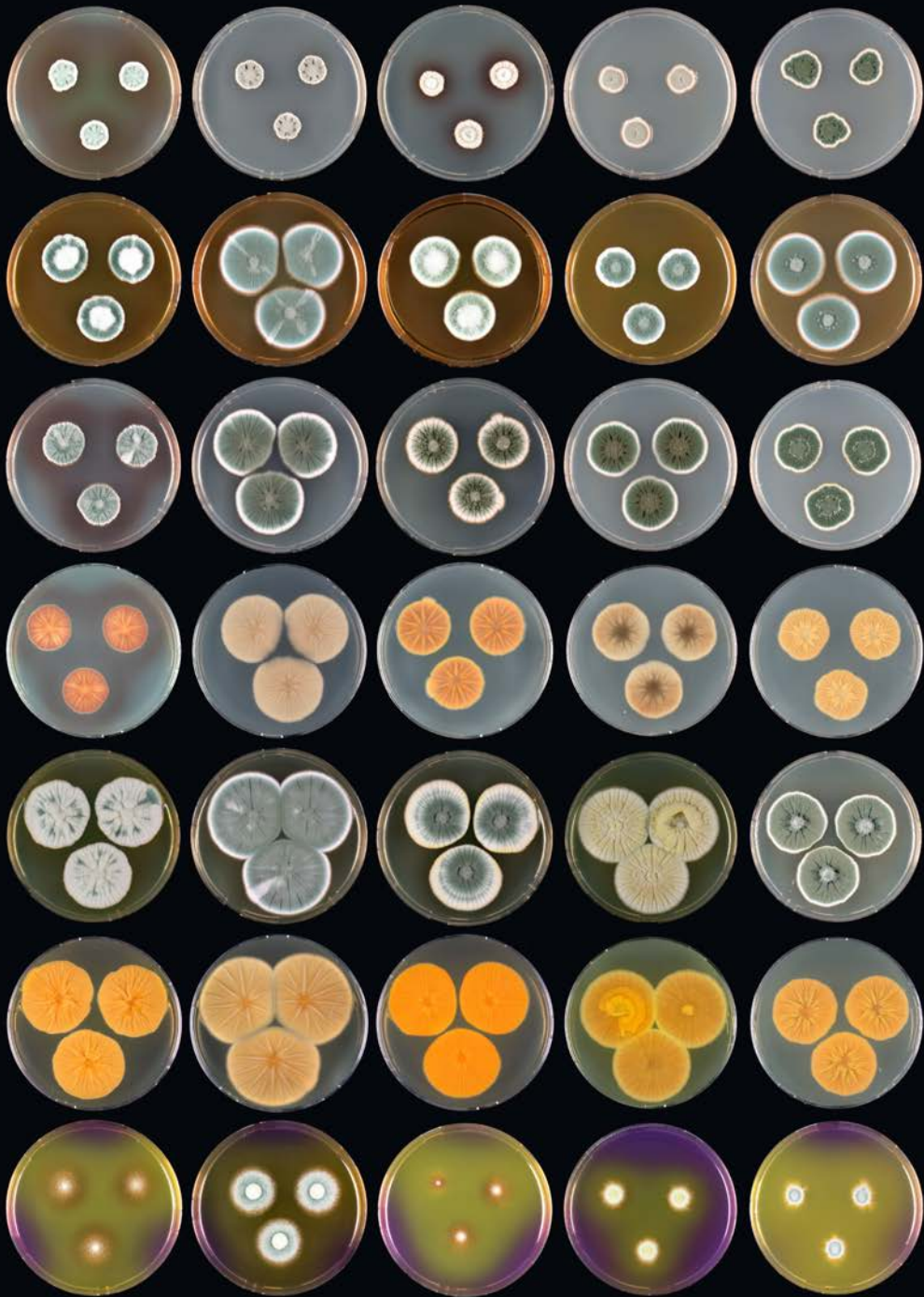
FAQ

How can I store freeze-dried ampoules? Ampoules we supply can be stored at room temperature in the dark for later use. To retain optimal vitality, storage at $6\text{ }^{\circ}\text{C}$ in the dark is recommended. Avoid freezing at all times.

How do I open lyophilised ampoules? The instructions for opening ampoules of our cultures are included in all shipments and can be found on our website: <http://www.wi.knaw.nl/images/pdf/LYOPHILE.PDF>

Can freeze-dried ampoules be opened for me? Yes, on request you can receive a strain taken from our freeze-dried stock as an active strain on an agar slant (additional fee applies).

What media should I use? Information on recommended media and conditions for growth are supplied with the cultures. Recipes of most used media can be found on our website. Fungi & Bacteria: <http://www.wi.knaw.nl/Collections>



COLUMNS, LEFT TO RIGHT:

- P. aurantiigriseum*
- P. polonicum*
- P. viridicatum*
- P. cyclopium*
- P. melanoconidium*

ROWS, TOP TO BOTTOM:

- CYA30 °C
- MEA
- CYA obverse
- CYA reverse
- YES obverse
- YES reverse
- CREA obverse



STANDARDS FOR QUALITY CONTROL AND AUTHENTICATION



The BRC provides its services under a quality management system according to ISO 9001:2015, which assures you that we work by standardised procedures in all workflows and practices in scope of the certificate, namely: *Accession, preservation, storage and supply of microorganisms or their DNA (public deposits, safe deposits and patent deposits) and related information.*

Our BRC meets the OECD standards for Biological Resource Centres for quality and expertise. Our biobanks are embedded in the unique scientific environment of the Westerdijk Institute, a world-renowned centre of mycological expertise. Westerdijk Institute scientists are very active in isolating and describing novel taxa. Fungal taxonomy is still a field very much in development and annually 500-800 novel ex-type strains are added to our biobanks. We also collaborate with many external specialists in taxonomy of particular groups of fungi, to obtain the input we need to keep the identification and data on our strains up-to-date.

Checks we do

Purity, vitality and phenotype identity checks

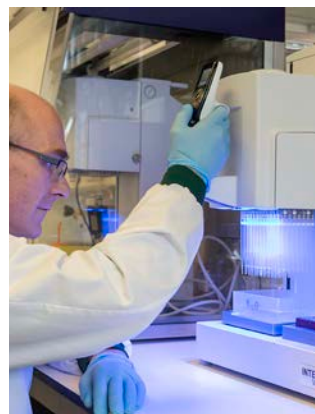
Routine checks are incorporated in our workflows keeping the information on individual batches up-to-date. Additional information used for authentication include mass spectrometry data (MALDI), physiological data and more.

DNA-sequencing of all fungal and yeast holdings

In the past years, ITS and LSU rDNA sequences have been generated for all fungal and yeast strains in the CBS biobank, and routinely for all new accessions. Additional loci are sequenced when needed. All sequences are validated by our curators in collaboration with experts. Most validated sequences of publicly available strains are accessible through strain records in the CBS catalogue and are incorporated as reference data for our blast tools on the Westerdijk Institute website and are, or will be released to public databases such as GenBank.

We value your input!

Any remarks you might have related to our services, or information you find related to strains in our databases are valuable to us.





CBS 113963

BSL-1

18.5252

Fusarium thapsinum

Sec-0

Date 05/07/2018

Medium OA

Growth 22°C

Storage 6 C

LY-W18-0153



ORDERING STRAINS AND/OR GENOMIC DNA EXTRACTS

Web catalogues to browse and select strains for ordering: <http://www.wi.knaw.nl/Collections>

- Information on the strains, including data on provenance, published DNA sequences, data on physiology, literature references, etc.
- Links from strain records to names in MycoBank with information on the species, synonyms (names no longer in use) and much more.
- Direct online ordering of living cultures or genomic DNA extracts (10 % discount on orders of 10 cultures or more – see the pricelist). After you created a user profile you can start ordering strains by selecting and placing them in the shopping cart.

How we supply the material

- Material will be transferred under the Westerdijk Institute-Material Transfer Agreement (MTA) or a specific MTA. This will provide legal certainty for you and the Westerdijk Institute.
- Use for commercial purposes requires written permission from the Westerdijk Institute, and you can contact our curators for advice.
- Strains will be supplied as lyophilised material in glass ampoules or active cultures on agar slants.
- Genomic DNA extracts can be supplied for strains in our Biobanks.
- Delivery time depends on the materials you have selected and administrative requirements for shipping these to your address.

Whom to contact for help?

Questions regarding ordering, special requirements and payment: *Sales staff* | sales@wi.knaw.nl

Questions regarding general information on strains: *Curators*

Fungi | Dr Gerard Verkleij (Head Curator),
g.verkleij@wi.knaw.nl

Yeasts | Dr Marizeth Groenewald (Deputy Curator),
m.groenewald@wi.knaw.nl

Bacteria, phages and plasmids | Mrs Marian Figge BSc,
nccb@wi.knaw.nl

FAQ

How can I find information about sporulation and other relevant properties? Although the Westerdijk Institute cannot guarantee sporulation of materials supplied, we are able to make the best possible choice regarding which strain(s) to use. Furthermore, we can also help you find other relevant information in our database.

Is MycoBank part of the CBS strain catalogue? No, the MycoBank database is a separate resource provided by the Westerdijk Institute. ‘Specimen’ records in MycoBank do not represent strains; CBS strains can only be viewed from the online strain catalogue, and from these you can open the corresponding linked name record in the MycoBank database.



DEPOSITING STRAINS IN THE PUBLIC CBS AND NCCB BIOBANKS

We invite you to deposit your strains in the public biobanks of the Westerdijk Institute so you can share them with the global scientific community. Up to 3 000 strains are deposited annually in our biobanks by scientists from all over the world.

We particularly welcome ex-type- and other reference strains and strains that are or will be cited in your key scientific papers. Before sending strains, please contact the curator to inquire after the procedures.

- *Depositing in the public collection is free of charge.* Once accessioned and released for distribution, your strains will be supplied to third parties against a handling fee as a contribution to the costs involved in maintaining our biobanks. In case you need a strain that you have deposited and which is no longer available in your own collection, we can resupply you with a subculture free of charge.
- *Microorganisms may be in scope of the Nagoya Protocol and/or national laws on access and benefit sharing (ABS) in the country of origin.* Our curators will ask you to supply data on provenance and other information on the material that is relevant to ABS, so they can check the conditions for use of the material under applicable laws and any requirements for future supply to third parties. *See also the page on access and benefit sharing (ABS).*

- *Declarations of Deposit can be provided to you on request.*

Curator contact details

Fungi | Dr Gerard Verkleij (Head Curator),
g.verkleij@wi.knaw.nl

Yeasts | Dr Marizeth Groenewald (Deputy Curator),
m.groenewald@wi.knaw.nl

Bacteria, phages and plasmids | Mrs Marian Figge BSc,
nccb@wi.knaw.nl

FAQ

How soon can I get an accession number of my deposit? This depends on the properties of your strain (especially growth rate and purity). On average for fungi we can provide CBS accession numbers within 2–3 weeks after receipt of the culture. For bacteria this may take longer. Our curators can give you a more accurate estimate.





CRYO-INDUSTRIAL GLOVES
INDUSTRIAL GLOVES
COLD RESISTANT

CRYO-INDUSTRIAL GLOVES
INDUSTRIAL GLOVES
COLD RESISTANT



DEPOSIT IN THE RESTRICTED BIOBANK

Patent deposits

The Westerdijk Institute is an International Depository Authority (IDA) under the regulations of the Budapest Treaty for deposit of microorganisms for the purpose of patent procedures.

When a patent application involves the use of a new microorganism, it is a requirement that this microorganism is deposited in a recognised IDA. The regulations of the Budapest Treaty define the procedures which depositors and depository authorities must follow, e.g. forms to be completed, the duration of the deposit and mechanisms for furnishing samples. The IDA ensures that the cultures will be stored confidentially for a period of at least 30 years.

- Our IDA accepts patent deposits under the Budapest Treaty for filamentous fungi, yeasts, oomycetes, actinobacteria, bacteria, plasmids and phage.

Safe deposits

Besides patent strains, the restricted Biobank also accepts Safe Deposits to safe-keep cultures for which patent protection has not been sought. We will take care to keep them viable and uncontaminated for the minimum period as chosen by the depositor.

- We accept Safe Deposits for filamentous fungi, yeasts, oomycetes, actinobacteria, bacteria, plasmids and phages, and for minimum contracting periods of 5, 10 or 20 years.

A safe-deposit can be converted, on request of the

depositor, into a patent strain deposit under the regulations of the Budapest Treaty with the same depository institution. As soon as the viability of the deposited strain has been checked the date of the request will be the date of conversion, and the strain will be stored in the restricted collection under the regulations of the Budapest Treaty for at least 30 years from that date.

Contact our patent officer if you are interested to deposit strains in the restricted biobank. On our website you can find information about the procedures and downloadable documents.

Patent officer | Mrs Francisca Begthel-Claus
f.claus@wi.knaw.nl
patent@wi.knaw.nl





ACCESS AND BENEFIT SHARING (ABS)

– NAGOYA PROTOCOL

The Convention on Biological Diversity (CBD) of 1993 recognises the sovereign rights of countries over their own biological resources, including micro-organisms. The Nagoya Protocol on ABS (entry into force 12th October 2014) aims at fair and equitable sharing of benefits arising from the utilisation of genetic resources and associated traditional knowledge. Many countries have now implemented access and benefit sharing legislation to implement the Nagoya Protocol (and for Europe the EU regulation 514/2014) at national level, including the Netherlands.

The policy of our Institute is to distribute genetic resources and foster their use while complying to the CBD and the Nagoya Protocol. All strains are supplied under the 'CBS-MTA' or specific MTA that clearly defines the responsibilities of the provider and recipient of the transferred materials. Strains will be transferred along with any information relevant to ABS. In the EU researchers are required to keep this information for at least 20 years after the end of using the strains.

Deposit of strains & ABS

Depositors of strains in our biobanks are asked to provide all the information that the curator needs to check if any ABS law or regulatory requirements apply to the material. Certain documents may be required before the strains can be accepted by the Westerdijk Institute, for example, prior informed consent (PIC), mutually agreed terms (MAT), or other equivalent documents (preferably to be sent to our institute by e-mail as full-colour scanned

copies). Without such documentation, we may not be able to fulfil applicable ABS requirements while accessioning, handling and distributing the strain. The CBS strain accession form contains the fields for the information that is needed (check obligatory fields).

Key-information needed to assess the status¹ of your strain under Nagoya (ABS)

- The geographical origin of the strain (or of the sample from which it was isolated), at least the country of origin, if applicable;
- The date the strain or sample was collected *in situ*;
- The name and affiliation of the person who collected the strain or sample.

¹ Useful guidance for microbial resources can be found in the CBD ABS Clearing House website: **MIRRI Best Practice Manual on ABS for BRCs** (Verkleij, Martin & Smith 2016).





CONTRACT RESEARCH

In addition to our own in-house research programs, the Westerdijk Institute also provides contract research services. These can be tailor-made projects on various issues including prevention of food spoilage, testing of effectiveness of preservatives and disinfectants, biodeterioration testing and development of (rapid) identification tools. We conduct both small and large-scale research projects for a diversity of clients in government, industrial, health care, pharmaceutical, food and beverage, and commercial sectors. Together with the client, we define their research questions, develop protocols and timelines and perform research to suit their needs and budget.

Fungi and food safety

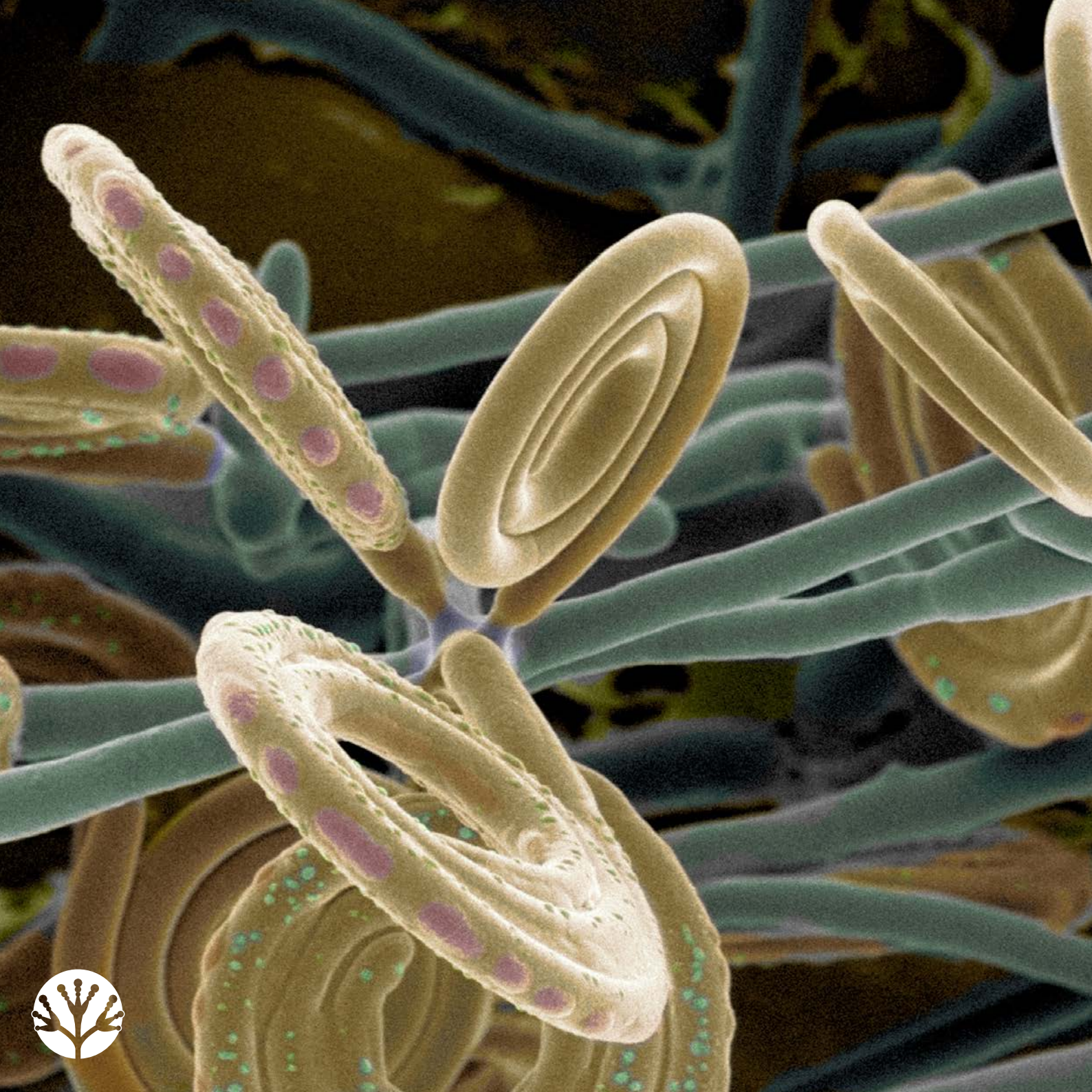
Worldwide, the quantity of food products that is lost due to fungal spoilage is immense. This loss can be caused by post-harvest problems, in which fungi attack still-living fruits, vegetables and grains, but it can also arise in processed foods affected by spoilage fungi. The growth of fungi may result in off-flavours, discoloration and altered texture. What is not so readily visible, but is even more alarming is the formation of mycotoxins in contaminated foods and feeds. The Westerdijk Institute has been working on fungal problems since many decades and are the leading authority in the mycological investigations of food, and beverages. We can assist you in ensuring the safety of your products, via consultation on mycological problems, studying various stresses (e.g. temperature, water activity, preservatives) on the germinating and growing fungus, and carrying out research (isolation) and surveys in the food sector.

Fungi in indoor environments

Fungal proliferation indoors is often related to leakage, flooding, condensation and humidity problems. Problems occur both in old and new buildings, and often arise after inferior renovation works, or after installation of tight insulation. Fungal problems can occur in any home and working environments including libraries and archives. The Westerdijk Institute has experience in analysing fungal problems in indoor environments (houses and buildings), including museums and archives. Our research has the aim to advise inhabitants or workers for adverse conditions for health by identifying the fungi found on building material, surfaces or in the air.

Contact: ServiceUnit@wi.knaw.nl





IDENTIFICATION, TYPING AND CONTRACT RESEARCH

The Westerdijk Institute offers a service to identify isolates and specimens of filamentous fungi, yeasts and bacteria. Our institute has experts for all major groups of fungi and the knowledge of its staff guarantees a state of the art identification of cultures. The identification is based on sequence data in combination with phenotypic characters. In most cases the sender receives the results of the identification within two weeks. Sometimes additional research is necessary, and in those cases the identification will take longer. For urgent services, contact us before sending material. Strain typing (e.g. by genome sequencing, MLST, STR, AFLP) is conducted upon request.

Fungal physiology

The conversion of plant and other (e.g. algal) biomass using fungi and fungal enzymes is also pursued. Topics that can be covered by this are (but not limited to):

- enzyme discovery and engineering
- strain discovery
- strain engineering (using both GMO and non-GMO methods)

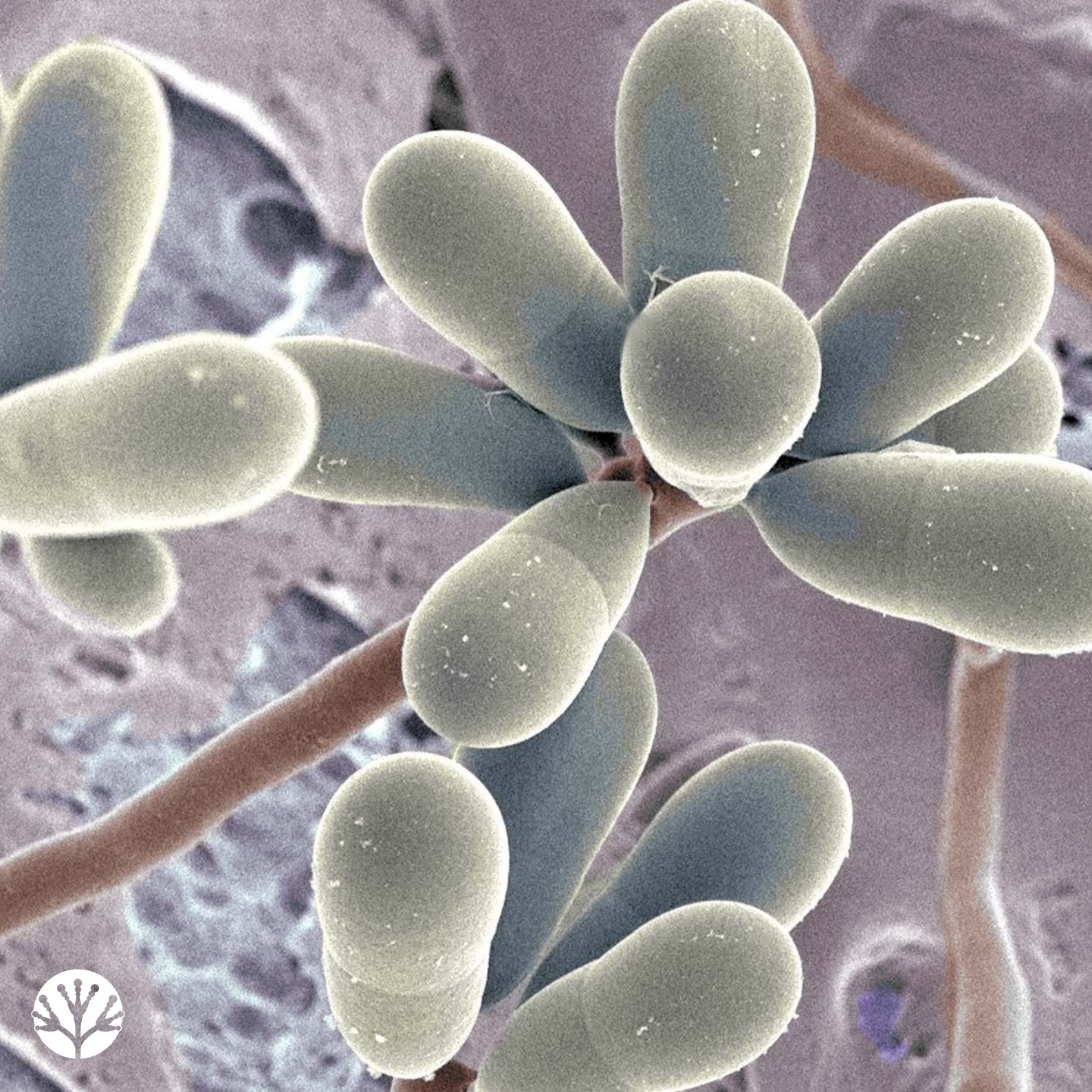
These topics cover both extracellular enzymes related to degradation or modification of the biomass as well as metabolic enzymes aimed at the production of specific compounds through fungal cell factories.

A fully developed bioinformatics infrastructure for (comparative) genomics, transcriptomics and proteomics data is available. With this we can also support external partners in their bioinformatic needs, combining basic bioinformatics methodology with our in depth experience with fungal systems.

Projects will always be tailor-made and fully confidential. The precise nature, set-up and costs will be discussed on a case-by-case basis.

Contact: ServiceUnit@wi.knaw.nl





COURSES

The Westerdijk Institute offers courses and training to workers in industry, food and beverage sector, academia, students and guest workers. The courses Food and Indoor fungi, Medical Mycology and Fungal Biodiversity are given on a yearly basis. The Westerdijk Institute courses are open to participants from the Netherlands and abroad. Lectures are given in English but several other languages are spoken.

The Westerdijk Institute also offers one or two days tailor-made courses at request on specific subjects, e.g. courses for bakeries on the isolation and recognition of the specific mycobiota of bakery products. We furthermore participate in lectures in courses at companies, institutes or universities.

Food and Indoor course

The course 'Food and Indoor Mycology' on the identification and detection of food- and indoor fungi is unique in the world. It is packed with background information on several subjects, such as the recognition, detection, occurrence and impact of these fungi on food products and in human dwellings. A hands-on training will be taught in phenotype based identification of common food- and airborne contaminants. This 3-day course is supplemented with several in-depth lectures on specific topics:

- Fungi and living crops
- Spoilage of processed food
- Fungi and mycotoxins
- Fungal indoor growth and health aspects
- Detection of fungi in indoor environments and foods
- The fungal spore in food mycology

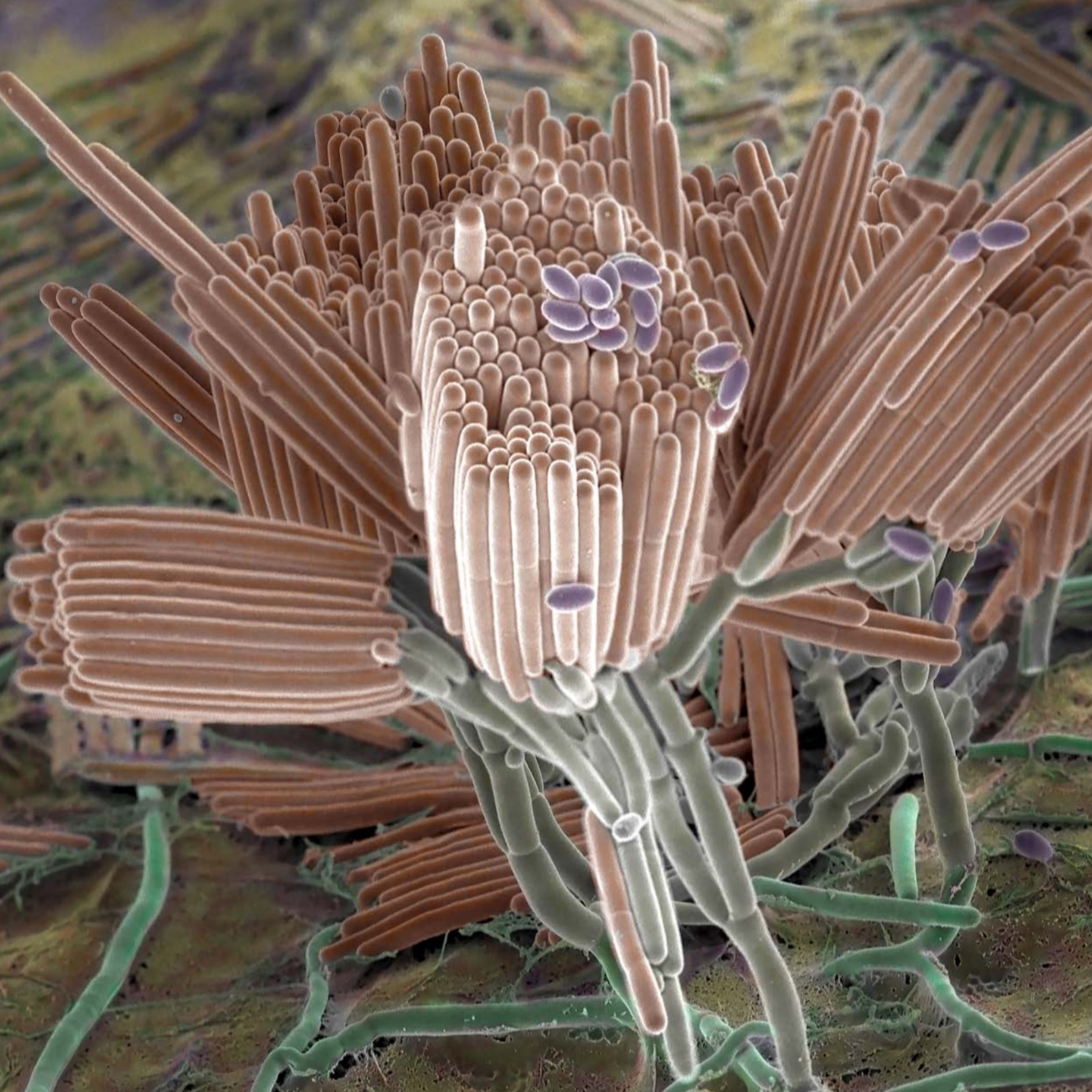
DNA based identification of fungi

The 2-day course 'DNA based identification of fungi' is linked to the Food and Indoor course. In this course we aim to give insight in the recent developments in this field. Besides in-depth presentations of various topics (see below), the course gives insight in ways to generate high quality sequence data from a culture (theoretical) and a hands-on training in DNA based identification, sequence data interpretation and analysis.

Topics:

- Molecular based detection and identification
- Trends and developments in food diagnostics
- Next generation sequencing for food quality and safety
- Fungal phylogeny
- MALDI-TOF and other proteomics approaches





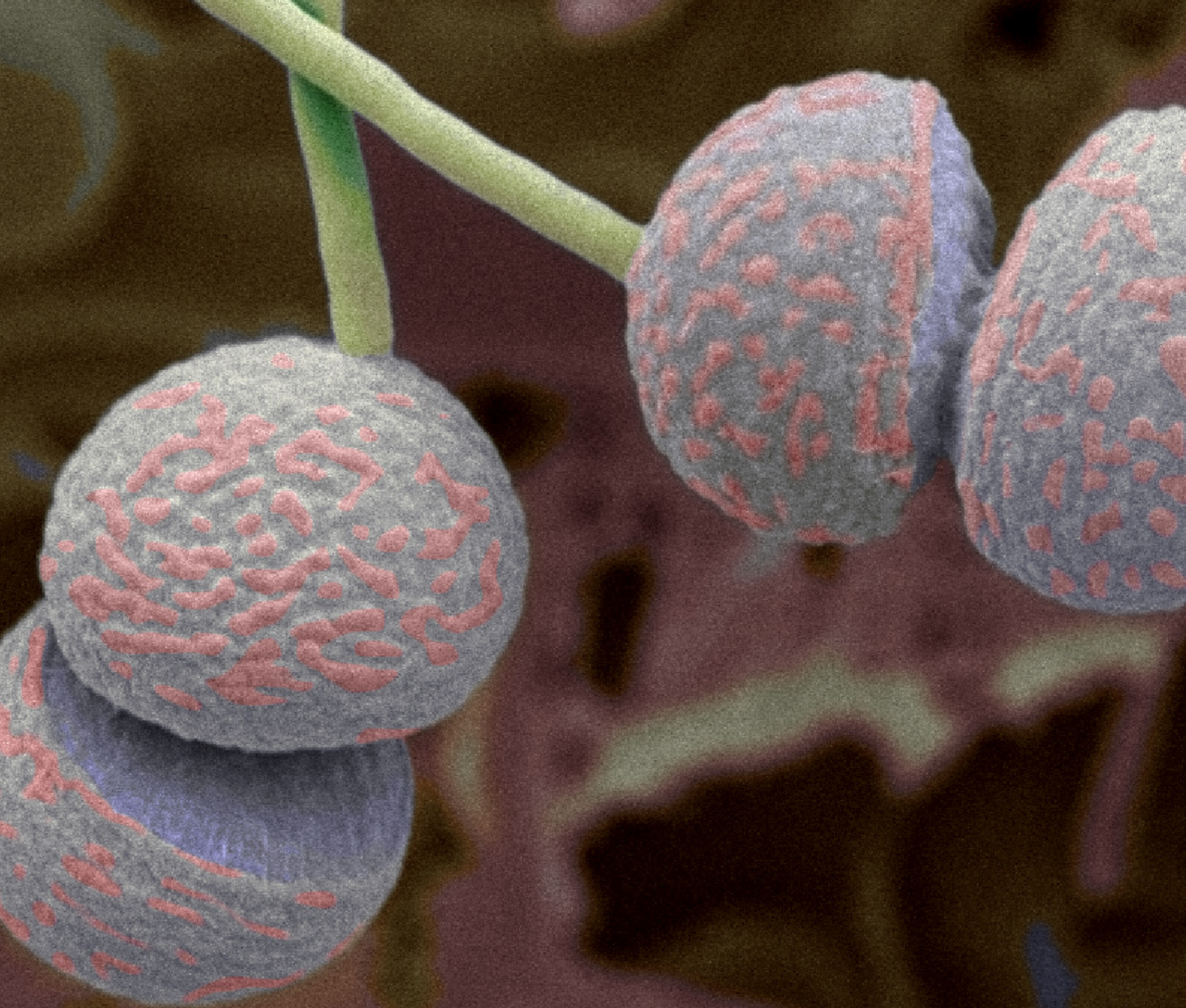
Fungal Biodiversity course

This 5-day course provides a concise overview of the biodiversity of organisms representing the Kingdom Fungi. The course focuses on systematics and general ecology of fungi, as well as related topics such as soil mycology and diagnostics of plant pathogens. Both visual and molecular recognition methods will be discussed and practical hands-on experience will be gained in the morphological recognition and cultivation of fungi. The course is intended for (micro)biology students, PhD students, technicians and scientists/students who would like to obtain a fundamental understanding of fungi.

Topics:

- General methods: Aseptic working, media and incubation, microscopic examination of Fungi Introduction to the Fungal Kingdom with examples: *Mucoromycota*, *Ascomycota*, *Basidiomycota*, yeasts
- Asexual morphs and conidiogenesis
- *Ascomycota*
- *Eurotiomycetes*: *Aspergillus*, *Penicillium*, *Paecilomyces* and sexual morphs with examples
- *Sordariomycetes* I: *Chaetomium*, *Bartalinia*, *Pestalotiopsis*, *Colletotrichum*, *Gliomastix*, *Microascus/Scopulariopsis*, *Sordaria*, *Thielaviopsis*
- *Sordariomycetes* II: *Neocosmospora/Fusarium*, *Neonectria* and allies, *Calonectria*, *Trichoderma*.
- *Dothideomycetes* and selected genera of *Leotiomycetes*: *Cladosporium*, *Septoria*, *Alternaria*, *Curvularia*, *Didymella*, *Epicoccum*, *Paraphaeosphaeria*, *Ascodesmis*, *Botrytis*, *Pezizula*
- *Basidiomycota* – an introduction with examples of species in culture
- Molecular methods for identification
- Yeasts: biology, phylogenies and polyphasic identification
- Polyphasic identification and other aspects of bioinformatics
- Clinical fungi diagnostics

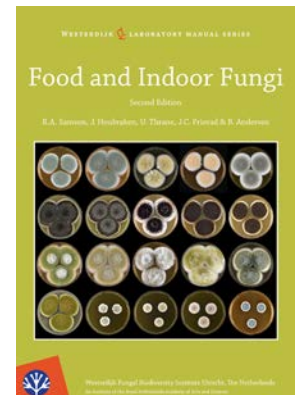
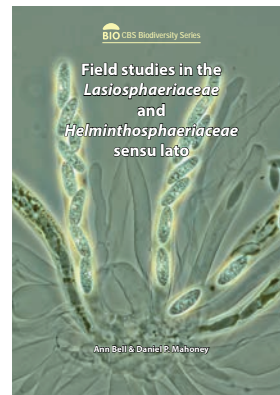
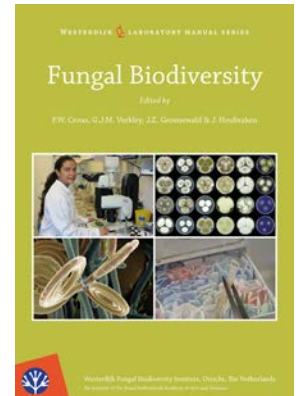




BOOKS AND JOURNALS

The Westerdijk Institute publishes two book series, namely the *Westerdijk Biodiversity Series* (focusing on all aspects of filamentous fungi and yeasts), and the *Westerdijk Laboratory Manual Series* (focusing on techniques in isolation, cultivation and morphological study of fungi). There are also three open access journals, namely *Studies in Mycology* (systematic monographs of filamentous fungi and yeasts, and special topical issues), and two journals for fungal systematics, namely *Persoonia* and *Fungal Systematics and Evolution*.

Books from the *Westerdijk Biodiversity Series* and the *Westerdijk Laboratory Manual Series* can be purchased in the Westerdijk webshop, <http://shop.fungalbiodiversitycentre.com>.





Westerdijk Fungal Biodiversity Institute

Uppsalalaan 8, 3584 CT Utrecht, The Netherlands

Phone: +31 30 2122600

Fax: +31 30 2122601

E-mail: info@wi.knaw.nl

www.wi.knaw.nl

Facebook: [@WesterdijkInstitute](https://www.facebook.com/WesterdijkInstitute)

Twitter: [@_Westerdijk_](https://twitter.com/_Westerdijk_)