

OPEN DOORS FELLOWSHIP INTERNATIONAL TRAINING PROGRAM

MODALITY A: APPLICATION TEMPLATE FROM FLEMISH RESEARCH GROUPS.

This modality has been conceived for research institutions in Flanders that are looking for new scientific partners in Africa and are willing to explore new joint research streams with their African counterparts.

The slots open slots offered by the Flemish research laboratories shall be published on the ODFP web page <https://ipbo.vib-ugent.be/en/belgian-research-groups-portal>

Information from the hosting institutions in Flanders

Contact details of a focal point	✉: wim.bert@ugent.be ; joseph.maosa@ugent.be ☎: ++3292645223
Name of the research or academic institution and acronym	Ghent University, UGent
Name of the research group	Nematology Research Unit (NRU)
Name and position of the focal point supporting the fellow	Wim Bert, Chair Nematology Research Unit & International MSc in Agro- and Environmental Nematology (IMaNema)
Website of institution /research group	https://www.ugent.be/en

Present the group's research line(s) and activities, including a list of current projects coordinated by the Flemish laboratory

The Nematology research unit has more than 90 years of experience in nematological research. Currently we focus on taxonomy, phylogeny, morphology, and biology of nematodes from natural and agricultural ecosystems, including free-living and plant-parasitic nematodes. Focusing from the backbone of nematode phylogeny to species delineation, we integrate a tradition of light-microscopy and ultrastructural morphology with molecular approaches.

Current topics under investigation in our research unit include:

- ✓ Optimizing nematode taxonomy: combining morphology and DNA-based species delimitation; (digital) morphological vouchers of sequenced individuals; sequences and ecology of specimens from type populations; DNA barcoding and comprehensive databanks.
- ✓ Diversity of plant-parasitic nematodes in tropical countries.
- ✓ The origin and evolution of plant-parasitism in nematodes.
- ✓ Ultrastructural morphology of nematodes and other animals.

Describe the primary hard and soft skills desirable from the awarded ODFP fellow to deliver the task at hand in the Flemish research group (i.e. *bioinformatics, genetic engineering, chromatography, sequencing, metabolomics, metagenomics*).

After collecting samples, nematodes will be extracted from roots and soil (will be done in collaboration). DNA will be extracted for the amplification of informative genes such as SSU and LSU of rRNA and COI of mitochondrial genes. Special focus will be given to plant-parasitic nematodes for which informative molecular barcodes are not yet available. This procedure will create a direct link between molecular data and morphological information (morphological vouchers) of the nematodes.

Nematode morphological vouchers will be prepared prior to **DNA extraction**. These vouchers are made with light microscopy of temporary mounts using a combination of video clips and photomicrographs. Vouchered nematodes will be subsequently picked from temporary mounts, and each specimen will be cut into pieces and transferred to an Eppendorf tube with worm lysis buffer. This will be followed by **PCR** and then send for sequencing.

The obtained sequences will be analyzed with other relevant sequences available in GenBank. Multiple alignments of the different genes will be made. Finally a molecular phylogeny will be constructed and interpreted (**basic bioinformatics**).

Therefore during the SRS in the NRU laboratory, **the fellow will learn** about basic molecular techniques (DNA extraction, conventional PCR), design of primers, sequence analysis and basic bioinformatics (e.g. sequence analysis in digital barcodes libraries). In addition, as part of her daily tasks, the fellow will also become acquainted with microscopy techniques, advanced morphological identification of PPNs, good laboratory management practices and safety in the lab. The intended candidate **should have demonstrated experience** in the field of nematology and soil health.

Indicate the short and long-term outputs that the Flemish research group would like to see arising from this collaboration.

Expected Short-term outputs (1-2 years)	Expected Long-term outputs (after two years)
This project may contribute to: -the development of a joint scientific publication. - collaboration to IMANEMA activities in Africa, such as the Basic Crash Course Nematology - Kenya (BCCN) https://imanema.ugent.be/basic-crash-course-nematology-kenya-bccn/ - cooperation in the framework of the follow up of the project Erasmus+ Capacity Building in Higher Education: Nematology Education in Sub-Saharan Africa (NEMEDUSSA) https://nemedussa.ugent.be/ -collaboration under the the follow up of the PANEMA network https://nemedussa.ugent.be/activities/panema/	Opportunity for long-term cooperation in nematological research, for example through MSc students or PhD thesis projects and research projects. Long term cooperation resulting from projects suggested in the short-term outputs

Summarise (600 - 800 words approx.) the research project(s) to which the ODFP fellow would contribute during the short research stage in Flanders.

This project contributes to several ongoing projects that aim at **studying diversity, biology and diagnostics of plant-parasitic nematodes (PPN) around the world in light of their efficient management in agricultural fields. Comprehensively delimited species and newly described species will be linked to the most informative and efficient molecular barcodes.**

The future of food security in Africa is under threat, and unless agricultural productivity in the region doubles within the next 2 decades, it will face major consequences in terms of famine

and associated problems. Plant-parasitic nematodes (PPN) are microscopic roundworms whose unmanaged presence can have a massively deleterious effect on crop productivity. Plant-parasitic nematodes infect many plants of great economic importance, including maize, potato, soybean and banana, resulting in annual yield losses of billions of USD worldwide. However, an effective implementation of non-chemical options, such as crop rotation and use of resistant crop varieties, requires a good understanding of the taxonomy and biology of PPNs, in which we are unfortunately largely lacking in information. In addition, most plant-resistance genes are only effective against a narrow range of PPN species or populations and thus, knowing the targeted parasite species will make it easier to choose appropriate plant genotypes or non-host crops with respect to crop rotation practices. There are also several cryptic species of PPN that are important in the context of food security, quarantine situations, and non-chemical management technologies, and therefore should not be ignored. Thus, to ensure that problems associated with plant-parasitic nematodes (PPN) are managed correctly, **the correct and efficient identification of PPN is extremely important. Nevertheless, most nematode species appear to remain undescribed and efforts to catalogue and explain biodiversity must be prioritized.**

Characterising PPN species often requires huge amounts of time and taxonomical expertise, and is done by morphological and/or molecular data analyses. Recently, the molecular diagnostics of nematodes based on DNA markers alone has been gaining enormous interest as it tends to avoid the time-consuming taxonomical work of identification based on phenotypes. **However, most nematode species, especially in the tropics have not yet been connected to informative sequences (= molecular barcodes).** Furthermore, The SSU and the LSU rRNA genes have historically been the most commonly used markers in nematode barcoding due to their extensive availability on databases and the possibility of using conserved regions for designing versatile primers. However, they have been reported to provide limited taxonomic resolution for certain nematode taxa. The mitochondrial COI gene, on the other hand, is the designated marker for many animals, as it is present in many identical copies per cell, evolves relatively quickly and carries sufficient 'signal' to allow species-level delimitation. However, there is a clear relative lack of nematode COI sequence information compared to that of rRNA gene markers. Conversely, more and more studies are beginning to suggest the importance of mitochondrial genes for nematode diagnostic purposes. For instance, the mitochondrial-based methodology developed in our laboratory, in the NRU, to identify notoriously difficult but economically extremely important tropical root-knot nematodes is currently being implemented worldwide as the standard identification technique (Janssen et al., 2016 <http://www.nature.com/articles/srep22591>). **Therefore, the generation of informative sequences, especially mitochondrial sequence data, for PPN has become high priority in light of their uses as effective molecular barcodes.**

Please list any other relevant resources (e.g. articles, videos, project documents and summaries, repositories) related to the targeted projects and the short research stay that would help applicants build up their project proposal for your group.

Most recent publications of our lab:

https://scholar.google.be/citations?hl=en&user=QjSIFxkAAAAJ&view_op=list_works&sortby=pubdate

Some methods we use in our lab:

https://www.youtube.com/channel/UCong71_WTFUlaolIZgQHUYA/featured

Our research is aligned with The International Master of Science in Agro- and Environmental Nematology (IMaNema):

<https://imanema.ugent.be/>

Databank:

<https://nematodes.myspecies.info/>

To complete this application, we need **an official letter from the Principal Investigator of the Flemish receiving group confirming the collaboration with the ODFP**. Please, send the application form and supporting letter as a separate **PDF file**.

Applications must be submitted electronically to IPBO@vib-ugent.be. The application form must be named as follows: "**ODFP_ModalityA_name of short research stay**".