


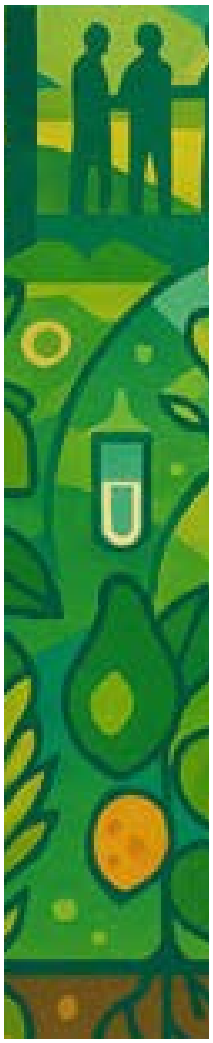



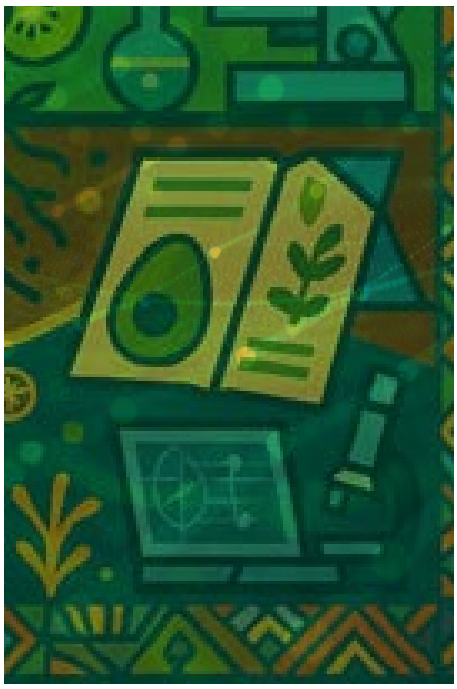

BIENNIAL REPORT

MAY 2023–MAY 2025

FABI

The Forestry and Agricultural Biotechnology Institute (FABI) is based at the University of Pretoria

The primary objectives of the Institute are to:

- Advance the fields of biotechnology and information technology in plant science through research of the highest possible calibre.
- Promote advanced education in these fields as it relates to forestry, agriculture and the environment.
- Produce new and improved products and services to support competitiveness and resilience of plant based industries.
- Impact plant productivity and resilience, environmental sustainability and biodiversity conservation through a transdisciplinary approach.
- In partnership with industries and government, provide both short and longer term benefits to the forestry and agricultural sectors of South Africa and beyond.

Report compiled by
Prof. MPA Coetzee and
Mr M Booij-Liewes

Design and layout by
JSES Studio
(janine@jses.co.za)

The association of FABI with the University of Pretoria, the largest residential University in South Africa, provides access to a wide range of human and technological resources. Currently, academic staff and postgraduate students from research programmes in the Departments of Biochemistry, Genetics and Microbiology (BGM), Chemistry, Computer Science, Plant and Soil Sciences, Physics, and Zoology and Entomology are associated with FABI. This affords FABI the opportunity to build future resources in biotechnology and information technology which will be crucial to the future of forestry and agriculture in South Africa.

FABI, in every way, represents an amalgamation of a tremendous base of expertise in forestry and agriculture from different universities and research organisations in South Africa and other countries in the world, as well as partners in industry and government.

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Unless otherwise indicated, this report covers the period 1 May 2023 until 30 April 2025.

FABI

Forestry and Agricultural Biotechnology Institute

INNOVATION AFRICA
UNIVERSITY OF PRETORIA

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

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DIRECTOR'S FOREWORD

FABI's approach has always been to explore and experiment with the new from the foundation of the proven. As we present the 2025 Biennial Report, that ethos remains our compass. We are a dynamic and collaborative community, anchored in excellence in research and postgraduate training for Future Food and Forests, and restlessly curious about the frontiers of knowledge in this regard. From our modest beginnings 27 years ago to the globally connected institute we are today, serving forestry and agriculture in South Africa, Africa and beyond, we remain convinced that it is partnerships that turn knowledge into impact.

Prof. Bernard Slippers
Director of FABI and Tree Protection Co-operative Programme

RESPONDING TO A RAPIDLY CHANGING WORLD

The world that emerged from the pandemic has not settled into stasis. Climate volatility, shifting regulatory and funding landscapes and the accelerating convergence of biology with data and AI are reshaping how we work. Our response has been deliberate to consolidate our foundations while scaling the capabilities that make science actionable from foundational knowledge for the benefit of companies, regulators, growers and communities. That dual focus runs through this report, namely rigorous science translated into tools, platforms and people who can act on it.

SCIENCE FOR IMPACT

FABI's portfolio delivers tangible public value. By bridging cutting-edge research with deployment in real operations, we help protect multi-billion-rand industries, secure rural livelihoods and translate knowledge into policy, practice and community engagement. Our programmes address staple and high-value crops such as maize, sunflower and other grains, citrus, avocado, macadamia, and kiwifruit (amongst others), developing sustainable strategies to deal with pests, diseases and climate variability. Innovations in diagnostics, biocontrol and resistance breeding raise yields, reduce harmful chemical use, safeguard human health and strengthen climate resilience, advancing national food and nutritional security and supporting export markets.

Equally, we work to safeguard natural and commercial forests. Through collaborative biosecurity platforms, plant-health programmes and omics tools, FABI acts as a shield against invasive pests and pathogens that threaten biodiversity and commercial forestry and agriculture. Our reference collections and precision monitoring tools inform global research and company/government decision-making, while our alumni strengthen capacity across society.

Finally, impact rests on people and participation. We engage growers through newsletters, symposia, workshops, advisories and digital platforms so that science is accessible and actionable. Outreach, from school visits and community food gardens to the 9-Biomes Garden at Constitution Hill, promotes biodiversity awareness and inclusion in science. Through postgraduate training, international collaborations and contributions to policy, FABI builds the human and institutional capacity needed to meet challenges of food insecurity, climate change and biodiversity loss.

DATA, AI AND SHARED INFRASTRUCTURE

AI is a theme in these pages and a thread in our work. For us, AI is a lens that supports human judgment and a lever that scales scarce expertise, powering predictive risk models, imaging and screening pipelines, and genome-scale analytics. The Information Hub continues to knit diagnostics, field observations, research and environmental data into decision-ready dashboards for operations, while new sensing workflows (UAV, hyperspectral and climate layers) are moving us from detection to early warning. Our world class, dedicated facilities, from high-throughput DNA extraction and sequencing, to chemical ecology, screening and phenotyping, are making quality-controlled, data-rich workflows the everyday norm.

Our fungal culture collection is now registered with the World Federation of Culture Collections and integrated into national biobank efforts. This and other living collections are being systematically digitised through genomics, providing thousands of fungal, insect, nematode, bacterial and plant genomes that are now available to the community, vastly expanding the reference base for discovery, diagnostics, training and biocontrol innovation. We aim to use these platforms to turn projects into infrastructure for the sector.

FOUNDATIONS THAT ENDURE

We remain rooted in the essentials that built FABI's reputation: diagnostics and extension, biosecurity and biocontrol, breeding support and resistance screening, and training at scale. Our community spans 24 research groups and satellite labs, linkages that connect world-leading expertise and tools for the protection and productivity of agricultural and forestry systems, and for the discovery and conservation of biodiversity.

FABI's strength is its people. Our academic staff, research fellows, students and professional teams form a hub that concentrates talent, shares resources and exchanges ideas, multiplying national capacity while extending South Africa's reach into global networks. Their achievements through publications, graduations, awards, facilities brought online, services delivered and partnerships grown are the living proof you'll see throughout this report.

GRATITUDE AND OUR FUTURE DIRECTION

Thank you to our students and staff for your creativity and grit, to our industry and government partners for your trust and challenge, and to our national and international collaborators for a shared commitment to open, rigorous and relevant science. The next two years will demand even more of us in terms of deep science with practical ends, data and AI woven into everyday workflows, and partnerships that keep us honest and extend our reach.

We will continue to invest in the infrastructure and capacity - human, digital and biological - that make resilience real, from better surveillance, to faster and cheaper diagnostics, climate-wise breeding and decision tools that meet growers and government where they work. And we will continue to grow people, our most important platform, through postgraduate training, mentorship and international exchange.

FABI has come of age as both anchor and bridge. An anchor for national capacity in plant health and resilience, and a bridge into global networks that accelerate discovery and uptake. With climate change as the defining challenge of our generation, and data-rich biology as the defining opportunity, we choose to be usefully ambitious, grounded in the fundamentals, bold at the frontier and always in partnership.

FABI IN A NUTSHELL

The Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria is a postgraduate training and research institute that was established in 1997, based on a recognition that the future of forestry and agriculture in South Africa will strongly depend on the incorporation of new and emerging technologies into these industries. Major opportunities for these industries have emerged in recent times, from the applications of biotechnology and information sciences to many others.

PhD STUDENTS GRADUATED SINCE 1998	MSc STUDENTS GRADUATED SINCE 1998
254	460

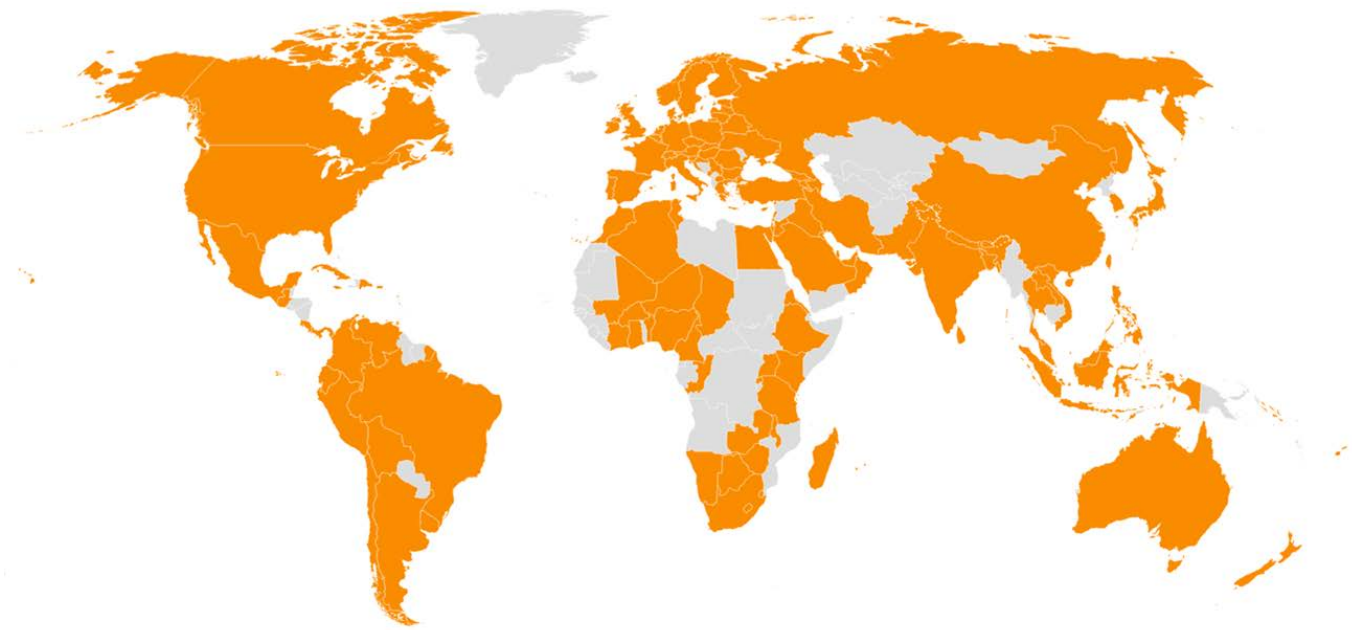
NUMBER OF RESEARCH PAPERS SINCE 1998	NUMBER OF RESEARCH PAPERS 2023–2025	TOTAL CITATIONS SINCE 1998
1 557	276	58 219

Data based on the Web of Science Core Databases. The following were included in the searches: Articles, Book chapters, Database reviews, Early access papers, Editorial materials, Letters, Proceeding papers and Review articles. ***Data as at the time of publication: November 2025***

FABI'S CORE MISSION

- Advance the fields of biotechnology and information technology in plant science through research of the highest possible calibre.
- Promote advanced education in these fields as it relates to forestry, agriculture and the environment.
- Produce new and improved products and services to support competitiveness and resilience of plant based industries.
- Impact plant productivity and resilience, environmental sustainability and biodiversity conservation through a transdisciplinary approach.
- In partnership with industries and government, provide both short and longer term benefits to the forestry and agricultural sectors of South Africa and beyond.

WORLDWIDE COLLABORATION



Countries highlighted show where FABI's co-authors were institutionally affiliated on published papers; countries in grey indicate no recorded collaborations.

36

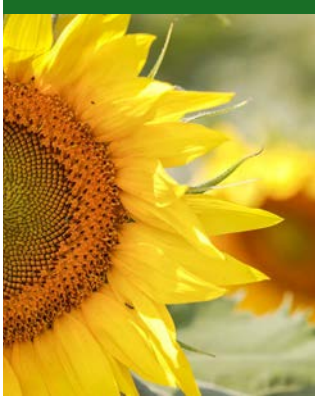
NRF RATINGS

3 A-ratings
9 B-ratings
18 C-ratings
1 P-rating
5 Y-ratings

11

STANFORD/ELSEVIER TOP 2% SCIENTISTS

Teresa Coutinho
Pedro Crous
Almuth Hammerbacher
Christiaan Pirk
Jolanda Roux
Bernard Slippers
Eva Stukenbrock
Cobus Visagie
Brenda Wingfield
Mike Wingfield
Neriman Yilmaz



388

STAFF AND RESEARCHERS 2025

37 Full-time academic staff
29 External research associates
30 Postdoctoral/ research fellows
86 PhD students
111 MSc students
40 Honours students
9 Interns
46 Professional support staff

RESEARCH OUTPUT

4

SATELLITE LABS AND INTERNATIONAL PROGRAMMES

- Satellite Lab in Applied Chemical Ecology
- Satellite Lab in Artificial Intelligence in Farming
- Satellite Lab in Remote Sensing and Plant Health
- RGE-FABI Tree Health Programme

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RESEARCH GROUPS

- African Plant Systems Biology for the Bioeconomy (APSB)
- Applied Mycology
- Bacterial Genomics and Host Pathogen Interactions
- Biophysics
- Citrus Health
- Crop Floral Biology and Environments (CFBE)
- Forest Molecular Genetics (FMG) Research Group and the Eucalyptus and Pine Pathogen Interactions (EPPI) Research Group
- DSTI/NRF SARChI Chair in Fungal Genomics
- Endophyte Ecology
- Hans Merensky Chair in Avocado Research
- Kiwifruit Protection Programme (KPP)
- Macadamia Protection Programme (MaPP)
- Molecular Plant Physiology
- Molecular Plant-Pathogen Interactions (MPPI)
- National Grain Research Platform (NGRP)
- Phytobacteriology
- Plant Virology
- Social Insects Research Group
- Systematics and Evolution of Symbiotic Nitrogen-Fixing Bacteria
- Tree Protection Co-operative Programme (TPCP)

FABI's research portfolio demonstrates a holistic and far-reaching impact across agriculture, forestry, food security, and environmental sustainability. Collectively, its programmes bridge cutting-edge science with tangible industry outcomes, while also contributing to broader social well-being. FABI's work directly supports some of South Africa's most critical agricultural and forestry sectors, protecting multi-billion-Rand industries and securing rural livelihoods. Its science is applied in real-world contexts, where knowledge is actively translated into practical tools, policies, and community engagement, thereby ensuring that research extends beyond the laboratory into everyday practice.

INDUSTRY AND SOCIETAL IMPACT OF FABI'S RESEARCH PORTFOLIO

AFRICAN PLANT SYSTEMS BIOLOGY FOR THE BIOECONOMY (APSB)

APSB works at the intersection of ecology, economics and culture to promote South Africa's plant biodiversity in ways that are inclusive and practical. In partnership with the University of Pretoria, the Botanical Society of South Africa, local growers, artists and academic collaborators, the team established a 9-Biomes demonstration garden at Constitution Hill in Johannesburg – an iconic site of justice, remembrance and civic transformation. More than a thousand climate-adapted indigenous plants were installed by volunteers in a single day, transforming a once-colonial courtyard into a living celebration of the country's botanical heritage. The garden now serves as an accessible space for public engagement, raising awareness of plant diversity and stimulating conversation about transformation, climate resilience and access to green spaces in urban South Africa. Looking ahead, modular versions of this garden will be scaled to other public sites, providing a blueprint for urban greening through indigenous biodiversity and helping to build pride in South Africa's unique flora.

BRINGING TO LIFE ORPHAN CROPS

Through the Future Africa Indigenous and Orphan Crops Collection, in collaboration with Future Africa and the Manie van der Schijff Botanical Garden, APSB promotes the use of under-utilised crops by developing agronomic best practice and assessing production potential. Field trials have focused on crops such as tsenza (*Coleus esculentus*) and chaya (*Cnidoscolus aconitifolius*), with propagation material provided to partners and produce used for undergraduate practicals and consumer-acceptability studies. Chaya cuttings have been supplied to community gardens, expanding local food options. Future work will extend formal trials at the Innovation Africa Experimental Farm and Future Africa campus into a network of community food gardens to evaluate these crops under real-world conditions, strengthening local livelihoods and nutritional security.

APPLIED CHEMICAL ECOLOGY

Working closely with industry partners, the Applied Chemical Ecology group co-designs projects that target priority pests where semiochemical-based monitoring and management can deliver the greatest benefit. This collaborative model has already moved discoveries from lab to landscape: at least one pheromone identified by the team progressed through field trials to broad-scale implementation against a cossid moth pest, with additional candidates advancing through the pipeline. The group has also transferred know-how to support products discovered by others, amplifying uptake beyond its own innovations. As awareness has grown, tools, such as mass trapping and mating disruption, are now regularly considered and applied within integrated pest-management programmes, strengthening biosecurity and improving sustainability across forestry and agricultural sectors.

APPLIED MYCOLOGY

Mycotoxins pose serious risks to food safety and production. Research in the Applied Mycology programme identifies the fungal species that produce these toxins and the conditions under which they arise, enabling prevention and control strategies that support food security goals. Mycotoxin contamination also imposes substantial economic losses across agricultural value chains; improved, research-led management practices reduce these costs to the benefit of producers and consumers. More broadly, fungi will contribute to solutions for climate change, food insecurity, environmental pollution and biodiversity loss. Maintaining access to diverse fungal cultures, therefore, remains essential for discovery and for harnessing species that can help address these global challenges.

BACTERIAL GENOMICS AND HOST–PATHOGEN INTERACTIONS

Research in the Bacterial Genomics and Host–Pathogen Interactions group is geared towards supporting the potato and sweet-potato industries with innovative, sustainable disease-management solutions. By combining genomics with field knowledge, the team aims to improve soil health, reduce losses and increase yields for farmers.

BIOPHYSICS

The Biophysics programme delivers practical benefits for farmers by enabling in situ fluorometric monitoring of plant stress. Early, pre-symptomatic diagnosis allows interventions days before visible symptoms develop, curbing disease spread, improving treatment success and reducing inputs. Because commercial hyperspectral cameras remain prohibitively expensive for most farmers in developing countries, the team is developing lower-cost instruments that use advanced data analysis and AI to improve speed and performance, with further savings when devices are optimised for specific applications. Recognising the need to reduce chemical use in Africa, the programme supports more accurate, targeted fungicide application in the short term and investigates less toxic alternatives over the longer term, including approaches based on understanding the physics of fungal spore dispersal.

CROP FLORAL BIOLOGY AND ENVIRONMENTS (CFBE)

CFBE advances climate-resilient agriculture in alignment with industry needs through the Climate Resilience Consortium established by Grain SA. Because much South African farming is rain-fed, dry years can delay planting and reduce yields. The programme studies the factors limiting yields at late planting dates to tailor agronomic practices that mitigate these losses. Within the South African Sclerotinia Research Network, CFBE investigates how practices such as planting date influence the severity of Sclerotinia head rot in sunflower and tests control strategies where planting date cannot be adjusted. Foundational work on floral responses to stress at physiological and molecular levels seeks heritable traits for breeding climate-resilient crops with improved floral thermotolerance, safeguarding seed production and food security.

CITRUS HEALTH

The Preharvest Disease programme focuses on sustainable management of fruit, foliar and soilborne pests and diseases in citrus. Its research spans better monitoring methods, evaluation of alternative and gentler management approaches, improved spray technology and strategies to deter resistance development. Understanding pathogen epidemiology helps to optimise the timing of interventions. This work supports a stable supply of citrus, food security and the livelihoods of farmers and farm workers. By reducing reliance on harsh chemicals and improving

resistance management, the programme promotes safer food and healthier ecosystems, while optimised tactics and application timing improve resource efficiency and reduce environmental impacts, strengthening the resilience of citrus farming in South Africa.

FOREST MOLECULAR GENETICS (FMG) AND EUCALYPTUS AND PINE PATHOGEN INTERACTIONS (EPPI)

The FMG and EPPI programmes create meaningful opportunities for student development and industry collaboration. A partnership with the University of Venda has provided hands-on training for emerging researchers, while internships sponsored by Sakata Seed have further strengthened academic–industry links. Beyond capacity building, the group contributes to global discussions on plant health and food security. Participation in the International Day of Plant Health Meeting at Future Africa (May 2023) helped shape conversations on innovation, regulation and capacity development, ensuring that research outcomes inform both policy and industry strategies for sustainable plant-health management.

ENDOPHYTE ECOLOGY

Understanding the drivers of microbial diversity and community assembly – such as environmental conditions, host interactions, resource availability and competition – opens opportunities to harness microbiomes for agriculture, environmental management and biotechnology. Although the Endophyte Ecology programme focuses on natural communities, its methods translate directly to applied questions: how soils, climate and host species determine microbiome composition and function, how these factors influence ecosystem processes and crop performance, and how such knowledge can be used to design microbiomes for resilience and productivity.

DSTI/NRF SARCHI CHAIR IN FUNGAL GENOMICS

The SARChI Chair delivers research with direct value to agriculture, forestry and environmental management by improving how plant-pathogenic fungi are detected, understood and managed. Early identification of *Chrysoporthe doradensis* and *C. colombiana* in Colombia, and multiple *Calonectria* species threatening *Eucalyptus* in China, equips forest managers to contain outbreaks and protect both biodiversity and commercial plantations. In crops, insights into the genetic control of reproduction in *Elsinoe* (agents of scab diseases) support resistance breeding and the discovery of more effective fungicides. Practical diagnostics have advanced through rapid LAMP assays for *Fusarium circinatum* and *Elsinoe necatrix*, enabling timely interventions that stabilise yields. Expanded whole-genome resources illuminate pathogen evolution, transmission and resistance mechanisms, while studies on fungal mating pheromones, including a newly discovered signal in Leotiomycetes and reproductive strategies in *Huntiella,* open avenues to disrupt disease cycles or harness beneficial fungi in biotechnology. Complementary work on mycoviruses highlights their promise as natural biocontrol

agents, reducing reliance on chemical inputs. Finally, evidence that *F. circinatum* responds to chemical cues from pine roots clarifies host-location and infection processes, informing novel prevention strategies. Collectively, these advances underpin more sustainable forestry and agriculture, strengthen food and timber security and promote environmentally responsible disease management.

NATIONAL GRAIN RESEARCH PLATFORM (NGRP)

The NGRP catalyses collaboration between government, industry and academia to target research and accelerate innovation across the grain and oilseed sectors. Integrated work in agronomy, plant physiology and diagnostics will support the development of more resilient, productive crop varieties, improving both yields and quality. An extension and diagnostic clinic, supported by sentinel plots, will deliver timely insights into the distribution and severity of pests and diseases, enabling earlier detection, stronger biosecurity and more effective management that reduces the economic impact of outbreaks. Together, these measures will enhance food availability and make a meaningful contribution to national food security.

KIWIFRUIT PROTECTION PROGRAMME (KPP)

The KPP underpins effective disease management in South African kiwifruit by enabling rapid, appropriate responses to priority pests and pathogens and by supporting the long-term viability of the industry. Guided by the South African Kiwi Growers Association, the programme aligns closely with grower needs and delivers data-driven outputs. Regular field visits across major growing regions enable direct engagement with farmers, helping them to recognise pest and disease problems and to implement phytosanitary guidance; progress and seasonal recommendations are shared at committee meetings and the Association's annual general meeting. The KPP advises the government on phytosanitary risks and communicates that these threats are actively being studied to refine risk assessments. Extension activities have identified several pathogens affecting local production – many newly reported on kiwifruit in South Africa – and curated isolates now strengthen reference collections for future research as capacity expands.

HANS MERENSKY CHAIR IN AVOCADO RESEARCH

The Hans Merensky Chair in Avocado Research is a collaboration between the Hans Merensky Legacy Foundation and the University of Pretoria. This multidisciplinary programme integrates plant pathology, molecular biology, and omics to tackle challenges in avocado production. Originally centred on *Phytophthora cinnamomi* (Phytophthora root rot), the scope now includes *Dematophora necatrix* (white root rot), other emerging root pathogens, and *Botryosphaeriaceae* in South Africa. With industry ties, including SAAGA, the Chair develops sustainable management strategies and serves as a diagnostics hub through its disease clinic, strengthening support and relationships.

MACADAMIA PROTECTION PROGRAMME (MaPP)

MaPP is explicitly solution-oriented, generating knowledge to inform improved pest and disease-management programmes and translating findings into practical recommendations for growers. The group engages regularly with producers through regional study groups and the annual Macadamia Grower Symposium, and disseminates information through fact sheets, best-practice guides, popular articles in the SAMAC journal and short research updates on the SAMAC YouTube channel. Diagnostic and extension services help growers to manage insect pests and pathogens effectively.

MOLECULAR PLANT PHYSIOLOGY

The Molecular Plant Physiology programme works with industry partners to address herbicide-resistant weed populations that threaten yields and to develop weed-control strategies with lower environmental impact. The team also investigates drought tolerance and its effects on nutritional quality, aiming to improve both food and nutritional security under changing climates.

MOLECULAR PLANT–PATHOGEN INTERACTIONS (MPPI)

Maize underpins food and feed security in South Africa, and research by MPPI strengthens on-farm production. Current work with the grain industry targets grey leaf spot (caused by *Cercospora zeina*), a major threat across sub-Saharan Africa. Management relies on deploying resistant cultivars and applying fungicides. Genetic mapping in Kenya has delivered DNA markers to breed resistant cultivars for East African farmers, where fungicide use is limited, and outreach has included a booklet on maize leaf diseases translated into Swahili. Fundamental research on RNA-based control of grey leaf spot is paving the way for environmentally friendly crop protection. Looking forward, breeding solutions will increasingly draw on genome editing, underscoring the importance of African leadership in technology development and innovation-friendly policy. The group's expertise is recognised internationally, including authorship of the 'Diseases of maize/corn' chapter in the sixth edition of Agrios' Plant Pathology by Prof. Dave Berger, a textbook widely used by researchers, students and managers.

PHYTOBACTERIOLOGY

Phytobacteriology research enhances food security and sustainable agriculture by identifying and managing plant-pathogenic bacteria. The findings drive innovation in disease control, including biocontrol methods, disease-resistant crops and targeted bacterial management. Understanding host shifts strengthens biosecurity, reducing the risk of disease outbreaks in agriculture and forestry.

PLANT VIROLOGY

The Plant Virology group contributes to safeguarding South African agriculture by enabling rapid, accurate detection and identification of plant viruses, thereby preventing major yield losses and supporting national food security. High-throughput sequencing surveillance, coordinated with the ARC and the Department of Agriculture, strengthens biosecurity by identifying quarantine incursions early and facilitating swift containment. Application of diagnostics and identification of causal agents assist with adherence to phytosanitary standards, protecting export markets and domestic movement of plant material. By clarifying vector transmission routes, the group guides targeted, evidence-based

control strategies that ultimately reduce unnecessary pesticide use and production costs. Screening local germplasm feeds clean-plant programmes, delivering virus-free cultivars adapted to South African conditions and resilient under climate change.

RGE-FABI TREE HEALTH PROGRAMME

The two core focus areas of the RGE-FABI Tree Health Programme are firmly set to impact positively on society and industry. In the former case, the programme concentrates on education of postgraduate students in the broad field of tree health. Students from both Indonesia and South Africa have completed MSc and PhD degrees in the past and new students continue to enter the programme. Projects are designed to establish new knowledge and develop management options for important insect pest and pathogen problems affecting plantation forestry. These consequently impact strongly on sustainable industrial development, including generating employment for people.

SOCIAL INSECTS RESEARCH GROUP (SIRG)

SIRG maintains strong engagement with stakeholders across academia, industry and the public. Each year, the group marks World Bee Day (May 20) and World Biodiversity Day (May 22) with activities across the University of Pretoria campuses and conducts outreach in schools from kindergarten to high school levels. Over the past two years, the group has given presentations and led discussions with the beekeeping industry and governmental partners such as the Agricultural Research Council, and shares findings with beekeepers across Gauteng to promote good practice and two-way knowledge exchange. Expertise is also shared with farmers and seed producers during Farmers' Days in the Western Cape. At continental level, SIRG contributed to drafting within the Comprehensive Africa Agriculture Development Programme (CAADP), leading to the inclusion of pollinators in the Kampala Declaration for the CAADP ten-year action plan (2026–2035).

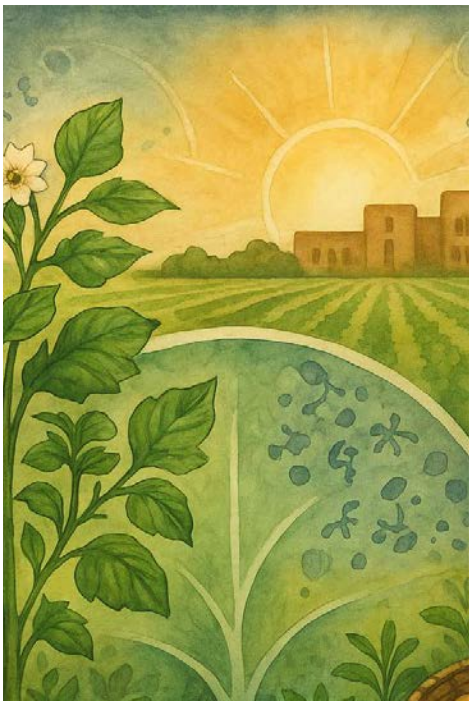
SYSTEMATICS AND EVOLUTION OF SYMBIOTIC NITROGEN-FIXING BACTERIA

This programme delivers tangible benefits to South African agriculture by matching legumes with effective rhizobial partners to boost nodulation, biological nitrogen fixation and soil health – raising yields while reducing dependence on synthetic fertiliser. Newly described, locally adapted strains create a pipeline for region-specific bioinoculants and standards, opening opportunities for small and medium enterprises and the broader agri-bioeconomy. Biogeographic and evolutionary insights guide climate-resilient legume-rhizobia choices across heat- and drought-prone agro-ecologies. The programme also contributes to ecosystem management by resolving the identities and evolution of symbionts for native and introduced legumes (including *Vachellia karroo* and acacias), informing risk assessments and targeted interventions for bush encroachment and invasive species to support rangeland restoration. Postgraduate training and multi-institution partnerships build national capacity for long-term impact.

TREE PROTECTION CO-OPERATIVE PROGRAMME (TPCP)

The TPCP provides a biosecurity shield for a R50-billion industry. Early-warning systems, diagnostics and biological-control programmes avert multi-million-Rand losses from invasive pests and diseases, safeguarding rural livelihoods and export markets. Through the Information Hub, forestry companies access live maps of pest hot-spots, biocontrol establishment and climate overlays, enabling rapid, data-driven management. The programme also builds national capacity – alumni hold key roles in regulatory bodies, forestry R&D, consulting and academia – thereby strengthening South Africa's biosecurity competence. Its research outputs and reference collections, including more than 60 000 cultures of plant-associated fungi, inform forest-health management worldwide and contribute to international initiatives.

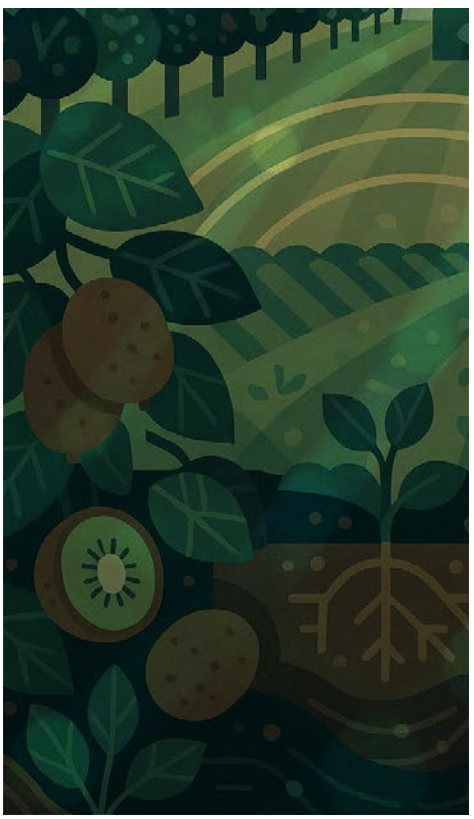
> **"FABI, in every way, represents an amalgamation of a tremendous base of expertise in forestry and agriculture from different universities and research organisations in South Africa and other countries in the world, as well as partners in industry and government."**



01

RESEARCH REPORTS

FRUIT, NUTS AND VEGETABLE CROPS



BACTERIAL GENOMICS AND HOST PATHOGEN INTERACTIONS

Research Leader: **Prof. Lucy Moleleki**

Research Team:
Prof. Rasheed Adeleke *(Department of Microbiology, North West University)*
Dr Sunett Laurie *(Agricultural Research Council, Roodeplaat, South Africa)*
Dr Philemon Tsele *(Department of Geography, Geoinformatics and Meteorology, University of Pretoria)*

BACKGROUND

The growing human population requires food production, but in a sustainable manner. Pests and pathogens pose a threat to food security. We take a two-pronged approach towards tackling pathogens. In the first instance, we identify effector molecules which pathogens use to undermine plant immunity. Doing so will, in the long run, help us boost plant immunity. High reliance on chemicals means that we now have soils that are degraded, needing to be regenerated. Secondly, we aim to improve soil health by improving microbial diversity. Thirdly, developing remote sensing tools for accurate, non-destructive prediction of yield. How can we do this? One way to restore soil health is to improve microbial diversity.

OBJECTIVES OF THE RESEARCH PROGRAMME

- Identify effector molecules of bacteria, oomycetes and nematodes
- Understand the role of effectors in undermining plant health
- Isolate and identify soil beneficial microbes
- Assess their plant growth-promoting attributes
- Assess the ability of isolates to inhibit the growth of pathogenic microbes

HIGHLIGHTS OF THE RESEARCH

Effector identification and characterisation:

- We have developed a computational tool to help us identify virulence/effectors of bacteria and oomycetes. In the oomycete, *Phytophthora parasitica*, we identified 71 core effectors.
- These are core effectors because they are highly conserved within isolates of *P. parasitica*, and therefore present good targets for engineering plants with the ability to detect these effectors and defend themselves against the pathogen.
- We further studied a select number of these effectors to see where in the plant these molecules localise and which plant defence mechanisms they undermine.
- With this knowledge, we aim to engineer plants with enhanced resistance to pathogens that inject effectors into host plants, suppress immunity and cause disease.

Soil microbial diversity:

- In an ongoing study, we isolated various growth promoting bacteria (PGPB) from soils and root samples from a field that had potato crop plants. These samples were collected after two years of crop rotation. We want to test the potential of these isolates in enhance potato plant growth under both biotic and abiotic stress.
- Rhizosphere microbiomes associated with two different types of sweet potato genotypes were also isolated, identified and tested for PGPB attributes. The two cultivars represented a highly susceptible (Blesbok) to *Fusarium* spp. (fungal plant pathogen) or highly resistant (Evangeline) cultivar.
- The observed differences in microbial composition between the two cultivars suggest that Evangeline's diverse microbiome may contribute to its enhanced resistance.
- We would like to test the ability of isolates obtained from the resistant cultivar to enhance resistance in the otherwise susceptible cultivar.

OUR IMPACT

- ***The Bacterial Genomics and Host Pathogen Interactions group supports the potato and sweet potato industries.***
- ***Its research develops innovative, genomics-informed strategies to control diseases.***
- ***The work promotes soil-health improvements through microbiome-aware practices.***
- ***The overall aim is higher, more stable yields for growers.***

CITRUS HEALTH

Research Team:
Prof. Jacquie van der Waals *(Citrus Research International)*
Prof. Teresa Coutinho
Prof. Chris Weldon
Dr Jan van Niekerk *(Citrus Research International)*

BACKGROUND

This research programme is fully funded by Citrus Research International, with emphasis on the sustainable management of important preharvest diseases, and pre- and postharvest insect pests of citrus in South Africa. The increased pressure on South African agriculture from the EU Green Deal, particularly on export crops such as citrus, necessitates the need to focus research on gaining a better understanding of the epidemiology of diseases and biology of insect pests in order to develop and advise on effective Integrated Pest Management strategies. The diseases currently under consideration in this programme are Phytophthora root rot, Botrytis grey mould and Alternaria brown spot. The complex of fruit flies (*Bactrocera* and *Ceratitis* species) and psyllids present or at risk of introduction to South Africa are the focus of our entomological research.

OBJECTIVES OF THE RESEARCH PROGRAMME

- Determine the efficacy of novel oomycete fungicides for the management of *Phytophthora nicotianae* from South African citrus orchards.
- Assess the effects of root disease on systemic fungicide uptake; establish the mobility of three novel oomycete fungicides into plant tissues in healthy rootstocks and rootstocks compromised by *P. nicotianae* infection.
- Test the *in vitro* and *in vivo* efficacy of biocontrol products, plant extracts and GRAS substances against *Phytophthora citrophthora* and *P. nicotianae*.
- Validate the accuracy of the Alter-Rater risk model in predicting *Alternaria* infections in Nova orchards.
- Determination of fungicide sensitivity of *Botrytis cinerea* isolates from South African lemon orchards.
- Evaluate the pathogenicity of fungi and fungal complexes isolated from Eureka blossoms.
- To evaluate the antifungal potential of indigenous South African plants against citrus fruit and foliar pathogens.
- Identify the fungi responsible for blossom blight and rind distortion in Eureka lemons and Valencia oranges in Northwest South Africa.

Orchard spray trial in Mooinooi


Phytophthora root rot


Rind distortion

- Identify the bacterial and fungal microbial community present on and in the fruit rinds of soft citrus, lemons and oranges under nets and in open orchards.
- Establish the role of temperature, relative humidity and fly physiology on the efficiency of fruit fly lures.
- Establish the interacting roles of protein bait location, application density and fruit fly physiological state on response by fruit flies (*Ceratitis capitata*, *Ceratitis cosyra* and *Bactrocera dorsalis*).
- Define the locations and times of the year when targeted, pre-harvest fruit fly control measures can be applied to minimise infestation of citrus in a diverse agroecological landscape.
- Investigate the influence of interactions between larval diet and gut microbiome on susceptibility of *C. capitata* and *B. dorsalis* larvae to post-harvest cold treatments for South African export citrus.
- Develop novel monitoring tools for African citrus psyllids (*Trioza erytreae*) in South Africa.

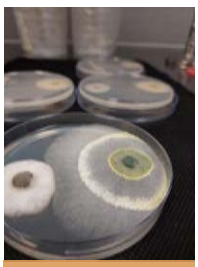
HIGHLIGHTS OF THE RESEARCH

- **Novel oomycide efficacy:** All four oomycete fungicides effectively inhibited *P. nicotianae* growth *in vitro*, with effective concentrations correlating to previous research in other countries. The results indicate that South African *P. nicotianae* isolates are sensitive to these oomycete fungicides. The preventative and curative *in vivo* applications of ethaboxam, mandipropamid and zoxamide yielded inconclusive results. Further orchard trials are recommended to fully investigate the effectiveness of these three agrochemicals against *P. nicotianae*.
- **Novel oomycide uptake:** Uptake and mobility of the novel oomycides were established in citrus rootstock cultivars using spectrometry. Chemometric models likened fungicide effects to phosphonate-induced resistance, pointing to a potential systemic action of the compounds.
- **Alternative controls for *Phytophthora* spp.**: Extracts from *Artemisia afra* were found to inhibit *P. citrophthora* and *P. nicotianae in vitro* at 78.2% and 62.1%, respectively. The *in vitro* inhibition of *P. citrophthora* by strains of *Trichoderma asperellum* and *Bacillus amyloliquefaciens* was 40.86% and 35.57%, respectively, and against *P. nicotianae* 52.31% and 55.56%, respectively.
- **Alter-Rater validation:** Three seasons of trials in a Nova orchard in Mooinooi were done to confirm infection periods predicted by the Alter-Rater model in PhytRisk. The findings suggest that the model will accurately predict *Alternaria alternata* infection periods after minor modifications to the algorithm. Another orchard spray trial was done over two growing seasons to compare the efficacy of the Alter-Rater fungicide spray programme with a standard calendar spray programme, an unsprayed control and a biological control programme. The results so far indicate that the model is accurately predicting spray timing intervals during a season with wet and hot conditions, as were experienced during the trial seasons.
- ***Botrytis cinerea* fungicide sensitivity:** Thirty *B. cinerea* isolates were screened *in vitro* for their sensitivity to four active ingredients from different FRAC groups. The results indicated that the isolates were sensitive to all four active ingredients tested. The results from this project will play a role in identifying the resistance patterns of *B. cinerea* and identify the mutations associated with the resistance of the isolates. This will improve the management of *B. cinerea* in lemon orchards.
- **Fungal complexes in citrus blossoms:** Results from *in planta* inoculation trials indicated that *Botrytis cinerea* and *Colletotrichum gloeosporioides* were the most virulent pathogens associated with blossom blight on lemons. These pathogens could threaten lemon production during flowering, resulting in disease development under favourable conditions. The outcomes of this project will assist the citrus industry in making effective and sustainable disease management decisions pertaining to blossom diseases.
- **Plant extracts against fungal pathogens:** Preliminary results show that several extracts are effective against the pathogens. Each extract displays different antifungal potency against the various pathogen species. No statistical conclusions can yet be made, but more data will further elucidate antifungal activity.
- **Rind distortion etiology:** Preliminary results show that multiple pathogens are present in blossoms and can infect all parts of citrus blossoms under various weather conditions. These pathogens may contribute to rind distortion, as rind distortion was observed on fruit in the orchard.

- **Citrus rind microbiome:** The species richness in the rind of all three citrus types under nets is less abundant than in open orchards.
- **Fruit fly lure efficiency:** Fly age influences the response of all species but is attractant specific, reflecting different requirements by *B. dorsalis* and *C. capitata* as they approach sexual maturity. Fly response generally increases with temperature, with lower thresholds ranging from 12.21 to 22.95°C depending on the species and attractant. Male *B. dorsalis* response to methyl eugenol drops by more than 90% when fed the attractant before testing.
- **Fruit fly response to protein baits:** Protein baits should be applied in the citrus tree canopy to optimise fly response. Higher levels of fly activity at warmer temperatures increase protein bait response. More flies visit protein bait when applied as many small spots in comparison to one single large point.
- **Fruit fly control optimisation:** In the Mooinooi area of North West province, South Africa, pest species like *C. capitata, C. cosyra*, and *C. quilicii,* were caught in high numbers during the dry winter season, which is inconsistent with the expectation that this period should have low fly numbers, with numbers decreasing leading into spring. Trap captures of these pests were concentrated in citrus, showing that fruit fly management in this landscape needs to target citrus orchards, even when fruit are not present, perhaps because of the sheltered microclimate and irrigation water available at these sites.
- **Post-harvest control treatment for fruit flies:** Removal of the egg chorion to prevent the transfer of bacteria from female flies to their offspring leads to slower development rates and lower survival in *B. dorsalis* and *C. capitata*.
- **Citrus psyllid monitoring tools:** Tested plant-derived odours did not improve *T. erytreae* catch during field cage or field trials, and weathering in the field did not affect the composition of odorants. However, temperature influenced odorant loss, and release rate from polyethylene bulbs decreased over time. Two artificial intelligence models showed promise as a workable means to speed up and improve the identification of psyllids on yellow sticky traps used for monitoring.

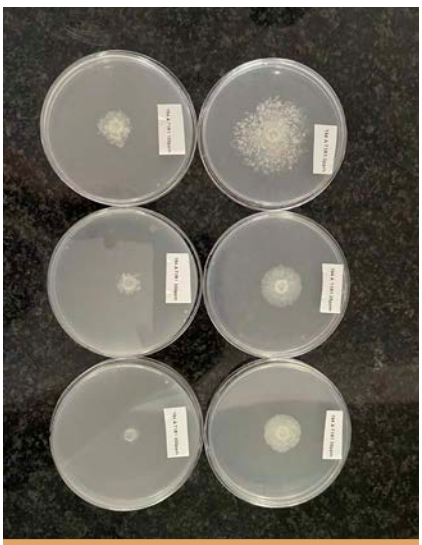
OUR IMPACT

- ***The Preharvest Disease Programme focuses on sustainable management of fruit, foliar, and soilborne pests and diseases in citrus.***
- ***Core activities include developing robust monitoring methods, identifying and testing gentler alternatives to conventional controls, refining chemical strategies to slow resistance, advancing spray technology, and studying pathogen epidemiology to optimise fungicide timing.***
- ***The work underpins a stable citrus supply, bolstering food security and the livelihoods of farmers and agricultural workers.***
- ***By reducing reliance on harsh chemicals and strengthening resistance management, the programme supports safer food production and healthier ecosystems.***
- ***Optimised insect and disease management reduces environmental impact and improves resource efficiency, aligning with sustainable agriculture and climate-change mitigation.***
- ***Overall, the programme enhances the resilience and sustainability of South African citrus farming, benefiting local communities and global markets.***



Dual culture assay

Leaf disk isolations



Amisulbrom *in vitro* trial

Grey mould Botrytis

Petal with grey mould and lesion

HANS MERENSKY CHAIR IN AVOCADO RESEARCH

Research Leader: **Prof. Noëlani van den Berg**

Research Team:
Dr Velushka Swart
Dr Robert Backer
Dr Maryke Carstens

Collaborators:
Prof. Gerda Fourie
Prof. Lucy Moleleki
Prof. Jacques Theron *(Department of Biochemistry, Genetics and Microbiology, University of Pretoria)*
Prof. Aureliano Bombarely *(Department of Biotechnology and Plant Breeding, Institute of Plant Molecular and Cellular Biology, University of Valencia, Spain)*

BACKGROUND

The Hans Merensky Chair in Avocado Research is a collaborative initiative between the Hans Merensky Legacy Foundation and the University of Pretoria. This multidisciplinary research programme integrates plant pathology, molecular biology, and omics-based approaches to address key challenges in avocado production. Originally focused on *Phytophthora cinnamomi*, the causal agent of Phytophthora root rot, the programme has expanded its scope to include *Dematophora necatrix* (White root rot) and other emerging avocado root pathogens and *Botryosphariaceae* in South Africa. With strong industry ties, including partnerships with the South African Avocado Growers' Association, the Chair aims to develop sustainable management strategies to support the avocado industry. Additionally, the programme plays a critical role as a hub for avocado disease diagnostics through its disease clinic, fostering stronger industry relations and providing essential services to farmers.

OBJECTIVES OF THE RESEARCH PROGRAMME

- Investigate the molecular mechanisms of avocado defence against *P. cinnamomi* and *D. necatrix*.
- Develop and utilise genomic and transcriptomic resources for avocado, *P. cinnamomi*, and *D. necatrix*.
- Expand research to include additional avocado root pathogens emerging in South Africa.
- Identify and characterise pathogenicity and virulence genes in *P. cinnamomi* and *D. necatrix.*
- Implement transformation protocols and CRISPR/Cas9-based gene editing for functional studies.
- Assess the efficacy of biocontrol agents and fluazinam as part of an integrated management strategy for *D. necatrix*.
- Investigate the avocado microbiome in the context of disease resistance.
- Continue to serve as a hub for avocado disease diagnostics through the disease clinic, strengthening industry relationships and providing crucial services to farmers.
- Develop molecular tools for rapid pathogen detection and breeding applications.
- Investigating the *Botryosphaeriaceae* and their role in branch dieback in the orchard and tip dieback in the nursery.
- Investigating the molecular basis for avocado sunblotch disease.

HIGHLIGHTS OF THE RESEARCH

- **Avocado omics resources and defence:** Leveraging a high-quality avocado genome assembly, we have identified and characterised key defence-related gene families, including NLRs (nucleotide-binding leucine-rich repeat proteins) and callose synthases.
- **Understanding *P. cinnamomi* pathogenicity:** Our research has uncovered a diverse array of pathogenicity factors, including RxLR, CRN, and NLP effectors. The identification of stable transformation protocols and a *Nicotiana benthamiana* pathosystem has enhanced functional gene characterization.

- **White Root Rot management:** The first complete genome and mitochondrial genome sequences of *D. necatrix* from South African orchards have been assembled. This has enabled the development of microsatellite markers and RT-LAMP assays for population structure investigations and rapid pathogen detection. Additionally, our research has contributed towards the application for the registration of fluazinam as a control method. We have provided insights into the effectiveness of biological control products, and deepened our understanding of the role of the avocado root microbiome during *D. necatrix* infection.
- **Expansion into emerging root pathogens:** Research efforts have been broadened to include emerging avocado root pathogens, ensuring proactive disease management strategies are developed to cater to the needs of the industry.
- **Molecular breeding platform for avocado:** Six avocado genomes have been sequenced to construct a pangenome, forming the foundation for a 12 000-marker SPET genotyping platform aimed at improving avocado breeding.
- **Avocado disease diagnostics:** The Chair has reinforced its role as a critical diagnostic hub for avocado diseases, strengthening collaborations with industry stakeholders and offering essential support for farmers through its disease clinic.
- **International recognition and collaborations:** The team has presented research at major international conferences, including the International Congress of Plant Pathology and the International Mycological Congress.

OUR IMPACT

- *The research is contributing to the development of molecular breeding strategies for avocado, with the aim of improving cultivar and rootstock selection and disease resistance.*
- *The identification of biocontrol agents and chemical treatments for* D. necatrix *is providing sustainable disease management solutions for avocado farmers.*
- *The continued effort to implement rapid molecular diagnostic tools promises to improve disease detection and orchard management.*
- *The programme plays a pivotal role in capacity building, training postgraduate students in cutting-edge plant pathology and bioinformatics techniques.*
- *The Hans Merensky Chair's disease clinic provides a critical service for avocado farmers, offering diagnostic support and fostering stronger engagement between researchers and industry.*

Inoculation of avocado trees with *Dematophora necatrix* for a trial assessing the effectiveness of select biocontrol agents

Agroinfiltration of *Nicotiana benthamiana* with *Phytophthora cinnamomi RxLR* genes

In field sampling for *Dematophora necatrix* sexual structures

KIWIFRUIT PROTECTION PROGRAMME (KPP)

Research Leader: **Prof. Irene Barnes**

Research Team:
Prof. Mike Wingfield
Dr Firehiwot Eshetu
Dr David Nsibo

BACKGROUND

Kiwifruit production in South Africa is relatively small, with around 230 hectares of fruit harvested every season and the majority of which is exported. However, with a growing understanding of cultivation practices and the introduction of the sweeter, more sought-after yellow and red cultivars, the industry is rapidly expanding. One facet, of which very little is known, is the pests and pathogen threats this industry in South Africa faces. This became evident in 2022, with the discovery of a *Ceratocystis* sp. causing wilt and dieback in several of the orchards. Concurrently, a serious new spot and rot disease emerged across three provinces in South Africa, affecting fruit close to harvest. The team at FABI identified this as a species of *Pseudocercospora* not previously reported from kiwifruit. These outbreaks highlighted the absence of a structured support system to help farmers not only identify pest and pathogen threats, but also develop potential control strategies. In response, the Kiwifruit Protection Programme (KPP) was launched in February 2023 in collaboration with the South African Kiwi Growers Association (SAKGA).

FABI team doing *Ceratocystis* inoculations on kiwifruit grown in the greenhouses

The KPP now provides extension services to the industry, focusing on monitoring and diagnosing pathogens affecting kiwifruit production, while building a database of threats that require further investigation. Current research includes studies on Ceratocystis canker and wilt (*Ceratocystis* sp.), Verticillium wilt (*Verticillium* spp.), leaf spot (*Sclerotiniaceae* sp.), and Pseudocercospora fruit spot and rot (*Pseudocercospora* spp.). Given the significant impact of the recent *Pseudocercospora* outbreaks on the industry, the team is also investigating the epidemiology of this pathogen and evaluating fungicide efficacy to support the development of a robust spray programme for its control.

OBJECTIVES OF THE RESEARCH PROGRAMME

- Document and monitor diseases affecting kiwifruit production across South Africa.
- Isolate and preserve the potential causal agents of the diseases.
- Study and characterise novel species and develop inoculation protocols to try to understand the onset and progression of the disease symptoms they cause.
- Provide a platform where kiwifruit cultivars grown by farmers can be screened for resistance to infection by the most important pathogens.
- Develop an understanding of the epidemiology of the most important pathogens affecting kiwifruit and thus guide disease management in the orchards.
- Screen fungicides to determine their efficacy in controlling *Pseudocercospora* spp. causing fruit spot and rot disease on kiwifruit in South Africa.

HIGHLIGHTS OF THE RESEARCH

- PhD candidate, Cheyenne Theron, is working on three diseases affecting kiwifruit production in South Africa. She is currently characterising the causal agents, of which several represent novel species.
- Epidemiological studies on *Pseudocercospora* have revealed periods of peak spore dispersal. This allows for correlation with climate data to identify windows during kiwifruit development in which chemicals should be applied to control *Pseudocercospora* spp.
- The KPP Diagnostic Clinic has processed over 60 samples sent in by members of the industry and the extension team have spent over 40 days in the field to support local farmers. The cultures obtained from these samples are being used in several student projects.
- Postdoctoral fellow Dr Firehiwot Eshetu joined the KPP in May 2024 to conduct *in vitro* fungicide screenings for the control of *Pseudocercospora* spp. She evaluated a range of fungicides representing different modes of action and chemical groups. Results from these *in vitro* screenings have been used to set up a *Pseudocercospora* epidemiological study and have provided a foundation for the establishment of chemical spray trials under field conditions.

OUR IMPACT

- ***Disease management:*** *The work of the KPP facilitates an appropriate and rapid response against important pests and pathogens affecting kiwifruit production, ensuring a yearly production turnover and long-term feasibility of kiwifruit in South Africa.*
- ***Data-driven decision making:*** *The programme works in close association with the South African Kiwi Growers Association, and the needs of the industry drive research areas and outputs.*
- ***Science engagement:*** *Field visits done by the researchers in the programme allow for the opportunity to engage with farmers in the different kiwifruit growing regions, providing insights on how to identify pest and pathogen issues and provide some phytosanitary guidelines. Researchers also present their data in committee meetings and at the yearly South African Kiwi Growers Association Annual General Meeting to keep farmers updated on the research outcomes and provide recommendations for the season.*
- ***Policy and proactive actions:*** *The KPP informs the government of the phytosanitary risks that the pathogens associated with kiwifruit in South Africa can pose to export countries, but also reiterates that these threats are being studied to understand better the risk they pose.*
- ***Identifying research gaps:*** *Extension services provided by the KPP have identified several pathogens affecting kiwifruit production in South Africa, many of which are new reports on this host for the country and for which the impact is unknown. These fungal strains are used to enrich reference collections which will form the basis of future projects as the capacity of the KPP grows.*

Cheyenne Theron in the KPP diagnostic clinic isolating *Pseudocercospora*

Young kiwifruit

MACADAMIA PROTECTION PROGRAMME (MaPP)

Research Leader: **Prof. Gerda Fourie**

Research Team:
Dr Rosali Moffat
Collaborators:
Prof. Olufemi Akinsanmi *(University of Queensland, Australia)* • **Prof. Bernard Slippers** • **Prof. Emma Steenkamp**
Prof. Noëlani van den Berg • **Prof. Fanus Venter** • **Prof. Brenda Wingfield** • **Prof. Mike Wingfield**
Dr Nicky Cruex • **Dr Veluskha Swart**

BACKGROUND

The Macadamia Protection Programme (MaPP) is a collaborative research partnership between Macadamia South Africa NPC (SAMAC), the University of Pretoria (UP) and the Forestry and Agricultural Biotechnology Institute (FABI). Through a multidisciplinary approach, our goal is to conduct solution-orientated research that will translate to practical pest and disease management options for macadamia growers. The programme also provides extension as well as pest and disease diagnostic services to the macadamia industry.

OBJECTIVES OF THE RESEARCH PROGRAMME

- Identify causal agent(s) of macadamia diseases and identify pests of economic concern.
- Develop molecular tools for rapid pest and pathogen identification.
- Track spatial and temporal changes in pathogen populations and insect pest damage in macadamia orchards and assess the presence and abundance of natural enemies and monitor their parasitism levels.
- Study pathogen biology, epidemiology and determine environmental conditions conducive for disease development.
- Calculate degree-day models and investigate aspects of thermal physiology of insect pests.
- Assess the efficacy of commercial fungicides and biological control agents against causal agents of economic concern.
- Determine consumption rates of predators and parasitism rates of parasitoids.
- Investigate alternative control options, including the use of semiochemicals for pest management.

HIGHLIGHTS OF THE RESEARCH

Pest Research

- Twenty-nine plant species were obtained from analysis of the gut contents of *Bathycoelia distincta* (two-spotted stink bug) highlighting the polyphagous nature of *this* insect pest. The high diversity of plant species detected early in the season suggests that migration occurs as soon as there is fruit to support population growth. The high relative abundance of *Pinus* spp. underscores its potential role as an overwintering host.
- *Pantoea bathycoeliae* sp. nov was described as the primary M4 gut symbiont of *B. distintca* based on the rules of the SeqCode. Removal of this species by means of surface sterilization using micronutrient fertilizers with antibacterial properties negatively affected the survival, development, and fitness of the treated nymphs, which suggest that it can be used as an alternative control option to manage stink bugs.
- Species distribution modelling of *Acanthococcus ironsidei* (Macadamia felted coccid; MFC) suggests that most macadamia growing regions are suitable for establishment, with some exceptions in the Eastern and Western Cape. The implementation of phytosanitary measures is therefore important to limit the spread of MFC to other growing regions in the country.

- Feeding trials using commercially available *Rhyzobius lophanthae* (ladybug), *Cryptolaemus montrouzieri* (ladybug) and *Chrysoperla zastrowi* (lacewing) suggests that lacewings can be a good biological control candidate for MFC.

Disease Research

- A high diversity of species within the *Botryosphaeriaceae*, all with the potential to cause branch dieback symptoms, was obtained from symptomatic and asymptomatic macadamia branches. A greater species diversity and isolation frequency was obtained from leaves compared to fruits and racemes, highlighting the important role that the species play in brown leaf blight.
- Results from inoculation trials under water stress and flooding showed an association between water stress and increased Botryosphaeria branch dieback disease expression.
- Several *Neopestalotiopsis* species, including some known to be dry flower disease causal agents were isolated from yellow halo leaf spot diseased leaves. Although these species were identified as weak or opportunistic pathogens and may not pose a significant threat as leave pathogens, leaves could act as a survival reservoir, potentially serving as an inoculum source for infecting flowers and contributing to the onset of dry flower disease.
- The *in vitro* efficacy of fungicides against flower blight causal agents showed that pydiflumetofen was the most effective inhibitor of mycelial growth and conidial germination of *Neopestalotiopsis macadamiae* and *Cladosporium cladosporioides*. Other fungicides also considered to be effective inhibitors include difenoconazole, boscalid, fludioxonil and chlorothalonil.
- The whole genome sequence of *N. macadamiae* was annotated and used as a reference genome for comparative analysis of additional flower blight causal agents (*N. drenthii*, *N. olumideae* and *N. zakeelii*) to gain insight into their mating strategy, pathogenicity, and trophic lifestyles. In addition, these genomes were also used to select gene regions for the development of a Loop-mediated isothermal amplification (LAMP) diagnostic tool.
- Fungal symbionts of *Euwallacea fornicatus*, *Xyleborus ferrugineus*, *Xylosandrus crassiusculus* and *Euplatypus parallelus* were confirmed as non-aggressive pathogens in macadamia tissue.

OUR IMPACT

- ***The research is aimed at generating knowledge that will assist in the development of improved pest and disease management programmes. The research is therefore solution orientated and translated to practical management solutions to growers.***
- ***Members of the group regularly interact with macadamia growers at region specific study groups and the annual macadamia grower symposium. We also share information with growers in the form of information fact sheets, best practise sheets, popular articles in the SAMAC journal and short research video updates on the SAMAC YouTube channel.***
- ***We offer diagnostic clinic and extension services to assist growers in managing insect pest and pathogens.***

Members of the MaPP team hosting international collaborator Prof. Olufemi Akinsanmi from University of Queensland, Australia

Mpho Matsetela at the Macadamia Protection Programme exhibition stand ready to talk to growers about macadamia pests and diseases and our services to industry

MOLECULAR PLANT PHYSIOLOGY

Research Leader: **Prof. Juan Vorster**

Team Member:
Prof. Karl Kunert

BACKGROUND

The MPP research group is working on two crucial challenges faced by farmers: drought resistance and herbicide resistance. Our group has a long history of working to understand the physiological responses and adaptations relating to drought stress and drought resistance in plants. In collaboration with various research partners in Italy and France, we are working on developing climate-resilient dry bean varieties adapted to local growing conditions. We are also working closely with local farmers and industry members to track and identify cases of herbicide resistance and identify the molecular mechanisms underlying these traits. Ultimately, we develop alternative management programmes for farmers and track the success of these programmes in controlling these weeds and preventing their spread.

OBJECTIVES OF THE RESEARCH PROGRAMME

- Evaluate dry bean lines under greenhouse and field conditions for drought resilience.
- Evaluate the effects of stress on the nutritional value of legume seeds.
- Monitor and evaluate cases of herbicide resistance in weeds.
- Determine the physiological mechanisms of confirmed cases of herbicide resistance in weeds.

Herbicide resistant *Amaranthus* in a maize field

Evaluating drought tolerance in dry beans

HIGHLIGHTS OF THE RESEARCH

- We evaluated several dry bean lines under drought stress conditions grown in different locations across South Africa and Italy.
- We evaluated the mineral content of the seeds of these trials and were able to show that drought did not alter the mineral content of the tested lines and that mutant lines with higher mineral content performed as well as commercial lines.
- We have identified several populations of *Amaranthus* (Pigweed) resistant to different herbicides.
- Together with farmers and industry partners, we are developing alternative management programmes to control herbicide-resistant weed populations.

OUR IMPACT

- ***The Molecular Plant Physiology programme works closely with industry partners to address herbicide-resistant weeds that threaten crop yields and food security.***
- ***Its research develops improved weed-control strategies designed to be healthier for the environment.***
- ***The programme investigates drought tolerance and its consequences for plant nutrition.***
- ***Insights from this work support both food security and nutritional security.***

PHYTOBACTERIOLOGY

Research Leader: **Prof. Teresa Coutinho**

Research Team:
Prof. Lindsey du Toit *(Department of Plant Pathology, Washington State University, USA)*
Prof. Theo Smits *(School of Life Sciences and Facility Management, ZHAW, Switzerland)*
Dr Pedro Lebre *(Centre for Microbial Ecology and Genomics, University of Pretoria)*

BACKGROUND

Plant pathogenic bacteria play a crucial role in agriculture and horticulture, as they can lead to significant economic losses and reduced crop productivity. While some bacterial species do not typically infect healthy plants, they can take advantage of weakened or stressed plants to establish infections. These opportunistic pathogens invade and cause disease when plant health is compromised. This programme primarily focuses on understanding how these bacteria cause disease in stressed hosts.

OBJECTIVES OF THE RESEARCH PROGRAMME

- Identify the causes of plant-associated and plant-pathogenic bacterial infections in agricultural crops.
- Analyse the bacterial community linked to bacterial rot in onion bulbs.
- Investigate the host shift of *Xanthomonas vasicola* pv. *vasculorum* from sugarcane to *Eucalyptus*.

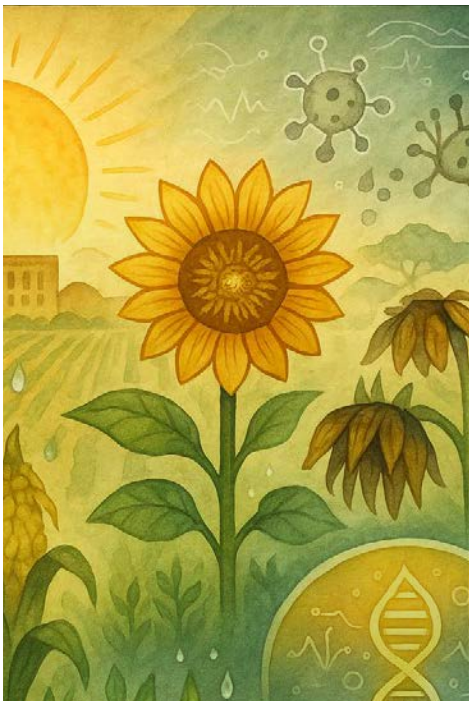
HIGHLIGHTS OF THE RESEARCH

- *Enterobacter ludwigii* was found to be the primary species in the genus responsible for causing bulb rot of onions.
- A novel species associated with onion bulb rot, *Ewingella allii,* was described.
- Metagenomics and 16s amplicon-sequencing community analysis were used to identify bacteria and viruses present in storage onion bulbs that were symptomatic and asymptomatic for bacterial bulb rot, from crops grown in the USA.
- Using comparative genomics, genetic determinants such as insertion sequences, genomic islands, recombination events, the type III secretion system and orthologous clusters were identified in *Xanthomonas vasicola* strains as potential contributors to host expansion and adaptation.

OUR IMPACT

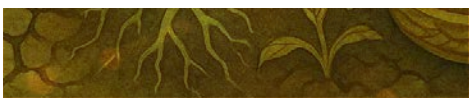
- ***Phytobacteriology research strengthens food security and sustainable agriculture by detecting and managing plant-pathogenic bacteria.***
- ***Results inform innovative disease-control solutions, including biocontrol interventions, development of disease-resistant crops, and precise bacterial management.***
- ***Insights into pathogen host shifts enhance biosecurity planning and early warning systems.***
- ***These advances help prevent disease outbreaks in both agriculture and forestry.***

Symptoms of bacterial bulb rot caused by *Ewingella allii*



02
RESEARCH REPORTS

GRAIN CROPS



APPLIED MYCOLOGY

Research Leaders: **Prof. Cobus Visagie • Dr Neriman Yilmaz**

Research Team:
Prof. Pedro Crous
Prof. Bernard Slippers
Prof. Emma Steenkamp
Prof. Brenda Wingfield
Prof. Mike Wingfield

BACKGROUND

Fungi play an important role in many aspects of human life, e.g., as decomposers in the carbon cycle and in the production of food and drinks. Many species produce useful medicines or enzymes. Despite these benefits, fungi can also present significant challenges for humans, animals and plants. One of the most critical concerns is the production of various mycotoxins in food and feed, which cause serious health problems, including immune suppression, organ damage, and carcinogenic effects in both humans and animals when consumed above critical limits. Mycotoxin contamination impacts the entire food chain from producers to consumers, posing a significant risk to food safety and security, directly threatening the United Nations Sustainable Development Goal 2 (SDG2) to end hunger by 2030.

We aim to describe fungal biodiversity across South Africa, with a focused effort on understanding where species occur, as well as their function and impact. We specialise in important genera like *Aspergillus*, *Fusarium*, *Penicillium* and *Talaromyces*, but also study many others.

Fungal colonies of (A) *Fusarium*, (B) *Penicillium* and (C) *Aspergillus*

During surveys, we isolate, preserve and identify fungi using modern taxonomic approaches. For key species, we also determine their secondary metabolite profiles and generate whole genome sequences.

This workflow helps expand biodiversity resources available to South African researchers. Ultimately, our goal is to safeguard food and feed from farm to fork for future generations, ensuring resilient agricultural systems and food security in a changing climate.

OBJECTIVES OF THE RESEARCH PROGRAMME

- Determine where fungal species occur across South Africa.
- Complete taxonomic revisions of important fungal genera, like *Aspergillus*, *Fusarium* and *Penicillium*.
- Expand biodiversity resources such as culture collections or biobanks.
- Develop novel culture-independent methods to better characterise fungal microbiomes at large scale.

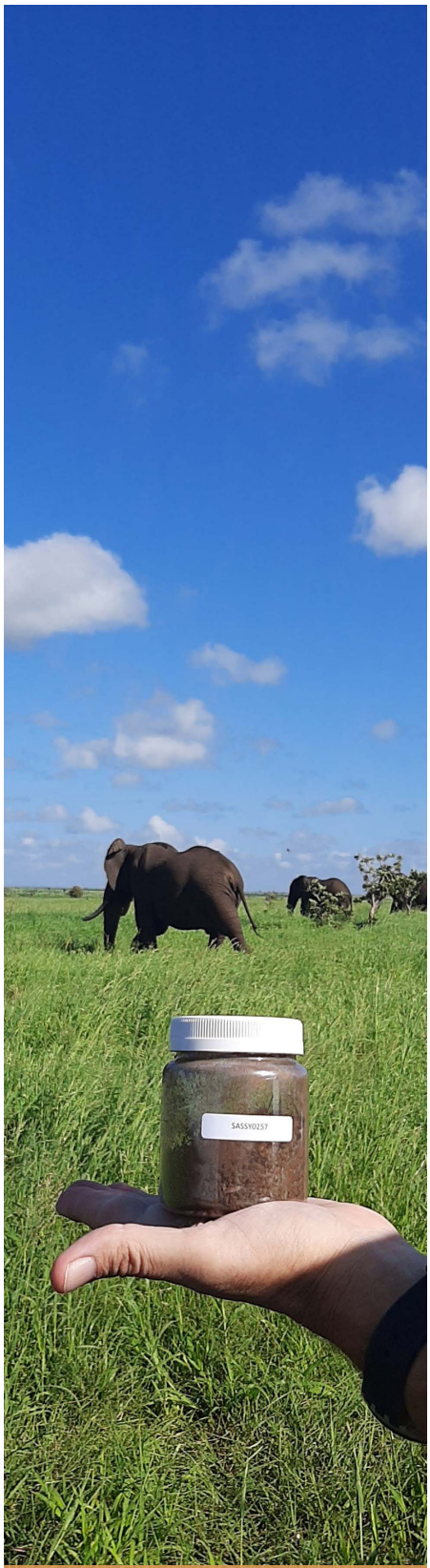
- Study genomes, transcriptomes and secondary metabolites to better understand why, when and how specific species produce mycotoxins.

HIGHLIGHTS OF THE RESEARCH

- Prof. Cobus Visagie and Dr Neriman Yilmaz are part of an international project, Mycobiomics, funded by the Marie Skłodowska-Curie Actions Research and Innovation Staff Exchanges (MSCA-RISE). The project allows research teams from Asia, Africa and Europe to explore fungal communities for potentially useful metabolites and biological control agents using 'omics' techniques. FABI hosted several researchers and students from Germany, the Netherlands, Austria and Czech Republic, while FABIans also spent time in Europe at these partner labs.
- A new partnership was launched on 8 May 2023 between the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria and Milk South Africa (Milk SA) to study Sporidesmin-induced liver disease (SILD) in dairy cattle in the Eastern Cape province of South Africa. The disease is commonly referred to as facial eczema, which is a liver disease rather than a skin disease caused by the mycotoxin sporidesmin, which is produced by the fungus *Pseudopithomyces toxicarius* (previously thought to be *P. chartarum*).
- A collaboration between FABI and Hexagon Bio (USA) resulted in whole genomes sequenced for 7971 strains that represent 10 classes, 38 orders, 7 families, 247 genera and ~1000 species. Many belong to plant pathogens or new species and will serve as important references for future studies.

OUR IMPACT

- ***Food safety and security:*** *Mycotoxins pose significant risks to food production and safety. Research identifying which fungal species produce these toxins and under what conditions allows for the development of effective prevention strategies. This work directly supports global initiatives to ensure food security, including the United Nations Sustainable Development Goal of ending hunger by 2030.*
- ***Economic implications:*** *Mycotoxin contamination results in substantial economic losses throughout the agricultural sector. By developing improved management practices through research, these financial impacts can be significantly reduced, benefiting producers and consumers alike.*
- ***Addressing global challenges:*** *Fungi is expected to play a significant role in addressing several global challenges, including climate change, food insecurity, environmental pollution, and biodiversity loss. Access to fungal cultures provides researchers the opportunity to study which of these fungi can help solve some of our greatest challenges.*



The South African Soil Survey (SASSY) aims to characterise the soil fungal communities across South African nature reserves – this sample was taken in the Kruger National Park

CROP FLORAL BIOLOGY AND ENVIRONMENTS (CFBE)

Research Leader: **Dr Nicky Creux**

Research Team:
Prof. Emma Archer *(Department of Geography, UP)*
Prof. Almuth Hammerbacher
Dr Markus Wilken
Dr Gert Ceronio *(Department of Soil, Crop and Climate Sciences, UFS)*
Dr Dirk Swanevelder *(Biotechnology platform, ARC)*
Deon du Toit *(Grain Crops, ARC)*

BACKGROUND

The Crop Floral Biology and Environments (CFBE) programme was established in 2019 with a major focus on understanding how changing environments will affect crop floral biology, pollination and ultimately yield. The programme has grown rapidly over this period and has expanded the focus to understanding the broader effects of climate on crop plant development, pathogen load and yield. This multi-disciplinary programme has brought together meteorologists, agronomists, biotechnologists, engineers and plant biologists to provide a holistic view of plant-environment interactions. The growing connections with local and international university and industry partners have provided a strong basis from which to explore the important questions facing agriculture in light of climate change.

OBJECTIVES OF THE RESEARCH PROGRAMME

- To investigate floral adaptations to heat stress on the physiological and molecular level.
- To investigate the regulatory mechanisms underlying a flower's response to temperature and how these can be harnessed to protect flowering and pollination from extreme weather events such as heatwaves.
- To identify the factors associated with agricultural practices, such as planting date, which alter the climate under which a crop is grown and assess how these changes might affect crop development, pollination and yield.
- To predict the local effects of climate change on crop development and yield in South Africa and the impact on plant health and pathogen load.

The difference a planting date can make: Two different planting dates in a trial at Bloemfontein, Free State, South Africa where the earlier planting date shows significant drought effects and the next planting date one month later is faring better

HIGHLIGHTS OF THE RESEARCH

- Sclerotinia head rot is a critical disease for the sunflower industry, we show that aligning flowering with the hottest period of the summer can limit disease progression in the sunflower head as long as the high temperatures are consistently above 27°C. This work highlights the complexities of controlling this devastating disease by agricultural practices alone (published in Plant Pathology).
- We report the first incidence of Bidens mottle virus on Sunflower in South Africa, which is only the second report of a natural infection of this disease on sunflower. In an open field study, we show this virus can severely limit yield production in infected plants and should be monitored by the industry for spread (published in Plant Pathology).
- We have identified several mechanisms by which sunflower can adapt its flowers to maintain pollination and seed production during heat wave events. Juvenile sunflowers that are exposed to a heat wave will "remember" this heat stress and at flowering produce flowers that are better able to receive pollen and produce seed. If sunflower florets are directly exposed to a heat wave they can shift the timing of pollen emergence to earlier in the morning, which helps them avoid the hottest part of the day and maintains synchronicity with their pollinators.
- We conducted a historical climatic survey across the agricultural district of South Africa in Mpumalanga, North West and Free State provinces and show that over the last 30 years these districts have generally become hotter and drier but there are differences across districts suggesting down scaled climate models will be more helpful to the farmers with boots on the ground (Published in Applied Climatology).
- Our climate change projection models were used to explore how planting dates of short and medium maturing maize varieties might be affected by climate change in the next century. We show that the optimal planting date of mid-December (typical for several regions of South Africa) will in the future expose maize crops during flowering to the largest number of days above 35°C threatening production. It is critical that industry monitor planting dates regularly to ensure maize life cycles are aligned with appropriate weather conditions to maintain yields in the future (Published in Agricultural and Forestry Meteorology).

CFBE team member harvesting heat treated sunflower florets for physiological measurements to understand how heat stress affects the flowering process

OUR IMPACT

- *The Crop Floral Biology and Environments (CFBE) programme advances climate-resilient agriculture.*
- *CFBE participates in the Climate Resilience Consortium (Grain SA) and aligns research with industry needs, focusing on factors that drive poor yields at late planting dates.*
- *Because most South African farming is rain-fed with limited irrigation, dry years delay planting and depress yields; CFBE identifies constraints on late-planted crops and tailors agronomic practices to mitigate these losses.*
- *Within the South African Sclerotinia Research Network (Grain SA), CFBE addresses Sclerotinia head rot in sunflower by quantifying how practices such as planting date influence disease severity and by evaluating control strategies when planting dates cannot be changed.*
- *CFBE conducts foundational research on floral responses to environmental stress at physiological and molecular levels to identify heritable traits.*
- *These insights enable breeding for floral thermotolerance, safeguarding seed production, yields, and broader food security.*

MOLECULAR PLANT-PATHOGEN INTERACTIONS (MPPI)

Research Leader: **Prof. Dave Berger**

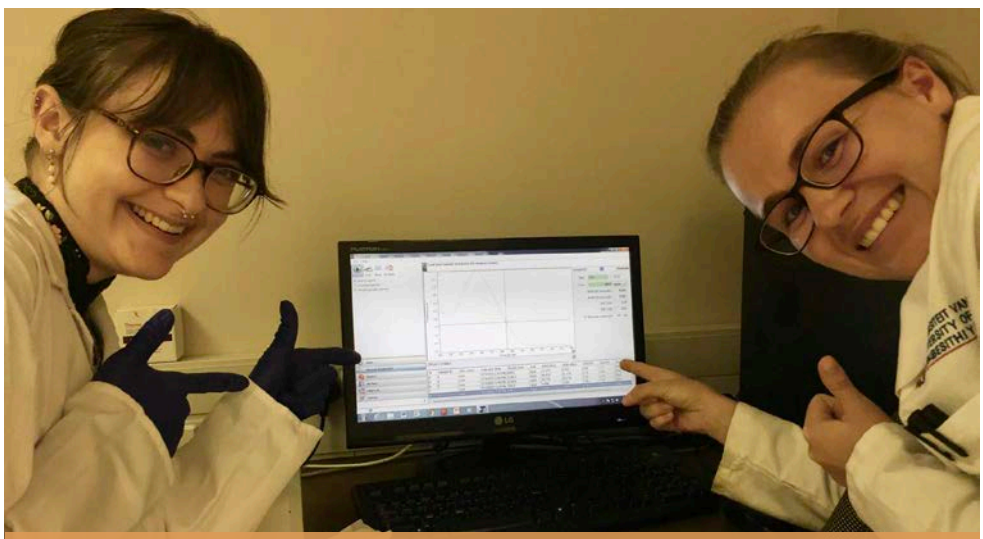
Research Team:
Prof. Irene Barnes
Prof. Tuan Duong
Prof. Cobus Visagie
Dr David Nsibo
Prof. Mathews Dida *(Maseno University, Kenya)*
Prof. Ingo Hein *(James Hutton Institute, University of Dundee, Scotland)*
Prof. Eva Stukenbrock *(Max Planck Institute for Evolutionary Biology and University of Kiel, Germany)*
Prof. Jacques Theron *(Department of Biochemistry, Genetics and Microbiology, University of Pretoria)*
Prof. Yves Van de Peer *(VIB and Ghent University, Belgium)*
Dr Simo Maduna *(NIBIO, Norway)*
Dr Suresh Mahabaleswara *(CIMMYT, Kenya)*

BACKGROUND

The MPPI research group conducts collaborative research on crop diseases of economic importance in Africa and globally. The main research focus is grey leaf spot (GLS) disease in maize. This pathosystem is used as a research model to understand molecular mechanisms of plant host resistance and fungal pathogenicity. The goal is to develop sustainable management strategies for long-term food security. MPPI is also deploying expertise developed in the agricultural projects towards a genomics project on the biodiversity conservation of the medicinally-important tree genus *Greyia*, endemic to South Africa.

OBJECTIVES OF THE RESEARCH PROGRAMME

- Understanding maize resistance to GLS disease.
- Determining molecular mechanisms of pathogenicity in the GLS pathogen *Cercospora zeina*.
- Tracing the origins and population diversity of *C. zeina* in Africa.
- Developing diagnostics and RNA-based control methods for maize foliar diseases.
- Collecting foundational biodiversity and genetic data on the *Greyia* tree genus.



MPPI lab members Jana Botes and Iné Botha celebrating quality RNA extraction from *Greyia* after troubleshooting

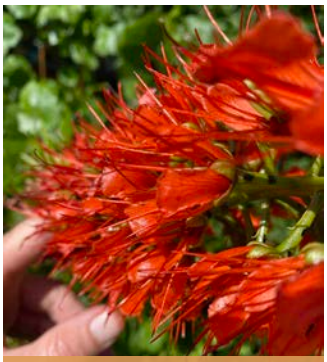
HIGHLIGHTS OF THE RESEARCH

- Genetic markers for resistance to two leaf diseases of maize were identified in tropical maize. This will boost maize breeding efforts by CIMMYT in East Africa to support food security in the region.
- Treatment of maize leaves with RNA targeting genes of the fungal pathogen resulted in grey leaf spot disease control – this is a step towards RNA fungicides, a "green chemistry" solution for crop protection.
- Comparing thousands of DNA markers between fungi causing grey leaf spot disease of maize in five countries in Africa revealed distinct populations in East and Southern Africa. This highlights the need for region-specific breeding programmes.
- Gene editing is an emerging technology that can accelerate breeding of climate-smart crops. A quantitative analysis of research outputs and patents showed that uptake of the technology in Africa needs to be boosted. An opinion piece in Nature Biotechnology and accompanying Policy Brief with the African Union Development Agency for the AU parliament outlined priority actions.
- Governments around the world are grappling with developing regulatory policies for gene and genome editing, especially cases where these methods offer a fast-track plant breeding solution without inclusion of foreign DNA. FABI researchers are not only employing gene editing in their research but also advocating for a science-based policy framework for gene editing products in South Africa.

OUR IMPACT

- *Maize underpins food and feed security in South Africa. Research done in the MPPI group contributes to the first stage of the "farm to fork" pipeline by improving on-farm maize production. The research supported by the Grain industry in South Africa is focused on grey leaf spot disease of maize caused by the fungus Cercospora zeina, which is a threat throughout sub-Saharan Africa.*
- *Two main strategies are employed to manage the disease at farm level – planting resistant cultivars and spraying fungicides. Genetic mapping of maize disease resistance genes in Kenya contributed DNA markers for development of resistant cultivars for farmers in East Africa where fungicide control is seldom used. As part of this research supported by the British Society for Plant Pathology, a booklet on maize leaf diseases was developed and translated into Swahili for farmers in Kenya.*
- *Work on novel "fungicides" such as an RNA-based control of grey leaf spot disease is fundamental research that will lead eventually to environmentally friendly crop protection. This research was selected by the British Society for Plant Pathology for the blog post: "RNA interference – the next frontier of "green chemistry" fungicides?"*
- *Future breeding solutions to crop diseases such as grey leaf spot will be developed using genome editing. It is therefore essential that African scientists contribute to the development of this emerging technology and support their governments in developing robust and innovation-friendly policy to benefit society.*
- *Prof. Dave Berger wrote the chapter "Diseases of maize/corn" in the 6th Edition of "Agrios' Plant Pathology", Academic Press, Netherlands, which is a popular text for plant pathology researchers, students and crop protection managers worldwide.*

Prof. Dave Berger on sabbatical labwork at James Hutton Institute, UK with Prof. Ingo Hein, Extra-ordinary Professor, FABI and Department of Plant and Soil Sciences, UP



Pollinating *Greyia* flower for genetic analysis

Greyia seed pods after successful pollination

Sampling *Greyia* trees in the Drakensberg – Nkosinathi Ndaba, Iné Botha, Jana Botes

NATIONAL GRAIN RESEARCH PLATFORM (NGRP)

Research Leaders: **Prof. Cobus Visagie • Dr Nicky Creux**

Research Team:
Prof. Dave Berger • Prof. Martin Coetzee • Prof. Tuan Duong • Prof. Almuth Hammerbacher Prof. Brett Hurley Prof. Tjaart Krüger • Prof. Bernard Slippers • Prof. Emma Steenkamp • Prof. Albé van der Merwe Prof. Juan Vorster • Prof. Brenda Wingfield • Dr Nickey Creux • Dr Lieschen de Vos • Dr David Nsibo Dr Honest Machekano • Dr Robert Mangani • Dr Thabiso Motaung • Dr David Read • Dr Markus Wilken Dr Neriman Yilmaz

BACKGROUND

The National Grain Research Platform (NGRP) supports the national grain and oilseed industry through research and innovation with the vision to: 1) strengthen collaboration between government, industry and local universities or research institutes; 2) increase engagement between grain and oilseed industry stakeholders; and 3) promote industry-relevant, outcomes-based research. The NGRP is a national programme that currently involves the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria, North-West University (NWU), University of the Free State (UFS), Stellenbosch University (SU), Grain South Africa (Grain SA), South African National Seed Organisation (SANSOR), Maize Trust, Department of Science and Innovation (DSI), and Department of Agriculture, Land Reform and Rural Development (DALRRD).

The NGRP uses key expertise to build and lead research initiatives to deliver basic and solution-oriented research, which in turn forms the basis for innovation in South Africa's agricultural sector. At FABI, a diverse trans-disciplinary team of research leaders contribute to the research effort. Our main research themes include agronomy, biosecurity, pest and disease diagnostics and control, plant physiology, plant phenotyping, soil microbial surveys, and weed science.

The pest and disease extension and diagnostic clinic was established during the 2020/21 growing season and has since made ±5000 fungal, bacterial and viral and ±10000 insect collections across South African farms. This collection data is captured in the Information Hub hosted by Innovation Africa @UP, which offers a cloud-based digital tool to safely and effectively collect and collate information, add value to connected data (interdisciplinary), and produce useable outputs from it (broad user community). In the process, we collect valuable information regarding the distribution and severity of diseases and infestations across the country contributing to biosecurity and surveillance in the country. As a collective, this information is invaluable to direct research efforts and resources to address current problems and pre-emptively future problems.

OBJECTIVES OF THE RESEARCH PLATFORM

- Strengthen collaboration between government, industry and local universities or research institutes.
- Increase engagement between grain and oilseed industry stakeholders.
- Promote industry-relevant, outcomes-based research.
- Provide pest and disease extensions and diagnostic services.

NGRP students measuring crop physiology

HIGHLIGHTS OF THE RESEARCH

- Annual research days for the programme were held at Stellenbosch University (3-4 April 2023), University of the Free State (3-5 April 2024) and North-West University (18-20 March 2025). These meetings provided an opportunity to showcase grain research from partner research institutes and to have open discussions with industry and government on the research directions and priorities needed to address the major challenges related to grain production in the country.
- A network of sentinel plot projects has anchored monitoring efforts in strategic locations across South Africa, which adds to data collected during the normal GRP pest and disease extensions and diagnostic clinic activities.
- The GRP pest and disease extension and diagnostic clinic played a key role in the first identification of the bacterium *Clavibacter nebraskensis* causing Goss's wilt (sometimes referred to as Goss's leaf blight) in South African maize during the 2023/24 season. The team formally notified DALRRD about the detection, served on the subsequent steering committee, and prepared a scientific publication on the topic with collaborators from the Plant Disease Clinic at Stellenbosch University.
- GRP collaborations played a crucial role in the first report of Bidens mottle virus on sunflower in South Africa and only the second report of a natural infection globally. DALRRD was informed and the threat was assessed and found to be limited.
- The clinic strengthened its partnership with the Ukhanyo Farmer Development (UFD) programme, a non-profit organisation that helps to commercialise its network of >2000 small-scale rural farmers in the Eastern Cape. Our goals are to connect farmers with researchers, provide a platform to access existing pest and pathogen data and empower them to help record data of these.
- Help farmers to efficiently survey and report pests and diseases from their fields in real time.
- GRP team members assessed the current impact of climate change across maize producing regions of South Africa showing most districts are already hotter than 30 years ago and the study showed district level climate assessments would be more appropriate for guiding farmers in mitigation strategies.
- We show that under future climate change projections the current optimal crop planting dates will expose plants, particularly during the flowering period, to extreme high temperatures and will threaten yields in the future. We suggest, regular monitoring of planting windows as climate change progresses to help mitigate the impact on yields in the future.

OUR IMPACT

- ***Enhanced collaboration and innovation:*** *By fostering collaboration between government, industry, and academia, the NGRP can lead to more effective and targeted research, driving innovation in the grain and oilseed sectors.*
- ***Improved crop yields and quality:*** *Research in agronomy, plant physiology, and pest and disease diagnostics can help develop more resilient and productive crop varieties, enhancing overall crop yields and quality.*
- ***Better disease management:*** *The establishment of a pest and disease extension and diagnostic clinic provides valuable insights into disease distribution and severity, enabling more effective disease management strategies.*
- ***Food security:*** *Improved crop yields and disease management can enhance food availability, contributing to national food security.*
- ***Biosecurity:*** *The establishment of sentinel plots and diagnostic clinics helps in early detection and management of pests and diseases, reducing the economic impact of outbreaks.*

NGRP students preparing for drone imaging

NGRP students in the field

PLANT VIROLOGY

Research Leader: **Dr David Read**

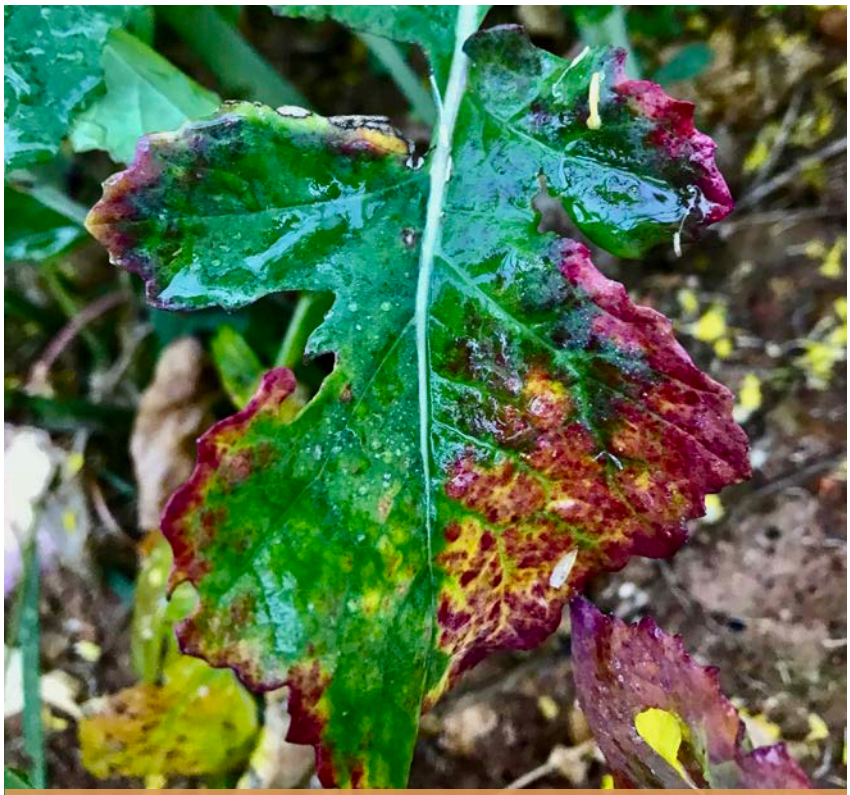
Research Team:
Prof. Bernard Slippers
Prof. Emma Steenkamp
Prof. Gerhard Pietersen *(Patho Solutions, Wellington, Western Cape)*
Dr Lindy Esterhuizen *(Agricultural Research Council – Plant Health and Protection)*

BACKGROUND

Viruses represent a highly diverse group of biological entities, many of which interact with plants through complex mechanisms. Their obligate parasitic lifestyles often result in negative metabolic outcomes for the host. While many plant virus infections are cryptic and symptomless, others can cause significant economic losses in agriculturally important crops. Accurate identification of the causal agent, along with an understanding of transmission mechanisms, is essential for the effective management of plant viral diseases. One of the major challenges historically faced by plant virologists has been the lack of tools to rapidly detect and characterise novel viral pathogens. However, the advent of high-throughput sequencing (HTS) has revolutionized the field, enabling rapid and comprehensive profiling of plant viral communities. With the surge in viral diversity uncovered by HTS, new challenges have emerged: establishing causal links between viral presence and disease symptoms, and understanding the transmission dynamics of newly discovered viruses and novel host-virus combinations. The Plant Virology Group (PVG) employs both advanced and conventional technologies to address these challenges and to drive innovation in plant virology research - particularly in ways that support South African agriculture.

OBJECTIVES OF THE RESEARCH PROGRAMME

- Characterise viral populations associated with crops using metaviromics approaches.
- Implement diagnostic assays - based on PCR or immunological tests - for detecting new viral incursions in South Africa.
- Screen local germplasm of selected crops for potential resistance to economically significant viruses.
- Contribute to South Africa's biosecurity efforts through the rapid identification of quarantine pathogen incursions, and support governmental departments in their subsequent management.
- Develop human capacity and strengthen plant virology expertise through postgraduate training and internship programmes.



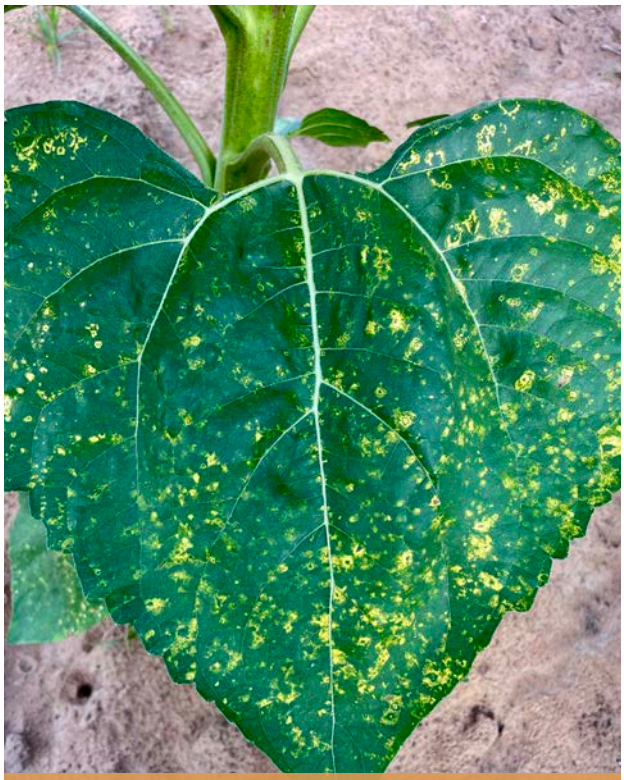
Turnip yellows virus infection of canola in the Western Cape

HIGHLIGHTS OF THE RESEARCH

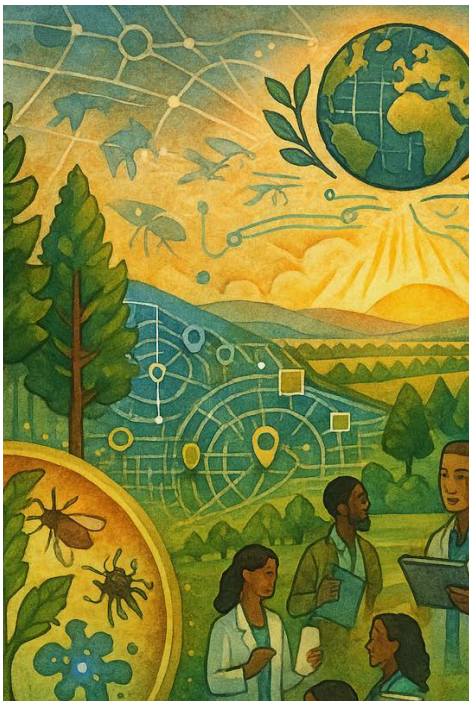
- The detection of Pepper ringspot virus (PepRSV) in sunflower (a newly identified host) during the previous reporting period was a significant finding, given the virus's quarantine status at the time and its economic impact on potato. This discovery led to the inclusion of PVG members in a national task team overseeing research on the pathogen. It also spurred the expansion of the Sunflower Virology Project, primarily funded by the Department of Agriculture (DoA) via the Agricultural Research Council (ARC). As a result, strong collaborative ties have developed between the PVG, FABI, and ARC, and further support has been secured for research on other nationally important viral pathogens.
- The PVG has a long-standing relationship with Macadamias South Africa (SAMAC). Through various collaborations, the first standalone virology project has now been launched between PVG and SAMAC. The project aims to determine the transmission routes of the recently described Macadamia ringspot-associated virus.
- During the reporting period, the PVG published nine peer-reviewed articles and celebrated the completion of four postgraduate degrees. There are currently 11 registered postgraduate students directly affiliated with the group.

OUR IMPACT

- ***The Plant Virology group contributes to protecting South African agriculture by enabling rapid, accurate detection and identification of plant viruses, preventing major yield losses and bolstering national food security.***
- ***High-throughput sequencing surveillance, coordinated together with the ARC and the Department of Agriculture, strengthens biosecurity by flagging quarantine incursions early and enabling swift containment.***
- ***Diagnostic application and causal-agent identification support national compliance with phytosanitary standards, safeguarding export markets and the domestic movement of plant material.***
- ***Clarifying vector transmission routes informs targeted, evidence-based control strategies that reduce unnecessary pesticide use and lower production costs.***
- ***Screening local germplasm underpins clean-plant programmes, delivering virus-free cultivars suited to South African conditions and resilient to climate change.***

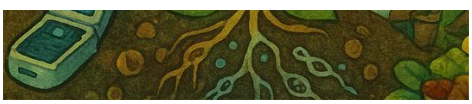


Symptoms associated with pepper ringspot virus (PepRSV) on sunflower



03
RESEARCH REPORTS

FORESTRY



DSTI/NRF SARCHI CHAIR IN FUNGAL GENOMICS

Research Leader: **Prof. Brenda Wingfield**

Research Team:
Prof. Irene Barnes
Prof. Martin Coetzee
Prof. Tuan Duong
Prof. Almuth Hammerbacher
Prof. Bernard Slippers
Prof. Emma Steenkamp
Prof. Albé van der Merwe
Prof. Cobus Visagie
Prof. Mike Wingfield
Dr Lieschen de Vos
Dr Nam Pham
Dr Markus Wilken
Dr Andi Wilson
Dr Neriman Yilmaz

BACKGROUND

The study of fungal genetics has advanced rapidly with the availability of numerous fungal genome sequences, firmly establishing the field within modern genomics. This wealth of genetic data has transformed our ability to investigate fundamental questions about fungal biology that were previously unanswerable. Fungi are dynamic biological systems, and new plant pathogens are constantly emerging. By building on tools developed through prior research, we can now detect and manage these pathogens more effectively, using an expanding range of genomic and molecular technologies. The SARChI Chair in Fungal Genomics has pioneered innovative techniques to assess the risks these pathogens pose to forests and forestry. A critical aspect of this research is understanding how newly discovered fungal pathogens relate to known species. By analysing their genetic diversity and population structure, researchers can determine whether these pathogens were introduced from other regions or have evolved from native species. These insights are essential for mapping global pathogen movement and understanding how some fungi adapt to infect new hosts. Through cutting-edge genomics, the SARChI Chair in Fungal Genomics contributes to safeguarding forests by improving disease detection, tracking pathogen spread, and developing strategies for sustainable forest management.

OBJECTIVES OF THE RESEARCH PROGRAMME

Our research focuses on understanding how fungal pathogens that affect trees spread and evolve worldwide. These fungi provide valuable insights into key biological questions, such as how they reproduce, their genetic makeup, how they cause disease, and their resistance to fungicides. To study these issues, we use a variety of scientific methods, including DNA analysis, genetic studies, and advanced molecular tools like CRISPR-Cas gene editing.

HIGHLIGHTS OF THE RESEARCH

- First report of two fungal pathogens, *Chrysoporthe doradensis* and *Chrysoporthe colombiana*, infecting the tree species *Henriettea seemannii* in Colombia. These fungi could have significant impacts on tree health in the region.
- Identification of genetic factors controlling reproduction in *Elsinoe* species, a group of fungi responsible for scab diseases in plants. Understanding these genes may help develop better disease management strategies.
- Discovery of multiple *Calonectria* fungal species causing disease in *Eucalyptus* plantations in China. These findings are important for protecting commercial forestry from emerging fungal threats.
- Expansion of whole-genome sequencing (WGS) data for important tree pathogens and related fungi. This genetic information helps scientists understand how these fungi spread and cause disease, aiding in future control methods.
- Development of a practical method for assembling and analysing the complete genetic material of basidiomycete fungi. This approach makes it easier for researchers to study complex fungal genomes.
- Investigation of how fungi reproduce by studying mating pheromone genes in *Huntiella*. This research helps explain how fungi exchange genetic material and adapt to new environments.
- Discovery of a previously unknown pheromone in *Leotiomycetes*, a group of fungi that includes plant pathogens. This finding contributes to our understanding of fungal communication and reproduction.

- A detailed review of mycoviruses - viruses that infect fungi - and their potential impacts on fungal behaviour and disease development. These viruses could be used as a natural method to control harmful fungi.
- Identification and genetic analysis of mycoviruses found in *Ceratocystidaceae*, a family of fungi that includes serious plant pathogens. Studying these viruses may reveal new ways to weaken fungal diseases.
- Development of a rapid and simple diagnostic test (LAMP assay) for detecting *Fusarium circinatum* and *Elsinoe necatrix,* two fungi that cause serious plantation tree diseases. This test will help in early detection and management of infections.
- Discovery that a fungal pathogen, *Fusarium circinatum*, grows toward pine root extracts in response to a chemical signal. This finding sheds light on how fungi locate and infect their host plants, which may help in developing targeted disease prevention strategies.

OUR IMPACT

The research conducted DSTI/NRF SARChI Chair in Fungal Genomics program has significant implications for both society and industry, particularly in the fields of agriculture, forestry, and environmental management.

- ***Protecting forest ecosystems and commercial plantations:*** *The discovery of* Chrysoporthe doradensis *and* Chrysoporthe colombiana *as pathogens in Colombia is crucial for tree conservation efforts. By identifying these fungi early, forest managers can implement strategies to mitigate their spread, preserving biodiversity and preventing large-scale tree loss. Similarly, the identification of multiple* Calonectria *species affecting* Eucalyptus *plantations in China provides essential knowledge for commercial forestry. This research supports the development of targeted disease management strategies, ensuring the sustainability of eucalyptus-based industries, which are vital for paper and timber production.*
- ***Advancing crop disease management:*** *Understanding the genetic factors controlling reproduction in* Elsinoe *species, which cause scab diseases in plants, paves the way for improved crop protection strategies. This knowledge can lead to the breeding of disease-resistant plant varieties and the development of more effective fungicides, benefiting agricultural productivity and food security.*
- ***Enhancing disease diagnostics and control:*** *The development of a rapid LAMP assay for detecting* Fusarium circinatum *and* E. necatrix *has direct applications in agriculture and forestry. Early and accurate diagnosis of these harmful fungi allows for quicker intervention, reducing crop losses and improving yield stability. This tool is particularly beneficial for farmers, forestry professionals, and plant health regulators.*
- ***Expanding genomic resources for fungal research:*** *The expansion of whole-genome sequencing (WGS) data for tree pathogens and related fungi provides a valuable resource for scientists studying fungal diseases. This genetic information enhances our understanding of pathogen evolution, transmission, and resistance mechanisms, ultimately leading to more effective disease management solutions.*
- ***Innovations in fungal biology and reproduction:*** *Research into fungal mating pheromones, including the discovery of a new pheromone in* Leotiomycetes *and reproductive strategies in* Huntiella*, improves our understanding of fungal lifecycle dynamics. These findings can influence biotechnology applications, such as the controlled cultivation of beneficial fungi for industry or the disruption of pathogenic fungi's reproductive cycles to limit their spread.*
- ***Harnessing mycoviruses for biological control:*** *The comprehensive review and genetic analysis of mycoviruses highlight their potential as natural biocontrol agents against harmful fungal pathogens. By leveraging mycoviruses to weaken or suppress disease-causing fungi, industries can reduce reliance on chemical fungicides, leading to more sustainable and environmentally friendly disease management practices.*
- ***Understanding fungal-plant interactions:*** *The discovery that* F. circinatum *responds to chemical signals from pine roots provides insight into how fungal pathogens locate and infect host plants. This knowledge can contribute to the development of novel disease prevention strategies, such as breeding trees with altered chemical profiles to reduce susceptibility to infection.*

In summary, our research has far-reaching benefits for society and industry by improving disease detection and management, supporting sustainable forestry and agriculture, and advancing scientific knowledge on fungal biology. These contributions help protect ecosystems, enhance food and timber security, and promote environmentally responsible disease control methods.

FOREST MOLECULAR GENETICS (FMG) RESEARCH GROUP AND THE EUCALYPTUS AND PINE PATHOGEN INTERACTIONS (EPPI) RESEARCH GROUP

Research Leader: **Prof Sanushka Naidoo**

Research Team:
Prof. Bernard Slippers
Prof. Almuth Hammerbacher
Prof. Emma Steenkamp
Prof. Albé van der Merwe
Prof. Brenda Wingfield
Prof. Mike Wingfield
Prof. Zander Myburg *(Department of Genetics, University of Stellenbosch)*
Dr Nanette Christie *(Department of Genetics, University of Stellenbosch)*

BACKGROUND

The Forest Molecular Genetics (FMG) Research Group and the Eucalyptus and Pine Pathogen Interactions (EPPI) Research Group are dedicated to advancing the scientific understanding of forestry genetics and plant-pathogen interactions. Both groups operate within the broader scope of sustainable forestry, utilising cutting-edge molecular biology, genetics, and bioinformatics approaches to improve tree health, productivity, and resilience.

The FMG programme focuses on the genetic improvement of *Eucalyptus* and Pine, by studying molecular and genetic traits underlying wood and growth properties. The research integrates genomics, quantitative genetics, and biotechnology to improve tree breeding programmes, improve stress tolerance, and optimize growth characteristics. The EPPI programme specialises in understanding plant-pathogen interactions affecting *Eucalyptus* and Pine plantations. With a particular emphasis on fungal and bacterial diseases, the research within this group uses molecular diagnostics, pathogen genomics and host resistance studies to develop effective disease management strategies for forestry.

Both programmes contribute to enhancing the competitiveness of the South African forestry landscape and in 2024, these programmes merged to become the FMG-EPPI programme which is led by Prof. Sanushka Naidoo.

OBJECTIVES OF THE RESEARCH PROGRAMME

- Genetic Improvement of *Eucalyptus* and Pine – Enhancing wood and growth properties through molecular and genetic studies by utilising genomics, quantitative genetics and advanced biotechnology research methods.
- Understanding Plant-Pathogen Interactions – Investigating how fungal and bacterial diseases affect *Eucalyptus* and Pine plantations.
- Developing Disease Management Strategies – Using molecular diagnostics, pathogen genomics, and host resistance studies to enhance disease control in forestry.

HIGHLIGHTS OF THE RESEARCH

- A new genotyping technology (Flex-seq) for haplotype-based breeding in *Eucalyptus* was developed. This technology can be used to identify gene variants (haplotypes) that are linked to woody biomass traits.

- Work was done by Dr Christie to demonstrate how the Pitro50K SNP chip can identify pine species and hybrids, underscoring its value for future breeding decisions.
- Prof. Myburg's team received the Oxford Nanopore PromethION P2Solo instrument in May 2023; this is the first of its kind on the African continent. The instrument will support a new genome sequencing project for tropical pines and will be used to sequence the genomes of 96 reference *E. grandis* individuals from South African breeding populations.
- The draft Black wattle genome assembly that contains an estimated 95% of the gene space was completed.
- Developments were made in a FT-IR model for predicting disease resistance in *Eucalyptus*, with an initial 75% confidence in distinguishing resistant and susceptible genotypes.
- Successfully developed and optimized the *Eucalyptus* hairy root transformation system in *E. nitens* and this could enable future functional genetic testing of candidate defence genes.
- A qPCR assay to determine the fungal load of *F. circinatum* in pine seedlings as a proxy for resistance against the pathogen was developed. This showed promising results for phenotyping experiments.
- In February 2023, Prof. Naidoo and her team performed in-field *C. austroafricana* inoculations of 4 000 *E. grandis* x *E. urophylla* backcross ramets, representing 200 progeny. Stem tissue was harvested from 1 200 ramets to investigate in-field responses. The team returned in May 2023 to score the remaining 2 800 ramets to generate in-field resistance phenotypes for the population for comparison with nursery phenotyping of the same population.

OUR IMPACT

- ***The Forest Molecular Genetics (FMG) and Eucalyptus and Pine Pathogen Interactions (EPPI) programmes create strong pathways for student development and industry collaboration.***
- ***A partnership with the University of Venda delivered hands-on training in forestry biotechnology to Wendy Zulu and Mpho Mudau (2023), and Faith Nethononda, Amos Muhwandavaka, and Lutendo Makekemba (2024).***
- ***In 2024, Joshua King and Marli Pretorius joined FMG–EPPI as Sakata Seed–sponsored interns, deepening industry–academic ties.***
- ***The group contributes to global plant-health and food-security dialogues; Prof. Naidoo served as a panelist at the International Day of Plant Health meeting at Future Africa (May 2023), discussing innovation, food-security challenges, regulatory frameworks, and capacity development.***
- ***These activities ensure the research both advances science and informs policy and industry strategy for sustainable plant-health management.***

RGE-FABI TREE HEALTH PROGRAMME

Research Leader: **Prof. Mike Wingfield**

Research Team:

Based at FABI
Prof. Irene Barnes
Prof. Brett Hurley
Prof. Bernard Slippers
Prof. Brenda Wingfield
Dr Nam Pham
Dr Ariska van der Nest

Based in Indonesia
Dr Alvaro Durán
Dr SriKumar Koda Kkadan
Dr Kira Lynn
Dr Samuel Alves Dos Santos
Dr Marthin Tarigan

Based in Brazil
Dr Leonardo Sarno Soares Oliveira

BACKGROUND

The RGE-FABI Tree Health Programme (RGE-FABI THP) was established in 2018 as a collaborative initiative between the Indonesia-based Royal Golden Eagle (RGE) Group and the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria. This partnership addresses the increasing threat posed by insect pests and diseases to RGE's forestry operations in Indonesia and Brazil. FABI researchers work closely with RGE's operational divisions - Asia Pacific Resources International Holdings Limited (APRIL) and the Brazil-based Bracell Limited - to tackle these challenges.

Globally, insect pests and diseases are among the most serious threats facing plantation forestry, posing significant risks to all forestry enterprises. The RGE-FABI THP leverages FABI's position as the world's largest single group of scientists dedicated to plantation tree health. While the FABI team conducts research across natural and planted forest ecosystems, its core focus lies in minimizing the impact of pests and pathogens on plantations of primarily non-native species, such as *Eucalyptus*, *Acacia*, and *Pinus*. It is within this space that the collaboration between RGE and FABI is most active.

Professor Mike Wingfield, coordinator of the RGE-FABI THP, advocates strongly for international cooperation in managing these threats. His philosophy emphasizes that collaboration among global forestry stakeholders is essential for addressing the rapidly spreading pests and pathogens that impact plantation forests. Early awareness of potential threats before they emerge in new regions enables forestry companies to plan proactively and mitigate future losses. Similarly, the success of interventions like biological control depends on cross-border partnerships and globally coordinated strategies.

As with other FABI-industry collaborations, the RGE-FABI THP is rooted in fundamental research and training. It aims to strengthen in-house research and development capabilities, allowing scientific insights to be applied directly at the operational level. In doing so, the programme not only benefits RGE and FABI but also contributes to the broader international forestry sector by enhancing collective knowledge and preparedness for pest threats worldwide.

The RGE-FABI THP stands out as one of the most significant and dynamic recent global initiatives focused on tree health. It forges a strong connection between the extensive research efforts of RGE and FABI, while also supporting postgraduate students and postdoctoral researchers from around the world. These individuals investigate high-priority pest and disease issues across international boundaries, placing RGE's forestry divisions at the forefront of proactive forest health management, especially in *Eucalyptus* and *Acacia* plantations. At the same time, the programme broadens the research opportunities and global exposure of emerging scientists, cultivating the next generation of experts in tree health and international collaboration.

OBJECTIVES OF THE RESEARCH PROGRAMME

- Investigate priority pest and disease challenges affecting the RGE Group's plantation operations in Indonesia and Brazil.
- Collaborate with RGE's research and development teams to translate research findings into effective pest and disease management strategies for operational use.
- Support education and capacity-building initiatives within the RGE Group to strengthen in-house expertise.
- Provide diagnostic assistance to the RGE research team in identifying and addressing pest and disease issues.

HIGHLIGHTS OF THE RESEARCH

- Several newly emerging pests and pathogens affecting *Acacia* and *Eucalyptus* have been identified and are currently under investigation.
- A major focus of the programme has been on Eucalyptus scab and shoot malformation. Intensive research led to the discovery of the causal agent, a previously unknown fungal species now formally described as *Elsinoe necatrix*. Ongoing studies aim to determine the pathogen's origin and explore effective management strategies.
- Ganoderma root rot has become an increasingly significant issue in *Eucalyptus* plantations in Indonesia. The team has confirmed the pathogen as *G. philippii*. Molecular markers and identification tools are being developed from genome resources to better understand patterns of spread and thus to implement effective disease mitigation strategies.

The RGE-FABI Tree Health Programme team

- Research on Ceratocystis wilt, caused by *Ceratocystis manginecans*, has advanced understanding of pathogen detection and distribution. A qPCR diagnostic tool has been developed to identify species in the Ceratocystis Latin American Clade, with validation currently in progress. The global occurrence of this disease in *Eucalyptus* plantations is also being mapped and the modes of spread of the pathogen intensively interrogated.
- The programme includes detailed studies on emerging pathogens of *Acacia crassicarpa* in Indonesia. These include several new *Fusarium* species and *C. manginecans* associated with bark beetles as well as leaf disease caused by *Passalora perplexa.*

OUR IMPACT

- ***The RGE–FABI Tree Health Programme is structured around two core focus areas with clear benefits for society and industry.***
- ***Regarding societal impacts, the programme prioritises postgraduate education in tree health, training MSc and PhD students and maintaining a steady pipeline of new entrants.***
- ***The cohort is international, with graduates from Indonesia and South Africa completing advanced degrees and contributing specialised expertise to the sector.***
- ***Research projects generate new knowledge and provide management options regarding key insect pests and pathogens affecting plantation forestry.***
- ***These outputs directly support sustainable industrial development in forestry by informing evidence-based management and resilience planning.***
- ***The programme's contributions help safeguard productivity and enable employment opportunities across the forestry value chain.***

TREE PROTECTION CO-OPERATIVE PROGRAMME (TPCP)

Research Leader: **Prof. Bernard Slippers**

Research Team:
Prof. Irene Barnes
Prof. Martin Coetzee
Prof. Tuan Duong
Prof. Almuth Hammerbacher
Prof. Brett Hurley
Prof. Sanushka Naidoo
Prof. Emma Steenkamp
Prof. Noëlani van den Berg
Prof. Albé van der Merwe
Prof. Fanus Venter
Prof. Cobus Visagie
Prof. Brenda Wingfield
Prof. Mike Wingfield
Dr Thabiso Motaung
Dr Markus Wilken
Dr Neriman Yilmaz

BACKGROUND

Founded in 1989 and now the world's largest academic team dedicated to plantation-forest health, the TPCP integrates university scientists, government agencies and every major South-African forestry company. From its base in FABI, it delivers research, diagnostics, surveillance, biological control and human-capital development that keep the country's R50-billion forestry sector internationally competitive and bio-secure. The TPCP reach also extend well beyond South Africa, with strong international partnerships that help address plantation tree health issues around the world.

OBJECTIVES OF THE RESEARCH PROGRAMME

- **Detect and diagnose:** Provide rapid, accurate identification of pests and pathogens through an accredited Diagnostic Clinic (using unique digital and physical reference collections and capacity) and national surveillance network.
- **Understand and manage:** Unravel biology, genetics and ecology of key threats to design sustainable control (e.g. supporting breeding for resistance, development of biological control agents, silvicultural measures and more).
- **Predict and prevent:** Develop data management, remote-sensing, gene-editing and modelling tools for early warning and risk forecasting.
- **Build capacity:** Train postgraduate students, postdoctoral Fellows and biosecurity interns and mentor emerging scientists for academia, government and industry.
- **Share knowledge:** Publish regular formal and informal information, and maintain real-time information systems and extension services that translate science into operational decisions for growers and regulators.

HIGHLIGHTS OF THE RESEARCH

- **National forest-health surveillance launched and scaled:** More than 1 000 monitoring sites covering pine, eucalypt and wattle estates now feed real-time pest and disease data into a cloud-based Information Hub, enabling the first country-wide risk map for plantation forestry, in partnership with FSA and DFFE.
- **Diagnostics and extension at record levels:** The Diagnostic Clinic processed >1 300 individual samples while the extension team logged 133 field trips / 1685 person-days to support growers - from smallholders to multinational companies - on the ground.
- **Taking care of new and old pests and pathogens:** We maintained capacity and active projects on all the major insect and pathogen groups plaguing the SA forestry. In addition, new aphid, beetle and *Phytophthora* species were identified, alerts created and impact assessments launched, illustrating the value of continuous surveillance.
- **Biological-control successes:** Biological-control operations delivered high-quality *Deladenus siricidicola* nematodes against *Sirex noctilio* (with a new strain identified and introduced from Australia) and advanced work on egg and larval parasitoids, entomopathogenic fungi and nematodes for *Gonipterus* and other pests, amongst others. Gene-editing and parasitoid work also advanced for the Sirex woodwasp and Gonipterus snout beetle, supported by mass-rearing at FABI's Biocontrol Facility.

- **Screening facility:** Screening protocols and systems were developed for a new semi-quarantine disease-screening facility with three climate-controlled tunnels, supporting work on *Phytophthora*, *Fusarium circinatum* and other pathogens. Apart from screening industry breeding material, the facilities also support spectral imaging research related to tree diseases.
- **Digital innovation:** Supported by the cloud-based Information Hub, LoRaWAN sensor networks and hyperspectral and UAV imagery were deployed to link nursery, laboratory and field conditions with pest-impact and early detection models; this work will feed into an automated phenomics greenhouse that is under construction to fast-track resistance screening.
- **Global reach strengthened:** Renewal of the RGE-FABI Tree Health Programme (Indonesia/Brazil), a five-year ACIAR project on *Acacia*/*Eucalyptus* pests in Ethiopia, and a new MoU with North-Carolina State University's Camcore expand the TPCP's footprint on four continents, amongst numerous other academic links in Africa, Asia, Australia, Europe, South and North America.
- **Human-capital pipeline:** Across 2023-24 the programme supported 63 postgraduate students and 14 post-doctoral fellows, plus 18 dedicated biosecurity interns, ensuring scarce skills for both government and industry.
- **Science and science system contribution:** During this period the research group produced more than 120 research papers in leading peer-reviewed international journals, and numerous news and industry publications. Members of the group serve as editors and reviewers of leading journals, led international initiatives in organisations such as IUFRO and the FAO, and developed international partnerships with BiCEP, Camcore and ACIAR, amongst others.

OUR IMPACT

- ***Biosecurity shield for a R50bn industry:*** *Early warning, diagnostics and biological-control programmes prevent multi-million-Rand losses from invasive pests and diseases, protecting rural livelihoods and export markets.*
- ***Data-driven decision support:*** *Forestry companies can now log into the Information Hub to view live pest hot-spots, biocontrol establishment and climate overlays, enabling rapid, science-based, precision management.*
- ***Workforce development:*** *Alumni occupy key roles in government regulatory bodies, forestry R&D, consulting and academia, expanding South Africa's national biosecurity competence.*
- ***Global public good:*** *Research outputs and reference collections (e.g., more than 60 000 cultures in the culture collection of plant-associated fungi) inform forest-health management worldwide and feed into various global initiatives.*

Participants in the 35th Annual TPCP Symposium in May 2024

Signing of the FABI-Camcore MoU

Field training for National Pest and Disease Monitoring

Monitoring sites for pests and pathogens on young eucalypts

04

RESEARCH REPORTS

SYSTEMS BIOLOGY, SYSTEMATICS AND BIOPHYSICS

AFRICAN PLANT SYSTEMS BIOLOGY FOR THE BIOECONOMY (APSB)

Research Leader: **Prof. Eshchar Mizrachi**

Research Team:
Prof. Tuan Duong
Prof. Almuth Hammerbacher
Prof. Nicky Creux
Prof. Bernard Slippers
Prof. Tjaart Kruger
Prof. Steven Hussey

BACKGROUND

Our programme leverages South Africa's exceptional plant biodiversity and our genomic expertise to advance sustainable solutions in agriculture, biotechnology, and the broader bioeconomy. Focusing on evolutionary innovations in southern African flora, the programme explores key traits like polyploidy, root development and phosphorus acquisition, drought tolerance and pigment biosynthesis. We have generated high-quality genomic and transcriptomic resources for underexplored but ecologically and economically important plant lineages – including *Protea*, ferns, cycads (*Encephalartos*), succulents, *Strelitzia*, *Asparagus*, and members of the Restionaceae (restio) and Cyperaceae (sedge) families.
By integrating phylogenomics, functional genetics, and trait evolution, our work reveals how plants adapt to nutrient-poor soils, water scarcity, and a changing climate. These insights inform biotechnological strategies for developing climate-resilient crops and bio-based products.

The research also contributes to global biodiversity science through public databases and partnerships with organisations like DIPLOMICS, positioning South Africa as a leader in harnessing plant genomic diversity for innovation and sustainability.

OBJECTIVES OF THE RESEARCH PROGRAMME

- We utilise 'omics, systems biology, evo-devo approaches, genome engineering, and synthetic biology to investigate important traits in African plants of ecological, cultural, and economic importance.
- We are particularly interested in unravelling the molecular networks of development and stress tolerance in endemic South African plant species, as well as in studying their primary and secondary metabolism.
- Our goal is to scale 'omics research on South Africa's native biodiversity and unlock its potential for agricultural and horticultural biotechnology.
- We engage with multiple stakeholders and partners – both in urban farming networks, as well as in the Creative Industries – for societal transformation and transdisciplinary research on Ecocultural Justice in South Africa, Africa, and the Global South.

HIGHLIGHTS OF THE RESEARCH

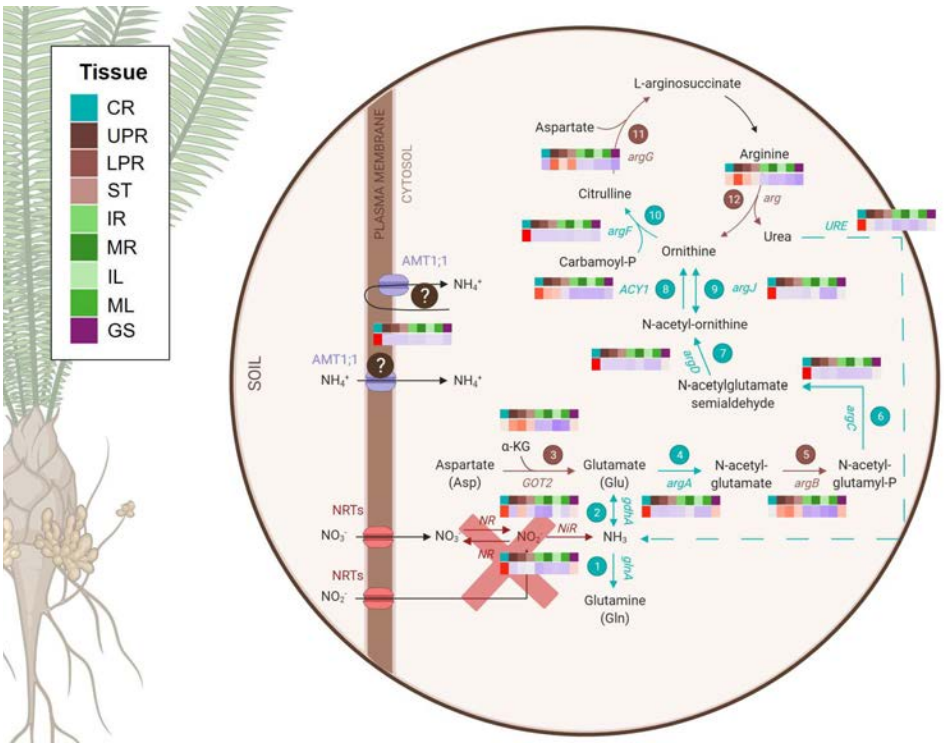
- **Phosphorus-mining plants and their evolutionary innovations:** We produced the first reference genomes and gene expression atlases for the restio *Elegia tectorum* and the sedges *Carex oshimensis* and *Carex austro-africana*, uncovering genes involved in root phosphorus (P)-mining and acquisition.
Alongside a newly produced gene expression atlas for the King Protea, *Protea cynaroides*, we are compiling a genetic and gene expression "tool-kit" for P-mining roots in both monocots and eudicots. This forms an important contribution not only to our understanding of how this trait has been invented multiple times in plant evolution, but also to the future of sustainable agriculture – by informing phosphorus-use efficiency and ultimately utilising biotechnology to reduce fertilizer dependency.
- **Cycad-cyanobacterial symbiosis: pathways repurposed:** We've completed the first in-depth study of molecular pathways involved in cycad-cyanobacterial symbioses, by studying the coralloid roots of the iconic indigenous southern African cycad *Encephalartos natalensis*.
Using a combination of microscopy, transcriptomics, metabolomics, and metagenomics, we demonstrate that cycads have repurposed canonical mycorrhizal- (i.e. fungal) symbiosis genes to facilitate nitrogen-fixing partnerships with cyanobacteria, despite cycads lacking fungal symbionts.

Our study also offers a suite of genes and transporters involved in this symbiosis for both carbon and nitrogen transport and exchange.

- ***Strelitzia* genome sequencing for conservation and pigment innovation:** In partnership with DIPLOMICS, we sequenced all South African *Strelitzia* species and the Traveller's palm (*Ravenala madagascariensis*), which is a Madagascan relative to explore unique pigment biosynthesis, paving the way for advances in horticultural biotechnology. These genomes will also guide molecular marker-based strategies for population analyses and the conservation of these iconic South African endemic species.
- **Decoding succulence in the world's richest region:** With South Africa being the sole home for half of all globally described succulent species, our genomic studies of succulence – an independently evolved trait in many plant lineages, aim to map out the genetic toolkit underlying drought tolerance and water storage, offering valuable pathways for climate-resilient agriculture and bioeconomy innovation. We have embarked on a large-scale comparative project of more than 15 instances of independent succulence evolution in different plant families.

Additionally, in collaboration with our international partners, we have contributed to work relating to:

- **Polyploidy and environmental resilience:** Our research shows that genome duplication in polyploid plants enhances signal diversity in gene networks, enabling niche expansion and greater resilience during environmental upheaval. This explains potential adaptive mechanisms in the immediate term for polyploids, as well as provides key insights for developing stress-tolerant crops in the face of climate change.
- **Fern genomics and cell wall evolution:** By generating high-quality transcriptomes for 22 fern species covering the fern lineage, we uncovered fern-specific gene families and – among other cell wall polysaccharide composition innovations – demonstrate independent lignin pathway evolution, offering a new foundation for bio-based materials research and sustainable plant biotechnology.
- ***Asparagus* evolution and sex chromosome origins:** A comprehensive phylogenomic study of *Asparagus* revealed two independent transitions to dioecy originating from southern Africa, providing a powerful model for understanding sex chromosome evolution, as well as aiding crop breeding and development strategies through species prioritization and insights into patterns of genetic diversification in the genus's history.



The cycad *Encephalartos natalensis* uses ammonia from its Nostoc symbiont ("cyanobiont") as a precursor for nitrogen metabolism, instead of nitrogen sources from the soil. Enzymatic steps shown in teal indicate that coralloid roots of cycads utilise this ammonia for the synthesis of nitrogen rich molecules – ornithine and citrulline – which get transported to and converted to amino acids in other root types (shown in brown)

OUR IMPACT

Bringing Orphan Crops to Life

- *Partnership with Future Africa and Manie van der Schijff Botanical Garden via the Future Africa Indigenous and Orphan Crops Collection.*
- *Promotes underutilised species and develops agronomic best practices through field trials (e.g., tsenza* Coleus esculentus*, chaya* Cnidoscolus aconitifolius*).*
- *Provides produce and propagation material to partners: chaya cuttings to community gardens; tsenza tubers to the Department of Consumer and Food Sciences for teaching and consumer acceptability research.*
- *Next phase: expand beyond formal trials at Innovation Africa Experimental Farm and Future Africa campus to parallel trials in community food-garden networks for real-world testing and uptake.*

Tsenza (*Coleus esculentus*) and Chaya (*Cnidoscolus aconitifolius*), two focus crops being promoted and trialled in our community food garden network as resilient, nutrient-dense cropping options for urban food growers

The stunning orange and blue pigmentation of seed arils of *Strelitzia reginae* (left) and *Ravenala madagascariensis* (right). Microscopy by Bernard Slippers

9-Biomes Garden at Constitution Hill, Johannesburg

- *Transdisciplinary collaboration between APSB, UP partners, Botanical Society of SA, local growers, artists, and academics.*
- *Established a public demonstration garden representing all nine South African biomes – transforming a former colonial courtyard into a living celebration of botanical heritage.*
- *1 000+ climate-adapted indigenous plants installed in a single volunteer-driven day, with input from expert growers/breeders.*
- *Serves as an inclusive space for public engagement, biodiversity awareness, and dialogue on transformation, climate resilience, and urban access to green spaces.*
- *Tackles plant awareness disparity and showcases SA's unique flora.*
- *Roadmap to scale modular biome gardens to other public sites, democratising access to nature and advancing a more biodiverse, equitable, climate-conscious future.*

https://amandlawecell.org.za/

BIOPHYSICS

Research Leader: **Prof. Tjaart Krüger**

BACKGROUND

When plants experience stress due to factors such as excessive or fluctuating light illumination, drought, non-optimal temperatures, and various diseases, they switch into a photoprotective mode during which a substantial amount of the light energy absorbed by the plant is safely dissipated as heat. The light emitted during the first steps of the photosynthetic process can be used as a sensitive probe to study the molecular mechanisms of photoprotection.

OBJECTIVES OF THE RESEARCH PROGRAMME

- Develop a detailed understanding of the fast molecular mechanisms of photoprotection.
- Conduct non-invasive, *in situ* fluorometric monitoring of stress responses in plants.
- Develop cost-effective experimental equipment and software for multispectral imaging and for spectroscopy down to the single-molecular level.
- Investigate the biophysics of fungal spore dispersal to understand the mechanisms that control fungal spore dispersal with the goal of controlling these factors.

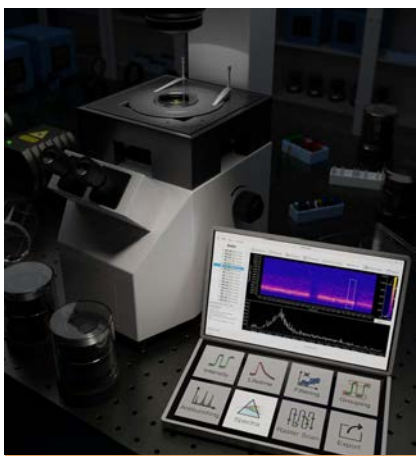
HIGHLIGHTS OF THE RESEARCH

- We discovered a new photoprotection mechanism in plants used by all types of light-harvesting antennas. This photoprotective mechanism is immediately activated when the plant experiences stress.
- A new method to monitor fast photoprotection at the bulk level was developed – instead of previous methods that are only sensitive at the level of individual light-harvesting antennas.
- We developed our first prototypical multispectral camera for R3 000.
- We organised a successful, multidisciplinary workshop on the biophysics of fungal spore dispersal.

OUR IMPACT

- In situ *fluorometric monitoring of stress responses in plants enables early, pre-symptomatic diagnosis of plant stress, allowing the farmer to treat diseases or optimise abiotic factors at the earliest stages, which can be several days before the plants would show symptoms that are observable by eye. Early treatment curbs the spread of diseases, increases the chances of successful treatment, and reduces the resources required for treatment. The non-invasiveness of fluorometric methods also enables precision agriculture and plant phenotyping for resistance breeding.*
- *Commercial hyperspectral cameras are prohibitively expensive, making this technology inaccessible to most farmers in developing countries. We are developing cameras for a fraction of the price, making use of advanced data-analysis approaches and AI to optimise speed and performance. The cost of such instruments can be further reduced when optimised for targeted applications.*
- *Reducing chemical use for pest management is an urgent need in Africa for cost, food safety, and environmental sustainability. Key problems of pesticides and fungicides are the growing resistance of pests and fungi, and their toxicity to humans, animals, and the environment. We therefore urgently need to develop alternative ways to enable more accurate use of fungicides in the short term and explore less toxic alternatives in the long term. An example is to control spore dispersal from fungi, which can only be done when understanding the mechanics of fungal dispersal.*

Sarah Burnett conducts fluorometric measurements of the heat stress response of wheat plants



Single-molecule experimental laboratory and new open-source software suite

ENDOPHYTE ECOLOGY

Research Leader: **Prof. Michelle Greve**

Research Team:
Prof. Bernard Slippers

BACKGROUND

One of the most fundamental questions in ecology is characterising patterns of diversity, and understanding what drives these. Such an understanding allows us to predict how global change factors, such as climate change and habitat loss will influence communities in future. The factors that drive diversity in macro-organisms (e.g. plants and animals) have been well tested, but much less is known about patterns and drivers of diversity in microbial communities. Therefore, we describe patterns of diversity and envisage to understand what drives such patterns. Our work has focussed primarily on foliar fungal endophytes.

OBJECTIVES OF THE RESEARCH PROGRAMME

- To characterise patterns of microbial diversity.
- To understand drivers of microbial diversity. For example, we test the relative influence of environmental factors such as climate, host characteristics, space and random processes on how microbial communities assemble.

HIGHLIGHTS OF THE RESEARCH

- We authored and co-authored four papers on microbiomes in a diversity of systems, ranging from Antarctica to African tropics, in high profile journals, including a review on how to curate microbiome data to increase its relevance and reusability.
- The microbiome of two widespread grass genera were characterised, across its global range, including Africa, Asia and Australia; and understanding its drivers of endophyte richness. By using global climate and fire data, we could show that productivity is a major driver of grass endophyte richness.
- We showed that microbiome communities are strongly linked to grass flammability and palatability traits, which suggests that there is a tight interplay between grass function and microbiome composition.
- One PhD student graduated from the research conducted in this group.

OUR IMPACT

- ***The Endophyte Ecology programme investigates the factors that drive microbial diversity and composition, including environmental factors, host interactions, resource availability, and competition.***
- ***This knowledge generated in the programme enables us to harness microbial communities for solutions in health, agriculture, environmental management, and biotechnology.***
- ***The programme develops transferable methods that quantify the roles of soils, climate, and host identity in the assembly and functioning of microbial communities.***
- ***Insights connect microbial community dynamics to ecosystem processes and to crop performance in real-world settings.***

Assessing impact of fire intensity on leaf endophyte communities in a grassland

Azorella selago, a keystone species on isolated Marion and Prince Edward Islands, supports relative depauperate leaf endophyte communities

DNA extractions in the lab

SOCIAL INSECTS RESEARCH GROUP

Research Leaders: **Prof. Christian Pirk • Prof. Abdullahi Yusuf**

Research Team:
Prof. Robin Crewe *(Department of Zoology and Entomology)*
Prof. Robin Moritz *(extra ordinary, Department of Zoology and Entomology)*
Prof. Baldwyn Torto *(extra ordinary, Department of Zoology and Entomology)*
Dr Ezette du Rand *(Industry funded researcher, Department of Zoology and Entomology)*
Dr Hannelie Human *(extra ordinary, Department of Zoology and Entomology)*

BACKGROUND

The Social Insects Research Group (SIRG), also known as the Bee group, focuses its studies, but does not limit itself, to fundamental and applied aspects of sociality in ants, bees, termites and wasps, with a particular focus on honey bees. Hence, we are teaching and building capacity for bee research, including pollination services and disease control, on the African continent and beyond.

OBJECTIVES OF THE RESEARCH PROGRAMME

- One of our main research objectives is understanding the pheromonal communication between colony members, using behavioural observations, analysis of the relatedness of the individuals, bioassays of their responses to pheromonal compounds and gas chromatographic analysis of chemical signals produced. This work allows us to explore the regulation of reproductive conflicts in honey bee colonies and enables us to tease apart social organisation, especially how one individual (the queen) controls thousands of individuals (workers).
- Conserving pollinators and reducing the threats they face amidst changing climate, intensification of agriculture and habitat transformation. We look at the impact of pesticides and how they affect survival, learning and behaviour impairment, foraging and physiology as well as how bees cope with these challenges.
- Recently we expanded our research interests into the field of insects for feed and food. Starting with alternative protein source, like termites, to ensure protein supply to a growing human population. We looked beyond social insects and started research into other insects as feed and food to address the UN SGDs of Gender, Zero Hunger, and Sustainable Production among others.

HIGHLIGHTS OF THE RESEARCH

- On 27 June 2023, the SIRG hosted a German delegation which included the Presidents of two main German fundings agencies: the Alexander von Humboldt Foundation, DAAD, members of the German Parliament, DG of International Affairs Federal Ministry of Education and Research (BMBF), and Director General for Cultural Affairs of the German Foreign office. Their visit was to see and access the capacity building and research conducted with German funding over the years at SIRG.
- On 20 March 2024, SIRG hosted a German delegation which included Prof. Sabine Döring, Secretary of State German Ministry of Education and Research, Dr Erik Hansalek, Head of the Division for Cooperation with Africa and the Middle East, German Ministry of Education and Research, and Dr Doreen Strauhs-Heymann, Desk Officer at the Division for Cooperation with Africa and the Middle East, German Ministry of Education and Research. This was part of a visit to the University of Pretoria to affirm and strengthen existing and ongoing research collaborations with German Academic Institutions, and SIRG was chosen as one of the leading examples.
- On the 28 January 2025, SIRG hosted a meeting with Prof. Tobias Bonhoeffer (Advisor for the Africa Programme to the President of the Max Planck Society and Dr Andrea Rottach (General Administration at Max Planck Society) as part of their visit to the University of Pretoria to enhance our scientific exchange and establish cooperation projects between UP and the Max Planck Society.

A honey bee (*Apis mellifera scutellata)* forager

- Dr Ezette du Rand was re-appointed as senior researcher for the pollination services research programme which was established in 2022 and focuses on vegetable seed production in collaboration with an industry partner.

OUR IMPACT

- ***The Social Insects Research Group (SIRG) sustained strong engagement with stakeholders across academia, government, industry, and the public.***
- ***The team marked World Bee Day (20 May) and World Biodiversity Day (22 May) with activities on the UP main campus and other UP campuses.***
- ***Outreach extended to schools, engaging learners from kindergarten through high school to build awareness of pollinators and biodiversity.***
- ***SIRG delivered presentations and led discussions with the beekeeping industry and government partners, including the Agricultural Research Council.***
- ***Research findings were shared with beekeeping groups across Gauteng to promote good practice and enable two-way knowledge exchange.***
- ***The group provided expertise to farmers and seed producers at Farmers' Days in the Western Cape.***
- ***SIRG contributed to drafting within the Comprehensive Africa Agriculture Development Programme (CAADP), resulting in the inclusion of pollinators in the Kampala Declaration for the CAADP ten-year action plan (2026–2035).***

SYSTEMATICS AND EVOLUTION OF SYMBIOTIC NITROGEN-FIXING BACTERIA

Research Leaders: **Prof. Fanus Venter • Prof. Emma Steenkamp • Prof. Martin Coetzee**

Research Team:
Prof. Volker Brözel *(South Dakota State University, USA)*
Dr Chrizelle Beukes *(James Hutton Institute, Scotland)*
Dr Esther Muema *(Stellenbosch University)*
Dr Marike Palmer *(University of Manitoba, Canada)*

BACKGROUND

South Africa is remarkably rich in legumes and their bacterial symbionts (also referred to as rhizobia), with which they contribute significantly to biological nitrogen-fixation. Rhizobial associations are crucial for legume establishment and general ecosystem health. In the case of non-native agricultural legumes, these symbiotic bacteria are relatively well-studied. In contrast very little is known about the identity and evolution of rhizobia associating with native legumes and their potential in agricultural settings. From a biodiversity point of view, rhizobia may also facilitate invasion by non-native legumes such as Australian *Acacia* species, and/or encroachment by generalist native species such as *Vachielia karroo*.

OBJECTIVES OF THE RESEARCH

Our overall goals are to characterise and describe the rhizobia associated with both native and non-native legume species (including agricultural important legumes such as soybean). For this purpose, we employ standard microbiological procedures combined with genetics and genomics approaches to study the processes driving rhizobial evolution and to reconstruct their evolutionary histories. In this way, we endeavour to determine how rhizobial identity and genetics relate to legume host, geography and environmental factors, to ultimately shed light on the possible forces shaping the biogeography, ecology and agricultural application of these bacteria.

HIGHLIGHTS OF THE RESEARCH

- We formally described seven new *Mesorhizobium* species obtained from root nodules of *Vachellia karroo*, seen as an encroaching tree legume in various biomes in southern Africa. These species were described under the SeqCode to overcome the negative impact of national biodiversity regulations on the description of new bacterial species isolated from South Africa.

Germinated soybean seedlings being planted in growth medium inoculated with rhizobial strains for experiments evaluating nodulation efficiency

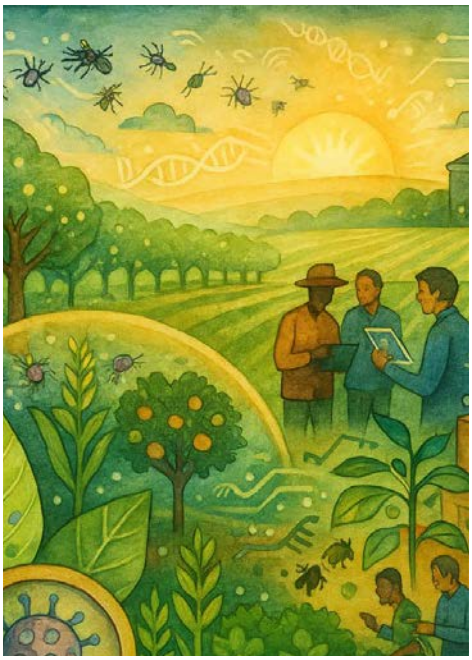
- We also described *Mesorhizobium salmacidum* sp. nov. and *Mesorhizobium argentiipisi* sp. nov. which are symbionts of the indigenous dry-land forage legumes *Lessertia diffusa* and *Calobota sericea*.
- We investigated the complex evolutionary history of photosynthesis in the genus *Bradyrhizobium.* This study provided a meaningful basis from which to explore how photosynthesis impact the physiology and ecology of these bacteria.
- Overall, our research contributed to establishing a solid knowledge base of the diversity of rhizobia associated with native and other locally relevant legumes, and development of the necessary tools for studying the evolution of this assemblage of agriculturally-important bacteria.

Germination of soybean seeds for use in rhizobial inoculation experiments

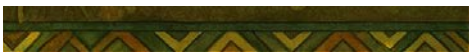
OUR IMPACT

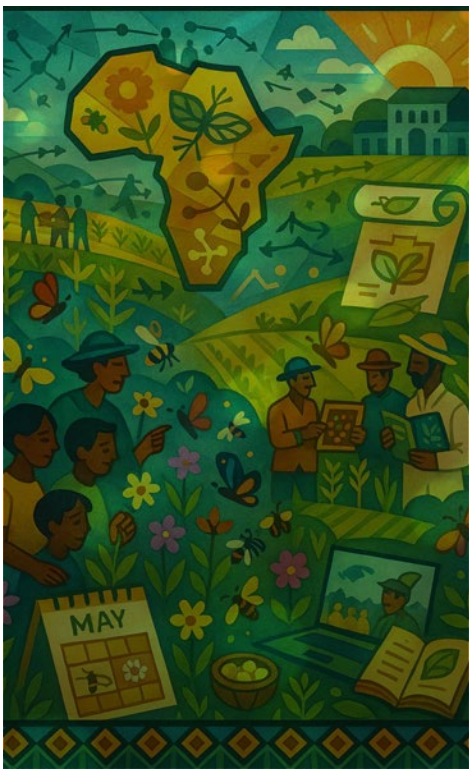
- *The Systematics and Evolution of Symbiotic Nitrogen-Fixing Bacteria programme optimises legume–rhizobia pairings to enhance nodulation, biological nitrogen fixation, and soil health – raising yields while reducing dependence on synthetic fertiliser.*
- *Newly described, locally adapted rhizobial strains create the possibility for region-specific bioinoculants and quality standards, opening opportunities for SMEs and the agri-bioeconomy.*
- *Biogeographic and evolutionary insights guide climate-resilient legume–rhizobia choices across heat- and drought-prone agro-ecologies.*
- *The work advances ecosystem management by resolving the identities and evolution of symbionts for native and introduced legumes, including* Vachellia karroo *and Acacias.*
- *Findings inform risk assessments and targeted interventions for bush encroachment and invasive species, supporting rangeland restoration.*
- *Postgraduate training and multi-institution partnerships build national capacity in symbiotic nitrogen-fixation science and its applications.*

Pot experiments conducted to assess the nodulation efficiency of various rhizobial strains on soybean



FABI FOOTPRINT: SATELLITE LABS, RESEARCH SUPPORT FACILITIES, FABI COMMUNITY, INDUSTRY PARTNERS AND FUNDING





SATELLITE LAB IN APPLIED CHEMICAL ECOLOGY

Research Leader: **Prof. Jeremy Allison**

Research Team
Prof. Almuth Hammerbacher
Prof. Brett Hurley
Prof. Bernard Slippers
Dr Gerda Fourie

BACKGROUND

The primary focus of research conducted by the Applied Chemical Ecology group is the development of an understanding of the chemical ecology of insect pests of plantation forests and agricultural crops. By using pest species as model systems the group is able to simultaneously make discoveries that advance the understanding of the natural world and provide pest management tools to stakeholders. The research is conducted in co-operation with the Great Lakes Forestry Centre of Natural Resources Canada, as well as other partners.

Specific ongoing projects include the development and optimization of survey and detection tools, characterization of the active space of semiochemical-baited traps and the biotic and abiotic factors that influence it, the impact of chemical ecology on the efficacy of biological control, the chemical ecology of insect pests of plantation and fruit and nut trees, the causes and consequences of variation in insect sex pheromones, and the development of management tactics that exploit our understanding of the chemical ecology of pest species.

OBJECTIVES OF THE RESEARCH PROGRAMME

- The development and optimization of survey and detection tools.
- Characterization of the active space of semiochemical-baited traps and the biotic and abiotic factors that influence it.
- Study the impact of chemical ecology on the efficacy of biological control.
- Expand knowledge about the chemical ecology of insect pests of plantation and fruit and nut trees.
- Elucidating the causes and consequences of variation in insect sex pheromones.
- Understand the influence of visual signals in the behaviour and response of insects to chemical signals.

HIGHLIGHTS OF THE RESEARCH

- Expansion of a fully functional chemical ecology lab, able to study all the aspects of the insect systems, from the chemistry itself, to the electrophysiological responses and behaviour.
- New pheromones were discovered, and the pheromone composition of *Sirex noctilio, Coryphodema tristis, Nudaurelia clarki, Euproctis terminalis, Gonipterus* sp. n. 2, *Kotochalia junodi* and *Bathycoelia distincta* was confirmed.
- We developed and tested field-based tools for the monitoring and management of the above mentioned pests. In the case of *Coryphodema tristis*, the pheromone has been used for mass trapping of this pest for management in *Eucalyptus nitens* plantations.
- We are proud of a number of high-quality research papers, the graduation of a number of PhD and MSc students, hosting of postdoctoral Fellows, national and international research collaborations, and strong industry partnerships, and leadership roles in International Union of Forest Research Organizations (IUFRO) working groups.
- An African Centre for Chemical Ecology was launched, which brings together stakeholders from the continent and around the world working in the discipline.

OUR IMPACT

- ***Projects are selected, designed and implemented together with industry partners, targeting priority pests where the use of semiochemical-based monitoring or management options (e.g. mass trapping or mating disruption) could have the greatest impact.***
- ***At least one pheromone discovered in our labs was advanced to field testing and to broad scale implementation (Cossid moth). A number of other promising projects are in the pipeline, and knowledge has been transferred for products discovered by others.***
- ***Industry awareness and involvement have significantly increased since the launch of the project, and this approach is now regularly considered and applied in integrated pest management programs.***

SATELLITE LAB IN REMOTE SENSING OF PLANT HEALTH

Research Leaders: **Prof Wouter Maes • Dr Michelle Schröder**

Research Team
Prof Bernard Slippers
Prof Almuth Hammerbacher
Prof Brett Hurley
Dr Privilege Makunde
Dr Nicky Creux
Dr Nicky Taylor
Dr Ilaria Germishuizen *(ICFR)*
Dr Rene Heim *(University of Gottingen)*

BACKGROUND

The Satellite Lab in Remote Sensing of Plant Health, established in September, 2020, under the leadership of Prof. Wouter Maes and Dr René Heim from the UAV Research Centre at Ghent University, is dedicated to the utilisation of remote and close-range sensor data obtained from satellites and unmanned aerial vehicles (UAVs) to monitor the health of crops and forests. The use of remote and close-range sensor data, obtained from satellites, aircraft, and UAVs, has already demonstrated its significant value, particularly in the detection of pests and diseases within both managed and natural landscapes. The integration of UAVs with optical sensors for crop and forestry monitoring represents a rapidly advancing field that presents unprecedented opportunities for managing plant health with a level of scale and precision never before achievable.

Within the context of its established leadership in addressing global plant disease and pest issues in commercial systems, as well as their impact on native vegetation, FABI serves as a host to world-leading programs. Furthermore, the university boasts substantial expertise in Engineering and Information Sciences, specifically within departments such as Civil, Electrical, Electronic and Computer Engineering, and Computer Science. The University of Pretoria seeks to leverage these capabilities to enhance its proficiency in remote sensing of plant health, thereby aligning with developments in chemical ecology, plant phenotyping, and data science within FABI.

The UAV Research Centre (URC), a recently-founded centre of excellence at Ghent University, consolidates knowledge pertaining to UAV-based remote sensing applications. Under the leadership of Prof. Wouter Maes and Prof. Hiep Luong, the URC is specifically dedicated to sustainable precision agriculture, with specialised competence in the early detection of pests and diseases. Moreover, the application of UAV technology to enhance agricultural practices in developing countries is a key focus area.

OBJECTIVES AND HIGHLIGHTS

- Established a strong core of capacity at the University of Pretoria, and stimulated further collaboration within UP and other South African researchers, as well as with SA forestry partners.
- Institutionalized a bi-weekly online lab meeting cycle, as well as regular research visits from Prof Maes to South Africa.
- Obtained and operationalized a high quality UAV, as well as RGB and multispectral sensors.
- Trained and registered three UAV pilots to support research projects.
- Completed numerous data collections campaigns and developed appropriate data analysis pipelines.
- Played a central role in the negotiation of a joint PhD program between Ghent University and the University of Pretoria
- Enrolled the first joint PhD student, Phumlani Nzusa, who is set to complete his PhD by the end of 2025, as well as established co-supervision with a number of other PhD students.
- Successfully applied for funding to allow UP students to spend time on research and training in UGhent, as well as for forestry and agricultural research.
- Published the first joint paper on assessing *Gonipterus* defoliation levels using multispectral UAV data in *Eucalyptus* plantations, with a number of others in preparation.

SATELLITE LAB IN ARTIFICIAL INTELLIGENCE IN FARMING

Research Leader: **Prof Abdoulaye Banire**
Research Team: **Prof Martin Coetzee • Prof Bernard Slippers**

The Satellite Lab in Artificial Intelligence in Farming was officially launched in September 2020. It is led by Prof. Abdoulaye Banire Diallo of the Bioinformatics Laboratory at Université de Québec à Montréal in Canada.

The current explosion in next generation biological and information technologies is disrupting agriculture globally. It is opening transformative new opportunities for intensification and diversification in a sustainable manner. Africa, rich in agricultural growth potential, is at a crucial juncture to stimulate economic and social development through accelerated agricultural progress.

However, Africa faces significant challenges. It lacks the capacity and data required to fully leverage the potential of digital and precision agriculture. Additionally, the continent's agricultural community is fragmented, requiring cohesive efforts to promote ownership, social development, and resilience. Furthermore, any intensification must be mindful of Africa's invaluable biodiversity and landscapes, which provide vital ecosystem services, and consider the mounting threats from climate change, pests, and disease.

The Artificial Intelligence in Farming Satellite Lab at FABI, in collaboration with Future Africa @UP (a global research hub at the University of Pretoria), is dedicated to addressing these challenges. Through a partnership with Engineering 4 @UP, it aims to transform the Innovation Africa @UP Experimental Farm into a digital research hub. This transformation involves the integration of sensor technology, autonomous vehicles, drone technology, virtual reality, data science, and artificial intelligence with biological sciences. Innovation Africa @UP serves as an anchor for the development of a network of like-minded agricultural research hubs, collectively transitioning into 'digital and precision agriculture research and training hubs' across the continent. These hubs will enable the sharing of resources, capacity, and data among similar organisations, creating a platform for focused investments in the future of agriculture in Africa.

This network will foster collaboration among businesses, governments, developmental organisations, and research institutions. It represents a promising path toward sustainable agricultural growth and social and economic development across the African continent.

RESEARCH SUPPORT FACILITIES

CHEMICAL ECOLOGY AT FABI

Academic member overseeing the facility:
Prof. Almuth Hammerbacher

Organisms communicate using volatile chemical signals, or smells, which influence the behavior of both the emitter and the receiver. These signals can be harnessed by industry to manipulate the behavior of insects and pathogens. For example, attractive volatiles released by mating partners can be used to trap pest insects that feed on crops. Similarly, volatile compounds from plants can deter insects or even be toxic to fungal pathogens. Leveraging nature's most common form of communication to protect crops is a key component of integrated pest and disease management. However, such technologies are not yet available for most pests and diseases.

To expand our understanding of these chemical communication signals, researchers at FABI have developed a platform to identify and characterize volatile compounds emitted by crops, pest insects, and fungal pathogens. They also study the behavioral responses these signals trigger in receiving organisms.

FABI's analytical laboratory is equipped to detect and quantify volatile communication signals from insects, fungi, and plants. It houses two state-of-the-art gas chromatographs coupled with mass spectrometers, which separate complex volatile blends into individual compounds and creates a diagnostic mass fingerprint for identification. To determine whether an insect can detect a volatile signal, the lab uses a gas chromatograph coupled with an electroantennogram detector. This instrument connects to an insect's antenna and measures the depolarization of olfactory neurons when the insect perceives a compound.

To study how insects respond behaviorally to these volatiles, FABI uses a wind tunnel and behavioral arenas monitored by cameras. Advanced software analyses recorded insect movements to determine which behaviors are elicited by specific volatile compounds.

By unlocking the potential of volatile chemical communication, FABI's research is paving the way for innovative pest and disease management strategies.

DNA SANGER SEQUENCING FACILITY

Custodians: Prof. Sanushka Naidoo, Prof. Wolf-Dieter Schubert and Dr Pamela de Waal
Staff: Renate Zipfel (Part time), Gladys Shabangu (Full time) and Onkgopotse Seabi (Student technical support eight hours per week)

For nearly 25 years, the DNA Sanger Sequencing Facility in the Faculty of Natural and Agricultural Sciences (NAS) has provided research support for DNA sequencing and fragment analysis. The facility works with researchers and students who prepare their own samples before submitting them for processing on two 3500xL Genetic Analyser instruments operated by skilled staff. In addition to sequencing and fragment analysis services, the facility provides technical support, troubleshooting, and training through workshops and individualised sessions.

The facility is also equipped with Qubit Fluorometer instruments, which are used to check DNA concentrations, particularly for samples intended for Next Generation Sequencing (NGS) on various platforms.

From 1 May 2023 to 31 January 2024, the facility processed over 100 000 DNA Sanger sequencing and fragment analysis samples for 62 different accounts. Fifty percent of these accounts are linked to different research projects within FABI and represent approximately 79% of the total sample submissions. These samples were used in a wide array of applications, including disease and pest diagnostics, taxonomy of animals, plants, insects, fungi, and bacteria, as well as phylogenetics, population genetics, DNA fingerprinting for parentage analysis, and more.

The facility offers practical workshops for clients of the facility to enhance sequencing and fragment analysis skills. The DNA Sanger Sequencing Workshop is held biannually (or more on demand), focusing on sequencing techniques, troubleshooting, and optimizing for high-quality data.

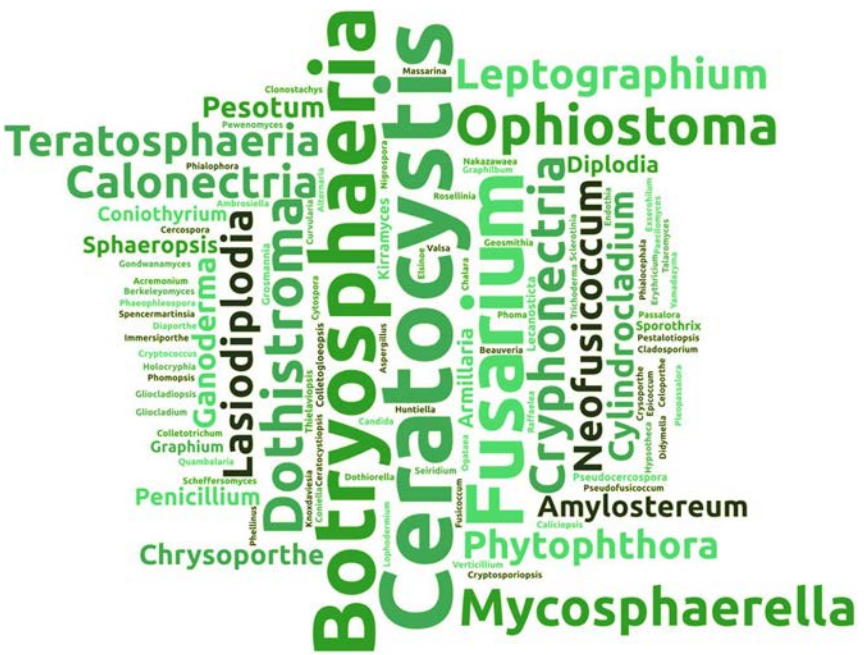
The annual Introductory Microsatellite Workshop (IMW) is a week-long, interactive workshop covering the basics of developing microsatellite markers and data analysis. The IMW2024 and IMW2025 workshops were hosted in March 2024 and April 2025. It is presented by various volunteer facilitators from the Department of Biochemistry, Genetics, and Microbiology. The 2024/2025 team included FABIans: Prof. Irene Barnes, Dr Ariska van der Nest, Alishia van Heerden, Taygen Fuchs, Dr Nam Pham and Anja Piso.

THE FABI CULTURE COLLECTIONS

Curator: **Nicole van Vuuren**
Technical staff: **Lydia Twala, Boitshoko Rammuki**
Academic member overseeing the collection: **Prof. Cobus Visagie**
Postgraduate student support: **Freddie Botha**

BACKGROUND

The CMW culture collection is one of the most important fungal collections in Africa. These cultures come from various projects by FABI researchers and their collaborators worldwide. In 2023, FABI also established and registered CMW-IA with the World Federation of Culture Collections (WFCC). CMW-IA is an open culture collection that houses a subset of important reference strains for forestry and agricultural research, including plant pathogens, ex-type reference strains and strains whose genomes have been sequenced. The FABI collections were recently recognised as one of South Africa's biobanks contributing to the National Science Collections Facility (NSCF) initiative.



The CMW culture collection was established in 1978 to preserve cultures relevant to the first forest pathology programme in South Africa. In 1989, this research-oriented collection became the formal repository for forestry-relevant fungi in South Africa as part of the Tree Protection Co-operative Programme (TPCP). The CMW collection moved with the TPCP when the Forestry and Agricultural Biotechnology Institute (FABI) was established at the University of Pretoria in 1998. The collection has developed into one of the most important and largest fungal collections in Africa and houses cultures from FABI researchers and their global collaborators.

More recently, in conjunction with the establishment of Innovation Africa at the University of Pretoria (IA@UP), the associated collection CMW-IA was established and registered with the World Federation of Culture Collections (WFCC). CMW-IA is an open culture collection that houses a subset of reference strains important for forestry and agricultural research, including plant pathogens, ex-type reference strains and strains whose genomes have been sequenced.

The CMW currently houses 61 088 fungal strains belonging to 772 genera and over 4 000 species. The CMW-IA houses 6 241 fungal strains in 314 genera and over 1 074 species. As part of a long-term vision for these collections, FABI collaborated with Hexagon Bio (CA, USA), whereby the genomes of 7 971 fungal strains from 247 genera and 994 species represented in CMW and CMW-IA were sequenced and made available to researchers to promote the research goals of the institute and its partners.

Between May 2023 and March 2025, 5 780 cultures were deposited in CMW. During this period, 2 114 strains were requested for research projects and removed from long-term storage.

The main collection is housed in three walk-in cold rooms in the FABI building, while certain groups of fungi are lyophilised or stored in special -80°C freezers. In addition to caring for the cultures, collection staff also oversee the microscope room with several state-of-the-art microscopes, a cryo-microtome that can section a sample at -20°C, and a freeze-dryer that is available to all FABI researchers.

HIGHLIGHTS OF THE FACILITY

- The CMW-IA collection was registered as an open collection with the World Federation of Culture Collections.
- Our collections are formally recognised as a South African biobank contributing to the NSCF. This unlocked new funding opportunities for the collection. In the past two years, the NSCF funded the salary for a technical assistant and procurement of two -80°C freezers.
- 7 871 genomes were received from Hexagon Bio and used in various projects.

HIGH-THROUGHPUT DNA EXTRACTION FACILITY (FMG-EPPI PROGRAMME)

Custodians: Melissa Reynolds and Prof. Sanushka Naidoo

Established in 2021 with funding from the Technology Innovation Agency (TIA), the High-Throughput DNA Extraction Facility is a key service of the Precision Tree Breeding Platform within the FMG-EPPI Programme. This facility houses two instruments, the GenoGrinder™ and the oKtopure™ DNA extraction robot, which enable efficient and high-throughput DNA extraction.

The facility specialises in extracting DNA from a variety of samples, predominantly eucalypt, pine, acacia and macadamia leaf samples, along with various other tissue types such as fruit and even small parasitic wasps. Using customized DNA isolation protocols, the team can also develop new extraction methods for additional tissue types as needed. The automation of the extraction process has resulted in reduced human error, decreased strain on technicians, and increased sample processing capacity, allowing the platform to meet the growing demands of industry partners.

In addition to its efficiency, the facility incorporates environmentally friendly practices, such as an off-deck tip washing station, which significantly reduces plastic waste and consumable costs. The service is available to members of the forestry and macadamia industries through the Precision Tree Breeding Platform, as well as to academics and other industries, provided that appropriate extraction protocols can be established.

INDUSTRY DISEASE RESISTANCE SCREENING FACILITY AT FABI

Academic member overseeing the facility: Prof. Almuth Hammerbacher

The combined effects of climate change and human activities have led to unprecedented yield losses in South African planted forests due to increasing pest and disease pressure. To ensure the long-term health of these forests, it is crucial to screen tree varieties developed in South African forestry breeding programmes for resistance or tolerance to pests and diseases.

FABI, in collaboration with Forestry South Africa, has begun developing a state-of-the-art pest and disease screening facility, featuring three fully automated greenhouse units. Screening methods have already been established for key pathogens and pests affecting commercial tree species, including *Fusarium circinatum* on pine, and *Teratosphaeria destructans*, *Elsinoe masingae*, *Phytophthora* species, and *Gonipterus* sp. n. 2 on *Eucalyptus*.

Additionally, FABI has acquired a high-resolution radiospectrometer, and researchers are developing methods to utilise hyperspectral data for precise assessments of pest and pathogen damage in screening trials.

The screening programme now employs a postdoctoral Fellow to assist with trials and provides bursaries for five postgraduate students to develop screening procedures for additional pests and diseases. Through this initiative, FABI and the TPCP aim to address a critical need in the South African forestry industry while advancing the technical capabilities for large-scale, accurate pest and disease assessments. By integrating novel technologies, the programme seeks to enhance precision in pest management strategies and support the sustainability of the country's forestry sector.

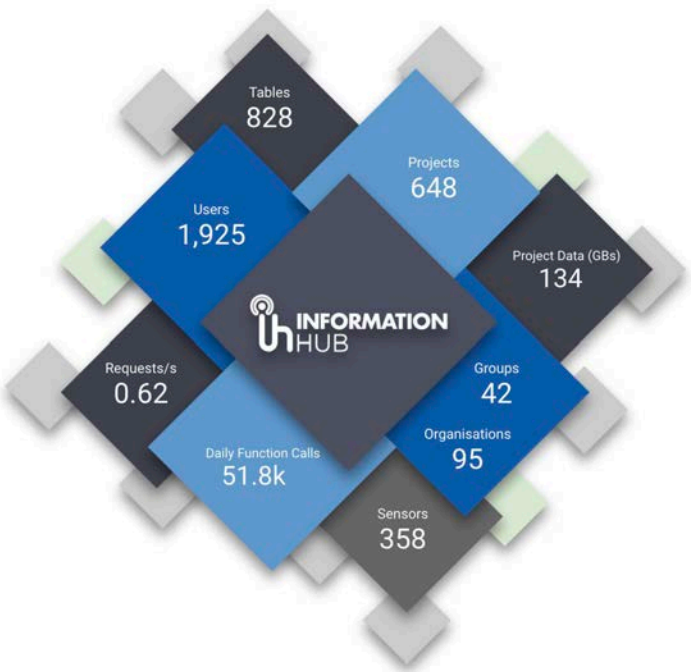
INFORMATION HUB: A WORLD CLASS DATA MANAGEMENT PLATFORM

Academic members overseeing the platform: Prof. Bernard Slippers and Prof. Martin Coetzee

The world is well into the 4th industrial revolution of artificial intelligence, robotics and internet of things (IoT), and South Africa is facing serious challenges in accelerating technological development and adoption in forestry and agriculture. Technological development associated with the 4th industrial revolution relies heavily on the availability of big data. Unfortunately, much of the data that Forestry and Agriculture would require to optimally unlock the potential of these technologies is not available digitally or sits in fragmented or inaccessible repositories.

With initial support from Forestry South Africa (FSA), and subsequently from the University of Pretoria and the Department of Science, Technology and Innovation (TIA program), a robust cloud-based data management system and associated app have been established to address this gap, referred to as the Information Hub (IH). The Information Hub data-platform is an initiative of Innovation Africa @UP and the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria.

The Information Hub is developing a centralized point for researchers, government, industry and practitioners in Agriculture and Forestry for the collection, management, sharing, and connection of information sources. The comprehensive, yet flexible, data-platform allows users to perform data analysis and visualization, connect sensor networks, manage tasks, engage with users – all in real-time.



This allows for the development of innovative and locally relevant digital tools to support national industry and government needs for growth and development. The data platform can facilitate the establishment of research networks, communities of practice (CoPs), and private sector and local government partnerships.

As an example, the Information Hub has supported the Tree Protection Co-operative Programme (TPCP) to make significant strides in digitizing its operations, encompassing the diagnostic clinic, culture collection, and fieldwork. The platform serves as a central repository, facilitating the seamless integration of historical data, partner contributions, and newly collected information. The Information Hub also acts as the core node for the National Forest Pest and Pathogen Surveillance project, funded by the DFFE, enabling comprehensive data analysis and decision support functionalities. Collaborations with the Institute for Commercial Forestry Research (ICFR) and Biosyntrix enhance GIS-based system support, information management, and in-field surveillance capabilities, bolstering the effectiveness and efficiency of the overall surveillance framework. This information feeds into a Biosecurity Information Hub, which collates similar data from various crops nation-wide to support the Department of Agricultural biosecurity data management and information needs (representing more than 100 000 data points at the point of writing).

The Information Hub is an open data platform that is now being used by more than 1900 user in various parts of the world, ingests a data-point every 0.62s and services more than 50000 functional calls daily. If you are not part of the Information Hub community yet, you can download the app from either the Apple iStore of the Google Playstore.

Scan to learn more about the Information Hub

MONITORING TREE HEALTH AT SENTINEL SITES: BOTANICAL GARDENS AND ARBORETA

Responsible persons:
Prof. Mike Wingfield, Prof. John R Wilson
(Centre for Invasion Biology, Department of Botany and Zoology, Stellenbosch University, Stellenbosch & South African National Biodiversity Institute, Kirstenbosch Research Centre, Cape Town), **Dr Felipe Balocchi and Dr Trudy Paap**

PROJECT RATIONALE

Biological invasions are among the main threats to biodiversity worldwide. Invasive plant pests and pathogens pose an increasing threat to natural ecosystems. This is largely driven by the rise in global trade, the lack of recognition of these organisms as threats, and the practical difficulties associated with management. Often, these pests and pathogens are only detected once they have already established, spread, and caused visible harm to their hosts. As a result, eradication strategies are often no longer feasible by the time of detection. Consequently, management efforts have largely focused on strengthening biosecurity standards, and adopting strategies to enhance early detection.

One effective strategy has been the use of sentinel plants and plantings, as well as the use of urban plantings as sentinels for early detection. Botanical gardens and arboreta provide ideal conditions for this purpose, as they often feature both introduced and indigenous plant species, along with detailed species inventories and reliable identification and introduction histories. International organizations such as Botanic Gardens Conservation International (BGCI), to which the South African National Biodiversity Institute (SANBI) is a signatory, have recognized this value and established global collaboration initiatives, such as the International Plant Sentinel Network (IPSN).

THE FABI-SANBI SENTINEL PROJECT

In 2016, the collaborative project “Monitoring Tree Health at Sentinel Sites: Botanical Gardens and Arboreta” was initiated between FABI and SANBI. The project aimed to enhance surveillance and the identification of new and emerging pest risks at botanical gardens to serve as early warning sentinel sites. This initiative aligns with SANBI’s Biological Invasions Directorate’s mission to protect biodiversity and ecosystems from the negative impact of invasive species.

The FABI-SANBI Sentinel Project has recently completed its fifth term and transitioned into a sixth. Since its inception, monitoring of plant collections through the project has led to multiple first reports for South Africa, including the noteworthy detection of the Polyphagous Shot Hole Borer (PSHB). In addition, the project has helped raise awareness among garden staff about the threat posed by invasive plant pests and pathogens, as well as the importance of adhering to biosecurity best-practice standards. Plant health training activities have been conducted with botanical garden staff, aiming to increase opportunities for the detection of invasive plant pests and pathogens in a country with a limited surveillance budget.

PROJECT HIGHLIGHTS

The highlights below include the most noteworthy outputs of the last 2-3 years.

- Development of a Guide to Biosecurity Best Practices for South African Plant Collections: In collaboration with SANBI's Horticultural Enrichment Forum, FABI researchers have developed a guide to biosecurity best practices for living plant collections in South Africa. The document is to be published as a SANBI Biodiversity Series.
- Monitoring plant collections: Visits were made to Harold Porter National Botanical Garden (NBG), Kirstenbosch NBG, KwaZulu-Natal NBG, Lowveld NBG, Pretoria NBG, Thohoyandou NBG, Arderne Gardens, Durban Botanic Gardens and Manie van der Schijff Botanical Garden. These visits include engagement with garden staff and the collection of samples on an ad hoc basis.
- Sample collection guidelines and a submission form were developed to enable garden staff to send samples when a site visit could not be arranged in the short term.
- Outputs: Several publications resulting from research conducted through the project have been finalized in recent years. These include:
  - The first report in South Africa of a range of alien *Phytophthora* species from botanical gardens, including novel host-pathogen associations and the description of a novel *Phytophthora* species.
  - The first report in South Africa of the Canary Island date palm pathogens *Fusarium oxysporum* f.sp. *canariensis* and *Nalanthamala vermoesenii* from ornamental plantings in Cape Town.
  - The identity confirmation of two alien aphid pests, *Cinara cupressi* and *C. tujafilina*, which have been associated with damage to *Widdringtonia* spp.
  - The first record of the fruit-crop pathogen *Dematophora necatrix* (also known as *Rosellinia necatrix*, or the white root rot pathogen) on South African indigenous trees.
  - The completion of a review of the risk of *Phytophthora cinnamomi* to the Cape Floristic Region. This review also proposes a management plan for this serious invader. The publication is linked to the completion of a Risk Analysis for Alien Taxa for the same pathogen, which has been submitted to the Alien Species Risk Analysis Review Panel.

Ganoderma eickeri on a Plane tree (KZN National Botanical Garden)

PLANT HEALTH EXTENSION AND DIAGNOSTIC CLINIC

Responsible persons: **Prof. Bernard Slippers** *(FABI Director),*
Dr Lieschen de Vos *(FABI Diagnostic Clinic)*
Hans Merensky Chair in Avocado Research: **Prof. Noëlani van den Berg** *(oversight),* **Alicia Vermeulen** *(disease clinic – manager)*
Macadamia Protection Programme (MaPP): **Prof. Gerda Fourie** *(oversight, MaPP),* **Steven Shange** *(field extension – manager),* **Nicolette Sianyuka** *(disease clinic – manager)*
National Grain Research Platform (GRP): **Prof. Cobus Visagie** *(health extension and diagnostics – manager),*
Dr David Read *(health extension and diagnostics – manager),* **Johan Cilliers** *(extension officer),* **Matthew Jackson** *(extension officer),* **Lawrence Mataha** *(extension officer),* **Annah Boreni** *(extension, disease clinic technician),*
Tjitjila Makhura *(extension, disease clinic technician)*
Tree Protection Co-operative Programme (TPCP): **Prof. Irene Barnes** *(oversight, diagnostics),* **Prof. Brett Hurley** *(oversight, tree health extension and diagnostics),*
Dr Wilma Nel *(diagnostic clinic – manager),* **Sandisiwe Jali** *(field extension – manager)*

The extension services of the Hans Merensky Chair in Avocado Research, the National Grain Research Platform (GRP), the Macadamia Protection Programme, and the Tree Protection Co-operative Programme (TPCP) at FABI are integral to the research and diagnostic activities of these programmes. In addition to supporting the forestry sector through the monitoring and diagnosis of pests and pathogens of native and plantation trees, these services also extend to important agricultural crops, including avocado, macadamia, and various grains.

Extension services involve routine field visits across the country, as well as field visits in response to emerging pest and disease issues, including new detections and outbreaks. Extension activities are also important to create awareness of plant health amongst the general public, foresters, farmers and conservation staff. Thus, extension activities include presentations at field days, reports in magazines and newspapers, radio and TV interviews, and articles posted on the TreeHealthNet list server. The extension services work closely with the FABI diagnostic clinic, submitting samples to the clinic, and visiting sites from where samples were submitted when further investigation is required to confirm the identity or evaluate the impact of a pest or pathogen.

Correct diagnoses are crucial to the monitoring function of the programmes. Samples that are submitted through the extension services and via our stakeholders are processed by the FABI diagnostic clinic, with the managers overseeing the sample processing and reporting, supported by a capable team of postgraduate students and interns. The clinic is well positioned within FABI, allowing it access to some of the best laboratories on the continent and to draw on the skills, expertise and research of a world-class tree health programme.

Besides the crucial services that field extensions and diagnostic clinics provide to the relevant stakeholders, these services also provide training for postgraduate students and interns, and thus contribute to the development of future capacity in plant health for South Africa.

PRECISION TREE BREEDING PLATFORM (FMG-EPPI PROGRAMME)

Custodians: Melissa Reynolds and Prof. Sanushka Naidoo

The Precision Tree Breeding Platform of the FMG-EPPI programme at the University of Pretoria provides a high-throughput research service to the forestry and macadamia industries in South Africa. Managed by Melissa Reynolds under the supervision of Prof. Sanushka Naidoo (previously, oversight was provided by Prof. Zander Myburg prior to his retirement in August 2024), the Platform consists of six members dedicated to providing DNA-marker services for researchers, breeders, and farmers.

The Platform specialises in DNA marker analysis which is essential for quality control in breeding programmes, and the implementation of molecular breeding strategies. Through a team of skilled technicians and analysts, DNA is extracted using FMG-EPPI's high-throughput extraction facility, followed by microsatellite or SNP analysis. The resulting data can be applied to verify clonal integrity, cultivar identity, pedigree confirmation, hybrid status, and evaluate pollination techniques, ensuring accuracy and efficiency in breeding and propagation. Furthermore, high-density, genome-wide DNA markers can be applied to molecular breeding strategies such as genomic selection.

Between 2023 and 2024, the Platform expanded its resources to enhance the value of DNA fingerprinting in macadamia production and propagation. This included developing DNA extraction protocols for macadamia kernels and pollen, as well as establishing and expanding a cultivar reference set for Macadamias South Africa (SAMAC) members.

Beyond industry support, the Platform plays a key role in academic development by assisting students in the FMG-EPPI programme and other research initiatives at the University of Pretoria. This has led to the development of macadamia and acacia microsatellite markers, with ongoing improvements to better serve acacia growers in South Africa. Through these contributions, the Precision Tree Breeding Platform continues to provide support to key South African industries and drive development in new technologies and applications.

FABI COMMUNITY

AWARDS AND HONOURS

FABIan OF THE YEAR

This is FABI's premium award for students, and it recognises excellence across a broad range of contributions, including research, mentorship, and support to the maintenance of the structures of the Institute and others. The recipient is chosen by FABI students.

2023: Johannes Christoff Joubert
2024: Kira Lynn

BEST FABI MSc DISSERTATION

This award is given to an MSc student who achieved the highest mark through an external examination of a dissertation.

2023: Cheyenne Theron
2024: Melandré van Lill

BEST FABI STUDENT PUBLICATION

Given the importance of research quality in FABI, one award recognises the best publication produced by a FABI student in the award year. The recipient in the case of this award is chosen based on the ISI impact factor of the paper produced.

2023: Anneri Lötter
2024: Alicia Fick

BEST POSTDOCTORAL FELLOW PUBLICATION

This award recognises the best publication produced by a postdoctoral Fellow in the award year. The recipient in the case of this award is chosen based on the ISI impact factor of the paper produced.

2023: Dr Tanay Bose, Dr Jane Chepsergon
2024: Dr Tanay Bose

FABI AWARD FOR MENTORSHIP

MSc or PhD students who have demonstrated outstanding mentorship, in the broad sense, to other students.

2023: Rosa Knoppersen, Kira Lynn, Myriam Solís
2024: Melandré van Lill, Anja Piso, Chanel Thomas

FABI AWARD FOR "GETTING THE MESSAGE TO THE PUBLIC"

This award goes to a student who has excelled in transferring the FABI science message to the public. Tangible evidence of transferring the accomplishments of FABI, or the science conducted by FABI or its members to the public must be demonstrated.

2023: Chanel Thomas

FABI AWARD FOR RECOGNISING CONTRIBUTIONS BY A PERSON EXTERNAL TO THE UNIVERSITY

This award acknowledges the exceptional contributions to FABI by a stakeholder external to the University of Pretoria. Selection of the recipient is made by the FABI community.

2023: Dr Ilaria Germishuizen *(Institute for Commercial Forestry Research)*
2024: Dr Eric Droomer *(York Timbers)*, **Johan Nel** *(TWK Agri)* **and Craig Norris** *(NCT Forestry)*

FABI AWARD FOR RECOGNISING CONTRIBUTIONS BY A MEMBER OF STAFF OF THE UNIVERSITY

This award is made to a member of staff of the University of Pretoria who has provided exceptional support to FABI.

2023: Mpho Maithufi *(Postdoctoral and Research Fellow Programmes Officer, UP)*
2024: Cuan Hendricks

PHOTOGRAPHIC AWARDS

Two awards are made annually for photographs judged to be the best in their category.

These categories are:

Best Photograph Illustrating a FABIan or FABIans at Work
2023: Demissew Teshome
2024: Alicia Fick

Best Photograph Illustrating FABI Research
2023: Cheyenne Theron
2024: Dr Ariska van der Nest, Alicia Fick and Sizwe Mthembu

FABI AWARD FOR POSTDOC MENTORSHIP/ OUTSTANDING CONTRIBUTIONS

This award goes to a full-time FABI postdoctoral Fellow who has demonstrated outstanding mentorship to other FABIans, or who has significantly contributed towards the goals of FABI, above what is expected.

2023: Dr Erik Visser
2024: Dr Felipe Balocchi

FABI AWARD FOR OUTSTANDING RESEARCH FELLOW CONTRIBUTIONS

This award goes to a full-time FABI Research Fellow who has demonstrated outstanding mentorship to other FABIans, or who has significantly contributed towards the goals of FABI, above what is expected.

2023: Dr Neriman Yilmaz
2024: Dr David Read

CREATIVE ART SUBMISSION

This award is made for the best creative art piece made by a FABIan and submitted based on the theme 'Biodiversity in art'. Any creative item that has a link with biodiversity/nature in any way can be submitted. This includes visual arts or crafts (paintings, drawings, sculptures, woodwork, needlework, jewellery, etc), word art, music or other forms of art.

2023: Elmarie van der Merwe
2024: Matthew Jackson, Johannes Christoff Joubert

UNIVERSITY OF PRETORIA AWARDS

EXCEPTIONAL ACADEMIC ACHIEVERS AWARD

2023: Prof. Teresa Coutinho and Prof. Fanus Venter

EXCEPTIONAL YOUNG ACHIEVERS AWARD

2023: Dr Markus Wilken

OTHER AWARDS TO FABI MEMBERS

IUFRO WORLD CONGRESS 2024

(23-26 July 2024, Stockholm, Sweden)

Prof. Mike Wingfield received the highest honour of IUFRO, namely Honorary Membership in recognition of the major impact he has had on the organization. Mike started to participate in IUFRO activities as a young scientist in 1977 in a Working Party dealing with diseases of pines grown in the tropics and southern Hemisphere and was elected the IUFRO President (2014-2019 and served as Immediate Past President (2019-2024) of the organization.

Prof. Brenda Wingfield received the IUFRO Scientific Achievement Award 2024. The award recognises that she is a world-leading scientist in forest health, with over 450 publications on fungal speciation and evolution. Her research has been instrumental in understanding pathogen diversity and developing strategies to manage tree diseases in commercial and natural forests. She has pioneered molecular techniques for early and accurate pathogen detection, enhancing disease control efforts globally. Beyond her research, she has mentored over 100 students and actively contributes to IUFRO discussions on forest health, collaborating with international researchers to address global forestry challenges.

Dr Josephine Queffelec received the IUFRO Award for Exceptional Doctoral Research in Division 7. Josephine's PhD project was part of a collaboration between FABI (Prof. Bernard Slippers) and the CFS in Canada (Prof. Jeremy Allison).

Ginna Granados, a PhD candidate in FABI received one of the three Best Poster Awards, made by IUFRO Division 7 (Tree Health).

NATIONAL SCIENCE AND TECHNOLOGY FORUM (NSTF) AWARDS

FABI Director, **Prof. Bernard Slippers**, was conferred the National Science and Technology Forum (NSTF) Management Award at the NSTF-South32 Awards. These are referred to as the 'Science Oscars' of South Africa, recognising outstanding contributions to science, engineering and technology (SET) and innovation by individuals, teams and organisations in South Africa. Prof. Slippers received the award in recognition of his leadership and participation in several substantive research programmes and his role in the foundation of the Future Africa Institute, the Africa Science Leadership Programme and Innovation Africa @UP, and in the Global Young Academy movement and SAYAS. *(11 July 2024)*

JOURNAL ISSUE DEDICATED TO PROF. MIKE WINGFIELD

FABI founding Director, **Prof. Mike Wingfield** has been uniquely honoured for his significant achievements and scientific contributions to the field of Mycology, on the occasion of his 70th birthday, celebrated on 21 April 2024 while he was on

sabbatical in the USA. The occasion is marked by Volume 13 of the journal Fungal Systematics and Evolution (FUSE), which is dedicated to Mike. Prof. Bernard Slippers, Prof. Cobus Visagie and Dr Neriman Yilmaz acted as handling editors for the special issue. The issue features various research articles specifically produced for this issue by friends of Mike from around the world. The issue includes 140 new species, 12 genera, including a new fungal species, *Mjuua agapanthi*, named in his honour by his PhD student and former Director of the Westerdijk Fungal Biodiversity Institute in the Netherlands, Prof. Pedro Crous.

He was also given a unique gift featuring a word cloud of the genera of the 827 species names in Mycobank on which Mike has been an author.

In the preface to the special issue, he is described as "one of the most productive scientists of his generation, and possibly ever in the field of forest health, with over 1 150 publications, accumulating more than 75 000 citations. He has also produced 11 books or monographs. What is remarkable is the breadth of the topics that Mike deals with regularly in his publications, consultations and talks, from forest pathology and forest entomology to mycology, nematology, and many others. And yet, breadth has not given way to depth, as illustrated by the high impact journals and citation record linked to his outputs".

They praise Mike for being an exemplary ambassador for science around the world. For example, he has co-authored papers with more than 200 fellow scientists from more than 60 different countries. One of the outstanding aspects of Mike's career is his focus on mentorship and training. He has trained more than 110 PhD students and numerous MSc students and postdoctoral Fellows. Amongst these students, leaders of major science organisations, business enterprises and academia now work in the United States of America, Netherlands, Britain, China, Indonesia, Oman, Australia, Cameroon, Uganda, Ethiopia, Chile, Colombia, Uruguay and South Africa, and more; indeed all around the world. He also served as the President of the International Union of Forest Research Organizations (IUFRO) from 2014-2019. *(July 2024)*

OTHER AWARDS AND ACCOLADES

Prof. Teresa Coutinho was elected the Secretary General of the International Society for Plant Pathology 2023-2028. *(August 2023)*

Prof. Tjaart Krüger received a fellowship from the Oppenheimer Memorial Trust in 2024

Prof. Tjaart Krüger received a fellowship from the UK Research and Innovation (UKRI) agency in 2025 to develop low-cost multispectral cameras for plant health monitoring in Africa.

Prof. Tjaart Krüger was elected a council member of the International Union for Pure and Applied Biophysics (IUPAB) in 2024.

Prof. Sanuska Naidoo was awarded fellowship of the South African Genetics Society (SAGS), recognising her research excellence and service to the Society.

Prof. Sanushka Naidoo and **Dr Demissew Teshome** attended and presented at the 2024 IUFRO Tree Biotechnology Conference Annapolis, Maryland, USA on 4–8 August. This is the biennial meeting on genomics, molecular biology and biotechnology of forest trees, associated with the IUFRO Working Party 2.04.06. Prof. Sanushka Naidoo was elected as the deputy co-ordinator of the Working Party for 2025-2026 and will be involved in the organisation of the next conference.

Prof Christian Pirk was elected Secretary general of the Academy of Science of South Africa in 2024

Prof Christian Pirk gave a plenary lecture at the 2nd conference of the EU COST action - BEekeeping products valorization and biomonitoring for the SAFEty of BEEs and HONEY (BeSafeBeeHoney).

Prof. Cobus Visagie received the prestigious Johanna Westerdijk Award for outstanding contribution to the culture collection of the Westerdijk Fungal Biodiversity Institute in the Netherlands. The Award is presented on special occasions to an individual who has made an outstanding contribution to the culture collection of the Institute, marking a distinguished career in mycology. Nominees are evaluated on the quality of their contributions to the collection and based on associated mycological research in general. *(April 2025)*

Prof. Cobus Visagie became an elected member of the International Commission on the Taxonomy of Fungi (ICTF).

Prof. Cobus Visagie became an elected member of the International Commission of *Penicillium* and *Aspergillus* (ICPA).

Prof. Brenda Wingfield was awarded the prestigious John FW Herschel Medal in 2023 by the Royal Society of South Africa in recognition of her outstanding research across multiple scientific disciplines. As the holder of the DSI–NRF SARChI Chair in Fungal Genomics, she has made significant contributions to biochemistry, microbiology, genetics, and plant health. Prof. Wingfield views this award as a testament to the impact of her research and the collaborative efforts of her colleagues and students. She emphasized that, in an era of misinformation, scientific excellence and public engagement are more important than ever. This achievement highlights both her dedication to advancing knowledge and the University of Pretoria's commitment to cutting-edge research.

Prof. Mike Wingfield was awarded fellowship of the International Society for Plant Pathology (ISPP), the highest award conferred on a member of the Society. *(August 2023)*

Prof. Mike Wingfield was included in the annual Clarivate Web of Science Highly Cited Researchers list in 2023 and 2024. Each researcher selected for inclusion in this list has authored multiple "Highly Cited Papers" which rank in the top 1% by citations for their field(s) and publication year in the Web of Science over the past decade.

Prof. Abdullahi Yusuf was successfully elected to the management committee of the EU COST action European Network In CHEmical Ecology: translating the language of life into sustainability (E-NICHE). The main aim and objective of E-NICHE is to address major societal issues for environmental and sustainable development goals by describing chemodiversity, evolutionary forces, and global changes that will impact biodiversity and ecological interactions.

Prof. Abdullahi Yusuf was the focal point for an Alexander von Humboldt alumni colloquium in Pretoria in early 2025, bringing together Alexander von Humboldt fellows from Southern Africa.

Prof Abdullahi Yusuf was elected as a Councillor for the International Society for Chemical Ecology for a three-year term (2024-2027).

Dr Jane Chepsergon, a postdoctoral Fellow in FABI received a Best Poster Award at the 12th International Congress of Plant Pathology (ICPP), in Lyon France. *(August 2023)*

Dr Nicky Creux won eLife's Ben Barrs Spotlight Award that highlight researchers from minorities in STEM fields and researchers from low-income countries. *(September 2023).*

Dr Nicky Creux was elected a Board member of the International Sunflower Association.

Dr David Read and **Dr Tanay Bose**, postdoctoral Fellows in the Grain Research Programme (GRP) and Tree Protection Co-operative Programme (TPCP) at FABI, have each been awarded a Senior Postdoctoral Fellowship by the University of Pretoria. Both are currently affiliated with the Department of Biochemistry, Genetics, and Microbiology in the Faculty of Natural and Agricultural Sciences. The Senior Postdoctoral Fellowship, awarded by the University of Pretoria's Department of Research and Innovation, provides an invaluable opportunity for recipients to delve deeper into their respective fields of study and make substantial contributions to the scientific community. Over the course of their fellowship, Drs Read and Bose will concentrate on their research on plant virology and tree microbiomes, respectively. *(July 2023)*

Dr Bertus van Heerden received the NRF Research Excellence Award for Next-Generation Researchers. *(August 2023)*

Dr Bertus van Heerden attended the 2024 Lindau Nobel Laureate Meeting. *(July 2024)*

Dr Neriman Yilmaz won the 2nd Best Oral Presentation Award for Early Career Mycologists at the 12th International Mycological Congress, Maastricht, the Netherlands. *(August 2024)*

Matthew Jackson won the best student presentation award at the 23rd Congress of the Entomological Society of Southern Africa (ESSA). *(July 2023)*

Phumlani Nzuza, a PhD candidate in FABI was the runner-up for the Best Student Poster Award at the 23rd Congress of the Entomological Society of Southern Africa (ESSA). *(July 2023)*

Anneri Lötter, a PhD candidate in FABI, won one of the three SAGS student awards at the South African Society for Bioinformatics (SASBi) and

South African Genetics Society (SAGS) BIO2024 Conference for 'Best paper' in the category: Genetic methodologies and data analysis. *(September 2024)*

Kayla Midgeley was awarded the Grace Waterhouse Fellowship to support her research visit to the James Hutton Institute in Scotland.

Innocent Rakubu, a MSc student in FABI, was awarded the prize for the Third Best Oral Presentation at the 24th Symposium of the Nematological Society of Southern Africa (NSSA). *(September 2023).*

Melissa Reynolds was selected as the winner of the annual "She is Forestry Award" present by Forestry SA. This prestigious award highlights her remarkable contributions to the forestry sector.
(August 2023)

Samkelisiwe Thango, a PhD candidate in FABI, received the Best Poster Award at the 53rd Congress of the Southern African Society of Plant Pathology (SASPP). (February 2024)

Cheyenne Theron, a MSc student in FABI received the Best Student Talk Award for her presentation at the 53rd Congress of the Southern African Society of Plant Pathology (SASPP). *(February 2024)*

Rodé Visser was awarded the Inqaba Biotec Prize at the University of Pretoria's Autumn Graduation in May 2023. This award is presented to the student with the highest weighted average in the BSc Hons Biotechnology study programme.

Seven members of the Hans Merensky Chair in Avocado Research were awarded travel grants to attend the 12th International Congress of Plant Pathology (ICPP) in Lyon, France, where they presented research on all aspects of the research conducted in this programme.

SABBATICALS

Prof. Bernard Slippers: Hosted by **Prof. André Fleißner** (Centre for Biology at Technische Universität Braunschweig – TUBS, Germany). *(June–July 2023).*

Prof. Dave Berger: Hosted by **Prof. Eva Stukenbrock** (Environmental Genomics Group, Christian-Albrechts-Universität zu Kiel, Germany), **Prof. Ingo Hein** (James Hutton Institute, Scotland) and **Prof. Yves Van de Peer** (Vlaams Instituut voor Biotechnologie, Belgium). *(February–November 2023).*

Prof. Brenda Wingfield and Prof. Mike Wingfield: Hosted by **Prof. Jiri Hulcr, Prof. Jeremy Brawner** and **Prof. Matthew Smith** (Institute of Food and Agricultural Sciences (IFAS), University of Florida, Gainesville). *(Early 2024).*

SABBATICAL VISITORS HOSTED AT FABI

Prof. Anne Pringle and David Johnson (Departments of Botany and Bacteriology, University of Wisconsin–Madison, USA). *(July 2022–July 2023).*

Prof. Fikret Işık (NC State University, USA). *(March–December 2024).*

INAUGURAL ADDRESSES

- Prof. Brett Hurley "Protecting Africa's forest resources" *(October 2023)*
- Prof. Sanushka Naidoo "Tree resilience to pests and pathogens in the face of climate change" *(October 2023)*
- Prof. Noëlani van den Berg "A journey into the unknown – deciphering Avocado defence against pathogens" *(November 2023)*
- Prof. Chris Weldon "Using insect behaviour and temperature responses for precision pest management and African food security," *(April 2025)*
- Prof. Irene Barnes "Strengthening forest health through population genetic insights and global networks" *(April 2025)*

FABI PEOPLE

ACADEMIC STAFF AND RESEARCH LEADERS

Prof. Bernard Slippers (Director)
Prof. Fanus Venter (Deputy Director)
Prof. Yusuf Abdullahi Ahmed
Prof. Irene Barnes
Prof. Dave Berger
Prof. Martin Coetzee
Prof. Teresa Coutinho
Prof. Tuan Duong
Prof. Gerda Fourie
Prof. Michelle Greve
Prof. Almuth Hammerbacher
Prof. Brett Hurley
Prof. Tjaart Kruger
Prof. Eshchar Mizrachi
Prof. Lucy Moleleki
Prof. Zander Myburg (retired 2024)
Prof. Sanushka Naidoo
Prof. Christian Pirk
Prof. Catherin Sole
Prof. Emma Steenkamp
Prof. Noëlani van den Berg
Prof. Albé van der Merwe
Prof. Jacquie van der Waals
Prof. Cobus Visagie
Prof. Juan Vorster
Prof. Chris Weldon
Prof. Brenda Wingfield
Prof. Mike Wingfield
Dr Khumbuzile Bophela
Dr Nicky Creux
Dr Honest Machekano
Dr Robert Mangani
Dr Thabiso Motaung
Dr David Nsibo
Dr Tshima Ramakuwela
Dr Velushka Swart
Dr Markus Wilken
Dr Neriman Yilmaz

PROFESSIONAL SUPPORT STAFF

Dr Robert Backer
Dr Maryke Carstens
Dr Rosali Moffat
Dr Ronishree Mangwanda
Dr Wilma Nel
Dr Nicky Olivier
Dr Avishoni Zwane
Morné Booij-Liewes
Annah Boreni
Samantha Bush
Helen Doman
Zelda du Toit-Boshoff
Heidi Fysh
Onke Gayiya
Ruth Guilande
Freddy Henneke (till 2025)
Matthew Jackson
Sandisiwe Jali
Joseph Khadile
Tebogo Khantsi
Pritty Khumalo
Daniella Kramer
Ncobile Kunene
Josias Letaoane
Siyabonga Magagula (till 2024)
Grieta Mahlangu-Kobe
Lawrence Mataha
Zandile Mngadi
Tersia Moabelo
Katlego Moatshe
Jastina Modise
Patience Motaung
Sindiso Mtshubungu
Alec Mtuyedwa
Eva Muller
Kelly Naidoo
Aysha Ndou
Celani Nkosi
Sophie Nyoni
Boitshoko Rammuki
Melissa Reynolds
Esther Seanego
Doleen Sehlabane
Gladys Shabangu
Steven Shange
Nicolette Sianyuka
Lydia Twala
Alishia van Heerden
Madelein van Heerden
Estie van Rensburg
Nicole van Vuuren
Adri Veale
Alicia Vermeulen
Anien Viljoen
Thandeka Wasserman
Renate Zipfel

RESEARCH FELLOWS

Dr Janneke Aylward
Dr Tanay Bose
Dr Nanette Christie (till 2024)
Dr Lieschen de Vos
Dr Gudrun Dittrich-Schröder
Dr Seonju Marincowitz
Dr Esther Muema (till 2024)
Dr Trudy Paap
Dr David Read
Dr Erik Visser (till 2024)
Dr Ashok Prabu (till 2023)
Dr Michelle Schröder
Dr Magriet van der Nest

POSTDOCTORAL FELLOWS

Dr Felipe Balocchi
Dr Jane Chepsergon (till 2024)
Dr Charlene Clarke
Dr Firehiwot Eshetu
Dr Alicia Fick
Dr Katrin Fitza (till 2024)
Dr Felix Fru (till 2023)
Dr Tanweer Goolam Mahomed
Dr Merfin Gossa (till 2025)
Dr Mehari Hawku
Dr Adeoye Kayode
Dr Melissa Joubert
Dr Dawit Kidanemariam (till 2024)
Dr WenWen Li
Dr Privilege Makunde
Dr Molly Malefo (till 2024)
Dr Kevin Malod
Dr Phrasia Mapfumo
Dr Marzieh Mehrabioon Mohammadi
Dr Yamkela Mgwatyu
Dr Nthabiseng Mokoena
Dr Jackson Muyobela
Dr Towan Nothling
Dr Olabimpe Orubuloye (till 2023)
Dr Elisa Pal (till 2024)
Dr Nam Pham
Dr Mary Ranketse
Dr Myriam Solís Garcia
Dr Lazarus Takawira
Dr Demissew Tesfaye Teshome
Dr Ariska van der Nest
Dr Bertus van Heerden
Dr Tanya Welgemoed
Dr Andi Wilson (till 2023)

PhD CANDIDATES

Conrad Addikah
Gbenga Alabi
Callin Ceriani
Claudette Dewing
Philani Dlamini
Lihan Esterhuizen
Taygen Fuchs
Ginna Granados
Aaron Harvey
Pilar Hemmelman Pison
Vaylen Hlaka
Bianca Hough
Carlynn Jacobs
Christoff Joubert
Rosa Knoppersen
Katlego Kopotsa
Sithembile Kunene
Frances Lane
Anneri Lotter
Mabodiba Maake
Koketso Maenetja
Yosep Marpaung
Kenny Masuku
Ofentse Mathibela
Lazarus Mavima
Thandeka Mbanjwa
Khulekani Mbatha
Kayla Midgely
Tsakani Miyambo
Spumelele Mkhize
Thembeka Mkhize
Ofentse Mmako
Tshepo Mmushi
Fanele Mnguni
Heike Möller
Whelma Mphela
Sizwe Mthembu
Trystan Nadasen
Ruth Nante
Nkosinathi Ndaba
Ndamulelo Nengovhela
Phophi Nethononda
Celiwe Nxumalo
Phumlani Nzuza
Evanson Omuse
Siphephelo Phungula
Jenna-Lee Price
Dylan Pullock
Innocent Rakubu
Jane Ramaswe
Francina Ratsoma
Agni Saha
Onkgopostse Seabi
Luki-Marié Scheepers
Cassandra Schoeman
Lehlogonolo Shalang
Preston Shaw
Nomfondo Shinga
Mandla Sibiya
Nike Sinulingga
Byron Sonnekus
Benedicta Swalarsk-Parry
Shae Swanepoel
Samkelisiwe Thango
Cheyenne Theron
Chanel Thomas
Garyn Townsend
Alida van Dijk
Alishia van Heerden
Melandré van Lill
Lenteli van Zyl
Raven Wienk
Nomakula Zim
Ngoye Zondo

MSc STUDENTS

Lina Angel Salazar
Allen Arineitwe
Adam Bazerbachi
Matthew Bennett
Caylee Benson
Jessica Berry
Lindo Biyela
Simoné Bornman
Ryan Bosch
Eneri Botha
Freddie Botha
Iné Botha
Lisa Botha
Jana Botes
Marcelle Booysen
Vida Burger
Sarah Burnett
Hlengiwe Chiliza

Johan Cilliers
Johane Cilliers
Streicher Claassens
Gabrielle Clara
Janie Coetzer
Kyle Craninx
Cerista de Meulenaere
Angelique de Wet
Robyn Dzirba
Caitlyn English
Kerryn Fourie
Jennifer Gomes de Freitas
Johan Griesel
Adri Grobler
Christiaan Grobler
Bianca Hattingh
Alecia Heyns
Fanele Hlabisa
Cliriska Hoffman
Brittney-Aidan Jamieson
Zimazile Jazi
Thandiwe Joe
Mukondeleli Khethani
Randy Khoza
Wisely Kola
Nigel Kombora
Jolize Kruger
Kyle Leeuwendaal
Marchelle Ludick
Julia Lutz
Lekhetho Maffa
Chulumanco Majavu
Bianke Marx
Mpho Matsetela
Precious Mbara
Tshegofatso Mbere
Jason McNeil
Thabo Moabi
Percy Mokwena
Tebogo Molemela
Otlotleng Moloto
Tshoganyetso Motete
Tuelo Motloba
Kiara Munsamy
Thobeka Mzimela
JJ Nelson
Catherina Ngongi-Kuetezang
Nhlonipho Ngubane
Nwabisa Ngwentle
Sinethemba Nkosi
Annabel Norval
Kwazi Nxumelo
Ipeleng Pooa
Deanné Raaths
Lizzy Ramela
Michane Reutener
Vera Roder
Lize Rostoll
Sean Schultze
Alinaswe Selebi
Siphamandla Shongwe
Sinenhlanhla Shongwe
Aviwe Simandla
Adelaide Simelane
Kaliwe Sindazi
Qiniso Sithole
Drake Slabbert
Michal Slupski
Megan Smit
Shae Swanepoel
Lizaan Taljaard
Grant Terblanche
Kayla Thomas
Unathi Tshabalala
Jean van den Berg
Megan van der Westhuizen
Bertus van Rooy
Anien Viljoen

HONOURS (Year of degree registration)

2023

Adam Bazerbachi
Simone Bence
Matthew Bennet
Jessica Berry
Marcelle Booysen
Simoné Bornman
Jana Botes
Jessica Coetze
Sapphire de Zoete
Vicki Hurwitz
Michelle Kretzschma
Anthea le Roux
Tshwanelo Mashimbye
Goitseona Modisane
Phenyo Mokgadi
Sophie Nyoni
Grant Terblanche
Ipeleng Pooa
Tanya Pretorius
Bernice Small
Faan Smit
James Smit
Alexander Sotiralis
Hanneke van Loggerenberg

2024

Caylee Benson
Freddie Botha
Janie Coetzer
Matthew Ronan Cosser
Kyle Craninx
Aspen Downing
Sam Eichhorn
Caitlyn English
Kerryn Fourie
Jennifer Gomes de Freitas
Natalie Kapsosideris
Tshiamo Lesedi
Julia Lutz
Nokhutula Madekufamba
Bianke Marx
Tshwanelo Mathala
Sokunene Mpupa
Mandisa Mthombeni
Promise Ndlovu
JJ Nelson
Annabel Norvaln
Cloé Özdemir
Deanné Raaths
Michané Reutener
Holly Rosenberg
Kaliwe Sindazi
James Smith
Tolu Soogun
Lizaan Taljaard
Kananelo Thelejane
Kayla Thomas
Unathi Tshabalala
Anmari van Buuren
Jean van den Berg
Itha Wessels

2025

Carla Botha
Kaylen Botha
Anya Cilliers
Zandri Coetzee
Sydney Cohen
Janhvi Dayah
Paul Els
Nandus Grobbelaar
Nadia Gürtel
Palesa Kubayi
Chloe Launder
Oratile Lekalakala
Ndumiso Mabuza
Mamello Machusi
Damei McCue
Leanne Meyer
Nondumiso Mngomezulu
Tiisetso Moiloa
Karabelo Mokoena
Cebo Nkosi
Pearl Nkosi
Rabia Omar
Ayanda Phululа
Michelene Ramphal
Albert Retief
Danielle Rosner
Monique Saayman
Kiara Schutte
Jessie Sherriffs
Maxine Short
Agreanette Sibanyoni
Anna Tendenedzai
Mckayla Tobias
Nicole Umutoni
Cairin van 'T Hof
Nicki van Aardt
Wesley van der Wel
Melissa Venter
Jandré Verster
Keegan Walton

INTERNS

Andile Matabata *(2023-2024)*
Bongani Mahlangu *(2023-2024)*
Mukondeleli Khethani *(2023-2024)*
Tjitjila Makhura *(2023-2024)*
Nicolette Siyanyuka *(2023-2024)*
Lerato Dhlamini *(2023-2024)*
Khulekani Mbatha *(2023-2024)*
James Smith *(2024)*
Forgiveness Chiloane *(2024-2025)*
Phenyo Mokgadi *(2024-2025)*
Annah Boreni *(2024-2025)*
Charmaine Mabena *(2024-2025)*
Nomasonto Mahlaba *(2024-2025)*
Steven Shange *(2024-2025)*
Nolusizo Sithole *(2024-2025)*
Nosihle Xulu *(2024-2025)*
Phenyo Mokgadi *(2025-2026)*
Beverly Buthane *(2025-2026)*
Gcinokuhle Buthelezi *(2025-2026)*
Bonolo Ditshego *(2025-2026)*
Julia Mashishi *(2025-2026)*
Ronewa Nethononda *(2025-2026)*
Precious Ramovha *(2025-2026)*
Zoyolo Somi *(2025-2026)*
Leanie de Beer *(ARP- 2025)*

FABI GRADUATES

PhD

Dr Juanita Avontuur
Thesis: Genome-based systematics of *Bradyrhizobium* and its species
Supervisor: Prof. ET Steenkamp
Co-supervisors: Prof. MPA Coetzee, Prof. SN Venter
External co-supervisor: Prof. TM Stepkowski *(Warsaw University of Life Sciences, Poland)*

Dr Felipe Balocchi Schalchli
Thesis: Araucaria (*Araucaria araucana*) canker disease in Chile: etiology and fungal diversity
Supervisor: Prof. I Barnes
Co-supervisors: Prof. MJ Wingfield
External co-supervisor: Dr RJ Ahumada *(Arauco, Chile)*

Dr Harm Barten
Thesis: Factors influencing the efficacy of biological control of *Gonipterus* sp. n. 2 by *Anaphes nitens*
Supervisor: Prof. BP Hurley
Co-supervisors: Prof. B Slippers, Dr ML Schröder

Dr Julia Candotti
Thesis: Haplogenome analysis and genetic dissection of growth and wood property traits in *Eucalyptus urophylla* x *E. grandis* hybrids
Supervisor: Prof. AA Myburg
Co-supervisors: Prof. E Mizrachi, Prof. S Naidoo, Prof. AT Duong

Dr Firehiwot Eshetu
Thesis: Diversity in *Sirex noctilio*, *Amylostereum areolatum* and *Deladenus siricidicola* populations in Australasia and its implications for biological control
Supervisor: Prof. B Slippers
Co-supervisor: Prof. I Barnes
External co-supervisor: Dr H Nahrung *(University of the Sunshine Coast, Australia)*

Dr Sasha-Lee Gush
Thesis: Disentangling shifts in the soil microbiome of potatoes infected with *Rhizoctonia solani* AG 3-PT in two contrasting regions of South Africa
Supervisor: Prof. JE van der Waals
Co-supervisors: Prof. TA Coutinho, Prof. DA Cowan, Dr PH Bixirao Neto Marinho Lebre

Dr GuoQing Li
Thesis: Diversity and biology of Botryosphaeriaceae species associated with *Eucalyptus* in southern China
Supervisor: Dr SF Chen
Co-supervisors: Prof. B Slippers, Prof. MJ Wingfield

Dr WenWen Li
Thesis: Distribution, biology and diversity of *Calonectria* species on *Eucalyptus* in southern China
Supervisor: Prof. AT Duong
Co-supervisors: Prof. MJ Wingfield, Dr SF Chen, Dr F Liu

Dr QianLi Liu
Thesis: Phylogeny, taxonomy and the ecology of *Calonectria* species
Supervisor: Dr SF Chen
Co-supervisors: Prof. MJ Wingfield, Prof. BD Wingfield, Prof. AT Duong

Dr Teresia Macharia
Thesis: Identification and functional characterization of *Meloidogyne javanica* pathogenicity factors
Supervisor: Prof. LN Moleleki

Dr Privilege Makunde
Thesis: Biology and ecology of *Eucalyptus* psyllid pests in South Africa
Supervisor: Prof. BP Hurley
Co-supervisor: Prof. B Slippers

Dr Silindile Maphosa
Thesis: Secretome analyses of selected *Pectobacterium brasiliense* 1692 secretion systems
Supervisor: Prof. LN Moleleki

Dr Mandy Messal
Thesis: Fungal community interactions in the *Eucalyptus grandis* phyllosphere
Supervisor: Prof. B Slippers
Co-supervisor: Prof. S Naidoo
External co-supervisor: Dr M Kemler *(Ruhr-University Bochum, Germany)*

Dr Rachel Mkandawire
Thesis: Diversity of *Fusarium* Link and mite species associated with malformed *Syzygium cordatum* Hochst. Ex Krauss (water berry) inflorescences
Supervisor: Dr G Fourie
Co-supervisors: Prof. ET Steenkamp, Prof. MJ Wingfield, Dr N Yilmaz

Dr Knowledge Mushonga
Thesis: Crop rotation effects on soil and plant health in a dryland production system in South Africa
Supervisor: Prof. JE van der Waals
Co-supervisor: Prof. JM Steyn
External co-supervisor: Prof. WJ Swart *(University of the Free State)*

Dr Deborah Narh Mensah
Thesis: Characterising some mechanisms of iron homeostasis in selected *Armillaria* species
Supervisor: Prof. MPA Coetzee
Co-supervisor: Prof. BD Wingfield

Dr Elisa Pal
Thesis: Ecology and management of *Bathycoelia distincta* (two-spotted stink bug) in Macadamia orchards in South Africa
Supervisor: Dr G Fourie
Co-supervisors: Prof. JD Allison, Prof. BP Hurley, Prof. B Slippers

Dr Nam Pham
Thesis: Discovery of the cause and relevance of a serious new *Eucalyptus* foliar disease in Indonesia
Supervisor: Prof. MJ Wingfield
Co-supervisors: Prof. I Barnes, Prof. BD Wingfield

Dr Lazarus Takawira
Thesis: Inferring secondary cell wall-related R2R3-MYB transcription factor gene targets in *Eucalyptus grandis* using DNA affinity purification sequencing
Supervisor: Dr SG Hussey
Co-supervisors: Prof. E Mizrachi, Prof. AA Myburg

Dr Marthin Tarigan
Thesis: Emerging pathogens of *Eucalyptus* and *Acacia* plantation forestry in Indonesia
Supervisor: Prof MJ Wingfield
Co-supervisor: Prof I Barnes

Dr Demissew Teshome
Thesis: The response of *Eucalyptus grandis* to drought stress, rewatering and combined stress involving *Chrysoporthe austroafricana* infection
Supervisor: Prof. S Naidoo
External co-supervisors: Prof. GE Zharare *(University of Zululand)*, Dr RAP Ployet *(Oak Ridge National Laboratory, United States of America)*

Dr Tanya Welgemoed
Thesis: Comparative genomics of diverse African isolates of *Cercospora zeina*
Supervisor: Prof. DK Berger
Co-supervisors: Prof. I Barnes, Prof. AT Duong
External co-supervisor: Prof. E Holtgrewe-Stukenbrock (Christian-Albrechts University of Kiel, Germany)

MSc *(* with distinction)*

Jade Ashmore*
Dissertation: Development of CRISPR/Cas9 gene editing tools for the insect pest *Gonipterus* sp.n. 2
Supervisor: Dr G Dittrich-Schröder
Co-supervisors: Prof. AT Duong, Prof. B Slippers

Vasili Balios
Dissertation: Engineering early floral induction in *Eucalyptus* by manipulating the Flowering Locus T (FT) gene
Supervisor: Prof. AA Myburg
Co-supervisor: Dr SG Hussey

Shivan Bezuidenhout*
Dissertation: The fungal diversity and mycotoxins associated with South African soybeans
Supervisor: Prof. CM Visagie
Co-supervisor: Dr N Yilmaz

Carla Buitendag
Dissertation: Gene silencing mediated by dsRNA reduces grey leaf spot disease in maize
Supervisor: Prof. DK Berger
Co-supervisor: Prof. J Theron

Callin Ceriani*
Dissertation: Population genetic and genomic analysis of *Fusarium circinatum* in Colombia
Supervisor: Prof. BD Wingfield
Co-supervisors: Prof. ET Steenkamp, Prof. MJ Wingfield

Derick Claassens
Dissertation: Diversity of diazotrophic bacteria associated with *Eucalyptus* and *Acacia* trees
Supervisor: Prof. ET Steenkamp
Co-supervisor: Prof. SN Venter

Vinolia Danki
Dissertation: Genome-wide analysis of fitness data in *Ceratocystis albifundus*
Supervisor: Dr MA van der Nest
Co-supervisors: Prof. ET Steenkamp, Prof. BD Wingfield, Dr L de Vos
External co-supervisor: Dr NP Mchunu *(National Research Foundation)*

Deanné du Plessis*
Dissertation: Genomic insights into the pathogenicity and host adaptation in species of the *Leptographium wageneri* complex
Supervisor: Prof. AT Duong
Co-supervisors: Prof. MJ Wingfield, Prof. BD Wingfield

Ruby Ebbeling*
Dissertation: Precision phenotyping of pines for resistance against *Fusarium circinatum*
Supervisor: Prof. S Naidoo
Co-supervisor: Dr EA Visser

Lihan Esterhuizen*
Dissertation: Detection of Phytophthora root rot in *Eucalyptus* trees using hyperspectral leaf reflectance
Supervisor: Prof. A Hammerbacher
Co-supervisors: Prof. B Slippers, Dr T Bose, Dr AS Bosman

Casey Gill
Dissertation: Metabarcoding of the fungal mutualists associated with *Xylosandrus crassiusculus* found on avocado in South Africa
Supervisor: Prof. N van den Berg
Co-supervisors: Dr J Engelbrecht, Dr G Fourie

Bianca Hough*
Dissertation: Genomic characterisation of mycoviruses associated with members of Ceratocystidaceae
Supervisor: Dr DA Read
Co-supervisor: Prof. BD Wingfield

Marisca Hough
Dissertation: Comparing a pathogenicity effector gene family from two *Cercospora* species by agroinfiltration into tobacco
Supervisor: Prof. DK Berger

Marizanne Jones
Dissertation: Diversity and virulence of the fungus *Beauveria* (Cordycipitaceae) species associated with *Gonipterus* sp. n. 2 (Coleoptera: Curculionidae) in South Africa
Supervisor: Dr ML Schröder
Co-supervisors: Prof. BP Hurley, Prof. B Slippers

Harris Keetse
Dissertation: Economic impact and re-establishment of biological control for *Gonipterus* sp. 2 in *Eucalyptus* plantations in South Africa
Supervisor: Prof. BP Hurley
Co-supervisor: Dr ML Schröder
External co-supervisors: Dr I Germishuizen *(University of KwaZulu-Natal)*, Dr BJ Sivparsad *(University of KwaZulu-Natal)*

Sung Hyu Luke Kim
Dissertation: CRISPR gene editing of glucuronoxylan methyltransferase genes in *Populus tremula* x *alba* hybrids to alter xylan properties for woody biomass processing
Supervisor: Prof. AA Myburg
Co-supervisors: Prof. E Mizrachi, Dr VJ Maloney

Daniella Krämer*
Dissertation: Characterization of hybridization events between three closely related species of *Ceratocystis*
Supervisor: Dr PM Wilken
Co-supervisors: Prof. ET Steenkamp, Prof. BD Wingfield

Lukanyo Makhabane*
Dissertation: Genome defence mechanisms in Basidiomycota fungi, with special reference to *Armillaria* species
Supervisor: Prof. MPA Coetzee
Co-supervisors: Prof. ET Steenkamp, Prof. BD Wingfield
External co-supervisor: Dr S van Wyk *(Stellenbosch University)*

Idea Makowe
Dissertation: Factors influencing the rearing and success of biological control agents of *Gonipterus* sp. n. 2 (Coleoptera: Curculionidae)
Supervisor: Prof. BP Hurley
Co-supervisor: Dr ML Schröder

Mmapaseka Malebe
Dissertation: Bacterial community associated with *Acacia crassicarpa* seeds and cotyledons
Supervisors: Prof. TA Coutinho
Co-supervisor: Dr G Shin

Nomaswazi Maseko
Dissertation: Transcriptional elements in the Ceratocystidaceae
Supervisor: Dr PM Wilken
Co-supervisors: Prof. ET Steenkamp, Prof. BD Wingfield

Lindokuhle Masimula
Dissertation: Characterization of selected rhizobia as potential inoculants for crop legumes in South Africa
Supervisor: Dr EK Muema
Co-supervisors: Prof. ET Steenkamp, Prof. SN Venter, Dr CW Krynauw

Ongeziwe Mbhele
Dissertation: Phenotype-genotype distinctions among clones of the pine pitch canker pathogen, *Fusarium circinatum*
Supervisor: Prof. ET Steenkamp
Co-supervisors: Prof. A Hammerbacher, Dr FF Fru, Dr QC Santana, Dr MA van der Nest

Kayla Midgley*
Dissertation: Identification and expression analysis of *Phytophthora cinnamomi* CRN effector genes during infection of *Persea americana* (Mill.)
Supervisor: Dr V Swart
Co-supervisor: Prof. N van den Berg

Valencia Mogashoa
Dissertation: Development of a Fourier Transform Infrared (FT-IR) model for screening susceptible and resistant *Eucalyptus* clones against *Chrysoporthe austroafricana*
Supervisor: Prof. S Naidoo
External Co-supervisor: Prof. P Bonello *(The Ohio State University, United States of America)*

Tumisang Mokgobu
Dissertation: Aggressiveness of diverse African isolates of *Cercospora zeina* on maize
Supervisor: Prof. DK Berger
Co-supervisor: Dr DL Nsibo

Alice Mthembu
Dissertation: Survey of soil fungal and oomycete diversity from maize field soil in the Eastern Cape, South Africa
Supervisor: Prof. CM Visagie
Co-supervisor: Dr N Yilmaz

Monique Muller*
Dissertation: Population genetic analysis and evolutionary history of the pine needle pathogen, *Dothistroma pini*
Supervisor: Prof. I Barnes
Co-supervisor: Prof. MJ Wingfield

Ruth Nante*
Dissertation: Comparative genomics of the nuclear and mitochondrial genomes of fungal tree pathogens causing Dothistroma needle blight
Supervisor: Prof. I Barnes
Co-supervisors: Prof. MPA Coetzee, A Postma

Tiphany Nkomo
Dissertation: Exploring the mycorrhizal interactions and deciphering the fungal diversity associated with orchid hybrids from the genus *Epidendrum*
Supervisor: Prof. A Hammerbacher
Co-supervisors: Prof. BD Wingfield, Dr T Bose

Chizné Peremore*
Dissertation: Biofilms and extracellular vesicles of *Fusarium verticillioides* and their implication for virulence
Supervisor: Dr TE Motaung
Co-supervisors: Prof. ET Steenkamp, Dr QC Santana

Tshiamo Phakalatsane
Dissertation: Analysis of the mating-type loci of *Chrysoporthe* species
Supervisor: Prof. NA van der Merwe
Co-supervisor: Dr PM Wilken

Tania Pogue*
Dissertation: Environmental and physiological correlates of response by three fruit fly (Diptera: Tephritidae) species to commercial lures
Supervisor: Prof. CW Weldon
External co-supervisor: Dr KNP Malod *(Stellenbosch University)*

Jenna-Lee Price*
Dissertation: The fungal diversity associated with maize from emerging farms in the Eastern Cape, South Africa
Supervisor: Prof. CM Visagie
Co-supervisor: Dr N Yilmaz

Dylan Pullock
Dissertation: Development of novel surveillance tools for rapid detection of citrus psyllids
Supervisor: Prof. CW Weldon
Co-supervisor: Prof. K Krüger
External co-supervisor: Prof. A Manrakhan *(Citrus Research International)*

Nombulelo Qikani
Dissertation: The fungal and oomycete diversity associated with commercial maize farm soils of South Africa
Supervisor: Prof. CM Visagie
Co-supervisors: Prof. ET Steenkamp, Dr N Yilmaz

Jostina Rakoma
Dissertation: Structure of the mating-type locus in ambrosial and asexual Ceratocystidaceae species
Supervisor: Dr PM Wilken
Co-supervisor: Prof. BD Wingfield

Innocent Rakubu*
Dissertation: Efficacy, host-finding ability and application methods of entomopathogenic nematodes to control pupae of *Gonipterus* sp. 2 (Coleoptera: Curculionidae)
Supervisor: Prof. BP Hurley
Co-supervisor: Dr A Katumanyane

Claire Randolph*
Dissertation: A population genetics study of *Fusarium euwallaceae* in South Africa
Supervisor: Prof. I Barnes
Co-supervisor: Dr T Paap

Kevin Scheepers
Dissertation: Effect of elevated CO_2 on maize susceptibility to grey leaf spot disease
Supervisor: Prof. DK Berger
Co-supervisors: Prof. JM Steyn, Dr NJ Taylor

Onkgopotse Seabi
Dissertation: Diversity of fruit flies (Diptera: Tephritidae) from the South African Highveld and Lowveld and a preliminary assessment of their infection with Wolbachia
Supervisor: Prof. CW Weldon
Co-supervisor: Prof. AD Bastos

Lebone Sebapu
Dissertation: Novel markers for inference of species boundaries in *Ceratocystis fimbriata* sensu lato
Supervisor: Prof. AT Duong
Co-supervisor: Prof. BD Wingfield

Kothibe Sedibane*
Dissertation: The role of *Pectobacterium brasiliense* 1692 outer membrane vesicles on members of soft rot Enterobacteriaceae and *Phytophthora parasitica*
Supervisor: Prof. LN Moleleki
Co-supervisor: Dr TE Motaun

Preston Shaw*
Dissertation: Alternative splicing in the fungal plant pathogens *Ceratocystis fimbriata* and *C. eucalypticola*
Supervisor: Prof. AT Duong
Co-supervisors: Prof. B Slippers, Prof. BD Wingfield

Cheyenne Theron*
Dissertation: Characterization of *Lecanosticta* and *Lophodermium* species on non-native pines in the southern Hemisphere
Supervisor: Prof. I Barnes
Co-supervisor: Prof. MJ Wingfield

Eloff Theron
Dissertation: Phosphonate sensitivity of *Phytophthora* in South African citrus orchards and nurseries
Supervisor: Prof. JE van der Waals
Co-supervisor: Prof. TA Coutinho
External co-supervisor: Dr J van Niekerk *(Citrus Research International)*

Chanel Thomas*
Dissertation: Reconsidering the taxonomy of *Sclerotinia* with special reference to *S. sclerotiorum*
Supervisor: Dr PM Wilken
Co-supervisors: Prof. MPA Coetzee, Prof. CM Visagie

Dee Twiddy*
Dissertation: Characterisation of Macadamia nut diseases in South Africa
Supervisor: Dr G Fourie
External co-supervisors: Prof. OA Akinsanmi *(The University of Queensland, Australia)*, Dr A Fourie *(Utrecht University, The Netherlands)*

Elmarie van der Merwe*
Dissertation: Development of CRISPR/Cas9 gene editing tools for the insect pest *Sirex noctilio*
Supervisor: Dr G Dittrich-Schröder
Co-supervisor: Prof. B Slippers

Alida van Dijk*
Dissertation: Development of CRISPR-Cas systems for genome and transcriptome editing in *Fusarium circinatum*
Supervisor: Prof. ET Steenkamp
Co-supervisors: Prof. BD Wingfield, Dr AM Wilson

Alishia van Heerden*
Dissertation: Characterisation of the melanin biosynthesis gene cluster and its application in species identification
Supervisor: Dr PM Wilken
Co-supervisors: Prof. MJ Wingfield, Prof. BD Wingfield

Melandré van Lill*
Dissertation: Prediction of key phenotypes of *Mesorhizobium* based on genome sequences
Supervisor: Prof. SN Venter
Co-supervisor: Prof. ET Steenkamp
External co-supervisor: Dr CW Krynauw *(The James Hutton Institute, United Kingdom)*

Nicole van Vuuren*
Dissertation: Fungal diversity in Namibian *Stipagrostis* 'fairy circles" including the description of new *Curvularia*species
Supervisor: Dr N Yilmaz
Co-supervisors: Prof. CM Visagie, Prof. MJ Wingfield

Sumari Venter
Dissertation: Differential gene expression linked to parasitic and mycetophagous forms of *Deladenus siricidicola* in culture
Supervisor: Prof. B Slippers
Co-supervisor: Ms A Postma

Edwin Wanjofu*
Dissertation: Taxonomy and symbiotic effectiveness of *Mesorhizobium* associated with chickpea
Supervisor: Dr EK Muema
Co-supervisors: Prof. ET Steenkamp, Prof. SN Venter, Dr CW Beukes

BSc HONOURS
(Dates indicate year of graduation)

- Susanna Anbu *(2023)*
- Yuvaan Bhimsan *(2023)*
- Ryan Bosch *(2023)*
- Taygen Fuchs *(2023)*
- Christiaan Grobler *(2023)*
- Aaron Harvey *(2023)*
- Brittney Jamieson *(2023)*
- Shalya Moodley *(2023)*
- Monique Muller *(2023)*
- Kiara Munsamy *(2023)*
- Anicka Nel *(2023)*
- Anja Piso *(2023)*
- Rorisang Tomotomo *(2023)*
- Bertus van Rooy *(2023)*
- Rodé Visser *(2023)*
- Adam Bazerbachi *(2024)*
- Simone Bence *(2024)*
- Matthew Bennet *(2024)*
- Jessica Berry *(2024)*
- Marcelle Booysen *(2024)*
- Simoné Bornman *(2024)*
- Jana Botes *(2024)*
- Jessica Coetzee *(2024)*
- Sapphire de Zoete *(2024)*
- Vicki Hurwitz *(2024)*
- Michelle Kretzschmar *(2024)*
- Anthea le Roux *(2024)*
- Tshwanelo Mashimbye *(2024)*
- Goitseona Modisane *(2024)*
- Phenyo Mokgadi *(2024)*
- Sophie Nyoni *(2024)*
- Ipeleng Pooa *(2024)*
- Tanya Pretorius *(2024)*
- Bernice Small *(2024)*
- Faan Smit *(2024)*
- James Smith *(2024)*
- Alexander Sotiralis *(2024)*
- Grant Terblanche *(2024)*
- Hanneke van Loggerenberg *(2024)*

VISITORS AND SEMINARS

FABI VISITORS

Prof. Diana Six, University of Montana, USA *(May 2023)*
Dr Esther de Rycke, Ghent University, Belgium *(May 2023)*
Prof. André Drenth, University of Queensland, Australia *(May 2023 & March 2024)*
Prof. Jonas Oliva, University of Lleida, Spain *(May 2023)*
Prof. Bruce Talbot, University of Stellenbosch, South Africa *(May 2023)*
Prof. Mary Scholes, University of the Witwatersrand, South Africa *(May 2023)*
Dr Ilaria Germishuizen, Institute for Commercial Forestry Research, South Africa *(May 2023)*
Dr Yolandi Ernst, University of the Witwatersrand, South Africa *(May 2023)*
Dr Jessica Steinkopf, University of the Witwatersrand, South Africa *(May 2023)*
Prof. Jonathan Jansen, University of Stellenbosch, South Africa *(May 2023)*
Dr JJ Acosta, North Carolian State University / CAMCORE, USA *(July 2023 & May 2024)*
Dr Srikumar Koda Kkadan, Asia Pacific resources International Holdings (APRIL), Indonesia *(April 2023)*
Nike Sinulingga, Asia Pacific resources International Holdings (APRIL), Indonesia *(April 2023)*
Dr Heinz Meissner, Milk SA, South Africa *(May 2023)*
Nico Fouché, Milk SA, South Africa *(May 2023)*
Dr Carlos Rodas, Smurfitt-Kappa, Colombia *(May 2023)*
Prof. Jolanda Roux, SAPPI, South Africa *(May 2023)*
Ms Izette Greyling, MONDI, South Africa *(May 2023)*
Prof. Pedro Crous, Westerdijk Fungal Biodiversity Institute, the Netherlands *(July 2023)*
Prof. Angel Medina-Vaya, Cranfield University, UK *(July 2023)*
Ben Pienaar, MONDI, South Africa *(July 2023)*
Dr Marius du Plessis, MONDI, South Africa *(July 2023)*
Prof. Rachel Green, Hebrew University of Jerusalem, Israel *(September 2023)*
SA Kiwi Growers Association (Board members), South Africa *(September 2023)*
Prof. Olufemi Akinsanmi, University of Queensland, Australia *(October 2023)*
Dr Katelyn Faulkner, SANBI, South Africa *(October 2023)*
Prof. Jiri Hulcr, University of Florida, USA *(October 2023)*
Prof. Caterina Villari, University of Georgia, USA *(October 2023)*
Southern Africa Biotechnology Study Tour delegation, Africa & USA *(October 2023)*
Univen student visit, South Africa *(October 2023)*
Milk SA (Board members), South Africa *(November 2023)*
Dr Khotso Mokhele, Hans Merensky Holdings, South Africa *(November 2023)*
Prof. Johan van Zyl, African Rainbow Capital, South Africa *(November 2023)*
Hennelie Coetzee, Artist, South Africa *(November 2023)*
Prof. Ben-Erik van Wyk, University of Johannesburg, South Africa *(November 2023)*
Prof. André Fleißner, Technical University of Braunschweig, Germany *(December 2023)*
Prof. Fikret Isik, North Carolina State University, USA *(December 2022 - December 2023)*
Prof. Yuyuan Peng, Hubei University of Science and Technology, China *(December 2023)*
Dr Daode Zhang, Hubei University of Science and Technology, China *(December 2023)*
Dr Xinbin Hu, Hubei University of Science and Technology, China *(December 2023)*
Dr Zew Fu, Hubei University of Science and Technology, China *(December 2023)*
Dr Yan Long, Hubei University of Science and Technology, China *(December 2023)*
Dr Xiuhong Liu, Hubei University of Science and Technology, China *(December 2023)*
Prof. Florence Hommais, University of Lyon 1, France *(December 2023)*
Shen Long, Embassy of the People's Republic of China in South Africa, China *(December 2023)*
Dr Li Yan, Embassy of the People's Republic of China in South Africa, China *(December 2023)*
Xie Wei, Embassy of the People's Republic of China in South Africa, China *(December 2023)*
Dr Pan Xu, Embassy of the People's Republic of China in South Africa, China *(December 2023)*
Prof. Yuyuan Peng, Hubei University of Science and Technology, China *(December 2023)*
Dr Daode Zhang, Hubei University of Science and Technology, China *(December 2023)*
Dr Xinbin Hu, Hubei University of Science and Technology, China *(December 2023)*
Dr Zew Fu, Hubei University of Science and Technology, China *(December 2023)*
Dr Yan Long, Hubei University of Science and Technology, China *(December 2023)*
Dr Xiuhong Liu, Hubei University of Science and Technology, China *(December 2023)*
Dr Guy Sutton, Rhodes University, South Africa *(January 2024)*

Prof. Dan Bebber, University of Exeter, UK *(February 2024)*
Prof. Eva Stukenbrock, Christian-Albrechts University of Kiel/Max Planck Institute of Evolutionary Biology, Germany *(February 2024)*
Dr Pamela Soltis, Florida Museum of Natural History, USA *(February 2024)*
Dr Frederik Mortier, Ghent University, South Africa *(February 2024)*
Dr Rose Marks, University of Illinois, USA *(February 2024)*
Makensie Mabry, Florida Museum of Natural History, USA *(February 2024)*
Prof. Doug Soltis, Florida Museum of Natural History, USA *(February 2024)*
Prof. Sherif Elsayed, Helmholtz, Centre for Infection Research, Germany *(March - June 2024)*
Botswana University of Agriculture and Natural Resources (delegation), Botswana *(April 2024)*
Dr Jeb Owen, Washington State University, USA *(April 2024)*
Prof. Paul Esker, Penn State University, USA *(May 2024)*
Dr Simon Lawson, University of the Sunshine Coast, Australia *(May 2024)*
Dr Andy Howe, University of the Sunshine Coast, Australia *(May 2024)*
Prof. David Drew, Stellenbosch University, South Africa *(May 2024)*
Prof. Martin Hill, Rhodes University, South Africa *(May 2024)*
Dr Agena Tanga, Ethiopian Forestry Research, Ethiopia *(May 2024)*
Jacqui Meyer, TIPWG, South Africa *(May 2024)*
Dr Jan Hendrik Venter, Department of Agriculture, South Africa *(May 2024)*
Prof. Brian Kvitko, University of Georgia, USA *(June 2024)*
Matthew Keulemans, Afrifungi, South Africa *(August 2024)*
Melinda Dunnet, Afrifungi, South Africa *(August 2024)*
Dr Andrey Yurkov, Leibniz Institute DSMZ, Germany *(October 2024)*
Dr Bill Hammond, University of Florida *(January 2025)*
Prof. Francis Petersen, Vice Chancellor and Principal of the University of Pretoria *(January 2025)*
Karin Nagel, ICFR, South Africa *(February 2025)*
Dr Ilaria Germishuizen, ICFR, South Africa *(February 2025)*
Greg Fuller, ICFR, South Africa *(February 2025)*
Prof. Jack Wang, North Carolina State University *(March 2025)*
Prof. Bart Thomma, University of Cologne, Germany *(March 2025)*
Prof. Martina Šeruga Musić, University of Zagreb, Croatia *(March 2025)*
Prof. Peter Mortimer, Applied Symbiotics *(April 2025)*
Prof. Dan Bebber, University of Exeter *(April 2025)*
Prof. Dr Ashraf Heniegal, President, Suez University *(April 2025)*
Dr Ali Maged Gharieb, Faculty of Science, Suez University *(April 2025)*
Dr Sherif Abu El-Magd, Suez University (April 2025)

WORKSHOP IN THE BIOPHYSICS OF FUNGAL SPORE DISPERSAL AND ITS RELEVANCE TO PLANT DISEASE *(June 2024)*

Dr Carlos Aguilar, University of Jyväskylä, Finland
Akori Esmel, Université Nangui Abrogoua Fundemental and Applied Physics Laboratory, Cote d'Ivoire
Lazaro Mashiku, Botswana International University of Science and Technology, Botswana
Dr Veera Norras, Finnish Environment Institute (Syke), Finland
Prof. Anne Pringle, University of Wisonsin-Madison, USA
Dr Lisa Rothman, University of the Free State, South Africa
Prof. Agnese Seminara, University of Genoa, Italy
Clovis Takembo Ntahkie, University of Buea College of Technology, Cameroon
Mark Unger, The Wonder Lab, USA

STUDENT VISITORS

Miriam Schalamun, Austria *(February-March 2023)*
Anne Oostlander, Technical University of Braunschweig, Germany *(December 2023)*
Milan Borchert, Technical University of Braunschweig, Germany *(December 2023)*
Leonie Berger, Helmholtz Centre for Infection Research, Germany *(March - June 2024)*
Marjorie Cedone, Helmholtz Centre for Infection Research, Germany *(March - June 2024)*
Sarah Fushimi, Helmholtz Centre for Infection Research, Germany *(March - June 2024)*
David Hernández Hernánde, Unidad de Protección Vegetal Spain *(March - July 2024)*

SPECIAL SEMINARS

Dr Esther de Rycke, Ghent University, Belgium
Title: Validation of rapid screening steps for mycotoxin analysis, taking the next steps
May 2025

Prof. Angel Medina Vaya, Cranfield University, UK
Title: Making fungi travel through time to predict future mycotoxins contamination in food commodities
July 2023

Katharina Gasser, BOKU, Austria
Title: *Fusarium* contamination of garlic in Austria
August 2023

Prof. André Fleißner, Technical University of Braunschweig, Germany
Title: Microbial dialogues: Intra- and interspecies communication in filamentous fungi
September 2023

Dr Katelyn Faulkner, SANBI, South Africa
Title: Understanding introduction pathways to inform invasive species management and policy
October 2023

Anna Oostlander, Technische Universität Braunschweig, Germany
Title: *Nerospora crassa* and *Diplodia sapinea*: From a model organism to forest pathology
December 2023

Prof. Florence Hommais, University of Lyon 1, France
Title: Virulence regulatory network of *Dickeya dadantii:* What is the role of post-transcriptional regulation?
December 2023

Prof. Dan Bebber, University of Exeter, UK
Title: Global crop pest and pathogen risks
January 2024

Prof. Dr André Drenth, Queensland Alliance for Agriculture and Food Innovation, University of Queensland, Australia
Title: The epidemic of plant disease epidemics
February 2024

Dr Jeb Owen, Washington State University, USA
Title: Using art to scaffold systems thinking and biomedical career pathways in young learners
April 2024

Prof. Paul Esker, Penn State University, USA
Title: Improving Soybean crop yields based on machine learning and causal models
May 2024

Melinda Dunnett and Matthew Keulemans, AfriFungi, South Africa
Title: AfriFungi: Unveiling the mystery
August 2024

Dr Andrey Yurkov, Leibniz Institute DSMZ - German Collection of Microorganisms and Cell Cultures, Braunschweig, Germany
Title: Wild yeasts: Diverse, versatile, and yet unexplored
September 2024

Prof. Marc Stadler, Helmholtz Centre for Infection Research (HZI), Germany
Title: Natural-product based drug discovery at the Helmholtz Centre for Infection Research
November 2024

Dr Bill Hammond, University of Florida
Title: What kills trees?
January 2025

Prof. Bart Thomma, Institute for Plant Sciences, Cluster of Excellence on Plant Sciences (CEPLAS), University of Cologne, Germany
Title: How fungal pathogens manipulate host microbiota to establish infection
March 2025

Prof. Martina Šeruga Musić, University of Zagreb, Croatia
Title: Phytoplasma story in Croatia: from the field to the genome and back
March 2025

JOINT FABI- SOUTH AFRICAN SOCIETY FOR SYSTEMATIC BIOLOGY (SASSB) SEMINAR SERIES

Dr Susan Perkins, City College of New York, USA
Title: Malaria's many mates: The systematics of haemosporidian parasites

Dr Shúné Oliver, Wits Research Institute for Malaria, South Africa
Title: Anthropogenic pollution as a driver of the evolution of insecticide resistance in the major malaria vector *Anopheles arabiensis* (Diptera: Culicidae)

Dr Mamohale Chaisi, SANBI, South Africa
Title: Genetic diversity and host-parasite relations of haemosporidia in Afrotropical birds
4 May 2023

Dr Mike Barker, University of Arizona, USA
Title: Polyploidy and the evolution of plant diversity

Ruan Van Mazijk, University of Cape Town, South Africa
Title: Genome size variation in Cape schoenoid sedges (Cyperaceae: Schoeneae) and its ecophysiological consequences

Hendrik Niemann, University of the Witwatersrand, South Africa
Title: *Hypoxis limicola* and *H. uniflorata* (Hypoxidaceae) deserve species rank: Multiple new lines of evidence
2 November 2023

Dr Susan Perkins, City College of New York, USA
Title: Protist systematics & evolution
4 April 2024

Prof. Alex Pyron, George Washington University, USA
Title: Unsupervised machine learning for species delimitation, integrative taxonomy, and biodiversity conservation
1 August 2024

Prof. Martin Coetzee, FABI, South Africa
Title: Phylogeny session for students
17 October 2024

COMMUNITY ENGAGEMENT, PARTNERSHIPS AND PRACTICE

Community engagement and partnerships is a serious consideration that is integrated into most of our activities. Here we present selected examples from 2023–2025 to illustrate our approach, rather than a comprehensive record of all activities. It highlights representative initiatives across education and training, producer-facing diagnostics, national forestry surveillance, biosecurity and invasive species management, international collaboration, and research infrastructure and scholarship. The items described are illustrative snapshots chosen to convey the range and character of FABI's contributions, with further activities documented in programme-specific reports and institutional news items.

FABI'S 25TH ANNIVERSARY SYMPOSIUM

FABI's 25th anniversary symposium at Future Africa (17 November 2023) reflected on the Institute's growth from a small unit to a globally connected organisation comprising 28 research programmes and a strong postgraduate pipeline. University leadership, industry partners, government and international collaborators discussed priorities spanning biosecurity, plant and microbial biology, resilience and management, data infrastructure and a range of other topics. Brief presentations from research groups showcased current work and future directions, while a science–art feature by Hannelie Coetzee underscored FABI's commitment to public-facing science. The event reinforced FABI's emphasis on partnership, practical solutions and talent development.

BUILDING THE PIPELINE: OUTREACH AND TRAINING

FABI's outreach covered schools, universities and early-career academics. School learners completed hands-on molecular biology and microscopy activities. Students from the University of Venda made a third visit to FABI for laboratory tours and career conversations, hearing from an alumnus who progressed from visitor to intern to MSc graduate and now PhD student. Participating in the Faculty of Natural and Agricultural Sciences Open Day, FABI drew substantial interest in plant health and biocontrol through demonstrations and discussions with staff and students. The outreach team returned to Mondi's National Science Week in Piet Retief with curriculum-linked exhibits that connected classroom theory to real-world science for large audiences of learners, teachers and the public. Interns in FABI's Phytosanitation and Biosecurity Internship Programme and others, received training that prepared them for roles in agriculture or for further study. At the senior end of the pipeline, the Department of Higher Education and Training's Future Professors Programme visited FABI to explore research leadership and group development. Collectively, these activities advanced science literacy and strengthened the national skills base.

PUBLIC PROFILE

The Phytosanitation and Biosecurity Internship Programme, supported in part by SACTA, was profiled by a commissioned film crew that interviewed interns, SACTA representatives and the programme coordinator. The feature highlighted the programme's role in developing scarce skills and consolidating industry partnerships. Further media engagement included a visit from the Oppenheimer Memorial Trust film team to profile science leadership and mentorship at FABI. In February 2025, IUFRO marked the International Day of Women and Girls in Science with a global webinar led by FABI alumna Dr Joséphine Queffelec, with several FABIans contributing as presenters and moderators. FABI also contributed to the City of Tshwane's online "Jacaranda Month" symposium, where Prof. Mike Wingfield outlined practical steps to protect *Jacaranda mimosifolia*. These and other similar engagements elevated FABI's public profile by showcasing its leadership in plant health, the strength of its training pipeline and its commitment to accessible, practice-focused guidance for stakeholders.

PRODUCER-FACING SERVICES AND INDUSTRY PARTNERSHIPS

Producer engagement emphasised actionable diagnostics and clear communication. The Grain Research Programme (GRP) maintained a strong presence at NAMPO Harvest Day and at Farmers' Days in Limpopo, Mpumalanga and the Eastern Cape, sharing research results on climate resilience, helping producers differentiate diseases and streamlining sample submission via the Information Hub. The joint FABI–ARC stand drew repeated visits and positive feedback for providing comprehensive, practical information. The National Grain Research Programme coordinated seed packing for the National Maize Cultivar Trials, with students and interns repackaging seed for standardised trials across eight agro-ecological regions in partnership with Grain SA, SANSOR and the Maize Trust. Research on Fall armyworm management included visits to smallholder farmers at the Dzindi and Tshiombo irrigation schemes in Venda to document practices and constraints through field observations and interviews. In perennial crops, the Macadamia Protection Programme contributed to the SAMAC Research Networking Day, connecting with industry and technical advisers and establishing collaborations. Field visits to farms in Levubu, Modjadjiskloof and Mashamba addressed flower blight during the blooming season. The Kiwifruit Protection Programme presented research priorities at the South African Kiwi Growers Association AGM hosted at Future Africa. These types of engagements link diagnosis, field support and strategic trials across sectors.

FORESTRY SURVEILLANCE AND OPERATIONAL PROBLEM-SOLVING

Forestry partners relied on FABI for national surveillance and rapid response. Through the Tree Protection Co-operative Programme (TPCP), and in partnership with the Department of Forestry, Fisheries and the Environment (DFFE), FABI initiated a National Forest Pest and Pathogen Surveillance Strategy. Building on national monitoring successes for *Sirex noctilio* and *Leptocybe invasa*, pilot studies in young eucalypt stands expanded to young and mature stands of pine, eucalypts and wattle across Mpumalanga, Limpopo, KwaZulu-Natal and the Eastern Cape.

Cropwatch Africa provided additional field capacity, while the Information Hub's web and mobile application aggregated observations into near real-time dashboards for decision-making. Operationally, FABI worked with all forestry stakeholders, from multinationals to individual farmers to investigate tree health issues, combining extension, extensive sampling and clinic-based screening to inform management. Field Days with forestry partners provided platforms to update growers on emerging threats and surveillance progress.

BIOSECURITY AND INVASIVE SPECIES: RESEARCH TO ACTION

Biosecurity remained a unifying theme across forestry and urban trees. FABI sustained research and public engagement on PSHB and its fungal symbiont. In 2024, Prof. Brett Hurley and PhD candidate Garyn Townsend joined collaborators in central Vietnam to collect PSHB-infested material in search of parasitoids and other natural enemies; samples were processed under quarantine at FABI as part of a DFFE-funded exploration of biological control options, following a similar trip to northern Vietnam in 2023. Locally, FABI presented on PSHB at the Wildlife and Environment Society of South Africa (WESSA) Friends Groups AGM, attended by representatives from 20 nature reserves. The original discovery of the PSHB in South Africa was part of the FABI-SANBI sentinel project focused on unlocking the value of botanical gardens as sentinels for the introduction of invasive species, discovering and describing numerous other unreported pest and pathogens, training garden staff and contributing to pest risk analysis and policy discourse. The Biosecurity Information Hub collates data from national role-players to support government services and decision processes. On Mandela Day, FABI staff and students cleared invasive alien plants from a two-hectare tract of rare lowland grassland at Innovation Africa @UP, combining biodiversity stewardship with community action and inter-faculty collaboration. These are just a few of numerous similar projects.

The NGRP outreach team visiting smallholder farmers in the Eastern Cape

The NGRP outreach team collecting field samples together with Eastern Cape smallholder farmers

In search of possible PSHB biocontrol agents with collaborators in Vietnam

INTERNATIONAL COLLABORATION AND REGIONAL IMPACT

Strategic partnerships supported regional and global problem-solving and is a core feature of FABI's value proposition to partners, as recorded throughout this report. A renewed memorandum of understanding between North Carolina State University and the University of Pretoria reaffirmed collaboration in forest genetics, pest and disease management and tree resilience. In Ethiopia, a five-year ACIAR-funded programme with Ethiopian Forestry Development, CIFOR-ICRAF, the University of the Sunshine Coast and the Institute for Commercial Forestry Research was launched in December 2024 to manage pests and diseases in forest crops. Early work combined field investigation of threats to moringa and eucalypts with socio-economic, value-chain and capacity-gap analyses to enable adoption of sustainable management strategies. In Kenya, collaborations with Kenya Agricultural and Livestock Research Organization (KALRO) and Maseno University produced maize disease fact sheets for Western Kenya farmers in English and Swahili, radio engagement in English and Luo, and field sampling for MSc research on Northern leaf blight diversity, supported by the British Society of Plant Pathology. These initiatives are a few of the many for the institute and exemplify FABI's approach to partnerships for impact.

FABI researchers collaborating with South African and Ethiopian researchers to investigate the pests and diseases of Moringa and eucalypts in Ethiopia

CROSS-SECTOR HEALTH: DAIRY "FACIAL ECZEMA"

FABI's partnership with Milk South Africa advanced understanding and mitigation of sporidesmin-induced liver disease ("facial eczema") in dairy cattle in the Eastern Cape. Launched in May 2023, the programme investigates the fungi and metabolites associated with the disease and evaluates options for monitoring and control. The first and second annual meetings (October 2023 and November 2024) convened veterinarians, mycologists and industry stakeholders at FABI, while links were established with international researchers in New Zealand, France, Portugal and Spain. This work demonstrates how plant and microbial expertise can inform animal health and productivity.

RESEARCH INFRASTRUCTURE AND INNOVATION

Targeted investments accelerated research and training. The Keyence VHX-7000 Series digital microscope, the first in Africa, enabled rapid, high-resolution, true-colour 3D imaging at micron-level resolution without specimen preparation, improving workflows from diagnostics to publication-quality figures and enriching workshops. In forest entomology, FABI researchers developed a technique to activate *Sirex noctilio* eggs *ex vivo*, enabling microinjection and gene-editing experiments and opening paths to CRISPR-based approaches in genetic pest management. These developments demonstrate how infrastructure and method innovation increase research efficiency and capability.

SCHOLARLY LEADERSHIP AND RECOGNITION

FABI's disciplinary leadership was reflected in major publications and appointments. FABI researchers co-produced a new, open-access Forest Entomology textbook (2024) with international collaborators, filling a long-standing gap in comprehensive teaching resources.

The sixth edition of Agrios' Plant Pathology (2024) includes chapters authored by FABI researchers on plantation forest diseases in the tropics and Southern Hemisphere, and on maize diseases – the first inclusion of forest pathology in this seminal text. In 2025, Springer published the first comprehensive volume on biological control in plantation forests, co-edited by FABI scientists and international colleagues, providing a key reference for researchers, policy-makers and industry.

The appointment of a number of Extraordinary Professors strengthened expertise in fungal cell communication and fusion, pathogen genetics and pathobiomes.

The sixth edition of Agrios' Plant Pathology includes inputs from FABI researchers

FABI's state-of-the-art Keyence VHX-7000 Series digital microscope, the first of its type in Africa

CULTURE, COMMUNITY AND IDENTITY

FABI's institutional culture supports excellence and cohesion. A painting by the late Abraham "Appie" van Wyk, father of Prof. Ben-Erik van Wyk, was donated to the Institute during the 2023 year-end function at the Javett Art Centre. The artwork, depicting a tree surrounded by people, resonates with FABI's celebration of trees, people and creativity. A recently introduced annual prize has highlighted the remarkable art produced by FABIans, and these works now decorate the walls of FABI. The art in FABI are also captured on our website and we invite you to explore that. FABI also builds community through our regular weekly meetings such as our Monday Morning Meetings for the whole group, and our Thursday Morning Seminars. We celebrate our PhD graduates through special seminars and public defenses, as well as first publications by MSc and PhD students. Socially we engage regularly through teas and special events that you will find reflected in these pages. We also host large numbers of visitors, either for research stays, special seminars, round table discussions or tours of FABI's facilities to gain insight into the Institute's behind-the-scenes work to keep trees and crops healthy. Community is the glue that keeps us working as a unit.

LOOKING AHEAD

The activities summarised here show how FABI integrates research, service and training in support of plant, tree and agricultural health. Through strategic collaborations with industry, government and international partners, ongoing extension, capacity building and public engagement, FABI continues to address critical challenges while nurturing the next generation of scientists. With strong networks, targeted infrastructure and a clear applied focus, the Institute is well positioned for the next phase of growth and service in South Africa and beyond.

PROFESSIONAL DEVELOPMENT AND TRAINING

FABI's professional development over the reporting period focused on efforts to build cutting-edge technical skills, widen international networks, translate expertise into sectoral impact, and grow the next generation through structured mentorship. Activities ranged from laboratory intensive and field-based practicums to international symposia, industry-facing forums and textbook authorship, together strengthening capacity across forestry, agriculture and biodiversity sciences. There are too many activities to list all here, and we therefore only highlight some examples to illustrate the general elements of this focus area.

BUILDING CORE RESEARCH SKILLS AT SCALE

Hands-on workshops delivered foundational and advanced competencies. For example, a five-day Genome Assembly Workshop took participants from command-line basics to high-quality fungal genome assemblies, culminating in a coordinated set of genome announcements, an exercise in both method and scholarly communication. Laboratory training on *Agrobacterium*-mediated transformation gave students and researchers step-by-step practice with fluorescent reporters and protocol adaptation, while a pine-needle "isolation jamboree" trained students to recognise and culture key foliar pathogens. Complementary statistics training focused on categorical data (GLMs and mixed models), ensuring that new experimental skills are paired with robust analytical practice. Field-centred capacity building featured diverse topics such as bark-beetle mycobiomes, from collection to isolation and identification, symbioses and data systems, to remote-sensing capability for UAV-based multispectral and high-resolution imaging to detect pest and disease damage.

INTERNATIONAL NETWORKS AND KNOWLEDGE EXCHANGE

FABI leveraged and deepened international ties through several research visits, exchanges and co-hosted events. For example, the Mycobiomics consortium connected partners in Asia, Africa and Europe around fungal microbiomes and metabolites, with reciprocal visits advancing metabolite profiling, gene-cluster characterisation and functional genetics of priority taxa. Extended engagements in Germany catalysed proposals on forest mycobiomes under climate change. Regional leadership included FAO-aligned Forest Invasive Species Network for Africa (FISNA) activities and several IUFRO Working Parties and Task Forces. These are just some of numerous directional student and staff exchanges that added and extended the FABI skills base.

TRANSLATION TO IMPACT: BIOCONTROL, PHYTOSANITATION AND POLICY-LINKED FORUMS

Applied training advanced biosecurity and biocontrol pipelines. For example, parasitoid-rearing internship at RAIZ (Portugal) informed protocols to establish a South African laboratory colony of *Anagonia lasiophthalma* against *Gonipterus* spp., alongside non-target testing preparations for potential release. Annual phytosanitation courses for interns covered IPPC frameworks, quarantine systems, regulated pests, surveillance and safe trade – tying skills directly to national and WTO-aligned compliance. Sector-facing forums connected science with decision-makers. For example, the National Grain Research Programme Research Days convened government, industry and universities around diagnostics, management practices and data-driven decisions, mirroring similar events with forestry stakeholders linked to the TPCP and FMG. FMG's Genomic Selection Indaba, concluding Prof. Fikret Isik's sabbatical course, aligned local breeding programmes with international genomic-selection practice and scoped a precision tree-breeding platform. At continental scale, participation in the inaugural African Conference on Agricultural Technology (ACAT) highlighted technology access, climate-smart farming and smallholder support opens new doors for engagement and impact.

THOUGHT LEADERSHIP, PUBLISHING AND OPEN SCIENCE

A hybrid publishing workshop, anchored by an eLife Senior Editor, unpacked transparent review models and preprints, while UP Library Services showcased institutional

support for writing and dissemination. Together, these efforts normalise rigorous, open and rapid publication practices across the institute. The numerous scientific convenings that FABI engage with amplified frontier questions. For example, the Plant Genomics and Evolution Symposium brought international and UP speakers to share advances in polyploidy, herbarium-scale genomics, resurrection plants and SA endemic genomes with applications spanning ecology to biotechnology. A distinctive biophysics workshop on spore dispersal, co-hosted with ICTP and NITheCS, linked physics, mycology and art. Leadership in local conference, such as the joint SASBi|SAGS BIO2024 conference, further expanded specialist networks, student exposure and the development of new partnerships and ideas.

MENTORSHIP AND STUDENT PIPELINES

Structured mentorship continued as a central pillar. The long-running CPHB–FABI undergraduate mentorship programme welcomed new cohorts (18 in 2024, and a record 30 in 2025) across BGM, Plant and Soil Sciences and Physics, pairing undergraduates with postgraduate mentors and integrating them into active labs. Course-linked visits (e.g., Crop Protection students to the Biocontrol and Insect Rearing Facility) exposed second-years to operational biofactories and career paths. Early-career visibility was also prioritised through FAO/FISNA and IUFRO webinars and student-led sessions at major conferences. Many former mentees have progressed into postgraduate studies and academic posts, illustrating the programme's long-term impact.

GUIDANCE AND STRATEGIC REFLECTION

FABI engages external advisers regularly on strategy and growth, such as through its External Advisory Board. In addition in this reporting period, workshops led by Prof. André Drenth (University of Queensland) reviewed global patterns in plant disease emergence, industry partnerships and university structures, translating decades of experience into concrete actions to sustain FABI's research impact across agriculture, forestry and biodiversity.

OVERALL CONTRIBUTION

Across laboratory, field and forum, FABI's professional development portfolio delivers: (i) practical, research-ready skills in genomics, transformation, surveillance, statistics and remote sensing; (ii) international, Africa-centred collaborations that accelerate discovery and application; (iii) direct pipelines to biosecurity, breeding and management decisions; and (iv) durable mentorship structures that convert undergraduate curiosity into postgraduate capability and professional leadership. The outcome is an institute that pairs scientific depth with translational reach, positioned to anticipate threats, innovate methods and develop people for the benefit of regional forestry and agriculture.

The 2024 cohort of interns in the FABI Internship in Phytosanitation and Biosecurity programme

SOCIAL EVENTS

The Annual Meeting of the Society for the Presentation of Outrageous Findings (SPOOF)

The annual meeting of the Society for the Presentation of Outrageous Findings (SPOOF) is a highlight of the FABI social calendar that sees students and staff go all out to win one of the coveted awards of the evening. Video and oral presentations reveal all manner of outrageous findings – always underpinned by rigorous scientific method!

2023: Symphony of Science

The "Best Dressed Female" award went to Elmarie van der Merwe for her regal "Purple Rain"–themed costume, while Nam Pham once again claimed the "Best Dressed Male" trophy for his Miley Cyrus "Wrecking Ball" outfit. Both the "Best Multimedia" and "Best Abstract" awards went to the Avocado Research Programme for their exposé on the nefarious dealings of the Avocado Underworld ("Avocado Underworld: Peeling Back the Layers of the Guac Cartel – Guacamole, Oliver A.; Greenfield, Aviana V.; Hass, Olive O. & Pitman, Ava S."). The "Best Oral Presentation" was won by Kira Lynn and Cheyenne Theron for "Comparative study: Influence of country-specific music on the growth of plant pathogenic fungi".

2024: The FABI Museum

The "Best Dressed Female" award went to Alida van Dijk, while Matthew Bennet took home the "Best Dressed Male" award. The unofficial "Best Dressed Child" prize went to Luna Visagie. The "Best Abstract" and "Best Video" awards were clinched by Chanel Thomas, Simoné Bornman, Nolusizo Sithole, Frances Lane and Dr Markus Wilken for "Investigating the presence of patellar structures in a local population of supervisors". The "Best Oral Presentation" went to Amy Collop and Fanele Hlabisa for "The biocontrol facility's quarantine ghost: how a ghostly entity can impact the rearing of biological control agents". A tip-packing competition added extra fun, with Prof. Irene Barnes showing the younger FABIans how it's done – taking the honours with ease.

SPOOF is a highlight of the FABI social calendar, and FABIans go all out to win a range of prizes

FABIans Welcome Spring!

FABI welcomed spring at the Institute's annual Spring Day tea on 15 September 2023. FABIans were treated to colourful cupcakes and enjoyed the warm sunshine in the company of their peers. They were encouraged to dress in bright colours, with Lydia Twala winning the prize for looking the most "spring-like" and colourful on the day.

The following year's Spring Tea was held on 19 September 2024, with the Social Club encouraging FABIans to wear hats or head decorations inspired by spring. A big thank you goes to the FABI Social Club, under the leadership of Dr Gerda Fourie and Dr Rosali Moffat, for their hard work in making these events such a success.

Book Fun and TV Series Reviews at the FABI MMM

Many FABIans take a well-deserved break during the December holiday period to recharge their batteries before the new academic year. It has become a tradition, under the encouragement of Prof. Fanus Venter, to host a Monday Morning Book Club session where FABIans share the books that left an impression on them during the year.

On 20 November 2023, several FABIans shared their reading highlights during the weekly Monday Morning Meeting (MMM), inspiring others to expand their own reading lists. As always, the list was varied and included several books adapted into films or television series – though, as Prof. Venter reminded everyone, "the book is always better than the movie or series."

Prof. Fanus Venter hosting book reviews at the FABI Book Fun 2023 event

In a change from the usual MMM programme, FABIans were invited on 1 July 2024 to share their favourite television series. Each presented a short summary and reasons they enjoyed the show, inspiring many to add new titles to their "must-watch" lists. This meeting theme was inspired by the annual FABI Book Club presentations in December.

Easter Tea Fun at FABI

The annual FABI Easter Tea is a cherished tradition. On the morning of 4 April 2023, FABIans gathered in the courtyard to enjoy cupcakes and hot cross buns with tea or coffee. The event, organised by the Social Club under Dr Rosali Moffat, included a playful treasure hunt; three white plastic bunnies were hidden in the courtyard, with prizes for those sharp-eyed enough to find them. A tree decorated with chocolate Easter eggs offered an extra treat, which could be exchanged for a short written message expressing gratitude.

On 16 April 2024, inclement weather moved the Easter Tea indoors, but the Social Club, under Melandré van Lill, ensured the event was a great success. Each FABIan received a bunny-themed gift bag containing a delicious cookie from Little Crumbs. Prof. Bernard Slippers welcomed attendees and emphasised the importance of social gatherings in building community within FABI. Quoting the English poet Robert Frost, "Nothing gold can stay", he reflected that while seasons change, strong roots (and strong bonds) help the Institute endure both good and challenging times.


FABI Easter Tea, 2024

FABIans Treated to a Special Premiere of Planet Fungi: Follow the Rain

FABIans were treated to a special screening of the Planet Fungi documentary Follow the Rain on 2 April 2025, hosted in the University of Pretoria's Senate Hall. The rights to show the film were secured by Prof. Mike Wingfield following his field trip to northern Zambia's miombo woodlands, linked to an ICRAF project. During that visit, he met the documentary's acclaimed creators, Stephen Axford and Catherine Marciniak, and was inspired to bring their work to FABI.

The film is a visually stunning showcase of fungi in their natural habitats in Australia, captured following rainfall events. The screening, attended by about 90 guests, including mycologists Prof. Peter Mortimer and Prof. Marieka Gryzenhout, was preceded by a presentation from Prof. Mortimer on his decade-long collaboration with the Planet Fungi team, and a talk by Prof. Wingfield on fungal diversity in Zambia.

Follow the Rain was available on Netflix in Australia and New Zealand, with hopes that global streaming rights will be acquired. In the meantime, audiences can enjoy more of Axford and Marciniak's work on the Fungal Planet YouTube channel.

FABI Year-end Functions

Dressed for success: The FABI Year-End Function 2024

2023

The 2023 FABI Year-end Function took place on 17 November at the Javett Art Centre at the University of Pretoria, forming part of FABI's 25th anniversary celebrations. The afternoon event followed the FABI Anniversary Symposium at Future Africa. Highlights included the presentation of the FABI Awards and the acceptance of a painting by the well-known botanist Prof. Ben-Erik van Wyk, painted by his late father, Abraham "Appie" van Wyk.

2024

FABIans celebrated the end of another successful year at the Sanlam Conference Centre on UP's Hatfield Campus. Guests included university representatives, industry partners, government officials, and visiting collaborator Prof. Marc Stadler with three of his PhD students visiting through the Mycobiomics Project. The guest speaker, Ben Durham (Chief Director: Bio-innovation, Department of Science and Innovation), delivered a thought-provoking talk entitled "Sustainability: A View from Inside Government."

A highlight of every Year-end Function is the announcement of the FABI Awards, presented by Prof. Irene Barnes, recognising excellence and contribution to FABI's mission. The most prestigious of these, FABIan of the Year, celebrates outstanding students for research, mentorship, and service to the Institute (see Achievements and Awards section for the list of recipients).

FABIans Celebrate Jackie Robinson Day

Jackie Robinson Day, celebrated annually on 15 April in North American Major League Baseball (MLB), honours the day in 1947 when Jackie Robinson, the first Black MLB player, made his debut. On that day, all MLB players, coaches, and umpires wear Robinson's iconic number 42. FABI embraced this tradition in 2023, thanks to avid baseball fans David Johnson and Prof. Anne Pringle, who were visiting the Institute on a 12-month sabbatical. David had previously presented a talk at an MMM on Robinson's life and legacy, and arranged for boxes of Cracker Jack snacks to be sent from the United States for FABIans to enjoy. Together, they also made and donated a Jackie Robinson Day banner, now proudly displayed each year. Since then, FABIans have gathered annually for an informal baseball game at UP's LC de Villiers Sports Campus, singing the unofficial baseball anthem "Take Me Out to the Ball Game" before enjoying traditional (and South African-inspired) baseball fare – hotdogs, Cracker Jack, and beer, kindly sponsored by David Johnson and Prof. Anne Pringle.

Jackie Robinson Day is celebrated with a game of baseball, followed hotdogs and Cracker Jack snacks

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- Agricol
- Amathole Forestry Company (Pty) Ltd
- April Group – Indonesia
- Arauco Forestal Chile
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- Bayer
- British Society for Plant Pathology
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- Cape Pine (Pty) Ltd
- Citrus Research International (CRI)
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- Department of Agriculture (previously Department of Agriculture Land Reform and Rural Development (DALRRD))
- Department of Forestry, Fisheries & the Environment (DFFE)
- Department of Higher Education
- Department of Science and Innovation (DSI)
- Deutsche Botschaft Pretoria (German Embassy, Pretoria)
- Deutscher Akademischer Austauschdienst (DAAD – German Exchange Service)
- Development Research Centre (IDRC-CARDI)
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- Safcol/Komatiland Forests (Pty) Ltd
- SANParks
- Sappi Southern Africa (Pty) Ltd
- SCRI (Speciality Crop Research Initiative) / USDA (United States Department of Agriculture): "Stop the rot: Combating onion bacterial diseases with pathogenomics tools and enhanced management strategies"
- Soltis
- South African Cultivar and Technology Agency (SACTA)
- South African Grain Lab
- South African Kiwi Growers Association
- South African National Seed Organisation (SANSOR)
- South African Pecan Nut Producers Association (SAPPA)
- Southern African Avocado Growers Association (SAAGA)
- Stop the Rot USDA NIFA SCRI Onion Bacterial Project (2019-51181-30)
- Syngenta South Africa
- The South African Avocado Nurserymen's Association (ANA)
- Technology Innovation Agency (TIA)
- The Forestry Sector Innovation Fund (FSIF)
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