Forestry & Agricultural Biotechnology Institute

Biennial Report

FABI

May 2011 - May 2013

The Forestry and Agricultural Biotechnology Institute (FABI) is located on the campus of the University of Pretoria. The primary objectives of the Institute are to:

- Promote the broad field of plant biotechnology through an interdisciplinary approach and with close linkage to a wide range of academic departments
- Undertake research of the highest possible calibre, while at the same time providing short and longer term benefits to the forestry and agricultural sectors of South Africa
- Establish partnerships with industries linked to agriculture and forestry, both nationally and internationally, to produce new and improved products and thus to promote competitiveness in trading
- Promote the education, particularly of South Africans, in the fields of forestry and agriculture

The association of FABI with the University of Pretoria, one of the largest residential Universities in South Africa, provides access to a wide range of human and technological resources. Currently, academic staff and post-graduate students from research programmes in the Departments of Biochemistry, Plant Science, Genetics, Microbiology and Plant Pathology, Zoology and Entomology and Plant Production and the Post-graduate School of Agriculture and Rural Development are associated with FABI. This affords FABI the opportunity to build future resources in biotechnology which will be crucial to the future of forestry and agriculture in South Africa.

In every way, FABI 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 through our collaborations. The Institute has been operational since 1998. This document represents the eighth FABI biennial report covering the period from May 2011 to May 2013.

FORESTRY AND AGRICULTURAL BIOTECHNOLOGY INSTITUTE (FABI)

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Forestry and Agricultural Biotechnology Institute

FUTURE FORESTS and *FOOD*

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FABI TEAM

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2nd Row

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Helen Walsh, David Read, Elna Cowley, Phia van Coller, Kershney Naidoo, Vivienne Clarence, Lindsay van Niekerk, Maretha van der Merwe, Seonju Marincowitz, DongHeyon Lee, Rene Sutherland, Elsie Cruywagen, Martha Mahlangu, Sanushka Naidoo, Elritha van Zyl, Renate Zipfel, Marie Theron, Janice de Wee, Bridget Crampton, Adri Veale, Omotayo Adenigba

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James Mehl, Zander Human, Brett Hurley, Sze Huei Yek, Stephanie Slinski, Bernard Slippers, Jeff Garnas, Gerhard Pietersen, Marc Bouwer, Caitlin Botha, Erik Visser, Steven Hussey, Albe van der Merwe, Simone Fouche, Stephanie van Wyk, Heidi Fysh, Quentin Santana, Lieschen de Vos, Nicky Creux

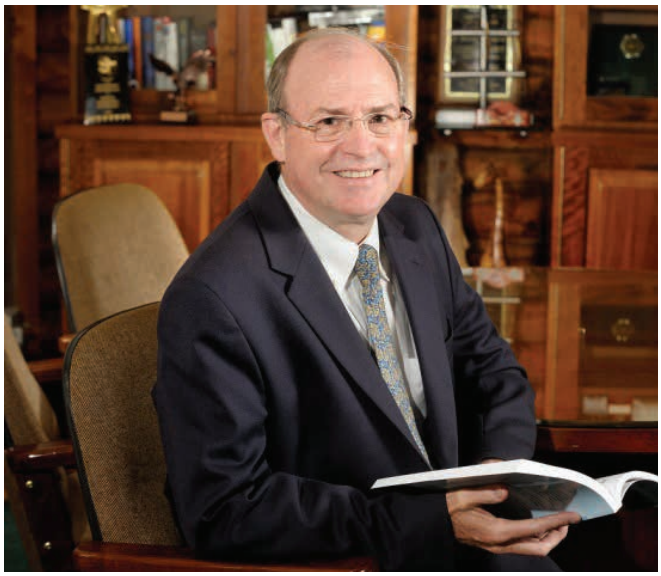
DIRECTOR'S REPORT

FABI has come of age! I say this because 2013 marks the 16th anniversary of the establishment of FABI. In many cultures, it is this birthday that marks the entry of youth into adulthood. And at this point in the history of FABI, I think it is fair to say that the Institute has reached a point of maturity where its own energy and focus can sustain its future. It remains remarkable to me that FABI found its footing so rapidly back in 1997 and how rapidly its national and international "footprint" became established and grew. I attribute this largely to the "FABI PEOPLE" - the most remarkable group of academics, support staff and especially post-graduate students who, from the very beginning, contributed their energy and passion to building something very special in South Africa.

How rapidly the two years since the compilation of our last biennial report has passed. This flash of time has marked many milestones and accomplishments for FABI and the research teams of the Institute. A small but significant sampling of these is presented in this report and I hope that you will enjoy reading about some of these. We always enjoy feedback on our activities - please let us know if you have suggestions or if you wish to join us to build new and exciting initiatives.

FABI has grown dramatically in its first 16 years. The Institute includes 22 academic staff members and the majority of their post-graduate students. Together with a team of administrative and technical staff members, FABI represents a community of approximately 180 people who are passionately committed to the common goal of promoting post-graduate research and education. As is typical of a university-based group, the FABI team changes continuously in composition with students graduating and leaving and others arriving to pursue their career goals. I have made the point many times that one of the greatest strengths of FABI is found in the diversity of its people – men and women with many different beliefs and cultures. There has not been a recent census of the different languages spoken in FABI but this surely remains close to the 30 or so mother tongue languages that were counted some years ago. This amazing diversity brings us so many opportunities for learning more about ourselves and I believe sincerely that it deepens our ability to produce increasingly innovative outputs.

FABI's research and post-graduate student outputs have been remarkable during the past years and they continue to grow. This should be clear from the various sections of this biennial report. During this period, members of the FABI Management Committee (better known internally as FABI Mancom) have instituted various initiatives to raise not only the quantity but especially the quality of our scientific outputs. The data are clear and impressive, with greater numbers of scientific articles in higher-impact journals as well as improved post-graduate student outputs and throughput rates. All members of the FABI Mancom (other than our student representative) now have Ph.D. degrees and most have National Research Foundation ratings. The levels of these ratings have continued to rise impressively and I am convinced that this is a positive trend that will continue. Moreover, FABI team members, both staff and students, have been recipients of numerous and impressive awards for accomplishments in Science and Technology. These are far too numerous to mention individually, but some are presented in this report.



While research and education at the post-graduate level are FABI's key performance goals, the FABI team members take great pride in a sincere commitment to the various communities linked to our activities and environment.

Our community involvement extends substantially beyond supporting the stakeholders that support our research projects and programmes. We are thus particularly proud of our broader community projects driven by the FABI Social Club that during the past few years have, for example, contributed funding and in-kind support for some of the communities (particularly their children) surrounding Pretoria that live under extremely difficult circumstances.

I am often asked how I see the future of FABI: what will the institute look like in, say, ten or twenty years' time? This is an intriguing question and I suspect that many people are somewhat surprised by my answer. The truth is that FABI never had a "blueprint" for its establishment or future. Clearly there has always been a focus, which is broadly on the health and improvement of plants and their products. But the FABI of 2013 is very different to that of 16 years ago. New projects have been established and new areas of focus have developed. With this in mind, I tend to suggest that FABI ten and twenty years ahead will look very different to what is seen today. And I am also convinced that its successes in every element of its broad value proposition will be both substantial and impressive.

Finally, I take this opportunity to thank the many institutions, commercial enterprises, granting organisations and other groups that support the research activities of FABI. I am also deeply grateful to a supportive Management Committee and broadly, to the amazing FABI team for their commitment, enthusiasm and support, which is fundamental to our success. It is a great privilege to lead FABI and it is a pleasure to share the contents of this biennial report with you.

Michael J Wingfield Ph.D., D.Sc.h.c.
(UBC, Canada; NCSU, USA) FRSSAf, ASSAf
Mondi Professor of Forest Pathology and Director of FABI

RESEARCH REPORTS

BACTERIAL GENOMICS AND TREE HEALTH

Research leader: Prof. Stephanus Venter

Research team: Prof. Teresa Coutinho
Prof. Emma Steenkamp
Dr. Martin Coetzee

OBJECTIVES OF THE RESEARCH PROGRAMME:

Genome sequencing and comparisons are currently one of the leading drivers in biological research. With the development and advances in high throughput sequencing platforms and the reduction in associated costs, sequencing and assembly of genomes have come within reach of most laboratories. The genome sequence of an organism not only serves as the blueprint of all the genes present but also provides the opportunity to expand our knowledge and understanding of the organism's biology and genomics.

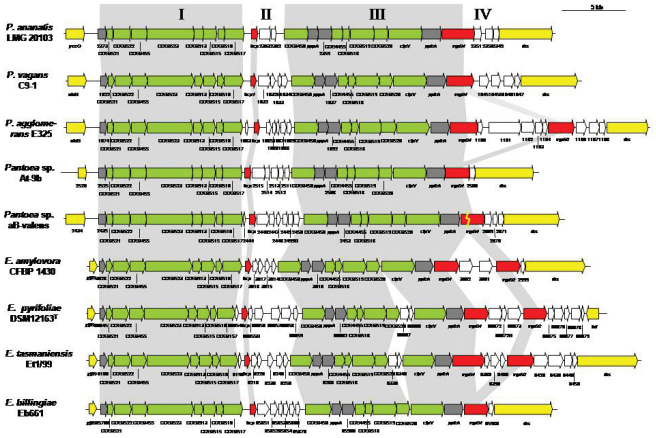
Bacterial genomics is used to gain insight into the pathogenicity of tree pathogens such as members of the genera *Pantoea*, *Ralstonia* and *Xanthomonas*. Phylogenomics is used to reconstruct the evolution of the genus *Pantoea* in order to understand how members of this genus have evolved to be pathogenic to both plants and animals. The genomes of strains representing the different species of *Pantoea* were used to validate genomic approaches for the delineation of species in this genus. Genomic and transcriptomics will also be used to study the interactions between the *Burkholderia* nitrogen-fixing symbiont and its tree host, *Virgilia*. These findings will shed light on how this interaction could be used to the benefit of the plant host, and what role the bacteria play in the fynbos ecosystem.

Visualisation of the shared single-copy genes amongst members of the genus *Pantoea*. Coloured ribbons indicate the percentage of genes shared between genomes.

HIGHLIGHTS OF OUR RESEARCH:

- The genomes of eight strains of *P. ananatis* have been sequenced, assembled and annotated. The genome announcements for two of these genomes have been published.
- Currently a database of 26 genomes, representing 13 of the 19 validly described *Pantoea* species, has been compiled. It is planned that genomes of strains representing the last six species will be added during 2013. The core genes shared amongst the different species have been identified and are currently used for the construction of a reliable phylogenetic tree to study the evolution of the genus *Pantoea*.
- Based on the comparison of the plasmids (LPP-1) associated with 20 *Pantoea* genomes, it was demonstrated that the LPP-1 encodes a large array of proteins that have played a major role in the adaptation of the different *Pantoea* spp. to their various ecological niches and their specialisation as pathogens, biocontrol agents or benign saprophytes found in many diverse environments.

Bacterial genomics provides crucial information necessary to study the pathogenicity and ecology of species. In addition it forms the foundation for understanding the genetic diversity and population dynamics within certain species. This information is essential for the development of strategies to predict and control future disease outbreaks associated with these pathogens and could be used to exploit symbiotic relationships to improve plant health.



Comparison of the Type 6 Secretion System loci in *Pantoea* and *Erwinia* species. The conserved regions (block I and III) are shaded in gray (de Maayer et al., 2011).

DST NRF CENTRE OF EXCELLENCE IN TREE HEATH BIOTECHNOLOGY (CTHB)

Director: Prof. Mike Wingfield

Programme manager: Prof. Emma Steenkamp

Project leaders:
Prof. Nigel Barker (RU)
Prof. Teresa Coutinho (UP)
Prof. Pedro Crous (UP & CBS, the Netherlands)
Prof. Deanne Drake (Wits)
Prof. Leanne Dreyer (US)
Prof. John Hoffmann (UCT)
Prof. Gert Marais (UFS)
Prof. Wally Marasas (UP) (deceased)
Prof. Gerhard Pietersen (ARC & UP)
Prof. Jolanda Roux (UP)
Prof. Mary Scholes (Wits)
Prof. Thomas Seifert (US)
Prof. Bernard Slippers (UP)
Prof. Fanus Venter (UP)
Prof. Brenda Wingfield (UP)
Prof. Edward Witkowski (Wits)
Dr. Irene Barnes (UP)
Dr. Martin Coetzee (UP)
Dr. Karen Esler (US)
Dr. Jeff Garnas (UF)
Dr. Marieka Gryzenhout (UFS)
Dr. Brett Hurley (UP)
Dr. Francois Roets (US)
Dr. Wayne Twine (Wits)
Dr. Alex Valentine (US)
Dr. Noëlani van den Berg (UP)
Dr. Albé van der Merwe (UP)

OBJECTIVES OF THE RESEARCH PROGRAMME:

The primary goal of the CTHB is to promote the health of trees native to South Africa through the application of biotechnology tools. To achieve this goal, the CTHB team typically studies the pathogens and pests that are associated with native trees and other woody plants. Members of the Centre also explore the possible effects that factors such as climate change, fire, genetic diversity and human activity may have on the health of native woody resources and ecosystems.

The CTHB is hosted by the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria (UP). The CTHB is structured as a virtual Centre of Excellence that conducts research via a collaborative network of scientists, with the central node of the network represented by researchers at UP. In addition to the UP group, the network include researchers and their post-graduate students at many other institutions in South Africa. Since 2011, these included the Agricultural Research Council, the University of Stellenbosch, the University of Cape Town, Rhodes University, and the Universities of the Witwatersrand and the Free State.

RESEARCH ACTIVITIES:

The research projects of the CTHB are typically focused on the following:

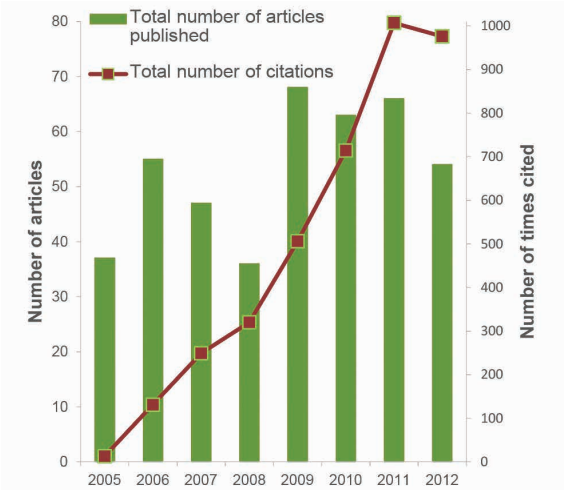
- The biology, ecology, genetics, population biology and systematics of insects and microbes associated with native woody plants
- The biology and ecology of specific tree species, as well as the effect that human practices might have on these species, the ecosystems in which they occur and the conservation of natural habitats
- The possible impacts of soil properties and nutrients, microbial symbioses and climatic factors on the health of woody plants in diverse landscapes
- The effects of drought, frost, fire and human activity on the sustainable use of indigenous woody resources

The majority of the work focusing on insects and microbes associated with native woody plants is conducted at UP. Projects studying the effects of environmental and

anthropogenic factors on the health of native woody hosts and natural habitats are conducted mostly at the other institutions. Together with the Tree Protection Co-operative Programme (TPCP), the CTHB annually produces a large number of research papers (see the figure right) of which more than 25-40 typically deal specifically with health issues of indigenous trees.

The CTHB routinely conducts surveys and field experiments in various parts of South Africa and elsewhere on the continent. Together with its partner programme, the TPCP, the CTHB maintains a world-class disease and insect pest Diagnostic Clinic. However, to facilitate and enhance the research and extension activities of the CTHB, the Centre has developed and implemented a number of ancillary processes. These include various databases and collections to manage and store information related to data and biological material used in projects.

The CTHB is actively involved in outreach initiatives aimed at promoting a robust and skilled South African human resource base. For this purpose a formal mentorship programme is used to target undergraduate students specifically. The CTHB also aims at improving the public's understanding of Science and providing high school learners with information about post-secondary education opportunities in the Natural Sciences.



Citation report for articles published in international peer-reviewed journals by researchers of the CTHB from 2005 to 2012. The data for this report were obtained using the Thomson Reuters Web of Knowledge (accessed 25 January 2013), which was also used to generate the citation statistics. Note that these data only include the papers produced by the members of the CTHB at UP, and not those produced by members of the extended programme at other Universities and at the ARC. During this analysis, the value for the H-index of the Centre's publications was 29 (according to Thomson Reuters Web of Knowledge.

Board of the CTHB at their meeting in March 2013.

Front: Mr. Mike Edwards (ex Managing Director: Forestry South Africa), Prof. Stephanie Burton (Vice-Principal: University of Pretoria), Prof. Eddie Mwenje (Vice Chancellor: Bindura University of Science Education), Dr. Nthabiseng Taole (Programme Director: Centres of Excellence and Knowledge Fields Development, National Research Foundation)

Back: Mr. Bheki Hadebe (Manager: Human Capital – High End Skills, Department of Science and Technology), Prof. Mike Wingfield (Director: CTHB), Prof. Anton Ströh (Dean: Faculty of Natural and Agricultural Sciences, University of Pretoria), Prof. Urmilla Bob (Associate Professor – Environmental Sciences, University of Kwazulu-Natal), Prof. Coert Geldenhuys (Extraordinary Professor – Forest Ecology, University of Stellenbosch), Prof. Emma Steenkamp (Programme Manager: CTHB), Dr. Wessel Vermeulen (Science Manager, Knysna, South African National Parks)

CERC-FABI *EUCALYPTUS* PROTECTION PROGRAMME (CFEPP)

Research leader: Prof. XuDong Zhou

Research team: Prof. Jolanda Roux
Prof. Mike Wingfield
Prof. YaoJian Xie (CERC, China)
Dr. Roger Arnold (CERC, China)
Dr. Wilhelm de Beer

OBJECTIVES OF THE RESEARCH PROGRAMME:

- Study *Eucalyptus* diseases and pests threatening plantation development in China
- Understand the biology and spread of these pests and pathogens
- Screen *Eucalyptus* hybrids tolerant to the most important diseases
- Train young researchers working on tree health
- Establish a model for the cooperation between South Africa and China
- Serve as the *Eucalyptus* health authority in China in the long run

HIGHLIGHTS OF OUR RESEARCH:

Eucalypt diseases

Continuous surveys have been conducted in major eucalypt plantations in South China, and close links have been established with major forestry companies there. In addition to monitoring/detecting the diseases and characterising their causal agents, significant efforts have been taken to study the spread and genetic diversity of a selection of important fungal pathogens such as those in the genus *Teratosphaeria*. A project on bacterial wilt, which is caused by *Ralstonia solanacearum*, has also recently been initiated.

Eucalypt pests

To respond to the request from local industries and due to the fact that pests result in significant losses, CFEPP has expanded its work on eucalypt pests. The gall wasp *Leptocybe invasa*, has wiped out one of the three most common commercial clones in Chinese plantations. Our work focuses on the selection of pest-resistant clones, including the understanding of enzyme activity and susceptibility of various clones.

Bark beetle-fungi interactions

Bark beetles represent one of most important forest pest groups. They often carry ophiostomatoid fungi, which include a number of important sap stain agents and several pathogens. Limited information is available in China. Our work focuses on the species in the genera of *Ips* and *Tomicus*, and their fungal associates in the genera *Ophiostoma*, *Grosmannia*, and *Ceratocystis*.

Prof. Zhou delivering the keynote talk during the joint conference of ACPP & APPS held in Darwin, Australia (top)
Looking at eucalypt disease in south China (bottom)

CEREAL FOLIAR PATHOGENS RESEARCH PROGRAMME

Research leader: Dr Bridget Crampton

Research team: Prof. Dave Berger
Prof. Burton Bluhm (University of Arkansas)
Dr. Irene Barnes
Dr. Maryke Craven (ARC Grain Crops Institute)

OBJECTIVES OF THE RESEARCH PROGRAMME:

The Cereal Foliar Pathogen Research group was established in July 2011. Pathosystems currently under study include *Exserohilum turcicum*, causal agent of northern corn leaf blight (NCLB) in maize, and *Cercospora zeina*, which causes grey leaf spot (GLS) in maize. Broad objectives of the research group include:

- Characterisation of cereal fungal pathogen population structures in southern Africa
- Identification and functional characterisation of cereal Dothideomycete fungal effector proteins
- Determination of cereal plants' response to wild-type and mutant Dothideomycete pathogens.

HIGHLIGHTS OF OUR RESEARCH:

Population structure of Exserohilum turcicum *in maize*

Northern corn leaf blight (NCLB), caused by the fungus *Exserohilum turcicum*, is a devastating leaf foliar pathogen that occurs in most maize growing areas throughout the world. In order to better understand the population structure of *E. turcicum* in South African maize and sorghum fields, we identified and designed simple sequenced repeats (SSRs) to the genome sequence of *Setosphaeria turcica*, the sexual stage of *E. turcicum*, which was sequenced as part of a Dothidiomycete sequencing project of the Joint Genome Initiative (http://www.jgi.doe.gov/genome-projects/). We screened 40 SSR markers and identified fourteen markers that displayed polymorphisms amongst a selection of South African *E. turcicum* isolates. Diseased leaf tissue was collected from various maize and sorghum growing regions throughout the country, and single conidial isolations were made from NCLB lesions. We are currently in the process of screening these isolates with polymorphic SSRs to assess population diversity of this fungus in South Africa.

Bridget Crampton, Burt Bluhm and John Smith in a maize field in the USA

Symptoms of NCLB on maize leaf (A) and GLS in maize (B)

Identification and characterisation of fungal effectors in Cercospora zeina

Grey leaf spot in Africa is caused by the fungal pathogen *Cercospora zeina*. This widespread and destructive pathogen causes millions of rands worth of loss to maize yields every year. In collaboration with Professors Dave Berger and Burt Bluhm, the research group is focussed on functional genomics of virulence factors of *C. zeina*. Previously characterised Dothideomycete effector genes and pathogenicity factors were targeted for characterisation in *C. zeina*. Genes of interest were identified in the recently assembled African *C. zeina* draft genome, and annotated prior to knocking out the genes in the fungus to characterise effector function. In order to knock out genes of interest, we successfully established a protocol for protoplast formation from *C. zeina* hyphae and subsequent transformation with a Green Fluorescent Protein (GFP) gene. We are presently assessing virulence of knocked out *C. zeina* strains through maize pathogenicity trials. Our current research is focused on the *in vitro* and *in planta* secretome of *C. zeina* in order to identify novel effector genes.

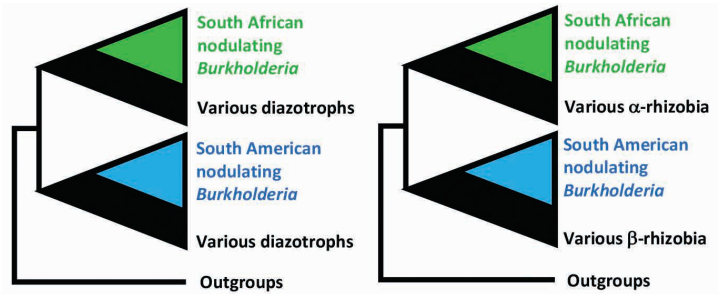
DIVERSITY AND EVOLUTION OF RHIZOBIA ASSOCIATED WITH NATIVE WOODY LEGUMES

Research leader: Prof. Emma Steenkamp

Research team: Prof. Stephanus Venter
Prof. Thomasz Stepkowski (Warsaw University of Agriculture, Poland)

OBJECTIVES OF THE RESEARCH PROGRAMME:

South Africa is remarkably rich in legumes that, through their symbiosis with rhizobia, contribute significantly to biological N_2-fixation and ultimately ecosystem health. Although the rhizobia associated with non-native agricultural legumes are relatively well studied, very little is known about the rhizobia associated with the vast majority of native South African leguminous woody plants. The overall goal of our research is therefore to: (i) characterise and describe the rhizobia associated with native legume species, as well as to (ii) reconstruct the evolutionary history and (iii) infer the phylo- and biogeography of these to bacteria. Ultimately, comparisons with the findings of similar studies on legumes from other parts of the world and with those conducted on non-native agricultural crops will provide valuable insight into the possible forces determining the biogeography and ecology of these bacteria.



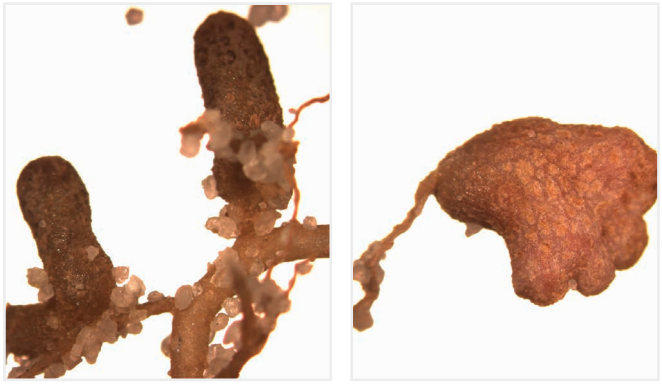
Phylogenies for the *nifH* (left) and *nodA* (right) genes that encode products involved in N_2-fixation and legume nodulation, respectively. These phylogenetic trees show that South African nodulating strains of *Burkholderia* acquired their N_2-fixation abilities from unrelated diazotrophs and not from other beta-rhizobia (i.e., rhizobia in the class Betaproteobacteria). Similarly, the South African nodulating *Burkholderia* acquired the nodulation trait from unrelated alpha-rhizobia (i.e., rhizobia in the class Alphaproteobacteria), and not from other beta-rhizobia.

RESEARCH HIGHLIGHTS:

- The diversity of the rhizobia native to South Africa appears to match that of their legume hosts. Rhizobia representing a large number of distinct lineages were isolated from the root nodules of various hosts in the tribes Podalyrieae, Hypocalyptieae, Crotalarieae and Genisteae, as well as mimosoid species like *Acacia karroo*. Further characterisation of these lineages also indicated that most potentially represent novel species that warrant formal description.

- Comparison of the rhizobia isolated from the root nodules of *A. karroo* to those obtained from non-native *Acacia* species revealed that these native and non-native *Acacia* species are nodulated by distinctly different sets of bacteria. Whether the rhizobial symbionts of the non-native *Acacia* species were introduced along with their hosts is not clear, but such "co-introductions" have been reported for other commercially relevant legumes and their symbionts.

- Our data showed that *Burkholderia* species associated with native legumes are highly diverse, forming part of an apparently monophyletic assemblage including other plant-associated *Burkholderia* species. Horizontal gene transfer has, however, shaped the symbiotic abilities of these bacteria, as genes involved in both N_2-fixation and nodulation have unique ancestries. It is thus possible that the evolution of these bacteria is closely aligned with the diversification and establishment of South Africa's native legume diversity.



The indeterminate nodules induced by *Burkholderia* species on the roots of *Hypocalyptus coluteoides*. The shapes of these nodules are commonly finger-like (left) and only rarely fanshaped (right). (Taken from the M.Sc. dissertation of Chrizelle Beukes.)

EUCALYPTUS AND PINE PATHOGEN INTERACTIONS (EPPI)

Research leader: Dr. Sanushka Naidoo

Research team: Prof. Dave Berger
Prof. Zander Myburg
Prof. Bernard Slippers
Prof. Emma Steenkamp

OBJECTIVES OF THE RESEARCH PROGRAMME:

Forest tree species such as *Eucalyptus* and Pine are subjected to attack by various pests and pathogens during their life-time. Examples are the insect pest, *Leptocybe invasa*; the stem canker pathogen, *Chrysoporthe austroafricana*; the root rot pathogen, *Phytophthora cinnamomi*; and the pitch canker pathogen, *Fusarium circinatum*. This is exacerbated by climate change, which is predicted to make environments more favourable for pathogens and pests in future. The phenomenon of "host-shifts" from native hosts to forest plantations is increasingly reported. Currently, these threats are managed by planting tolerant genotypes or, in the case of *L. invasa*, the use of biological control as part of an integrated management system to curb losses. Despite these measures, such threats are considered severe for a clonally propagated tree species. This calls for the understanding of the plant defence mechanisms that exist in *Eucalyptus* trees, which may be harnessed to improve their resistance capacity in future. Thus, EPPI is dedicated to uncovering the defence arsenal in *Eucalyptus* and Pine based on the study of the host "defensome" (or defence transcriptome). We study the interaction between *Eucalyptus* with *L. invasa*, *Eucalyptus* with *P. cinnamomi*, *Eucalyptus* with *C. austroafricana* and *Pinus patula* with *Fusarium circinatum*.

Ms Febe Wilken, Ms Ronishree Naidoo, Mr Erik Visser and Ms Therese de Castro surrounded by *Eucalyptus* seedlings in preparation for artificial inoculations with *C. austroafricana*

These pathosystems provide the biological platform to address key questions such as: (1) What is the molecular basis of tolerance and susceptibility? (2) What are the signature defence responses to different types of pests and pathogens? (3) "What are the convergent defence responses in the host? and (4) Which regulatory sequences and defence genes could be targeted for enhancing defence in *Eucalyptus*? This would provide a basis to implement biotechnology strategies to develop resistant families (seedling forestry) or clones (clonal forestry) in future.

HIGHLIGHTS OF OUR RESEARCH:

The *Eucalyptus* genome sequence, completed in 2010, provides a useful resource to identify genes related to plant defence. We set out to identify the orthologs of known defense genes previously characterised in model plant species such as *Arabidopsis* in the *E. grandis genome*. The *Arabidopsis* amino acid sequence of these pathogenesis-related (PR) genes, obtained from The *Arabidopsis* Information Resource (TAIR, version 10) was used as the query sequence against the predicted *E. grandis* proteome (first *ab initio* and homology-based annotation) in Phytozome v7.0, and transcripts were selected for further resolution of orthology. The *Populus trichocarpa* orthologs of the gene of interest were retrieved from NCBI. Phylogenetic analysis was conducted and gene expression was confirmed using EucGenIE to determine the expression pattern of the selected gene model across different tissues. Using this approach, we were able to identify putative orthologs for PR2, PR3, PR4, PR5 and lipoxygenase, many of which are members of multi-gene families. Some of these genes have also been shown to have antifungal activity.

Most of what is known about the host defence response to date revolves around the signalling mediated by the phytohormones salicylic acid (SA) and methyl jasmonate (MeJA). We investigated the expression of the identified orthologs under SA and MeJA treatment and identified concentrations of the phytohormones which provided the best induction of these genes. In collaboration with Prof. Dave Berger, Ms Ronishree Naidoo explored the use of these defense genes as indicators of the onset of SA or MEJA defence signalling. Our results suggest that PR2 and PR4 could be applied as markers of the SA and MeJA defence pathways respectively. The expression patterns of these genes were interrogated in susceptible and tolerant genotypes of *Eucalyptus* challenged with the canker pathogen *C. austroafricana*. The results suggested that SA was important for tolerance against the pathogen. This hypothesis was tested by Ms Linda Ferreira. The application of SA to susceptible *Eucalyptus* seedlings prior to inoculation with *C. austroafricana* provided enhanced tolerance, and lesion lengths were reduced to levels comparable to the tolerant *Eucalyptus* genotype. These results support the use of the *Eucalyptus* orthologs PR2 and PR4 as diagnostic tools for clues as to which of the two signalling pathways are important for defence in various *Eucalyptus*-pathogen interactions in future.

Ms Ronishree Naidoo on a field trip as part of the IUFRO Biotechnology Conference, June 26 – July 2 2011 – Arraial d'Ajuda, Bahia, Brazil

FOREST MOLECULAR GENETICS (FMG) PROGRAMME:

Genomics and Biotechnology for Superior Wood and Fibre

Research leader: Prof. Zander Myburg

Research team: Mr. Eshchar Mizrachi
Dr. Sanushka Naidoo
Dr. Daleen van Dyk

OBJECTIVES OF THE RESEARCH PROGRAMME:

Wood formation leads to the renewable production of valuable lignocellulosic biopolymers with wide industrial application. The biosynthesis of cellulose, xylan and lignin in the cell walls of wood fibre cells can be studied using systems biology approaches which integrate diverse types of genomics, transcriptomics, metabolomics and wood chemistry data. The Forest Molecular Genetics Programme aims to understand the integrated genetic control of wood fibre development in fast-growing forest trees. This knowledge is used to develop biotechnology tools for the improvement of wood quality in plantation tree species grown in South Africa. High-throughput genomics technologies are used to:

- Discover genes involved in wood fibre development in trees
- Dissect the regulatory networks and metabolic pathways underlying wood formation
- Test the function of candidate wood formation genes in trees
- Map tree genomes and associate DNA markers and genes with trait variation in tree populations
- Develop practical molecular breeding tools (DNA fingerprinting and genomic selection) for the genetic improvement of eucalypt and pine tree species

HIGHLIGHTS OF OUR RESEARCH:

With the completion of the *Eucalyptus* genome sequence in the past two years, we have had access to the entire molecular blueprint underlying tree growth and development. This has allowed whole-genome and whole-transcriptome analyses of wood formation in experimental tree populations.

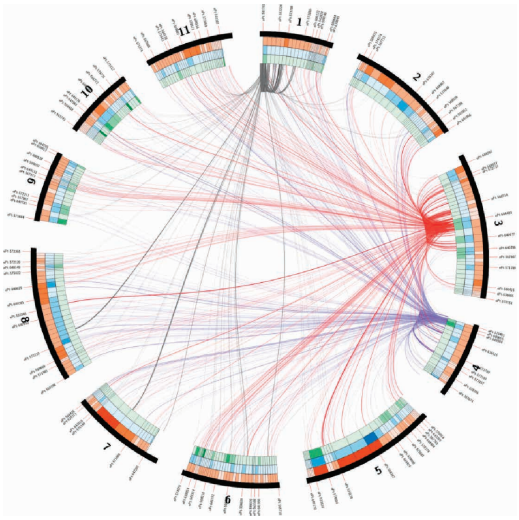
Genome mapping of wood property traits:

We produced high-density DArT and microsatellite marker linkage maps of a *Eucalyptus* hybrid *E. grandis* x *E. urophylla* backcross predigree (Sappi Forests Research) used for transcriptome profiling. The genetic maps were used to locate genomic regions (quantitative trait loci, QTLs) associated with volume growth (DBH), wood density and a range of wood cell wall chemistry traits.

Genome sequencing and genomic selection:

The US Department of Energy (DOE) Joint Genome Institute (JGI) released the draft (V1.1) genome assembly and annotation of *E. grandis* in 2012 (http://www.phytozome.net/eucalyptus.php). A total of 36,376 protein coding genes are annotated in the genome.

The genome sequence serves as a reference for the discovery of genetic variation in eucalypt breeding populations. As a first step towards the development of a genomic breeding resource, we have performed high-throughput genome sequencing of 24 individuals each of *E. grandis* and *E. dunnii* to identify single nucleotide polymorphisms (SNPs) segregating in these two



eQTL hotspots in the *Eucalyptus* genome

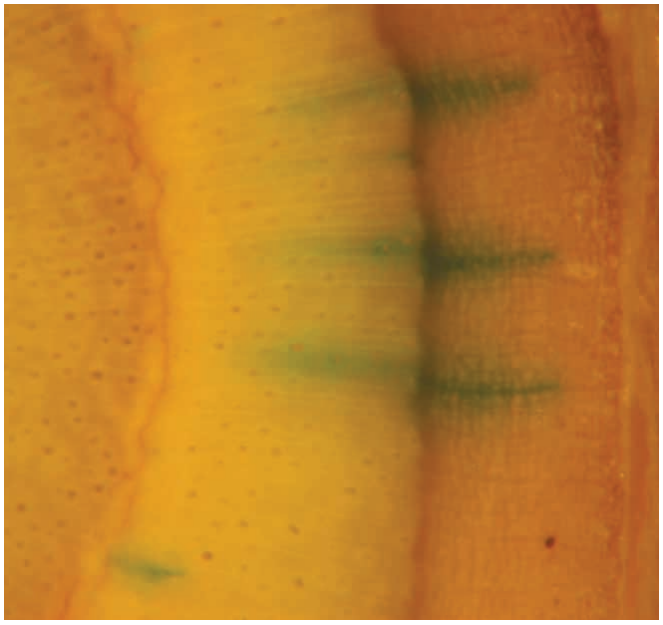
Systems genetics of wood formation

Building on our previous work to produce a whole-tree gene expression atlas for *Eucalyptus* trees (http://www.eucgenie.org/), we have used high-throughput RNA sequencing technology to profile the xylem transcriptomes of over 280 *Eucalyptus* hybrid (*E. grandis* x *E. urophylla*) trees with the aim of unravelling the genetic regulation of wood formation in these trees. The gene expression data were mapped to the *Eucalyptus* reference genome and more than 90,000 expression quantitative trait loci (eQTLs) were identified marking the locations of genetic polymorphisms affecting gene expression in wood forming tissues. eQTL "hotspots" mapped in the parental genomes represent key genetic loci underlying genetic differentiation between *E. grandis* and *E. urophylla*. We were able to show that several of the hotspots are enriched for genes in biosynthetic pathways associated with secondary cell wall formation. Our research points to the presence of a network of regulatory factors controlling carbon allocation and fibre cell wall formation in *Eucalyptus* trees. Metabolic profiling of the developing xylem tissues provided further insight into the flow and allocation of carbon during cellulose and xylan biosynthesis in fibre cells. We have initiated a collaboration with Ghent University aiming to build a systems model integrating genetic variation, gene expression and metabolic regulation of fibre cell wall formation in eucalypt trees.

species. In parallel, we have initiated projects to implement genome-wide genotyping and genomic selection for growth and wood properties in *E. grandis* and *E. dunnii* breeding populations.

Transcriptional regulation of cellulose and hemi-cellulose biosynthesis:

The transcriptional networks regulating the production of cellulose and xylan in wood form an important research focus. In the past two years we analysed the cis-regulatory architecture and diversity of cellulose synthase (*CesA*) genes expressed in wood fibre cells of *Eucalyptus* trees. In collaboration with the University of Melbourne we used induced somatic sector analysis (ISSA) to elucidate the regulation of these genes and we used a yeast model system (yeast-1-hybrid analysis) to identify transcription factors that may bind to the *Eucalyptus CesA* promoter. We also cloned and analysed *Eucalyptus* orthologs of transcription factors that have been identified to act as master regulators of fibre secondary cell wall formation in model plant systems.



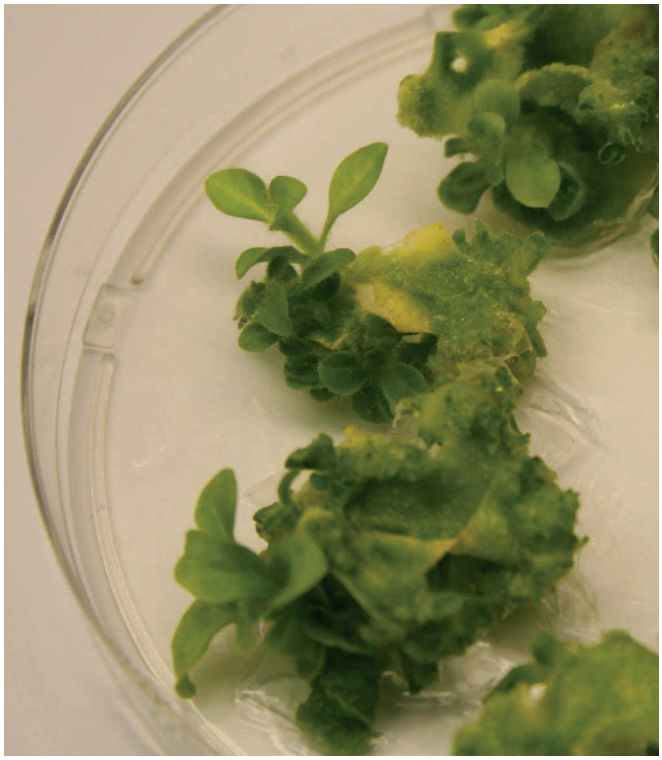
Induced somatic sector analysis (ISSA) of *CesA* promoters in *Eucalyptus*

Functional genetic testing of wood formation genes:

The combination of genome mapping and transcriptome analysis in wood forming tissues of field-grown eucalypt trees is generating hypotheses about candidate genes and biosynthetic pathways that can be tested in transgenic model systems. We have been using the model plant *Arabidopsis thaliana* to study the effect of altering the expression of specific candidate genes and observing the effect on biomass and cell wall-related traits compared to wild-type plants. We have also established a poplar tree-transformation platform in FABI that can be used for over-expression or knock-down of candidate genes.

Wood chemistry analysis:

We have over the past two years established capacity to perform wood chemistry (Klason lignin and HPLC cell wall sugar) analyses in a shared Sappi-UP laboratory now at the Sappi Tech Centre in Pretoria. This capacity is used to measure wood chemistry traits in experimental tree populations and in stem tissues of transgenic plants.



Tissue culture and transformation

DNA fingerprinting and parentage analysis of trees:

Microsatellite or simple sequence repeat (SSR) markers are powerful tools that can be used to fingerprint closely related trees and support routine tree breeding activities. We have developed microsatellite marker panels for *Eucalyptus* and pine tree species grown in South Africa and have implemented these in a variety of applications including clonal fingerprinting, parentage analysis, detection of pollen contamination, and cross and selfing analysis in open and controlled crosses. We have also implemented a panel of DNA markers that enable species and hybrid discrimination in *Eucalyptus*. This capacity is accessible as a research service to forestry companies in South Africa.

Xylem sampling

FRUIT TREE BIOTECHNOLOGY PROGRAMME

Research leader: Dr Noëlani van den Berg

Collaborators: Prof. Dave Berger
Prof. Teresa Coutinho
Prof. Zander Myburg
Dr. Sanushka Naidoo

OBJECTIVES OF THE RESEARCH PROGRAMME:

The Fruit Tree Biotechnology Programme (FTBP) represents a co-operative venture between the Hans Merensky Foundation and the University of Pretoria, and deals with avocado disease problems, especially focusing on Phytophthora root rot (PRR) and understanding the mechanisms involved in rootstock tolerance. In addition, the FTBP is also involved in banana research focusing on the unconventional improvement of Cavendish bananas.

HIGHLIGHTS OF OUR RESEARCH:

The Fruit Tree Biotechnology Programme (FTBP) was established in 2008 as a cooperative research programme between the Hans Merensky Foundation, Westafalia Technological Services and the University of Pretoria. Research deals with avocado disease problems and abiotic stress such as flooding and salt stress. The main focus is on Phytophthora root rot (PRR) and understanding the mechanisms involved in rootstock tolerance and pathogen infection.

Phytophthora root rot caused by *Phytophthora cinnamomi* Rands is one of the most devastating diseases of the fruit and has large economic impact on all avocado-producing countries around the world. The most significant problem is the lack of total resistance against this oomycete. To date the selection of superior avocado cultivars has been based on field evaluations within seedling populations. Research from our programme is therefore aimed at unraveling the molecular mechanism underlying tolerance in avocado and pathogenicity in *P. cinnamomi*.

We have sequenced and assembled the first defence transcriptome for avocado. The RNA was from a tolerant avocado rootstock infected with *P. cinnamomi* over time and also included a set of plants exposed to flooding. Sequence data has identified several expressed sequence tags (ESTs) that have been linked with defense and flooding responses in plants. Expression analysis, using quantitative real-time PCR, has been implemented to validate the sequence data and to study gene expression in avocado rootstocks with varying levels of PRR-tolerance.

Phytophthora cinnamomi is a ubiquitous oomycete and research in our group includes generating 1 gig of RNA sequencing data from the zoospores, cysts and germinating cysts. We have identified several pathogenicity related genes including ESTs with homology to effector molecules like the RXLRs. Research is further aimed at transforming *P. cinnamomi* with a GFP-marker to aid in infection studies using confocal microscopy. We have developed a molecular diagnostic and quantitative tool to identify and quantitate *P. cinnamomi in planta*. This tool can be applied in the selection of tolerant avocado rootstock material.

Additional research includes the development of microsatellite markers for *P. cinnamomi*, elucidating the effect of salinity and flooding on avocado root health, isolating endophytes from avocado roots and investigating their use as biological control agents and identifying other pathogens associated with root rot in avocado.

Renier Lourens, Elrea Appelgryn, Mariette Ferreira, Tuan Duong, Juanita Engelbrecht in an avocado orchard

FUSARIUM RESEARCH PROGRAMME

Research leader: Prof. Emma Steenkamp

Research team: Prof. Teresa Coutinho
Prof. Wally Marasas (deceased)
Prof. Jolanda Roux
Prof. Brenda Wingfield
Prof. Mike Wingfield
Dr. Martin Coetzee
Dr. Albé van der Merwe

OBJECTIVES OF THE RESEARCH PROGRAMME:

The *Gibberella fujikuroi* complex (GFC) represents a monophyletic assemblage of medically, veterinary and agriculturally important *Fusarium* species. Despite their global importance, little is known about their evolution or how they are adapting to new environments. Improvement of our knowledge regarding the evolutionary biology of these fungi and the forces driving their evolution is dependent on analyses against a well-supported phylogenetic framework. Our overall goal is, therefore, to reconstruct the evolution of the GFC to test hypotheses pertaining to its phylogeography, mycotoxicology, host/substrate preference, reproductive biology and pathology.

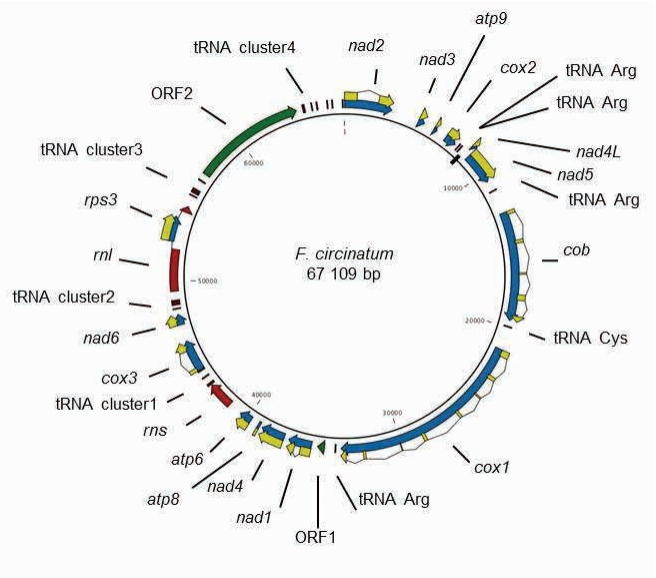
At the species/population interface we examine the geographic and ecological distribution of extant species and/or species groups by making use of a combination genomic and phylogenetic data. As these studies are often severely affected by incomplete taxonomic sampling, we also explore the diversity of these fungi in native South African environments with the aim of discovering new taxa. Because the processes determining microbial evolution include horizontal gene transfer between related and unrelated taxa, hybridisation, vegetative reproduction and sexual reproduction, experiments typically involve conventional genetic methods (e.g. controlled crosses, linkage mapping and the analyses of mutants) and genomic approaches.

HIGHLIGHTS OF OUR RESEARCH:

- For inference of the GFC phylogeny we have employed various molecular markers. Despite suggestions from previous studies, our results have shown that mating and reproductive genes are not suitable for this purpose due to sequence conservation and non-vertical inheritance. In fact, non-vertical inheritance (*i.e.* acquisition from an unrelated taxon) also appeared to be the major theme for the genes encoded on the mitochondrial genomes of these fungi.

- To allow for the identification of suitable molecular markers, we have extensively exploited next- generation sequencing technologies. For example, we have developed a cost-effective procedure for the routine development of microsatellite markers, specifically for testing taxonomic hypotheses. Most recently, we also determined one of the three GFC genomes that are currently available. In other words, we now have access to the complete genomes of these fungi for identifying markers and studying traits of interest.

- Comparative genomic studies revealed a remarkable level of macrosynteny among the genomes of *Fusarium* species in the GFC. However, localised and gross chromosomal rearrangements were also observed, many of which apparently came about early during the evolution of the complex. These data also highlighted the possibility of gene exchange among species because of the occurrence of unique genes and genes that support highly conflicting phylogenies. Although hybridisation in the GFC is not novel, such crosses appear to be associated with high levels of segregation ratio distortion that could potentially impact the fitness of progeny. However, the possibility cannot be excluded that some ancestral hybrids might have survived and shaped the evolutionary trajectories in this complex. The GFC thus represents an excellent model within which to study the evolution of species and their traits, as well as the processes driving the emergence of new pathogens.



Gene map for the *Fusarium circinatum* mitochondrial genome. Predicted protein-coding (blue = entire gene; yellow = coding sequence) and transfer RNA (tRNA, red) genes, as well as unique open reading frames (ORFs; green) are transcribed from the same strand. (Taken from the Ph.D. work of Gerda Fourie.)

MOLECULAR PLANT PATHOGEN INTERACTIONS

Research leader: Prof. Dave Berger

Research team: Dr. Bridget Crampton
Dr. Sanushka Naidoo

OBJECTIVES OF THE RESEARCH PROGRAMME:

The MPPI research group is involved in a range of research projects that address the general hypothesis that gene expression dictates phenotypes in plants, with particular emphasis on plant-pathogen interactions. The objective of our research into an *Arabidopsis*-bacterial wilt pathosystem is to gain fundamental knowledge into the molecular basis of plant defence mechanisms, as well as insights into the pathogenicity mechanisms of the bacterium *Ralstonia solanacearum*. This research is facilitated by the availability of molecular genetic and genomic tools for the model plant *Arabidopsis*, as well as the *Arabidopsis* growth rooms in FABI. The second pathosystem under investigation is between maize and grey leaf spot disease, caused by the fungus *Cercospora zeina*. We collaborate with Dr Bridget Crampton, leader of the Cereal Foliar Pathogens Research Group (CFPRP) in FABI. We have recently annotated the maize whole genome microarray (Plant Methods (2011) 7: 31), which has been used for expression profiling in the project, and developed a real-time PCR method for quantifying the fungus in diseased maize plants in the glasshouse and field (EJPP (2012) 133: 461-471). The MPPI group's research in the field of tomato genomics is described below.

HIGHLIGHTS OF OUR RESEARCH:

Understanding susceptibility and tolerance to bacterial wilt in Arabidopsis plants

The MPPI research group has made exciting progress in exploring the molecular exchange between the bacterial wilt pathogen *Ralstonia solanacearum* and the model plant *Arabidopsis thaliana*. FABI researchers previously observed that bacterial wilt is a sporadic disease in *Eucalyptus* plantations in South Africa, and have also identified the disease in other African countries. African isolates of *R. solanacearum* from *Eucalyptus* trees were screened against a range of *Arabidopsis* ecotypes from different parts of the world. These natural variants show phenotypic differences that have a genetic basis.

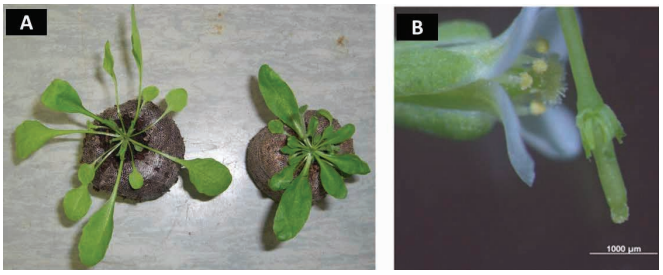
Some *Arabidopsis* ecotypes developed bacterial wilt disease, whereas others did not develop symptoms. Microarray-based expression profiling was carried out on the susceptible interaction (Forest Pathology (2011) 41: 101-113). Expression profiles were compared with those from other *Arabidopsis* pathosystems by mining gene expression databases using a custom bioinformatics tool called Rank Correlation Comparer. Bacterial wilt-diseased *Arabidopsis* plants displayed expression patterns that were most similar to plants challenged with virulent *Pseudomonas* or *Botrytis* pathogens, as well as abscisic acid treatment. Interestingly, a set of genes that responded to treatment by pathogen-associated molecular patterns (PAMPs) were expressed in the opposite manner in the presence of *R. solanacearum*. This suggested that this pathogen is able to manipulate host responses to facilitate disease progression. This work was mostly carried out by Dr Sanushka Naidoo, who used the ACGT Microarray Facility at the University of Pretoria, a genomics resource available to FABI.

In the second part of the project, a genetic approach was adopted to investigate the response of the ecotype that did not develop symptoms. The initial hypothesis was that this ecotype was resistant (immune) to bacterial wilt, however the surprising result was obtained that the symptomless ecotype harboured high bacterial numbers and did not show a reduction in fitness or yield (Molecular Plant-Microbe Interactions (2013) 26, 398-406). This indicated that the ecotype was tolerant, a phenomenon that has been little-studied at the molecular level in bacterial-plant interactions.

Arabidopsis-bacterial wilt pathosystem. *Ralstonia solanacearum* isolates from *Eucalyptus* trees are pathogenic, since they produce a hypersensitive response on tobacco (left). Healthy un-inoculated *Arabidopsis plants* on the left, and wilted *Arabidopsis* plants on the right after inoculation with *R. solanacearum* (right).

Current thinking was that tolerance was a quantitative trait encoded by multiple genes of small effect. However, F_1 plants of a cross between the tolerant and susceptible ecotype were susceptible, indicating a recessive trait. Furthermore, F_2 plants segregated in a 3:1 ratio of susceptibility to tolerance, which was consistent with single gene inheritance of tolerance. Cleaved amplified polymorphic sequence (CAPS) marker analysis showed that the trait segregated with an allele of the Resistance

to *Ralstonia solanacearum 1* (*RRS1*) gene from the tolerant ecotype. *RRS1* is a so-called plant resistance gene identified in a resistant ecotype. *RRS1* recognises *R.solanacearum* strains that carry the effector *PopP2*. A knockout of *popP2* in the *R.solanacearum* strain from *Eucalyptus* was constructed, and tolerance was abolished, providing strong evidence that tolerance is due to recognition of *PopP2* by *RRS1*. Complementation of the *popP2* knockout bacterial mutant with the *popP2* gene restored the tolerant phenotype, as expected.



Cross fertilisation in *Arabidopsis*. Panel A shows two different *Arabidopsis thaliana* ecotypes with different phenotypes (e.g. leaf shape). Panel B shows cross fertilisation between the ecotypes. Pollen from a flower of one of the ecotypes is being transferred to the stigma of an emasculated flower from the other Arabidopsis ecotype to produce F_1 progeny for genetic analysis.

Finally, F_1 progeny of a cross between the tolerant and the previously characterised resistant ecotype were tolerant to the *R. solanacearum* strain from *Eucalyptus*. This supported the hypothesis that the determinant of tolerance is *RRS1* in a gene-for-gene manner (MPMI (2013) 26, 398-406). These results illustrated that alleles of *RRS1* in different *Arabidopsis* ecotypes can act as resistance or tolerance determinants, and that tolerance is not necessarily a polygenic trait. Finally, the work highlights that deployment of genes such as RRS1 for control of bacterial wilt in *Eucalyptus* trees may result in tolerance, not immunity, and thus the pathogen may persist in the plantation. M.Sc. students Liesl van der Linden and Jane Bredenkamp carried out most of the work in the tolerance study. The *Arabidopsis*-bacterial wilt project involves team members from the EPPI and MPPI groups in FABI, with collaborators at CNRS-INRA, Toulouse, France and the University of Warwick, UK.

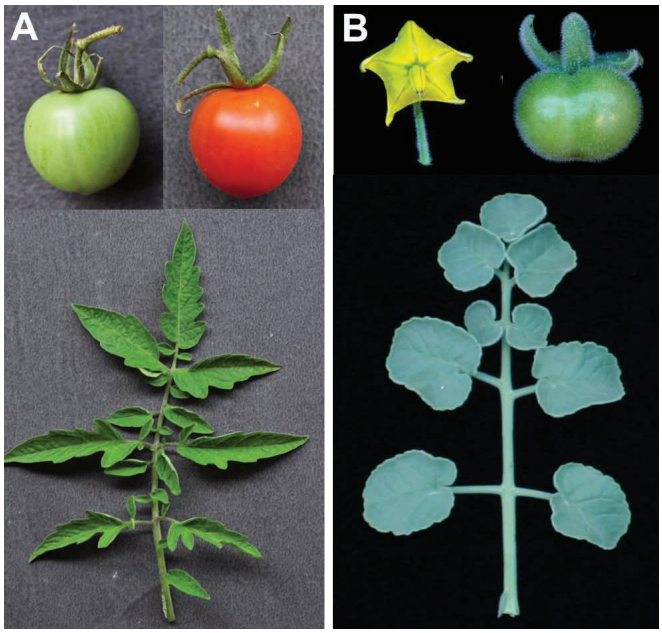
Tomato Diversity Array

The MPPI group was a partner in the European Union 6th Framework Integrated Project which involved more than 50 partners from Europe and other parts of the world. EU-SOL was focused on Health-based Consumer Quality Traits in Tomato and Potato (www.eu-sol.net). An aim of the EU SOL project was to explore biodiversity to improve tomato quality traits, and wild species are considered a useful source of genes for improving traits. But how does one find such genes?

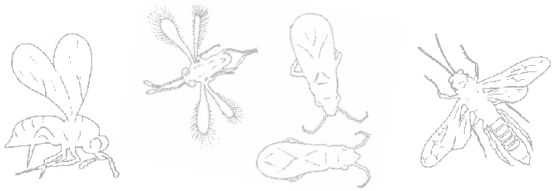
The MPPI group contributed to this "gene-hunting" exercise by leading the development of a "tomato diversity array". The diversity array was constructed from domesticated tomato *Solanum lycopersicum* and several wild species including *S. pennellii*, *S. galapagense*, *S. pimpinellifolium*, *S. habrochaites*, *S. arcanum*, *S. neorickii* and *S. chmielewskii*. The tomato diversity array increased the number of genetic markers for wild tomato species by up to tenfold. The diversity array (DArT) markers were validated by genetic mapping in an introgression line population derived from a cross between domesticated tomato and *S. pennellii* (Theoretical and Applied Genetics (2012) 124: 947-956).

During the course of the project, the finished version of the tomato genome sequence became available (published in *Nature* in May 2012), therefore the DArT markers were sequenced and matched to the genome. This resource has assisted EU-SOL partners in "gene-hunting" for traits such as tomato fruit texture and quality. The marker data has been made available to tomato breeders worldwide for future gene discovery through a publicly accessible database (SSHdb at UP and BreeDB at Wageningen, The Netherlands). Development of the tomato diversity array was carried out by Post-doctoral Fellow in the MPPI group Dr Antoinette van Schalkwyk in collaboration with Diversity Arrays Technology P/L, Australia, Imperial College London, and Wageningen University and Research Centre, The Netherlands.

Current and future work in the MPPI lab is focused on: (i) genomics of *Cercospora zeina* and quantitative disease resistance in African maize varieties; (ii) understanding the mechanism of tolerance to bacterial wilt in *Arabidopsis*; and (iii) applying diversity arrays to *Solanum* diversity in South Africa.



Tomato diversity. Figure A shows unripe fruit, ripe fruit and leaves of domesticated tomato *Solanum lycopersicum*. Figure B shows flower, fruit and leaves of wild tomato species Solanum pennellii, which has genes for useful agronomic traits such as disease resistance and drought tolerance. Molecular markers developed in the tomato diversity array were validated in an introgression line population developed from a cross between *S. lycopersicum* and *S. pennelllii*. Photos not to scale.



MOLECULAR PLANT PHYSIOLOGY PROGRAMME

Research leaders: Prof. Karl Kunert
Dr. Juan Vorster

Research team: Prof. Christine Foyer (University of Leeds, UK)
Prof. Sofie Goormachtig (VIB, Belgium)
Prof. Dominique Michaud (Universitè Laval, Canada)

OBJECTIVES OF THE RESEARCH PROGRAMME:

Our research focuses on stress biology with specific emphasis on stress resistance, protein engineering and modelling. Our work, carried out with partners in the UK, USA, Canada, Belgium and Africa, contributes to understanding these mechanisms in more detail, thereby allowing plants to survive threats in environments relevant to Africa. Our ultimate goal is applying the learnt principles to the design of crops that are better adapted to these environments.

RESEARCH FOCUS:

The symbiotic association between soybean and *Bradyrhizobium japonicum* allows for the fixation of atmospheric nitrogen by the bacteria inside root nodules. The life of a nodule is, however, very short, and early losses in nitrogen fixation capacity, induced by environmental stresses, lead to nitrogen limitation within the plant. This has a major impact on seed production, crop quality and yield. During 2011 and 2012 we investigated the effects of drought stress on nodule development and performance in the soybean. We found that drought decreased the total number and biomass of nodules as well as the activity of these nodules with regards to nitrogen fixation. We identified significant cultivar-drought interactions, indicating underling genetic differences allowing some cultivars to perform better under water limiting conditions. We also found that photosynthesis showed a strong positive correlation with symbiotic nitrogen fixation, particularly under drought conditions, which could be a useful selection measurement (Fenta et al., 2012). In collaboration with the Flemish Institute for Biotechnology (VIB) and the University of Ghent in Belgium we also identified 39 CLE genes in the soybean genome, the majority of which have not been annotated yet. CLE peptides are potentially involved in nodule development as well as autoregulation of nodulation that restricts the number of nodules. We also showed that two different CLE expression patterns exist, one linked with nodule primordium development and a new one linked to nodule maturation (Mortier et al., 2011). We also identified two possible receptors responsible in the recognition of the CLE peptides (Mortier et al., 2011).

Another aspect of our research related to stress mechanisms and tolerance, focusing on the cysteine protease & cysteine protease inhibitor (cystatin) system.

HIGHLIGHTS OF OUR RESEARCH (2011-2012):

An EU-funded (IRSES-LEGIM) Stress Biology and Plant Development workshop was hosted in November 2011 on plant stress biology and plant development with a particular focus on legume development and senescence. Foreign scientists from the UK (Leeds University, John Innes Center), Belgium (VIB Ghent University, Antwerp University), USA (Case Western Reserve University, Cleveland) and Germany (Erlangen University) as well as local scientists from various South

Soybean plants in the greenhouse

African research institutions involved in these research topics, presented in this one day workshop their current research work and further discussed future trends in these research areas. The program of IRSES-LEGIM exchanges funded until June 2012 integrated researchers from the University of Pretoria with EU-based research organisations to create highly innovative and interdisciplinary approaches aimed at the identification of genes, processes and regulatory networks governing legume development and senescence. The integrated systematic research and training program of IRSES-LEGIM was comprised of methodological and complementary skills workshops, and scientific meetings that accompanied exchange visits to the partner laboratories. Through IRSES-LEGIM, the University of Pretoria-FABI has established a firmly founded priority for its future research, allowing long-term collaborative projects with European research groups such as the Africa College at Leeds University or Antwerp University.

Presenters at the Stress Biology and Plant Development workshop.

Prof. Nick Brewin (JIC, UK), Prof. Sofie Goormachtig (VIB, Belgium), Prof. Karl Kinert (UP), Dr Urte Schlüter (Erlangen, Germany), Dr Juan Vorster (UP), Prof. Christine Foyer (Leeds, UK), Dr Belen Marquez- Garcia (Leeds, UK) and Prof. Chris Cullis (CWRU, USA)

POTATO PATHOGEN AND PEST INTERACTIONS RESEARCH

Research leader: Dr. Lucy Moleleki

Research team: Prof. Teresa Coutinho
Prof. Jacques Theron

OBJECTIVES OF THE RESEARCH PROGRAMME:

The research programme studies molecular interactions between pests and pathogens of potato plants. Currently, there are two main research focus areas. The first research focus is on soft rot bacterial pathogens (soft rot enterobacteriaceae [SRE]) and the second research area is on potato root knot nematodes (RKN). The objectives of the research are:

- Molecular identification of potato pathogens and pests
- Functional characterisation of bacterial virulence factors
- Elucidation of potato plant responses elicited by both SRE and RKN

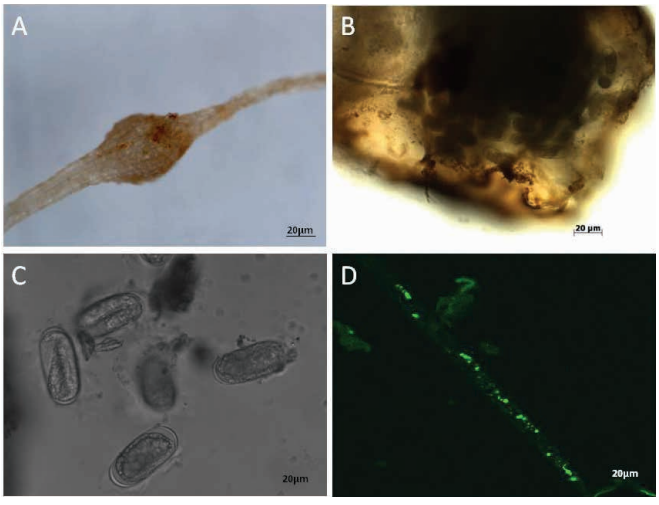
HIGHLIGHTS OF OUR RESEARCH:

Potato Root Knot Nematodes Research Focus Area:

Genetic diversity of Root Knot Nematodes in Potatoes

The root knot nematodes, also known as *Meloidogyne* spp., are important pests of many crop plants worldwide. The current withdrawal of chemical nematicides is likely to exacerbate the threat of RKN in crop production. Hence, it is important that alternative methods of control are investigated. For successful implementation of alternative control strategies, accurate diagnosis of *Meloidogyne* spp infecting a specific farm is of great importance. Identification of RKN species is largely based on the use of morphological differences between species. However, this is challenging even to skilled personnel. As a result, we chose a molecular-based approach towards the accurate identification of RKN infecting potatoes in South Africa. In this project, the genetic distribution of RKN infecting potatoes was mapped according to geographic (potato growing) region. The following important species were identified: *M. hapla*, *M. javanica*, *M. arenaria*, *M. incognita*, *M. chitwoodi* and *M. enterolobii* (Onkendi and Moleleki 2013 Plant Pathology 62, 1184 - 1192). The identification of *M. enterolobii* in a potato seed-producing region was particularly noteworthy as this is a highly virulent species known to break down the Mi-resistance present in many Solanaceous plants (Onkendi and Moleleki 2012 European Journal of Plant Pathology DOI 10.1007/s10658-012-0142-y). Its presence in potato seed-producing regions thus presents an added risk as this RKN spp is likely to be disseminated countrywide through contaminated seed.

The imminent threat of RKN to crop production due to reduced control options by growers may be heightened by possible synergy or interactions likely to occur between RKN and other microbes in the rhizosphere. While interactions between plant parasitic nematodes (PPN) and microbes such as fungi and viruses are well studied, the interaction between PPN and phytobacteria has lagged behind. As an example, to date, there have been no studies to evaluate potential interaction between RKN and soft rot bacteria (*Pectobacterium* spp.), an important bacterial pathogen of potatoes. One contributing factor could be the sole reliance on symptoms as a means of determining synergy between two organisms. Hence, we generated an mCherry-tagged *Pectobacterium carotovorum* subsp. *brasiliense* (*Pcb*) strain to study the interaction between RKN and *Pcb*. Using this strain we were able to demonstrate that synergy occurs between RKN and SRE. This synergy is based firstly on the ability of *Pcb* to attach to the surface coat of RKN and secondly on the SRE taking advantage of wounds generated by infecting RKN juveniles to gain entry into otherwise intact potato tissue (Mongae et al., 2012 DOI: 10.1111/lam.12045).



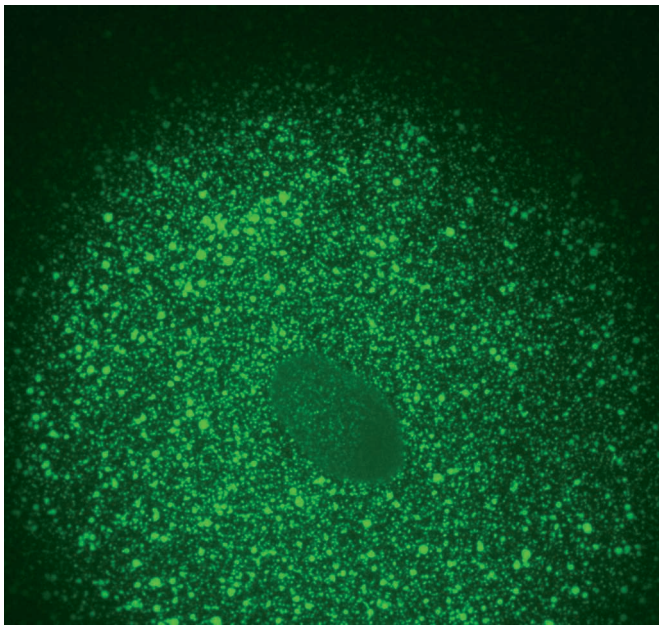
Root knot nematodes:

a) Gall formation on potato roots
b) Egg mass
c) eggs
d) second stage juvenile (J2)

Potato Soft Rot Research Focus Area:

Isolation and characterisation of Pectobacterium *wasabiae in South Africa*

Infected potato tubers obtained from growers in the Free State, South Africa were obtained. From these, pectolytic species were isolated and characterised. Apart from the common *Pectobacterium brasiliense* (*Pcb*) which was previously reported in South Africa, we isolated an atypical *Pectobacterium* spp. This species was characteristically unable to grow at 37°C and yet did not amplify with *P. atrosepticum*-specific primers, the only other *Pectobacterium* spp unable to grow at 37°C. Using a polyphasic approach including biochemical, species specific primers and multilocus sequence analysis, the infecting species was identified as *P. wasabiae*. This is the first time that *P. wasabiae* has been reported in South Africa (Moleleki et al. 2012, European Journal of Plant Pathology 135:279-288). Interestingly we noted that unlike other soft rot bacteria, *P. wasabiae* lacks a functional Type 3 Secretion System. This feature is similar to that of other *P. wasabiae* strains reported in other parts of the world including New Zealand and the USA.



AHL production by *Pectobacterium* spp. detected using *E. coli* indicator strain *(gfpmut3)*

mCherry fluorescent tagged Pcb reveals variable colonisation patterns in susceptible compared to resistant potato genotypes

Resistance to soft rot pathogens in potatoes is generally rare. Often partial resistance, based on stems or tubers, has been identified. In this project we screened different potato cultivars against *Pcb* infection. While most of the cultivars tested were highly susceptible to *Pcb* and developed excessive blackleg symptoms within 21 of inoculation, one of the cultivars appeared to be highly resistant, developing no visible signs of blackleg symptoms throughout the study. Using mCherry tagged *Pcb*, we observed that *Pcb*_mCherry accumulated in the xylem vessels of the susceptible cultivar. It formed biofilm-like aggregates that eventually led to complete occlusion of xylem vessels. Interestingly, *Pcb* was unable to form these biofilm like aggregates in the resistant cultivar and appeared to be dispersed in the stem (with no specific tissue preference). ork is ongoing in an attempt to understand the basis of resistance as well as to characterise factors that prohibit biofilm formation in *Pcb* interaction within the resistant cultivar.

Quorum sensing, a density dependant form of communication in bacteria

The soft rot pathogens are known as brute-force pathogens due to production of copious amounts of plant cell wall degrading enzymes (PCWDE). These PCWDE are used by the pathogens to macerate plant cell wall tissue to release nutrients. The onset of plant cell wall degrading enzyme production as well as other virulence

A potato cultivar with enhanced resistance to stem-inoculated *Pectobacterium* spp.

factors required by the pathogen for survival in the host is a well-coordinated density-dependant process. This requires communication in the bacteria mediated by a small molecule known as acyl homoserine lactones (AHL). *ExpI* is an enzyme responsible for the synthesis of AHL. Induction of virulence in soft rot pathogens requires a coordinated induction of many transcription factors and other virulence factors such as PCWDE. In our lab, we have generated a *ExpI* mutant lacking the ability to synthesis AHL. The mutant is attenuated in virulence. We are currently investigating various *in vitro* and *in planta* phenotypes under the coordination of quorum sensing. Future studies will attempt to investigate the regulatory networks governed by quorum sensing.

PHYTOBACTERIOLOGY PROGRAMME

Research leader: Prof. Teresa Coutinho

Research team: Prof. Jacques Theron
Prof. Fanus Venter
Prof. Mike Wingfield
Dr. Lucy Moleleki

OBJECTIVES OF THE RESEARCH PROGRAMME:

- Develop rapid, reliable methods of accurately identifying phytopathogenic bacteria
- Characterise and type isolates of pathogenic bacteria responsible for economically important diseases of *Eucalyptus* and selected agricultural crops
- Study the epidemiology, ecology and biology of selected emerging plant pathogenic bacteria
- Identify pathogenicity factors of selected plant pathogenic bacteria using a genomic approach

HIGHLIGHTS OF OUR RESEARCH:

Identification of bacterial plant pathogens

Isolations from *Eucalyptus* leaves with typical symptoms of bacterial blight continue to yield new and interesting species. In 2012, we described three new species of *Pantoea*, viz. *P. rodasii*, *P. rwandensis* and *P. wallisii*. Their role in causing the disease is unclear and many of the species isolated are probably epi- or endophytes. In South Africa we consistently isolate *P. ananatis* from blighted tissue but a *Xanthomonas* sp. is also occasionally isolated and in inoculation trials produces typical symptoms of blight.

Identification of virulence/pathogenicity factors in P. ananatis

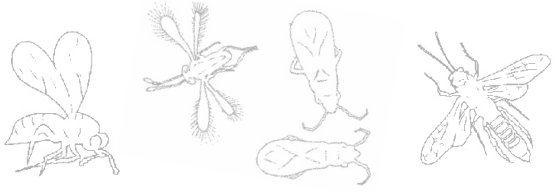
Pantoea ananatis is a ubiquitous organism found in almost every environment on earth. It has been implicated in diseases of a wide range of agronomic crops worldwide, including onion, maize, rice and pineapple, as well as a human disease. In South Africa, *P. ananatis* causes blight and dieback of *Eucalyptus*, resulting in severe losses of this important forestry resource. Nevertheless, little is known about the pathogenicity mechanisms utilised by this pathogen to cause disease in this host.

Type 6 secretion system (T6SS)

Three loci on the genome of LMG20103 (an isolate from *Eucalyptus*) encode three distinct copies of the Type VI secretion system, which has recently been demonstrated to play an important role in diseases caused by many plant- and animal-pathogenic bacteria. *In silico* analysis of these secretion systems showed that they are likely to secrete several pathogenicity effectors which may have a role in *P. ananatis* infection of both plant and animal hosts. This secretion system has also been found to play a role in interbacterial competition. Results from individual loci knockouts and complementation of individual genes showed that only one locus is involved in interbacterial competition. *Pantoea ananatis* is able to out-compete *Escherichia coli*, *Salmonella typhimurium*, *Pectobacterium carotovorum* subsp. *carotovorum*, *P. stewartii* subsp. *indologenes* and three other strains of *P. ananatis*. This ability could bestow a selective advantage to *P. ananatis* in an ecological niche and appears to be conferred by the effectors released by the T6SS.

Quorum sensing

Two N-acyl-homoserine lactones have been reported to be produced by *P. ananatis* and shown to play a role in the pathogenicity of this pathogen in onion. In this study, three quorum sensing systems, namely, EanI/R, the RhII/R and the *LuxS*, were identified in the genome sequence of the *Eucalyptus* strain LMG20103. The role of these three systems in the virulence of this pathogen has not yet been elucidated. A lambda red protocol was followed in order to delete the quorum sensing systems in LMG20103. Three mutant strains, EanI-EanR-, RhII-RhIR- and LuxS- were produced. Growth analysis showed that the wild-type and mutant strains had similar growth rates in nutrient-rich LB medium and M9 minimal medium. Virulence assays were conducted on onion seedlings, shown previously to be susceptible to this strain, using a stab inoculating method. A hypersensitive response, necrosis at the site of inoculation, was evident in the seedlings inoculated with the EanI-EanR- and RhII-RhIR- mutant strains three days post-inoculation. Seedlings inoculated with the LuxS- mutant showed no symptoms, whereas the wild-type strain produced typical symptoms. From these results it is evident that the EanI/R and RhIIR systems are required for this pathogen to successfully colonise host tissue. The LuxS system possibly regulates a phenotype, which is crucial for the virulence of *P. ananatis*. These results thus indicate that quorum sensing is required for virulence in this plant pathogen.



PLANT VIROLOGY RESEARCH PROGRAMME

Research leader: Prof. Gerhard Pietersen

OBJECTIVES OF THE RESEARCH PROGRAMME:

The research program of the Plant Virology Group focuses on grapevine leafroll disease of wine grapes, and the citrus disease caused by citrus tristeza virus (CTV). The group also studies citrus greening disease, associated with a fastidious bacterium "*Candidatus*" *Liberibacter africanus* (*Laf*), which has an epidemiology not unlike that of plant viruses. These three diseases are amongst the most important diseases of wine grapes and citrus, two high value crops in South Africa.

HIGHLIGHTS OF OUR RESEARCH:

A successful control strategy based on planting certified planting material, rouging of infected vines, control of mealybug numbers and dispersal has been developed by the group to control grapevine leafroll disease. Assessments of the efficacy of these control strategies have been conducted at a model wine estate, Vergelegen Wine Estate in Somerset West, where the success of the control strategy has been unequivocally demonstrated. Current research by the research group focuses on refinements of the control strategies; for example, a large scale detection technique is being developed to detect GLRaV-3, the causative agent of grapevine leafroll disease, in white cultivars where symptoms are not obvious. The technique is based on an isothermal loop-mediated amplification of DNA (LAMP). Trials have been completed to confirm the spread of leafroll between two successive vineyard blocks and assessment of control methods such as fallow periods, and systemic insecticide use with or without herbicide to prevent the perpetuation of grapevine leafroll infection from a neighbouring vineyard.

Candidatus Liberibacter africanus (*Laf*), the cause of citrus greening in South Africa, was not found in indigenous members of the Rutaceae (citrus) family during extensive surveys for this pathogen. However, at least three Liberibacter variants were recorded on the the indigenous plants, each seemingly being host specific.

The sequence of the whole genome of a novel Citrus tristeza virus genotype, CT-ZA, was determined. This will aid further cross protections studies to control this virus in South Africa.

Typical citrus greening symptoms on citrus leaves, along with (inset) *Trioza erytreae*, the vector of "*Candidatus Liberibacter africanus*", associated with citrus greening in South Africa.

Grapevine leafroll disease eradicated Cabernet Sauvignon vineyard, Autumn 2011, Vergelegen Wine Estate. Typically in autumn such vineyards in South Africa display the typical red-leaf symptoms of grapevine leafroll disease.

SEED- AND SOILBORNE DISEASE CONTROL OF MAIZE, COWPEA AND BEANS

Research leader: Prof. Terry Aveling

Research team: Prof. Nico Labuschagne
Dr. Quenton Kritzinger

OBJECTIVES OF THE RESEARCH PROGRAMME:

To evaluate the efficacy of fungicides, biological agents and botanical extracts in controlling seed- and soilborne diseases of maize, cowpea and beans.

HIGHLIGHTS OF OUR RESEARCH:

To evaluate the efficacy of fungicides as seed treatments on maize to control soilborne pathogens

The efficacy of Fungicide X, Fungicide Y (confidential new products) and Celest® XL for controlling *Pythium*, *Fusarium* and *Rhizoctonia* spp. on maize was tested in the greenhouse. When Monsanto seed was planted in *Fusarium* sp. inoculated soil, there was a large disease percentage difference between the inoculated and the uninoculated control, and all the treatments controlled the disease effectively. When PANNAR seed was planted in soil inoculated with *Fusarium* sp., it was found that the higher concentration of Fungicide X as well as the combination of Fungicide X and Fungicide Y treatments had significantly higher emergence percentages than the inoculated control. When Monsanto seed was planted in *Pythium* sp. inoculated soil, no significant differences were found in emergence percentages between any of the treatments. However, the low concentration of Fungicide X and the Fungicide X+Fungicide Y treatments resulted in plant heights that were significantly greater than that of the inoculated control, thus indicating some disease control.

In the repeat of this experiment a low emergence percentage was found in the inoculated control when compared to all other treatments, thus indicating that this isolate of *Pythium* sp. caused pre-emergence damping-off. When the PANNAR seed was planted in soil inoculated with *Pythium* sp., it was found that the combination of Fungicide X and Fungicide Y as well as the Celest® XL treatments unexpectedly had a lower emergence than any of the other treatments, possibly indicating phytotoxicity. However, this was not found in any of the other experiments. Monsanto seed was planted in *Rhizoctonia* sp. inoculated soil and all the seedlings emerged. The only significant difference found was that Celest® XL had a significantly lower dry shoot mass than the uninoculated control. However, there was no significant difference between the inoculated and uninoculated controls.

Lastly, PANNAR seed was planted in *Rhizoctonia* sp. inoculated soil and it was found that none of the treatments differed significantly from the inoculated control in terms of emergence. All treatments effectively controlled the disease and also had a higher dry root mass than the inoculated control. Overall, it was very difficult to find continuity between the repeats of the various experiments conducted. However, PANNAR seed planted in *Rhizoctonia* sp. inoculated soil appeared to produce the most consistent results, showing that all the treatments effectively controlled *Rhizoctonia* sp.

To evaluate the efficacy of botanical extracts in controlling Colletotrichum *spp. on cowpea and bean*

The curative efficacy of *Agapanthus caulescens* Spreng., *Allium sativum* L., *Carica papaya* L. and *Syzygium cordatum* Hochst.ex Krauss plant extracts and the synergy of the different combinations of plant water extracts was evaluated as a spray against bean (*Phaseolus vulgaris* L.) and cowpea (*Vigna unguiculata* L. Walp) anthracnose disease. The foliar application of 15 mg.ml-1 of *Allium*, *Agapanthus*, *Carica* water extracts and acetone (5 mg.ml-1) Carica extract and the combinations (2.5 mg.ml-1 + 2.5 mg.ml-1) of Allium + *Agapanthus*, *Allium* + *Carica*, *Agapanthus* + *Syzygium* and *Carica* + *Syzygium* registered low bean anthracnose (caused by *C. lindemuthianum*) disease and high leaf areas, but dry weights of bean plants were statistically similar throughout all the treatments. These treatments can be used as alternatives to synthetic fungicides against bean anthracnose. The cowpea plants treated with 15 mg.ml-1 water extracts of *Agapanthus* and the combinations of *Allium* + *Agapanthus*, *Agapanthus* + *Carica* and *Agapanthus* + *Syzygium* had low cowpea anthracnose (caused by *C. dematium*) disease severity, high leaf area and dry mass. The extracts listed above have a curative effect against anthracnose diseases and are good potential foliar treatment substitutes to the synthetic fungicides.

To evaluate the efficacy of biological agents as soil ammendments on maize to promote growth and control soilborne pathogens

Seedling trays filled with soil were inoculated with *R. solani*. One seed was planted per cell and 10ml of the bacterial inoculum was poured into each cell. Clear symptoms of *R. solani* infection were seen on the *R. solani* control. The uninoculated control was healthy and the commercial control effectively inhibited *R. solani*. Isolate A08, A07 and T19 gave significant control of *R. solani* as indicated by increased root mass of maize. These isolates also performed better than the commercial control which indicates that these isolates could contribute significantly to the agricultural industry if effective in field trials. PGPR isolates S6, S7, T29 and T22 did not show biocontrol activity towards *R. solani*. No significant differences were detected between the uninoculated control and the *R. solani* control when considering shoot mass. This could indicate that the pathogen does not affect shoot growth. Any increase in shoot growth of plants treated with the PGPR isolates can therefore be explained by a growth promotion effect rather than biocontrol effect.

TREE PROTECTION COOPERATIVE PROGRAMME (TPCP)

Research leader: Prof. Mike Wingfield

Research team: Prof. Jolanda Roux
Prof. Bernard Slippers
Prof. Emma Steenkamp
Prof. Fanus Venter
Prof. Brenda Wingfield
Dr. Irene Barnes
Dr. Martin Coetzee
Dr. Wilhelm de Beer
Dr. Jeff Garnas
Dr. Brett Hurley
Dr. Albé van der Merwe
Dr. XuDong Zhou

OBJECTIVES OF THE RESEARCH PROGRAMME:

- Development of field monitoring techniques to recognise the appearance of new pests and diseases as well as to monitor the spread and impact of those already established in South Africa
- Identify new and important tree pests and pathogens and evaluate their genetic structure so that they can be more effectively controlled
- Develop methods to screen trees for tolerance to the most important diseases present in the country
- Establish and evaluate contemporary breeding strategies in order to produce disease and pest tolerant species, clones and hybrids
- Establish an understanding of the biology of tree pests and pathogens to promote their better management
- Study and evaluate novel strategies for disease and pest control, particularly biological control

HIGHLIGHTS OF OUR RESEARCH:

The following treatments of specific disease and pest problems should be seen as summaries. They are supported by publications where these have appeared during the past year, and in some cases draft publications are provided. In the case of the pitch canker fungus and *Sirex noctilio*, there are specific working groups that have met regularly and for which separate and more detailed reports have been presented elsewhere.

The Sirex Woodwasp

The Sirex woodwasp, *Sirex noctilio*, remains one of the most important challenges to forestry in South Africa. It is likely to remain important for many years to come, requiring ongoing surveys and actions to reduce the population of the pest. A huge effort has been expended by a large number of institutions, companies and the TPCP to fight the Sirex epidemic during the course of the past decade. What is encouraging is that these actions are showing significant successes, with populations of *Sirex* dropping substantially in areas where they were previously very high. There is every reason to believe that this is a trend that will continue into the future.

The Sirex woodwasp problem and research underpinning its management falls under the ambit of the South African Sirex Steering Committee (SSC). Research linked to the TPCP and concerning *Sirex* is reported at meetings of the SSC, and this document serves only to provide a brief commentary on activities. TPCP research on *S. noctilio*, as is true for most projects, takes both a short- and long-term view. While much of the Sirex research is short term and includes, for example, efforts to improve the efficacy of the biological control options, research is also undertaken at a more basic level in an effort to understand the biology and genetics of the pest and its biological control agents. In the longer term, it is reasonable to expect that some of these more basic studies, also consistent with work done by students, will provide answers to problems that would not have been anticipated.

A study that stemmed from years of collections of *S. noctilio* with collaborators around the world was the elucidation of the diversity and invasion route of this pest. This study revealed that the simplistic view of limited, stepwise introductions of this wasp into the Southern Hemisphere is incorrect, and that the wasp has been introduced multiple times, also into South Africa. These results are important to consider in the light of our limited biocontrol options, and the possibility of incompatibility and the development of resistance in the wasp populations. The research done in past years to develop molecular markers for this wasp was invaluable to this study.

By far the most important element of the biological control of *S. noctilio* is the parasitic nematode *Deladenus siricidicola*. Research on this nematode by the TPCP is strongly focused on understanding its genetics, to ensure that we do not ultimately face a genetic “meltdown” in its population, as has been experienced previously. Thus, while the group is actively occupied in preparing nematodes for inoculation, we are also focused on seeking improved strains of the nematode for inoculation in the future.

There is good evidence from TPCP research in the past to show that populations of *D. siricidicola* are strongly affected by their food source, the fungus *Amylostereum areolatum*. For this reason it is important to understand the genetics of this fungus better, and how it might affect nematode production and its efficacy as a biological control agent in the future.

Ongoing research on Sirex has a broad focus including studies that will promote biological control, by the parasitoid wasp *Ibalia leucospoide*s, improve methods for monitoring wasp populations, and improve nematode efficacy. The group is seeking opportunities to bring additional biological control agents to South Africa so that the country can rely on a broader base of biological control than is possible at the present time. Likewise, together with collaborators in South Africa and abroad, various studies are underway that will substantially promote our understanding of *S. noctilio* and also lead to more effective control in the future.

Pitch canker and the pitch canker fungus, Fusarium circinatum

Research on the pitch canker fungus has covered many aspects of the pathogen, its biology and approaches to manage damage caused by it. A substantial proportion of the research has been conducted as part of the FSA initiative, led by Dr Andrew Morris of Sappi, to reduce the impact of the disease, particularly in forestry nurseries. A comprehensive report on that project is currently being compiled and this will be published as a special issue of the journal *Southern Forests*.

A substantial focus of TPCP and associated research of pitch canker is on understanding the genetic structure of the pathogen population and consequently, understanding the spread of the pathogen in South Africa. This work continues to be conducted and there is growing knowledge that the pathogen has likely been introduced into the country more than once and that it represents a very broad genetic base. This is rather different to other parts of the world where we are finding that introduced populations of the pathogen have a limited genetic base. This is of considerable concern as the genetic diversity of the pathogen in South Africa implies that it will be difficult to breed and select for resistance in the longer term.

The most serious manifestation of the pitch canker fungus in South Africa lies in the negative impact that it has had in nurseries, but particularly on establishment of *Pinus patula*. This problem has become so severe that it is likely that *P. patula* is gradually being eliminated from planting programmes in favour of other, often less desirable, yet resistant species. In this case, species of particular interest are *P. tecunumanii* and *P. maximinoi*, although they are limited by their susceptibility to frost damage. This issue, and other options to avoid damage due to the pitch canker fungus by selection of resistant planting stock, is being considered.

Even though the pitch canker fungus has been present in South Africa for more than 20 years, we lack knowledge about key aspects of its epidemiology. There is especially a lack of knowledge on how the fungus is killing seedlings in the nursery and how it moves from nursery to field. Likewise, little is known regarding the role of irrigation water in spreading the pathogen and even less is known with regard to the role of insects as its vectors. All of these questions are currently being studied by TPCP group members.

Botryosphaeriaceae including Diplodia

The Botryosphaeriaceae include some of the most important pathogens of trees including conifers and hardwoods. Thus, from a South African forestry perspective, we have a long track record of working with notorious pathogens such as *Diplodia sapinea* on pines and with various *Botryosphaeria* spp. (in the broad sense) on

Sirex woodwasp, S. *noctilio*

Eucalyptus and *Acacia mearnsii*. Survey work linked to the TPCP, but also including the activities of the CTHB, considers these pathogens, particularly on native hardwood trees. Many of these are also known to occur on both native South African trees as well as on *Eucalyptus*. Thus, studies on trees in general allow some members of the team to develop conceptual models of the manner in which these pathogens are moving, both locally and globally. It has thus also been possible to show how the *Botryosphaeriaceae* can move between native and non-native hosts and that there is gene-flow between the fungi on these trees. Thus, in terms of *Eucalyptus*, we believe that various *Botryosphariaceae* of native origin have adapted to infect these trees, while others are likely to have been introduced into South Africa and then moved to both native and non-native trees. The implications of such movement are yet to be understood.

Diplodia sapinea is arguably the best-known tree pathogen in South Africa. It was discovered on *Pinus* spp. when they were first planted in South Africa, with a first record being documented in the precursor to the *Farmer's Weekly* in 1912. The fungus has caused huge damage to pine plantations and is one of the reasons why species such as *P. radiata* could not be planted in much of South Africa. TPCP studies over many years have resulted in a wealth of knowledge regarding the pathogen and how damage can be managed. Yet, it remains an important opportunist that kills trees where circumstances allow it to develop.

An intriguing situation in some parts of the world where *Pinus* spp. are native is that there is a second species (for a time known as a different morphotype of *D. sapinea*) that is less pathogenic but widely found with *D. sapinea*. In previous studies by the TPCP, this fungus was given the name *D. scrobiculata* and interestingly it was recently found for the first time in South Africa. A particular interest for TPCP studies has been to consider whether these fungi have viruses and whether these might be used in the biological control of the pathogen. This work is long term and of an enabling nature, but it is widely believed to have potential for disease control in the future. While not a core focus of the TPCP programme, where opportunities arise, we attempt to maintain some capacity to study this intriguing subject.

Diplodia sapinea has always been considered as a fully asexual fungus and thus the fact that it is highly genetically diverse in South Africa has been explained by the fact that it was probably introduced into this country many times. A sexual state for the fungus has never been found supporting this view. However, recent molecular genetic studies have linked the hyper-diversity of the pathogen in South Africa to a cryptic sexual state. This has significant consequences for forestry in South Africa, where we might now expect rapid adaptation of strains of the pathogen to newly-produced resistant planting stock.

*Winter bronze bug (*Thaumastocoris peregrinus*)*

Thaumastocoris peregrinus now occurs in every part of South Africa where *Eucalyptus* spp. are found and it is considered one of the most serious pests of these trees in plantations. A great deal has been learned regarding the pest since its first appearance in the country and it is now also well understood that its incidence and the damage that it causes is variable from year to year. Clearly some planting stock, for example that containing *E. camaldulensis*, is most severely affected, and the level of damage appears to be worst under conditions of drought. The periodicity of occurrence of the pest has been studied in substantial detail and this knowledge will be useful as biological control is applied in the future.

The current focus of TPCP research on *T. peregrinus* is to develop a biological control strategy for the pest. The Mymarid parasitoid *Chleruchoides noackii* has been identified in Australia as a potentially useful biological control agent, and shipments of this insect have been received at regular intervals in order to study it in quarantine. A great deal of research concerning the life cycle of the parasitoid has been conducted, and the essential choice tests have been conducted to support an application to release *C. noackii* in South Africa. After showing that there would be no risk to introducing the biological control agent, an application to release has been formally submitted to the Department of Agriculture, Fisheries and Forestry.

*Eucalyptus gall wasp (*Leptocybe invasa*)*

The Eucalyptus gall wasp, *Leptocybe invasa*, has become one of the most important pests of *Eucalyptus* species in South Africa. It has spread around the country rapidly and has already caused the failure of a number of clones important to the forestry industry. There are effectively only two possible approaches to dealing with this pest. One is to develop planting stock that is resistant to infestation. The other lies in biological control. TPCP research has focused on both these opportunities.

Research concerning resistance to infestation by *L. invasa* has provided some fascinating results. While there are clearly species that are especially susceptible to infestation, such as *E. camaldulensis*, the situation with hybrids is highly variable and unpredictable. Thus, some hybrids of for example *E. grandis* x *E. urophylla* have low levels of susceptibility while others are highly susceptible. The upshot of this situation is that it would be necessary to test all clones before deployment and that, at least at the present time, there is no sure way to predict resistance in a clone. Clearly, there is a great need for trait-linked markers to be able to make such judgments before field testing. Another problem, however, is that there appears to be very strong environment by genotype interaction, with some clones being affected in one area but not in another.

The best possible solution to the *L. invasa* problem lies in biological control. Somewhat serendipitously the TPCP team, with the help of Prof. Stefan Neser (contracted to the group), discovered a potential biological control agent in Australia, but not known there. This parasitoid, now having been given the name *Selitrichoides neseri* in honour of Prof. Neser, has been studied in great depth in the FABI Biological Control Facility. Data gathered regarding the biology of the parasitoid were eventually sufficient for the TPCP to apply for permission to release this insect. It was thus a matter of great celebration when this permission was granted and the first *S. neseri* individuals were released in the field in July 2012.

Releases of *S. neseri* continue and this parasitic wasp has currently been spread to hundreds of sites in areas infested with *L. invasa*. Encouragingly, *S. neseri* has been recovered at nearly all of the release sites selected for monitoring. These sites will be continually monitored to assess the rate of establishment of *S. neseri* and investigate factors that may influence establishment. Studies are also underway to better understand the phenology of *L. invasa* in South Africa and to examine the interaction between silviculture, host resistance and biological control.

Quambalaria infected *Eucalyptus* leaves

Leaf/shoot diseases of eucalypts caused by species of Teratosphaeria *and* Quambalaria

Eucalypt leaf and shoot diseases have the potential to devastate plantation programmes. For South Africa, a classic example lies in the very severe impact that the fungus now known as *Teratosphaeria nubilosa* had on early plantings of *E. globulus*, and later some provenances of *E. nitens* in the country. There are various leaf and shoot pathogens present in South Africa and much progress has been made to reduce their impact by selecting species and clones that have high levels of tolerance to them. Yet, even though they are not high priority at the present time, the TPCP must retain a capacity to work with and study these pathogens. Tracking the incidence of the more important species globally and as they move into new areas is also important.

One of the most devastating eucalypt leaf and shoot pathogens is *Teratosphaeria destructans*, which has also been known as *Kirramyces destructans*. This fungus first appeared in *Eucalyptus* plantations in Indonesia and it has subsequently moved throughout South East Asia. Our work has shown that it has moved with planting stock and it seems inevitable that it will eventually reach South Africa. This is probably true of a number of other devastating pathogens related to it.

An emerging group of very serious leaf, shoot and even canker pathogens of eucalypts resides in the Basidiomycete genus *Quambalaria*. One species of this group, *Q. eucalypti*, has been accidentally introduced into South Africa and it has caused serious damage as well as the loss of clones in the past. Another species, *Q. pitereka*, has the potential to devastate new plantings of *Corymbia* spp. such as *Q. henryi*. Given the fact that *Q. eucalypti* entered South Africa, it seems likely that this would have occurred with seed. This could easily happen again and every effort must thus be made to exclude other species such as *Q. pitereka* from being accidentally introduced.

SABBATICAL VISITS

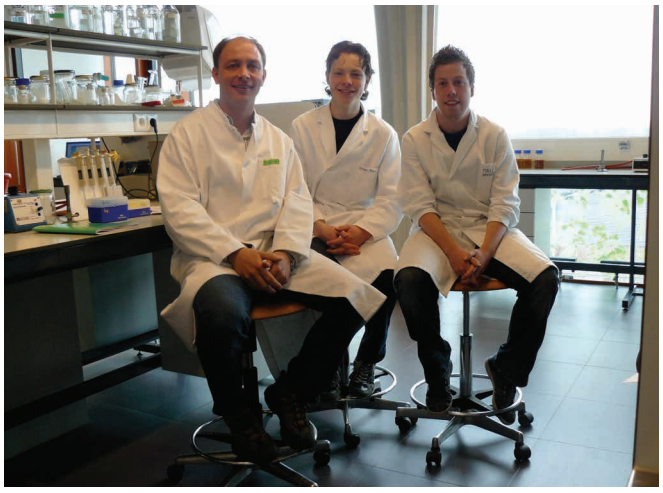
Professor Bernard Slippers

Host: Prof. Duur Aanen

Location: Department of Genetics, Wageningen University, Wageningen, The Netherlands

Duration: 23 December 2010 – 30 June 2011

Objectives: The aim of the study was to advance the understanding of the evolutionary biology of the *Sirex-Amylostereum* mutualisms, as well as to prepare for the genome sequencing of the fungus.



Prof. Duur Aanen isolating fungi (top) and Prof. Bernard Slippers with students in the laboratory of the Department of Genetics, Wageningen (bottom)

Prof. Aanen is a long-standing collaborator of the FABI in the area of insect-fungal symbioses. He is, amongst other focus areas, a world-leading expert on the evolution and ecology of the mutualism between termites and the fungal associates. He has frequently visited South Africa to sample these organisms from their native environment, then based in FABI. During these research visits he has contributed much to the discussions on the evolution of fungal-insect symbioses, including the *Sirex-Amylostereum* system and bark beetles, their Ophiostomatoid fungi and associated bacteria. During the research visit to Wageningen University these interactions were expanded to contribute to the theoretical framework for understanding the evolution and stability of the *Sirex-Amylostereum* mutualism.

A particular focus of the research visit was to consider the impact of invasion on the stability of this symbiosis. Subsequently published work from our group has shown that invasion can play an important role in breaking down the apparent specificity of the mutualism, specifically in North America where native wasps and fungi are present. In the Southern Hemisphere, where such native wasps are not found, the predominance of asexual reproduction in the fungus can, however, also influence the symbiosis by affecting the fitness of the fungus. It was shown during the research visit that potential deleterious mutations might have accumulated in the background of populations of *Amylostereum* in the Southern Hemisphere. These findings are being further explored through full genome sequencing, for which material was produced during the course of the sabbatical. Tools were also explored to study the genetics of the fungus through nuclear staining. This led to the discovery of a potentially diploid nuclear state and the absence of clamps, as opposed to the normal dikaryotic that is spread through clamp connections. These isolates now form the basis of genomics projects in the research group. A final focus was to explore the *Amylostereum* populations for the presence of viruses. Putative viruses were identified and their transmission in the populations studied.

Apart from the work in Wageningen, Prof. Aanen also used the opportunity to link with old and new collaborators in other parts of Europe. Research visits and presentations were made at the University of Utrecht (Netherlands), the University of Bern (Switzerland), the University of Copenhagen (Denmark) and the Swedish University of Agricultural Sciences (Sweden).

The sabbatical visit was academically enriching, helped to further strengthen research ties with a number of collaborators and provided much material that now forms the basis of ongoing projects. We thank Prof. Aanen and the Department of Genetics at Wageningen University for their generous support, stimulating discussions and for their friendship.

SERVICES

TREE HEALTH EXTENSION

Responsible researchers: Prof. Jolanda Roux (Extension, Monitoring, and Diagnostic Clinic)
Ms. Izette Greyling (Diagnostic Clinic and Extension)
Dr. Brett Hurley (Pest monitoring and Extension)
Prof. Mike Wingfield
Dr. Wilhelm de Beer (Treehealthnet)
Mr. Darryl Herron (Diagnostic Clinic)

OBJECTIVES:

Extension activities form an important component of the Tree Protection Co-operative Programme (TPCP) and DST/NRF Centre of Excellence in Tree Health Biotechnology (CTHB). These activities are divided into a number of components. They include all activities linked to the monitoring of pests and diseases of native and plantation trees. Furthermore, they form an important component in the training of post-graduate students and the creation of tree health awareness amongst the general public, foresters, farmers and conservation staff. Monitoring includes efforts to detect new pathogens and pests in a timely fashion and the evaluation of the change in status of pathogens and pests, which have been present for many years. One of the key components of the monitoring programme is the diagnostic clinic that provides one means of rapid detection of new diseases and pests. Data from the clinic and field extension/monitoring activities also form part of a longer term historical record of pests and diseases in South Africa and many other countries where the teams work

Post graduate students of the 2012 Diagnostic Clinic team studying the roots of a dying eucalypt trees near KwaMbonambi, South Africa

EXTENSION ACTIVITIES 2011/2012

The extension services of the TPCP and CTHB programmes are managed via a broad range of mechanisms. These include lectures presented at field days, such as those organised by the ICFR and other stakeholders, reports in magazines and newspapers, radio and TV interviews, newsletters such as Tree Health News and routine field visits. The extension services are closely linked to the pest and disease diagnostic clinic. Thus, where samples are sent to the clinic for diagnoses, follow-up visits to the field to inspect problems first hand are common. This forms part of an extensive network used to monitor the health of plantations and native forests.

Visiting a tree farmer in Ghana to identify the cause of teak death

Field visits to plantations and forests by TPCP/CTHB staff and students remain one of the most important components of these programmes. Field trips include those specifically providing extension lectures, those that are associated with the diagnoses of pests and diseases, as well as those that are linked to field research work of students. During 2011, 795 person days, and in 2012, 899 were spent in the forestry areas of South Africa. This represents the presence of members of the TPCP/

Evaluating the population levels of *Eucalyptus* weevils during a monthly monitoring field trip

CTHB research teams in the field virtually every week of the year, but it is sufficiently important to undertake field work that this is encouraged rather than discouraged. A number of field trips were also conducted to neighbouring and other African countries including Cameroon, Ghana, Ethiopia, Malawi, Mozambique, Uganda and Zimbabwe, for the purposes of surveying tree health and building collaborations with various institutes and companies in these countries. During these research trips presentations and field days are often presented by CTHB/TPCP staff and students. Several research projects and publications in ISI-rated journals emerged from extension visits undertaken in 2011 and 2012.

The e-mail list server TreeHealthNet has continued to grow and this has become a major base for communication between the TPCP and CTHB teams and their forestry stakeholders. The list server is used to announce field trips, such that stakeholders are able to make easy contact with team members travelling to the field, and feedback on new discoveries can be rapidly disseminated using this mode of communication. The server currently connects more than 900 foresters and it is anticipated that it will grow in importance in future. We therefore encourage all foresters and conservationists in South Africa to join. This is simply achieved by sending a message to Wilhelm de Beer (Wilhelm.deBeer@fabi.up.ac.za) and being listed on TreeHealthNet@kendy.up.ac.za. Once listed, it is possible for any member to write a note and this will rapidly reach all other members.

TPCP students visiting a commercial farmer during an extension field trip in the KZN Midlands

Like TreeHealthNet, the TPCP and CTHB web pages form an extremely important part of the portal of communication between the programme and its members. All newsletters of the TPCP/CTHB are posted on the website and all disease diagnostic aids can also be found there. This is a major source of information for members and it is being very actively used. The TPCP and CTHB sites can be accessed via the FABI site at www.fabinet.up.ac.za.

The newsletter of the TPCP and CTHB programmes, "Tree Protection News", represents an important means of distributing new information to members. Two issues of the newsletter are distributed annually and these were dispatched by the ICFR together with ICFR News. All issues of the newsletter can also be found on our webpages. In addition to “Tree Protection News”, articles have regularly been produced for magazines or newspapers to inform foresters and the public of our activities. Various news items are also regularly posted on the TPCP web site.

CTHB students evaluating the health of *Acacia erioloba* (camelthorn) trees in the Northern Cape

DIAGNOSTIC CLINIC

The insect pest and disease diagnostic clinic provides an important service to the members of the TPCP and CTHB. This service is actively used and as mentioned previously, it also provides one of the mechanisms by which new pest and disease problems emerging in plantations and native forests can be identified rapidly. The clinic received a total number of 3185 samples in 2011 and 2036 in 2012.

PINE PITCH CANKER SCREENING FACILITY

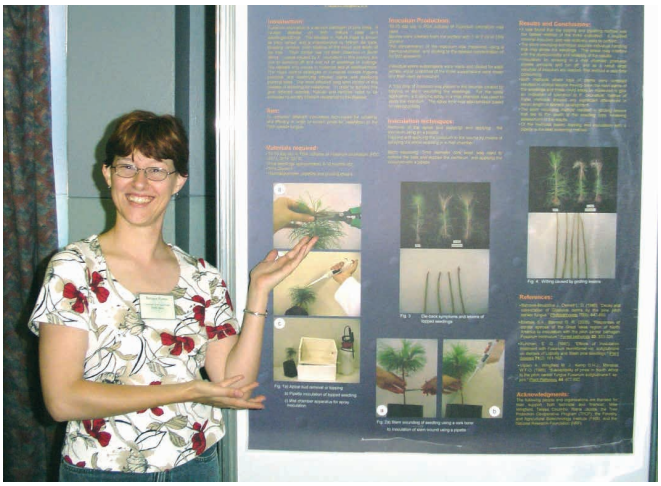
Facility management team: Prof. Emma Steenkamp
Prof. Teresa Coutinho
Prof. Mike Wingfield

Technical managers: Ms. Bernice Porter
Mr. Zakheleni Dube

Technical committee: Mr. A Nel (Sappi Forests)
Mr. K. Payn (Mondi)
Mr. P Hongwane (KLF)
Mr. G Mitchell (York Timbers)
Dr. J Chan (BG Bison)
Mr. B Maree (Hans Merensky)

In 2005 a collaborative project was launched by various South African forestry companies to have their pine breeding stock screened for tolerance to the pitch canker fungus, *Fusarium circinatum*. This project was conducted in the Pitch Canker Screening Facility next to the FABI Biocontrol Centre on the University of Pretoria's Experimental Farm. Until 2012, Ms Bernice Porter represented the technical manager of the facility. In 2013, this responsibility was taken over by Mr Zakheleni Dube, who is a Ph.D. student with FABI.

Twice every year, between 15 000 and 20 000 seedlings and/or cuttings are inoculated with the pitch canker fungus. For this purpose, a standardised method developed at FABI is used. After six weeks of incubation in this greenhouse facility, lesion development is measured. The various forestry companies then analyse the performance of their seedlings/ cuttings to inform their pine breeding programmes.



Bernice Porter at the poster on screening methods for *Fusarium circinatum*, which she presented at a national conference

Left: healthy seedlings before inoculation with *Fusarium circinatum*.
Right: close-up of seedlings which show the progression of disease from the point of inoculation with the pathogen

Zakheleni Dube in the screening facility on the University of Pretoria's Experimental Farm

ION TORRENT SEQUENCING FACILITY

Facility director: Prof. Brenda Wingfield

Facility staff: Mr. Nicky Olivier
Ms. Renate Zipfel
Dr. Elritha van Zyl

The Faculty of Natural and Agricultural Sciences acquired an Ion Torrent Personal Genome Machine in 2012, with financial contributions by the FABI Centre for Excellence in Tree Health Biotechnology, the Genomics IRT and several Departments in the Faculty. The Genomics IRT under Prof. Don Cowan has also provided additional funding for equipment and a part-time technician. The Director of the Facility is Prof. Brenda Wingfield, while Renate Zipfel and Nicky Olivier co-manage finances and operations. Dr Elritha van Zyl is the technician responsible for library preparations and sequencing. The instrument is housed in a dedicated laboratory in the new Plant Sciences Complex.

The Ion Torrent sequencing technology relies on the creation of a size-fragmented library which is clonally amplified on beads. The enriched library-bound beads are loaded on the sequencing chip where they fit snugly in cavities in the chip base. Unmodified bases are flowed across the chip base and incorporation of a base leads to a release of H+, and this drop in pH is converted to an electronic signal. Homopolymer runs of up to 9 bases can be differentiated by this technology.

The instrument can accommodate three types of sequencing chips, yielding 30Mbp, 300Mbp or 1Gbp respectively, and this allows the instrument protocols and output to be tailored to the requirements of each research project. Currently the instrument produces sequence data with 300bp read lengths, but by mid-2013 the read length will be increased to 400bp, increasing both the yield and cost efficiency for projects.

To date the Facility has sequenced several bacterial and fungal genomes, and will start with viral DNA sequencing and cancer gene typing during 2013. As the workflow allows for barcoding, several samples can be pooled and sequenced on the sample chip, thereby lowering sequencing costs and increasing research outputs. The technology is also ideally suited to amplicon sequencing, and with the longer reads this approach should increase the efficiency of genotyping projects. Currently the Facility is involved in sequencing projects for Departments in the Faculties of Natural and Agricultural Sciences, Health Sciences and Veterinary Science.

Renate Zipfel, Dr. Elritha van Zyl, Prof. Don Cowan (Genomics IRT) and Nicky Olivier with the Ion Torrent PGM sequencer

MICROARRAY SERVICE

Facility director: Prof. Dave Berger

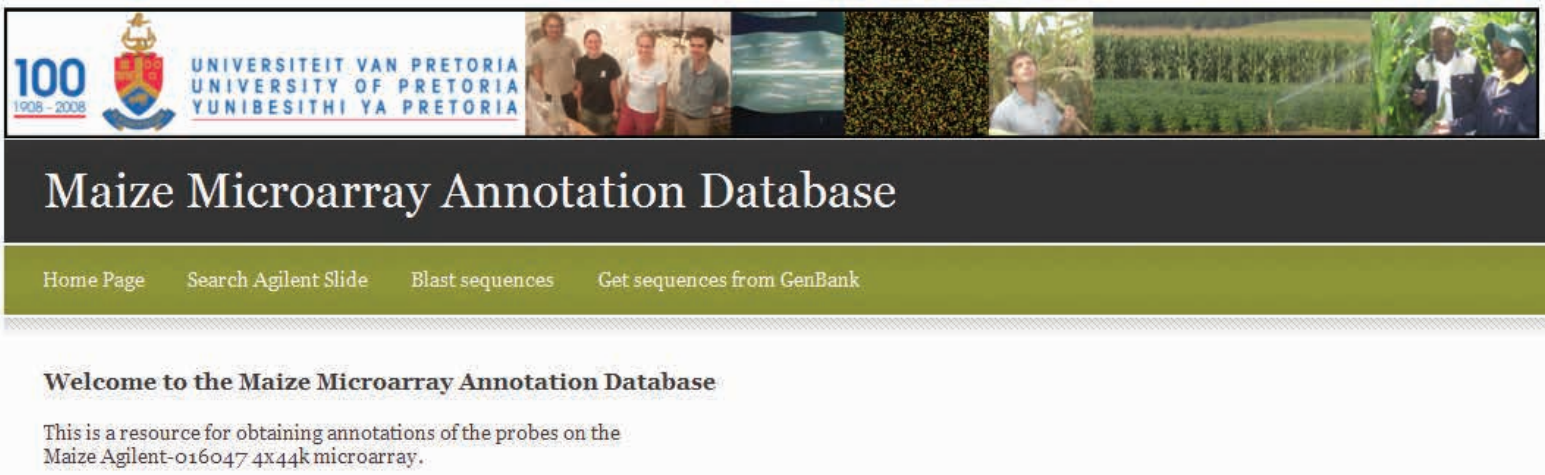
Microarray scientific officer: Mr. Nicky Olivier

The ACGT (African Centre for Gene Technologies) Microarray Facility has a strong focus on student training and capacity building in the local microarray community, and provides microarray services for researchers throughout Africa. The Facility has the only active microarray slide spotter in South Africa, and can provide glass slides at a density up to 9200 unique genes per slide. The Generation III Array Spotter produces a maximum of 36 replicate slides in a single run, and is housed in a controlled-environment laboratory. Typically the DNA sources for spotting are cDNA library clones or long oligonucleotides (~70mer) for gene expression studies. Dye intensities on processed slides are measured on a Genepix 4000B Scanner, scanning at 532nm and 635nm to provide high quality image files for spotfinding and downstream analysis.

Due to the greatly increased availability of genome sequence and transcriptome information, most new research projects incorporate the Agilent platform for microarray studies. Users compile a catalogue of sequences to be added to their array, and the free web-based Agilent software computes the most optimal oligonucleotides (60mer) to be synthesised on their arrays. Flexible configurations of arrays on the slides with scalable numbers of spots can also be selected, providing a good balance between cost and data throughput. Due to the highly reproducible spot diameters and spot oligonucleotide concentrations, this microarray platform produces high-quality data across multiple experiments. Species studied to date using Agilent slides include *Rhipicephalus Boophilus microplus* (ticks), *Arabidopsis thaliana*, *Zea mays* (maize), *Triticum aestivum* (wheat), (cancer in) *Homo sapiens*, *Plasmodium falciparum* (malaria), *Sorghum bicolor and Babesia divergence*. The ACGT microarray facility houses all the required hardware for processing Agilent slides, along with extensive expertise in experimental design, hybridisation procedures and custom data analysis using open-source software (R and Bioconductor).

Since RNA integrity and purity is critical for downstream expression analyses (RT-qPCR, microarrays, etc.) and RNA sequencing applications, the Facility's BioRad Experion automated electrophoresis system is of great importance. Multiple samples are analyzed in one run, and results include concentration, purity and a numerical indication of the RNA integrity (RQI value). RQI values can be used as a benchmark to ensure sufficient quality and reproducibility of RNA samples across different experimental conditions and applications. The cost-only use of the instrument is not limited to microarray studies, and is available to all interested researchers in the ACGT partner institutions.

For more information, please consult http://www.microarray.up.ac.za/



Screenshot of the Maize Microarray Annotation Database (http://maizearrayannot.bi.up.ac.za/)

LIGHTCYCLER 480 FACILITY

Facility managers: Prof. Dave Berger
Prof. Zander Myburg

Technician: Ms. Ronishree Naidoo

In 2006, the Roche Lightcycler 480 instrument was purchased by the University of Pretoria with joint funding from the University and the NRF. The instrument is managed jointly by Prof. Dave Berger and Prof. Zander Myburg, while students and technical assistants from Prof. Myburg's research group administer all aspects of the instrument. Technicians responsible for the instrument to date are Nicky Creux, Marja O'Neill and Ronishree Naidoo. To increase the level of service, preferential pricing on consumables is negotiated and users can then purchase their consumables directly from the Facility.

Two training workshops were presented annually in concert with Roche, and students and researchers gained valuable experience in most aspects of a qPCR experiment, including data analysis and experimental design. These training workshops were attended by 35 post-graduate students between 2011 and 2013, greatly increasing the level of expertise and the awareness in the local scientific community. Software for results analysis is also available from the facility, and this assists researchers to conform to MIQE standards for GLP and publication purposes. To date, numerous students have benefitted from the availability of the instrument, and the quality of research has improved immensely (publications in high impact journals such as *BMC Plant Biology* and *BMC Genomics*, and Hons/M.Sc. and Ph.D. students have written excellent theses).

Departments/institutions that made use of the Facility include the University of Pretoria Departments of Biochemistry, Genetics, Microbiology and Plant Pathology, Plant Science; FABI and CSIR Biosciences.

***Arabidopsis* plant growth room facilities in FABI Square**

The HTC Litecycler has been used extenstively for expression profiling of Arabidopsis genes involved in xylogenesis and pathogen defence by the FMG, MPPI and EPPI research groups in FABI.

AWARDS

FABI AWARDS FOR EXCELLENCE

Ever since its establishment in 1998, FABI has pursued excellence across its many key performance indicators. This approach has resulted in many accolades for FABI students, academic staff members and for the Institute itself. Large numbers of students have thus received prestigious bursaries from various organisations, awards for research excellence and for travel, amongst others. Likewise, academic staff members have received special awards from organistions such as the Department of Water Affairs and Forestry, the Department of Science and Technology, the National Research Foundation, the South African Association for Art and Science, the Royal Society of South Africa, the Academy of Sciences of South Africa and various others. Against this background of excellence, the FABI Management decided to institute a suite of awards to be made annually to exceptional FABIANS and FABI stakeholders.

FABI awards were made for the first time in 2007 and these have already come to be recognised as important and highly prized. The FABI awards are as follows:

Best FABI student publication

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

2011 Simon Martin
2012 Eshchar Mizrachi

Best FABI M.Sc. thesis

This award is given to a M.Sc. student who achieved the highest mark through external examination of a thesis.

2011 Simon Martin
2012 Melissa Simpson

FABI award for mentorship

This is awarded to M.Sc. or Ph.D. students who have demonstrated outstanding mentorship, in the broad sense, to other students.

2011 Quentin Santana, Tuan Duong
2012 Gerda Fourie, Tracy Hall, Markus Wilken

Best FABI student personal website

The aim of this award is to encourage FABI students to produce personal websites of high quality. Selection of the winner is made through confidential ballot.

2011 Febe Wilken

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.

2011 Osmond Mlonyeni, Markus WIlken, Mmatsepho Phasa, Johan van der Linde
2012 Amy Wooding

FABI award for recognising contributions by a member of staff of the University

2011 Ms Cathy Barnard
2012 Prof. R Crewe

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.

2011 Mr. Mike Edwards (FSA)
2012 Dr. Andrew Morris (Sappi)

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, support to the maintenance of the structures of the Institute and others. The recipient is chosen by FABI students.

2012 Tuan Duong

FABI 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

2011 Bridgit Crampton
2012 Barry Christie

Best photograph illustrating FABI Research

2011 Dr. Irene Barnes
2012 Dr. Irene Barnes

AWARDS TO MANCOM MEMBERS

Queen's Award

The Commonwealth Forestry Association bestowed **Professor Jolanda Roux** with the Queen's Award for her contribution to forestry. The award, which recognises the achievements and supports the future work of an outstanding mid-career forester, comprises a certificate, a cash prize and a travel grant.

DST distinguished young woman scientist award

Professor Jolanda Roux received the Department of Science and Technology Award for DISTINGUISHED YOUNG WOMEN SCIENTISTS in the Life, Natural and Engineering Sciences. These awards go to young women scientists and researchers who have made an outstanding contribution to advancing Science and building the knowledge base in their respective disciplines. The criteria used for this award include excellence in teaching and research, research and innovation outputs, national and international eminence and supervision and mentorship of students aimed at achieving equity and redress. Most of these accomplishments on Jolanda's part are very closely connected to her research, linked to and supported by the Tree Protection Co-operative Programme and the DST/ NRF Centre of Excellence in Tree Health Biotechnology.

NSTF-BHP Billiton Science and Technology Awards

Professor Jolanda Roux won the award for Capacity Building in Science Engineering and Technology Innovation during the last 5-10 years in 2012. This is a great accomplishment – very much deserved and also a great credit and honour to FABI and the TPCP.

Third World Academy Of Sciences (TWAS) young scientist award

Professor Bernard Slippers was awarded the prestigious Third World Academy Of Sciences (TWAS) young scientist award. This award arises from a very vigorous national competition and has been awarded based largely on his research outputs in the field of forests pests and diseases and working towards their control.

Honorary doctorates

Congratulations to **Professor Mike Wingfield** who was awarded an honorary Doctor of Science degree from the University of British Colombia during a graduation ceremony held on the Vancouver campus of UBC on the 21st of November. He was one of three recipients of honorary degrees - the others were renowned musician Bramwell Tovey, conductor of the Vancouver Philharmonic Orchestra and the Right Honourable Paul Martin, economist and past president of Canada. In his acceptance address to the congregation, amongst other issues, Mike spoke of the advantages and the privilege of living and working in Africa. He made the point that the great future of Africa has yet to be realised and that well-established universities such as UBC could benefit greatly from closer engagement on this continent.

Prof. Wingfield received a second honorary Doctor of Science degree from North Carolina State University in May 2013.

Johanna Westerdijk Award

Professor Mike Wingfield has been awarded the prestigious Johanna Westerdijk Award by the Centraalbureau voor Schimmelcultures (CBS) Fungal Biodiversity Centre. This award is made on special occasions to an individual who has made an outstanding contribution to the culture collection of the CBS Fungal Biodiversity Centre, marking a distinguished career in mycology.

JE vanderplank Award

The prestigious JE vanderplank Award was awarded to **Professor Bernard Slippers** by the Southern African Society for Plant Pathology (SASPP) for his outstanding contribution to plant pathology research in southern Africa.

Prof. Mike Wingfield and Prof. Nabil Ibrahim standing alongside a statue of Kwame Nkrumah in front of the AU building in Addis Ababa

African Union (AU) Kwame Nkrumah Scientific Award

"In Africa we must unite in Science and Technology." **Professor Mike Wingfield**, Director of the Forestry and Agricultural Biotechnology Institute (FABI) in the Faculty of Natural and Agricultural Sciences, shared these words upon receiving the prestigious African Union (AU) Kwame Nkrumah Scientific Award in the Life and Earth Sciences category in Addis Ababa on 25 May 2013.

The African Union (AU) Kwame Nkrumah Scientific Awards programme is one of the several bold steps taken by the AU Commission to boost and popularise Science and Technology in Africa through empowering African scientists, celebrating their achievements and promoting all efforts to transform scientific research into economic growth.

In his acceptance speech, Professor Wingfield spoke on behalf of himself and Professor Nabil Ibrahim of Egypt, a Professor in Textile Chemistry and Technology, who won the Award in the Basic Sciences, Technology and Innovation category. Prof. Wingfield said that "this award is deeply an illustration of the tremendous support for Science and Technology of our two home countries, Egypt and South Africa". Speaking to an audience that included numerous heads of state and national leaders, he urged the leaders of Africa "to join forces and to seriously commit to building capacity in Science and Technology". He made the further point that "what is needed is not only support, but sustained support over a long period of time".

TRIBUTE TO PROFESSOR WALLY MARASAS

1941–2012

The world-famous mycotoxicologist and *Fusarium* specialist, Wally (Walter) Marasas, passed away very suddenly on the 6th of June 2012. His death came as a terrible shock to his many close friends in FABI and to those past members of the FABI team.

Wally Marasas was part of FABI in so many ways. He was a close friend and collaborator of numerous members, both students and staff, who originally came to establish FABI. In this respect, he played a special part in enabling the establishment of FABI and he took his role as a member of the FABI team very seriously. He was appointed as an Extraordinary Professor of the University of Pretoria linked to FABI, very early in the history of the Institute. He took this role very seriously, attending as many FABI meetings and functions as he could, acting as an advisor or co-advisor to students, playing an important mentorship role for students and staff and generally supporting FABI as strongly as he could.

Wally Marasas was world famous for his ground-breaking research on mycotoxins, especially those associated with *Fusarium* spp. He was also amongst the world's leading *Fusarium* taxonomists. He had friends and admirers in many parts of the world. He was a larger-than-life character who inspired people around him and he is deeply missed by his many friends and colleagues. Wally's passion for biology, and mycology in particular, was infectious, and he shared his experiences and skills with great numbers of people, not least those in FABI. He mentored researchers and students of FABI and persuaded many to pursue their mycological dreams.

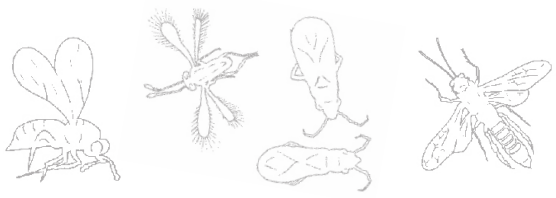
Those who knew Wally only as a mycologist/mycotoxicologist probably did not know that he was an accomplished botanist with a deep love for the flora of South Africa, spending long hours with his wife Rika, identifying and photgraphing flowering plants. He was also an avid philatelist and after his formal retirement five years ago, worked furiously to complete a book illustrating most of the world's fungus stamps, which he classified taxonomically. In this regard, he also bequeathed his extensive and remarkable collection of mushroom stamps to FABI. The future of this collection is currently being decided but it will likely form part of a FABI exhibition together with the associated book, so that others can enjoy and learn from the products of his passion.

Wally Marasas had an illustrious research career. He published in excess of 300 scientific papers, numerous books and was amongst the world's most highly cited mycologists. He was a founder member (fellow and honorary member) of the Southern African Society for Plant Pathology, Fellow of the American Phytopathological Society, Fellow of the South African Veterinary Association and one of only three South African Foreign Associate Members of the US National Academy of Science. He was the recipient of many international awards and held honorary doctorates from the University of the Free State and the University of Pretoria.

Wally's death leaves a great void in the lives of his many friends and colleagues, both young and old, both in FABI and elsewhere. He brought happiness to the people around him and he provided tremendous support, guidance and mentorship for an incredibly large number of people. He had a special knack for being able to focus on the real issues and to provide wise council. Many mycologists will know that he held very strong views regarding mycological issues and principles and he was not shy to share these openly. This firm commitment to what he believed to be "good practice" and the courage to express his feelings is what many of us relied on most. His loss will be felt for many years to come.

Wally is survived by his wife Henrika (Rika) Marasas and two children, Carissa and Walter Jr, and two grandsons. He was not only a wonderful friend to many but a loving family man. May he rest in peace.

Prof. Wally Marasas with Prof. Emma Steenkamp (left) and Marija Kwas (right)



TRIBUTE TO PROFESSOR JOHANNES VAN DER WALT

1925-2011

Professor Johannes van der Walt, internationally recognised yeast taxonomist, passed away on the 13th of November 2011. Although he was challenged by numerous health problems, he remained active in FABI until only a few weeks before his death, which was unexpectedly sudden.

Johannes Petrus van der Walt was born in Pretoria on the 10th of February 1925. He was a born biologist, and as a boy was encouraged by his father to collect and classify arid-dwelling plants in the Karoo. Visits to this part of the world were part of an annual vacation and he would accompany his father, hiking through the veld to identify the unusual lithops and other succulent plants native to this area. There is little doubt that these vacation excursions contributed substantially to his love of nature and to his profession as a scientist.

Johannes completed his D.Sc. under the guidance of Professor AJ Kluyver with Chemistry as his major subject and microbiology as a secondary subject at the Rijks University of Leiden in 1949. He returned to South Africa where he was employed by the CSIR until his retirement in 1988. During the early stages of his career he established the first modern microbiological investigation into sorghum beer. In 1957, he moved to Stellenbosch, where his research focused on the industrial problems being experienced by the wine industry with yeasts that acidified wine. In 1961, he was appointed as Head of the Microbiology Research Group where he pursued his passion for the systematics, genetics and ecology of yeasts. During the years of 1963 to 1967, he led the first mycotoxin research programme at the CSIR.

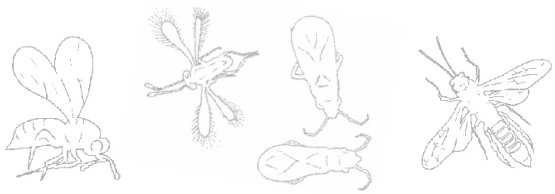
Johannes was regularly invited to present his research internationally. He published 131 scientific papers and four significant books on yeast taxonomy. He was appointed as an honorary professor at the University of Pretoria between 1980 and 1983 and again between 1999 and 2001, and at the University of the Free State from 1984 until 2000. In 1994, he was awarded an honorary doctorate from the University of the Free State for his important contributions to yeast taxonomy.

Johannes van der Walt made many important contributions to Science nationally and internationally. His best-known contributions were in the field of yeast taxonomy where he described very large numbers of new taxa. He also contributed important chapters to books such as *The Yeasts, a taxonomic study* 2nd and 3rd editions and the 2nd edition of *The Yeasts*. He had an amazing ability to discover novel yeasts and was a passionate advocate of enrichment techniques that enabled him to discover yeasts overlooked by others in similar environments.

Johannes became involved in the fledgling Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria when it was established in 1998. In this environment, he was able to share his passion for Science, particularly with post-graduate students and academic staff. He thoroughly enjoyed challenging students, sometimes mischievously, to think and to question. Johannes had an amazing knowledge of languages and was especially passionate about Latin and Greek. This interest led him to delight in deciding on names for new fungi and bacteria and here he always preferred Greek. In his later years, Johannes made weekly visits to the FABI laboratories to isolate yeasts, particularly from lichens, and these visits were the highlight of his week.

Johannes lived life to the full. He loved people and was always wonderful company. He was a great man of Science and a friend to many.

Prof. Van der Walt



WORKSHOPS AND CONFERENCES

47th Congress of the Southern African Society of Plant Pathology (SASPP)

The 47th Southern African Society for Plant Pathology (SASPP) congress was held at the Berg-en-Dal Conference Centre in the Kruger National Park, South Africa from the 23rd to the 26th of January 2011. The congress was organised by the University of Pretoria, CSIR and Syngenta SA. Prof. Theresa Aveling (Department of Microbiology and Plant Pathology, Forestry and Agricultural Biotechnology Institute) was the chairperson and Dr Quenton Kritzinger (Department of Plant Science) was the secretary of the organising committee.

Prof. Theresa Aveling (Congress Chairperson) opening the 47th SASPP Congress

The congress was attended by 198 delegates. Prof. Aveling opened the congress on Sunday evening, followed by the Dr JE Vanderplank memorial lecture presented by Prof. Chrissie Rey. Of the 12 international delegates attending, five gave keynote addresses: Dr Guro Brodal (Norway), Prof. Burt Bluhm (USA), Dr Kevin Hyde (United Kingdom), Prof. Wojciech Janisiewicz (USA) and Dr Paul Birch (United Kingdom). Dr Marieka Gryzenhout presented the Ethel Mary Doidge memorial address. There were a total of 59 oral presentations, of which 32 were presented by post-graduate students, and 66 poster presentations. Social events included a welcoming reception on Sunday, the traditional "John Mildenhall Stakes" on Monday and a Conference "Bush Banquet" on Tuesday.

SASPP Congress delegates in the Berg en Dal Conference Centre, Kruger National Park

Prof. Lindsey du Toit (international delegate from the USA) attempting the "John Mildenhall Stakes"

48th Congress of the Southern African Society of Plant Pathology (SASPP)

The Southern African Society of Plant Pathology hosted its 48th conference in January 2013 at the Klein-Kariba ATKV Resort, Bela Bela, Limpopo. The congress was organised by the council of the SASPP and also celebrated the 50th anniversary of the Society. The conference started with two workshops on Sunday the 20th of January. The workshops were attended by more than 50 people. The workshops dealt with "New technologies" and "Field trial design and analyses" and were organised by Prof. Brenda Wingfield (FABI) and Prof. Zakkie Pretorius (UFS) respectively.

Prof. Gerhard Pietersen (FABI) discussing virus diseases with students during the SASPP mid-congress field tour

During the welcome reception of the SASPP, two of the founding fathers of the Southern African Society for Plant Pathology, Prof. Chris Rabie and Prof. John Mildenhall, provided attendees of the meeting with a brief history of the Society. This was followed by the cutting of a 50th anniversary cake to celebrate the half century of the Society.

The 48th Conference was officially opened by Prof. Brenda Wingfield, Dean of Research at the University of Pretoria. Members of the Society invited two international keynote speakers to the conference, Dr Dave Hodson of CIMMYT in Ethiopia and Prof. Holger Deising from the Martin Luther University in Germany. Other talks by invited speakers included the Van der Plank lecture which was presented by Dr Rikus Kloppers of Pannar, and the Ethel M Doidge lecture presented by Prof. Pedro Crous of the CBS in the Netherlands.

Prof. Mike Wingfield paid tribute to Prof. Wally Marasas at the gala dinner, who sadly passed away in 2012 and who was one of South Africa's most famous plant pathologists and mycologists, both locally and internationally.

During the event several prestigious awards were made to members of the Society. Prof. Lise Korsten (Department of Microbiology and Plant Pathology, University of Pretoria) and Prof. Pedro Crous (Director of CBS in the Netherlands) were elected as Fellows of the Society. Prof. Bernard Slippers of FABI at the University of Pretoria was awarded the Van der Plank Medal for his research in plant pathology over the ten-year period since he received his Ph.D. Bernard has already authored and co-authored more than 100 papers in international journals since completing his Ph.D. in 2004, has an NRF P rating and is also the co-chair of the Global Academy of Young Scientists, to name but three of his many achievements. A new award to a Ph.D. student, made possible by a donation from Prof. John Mildenhall and Mrs Petakin Mildenhall, was made to Johan van der Linde of FABI. This award recognises research excellence by a Ph.D. student and was awarded to Johan for his research on *Euphorbia ingens* mortality in South Africa, from which he has already published three papers in international journals.

Several awards for excellence in Science communication during the course of the conference were made at the gala dinner. These awards, made to students, aim to encourage excellence in Science and the presentation of scientific results by students of the Society. The Pannar trophy for the overall best oral presentation by a student was made to Darryl Herron (FABI). The best presentation in the field of molecular biology, sponsored by Inqaba Biotech, went to Anandi Reitman (FABI).

Darryl Herron receiving the Pannar trophy, for the best student oral presentation, from Dr. Rikus Kloppers and Vicky Knight

Hosting a conference successfully is only possible through teamwork. The organising committee of the 48th SASPP conference gratefully acknowledges each and every one who helped us to make this conference a success. This includes our sponsors, the team at ATKV Klein Kariba, students of the University of Pretoria who helped with audiovisuals, poster boards, registration and many other tasks, and the administration staff of FABI at the University of Pretoria.

PUBLICATIONS 2011-2013

These lists include only publications that had appeared by the end of May 2013. Manuscripts in press and submitted for publication are not included.

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KUBHEKHA, G.C., A. HALL, T.A. COUTINHO, L.N. MOLELEKI (2012). Infection and colonisation patterns of mCherry tagged *Pectobacterium carotovorum* subsp. *brasiliensis* in different potato cultivars. Poster, 7th Australasian Symposium on Soilborne Diseases. Fremantle Australia.

KURIAKOSE, B., E. VILJOEN, A. KILLIAN, F. CARRIERO, S. MINOIA, A. BENDAHAME, D.K. BERGER (2012). Diversity Array analysis of Methyltransferase (MET1) mutants of tomato, 38th Congress of the SA Association of Botanists (SAAB), Pretoria, RSA.

KVAS, M., T. KONE, M. GRYZENHOUT, M.J. WINGFIELD AND E.T. STEENKAMP (2011). DNA barcoding reveals that diverse *Fusarium* species have an endophytic association with native *Acacia karroo*. Proceedings of the 47th Annual Congress of the Southern African Society for Plant Pathology, 23-26 January 2011, Kruger National Park, South Africa.

LABUSCHAGNE, A.H., T.A.S. AVELING (2011). Fungicide seed treatment of maize for control of *Pythium, Fusarium* and *Rhizoctonia*. South African Society for Microbiology, Cape Town.

LABUSCHAGNE, A.H., T.A.S. AVELING (2011). Fungicide seed treatment of maize: Effect on germination and vigour. South African Society of Plant Pathology biennial congress, Kruger Park.

LEE, D., J. ROUX, M.J. WINGFIELD, B.D. WINGFIELD (2013). The wattle wilt pathogen *Ceratocystis albifundus* displays multiple reproduction strategies in nature. Proceedings of the 48th Congress of the Southern African Society for Plant Pathology, 20-23 January 2013, Klein-Kariba, Bela Bela, South Africa.

LETSOALO, T., M. MBENOUN, M.J. WINGFIELD, J. ROUX (2013). *Ceratocystis* species diversity and insect associates on *Acacia mearnsii* in the Kwazulu-Natal Midlands of South Africa. Proceedings of the 48th Congress of the Southern African Society for Plant Pathology, 20-23 January 2013, Klein-Kariba, Bela Bela, South Africa.

LOMBARD, B., C.A. HEFER, A. VAN DER MERWE, E. MIZRACHI, A.A. MYBURG (2012). Single nucleotide polymorphism (SNP) diversity in xylem and leaf expressed cellulose synthase genes of *Eucalyptus grandis*. South African Association of Botanists Symposium, 15-18 January 2012, Pretoria(Poster presentation).

LOURENS, R., A.A. MYBURG, S. NAIDOO (2012). In silico analysis reveals two potential orthologs of the non-expressor of PR1 (*NPR1*) gene in *Eucalyptus grandis*, South African Genetics Society meeting, 10-12 September 2012, University of Stellenbosch.

LUBB,E J.W., G. PIETERSEN (2012). Characterisation of two candidate pre-immunizing Citrus tristeza virus sources. 7th Citrus Research Symposium, 20-22 August 2012, Champagne Sports Resort, Drakensberg.

MAHOMED, W., A.A. MYBURG, N. VAN DEN BERG (2011). Moving towards understanding defence in avocado-*Phytophthora cinnamomi* interactions. 47th congress of the Southern African Society for Plant Pathology (SASPP), Berg-en-Dal, Kruger National Park.

MAHOMED, W., B. REEKSTING, N. VAN DEN BERG (2013). Debut of the avocado stress transcriptome: *Phytophthora cinnamomi* and flooding. 48th congress of the Southern African Society for Plant Pathology (SASPP), Klein Kariba, Bela-Bela, Limpopo.

MAHOMED, W., N. VAN DEN BERG (2012). Profiling the defence response of the host-pathogen interaction between *Persea americana* and *Phytophthora cinnamomi*. Poster session presented at: SAGS 2012. Proceedings of the congress of the South African Genetics and Bioinformatics Society; 2012 Sep 10-12; University of Stellenbosch, South Africa.

MARSBERG, A., M. GRYZENHOUT, B. SLIPPERS, M.J. WINGFIELD (2011). Barcoding and pyrosequencing reveal a high diversity of fungal endophytes in a healthy *Syzygium cordatum* tree. 37th Annual Congress of the South African Asociation of Botanists held at Rhodes University, Grahamstown.

MASANGWA, J.I.G., T.A.S. AVELING, Q. KRITZINGER (2011). *In vitro* screening of plant extracts for antifungal activities against *Colletotrichum* species of common bean and cowpea. South African Society of Plant Pathology biennial congress, Kruger Park.

MASHAVHA, L.M., T.A. COUTINHO, I.K. TOTH, L.N. MOLELEKI (2011). The characterisation of *Pectobacterium carotovorum* subsp. *brasiliensis* a newly described pathogen of patoto in South Africa. SASPP Kruger South Africa.

MAÚSSE SITOE, S.N.D., S.F. CHEN, C. RODAS, N.A. VAN DER MERWE, M.J. WINGFIELD, J. ROUX (2013). Discovery of *Chrysoporthe austroafricana* as an endophyte in healthy Myrtales. Proceedings of the 48th Congress of the Southern African Society for Plant Pathology, 20-23 January 2013, Klein-Kariba, Bela Bela, South Africa.

MBENOUN, M., B.A.D BEGOUDE, M.J. WINGFIELD, J. ROUX (2011). *Ceratocystis* species and their nitidulid beetle vectors on tree wounds in South Africa and Cameroon. 5th Natural Forests and Woodlands Symposium, 10-14 April 2011, Richards Bay, South Africa.

MBENOUN, M., M.J. WINGFIELD, B.A.D BEGOUDE, B.D. WINGFIELD, J. ROUX (2012). Biodiversity of *Ceratocystis* species infecting wounds on elephant-damaged trees in the Kruger National Park. South African Association of Botanists (SAAB) congress, January 2012, Pretoria.

MBENOUN, M., M.J. WINGFIELD, J. ROUX (2011). Distribution of tree-infecting *Ceratocystis* species in Africa shows evidence of environmental specialization. Proceedings of the 47 th Annual Congress of the Southern African Society for Plant Pathology, Kruger National Park.

MBENOUN, M., M.J. WINGFIELD AND J. ROUX. (2011). Distribution of tree-infecting *Ceratocystis* species in Africa shows evidence of environmental specialization. Proceedings of the 47th Annual Congress of the Southern African Society for Plant Pathology, 23-26 January 2011, Kruger National Park, South Africa.

MEWALAL, R., E. MIZRACHI, S.D. MANSFIELD, A.A. MYBURG (2012). Functional characterization of a putative secondary cell wall-related Protein of Unknown Function (PUFs). South African Genetics & Bioinformatics Society Conference, "The Data-mining Revolution", 10-12 September 2012, The Conservatoire, University of Stellenbosch, Stellenbosch.

MEYER, J., A.P.VAN DER WALT, S.MURRAY, DK BERGER (2012). Appling RNA sequencing to SNP discovery in maize, Joint South African Genetics & Bioinformatics Society Conference, Stellenbosch, RSA.

MISSE, A., F. ROETS, M.J. WINGFIELD, J. ROUX (2013). Diversity of *Ceratocystis* species associated with trees in the Garden Route National Park of South Africa. Proceedings of the 48th Congress of the Southern African Society for Plant Pathology, 20-23 January 2013, Klein-Kariba, Bela Bela, South Africa.

MIZRACHI, E., A. DOS SANTOS, A.R. KERSTING, A. VAN DER MERWE, C.A. HEFER, M. RANIK, S.D. MANSFIELD, A.A. MYBURG (2012). A comprehensive expressed gene catalog of *Equisetum ramosissimum* uncovers molecular innovations in vascular plant evolution. South African Genetics & Bioinformatics Society Conference, "The Data-mining Revolution", 10-12 September 2012, The Conservatoire, University of Stellenbosch, Stellenbosch.

MIZRACHI, E., A.A. MYBURG, The Forest Molecular Genetics Group (2012). The tree as a feedstock in the emerging bioeconomy. ASSAf-DST-NRF Third Annual South African Young Scientists' Conference: Our Energy Future. 16-18 October 2012, CSIR International Convention Centre, Pretoria (Oral presentation).

MIZRACHI, E., M.M. VAN DYK, C.A HEFER, A.R.K. KULLAN, F. JOUBERT, A.A. MYBURG (2012). Systems genetics of wood formation in *Eucalyptus*. South African Association of Botanists Symposium, 15-18 January 2012, Pretoria,.

MLONYENI, X.O., B.P. HURLEY, B.D. WINGFIELD, M.J. WINGFIELD, R. AHUMADA, P. KLASMER, B. SLIPPERS (2011). The *Sirex – Amylostereum – Deladenus* complex: Understanding diversity in pest biological control programs. 17th Congress of the Entomological Society of Southern Africa, 3 - 6 July 2011, Bloemfontein, South Africa.

MOLELEKI, L.N. (2011). Molecular characterisation of root knot nematodes in South Africa. NSSA Spier Estates, Cape Town.

MOLELEKI, L.N., E. ONKENDI, A.O. MONGAE (2012). The Interaction between root knot nematodes and soft rot enterobacteriaceae. Paper, 7th Australasian Symposium on Soilborne Diseases. Fremantle Australia.

MULLER, M.F., B. BLUHM, I. BARNES, B.G. CRAMPTON, D. BERGER (2013). Mining the genome sequence of *Cercospora zeina* for SSR markers. 48th Congress of the Southern African Society for Plant Pathology, 20-23 January, ATKV Klein Kariba, Pretoria, South Africa.

MULLER, M.F., B.H. BLUHM, B.G. CRAMPTON, D.K BERGER (2012). Molecular diversity of *Cercospora zeina* on maize in South Africa, Symposium of the Northern branch of the SASPP, 31 August 2012, University of Pretoria.

MULLER, M.F., B.H. BLUHM, I. BARNES, B.G. CRAMPTON, D.K BERGER (2013). Mining the genome sequence of *Cercospora zeina* for SSR markers, 48th congress of the SASPP, Bela Bela, South Africa.

MUTITU, K.E., J. GARNAS, B.P. HURLEY, M.J. WINGFIELD, B. SLIPPERS (2011). Invasion and subsequent decline of the *Thaumastocoris peregrinus* (Heteroptera: Thaumastocoridae) population in Kenya. 17th Congress of the Entomological Society of Southern Africa, 3 - 6 July 2011, Bloemfontein, South Africa.

MYBURG, A.A., E. MIZRACHI, M.M. VAN DYK, A.R.K. KULLAN, C.A. HEFER, F. JOUBERT (2012). Genomics of wood formation in field-grown *Eucalyptus* hybrid trees. Southern African Plant Breeding Symposium, 12-14 March 2012, Protea Hotel Kruger Gate, Skukuza (Oral presentation).

NAIDOO R., A.A. MYBURG, D.K. BERGER, S. NAIDOO (2012) A step towards understanding the SA and JA signalling pathways in *Eucalyptus grandis*. 5th ACGT Regional Plant Biotechnology Forum, 23 April 2012, Wits Professional Hub.

NAIDOO, R., A.A. MYBURG, D.K. BERGER, S. NAIDOO (2012). Elucidation and characterization of markers of the salicylic acid and methyl jasmonate signalling pathways in *Eucalyptus grandis*. South African Association of Botanists meeting, 15-18 January 2012, University of Pretoria.

NAIDOO, S., C. OATES, R. NAIDOO, E.A. VISSER, F. WILKEN, A.A. MYBURG (2012). Transcriptome profiling in *Eucalyptus*: a tool to dissect defence responses, 5th Forest Science Research Symposium, 24-25 July 2012, Hilton College School, Hilton.

OATES, C., A.A. MYBURG, B. SLIPPERS, S. NAIDOO (2012). A hypothetical *Eucalyptus grandis* defence model against *Leptocybe invasa* based on transcriptome sequencing. South African Association of Botanists meeting, 15-18 January 2012, University of Pretoria.

OSORIO, J.A., Z.W. DE BEER, M.J. WINGFIELD, J. ROUX (2013). Botryosphaeriaceae associated with mangroves in South Africa. Proceedings of the 48th Congress of the Southern African Society for Plant Pathology, 20-23 January 2013, Klein-Kariba, Bela Bela, South Africa.

PHASHA, M.M., M.P.A. COETZEE M, B.D. WINGFIELD, E.T. STEENKAMP (2011). The characterization of introns in housekeeping genes of four plant pathogenic species of *Fusarium*. Proceedings of the 47th Annual Congress of the Southern African Society for Plant Pathology, Kruger Park.

PINARD, D., E. MIZRACHI, A. KERSTING, A.A. MYBURG (2012). CAZyme repertoire of woody perennials. South African Genetics & Bioinformatics Society Conference, "The Data-mining Revolution", 10-12 September 2012, The Conservatoire, University of Stellenbosch, Stellenbosch (Oral presentation).

PINARD, D.S., E. MIZRACHI, F. JOUBERT, A.A. MYBURG (2012). In silico analysis of carbohydrate-binding modules and their associated domains in the genome of *Eucalyptus grandis*. South African Association of Botanists Symposium, 15-18 January 2012, Pretoria (Poster presentation).

PORTER, B., T.A. COUTINHO AND M.J. WINGFIELD (2011). *In Planta* competition between three *Fusarium circinatum* isolates. Proceedings of the 47th Annual Congress of the Southern African Society for Plant Pathology, 23-26 January 2011 Kruger National Park, South Africa.

READ, D., G. PIETERSEN (2011). Comparison of Citrus tristeza virus populations in Grapefruit trees, pre-immunized with two different cross-protecting sources. 47th Congress of the Southern African Society for Plant Pathology, 23-26 January, 2011, Berg-en Dal, Kruger National Park, South Africa.

READ D.R., G. PIETERSEN (2011). Strain diversity of Citrus tristeza virus (CTV), within South African red grapefruit trees in the field. South African Society for Microbiology 2011, 6-9 November, 2011, Cape Town.

READ, D.R., G. PIETERSEN (2012). CTV diversity in Southern African grapefruit orchards and the improvement of cross-protection. 7th Citrus Research Symposium, 20-22 August 2012, Champagne Sports Resort, Drakensberg.

REYNOLDS, S.M., M.M. VAN DYK, M. LUO, E. OKOGBENIN, L.A. BECERRA LOPEZ-LAVALLE, M. FERGUSON, A.A. MYBURG, P. RABINOWICZ (2012). SNP genetic linkage maps of cassava (*Manihot esculenta*). South African Association of Botanists Symposium, 15-18 January 2012, Pretoria.

REYNOLDS, S.M., M.M. VAN DYK, M. LUO, E. OKOGBENIN, L.A. BECERRA LOPEZ-LAVALLE, M. FERGUSON, A.A. MYBURG, P. RABINOWICZ (2012). Genetic linkage mapping and whole-genome SNP diversity analysis of cassava (*Manihot esculenta*). South African Genetics & Bioinformatics Society Conference, "The Data-mining Revolution", 10-12 September 2012, The Conservatoire, University of Stellenbosch, Stellenbosch.

ROUX, J. (2012). Healthy trees for a healthy society. Christina Scott Memorial Lecture. SCIFEST Africa 2012. 14-20 March 2012, Grahamstown, South Africa.

ROUX, J., N.G. KAMGAN, M. MBENOUN, M.J. WINGFIELD (2011). Fungus-Insect interactions and tree health in South Africa. Meeting of the Southern African Society of Botanists, January 2011, Grahamstown, South Africa. South African Journal of Botany 77, 555.

ROUX, J., M.J. WINGFIELD (2012). The rust pathogen, *Puccinia psidii,* an imminent threat to South Africa. South African Association of Botanists (SAAB) congress, January 2012, Pretoria.

ROUX, J., S. CHEN, M. GRYZENHOUT AND M.J. WINGFIELD (2011). The Cryphonectriaceae: a threat to native *Metrosideros angustifolia* in the Western Cape? Proceedings of the 47th Annual Congress of the Southern African Society for Plant Pathology, 23-26 January 2011, Kruger National Park, South Africa.

ROUX, J., S. CHEN, M.J. WINGFIELD, X.D. ZHOU, D. PACIURA, Z.W. DE BEER (2011). China - South Africa collaboration on tree fungi: working together to keep trees healthy. CHINA-RSA symposium, October 2011. Durban, South Africa.

RUDOLPH, N., T.A.S. AVELING, N. LABUSCHAGNE (2011). Efficacy of selected Rhizobacterial isolates for growth promotion of maize in South Africa. South African Society for Microbiology, Cape Town.

RUDOLPH, N., T.A.S. AVELING, N. LABUSCHAGNE (2012). Efficacy of selected rhizobacterial isolates for growth promotion of maize and biocontrol of *Rhizoctonia solani.* Southern African Society for Plant Pathology Northern Branch one-day post-graduate symposium, 31 August 2012, University of Pretoria, Pretoria.

SANTANA, Q.C., M.P.A. COETZEE, O.M. MAKARI, M.J. WINGFIELD, B.D. WINGFIELD AND E.T. STEENKAMP (2011). Population dynamics of *Fusarium circinatum* from a pitch cancer outbreak in South Africa. Proceedings of the 47th Annual Congress of the Southern African Society for Plant Pathology, 23-26 January 2011, Kruger National Park, South Africa.

SELOWA, C., R. SUTHERLAND, A. VEALE, N. VAN DEN BERG (2011). Evaluation of the *Fusarium oxysporum* f.sp. *cubense* pathosystem for bananas. 47th congress of the Southern African Society for Plant Pathology (SASPP), Berg-en-Dal, Kruger National Park.

SIMPSON, M.C., P.M. WILKEN, M.P.A. COETZEE, M.J. WINGFIELD, B.D. WINGFIELD. (2011). Evaluation of microsatellites in the genome of *Ceratocystis fimbriata*. Proceedings of the 47th Annual Congress of the Southern African Society for Plant Pathology, 23-26 January 2011, Kruger National Park, South Africa.

SINGH, P., E. MIZRACHI, A.A. MYBURG (2012). Predicting the segregating xylem proteome from a backcross population of hybrid eucalypts using next-generation RNA sequencing transcriptome data. South African Genetics & Bioinformatics Society Conference, "The Data-mining Revolution", 10-12 September 2012, The Conservatoire, University of Stellenbosch, Stellenbosch.

SINGH, P., S.G. HUSSEY, C. MARITZ-OLIVIER, E. MIZRACHI, A.A. MYBURG (2012). Expression and characterisation of EgrSND2, a *Eucalyptus grandis* transcription factor potentially involved in secondary cell wall regulation. South African Association of Botanists Symposium, 15-18 January 2012, Pretoria.

STANTON, S.L., C.F. VAN DER MERWE, A. HUSSEIN, T.A. COUTINHO, J.J.M. MEYER (2012). A phytochemical and morphological comparison between *Pachystigma macrocalyx*, *Pachystigma pygmaeum* and *Pachystigma* thamnus. Proceedings of the South African Botanist Society, 16-18 January 2012, University of Pretoria.

STANTON, S.L., J.J.M. MEYER, C.F. VAN DER MERWE, A. HUSSEIN, S.N. VENTER, T.A. COUTINHO (2011). *Pachystigma pygmaeum*: its endophytes and toxic compound(s). Proceedings of the South African Botanist Society, 17-20 January 2011, Rhodes University.

SUTHERLAND, R., A. VILJOEN, A.A. MYBURG, N. VAN DEN BERG (2012). The effect of cold stress on infection of Cavendish bananas with *Fusarium oxysporum* f. sp. *cubense*. South African Association of Botanists Symposium, 15-18 January 2012 , Pretoria (Oral presentation).

TAOLE, M.M., T.I. BURGESS, M. GRYZENHOUT, M.J. WINGFIELD, B.D. WINGFIELD (2011). Phylogenetic and morphological re-evaluation of *Teratosphaeria epicoccoides* causing disease on *Eucalyptus*. Proceedings of the 47th Annual Congress of the Southern African Society for Plant Pathology, 23-26 January 2011, Kruger National Park, South Africa.

VAN DER LINDE, J.A., D.L. SIX, M.J. WINGFIELD, J. ROUX (2011). Factors associated with the decline of *Euphorbia ingens* in the Limpopo province, South Africa. Proceedings of the 47th Annual Congress of the Southern African Society for Plant Pathology, 23-26 January 2011, Kruger National Park, South Africa.

VAN DER LINDE, J.A., D.L. SIX, M.J. WINGFIELD, J. ROUX (2013). Fungi associated with *Euphorbia ingens* die-offs in South Africa and Zimbabwe. Proceedings of the 48th Congress of the Southern African Society for Plant Pathology, 20-23 January 2013, Klein-Kariba, Bela Bela, South Africa.

VAN DER LINDE, J.A., D.L. SIX, M.J. WINGFIELD, J. ROUX (2011). Factors associated with the decline of *Euphorbia ingens* in the Limpopo Province, South Africa. 5th Natural Forests and Woodlands Symposium, 10-14 April 2011, Richardsbay, South Africa.

VAN DER LINDE, J.A., D.L. SIX, M.J. WINGFIELD, J. ROUX (2012). Climate change driven mortality of *Euphorbia ingens* in the Limpopo Province: Causal abiotic and biotic factors. South African Association of Botanists (SAAB) congress, January 2012, Pretoria.

VAN DER MERWE, K., C.A. HEFER, E. MIZRACHI, F. JOUBERT, A.A. MYBURG (2012). EucGenIE: The *Eucalyptus* Genome Integrative Explorer database for *Eucalyptus* genomics and transcriptomics. South African Genetics & Bioinformatics Society Conference, "The Data-mining Revolution", 10-12 September 2012, The Conservatoire, University of Stellenbosch, Stellenbosch (Oral presentation).

VAN DER MERWE, N.A., E.T. STEENKAMP, B.D. WINGFIELD, M.J. WINGFIELD (2011). Host switching in a population of *Chrysoporthe cubensis* from Colombia, infecting *Eucalyptus* and mortino. 37th Annual Congress of the South African Association of Botanists held at Rhodes University, Grahamstown.

VAN DYK, M.M., A.R.K. KULLAN, E. MIZRACHI, C.A. HEFER, L. JANSEN VAN RENSBURG, D. NEWMAN, N. COETZER, T.J. TSCHAPLINSKI, K.C. CUSHMAN, N.E. ENGLE, G.A. TUSKAN, N. JONES, A. KANZLER, A. BAYLEY, A.A. MYBURG (2012). Identifying genomic regions involved in growth, wood property, transcript and metabolite variation in an F2 pseudo-backcross pedigree of *Eucalyptus grandis x E. urophylla*. South African Association of Botanists Symposium, 15-18 January 2012, Pretoria.

VAN DYK, M.M., E. MIZRACHI, C.A. HEFER, N. COETZER, N. JONES, A. KANZLER, A.A. MYBURG (2012). Combinatorial mapping of wood property, metabolite and gene expression quantitative trait loci (QTLs) in *Eucalyptus* hybrids. South African Genetics & Bioinformatics Society Conference, "The Data-mining Revolution", 10-12 September 2012, The Conservatoire, University of Stellenbosch, Stellenbosch.

VAN JAARSVELD, B., E. MIZRACHI, F. JOUBERT, A.A. MYBURG (2012). Annotating transcription start sites and analysis of core promoter usage in *Eucalyptus grandis.* South African Genetics & Bioinformatics Society Conference, "The Data-mining Revolution", 10-12 September 2012, The Conservatoire, University of Stellenbosch, Stellenbosch.

VAN JAARSVELD, B., E. MIZRACHI, F. JOUBERT, A.A. MYBURG (2012). High-throughput SNP discovery in the genetically diverse genome of *Eucalyptus grandis* using next-generation DNA-sequencing technologies. South African Genetics & Bioinformatics Society Conference, "The Data-mining Revolution", 10-12 September 2012, The Conservatoire, University of Stellenbosch, Stellenbosch.

VAN JAARSVELD, I., E. MIZRACHI, F. JOUBERT, Y. VAN DE PEER, A.A. MYBURG (2012). Ensemble optimisation of cis-regulatory element discovery: *in planta* benchmark and discovery in *Eucalyptus*. South African Association of Botanists Symposium, 15-18 January 2012, Pretoria.

VERMEULEN, M., M. GRYZENHOUT, M.J. WINGFIELD, J. ROUX (2011). Cryphonectriaceae: an unexplored group of tree pathogens in Africa. Proceedings of the 47th Annual Congress of the Southern African Society for Plant Pathology, 23-26 January 2011, Kruger National Park, South –Africa.

VILJOEN, R., E.T. STEENKAMP, G. PIETERSEN (2012). Alternative hosts of "*Candidatus* Liberibacter africanus" amongst indigenous members of the Rutaceae. 7th Citrus Research Symposium, 20-22 August 2012, Champagne Sports Resort, Drakensberg.

VILJOEN, R., E.T. STEENKAMP, G. PIETERSEN (2012). Alternative indigenous Rutaceous hosts of '*Candidatus* Liberibacter africanus' and '*Candidatus* Liberibacter africanus subsp. capensis'. South African Association of Botanists, January 2012.

VILJOEN, R., G. PIETERSEN (2011). Alternative host of Citrus Tristeza Virus (CTV) and *Candidatus* Liberibacter africanus (Laf). 47th Congress of the Southern African Society for Plant Pathology, 23-26 January, 2011, Berg-en Dal, Kruger National Park, South Africa.

VISSER, E.A., J.V.W. BECKER, A.A. MYBURG, S. NAIDOO (2012). Terpenoid defence against *Chrysoporthe austroafricana* in *Eucalyptus grandis*. South African Genetics Society meeting, 10-12 September 2012, University of Stellenbosch.

WALSH, H., G. PIETERSEN (2011). Detecting grapevine leafroll- associated virus type 3 using loop-mediated amplification. South African Society for Microbiology, 6-9 November, 2011, Cape Town.

WELLER, T., T.A. COUTINHO, I. TOTH, J. THERON (2011). Identification and characterisation of pili and fimbriae mediating attachment of *Pantoea ananatis* to *Eucalyptus* leaf surfaces. Proceedings of the 47th Annual Congress of the Southern African Society for Plant Pathology, 24-27 January 2011, Berg-en-Dal, Kruger National Park.

WILKEN, F., R. NAIDOO, N. VAN DEN BERG, D.K. BERGER, A.A. MYBURG, S. NAIDOO (2011). Gene expression profiling of putative defence gene orthologs in *Eucalyptus* nitens upon challenge with *Phytophthora cinnamomi*. South African Society of Plant Pathologists meeting, January 2011, Kruger National Park.

WILKEN, P.M., E.T. STEENKAMP, Z.W. DE BEER, M.J. WINGFIELD, B.D. WINGFIELD (2012). Gene loss during mating type switching in *Ceratocystis fimbriata*. In: South African Genetics & Bioinformatics Society Conference, 10-12 September 2012, University of Stellenbosch, South Africa.

WILKEN, P.M., Z.W. DE BEER, E.T. STEENKAMP, M.J. WINGFIELD, B.D. WINGFIELD (2011). Full genome sequencing contributes to an understanding of mating in *Ceratocystis fimbriata*. Proceedings of the 47th Annual Congress of the Southern African Society for Plant Pathology, 23-26 January 2011, Kruger National Park, South Africa.

WINGFIELD, M.J. (2011). Plenary lecture: Global tree health: What next? 37th Annual Congress of the South African Association of Botanists held at Rhodes University, Grahamstown.

WOODING, A.L., J.M. GREEFF, J GARNAS, B.P. HURLEY, G. DITTRICH-SCHRODER, M.J. WINGFIELD, B. SLIPPERS (2011). Understanding the persistence of highly male-biased sex ratios in South African populations of *Sirex noctilio* Fabricus (Hymneoptera: Symphyta). 17th Congress of the Entomological Society of Southern Africa, 3 - 6 July 2011, Bloemfontein, South Africa.

ZABLOCKI, O.A., G. PIETERSEN (2012). Citrus Tristeza virus in South Africa: genotype diversity and development of an unbiased Illumina sequencing pipeline. 7th Citrus Research Symposium, 20-22 August 2012, Champagne Sports Resort, Drakensberg.

ZABLOCKI, O.D.J., G. PIETERSEN (2011) Citrus Tristeza Virus genotype diversity within five orange cultivar populations from Nelspruit, South Africa. 47th Congress of the Southern African Society for Plant Pathology, 23-26 January 2011, Berg-en Dal, Kruger National Park, South Africa.

SEMINAR PRESENTATIONS

All post-graduate students linked to FABI present two seminars each year on a Thursday morning. Special seminars, presented by invited speakers, are also regularly held.

Prof. Burt Bluhm
University of Arkansas, USA
January 2011
Functional genomics and genome sequencing of *Cercospora* and *Fusarium* pathogens of maize

Dr Barbara de Conink
KU Leuven, Belgium
February 2011
Defence response in *Arabidopsis* mutants infected with *Fusarium*

Dr Michael Poulson
University of Copenhagen, Denmark
February 2011
From ants to termites: exploring the fungus-growing termite microbiome

Prof. Toshiya Muranaka
Osaka University, Japan
March 2011
Metabolic diversity of terpenoids in plants and its application to combinatorial biosynthesis

Prof. Lindsey du Toit
Washington State University, USA
March 2011
Starting a career in applied plant pathology

Dr Miroslav Kolarik
Department of Biology, Charles University, Czech Republic
April 2011
Geosmithia as regular and widespread symbionts of bark beetles

Prof. Thomas Coudrun
Agricultural Research Service, Biological Control of insects Research Laboratory, USA
May 2011
Global forces influencing the future of biological control

Prof. Pedro Crous
CBS, the Netherlands
July 2011
Species Complexes or Complex Species

Dr Lorenzo Lombard
CBS, the Netherlands
October 2011
DNA barcoding in Europe

Ms Melodie Putman
January 2012
Plant disease clinic at OSU

Prof. Joseph Hirschberg
Dept of Genetics, Hewbrew University of Jerusalem, Israel
January 2012
Plant metabolic engineering and golden rice

Prof. Paul Krokene
Norwegian Forest and Landscape Institute, Norway
February 2012
Vaccinating trees against pests and pathogens - an update on conifer-bark beetle interactions

Dr Sze Huei (Zoe) Yek
University of Copenhagen, Denmark
February 2012
Immune and defense dynamics of leaf-cutting ants

Prof. Shawn Mansfield
University of British Colombia, Canada
March 2012
Genomics of wood formation in *Populus*

Dr Arnold Schumann
University of Florida, USA
March 2012
The current status of Huanglongbing and precision farming of citrus in Florida

Dr Rees Kassen
University of Ottawa, Canada
May 2012
Genomics of adaptation

Dr Dror Avisar
FuturaGene, Israel
May 2012
The application of genetic tools in the commercial environment

Dr Sijmen Schoustra
University of Wagningen, the Netherlands
June 2012
Beneficial mutations, adaptive walks and experimental evolution of microbial eco-systems

Prof. Jan Giliomee
University of Stellenbosch
July 2012
Entomology in South Africa: where do we come from, where are we now and where are we going?

Prof. Dario Grattapaglia
Embrapa Genetic Resources and Biotechnology, Brazil
September 2012
Genomic selection: capturing the missing heritability and accelerating breeding for complex traits

Prof. John Leslie
Kansas State University, USA
September 2012
Fusarium - Defining species comes before understanding populations

Dr David Cibrian Tovar
University of Chapingo, Mexico
November 2012
Pests and Diseases of Forest Trees in Mexico

Prof. Ian Toth
James Hutton Institute, UK
November 2012
Bacteriology research at the James Hutton Institute

FABI TEAM 2011-2013

FULL TIME ACADEMIC & RESEARCH STAFF

Prof. Dave Berger (C1*)
Prof. Teresa Coutinho (B3)
Prof. Karl Kunert (C1)
Prof. Zander Myburg (B3)
Prof. Jolanda Roux (B2)
Prof. Bernard Slippers P
Prof. Brenda Wingfield (B2)
Prof. Michael Wingfield (A1)
Extraordinary Prof. Gerhard Pietersen
Assoc. Prof. Terry Aveling (C2)
Assoc. Prof. Emma Steenkamp (C2)
Assoc. Prof. Fanus Venter (C2)

Dr. Martin Coetzee (Y2)
Dr. Bridget Crampton (Y2)
Dr. Wilhelm de Beer
Dr. Jeff Garnas
Dr. Brett Hurley
Dr. Lucy Moleleki
Dr. Sanuska Naidoo
Dr. Noëlani van den Berg (Y2)
Dr. Albé van der Merwe
Dr. Juan Vorster
Dr. XuDong Zhou (C3)

* denotes NRF rating

TECHNICAL STAFF

Ms. Rouxle Botha
Ms. Daphney Chokoe
Ms. Elna Cowley
Mr. Jurgens de Bruin
Ms. Minique de Castro
Mr. Ndumiso Dlamini
Mr. Neil de Jager
Ms. Juanita Engelbrecht
Ms. Gerda Fourie
Ms. Sonica Goddard
Ms. Izette Greyling
Ms. Tracey Hatherell
Mr. Hardus Hatting
Ms. Alex Jansen van Rensburg
Ms. L'Zanne Jansen van Rensburg
Ms. Pritty Khumalo
Ms. Jeanne Korsman
Mr. Ian Law
Ms. Annelie Lübben
Ms. Grieta Mahlangu
Dr. Seonju Marinkowitz

Ms. Babalwa Mbebe
Mr. Eshchar Mizrachi
Ms. Eva Müller
Ms. Karin Muller
Ms. Valentina Nkosi
Mr. Nicky Olivier
Mrs. Marja O'Neill
Ms. Patience Ralikonyana
Ms. Melissa Reynolds
Ms. Heidi Roos
Ms. Anita Steyn
Ms. Melissa Turton
Ms. Lydia Twala
Ms. Liesl van der Linden
Ms. Karen van der Merwe
Ms. Erika van der Walt
Dr. Daleen van Dyk
Ms. Irene van Nugteren
Mrs. Adri Veale

ADMINISTRATIVE STAFF

Ms. Mmampe Aphane
Ms. Vivienne Clarence
Ms. Helen Doman
Ms. Jenny Hale
Ms. Adrene Laubsher
Ms. Martha Mahlangu
Ms. Annette Schnetler
Ms. Madelein van Heerden
Ms. Rose Visser (until end of March 2011)

INFORMATION SPECIALIST

Ms. Janice de Wee (until 2011)
Ms. Marie Theron

HONORARY PROFESSORS/LECTURERS

Prof. P Birch
Prof. PW Crous
Prof. WFO Marasas
Prof. S Neser
Prof. I Toth
Prof. S Verryn
Prof. XD Zhou
Dr. T Burgess

SABBATICAL VISITORS

Ms. Melodie Putman, Oregon State University, USA
Prof. Reyes Blanco, University of Almeria, Spain

UP RESEARCH FELLOW

Dr. Irene Barnes
Population genetics of plant pathogens

POST-DOCTORAL FELLOWS

Dr. Wubetu Bihon
Population studies in *Diplodia pinea*

Dr. Maryke Carstens
Genomics of quantitative disease resistance in African maize varieties

Dr. Shuaifei Chen
Cryphonectriaceae associated with native trees in the Western Cape province

Dr. Pieter de Maayer
Comparative and functional genomics of *Pantoea* spp.

Dr. Lieschen de Vos
Characterization of the *Fusarium circinatum* genome

Dr Raj Deepika Kaul
Development and optimization of an *in vitro* regeneration and genetic transformation protocol for genetic modification of cellulose biosynthesis in *Eucalyptus* clones grown in South Africa

Dr. Gilbert Kamgam Nkuekam
Cryphonectriaceae in Myrtales in Hawaii

Dr. Martin Kemler
Molecular ecology and evolution of Botryosphaerieaceae

Dr. Boney Kuriakose
Genomics of quantitative disease resistance in African maize varieties

Dr. Lu Min
Ophiostomatoid fungi associated with bark beetles

Dr. Sonia Phillips
Genomics of quantitative disease resistance in African maize varieties

Dr. Pedro Romon
Conifer bark beetles and associated phytopathogenic fungi

Dr. Lucas Shuttleworth
Botryosphaeria spp. associated withthe Myrtales

Dr. Stephanie Slinski
Characterization of the pitch canter Lingus, *Fusarium circinatum*

Dr. Daleen van Dyk
Genetic dissection of gene expression regulation, metabolite profiles and wood fibre traits in *Eucalyptus* hybrid tree populations

Dr. Sze Huei Yek
Host reponse of *Sirex* to nematode infection

Dr. Chongzing Zhang
Diversity and genetics of nematodes for biological control of forest pests

Dr. Rika Linnaokoski
Bark beetles and their fungal associates

CURRENT Ph.D. STUDENTS

Teddy Amuge
Gene expression study of interactions between cassava and cassava brown streak disease
Advisors: DK Berger, M Ferguson, J Harvey & AA Myburg

Kwabena Baffoe
Management of *Leptocybe invasa*
Advisors: B Hurley, B Slippers & MJ Wingfield

Chrizelle Beukes
Evolution of indigenous *Bradyrhizobium*
Advisors: ET Steenkamp & SN Venter

Elbie Beukes (registered at University of Stellenbosch)
Enhancement of the probiotic potential of Southern African produced kefir
Advisors: TJ Britz, ET Steenkamp & PJ Jooste

Marc Bouwer
Chemical ecology of South African forest insects
Advisors: E Rohwer, B Slippers & MJ Wingfield

Gabrielle Carstensen
Bacterial wilt of *Eucalyptus*
Advisors: TA Coutinho, SN Venter & MJ Wingfield

Annie Chan
Gene expression in a symbiotic *Burkholderia* sp.
Advisors: SN Venter & ET Steenkamp

Nanette Coetzer
Gene co-expression network analysis of the maize-grey leaf spot pathosystem
Advisors: DK Berger & AA Myburg

Nicky Creux
Transcriptional regulation of cellulose biosynthesis in *Eucalyptus* trees
Advisor: AA Myburg

Elsie Cruywagen
A survey of diseases of *Adansonia digitata* (baobab) and related species
Advisors: MJ Wingfield, J Roux & B Slippers

Dawit Degefu
Biology and biological control of *Coryphodema tristis*
Advisors: B Slippers, B Hurley & MJ Wingfield

Gudren Dittrich-Schroder
Diversity and control of *Leptocybe invasa*
Advisors: B Slippers, MJ Wingfield & B Hurley

Kosi Dongo
Mycotoxins associated with maize beer in Mpumalanga
Advisor: TAS Aveling

Nicoleen Douglas-Smit
Transmission of Aster yellows to grapevine by insect vectors
Advisors: K Kruger & G Pietersen

Tuan Duong
Molecular characterization of *Leptographium serpens* and related species
Advisors: MJ Wingfield & BD Wingfield

Bianco Farrow
Elucidating the early response of *Persea americanna* to hypoxia in association with *Phytophthora cinnamomi*
Advisors: N van den Berg, C Maritz-Oliver & N Taylor

Marna Ferreira
Spread of grapevine leafroll-associated virus 3 (GLRaV-3) by scale insects
Advisors: K Kruger & G Pietersen

Gerda Fourie
A study of virulence of *Fusarium circinatum* from a genomics perspective
Advisors: ET Steenkamp, BD Wingfield & MJ Wingfield

Felix Fru
Field ecology of *Fusarium circinatum* in South African pine plantations
Advisors: J Roux, MJ Wingfield & ET Steenkamp

Inge Gazendam
Identification of genes in cowpea responding to drought stress
Advisors: DK Berger & D Oelofse

James Harrison
Complementary morphological and molecular approaches to plantation white grubs (Scarabaeidae) identification
Advisors: MJ Wingfield & C Scholz

Steven Hussey
Analysis of cellulose biosynthesis-related transcription factor binding sites in *Arabidopsis* and *Eucalyptus*
Advisor: AA Myburg

Fahimeh Jami
Phylogeography of Botryosphaeriaceae on Acacia
Advisors: MJ Wingfield, B Slippers & M Gryzenhout

Luke Jimu
Diseases of eucalypts in Zimbabwe, with particular reference to Kirramyces stem canker
Advisors: J Roux, E Mwenje & MJ Wingfield

Maythasith Konkarn
Ophiostomatoid fungi associated with bark beetles in Thailand
Advisors: XD Zhou, ZW de Beer, K Hyde & MJ Wingfield

Jeanne Korsman
Functional studies of maize defence genes against grey leaf spot
Advisors: DK Berger & BG Crampton

Donghyeon Lee
Pathogeniciry or *Ceratocystis albitundus*
Advisors: MJ Wingfield, BD Wingfield & J Roux

Waheed Mahomed
Unravelling the *Phytophthora cinnamomi* triggered defence pathways of *Persea Americana*
Advisor: N van der Berg

Eugene Makgopa
Cystatin expression in transgenic soybean
Advisor: K Kunert

Celia Martins
Drought stress in cowpea
Advisor: KJ Kunert

Michael Mbenoun
Ceratocystis spp. and their insect vectors on trees in Africa
Advisors: J Roux, MJ Wingfield, BD Wingfield & BAD Begoude

James Mehl
Phylogeography and ecology of selected species of Botryosphaeriaceae
Advisors: MJ Wingfield, B Slippers & J Roux

Jacqueline Meyer
Transcriptomics of the maize-GLS pathosystem
Advisors: DK Berger, BG Crampton & S Murray

Ritesh Mewalal
Functional characterization of secondary cell wall-related proteins of unknown functions (SCW-PUFs) implicated in development of *Eucalyptus* wood
Advisor: AA Myburg

Alaine Misse
Diversity of bio-ecology of *Ceratocystis* spp. and their arthropod vectors on Afromantane trees in Cameroon and South Africa
Advisors: J Roux, F Roets & MJ Wingfield

Eshchar Mizrachi
Transcriptome analysis of wood formation in a fast growing *Eucalyptus grandis* x *E. urophylla* hybrid plantation forest tree as a method of refining candidate genes for forest biotechnology
Advisor: AA Myburg

Osmond Mlonyeni
Population genetics of *Deladenus siricidicola*
Advisors: B Slippers, B Hurley, MJ Wingfield & BD Wingfield

Josephine Muchwezi
Identification of resistance proteins against banana weevils
Advisors: K Kunert, A Viljoen & R Chikwamba

Eston Mutitu
Studies of *Thaumastocoris peregrinus* and its biological control agent, *Clerochoides noackae*
Advisors: B Slippers, B Hurley & MJ Wingfield

Jan Nagel
Causes and consequences of speciation within the *Neofusicoccum parvum - Neofusicoccum ribis* complex
Advisors: B Slippers & MJ Wingfield

Kershney Naidoo
Molecular fungal diagnostics of *Ceratocystis albifundus*
Advisors: BD Wingfield, ET Steenkamp & MJ Wingfield

Ronishree Naidoo
Defense responses against *Chrysoporthe austrafricana* in *Eucalyptus*
Advisors: S Naidoo & AA Myburg

Alexander Osorio
Diseases of mangroves and their associates in South Africa
Advisors: J Roux, MJ Wingfield & ZW de Beer

Mmatshepho Phasha
Characterization of introns in four plant pathogenic species of *Fusarium*
Advisors: ET Steenkamp, BD Wingfield & MPA Coetzee

Quentin Santana
Genome evolution and architecture of the pitch canker fungus, *Fusarium circinatum*
Advisors: MPA Coetzee, BD Wingfield, ET Steenkamp & MJ Wingfield

Divine Shyntum
Pathogenecity and host specificity exhibited by *Pantoea ananatis*
Advisors: TA Coutinho, SN Venter & I Toth

Phathie Sibanda
Role of quorum sensing in *Pantoea ananatis*
Advisors: TA Coutinho, J Theron & L Moleleki

Melissa Simpson
Microsatellite analysis of *Ceratocystis* species
Advisors: BD Wingfield, MPA Coetzee & MJ Wingfield

Rene Sutherland
The effect of cold stress on resistance in Cavendish bananas to Fusarium wilt
Advisors: N van den Berg, A Viljoen, R Chikwamba & AA Myburg

Matsepo Taole
Taxonomy and phylogeny of *Teratosphaeria epicoccoides* from diseased *Eucalyptus* leaves
Advisors: BD Wingfield, T Burgess & MJ Wingfield

Steven Taerum
Ophiostoma spp. associated with bark beetles
Advisors: MJ Wingfield & ZW de Beer

David Talengera
Identification and regulation of cyclin genes in banana
Advisor: KJ Kunert

Johan van der Linde
Factors associated with the decline of *Euphobia ingens*
Advisors: J Roux, D Six & MJ Wingfield

Marelize van Wyk
The genus *Ceratocystis*
Advisors: MJ Wingfield & BD Wingfield

Stefan van Wyk
Functional genetics of nodule development in soybean
Advisors: J Vorster & K Kunert

Erika Viljoen
Development of genomic tools to explore nutritional traits in *Amaranthus* species
Advisors: DK Berger, D Odeny & J Rees

Tania Weller-Stewart
Role of Type IV pili in *Pantoea ananatis*
Advisors: J Theron & TA Coutinho

Markus Wilkin
Characterization of the *Ceratocystis fimbriata* genome
Advisors: BD Wingfield, MJ Wingfield & ET Steenkamp

MingLiang Yin
Factors associated with conifer bark beetles in China
Advisors: MJ Wingfield & ZW de Beer

CURRENT M.Sc./M.Sc. (AGRIC) STUDENTS

Jon Ambler
Genome evolution and characteristics of *Armillaria fuscipes*
Advisors: MPA Coetzee, ET Steeenkamp & F Joubert

Elrea Appelgryn
Investigation of the *Phytophthora cinnamomi-Persea americana* interaction with a fluorescently-tagged strain of Phytophthora cinnamomi
Advisors: N van den Berg, B Crampton & TA Coutinho

Robert Backer
Isolation and characterization of non-expressor of pathogenesis related 1 (NPR1) in *Phytophthora cinnamomi* infected avocado (*Persea americana*)
Advisor: N van den Berg

Velushka Birkenbach
Study of toxin biosynthesis genes in *Cercospora zeina*
Advisors: DK Berger & BG Crampton

Eric Birkholtz
Microbial community associated with *Sirex noctilio* larvae
Advisors: SN Venter & B Slippers

Kay Bophela
Enterobacter and *Xanthomonas* species associated with *Eucalyptus* blight and dieback in South Africa
Advisors: TA Coutinho & SN Venter

Francois Boshoff
Phylogeography of *Bradyrhizobium* species associated with native and non-native *Acacia* species
Advisors: ET Steenkamp & SN Venter

Jonathan Botha
The characterization of a promoter-protein interaction in the wood fibre cells of *Eucalyptus grandis*
Advisor: AA Myburg

Renate Botha
Evaluating somaclonal banana varieties for tolerance against *Fusarium* wilt
Advisor: N van den Berg

Jane Bredenkamp
Root-specific defence responses in *Arabidopsis*
Advisors: DK Berger & S Naidoo

Vanessa Cronje
Early infection events in onion seedlings infected with *Pantoea allii* and *P. ananatis*
Advisors: TA Coutinho & N van den Berg

Herman de Bruin
Characterizing the diversity of *Beauveria* species in South African plantations
Advisors: B Slippers & ZW de Beer

Magdeleen du Plessis
Cysteine protease activity and gene expression in soybean nodules during development and drought stress
Advisors: J Vorster & K Kunert

Marike du Plessis
Phylogenomics of the genus *Pantoea*
Advisors: SN Venter, ET Steenkamp, MPA Coetzee & TA Coutinho

Miekie Haasbroek
Characterization of *Exserohilum turcicum* isolates within South African maize production areas
Advisors: BG Crampton & DK Berger

Arista Fourie
Evaluation of genetic markers for phylogenetic analysis of Ceratocystis species
Advisors: I Barnes, BD Wingfield & MJ Wingfield

Jean Hakizimana
Understanding the role of oxygen stress and endophytes in avocado root
Advisors: N van den Berg, M Gryzenhout & TA Coutinho

Tracy Hall
Characterization of the *Ceratocystis moniliformis* genome
Advisors: BD Wingfield, MJ Wingfield & M Wilkin

Darryl Herron
Gibberella fujikuroi complex associated pines
Advisors: ET Steenkamp, BD Wingfield, MJ Wingfield & WFO Marasas

Monique Heystek
Maize promoter studies
Advisors: DK Berger & BG Crampton

Zander Human
Actinomycetes associated with bark beetles
Advisors: SN Venter, B Slippers, MJ Wingfield & ZW de Beer

Barend Jansen van Vuuren
Population dynamics of *Phytophthora cinnamomi* in South African avocado orchards
Advisors: N van den Berg & I Barnes

Degracious Kgoale
Arabidopsis candidate defence genes
Advisors: DK Berger & S Naidoo

Nelly Khumalo
Pathogenicity of *Phytophthora cinnamomi* on avocado in South Africa
Advisors: N van den Berg & TA Coutinho

Tondani Kone
Characterization of the pheromone receptors of *Fusarium* spp.
Advisors: ET Steenkamp, BD Wingfield, NA van der Merwe & G Fourie

Lindsay Kriel
Development of tissue culture, in vitro micropropagation and transformation techniques and the characterization of thaumatin, a potential defence-related gene in *Persea americana* Mill.
Advisor: N van den Berg

Teboho Letsoalo
Ceratocystis species and their insect vectors on forestry trees in South Africa and Uruguay
Advisors: J Roux, MJ Wingfield $ M Mbenoun

Johan Liversage
Identification of novel effector proteins in *Cercospora zeina*
Advisors: BG Crampton & DK Berger

Brigitte Lombard
Functional characterization of the effector genes avr4 and ecp6 in *Cercospora zeina*
Advisors: BG Crampton & DK Berger

Rynier Lourens
The cloning and characterization of the non-expressor of pathogenesis related 1 (NPR1) gene in two economically important crops, *Eucalyptus grandis* and *Persea americana*
Advisors: N van den Berg, S Naidoo & AA Myburg

Eugene Makgopa
Expression of NPR1 in plants
Advisors: KJ Kunert & R Chikwamba

Olga Makhari
Vegetative compatibility in the pitch canker fungus, *Fusarium circinatum*
Advisors: ET Steenkamp, TA Coutinho & MJ Wingfield

Mkhululi Maphosa
Developing a rapid dagnostic for *Fusarium circinatum*
Advisors: BD Wingfield & ET Steenkamp

Qaqamba Mapatwana
A population study on the occurrence of *Fusarium verticillioides* and fumonisins in the maize milling process
Advisors: GJ Marais, ET Steenkamp & C Erasmus

Claire Martin
Elicitation of medicinally active dicaffeoylquinic acid derivatives from *Helichrysum populifolium*
Advisor: BG Crampton

Abigail Mashamba
Nodule-specific expression of cysteine proteinase inhibitors in soybean
Advisors: K Kunert & U Schlüter

Lenny Mashavha
Characterization of the T6SS and its secretome in *Pectobacterium carotovorum* subsp. *brasiliensis*
Advisors: L Moleleki & TA Coutinho

Silvia Mausse-Sitoe
Fungal diseases of *Eucalyptus* in Mozambique
Advisors: J Roux, MJ Wingfield & SF Chen

Lungi Mavuso
Studying the effect of salt stress on avocado tree health
Advisor: N van den Berg

Molly Molefo
Functional characterization of the putative pathogenicity factor gene, *czk3* in *Cercospora zeina*
Advisors: BG Crampton & DK Berger

Aobakwe Mongae
The interaction between *Meloidogyne* spp. with pathogenic bacteria and their host plant, *Solanum tuberosum*
Advisors: L Moleleki & P Hammes

Mischa Muller
Population study of *Cercospora zeina* in South Africa
Advisors: DK Berger, BG Crampton & I Barnes

Sonia Naidoo
Defining heterotic groups and parentage analysis of South African sweet potato (*Ipomea batata* L.)
Advisors: BG Crampton & D Odeny

Linda Ndlove
Botryosphaeriaceae occurring on Southern Hemisphere gymnosperms, with specific reference to *Podocarpus* spp. in South Africa
Advisors: B Slippers, MJ Wingfield & E Cruywagen

Rofhiwa Nesamari
Diseases of cycads in South Africa
Advisors: J Roux & TA Coutinho

Nare Ngoepe
Optimizing genotyping-by-sequencing for sweet-stem- and grain-sorghum (*Sorghum bicolor* L. Moench) for genetic mapping
Advisors: BG Crampton, J Rees & D Odeny

Nokukhanya Nxumalo
Epidemiology of *Fusarium* spp. causing wilt on potatoes in South Africa
Advisors: J van der Waals & TA Coutinho

Caryn Oates
Host responses to the gall wasp *Leptocybe invasa*
Advisors: S Naidoo, B Slippers & AA Myburg

Francina Philane
Diversity of rhizobia associated with the root nodules of *Lebeckia* species
Advisors: ET Steenkamp & SN Venter

Desre Pinard
Characterization of cellulose binding module-containing proteins in the *Eucalyptus grandis* genome
Advisor: AA Myburg

Rudi Pretorius
Unravelling the *Pectobacterium carotovorum* subsp. *brasiliensis* quorum sensing regulon
Advisors: L Moleleki & J Theron

Sitha Ramsuchit
Pathogenicity of mating types of *Phytophthora cinnamomi* in *Eucalyptus* and Avocado
Advisors: N van den Berg & S Naidoo

David Read
Citrus tristeza virus populations in Grapefruit trees, pre-immunized with two different cross-protecting sources
Advisor: G Pietersen

Anandi Reitmann
Identification of pathogenicity-related genes in *Phytophthora cinnamomi*
Advisors: N van den Berg & DK Berger

Danielle Roodt
Mahng hype loci in Ceratocystis albifundus
Advisors: BD Wingfield, MJ Wingfield & PM Wilkin

Melissa Reynolds
Genome-wide SNP marker diversity analysis of Cassava
Advisor: AA Myburg

Nicole Rudolph
Plant growth promoting rhizobacteria amended to manure and their effect on maize cultivation
Advisors: TAS Aveling & N Labuschagne

Thomas Schmidt
Transient transformation in maize
Advisors: DK Berger & BG Crampton

Christina Selowa
Elucidation of the role of pathogenesis related proteins in *Musa accuminata*
Advisor: N van den Berg

Gina Shin
Population genetics of *Pantoea ananatis*
Advisors: SN Venter & TA Coutinho

Vimbai Siziba
Population genetics of teh DNB pathogen, *Dothistroma pini*
Advisors: I Barnes, BD Wingfield & MJ Wingfield

Pooja Singh
Predicting the segregating xylem proteome from a backcross population of hybrid eucalypts using next generation RNA sequencing transcriptome data
Advisor: AA Myburg

Rynhard Smit
Characterization of genetic diversity in moringa using molecular markers
Advisor: J Vorster

Katie Termer
Resource quality from the perspective of Sirex larvae
Advisors: J Garnas & B Hurley

Annie Thomas
Impact of genetically modified plants on the South African flora
Advisors: K Kunert

Sophia van Coller
Study of mutation rates in *Fusarium circinatum*
Advisors: ET Steenkamp & BD Wingfield
Advisors: K Kunert & AJ Buys

Ariska van der Nest
Comparative study on *Phoma sorghina* associated with indigenous trees and commercially produced food crops
Advisors: GJ Marais & ET Steenkamp

Burger van Jaarsveld
A comparative analysis of RNA-Seq. and DArT-Seq. data for SNP discovery in *Eucalyptus grandis*
Advisor: AA Myburg

Ida van Jaarsveld
De novo discovery of cis-regulatory motifs and modules which are implicated in the transcriptional regulation of genes associated with secondary cell wall formation and cellulose biosynthesis in *Eucalyptus grandis*
Advisor: AA Myburg

Stefan van Wyk
Cystatin mutation for improved activity
Advisor: K Kunert

Ronel Viljoen
Candidatus Liberibacters found in four indigenous Rutaceous species from South Africa
Advisors: G Pietersen & ET Steenkamp

Helen Walsh
Rapid detection of Grapevine Leafroll-associated virus Type 3 using the reverse transcription loop-mediatedamplification method
Advisor: G Pietersen

Febé Wilken
Transcript profiling of the compatible interaction between *Eucalyptus* and *Phytophthora cinnamomi*
Advisors: S Naidoo, AA Myburg, DK Berger & N van den Berg

Amy Wooding
Reproduction and transmission in the *Sirex-Amylostereum* symbiosis
Advisors: MJ Wingfield, B Hurley & B Slippers

Oliver Zablocki
Development and application of Illumina sequencing protocols for Citrus Tristeza virus population studies
Advisor: G Pietersen

4TH YEAR AND HONOURS STUDENTS

Stefan Bam (2011)
Arista Fourie (2011)
Danielle Roodt (2011)
Pooja Singh (2011)
Brigitte Lombard (2011)
Elrea Appelgryn (2011)
Andrew dos Santos (2011)
Cornell Kortenhoven (2011)
Rofhiwa Nesamari (2011)
Vanessa Cronje (2011)
Teboho Letsoalo (2011)
Elrea Appelgryn (2011)
Jacolene Lubbe (2011)
Megan Calvert (2012)
Kudzai Chikwamba (2012)
Sylvia Phokane (2012)
Thintswalo Maluleke (2012)
Malegola Mohlala (2012)
Roux-Le Botha (2012)
PG Erasmus (2012)
Savo Smocilac (2012)
Vimbai Siziba (2012)

STUDENT ASSISTANTS

Bongani Qekwana (2009-2011)
Anna-Mari Kok (2011)
Izaan van der Merwe (2011)
PG Erasmus (2011)
Tintswalo Maluleke (2011)
Danika dos Santos (2011, 2012)
Boitumelo Ntlatleng (2012)
Koketso Setshedi (2012)
Phiwokuhle Mamba (2012)
Tiny Ntsae Monageng (2012)
Gerhard van der Walt (2012)

CTHB MENTORSHIP STUDENTS

Angelique du Preez (2011, 2012)
Mariette Ferreira (2011, 2012)
Tanweer Mahomed (2011)
Thato Mohajanea (2011)
Danielle Roodt (2011)
Wilke Strasheim (2011)
Annika Theron (2011)
Estine Theron (2011)
Shaun van der Walt (2011)
Brigitte van Dyk (2011)
Mia Kruger (2011)
Colan Balkwill (2011, 2012)
Ethan Besaans (2011)
Robynne Clark (2011)
Thoko Mhlambi (2011)
Samila Ramscharither (2011, 2012)
Michael Reich (2011)
Mohamed Seedat (2011, 2012)
Omphile Sehoole (2011, 2012)
Andrea Wilson (2011, 2012)
Juanita Avontuur (2012)
Trevor Burger (2012)
Lisa Boerstra (2012)
Yves du Toit (2012)
Lynette Herbst (2012)
Andrea Jansen van Vuuren (2012)
Maren Kruger (2012)
Douglas Martin (2012)
Khotso Mokhele (2012)
Lara Nicolson (2012)
Koketso Setshedi (2012)

FACULTY MENTORSHIP STUDENTS

Deon de Jager (2011)
Faith Kavishe (2011)
Saranya Naidoo (2011)
Naadhira Omar Ismail (2011)
Andy Wilson (2011)
Annelize Pienaar (2012)
Mamni Thandekile (2012)
Bianca Janse van Rensburg (2012)
Marius Laubscher (2012)
Megan Harris (2012)

Ph.D. GRADUATES

Wubetu Bihon (2011)
Understanding the global population genetics of *Diplodia pinea* and its life cycle in plantation pines
Advisors: BD Wingfield, B Slippers, MJ Wingfield & T Burgess

Shuaifei Chen (2011)
Fungal diseases of eucalypts in China
Advisors: XD Zhou, MJ Wingfield, J Roux & Y Xie

Maria-Noel Cortinas (2011)
Taxonomy and population genetics of *Kirramyces* spp. causing stem cankers on Eucalyptus trees
Advisors: BD Wingfield & MJ Wingfield

Pieter de Maayer (2011)
Genome comparison to identify selected pathogenicity factors of a plant-associated *Pantoea ananatis* strain
Advisors: TA Coutinho, SN Venter & P Birch

Charles Hefer (2011)
De novo assembly and analysis of the expressed gene catelog of a fast-growing *Eucalyptus* hybrid tree
Advisors: F Joubert & AA Myburg

Adriaana Jacobs (2011)
Taxonomy of species within the *Gibberella fujikuroi* complex
Advisors: TA Coutinho, BD Wingfield, MJ Wingfield & WFO Marasas

Gilbert Kamgan Nkuekam (2011)
Ophiostomatoid fungi and their insect associates on *Eucalyptus* trees in Australia and South Africa
Advisors: J Roux & MJ Wingfield

Alejandro-Guillermo Perez-Suarez (2011)
Global genetic diversity of the *Eucalyptus* leaf pathogen *Teratosphaeria nubilosa* species complex in native forests and commercial plantations
Advisors: MJ Wingfield, B Slippers & BD Wingfield

Dirk Swanevelder (2011)
Aphid-plant interactions and the possible role of an endosymbiont in aphid biotype development
Advisors: A-M Oberholster & E Venter

Magriet van der Nest (2011)
Mycelial compatibility in *Amylostereum areolatum*
Advisors: BD Wingfield, B Slippers, J Stenlid & MJ Wingfield

Rosita Yogco (2011)
Functional characterization of two NPRI genes
Advisors: KJ Kunert & R Chikwamba

Ali Al'Adawi (2012)
Studies on *Ceratocystis* spp. associated with mango die-back in Oman
Advisors: MJ Wingfield, M Deadman & BD Wingfield

Wilhelm de Beer (2012)
The occurrence of Ophiostomatoid fungi in wood and wood products in South Africa
Advisor: MJ Wingfield

Lieschen de Vos (2012)
Characterization of the *Fusarium circinatum* genome
Advisors: BD Wingfield, MJ Wingfield & AA Myburg

Inge Gazendam (2012)
Identification and functional evaluation of a drought-induced "late embryogenesis abundant" gene from cowpea plants
Advisors: DK Berger & D Oelofse

Endale Gebre Kedisso (2012)
Manipulation of gibberellin biosynthesis for the control of plant height in Eragrostis tef for lodging resistance
Advisors: KJ Kunert, U Schlüter & BJ Vorster

Glen Mitchell (2012)
Tolerance and susceptibility of Pinus species to *Fusarium circinatum*
Advisors: TA Coutinho, ET Steenkamp & MJ Wingfield

Elizabeth Ngadze (2012)
Studies on *Ralstonia solanacearum* of potatoes in Zimbabwe
Advisors: J van der Waals & TA Coutinho

David Talengera (2012)
Effect of over-expresion of *CyclinD2,1*-type genes on growth and development of banana plants
Advisors: KJ Kunert & GTS Beemster

Albé van der Merwe (2012)
Phylogeography and population biology of *Chrysoporthe austroafricana* and allied species
Advisors: BD Wingfield, ET Steenkamp & MJ Wingfield

Berhanu Amsalu Fenta (2013)
Investigatrion of the physiological responses in soybean and common beans to water deficit
Advisors: KJ Kunert & SE Beebe

Anand Kullan (2013)
Genetic mapping of wood property and growth traits in interspecific hybrid progeny of *Eucalyptus* tree species
Advisors: AA Myburg & R Vaillancourt

M.Sc. GRADUATES

Therese de Castro (2011)
Investigating the role of the candidate defense response gene peroxidase 34 in defense against *Ralstonia solanacearum*
Advisors: S Naidoo & AA Myburg

Lise-Danielle de Wet (2011)
Population dynamics of *Fusarium circinatum* in the pine nursery environment
Advisors: ET Steenkamp, BD Wingfield, MJ Wingfield & N Jones

Simon Martin *cum laude* (2011)
Mating type and pheromone genes in the *Gibberella fujikuroi* species complex: an evolutionary perspective
Advisors: BD Wingfield, MJ Wingfield & ET Steenkamp

Osmond Mlonyeni *cum laude* **(2011)**
High throughput development of population genetic markers for the *Sirex noctilio* woodwasp and its nematode parasite, *Deladenus siricidicola*
Advisors: B Slippers, BD Wingfield & MJ Wingfield

Bernice Porter (2011)
Pathogenicity and competition studies on *Fusarium circinatum*, a pathogen of pine trees
Advisors: TA Coutinho & MJ Wingfield

David Read (2011)
Citrus tristeza virus populations in grapefruit trees, pre-immunized with two different cross-protecting sources
Advisor: G Pietersen

Irene Schoeman (2011)
Evaluation of two viral vectors for virus-induced gene silencing in pearl millet
Advisors: DK Berger & I Hein

Corne Schriek (2011)
Development of a bioinformatics resource for the analysis and management of marker genotyping data
Advisors: F Joubert & AA Myburg

Janine Silberbauer *cum laude* (2011)
Deep digital gene expression profiling during early and late tension wood induction in *Eucalyptus* trees
Advisors: AA Myburg, DK Berger & F Joubert

Liesl van der Linden *cum laude* (2011)
Genetic studies of bacterial wilt disease resistance in *Arabidopsis thaliana*
Advisors: DK Berger & S Naidoo

Stefan van Wyk *cum laude* (2011)
Improving the inhibitory potency of papaya cystatin using site-directed mutagenesis
Advisors: KJ Kunert, U Schlüter & BJ Vorster

Erika Viljoen (2011)
Morphology and genetic relationships in members of the *Solanum nigrum* L. complex used for jam producton in the Highveld of Southern Africa
Advisors: DK Berger & AE van Wyk

Tania Weller (2011)
Identification and characterization of pili (fimbriae) mediating attachment of *Pantoea ananatis* to *Eucalyptus* leaf surfaces
Advisors: J Theron, TA Coutinho & I Toth

Chrizelle Beukes *cum laude* (2012)
Isolation, identification and characterization of the root nodule bacteria associated with *Pterocarpus* and *Hypocalyptus* species
Advisors: ET Steenkamp, SN Venter & I Law

Gabrielle Carstensen *cum laude* (2012)
Identification of bacteria causing leaf nodules in *Pavetta* spp.
Advisors: TA Coutinho & SN Venter

Annie Chan (2012)
Assembly of the *Pantoea ananatis* genome and confirmation of metabolic pathways
Advisors: SN Venter & TA Coutinho

Barry Christie (2012)
Understanding root rot resistance in avocados
Advisors: N van den Berg, TAS Aveling & K Pegg

Juanita Engelbrecht *cum laude* (2012)
Isolation of defense genes from the superior 0.09 rootstock in response to *Phytophthora cinnamomi*
Advisors: N van den Berg & AA Myburg

Katrin Fitza (2012)
Molecular basis of induced resistance in *Pinus patula*
Advisors: S Naidoo, AA Myburg & ET Steenkamp

Dina Gomez (2012)
Ophiostomatoid fungi from bark beetles in China with special reference to species with *Leptographium* and *Pesotum anamorphs*
Advisors: XD Zhou, K Jacobs & MJ Wingfield

Waheed Mahomed *cum laude* (2012)
High throughput EST sequencing of defense related genes from avocado in response to *Phytophthora cinnamomi*
Advisors: N van den Berg & B Crampton

Angelica Marsberg (2012)
Diversity and distribution of fungal endophytes associated with native *Syzygium cordatum* in South Africa
Advisors: M Gryzenhout, B Slippers & MJ Wingfield

Johnny Masangwa (2012)
The effect of plant extracts on anthracnose of *Phaseolus vulgaris* and *Vigna unguicilata*
Advisors: TAS Aveling & Q Kritzinger

Phasha Mmatshepho (2012)
Characterization of introns in *Fusarium circinatum*
Advisors: ET Steenkamp, BD Wingfield & MPA Coetzee

Lunghile Mthombeni (2012)
Characterization of *Burkholderia* species associated with the root nodules of legumes indigenous to South Africa
Advisors: ET Steenkamp & SN Venter

Ronishree Naidoo *cum laude* (2012)
Gene expression profiling of a *Eucalyptus* hybrid challenged with *Ralstonia solanacearum*
Advisors: S Naidoo, AA Myburg & DK Berger

Mulalo Nemutanzhela (2012)
Establishment of an efficient in vitro micropropagation protocol for *Hoodia gordonii*
Advisors: S Naidoo, RK Chikwamba & BG Crampton

Kerry-Anne Pillay (2012)
Diversity of endophytic fungi of *Eucalyptus*
Advisors: B Slippers, M Gryzenhout & MJ Wingfield

Priyen Pillay (2012)
The influence of cystatins on the expression of FMD VP1 protein expression in different cellular compartments of tobacco
Advisors: K Kunert, R Chikwamba & U Schlüter

Jamie-Lee Sauer Moss (2012)
The subcellular localization of *Eucalyptus grandis* sucrose synthase (*SUSY*) proteins expressed in *Arabidopsis thaliana*
Advisors: AA Myburg, DK Berger & S Naidoo

Melissa Simpson *cum laude* (2012)
Characterization of microsatellites in *Ceratocystis fimbriata*
Advisors: BD Wingfield, MJ Wingfield, MPA Coetzee & M Wilkin

Ancel Stewart (2012)
Enterobacteriaceae endophytes in healthy *Eucalyptus* leaves
Advisors: SN Venter & TA Coutinho

Renaan Thompson (2012)
Detection of *Fusarium* species on maize seed
Advisor: TAS Aveling

Johan van der Linde *cum laude* (2012)
Factors associated with decline of *Euphorbia ingens* in the Limpopo Province, South Africa
Advisors: J Roux, D Six & MJ Wingfield

Marcele Vermeulen *cum laude* (2012)
Ecology and distribution of Cryphonectriaceae in southern Africa
Advisors: J Roux, M Gryzenhout & MJ Wingfield

Godfrey Kgatle (2013)
Pathogenic seed-borne, small-spored *Alternaria* spp. on sunflower (*Helianthus annuus* L.)
Advisors: TAS Aveling & JE van der Waals

Tsholofela Kibido (2013)
Protection of recombinant glutathione reductase by oryzacystatin-I in transgenic tobacco
Advisors: KJ Kunert & BJ Vorster

Gugulethu Kubheka (2013)
Colonisation patterns of *Pectobacterium carotovorum* subsp. *brasiliensis* in potato plants
Advisors: L Moleleki & TA Coutinho

Alinke Labuschagne (2013)
Efficacy and crop tolerance of Stamina (pyraclostrobin) and Flite (triciconazole) seed treatment formulations against *Fusarium, Pythium* and *Rhizoctonia* soilborne diseases of maize
Advisors: TAS Aveling & JE van der Waals

Valery Moloto (2013)
Characterisation of *Agrobacterium* spp. in South Africa
Advisors: TA Coutinho & T Goszczynska

Jan Nagel *cum laude* (2013)
Phytophthora species in South Africa
Advisors: B Slippers, M Gryzenhout & MJ Wingfield

Edward Onkendi (2013)
Molecular characterization of *Meloidogyne* spp. infecting potato in South Africa
Advisor: L Moleleki

Siphathele Sibanda *cum laude* (2013)
The role of quorum sensing in *Pantoea ananatis*
Advisors: TA Coutinho & J Theron

PRESTIGIOUS NRF BURSARY HOLDERS

Nicky Creux
Steven Hussey
Kershney Naidoo
Rene Sutherland
Marelize van Wyk

NRF SCARCE SKILLS/INNOVATION SCHOLARSHIPS

Gerda Fourie (2009-2011)
Steven Hussey (2011-2013)
Nicky Creux (2011-2013)
Ritesh Mewalal (2011-2013)
Gabrielle Carstensen (2012-2014)
Barend Jansen van Vuuren (2012)
Anandi Reitmann (2011-2012)
Elrea Appelgryn (2011-2012)
Vanessa Cronje (2011-2012)
Nelly Khumalo (2011-2012)
Robert Backer (2013-2014)
Waheed Mohammed (2012-2013)
Bianca Farrow (2013)

MANDELA-RHODES SCHOLARSHIPS

Steven Hussey
Osmond Mlonyeni
Mmatshepho Phasha

OTHER SCHOLARSHIPS

Charline Kamburona (DAAD, TUCSAN Scholarship)
Eugenia Itumeleng Kgang (ARC and NRF Equity Scholarship)
Endale Gebre, Ethiopian Institute of Agricultural Research (EIAR)
Berhanu Fenta, International Center for Tropical Agriculture (CIAT)
Juanita Engelbrecht, Hans Merensky Foundation
Christina Selowa, Thuthuka Women in Science (2012)
Brittany Mitchell, Hans Merensky Foundation
Nelly Khumalo, Hans Merensky Foundation
Waheed Mohammed, Hans Merensky Foundation

CTHB BURSARY HOLDERS

B.Sc. honours

Jon Ambler (2011)
Elrea Appelgryn (2011)
Bodiba Molebogeng (2011)
Marike du Plessis (2011)
Elodie Ekokan Etouman (2011)
Teboho Letsoale (2011)
Olwethu Ndyoko (2011)
Rofhiwa Nesamari (2011)
Rachida Said (2011)
Karabe Sereme (2011)
Jeanne van Rensburg (2011)
Kerryn-Leigh Scheepers (2012)
Juanita Avontuur (2013)
Angelique du Preez (2013)
Vusi Letsoalo (2013)
Palesa Madupe (2013)
Dineo Moswathupa (2013)
Yolanda Musasira (2013)
Jacques Potgieter (2013)
Kavani Sanasi (2013)

M.Sc.

Jean Hakizimana (2011-2012)
Angelica Marsberg (2011-2012)
Ronel Viljoen (2011-2012)
Francois Boshoff (2012)
Vanessa Cronje (2012-2013)
Darryl Herron (2011-2013)
Zander Human (2011-2013)
Tebogo Letsoale (2012-2013)
Lunghile Mthombeni (2012)
Linda Ndlove (2011-2013)
Karabe Sereme (2012-2013)
Ariska van der Nest (2011-2013)

Ph.D.

Chrizelle Beukes (2012-2013)
Annie Chan (2012-2013)
Elsie Cruywagon (2011-2013)
Tuan Duong Anh (2011-2013)
Gerda Fourie (2011-2013)
Fahimeh Jami (2011-2013)
Michael Mbenoun (2011-2013)
Quentin Santana (2011-2013)
Divine Shyntum (2011-2013)

Postdoctoral fellowship

ShuaFei Chen (2011-2012)
Gilbert Kamgan Nkuekan (2013)

MANAGEMENT

MANAGEMENT COMMITTEE

Prof. D Berger
Prof. TA Coutinho
Prof. J Roux
Prof. K Kunert
Prof. AA Myburg
Prof. B Slippers
Prof. MJ Wingfield (Chairman)

Assoc. Prof. TAS Aveling
Assoc. Prof. ET Steenkamp
Extraordinary Prof. G Pietersen

Dr. M Coetzee
Dr. B Crampton
Dr. ZW de Beer
Dr. J Garnas
Dr. B Hurley
Dr. L Moleleki
Dr. S Naidoo
Dr. N van den Berg
Dr. A van der Merwe
Dr. J Vorster
Markus Wilken (Post-graduate student representative 2011)
Waheed Mahomed (Post-graduate student representative 2012)

ADVISORY COMMITTEE

Prof. A Ströh (Chairman), Dean of the Faculty of Natural and Agricultural Sciences
Prof. P Bloomer, Head of the Dept of Genetics
Prof. SN Venter, Head of the Dept of Microbiology & Plant Pathology
Prof. D Meyer, Head of the Dept of Biochemistry
Prof. M Meyer, Head of the Dept of Plant Science
Prof. C Annandale, Head of the Dept of Plant Production
Prof. C Chimimba, Head of the Dept of Zoology & Entomology
Prof. P Chirwa, Forestry School
Prof. CL Machethe, Post-graduate School of Agriculture and Rural Development
Prof. D. Cowan, Director Genomics Research Institute
Prof. BD Wingfield, Deputy Dean of NAS
Prof. MJ Wingfield, Director of FABI

SOME SOCIAL HIGHLIGHTS IN FABI

Annual SPOOF meeting*

**Society for the Publication Of Outrageous Findings*

THEME: OUT OF AFRICA (2011)

Fahimeh Jami, Tanya Joffe, Kerry-Anne Pillay, and Terence Scott

Pedro Romon and Gracie Romon

Jenny Hale and Heidi Fysch

Marike du Plessis, Vanessa Cronje, Janneka Grove, and their partners

Francois Boshoff and Markus Wilkin

Jan Nagel and Waheed Mahomed

THEME: INTERNATIONAL TRAVEL (2012)

Zander Human and partner

Elrea Appelgryn and Arista Fourie

Nicole Wright, Fahimeh Jami, Ariska van der Nest, Milica Zlatkovic, Katie Termer

Degracious Kgoale, her partner, Jean Korsman, Bridget Crampton, Jane Bredenkamp

John Brantberg and Jeff Garnas

Katie Termer, Fahimeh Jami, Milici Zlatkovic and Nicole Andree

YEAR-END FUNCTION 2011

Kevin Barnes, Irene Barnes, Alisa Postma and Werner Botha

Anandi Reitman, Elrea Appelgryn, Renier Lourens, Barend Jansen van Vuuren, Juanita Engelbrecht, Bianca Reeksting, Rene Sutherland, Christina Selowa, Tuan Duong, Grieta Mahlangu, Noelani van den Berg, Mariette Ferreira and Sitha Ramsuchit

Front: Janneka Grove, Marike du Plessis, Vanessa Cronje, Jackie Lubbe and partners
Back: Ernie Aylnard, Vemon Palmer, Etienne Pienaar, Pieter Kleynhans

Front: Lerato Mokola, Dragracious Kgoale, Monique Heystek, Jane Bredenkamp
Back: Botselo Petswalo, Lebogang Maphokoene, Jan du Plessis

YEAR-END FUNCTION 2012

Pieter Kleynhans, Jackie Lubbe, Martin Roberts and Ronel Viljoen

Steven Hussey, Pooja Singh, Desre Pinard, Erik Visser, and partners

Tania Weller-Stewart and Noelani van den Berg

Nkhululi Maphasa, Milica Ztatkovic, Seonju Marinconitz, Luke Jumi, Fahimeh Jami, Stephanie Slinski, Lydia Twala

Helen Doman, Madelein van Heerden, Maretha van der Merwe, Heidi Fysch

Michael Peter, Ronel Stroh, Prof Anton Stroh, Di Edwards, Tanja Peter, Mike Edwards

COMMUNITY INITIATIVES

COMMUNITY PROJECT 2011

On a cold, wet morning on Wednesday the 6th of December 2011, a group of approximately 20 FABIANS set off to bring a little Christmas cheer to a group of children who desperately needed it. Arriving at the still empty community centre in place, we drove around for about half an hour collecting the children that were making their way towards the party so that they wouldn't have to walk in the rain. Approximately 40 children between the ages of 4 and 12 attended the party which was started off with sweets, chips, cupcakes and colouring-in. While the men prepared the hot dog rolls for lunch, the rest of us practised our art skills in the field of face painting. While we were somewhat embarrassed by our attempts, the children were delighted that they now looked like Spidermen, tigers and butterflies. Once everyone was fed and painted, all the children assembled in the school classroom and personal gifts were handed to every child by our very own jolly Santa (Barend). Happy and tired, the children headed home soon afterwards. FABI also donated enough money to the community centre to enable them to provide each Grade 1 learner with the needed stationery pack required by the school for the academic year of 2012.

COMMUNITY PROJECT 2012

On the 5th of December 2012 a group of FABIANS visited a community vegetable garden in Soshanguve. Brightly coloured T-shirts handed out to community children and FABIANS displayed the goal for the day: "FABI - Keeping kids happy". This was not difficult to achieve as the handing out of lucky packets and sweets soon had the children smiling from ear to ear. Then it was the children's turn to impress FABI with their knowledge of vegetable farming. The garden was established by Nutri-Kids, a non-profit organisation with the main objective of establishing a community-based programme where the emphasis is on poverty alleviation, income generation and sustainability through vegetable gardening. Community leaders are responsible for the maintenance of the garden and they make sure that the children of the community are involved every step of the way. Questions such as what role bees play in the garden, why compost is important and the identities of different crop plants were answered very enthusiastically by the children.

The children were completely caught by surprise as Santa Claus suddenly appeared from nowhere carrying a huge bag of presents! Every child had his name read out and, with a hug from Santa, received a goodie bag filled with treats such as colouring books, soccer balls, stationery, jewellery and toy cars. Hot dogs were served for lunch and were followed by some fun activities such as face painting and making "grasshead men". The day was ended by Elizabeth, a community leader, thanking FABI on behalf of the community for making the day so special for the children. She said that most of the children have never received a gift before this day and she emphasised the role of agriculture in community upliftment and the fighting of poverty.

BLANKET DRIVE 2011/2012

As winter crept up on us, FABIANS opened their hearts to those who feel the cold more bitterly than we do. From the 1st of May we started collecting blankets and clothing and by mid-June we had approximately 150 blankets and 2 bags of clothing to donate to those less fortunate than ourselves. We donated the blankets and clothing to Bryanston Bible Church, who distributed it to homeless people living on the streets of Hillbrow.

MENTORING AND OUTREACH ACTIVITIES BY THE CTHB

Although the CTHB is involved mainly with postgraduate training and research, the importance of supporting and being involved in outreach programmes at all levels of the education chain is fully appreciated. The CTHB is therefore actively involved in communicating the importance of science to learners at school level. Since 2005 the Centre has been involved with initiatives such as the CTHB Mentorship Programme, "UP with Science" programme, the National Science Week, Scifest, visits to local schools, visits by school children to FABI and other SAASTA (South African Agency for Science and Technology Advancement) initiatives. The activities and successes of the CTHB in these areas since 2009 are outlined below.

MYRE Group 2012

Undergraduate Mentorship Programme

The CTHB mentorship programme specifically targets undergraduate students who have the potential to follow long-term careers in science. The objective of this program is to expose undergraduate students to a strong culture of Science in a programme that is internationally recognised. In this way these students are encouraged to undertake postgraduate studies and a career in science.

Overall the program has been highly effective in terms of encouraging students to progress to Honours, MSc, PhD and Post-doctoral studies. In 2011, 20 students (11 2nd years and 9 3rd years) under the supervision of 21 mentors were chosen. Of these, one continued studies in Veterinary Science, one enrolled for engineering and three continued to do honours. In 2012, 20 undergraduate students under the supervision of 20 postgraduate mentors took part in the programme.

The CTHB monitors the progress and career paths followed by students that participated in the mentoring program. Of the 97 mentorship students supported since 2005, one accepted a postdoctoral position at Oxford University, three continued their PhD studies in the UK, one had a postgraduate fellowship at Yale University, six registered for their PhD studies in SA and 20 either registered for or completed their MSc degrees.

In addition to inspiring and informing the undergraduate student body, the Mentorship Programme is beneficial to postgraduate students. Having the responsibility to mentor another younger and less experienced student is considered to be an important learning experience and skill that needs to be developed in the career of any postgraduate student. Senior postgraduate students in the CTHB Mentorship Programme have been allowed to guide younger students in terms of mentorship. A biannual assessment is done to evaluate the progress of the students and mentors and thus the success of the CTHB Mentorship Programme. As this is the ninth year of the initiative, it remains important to monitor it closely to understand the dynamics and thus also to continually improve the quality of mentorship.

UP with Science Programme

The University of Pretoria runs a programme designed to actively engage students in the City of Tshwane Municipality. This programme is known as "UP with Science" and is managed by the University of Pretoria Science Centre (http://www.upwithscience.up.ac.za/). The CTHB participates annually in this programme. The Grade 10 learners have a day long programme where they are exposed to a number of molecular genetic techniques and they also participate in some "hands on" Genetics tutorials. In Grade 11, the learners choose a project within the different programmes at the University of Pretoria. The projects offered by the CTHB have been very popular every year and the learners enjoy using the sophisticated equipment available in a research laboratory to generate their scientific data. They also learn how to analyse and present the data in a scientific manner. Many of these projects have been sufficiently impressive to be included in the ESKOM Regional Finals of the National Expo for Young Scientists and in some cases the learners have won medals for their efforts.

The following UP with Science projects were managed by postgraduate students of the CTHB:

2011: *Postgraduate students involved*: Markus Wilken, Melissa Simpson, and Tracy Hall

Project: "Mushroom diversity in botanical gardens" – identification of mushrooms collected in Pretoria Botanical Gardens using DNA based identification methods.

2012: *Postgraduate students involved*: Tracy Hall, Barend Jansen van Vuuren, Melissa Simpson and Markus Wilken

Project: "Microbial CSI: Bacteria versus Fungi" – project aimed at understanding fungal and bacterial diversity in food products and the effect of these organism in the rotting process of food, such as hamburger patties and yoghurt

CTHB Mentors

MRYE (Mpepu Rural Youth Encouragement) Outreach Programme

The CTHB has supported the MRYE outreach initiative since 2005. MRYE was initiated by a group of inspired 3rd and 4th year students at the University of Pretoria, all of whom come from disadvantaged rural backgrounds and were aware of the problems of poverty, poor education and deprivation facing these learners in the rural areas. The group's mission is to spread the message that education provides the key to enable hard-working learners to rise above their personal situations.

Fahimeh Mamelodi trip

The mission set by MRYE is achieved by visiting schools in rural areas during the University's recess. During these visits the MRYE group informs Grade 10, 11 and 12 learners, in particular, of subjects that should be included in their matriculation curriculum to enable them to study for certain careers. They also present literature and documentation from FET and HEIs and other training institutions including the University of Pretoria. They also inform these learners about the availability of bursaries and loans. After the acceptance of these students to the University, the MRYE group provides the new 1st years students with mentorship.

What is very special about the MRYE programme is that it is run by the students who are incredibly passionate about both their studies and enabling others to follow them in undertaking careers in education, science, commerce and engineering. The response from the schools to this programme has been enthusiastic with many rural schools requesting annual visits. The MRYE "alumni" continue to spread the message.

Scifest and the National Science Week participation by CTHB

The CTHB has been actively involved in Science awareness activities hosted both by SAASTA and by the DST and NRF. In 2011 and 2012 the CTHB participated in the National Science Week activities at the Mondi Science Centre in Piet Retief. During the week, talks and experiments were presented that were aimed at educating school learners about the wonders of Science. These presentations were appreciated not only by learners, but also by the educators as they often asked for the "recipe" of the experiments using simple household ingredients to teach the basic principles of chemistry and physics in a lively, interesting and fun way to the learners.

OTHER INITIATIVES TO PROMOTE SCIENCE AWARENESS

Exhibitions

The CTHB is regularly invited to exhibit the research of the programme at official functions. Early in 2011, a group of CTHB students exhibited at the DST/NRF CoE Annual day held at UCT and had the opportunity to interact with the Minister of DST, Naledi Pandor. In October 2011, the joint TPCP-CTHB programme was represented at the DTI's annual Technology two day Exhibition that was attended by between 400 and 500 learners from local schools with the purpose of encouraging them to pursue careers in science, engineering and technology. The exhibition culminated in an awards ceremony for three DTI technology programmes. The TPCP/CTHB was the winner of the THRIP award for "Human Resource Development – quantity and quality of students". In November 2012, the CTHB hosted the DST-NRF annual CoE day at the University of Pretoria where the CTHB and other CoEs prepared another eye-catching exhibition for the target audience made up of the other CoEs, industry, academia and government.

UP with science 2011

School visits and community engagement

The CTHB student body is actively involved in community engagement. In 2011, a team of CTHB students visited the Glen High School where they presented talks on Science and Technology to Grade 12 learners and used "DIY" DNA isolations experiments to explain the chemical and genetic principles surrounding the DNA-based technologies. The CTHB will continue with its endeavours in this direction.

MRYE at school

SPONSORS OF RESEARCH

Many of these commercial companies or organisations fund more than one programme in FABI:

ACIAR (Australia)
Agropolis Advanced Research Platform (France)
Amathole Forestry
Banana Growers Association of South Africa
BASF
BAYER
Belgium Embassy
BIOPAD
Capepine (Pty) Ltd
China/South African Governments Bilateral Agreement
Chinese Academy of Forestry
CIRAD
Citrus Growers Association
Citrus Research International
CGIAR Generation Challenge Programme
CNRS/South African Government Agreement
CSIR
DFG (Deutche Forshungs-Gemeinschaft: German Research Foundation)
Department of Agriculture, Forestry and Fisheries (DAFF)
Department of Trade and Industry through THRIP initiative
Department of Science and Technology through the Innovation Fund and CTHB
Department of Science and Technology
Du Roi QMS
EARO (Ethiopia)
European Union 6th Framework Agreement
Forestry South Africa
Hans Merensky Holdings
Hans Merensky Foundation
Innovation Fund
International Institute of Tropical Agriculture (IITA)
Italian/South African Governments Bilateral Agreement
IRT Genomics, University of Pretoria
Japanese/South African Governments Bilateral Agreement
Loskop Irrigation Board
Maize Trust
Mellon Foundation
Ministry of Education (China)
Ministry of Finance (China)
Ministry of Science and Technology (China)
Mondi
National Bioinformatics Network
National Natural Science Foundation (China)
National Research Foundation (NRF)
NCT
Norway/South Africa Governments Bilateral Agreement
Oppenheimer Foundation
Pannar
PG Bison
Protein Research Foundation
Rockefeller Foundation
SABI
SAFCOL/Komatiland Forestry
Sappi
SIDA/South African Governments Bilateral Agreement
South Africa/Argentina Governments Bilateral Agreement
Syngenta South Africa
Tanzanian Government
Thuthuka
Technology Innovation Agency
Tuscan Namibia/DAAD (Germany)
TWK
UP Research Development Fund
Water Research Commission
Winetech
Wheat Cereal Trust
York Timbers

Forestry &
Agricultural
Biotechnology
Institute