FORESTRY AND AGRICULTURAL BIOTECHNOLOGY INSTITUTE








FABI

FUTURE FORESTS AND FOOD

BIENNIAL REPORT 2007/2008

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 University in South Africa, provides access to a wide range of human and technological resources. Currently, academic staff and postgraduate students from research programmes in the Departments of Biochemistry, Plant Science, Genetics, Microbiology and Plant Pathology, Zoology and Entomology and Plant Production 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 sixth FABI biennial report covering the period from May 2007 to May 2009.

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Forestry and Agricultural Biotechnology Institute
FUTURE FORESTS and FOOD

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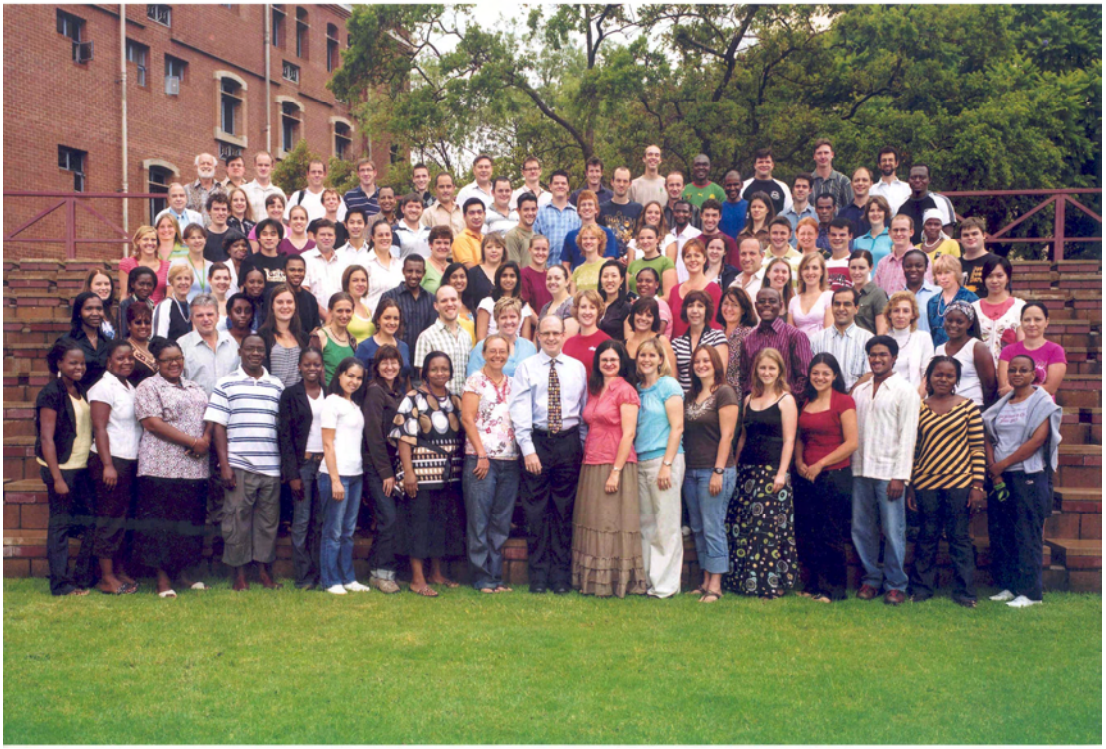
FABI TEAM

This photograph includes those members of the team available on 19/01/2009.



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Grieta Mahlangu, Kershney Naidoo, Karl Kunert, Olga Makhari, Erika v/d Walt, Rene Sutherland, Febe Wilken, Juan Vorster, Vivienne Clarence, Juanita Engelbrecht, Rose Visser, Helen Doman, Anna-Maria Oberholster, Michael Mbenoun, Mahdi Ziaratnia, Eva Muller, Rosita Endah, Magriet v/d Nest.

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7th Row
Stefan Neser, Nicky Olivier, Brett Hurley, Martin Ranik, Michael Fischer, Steven Hussey, Gert Marais, Hardus Hatting, Barry Christie, James Mehl, Didier Begoude, Zander Myburg, Ronald Heath Dave Berger.

DIRECTOR'S REPORT

This issue of the Biennial Report of FABI might well be considered our Birthday Issue. I say this because FABI celebrated its 10th Anniversary in 2008. And it was particularly pleasing that we were able to do so in the same year that the University of Pretoria celebrated its 100th Anniversary. So 2008 was an amazing year for us in many ways, especially in allowing the FABI team to reflect on an incredible first ten years. Perhaps more importantly, to also look ahead to our next decade leading the charge to uplift research and education in the broad plant sciences in South Africa and globally.

FABI has achieved so much in little more than ten years that it is difficult to capture the essence of these accomplishments. The Institute began with the core intention of bringing together committed researchers working in the broad field of plant biotechnology and plant health. In effect it provided a voluntary bridge for academics from different departments including Microbiology and Plant Pathology, Zoology and Entomology, Genetics, Biochemistry and Plant Production. The initial group included academics with experience in all of these fields, but all working on forest health related topics. The challenge was to grow the founding core, but also to draw in others interested in being part of a multi-disciplinary team that would benefit from the synergy that can arise when people with different interests come together. And what a success this has been! From a group of about 55 mainly post graduate students, the FABI team has grown to include about 180 academics, post graduate students and a small core of technical and administrative assistants.

Growth in numbers and success are two very different matters. In terms of the former metric, FABI has grown amazingly. We have reached our capacity in terms of the space we occupy. But what of our success in the more important areas of education, research outputs and community services? Here I am happy to report that we have also been enormously successful. In just ten years 117 M.Sc. and 70 Ph.D. students have graduated from projects that form part of FABI. We have produced some 500 publications in ISI listed journals and here we have also worked actively to "lift the bar" and publish in journals of increasingly higher impact. Adding to this, we have consistently grown our external grant support which provides the core funding for all of FABI's research. Very pleasingly, FABI and FABIANS have been the recipients of many awards and accolades such that they are far too numerous to mention in this brief introduction.

In order to appropriately mark the occasion of FABI's tenth anniversary, we held a major colloquium followed by a gala dinner on 14 May 2008 for our stakeholders and colleagues. The focal theme of the colloquium was designed to highlight the activities of the seven Centres of Excellence established by the Department of Science and Technology (DST)/ National Research Foundation (NRF). The choice of this theme emerged from the fact that FABI houses one of these Centres, the DST/NRF Centre of Excellence in Tree Health Biotechnology (CTHB), and that the activities of the CoE's had never previously been presented at a single forum. The fact that the CoE's are led by a cohort of highly recognized scientists made for a fabulous occasion and one that importantly highlighted Science Excellence, which is also the keystone focus of FABI.

As part of the FABI tenth anniversary celebration, the FABIANS produced a fifteen minute long DVD covering highlights of our first ten years. This DVD is available on the FABI Web Site and I hope that you will take the time to see it. Many interesting facts emerged from putting together the DVD and interesting comments made by some of the students were captured for posterity. I rather liked the comment that Prof. Dave Berger made to the effect that "we are currently sequencing our favourite genes but we are rapidly moving to sequencing our favourite genomes". This is so true with various FABI projects now focused on genome sequencing and the genomics that comes with these projects.

One of the great successes of FABI lies in the interdisciplinary nature of the group and the ease with which we are able to interact intellectually. Our students attend seminars that cover an unusually large diversity of topics. This means that techniques and ideas are shared in a seamless fashion and we have truly captured the strength of the so-called "intersections" that Johannsen speaks of in his remarkable book "The Medici Effect". On the FABI DVD, Brenda Wingfield talks of the power of the interdisciplinary team that makes FABI so effective. Many academics now believe that FABI presents an intriguing model that can be used to integrate disciplines at a University without necessarily collapsing departments and core disciplines. I am sure that we will have more to say about this topic in coming years.

In my view, one of the most important pillars of strength of FABI is the multicultural nature of the group. Students at FABI come from many countries of the world and on any one day, 30 or more languages are spoken in the Institute. This integration of the cultures brings tremendous strength through challenging what might be considered the normal boundaries of interaction and also through global networking I again refer to the power of the intersections and how these bring new and innovative thinking and growth.

FABI's tenth year was also the year in which we needed to undergo our second five year review. Such reviews are mandatory at the University of Pretoria and they allow for self analysis and also for benchmarking against like programmes elsewhere in the world. The outcomes of the review were excellent with a strong focus on some of the most important accomplishments of the Institute and its members. But there were also strong recommendations for improvement and these now form the roadmap for the coming five years. Once again, the FABI team came out of its review, mindful of how important external review is to future growth. I say this also recognizing that preparation for such a review requires tremendous effort and it is also humbling to have to receive not only compliments but constructive criticism.

FABI has grown remarkably during the course of its first ten years, and we now look ahead with enthusiasm to further growth in the pursuit of research excellence. Achievements seldom emerge from the achievements of individuals but rather from the efforts of groups of exceptional people. In this regard, FABI also recognizes its stakeholders and sponsors, without whom we would certainly not be able to achieve our many goals. Many thanks to you all!

Mike Wingfield Ph.D. (Minnesota), FRSSA, ASSAf
Mondi Professor of Forest Pathology, Director of FABI, the Tree Protection Co-operative Programme (TPCP) & The DST/NRF Centre of Excellence in Tree Health Biotechnology (CTHB)

RESEARCH REPORTS

Centre for Applied Mycological Studies (CAMS)

Research Leader: Dr Gert Marais

Research Team: Ms Magda Fouché
Ms Babalwa Mbebe
Ms Annelie Lübben

Objectives of the research programme:

- Building collaboration between FABI and CSIR Biosciences
- Promoting mycological research in South Africa
- Exploiting the fungal culture collections of FABI and CSIR for value added products in the agricultural, food, medical and industrial fields
- Understanding the role of fungi and their mycotoxins in food and feed processing in South Africa
- Promoting mycology as a research discipline through education

Highlights of research:

One of the objectives of CAMS is to document South Africa's fungal biodiversity and apply this knowledge to the benefit of the economy of the country. An example of this is the recent licensing of the production of the blue cheese flavour to a company in Stellenbosch. The fungus that is used in this process was isolated in South Africa and originated from a food source in the Northern Cape Province. In a separate project, 280 fungi from the CSIR and FABI culture collections were screened for flavour production. Confirmatory analytical tests on two *Penicillium* species from this collection have shown that they are capable of producing methoxy-pyrazines, which resembles the green pepper flavour. This is the first report that these fungal species have this ability. Recently, 10 new fungal species and a genus of the Botryosphaeriaceae from indigenous *Acacia* trees in southern Africa were found during an MSc study in CAMS. To our knowledge, this is the biggest find of this group of fungi in a single study and on a single plant host, namely, *Acacia mellifera*. This is also further evidence of the richness of the fungal biodiversity in South Africa, which is vastly underexploited to date.

Retted fibre of *Hybiscus cannabinus*

A study on the phylogenetic relatedness of isolates of the fungus, *Phoma sorghina*, has thus far produced startling results, showing that isolates from sorghum and millet, as well as indigenous trees from southern Africa, form a distinct clade when compared to other closely related *Phoma* species. Results also indicated that the ability of this fungus to cause onyalai, a blood disease among certain people in southern Africa, is not conserved in any of the sub-clades among southern African isolates. These findings suggest that *P. sorghina* isolates in southern Africa are not host specific and is likely distributed without any preference between food crops and indigenous plant hosts.

CMW Culture Collection

CAMS has been involved in a project to investigate the migration and distribution of fungi and their mycotoxins in the maize milling system in South Africa. Six of the commercial maize mills have been sampled and the levels of fungi and mycotoxins were monitored from the grain silo to the various fractions such as super maize meal, special maize meal, braaipap, samp, and hominy chop. Results indicated that maize products deriving from the floury endosperm and hull of the maize kernel, such as special maize meal, flour and chop are high risks to contain high levels of fungi and their mycotoxins. It has also been shown that storage fungi increase significantly during the milling process that can have an influence on the shelf life of maize products.

The production of kenaf is done by using the plant, *Hibiscus cannabinus*, and putting the stems through a retting process to separate the fibres. A dry retting process was developed for the kenaf industry in South Africa by using a fungus that was isolated from nature. Results showed that the quality of the retted fibres seems to be the same as obtained elsewhere in the world.

Cereal Genomics
Molecular genetic mechanisms involved in host resistance to pests

Research Leader: Prof AM Botha-Oberholster

Objectives of the research programme:
The research aim is to increase the current understanding of the genetic mechanisms involved in host defence (*Triticum aestivum* L., bread wheat) against *Diuraphis noxia* Mordvilko (Russian wheat aphid, RWA). In the programme we assess the super family of resistance (R) and defence related (DR) gene sequences applicable to insect resistance in wheat. To achieve this we address the following issues:

- Isolate, characterize and study the genes/pathways involved in host resistance.
- Study the evolutionary development of RWA biotypes.
- Development of a marker system for mass screening of breeding material.
- Map selected *Dn* resistance genes with the long-term objective of map-based cloning of these resistance genes.

Highlights of research:
The aim of the project is to provide a DNA-based marker system with high-throughput capabilities; that is background non-specific, "gene" based and trait-linked. We also strive to provide the wheat community with scientific information on the Russian wheat aphid-plant interaction, and Russian wheat aphid biotype differences. In order to achieve these goals we studied the wheat-Russian wheat aphid interaction and Russian wheat aphid biotypes. To date we have identified 280 genes that are important in the cereal host, as well as eliciting agents in the Russian wheat aphid. A complete breakdown in RWA resistance was reported in the USA, and eight new biotypes were identified. A new SA biotype has also been reported for South Africa. Tugela*Dn2* and Gamtoos*Dn7* (cv. 98M370) are reported to be the only resistance lines with some expressed resistance/tolerance to the new RWA US biotypes. However, when screening a total of 71 genotypes, we found that *Dn2* provided only low to intermediate resistance to the South African Mutant biotype (*i.e.* biotype that developed after selection pressure on *Dn1*), whereas resistance against this biotype was still conferred by the *Dn5* and *Dn7* resistance genes. Results indicated that the South African biotypes differ significantly from the US biotypes on genomic and transcript level, although the virulence factors are proteins in both cases. It was also found that these eliciting proteins differ in size and was probably the result of a duplication event. We have also found that *Diuraphis noxia*, unlike some other *Diuraphis* species, contain only one endosymbiont (*Buchnera aphidicola*) and that regulation via a stemloop structure may enable divergence into new biotypes and breakdown in resistance in the field. Results using transcript profiling (i.e. Affymetrix wheat array analyses consisting of 55,000 genes and cDNA-AFLP profiling) showed that the defence responses elicited by the different RWA biotypes are very specific, and that different resistance strategies/defence pathways are used during host defence according to the different *Dn* resistance genes. In our studies, it was found that although the different resistant genes (*i.e. Dn1*, *Dn2*, *Dn5*, *Dn7*) share common pathways, divergent defensive strategies/pathways are also involved. We were able to identify some of the key genes involved in the divergent pathways that are associated with the known respective modes of resistance (*i.e.* antibiosis, antixenosis and tolerance). During 2007/2008 a new technology (*i.e.* viral induced gene silencing, VIGs) has been introduced that enable us to silence genes *in vivo*. To date, we successfully confirmed the involvement of two genes in resistance against the Russian wheat aphid, and thus, we now have a tool to determine whether our previously identified genes are directly or indirectly responsible in conferring resistance to the different RWA biotypes and associated with which of the respective RWA resistance genes (*i.e. Dn1*, *Dn2*, *Dn5* and *Dn7*). If confirmed, these genes can be applied for mass screening of lines with "desirable" agronomic- and –resistance traits. Although we are already able to screen wheat lines using high throughput technology, the costs involved in using our present system are high and thus, our future efforts will be directed at decreasing the cost, while still maintaining the same level of accuracy.

Anna-maria Oberholster-Botha in a Triticale field (left) and a typical wheat field infected with the Russian wheat aphid (right)

DST NRF Centre of Excellence in Tree Heath Biotechnology (CTHB)

Director: Prof Mike Wingfield

Programme manager: Prof Brenda Wingfield

Project leaders: Prof Teresa Coutinho
Prof Pedro Crous
Prof Jolanda Roux
Prof Bernard Slippers
Prof Wally Marasas
Dr Emma Steenkamp
Dr Gert Marais
Mr Brett Hurley

Objectives of the research programme:

The CTHB has a focus on Tree Health and the application of Biotechnology to reduce the impact of pests and diseases that threaten indigenous trees in South Africa.

Highlights of research 2007/2008:

The CTHB has become a fully functional and highly visible Centre of Excellence. This has been achieved through a great deal of effort and realignment of original plans, but it has also been a positive and effective experience. The CTHB now has its full complement of staff. A significant number of students and projects have been identified and established. In forming the CTHB, there has already been an exciting shift in research focus within FABI. This has already resulted in, and it will continue to deliver additional research capacity and knowledge production in the next 5 year term.

Although not initially anticipated, establishment of the CTHB has resulted in a new and unique research initiative in South Africa. With a focus on the health of native trees, an opportunity has arisen not only to consider a biologically important issue, but also to promote a national understanding of microbial biodiversity. This has been an entirely overlooked area, clearly exemplified by the publication of the new Biodiversity Act, which entirely ignored microbes. Students who have been assigned to the CTHB have shown a remarkable excitement for this new venture, which will clearly lead to the education of top class scientists in crucially important areas of science. While the CTHB has emerged as a Centre of Excellence rather different to that initially anticipated, it appears that this new focus is enormously positive.

Boabab tree in Limpopo Province

An unexpected outcome of the development of the CTHB has been the discovery of an unprecedented number of new species of fungi. Having a research focus in previously poorly studied niches we had expected to discover a number of fungi new to science. What has however, been surprising is the large numbers of these previously undescribed fungal species. This serves to highlight the value of these kinds of studies and the fact that Southern Africa has a huge amount of biological diversity much of which has never actually been studied. The opportunities in terms of understanding the biodiversity of these niches in this respect are enormous and the research within the CTHB should be able to take full advantage of these discoveries. A core focus of the CTHB is in education and capacity building for the Science System of South Africa. Very substantial progress has been made in this regard. One of the unique and exciting elements in this regard is the very multi-disciplinary nature of the research that is being conducted by students in the CTHB. The Centre will clearly provide outstanding and well–trained students in many different disciplines relating to biology in the future.

Francois van der Walt in front of a dying camel thorn tree

Knowledge brokering, public engagement and involvement in national issues relating to biological sciences in South Africa represent key areas of activity for the CTHB. Team members are deeply involved in all of these areas, and substantial time is spent extending outputs and expertise of the group to the public as a whole. Involvement in national issues such as those relating to the development of regulations, to govern the movement of Alien Invasive Pathogens, represents key activities. Furthermore, involvement in initiatives to promote science education and research in South Africa, for example through the National Science and Technology forum, are also included in the activities of team members.

The CTHB has been in existence for 5 years. The initial uncertainty and challenges have been overcome and there is a real sense that the Centre is now fully established. Perhaps the best evidence for this is that research outputs from projects initiated with the starting of the Centre are now appearing in the international literature. Students are graduating and the Centre already has a significant national and international footprint.

DST-CTHB Board

Front row left to right: Prof Diana Six (University of Montana, USA), Dr. Eddie Mwenje (National University of Science and Technology, Zimbabwe), Prof Robin Crewe (Vice Principal (Research) UP), Mr. Mike Edwards (Forestry SA) and Ms. Jenny Hale (Administrator, UP)

Back row left to right: Prof Mike Wingfield (Director: CTHB), Mr Joseph Tshikomba (DST), Prof Anton Ströh (Dean: Faculty of Natural and Agricultural Sciences, UP), Prof Brenda Wingfield (Programme Manager: CTHB), Mr. Bheki Hadebe (DST), Mr. Gerald Moolman (NRF) and Coert Geldenhuys (Forestwood CC)

MRYE outreach programme

Two of the five Key Performance Indicators of the DST/NRF Centre of Excellence in Tree Health Biotechnology (CTHB) programme are "knowledge brokerage" and "service rendering". In order to perform in these areas the CTHB has engaged with a variety of student and science outreach groups. In particular the CTHB has supported a special outreach project since late 2005 - the MRYE (Mpepu Rural Youth Encouragement) Outreach Programme.

MYRE group

This initiative was started by a group of inspired and enthusiastic 3rd and 4th year students led by Samukelo Vilakazi 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. This group has grown to include students from the faculties of Natural Sciences and Agriculture, Commerce and Marketing, Humanities and Law as well as students from other Higher Education Institutions. The group's mission – "An educated nation = a well informed nation"- is to spread the message that education provides the key to enable hard-working learners to rise above their personal situations. With some support from the CTHB, they have sought to open up opportunities for learners to continue with tertiary education, at HEI's all over the country and so to embark on successful careers.

Over the four year period (late 2005-end of June 2009) during the January, April and July University holidays, the MRYE group have visited schools in rural areas in Kwazulu-Natal, the Eastern Cape, Limpopo & Mpumalanga and North-West Province. These longer visits have been sponsored by the CTHB. In addition they have paid a number of self-sponsored Saturday visits to schools and community centres to areas closer to Pretoria.

The response from the schools to this programme has been very enthusiastic with many schools requesting annual visits. In many ways the MRYE group represent South Africa's future.

SCIFEST 2007

March 19th saw the start of a very productive science communication rally, where 8 FABI delegates undertook the journey to Grahamstown for the 2007 Sasol SciFest. Marked as the international year of the polar bear with many featured aspects concerning climate change, this SciFest promised to be action packed, allowing young and old the opportunity to mingle with some of the most renowned national and international scientists. Aptly themed "Make Science Count", Sasol SciFest boasted its eleventh successful year. With some 40 000 visitors over the seven day festival, there was something for everyone. This included understanding the controversy of a long standing feud between the South Africans and the Australians, this time not on a cricket pitch. It also included understanding the dynamics behind such things as the planned Square Kilometer Array, the largest radio telescope bid; jet-fuelled rockets; and a Bone Woman.

Activities at SCIFEST

The CTHB exhibition was hosted on the first floor of the 1820 Settler's Monument building. Efficiency lay in the quick assembly of the display with minimum effort and a great output. The "forest" had taken shape and featured what was to be the talk of the Festival – "The Green Broccoli Head". "Keeping trees Healthy" provided the draw card allowing the exhibition to have a universal appeal. The team was very eager to meet the various contributors and view the many exhibitions. The "Meet and Greet" afforded the perfect opportunity for us to network and relax after a long day. SciFest had an extremely well organized team to cater for our every need. "It's all about the Science, baby", read the caption of the first edition of the *SciCue*, the local publication covering SciFest. This encapsulated the start of SciFest perfectly, and it was all systems go with a stampede of enthused scholars. Our popular "Mrs. Broccoli Head" made her way into the press, featuring in that edition of SciCue.

"Do you see what I see?" was a crazy insight into the mind of an excellent physicist, Dr Gillian Arendse. He presented workshops daily as well as a featured evening lecture demonstrating the physics of music and his enthusiasm to encourage young minds to explore the theories and prove or disprove them as they wished. Carbon foot printing was a hot topic of discussion, fuelled by Dr Maggie Aderin-Pocock. Esteemed "instrumentationalist", Maggie had one questioning the lifestyle choices that we all make, leaving the audience with an unsettling message: "Tomorrow's climate is today's challenge! And hat is everybody's problem!"

CERC-FABI *Eucalyptus* Protection Programme (CFEPP)

Research leader: Dr XuDong Zhou

Research team: Prof. Mike Wingfield
Prof. YaoJian Xie (CERC, China)
Prof. Jolanda Roux
Mr. Zhihua Wu (CERC, China)

Objectives of the research programme:

- To study *Eucalyptus* diseases and pests threatening plantation development in China
- To understand the biology and spread of these pests and pathogens
- To screen *Eucalyptus* hybrids tolerant to the most important diseases
- To train young researchers working on tree health
- To establisht a model for the cooperation between South Africa and China
- To serve as the *Eucalyptus* health authority there in the long run

Highlights of research:

Signing of MOU
FABI and CERC (China Eucalypt Research Centre) have built a sound research linkage through exchange visits and inter-governmental agreements. In December of 2006, a Memorandum of Understanding was signed at the South China Experiment Nursery (CERC's national nursery) by Mr. JieFeng Liu (Director of CERC) and Prof. Mike Wingfield (Director of FABI), launching the official cooperation between two organizations and CFEPP.

Mike Wingfield, XuDong Zhou and postgraduate students undertaking a disease survey in GuangDong Province, China

Disease surveys
Eucalyptus plantations, with very limited clones, have developed tremendously in South China in the past twenty years to meet the needs of rapid growth of national economy, perhaps at the fastest rate in the world reaching around 3 million ha by the end of 2008. Despite the fact that they threaten long term sustainability of the industry, very little work has been conducted on diseases and insect pests of *Eucalyptus* plantations in the country. The CFEPP team have, therefore, taken the lead and conducted a number of *Eucalyptus* health surveys in the major plantation areas including GuangXi, GuangDong, HaiNan and FuJian in the past two years. The most obvious stem diseases encountered are bacterial wilt caused by *Ralstonia solanacearum*, stem cankers caused by *Chrysoporthe cubensis*, *Kirramyces zuluensis*, as well as species of *Botryosphaeria* and a *Ceratocystis* sp. Leaf and shoot diseases are also important and the more important pathogens include *Kirramyces destructans*, *K. epicoccoides*, *Quambalaria pitereka* as well as species of *Cylindrocladium*, *Mycosphaerella* and *Pilidiella*.

Capacity building
The CFEPP team secured the very first key project between South Africa and China for quite substantial funding working on *Eucalyptus* health in 2007. In 2008, CFEPP again secured a significant grant and purchased the state-of-art ZEISS IMAGER microscope.

Jolanda Roux training postgraduate student at CERC

Student training
CFEPP considers training young researchers as a crucial part the programme. In the past two years, two full-time Ph.D students, Shuaifei Chen and XinTao Mou joined the team.

XuDong Zhou deliveringa national TV lecture on eucalypt health in the State Forestry Administration, Beijing

Eucalyptus Pine Pathogen Interactions (EPPI)

Research leader: Dr Sanushka Naidoo

Collaborators: Prof Dave Berger
Prof Zander Myburg
Dr Noelani van den Berg
Prof Teresa Coutinho
Dr Emma Steenkamp

Objectives of the research programme:

The *Eucalyptus* Pine Pathogen Interactions (EPPI) Programme was initiated in 2007 with the aim of investigating the genomics and molecular biology of defense responses of forest trees to various pathogens. *Arabidopsis thaliana* is used to model plant-pathogen interactions in *Eucalyptus* or *Pinus* in order to understand and identify resistance mechanisms that can be manipulated in trees in future. We undertake a genomics approach to perform gene discovery in *Arabidopsis*, *Eucalyptus* and *Pinus*. The technology platforms employed (and planned) include microarrays, quantitative RT-PCR profiling, Illumina digital gene expression profiling (DGE), quantitative trait loci (QTL) mapping and expression QTL mapping (eQTLs). Reverse genetics approaches are undertaken to investigate the functional role of candidate defense genes in *Arabidopsis* using RNAi knockdown technology, T-DNA knockouts and over-expression strategies.

Our focus is on broad-spectrum resistance, which would provide resistance to various pathogens. In the forestry industry, horizontal resistance of forest trees to several pathogens may be desirable as the same tree species is often attacked by various pathogens in different geographic locations during its life span. The ultimate objective of EPPI is to identify candidate genes and regulatory sequences that can be used to improve the resistance of forest trees to threatening pathogens in future.

Highlights of research:

Understanding the defense response against bacterial wilt

Ralstonia solanacearum, the causal agent of bacterial wilt disease, infects a range of hosts including tree species of the genus *Eucalyptus*. We have been modeling the interaction between a *Eucalyptus* isolate of *R. solanacearum* and the host using *Arabidopsis thaliana*. *Arabidopsis* ecotype Col-5 was shown to be susceptible to a *Eucalyptus* isolate of *R. solanacearum*. Microarray expression profiling of 5000 *Arabidopsis* unigenes revealed 140 genes responding to infection by the bacterial wilt pathogen compared to uninfected plants (Naidoo et al., manuscript submitted). Bioinformatic comparison of *Arabidopsis* Affymetrix expression profiles using the Rank Correlation Comparer tool (RCC) suggest that *R. solanacearum* induces similar responses to infection with the bacterial pathogen *Psuedomonas syringae pv. tomato* and the fungal pathogen *Botrytis cinerea*, and the abscisic acid signaling pathways appeared to be operating in response to bacterial wilt. In accordance with previous findings, the MeJA and ethylene signaling pathways appear to be induced by *R. solanacearum* infection.

In previous work supervised by Prof Dave Berger, Mrs Joanne Fouchè-Weich showed that the *Arabidopsis* ecotype Be-0 was susceptible and ecotype Kil-0 was resistant to a *Eucalyptus* isolate of *R. solanacearum*. A subsequent study profiling the whole *Arabidopsis* genome using plant material challenged with *R. solanacearum*, revealed thirteen candidate genes which were induced to high levels early on in the resistant interaction compared to the susceptible interaction (Naidoo, PhD thesis). These genes are potential candidates to provide resistance against *R. solanacearum* in *Arabidopsis* and could serve as long-term targets for manipulation in *Eucalyptus*. One gene in particular, a member of the peroxidase gene family, has previously been implicated in defense against a range of pathogens. Currently, Ms Therese de Castro is testing this candidate gene to determine its role in defense against *R. solanacearum* in *Arabidopsis* using T-DNA knock-out and over-expression transgenic lines.

Development of tree pathosystems and gene discovery

In order to perform expression profiling experiments on *Eucalyptus* hosts, reliable infection systems are needed. Ms Ronishree Naidoo is in the process of setting up a pathosystem between *Eucalyptus* and *R. solanacearum* in order to understand and characterize the response of *Eucalyptus* to the bacterial pathogen. Additionally, Ms Febè Wilken in collaboration with Dr Noëlani van den Berg, is developing a pathosystem using *Eucalyptus* and *Phytophthora cinnamomi*. A comparison of the expression profiles elicited by both bacterial and oomycete pathogens will indicate whether there is overlap between the host responses to two different pathogens and allow the identification of candidate genes required for defence in *Eucalyptus*. We are at an exciting stage of gene discovery as the whole genome sequence of *Eucalyptus* is available for mining. Mr David de Veredicis is undertaking a bioinformatics study in order to facilitate the identification of candidate defence gene orthologs in *Eucalyptus* based on known defence genes in *Arabidopsis*.

Liesl van der Linden, Therese de Castro, Gareth Enslin and Sanushka Naidoo preparing *Arabidopsis thaliana* plants for inoculation with the bacterial wilt pathogen *R. solanacearum*

Induced resistance in pine

Literature and plant trials suggest that biological and chemical inducers which result in systemic acquired resistance or induced systemic resistance may offer a degree of protection against various pathogens including *Fusarium circinatum* in *Pinus patula*. Ms Katrin Fitza is investigating the molecular basis of induced resistance in pine by profiling *P. patula* plants treated with an inducer that has potential to afford protection. In this way, it is expected that candidate genes important for conferring defence in *P. patula* can be identified.

Forest Biotechnology
Propagation of Pine Species

Research Leader: Prof AM Botha-Oberholster

Research Team: Mrs Anita Steyn

Objectives of the research programme:

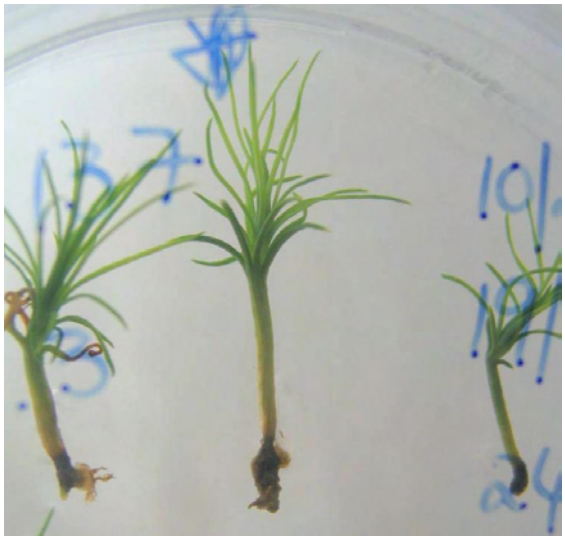
- Supply the Komatiland Forest Research with a protocol for somatic embryogenesis using female gametophytes/immature embryos as explants.
- Evaluate changes at the genomic level in cell lines in culture/stored for extended periods.
- Increase the understanding of the development of somatic embryos through a comparative study of somatic and zygotic embryos. The research has focused on similarities and differences between somatic and zygotic embryos in terms of morphology, histology, biochemical and metabolic pathways.

Highlights of research:

Research in this programme represents a joint effort between Komatiland Forest Research and the University of Pretoria. It especially focuses on the propagation of several pine species of commercial importance. The study not only focused on protocol development, but also on understanding the difficulties as to why the success with the process is low in terms of commercialization. To date, a total of 37,185 somatic embryos (SEs) have been produced and delivered to KFL for planting in their nurseries/hedges. These somatic embryos were produced from 9 open pollinated *Pinus patula* lines and 70 control-pollinated *Patula* hybrids. All these lines are stored using cryopreservation and 19 of these cryopreserved lines already produced 3,990 plantlets. Recently KFL Research planted the first field trail with locally propagated SEs to compare the performance of SEs that were produced directly and after cryopreservation. Future research will focus on refining the cryopreservation of cell lines.

Sifiso Nzama, Anita Steyn and Dineo Makala in the tissue culture facility at Tweefontein, Sabie

Anita Steyn, Sifiso Nzama and Dineo Makala in the Tree Biotechnology nursery at Tweefontein, Sabie



Somatic embryos of *Pinus patula* produced from a cell line that was cryo preserved

Forest Molecular Genetics (FMG) Programme:
Tree Genomics and Biotechnology for Superior Wood and Fibre

Research leader: Prof Zander Myburg

Research Team: Dr Sanushka Naidoo
Dr Noëlani van den Berg
Dr Daleen van Dyk
Mr Eshchar Mizrachi

Objectives of the research programme:

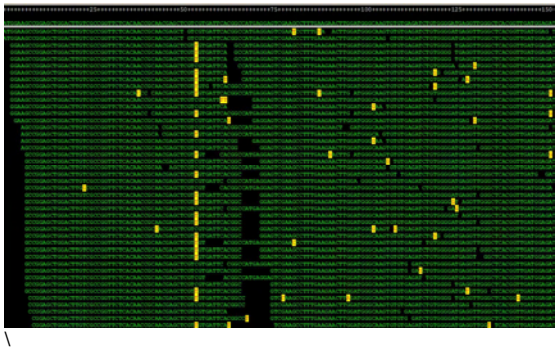
Fast-growing forest tree plantations are an excellent renewable resource for wood, pulp, paper and bioenergy and hold great promise for the sustainable production of fibre and energy for future generations. The main focus of the Forest Molecular Genetics Programme is to study the molecular basis of wood fibre development and to develop biotechnology tools for the improvement of plantation tree species grown in South Africa. High-throughput molecular (genomics) technologies are used to:

(**A**) ***discover genes involved in fibre development*** in trees**,**
(**B**) ***dissect the genetic regulation of pathways*** that lead to wood formation,
(**C**) ***test the function of candidate fibre cell wall development genes*** in model systems such as *Arabidopsis thaliana* and in trees,
(**D**) ***map and associate allelic variation in these genes with trait variation*** in tree populations, and
(**E**) ***develop molecular breeding tools*** (fingerprinting and trait-linked markers) for the genetic improvement of plantation forest tree (*Eucalyptus* and *Pinus*) species.

Highlights of the research:

FMG Research Team 2008

Transcriptome analysis:
Gene expression profiling in differentiating woody tissues (e.g. immature xylem, cambium and phloem) can be used to dissect the spatial and temporal regulation of genes and biochemical pathways in wood fibre development. In the past two years, we completed a study of the diurnal expression profiles of wood formation genes in *Eucalyptus* trees. Many aspects of carbon allocation into the main components of fibre cell walls (cellulose, hemi-cellulose and lignin) are regulated in a diurnal fashion and more than 200 candidate genes in regulatory and biochemical pathways were identified by this approach. In the past year, the emphasis of our gene discovery research has shifted towards whole-transcriptome sequencing and profiling in *Eucalyptus* trees. This exciting new development was made possible by the availability of new ultra-high-throughput (Illumina Genome Analyzer) DNA sequencing technology. In 2008, we embarked on the sequencing and deep expression profiling of the transcriptome of a fast-growing *Eucalyptus* F1 hybrid (*E. grandis x E. urophylla*) clone. To date we have produced more than two billion base-pairs (2 Gbp) of transcriptome sequence for this clone, which assembles into more than 17,000 putative transcript sequences with average length of approximately 1100 bp.



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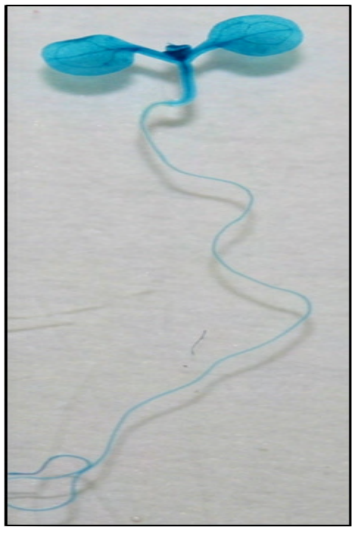
Transcriptome sequencing and profiling in *Eucalyptus*

Genome mapping: We have produced the first high-density (1 cM resolution) genetic linkage map for an F1 interspecific hybrid of *Eucalyptus* tree species (same hybrid clonal genotype being used for transcriptome sequencing). The genetic map contains more than 1000 genetic markers which will be used for the identification of trait-linked markers for a variety of physical and chemical wood property traits segregating in the F2 backcross progeny of the hybrid. The majority of the markers are Diversity Arrays Technology (DArT) markers which can be used to cross-link our genetic maps to the *Eucalyptus* genome sequence (see below).

The Eucalyptus Genome Project:
We continue to coordinate and host the International Eucalyptus Genome Network (EUCAGEN, www.eucagen.org). In 2007, EUCAGEN submitted a successful proposal to the US Department of Energy (DOE) to produce a complete genome sequence for *E. grandis*. The genome sequencing is being done at the DOE's Joint Genome Institute (JGI) in Walnut Creek, CA and an 8X draft of the approx. 600 Mbp genome should be completed by the end of 2009.

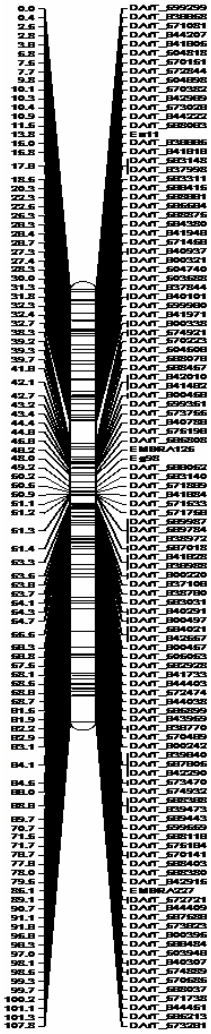
A window on fibre development

Genetic regulation of cellulose biosynthesis: Cellulose is the main component of fibre cell walls and its production in trees is a major biotechnology target. The transcriptional pathway that leads to cellulose production is an important regulatory component of wood formation. We have isolated the gene regulatory regions (promoters) of the cellulose synthase (CesA) genes of *Eucalyptus* trees and demonstrated their utility to drive transgene expression in the model plant *Arabidopsis*. By comparing the Eucalyptus CesA promoter sequences to those of the corresponding *Arabidopsis* and *Populus* CesA genes, we were able to identify cis-regulatory elements in these promoters that underlie their unique temporal, spatial and stress-responsive expression patterns. These sequences are now being used to identify upstream components (e.g. transcription factors) that regulate cellulose production in trees. The aim of this work is to characterize the transcriptional network that regulates cellulose production during fibre cell walls development in trees.

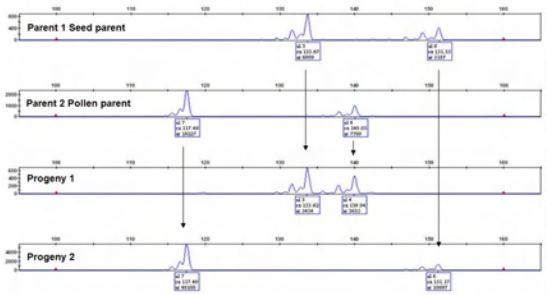


Expression of an *Eucalyptus* cellulose gene promoter in an *Arabidopsis* plant

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 *Pinus* tree species grown in South Africa and used these in a variety applications including clonal fingerprinting, detection of pollen contamination, and cross and selfing analysis in open and controlled crosses of *Eucalyptus* and pine trees.



***Eucalyptus* chromosome map**



Parentage analysis in *Eucalyptus* using microsatellite markers

Funding: The research activities in this programme are co-funded by the University of Pretoria, Sappi, Mondi, the Technology and Human Resources for Industry Programme (THRIP) and the National Research Foundation (NRF). In addition, we have received a strategic grant from the Department of Science and Technology (DST) to support the development of a local *Eucalyptus* genomics research platform.

Fruit Tree Biotechnology Programme

Research leader: Dr Noëlani van den Berg

Objectives of the research programme:

The Fruit Tree Biotechnology Programme (FTBP), a programme of the Forestry and Agricultural Biotechnology Institute (FABI), represents a cooperative venture between The Hans Merensky Foundation and the University of Pretoria, to investigate avocado disease problems, especially Phytophthora root rot. In addition, the FTBP is also involved in banana research focusing on the unconventional improvement of Cavendish bananas.

Avocado Research at FABI

In 2008 Westfalia Technological Services and FABI established a collaborative joint venture to complement the research objectives of a sustainable avocado breeding program. The specific research focuses on the understanding of disease tolerance/resistance of avocado rootstocks against *Phytophthora cinnamomi* to facilitate the development of superior avocado rootstocks.

The following objectives have been set:

- Understanding the avocado tolerance/resistance to Phytophthora root rot by identifying the host defence mechanisms in various rootstocks.
- Identification of the genes that control certain defence mechanism and the development of molecular markers to aid in the selection and screening of avocado rootstocks.

Banana Research at FABI

In the past couple of years the research made a shift towards the unconventional improvement of bananas against pests and diseases. The group has made several significant contributions to Fusarium wilt research in the world with the financial support of the Banana Growers Association of South Africa (BGASA) and the THRIP and Thuthuka programmes. Apart from our research on banana gene mining, elucidating the banana defence response and banana transformation, the group has also completed an extensive population genetics study of the pathogen, *Fusarium oxysporum* f.sp. *cubense* (Foc). Research related to the isolation and identification of pathogenicity and virulence factors in Foc has progressed in our laboratory in order to design novel control strategies.

Research objectives for 2007 and 2008 focused strongly on identifying defence-related genes, and establishing a programme to introduce resistance into bananas against major pathogens and pests using unconventional biotechnological approaches.

The programme is now built on the following foundations:

- The identification and characterization of genes in banana involved in resistance to fungal diseases and insects.
- Establishing a banana transformation facility to introduce resistance genes into banana.

Substantial progress is being made by the Banana Research Program (BRP) and the group has continued to grow in the past few years and is recognized as a leading research group on Fusarium wilt of banana. We have successfully transformed banana with two genes, GT1 and NH1. The tissue-culture facility produces high quality plantlets throughout the year that are used for research purposes. The group has published two scientific articles in peer-reviewed journals and presented several posters and presentations at conferences.

Highlights of research:

- A set of genes associated with defence in response to Fusarium wilt has been isolated using cDNA-AFLP.
- Expression profiles for at least 5 defence-related genes have been generated.
- The transformation facility is continuously multiplying banana tissue-cultured plantlets and transformation is also underway.
- The first set of transformed bananas with NH1 has been PCR-screened for the presence of the transgene.
- Putative *NH1* and transformants will be subjected to Southern blots in 2009 and will then be tested in glasshouse trials.
- An *Agrobacterium tumefaciens*-mediated transformation system was developed for *Foc* for the disruption of known or random genes.

Tissue culture banana plants in a hydroponic system (left)
Tanja Meyer loading a gel (right)

Ken Peg, Noëlani van den Berg and Jan van Niekerk examing an avocado tree for Phytophthora root rot

Microbial Diversity & Evolution Research Programme

Research leader: Dr Emma Steenkamp

Research Team: Prof Wally Marasas
Prof Brenda Wingfield
Prof Mike Wingfield
Prof Fanus Venter

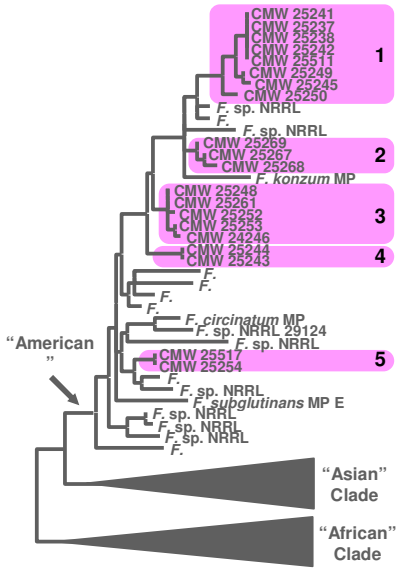
Objectives of the research programme:

This research programme focuses on evolution and the processes determining the evolution of microbial species. At the species/population interface we examine the geographic and ecological distribution of extant bacterial and fungal species and/or species groups. For this purpose, we combine genomic and phylogenetic information with palaeontological data. As these studies are often severely affected by incomplete taxonomic sampling, we also explore the diversity of specific groups of bacteria and fungi in native South African environments with the aim of discovering new taxa. The processes that determine microbial evolution include horizontal gene transfer between related and unrelated taxa (especially in the case of bacteria), as well as hybridization, vegetative reproduction and sexual reproduction (in the case of fungi, for example). As a result, experiments typically involve conventional genetic methods such as controlled crosses, linkage mapping and the analyses of mutants. In some cases genomic data are also generates and analyzed.

Some research highlights for 2007-2008:

Identification of various novel Fusarium species associated with pine trees in Colombia

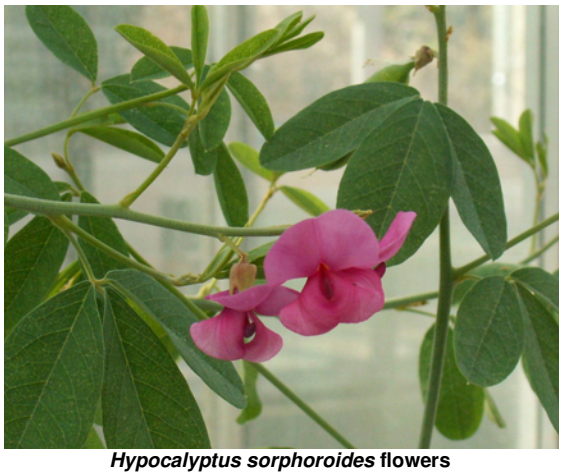
Pinus species are affected by a range of pathogenic fungi. A recent survey in Colombia revealed that the tissue of diseased pine seedlings and established plantation trees are colonized by diverse and novel *Fusarium* species in the *Gibberella fujikuroi* complex (GFC). Consistent with the contemporary ideas on the phylogeography of this complex, all of the Colombian isolates form part of the so-called "American Clade". The fact that these species also occur in sympatry (i.e. on the same host and in the same geographic location) widens the scope for further studying speciation in this group of important fungi.



Five new species in the "American Clade" of the *Gibberella fujikuroi* complex

***Discovery that many indigenous South African legumes are nodulated by Burkholderia* species**

The majority of the legumes that have been studied so far appear to be nodulated by members of the Rhizobiales (alphaproteobacteria). The fact that betaproteobacteria from the genus *Burkholderia* can establish a successful symbiosis with legumes has been demonstrated in 2003 for *Aspalathus carnosa* (a close relative of the rooibos tea legume *A. linearis*). Since this discovery, a small number of *Burkholderia* species with symbiotic nitrogen fixing abilities have been identified, mostly from mimosoid legumes. In a study of the root-nodule bacteria associated with the enigmatic legume tribe Hypocalypteae, as well as legume genera in the related tribe Podalyriae, a number of additional *Burkholderia* lineages displaying this property were identified. These findings suggest that beta-rhizobia are capable of establishing nitrogen-fixing symbioses with a range of other indigenous non-mimosoid legumes.



***Hypocalyptus sorphoroides* flowers**

Other recent highlights:

- Development of a cost-effective approach for large scale microsatellite (simple sequence repeat) discovery in enriched genomic libraries using GS FLX pyrosequencing.
- Discovery of some *Fusarium circinatum* populations in South Africa are genetically distinct from other populations of this fungus.
- Identification of a vast diversity of *Fusarium* species, of which many are novel, associated with the malformed flowers of waterberry.
- Launch of the *Gibberella fujikuroi* complex comparative mitochondrial genome project.
- Discovery that indigenous members of the legume genus *Lebeckia* are nodulated by various alpha- and beta-rhizobia.

Molecular Plant Pathogen Interactions

Research leader: Prof Dave Berger

Objectives of the research programme:

- Describe mechanisms whereby plants defend themselves against pathogens.
- Produce genetically modified (GM) plants as a tool to study plant resistance mechanisms.
- Use DNA Microarrays as a tool in understanding plant function.

Highlights of research 2007/2008:

Genomics of quantitative disease resistance in African maize varieties

The project involves the identification of maize expression quantitative trait loci (QTL) that confer resistance to grey leaf spot (GLS) in maize. The principal investigator of this country-wide collaborative project is Prof Dave Berger of the MPPI group.

The research and field trials are being conducted in South Africa. Researchers from the Department of Plant Science, Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria and the Centre for Proteomic & Genomic Research in Cape Town are applying microarray technology to simultaneously compare all 44000 maize genes from different maize varieties. The field trials are being conducted at several research sites throughout the East Coast of South Africa by the commercial seed company PANNAR Pty (Ltd) and the African Centre for Crop Improvement at the University of Kwa-Zulu Natal. The short term expectations of the project include the identification of diagnostic tools that have commercial value both locally and internationally. The long term expectations from the microarray expression profiling and bioinformatics analysis are the identification of genes that confer resistance to GLS in maize with the overall outcome resulting in the identification of new genetic markers that would either be located inside the QTLs or will be tightly linked to the QTL. The project is funded by the PlantBio Trust and the University of Pretoria.

In the first output from the project, the causal agent of grey leaf spot disease in maize production areas of Southern Africa was shown to be the recently named *Cercospora zeina*, and not *Cercospora zeae-maydis* (Meisel *et al*. 2009). Morphological and molecular phylogenetic approaches (sequencing of ITS and elongation factor genes) were used to draw this conclusion for single conidial isolates from fields in South Africa, Zimbabwe and Zambia. Koch's postulates were fulfilled for the isolates using a greenhouse assay, a procedure that is known to be difficult for this pathogen. A rapid identification test using PCR amplification with Cercospora-specific primers directly from diseased maize leaves was also developed.

Induced resistance to the rust fungus *Puccinia substriata* in pearl millet

Pearl millet (*Pennisetum glaucum*) is a cereal crop important for food security in Africa, as well as in India. It is classified as an "orphan crop", since limited research funding has been devoted to it and there are particularly few genomics resources available. The PhD study of Bridget Crampton, entitled "Elucidation of defence response mechanisms in pearl millet", was carried out to investigate the pathosystem between pearl millet and the rust fungus, *Puccinia substriata*, using genomics tools. An exciting discovery from her study was that salicylic acid treatment of pearl millet plants protected against subsequent attack by the rust fungus, *Puccinia substriata*. A cDNA library enriched for pearl millet defence response genes using the suppression subtractive hybridization (SSH) technique was constructed. Microarray expression profiling was used to identify candidate genes that might contribute to this resistance (see Crampton *et al*., 2009). This work was awarded the Bronze Medal from the Southern African Association of Botanists, which is an award for the best PhD thesis in a given year.

MADIBA: bioinformatics software for Microarray data

Collaboration between the MPPI group in the Department of Plant Science, FABI and the Bioinformatics and Computational Biology Unit in the Department of Biochemistry at UP resulted in the development of the MADIBA software for interpretation of microarray data (Law *et al.,* 2008).

MADIBA (MicroArray Data Interface for Biological Annotation) is an open access web-based tool that assists researchers in assigning biological meaning to gene expression data. MADIBA can be customized for studies of any organism for which an annotated genome sequence is available. Currently, it is used for studies of the malaria parasite, *Plasmodium falciparum*, a bacterial plant pathogen, *Pectobacterium atrosepticum*, and representatives of both dicot and monocot plants, *Arabidopsis thaliana* and rice, respectively.

MADIBA is used as follows: a user will enter a list of co-expressed genes that he/she has identified by Microarray analysis. The cluster of genes is processed by the MADIBA software to look for over-representation of Gene Ontology terms, metabolic pathways, or transcriptional regulatory sequences, and other specialised analyses. This work was published in the open access journal BMC Genomics and has been downloaded 1454 times since publication in Feb 2008. Philip Law was awarded the MSc (Bioinformatics, UP) degree *cum laude* for this work.

Symptoms of grey leaf spot disease on maize and structures of *Cercospora zeina*

Molecular Plant Physiology Programme

Research leader: Prof Karl Kunert
Dr Rachel Chikwamba

Research team: Dr Urte Schlüter
Dr Juan Vorster

Objectives of the research programme:

The overall objective of this research program is to understand stress biology and stress resistance. The first major research activity in 2007/8 has been the investigation of the cysteine protease /cysteine protease inhibitor system and its involvement in plant senescence and plant resistance against insects. A second research focus has been on understanding of gene function in broad-spectrum pathogen resistance. A further aspect of our research during this time focused on the plant genome and how genetic transfer between the nucleus and organelles could be affected by stress.

Highlights of research 2007/2008:

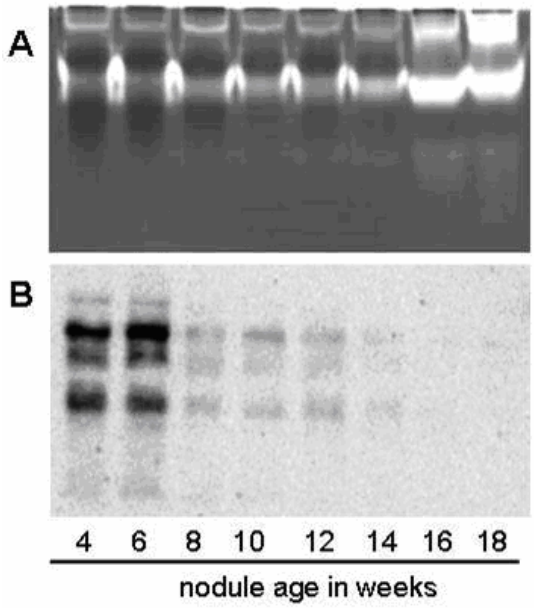
Plants had to develop mechanisms to survive in harsh environments. Our work carried out with partners in the UK, USA, Canada and Africa contributes to understand these mechanisms in more detail allowing plants to survive abiotic and biotic threats in environments relevant to Africa. Our ultimate goal is of applying the learnt principles to the design of crops that are better adapted to these environments.

Nodule development

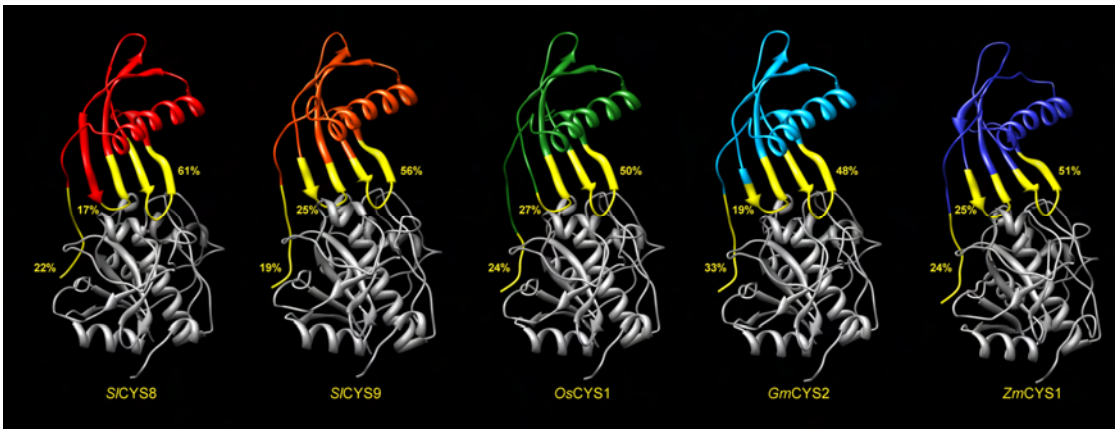
The main research goal was to investigate the role of cysteine proteases and their inhibitors (phytocystatins) in soybean nodule development with specific focus on the processes during nodule senescence. A detailed analysis of the nodule transcriptome of soybean nodules was performed by using microarray technology in close collaboration with Rothamsted Research, UK. For this experiment, nodules from two varieties grown in South Africa (Highveld Top and PAN 809) were harvested, total RNA extracted and sent to AROS Applied Biotechnology in Denmark for probing against a soybean chip. About 220 genes showed the same developmental pattern in both investigated soybean varieties, thereby 180 genes were up-regulated and only 40 genes were down-regulated in older nodules. About 17% of up-regulated gene sequences belonged to transcription factor families. Further, up-regulated genes identified are involved in cell wall modification, general metabolic regulation and stress response. Seven gene sequences involved in protein degradation have been found to be up-regulated in eleven weeks old nodules. These gene sequences consisted of one cysteine protease, two peptidases and four mainly putative trypsin (serine protease) inhibitors. Parallel to the transcriptome analysis, activity of different proteases was tested in soybean crown nodules. These experiments clearly showed the appearance of a new protease band in zymograms appearing in older nodules. Contrary to our expectations, this protease does not seem to belong to the papain-like protease family. A more sensitive method using DCG-04 molecules, which are specific for the detection of papain-like proteins, indicated that cysteine proteases are present mainly in the young nodules. Investigation of the specific role of proteases from the papain family in nodule development will be the focus of further investigations.

Modelling protein structure and interactions

Phytocystatins represent an attractive alternative for the design of pest-resistant transgenic crops intended for human use, given the absence of target cysteine proteases in the human gut and the widespread occurrence of these enzymes among herbivorous Coleoptera. It has been shown that selected mutations of plant cystatins can alter their inhibitory potential against a range of cysteine proteases. In order to perform a rational design of these inhibitors for targeted activity we first need a better understanding of the structure/function relationships of these proteins and how they relate to their interactions with cysteine proteases. In the first part of this study conducted in collaboration with Prof. Dominique Michaud at Laval University in Quebec, Canada, we assessed the contribution of different parts of plant cystatins interacting with papain (a plant cysteine protease) and have shown that while the contribution of the N-terminal towards the interaction energy is only between 19 – 33%, removal of the N-terminal generally leads to a loss of activity, indicating that it also plays a significant role in stabilizing the protein during binding. Up to now the role of the N-terminal in plant cystatins have not been clearly demonstrated. Secondly the effect of a range of mutations on the tomato cystatin *Sl*CYS8 (at a site under positive selection) on its ability to inhibit the cysteine proteases namely papain, cathepsin B and cathepsin L is also being investigated using a protein-protein docking approach. These results will help us in future to predict which mutations will allow for targeted activity of cystatins against selected cysteine proteases.



[A] Gelatine containing protease zymogram with clear bands indicating protease activity at pH 6.0 in extracts from soybean nodules of different ages
[B] Specific labelling of papain-like cysteine proeases with DCG-04 in extracts from soybean nodules of different ages

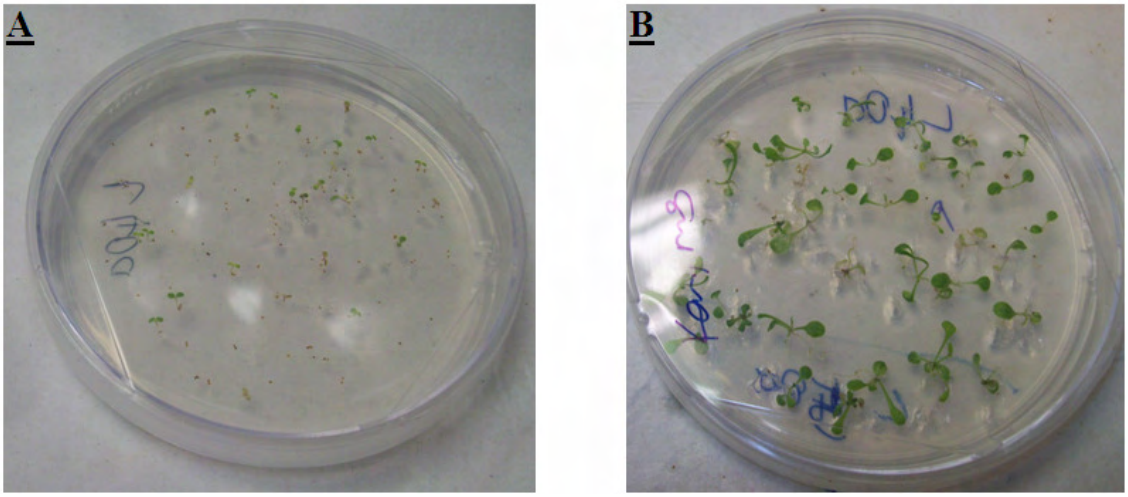


The contribution made by the different areas (N-terminal, 1st and 2nd inhibitory loops) to the overall interaction energy between different plant cystatins and papain

Characterization of the banana NPR1 gene

Dr Rachel Chikwamba leads work on non-expressor of pathogenesis-related gene 1 (NPR1), an essential positive regulator of salicylic acid (SA)-induced pathogenesis-related (PR) gene expression and systemic acquired resistance (SAR), which is important in broad spectrum pathogen resistance in plants. NPR1 genes have been described in many species and recently also by our group in banana. However, to date, neither NPR1 nor the systemic acquired resistance pathway has been described in Musa species. To date, we have isolated two novel full-length *NPR1*-like genes; *MNPR1A* (GenBank accession no. **DQ925843**) and *MNPR1B* (GenBank accession no. **EF137717**), from banana by a combination of PCR, rapid amplification of cDNA ends (RACE) and genome walking techniques. The two identified *MNPR1*-sequences differed greatly in their expression profile using quantitative real time (qRT)-PCR following either elicitor or *Fusarium oxysporum* Schlecht f. sp. *cubense* (Smith) Snyd (*Foc)* treatment. *MNPR1A* was greatly expressed after *Foc* treatment with higher and earlier expression in the *Foc*-tolerant cultivar GCTCV-218 than in the sensitive cultivar Grand Naine. In comparison, *MNPR1B* was highly responsive to SA, but not to methyl jasmonate (MeJA) treatment, in both the tolerant banana cultivar GCTCV-218 and the more sensitive cultivar Grand Naine. Expression of the *MNPR1* genes further directly related to *PR* gene expression known to be involved in fungal resistance. Reduced sensitivity to *Foc* in GCTCV-218 might be partially attributed to the higher and an earlier expression of both *MNPR1A* and *PR-1* in this cultivar after *Foc* treatment. This work has been published in the Journal Plant Physiology and Biochemistry. We are thereby currently investigating complementation of Arabidopsis npr1 mutants with either MNPR1A or MNPR1B to determine if either or both of these genes can restore PR gene activation and SAR upon pathogen infection.

The Molecular Plant Physiology group is also interested in the role of Glutathione in NPR1 mediated disease response, and is also characterising NPR1 activation by glutathione using *Arabidopsis* mutants deficient in cytosolic glutathione and Arabidopsis over-expressing an exogenous *GSH1* gene encoding γ-glutamylcysteine synthetase alone (allowing increased glutathione synthesis) or in combination with either of the two *NPR1* genes alone or in combination. Rosita Endah, a PhD student on this project, and Eugene Magkope Spend some time in the laboratory of Dr Christine Foyer learning how to measure glutathione and other metabolites at New Castle upon Tyne.



T-2 Complimented npr1/MNPR1A *Arabidopsis* plants on Murashige and Skoog (MS) medium after one week (A) and two weeks (B) of selection with Kanamycin

Phytopathology Programme

Research leader: Prof Teresa Coutinho

Research team: Dr Lucy Moleleki
Prof Fanus Venter
Prof Mike Wingfield

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.

Highlights of research:

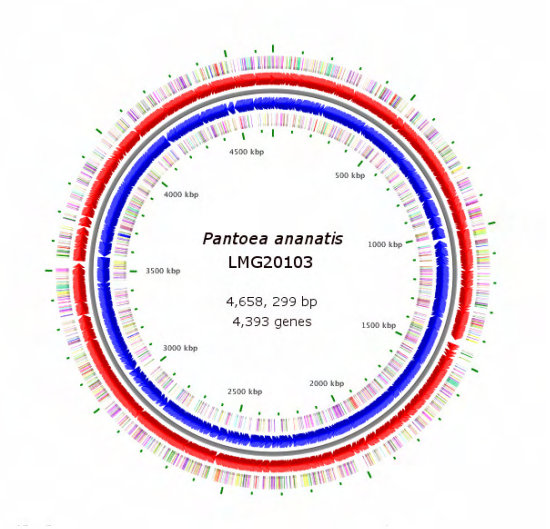
Identification of bacterial plant pathogens

Species belonging to the genus of *Pantoea* are commonly isolated from plants, humans and the natural environment. The species of the genus are phenotypically closely related, making rapid identification of *Pantoea* strains to the species level difficult. Multilocus sequence analysis (MLSA) was evaluated as means for rapid classification and identification of *Pantoea* strains. Four housekeeping genes, *gyrB*, *rpoB*, *atpD* and *infB*, were sequenced for strains assigned to the genus. Included in the study were (1) reference strains from the seven currently recognized species of *Pantoea*, (2) strains belonging to Brenner DNA groups II, IV and V, previously isolated from clinical samples and difficult to identify because of high phenotypic similarity to *P. agglomerans* or *P. ananatis*, and (3) isolates from diseased *Eucalyptus*, maize and onion, assigned to the genus on the basis of phenotypic tests. Phylogenetic trees were constructed from the sequences of the four housekeeping genes. The "core" *Pantoea* species formed a cluster separate from the "Japanese" species which formed a tight cluster that included the genus *Tatumella* when the tree was based on concatenated sequences of the four genes. The MLSA data further suggested the existence of ten potential novel species, phylogenetically related to the currently recognized *Pantoea* species, and the possible inclusion of *Pectobacterium cypripedii* in the genus *Pantoea*. When compared with DNA-DNA hybridization data a good congruence was observed between both methods, with *gyrB* sequence data being the most consistent. In conclusion, MLSA of partial nucleotide sequences of the genes *gyrB*, *rpoB*, *atpD* and *infB* can be used for classification, identification and phylogenetic analyses of *Pantoea* strains.

Typical symptoms of bacterial blight

Comparative Genomics

Pantoea ananatis is a pathogen on a wide range of plants and has been implicated in opportunistic human infections. It is frequently isolated from a wide range of environmental sources including the plant environment and from insects. It thus has an extraordinary ability to survive in a multitude of environmental niches, under a variety of conditions and cause cross-kingdom infections. The genome of a pathogenic strain isolated from *Eucalyptus* was sequenced using 454 technology. The genome consists of a single circular chromosome 4.65 Mb in size with a GC content of 53.7%, encoding 4,140 protein coding sequences (CDS). Genome comparisons against closely related phytopathogens revealed the presence of an exopolysaccharide with high homology to stewartan, the major pathogenicity factor in the corn pathogen, *Pantoea stewartii.* A Type III secretion system is absent. Three copies of a novel disease-associated Type VI secretion system are present on the genome. Further comparisons against all available genome sequences indicated a large number of CDS with distinct homology to bacteria occupying specific niches, particularly the plant, insect and animal niches frequented by *P. ananatis*. A fimbrial system in common with insect associated bacteria may play a role in attachment to insect hosts, while an acid tolerance system shared only with human and animal pathogens may allow survival in the acidic intestinal environment. CDS shared with plant-associated bacteria included a number of factors required for proliferation in the plant environment and several factors involved in causing disease in plant hosts. The genome sequence of *P. ananatis* thus gives an indication of an organism that is well adapted to survival in a wide range of environments and that is capable of causing disease symptoms in a number of hosts.



Genome representation of a virulent strain of *P. ananatis*

Seed Pathology Research Programme

Research leader: Prof Terry Aveling

Research team: Dr Quenton Kritzinger
Prof Nico Labuschagne
Dr Reyes Blanco

Objectives of the research programme:

Study the seed pathology and vigour of indigenous food crops and those crops consumed on large scale by local populations such as sorghum and maize.

Highlights of research 2007/2008:

Fungicide seed treatments are important to protect seeds from diseases and pests. In one of the studies the efficacy of fungicide seed treatments on maize (*Zea mays* L.) was investigated by comparing germination and vigour of treated seeds and examining efficacy of the fungicides after maize seeds were subjected to 2 and 4 day accelerated ageing (AA) (45 ºC; 100 % RH) and long-term storage for 3 and 6 months (30 ºC; 75% RH). Maize seeds were treated with: Apron® XL (metalaxyl); Apron Star® (thiamethoxam, metalaxyl, difenoconazole); Thiram (thiram) and Celest® XL (fludioxonil, metalaxyl). For unstored seeds, thiram had an 80% germination followed by Celest® XL (51%). Seeds treated with thiram maintained 60% germination after 2 days AA but decreased in percentage after 4 days AA (28%). This correlated with results obtained after 3 (61%) and 6 (23%) months storage. In contrast all other treatments retained their germination percentages after 2 days AA and 3 months storage but failed to germinate after 6 months storage. Seeds treated with Apron® XL showed an increase in weight after being subjected to slow and fast imbibition and a decrease in the number of seeds with living tissue as indicated by tetrazolium staining. Seeds treated with thiram had the highest percentage germination in both AA tests and during long-term storage when compared to the other treatments.

Untreated seed and seed treated with the chemicals, Celest® XL, Apron® Star, Apron®XL and Thiram were used in two greenhouse trials. The first trial consisted of seeds sown in seedling trays (1 seed/cell of the tray) filled with uninoculated pasteurized soil (Braaks, Pretoria). The second trial consisted seeds that were sown into the seedling trays 24 hr after the soil had been inoculated with *Fusarium graminearum* (Schwabe) (originally isolated from a maize plant showing damping-off symptoms). Both trials were terminated three weeks after planting and the results were expressed the percentage emerged seedlings and percentage plants showing disease symptoms (in the case of the inoculated trail) by the end of the test period. In the standard germination test, all treatments had percentage germination above 75%. Apron® XL had the highest percentage (83%), although it did not differ significantly from any of the other treatments. Comparing standard germination and greenhouse emergence in the uninoculated trial, with the exception of Thiram (84%), greenhouse emergence was significantly lower than percentage germination. In the inoculated trial both Thiram and Apron® Star had lower percentage diseased plants (17.3% and 28.0% respectively) but did not differ significantly from each other. As was expected in the inoculated trial, the control had the highest percentage diseased plants (58.7%). In this study, Apron® Star, which is also useful to combat insect infestation, maintained the same emergence percentage (65.3%) in the inoculated trial as in the uninoculated trial and successfully suppressed infection by *F. graminearum*. Thiram, a broad-spectrum fungicide, effectively controlled *F. graminearum* whilst maintaining high percentages germination and emergence and was found to be the best treatment in this study.

Germinating onion seeds

During storage of maize, fungi can cause 50 - 80% seed damage if conditions are favourable for their growth and multiplication. In tropical regions, the most commonly encountered fungal genera include *Penicillium, Aspergillus and Fusarium*. Development and validation of a method to test for *Fusarium verticillioides* (Sacc.) Nierenberg (= *F. moniliforme* Sheldon) on maize seeds is essential. Maize seeds (healthy or rotten and *Fusarium* infected) were surface sterilized with sodium hypochlorite at different concentration levels and for different time periods. Surface sterilized seeds were then plated on different media including potato dextrose agar (PDA) and carnation leaf agar (water agar, 15 g/L, amended with either KCl or NaCl, 8 g/L, and autoclaved carnation leaf pieces). The seeds were placed directly adjacent to the carnation leaf pieces and incubated at room temperature. Following 5-7 days of incubation, the fungi growing on the media were identified and the percentage of *F. verticillioides* infected seeds recorded. Results from this study showed that surface sterilization at a sodium hypochlorite concentration of 1% for a time period of 5 min gave the most consistent results. The carnation leaf agar was effective in inhibiting the growth of saprophytes such as *Rhizopus*, which make it more difficult to identify other fungi, and in promoting sporulation of the fungi allowing quick identification of *F. verticillioides*. Rapid formation of clearly visible long chains of microconidia, phialides as well as macroconidia in sporodochia were easily visible on or near the surface of the carnation leaf pieces. Subsequent studies are needed to test and validate this method using several laboratories.

Highlights: International recognition: Prof Terry Aveling was made a member of the Scientific Programme Advisory Committee of the 28th International Seed Testing Association (ISTA) Congress, Iquassu Falls, 5-11 May 2007. Furthermore, the grantholder was also made Convenor of both the ISTA – Seed Health Workshop (7-11 April 2008, University of Pretoria) and the ISTA – 6th Seed Health Symposium (14-18 April 2008, Kruger National Park).

Tree Protection Cooperative Programme (TPCP)

Research leader: Prof Mike Wingfield

Research team: Prof Teresa Coutinho
Prof Brenda Wingfield
Prof Jolanda Roux
Prof Bernard Slippers
Prof Fanus Venter
Dr Emma Steenkamp
Dr Martin Coetzee
Mr Brett Hurley

Objectives of the research programme:

- Development of field monitoring techniques to recognize 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 research 2007/2008:

A summary of the research activities of the team members and postgraduate students of the Tree Protection Co-operative Programme (TPCP) is provided, focussing on highlights and important findings. There are a great number of pest and disease problems and in this report we touch on only a few. Publication and project lists as well as more comprehensive information on the research activities of the TPCP are available on the FABI website (http://www.fabinet.up.ac.za/tpcp).

Establishment of insect quarantine facilities

There appears to be a growing number of introduced insect pests threatening plantation forestry in South Africa. For many of these the only viable control option is integrated programmes involving biological control agents. Biocontrol agents can sometimes be brought from areas where they have been employed before, or need to be discovered anew. In both cases, the control agents need to be brought into, and studied in, quarantine facilities. The TPCP, with financial support from the University of Pretoria, established facilities to do this work on the UP experimental farm, in close proximity to the existing FABI nursery and plant tunnels. The facility was certified as a quarantine facility by the Department of Agriculture in mid-2008 and has since been in full use for work on *Sirex noctilio*, *Thaumastocoris peregrinus* and *Leptocybe invasa*.

Sirex woodwasp

The Sirex Woodwasp continues to pose a serious threat to the forestry industry of South Africa. Although infestation levels of this pest appear to have decreased in the last couple of years, Sirex is still causing considerable losses in the Eastern Cape and KwaZulu-Natal. Furthermore, the movement of Sirex into Mpumulanga, where much of the pine resources are located is of great concern.

Sirex research at FABI takes a holistic approach to understand the interactions between the wasp, its mutualistic fungal symbiont (*Amylostereum areaolatum*), biological control agents (especially the nematode *Deladenus siricidicola*), the tree host and the environment. This approach has yielded unique insights into the transmission of the symbiont between wasp generations. It has also revealed patterns of diversity and spread of the fungus and wasp world-wide. Recent work on the genetics of the fungal symbiont have also revealed the genetic mechanisms underlying self and mating recognition in the *A. areolatum*, and provided a genetic linkage map for this fungus. This work is sure to inform novel future control strategies and genomics work.

One of the major efforts of the programme since it has been involved in forestry entomology, is the introduction of biological control agents for Sirex. The primary of these is the parasitic nematode, *Deladenus siricidicola*. In 2008 the TPCP team produced more than 3 billion of these nematodes for the inoculation of approximately 30000 trees by the forestry industry. The production of these nematodes was a major operation within the TPCP and involved the whole group – staff and students – many of whom volunteered weekends and evenings to assist in this formidable task. Large-scale production of these nematodes will continue into the future.

The dissection of emerging Sirex wasps is needed to determine parasitism levels of the nematode and thus provide feedback on the success of the inoculation programme. More than 12000 wasps were dissected in 2007 and 2008. Results showed very encouraging levels of background parasitism (natural spread of the nematode), but the actual inoculation success is still very poor. This means that the industry is still very vulnerable to outbreaks of Sirex, for example in the Mpumalanga region. To combat this risk, the TPCP continues to study the factors resulting in low inoculation success and to collect new strains of the nematode from other countries and test these for their effectiveness in South African conditions. The research team is also increasingly focussing on other biological control agents, such as *Ibalia leucospoides* and other parasitic wasps.

Monitoring, especially ahead of the Sirex front, is critical to for its control.The success of the monitoring programme is largely dependant on the efficiency of the monitoring tool used. The TPCP has tested various traps and lures over the last number of years. This has resulted in the current trap and lure that have been used effectively in the 2007 and 2008 emergence seasons to detect new infestations.

Chrysoporthe and Cytospora cankers

Canker on *Eucalyptus,* caused by species of *Chrysoporthe,* are amongst the most damaging diseases affecting forestry in South Africa. Past research has included intensive work focused on understanding the cause of this disease and also regarding efforts to reduce its impact. One of the issues of greatest confusion in the past has surrounded the relationship between the *Chryphonectria* spp. that cause severe canker diseases on northern hemisphere trees such

as Chestnut (note Chestnut blight caused by *C. parasitica*) and the *Eucalyptus* canker pathogens. It is now clear that these are very different fungi, although equally pathogenic. Thus, the Eucalyptus canker pathogens are in the genus *Chrysoporthe* i.e. *Chr. cubensis* and *Chr. austroafricana*. The former species is the one that was much feared in South Africa for many years and the latter is the fungus responsible for cankers on *Eucalyptus* in this country. One of the issues of concern to the programme is that surveys have shown that *Chr. cubensis* is present in Africa and it is presently as far south as Mozambique. We have shown that the fungus has clearly been introduced into this region and it has the potential to become a serious *Eucalyptus* pathogen in South Africa.

Another canker pathogen on *Eucalyptus* in South Africa and of importance to forestry is *Holocryphia eucalypti*. This is the fungus previously known as *Cryphonectria eucalypti* that had a very serious impact on saw timber eucalypts in various parts of South Africa in the past. Research has shown clearly that this is a native *Eucalyptus* pathogen in Australia. Intriguingly, it has undergone a host shift to *Tibouchina* in that country. This is the same as the situation with *Chr. austroafricana* in South Africa that has equally acquired the ability to infect *Tibouchina* as well as *Eucalyptus*.

Cytospora spp. include a group of relatively weak pathogens. These fungi cause disease on trees that are stressed or stressed tree parts. Intriguingly, the first of these fungi found on eucalypts was described from Australia. Many species are now known and they are commonly encountered in *Eucalyptus* disease surveys. Although they are not considered a priority in terms of TPCP activities, their presence is recorded and we are now in a good position to identify them, where necessary.

Coniothyrium Canker

Coniothyrium canker is one of the most important causes of damage to eucalypt trees in South African plantations. A very substantial effort has been made to reduce the impact of the disease from clonal *Eucalyptus* plantations such as those in sub-tropical regions. This effort has been quite successful, but it remains important to include the disease in clonal screening trials as it has the potential to emerge as serious very rapidly.

TPCP research on Coniothyrium canker is focused largely on monitoring and maintaining a capacity to screen for disease resistance where necessary. Our research has now shown that there are two species of fungi responsible for this disease. One of these now known as *Kirramyces zuluense* causes a canker disease in South Africa. The other, *Kirramyces gauchensis,* causes exactly the same symptoms, but is found only in South America. A focus of our research is to better understand global patterns of spread of these pathogens. To this end, microsatellite markers have been produced for them and these are now being used to track their origin and global movement.

Mycosphaerella leaf and shoot diseases

Diseases caused by *Mycosphaerella sensu lato* on pines and eucalypts are amongst the most important known to plantation forestry worldwide. For example, the Dothistroma needle blight pathogens that have been devastating in New Zealand, Australia and various southern hemisphere countries, belong in this group. It is, therefore, important that the TPCP team maintains competence in working with these pathogens. Currently the group is amongst the best recognized in the world in this regard. This competence is based on studying these pathogens not only in South Africa, but from a global perspective.

Recent research has shown that the *Mycosphaerella* spp. occurring on pines and eucalypts are only distantly related to those, for example on grasses and other crops. The former group have consequently been transferred to *Teratosphaeria* and new names are being provided for the species. This work has a very substantial impact on species such as those causing Coniothyrium canker on eucalypts that are now accommodated in *Kirramyces* rather than *Coniothyrium*. Likely, they will ultimately be known in *Teratosphaeria*.

Guillermo Perez holding an eucalyt leaf infected with a *Mycospherella* sp.

Research on *Mycosphaerella* spp. on *Eucalyptus* during the past ten years has led us to be relatively sure that the majority of species have come to South Africa, and other countries cultivating these trees, from Australia. The most likely pathway of entry has been with seed, although very little evidence is available for this supposition. An important aspect of TPCP work on *Mycosphaerella* is to predict risks to South Africa regarding these pathogens. Thus, strong bases of collaboration have been established with colleagues in Australia and we have made substantial efforts to assist them in identifying these pathogens.

Botryosphaeriaceae cankers of pines and *Eucalyptus*

The Botryosphaeriaceae are some of the most important pathogens of pines and eucalypts. In South Africa, the best known pine pathogen in this group is *Diplodia pinea.* The TPCP research on *D. pinea* is currently on trying to better understand the relationships between the pathogen and its host.

On *Eucalyptus*, the Botryosphaeriaceae cause cankers, and this is also true for many other woody plants such as fruit trees. Some of these species appear to be relatively host specific while others are generalists. They are all endophytes, able to exist in their hosts in an asymptomatic form, but they cause serious disease problems when the trees are under stress. These stresses are not well understood, but certainly, they include clones or cultivars that might have excellent pulping or other characters, but are not well suited to the sites in which they are growing. Research by the TPCP has been instrumental in unravelling the complex of 23 Botryosphaeriaceae species that affect this host world-wide.

Given their wide host ranges, there is a chance that native Botryosphaeriaceae are able to move from native plants to *Eucalyptus*. This would be most likely to occur in the case of trees related to *Eucalyptus* such as *Syzigium cordatum*. Such a hypothesis is consistent with the movement of for example *Chr. austroafricana* from waterberry to *Eucalyptus*. A study was thus undertaken on *S. cordatum* to ascertain whether Botryosphaeriaceae on this tree might have moved to *Eucalyptus* and *vice versa*. This has resulted in intriguing results suggesting that such host shifts are occurring, although there remain many questions to be answered. Certainly, when trees such as *Eucalyptus* are being planted outside their native range, they are acquiring new Botryosphaeriaceae and this poses a threat to these trees in their native range.

Phytophthora root disease of *Eucalyptus*

Phytophthora spp. are all pathogens and they include causal agents of some of the most serious diseases of plants in the world. They also include serious pathogens of plantation trees including eucalypts, pines and acacias in South Africa. The TPCP has undertaken research on Phythophthora root rot of *Eucalyptus* almost continuously. This disease problem is not widespread and it has typically been associated with cold tolerant species such as *E. fraxinoides*, *E. smithii* and *E. fastigata*. In this case, the

pathogen has been the well-known *P. cinnamomi*, which is also introduced into South Africa.

TPCP research in recent years has focused on assisting members that plant cold-tolerant eucalypts to select for disease tolerance. As part of this work, isolates of *Phytophthora* spp. that were atypical were discovered. An intensive study of these isolates has shown that they represent two undescribed species that have recently been provided with names. Both species, *Phytophthora figida* and *Phytophthora alticola*, are pathogens of *Eucalyptus* and future surveys will need to take these into consideration. Their origin is not known but they are most likely native to South Africa, given that they originated from soil samples taken from around the root zone.

Bronze bug - *Thaumastocoris peregrinus*

Thaumastocoris peregrinus causes serious chlorosis en defoliation of *Eucalyptus* trees. It has spread to virtually every corner of South Africa since 2003, and has also been detected in Zimbabwe and Malawi. *Thaumastocoris peregrinus* has also been reported from South America since 2005, in Uruguay, parts of northern Argentina and southern Brazil. There too it is causing severe damage and tree death in some cases. Being a newly emerged pest, very little is known about the pest and no control programme is available. The TPCP has thus embarked on a comprehensive research programme on the pest and its control.

Ryan Nadel collecting the bronze bug from eucalypts

Surveys by the TPCP have shown that all the *Eucalyptus* material planted commercially in South Africa, as well as most other species that occur in the country, is susceptible to this pest. There thus seems to be little opportunity for control through breeding or species selection. A monitoring system was developed using a yellow sticky trap, which is now deployed throughout the country to quantify fluctuations in Bronze Bug populations together with factors that might influence it. Population diversity studies, based on mitochondrial diversity, have shown that the bugs' diversity in South Africa is limited, but that the country had two separate introduction events. There appears to only have been one introduction into South America, and this was independent from the South African introduction. The introductions in both these invaded countries could be traced to urban centers in Australia, especially Sydney. These data now guide collection efforts of biological control agents.

The only conceivable method to control *T. peregrinus* populations currently is through biological control. This has to be developed from the start. Members of the TPCP visited collaborators in Brisbane, Sydney and Perth, Australia to collect eggs of *T. peregrinus* or other *Thaumastocoris* spp. to rear possible egg parasitoids from them. The mission was successful as they managed to rear a good number of the parasitic wasp, *Cleruchoides noackii*, from the eggs. Initial studies have been completed and a further round of imports of these wasps into quarantine is planned during 2009.

Pitch canker of pines

Pitch canker of pines caused by *Fusarium circinatum* is the most important fungal disease affecting forest plantation trees in South Africa. For many years, the pathogen was known only in nurseries where it has, and continues to cause very serious damage. This is also true for various countries around the world including Chile. The TPCP thus participates in various forest industry initiatives to deal with this problem.

It was of great concern that pitch canker, the disease on mature trees broke out in Cape Town in 2005. This manifestation of infection by *F. circinatum* has now spread up the East Coast of South Africa where it has been found on various pine species. Early evidence suggests that the pathogen was introduced into Cape Town with infected seedlings produced in George. This question is currently being investigated in the hope that we will be able to prevent such introductions in the future.

The Eucalyptus gall wasp - *Leptocybe invasa*

The wasp, *Leptocybe invasa* causes galling on the midrib of young *Eucalyptus* leaves, petioles or branches. In severe cases the galls causes significant stunting of young plants. The wasp has spread to virtually all *Eucalyptus* growing countries in the world since 2000, and was reported from South Africa in 2007. The TPCP was fortunate to have built up significant knowledge and contacts with other research groups focusing on *L. invasa* before it arrived in South Africa. The TPCP could therefore embarked on a research programme to develop a control programme for *L. invasa* soon after it was noticed in the country. From early observations it is clear that an integrated control programme, including eradication, biological control and breeding for resistance will be needed. One aspect of this programme is therefore focused on identifying resistant material amongst the most important growing stock of the SA forestry industry.

Galls on eucalypt leaves caused by *L. invasa*

A major focus of TPCP research on *Leptocybe* is to establish a biological control programme for this wasp in the country. Collaborators in Israel has already identified a number of wasps that parasitise the larvae of *Leptocybe*. The TPCP obtained import permits for these wasps. The first consignment of these wasps will be tested in quarantine. The experiments to rear the parasitoids in the FABI quarantine facility on the experimental farm will continue in 2009, with the aim of producing large enough numbers to do the tests needed for eventual release of the parasitoids. As in the case of *T. peregrinus* this is likely to be a long process, but we have already made significant progress.

SABBATICAL VISIT

Professor DK Berger

Visit to Scottish Crops Research Institute (June 2007)

The first of two mini-sabbatical visits made during 2007 was to the Scottish Crops Research Institute (SCRI), building on the excellent collaborations between SCRI and FABI. Prof Paul Birch and Prof Ian Toth from SCRI are extra-ordinary Professors in FABI, and together with Dr Ingo Hein have co-published several papers with FABI research groups, and continue to co-advise several students.

Dave Berger working in the ACNFP greenhouses

The MPPI research group, through the MSc study of Irene Van Nugteren is developing virus induced gene silencing in pearl millet. The motivation for this work is to have a reverse genetics approach for testing candidate genes identified in the gene discovery project completed in the lab. The sabbatical visit coincided with the visit of Irene to work with Dr Ingo Hein, who has used the VIGS vector Barely Stripe Mosaic Virus (BSMV) for testing candidate disease resistance genes in barley. Experiments were carried out to develop and test a BSMV vector that had been engineered with a fragment of the phytoene desaturase (PDS) gene from pearl millet. This is commonly used as a positive control in developing a new VIGS system since silencing of PDS results in chlorophyll bleaching which appears as white streaks on the leaves. The visit was followed up by the VIGS workshop presented by four SCRI scientists in FABI in February 2008.

Richard Oliver and Dave Berger, Bibbulman Track, Western Australia

At the same time, MSc student Philip Law from the MPPI group visited Dr. Leighton Pritchard, the Bioinformaticist working with Prof Birch's group. Two improvements to the MADIBA database for interpreting Microarray data were made. The first was to include the *Pectobacterium atrosepticum* (Pba) genome so as to demonstrate efficacy of MADIBA with a bacterial plant pathogen, particularly since the SCRI group had recently completed a series of Microarray experiments to investigate quorum sensing in Pba. Additionally, the Arabidopsis plant defence pathway module in MADIBA was enhanced by including an option to search the DRASTIC database developed by Dr Gary Lyon's group at SCRI.

In subsequent work back at UP, a new microarray experiment comparer tool has been developed. The aim is find a treatment that elicits a similar expression profile to the treatment in your experiment, and thus infer for example which defence signalling pathway is responding to your plant pathogen of interest. Rank Correlation Comparer (RCC) has been useful in the study of the plant response to bacterial wilt in the MPPI and EPPI research groups. The tool compares the expression profile of a submitted set of Arabidopsis genes to the expression profiles of previously acquired Affymetrix data obtained from NASCArrays (Nottingham Arabidopsis Stock Centre Arrays) (several hundred experiments). The $\log_2$-ratios for experiments in NASCArrays were calculated and stored in a local database. RCC calculates the Spearman rank correlation coefficient between the submitted data and each experiment stored in the database. The sorted correlation coefficients, p-values and links to the NASCArrays experiments from all the comparisons are reported. The RCC is accessible at http://www.bi.up.ac.za/MADIBA/organisms.php.

Sabbatical Visit to the Australian Centre for Necrotrophic Plant Pathogens (September-December 2007)

The second mini-sabbatical visit was to the Australian Centre for Necrotrophic Plant Pathogens (ACNFP), Murdoch University, Western Australia led by Prof. Richard Oliver. Prof. Oliver has developed a general hypothesis based on the fact that a particular group of fungi (the Dothidiomycetes) that include many plant pathogens have evolved specific phytotoxins that assist in pathogenicity (called host-selective toxins). The hypothesis is that a genetic basis for recessive resistance can be found in certain accessions of a plant species, as he has demonstrated for the Wheat-*Stagnospora nodorum* interaction. This represents a special case of the gene-for-gene hypothesis, since recognition of the fungal factor (ToxA in this case) by the plant receptor (Tsn1 in Wheat) results in susceptibility. In the classical gene-for-gene model, recognition of pathogen effectors (eg Avr proteins) by Resistance (R) proteins results in resistance.

The aim of my lab work in Prof Oliver's lab was to test this hypothesis in a new system, namely the model legume *Medicago truncatula* (barrel medic) and the fungus *Phoma medicaginis*. Previous genetic studies in the lab provided support for the hypothesis. Progress was made in characterizing phytotoxic activitiy from *P. medicaginis* in *Medicago* and other crops, and the data generated was presented in two lab meetings at the ACNFP. The work is being continued by a PhD student in the lab. The following talk was also presented: "SSHscreen – an R package for screening Suppression Subtractive Hybridization (SSH) cDNA libraries on microarrays".

SERVICES

Tree Health Extension

Responsible researcher: Prof. Jolanda Roux (Extension, Monitoring, Diagnostic Clinic)

Team Members:
Ms. Izette Greyling (Diagnostic Clinic and Extension)
Mr. Brett Hurley (Pest monitoring and Extension)
Prof. Bernard Slippers
Prof. Mike Wingfield
Mr. Wilhelm de Beer (Treehealthnet)

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 our post-graduate students and the creation of 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.

Diseases and pest recognition workshop for a forestry mensuration team

Field activities 2007/2008: During 2007 a total of 42 field trips were undertaken in South Africa and five to neighbouring countries, accounting to 622 person days in the field. In 2008, 46 field trips were undertaken to areas in South Africa and one field trip to a neighbouring country, representing 593 person days in the field. These field trips included presentations at field days and disease and pest workshops. The dissemination of information regarding pests and diseases forms an important part of the field extension activities and often results in the report of new outbreaks by foresters, farmers and botanists/conservationists. Fieldtrips are also important in obtaining inputs from visiting international scientists. Several field visits with foreign visitors were, therefore, undertaken in 2007/8. During these visits it is attempted to provide as much exposure of these visitors to farmers and foresters as possible, with guests often presenting talks at small field days. Visiting scientists are also crucial in the training of students and staff of the TPCP and CTHB, providing them with valuable international views.

Diagnostic Clinic: The Diagnostic clinic received a total of 2913 samples for the period January to the end of December 2007. Most samples were received in August. Of the samples sent, the majority were from pine (54%), 5.4% were from eucalypts, 0.6% from wattle and 40% were classified as other. The clinic received a total number of 2036 samples during 2008. Pine samples, including both nursery samples for Fusarium screening and disease analyses samples, comprised approximately 85% of the total number of samples received. Of the rest of the samples, 5% were from *Eucalyptus* and 10% of samples were classified as other. Black wattle samples comprised only 0.4% of total samples received. Samples classified as other include water, soil, insect and Petri dish samples, as well as native or other non-native tree species.

Newsletters, articles, treehealthnet, and internet: The TPCP and CTHB extension services include several media other than field visits. The groups publish a newsletter, Tree Health News, twice a year. This newsletter is distributed by the Institute for Commercial Forestry Research (ICFR), together with ICFR news. Furthermore, regular articles are published in forestry and agricultural magazines. The group also manages a list server, Treehealthnet which alerts foresters and farmers to new disease outbreaks, interesting forestry facts and field visits to their areas. News items and scientific articles are posted on the TPCP and CTHB websites (www.fabinet.up.ac.za). The TPCP and CTHB are active participants of the Forest Invasive Species Network for Africa (FISNA) and publish new disease reports on the webpage.

Field day with South African foresters and international tree health experts

Pine Pitch Canker Screening Facility

Facility management team:

Prof Teresa Coutinho
Prof Jolanda Roux
Dr Emma Steenkamp
Prof Mike Wingfield

Technical manager:

Ms Bernice Porter (2008)
Ms Izette Greyling (2007)

Technical committee:

Mr A Nel (Sappi Forests)
Mr J Vermaak (Mondi Business Paper)
Mr G Mitchell (Komatiland Forestry)

In 2005 a collaborative project was launched by Sappi Forests, Mondi Business Paper and Komatiland Forestry to have their pine breeding stock screened for tolerance to the pitch canker fungus, *Fusarium circinatum*. Twice a year, in February and November, between 15 000 and 20 000 seedlings and/or cuttings are inoculated with the fungus. Research was undertaken previously to determine the best inoculation technique to use as well as which isolates to select for optimal screening. A 10µl droplet of a spore suspension, comprised of three virulent isolates, is added to the cut surface of each pine stem with a micropipette. Six weeks later lesion length is determined.

Six weeks after inoculation, the lesion length is measured by postgraduate students in the programme and the susceptibility/tolerance of the individual family/hybrid/species determined

Microarray service

Facility manager: Prof Dave Berger

Microarray scientific officer: Mr Nicky Olivier

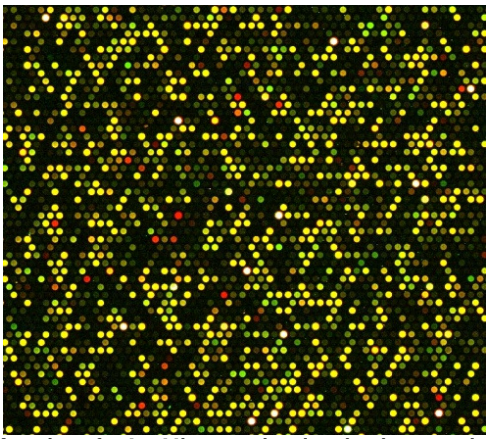
The ACGT (African Centre for Gene Technologies) Microarray Facility provides a service of printing DNA samples on glass slides at a density up to 9200 unique genes per slide. A maximum of 36 replicate slides are produced in a single spotting run. Printing is performed using a Generation III Array Spotter (Molecular Dynamics Inc, Sunnyvale, California, USA) housed in a controlled-environment laboratory. Arrayed slides are made available to users who either carry out the required experimental procedures in their own laboratories, or use the laboratory facilities at the University of Pretoria. Processed slides are brought to the Facility for the Scanning service, during which the fluorescence signals across the glass slides are measured and quantified using a GenePix 4000B Scanner (Molecular Devices Corporation, Foster City, California, USA). The captured microarray images and computed raw data are then provided to the user electronically. The Facility has a resident statistician who can assist users in the data analysis procedure using custom scripts in R and limma.

Recent developments at the ACGT Microarray Facility include:

- Expansion of Agilent slide processing capabilities
  A grant from the NRF enabled the Facility to purchase an Agilent Hybridization oven and hybridization chambers. Combined with the 5 µm resolution scanning ability of the current microarray scanner, the Facility is uniquely suited to fully process Agilent microarray slides. The Agilent system provides an extremely flexible and user-friendly way to design very high quality microarray slides, if sufficient genome sequence information is available. Standard microarray designs for selected organisms are also available from Agilent, and the processing of these slides is optimally performed using the hybridization oven and hybridization chambers now available at the Facility.

  The most widely used application for Agilent microarray slides is gene expression studies, and the Facility has assisted several researchers to process their slides. Species studied to date include *Homo sapiens* (cancer), *Rattus norvegicus*, *Plasmodium falciparum* and *Zea mays*.

  Except for gene expression studies the Agilent system is well suited for array Comparative Genome Hybridization (aCGH) studies. In this technique differences in genome copy numbers are determined for a test sample relative to a reference sample, with different cancer pathologies often displaying consistent copy number variations. The Facility has now started building some expertise in this field by assisting researchers from the University of the Witwatersrand Medical School, Department of Molecular Medicine & Haematology with human cancer aCGH experiments. The data analysis required for these studies is multilayered, with the initial data processing performed in the Facility, while the final comparisons and significance correlations are performed by the researcher concerned using Agilent proprietary software.



A region of a 4 x 44k array showing the dense probe coverage and spot quality for the Agilent array system

- Expansion of expertise in Open Source software:
  Bioconductor, USA (www.bioconductor.org).
  In partnership with BioPAD and the ACGT Bioinformatics and Computational Biology Unit at UP, expertise is being developed in the analysis of a variety of microarray datasets using open source R modules. This is the preferred method of data analysis endorsed by the Facility, and is performed with assistance of a statistician. Recently more sophisticated limma scripts have been developed that are useful for the analysis of single channel data in two channel gene expression studies.

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

FABI research groups have used the ACGT Microarray Facility in their research projects. A project of the Fungal Genetics Group led to the development of a 20-mer oligo diagnostic slide for differentiating between *Leptographium* species. The Eucalyptus Pine Pathogen Interactions Group studied the resistance to the bacterial pathogen *Ralstonia solanacearum* in *Arabidopsis thaliana*. The Molecular Plant-Pathogen Interactions group has on ongoing project on expression profiling the response of maize plants to grey leaf spot disease using whole genome maize arrays. The MPPI Group also uses microarrays to identify DArT markers in a tomato recombinant inbred line population.

Departments/institutions that made use of the Facility include the University of Pretoria Departments of Biochemistry, Genetics, Microbiology and Plant Pathology, Plant Science, Medical Physiology, University of Johannesburg Department of Biochemistry, University of the Witwatersrand Schools of Molecular and Cell Biology, School of Anatomical Sciences, CSIR Biosciences and the ARC Vegetable and Ornamental Plant Institute.

AWARDS

Awards for Excellence introduced in FABI

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 organizations, awards for research excellence and for travel to mention but a few. 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 recongnised as important and highly prized. The FABI awards are as follows:

Best FABI student publication

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

2007 Lieschen de Vos
2008 Nicky Creux

Best FABI MSc thesis

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

2007 Michelle Victor
2008 Luke Solomon

FABI award for mentorship

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

2007 Irene Barnes
Wilhelm de Beer
Martin Ranik
2008 Magriet van der Nest

Best FABI student personal website

The aim of this award is to encourage FABI students to produce personal web sites of high quality. Selection of the winner in this case is made through confidential ballot by students.

2007 Gilbert Kamgam Nkuekam
Chrizelle Beukes
2008 Bernice Porter

Best FABI student feature article on the website

The FABI web site includes short popular exposes of research papers and the best of these is selected by students to receive this award.

2007 Marelize van Wyk
2008 Nicky Creux

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.

2007 Marieka Gryzenhout
2008 Joha Grobbelaar

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

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

2007 Marie Theron
2008 Cathy Barnard

FABI award for recognizing 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.

2007 Mike Edwards (Executive Director of Forestry South Africa)
2008 Colin Dyer (Director of the Institute for Commercial Forestry Research)
Bernard Janse (Mondi)

FABIAN of the year

This is FABI's premium award for students and it recognizes 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.

2007 Draginja Pavlic
2008 Irene Barnes

Figures from left to right, top to bottom
Mike Wingfield handing the awards to (A) Draginja Pavlic (2007); (B) Irene Barnes (2008); (C) Marie Theron (2007); (D) Cathy Barnard (2008); (E) Mike Edwards (2007); (F) Bernard Janse (2008); (6) Marieka Gryzenhout (2007); and (H) Nicky Creux (2008)

FABI celebrates two recipients of UP honorary doctorates

During the past two years, the University of Pretoria has conferred Honorary Doctorates on two truly exceptional people that have also had close ties with FABI. An Honorary Doctorate represents the highest academic award made by the University, recognizing exceptional contributions to society. Illustrating this level of excellence is found in past recipients of UP honorary doctorates that include Nelson Mandela, Professor Wally Marasas FABI was thus delighted that the Council of the University of Pretoria chose to award honorary doctorates to Mr. Antony (Tony) Trahar in 2007 and to Mr. Ken Pegg in 2008. These awards were made in the Faculty of Business and Management Sciences and in the Faculty of Natural and Agricultural Sciences respectively.

Tony Trahar is one of South Africa's best known business personalities. His first association with FABI was at the time when he was Chairman of Mondi and when he was instrumental in establishing the Mondi Chair in Forest Pathology. This was some years prior to the establishment of FABI, but Mondi has continues to support the chair, in the interests of promoting tree health in South Africa. Tony went on to become the Chairman of Anglo American PLC and he has contributed substantial to the lives and livelihoods of large numbers of South Africans. His receipt of an honorary doctorate appropriately recognize his huge contributions directly and indirectly to the University of Pretoria and to South Africa.

Ken Pegg, an Australian scientist living in Brisbane, is arguably one of the world's best known plant pathologists. More specifically, he has contributed a lifetime of research and leadership in the field of subtropical fruit pathology. He is for example well-known for the contributions that he has made to finding practical solutions to the devastating Phytophthora root root of Avocado's. While he has produced large numbers of exceptional research publications during his career, Ken Pegg is especially appreciated for the tremendous mentorship that he has provided to many young pathologist and for the practical solutions that he has brought to the sub-tropical fruit industry including in South Africa, that sustains a continuous battle against a growing number of disease problems. FABI researchers have benefited deeply from the many scientific and leadership contributions of Ken Pegg and were delighted to celebrate his well-deserved honorary doctorate with him.

Mike Wingfield and Tony Trahar (left) and Ken Pegg (right) after they received their honorary doctorates

University of Pretoria Chancellor's medal award to two FABI supporters

The University of Pretoria Chancellor's medal is one of the highest awards of the institution. This award recognized the exceptional lifetime achievements of exceptional people, and particularly those that have been in some way involved in the activities of the University. In 2008, two exceptional South Africans that were also hugely involved in growth and development of FABI received UP Chancellor's medals. These went to Mr. Mike Edwards, past executive director of Forestry South Africa, and Mr. Rodney Hearne, a farmer who has been hugely influential in building the South African banana industry. While the Chancellor's awards are normally presented at UP graduation ceremonies, a special exception was made in the case of these two awards that were made as part of the FABI 10-year celebrations.

Rodney Hearne became associated with FABI shortly after the institute was founded in 1998. As a leader of the South African Banana Grower's Association, he recognized the importance of research to improve banana-growing in South Africa. More specifically, he and his colleagues sought to promote research on the devastating banana disease known as Panama Wilt and caused by the fungus *Fusarium oxysporum* f.sp. *cubense*. He was thus instrumental in establishing a research programme in FABI focused on banana pests and diseases and especially on Panama Wilt. Rodney's many contributions to the betterment of the life of South African's extend far beyond his involvement in FABI and his receipt of the UP Chancellor's medal is deeply deserved.

Although its reach now extends much more widely, FABI was established based on a programme focused on research on pests and diseases important to the South African forestry industry. It is, therefore, not surprising that Mike Edwards, in his capacity as Executive Director of Forestry South Africa, was fundamentally involved in the establishment of FABI. He was closely involved in the first discussions relating to moving the Tree Protection Co-operative Programme to the University of Pretoria and in so doing, establishing a new post graduate research institute to house the TPCP. Post the establishment of FABI, Mike has been hugely involved in leading many research projects in FABI serving on the board of the TPCP. In recent years, he has also guided the DST/NRF Centre of Excellence in Tree Health Biotechnology (CTHB), also serving on the Centre's board. FABI was thus delighted that the Senate and the Council of the University of Pretoria decided to present Mike Edwards with the Chancellor's award.

Figures from left to right, top to bottom:
Prof Ströh, Mike Wingfield, Mike Edwards, Rodney Hearne and Prof Crewe (L to R) after the Chancellor's award were given to Mike and Rodney
Prof Mike Wingfield receiving his APS fellowship in the USA
Brenda Wingfield receives the Woman in Science Award from the Minister of Science & Technology
XuDong Zhou (3rd from left) receiving the Outstanding Youth Award from the Chinese Academy of Forestry

TPCP and CTHB scientists awarded for outstanding science

Professor Brenda Wingfield was awarded the national Distinguished Woman Scientist Award in the area of Life Science during an awards dinner in Johannesburg on the 8th of August 2008. This award, made by the South African Department of Science and Technology (DST) celebrates "Women in Science" as a direct response to the vision encapsulated in the National Research and Development Strategy of ultimate improvement in the quality of life of South Africans. The adjudication criteria were a proven research publication record, evidence of international eminence, experience in supervising other researchers, national and/or international acclaim for their research, contribution of research outputs to building the knowledge base and exploitability of outputs. She was also awarded the Woman in Water Sanitation and Forestry award in 2007 from the Department of Water affairs and Forestry.

Professor Mike Wingfield was the recipient of two prestigious awards in 2008. On the 29th of July Mike was one of only 12 recipients of a prestigious APS *Fellow award* handed out by the American Phytopathological Society. The Society grants this honour to a current APS member in recognition of distinguished contributions to plant pathology and/or to The American Phytopathological Society. Fellow recognition is based on significant contributions in one or more of the following areas: original research, teaching, administration, professional and public service, and/or extension and outreach. The ceremony took place at the APS Centennial conference in Minneapolis, USA. To quote the President of the APS, Prof Ray Martyn: "It gives me great pleasure to inform you that you have been elected an APS Fellow this year. As you know, this is the highest honour our society bestows upon a member and it recognizes your outstanding career and service to APS".

The second award Mike received this year was the Academy of Science of South Africa's (ASSAf) *Science-For-Society 2008 Gold Medal*. The committee of the ASSAf were particularly impressed by Prof Wingfield's self-initiated research, his record of training postgraduate students and the potential contribution of his research to South African society.

Professor Bernard Slippers was awarded one of the University of Pretoria's seven Exceptional young researcher awards. One of the University of Pretoria's most important goals is its delivery of quality research outputs. To give recognition to the people who are responsible for the establishment and development of the University's reputation as a research institution of note, the University annually holds an Awards Ceremony to honour its outstanding achievers in the academic field. There are three categories for these awards: the Chancellor's Awards, the Outstanding Achievers: Academic, and the Exceptional Young Researchers Awards.

Professor Jolanda Roux was the runner in the Woman in Water Sanitation and Forestry award in 2007 from the Department of Water Affairs and Forestry.

Dr. Irene Barnes was awarded the PANNAR floating trophy award at the Southern African Society of Plant Pathology for the best paper presentation (2009).

WORKSHOPS & CONFERENCES

First International Banana Symposium

During 10-14 September 2007, The International Society for Horticultural Science (ISHS) and the Global Programme for *Musa* Improvement (ProMusa) hosted their first international symposium *Foc*using on "The recent advances in banana crop protection for sustainable production and improved livelihoods". The event was co-organised by Bioversity International and The Banana Research Programme @ FABI, University of Pretoria. Financial support was received from FABI, Bioversity International, Du Roi Laboratories, the Centre for Agricultural and Rural Cooperation, Inqaba Biotech, Dole South Africa, Bayer and the Kiepersol branch of BGASA.

Ninety two delegates from 25 countries came together for a three-day symposium to discuss the status of banana pests and diseases and the progress made in control strategies. The programme included the following sessions:

- Management of bacterial and viral diseases
- Enhancing soil health for pathogen and pest management
- New approaches to foliar disease management
- Understanding diversity, managing diseases
- Understanding plants responses to diseases and pest challenge
- The role of crop improvement in pest and disease management
- Improving crop protection: on-farm experiences and approaches for more effective training, input delivery and information

The abstracts booklet (in pdf form) can be downloaded from http://www.promusa.org/news/ISHS_ProMusa_program.pdf.

Diversity Array Technology Workshop (DArT) (March/April 2008)

Diversity Arrays are a powerful technology for plant breeding, genetic analysis and biodiversity studies. It has been particularly useful for the study of crop plants, and is currently being applied in two research programmes of FABI – tomato diversity arrays being used by Dr Antoinette Van Schalkwyk in the MPPI group of Prof Dave Berger and Eucalyptus diversity arrays in the FMG group of Prof Zander Myburg.

Dr. Andrzej Kilian, the inventor of this technology, presented a workshop on Diversity Arrays during March/April 2008 in FABI that was attended by 26 South African scientists. Participants were from University of Limpopo, University of Venda, University of Zululand, University of the Western Cape, University of the Witwatersrand, University of Freestate, University of Stellenbosch, University of Pretoria, SANBI, four different institutes of the Agricultural Research Council, University of Nairobi and International Livestock Research Institute, Kenya, and industry was represented by SAKATA Vegenetics, RSA and CenGen, Western Cape.

The Department of Science and Technology provided funding for most of the delegates to attend the workshop as well as the travel of Dr. A. Kilian to South Africa. The workshop was arranged as a satellite activity to the SA Genetics Society congress, SAGS2008. This meant that over 100 delegates were able to benefit from the plenary lecture of Dr A. Kilian, and also presentations by Prof Berger, Prof Myburg and Dr Van Schalkwyk. Furthermore, DArT workshop participants were also given the opportunity to be sponsored to attend the SAGS2008 congress (eleven in total). The DArT workshop was a great success with very positive feedback from the participants. In addition, Dr. Matias Kirst, a guest of Prof Myburg at SAGS2008, presented a guest lecture on genetic mapping at the workshop.

DArT Workshop participants with presenters Dr. Andrzej Kilian and Dr. Matias Kirst.

Virus induced gene silencing (VIGS) workshop (February 2008)

Viral vectors have found great use in plant functional genomics for the *in vivo* silencing of specific genes as well as the over-expression of gene products. The University of Pretoria and the Scottish Crops Research Institute (SCRI) arranged a South Africa-UK science network activity funded by the Royal Society and the NRF to provide technical and theoretical assistance to researchers interested in the use of viral vectors in plant studies. The network was made up of Prof Dave Berger (FABI, UP), Dr. Bridget Crampton (CSIR Biosciences) and Dr Eduard Venter (University of Johannesburg) on the South African side and Dr. Ingo Hein from SCRI in the UK.

VIGS workshop delegates with Dr Hein, Dr Gilroy and Prof Birch

The training course started with a one-day symposium hosted at the CSIR Biosciences in Pretoria, where guest speakers presented talks about several aspects of the use of virus vectors in plant functional genomics. The speaker delegation from SCRI were Dr Hein, Prof Paul Birch, Dr Eleanor Gilroy, and Dr Leighton Pritchard. Local guest speakers were Prof Chrissie Rey from University of Witwatersrand, Prof Johan Burger from University of Stellenbosch, Dr. Crampton and Dr. Venter.

The Symposium was attended by 75 postgraduate students and scientists from many different University Departments and Science Councils in South Africa, including 12 from CSIR Biosciences, 8 from University of Johannesburg, 25 from University of Pretoria representing Departments of Plant Science, Genetics, Biochemistry, Bioinformatics, Zoology and Entomology, Microbiology and Plant Pathology and the Forestry and Agricultural Biotechnology Institute (FABI), 9 from University of Witwatersrand, and also delegates from Citrus Research International, I Temba Labs, South African National Biodiversity Institute (SANBI), South African Sugarcane Research Institute (SASRI), and the Agricultural Research Council Vegetable and Ornamental Plant Institute.

This was followed by a four-day laboratory workshop in the MPPI lab at FABI. Participants were from several laboratories across the country that are using or planning to use plant viral vectors for their research. Intensive hands-on experience was gained in the design and execution of virus-induced gene silencing (VIGS) experiments in monocotyledonous and dicotyledonous plant species. RT-qPCR assays using the Roche HTC480 Litecycler in FABI were also carried out, an important tool to assess the efficacy of silencing.

Local presenters at Plant Virus Vector Symposium, CSIR: Prof C Rey, Prof J Burger, Dr E Venter and Dr B Crampton

International Symposium on the Sirex Woodwasp

Forty international researchers and foresters from 17 different countries, and as many delegates from South Africa, convened between 9-16 May 2007 in Pretoria and Pietermaritzburg, to engage with the subject of the *Sirex* woodwasp and its control. The meeting was jointly organised by *Sirex* researchers at FABI (Prof Mike Wingfield, Prof Bernard Slippers and Mr Brett Hurley), the South African *Sirex* Control Programme and the Institute for Commercial Forestry Research (ICFR) (Prof Colin Dyer and Mrs Sally Upfold). This symposium emerged from the realization that there is an international need to combine efforts to combat the growing threat of *Sirex* globally. The symposium succeeded in bringing together a rich mosaic of both practical and academic experience from virtually all groups working in this domain around the world, providing an international summary of the leading research and management efforts around *Sirex*.

After the symposium, international delegates had the opportunity to experience first hand the efforts of the South African Sirex Control Programme. After a field trip through Mpumalanga and Zululand in KwaZulu-Natal, they spent a day in-field in the KwaZulu-Natal midlands, looking at forest compartments where *Sirex* is present and the control efforts surrounding it. This was followed by a one-day workshop held in Pietermaritzburg, focused on combining international and local expertise and experience towards more effectively management of *Sirex* in southern Africa.

One of the most important outcomes of the International Symposium and Workshop was that it facilitated the birth of invaluable collaboration and partnerships with experts from around the globe. It was also decided to establish a central data base of literature and information (www.fabinet.up.ac.za/sirex) pertaining to the Sirex woodwasp and other Siricidae. There can be no doubt that this remarkable event will continue to support efforts to manage the Sirex woodwasp well into the future.

Delegates of the International Sirex Symposium (Photo by Luke Esprey)

IUFRO Research Group 7.03.00 (Entomology) conference: Recent Advances in Forest Entomology

The conference, "Recent Advances in Forest Entomology" was held 1-6 July 2008 in Pretoria. The meeting was sponsored by IUFRO Research Group 7.03.00, "Entomology" and organized by researchers and staff at FABI (Bernard Slippers, Mike Wingfield, Jolanda Roux, Brett Hurley, Jenny Hale, Eva Muller, Rose Visser and Heidi Roos) and Andrew Liebhold from the USDA. The conference was organized as a satellite meeting to the XXIII International Congress of Entomology that was held the following week in Durban, South Africa. Following two days of scientific presentations in Pretoria, delegates spent two days viewing sites of entomological and tourist interest en route to Durban.

The conference was attended by 63 delegates representing the following 21 countries: Argentina, Australia, Brazil, Canada, Chile, China, Czech Republic, France, Finland, Hungary, Indonesia, New Zealand, Northern Ireland, South Africa, Sweden, Switzerland, Russia, Spain, Uruguay, USA and Zambia. A total of 37 oral and 10 poster presentations were given. This conference represented the continuation of a tradition in RG 7.03.00 of holding a satellite meeting in conjunction with the International Congress of Entomology, which is held every four years. As in previous years, the meeting was a chance for forest entomologists to take a little extra time and meet on their own, network and build strong relationships with fellow scientists who share common interests, as well as become acquainted with local entomological problems. This conference was particularly successful in meeting these goals, in part because of the unique geographical representation of delegates, particularly from countries in Latin America and Africa, which typically are under-represented at IUFRO meetings.

Delegates of the 'Recent Advances in Forest Entomology' conference

PUBLICATIONS 2007-2009

These lists include only publications that had appeared by the end of May 2009. Manuscripts in press and submitted for publication are not included.

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Inventors: C Munro and A Viljoen

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Silberbauer J, McNair G, Ranik M. Myburg AA (2008) Diagnostic marker genes for early and late induction of tension wood in *Eucalyptus* trees. South African Genetics Society 2008 Congress, Pretoria, 27 - 29 March 2008. (Awarded as the best student poster presentation).

Solomon L, Myburg AA (2008) A wooden clock: Diurnal and circadian rhythms of gene expression in wood-forming *Eucalyptus* tissues. South African Genetics Society 2008 Congress, Pretoria, 27 - 29 March 2008. (Awarded as the best postgraduate student oral presentation).

Sutherland R, Chikwamba, Viljoen A (2008) Identification of unique DNA fragments in *Fusarium oxysporum* f. sp. *cubense* 'tropical' and 'sub-tropical' race 4. 20th Biennial Congress of the South African Genetics Society. Pretoria. South Africa 27-29 March.

Swanevelder ZH, Venter E, Botha A-M (2008) The effect of normalization methods on the identification of differentially regulated genes after Affymetrix analysis. 20th Biennial Congress of the South African Genetics Society, University of Pretoria, Pretoria, 27-29 March 2008.

Swart L, Venter SN, Roux J, Coutinho TA (2009) *Xanthomonas* species associated with bacterial blight and die-back of Eucalyptus in South Africa. Proceedings of the 46th Annual Congress of the Southern African Society for Plant Pathology, Gordon's Bay.

Taole MM, Burgess TI, Wingfield BD, Wingfield MJ (2009) Population biology and phylogenetic reassesment of Eucalyptus pathogen *Kirramyces epicoccoides* from diseased Eucalyptus leaves. Proceedings of the 46th Annual Congress of the Southern African Society for Plant Pathology, Gordon's Bay.

Van der Linde JA, Begoude BAD, Roux J (2009) Botryosphaeriaceae occurring on native and introduced *Acacia* spp. in South Africa. Proceedings of the 46th Congress of the Southern African Society for Plant Pathology, Gordon's Bay, South Africa.

Van der Linden LE, Naidoo S, Berger DK (2008) *Arabidopsis thaliana,* ecotype Kil-0, shows single gene resistance to a bacterial wilt isolate from *Eucalyptus*. 20th Biennial Congress of the South African Genetics Society. Pretoria, South Africa, 27-29 March.

Van der Linden LE, Naidoo S, Berger DK (2009) Genetic analysis of an *Arabidopsis thaliana* ecotype showing resistance to a bacterial wilt isolate from Eucalyptus. 35th Annual Conference of the South African Association of Botanists (SAAB), Stellenbosch, South Africa.

Van der Merwe JJ, Coutinho TA, Van der Waals J (2007) Recent outbreaks of blackleg on potatoes in South Africa. Proceedings of the 45th Congress of the Southern African Society of Plant Pathology, 21-24 January, Kopanong Conference Centre, Benoni.

Van der Merwe JJ, Coutinho TA, Van der Waals JE (2009) Effect of Si soil amendments on defense responses of potato tubers to *Pectobacterium* spp. Proceedings of the 46th Annual Congress of the Southern African Society for Plant Pathology, Gordon's Bay.

Van der Merwe NA, Steenkamp ET, Heath RN, Nakabonge G, Gryzenhout M, Roux J, Wingfield MJ, Wingfield BD (2008) Chronometric analyses of DNA sequences reveal native hosts for the tree pathogen *Chrysoporthe austroafricana* in Africa. 20th South African Genetics Society Congress, Pretoria.

Van der Nest A, Steenkamp ET, Marais GJ (2007) *Phoma sorghina*: a review of the complexity of its taxonomy and ecological distribution. 45th Congress of the Southern African Society for Plant Pathology, Benoni.

Van der Nest A, Steenkamp ET, Marais GJ (2008) Phylogenetic diversity of *Phoma sorghina* in South Africa. Biennial Conference of the South African Society for Microbiology (BIO-08), Rhodes University, Grahamstown.

Van der Nest A, Steenkamp ET, Marais GJ (2008) Phylogenetic variation within *Phoma sorghina* sensu lato. 20th Biennial Congress of the South African Genetics Society. Pretoria, South Africa 27-29 March.

Van der Nest A, Steenkamp ET, Marais GJ (2009) Phylogenetic definition of *Phoma sorghina* based on the ITS, EF-1α and β-tubulin gene regions. Abstracts of the 46th Congress of the Southern African Society for Plant Pathology / 6th Congress of the African Mycological Association, Villa Via Hotel, Gordon's Bay, 25-28 January 2009.

Van der Nest MA, Slippers B, Wilkens M, Van Zyl C, Stenlid J, Wingfield MJ, Wingfield BD (2008) Placement of *Amylostereum areolatum* compatibility genes and QTLs for homokaryon vigour on an AFLP linkage map. 20th South African Genetics Society Congress, Pretoria.

Van der Nest MA, Wilkens M, Slippers B, Stenlid J, Wingfield BD, Wingfield MJ (2007) Sexual compatibility in

Amylostereum areolatum Proceedings of the 45th Annual Congress of the Southern African Society for Plant Pathology, Kopanong, 21-24 January.

Van der Walt FJJ, Marais GJ, Slippers B, Roux J, Wingfield MJ (2007) Botryosphaeriaceae associated with native *Acacia* species in Southern Africa. Abstracts of the 45th Congress of the Southern African Society for Plant Pathology, Copanong Conference Centre, Benoni, 21-24 January 2007.

Van der Walt FJJ, Marais GJ, Slippers B, Roux J, Wingfield MJ (2008) New species of Botryosphaeriaceae with native *Acacia* species in Southern Africa. 20th Biennial Congress of the South African Genetics Society, University of Pretoria, Pretoria, 27-29 March 2008.

Van der Walt FJJ, Marais GJ, Slippers B, Roux J, Wingfield MJ (2008) Botryosphaeriaceae associated with native *Acacia* spp. with special reference to *Acacia mellifera* (M. Vahl.) Benth. Abstaracts of the Bio-08 (SASM) congress at Rhodes University, Grahamstown, 21-23 January 2008.

Van der Walt, E, Van Schalkwyk A, Berger DK (2008) Genetic relationships between South African *Solanum retroflexum* and other related species using partial 18S sequencing. Joint congress of the SA Association of Botanists (SAAB) and SA Soc for Systematic Biology (SASSB), Drakensville, RSA, 14-18 Jan 2008 and SAGS2008: 20th biennial congress of the SA Genetics Society, University of Pretoria, 27-29 March 2008.

Van Schalkwyk A, Van der Walt E, Berger DK (2008) Genotyping *Solanum lycopersicum* and its related wild species using Diversity Arrays Technology (DArT), Joint congress of the SA Association of Botanists (SAAB) and SA Soc for Systematic Biology (SASSB), Drakensville, RSA, 14-18 Jan 2008.

Van Staden D, Marais GJ, Lübben A (2007) Spoilage of commercial white bread and wheat with specific reference to fungi and their mycotoxins. Abstracts of the 45th Congress of the Southern African Society for Plant Pathology, Copanong Conference Centre, Benoni, 21-24 January 2007.

Van Wyk M, Wingfield BD, Wingfield MJ (2008) A new *Ceratocystis* sp. associated with wounds on *Styrax benzoin* made to produce incense in Indonesia. 20th South African Genetics Society Congress, Pretoria.

Van Wyk M, Wingfield BD, Wingfield MJ (2008) Unraveling species boundaries in the *Ceratocystis fimbriata sensu lato* complex based on DNA sequences and phylogenetic inference. 20th South African Genetics Society Congress, Pretoria.

Van Wyk SJP, Rose LJ, Coutinho TA, Wingfield MJ, Viljoen A (2009) Optimizing species-specific primers to distinguish between *Fusarium circinatum* and *F. proliferatum*. Proceedings of the 46th Annual Congress of the Southern African Society for Plant Pathology, Gordon's Bay.

Van Wyk SJP, Rose LJ, Coutinho TA, Wingfield MJ, Viljoen A (2009) Screening *Pinus* spp. and families for resistance to the pitch canker fungus, *Fusarium circinatum*. Proceedings of the 46th Annual Congress of the Southern African Society for Plant Pathology, Gordons Bay.

Van Zuydam NR, Wingfield BD, Jacobs K, Lezar S, Wingfield MJ (2008) Design and application of a Diagnostic array for *Leptographium* species. 20th South African Genetics Society Congress, Pretoria.

Van Zuydam NR, Wingfield BD, Jacobs K, Wingfield MJ (2007) Microarrays: a novel diagnostic technology for *Leptographium*. Proceedings of the 45th Annual Congress of the Southern African Society for Plant Pathology, Kopanong, 21-24 January.

Van Zyl K, Van der Nest MA, Slippers B, Stenlid J, Wingfield MJ, Wingfield BD (2009) Identification and characterization of selectively induced genes expressed during vegetative incompatibility in *Amylostereum areolatum*. Proceedings of the 46th Annual Congress of the Southern African Society for Plant Pathology, Gordon's Bay.

Vermeulen M, Gryzenhout M, Wingfield MJ, Roux J (2009) New host and geographic records for the Cryphonectriaceae in Africa. Proceedings of the 46th Annual Congress of the Southern African Society for Plant Pathology, Gordon's Bay.

Viljoen A, Nel B, Van den Berg N, Munro C, Paparu P, Belgrove A, Sutherland R (2007) The role of disease resistance in the integrated management of Fusarium wilt of banana. 17th Annual soil-borne plant disease symposium, Stellenbosch, South Africa, 19-20 September.

Wilken FE, Ros B, Berger DK (2009) Expression analysis of the defence gene *SGT1* (suppressor of the G2 allele of *skp1*) in pearl millet (*Pennisetum glaucum*) during salicylic acid treatment. 35th Congress of the SA Association of Botanists (SAAB), Stellenbosch, RSA.

Wilken PM, Wingfield BD, De Beer ZW, Wingfield MJ (2008) The amplification of MAT-2 genes in the fungal genus *Ophiostoma*. 20th South African Genetics Society Congress, Pretoria.

Wilken PM. Wingfield MJ, De Beer ZW, Wingfield BD (2009) Mating (MAT) genes in the fungal genus *Ophiostoma*. Proceedings of the 46th Annual Congress of the Southern African Society for Plant Pathology, Gordon's Bay.

Wingfield BD (2009) The future of DNA based identification of fungi. Proceedings of the 46th Annual Congress of the Southern African Society for Plant Pathology, Gordon's Bay.

Wright J, Ganley RJ, Steenkamp ET, Iturritxa E, Ahumada R, Wingfield BD, Marasas WFO, Wingfield MJ (2007) Phylogeny of the pine pitch canker fungus, *Fusarium circinatum*: an emerging global view. Proceedings of the 45th Annual Congress of the Southern African Society for Plant Pathology, Kopanong, 21-24 January.

Wright LP, Lombard L, Wingfield BD, Wingfield MJ (2007) Polymorphic microsatellites for studying the population genetics of *Cylindrocladium pauciramosum* Proceedings of the 45th Annual Congress of the Southern African Society for Plant Pathology,

SEMINAR PRESENTATIONS

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

Dr Robert Park
Cereal Rust Laboratory, Australia
January 2007
Eucalyptus leaf diseases

Dr Dominik Begerow
Max-Planck Institute for Terrestrial Microbiology, Germany
January 2007
Hitchhiking through the botanic realm – plant parasitic fungi in time and space

Prof Bruce Chassy
University of Illinois, USA
February 2007
Genetic modification, food safety and safety evaluation of "biotech" foods

Prof Steve Strauss
Oregon State University, USA
April 2007
Physiological sculpture of trees by genetic modification of gibberellic acid signaling

Prof D Frischmann
Technical University of Munich, Germany
April 2007
High-throughput genome annotation: "the current status"

Prof P Birch
Scottish Crops Research Institute, UK
April 2007
The battle of susceptibility and resistance in plant-pathogen interactions

Dr I Toth
Scottish Crops Research Institute, UK
April 2007
The power of plant pathogen genomics: *Pectobacterium atrosepticum* – a case study

Dr P Boevink
Scottish Crops Research Institute, UK
April 2007
Aspects of cell biology that relate to studying host-pathogen interactions

Mr James Zanzot
Auburn University, USA
July 2007
The role of Ophiostomatoid fungi and their vectors in longleaf pine decline

Dr Tom Hash
ICRISAT, India
September 2007
Recent progress in molecular and conventional breeding of sorghum and millets

Prof William Fry
Department of Plant Pathology, Cornell University, USA
February 2008
Phytophthora infestans: why still a problem?

Prof Dave Richardson
Centre of Invasion Biology, Department of Botany and Zoology, University of Stellenbosch
March 2008
Mutualisms - key drivers of invasions....key casualties of invasions

Dr Ken Pegg
Queensland Dept of Primary Industries, Australia
April 2008
Control of Phytophthora root rot of avocado

Prof Richard Oliver
Australian Centre for Necrotrophic Fungal Pathogens (ACNFP), Murdoch University, Australia
May 2008
Analysis of the genome sequence of *Stagonospora nodorum*: evolution of virulence in Pleosporalean cereal pathogens

Prof Lorna Casselton
University of York, UK
May 2008
Fungal mating pathways: insights into cell signalling and genome evolution

Dr Hans Hagen
Royal Society, UK
May 2008
Royal Society's UK international funding portfolio

Prof Dominique Michaud
Laval University, Quebec, Canada
May 2008
Proteomic strategies for the characterization of novel plants and food

Dr Thomas Jung
Forest Health Consultant, Germany
July 2008
Introduced Phytophthora pathogens as driving force of devastating forest declines in Europe.

Dr Conrad Schoch
Department of Botany and Plant Pathology, Oregon State University, USA
July 2008
The fungal tree of life: systematics meets genomics

Prof Jarko Hantula
METLA, Finland
August 2008
Potential of Chondrostereum purpureum as a sprout control of birch in Finland

Dr Hikaru Seki
Kihara Institute for Biological Research, Yokohama City University, Japan
September 2008
The identification of a new cytochrome P450 monooxygenase gene involved in the biosynthesis of the natural sweetener, glycyrrihizin in Licorice plants

Prof John Leslie
Department of Plant Pathology, Kansas State University, USA
November 2008
Toxins and fungal genetic diversity from sorghum and millet (and a few other African crops)

Prof Steven Lindow
University of California, Berkeley, USA
January 2009
Pathogen confusion and control of *Xylella fastidiosa*

Dr Jeff Garnas
Dartmouth College, USA
February 2009
Elucidating the role of non-native insects and disease in structuring forests: a case study of beech bark disease in North America

Dr Jennifer Juzwik
USDA Forest Services, St. Paul, USA
March 2009
Ceratocystis spp. and their insect vectors in the USA

Prof Don Lee
Department of Forestry, Seoul National University, Korea/President of IUFRO
March 2009
Introduction to IUFRO

Dr Ian Toth
Scottish Crops Research Institute, Scotland, UK
April 2009
An update on Pectobacterium genomics

Dr Zvi Mendel
Volcani Centre, Israel
May 2009
Conservation biological control of the pine processionary moth (Thaumetopoea wilkinsoni)

Prof Volker Brözel
South Dakota State University, USA
May 2009
Escape from the laboratory: Characterizing growth of *Bacillus subtilis* in its native environment

FABI TEAM

2007-2009

Full time academic & research staff

Prof Dave Berger
Prof Teresa Coutinho
Prof Karl Kunert
Prof Anna-Maria Botha-Oberholster
Prof Brenda D. Wingfield
Prof Michael J. Wingfield
Assoc Prof Terry Aveling
Assoc Prof Zander Myburg
Assoc Prof Jolanda Roux
Assoc Prof Bernard Slippers
Assoc Prof Fanus Venter
Dr Rachel Chikwamba
Dr Gert Marais
Dr Lucy Moleleki
Dr Sanuska Naidoo
Dr Noëlani van den Berg
Dr XuDong Zhou
Mr Brett Hurley

Technical staff

Ms Joanne Bradfield
Ms Elna Cowley
Mr Neil de Jager
Ms Gerda Fourie
Ms. Sonica Godard
Ms Izette Greyling
Mr Hardus Hatting
Ms Tracey Hatherell
Ms Pritty Khumalo
Ms Jeanne Korsman
Mr Ian Law
Ms Annelie Lübben
Ms Grieta Mahlangu
Ms Babalwa Mbebe
Ms Tanja Meyer
Ms Eshchar Mizrachi
Ms Tsholofelo Mojela
Ms Eva Müller
Ms Karin Muller
Mr Duncan Newman
Ms *Valentina* Nkosi
Ms Nicky Olivier
Ms Heidi Roos
Ms Anita Steyn
Ms Melissa Turton (until January 2009)
Ms Lydia Twala
Ms Liesl van der Linden
Ms Erika van der Walt
Ms Irene van Nugteren
Ms Martie van Zyl (until February 2009)
Ms Adri Veale

Administrative staff

Ms Mmampe Aphane
Ms Vivienne Clarence
Ms Helen Doman
Ms Magda Fouche
Ms Jenny Hale
Ms Adrene Laubsher
Ms Martha Mahlangu
Ms Rose Visser

Computer support

Mr Chris Visagie (until 1st May 2007)
Mr Charl Joubert (until 30th June 2008)
Mr Hendrik Swanepoel

Information specialist

Ms Marié Theron (Until end of January 2008)
Ms Leonie Muller (until end of April 2009)
Ms Elna Randall

Honorary professors/lecturers

Prof P Birch
Prof PW Crous
Prof WFO Marasas
Prof JP van der Walt
Prof J Webster
Prof S Neser
Dr T Burgess
Dr B Eisenberg
Dr O Preisig
Dr I Toth

Sabbatical visitors

Prof Reyes Blanco, University of Almeira, Spain

Postdoctoral fellows

Dr Yoseph Beyene
Genetic characterization of resistance in *Arabidopsis thaliana* to an African isolate of the bacterial wilt pathogen, *Ralstonia solanacearum*

Dr Irene Barnes
Mating strategies in the native fungal pathogen, *Ceratocystis albifundus*

Dr Mesfin Bogale
Mitochondrial sequencing of *Fusarium*

Dr Emilie Boisson
The molecular ecology and evolution of the *Amylostereum* – Siricid mutualism

Dr Carrie Brady
Taxonomy of plant associated members of the Enterobacteriaceae

Dr Marieka Gryzenhout
The taxonomy of relevant fungi, focusing on the pathogen group Cryphonectriaceae and endophytes of *Eucalyptus* and *Syzygium*

Dr Wolfgang Maier
Global phylogeny of rust fungi with specific focus on African species

Dr Seonju Marinkowitz
Fungi on *Protea* species

Dr Lu Min
Ophiostomatoid fungi associated with bark beetles

Dr Eunsong Oh
Phytophthora species in the indigenous forests of South Africa

Dr Donovan Porter
Survival of *Pantoea ananatis* in the environment

Dr Francois Roets
Phylogeny of the Ophiostomatales on *Protea* species in South Africa

Dr Barbara Ros
Genomics of quantitative disease resistance in African maize varieties

Dr Urte Schlüter
Nodule senescence under drought stress

Dr Christell van der Vyver
Radiation-induced genome changes

Dr Antoinette van Schalkwyk
High quality Solanaceous crops for consumer, processors and producers by exploration of natural biodiversity through Diversity Array Technology

Dr Juan Vorster
Protein modelling and design

Dr Jane Wright
The global population biology of *Fusarium circinatum*

UP research fellow

Martin Coetzee
Taxonomy and phylogenetic analyses of African *Ganoderma* species
Mitochondrial genomes of plant pathogenic fungi: molecular characterization and evolution

Current postgraduate students

PhD students

Didier Begoude
Identity and diversity of Botryosphaeriaceae associated with *Terminalia* spp. in Africa
Advisors: J Roux, MJ Wingfield & B Slippers

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

Wubetu Bihon
Characterization of *Diplodia pinea* in South Africa
Advisors: BD Wingfield, MJ Wingfield, B Slippers & T Burgess

ShuaiFei Chen
Fungal diseases threatening eucalypt plantations in China
Advisors: XD Zhou, J Roux, YJ Xie & MJ Wingfield

Maria-Noël Cortinas
Population genetics of the stem canker pathogen, *Coniothyrium zuluense*
Advisors: BD Wingfield & MJ Wingfield

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

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

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

Pieter de Maayer
Virulence factors associated with *Pantoea ananatis*
Advisors: TA Coutinho & SN Venter

Lieschenn de Vos
Characterization of the *Fusarium circinatum* genome
Advisors: BD Wingfield, MJ Wingfield & Z Myburg

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

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

Alvaro Duran
Pine needle disease of *Pinus radiata* in Chile
Advisors: MJ Wingfield, B Slippers, M Gryzenhout & BD Wingfield

Rosita Endah
Functional characterization of two NPRI genes
Advisors: KJ Kunert & R Chikwamba

Berhanu Fenta
The role of the protease/protease inhibitor system in nodule senescence under water deficit in legumes
Advisor: KJ Kunert

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

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

Endale Gebre
Induction of dwarfism for lodging resistance in Tef (*Eragrostis tef*)
Advisor: KJ Kunert

Andile Grootboom
Increasing the lysine content in maize by engineering proteinase inhibitor
Advisors: R Chikwamba & KJ Kunert

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

Brett Hurley
Molecular ecology and establishment of the *Sirex noctilio* biocontrol agents, *Deladenus siricidicola* and *Ibalia leucospoides*
Advisors: B Slippers & MJ Wingfield

Riana Jacobs
Studies on the *Fusarium* spp. in the *Gibberella fujikuroi* complex
Advisors: TA Coutinho, MJ Wingfield, BD Wingfield & WFO Marasas

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

Gilbert Kamgam Nkuekam
Ophiostomatoid fungi on broad-leaf trees, with particular reference to southern Africa
Advisors: J Roux & MJ Wingfield

Presidor Kendabie
Mapping of determinants of drought in *Musa*
Advisors: A-M Oberholster & AA Myburg

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

Anand Kullan
Genetic mapping of wood property and growth traits in interspecific hybrid progeny of *Eucalyptus* tree species
Advisor: AA Myburg

Lorenzo Lombard
Phylogeny and taxonomy of *Cyclindrocladium* spp. with obpyriform to ellipsoidal vesicles
Advisors: MJ Wingfield, BD Wingfield & PW Crous

Celia Martins
Drought stress in cowpea
Advisor: KJ Kunert

Bongani Maseko
Phytophthora root rot associated with cold tolerant eucalypts in South Africa
Advisors: TA Coutinho, MJ Wingfield, BD Wingfield & T Burgess

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

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

Lorraine Moses
Fumonisin regulating genes in *Fusarium verticillioides* and other fumonisin producing fungi
Advisors: MJ Wingfield, BD Wingfield & WFO Marasas

XinTao Mou
Cylindrocladium spp. on eucalypts in China
Advisors: XD Zhou, J Roux & MJ Wingfield

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

Ryan Nadel
Molecular and chemical ecology of the interaction between *Taumastocoris peregrinus*, the *Eucalyptus* host and its parasites
Advisors: B Slippers, M Scholes & MJ Wingfield

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

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

Marie Onanema
Impact of cartegena protocol on Cameroon
Advisors: KJ Kunert & R Chikwamba

Draginja Pavlic
Population biology of *Botryosphaeria* spp. from native and introduced hosts in Southern Africa
Advisors: B Slippers, MJ Wingfield & TA Coutinho

Guillermo Perez
Biology and population dynamics of *Mycosphaerella* spp. infecting eucalypts
Advisors: MJ Wingfield & B Slippers

Martin Ranik
Molecular genetics of cellulose and hemi-cellulose biosynthesis in Eucalyptus
Advisor: AA Myburg

Quentin Santana
Molecular characterization of vegetative compatibility in the pitch canker fungus, *Fusarium circinatum*
Advisors: MPA Coetzee, BD Wingfield, ET Steenkamp & MJ Wingfield

M Callies Selala
Apoptosis and induced genotoxicity in selected cell lines
Advisors: PJ Oberholster & A-M Botha-Oberholster

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

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

Dirk Swanevelder
Signal transduction during RWA defense
Advisors: AM Oberholster & E Venter

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

Matsepo Taole
Population biology and phylogenetic reassessment of the *Eucalyptus* pathogen, *Kirramyces epicoccoides*
Advisors: BD Wingfield, MJ Wingfield & T Burgess

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

Magriet van der Nest
Compatibility in *Amylostereum areolatum*
Advisors: MJ Wingfield, BD, Wingfield, B Slippers & J Stenlid

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

MSc students

Chrizelle Beukes
Isolation, identification and characterization of the root nodule bacteria associated with *Pterocarpus* and *Hypocalyptus* species
Advisors: ET Steenkamp

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

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

Marc Bouwer
Chemical ecology of the *Gonipterus scuttelatus-Eucalyptus* interaction
Advisors: E Rohwer, B Slippers & MJ Wingfield

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

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

Donald Chungu
Pathogens associated with plantation tree diseases in Zambia
Advisors: J Roux, Muimba A Kankolongo & MJ Wingfield

Pranitha Dawlal
Resistance of South African maize cultivars to the infestation of mycotoxigenic fungi
Advisors: GJ Marais & E Barros

Therese de Castro
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
Population dynamics of *Fusarium circinatum* in the pine nursery environment
Advisors: ET Steenkamp, BD Wingfield & MJ Wingfield

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

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

Katrin Fitza
Molecular basis of induced resistance in *Pinus patula*
Advisor: S Naidoo

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

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

Briar Harmer
Molecular characterization of the MAT2 mating type gene of *Ceratocystis albifundus*
Advisors: MPA Coetzee & BD Wingfield

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

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

Carlo Jackson
Viral induced gene silencing of selected genes in wheat using Barley SMV
Advisor: A-M Botha-Oberholster

Bedel Kalonji
Biological and chemical control of seedling diseases of lettuce
Advisors: TAS Aveling, N Labuschagne & JE van der Waals

Amelia Keyser
Botryosphaeriaceae associated with Acacias in Africa with special reference to *Acacia millefera*
Advisors: GJ Marais, ET Steenkamp & C Erasmus

Daniel Khumalo
Seed treatment of cowpea to control seedling diseases
Advisor: TAS Aveling

Tsholofelo Kibido
Protection of exogenous glutathione reductase against protease-mediated degradation
Advisor: KJ Kunert

Marija Kvas
Fusarium spp. associated with *Syzigium cordatum* malformation
Advisors: ET Steenkamp, BD Wingfield & MJ Wingfield

Waheed Mahomed
High throughput EST sequencing of defense related genes from avocado in response to *Phytophthora cinnamomi*
Advisors: N van den Berg & AA Myburg

Aisha Mahomed-Ali
Production of pyrazine flavours by mycelial fungi
Advisors: GJ Marais, ER Rohwer & PJ van Zyl

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

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

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

Thuto Matsioloko
Using cDNA-AFLP and microarray analysis for rapid identification of *Diuraphis noxia* induced expressed genes
Advisors: A-M Oberholster & AA Myburg

Aisha Mahomed-Ali
Production of pyrazine flavours by mycelial fungi
Advisors: GJ Marais, ER Rohwer & PJ van Zyl

Simon Martin
Sexual recognition in the *Gibberella fujikuroi* complex
Advisors: BD Wingfield, ET Steenkamp & MJ Wingfield

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

Grant McNair
Functional genetic analysis of micro RNA genes and targets in *Eucalyptus* trees
Advisors: AA Myburg & J Theron

James Mehl
Factors associated with the death of *Pterocarpus angolensis* in South Africa
Advisors: MJ Wingfield, J Roux & B Slippers

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

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

Mmoledi Mphahlele
Genetic manipulation of carbon allocation during wood formation in *Eucalyptus*
Advisor: AA Myburg

Lunghile Mtombeni
Description of the *Burkholderia* species that nodulate Hypocalyptus and related genera
Advisors: ET Steenkamp & SN Venter

Karin Muller
Mapping *Dn1* in a "Tugela DNA'" and "Tugela Fast Grow" mapping population
Advisor: A-M Oberholster

Vuledzani Muthelo
Structure of the mitochondria genome of *Ganoderma* species
Advisors: MPA Coetzee

Jan Nagel
Phytophthora species in South Africa
Advisors: B Slippers, M Gryzenhout & MJ Wingfield

Ronishree Naidoo
Gene expression profiling of a *Eucalyptus* hybrid challenged with *Ralstonia solanacearum*
Advisor: S Naidoo

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

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

Marja O'Neill
Functional genetic testing of the *EgCesA1* gene in *Arabidopsis thaliana*
Advisors: AA Myburg & S Naidoo

Kerry-Anne Pially
Diversity of endophytic fungi of *Eucalyptus*
Advisors: B Slippers, M Gryzenhout & MJ Wingfield

Priyen Pillay
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

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

Thabang Ramagodi
Seedborne pathogens of sorghum
Advisor: TAS Aveling

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

Thia Schultz
Transcript profiling of *Diuraphis noxia* elicited responses in Betta NILs
Advisor: A-M Botha-Oberholster

Janine Silberbauer
Whole transcrptome analysis of genes induced during tension wood formation in *Eucalyptus* trees
Advisors: AA Myburg, DK Berger & F Joubert

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

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

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

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

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

Hanlie van der Merwe
Epidemiology of *Pectobacterium* and *Dickeya* spp. on potatoes in South Africa
Advisors: J van der Waals, TA Coutinho & L Korsten

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

Erika van der Walt
Morphology, genetic relationships and metabolite content in members of the *Solanum nigrum* L. complex used for jam production in the Highveld region of South Africa
Advisors: DK Berger, A van Schalkwyk & A van Wyk

Lorinda van der Westhuizen
Pantoea and *Xanthomonas* spp. associated with bacterial blight of *Eucalyptus*
Advisors: TA Coutinho & SN Venter

Schalk van Wyk (registered at Universtiy of Stellenbosch)
Epidemiology of pitch canker in Tokai plantation in the Western Cape
Advisors: A Viljoen, TA Coutinho & MJ Wingfield

Irene van Nugteren
Virus induced gene silencing in pearl millet
Advisors: DK Berger & I Hein

Natalie van Zuydam
Molecular characterization of *Leptographium* species using a high-density, oligonucleotide microarray chip
Advisors: BD Wingfield, MJ Wingfield & K Jacobs

Marcele Vermeulen
Ecology and distribution of Cryphonectriaceae in southern Africa
Advisors: J Roux, M Gryzenhout & MJ Wingfield

Tanya Weller
Recognition and attached of *Pantoea ananatis* to *Eucalyptus* leaves
Advisors: J Theron & TA Coutinho

Febé Wilken
Transcript profiling of the compatible interaction between *Eucalyptus* and *Phytophthora cinnamomi*
Advisor: S Naidoo

Markus Wilken
Development and application of mating-type based markers in the genus *Ophiostoma*
Advisors: BD Wingfield, MJ Wingfield & ZW de Beer

4th year and honours students

Herman Badenhorst (2007)
Deepa Bhana (2007)
Anandi Bierman (2007)
Therese de Castro (2007)
Lisa-Danelle de Wet (2007)
Nizé du Toit (2007)
Gareth Enslin (2007)
Mmaphefo Maluleke (2007)
Simon Martin (2007)
Zinzi Mboweni (2007)
Osmond Mlonyeni (2007)
Bongiwe Mthethwa (2007)
Jamie-Lee Moss (2007)
Janine Silberbauer (2007)
Dekker van Wyk (2007)
Dia van Staden (2007)
Francois Burger (2008)
Gabriel de Ridder (2008)
Gifty Hammond (2008)
Steven Hussey (2008)
Waheed Mahomed (2008)
Ronishree Naidoo (2008)
Jan Nagel (2008)
Priyen Pillay (2008)
Kerry-Ann Pillay (2008)
Britta Riby-Smith (2008)
Angela Shumba (2008)
Johan van der Linde (2008)

Melanie van der Vaart (2008)
Sefan van Wyk (2008)
Karien van Zyl (2008)
Febé Wilken (2008)
Gabriella Carstensen (2009)
David de Veredicis (2009)
Zander Human (2009)
Gugu Kubheka (2009)
Stewart McCulloch (2009)
David de Veredicis (2009)
Fati Thobejane (2009)

Student assistants

Shani Bekker (2007)
Margo Bradfield (2007)
Thys Geldenhuys (2007)
Steven Hussey (2007)
Patricia Modiba (2007)
Refilwe Moiloa (2007)
Solomon Ntladi (2005-2007)
Lindsay Kriel (2008
Penny Yu (2008)
Michelle Silberbauer (2008)
Shani Bekker (2008)
Gugulethu Kubheka (2008)
Alfonce Mahwanu (2008)
Jenny Ceronio (2009)
Monique Heystek (2009)
Mase Moleleki (2009)
Marinda Moller (2009)
Thomas Schmidt (2009)

CTHB Mentorship students

Sameera Ebrahim (2007, 2008)
Gideon Geldenhuys (2007)
Jan Nagel (2007)
Jaco Nieuwenhuijs (2007)
Melanie van der Vaart (2007)
Daniel Diedericks (2007, 2008)
Caron Griffiths (2007, 2008)
Jaco Nieuwenhuis (2007)
Dumisane Hlongwane (2007)
Duncan Patterson (2007)
Mathews Sebenego (2007, 2008)
Melissa Simpson (2007, 2008)
Riaan Theron (2007 - 2009)
Juanita van Wyk (2007, 2008)
Melanie van der Vaart (2007)
Lizette Castanho (2008)
Daniel Diedericks (2008)
Angela Marsberg (2008)
Mmatshepho Phasha (2008)
Fati Thobejane (2008)
Maria Bosua (2008)
Barend Jansen van Vuuren (2008, 2009)
Louri Lemmer (2008)
Benjamin Letsoale (2008)
Aobakwe Mongae (2008, 2009)
Nadja Roelofse (2008)
Thembi Moloantoa (2008, 2009)
Vusi Letsoale (2009)
Letta Mbula (2009)
Nadja Roelofse (2009)
Gina Shin (2009)
Sphiwe Sibanyoni (2009)
Arista Fourie (2009)
Nigel Peacock (2009)
Elre Pretorius (2009)
Danielle Snyman (2009)
Jake van der Merwe (2009)

Recent graduates

PhD

Marieka Gryzenhout (2007)
Taxonomic studies on *Cryphonectria* and *Endothia*
Advisors: MJ Wingfield & BD Wingfield

Teresa Goszczynska (2007)
Pantoea ananatis and *P. agglomerans* associated with onion seed in South Africa
Advisors: TA Coutinho & SN Venter

Gavin Hunter (2007)
Mycosphaerella leaf blotch of *Eucalyptus* in South Africa
Advisors: MJ Wingfield, BD Wingfield & PW Crous

Grace Nakabonge (2007)
Taxonomy and population biology of *Chrysoporthe* species infecting trees in Africa
Advisors: J Roux & MJ Wingfield

Mesfin Bogale (2008)
Fusarium spp. associated with teff production in Ethiopia
Advisors: BD Wingfield, MJ Wingfield & ET Steenkamp

Juanita de Wet (2008)
Molecular taxonomy and phylogeny of *Sphaeropsis sapinea* and its association with dsRNA elements
Advisors: MJ Wingfield, O Preisig & BD Wingfield

Veloshinie Govender (2008)
Seed pathology and vigour of maize stored under subsistence farming conditions
Advisors: TAS Aveling & Q Kritzinger

Andrew Kiggundu (2008)
Identification of candidate genes for resistance to banana weevil in East African Highland bananas
Advisors: K Kunert, D Michaud, A Viljoen, M Pillay & C Gold

Barnabas Kiula (2008)
Effect of gray spot of testcross performance, combining ability and heterosis of Tanzanian inbred and open-pollinated maize varieties
Advisors: A-M Oberholster & DE Lyimo

Sanuska Naidoo (2008)
Genetic studies of resistance to the bacterial pathogen, *Ralstonia solanacearum*, in *Arabidopsis thaliana*.
Advisors: DK Berger & K Denby

Kitt Payn (2008)
Phylogenetic relationships within a species-wide reference population of *Eucalyptus urophylla* inferred from gene-based and genome-wide levels of genetic diversity
Advisors: B Dvorak, AA Myburg, R Sederoff & G Hodge

Anneka Prins (2008)
Expression of cysteine proteases and their inhibitors under natural and stress-induced senescence
Advisors: KJ Kunert & CH Foyer

Juan Vorster (2008)
Genome analysis focusing on radiation induced mutations and horizontal transfer
Advisors: KJ Kunert & C Cullis

Carlos Perez (2008)
Diseases of eucalypts in Uruguay
Advisors: RA Blanchette & MJ Wingfield

Irene Barnes (2009)
Taxonomy, phylogeny and population biology of the red band needle blight fungus and related species
Advisors: MJ Wingfield & BD Wingfield

Carrie Brady (2009)
Examining the global epidemiology of Pantoea ananatis using MLST
Advisors: SN Venter & TA Coutinho

Ronald Heath (2009)
Studies of wound infecting pathogens of plantation hardwood trees in Southern and Eastern Africa
Advisors: J Roux, MJ Wingfield & BD Wingfield

Evelyn Madoroba (2009)
The use of molecular tools for quality control of starter cultures
Advisors: ET Steenkamp & TE Cloete

Pamela Paparu (2009)
Plant-endophyte interactions in East African Highland bananas (AEHB)
Advisors: A Viljoen, D Coyne & T du Bois

MSc

Frank Maleka (2007)
Comparative analysis of nucleotide diversity in a lignin and cellulose biosynthetic genes of *Eucalyptus* and *Arabidopsis*
Advisors: AA Myburg & P Bloomer

Charline Kamburona (2007)
Evaluating genetic diversity and performance of peanut (Arachis hypogaea) lines
Advisors: A-M Oberholster & A Cilliers

Leon van Eck (2007)
Tanscript profiling in Tugela near isogenic lines in response to RWA feeding
Advisors: A-M Oberholster & N Lapitan

Nicky Creux (2007)
Characterization of tissue-specific promoters involved in wood formation in *Eucalyptus* trees
Advisors: AA Myburg, DK Berger & V van Staden

Elsie de Meyer (2007)
Fungi associated with utility poles in South Africa
Advisor: MJ Wingfield & ZW de Beer

Gilbert Kamgan Nkuekam (2007)
A study of the *Ceratocystis* and Ophiostoma species infecting wounds on trees
Advisors: J Roux & MJ Wingfield

Rebecca Makhado (2007)
Endophytic studies on *Pantoea* spp. associated with eucalypts in South Africa
Advisors: TA Coutinho & SN Venter

Rosie van Zyl (2007)
Identification of virulence factors secreted by the RWA during feeding
Advisor: A-M Oberholster

Aneen Belgrove (2008)
The application of non-pathogenic forms of *Fusarium oxysporum* for the biological control of Fusarium wilt of banana
Advisors: A Viljoen & C Steinberg

Nelani Bezuidenhout
Responses in barley gene expression after pathogen infection
Advisors: E Venter & A-M Botha-Oberholster

Rosita Endah (2008)
Characterization of NPR1 like genes in banana
Advisors: R Chikwamba, KJ Kunert & N van den Berg

Gerda Fourie (2008)
The evolutionary biology of *Fusarium oxysporum* f.sp. *cubense*
Advisors: A Viljoen, E Steenkamp & T Gordon

Izette Greyling (2008)
Studies on the *Pantoea* spp. associated with Coniothyrium canker in South Africa
Advisors: TA Coutinho, SN Venter & MJ Wingfield

Bedel Kalongi (2008)
Biological and chemical control of seedling diseases of lettuce
Advisors: TAS Aveling, J van der Waals & N Labuschagne

Delphin Kandolo (2008)
Effect of fungicide seed treatments on vigour of maize
Advisors: TAS Aveling & Q Kritzinger

Noelani Janse van Vuuren (2008)
Characterization of gene sequences induced in barley after pathogen infection
Advisors: E Venter & A-M Botha-Oberholster

Claire Munro (2008)
Identification of defence genes related to resistance against Fusarium wilt of banana
Advisors: A Viljoen, Z Myburg & N van den Berg

Luke Solomon (2008)
Identification of circadian rhythms in the expression patterns of wood-formation genes in Eucalyptus
Advisors: AA Myburg & DK Berger

Dewald Zaayman (2008)
Transcript profiling in Gamtoos Dn7 a gene with bimodal functioning
Advisors: A-M Oberholster & N Lapitan

Joha Grobbelaar (2009)
Molecular phylogeny and population genetics of *Ophiostoma quercus*
Advisors: MJ Wingfield & BD Wingfield

Phillip Law (2009)
MADIBA: Database tool for annotation of microarray data
Advisors: DK Berger & F Joubert

Happy Maleme (2009)
Botryopshaeria spp. on eucalypts in South Africa
Advisors: MJ Wingfield & BD Wingfield

Tanja Meyer (2009)
Identification and characterization of virulence factors in *Fusarium oxysporum* f.sp. *cubense*
Advisors: A Viljoen & A Churchill

Francois van der Walt (2009)
Botryosphaeriaceae associated with Acacias in Africa with special reference to *Acacia millefera*
Advisors: GJ Marais, J Roux, MJ Wingfield & B Slippers

Prestigious NRF bursary holders

Irene Barnes
Nicky Creux
Franco du Preez
Marieka Gryzenhout
Ronald Heath
Steven Hussey
Mmoledi Mphahlele
Kershney Naidoo
Luke Solomon
Rene Sutherland
Dirk Swanevelder
Magriet van der Nest
Marelize van Wyk
Michelle Victor
Juan Vorster

NRF scarce skills/innovation scholarships

Carrie Brady (2002; 2003-2004; 2005-2008)
Abigail Mashamba (2008)
Tsholofelo Kibido (2008)

Liesl van der Linden (2007-2009)
Ryan Nadel (2006-2009)
Febé Wilken (2009-2010)

Other scholarships

Charline Kamburona (DAAD, TUCSAN Scholarship)
Lesesse Beyene (EARO, Ethiopia)
Yoseph Beyene (EARO, Ethiopia)
Joseph Ndunguru (IITA, Nigeria)
Pamela Paparu (IITA)
Shahasi Athman (IITA)
Eugenia Itumeleng Kgang (ARC and NRF Equity Scholarship)
Endale Gebre, Ethiopian Institute of Agricultural Research (EIAR)
Berhanu Fenta, International Center for Tropical Agriculture (CIAT)
Barry Christie, Hans Merensky Foundation
Juanita Engelbrecht, Hans Merensky Foundation
Donald Chunga, DST/NRF African Scholarship

MANAGEMENT

Management committee

Professor MJ Wingfield (Chairman)
Professor D Berger
Professor TA Coutinho
Professor K Kunert
Professor A-M Botha-Oberholster
Professor BD Wingfield
Assoc Professor TAS Aveling
Assoc Professor AA Myburg
Assoc Professor J Roux
Assoc Professor B Slippers
Assoc Professor SN Venter
Dr R Chikwamba
Dr G Marais
Dr L Moleleki
Dr S Naidoo
Dr E Steenkamp
Dr N van den Berg
Mr B Hurley
Mr R Nadel (Postgraduate student representative 2007, 2008)

Advisory committee

Professor A Ströh (Chairman), Dean of the Faculty of Natural and Agricultural Sciences
Professor H Huismans, Head of the Dept of Genetics
Professor TE Cloete, Head of the Dept of Microbiology & Plant Pathology (until end of 2008)
Professor J Verschoor, Head of the Dept of Biochemistry
Professor M Meyer, Head of the Dept of Plant Science
Professor C Reinhardt, Head of the Dept of Plant Production (until end of 2008)
Professor S Nicolson, Head of the Dept of Zoology & Entomology
Professor MJ Wingfield, Director of FABI

Some social highlights in FABI

Annual SPOOF* meeting

***Society for the Publication of Outrageous Findings**

Theme: Hobos (2007)

From top to bottom, left to right:
Courtyard prior to the commencement of the party; Marcele Vermeulen, Francois van der Walt, Marelize van Wyk and Ronald Heath (L to R); Markus Wilken and Ricky Wilken (L to R); Quentin Santana (in sleeping bag) and Kershney Naidoo; Draginja Pavlic and Lorenzo Lombard (L to R); and Jolanda Roux and Bernice Porter (L to R)

Theme: 80s (2008)

Left to right, top to bottom

Drainja Pavlic, Ryan Nadel and Bianca Hinze (L to R); James Mehl and Francois Boshoff (L to R); Kevin Barnes, Irene Barnes, Mike Wingfield, Henk Huismans (L to R); Juan Carro, Guillermo Perez, Draginja Pavlic and Derien Escheverri (L to R); Lyndia Twala an Valentina Nkosi (L to R); and Ryan Nadel and Barry Christie (L to R)

Year end function 2007

From left to ri ht, top to bottom
Brenda Wingfield, Mike Edwards, Di Edwards and Mike Wingfield; Marieka Gryzenhout, Juan Gryzenhout, Fannie Carroll, George Carroll, Irene Barnes and Kevin Barnes; Anton van den Berg, Noelani van den Berg, Sonja de Beer, Wilhelm de Beer, Zander Myburg and Christne Myburg; Osmond Mlonyeni, Happy Maleme, Mmoledi Mphahlele and Disele Mathabatha, Brett Hurley and Tanya Hurley; Bebe Mbebe, Mandla Mahlalela, Pritty Khumalo; MJ Oosthuizen, Albe van der Merwe and Charl Joubert; and Prof John Leslie delivering his address

Year end function 2008








From left to right, top to bottom
Jan Nagel, Priven Pillay, Simon Martin and Sameera Ebrahaim; Dylan Pillay, Pranitha Dawlal, Marija Kvas, Derien Escheverri and Draginja Pavlic; Jenny Hale, Prof and Mrs Roux, Henk Huismans and Miemie Huismans; Andre Smit, Martie Smit, Izette Greyling and Bernice Porter; Mike Wingfield, Bernard Slippers and Jana Slippers; Darryl Herron and CJ Henley-Smith; Prof and Mrs Roux; and Bernice Porter, Monique Sakalidis and Izette Greyling

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
Belgium Embassy
BIOPAD
Central Timber Co-operative (CTC)
China/South African Governments Agreement
Chinese Academy of Forestry
CIRAD
Citrus Growers Association
CGIAR Generation Challenge Programme
CNRS/South African Government Agreement
CSIR
DFG (Deutche Forshungs-Gemeinschaft: German Research Foundation)
Department of Water Affairs and Forestry (DWAF)
Department of Trade and Industry through THRIP initiative
Department of Science and Technology through the Innovation Fund and CTHB
Department of Science and Technology through the NRF
Department of Science and Technology
Du Roi QMS
EARO, Ethiopia
ESKOM
European Union 6th Framework
Flemish/South African Governments Agreement
Forestry South Africa
Global Forestry Products
Hans Merensky Holdings
Hans Merensky Foundation
Innovation Fund
International Institute of Tropical Agriculture (IITA)
Italian/South African Governments Agreement
Komatiland Forest Research (KLF)
Loskop Irrigation Board
Mellon Foundation
Ministry of Education, China
Ministry of Science and Technology, China
Mondi
Mondi Shanduka
Mountain to Ocean (MTO) Forestry
National Bioinformatics Network
National Natural Science Foundation, China
National Research Foundation (NRF)
NCT
Norway/South African Governments Agreement
PlantBio – National Innovation Centre in Plant Biotechnology
Protein Research Foundation
Rockefeller Foundation
SAFCOL/Komatiland Forestry
Sappi
SIDA/South African Government Agreement
South African Wattle Growers Union
Syngenta South Africa
Tanzanian Government
Technology and Human Resources and Industry Programme (THRIP)
Thuthuka
Tuscan Namibia/DAAD (Germany)
TWK
UP Research Development Fund
Water Research Commission
Wattle Growers Union of South Africa (SAWGU)
Winter Cereal Trust