FABI

Forestry & Agricultural Biotechnology Institute

2005/2006 Biennial Report

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, 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, Botany, 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 fifth FABI biennial report covering the period from May 2005 to May 2007.

Forestry and Agricultural Biotechnology Institute (FABI)
University of Pretoria
PRETORIA
0002
Tel: +27-12-420 3938
Fax: +27-12-420 3960
E-mail: Mike.Wingfield@fabi.up.ac.za
WWW: http://fabinet.up.ac.za/

Compilation, layout and design by TA Coutinho

Front page design depicting the "Fabians": Luke Solomon

Forestry and Agricultural Biotechnology Institute
FUTURE FORESTS and FOOD

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DIRECTOR'S REPORT

This biennial report of the Forestry and Agricultural Biotechnology Institute is the fourth since FABI first came into being in 1998. I am reminded how rapidly we are moving to the end of the tenth year of FABI's remarkable history. Looking at the Institute today, it is enormously pleasing to see how the group has matured and particularly how it has found its place amongst the best-known plant science and particularly, plant biotechnology groups in South Africa. Moreover, FABI has in a relatively short period of time, established a firm international reputation for high quality tertiary education and research in its chosen fields of activity.

The two years (2005 and 2006) on which this report is based have been remarkable in many ways. At the time of publishing our last biennial report, the tree health group in FABI had been recognized as one of the six (now seven) Department of Science and Technology (DST)/National Research Foundation (NRF) Science Centres of Excellence. Thus the DST/NRF Centre of Excellence in Tree Health Biotechnology (CTHB) was established and, like FABI, it has rapidly taken hold and grown to establish its own unique focus and direction. In this regard, it has been particularly pleasing to see how positively the CTHB has interacted with the now 18-year-old Tree Protection Co-operative Programme (TPCP), also housed in FABI. The two programmes have maintained and enhanced their own identity, while also seizing the opportunities for synergy. I don't think that there is any doubt that we will see more of the same in the future.

FABI has grown remarkably since its inauguration in 1998. At that time, the Institute included approximately 55 people, and the majority worked in the field of forest tree health. Today, the FABI team is comprised of approximately 180 participants, mostly M.Sc. and Ph.D. students, post doctoral fellows and a core of academic and technical staff. Research interests of the institute staff and students have expanded considerably, as will be quite evident from this report.

When writing about the activities and achievements of FABI and the FABI team of researchers and students, I am always hesitant to single out any one group or person. The fact of the matter is that the research teams in FABI are all excelling in so many ways. New and exciting grants are being secured regularly and FABI researchers and students commonly receive awards and other forms of recognition. Allow me to mention just a few remarkable achievements. During the last year, the Institute was a finalist in the National Science and Technology Forum (NSTF) annual competition and hopefully we will take this award home in the future. FABI also won the THRIP (Technology and Human Resources for Industry) award for post graduate education in South Africa. In the last few weeks, the Tree Biotechnology Group in FABI learned that their efforts to gain support from the USA Department of Energy to have the *Eucalyptus* genome sequenced has been successful. This will bring many new and exciting opportunities to researchers in FABI who have an interest in Eucalypts.

During the last two years, FABI has hosted a large number of meetings including a number of very significant international gatherings. In late 2005, we hosted the International Union of Forestry Research Organisation's (IUFRO) Tree Biotechnology meeting. In 2006, we contributed significantly to organizing an international meeting, "The Ophiostomatoid fungi: Expanding Frontiers", held at North Stradbroke Island, off the coast of Brisbane in Australia. To add to this list, we have very recently hosted an International symposium on the Sirex wood wasp, an insect that is devastating pine forests in many parts of the southern hemisphere. All of these and the other meetings

that have been hosted by, or supported by FABI or FABI researchers have enhanced our national and international links substantially. Perhaps equally important, they have added opportunities for FABI graduate students to establish friendships and to build collaborations with colleagues from many parts of the world.

A remarkable group of dedicated research leaders and post graduate students have contributed to the great number of accomplishments of FABI. I am so often asked to what I might attribute the remarkable success and growth of FABI. While one might interrogate such a question at various levels, I am convinced that the clear driver is the community of FABI, often referred to as the FABI family or the FABI team. I am also convinced that we can attribute the many successes of FABI to its tremendously multi-cultural composition. The fact that some 30 languages are spoken in the Institute and that staff and students interact closely with people from many different countries, makes FABI a unique and most enlightening environment in which to work.

At the end of 2007, FABI will have completed ten years of activity, promoting multi-disciplinary research and education in the broad field of the Plant Sciences. During this period of time, 95 M.Sc. and 60 Ph.D. students have graduated and the scientific outputs (in all their various manifestations) have been superb.

Although FABI has no fixed "date of birth", we became seriously active during the first three months of 1998 and we will thus celebrate our tenth birthday some time during the first quarter of 2008. Coincidentally, 2008 also marks the 100th Anniversary of the University of Pretoria. With such a history, we can certainly proceed into the future with pride. At the same time, we must not forget our many friends and colleagues, nationally and internationally, who have contributed in so many diverse ways towards our growth and our success. 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)

FABI TEAM

This photograph includes those members of the team available on 15/01/2007. Our apologies to others not included and that could not be captured photographically.

Front row from left to right: Didier Begoude, Qaqamba Mapatwana, Olga Makhari, Vuledzani Muthelo, Mpho Mbonani, Tsholofelo Kibido, Bongani Maseko, Mike Wingfield, Boitumelo Mashangoane, Tsholofelo Mojela, Gilbert Kamgan, David Talengera, Lydia Twala, Valentina Nkosi, Rachel Chikwamba and Happy Maleme

Second row from left to right: Jenny Hale, Noelani van den Berg, Gerda Fourie, Tracey-Ley Haterell, Chrizelle Beukes, Rose Visser, Elna Cowley, Marcele Vermeulen, Marieka Gryzenhout, Grieta Mahlangu, Jane Wright, Soenju Marincowitz, Makuena Lebusa, Dina Piciura, Irene Barnes, Joha Grobbelaar, Aisha Mahomed-Ali, Pranitha Dawlal, Veloshinie Govender, Karen Muller and Mahdi Ziaratnia

Third row from left to right: Tumi Kgang, Britta Tonsing, Jolanda Roux, Marija Kvas, Joanne Bradfield, Helen Doman, Briar Harmer, Vivienne Clarence, Emma Steenkamp, Claire Munro, Draginja Pavlic, Rene Sutherland, Elsie de Meyer, Magda Fouche, Carl Roux, Terry Aveling, Kershney Naidoo, Pritty Khumalo, Martin Ranik and Derian Echeverri

Forth row from left to right: Ariska van der Nest, Bernice Porter, Abigail Mashamba, Sanuska Naidoo, Kgosi Mongwaketsi, Bernard Slippers, Heidi Roos, Marja O'Neill, Tanja Meyer, Joanne Fouche, Bianca Hinze, Martha Mahlangu, Renate Zipfel, Ancel Stewart, Fanus Venter, Liezel Vorster, Adrene Laubscher, Jeanne Korsman, Brenda Wingfield, Magriet van der Nest and Djibo Zanzot

Fifth row from left to right: Nico Labuschagne, Gavin Hunter, Guillermo Perez, Lorenzo Lombard, Martin Coetzee, Mesfin Bogale, Carlo Jackson, Dirk Swanevelder, Juanita de Wet, Marelize van Wyk, Martie van Zyl, Luke Solomon, Urte Schluter, Rikka Linnakoski, Eva Muller, Rosie van Zyl, Barbara Ros, Amelia Keyser, Nicky Olivier and Carrie Brady

Sixth row from left to right: Grant McNair, Pieter de Maayer, Ryan Nadel, Izette Greyling, Brett Hurley, Eshchar Mizrachi, Gert Marais, Markus Wilken, Dewald Zaayman, James Mehl, Ronald Heath, Zander Myburg, Kitt Payne, Dave Berger, Hardus Hatting, Robert Walters, Wolfgang Maier, Wilhelm de Beer, Natalie van Zuydam and Quentin Santana

RESEARCH REPORTS

Forest Protection

Research leader: Prof Mike Wingfield

Research team: Prof Teresa Coutinho
Prof Brenda Wingfield
Prof Jolanda Roux
Dr Bernard Slippers
Dr Emma Steenkamp
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.

Highlights of research 2005/2006:

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).

Over the past two years, the disease and insect problems affecting South African forestry have expanded alarmingly. An intriguing trend in recent years has been the number of examples of native pests and pathogens adapting to be able to infect non-native trees. Examples that have affected South African forestry are found in the goat moth, *Coryphodema tristis,* Eucalyptus rust caused by *Puccinia psidii* and the canker pathogen *Chrysoporthe austroafricana*. The driving force behind these host jumps is unknown and understanding the underlying concepts of why they occur will enable us to better predict new disease and pest problems. Clearly these new pathogens threaten the trees to which they have become adapted in their native lands.

Basal canker on *E. grandis* caused by *Chrysoporthe austroafricana*

Pest and disease problems affecting plantation forestry can be managed. This is not particularly different to the situation with other crops where managing pests and diseases has always been an integral part of the farming process. Past successes in dealing with pests and diseases

in forestry in South Africa and elsewhere in the world also illustrate this point. This is, however, complicated by the long rotation cycles of tree crops. Management strategies must, therefore, rely strongly on biological agents, which are more complicated and take longer to develop than chemical agents.

The Sirex wood wasp, *Sirex noctilio,* is unquestionably the most serious pest or disease problem facing the South African forestry industry at present. This pest is known to have been present in South Africa for just over a decade and for a long while was restricted to the Western Cape Province. In that area, biological control, particularly with the parasitic nematode *Deladenus siricidicola* was relatively effective. It is only when the wasp spread to the eastern Cape and then the KwaZulu Natal midlands that it reached epidemic proportions. The infestation in these areas has increased progressively during the past three years as the wasp continued to extend in its distribution. Very recently, it was shown to have crossed the Tugela Valley and its establishment in the large pine-growing areas of Mpumulanga appears to be a reality for the future.

Yellowing of needles characteristic of pine trees attacked by *Sirex*

The unabated spread of *Sirex noctilio* has led to huge efforts to control the wasp using the well-recognised biological control agent *D. siricidicola*. FABI and the TPCP were instrumental in negotiating access to a license to produce the nematode locally and this has enabled the group to undertake experimental work with the nematode that would otherwise not have been possible. The focus of this work has been to determine why the biological control agent has not worked effectively in the summer rainfall areas of South Africa. During 2006, the focus of the programme was to undertake, together with forestry companies concerned about *Sirex*, a mega trial comparing the efficacy of four different collections of the nematode. This was to ascertain whether the nematode might have lost its virulence due to repeated sub-culturing or whether cycling the nematode through a wasp generation might lead to a more virulent strain. This trial was started early in 2006 by rearing and inoculating different sources of the nematode strain. Emerging wasps have been tested for parasitism during the latter part of the year. After dissection of almost 18 000 wasps, it is clear that all strains of the nematode tested are equally ineffective at bringing about large scale biological control. While data are still in the process of being processed, these results are relatively clear and the team are convinced that new and more effective strains of the nematode will represent the only hope of gaining effective control of the wasp in the future. This work is currently being planned and will form part of a five year research strategy to bring the wasp under control.

The lack of efficacy of the nematode biological control agent has raised many questions regarding control programmes in countries of, for example, South America. It has also become clear that there are many misconceptions regarding the biological control of *Sirex* and that these have led to unreasonable expectations for controlling the problem. A critical analysis of the data pertaining to the control of *Sirex* has thus been undertaken and this has been subjected to international peer review. A very intensive research and development programme is going to be needed to bring about control of *Sirex* in South Africa.

Our research on pathogens broadly treated in the Botryosphaeriaceae has led to a greatly increased understanding of these fungi and the diseases that they cause. Certainly, a major step forward for our research in this domain has been to understand that these are endophytes that are able to live in infected tissue for extended periods without causing disease. But when trees are stressed, disease levels can be dramatic. A key example here is found with *Diplodia pinea*. This is one of the most important and damaging pathogens of *Pinus* spp. grown in South Africa and annual losses amount to millions of Rands. Understanding that this fungus lives in healthy pine trees and that it

typically becomes active after, for example, hail damage has dramatically changed our view on how to manage the problem.

Our research programme has focused for many years on developing techniques to rapidly screen pine trees for resistance to infection by *D. pinea* and results of this work have been transferred to the field level. While it remains a long term approach, we continue studies on viruses that infect this fungus. This work has progressed well during 2006 and characterization of key viruses will be completed in 2007. At that point, it will be necessary to consider whether these might be applied in biological control or not.

The Botryosphaeriaceae that infect *Eucalyptus* and cause cankers are extremely complex to identify. What complicates matters here is that there are numerous species found on single trees and we continue to try to unravel questions relating to their relative importance. A crucially important first step must be to define the species present and to understand where these fungi have originated. We have thus embarked on studies in collaboration with colleagues from various parts of the world to consider the occurrence of Botryosphaeriaceae on *Eucalyptus* in different geographical areas. Whether they come from native plants and infect Eucalypts or whether they are specific to various hosts or groups of hosts is a question that continues to be important. We have, for example, in the last year completed work on these fungi on native waterberry following the hypothesis that species on *Eucalyptus* might be linked to those on waterberry. Once the species and their occurrence have been more clearly defined, it is possible to conduct meaningful pathogenicity studies and hopefully also implement screening procedures as has for example been done by one of our international students for species occurring in Venezuela. Here, it can be seen that these fungi differ in their pathogenicity and that it is important to understand what species are involved in a particular disease problem, and then to screen for resistance to those particular species.

One of the more important discoveries from our research in recent years has been that the very serious wilt pathogen *Ceratocystis fimbriata* (broad sense) occurs on *Eucalyptus* in South Africa. This fungus has caused severe damage to trees in other African countries and also in countries of South America. Our view is that *C. fimbriata* has been introduced into South Africa, probably through movement of Eucalypt wood and that it is simply a matter of time before it becomes evident as a pathogen in plantations. In order to gain a clear understanding of this fungus on Eucalypts in South Africa, and to confirm our hypothesis that it is an introduced pathogen, we have undertaken population biology studies on it. These have shown clearly that the fungus has a clonal population structure in South Africa and they suggest strongly that the fungus is an alien invasive pathogen. Field surveys and monitoring are now being used to evaluate its importance further.

One of the more serious pests to have appeared in *Eucalyptus* plantations during the course of the last few years is the so-called bronze bug, *Thaumastocoris peregrinus*. The insect first appeared in Mpumulanga plantations where it seemed to be most damaging on somewhat stressed trees and particularly on *E. camaldulensis*. The insect spread extremely rapidly to Zululand plantations and it has since spread throughout the country.

***Thaumastocoris* adult on a *Eucalyptus* leaf**

An intensive research programme has been established to study *Thaumastocoris* and this is only beginning to gain momentum. What is particularly worrying, is the fact that this is a pest for which there is virtually no prior knowledge. Indeed it was first discovered relatively recently in Australia where we believe that it is probably native. In recent years, *T. peregrinus* has become important in the city of Sydney where some chemical control through tree injection has been attempted. A similar insect and possibly a different species has also appeared in Argentina, but no control strategies have been developed for it.

The ultimate solution to dealing with *Thaumastocoris* will be to introduce biological control agents into South Africa to reduce its population. This will require extensive collecting and research in Australia. Significant effort will also be required to obtain Government permission to bring biological control agents for *T. peregrinus* into South Africa. Clearly our work on *Thaumastocoris* in South Africa is only just beginning.

Pitch canker of pines caused by *Fusarium circinatum* has become one of the most serious diseases affecting *Pinus* spp. in the world. The pathogen has been present in South Africa for at least sixteen years. It first appeared in the country in a single pine-growing nursery where it caused severe damage. It has since spread to nurseries throughout the country, where it causes significant losses to planting stock, especially in *P. patula* and *P. radiata*. The pathogen has substantially retarded programmes seeking to develop Pine planting stock through cuttings and thus the emergence of wide-scale hybrid pine forestry. Our research programme was responsible for discovering the pitch canker pathogen in South Africa and very significant progress has been made in understanding its biology and control. Our research on the pathogen has led to practical methods to screen trees for resistance to the pathogen and to the development of rapid screening tools. These tools are being used by forestry companies in South Africa and now also in other parts of the world.

Pitch canker symptoms

One of the important questions for which we have sought an answer recently is whether the population of the pitch canker pathogen is changing and to understand how this might be influencing the epidemic in nurseries in South Africa. We were aware that there were about 27 genotypes of the fungus in the country after the first four years of its first discovery. Recent research has shown that there are many more genotypes present now and this strongly suggests that sexual reproduction is occurring in the field, even though it might not be obvious in terms of the fungal structures that are found.

A very serious development concerning the pitch canker pathogen in South Africa during the last year has been that the disease was found to have moved to adult trees. This emerged after an outbreak of a very serious canker disease on *P. radiata* on the Cape Peninsula. Intensive research was undertaken on this disease problem and it was shown that it represented the first occurrence of full-blown pitch canker in South Africa. The pathogen was characterized, shown to be typical of *Fusarium circinatum* and it was shown to have developed an association with the weevil *Pissodes nemorensis*. This is a most worrying situation and research during the coming year will focus on understanding the problem better.

In South African pine nurseries, the pitch canker fungus has been shown to cause most serious damage when it is in association with fungus gnats. An effort has thus been made to understand the relationship between fungus gnats in pine nurseries and the pitch canker fungus. This work has led to the identification of the insects associated with *F. circinatum*, the discovery of a fungus gnat not previously known in South Africa and a better understanding of the relationship between the gnats and the fungus.

The increased pressure of pests and diseases in recent years on South African plantation forestry is reflecting a world-wide trend. Increased people movement and international trade are distributing foreign organisms at an alarming rate. Illustrating this point, a new and most serious pest of *Eucalyptus*, *Leptocybe invasa* (the bluegum chalcid wasp), was identified from the Pretoria region as this report was being written. These increasing pressures will take an inordinate effort to understand and control, through the combined efforts of the TPCP and forestry companies in South Africa. It is fortunate that the TPCP has been able to establish a strong foundation over the past 18 years to continue with this crucial task.

Cereal Genomics

Molecular genetic mechanisms involved in host resistance to pests

Research Leader: Prof AM Botha-Oberholster

Objectives of the research programme:

The research aims to increase the current understanding of the genetic mechanisms involved in host resistance i.e. *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 2005/2006:

The aim of the project is to provide for a DNA-based marker system with high-throughput capabilities, that is background non-specific, is "gene" based/specific and trait-linked. We use the Russian wheat aphid-plant interaction as a model system, since we are well acquainted with the interaction, and thus have a good understanding of the genetic basis of the interaction. Our strategy in the project is based on expression profiling analysis (i.e. cDNA AFLP analysis, SSH-libraries, microarray analysis) and DNA-fingerprinting technology, and thus our study material is DNA and RNA based. To date, we have constructed cDNA libraries, and the material used for the construction of libraries include PI 242994 (*Dn*5), PI 137739 (*Dn1*), SA1684, SA463, SA2199, 'Tugela', 'TugelaDN' and the Tugela NILs (*Dn1, Dn2* en *Dn5*), Betta, 'BettaDN', Kariga, Gamtoos susceptible to RWA, Gamtoos *Dn7* ('94M370') and *Triticum tauschii.* Screening of the libraries/material resulted in the identification of several genes/loci linked to disease resistance. These and other genes were then used in a prototype "DNA chip". The prototype "DNA chip" consisted of 380 clones and we printed 36 chips. Results obtained from the prototype chip clearly illustrated the usefulness of such a chip for mass screening purposes. The obtained results further demonstrated the importance of NBS-LRR sequences in plant defence against pests and pathogens, as these elements provided for resistance against leaf rust (*Lr10*, *Lr21*) as well as RWA resistance (*Dn1*). Other important genes that were identified include the RGA-2, *Mla*-locus, cathepsin B and cysteine proteinase inhibitor (all previously shown to be associated with pathogen or green bug resistance), to name a few. The chip further served as a basis for follow-up studies in collaboration with the international wheat community (IGROW). We donated 150 clones to the international wheat chip initiative (i.e. 55,000 Affymetrix wheat array chip and the

Winged and wingless females of *Diuraphis noxia* Mordvilko (Photo courtesy of Leon van Eck)

2,200 Spot Array chip). Our mapping efforts are also progressing well and we are in the process of constructing "saturated" genetic maps for RWA resistance genes *Dn1*, *Dn2* and *Dn5*.

A complete breakdown in RWA resistance was reported for the USA, and eight "new" biotypes were identified. Tugela*Dn2* and Gamtoos*Dn7* (cv. 98M370) are reported to be the only resistance lines with some expressing resistance/tolerance to the new biotypes (Scott Haley, Pers. Comm., CSU). We then focused our efforts on understanding the development of new RWA biotypes. For this, we sequenced a number of selected genes from known RWA biotypes and other aphid species and analyzed the data phylogenetically. Results indicated that the South African biotypes differ significantly from the US biotypes. This was confirmed by AFLP and SSR genotyping of the RWA biotypes. Several SSRs and AFLPs provided "fingerprints" for the identification of RWA biotypes. To increase our understanding of the RWA-wheat interaction, we have purified proteins from salivary glands of four selected RWA biotypes (i.e. two South African biotypes and two US biotypes), and demonstrated firstly, that the virulence factor(s) that elicits the defense response in wheat is a proteinacious compound. Secondly, that these virulence factors/proteins present in RWA saliva differ in size and composition. Results using transcript profiling showed that the defense responses elicited by the different RWA biotypes is very specific, and that different resistance strategies/defense pathways are used during host defense with different *Dn* resistance genes.

An Affymetrix wheat array was also conducted consisting of 55,000 genes. Genes with significant differential expression were analyzed for their association to RWA resistance. Furthermore, genes specific to the different RWA biotypes have been identified. A new technology has been introduced that enable us to knock out the genes *in vivo*. This technology (i.e. viral induced gene silencing, VIGs) should provide the answer to whether these genes are directly involved in conferring resistance to the different RWA biotypes and RWA resistance genes (i.e. *Dn1*, *Dn2*, *Dn5* and *Dn7*). If so, the genes can be applied for mass screening of lines with "desirable" agronomic-and –resistance traits. The latter testing will be in done in collaboration with CSU (Prof. Nora Lapitan using US lines) and Purdue University (Dr. Steve Scofield, VIGs).

Prof. Nora LV Lapitan in a Triticale field while attending a WRC-US farmers' day in the Swartland area

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 2005/2006:

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 successes with the process is low in terms of commercialization. To date, a total of 35,903 has 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 one of these cryopreserved lines already produced 3,246 plantlets. The production of adequate somatic embryos (SEs) will enable KLF Research to compare the performance of SEs that was produced directly and after cryopreservation during a trail that is planned for 2007. Future research will focus on refining the cryopreservation of cell lines.

Plantlets produced via somatic embryogenesis. Picture was taken at the nurseries of KLF Research in Sabie. From left to right: Ms. Thandi Mnisi (researcher at KLF), Mrs. Anita Steyn and Prof. Anna-Maria Botha-Oberholster (UP) (Photograph courtesy of Glen Mitchell, Researcher at KLF Research).

Molecular Plant-Pathogen Interactions

Research Leader: Prof Dave Berger

Objectives of the research programme:

- Describe mechanisms whereby plants defend themselves against pathogens.
- Study plant anti-fungal polygalacturonase-inhibiting proteins (PGIPs).
- 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 2005/2006:

Combining microarray and bioinformatic analyses in plant defence gene discovery: Approaches used internationally by scientists to study plant disease resistance include expression profiling using microarrays and gene function studies using mutant analyses in the model plant species *Arabidopsis thaliana*. This plant has also been used by the Molecular Plant-Pathogen Interactions group at FABI to model plant-pathogen interactions against important bacterial pathogens such as *Pseudomonas syringae* and *Ralstonia solanacearum*. Arabidopsis affords a tremendous advantage for such research, as the whole genome sequence, public microarray data and several defence response mutants are available. One such mutant is *cir1* (constitutively induced resistance 1) which has enhanced resistance to *Pseudomonas syringae* pv *tomato* DC3000 (*Pst*).

In a study by PhD student Sanushka Naidoo in collaboration with UCT, it was hypothesised that genes induced or repressed in *cir1* compared to the wild-type would be required for resistance against *Pst*. A set of 500 genes, annotated as putative defence response and signalling genes, were selected for the preparation of a custom defence response microarray. Expression profiling using the custom microarray revealed several differentially expressed genes in *cir1* at a significance threshold of $p<0.001$ using a mixed model ANOVA approach (see Fig. 1) (Naidoo *et al*., 2007). Publicly available microarray data was used to compare the expression patterns of these genes under *Pst* experiments at various time-points. The data for most of the selected genes were in accordance with publicly available data suggesting a role for these genes in resistance against *Pst* in *cir1*. This study demonstrates the use of a combination of customized microarrays and bioinformatics analysis of public data to identify genes involved in conferring resistance.

Further gene function studies, which would alter the expression of these genes in the plant, are necessary to determine whether the identified genes are key resistance genes. The ultimate goal of the research in *Arabidopsis* is to identify the orthologues of these genes in more important crop plants and thus confer resistance or enhanced tolerance to the pathogen.

In a study by MSc student Joanne Fouché carried out in collaboration with INRA-CNRS, France, isolates of the bacterial wilt pathogen *Ralstonia solanacearum* from *Eucalyptus* roots were characterized by molecular and morphological approaches. The hypersensitive response and pathogenicity (*hrp*) genes found in many plant pathogenic bacteria, including *R. solanacearum*, encode a type III secretion system involved in delivery of virulence effectors into susceptible plant hosts. PCR-RFLP analyses of selected *hrp* genes from the African *R. solanacearum* isolates was used to confirm the classification of the *Eucalyptus* isolates as belonging to biovar 3, in contrast to most potato isolates which are biovar 2 (See Fig. 2) (Fouché-Weich *et al*., 2006) . This PCR-RFLP test is rapid and easy

to perform, and provides a reliable diagnostic test for this pathogen from diseased material from *Eucalyptus* plantations. Another outcome of this study was the development of a novel *Arabidopsis*-bacterial wilt pathosystem which is the topic of an ongoing functional genomics study in the lab.

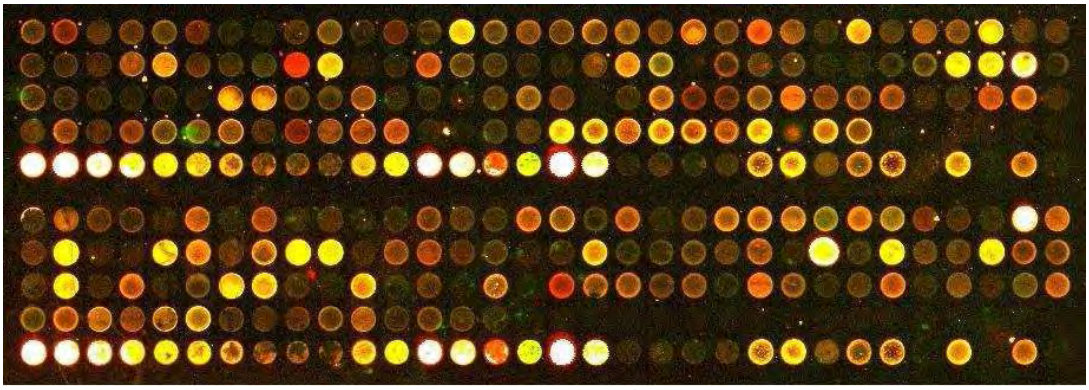


Fig. 1 A section of the *Arabidopsis thaliana* custom defence-response microarray showing the expression pattern of genes in the mutant cir1 (red) compared to the wild-type (green).

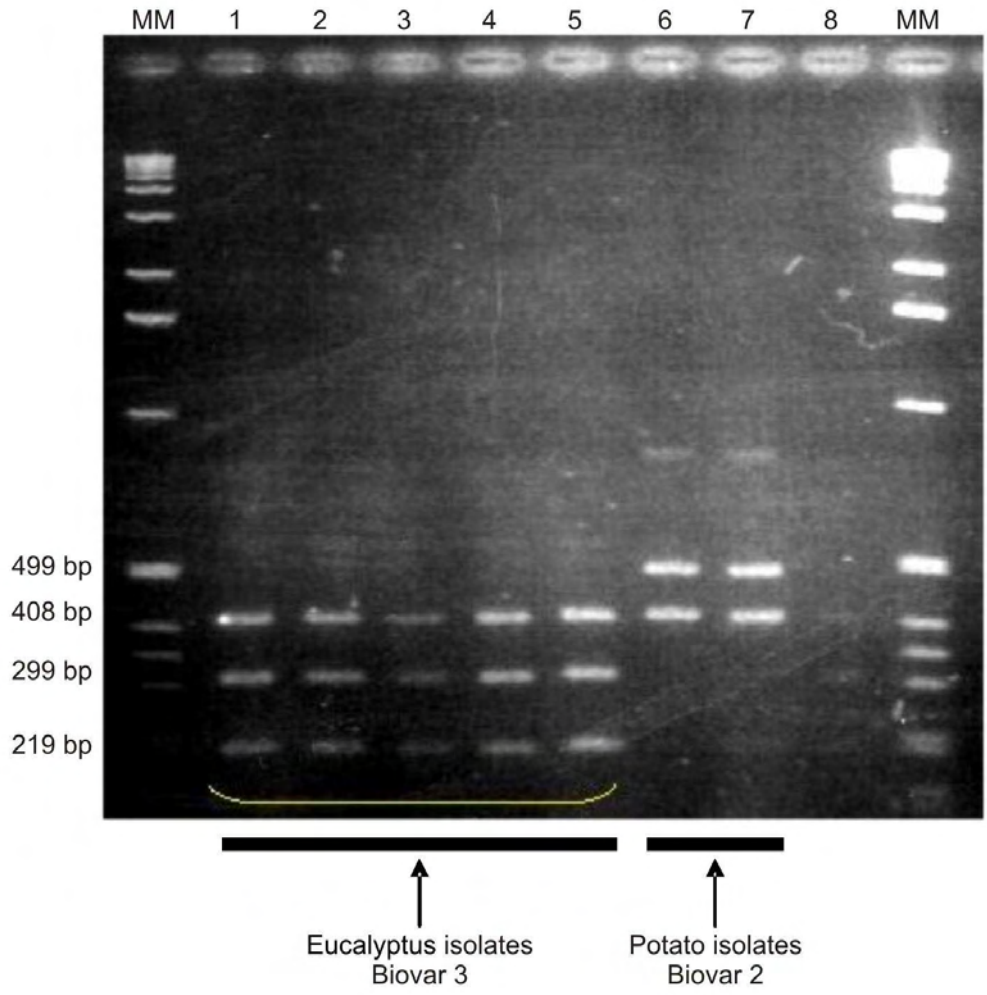


Fig. 2 Diagnostic Test using PCR-RFLP of *hrp* genes from *Ralstonia solanacearum* isolates

Research Leader: Dr Gert Marais

Research Team: Ms Annelie Lübben (CSIR)

Objectives of the research programme:

- Building collaboration between FABI and CSIR Bio/Chemtek.
- 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.

Highlights of research 2005/2006:

CAMS has grown substantially over the last two years, especially in the field of mycotoxicology of grain crops. Projects conducted in the group mainly cover crops such as maize, wheat, sorghum and millet and is aimed to address processing and storage of these commodities. Significant strides have also been made in the production of flavours and fragrances from fungi in the CSIR and FABI culture collections, representing certain groups of fungi occurring naturally in South Africa. A project investigating the diversity of *Botryosphaeria* species in indigenous *Acacia* plants has led to the discovery of at least 10 new fungal species and possibly a new genus. Some of the highlights are discussed below.

Establishment of CAMS: An agreement was signed in May 2007 for the official establishment of CAMS between the University of Pretoria and the CSIR. The centre is situated at the premises of the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria and has strong ties to CSIR Biosciences. Most of the projects conducted in CAMS are done in collaboration with other researchers in both CSIR Biosciences and FABI. The aim of CAMS is to build capacity in the study of fungi (mycology) in various fields and to utilise South Africa's fungal resources as a means of creating value within the country. The aim is also to ensure the protection and maintenance of our fungal biodiversity. CAMS aims to create an environment where international collaborators can liase with a local institution such as CAMS at FABI to do research and development on South African fungi, to ensure that benefits flow back to the country.

Flavours and fragrances: CAMS was involved in a BioPAD BRIC project to commercialize the production of blue cheese flavour compounds. An industrial process was developed in conjunction with CSIR Biosciences and a technology package was finalized. In a separate study, two hundred and eighty fungi were evaluated for their ability to produce pyrazine flavours. Aromas detected included nutty, meaty, caramel, chocolate, green, and potato flavours, characteristic of pyrazines. Results have indicated that 45% of the total fungi screened produced aromas resembling pyrazine flavours. The green flavour was most prominent and includes mainly members of *Aspergillus* and *Penicillium* as strong producers. Some of these fungi were found to produce methoxypyrazines that has the typical green bell pepper odour and possibilities are being investigated to produce these flavours at larger scale.

Maize resistance to mycotoxigenic fungi: A project with The Maize Trust and THRIP as funding agencies was completed at the end of 2006 to identify resistant commercial maize cultivars against mycotoxigenic fungi during storage. The project was done in collaboration with Dr Eugenia Barros at CSIR Biosciences. The rationale behind the project was that considerable work has been done on resistance of maize against plant pathogens in the field. However, humans consume processed or milled maize products that are sometimes stored for long periods. During the storage process mycotoxigenic fungi can be introduced, changing the fungal population and thus mycotoxins that could be detrimental to the health of humans and animals.

In the study, 49 maize cultivars, obtained from the South African National Cultivar Trial of the 2003/2004 season were screened. Ten important fungi associated with maize commodities in South Africa were identified to be used in resistance trials. The fungi were selected as such to represent five traditionally known field- and five storage fungi. Overall, the selected field fungi performed somewhat weaker under storage conditions than those fungi that are known to be associated with post harvest spoilage. Results indicated that there is a difference during storage between field and storage fungi, and that different mechanisms could be involved. Based on the results obtained in the resistance trials, PAN 6146 has shown resistance consistently throughout the resistance trial. This cultivar can thus be regarded as the most resistant cultivar screened in this study. CRN 3549, on the other hand, was susceptible in both instances when exposed to field- and storage fungi.

Migration of mycotoxigenic fungi in maize mills: A project was recently started to investigate the presence of mycotoxigenic fungi and their mycotoxins during the milling process. It is a Maize Trust / THRIP funded project in collaboration with Dr Corinda Erasmus at CSIR Biosciences. The objective of this project is to provide the maize milling industry with information on the role that the industry is playing in the formation of mycotoxins in milled products. The project specifically aims to gather statistical data from at least 6 maize mills in South Africa and identify high risk products from the milled fractions. The project also investigates the phylogenetic relations of mycotoxigenic fungi that occur in South African maize over the last few decades. There is reason to believe that certain fungi such as *Fusarium verticillioides* are much more aggressive colonizers of maize today than experienced a few decades ago.

Maize resistant trials against mycotoxigenic fungi

Fungal biodiversity in indigenous trees: As part of the CTHB Centre of Excellence at FABI, a study is being conducted on *Botryosphaeria* species associated with *Acacia* trees in Southern Africa. Results obtained thus far indicate that at least 10 undescribed fungal species are found in selected areas such as Namibia, Northern Cape Province and Pretoria. It is also likely that a new fungal genus will be described in the near future. This is evidence that Southern Africa is an area that is relatively unexplored regarding its fungal biodiversity and it is likely that many undescribed fungi will be discovered in future.

Indigenous quiver tree in the Northern Cape Province

Phoma sorghina *in Southern Africa*: This fungus is associated with more than 80 host plants worldwide and the morphological characteristics could be quite diverse. A study

was conducted to investigate the phylogenetic diversity among *P. sorghina* isolates from various commodities and plants in Southern Africa. This fungus is best known because of its association with a disease called onyalai among especially black people who consume millet and sorghum in significant quantities. The disease lowers the blood plate counts of patients who eventually become bleeders. The taxonomy of this fungus is not well defined and it is likely that isolates from different hosts and commodities could represent different fungal species.

Molecular Plant Physiology

Research leaders: Prof Karl Kunert
Dr Rachel Chikwamba

Research team: Dr Urte Schlüter
Dr Christell van der Vyver
Dr Getu Beyene

Objectives of the research programme:

The overall objective of this research programme is to understand stress biology through functional genomics and precision breeding. The first major research concern in 2005/6 has been the investigation of the cysteine proteinase/cysteine proteinase inhibitor system and its involvement in plant senescence. A second research concern has been on understanding of gene function in broad-spectrum pathogen resistance.

Highlights of research 2005/2006:

Plants cannot run or hide and they have to survive in harsh environments. Our work executed with partners in the UK, USA and Canada and also African partners contributes to understand the mechanisms allowing plants of relevance to Africa to survive in these environments by being exposed to abiotic and biotic threats relevant to Africa. Our ultimate goal is applying the learnt principles to the design of crops that are better adapted to these stresses.

The first highlight of our research was the development of tools for studying gene function and precision breeding. Techniques for the *in vitro* manipulation of elite maize germplasm as a cereal crop and soybean as a legume crop as tools for plant improvement have been developed. We have primarily focused on routine tissue culture and regeneration protocols specific for elite germplasm with broad adaptation to Southern Africa as a basis for the development of a robust *Agrobacterium*-based transformation protocol for local maize and soybean. A robust transformation technique is a key component tool in any functional genomics kit, with utility in validation of gene function by over-expression or down-regulation of candidate genes. So far we have established a tissue culture regeneration system from maize embryogenic callus and for soybean from cotyledonary nods and embryonic tips. Constructs containing cysteine proteinase inhibitors under constitutive and nodule specific control have been created and will be introduced into soybean variety Williams 82.

The second highlight of our research was the understanding of gene function in broad-spectrum pathogen resistance. Our work in this area focused on the discovery and characterization of NPR-1 like genes, key modulators in the systemic acquired resistance (SAR) pathway which confers broad spectrum long term pathogen resistance upon initial attack of a crop by a pathogen. This work currently focuses on crops in which these genes have not been previously described. We were recently able to isolate two NPR-1 genes from banana MNPR1A and MNPR1B (Genbank Accession numbers: DQ925843 and EF137717). Understanding the function and regulation of these genes will contribute significantly to the development of strategies to enhance broad spectrum pathogen resistance in crop plants.

The third highlight of our research was the understanding of gene function in abiotic stress-plant senescence. This research focused on the processes responsible for the premature senescence in soybean and in particular nodules induced by abiotic stress, such as drought. Specific subject of investigation has been the characterization of the function of the cysteine proteinase/cysteine proteinase inhibitor system in the senescence process. In collaboration with the group of Prof. Foyer we are currently

carrying out a transcriptome analysis using legume nodules of different ages to investigate in greater detail the senescence process. In these experiments nitrogenase activity was used as a marker for the viability of the nodules and RNA from crown nodules have been harvested for RNA isolation and transcriptome analysis using the micro-array technique. The cysteine proteinase/cysteine proteinase inhibitor system is further extensively studied in our current work and includes the investigation of its functions in minimising insect attack and improving the yield of useful bio-engineered proteins.

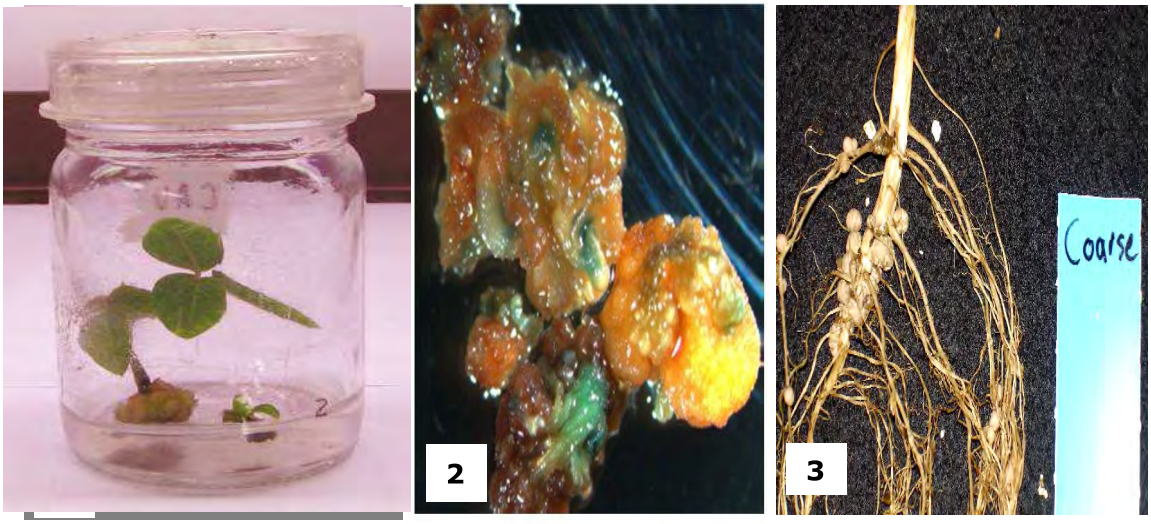


Fig. 1 Soybean plant regenerated in tissue culture from cotyledonary node
Fig. 2 Gus expression in herbicide-resistant maize callus
Fig. 3 Crown nodules from 3 weeks old soybean plants

Future research activities will focus on improvement of recombinant protein stability using protease inhibitors. The interest in plants as a safe and economic production system for recombinant proteins, such as vaccines, is increasing rapidly. Proteases are responsible for the degradation of recombinant proteins in plants thus severely limiting the amount of extractable recombinant foreign proteins. One possibility for alteration of protease activity, which we will explore in plants, is the manipulation of their activity by expression of their natural inhibitors (protease inhibitors). More detailed information about the specific activity profile of certain proteases and the influence of their inhibitors on recombinant protein degradation will substantially contribute to the improvement of plants as potential production system for recombinant proteins. The particular research questions we intend to ask are if endogenous proteases are involved in the process and if natural inhibitors provide an effective system to prevent recombinant protein degradation. The obtained information will directly contribute to the improvement of an efficient production system for recombinant proteins in plants.

Plant Growth Promoting Rhizobacteria (PGPR) as Biocontrol and Growth Promoting Agents in Sorghum

Research leaders: Prof Nico Labuschagne
Prof Lise Korsten

Objectives of the research programme:

- Isolate rhizobacteria from sorghum rhizosphere in Ethiopia and from the rhizosphere and rhizoplane of grasses at Nylsvlei nature reserve in South Africa.
- Screen the rhizobacterial isolates for *in vitro* and *in vivo* mycelial inhibition of the soilborne pathogens *Fusarium oxysporum* and *Pythium ultimum* as well as in terms of their growth promoting ability in pathogen free soil in the greenhouse.
- Determine the modes of action for biocontrol and growth promotion activities.
- Identify the most effective isolates to species level.

Highlights of the research 2005/2006:

The research during this period was a continuation of the PhD study of Mr. Ahmed Idris Hassen which initially involved isolation of Plant growth promoting rhizobacteria (PGPR) and subsequent *in-vitro* screening experiments. The current report focuses on the following two aspects of research conducted under greenhouse conditions: i) Evaluation of the isolates for biocontrol of *F. oxysporum* and *P. ultimum* causing root rot in sorghum and ii) Screening of the isolates in terms of their growth promoting ability in sorghum in pathogen free soil. PGPR have the capacity to rapidly colonize the rhizosphere and the rhizoplane and compete with soilborne pathogens at the root surface by producing antifungal metabolites. In addition, PGPR, with their capacity to secrete the phytohormone indole-3-acetic acid and siderophores, are able to enhance growth in many plants by improving phosphorous and iron acquisitions by the roots.

From as many as 78 Ethiopian isolates which were initially screened for *in vitro* and *in vivo* antagonistic activity against *F. oxysporum* and *P. ultimum*, we were able to select five best performing rhizobacterial isolates. These were identified by means of the API and 16S rDNA sequencing methods as *Bacillus cereus* (NAE1-7 & KBE5-1), *B. circulans* NAE5-7, *B. stearothermophilus* KBE5-7 and *Chromobacterium violaceum* KBE9-1. Similarly out of 86 bacterial isolates initially isolated from the Nylsvlei Nature Reserve in South Africa, six isolates have been selected as the best performing biocontrol rhizobacterial isolates. These were identified as *B. cereus* (KBS5-H & KFP9-K), *Serratia marcescens* (KBS9-R & KBS6-H), *Pseudomonas fluorescens* KBS6-17 and *Chryseomonas luteola* KBS5-F. All the selected isolates were able to significantly inhibit *F. oxysporum* and *P. ultimum* both in the dual culture assay and under greenhouse conditions. The formation of prominent inhibition zones in the dual culture assays against these pathogens was indicative of the ability of the bacterial isolates to produce certain antifungal metabolites. In the screening experiment under greenhouse conditions too, these isolates effectively suppressed root rot caused by *F. oxysporum* and *P. ultimum* rendering disease suppression levels of 60 % -100 %. The treatments which received both the pathogens and these effective bacterial isolates resulted in plants which looked healthy, showing no or little symptoms of root and crown rot. On the other hand control plants not treated with bacterial isolates but only with the fungal pathogens developed infected roots characterized by dark red to black discoloration.

Specific modes of action studies revealed that the successful suppression of *F. oxysporum* and *P. ultimum* root rot in sorghum by these rhizobacterial isolates was due to their ability to produce antibiotic substances in culture filtrates, produce siderophores, degrade chitin and induce systemic resistance in the plants.

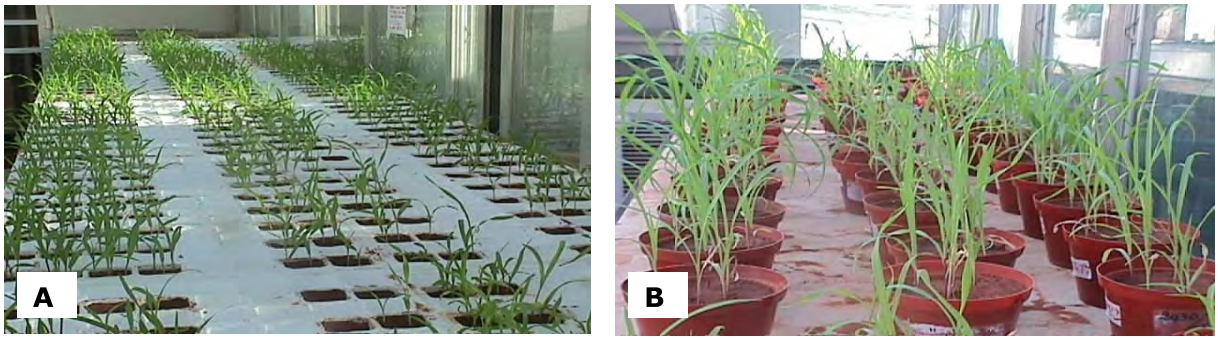


Fig. 1 Experimental layout in the screening of rhizobacterial isolates for suppression of *Fusarium oxysporum* root rot in sorghum. Preliminary screening in Styrofoam seedling trays (A) and greenhouse pot trial (B)

In terms of growth enhancement in pathogen free soil, *B. cereus* KBE7-8 and *C. violaceum* KBE9-1 were identified and screened as the best growth promoting Ethiopian isolates, whereas *S. marcescens* (KBS9-R & KBS6-H), *B. cereus* (KBS5-H & KFP9-K), *C. luteola* KBS5-F and *P. fluorescens* KBS6-17 were selected as the best growth promoting South African isolates. These isolates colonized the roots at a higher concentration than the threshold level (10^{5} cfu/g) necessary for rhizosphere competence and resulted in increased root and shoot biomass, shoot length and chlorophyll content compared to the untreated controls. The modes of action studies revealed that these isolates were able to solubilize phosphate (P), produce the phytohormone indole-3-acetic acid (IAA) and produce siderophores. Substantial productions of IAA, phosphate solubilizing enzymes and siderophores have been implicated as the major determinants for growth promotion in plants by rhizobacteria.

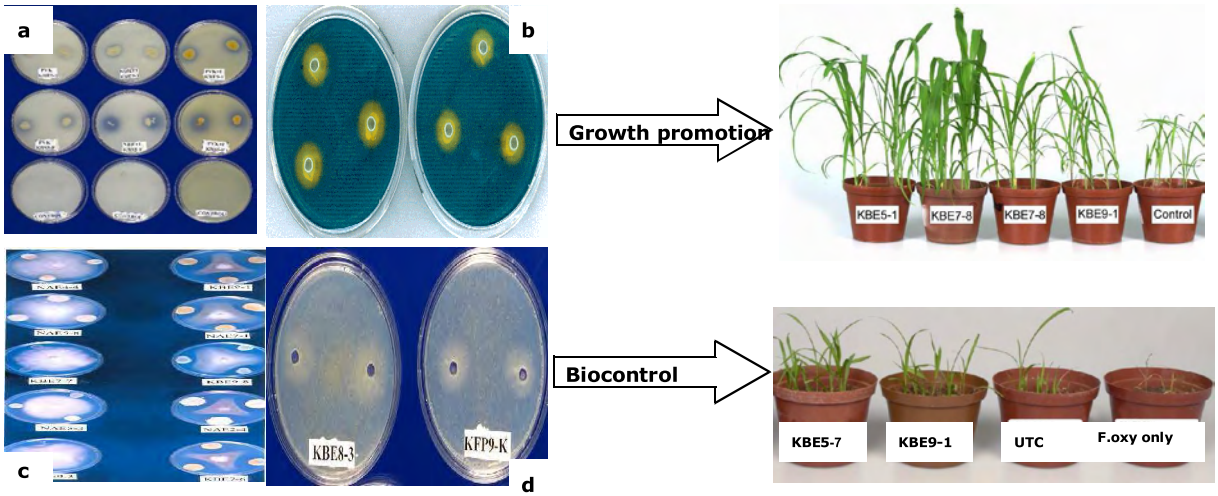


Fig. 2 Phosphate solubilization on Pikovskaya medium (a) and siderophores production on Chrome-azurol S agar plate (b) are some of the modes of action exerted by the effective isolates to enhance sorghum seedling growth in pathogen free soil (top-right). *In-vitro* production of antibiotic substances on potato dextrose agar (c) and degradation of chitin on chitin agar medium (d) were involved in biocontrol activity against *Fusarium oxysporum* with significant disease suppression by isolates KBE5-7 & KBE9-1 compared to the control (bottom right , UTC= untreated control)

In most developing countries, the existence and the resulting agricultural significances of PGPR have barely been described or studied. In countries such as Ethiopia, the farming practices are mainly small scale monoculture involving planting of a single crop such as sorghum (*Sorghum biocolor*), teff (*Eragros teff)* or maize (*Zea mays*) over an extended period of time. This extensive monoculture leads to the development of several soilborne fungal and bacterial pathogens resulting in continuous reductions in yield. The findings of

this study contributes to knew knowledge pertaining to the application of PGPR in agricultural soils in countries such as Ethiopia and South Africa.

Phytobacteriology

Research leader: Prof Teresa Coutinho

Research team: 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*, bananas and other agricultural crops.
- Study the epidemiology, ecology and biology of selected emerging plant pathogenic bacteria.
- Identify pathogenicity factors of selected plant pathogenic bacteria.
- Train and educate students in phytobacteriology.
- Establish a centre of excellence in phytobacteriology.

Highlights of research 2005/2006:

The main focus of our research is on *Pantoea ananatis,* a ubiquitous bacterium which occupies diverse ecological niches. It is known to cause diseases in a number of plant hosts, including eucalypts and maize in South Africa. It has also been detected in locally produced onion seed but the disease it causes, central rot, has never been observed in the country. Little is known about the epidemiology, ecology and biology of *P. ananatis.* Thus far, we have established that this pathogen resides both epi- and endophytically within healthy eucalypt leaves. However, their exact role in the life cycle of the pathogen is still unclear. Our belief is that *P. ananatis* is an opportunistic pathogen which infects its host when environmental conditions are optimal and the inoculum density is at a level which readily allows infection to take place.

One of the objectives of our research over the past two years has been to develop methods to distinguish between *P. ananatis* and other *Pantoea* spp. The majority of these *Pantoea* spp. were isolated by our research team from *Eucalyptus* spp. grown in Africa, South America and South East Asia. The symptoms on these host were similar to the bacterial blight and die-back, caused by *P. ananatis*, observed in South Africa. In addition, clinical strains isolated from researchers elsewhere and strains incorrectly placed in the genus have been reclassified. The methods used to undertake this research have included standard phenotypic tests, fluorescent Amplified Fragment Length Polymorphisms (AFLPs) and multilocus sequence analysis (MLSA). From our results it is clear that we are not only dealing with described species but also with a number of unknown species. We are now in the process of describing 10 new species, some of which are in the genus *Pantoea* while others will be placed in other genera of the Enterobacteriaceae.

Symptoms of bacterial blight on a *Eucalytus* leaf

Potential elicitors and regulators of pathogenicity of *P. ananatis* in eucalypts have been investigated. The phenotypic elicitors detected, which appear to be involved in pathogenicity, are indole acetic acid and extracellular polysaccharides. We have also attempted to identify genes involved in pathogenicity and homologs of some pathogenicity genes have been found in *P. ananatis.* The difficulties experienced with locating the pathogenicity factors and the creation of other opportunities such as conducting comparative genomics, has led us to the decision to sequence the entire

genome of this bacterium. The genome has now been sequenced by Inqaba Biotech and our next step is to assemble and annotate it.

Diseases of Indigenous Food Crops Grown by Smallholder Farmers

Research leader: Prof Terry Aveling

Research team: Prof Nico Labuschagne
Dr Quenton Kritzinger (Dept of Botany)

Objectives of the research programme:

To identify and study the plant pathogens, storage fungi and associated mycotoxins of cowpea and other indigenous food crops.

Highlights of the research 2005/2006:

Thiram and different concentrations of Celest® XL [fludioxonil and mefenoxam] were evaluated against *Rhizoctonia solani, Pythium ultimum* and *Fusarium solani* on cowpea. A germination test was performed according to the rules of the International Seed Testing Association (ISTA). Celest® XL and Thiram improved cowpea germination and increased shoot and root length. Percentage diseased seeds were significantly lowered by all the treatments when compared to the control. In greenhouse trials, results showed all fungicides, when compared to the inoculated control, increased the percentage emergence and reduced disease incidence. In treatments infected with *R. solani* only Celest® XL at 1.25x and 2x the recommended rate were able to significantly increase plant height above that of the inoculated control. When compared to the inoculated control, dry shoot mass for treatments infected with *P. ultimum* and *F. solani* was significantly increased by all fungicides.

Excursion to the Lowveld and Kruger Park with 2007 Honours students

The surface topography of various legume seed coats was studied using scanning electron microscopy. Different varieties of pigeonpea (*Cajanus cajan*), lablab (*Lablab purpureus*), cowpea (*Vigna unguiculata* and *V. vexillata*) and bambara groundnut (*Vigna subterranean*) were obtained from the Agricultural Research Council, Range and Forage Institute – Genebank. The varieties of seeds varied in colour from white, beige, tan, mottled, dark brown to black. The results showed that the lighter seed coats had a rough surface compared to the smoother surfaces of the darker seed coats. This is a trend among species within a genus. The rough surface of the white seed could facilitate adherence of pathogens and increase the occurrence of disease. *C. cajan* (mottled appearance) showed numerous pits on the surface which could provide openings for fungal infection.

Fusarium solani, Rhizoctonia solani and *Pythium* sp. are known to be destructive pathogens of lettuce grown by emerging and commercial farmers, causing severe yield losses in South Africa. The aim of this research was to evaluate the efficacy of selected fungicides and biological control agents against these pathogens on lettuce seedlings. Three new fungicides, A, B and C, were tested at two different concentrations (at, and double, the recommended dose) as foliar and soil treatments. Percentage emergence and diseased plants were determined. Phytotoxicity was recorded and plant height and dry

mass of shoots and roots was determined. None of the fungicide treatments caused any visible phytotoxicity expressed as burning, chlorosis and necrosis. Fungicide A significantly reduced percentage diseased seedlings in the *Fusarium, Pythium* and *Rhizoctonia* treatments. The root and shoot dry mass of inoculated plants treated with fungicide A was equal or better than that of the uninoculated control. Fungicide B and C did not follow the same trend. Fungicide A is currently undergoing further evaluation and should be registered shortly in South Africa.

Subsistance farmers were visited in the Makatini Flats, KwaZulu-Natal and southern Mocambique during March 2005-2007. Maize seed samples were collected from various types of storage structures and containers and from the field. The germination and vigour of these seeds were tested and the viability of treated maize seed when stored under conditions of fluctuating temperature was evaluated. Seeds that were commercially treated with Celest served as a control. Germination was measured according to the International Seed Testing Association (ISTA) rules. Of the samples tested, the maize that was left on the field to dry gave 100% germination. The treated control had a germination of 92.5%. Seeds that were imbibed for 40 hr had the highest percentage weight increase but five of the eight samples maintained germination above 70% following imbibition. The conductivity of the solute was read following imbibition. Field stored maize had the lowest solute leakage (1267 µS) and this correlated with percentage seeds with living tissue as indicted by tetrazolium staining following fast (95.8%) and slow (94.7%) imbibition. After the first set of experiments, samples were stored at room temperature to simulate the fluctuating original storage conditions. A year later the samples were again subjected to the germination test. The decline in seed viability during the storage period was exhibited by the standard germination test. Field stored maize had a 76.5% drop in germination while samples obtained from a general store and the treated control maintained germination above 80%. Two of the eight samples failed to germinate. This study also showed that seed treatment is a viable option especially when the maize has to be stored until the next season.

A further highlight of the 2005/2006 period was that Prof. Aveling's research speciality is seed pathology and Prof. Aveling was nominated as member of the Scientific Programme Advisory Committee (SPAC) for the 28th International Seed Testing Association Symposium to be held in Brazil in 2007. She was also nominated and appointed Chairperson of the Plant Disease Committee 2007-2010 at the 27th Congress of the International Seed Testing Association held in Iquassu, Brazil May 2007.

Members of the ISTA Seed Health Committee, Iguassu, Brazil

Potato Pathology

Research leader: Dr Jacquie van der Waals

Research team: Prof Teresa Coutinho
Prof Lise Korsten
Dr Johan van der Waals (Dept of Plant Production & Soil Science)

Objectives of the research programme:

This research programme focuses on three important diseases of potatoes in South Africa, namely soft rot and *Pectobacterium, Dickeya, Fusarium* and *Verticillium* wilts. The project has various objectives:

- To investigate epidemiological factors, importance, incidence and severity of soft rot, *Pectobacterium, Dickeya, Fusarium* and *Verticillium* wilts of potatoes in South Africa.
- To investigate and interpret the genetic diversity of these various pathogens on potatoes in South Africa.
- To develop new and evaluate current potato seed tuber testing guidelines for *Pectobacterium, Fusarium* and *Verticillium.*
- To evaluate of cultivar susceptibility to *Verticillium* wilt.
- To determine the socio-economic impact of the diseases on the local industry.

Another focal area of my programme is to determine the effect of Silicon on the incidence and severity of these and other potato diseases. In recent years the effect of Si on the resistance of plants to pests and pathogens has become a source of interest. Silicon is not an essential element but it has proven beneficial in reducing the effects of a range of biotic and abiotic stresses.

Highlights of the research 2005/2006:

Pectobacterium

Very little research has previously been published on this disease complex in South Africa before, although it has been widely researched globally. Ongoing field trips and isolations from diseased plant material have given us a good idea of the current status of this disease complex in South Africa. The most significant event in 2006 in the *Pectobacterium* project was the discovery of a new causal agent of blackleg in South Africa. This species has previously only been reported on potatoes in Brazil and is thus a very exciting development. We will now investigate the impact this new species will have on the spread and control of blackleg in South Africa. In addition, a species specific PCR is being developed to test for South African *Pectobacterium* strains in seed tubers.

Black leg symptoms on potato

Verticillium

A pre-screening technique to screen potato breeding lines for tolerance to *Verticillium* wilt, using tissue culture plantlets of existing cultivars, was developed. The results obtained by using tissue culture plantlets were comparable to results obtained in the greenhouse. Traditional screening for resistance to *Verticillium* wilt involves growing potential germplasm in infested soil in the greenhouse and field. However, disease development and symptom expression are affected by climate, including temperature and day length, as well as agronomic practices such as irrigation and rate of nitrogen application. In addition, *V. dahliae* may also show

synergistic effects with other pests and pathogens, such as nematodes. Critical evaluation of potato germplasm and clones for resistance to *V. dahliae* under field conditions is also time-consuming and expensive. It is for these reasons that the *in vitro* screening technique represents an important development for the potato seed-certification scheme in SA.

Verticillium wilt and yellowing of potatoes

Fusarium

The results of the investigation of the current status of *Fusarium* wilt on potatoes in South Africa implicated *F. oxysporum* as the main cause of Fusarium wilt of potatoes in South Africa, as previously reported by Visser (1999). The reason why *F. oxysporum* is more prevalent than *F. solani* is perhaps due to climate, cultivars and virulence of this species. *F. solani* was also found, although less frequently. The results indicate that *Fusarium* species are spread easily through potato growing regions and are not restricted to one region. This could contribute to the variety of strains that are found in each potato growing region, which would in turn affect management and control options.

General

The on-going collaboration between the Potato Division of the Vegetable and Ornamental Plant Institute (VOPI) at the Agricultural Research Council (ARC) and the Potato Pathology Programme at UP has facilitated knowledge transfer between the two groups. This is beneficial to both groups and especially to post-graduate students in the Pathology Programme, who are able to learn from the wealth of knowledge the researchers at the ARC possess.

Discolouration of potato stems due to *Fusarium* wilt

Sound relationships with the staff of Potatoes South Africa and various potato growers were built this year, through numerous field trips, attendance of field days and a good, positive presence at the Annual National Potato Research Feedback meeting. This has allowed us to easily obtain important information from growers about wilt diseases on their farms, as well as samples of diseased plant material, which might otherwise have been difficult. In any research project, it is of vital importance that the researchers and their work be visible and accessible to the industry and the respective markets. These visits gave students direct exposure to the potato industry and their understanding of the impact of the diseases became a reality to them.

In addition to being beneficial to students, field trips and grower workshops have an important role to play in educating growers, reducing their dependence on pesticides and helping them to make informed disease management decisions. In an effort to facilitate this process of technology transfer, Potatoes South Africa and South African potato growers are continually informed of the research conducted in this study and results obtained. This is done through presentations at workshops for growers and industry representatives, as well as publication of results in the official magazine of Potatoes South Africa, Chips, which is circulated to most South African potato growers, and in an agricultural glossy magazine, Afgriland.

The international contacts established have brought this programme into the international arena and other researchers working in the same field are aware of the work we are doing. International positioning is extremely important in any scientific project, as it ensures that one's work is relevant and on the "cutting edge" of the respective sciences. In addition, good working relationships with highly renowned

scientists allow one to tap into their knowledge and gain practical advice that is not always found in scientific publications.

Fusarium Diversity in South Africa

Research leader: Dr Emma Steenkamp

Research team: Prof Brenda Wingfield
Prof Mike Wingfield
Prof Wally Marasas

Objectives of the research programme:

The objective of this research programme is to obtain a global idea of the evolution and ecology of species in the fungal genus *Fusarium*. The research focuses strongly on relationships within and among species of the so-called "*Gibberella fujikuroi* complex" with its well-known phytopathogenic members. Accordingly, our major goals are to:

- characterise *Fusarium* species that are of ecological, agricultural, commercial and medicinal value using morphology and DNA-based approaches;
- analyse the population biology of these important species using cultural and molecular characters; and
- build an overall picture of the relationships among *Fusarium* groups, sections and species complexes using molecular phylogenetic approaches.

Highlights of the research 2005/2006:

During this period, much of our research efforts focussed on identifying *Fusarium* species associated with the malformed flowers of waterberry (*Syzygium cordatum*) (Fig. 1). These disease's symptoms strongly resemble inflorescence malformation of mango (*Mangifera indica*), which is also characterized by abnormally branched and thickened panicles that produce up to three times the normal number of flowers (Fig. 2). The causal agent of the disease on mango has been identified as *F. mangiferae* in the *Gibberella fujukuroi* complex. To determine the identity of the fungi associated with affected waterberry flowers, we used morphology and DNA sequence comparisons for the gene encoding translation elongation factor 1α. Our results showed that numerous *Fusarium* species such as *F. oxysporum* and *F. equiseti* are associated with malformed waterberry flowers. However, several novel species which have not yet been described were also isolated. Many of these represent members of the *Gibberella fujukuroi* species complex and may potentially play a significant role in the development of the disease on waterberry. This research was presented by Marija Kvas in the form of an oral paper entitled "*Fusarium* species in the *Gibberella fujikuroi* complex associated with *Syzygium cordatum* floral malformation" at the 45th Congress of the Southern African Society for Plant Pathology (21-24 January 2007) held in Benoni.

Fig. 1 Malformed inflorescence of mango

Fig. 2 Malformed inflorescence of mango

Rhizobial Diversity Associated with Indigenous Legumes

Research leader: Dr Emma Steenkamp

Research team: Dr Ian Law (ARC-PPRI)

Objectives of the research programme:

Our overall objective is to characterise the diversity of rhizobia associated with Southern African legumes, especially those that are of agricultural, commercial and medicinal value. To accomplish this, we isolate and identify the rhizobial bacteria from the root nodules of legumes from various regions in Southern Africa. Such identifications are generally achieved with a combination of traditionally used morphology and biochemical tests, as well as DNA-based approaches. These bacteria are also evaluated for their ability to nodulate and to fix atmospheric nitrogen. Ultimately these data provide an indication of the distribution of rhizobial species and their ecological significance for indigenous legumes.

Highlights of the research 2005/2006:

The indigenous legume cowpea (*Vigna unguiculata*) is widely grown as a grain, fodder and vegetable crop. Cultivation of this plant also helps maintain soil quality through biological nitrogen fixation by symbiotic *Bradyrhizobium* species (Fig. 1). Although inoculant strains are widely used to improve or assist with the nodulation and nitrogen fixing processes, recent findings suggest that many of the bradyrhizobia already present in certain Southern African soils are more competitive and effective than the inoculant strains. In the 2006/2007 period we determined the identity of these Southern African strains and found that the majority of the examined cowpea strains are conspecific with or closely related to known species of *Bradyrhizobium*, while others remain to be described. Our results also suggest that many of these strains represent locally adapted ecotypes or biovarieties, thus reflecting the uniqueness of the Southern African soils with respect to *Bradyrhizobium* symbionts of cowpea.

Fig. 1 Nodules induced by *Bradyrhizobium* sp. on cowpea roots

Fig. 2 *Hypocalyptus sophoroides* flowers

Another research highlight for this period involved the discovery of yet another legume that is nodulated by betaproteobacteria. To date, most legumes that have been studied appear to be nodulated by members of the alphaproteobacterial Rhizobiales. The fact that betaproteobacteria *Burkholderia* species 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*), after which a small number of additional species with symbiotic nitrogen fixing abilities have been identified. In our study of the root nodule bacteria of *Hypocalyptus oxalidifolius*, *H. coluteoides* and *H. sophoroides* (see Fig. 2), endemic to the Western Cape, we have identified a number of additional *Burkholderia* lineages displaying this property.

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

Research leader: Prof Zander Myburg

Research team: Ms Sanushka Naidoo

Objectives of the research programme:

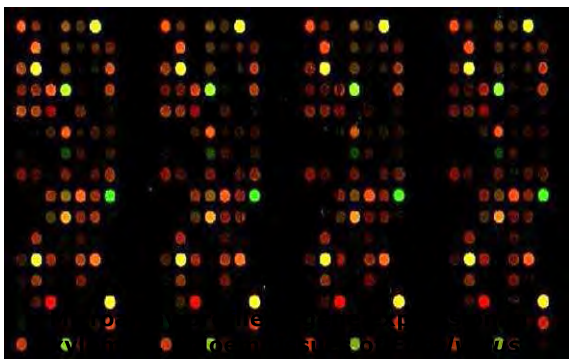
Fast-growing forest tree plantations are an excellent renewable resource for wood, pulp, paper and bioenergy. Forest trees are still undergoing domestication and hold great promise for the sustainable production of fibre and energy for future generations. The main focus of the Forest Molecular Genetics 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 technologies are used to:

- ***discover genes involved in fibre development*** in trees;
- ***dissect the regulatory pathways*** that lead to wood formation;
- ***test the function of fibre development genes*** in model systems such as *Arabidopsis thaliana* and in trees;
- ***find allelic variants of these genes*** in tree populations; and
- ***develop molecular breeding tools*** for the genetic improvement of plantation forest tree (*Eucalyptus* and *Pinus*) species.

Highlights of the research 2005/2006:

Gene Discovery: Gene expression profiling in differentiating woody tissues (e.g. immature xylem, cambium and phloem) can be used to dissect the roles of genes and biochemical pathways in wood fibre development. In the past two years, we have made extensive use of cDNA-AFLP and cDNA-microarray analysis to study the spatial and temporal regulation of wood formation genes in *Eucalyptus* trees. cDNA-AFLP analysis of xylem, immature xylem, phloem and cork tissues collected from different positions along the stems of fast-growing *Eucalyptus* trees allowed the identification of 1374 transcript derived fragments (TDFs) that differ in spatial regulation during wood formation. We have also used a 2600-gene cDNA-microarray (kindly provided by Prof. Ron Sederoff at North Carolina State University) to study the diurnal expression profiles of wood formation genes in *Eucalyptus* trees. Carbon allocation into the main

Taking a peek at fibre



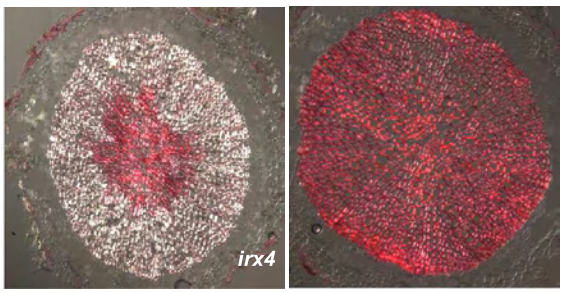
components of fibre cell walls (cellulose, hemi-cellulose and lignin) is regulated in a diurnal fashion and many candidate genes in regulatory and biochemical pathways were identified by this approach.

Cellulose is the main component of fibre cell walls and its production in trees is a major biotechnology target. Starting from a single xylem-specific cDNA-AFLP fragment, we were able to isolate full-length copies of six members of the cellulose synthase (CesA) gene family of *Eucalyptus* trees. We showed that three of these genes are likely to be involved in cellulose production in the secondary cell walls of wood fibre cells, while the remaining three are responsible for cellulose biosynthesis in primary cell walls. We also isolated two members of the sucrose synthase (SuSy) gene family in *Eucalyptus*, which encode enzymes that produce the activated sugar molecules polymerized into long cellulose molecules by CESA proteins. The CesA and SuSy genes represent the core cellulose biosynthesis machinery of *Eucalyptus* trees and their cloning is allowing us to perform detailed functional genetic analysis of cellulose production in trees.

Gene regulation: The transcriptional pathway that leads to cellulose production is an important component of wood formation. We isolated the promoters of the primary and secondary cell wall associated CesA genes of *Eucalyptus* trees and identified cis-regulatory elements in the 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. miRNAs are a novel class of regulatory short (~21nt) RNAs that have only been discovered in the past seven years. We have successfully isolated 48 miRNAs from wood-forming tissues of *Eucalyptus* trees. Of these, 28 are part of putatively novel miRNA families in plants which may be involved in the transcriptional regulation of wood formation processes in trees.

Gene Function: We are using the *Arabidopsis thaliana* model plant system for functional genetic analysis of genes discovered in *Eucalyptus* trees. Vascular development and biochemical mutants of *Arabidopsis* such as the *irregular xylem* (*irx*) mutants have been successfully transformed with the corresponding tree genes and used to demonstrate functional complementation of the *Arabidopsis* mutants. This provides a rapid method to evaluate the function of genes that affect adult tree phenotypes which may take years to develop.

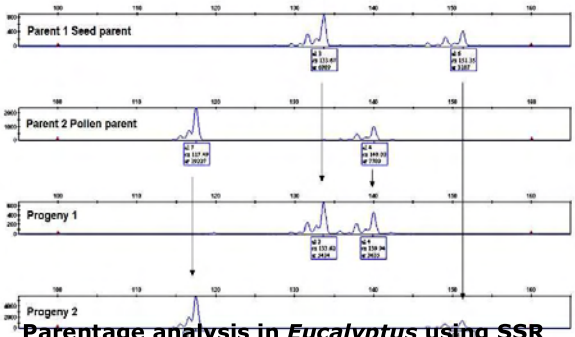
Gene Variation: Knowledge of the amount and structure of allelic variation in tree breeding populations is crucial for the development of genetic markers for wood and fibre quality. We have completed three projects in which we assayed allelic diversity in wood and fibre genes in *Eucalyptus* and pine tree species. This work allowed us to achieve a better understanding of the molecular evolution of wood formation genes and the structure of allelic diversity in tree breeding populations.



Expression of a tree gene in *Arabidopsis* plants

Breeding Tools: 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. In the past two years we have used SSR markers to successfully fingerprint commercial forest tree clones and to determine the level of pollen contamination and selfing in open and controlled crosses of *Eucalyptus* and pine trees.

External engagement: In Nov 2005 we had the privilege of co-hosting the IUFRO Tree Biotechnology 2005 meeting, which brought world leaders in tree molecular biology and genomics to South Africa. We also hosted the International *Eucalyptus*



Parentage analysis in *Eucalyptus* using SSR markers

Network (EUCAGEN, www.eucagen.org) and coordinated a successful proposal to the US Department of Energy to sequence the genome of *Eucalyptus grandis,* a potential bioenergy crop.

Diseases and Pests of Banana

Research leaders: Prof Altus Viljoen (Dept of Plant Pathology, University of Stellenbosch (2007-)
Dr Noelani van den Berg

Research team: Prof Karl Kunert
Prof Nico Labuschagne
Prof Zander Myburg
Prof Dave Berger
Dr Rachel Chikwamba

Objectives of the research programme:

Research objectives for 2005 and 2006 focused strongly on understanding the host pathogen/pest interaction in banana, and establishing a programme to introduce resistance into bananas against major pathogens and pests using unconventional biotechnological approaches.
The programme is built on four foundations:

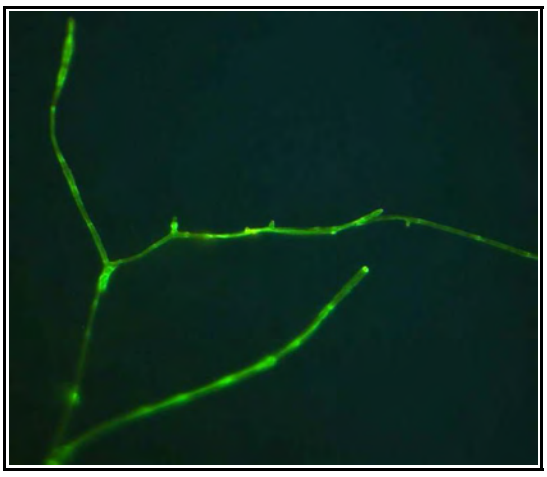
- The identification and characterization of genes in banana involved in resistance to fungal diseases and insects.
- Understanding virulence in *Foc*.
- Establishing a banana transformation facility to introduce resistance genes into banana.
- Development of molecular markers.

In addition, our research on integrating disease and pest management strategies in an environmentally safe and economically feasible way still continues.

Highlights of the research 2005/2006:

In the past 2 years, the Banana Research Programme (BRP) 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 programme. Apart from our research on the biology, epidemiology and management of the disease, several innovative contributions have been made that have not been done on the Fusarium wilt pathogen (*Foc*) anywhere in the world:

- *Foc* isolates have been transformed with the green fluorescent protein (GFP) gene.
- The mating type genes in *Foc* have been determined.
- Microsatellite and other molecular markers have been developed for *Foc*.
- Field trials to test a range of compounds that induce systemically acquired resistance have been done in cooperation with Australian researchers in the field on established and new plantings, and in the greenhouse.
- The BRP was the first group in the world that was able to isolate and identify genes in Cavendish bananas related to Panama disease tolerance/resistance.



Research related to the isolation and identification of pathogen virulence factors and

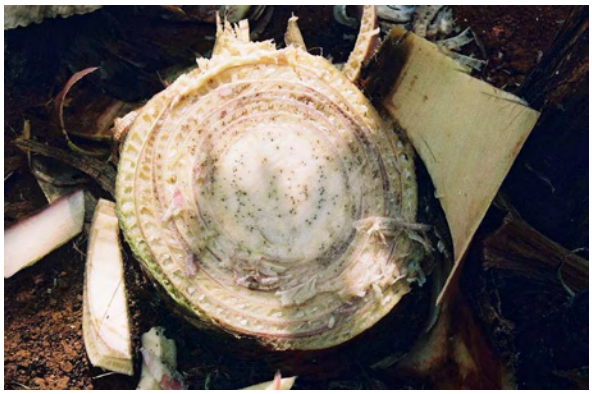
genes in *Foc* is currently progressing in our laboratory in order to design novel control strategies.

***Foc* transformed with the green fluorescent protein**

In addition to the above further highlights include:

- Defence-related genes to Fusarium wilt and the banana weevil were isolated and identified.
- Virulence in *Foc* was studied by means of random and site-specific insertional mutagenesis.
- A banana transformation facility was established, and marker and functional genes were introduced into Cavendish bananas.
- Molecular markers were developed for important fungal pathogens of banana. A preliminary patent was registered in 2006.
- Pest and disease management strategies were developed for the banana weevil borer and Fusarium wilt of banana, respectively.
- The phylogenetic relationships in a worldwide collection of *F. oxysporum* f.sp. *cubense* were investigated by means of sequencing and microsatellite analysis.
- The mode of action whereby non-pathogenic *F. oxysporum* protects banana roots against Fusarium wilt and nematodes were studied by means of biochemical, molecular and microscopical analysis. For confocal laser microscopy, isolates of *F. oxysporum* pathogenic and non-pathogenic to banana were *Agrobacterium*-mediated transformed with green and red fluorescent proteins.
- Isolates of *Xanthomonas compestris* pv. *musacearum* have been characterized, and the phylogenic relationships of populations from Uganda, Ethiopia and DRC have been investigated.

Banana trial evaluating biocontrol agents against Fusarium wilt



Internal Fusarium wilt symptoms

Joanne Fouché and Claire Munro evaluating banana cultivars for disease resistance against Fusarium wilt

DST/NRF CENTRE OF EXCELLENCE IN TREE HEALTH BIOTECHNOLOGY

Director: Prof Mike Wingfield

Manager: Prof Brenda Wingfield

Programme leaders: Prof Teresa Coutinho
Prof Pedro Crous (CBS, Utrecht, Netherlands)
Prof WFO Marasas (MRC)
Prof Jolanda Roux
Dr Gert Marais
Dr Bernard Slippers
Dr Emma Steenkamp
Mr Brett Hurley

Objective
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.

***Research**:* New research projects have been identified for students starting degree programmes in 2005 and 2006. These include studies on *Acacia karoo*, *A. mellifera, Adansonia digitata* (Baobab), *Pterocarpus angolensis* (Kiaat), *Sclerocarya birrea* (Marula), *Syzygium cordatum* (Waterberry) and *Terminalia*. In addition, significant progress has been made on some of the studies started under the auspices of the TPCP, which have a focus on pathogens of indigenous trees. These include studies on pathogens in the genera *Armillaria, Botryosphaeria, Ceratocystis, Cryphonectria, Chrysoporthe, Coniothyrium, Dothistroma, Fusarium, Ganoderma, Pantoea*, *Ophiostoma,* as well as those in the *Uredinales*. An area of research, which is also growing in the CTHB is that focused on insect pests. In 2006, a student project was started with a focus on *Coryphoderma tristis* (Goat moth). This insect appears to be native to South Africa and has been reported from native trees including the Malvaceae, Combretaceae and five other indigenous plant families. In recent years it has become a significant problem in *Eucalyptus nitens* plantations. This project again highlights the continuing research synergy between the TPCP and the CTHB.

Education and Training: In 2005, four post-doctoral fellows, ten Ph.D., eight M.Sc. and five honours students participated directly in the CTHB. In 2006 this number increased. One research fellow, six post-doctoral fellows, eleven Ph.D.'s, fourteen M.Sc.'s and five honours students participated directly in the CTHB. Five honours, one M.Sc. and two Ph.D. students from TPCP/CTHB completed their degrees in the 2005/2006 period.

Dr. Martin Coetzee ran two Phylogenetic workshops in 2006. The first workshop took place from 22-26 May 2006. This was attended by members of the ARC- OVI, NICD, ARC-PPRI, and other students and staff members at the University of Pretoria. The second workshop took place from 2-6 October 2006. This was attended by researchers/scientists both inside and outside the University of Pretoria. These workshops provide one of the "knowledge brokering" outputs of the CoE. They aim to significantly boost the capacity of students in the group to work with DNA sequence data and to better understand the relationships between organisms that are affecting tree health. In 2007, two phylogenetics workshop are planned the first in May and the second in October.

The mentoring programme for undergraduate students has now been formalised. In 2005 the first students were successfully mentored and judging by interviews with

mentors and mentorship students, the programme was hugely successful. In 2006, the CTHB sponsored nine third year students. It is a measure of success of the mentoring programme that of this group of 9 students, 8 were accepted for Honours in the Departments of Genetics, Microbiology and Biochemistry. In 2006, 4 second year students were supported, all of whom had been mentorship students in their first year. Of this group, 2 students have been accepted into the programme for 2007. A further 3 promising 3rd year students were accepted to bring the current 3rd year component to a total of 5 students. There was very stiff competition for the intake of new 2nd year students in 2007 and we were hard-pressed to choose 7 students. Thus, in 2007 we are supporting a total of 12 students.

***Information Brokerage**:* A new data base (DNA data base) including sequences of key tree pathogens and pests has been started which will be used, not only by researchers in the programme, but also by research groups around the world. A number of publications have appeared in the scientific literature and presentations were given regarding research in the CTHB at National and international meetings during 2005 and 2006. The same types of activity are planned for 2007. The CTHB web-site is kept updated and provides an overview of the activities in the CTHB (http://www.fabinet.up.ac.za). The CTHB has continued to work with and support the UP with Science programme in 2006 and will do so again in 2007. The MRYE outreach programme, initiated in 2006, is now in its second year of support and has been a tremendous success. The CTHB participated in the National Science Week in 2006 and we have plans to do this again in 2007. For the first time, FABI through the CTHB participated in Scifest in Grahamstown from 21-27 March and sent a team of 7 students and one staff member to "man" the CTHB exhibit. In this way substantial positive engagement was made with large numbers of young South African learners, aspiring to careers in Science.

Networking: The CTHB has facilitated meetings between the project leaders within the CTHB. In addition, a number of researchers from around the world have already been involved in the initial development of projects in the CTHB. The meeting on the Ophiostomatoid fungi held in Brisbane in 2006, which was partially hosted by the CTHB, was a tremendous success and served to allow the CTHB team to network with research leaders from around the world. The CTHB/TPCP team presented a number of posters and presentations at the eighth International Mycological Congress (IMC 8) in Cairns. The fact that a number of the students were chosen to participate in the organised symposia, increased the overall exposure of the group and provided a number of networking opportunities for the CTHB. Likewise, a number of students and staff attended the Southern African Plant Pathology Congress in January 2007. Plans are already underway to allow students and staff to attend a number of meetings within South Africa and abroad during 2007.

The CTHB was ready to sign a collaborative agreement with a group at the University of Stellenbosch by mid 2006. However, a change of Research Directors at US led to additional clauses being added by Stellenbosch. These are still being negotiated. We are still in negotiations regarding an agreement with a group at UKZN, Pietermaritzburg.

Service rendering: The TPCP disease and pest Diagnostic Clinic has been expanded to accommodate pest and pathogen identification of indigenous trees. A number of Field Trips with a focus on the indigenous trees within South Africa were undertaken during 2006. Two trips to neighbouring countries with a focus on indigenous and plantation tree pests and diseases were also completed in 2006. These field trips serve to foster CTHB interaction with scientists and researchers in countries to the North of South Africa. Professors Brenda and Mike Wingfield undertook a field trip to the northwest of Australia, while on sabbatical. The aim here was to consider Boabab health in that area. This is an important component of the research work being undertaken on the health of the South African Baobab, *Adansonia digitata*.
A number of projects with a focus on the pests and pathogens of indigenous trees have been started in conjunction with the South African National Parks Board. These have been specifically in connection with research in Kruger National Park and the Gauteng

Department of Agriculture Conservation and Environment Leeuwfontein Collaborative Nature Reserve in Gauteng. The fact that a number of publications have resulted from these collaborations reflects the success of these projects. These projects will continue in 2007.

Members of the CTHB research team are actively involved in providing services to the government. For example, the director of the CTHB has been deeply involved in the process towards developing regulations governing the movement of alien invasive pests and pathogens. This is a complex and politically sensitive matter that has already required ministerial involvement and work will proceed throughout 2007. Likewise, through her involvement in the leadership of the National Science and Technology Forum (NSTF), Prof. B. Wingfield has been involved in various initiatives to promote science education in South Africa. Furthermore, members of the group are regularly called upon to advise Government Departments regarding pest and pathogens, particularly but not exclusively, which infest or infect trees.

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 (Manager: CTHB), Mr. Bheki Hadebe (DST), Mr. Gerald Moolman (NRF) and Coert Geldenhuys (Forestwood CC)

SABATICAL VISITS

Professor A-M Botha-Oberholster

Duration of the Sabbatical visit: May 2005-June 2006.
Host: Prof. NVL Lapitan, Department of Soils and Crop Sciences, Colorado State University, Fort Collins, USA.

Colorado State University, Ft. Collins, CO

The objective of my recent sabbatical visit to the Wheat Genomics laboratory, Colorado State University, Ft Collins, USA was to improve my current understanding of the proposed gene-for-gene interaction between a host and insect pest. In order to attain this objective, I partook in the following projects:

(1) **Phenotypic and biochemical responses of wheat plants to *in vivo* injection of compounds from Russian wheat aphid (*Diuraphis noxia*).** The molecular bases are unknown for aphid-plant interactions which are predicted to follow a gene-for-gene model, as in the case of plant-pathogen interactions. The study aimed to detect molecular fractions present in Russian wheat aphids (RWA) which plant gene(s) conferring RWA resistance could recognize and trigger defence responses. The obtained results suggested that RWA proteins seemed to be putative elicitor(s) that could interact with the *Dn* genes to induce defences against RWA attacks. This study also implied that the two RWA biotypes might diversify more among their proteins than their respective metabolites.

(2) **Defense mechanisms are utilized in *Dn7* containing genotypes in response to Russian Wheat Aphid biotypes 1 and 2.** Since we observed differences in the responses of susceptible Gamtoos ($Dn7^-$) and resistant 94M370 ($Dn7^+$) on a morphological and biochemical levels, through the assessment of leaf rolling and streaking symptoms, as well as the level of marker proteins (i.e., PR-protein levels like catalase, peroxidase and β-glucanase) in response to *in vivo* injection of total RWA-1 and RWA-2 proteins, a Affymetrix arrayer experiment was conducted to answer questions relating to the specific defence pathways involved to protect the resistant plants against feeding by different aphid biotypes. Two known defence pathways have been described for pathogens, i.e., systemic acquired resistance (SAR) and the jasmonic acids/ethylene (ETR) receptor pathway that also applies to RWA-wheat interactions. The expression of total RNA extracted from susceptible Gamtoos ($Dn7^-$) and resistant 94M370 ($Dn7^+$) in response to infestation by RWA1 and RWA2 biotypes were analysed and a total of 133 genes significantly regulated (up-and down-regulated) were obtained. The obtained gene set includes known receptors/signalling agents and transcription factors/regulators, i.e., MAPPKs, threonine-seriene phosphatases, zinc finger proteins, etc. More importantly, several unknown genes were identified with putative assigned function in plant/host defence.

(3) **Understanding the development of RWA biotypes in SA and USA** Since the introduction of *Diuraphis noxia* (Russian wheat aphid) in South Africa and the United States in 1978 and 1986 respectively, only one population existed in both countries. However, in 2003 a new population of the biotype appeared in Colorado and more recently, a putative biotype was also reported for SA, which overcame existing resistant cultivars. Since then at least six new populations were discovered in the US. These newly emerged populations are referred to as biotypes. Biotype characterization is done by the differential reactions to wheat genotypes containing different RWA resistance genes (*Dn* genes). The objective of this study was to analyze the genetic divergence among eight US biotypes and two South African biotypes using DNA markers. Phylogenetic trees

established based on AFLP data and *mtCOI* sequence data show that the South African biotypes significantly differed from the US biotypes. The low level of genetic differentiation in both nuclear and mitochondrial genomes may be explained by founder effect, since the RWA species was just established in both countries about 20 years ago.

(4) **Functional genomics of malting in Barley** Barley (*Hordeum vulgare* L.) is an important crop for food, animal feed and malting, a process conducted during the production of beer. Malting quality is a complex phenotype with many interrelated trait components that shows complex inheritance. The genetic improvement of malting quality in barley is hampered by the lack of understanding of this complex process, the quantitative inheritance and low heritability. In order to gain insight into this complex process, as well as insight into the key malting quality determinants, we conducted an expression profiling experiment using RNA extracted from seed exposed to micromalting hybridized against the Barley1 Affymetrix GeneChip probe array. The quality of the malt relies upon the intrinsic characteristics of the raw barley, and on the malting process. During micromalting barley is germinated under strictly-controlled environmental conditions. This process consists of three phases namely steeping, germination and kilning. During the steeping phase, the barley seed is soaked in water to reach predefined moisture content. During the second phase, hydrolytic enzymes are synthesized by the aleurone cell and /or by the scutellum. These hydrolytic enzymes are secreted into the endosperm where it acts on the cell walls of the starchy endosperm. Thus, within the seed, the hydrolytic enzymes convert high molecular proteins and carbohydrates into partially degraded biopolymers and seed metabolism is thus fully activated during the first phases of the malting process. During kilning, the malted seed is dried, and it has been shown that the process reduce the endogenous activity of the enzymes. It is also suggested that kilning is a determining phase for the malting process, since it is performed to arrest modification and render the malt stable for storage. Hence, kilning should also ensure the survival of most heat-sensitive enzymes required for the further breakdown of carbohydrates in the subsequent mashing process. The reserves used to maintain growth of the developing embryo during germination is initially drawn from the embryo itself, later from the starchy endosperm and then from the aleurone layer. Barley seed micromalted for 139 h (44h steeped and 95h germinated) was compared to dry seed to correlate the morphological changes with the gene expression associated with the germination process that is an integral part of the malting process. The alerone layer showed little change in structure when comparing the dry and malted seed, however in the endosperm the starch granules were smaller in size and less dense in structure. Several key enzymes have previously been identified to be involved as determining factors of malting quality. These include the starch degrading enzymes *alpha*-amylase (1,4-α-D-glucanohydrolase, EC 3.2.1.1), which is thought to be the only enzyme that can initiate the breakage of native starch granules by hydrolyzing α-1,4-linked glucose polymers. The debranching and breakdown of the resultant maltdextrins are then completed by hydrolyses through *beta*-amylase (1,4-α–D-glucan malto-hydrolase, EC 3.2.1.2), *alpha*-glucosidase, β-glucosidase, and limit dextrinase (LD, EC 3.2.1.41). *Beta*-amylase catalyses the release of β-maltose from the non-reducing chains ends of gelatinized starch and related compounds, while LD is the only enzyme in germinating barley capable of cleaving (1→6)-α-bonds in branched dextrins formed by the action of *alpha*- and *beta*-amylases. However, the role of other enzymes in debranching and breakdown has been to date completely underestimated. When comparing the expression of specific genes in 2-row and 6-row barley varieties, the study clearly indicated that although the above mentioned enzymes are important as determining factors of malting quality, other proteins and/or enzymes like may even be more useful in prediction of malting quality. These genes and gene products will now be investigated for the presence of single nucleotide polymorphisms (SNPs) which is especially useful in prediction of function.

Professors MJ and BD Wingfield

1st July to 13th August. This period was spent doing research which was mainly based at Murdoch University with Prof. Giles Hardy and Dr. Treena Burgess. Both Prof. Hardy

and Dr. Burgess have close links with the TPCP and CTHB research programmes at FABI. The research undertaken during the sabbatical involved collections of fungal pathogens of native Australian trees including *Eucalyptus* and *Adansonia* (Australian Baobab), which contributed to research questions that form part of the service level agreement of the Center of Excellence in Tree Health Biotechnology (CTHB) at FABI.

13th to 19th July. This period was spent attending the 2nd International Research Workshop on Ophiostamatoid fungi was held on North Stradbroke Island. The meeting was organized by Prof Mike Wingfield from FABI and Dr Keith Seifert from Agriculture and Agri-Food Canada and preceded the 8th International Mycological Congress (IMC8). It was attended by 41 delegates from 12 countries. Holding this meeting was one of the major deliverables of the South Africa/ Norway research project associated with the TPCP/CTHB, 2006 was the final year of this project. It is anticipated that the proceeding of this meeting will be published in 2007. This book will include chapters by all the participants of the meeting.

Fig. 1 Mike Wingfield on a field trip in the Australian outback
Fig. 2 Boabab trees in Australia
Fig. 3 Brenda Wingfield, Giles Hardy and Treena Burgess

20th August to 5th September. Profs. BD and MJ Wingfield attended the International Mycological Congress (IMC) held in Cairns during this time. Both Profs. BD and MJ Wingfield participated in the organising of a number of symposia and presenting talks at the meeting. Prof MJ Wingfield gave one of the plenary presentations. Sixteen members of the research team at FABI also attended this meeting and all presented papers and posters. After the meeting one week was spent visiting colleagues and collecting specimens important to TPCP/CTHB research programme.

SERVICES

Tree Health Extension

Responsible researchers: Prof. Jolanda Roux (Extension, Monitoring, Diagnostic Clinic)
Ms. Izette Greyling (Diagnostic Clinic)
Mr. Brett Hurley (Pest monitoring and Extension)
Dr. 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.

Field activities 2005/2006: During 2005 a total of 51 field trips were undertaken in South Africa, accounting to 520 person days in the field. In 2006, 44 field trips were undertaken to areas in South Africa and two field trips to neighbouring countries, representing 531 person days in the field in South Africa and 113 in neighbouring countries. These field trips included more than 20 presentations at field days in 2005 and six in 2006. 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 2005/6. 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 1065 samples for the period January to the end of December 2005. Most samples were received in April. Of the samples sent, the majority were from pine (79%), 13% were from eucalypts and 7% were classified as other. The clinic received a total number of 1635 samples during 2006. Pine samples, including both nursery samples for *Fusarium* screening and disease analyses samples, comprised approximately 67% of the total number of samples received. Of the rest of the samples, 8% were from *Eucalyptus* and 24% of samples were classified as other. Black wattle samples made up the remaining 1% of total samples received. Samples classified as "other" include water, soil, seed, 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 (http://www.fao.org/forestry/site/26951/en/).

FIELD ACTIVITIES OF THE TPCP

Fig. 1 Staff from the Copperbelt University, Zambia and TPCP/CTHB during a visit to forests and plantations in Zambia
Fig. 2 Foresters, international visitors and TPCP staff during a field visit to a Sirex infested Pine compartment
Fig. 3 Students visiting the Kruger National Park herbarium during field work in the park. (Irene Barnes, Mrs. Thembi Khoza of Sanparks, Vuledzani Muthelo)
Fig. 4 Nursery management staff and international visitors during a field tour of South African plantations. (Mrs. Gerry Berghdal, Prof. Dale Bergdahl, Arthur Ndlovu, Wynand de Swart and Prof. Jolanda Roux)

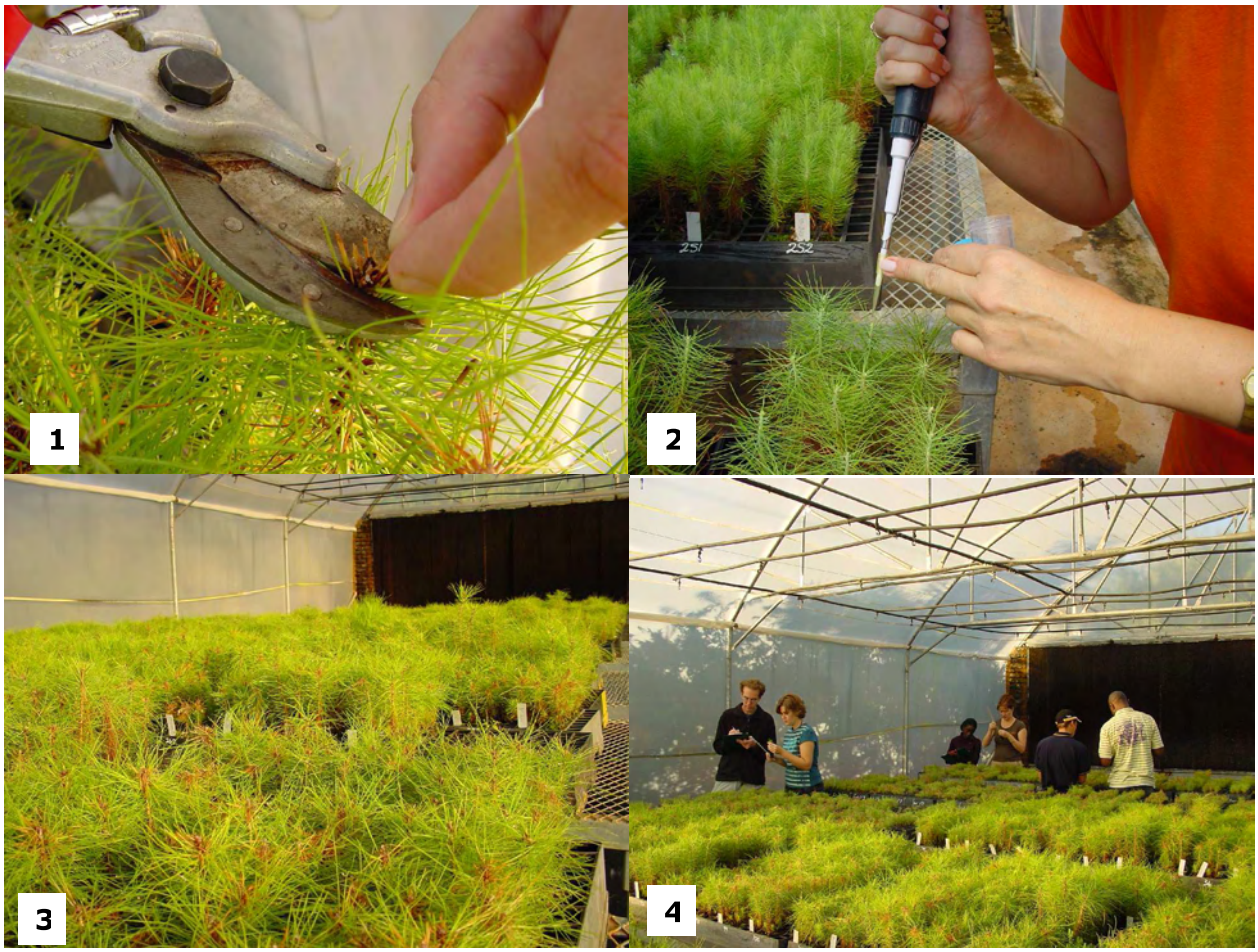
Pine Pitch Canker Screening Facility

Facility management team:
Prof Teresa Coutinho
Prof Jolanda Roux
Prof Mike Wingfield

Technical manager:
Mr Kgosi Mangwaketsi (2005-2006)
Ms Izette Greyling (2007)

Technical committee:
Dr A Kanzler (Sappi Forests)
Mr P Nolonolo (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, between 15 000 and 20 000 seedlings and/or cuttings, are inoculated with the fungus and lesion development measured after six weeks. Research was undertaken previously to determine the best inoculation technique to use as well as which isolates to select for optimal screening.



Method used to inoculate pines: (1) apical bud removed with a sterile secuteur; (2) drop of inoculum placed on the cut surface; (3) after six weeks lesion develop is evident and (4) lesions are measured

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 arraying (spotting) 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. Arraying is performed using a GEN III Array Spotter (Molecular Dynamics Inc, Sunnyvale, California, USA) housed in a controlled-environment. Arrayed slides are made available to users who carry out the required experimental procedures in their own laboratories. Users return their slides to the facility for the Scanning service, in which the hybridization signals across the glass slide 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.

Recent developments at the ACGT Microarray Facility include:

- Replacement of the green laser on the Genepix 4000B scanner (Molecular Devices Corporation).
  Genepix 4000B scanners are widely used in glass slide Microarray facilities worldwide. This instrument has a red and a green laser for excitation of the Cy-dyes used to label the DNA targets. Replacement of the green laser was necessary as a routine precaution, since it had reached its lifetime of total hours usage.

- Upgrade of the Genepix Scanner software to Genepix Pro version 6.0.
  The upgrade was considered due to the improved scanning algorithm and improved spot finding characteristics of the new version. To enable users to perform data capture and analysis on their own computers, the facility is in possession of two additional hardware licenses for the Genepix Pro 6.0 software package. These licenses are available free of charge for users of the facility, but only for limited time periods.

- National Microarray workshops.
  In partnership with BioPAD, two national Microarray workshops were presented by the Facility in 2005 and 2006. The aim of the workshops was to expose interested researchers to all aspects of a microarray experiment; from experimental design to data analysis and interpretation.

- Lectures on the fundamentals of techniques were complimented by hands-on training, following the work-flow of a complete experiment. All the quality control and troubleshooting procedures were also emphasized to give users confidence in performing informative and reproducible experiments at their home institutions.

- Several attendees of the workshops have since started performing microarray experiments, aided by the Facility with technical and troubleshooting expertise, and have produced results that have been incorporated in theses, published articles in peer-reviewed journals, and presentations at national and international conferences. These researchers are from a wide range of institutions, including the University of Pretoria, the University of North-West (Potchefstroom Campus), the University of Johannesburg (Auckland Park Kingsway Campus), The University of KwaZulu-Natal Medical School, the University of the Free State, the University of the Witwatersrand Medical School, The CSIR, the National Institute for Communicable Diseases, the National Institute for Occupational Health and Citrus Research International.

- Expansion of expertise in Open Source software:
    - Microarray Database in BASE format (BioArray Software Environment).
    - The current version of BASE has been upgraded from version 1.2.1.17 to version 2.1.2. All users of the Facility will in future be required to upload all data to the BASE server. This serves as a data backup service for users, but also aids in capturing all relevant experimental data, in the recommended MIAME format, for publication and reporting purposes. Data can be exported from the BASE server in data formats supported by internationally accepted repositories of microarray data. The facility is collaborating with the Universities of Cape Town and Witwatersrand to establish a national BASE implementation strategy.
    - 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 preformed under the supervision of a statistician.

- The BioPAD Microarray Platform Project
  The BioPAD funded Microarray Platform Project was started in June 2005, with the aim of increasing capacity in microarray science in the BioPAD region. Activities are centered at the ACGT microarray facility at the University of Pretoria, with additional input from Inqaba Biotec, and the University of the Witwatersrand.

- In its first two years of operation, the project has achieved its aims, by providing a unique and much needed resource to researchers from all over South Africa and by facilitating the training of several young scientists in all aspects of microarray techniques, including experimental design, technical laboratory skills and data analysis.

- Activities at the project are divided into three major work packages, namely standard operating procedures (SOPs), training, and support of external users.

- Standard operating procedures covering all aspects of microarray experiments have been developed and tested in the labs of the project members. These SOPs are regularly updated and are freely available, along with other useful information, on the Facility's website.

- In-house training at the project has focused on an experiment comparing the oligonucleotide and cDNA microarray platforms. Individuals within the platform have contributed their particular skills to the group, resulting in a core of well-trained scientists capable of performing all aspects of microarray experiments. These skills are used to provide assistance to both internal and external users. Trainees from Inqaba Biotec have provided sequencing and oligonucleotide synthesis services for the project, and have also independently completed microarray experiments.

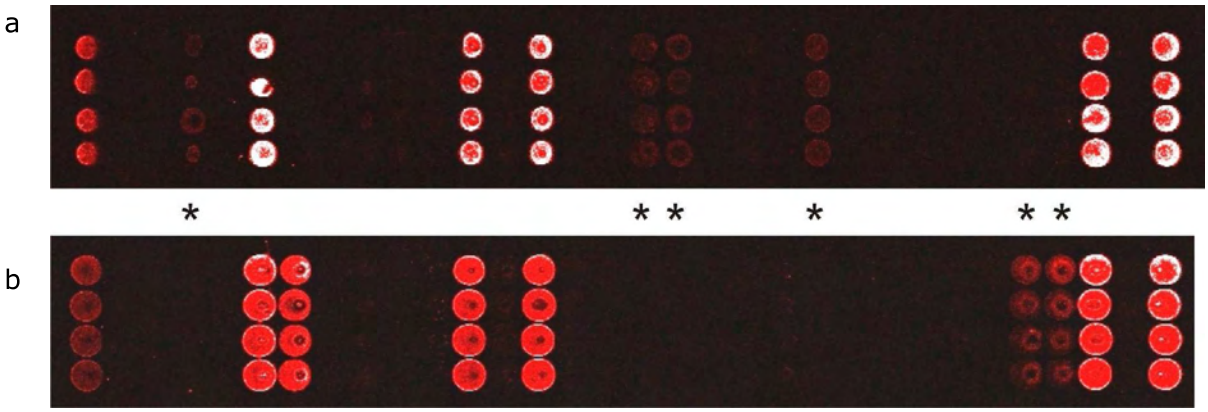
- Development has not been restricted to Pretoria, as an exciting aspect of the project has been the involvement of researchers from Wits. A new node of expertise is developing in Johannesburg, and a microarray users group that meets to discuss technical and experimental issues has been formed to support users there.

- With the solid foundations developed during the last two years, the BioPAD supported microarray platform project at the ACGT microarray facility is ready to maintain its track record of excellence and provide increasing in-depth support to South African researchers in the years ahead.

Members of the The BioPAD Microarray Platform Project, *left to right* Sanushka Naidoo (UP), Liesl van der Linden (UP), Irene van Nugteren (UP), Loveness Dzikiti (UP), Prof Dave Berger (UP), Erica Pierce (WITS), Tumi Mpete (Inqaba), Nicky Olivier (UP), Dr Oliver Preisig (Inqaba), Phumuza Langa (Inqaba), Luke Solomon (UP).

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

Several FABI research groups have used the ACGT Microarray Facility in their research projects, some of which have produced outputs that have been published internationally. Current/past projects include the development of an 20-mer oligo diagnostic slide for differentiating between *Leptographium* species (CTHB and TPCP), studying the circadian rhythms in plants with reference to *Eucalyptus* wood development (Forest Molecular Genetics Group), profiling the response of wheat to the Russian wheat aphid (Cereal genomics Group), genetic studies into the resistance to the bacterial pathogen *Ralstonia solanacearum* in *Arabidopsis thaliana* and the elucidation of defence response mechanisms in pearl millet (Molecular Plant-Pathogen Interactions Group).



Microarray images displaying hybridization differences between *Leptographium* species (a) *Leptographium dryoceotidis* and (b) *Leptographium leptographioides*, using a 20-mer diagnostic oligo array (* indicates differential binding between slides)

High-throughput quantitative real-time PCR

Facility Managers: Prof Dave Berger (Research Leader in FABI)
Prof Zander Myburg (Research Leader in FABI)

The Roche LightCycler® 480 instrument housed in the Agricultural Sciences building, Faculty of Natural and Agricultural Sciences at the University of Pretoria is a national facility with the aim to increase the capacity for quantitative real-time PCR both regionally and nationally. Use of the instrument is therefore not limited to academic researchers in Pretoria, but also to academic and commercial researchers throughout South Africa. Training workshops are provided by Roche at least twice per year, highlighting the principles of the real-time PCR techniques, the capabilities of the instrument, experimental design strategies, as well as providing hands-on training on the operation of the instrument.

Funding for the instrument was provided in partnership with the National Research Foundation (NRF) through the National Equipment Programme (NEP) for 2005. Additional contributions were made by stakeholders at the University of Pretoria and industrial partners.

University of Pretoria contributors:
- Prof Robin Crewe - Vice-Principal: Research & Postgraduate studies
- Prof Anton Ströh - Dean: Faculty of Natural and Agricultural Sciences
- Prof Dave Berger - Department of Botany
- Prof Zander Myburg - Department of Genetics
- Prof Jacques Theron - Department of Microbiology and Plant Pathology
- Dr Emma Steenkamp - Department of Microbiology and Plant Pathology
- Dr Altus Viljoen - Department of Microbiology and Plant Pathology
- Prof Mike Wingfield - Forestry and Agricultural Biotechnology Institute
- Dr Rachel Chikwamba - Forestry and Agricultural Biotechnology Institute

External contributors:
- Sappi Ltd
- Mondi Business Paper South Africa

The LightCycler® 480 instrument is a rapid, thermal block cycler capable of performing a 40-cycle, 96- or 384-well quantitative PCR run in less than 40 minutes with extraordinary well-to-well temperature homogeneity and maximized inter-well, inter-cycle reproducibility. The special arrangement of optical components ensures the uniform collection of signals across the plate and makes analysis independent of the sample position on the plate. All current probe formats are supported (e.g., SYBR Green I, Hydrolysis Probes, HybProbe Probes), and the instrument is ideal for fast and precise qualitative or quantitative detection of nucleic acids, genotyping, and mutation analysis. The ability to freely combine five excitation and six emission filters permits analysis of signals from multiple dyes (e.g., LightCycler® Red 610, 640, LightCycler® CYAN 500, FAM, VIC, HEX, Cy5, and Fluorescein) in monocolor as well as in multiplex assays. The instrument's software enables highly flexible and extensive data analysis for different scientific needs.

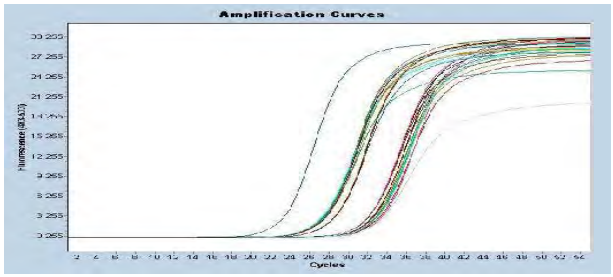
Applications of the LightCycler® 480 instrument include:

- High-resolution melting curve analyses
- High-throughput gene expression and genotyping analyses
- High-resolution and high-throughput multiplex PCR analyses

For more technical information visit the LightCycler® website (http://www.lightcycler-online.com/)

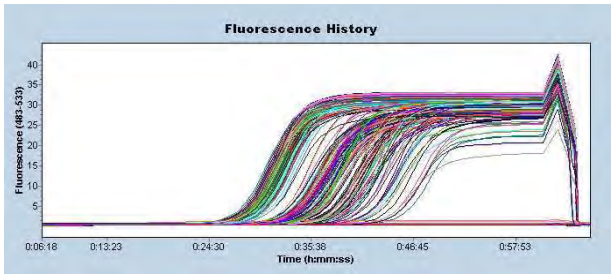
For information about using the LightCycler® 480 instrument at the University of Pretoria, please contact: Martin Ranik (martin.ranik@fabi.up.ac.za) or Nicky Creux (nicky.creux@fabi.up.ac.za).

a



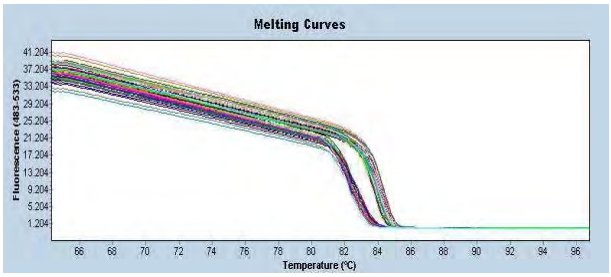
Amplification curves

b



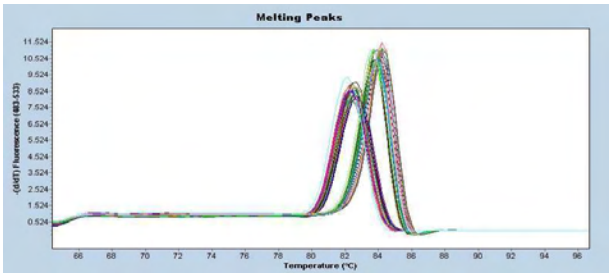
Fluorescence history

c



Melting curves

d



Melting peaks

Examples of raw data presentations obtained for the same dataset with the LightCycler® 480 instrument, indicating a) the amplification curves showing the increase in products after comparative cycles, b) the fluorescence histories indicative of the efficiency of each reaction, c) the melting curve for each reaction which is used to display d) the melting peaks for each reaction, indicative of different products present in the reactions. Each coloured line indicates a separate reaction in the PCR plate. The instrument also presented the data in formats ready for analysis in various computational programs (not shown).

WORKSHOPS & CONFERENCES

International Fusarium Wilt diagnosis and characterization training workshop

Dr Altus Viljoen and Gerda Fourie, together with Linda Smith and Lisa Gulino from QDPI, Brisbane presented an International workshop on Fusarium wilt of banana. This workshop was held at the Malaysian Agricultural Research and Development Institute (MARDI), Kuala Lumpur, Malaysia from 24-28 April 2006. Representatives from Bangladesh, Cambodia, China, India, Indonesia, Malaysia, PNG, Philippines, Sri Lanka, Thailand, Vietnam, Taiwan and Cuba were invited by INIBAP to participate. The purpose of this training course was to establish basic Fusarium wilt diagnostic and molecular characterization knowledge. Many of the participants research fields/focus falls outside Fusarium wilt and we hope that this workshop would establish more Fusarium and banana research, especially since tropical race 4 (VCG 01213, VCG 01216) are rapidly spreading though-out Asia leading to considerable economic losses. Ongoing collaboration involves the vegetative compatibility group (VCG) characterization of isolates collected from field trips following this workshop.

Attendees of the workshop held in Malaysia

5+5 Meeting (SA-UK) for young scientists

Organized by Dr R Chikwamba (CSIR/UP) and Dr A Edwards (John Innes Institute, UK) (August 2006).

This Royal Society/ NRF programme was aimed to link early-career scientists from South Africa with counterparts in UK. With Dr Rachel Chikwamba (CSIR), Professor Nick Brewin (John Innes Institute, UK)) and Prof Chris Cullis (Case Western Reserve University) initiated a training exercise on writing international grant proposals. This resulted in the development and submission of two research proposals under a DFID call and helped to conceive the acronym "UKSASA" which in English means "UK-SA Sustainable Agriculture" and in Zulu it means "The Future".

Generation Challenge Program workshop on Plant Genetic Diversity and Molecular Marker Assisted Breeding

The Generation Challenge Program held a training workshop at FABI in May 2005. The workshop was run by international and local resource scientists and was attended by 14 participants representing 10 African countries.The lectures, discussions and practicals were all held in the FABI facilities including the ACGT computer lab. The goal of this workshop was to provide both conceptual and hands-on training in characterizing plant genetic diversity and to use DNA molecular marker assisted breeding. Emphasis was on practical applied usage and improving the links between plant breeding, germplasm management and utilization, and molecular biology methods, with a particular focus on the use of microsatellite markers. The workshop provided opportunities for the participants to interact and form collaborative networks.

Attendees of the Generation Challenge Program workshop on Plant Genetic Diversity and Molecular Marker Assisted Breeding

Generation Challenge Programme (GCP) supported Training Workshop on 'Databases, Internet Resources and Bioinformatics for Crop Improvement '

The Generation Challenge Programme (GCP) of the CGIAR is aimed at using molecular biology and crop genetic resources to improve Agricultural production in developing countries (see http://www.generationcp.org/index.php). As part of the Capacity Building Programme of GCP (theme 5), a workshop was held in the FABI Square Bioinformatics building at the University of Pretoria in September 2006. It was presented by Prof Dave Berger and postdoctoral fellow Dr Yoseph Beyene of the Botany Department, FABI and the GCP-sponsored visiting Professor Jan Peter Nap from Applied Bioinformatics, Plant Research International, Wageningen University and Research Centre, Wageningen.

The workshop was attended by 21 delegates from National Agricultural Research Programmes in ten African countries in addition to South Africa, namely Nigeria, Kenya, Uganda, Angola, Cote d'Ivoire, Zimbabwe, Sudan, Ghana, Ethiopia and Tanzania (see photo of participants).

Worldwide, current gene technology depends more and more on the use of public domain resources that can help to speed up gene discovery, marker development and breeding. A rapidly growing number of these resources can now easily be accessed via the worldwide web. This makes the internet an important medium to empower agricultural research, also, or perhaps particularly, for smaller non-model "orphan" crops and low-input agricultural systems. In this way, the computer can replace in part the use of the pipette in agricultural research. This can add to the efficiency and application of breeding in combination with laboratory biotechnology (marker-assisted breeding, plant transformation) and may reduce the pressure on already limiting research budgets.

With these potential advantages in mind, this workshop financed by the GCP (CGIAR), exposed young and established African scientists (either breeders, biotechnologists or both) from notably National Agricultural Research centers (NARs) to internet resources, databases and bioinformatics tools relevant for research related to breeding and crop improvement. The motto of the workshop was 'learning by doing'. It combined lectures, ample hands-on assignments and feedback using the excellent bioinformatics facilities in the AGCT Bioinformatics and Computational Biology Unit, FABI Square Bioinformatics building. Participants will learn to master key resources for current and future breeding and crop improvement in a way that will allow them to integrate this competence in their own future research, as long as a decent Internet connection is available.

For more information, see http://www.bi.up.ac.za/gcp2006. Course material was prepared from scratch mostly by Prof JP Nap and Dr. Y. Beyene, and has been made available on the GCP website. This complements the course material developed for the GCP supported Workshop entitled "Plant Genetic Diversity and Molecular Marker Assisted Breeding" hosted in FABI during 2005.

Participants in Generation Challenge Programme (GCP) supported Training Workshop on 'Databases, Internet Resources and Bioinformatics for Crop Improvement ' held in FABI Square Bioinformatics, September 2006

IUFRO Tree Biotechnology 2005 Meeting

The International Union of Forestry Research Organizations (IUFRO) Working Party 2.04.06 organizes a biennial international meeting on the genomics, molecular biology and biotechnology of forest trees. The most recent IUFRO Tree Biotechnology meeting held in Pretoria, South Africa was the first in the post-genomic era of forest trees. Presentations on the poplar genome and research enabled by this tremendous new resource were obvious highlights of the meeting. With the genome data in hand, it is now possible to investigate the detailed evolution of a forest tree genome and its relationship to other plant genomes. Such comparisons allow us to ask "*What genes make a tree?*" and will greatly accelerate our journey towards a more complete understanding of the genes that underlie important traits in forest trees. One outcome of the post-genomic era is large-scale biology and the creation of huge databases of genes, proteins and metabolites. The organization, bioinformatics and sharing of such data were a central discussion theme of the meeting. The sequencing of other tree genomes such as that of *Eucalyptus* species was also discussed.

The IUFRO Tree Biotechnology 2005 meeting was hosted by the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria in Pretoria, South Africa (co-organized by Prof. Brenda Wingfield and Prof. Zander Myburg). Major sponsors of the meeting included Sappi, Mondi Business Paper South Africa and SweTree Technologies. The meeting attracted more than 200 delegates representing 26 countries, 45 universities and 44 forest research institutions or biotech companies. More information and abstracts from the meeting can be found at www.iufro.up.ac.za.

IUFRO TREE BIOTECHNOLOGY - 2005
MEETING ATTENDEES

PUBLICATIONS 2005-2007

These lists include only publications that had appeared by the end of May 2007. Manuscripts in press and submitted for publication are not included.

In refereed journals

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Adandonon A, Aveling TAS, Labuschagne N & Tamo M (2005) Control of *Sclerotium*-caused cowpea damping off and stem rot using *Moringa oleifera* extract and biocontrol agents. 43rd Annual Congress of the Southern African Society for Plant Pathology. Hartenbos Beach Resort, Mossel Bay.

Ahmed Idris H, Labuschagne N & Korsten L (2007) Biocontrol activity of rhizobacterial isolates against *Pythium ultimum* causing root rot in sorghum. 45th congress of the Southern African Society for Plant Pathology, Kopanong Conference centre, Benoni.

Aveling TAS (2006) Symposium on Micronutrients and Soilborne Plant Diseases. Plant Protection Research Institute, Stellenbosch.

Bahlmann L, Wingfield MJ, Myburg AA & Wingfield BD (2005) Identifying Pathogenicity Quantitative Trait Loci (QTLs) in a (*Fusarium circinatum* x *F. subglutinans*) x *F. circinatum* backcross population. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Belgrove A, Nel B & Viljoen A (2005) The application of non-pathogenic *Fusarium oxysporum* endophytes for the biological control of Fusarium wilt of banana. 43rd Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Beyene Y, Oberholster AM & Myburg AA (2006) Genetic diversity among traditional Ethiopian highland maize accessions assessed by SSR markers and morphological traits. South African Plant Breeders Symposium, Club Mykonos, Langebaan.

Coetzee MPA, Wingfield BD & Wingfield MJ (2005) Genotypic diversity of the root rot fungus *Armillaria fuscipes* in South African pine plantations. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Coetzer N & Berger DK (2007) Annotation of a cDNA Microarray using SSHscreen and MADIBA software 1st Southern African Bioinformatics Workshop, University of Witwatersrand, Johannesburg.

Coutinho TA, Goszczynska T & Venter SN (2006) Current status of phytobacteriology in South Africa. 44th Annual Congress of the Southern Africa Society for Plant Pathology, Magalies Park Country Club, Hartebeespoortdam.

Crampton BG & Berger DK (2005) cDNA microarray analysis of a non-model organism: pearl millet. Moelcules-R-US Congress, 19th Meeting of the South African Society of Biochemistry and Molecular

Crampton BG, Law P, Coetzer N, Vos W & Berger DK (2007) Can genomics and bioinformatics be applied to studies of non-model plants such as pearl millet? XXXIII Annual Conference of the South African Association of Botanists (SAAB), UCT, Cape Town.

Dawlal P, Marais GJ & Lübben A (2006) The effect of irradiation on mycotoxigenic fungi in commercially produced maize cultivars. 44th Congress of the Southern African Society for Plant Pathology, Magalies Park Country Club, Hartebeespoortdam.

Dawlal P, Marais GJ & Lübben A (2006) Resistance of maize against the infestation of mycotoxigenic fungi. 14th Biennial Conference of the South African Society for Microbiology, CSIR International Convention Centre, Pretoria.

Dawlal P & Marais GJ (2007) Resistance of commercially produced maize cultivars against mycotoxigenic fungi during storage. 45th Congress of the Southern African Society for Plant Pathology, Kopanong Conference Centre, Benoni.

De Beer ZW, de Fine Licht HH, Aanen DK & Wingfield MJ (2005) *Ophiostoma* spp. associated with terminte and termite combs in South Africa. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

De Meyer EM, De Beer ZW, Vismer HF & Wingfield MJ (2005) DNA sequence comparisons reveal that the environmental and clinical isolates of *Sporothrix schenckii* represent different species. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Du Plooy H, Aveling TAS & Labuschagne PM (2005) Development of wet bubble disease (*Mycogone perniciosa*) during the various cultivation stages of *Agaricus bisporus*. 43rd Annual Congress of Southern African Society for Plant Pathology, Hartenbos Beach Resort, Mossel Bay.

Fouché JP, Viljoen A & Coutinho TA (2006) Characterisation of *Xanthomonas campestris* pv. *musacearum* causing disease of Ensete and banana in central Africa. 44th Annual Congress of the Southern Africa Society for Plant Pathology, Magalies Park Country Club, Hartebeespoordam.

Fouché JP, Marco Y, Coutinho TA & Berger DK (2005) Optimization of a pathosystem between Arabidopsis thaliana and Ralstonia solanacearum. 43rd Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Fourie G, Steenkamp ET, Gordon TA & Viljoen A (2005) A multigene phylogeny determines the relatedness among vegetative compatibility groups (VCGs) within *Fusarium oxysporum* f.sp *cubense*. 43rd Annual Congress of Southern African Society for Plant Pathology, Hartenbos Beach Resort, Mossel Bay.

Gevers T, Groenewald S & Viljoen A (2005) Comparative Analysis of a MAP kinase-coding gene (fmk) in *Fusarium oxysporum*. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Gomez D, Jacobs K, Zhou X-D, Ye H, De Beer ZW, Wingfield BD & Wingfield MJ (2005) *Pesotum* spp. Associated with bark beetles on conifers in Southwestern China. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Goszczynska T, Moloto VM & Coutinho TA (2006) Bacterial blight of leek and onion caused by *Pseudomonas syringae*. 44th Annual Congress of the Southern Africa Society for Plant Pathology, Magalies Park Country Club, Hartebeespoortdam.

Grobbelaar J, de Beer ZW, Wingfield BD & Wingfield MJ (2005) Sibling species and hybrids in the *Ophiostoma quercus* complex? 43rd Annual Congress

of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Gryzenhout M, Wingfield BD & Wingfield MJ (2005) Discovery of novel hosts of the *Eucalyptus* canker pathogen *Chrysoporthe cubensis*. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Hammerbacher A, Coutinho TA, Wingfield BD & Wingfield MJ (2005) Effect of inoculum concentration, plant vigour and wounding on infection of *Pinus patula* by *Fusarium circinatum*. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Heath RN, Roux J, Mbaga A, Meke G, Jacobs K & Wingfield MJ (2005) Ophiostomatoid fungi associated with wounds on hardwood forest species in Malawi and Tanzania. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Heath RN, Roux J, Labuschagne L, Kamgan Nkuekam G & Wingfield MJ (2005) Native hosts of the *Acacia mearnsii* wilt pathogen, *Ceratocystis albifundus* in South Africa. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay

Hinze B, Slippers B, Pavlic D, Wingfield BD & Wingfield MJ (2007) Identification and characterization of *Botryosphaeriaceae* associated with native Marula trees in South Africa. 45th Annual Congress of the Southern African Society for Plant Pathology, Kopanong, Benoni.

Hurley BP, Slippers B, Govender P, Coutinho T, Wingfield BD & Wingfield MJ (2005) Diversity and phylogeography of *Bradysia difformis* Frey. (Sciaridae: Diptera) in forestry nurseries of South Africa. 15th Entomological Congress of Southern Africa, Grahamstown.

Hurley BP & Wingfield MJ (2005) Success of *Beddingia siricidicola* as a biological control agent for the Sirex woodwasp, *Sirex noctilio,* in South Africa. 15th Entomological Congress of Southern Africa, Grahamstown.

Hunter GC, Cortinas M-N, Wingfield MJ, Wingfield BD & Crous PW (2005) Multi-gene phylogeny for species of *Mycosphaerella* occurring on *Eucalyptus* leaves. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Jacobs A, van Wyk PS, Marasas WFO, Wingfield BD, Coutinho TA & Wingfield MJ (2005) A new *Fusarium* species in the *Gibberella fujikuroi* complex from pineapple in South Africa. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Jacobs K, Wingfield BD, Krokene P, Solheim H & Wingfield MJ (2005) A new species of *Leptographium* from Norway. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Jacobs K, Wingfield BD, Solheim H & Wingfield MJ (2005) An unusual species of *Leptographium* with red conidiophores. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Jacobs K, Wingfield BD, Solheim H & Wingfield MJ (2005) Taxonomic re-evaluation of *Leptographium lundbergii* based on morphology and DNA sequence comparisons. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Jacobs K, Wingfield BD & Wingfield MJ (2006) Seeing the bigger picture: a multi-gene view of Leptographium phylogeny. Proceedings of the 44th Annual Congress of the Southern African Society for Plant Pathology, Magalies Park Country Club, Hartebeespoortdam.

Kalonji JB, Aveling TAS, Labuschagne N & van der Waals J (2005) Efficacy of fungicides and biological control agents against seedling diseases of lettuce. 43rd Annual Congress of the Southern African Society for Plant Pathology, 22-25 January 2005. Hartenbos Beach Resort, Mossel Bay.

Kamgan Nkuekam G, Roux J, Jacobs K, Ahumada R & Wingfield MJ (2005) *Pesotum* species associated with tree wounds in Chile, South Africa and Uganda. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Kemp J, Kanzler A & Myburg AA (2006) Allelic diversity in two novel cellulose synthase genes of *Pinus patula*. South African Genetics Conference, Bloemfontein.

Kritzinger Q & Aveling TAS (2005) Prospects and problems associated with cowpea cultivation by resource poor farmers in Mpumalanga, South Africa. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos Beach Resort, Mossel Bay.

Kvas M, Marais GJ, Steenkamp ET & Lübben A (2005) Mycotoxigenic fungi associated with commercial pet food. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Kvas M, Steenkamp ET, Wingfield BD, Marasas WFO & Wingfield MJ (2007) *Fusarium* species in the *Gibberella fujikoi* complex associated with *Syzgium cordatum* floral malformation. 45th Annual Congress of the Southern African Society for Plant Pathology, Kopanong, Benoni.

Law PJ, Claudel-Renard C, Joubert F, Berger DK & Louw AI (2007) Development of a web toolkit for the biological interpretation of microarray gene clusters 1st Southern African Bioinformatics Workshop, University of Witwatersrand, Johannesburg.

Lombard L, Wingfield MJ & Crous PW (2005) *Cylindrocladium pauciramosum*, dominant in South African *Eucalyptus* nurseries. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Mahommed-Ali AB & Marais GJ (2006) Pyrazine flavour production by South African fungi. 14th Biennial Conference of the South African Society for Microbiology, CSIR International Convention Centre, Pretoria.

Mahomed-Ali AB, Marais GJ, Rhower ER, Naudé Y (2007) Production of methoxypyrazine flavours by mycelial fungi from South Africa. 45th Congress of the

Southern African Society for Plant Pathology, Kopanong Conference Centre, Benoni.

Maier WFA, Harmse N, Khoza T, Wingfield MJ & Wingfield BD (2005) "Snow" in Kruger Park: A fungal epidemic on buffalo thorn caused by *Coniodictyum chevalieri*. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Maier WFA, Ritz CM, Oberwinkler F & Wissemann V (2005) Phylogeny and pathogenicity of rusts on dog roses. 43rd Congress of the Southern African Society for Plant Pathology. Hartenbos, Mossel Bay.

Maleka FM, Payn KG, Bloomer P, Janse BJH, Dvorak WS & Myburg AA (2006) Allelic diversity and linkage disequilibrium in wood and fibre genes of Eucalyptus urophylla. South African Genetics Society 2006 Conference, Bloemfontein.

Maleme H, Pavlic D, Slippers B, Wingfield BD & Wingfield MJ (2007) Identification of *Botryosphaeriaceae* from *Eucalyptus* planted to feed Koala bears at the Pretoria Zoo. 45th Annual Congress of the Southern African Society for Plant Pathology, Kopanong, Benoni.

Maphosa L, Wingfield BD, Coetzee MPA, Mwenje E & Wingfield MJ (2006) Phylogenetic relationships among *Armillaria* sp. Based on partial EF1-DNA sequence data. 44th Annual Congress of the Southern African Society for Plant Pathology, Magalies Park Country Club, Hartebeespoortdam.

Marais GJ (2006) The creative use of micro-organisms in the world of flavours and fragrances. Symposium of the South African Association of the Flavour & Fragrance Industry (SAAFFI), Volkswagen Conference Centre, Midrand.

Marais GJ (2006) Managing the emerging risks of mycotoxins along the supply chain. HACCP 2006 conference from farm to fork, Volkswagen Conference Centre, Midrand.

Marais GJ (2006) The importance of fungi and their mycotoxins in the bakery industry. SAAFoST Expo Bakery Symposium, CSIR Conference Centre, Pretoria.

Marais GJ (2007) Fungi and their mycotoxins in the South African context. Southern Cape Environmental Health Congress, South African Institute of Environmental Health, Fancourt, George.

Matsaunyane LBT, Oelofse D & Berger DK (2005) PGIP:PG interactions – a brief overview with special reference to apple PGIPs. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Mehl JWM, Hammerbacher A, Coutinho TA, Wingfield MJ & Wingfield BD (2005) Detection of the pitch canker fungus, *Fusarium circinatum*, in pine seeds. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Moses LM, Marasas WFO, Vismer HF, Rheeder J & Wingfield BD (2005) Molecular analysis to determine the mating type of *Fusarium globosum* strains. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Munro C, Fourie G & Viljoen A (2005) The Application of PCR-RFLP's for rapid identification of Mycosphaerella species from Banana leaves in South Africa. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Myburg AA (2006) Fibre Genomics: Assisting tree breeders to improve fibre quality in forest plantations. South African Plant Breeders Symposium, Club Mykonos, Langebaan.

Naidoo S, Fouche JP, Denby KJ, Berger DK (2006) Investigating resistance against the causal agent of bacterial wilt, *Ralstonia solanacearum*, in the model plant, Arabidopsis thaliana. 44th Congress of the Southern African Society for Plant Pathology, Magalies Park Country Club, Hartebeespoortdam.

Nakabonge G, Heath RN, Gryzenhout M, Wingfield MJ & Roux J (2005) *Chrysoporthe* species in Eastern and Southern Africa. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Oberholster PJ, Botha A-M & Cloete TE (2006) Toxic Cyanobacterial blooms in a shallow artificially mixed urban lake in Colorado, USA. Society of Microbiology Meeting, CSIR Convention Centre, Pretoria.

Payn KG, Maleka FM, Janse BJH, Dvorak WS & Myburg AA (2006) Phylogeography of *Eucalyptus urophylla* based on the chloroplast JLA region. South African Plant Breeders Symposium, Club Mykonos, Langebaan.

Pieterse Z, Aveling TAS & Labuschagne PM (2005) Interaction between *Agaricus bisporus* and *Mycogone perniciosa.* 43rd Annual Congress of Southern African Society for Plant Pathology, Hartenbos Beach Resort, Mossel Bay.

Porter B, Coutinho TA & Wingfield MJ (2005) Evaluation of different inoculation techniques using *Fusarium circinatum* and *Pinus patul*a seedlings. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Ramusi TM, Aveling TAS, van der Waals J & Labuschagne N (2005) Biological and fungicidal control of seedling diseases of cowpea caused by *Fusarium solani*, *Pythium* sp. and *Rhizoctonia solani*. 43rd Annual Congress of Southern African Society for Plant Pathology, Hartenbos Beach Resort, Mossel Bay.

Ranik M, Bradfield J & Myburg AA (2006) Money may not grow on trees, but paper does: Seven new cellulose synthase genes are associated with primary and secondary cell wall biosynthesis in Eucalyptus trees. South African Genetics Society 2006 Conference, Bloemfontein.

Roux J, Solheim H & Wingfield MJ (2005) *Ceratocystis* and *Ophiostoma* species infecting native broad leaf trees in Norway. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Roux J, Heath RN, Geldenhuis C, Meke G, Mlambo F, Nguvulu G, Rau D & Wingfield MJ (2005) *Ceratocystis* and *Ophiostoma* species on native Southern African tree species. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Slippers B, Vasilliaukas R, Stenlid J & Wingfield MJ (2005) The influence of the Amylosterum and Sirid woodwasp symbiosis on the populations of *A. areolatum* and *A. chailletii*. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Solomon OL & Myburg AA (2006) Temporal regulation of gene expression in wood forming tissues of Eucalyptus. South African Genetics Society 2006 Conference, Bloemfontein.

Sutherland R, Escalant JV, Kunert K & Viljoen A (2005) Applications of cell and tissue culture in banana (*Musa* spp.). 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Sutherland R, Escalant JV, Kunert K & Viljoen A (2005) Establishment of a transformation facility for engineering banana for disease and pest resistance in South Africa. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Swart L, Brady CL, Greyling I, Venter SN, Coutinho TA (2006) Phylogenetic relationship between *Pantoea* spp. and the bacteria causing blight and die-back of *Eucalyptus*. 44th Annual Congress of the Southern Africa Society for Plant Pathology, Magalies Park Country Club, Hartebeespoortdam.

Swart L, Brady CL, Venter SN & Coutinho TA (2006) *Pantoea* spp. associated with bacterial blight and die-back of *Eucalyptus*. 14th Biennial Congres of the South Africa Society for Microbiology, CSIR International Convention Centre, Pretoria.

Van der Merwe JJ, van der Waals JE (2006) Optimisation of inoculation techniques for *Pectobacterium* spp. (*Erwinia*) on potatoes. 44th Annual Congress of the Southern African Society for Plant Pathology. Magalies Park, Hartebeespoortdam.

Van der Nest A, Marais GJ & Lübben A (2006) Fungi and their mycotoxins associated with animal feed in South Africa. 44th Congress of the Southern African Society for Plant Pathology, Magalies Park Country Club, Hartebeespoortdam.

Van der Nest A, Marais GJ & Lübben A (2006) The role of mycotoxigenic fungi in commercially produced animal feed. 14th Biennial Conference of the South African Society for Microbiology, CSIR International Convention Centre, Pretoria.

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

Van der Nest MA, Wilkens M, Slippers B, Stenlid J, Wingfield BD & Wingfield MJ (2006) Sexual compatibility in *Amylostereum aerolatum*. 44th Annual Congress of the Southern African Society for Plant Pathology, Magalies Park, Hartebeespoortdam.

Van der Waals JE & Coutinho TA (2006) *Erwinia* on potatoes in South Africa: the road ahead. 44th Annual Congress of the Southern Africa Society for Plant Pathology, Magalies Park Country Club, Hartebeespoortdam.

Van der Walt F, Marais GJ & Lübben A (2006) Fungal biodiversity of indigenous trees and plants in the Northern Cape. 44th Congress of the Southern African Society for Plant Pathology, Magalies Park Country Club, Hartebeespoortdam.

Van der Walt FFJ, Marais GJ & Lübben A (2006) Endophytic fungi associated with indigenous trees and plants in the Northern Cape. 14th Biennial Conference of the South African Society for Microbiology, CSIR International Convention Centre, Pretoria.

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

Van der Watt N, Aveling TAS & Van der Merwe CF (2006) Surface topography of various legumes with different testa colours. 45th Annual Conference Microscopy Society of Southern Africa, University of Port Elizabeth, Port Elizabeth.

Van Nugteren I, Hein I & Berger DK (2007) Development of a virus-induced gene silencing system in pearl millet. XXXIII Annual Conference of the South African Association of Botanists (SAAB), UCT, Cape Town.

Van Wyk M, Roux J, Barnes I, Wingfield BD, Liew ECY, Summerell BA & Wingfield MJ (2005) *Ceratocystis polychroma*, a potentially important pathogen of clove. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Van Wyk M, Wingfield BD, Al-Adawi A, Deadman M & Wingfield MJ (2005) Two *Ceratocystis* spp. Associated with Mango tree death in Oman. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Van Zuydam N, De Vos L, Wingfield MJ, Wingfield BD & Aldous C (2006) Establishing synteny relationships among *Fusarium circinatum, F. subglutians* and *F. graminarium*. 44th Annual Congress of the Southern African Society for Plant Pathology, Magalies Park, Hartebeespoortdam.

Victor M, Lu S, Sun Y-H, Chiang VL & Myburg AA (2006) MicroRNA and siRNA profiling in woody tissues of *Eucalyptus* and *Populus*. South African Genetics Society 2006 Conference, Bloemfontein.

Wingfield BD (2005) A Centre of Excellence in Tree Health. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Wingfield MJ (2005) Forest pathology and forest pathogens in South Africa. The past and the future. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Wright J. Ganley RJ, Steenkamp ET, Iturritxa E, Ahumada R, Wingfield BD, Marasas WFO & Wingfield MJ (2006) Phylogeny of the pine pitch canker fungus, *Fusarium circinatum*: An emerging global view. 44th Annual Congress of the Southern African Society for Plant Pathology, Magalies Park, Hartebeespoortdam.

Wright LP, Wingfield BD, Crous PW, Brenneman T & Wingfield MJ (2005) Developing polymorphic microsatellites for studying the population genetics of *Cylindrocladium parasiticum*. 43rd Annual Congress of the Southern African Society for Plant Pathology, Hartenbos, Mossel Bay.

Wright LP, Lombard L, Wingfield BD & Wingfield MJ (2006) Polymorphic microsatellites for studying the population genetics of *Cylindrocladium parasiticum.* 44th Annual Congress of the Southern African Society for Plant Pathology, Magalies Park, Hartebeespoortdam.

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. Once a postgraduate student has been awarded a degree, he/she is invited to present a prestige seminar.

Special seminars

Prof Volker Brözel
Dept of Biology and Microbiology, South Dakota University, USA
January 2005
Multicellular behaviour of *Bacillus cereus*

Dr Walter Gams
Centraalbureau voor Schimmelcultures (CBS), the Netherlands
February 2005
Fungi in the field and in culture

Prof Jens Kossmann
Institute for Plant Biotechnology, University of Stellenbosch
February 2005
Understanding and influencing starch biochemistry

Dr Matthias Stoll
Universität Tübingen, Lehrstuhl für Spezielle Botanik und Mykologie, Germany
February 2005
Coevolution in smut fungi and their hosts

Prof Dale Bergdahl
Dept of Forestry, University of Vermont, USA
February 2005
Concepts in forest pathology in the face of exotic pathogens: a focus on butternut canker disease

Prof Diana Six
University of Montana, USA
March 2005
Temporal variation in bark beetle fungal symbionts

Ms. Allison Hansen (MSc student)
University of Montana, USA
March 2005
Homogenization of ground beetle assemblages mediated by an exotic forb in Rocky Mountain Savannas

Ms. Kjerstin Skov (PhD student)
University of Montana, USA
March 2005
Fire effects on Douglas-fir beetle reproduction in the first year after fire

Prof David Hawksworth
Editor: Mycological Research
June 2005
How many fungi are there really?

Dr Ndiko Ludidi
University of Stellenbosch
July 2005
Plant natriuretic peptides and cGMP as mediators of plant responses to salinity and osmotic stress

Prof Wally Marasas
PROMEC, MRC
October 2005
Mango malformation disease and the associated Fusarium species

Mark Russel
Private consultant/Entomologist/Artist
November 2005
The Apionidae

Dr Torstein Kvamme
The National Centre of Insect Diversity, Toyen, Oslo, Norway
November 2005
The National Centre of Insect Diversity at Toyen, Oslo and introduced pests of trees in Norway

Dr Duur Aanen
Institute of Biology, University of Copenhagen, Denmark
December 2005
As you reap, so shall you sow – the evolutionary stability of the symbiosis between termites and fungi

Dr Chris du Plessis
BHP Biliton, South Africa
January 2006
Between a rock and a soft place: biotechnology applications, exploitations and mind-shifts in the mining environment

Dr Jan Rademaker
NIZO Food Research, the Netherlands
January 2006
A comprehensive species to strain taxonomic framework for *Xanthomonas* based on fingerprint typing

Dr Kathy Bleiker
University of Montana, USA
February 2006
Not all fungi are created equal: interactions among the mountain pine beetle and its blue-stain associates

Prof Mike Wingfield
Director: FABI
February 2006
A forest pathologist's view of Darwin's view of Galapagos

Dr Phil Mjwara
Group Executive of CSIR
March 2006

Dr Keith Seifert
Agriculture and Agri-Food, Canada
April 2006
Development and testing of oligonucleotide based macroarrays for the fungal genera *Penicillium, Fusarium* and *Pythium*

Prof David Collinge
Dept of Plant Biology, Royal Veterinary Agricultural University, Denmark
June 2006
What is disease resistance? The defence response in the barley powdery mildew interaction

Dr Sandra Denman
UK Forestry Commission
June 2006
The rise of aerial *Phytophthoras*: plant trade fuelling the take off

Dr Gabi Krczal
AlPlanta Institute for Plant Research, Germany
August 2006
Improvement of grapevine and fruit trees with plant biotechnology

Prof Jan Peter Nap
Applied Bioinformatics, Plant Research International, the Netherlands
August 2006
Better safe than sorry: understanding and modifying gene expression in plants

Prof Nick Brewin
John Innes Centre, UK
September 2006
Plant-microbe cell signalling at the onset of the *Rhizobium*-legume root nodule symbiosis

Prof Stephanie Burton
Dept of Chemical Engineering, UCT
October 2006
Should we eat the grapes or drink the wine? A bioprocess engineering viewpoint

Prof Don Cowan
Dept of Microbiology, UWC
October 2006
Metagenomics and extremophiles: from Antartica to Inner Mongolia

Prof James Cavender, Dr Nicole Cavender, Katie Winsett
University of Arkansas, USA
October 2006
Planetary biodiversity inventory of the Eumycetozoe (slime molds)

Prof John Leslie
Dept of Plant Pathology, KSU, USA
November 2006
Fusarium graminearum: population genetics and genomics

Prof Sharon von Broembsen
Dept of Plant Pathology, Oklahoma State University, USA
November 2006
Crop biosecurity: issues and systems

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 signalling

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

Prestige seminars

Marelize van Wyk (MSc *cum laude*)
March 2005
Taxonomy and population biology of selected *Ceratocystis* spp. with hat-shaped ascospores

Barbara Nel (MSc *cum laude*)
April 2005
Management of Fusarium wilt of banana by means of biological and chemical control and induced resistance

Sabine Lezar (PhD)
June 2005
Assessment and development of microarray-based DNA fingerprinting in *Eucalyptus grandis* and related species

Carrie Brady (MSc *cum laude*)
August 2005
Taxonomy of *Pantoea* spp. associated with *Eucalyptus*

Martin Ranik (MSc *cum laude*)
October 2005
Expression profiling and characterization of wood formation genes in *Eucalyptus*

Yoseph Beyene (PhD)
October 2005
Genetic analysis of traditional Ethiopian highland maize using molecular and morphological markers: implication for breeding and conservation

Mesfin Bogale (PhD)
April 2006
Molecular characterisation of *Fusarium* isolates from Ethiopia

Grace Nakabonge (PhD)
June 2006
Studies on *Cryphonectria* spp. in Southern and Eastern Africa

Bridget Crampton (PhD)
June 2006
Elucidation of defence response mechanisms in pearl millet

Marieka Gryzenhout (PhD)
November 2006
Taxonomy and phylogeny of *Cryphonectria* and allied genera

Gavin Hunter (PhD)
January 2007
Taxonomy, phylogeny and population biology of *Mycosphaerella* species occurring on *Eucalyptus*

Teresa Goszczynska (PhD)
May 2007
Emerging diseases of maize and onion caused by bacteria belonging to the genus *Pantoea*

FABI TEAM
2005-2007

Full time academic & research staff

Prof Dave Berger
Prof Teresa Coutinho
Prof Karl Kunert
Prof Lise Korsten
Prof Anna-Maria Oberholster
Prof Brenda D. Wingfield
Prof Michael J. Wingfield
Assoc Prof Terry Aveling
Assoc. Prof Nico Labuschagne
Assoc. Prof Zander Myburg
Assoc. Prof Jolanda Roux
Assoc. Prof Fanus Venter
Dr Rachel Chikwamba
Dr Gert Marais
Dr Bernard Slippers
Dr Jacquie van der Waals
Dr Altus Viljoen (until December 2006)
Mr Brett Hurley

Research Fellows

Dr Martin Coetzee

Technical staff

Ms Trish Beart
Ms Joanne Bradfield
Ms Elna Cowley
Mr Neil de Jager
Ms Gerda Fourie
Ms Jeanne Korsman
Ms Izette Greyling
Mr Hardus Hatting
Ms Tracey Hatherell
Ms Pritty Khumalo
Ms Grieta Mahlangu
Mr Kgosi Mangwaketsi (until March 2007)
Ms Mpho Mbonani
Ms Eshchar Mizrachi
Ms Tsholofelo Mojela
Ms Eva Müller
Ms Karin Muller
Ms Valentina Nkosi
Mr Nicky Olivier
Ms Amanda Redmond
Ms Heidi Roos
Mr Callies Selala
Ms Thia Schultz
Ms Anita Steyn
Mr Danie Theron (until January 2006)
Ms Lydia Twala
Ms Liesl van der Linden
Ms Erika van der Walt
Ms Kerien van Dyk
Ms Irene van Nugteren
Ms Martie van Zyl

Administrative staff

Ms Vivienne Clarence
Ms Helen Doman
Ms Gerda Fourie
Ms Jenny Hale
Ms Adrene Laubsher
Ms Martha Mahlangu
Ms Daleen Muller
Ms Liana Viljoen
Ms Rose Visser

Computer support

Mr Chris Visagie (until 1st May 2007)
Mr Charl Joubert

Information specialist

Ms Marié Theron

Honorary professors/lecturers

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

Sabbatical visitors

Dr Paäl Krokene (2003)
Dr Diane Six (2004/2005)
Dr Ursula Heiniger (2004/2005)
Dr Dale Bergdahl (2005)
Dr Marianne Cronje (2005)
Prof Chris Cullis (2006)
Prof Nick Brewin (2006)
Prof Nora Lapitan (2006)

Postdoctoral fellows

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

Dr. Leanne Forsyth
Global gene expression profiling in banana against *Fusarium oxysporum* f.sp. *cubense* (*Foc*)

Dr Solomon Kebede
Development and use of microarray technology for genotyping and gene expression analysis in *Eucalyptus* trees

Dr Seonju Lee
Fungi on Protea species

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

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

Dr Urte Schlüter
Nodule senescence under drought stress

Dr Noelani van den Berg
Identification of defence-related genes in Cavendish bananas to *Fusarium oxysporum* f.sp. *cubense*

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 Jane Wright
The global population biology of *Fusarium circinatum*

Dr Lawrie Wright
Population dynamics of *Cylindrocladium pauciramosum*

Dr XuDong Zhou
Fungi associated with bark beetles

Current postgraduate students

PhD students

Shahasi Athman
Biological control of the banana nematode *Radopholus similis* with fungal endophytes and the study of host-pest-endophyte interactions
Advisors: N Labuschange, A Viljoen & T du Bois

Hugues Baimey
Scutellonema bradys as a pathogen of yam (*Dioscorea* spp.) in Benin
Advisors: N Labuschagne, D Coyne & A McDonald

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

Didier Begoude
Diseases of *Terminalia* species in Africa
Advisors: J Roux, MJ Wingfield & BD Wingfield

Wubetu Bihon
Biology and population dynamics of *Diplodia pinea* infecting *Pinus* spp.
Advisors: BD Wingfield, B Slippers & MJ Wingfield

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

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

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

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 & AA Myburg

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

Alvaro Duran
Pine Needle Disease of *P. radiata* in Chile
Advisors: MJ Wingfield, M Gryzenhout, B Slippers & BD Wingfield

Joanne Fouché
Biological control of Fusarium wilt through the use of rhizobacteria and induced systemic resistance
Advisors: A Viljoen, TA Coutinho & A McLeod

Anton Fourie
Efficacy of rhizobacteria for growth promotion and biocontrol of soil-borne pathogens on selected vegetable crops
Advisors: N Labuschagne & L Korsten

Veloshinie Govender
Seed pathology and vigour of maize stored under subsistence farming conditions
Advisor: TAS Aveling

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

Ahmed Hassen
Efficacy of *Rhizobacteria* for growth promotion and biocontrol of selected soilborne pathogens of sorghum in Ethiopia and South Africa
Advisors: N Labuschange & L Korsten

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

Brett Hurley
Molecular ecology and establishment of the Sirex biological control 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

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

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

Sinnia Kappindu
Mechanisms of banana weevil (*Cosmopolitus sordidus*) biocontrol using fungal endophytes
Advisors: A Viljoen, N Labuschagne & T du Bois

Andrew Kiggundu
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
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

Makuena Lebusa
Biology, population dynamics, microbial association of the cossid moth, *Coryphodema tristis*, infecting *Eucalyptus* in South Africa
Advisors: B Slippers, BD Wingfield & MJ Wingfield

Solomon Lephai
Programmed cell death induced by biotoxins
Advisors: PJ Oberholster & A-M Oberholster

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

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

Cornel Millard
Verticillium on potatoes in South Africa
Advisors: J van der Waals & F Denner

Calvyn Molepo
Molecular phylogeny of the *Ravenelia* spp. in South Africa
Advisors: BD Wingfield, W. Maier & MJ Wingfield

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

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

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

Joseph Ndunguru
Molecular characterization and dynamics of cassava mosaic geminiviruses in Tanzania
Advisors: TAS Aveling, G Thompson, J Legg & C Fauquest

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

Kitt Payn
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

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

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 *Eucalyptus*
Advisors: MJ Wingfield, B Slippers & BD Wingfield

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

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

Rene Sutherland
The effect of cold stress on resistance in Cavendish bananas to Fusarium wilt
Advisors: A Viljoen & R Chikwamba

Ezanne Swanepoel
Mapping *Diuraphis noxia* resistance loci in *Triticum aestivum*
Advisors: A-M Oberholster, AA Myburg & MT Labuschagne

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

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

Albé van der Merwe
Population genetics of *Cryphonectria cubensis*
Advisors: BD Wingfield, MJ Wingfield & ET Steenkamp

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

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

Mahdi Ziaratnia
Characterization of key genes involved in the biosynthetic pathway of medicinal compounds of indigenous plant species
Advisors: K Kunert, M Meyer & N Lall

Current MSc/MSc (Agric)/M Inst Agrar students

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

Chrizelle Beukes
Rhizobial diversity associated with the root nodules of *Hypocalyptus* spp. and its relatives
Advisors: ET Steenkamp, SN Venter & I Law

Jane Boshoff
Biological control of Pythium wilt and root rot of hydroponically grown lettuce
Advisors: N Labuschagne, L Korsten & T Regnier

Nanette Coetzer
Development of SSHscreen software
Advisor: DK Berger

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

Rosita Endah
Characterization of NPR1 like genes in banana
Advisors: R Chikwamba & Kunert KJ

Derien Echeverri
Understanding and managing the *Eucalyptus* snout beetle (*Gonipterus scutellans*) (Coleoptera: Curculionidae) in South Africa
Advisors: B Slippers, S Gebeheyu & MJ Wingfield

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

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

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

Joha Grobbelaar
Molecular phylogeny and population genetics of *Ophiostoma quercus*
Advisors: MJ Wingfield, BD Wingfield & P Bloomer

Susan Groenewald
The biology and pathogenicity of *Fusarium oxysporum* f.sp. *cubensis*
Advisors: A Viljoen, N van der Berg & WFO Marasas

Bianca Hinze
Botryosphaeriaceae associated with the South African indigenous tree *Sclerocarya birrea*
Advisors: MJ Wingfield & B Slippers

Carlo Jackson
Viral induced gene silencing in wheat
Advisor: A-M Oberholster

Eugenia Itumeleng Kgang
Differential gene expression in radiated drought-tolerant plants
Advisor: K Kunert

Briar Harmer
Mating type switching in *Ceratocystis*
Advisors: M Coetzee, BD Wingfield & MJ Wingfield

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

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

Delphin Kandolo
Effect of fungicide seed treatments on vigour and germination of various crops
Advisor: TAS Aveling

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

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

Philip Law
MADIBA: Database tool for annotation of microarray data
Advisors: DK Berger & F Joubert

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

Olga Makhari
Vegetative and sexual compatibility in South African isolates of *Fusarium circinatum*
Advisors: ET Steenkamp, TA Coutinho & MJ Wingfield

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

Happy Maleme
Botryopshaeria spp. on eucalypts in South Africa
Advisors: B Slippers, MJ Wingfield & BD Wingfield

Vonia Mampuru
Biodiversity of Opisthokont protests in South African freshwater
Advisor: ET Steenkamp

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

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

Celia Martinze
Stability of Bt toxin in transformed tobacco under drought
Advisor: K Kunert

Tumi Mashangoane
Development and evaluation of polymorphic markers for intraspecific studies on the pine pitch canker pathogen, *Fusarium circinatum*
Advisors: ET Steenkamp, BD Wingfield & MJ Wingfield

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

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 die-back of *Terracarpus angulensis* (Kiaat) in South Africa
Advisors: MJ Wingfield, J Roux & C Geldenhuys

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

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

Claire Munro
Identification of defence genes related to resistance against Fusarium wilt of banana
Advisors: A Viljoen & Z Myburg

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

Vuledzani Muthelo
Population genetics of *Ganoderma* spp. in South Africa
Advisors: M Coetzee, BD Wingfield & MJ Wingfield

Innocentia Nkosi
Effect of Si on incidence and severity of common scab on potatoes in SA
Advisors: JE van der Waals & R Gouws

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 & DK Berger

Zelda Pieterse
Interaction between *Mycogone perniciosa* and *Agaricus bisporus*
Advisors: TAS Aveling & PM Labuschagne

Nditsheni Rabambi
Antimicrobial activity of tea (*Camellia sinensis*) extracts against plant pathogenic viruses on selected vegetable crops
Advisors: N Labuschagne, Z Apostolides & G Thompson

Martin Ranik
Gene discovery in differentiating xylem of *Eucalyptus* and *Arabidopsis*
Advisor: AA Myburg

Moses Ramusi
Biological and chemical control of seedling diseases of cowpea
Advisors: TAS Aveling, N Labuschagne & JE van der Waals

Quentin Santana
Identificaton of *vic* genes in *Fusarium circinatum*
Advisors: M Coetzee, BD Wingfield & MJ Wingfield

Thia Schultz
Expression profiling of RWA induced transcripts in Betta NILS
Advisor: A-M Oberholster

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

René Sutherland
Transformation of Cavendish bananas for Fusarium wilt resistance
Advisors: A Viljoen, J-V Escalant & K Kunert

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

Liesl van der Linden
Genetic studies of bacterial wilt disease resistance in *Arabidopsis thaliana*
Advisor: DK Berger

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

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

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

Irene van Nugteren
Virus induced gene silencing in pearl millet
Advisor: DK Berger

Natalie van Zuydam
Designing a microarray diagnostic for *Leptographium* species
Advisors: MJ Wingfield, BD Wingfield & K Jacobs

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

Fanie Verwey
Control of Pythium wilt and root rot in hydroponically grown lettuce
Advisors: N Labuschagne & FC Wehner

Robert Walters
Development of markers for identification of different aphid biotypes
Advisors: A-M Oberholster & V Tolmay

Markus Wilkin
Mating genes in Ophiostomatoid fungi
Advisors: BD Wingfield & MJ Wingfield

Michelle Wilmot
Antimicrobial activity of tea (*Camellia sinensis*) extracts against pathogenic fungi on selected vegetable crops
Advisors: N Labuschagne & Z Apostolides

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

4th year and honours students

Chrizelle Beukes (2005)
Joanne Bradfield (2005)
Bianca Hinze (2005)
Murray Logan (2005)
Mpho Makinta (2005)
Marja O'Neill (2005)
Clair Strange (2005)
Lorinda Swart (2005)
Ariska van der Nest (2005)
Francois van der Walt (2005)
Hanlie van der Merwe (2005)
Nadine Varelas (2005)
Marinda Veenendaal (2005)
Markus Wilken (2005)
Kultano Hutamo (2006)
Tumi Mashangoane (2006)
Nokukhanya Nxumalo (2006)
Alisa Postma (2006)
Quentin Santana (2006)
Bernet van der Merwe (2006)
Marcel Vermeulen (2006)
Anandi Bierman (2007)
Nizé du Toit (2007)
Bongiwe Mthethwa (2007)
Dekker van Wyk (2007)
Dia van Staden (2007)
Lisa-Danelle de Wet (2007)
Deepa Bhana (2007)
Mmaphefo Maluleke (2007)
Jamie-Lee Moss (2007)
Janine Silberbauer (2007)

Student assistants

Wilhelm Dreyer (2005)
Buyi Mthalane (2005)
Barry Christie (2006)
Juanita Engelbrecht (2006)
Dineo Makala (2006)
Estien Moller (2006)
Thehan Claassen (2006)
Thys Geldenhuys (2007)
Steven Hussey (2007)
Margo Bradfield (2007)
Shani Bekker (2007)
Patricia Modiba (2007)
Refilwe Moiloa (2007)
Solomon Ntladi (2005-2007)

CTHB Mentorship students

Dalemari Crowther (2005)
Kutlwano Hufamo (2005)
Eugene Mokgopa (2005)
Sonja Meyer (2005, 2006)
Osmond Mlonyeni (2005)
Petra Ros (2005)
Tondani Kone (2005, 2006)
Amy Kopke (2005)
Dineo Makala (2005)
Duncan Paterson (2005, 2006, 2007)
Gifty Hammond (2006)
July Lai (2006)
Mmaphefo Maluleke (2006)
Simon Martin (2006)
Catherine Molefe (2006)
Chantel Paynter (2006)
Karlien van Zyl (2006)
Tania Weller (2006)
Sameera Ebrahim (2006, 2007)
Solomon Ntladi (2006)
Gideon Geldenhuys (2007)
Jan Nagel (2007)
Jaco Nieuwenhuijs (2007)
Melanie van der Vaart (2007)
Daniel Diedericks (2007)
Caron Griffiths (2007)
Dumisane Hlongwane (2007)
Mathews Sebenego (2007)
Melissa Simpson (2007)
Riaan Theron (2007)
Juanita van Wyk (2007)

Recent graduates

PhD

Quenton Kritzinger (2005)
Mycotoxins and medicinal properties of cowpea
Advisor: TAS Aveling
Co-advisor: N Lall

Sabine Lezar (2005)
Fingerprinting in *Eucalyptus* using microarrays
Advisor: BD Wingfield
Co-advisors: AA Myburg, D Berger & MJ Wingfield

Yosef Beyene (2005)
Genetic and morphological diversity in traditional Ethiopian highland maize [*Zea mays* (L.)] populations
Advisor: AA Myburg
Co-advisor: A-M Oberholster

Legesse Beyene (2005)
Genetic diversity in maize inbreds and its association with testcross performance, combining ability and heterosis
Advisor: A-M Oberholster
Co-advisors: AA Myburg, K Pixley & TK Tumasi

Sari Mohali (2005)
Cylindrocladium spp. in Venezuela
Advisor: MJ Wingfield
Co-advisor: BD Wingfield

Getu Beyene (2006)
Gene expression and plant performance in oryzacystatin-I (OC-I) expressing transgenic tobacco (*Nicotaiana tabacum* L. cv Samsun) plants under abiotic stress
Advisor: K Kunert
Co-advisor: CH Foyer

Mesfin Bogale (2006)
Fusarium spp. associated with teff production in Ethiopia
Advisor: BD Wingfield
Co-advisors: MJ Wingfield & ET Steenkamp

Johan de Graaf (2006)
Integrated pest management of the banana weevil, *Cosmopolites sordidus* (Germar), in South Africa.
Advisor: A Viljoen
Co-advisor: P Govender

Noelani van den Berg (2006)
Identification of genes associated with tolerance in Cavendish banana selection GCTCV-218 against *Fusarium oxysporum* f.sp. *cubense* 'subtropical' race 4.
Advisor: A Viljoen
Co-advisors: D Berger, P Birch & MJ Wingfield

Shahasi Athman (2006)
Host-endophyte-pest interactions of endophytic *Fusarium oxysporum* antagonistic to *Radopholus similis* in banana (*Musa* spp.)
Advisor: A Viljoen

Bridget Crampton (2006)
Elucidation of disease resistance in monocotyledous plants through DNA microarray analysis
Advisor: D Berger

Marieka Gryzenhout (2006)
Revision of the taxonomy of the fungal genera *Endothia* and *Cryphonectria*
Advisor: MJ Wingfield
Co-advisor: BD Wingfield

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

Gavin Hunter (2007)
Mycosphaerella leaf blotch of *Eucalyptus* in South Africa
Advisor: MJ Wingfield
Co-advisors: BD Wingfield & PW Crous

MSc

Franco du Preez (2005)
Analysis and origin of the different classes of Nucleotide Binding Site (NBS) motifs present in bread wheat
Advisor: A-M Oberholster
Co-advisor: AA Myburg

Joanne Fouche (2005)
Pathogenicity of African isolates of bacterial wilt on *Arabidopsis thaliana*
Advisor: D Berger
Co-advisor: TA Coutinho

Almuth Hammerbacher (2005)
Epidemiology of the pitch canker fungus in South Africa
Advisors: TA Coutinho
Co-advisors: MJ Wingfield & BD Wingfield

Zhou Honghai (2005)
Functional analysis of *Eucalyptus* wood formation genes in *Arabidopsis*
Advisor: AA Myburg
Co-advisor: DK Berger

Therese Lotter
Characterisation and expression of a polygalacturonase gene from the lupin antracnose fungus identified as *Colletotrichum lupine* var. *setosum*
Advisor: D Berger

Lance Maphosa (2005)
Taxonomic and population biology on *Armillaria* spp. in Zimbabwe
Advisor: BD Wingfield
Co-advisors: M Coetzee, MJ Wingfield & E Mwenje

Lerato Matsaunyane (2005)
Isolation and characterisation of the apple polygalacturonase inhibiting protein 2 gene (*pgip 2*) from apple and investigation into the proteins' antifungal activity
Advisor: DK Berger
Co-advisor: D Oelofse

Barbara Nel (2005)
Management of Fusarium wilt of banana by means of biological, chemical control and induced resistance
Advisor: A Viljoen
Co-advisors: C Steinberg & PS van Wyk

Draginja Pavlic (2005)
Botryosphaeria spp. endophytic in eucalypt and *Syzigium* in South Africa
Advisor: TA Coutinho
Co-advisors: MJ Wingfield & B Slippers

Martin Ranik (2005)
Expression profiling and characterization of wood formation genes in Eucalyptus
Advisor: AA Myburg

Brett Hurley (2006)
Species composition, pathogen interactions and management of fungus gnats in forestry nurseries
Advisor: P. Govender
Co-advisors: MJ Wingfield, TA Coutinho & BD Wingfield

Minique de Castro (2006)
Nucleotide diversity in cellulose biosynthetic genes of *Eucalyptus*
Advisor: AA Myburg
Co-advisor: P Bloomer

Rene Sutherland (2006)
Genetic modification of Cavendish bananas (*Musa* spp) in South Africa.
Advisor: A Viljoen
Co-advisors: R Chikwamba, K Kunert & J.V. Escalant

Susan Groenewald (2006)
Biology, Pathogenicity and diversity of *Fusarium oxysporum* f. sp. *cubense*
Advisor: A Viljoen
Co-advisors: N van den Berg & WFO Marasas

Natalie Feltman (2006)
Development of the polygalacturonase inhibiting protein (PGIP) for delivery of foreign proteins to the surfaces of plant cells
Advisor: DK Berger
Co-advisor: M Cloete

Nonnie Geldenhuis (2006)
Studies on fungi associated with dying *Schizolobium parahybrum* in Ecuador
Advisor: MJ Wingfield
Co-advisors: BD Wingfield & J Roux

Christian Giesel (2006)
Transformation of tobacco with a lupin chitinase gene under control of a stress inducible promoter
Advisor: DK Berger
Co-advisor: B Crampton

John Kemp (2006)
Eco-TILLING of wood and fibre genes in forest trees
Advisors: AA Myburg
Co-advisor: L van Rensburg

Celia Martins (2006)
The expression of Bt *Cry1Ac* in transformed cotton under abiotic stress
Advisor: K Kunert
Co-advisor: K Krüger

Liesl Stronkhorst (2006)
The effect of pH and N-fertilization practices on the incidence of Fusarium wilt (Panama disease) of bananas
Advisors: J van der Waals & A Viljoen

Michelle Victor (2006)
MiRNA profiling in differentiating woody tissues of *Eucalyptus*
Advisor: AA Myburg
Co-advisor: H Huismans

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

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

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

Rebecca Makhado (2007)
Endophytic studies on *Pantoea* spp. associated with eucalypts in South Africa
Advisor: TA Coutinho
Co-advisor: SN Venter

Mariette Truter (2007)
Epidemiology and control of black scurf and stem canker of potatoes
Advisor: F Wehner

MSc (Agric)/MInstAgrar

Moses Ramusi (2006)
Biological and chemical control of fungal seedling diseases of cowpea
Advisors: TAS Aveling, N Labuschagne & JE van der Waals

Prestigious NRF bursary holders

Irene Barnes
Johan de Graaf
Franco du Preez
Marieka Gryzenhout
Almuth Hammerbacher
Ronald Heath
Gavin Hunter
Kershney Naidoo
Anneke Prins
Luke Solomon
Rene Sutherland
Ezanne Swanepoel
Dirk Swanevelder
Noëlani van den Berg
Magriet van der Nest
Leon van Eck
Marelize van Wyk
Michelle Victor
Juan Vorster

Aaron Klug scholarship

Juanita de Wet

UP Postgraduate Mentorship Bursary

Kershney Naidoo

Mellon Foundation grants

Irene Barnes
Lieschen de Vos
Gavin Hunter
Bongani Maseko
Sanushka Naidoo
Noëlani van den Berg
Albé van der Merwe

NRF scarce skills scholarships

Carrie Brady (2002; 2003-2004; 2005-2008)
Aneen Belgrove (2005)
Joanne Fouché (2005-2006)
Rene Sutherland (2005-2006)
Abigail Mashamba (2005-2006)
Martin Ranik (2006-2008)
Ryan Nadel (2007-2009)

Other scholarships

Andrew Kiggundu (Rockefellar Foundation)
Sinnia Kappindu (IITA)
Josephine Mukiibi (Belgium Embassy & INIBAP)
Charline Kamburona (DAAD, TUCSAN Scholarship)
Lesesse Beyene (EARO, Ethiopia)
Yoseph Beyene (EARO, Ethiopia)
Mesfin Bogale (EARO, Ethiopia)
Joseph Ndunguru (IITA, Nigeria)
Pamela Paparu (IITA)
Shahasi Athman (IITA)

Rene Sutherland (NRF Mobility grant to travel to Orlando, Florida for "Plastid transformation of bananas and plaintains)

Michelle Victor (UP Postgraduate Research Visit Bursary to Prof V Chiang, NC State University, USA)

Noelani van den Berg (Claude Leon postdoctoral fellowship)

Eugenia Itumeleng Kgang (ARC and NRF Equity Scholarship)

UP Postgraduate Research Visit Bursary (Ms Michelle Victor, Nov 2004 through Jan 2005, research visit to work with Prof. Vincent Chiang, NC State University)

MANAGEMENT

Management committee

Professor MJ Wingfield (Chairman)
Professor BD Wingfield
Professor L Korsten
Professor K Kunert
Professor TA Coutinho
Professor A-M Oberholster
Professor D Berger
Assoc Professor TAS Aveling
Assoc Professor J Roux
Assoc Professor N Labuschagne
Assoc Professor AA Myburg
Assoc Professor SN Venter
Dr A Viljoen
Dr G Marais
Dr E Steenkamp
Dr B Slippers
Dr R Chikwamba
Dr JE van der Waals
Mr B Hurley
Irene Barnes (Postgraduate student representative 2005, 2006)

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
Professor J Verschoor, Head of the Dept of Biochemistry
Professor M Meyer, Head of the Dept of Botany
Professor C Reinhardt, Head of the Dept of Plant Production
Professor S Nicolson, Head of the Dept of Zoology & Entomology
Professor M Wingfield, Director of FABI

Some social highlights in FABI

Annual SPOOF* meeting

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

Theme: Movie night in Hollywood (2005)

Marija Kvas and Pranitha Dawlal

Julia Maier, her daughter,Maria-Noel Cortinas, Draginja Pavlic, Wilhelm and Sonja de Beer

Theme: Pirates (2006)

Joanne Fouché, Johan Rousseau and Claire Munro

Joha Grobbelaar, Irene Barnes, Stephanie Muller

Year end function 2005

Pritty Khumalo, Buyi Mthalani, Grieta Mahlangu and Ms Tsholofelo Mojela

Kerien van Dyk, Terry Aveling, Nico Labuschagne and Magda Labuschagne

Year end function 2006

Urte Schlüter, Maria Noel Cortinas and Ryan Nadel

Sonja September, Nico van Blerk and Lorinda Swart

Prof and Mrs Verschoor

Prof and Mrs Roux

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
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
Du Roi QMS
EARO, Ethiopia
ESKOM
European Union
Flemish/South African Governments Agreement
Forestry South Africa
Global Forestry Products
Hans Merensky Holdings
Innovation Fund
International Institute of Tropical Agriculture (IITA)
Italian/South African Governments Agreement
Mellon Foundation
Mondi Business paper South Africa and Mondi Shanduka
Mountain to Ocean (MTO) Forestry
National Bioinformatics Network
National Research Foundation (NRF)
Norway/South African Governments Agreement
PlantBio – National Innovation Centre in Plant Biotechnology
Potatoes South Africa
Protein Research Foundation
Rockefeller Foundation
SAFCOL/Komatiland Forestry
Sappi
SIDA/South African Government Agreement
South African Avocado Growers Association
South African Litchi Growers Association
South African Mushroom Farmers Association
South African Wattle Growers Union
Tanzanian Government
Technology and Human Resources and Industry Programme (THRIP)
Tuscan Namibia/DAAD (Germany)
TWK
UP Research Development Fund
Wattle Growers Union of South Africa (SAWGU)
Wheat Cereal Trust

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