FABI

Forestry and Agricultural Biotechnology Institute

Biennial Report 2002/2003

Sponsors of research

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

ACIAR (Australia)
Agropolis Advanced Research Platform (France)
Banana Growers Association of South Africa
Belgium Embassy
Central Timber Co-operative (CTC)
China/South African Governments Agreement
CIRAD
Citrus Growers Association
CNRS/South African Government Agreement
CSIR
Department of Water Affairs and Forestry (DWAF)
Department of Trade and Industry through THRIP initiative
Department of Arts, Science and Technology through the Innovation Fund
Du Roi QMS
EARO, Ethiopia
ESKOM
European Union
Flemish/South African Governments Agreement
Forestry South Africa
Global Forestry Products
Hans Merensky Holdings
INIBAP
Innovation Fund
International Institute of Tropical Agriculture (IITA)
Italian/South African Governments Agreement
Mellon Foundation
Mondi
National Research Foundation
Norway/South African Governments Agreement
Rockefeller Foundation
SAFCOL/Komatiland Forestry
Sappi
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)
Wattle Growers Union of South Africa (SAWGU)
Wheat Cereals Trust

The Forestry and Agricultural Biotechnology Institute (FABI) is located at 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 caliber, 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 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 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, Plant Production and Postgraduate School for Agriculture and Rural Development are associated with the Institute. 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.

FABI is not a new emerging venture, but rather an amalgamation of a tremendous base of expertise in forestry and agriculture from different universities and research organisations in South Africa. The Institute has been operational since April 1998, although it was only officially inaugurated on 13 March 1999. This third FABI biennial report covers the period from September 2001 to May 2003.

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://www.up.ac.za/academic/fabi

Compilation, layout and design by TA Coutinho

Cover photograph: Cross section through the base of the South African native tree, *Celtis africana*, suffering from a root disease and showing discolouration and fungal zone lines (photograph taken by R Heath).

Forestry and Agricultural
Biotechnology Institute
"FUTURE FORESTS and FOOD"

CONTENTS

	Page
Director's report	4
FABI team photograph	6
FABI growing – signs of a success story in plant biotechnology	7
Research reports	10
Services	51
Publications 2001/2003	54
Seminar presentations	70
FABI team 2002/2003	72
Some social highlights in FABI 2002/2003	81
Is FABI becoming FABYLON?	83
Sponsors of research	84

Director's Report

As I write this note, the fifth anniversary of the birth of FABI has just passed. It is truly amazing to look back and to realise that in this relatively short space of time, the Institute has achieved so much. FABI is now well recognised nationally as a leader in the broad field of plant biotechnology. The Institute has also rapidly gained international stature and there are few organisations with activities linked to ours that do not already know us well. This biennial report is the third in the history of the Institute and it is a great pleasure for me to share this brief summary of our activities during the last two years with you.

The FABI family has continued to grow and this has happened more rapidly than we might have expected. If you have followed our development, you will know that the founder FABIANS were approximately 50 in number. The group now represents about 130 mainly MSc, PhD students and post-doctoral fellows. This team is led by 14 academic staff that make up the core of the FABI management committee. We continue to function very much as a family, with all the privileges and responsibilities that go with being part of a family.

FABI's rapid growth has inevitably placed substantial pressure on our facilities. Space for students to work reasonably comfortably has become a contested resource. Armed with the statistics related to this problem and the fact that it was becoming necessary to limit the growth of some programmes, we have motivated for new research facilities. Of course here the business catch phrase "Return on investment" rapidly became dominant in discussions. However, the growth and great acco mplishments of FABI have made it relatively easy to persuade the University of the need for additional facilities. The new three storey building extension to FABI has risen rapidly and we look forward to occupying this fantastic new facility during July 2003. Some illustrations of the growth of FABI2 during the latter part of 2002 and the early part of this year, are presented in this report to give you an idea of the changing face of our Institute.

The new FABI facilities will considerably enhance the scope of the research that we are able to undertake. It is impossible to provide details of the new building in this brief report but I must mention a few features. These include laboratory space and seating for 30 additional students. We will now have access to an auditorium that is able to easily seat all FABIANS and in this respect seminars and research meetings will be considerably more comfortable. A suite of world class quarantine greenhouses and a top quality facility for tissue culture and transgenic research plants also form part of the new building. To add to this, a third floor, not strictly limited to, but closely allied to the interests of FABI, has been added to the building to accommodate a bioinformatics centre and new laboratories for our growing DNA sequencing enterprise.

Biotechnology in the broadest sense of the word has continued to grow rapidly in South Africa. Obviously this has many positive repercussions for FABI. The group has access to new funding opportunities and our students, the prime *raison de etre* of FABI, have access to even better employment opportunities. I intentionally use the word "even better" because the post graduate students emerging from FABI have been in high demand both nationally and abroad. There is no que stion in my mind that biotechnology will continue to grow in South Africa, with many new businesses emerging. FABI will surely grow in concert and will continue to be an important source of trained scientists to participate in these exciting new ventures.

I wanted to include in this brief introduction, some news of new research groups that have joined FABI during the course of the last two years. This is difficult to do without absorbing more space than I have been promised. However, I must make mention of the outstanding new plant biotechnology research programmes of Prof Dave Berger and Dr Zander Myburg. We have also continued to build on our strong links with the CSIR and about two years ago, initiated a joint appointment for Dr Gert Marais to build on our mutual

interests in food products and industrial mycology. Our activities in forest entomology and insect pests on banana have also been substantially expanded. To add to this, research and services linked to food safety are also growing rapidly.

One always needs to be cautious in focussing on the achievements of a large number of outstanding people working in a group such as FABI. The danger here is that one inevitably forgets to mention someone. I must thus generalise but yet make the point that a great number of research leaders and graduate students have been recipients of special awards and honours. These have come from within the University of Pretoria, from organisations linked to science in South Africa and also from international groups. It is a great pleasure to see these accomplishments and to realise what a fabulous group the FABIANS represent.

It has always been my firm belief that diversity builds strength. In this sense, living and working in South Africa provides great opportunities. A country with 11 official languages can hardly fail to provide an educational institution with an incredible source of diversity. FABI has in the past achieved the status of having at least one student that speaks every one of South Africa's official languages. The Institute has also become a home to students from many countries, in every hemisphere and every continent. A small census towards the end of last year showed that 28 languages were spoken by FABIANS at that time and some details are presented in this report. I believe that this number has grown, although it changes from month to month. The point is merely that FABI has become a truly international institute.

Support for research in FABI comes from a wide range of organisations and private enterprises. The majority of our funding comes from outside the University of Pretoria and includes large industries, small companies, farmers groups, international aid organisations, overseas business ventures, government and state funds. We are most fortunate to have a very sound base of funding that is nurtured enthusiastically by the research enterprise of the University of Pretoria. On behalf of all FABIANS, I take this opportunity to thank our research sponsors for their support.

Research linked to education represents the core business of FABI. While we have close alliances with research providers that are more "product" oriented, all our work is in some way linked to student training. This is consistent with our existence in a university environment. Our main research focus remains linked to the broader field of plant sciences and as a research team, we are unified by some interest in plants, plant biotechnology and DNA-based interests. The establishment of FABI has had a profound impact on these fields at the University of Pretoria as well as in South Africa as a whole. There is every reason to expect that FABI is entering a growth phase in both size and quality.

One can only feel excited and enthusiastic when looking to the future of FABI. Alliances with international funding organisations have brought a much broader focus to our work than I had expected five years ago. Plant, insect and microbial molecular genetics projects were relatively well-established when FABI was founded. New areas of interest and focus have, however, emerged as important, and these are growing rapidly. They include projects linked to the impact of genetically modified organisms on the environment, a major thrust in plant and microbial biodiversity, and rapidly emerging projects in the area of industrial plant and microbial biotechnology. The establishment of powerful new facilities in bioinformatics, and the emergence of the first research products in this field clearly herald a major new area of growth for FABI.

I feel hugely privileged to lead this special group. On behalf of all of the FABI family, I again thank the many organisations and industries in South Africa and in other parts of the world that support our research. We are also most grateful to our many colleagues and friends that have supported us in reviewing publications, examining theses and many other elements of the education and academic enterprise.

Michael J Wingfield
Mondi Professor of Forest Pathology and Director of FABI and the TPCP

FABI Team

Front row: Carlos Rodas, Almuth Hammerbacher, Juan Vorster, Brenda Wingfield, Marlien van der Merwe, Susan Groenewald, René van Zyl, Elsie de Meyer, Maria-Noël Cortinas, Renate Zipfel, Sonja de Beer and Sanushka Reddyl

2nd row: Ntsane Moleleki, Anita Steyn, Dilzara Aghayeva, Claudia Rodas, Terry Aveling, Andrew Kiggundu, Mike Wingfield, Awelani Muthsembele, Thuto Matsioloko, Charline Kamburono, Brenda Buthelezi, Maria Onanena, Joyce Jakavula, Busisewe Tshabalala, Solomon Gebeyehu and Annabé Louw-Gaume

3rd row: Therese Lotter, Retha Slabbert, Vivienne Clarence, Teresa Coutinho, Valentina Nkosi, Veloshinie Govender, Marinda Visser, Bongani Maseko, Lawrie Wright, Karl Kunert, Elizabeth Kola, Anna-Maria Oberholster, Mariette Truter, Marieka Gryzenhout, Rosemarie Visser, Leylani Grobler, Deshni Pillay, Thierry Regnier, Grace Nakabonge, Helen Doman, Izette Greyling, Barbara Nel, Martie van Zyl, and Irene Barnes

4th row: Prem Govender, XuDong Zhou, Lancelot Maphosa, Alemu Gezaghne, Gavin Hunter, Jolanda Roux, Marelize van Wyk, Eduard Venter, Riana Jacobs, Cassi Myburg, Legesse Beyene, Sabine Lezar, Elizabeth Attinger, Eva Müller, Noëlani van der Berg, Joanne Weich and Danie Theron

Back row: Wilhelm de Beer, Dirk Swanevelder, Altus Viljoen, Lorenzo Lombard, Gert Marais, Bernard Slippers, Albé van der Merwe, Brett Hurley, Hardus Hatting, Ronald Heath, Dave Berger, Zander Myburg, Quinton Kritzinger, Gina Swart, Juanita de Wet, Christelle van der Vyver, Draginja Pavlic, Schalk van Heerden and Paäl Krokene

FABI growing – signs of a success story in plant biotechnology

FABI, the Forestry and Agricultural Biotechnology Institute of the University of Pretoria was formally established in April 1998. The Institute has grown rapidly and in just five years has become one of South Africa's premier plant biotechnology research groups. FABI has also rapidly gained international recognition for outstanding student training and research productivity. At the time of its establishment, FABI included some 55 full time scientists, MSc and PhD students and post doctoral fellows. The group making up the so-called FABI Family is now in excess of 130 mainly scientists, with a small core of Technical and administrative support staff.

Based on outstanding research and training outputs, the University of Pretoria agreed, late in 2000, to extend the research facilities of FABI. Expansion will include a three -story building connected to what is known as the "downstairs FABI" building. The new building will add new seminar facilities, four research laboratories, a large plant propagation and tissue culture facility, a state of the art suite of eight quarantine greenhouses, walk in growth rooms and refrigeration, a new DNA sequencing facility, a large bioinformatics centre, offices and much more. In all, the new facilities will more than double the floor space available used by FABI in the past.

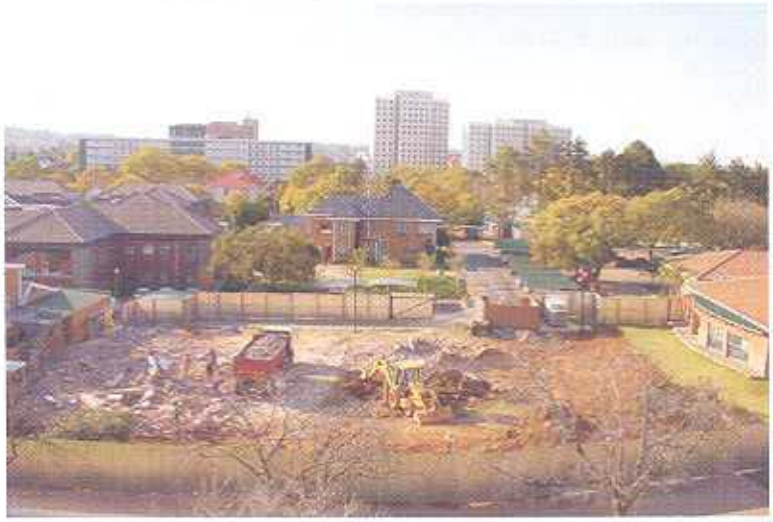
Construction of the new FABI facilities began in October 2002 on a site adjacent to the main FABI facility. The building site, previously two old houses, utilised by the administration department of the Faculty of Biological and Agricultural Sciences. Thus, prior to commencing with building, these houses needed to be de-commissioned and demolished. In addition, the site was found to have a relatively high water table and a sepcialised foundation with reinforced concrete piles able to carry up to seven floors (planned for the longer term), needed to be constructed. Completion of the building project is planned for June 2003 and FABIANS look forward to populating the building shortly thereafter.

The following photographs illustrate phases in the growth of the new FABI facilities. The first picture is an artist's impression of the building which will be completed by the time this report is published.

An artists impression of the completed building. Who is the lady in the foreground we ask?

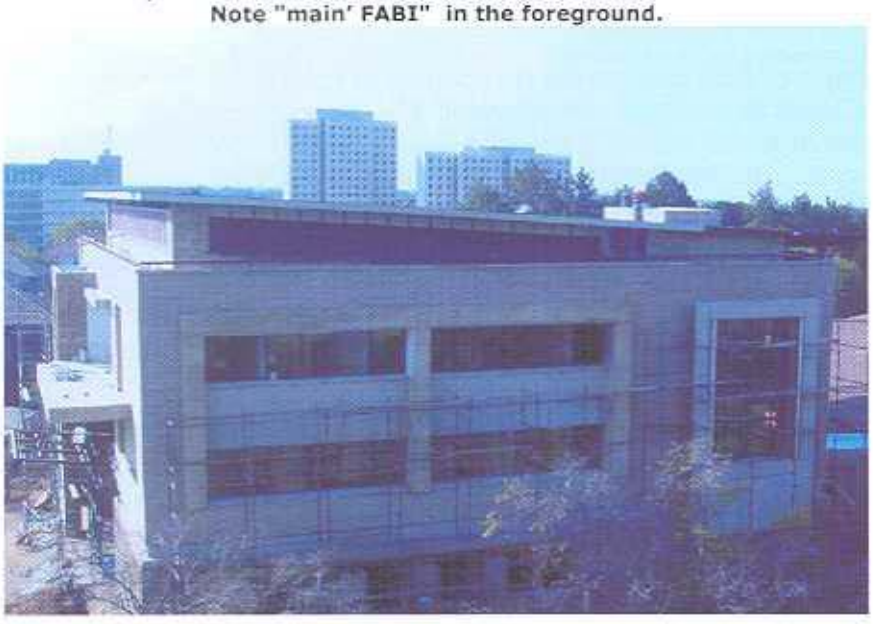
October 2002, prior to the demolition of the two faculty "houses"

October 2002, the demolition begins!



October 2002, clearing the site

January 2003, second floor up and the start of the third floor.
Note "main' FABI" in the foreground.



June 2003, building is almost completed

RESEARCH REPORTS

Forest Protection

Research leader: Prof Mike Wingfield

Research team: Prof Teresa Coutinho
Prof Brenda Wingfield
Dr Jolanda Roux
Dr Prem Govender
Dr Oliver Preisig
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 so that they may be more effectively controlled
- Study and evaluate novel strategies for disease and pest control

Highlights of research 2002/2003:

In this report, a brief summary of the various research activities of the team members and postgraduate students of the Tree Protection Co-operative Programme (TPCP) is provided. This is a condensed review with the focus on highlights and important findings.

Cryphonectria canker

Cryphonectria canker of *Eucalyptus* caused by *Cryphonectria cubensis* remains one of the most important threats to plantation forestry in South Africa. One of our major initiatives has been to conduct screening trials on hybrid clones in areas where the disease has been most severe. These trials have brought a great deal of knowledge to forestry companies supporting the programme. Disease tolerant planting stock has, in many cases, been identified in advance of planting. A limitat ion of this work has, however, been that the screening process is slow and results often emerge at a time when decisions have already been made regarding desirable material to plant. The research team will continue with screening inoculations in the future, but these trials will be much more specifically planned than in the past. They will also be geared to answering very specific questions such as whether different isolates of the pathogen respond similarly on different clones, or not.

The sudden appearance of Cryphonectria canker in South Africa and the known absence of the disease in the late 1970s has led us to believe that the causal agent was

introduced into the country. Knowledge pertaining to origin is highly important in terms of identifying appropriate planting stock and understanding the disease situation in South Africa. One of the problems in this regard is that the taxonomy of the genus *Cryphonectria* is poorly understood. In order to rectify this situation, we have undertaken a series of studies relating to the identification of *Cryphonectria* spp. Here we have begun to understand that species such as *C. cubensis* is very distantly related to, for example, the devastating causal agent of Chestnut blight, *C. parasitica*, in North America.

Sexual fruiting body of *C. cubensis*

An enigma regarding Cryphonectria canker in South Africa is that symptoms of the disease are somewhat different to those found elsewhere in the world. In addition, cankers in South East Asia and South and Central America, tend to be covered with sexual fruiting structures, whereas those in South Africa are covered by asexual fruiting structures. Early DNA sequencing studies in our laboratories showed no clear difference between isolates from these various areas of the world. However, more recently, we have undertaken studies where we have applied DNA sequence comparisons for multiple genes. Interestingly, the multiple gene genealogies show that the South African fungus is a distinct species. Data also indicate that the fungus in South America and that in South East Asia probably represent distinct species. These findings have significant implications for the management of Cryphonectria canker in South Africa and they will also impact strongly on quarantine measures. The latter actions must now be geared to ensuring that *C. cubensis* in its South American or South East Asian manifestation does not reach South Africa. Similarly, we have to warn countries in these areas of the world against the introduction of the South African fungus into their plantations.

Asexual fruiting bodies of *C. cubensis*

A second *Cryphonectria* sp., *Cryphonectria eucalypti*, occurs commonly on *Eucalyptus* in South Africa. This fungus was previously known as *Endothia gyrosa* but intensive DNA-based studies in our laboratories have previously shown that this fungus is a species of *Cryphonectria* and that it probably originates on *Eucalyptus* in Australia. Knowing that a second species of *Cryphonectria* occurs in South Africa has led us to consider the pathogenicity of the fungus. There have been some suggestions that the fungus is only weakly pathogenic and a more accurate answer to this question has been desired. We have thus undertaken intensive inoculation studies on a wide range of *Eucalyptus* clones, using a large set of isolates of the fungus. Most interesting results have been obtained showing that isolates of the fungus differ in pathogenicity and that clones differ in susceptibility to this fungus. Results also sugg est that the response of clones to inoculation is variable and is probably influenced by the time of inoculation. This would be consistent with our knowledge that the fungus tends to occur on the bark of somewhat stressed trees.

Eucalyptus snout beetle

The Eucalyptus Snout Beetle, *Gonipterus scutellatus*, was first recorded in South Africa in 1916, at Newlands, Cape Town. *Gonipterus scutellatus* was observed to

defoliate eucalypt trees, resulting in stunted growth and in severe cases, death. Native to Australia, *G. scutellatus* was without natural enemies and spread unhindered throughout South Africa, causing extensive damage to eucalypt plantations. The parasitic wasp, *Anaphes nitens*, a biological control agent from Australia, was introduced into South Africa. *Anaphes nitens* was very effective at most sites that have continued to experience high infestations of *G. scutellatus*. These infestations are especially prevalent at high altitude sites, where susceptible species, such as *Eucalyptus dunnii* and *E. smithii*, are planted.

In 2000, the research team undertook a study to investigate the influence of various abiotic factors (altitude, temperature and rainfall) over time on parasitism of *G. scutellatus* by *A. nitens*. Five study sites of varying altitude and rainfall were selected. All sites were compartments of *E. dunnii*. The percentage parasitism was measured at these sites.

Significant differences in parasitism between sites and over time were found. Parasitism at the highest altitude site was significantly lower than that at the lowest altitude site, confirming the reduced efficacy of *A. nitens* at high altitude sites. High altitude sites experienced an extended period of lower parasitism in winter. In both high and low altitude sites, parasitism dropped significantly after spring and increased again in summer.

Results of this research indicated that *G. scutellatus* infestations at high altitude sites are not only due to the presence of susceptible *Eucalyptus* species at these sites, but also due to the poor performance of *A. nitens*. This poor performance was attributed to the colder temperatures at high altitude sites. Cold temperatures can affect *A. nitens* indirectly, by reducing the number of hosts, and directly. The decrease in parasitism after spring was attributed to biotic factors, such as parasitoid - host interactions and superparasitism. Thus, the efficacy of *A. nitens* may be reduced by abiotic factors, such as temperature at high altitude sites and by biotic factors at high and low altitude sites.

Armillaria root rot

Armillaria root rot continues to be present in pine plantations in parts of KwaZulu/Natal and Mpumalanga. The disease is no longer considered serious but losses are found, particularly in damp river valley areas where the fungus is most active and aggressive. Much confusion has surrounded the identification of *Armillaria* spp. in South Africa and elsewhere. For many years, the fungus has been known as *Armillaria mellea*, but this name was clearly applied arbitrarily. There is particularly little knowledge available for the fungus in the southern hemisphere and we have maintained a small but active programme to identify species from the southern hemisphere. This has been linked to collaborations with colleagues in Australia and New Zealand as well as in collaboration with a colleague in Zimbabwe. These studies based on intensive DNA sequencing have shown fascinating relationships between Australasian species. They have confirmed the hypothesis that an undescribed species occurs in New Zealand. Furthermore, we have also shown that there are three species in Zimbabwe and that only one of these currently occurs in South Africa.

Mycosphaerella leaf blotch

Mycosphaerella leaf blotch was one of the first diseases to be recognised in South Africa as a threat to plantation forests. During the last two years, studies have been undertaken to determine which *Mycosphaerella* spp. occur, particularly on *E. nitens* in South Africa. This has important implications for disease control and for quarantine. In addition to understanding the composition of *Mycosphaerella* spp. associated with the disease, we have attempted to determine the relative importance of these species. Results have been extremely interesting and have indicated that the view that *M. juvenis* is the most important pathogen, is incorrect. At least for the areas surveyed, *M. nubilosa* is by far the most important cause of Mycosphaerella leaf blotch in South Africa. It is, however, possible that species composition changes with time and that different species are more important in some years, than in others. This question will have to be considered in the future. Because of the difficulty of identifying

Mycosphaerella spp., such surveys will require rapid identification protocols. Studies to develop these tools are currently under way and should be completed in the next year.

Dothistroma needle blight

In South Africa, Dothistroma needle blight is an enigma. The disease caused by *Dothistroma septospora* is one of the most important in the world and has caused huge losses to, mainly *P. radiata* plantations in countries such as Australia, New Zealand and Chile. What is interesting is that the disease is known to have been present in South Africa since the early 1960s, but it has remained on *P. radiata* and also in very limited areas of the eastern Cape. During the last year, the disease was also found associated with severe defoliation of *P. radiata* in the Limpopo Province.

Lack of understanding of Dothistroma needle blight in South Africa and concern that it could adapt to infect other hosts and perhaps hybrid pines, has prompted the research team to initiate a study of the pathogen. This study commenced in mid-2002 and will continue for three years. The key objectives will be to determine whether the pathogen is the same as that found elsewhere in the world. This question is important because of the enigma surrounding the distribution of the disease in South Africa. Another key objective will be to gain an understanding of the genetic diversity of the pathogen in the country and thus to consider the possibility of new disease outbreaks in the future.

Typical symptoms of *Dothistroma septospora* infection on a pine needle

Insect-related pathogens

Bark beetles are amongst the most important pests of forest trees in the world. There are literally hundreds of species and many are important. On pines, there are many examples of insects and these may pose a threat to South African plantations. At present, only three pine infesting bark beetles are known in South Africa and all three have been accidentally introduced into this country from Europe. The fact that bark beetles have already been introduced into pine-growing areas in this country suggests that others are likely to appear in the future. This could have a very negative impact on forestry in South Africa.

A fascinating and important aspect of bark beetles and particularly those infesting conifers, is that they live in close association with very specific fungi. These fungi, commonly known as the Ophiostomatoid fungi, include serious pathogens and agents of blue stain. The importance and role of many others is unknown. Researchers in the programme have a long track record of investigations into bark beetle biology and particularly concerning their association with fungi. Studies have elucidated important new relationships between these fungi and also between their bark beetle hosts. New species belonging to this group have been discovered including one on *Eucalyptus*. Although these studies have significant practical implications, they are largely also of a fundamental nature. The basic science surrounding these studies has enabled us to make strong connections with scientists in other parts of the world and thus to gain funding from initiatives such as the South Africa/Norway and South Africa/China bilateral government agreements. These in turn are helping substantially to expand the experience of students and staff of the group, particularly in the area of forest entomology.

Fungus gnats

Fungus gnats in the families Sciaridae and Mycetophilidae are suspected to transmit the pitch canker fungus, *Fusarium circinatum*, to pine seedlings in South African forestry nurseries. Our objectives have been to confirm the presence of and

to identify fungus gnats in these nurseries. Furthermore, to determine whether these fungus gnats assist in the transmission of *F. circinatum*. Four of the major pine growing nurseries in South Africa were used for our investigations.

Adult fungus gnat

Only one species of fungus gnat, *Bradysia difformis* (Sciaridae), was detected in the nurseries. This is the first record of *B. difformis* in South Africa. *Bradysia difformis* is a common commercial pest in Europe and *Bradysia* spp. have been recorded to transmit fungal pathogens in various overseas nurseries. However, *F. circinatum* was not isolated from the samples of *B. difformis* or any of the other flies collected in the nurseries. Studies are in progress to investigate whether any association exists between *F. circinatum* and the larvae of *B. difformis*.

Ceratocystis wilt

Ceratocystis species includes some of the world's most serious pathogens of trees. Notable examples are oak wilt in North America, sap streak disease and plane wilt in North America and Europe and *mal de machette* on a wide range of hosts in South America. In South Africa, wattle wilt caused by the newly discovered species and pathogen *Ceratocystis albofundus* has increased in importance each year since its discovery approximately a decade ago.

Studies on *Ceratocystis* spp. are leading us to conclude that these fungi are increasing in importance in forestry. We base this view on the discovery of new species such as *C. albofundus* and the growing evidence that this fungus is of African origin. Studies conducted during the last year, for example, have shown clearly that *C. albofundus* occurs naturally on *Protea* spp. and that the fungus does not only occur in South Africa but also in central Africa (Uganda). Population biology studies using microsatellite markers that we have developed and including isolates from Uganda and South Africa have added substantial substance to our belief that *C. albofundus* is an African pathogen. In this regard, it poses a substantial threat to some Australian *Acacia* spp. in their native range.

Until relatively recently, *Ceratocystis* spp. were not considered as serious pathogens of *Eucalyptus* spp. However, discoveries made by members of the TPCP team have shown that the well-known wilt pathogen *C. fimbriata* can lead to the rapid death of *Eucalyptus* spp. in eastern Africa and in Brazil. This work has now been expanded to include studies on isolates from Uruguay, which have shown that *C. fimbriata* can infect and rapidly kill *Eucalyptus* spp. after pruning. Of greate r concern is that the fungus has very recently been discovered on *Eucalyptus* in various parts of South Africa. This could be linked to commonly occurring but unexplained deaths of *Eucalyptus* trees, in plantations.

Studies by researchers in our group have begun to show that there are various pathogenic *Ceratocystis* spp. that have yet to be identified. An important question that has been asked in the past is whether *C. albofundus* might be present in Australia where *A. mearnsii* is native. As part of a sabbatical study, we were able to show that the fungus is probably not in that country, supporting our contention that it is native to South Africa. However, the study included *Eucalyptus* spp. and led to the discovery of a new and apparently pathogenic species of *Ceratocystis*. This fungus will be known as *Ceratocystis pirilliformis*. There is some evidence, although very preliminarily, to show that the fungus occurs in South Africa and that it is an aggressive pathogen. Studies are currently under way to test this hypothesis through robust experimentation.

Ostiolar hyphae at the apex of *C. pirilliformis prov. nom ascoma*

Pitch canker

The pitch canker fungus *F. circinatum* has, in recent years, become one of the most serious impediments to pine propagation in South Africa. The pathogen was first observed in a single nursery in Mpumalanga in the early 1990s. Since that time, it has spread to nurseries in all parts of the country. In these nurseries, it has resulted in very substantial losses and continues to do so. *Fusarium circinatum* has now also been found associated with failed or poor pine establishment and this situation appears to be deteriorating. The fungus has also been found associated with the bark beetle *Hylastes angustatus*. Although the disease known as pitch canker, which is typified by resinous cankers on the stems of established trees, has not appeared in South Africa, it is widely believed that "full-blown" pitch canker will ultimately appear in this country. Strategies to ensure that pi ne propagation is not destroyed are thus being considered and management tools developed.

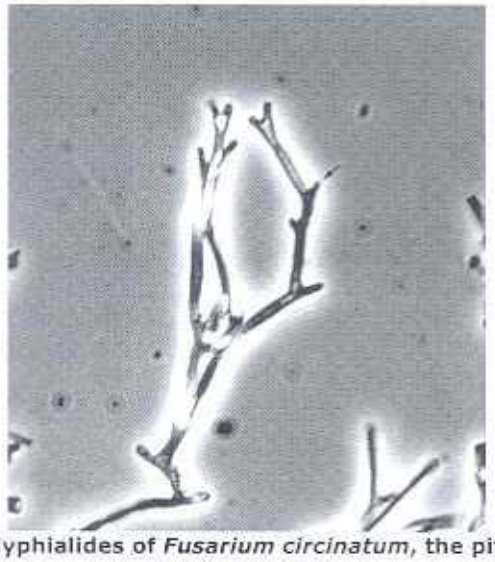
The research team has undertaken intensive studies on the pitch canker fungus in South Africa, and is internationally recognised as being a leader in this field. On e of the recent questions that has been posed and that concerns the impact of the fungus on pines in South Africa, relates to the relationship between the pitch canker fungus and the very similar fungus that causes a disease known as mango malformation. We have thus obtained isolates of the mango malformation fungus and compared these with those from pines in South Africa. This study has led to the discovery that there are two species of *Fusarium* causing mango malformation and that one is a species new to science. It is also now clear that there is no relationship between the pitch canker fungus and the causal agents of mango malformation. Consequently, there is also no risk of cross infection between the respective tree crops.

Many important questions pertaining to the pitch canker fungus in South Africa, remain to be answered. In our view, the most important of these are the following:

- Determine the role of the fungus in killing trees in nurseries. Intensive studies of potential associated insects such as fungus gnats will have to be included.
- Determine the importance of the pitch canker fungus in establishment failures and the role of *Hylastes angustatus* in this manifestation of the pathogen.
- Continue to evaluate the likelihood that "full-blown" pitch canker will appear in South Africa. These studies include some mentioned above pertaining to the pine weevils.
- Evaluate the changes in the population diversity of *F. circinatum* in South Africa and apply these data to impact assessment studies.
- Consider the relative susceptibility of South African pine planting stock and especially hybrids, to infection by the pitch canker fungus. These studies using artificial inoculation have already been established and will continue during the course of the next three to five years.

In order to undertake many of the above-mentioned investigations, the research team requires robust and rapid methods to identify isolates of the pathogen. Various studies have been completed linked to the identification of the pitch canker fungus and the question of differences between it and other related fungi. We are now using the data from these studies to produce a Real Time PCR technique for rapid identifications. This DNA-based technique will substantially increase the ease with which we work with the pitch canker fungus. Another tool that will be crucial in

our future studies of the pitch canker fungus, is one that will enable us to effectively identify individual genotypes of *F. circinatum*. To this end we have developed a robust set of microsatellite markers for *F. circinatum*. These will now be applied to evaluate and better understand the changes in the population structure of the pathogen in South Africa.



Polyphialides of *Fusarium circinatum*, the pitch canker fungus

Sirex wood wasp

One of the most important pests currently affecting pine plantations in South Africa is the wood wasp, *Sirex noctilio*. This pest was discovered for the first time, established in plantations of the western Cape, little more than a decade ago. Various biological control strategies were implemented with the support of SAFCOL who had primary interests in those plantations. Predictions were that the wasp would spread northwards at a rate of about 50km per annum. In 2001, the TPCP assumed responsibility for insect pest monitoring and the wasp was found near Knysna, considerably further north than was expected. During 2002, surveys showed for the first time that the wasp was established in the Umtata area. It has subsequently been found in Weza, close to Durban and in plantations in Stutterheim. Currently, we are not certain of the exact distribution of the pest. Surveys in 2003 will attempt to determine the northern most limit of *Sirex* in South Africa. For the present, we expect that it is considerably more widespread than anticipated and a concerted effort will clearly be needed to reduce potential losses.

Sirex exit holes on a pine stem

Other than surveys, an important task in 2002 has been to undertake field extension visits to plantations where *Sirex* is present, and to inform foresters of its biology and presence. In addition, a Sirex Action Plan has been formulated and relevant committees have been established to deal with the pest. During 2003, the following actions are planned:

- Appointment of an entomologist to assume responsibility for the *Sirex* Action Campaign and assist foresters with surveys and implementation of biological control.
- Negotiations with the CSIRO in Australia for permission to utilise the biological control nematode, *Deladenus siricidicola*, throughout South African forestry areas. This nematode was previously introduced into South Africa but use was restricted to south of 32 degrees latitude. In addition, to negotiating for the rights to utilise the nematode, it will also be necessary to acquire permission to re-introduce this organism.

The coming few years will mark a time of considerable effort to evaluate the threat of the *Sirex* wood wasp in South Africa and to begin to reduce its impact.

Botryosphaeria canker

Botryosphaeria canker on *Eucalyptus* spp. is a relatively newly recognised disease in South African forestry. The disease is somewhat similar to *Diplodia pinea* shoot blight and die-back, in that both diseases occur on trees subjected to stress due to factors such as hail storms, drought and

many others. During the course of the last decade, we have learnt a great deal about Botryosphaeria canker on *Eucalyptus* and much progress has been made in testing and selecting clones resistant to infection. There are, however, many questions that remain unanswered. Perhaps most complicated of these is linked to the fact that we now know that there are at least two species of *Botryosphaeria* infecting *Eucalyptus* in South Africa. This substantially chan ges our understanding of the pathogen and will demand re-evaluation of susceptibility of clones in the future.

Botryosphaeria is a complex genus and this significantly complicates research on diseases caused by species in this genus. During the last few years, we have thus expanded substantial effort to establish a taxonomic and phylogenetic foundation that will allow us to identify isolates accurately. This will enable us to use these fungi appropriately in our pathogenicity and disease sensitivity trials. Although the work is not entirely complete, much progress has been made and these studies should be completed in the next two years. Ecological studies and pathogenicity tests are continuing concurrently with our phylogenetic studies.

Diplodia shoot blight and die-back

Shoot blight and die-back caused by the fungus known as either *Sphaeropsis sapinea* or *Diplodia pinea* is one of the best known and most important diseases of pine in South Africa. It was the first plantation tree disease to be described in this country and much has been written regarding its biology and control. Due to its importance, the research team has maintained a strong focus on this pathogen, and will continue to do so in the future. Previous reports have provided summaries of research accomplished and this report is intended to provide a brief update on results of recent investigations.

Amongst the intriguing concerns relating to *S. sapinea* is the fact that the fungus has been reported to exist in different forms that, in mycological terms, are known as morphotypes. We have reported extensively on this topic in the past and indeed described a new morphotype for the fungus. Four morphotypes have thus been described for *S. sapinea* and these include the A, B, C and I types. Previous studies by members of our research group have shown that it is the A type that occurs in South Africa and that some of the others might present a threat to pine growing in this country.

Symptom development following artificial inoculation with *Diplodia sapinea*

Our recent research has led to the development of microsatellite markers for the A and C morphotypes of *S. sapinea*. This has provided the group with a powerful tool to track *S. sapinea* infections between plantations and between countries. In addition, we have been able to show that the A morphotype is the only one to occur in South Africa, Australia and New Zealand. Futhermore, the I morphotype appears not to be related to *S. sapinea* and is the same as *Botryosphaeria obtusa*. Further stud ies are now under way to consider the identity of the B morphotype and to determine whether it poses a threat to South African forestry.

Coniothyrium canker

Coniothyrium canker is now considered to be one of the most important diseases of *Eucalyptus*. The disease caused by *Coniothyrium zuluense* was first found in Zululand in 1990 and has spread rapidly throughout the country. It has now also been found in various parts of South America and South East Asia where it is causing serious damage to trees.

In South Africa, we have made considerable progress in reducing the impact of *C. zuluense*. This has mainly been through the selection of disease tolerant clones and

clonal hybrids. However, the disease still occurs and in some plantations is very damaging. There is also evidence that the fungus is adapting to infect new host genotypes. The implication is that this disease will continue to impart serious damage in the future and that research must continue to broaden our understanding of the pathogen and means to reduce its impact.

Apparent adaptation to previously selected resistant *Eucalyptus* genotypes has prompted the research team to consider variation in the population of *C. zuluense*. This has been done based on morphology as well as using the DNA-based AFLP technique. Results have shown a great deal of diversity in isolates of *C. zuluense* which is somewhat unusual as we have hypothesised that this is a fungus that was introduced into South Africa. But the results also help to explain great variation in the pathogenicity of isolates of *C. zuluense*. This work is clearly far from complete and further studies on the population diversity of the pathogen and its apparent synergistic relationship with two bacteria species, one of which is *Pantoea ananatis*, requires further study.

Pine weevils

The pine weevil, also known as the Deodar weevil *Pissodes nemorensis* is a well-known pest in South Africa. Damage by this pest has mainly been on *P. radiata* in the Southern Cape, although it occurs wide-spread in the country. Recent evidence has emerged to suggest that the pest is increasing in importance. In addition, there is considerable concern that *P. nemorensis* might emerge as an important vector or associate of the pitch canker fungus. The latter concern is based on the fact that *P. nemorensis* is associated with pitch canker in the south-eastern United States. TPCP team members have thus established a project to study *P. nemorensis*, and this study will include a specific focus on the potential for the insect to act as a vector of *Fusarium circinatum*.

There are a great number of weevils (Curculionidae) that are serious pests of conifers. Amongst these is *Pissodes validirostris*, which is also known as the pine cone weevil. This insect is native to Europe and also has the potential to cause substantial damage to pines. Of particular concern to South African forestry is the fact that this insect is being considered as a biological control agent for so-called "weed pines". The insect has now been introduced into South Africa, for experiments in quarantine, in Stellenbosch. Of great concern to the TPCP and to the forestry industry is that this insect could also become an important associate of the pitch canker fungus. This situation represents a great risk to forestry in South Africa and therefore requires very careful attention.

Eucalyptus rust

Eucalyptus rust caused by *Puccinia psidii* is one of the most serious diseases of *Eucalyptus*. The pathogen is restricted to South and Central America where it occurs on a wide range of species of Myrtaceae. Eucalyptus rust seriously threatens plantation eucalypts outside its current area of occurrence and it is also seen as one of the greatest threats to native Myrtaceae in Australia. For this reason, the research team is participating in an international project funded by the Australian government (ACIAR) to evaluate the risks to Myrtaceae, posed by rust. This project has been active for three years and will be concluded during the coming year. Much progress has been made and results present a substantial contribution to our understanding of the threats linked to *P. psidii*.

For more information on the activities of the Tree Protection Co-operative Programme (TPCP), please visit our web site at: http://www.up.ac.za/academic/fabi/tpcp

Forest biotechnology:
Propagation of pine species

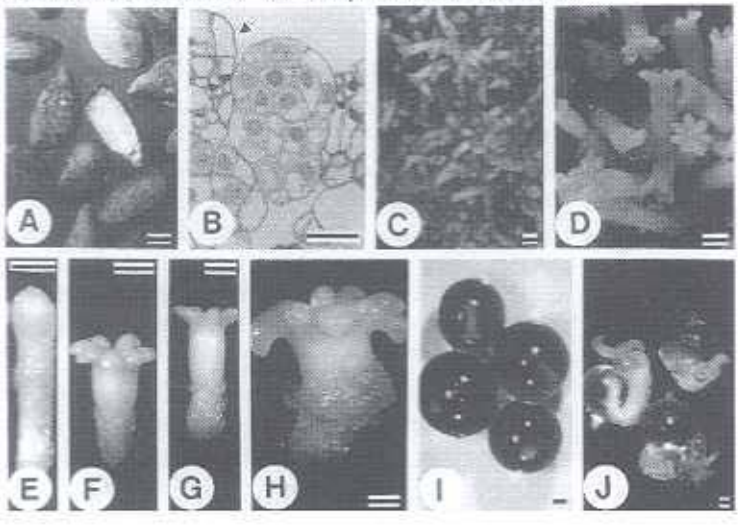
Research leader: Prof Anna-Maria Oberholster (neé Botha)

Objectives of the research programme:

- Supply 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 understanding of the development of somatic embryos through a comparative study of somatic and zygotic embryos. This research has focused on similarities and differences between somatic and zygotic embryos in terms of morphology, histology, biochemical and metabolic pathways
- Determine the role of late embryogenic associated proteins in the development of somatic embryos

Highlights of research 2002/2003:

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, namely *Pinus patula* and the hybrid *P. elliotti* x *P. carabaea*. The programme that runs in collaboration with Professor Chris H Bornman (Denmark), has produced somatic embryos in *P. patula*, *P. radiata* and *Picea abies* (model system), while embryogenic structures have been obtained for the hybrid species. 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 commercialisation. In a recent study, we compared aspects of the physiology/biochemistry (eg germination percentage, water, protein, lipid and carbohydrate content) of zygotic seed and its somatic counterpart. Conclusions drawn from this study include the fact that coniferous somatic embryos lack a suitable artificial megagametophyte, and that the somatic embryo, if it behaves like the isolated zygotic embryo cultured *in vitro*, does so with greatly reduced physiological vigour.



Different aspects of zygotic and somatic embryogenesis development . (A) Seed with embryo embedded in the megagametophyte, (B) Globular stage embryo surrounded by embryogenic tissue and callus (arrow); (C, D) Somatic embryos in torpedo stage, cotyledons visible; (E) Isolated zygotic embryo; (F-H) Mature (F), mature and partially desiccated (G) and teratogenic (H) somatic embryos; (I, J) Somatic embryos embedded in alginate (Bornman *et al.*, SA J of Bot. 2003).

Characterization of tree pathogenic and related fungi at the molecular level using DNA-based methodologies

Research leader: Prof Brenda Wingfield

Research team: Prof Mike Wingfield
Prof Teresa Coutinho
Prof Pedro Crous
Prof Wally Marasas
Dr Jolanda Roux
Dr Oliver Preisig

Objectives of the research programme:

- Develop molecular phylogenies for tree pathogenic and related fungi
- Develop DNA-based identification tools for fungi
- Investigate the population genetics of economically important fungal species using DNA-based polymorphic markers
- Characterise the viruses that occur in tree pathogens with a view to using these viruses as biological control agents.

Highlights of research 2002/2003:

The aim of this programme is to investigate the molecular phylogenetic relationships between economically important fungal pathogens. These relationships are studied both at the population as well as at the species level. Accurate molecular phylogenies and population genetics of fungal pathogens form the basis of disease management programmes. They are also the essence of biosecurity issues and are fundamental to South Africa's success in maintaining free trade and protection of our environment.

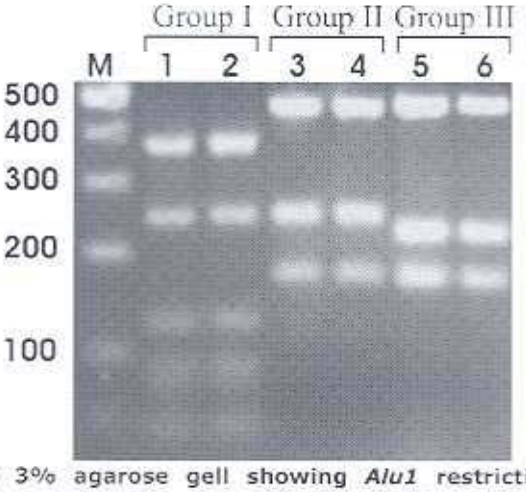
The last decade has seen huge opportunities emerge linked to advances in the use of molecular tools that enable a better understanding of phylogenetic relationships and population biology of micro-organisms. This research group has been at the forefront of producing some of the first molecular phylogenies for plant pathogens. These have proved invaluable in establishing effective and relevant pathogen management programmes, in South Africa as well as internationally. This work has highlighted the tremendous need for such studies for all plant pathogens. In the last two years, the first phylogeny for southern hemisphere Armillaria species was developed. This has resulted in better understanding of this genus worldwide and results have led us to suggest that this genus probably has a Gondwanean origin and that it originated in Africa.

Our studies on the pitch canker pathogen, *Fusarium circinatum*, and related species have resulted in the discovery of a number of previously undescribed species related to this globally important pine pathogen. In addition, we have reported on the delineation of a cryptic species related to the maize pathogen *Fusarium subglutinans*. This cryptic species is particularly interesting as it apparently occupies the same host and geographic region as *F. subglutinans*. This suggests that it occupies that same niche but is no longer recombining with *F. subglutinans* in nature, although the two fungi are sexually compatible in the laboratory.

Cryphonectria cubensis is a tree pathogen well-known in many *Eucalyptus* planting areas of the world. When it was first discovered in South Africa in the late 1980s, it was assumed that the fungus had been introduced into the country. Molecular phylogenetic studies of this fungus have shown otherwise. Furthermore, gene genealogies produced for *C. cubensis* isolates collected globally, suggest that this is not a single species but a species complex. The groups within this complex are species in their own right and appear to have originated in different geographic regions of the world. What is puzzling is that these fungi are so closely related yet are apparently native to the areas where they are found. Phylogenetic studies suggest a very recent divergence of these species, but that they have their apparent origins many thousands of miles apart on different continents. The DNA sequence data suggests that these fungi diverged a long time after continental drift but before humans started migrating around the world.

Molecular phylogenies are only the starting point for fungal identification. Many fungi are capable of asexual reproduction and, therefore, may be spread clonaly. Understanding the genetic diversity of a fungal population is an essential component of evaluating its potential to change and adapt in the field. It is only recently that robust molecular techniques have become available to easily evaluate genetics and diversity of fungal populations. In the last two years, we have developed molecular markers for more than 10 fungal genera. In the last two years, these have included markers for *Fusarium circinatum, Ophiostoma ips, Ceratocystis laricola* and *Botryosphaeria* spp. These markers have also been found to be useful for population studies on closely related species.

The polymorphic markers that we developed for *Sphaeropsis sapinea/ Diplodia pinea* have allowed us to undertake an extensive study of the population diversity of this species from many countries of the world. This has allowed us to better understand the disease that this pathogen causes in pine plantations. I have also made it possible for us to examine the value of quarantine strategies associated with the movement of pine seed to and between South Africa, New Zealand and Australia.



A 3% agarose gell showing *Alu1* restriction fragments for *Armillaria* isolates from Zimbabwe. Groups I, II and III probably represent new species. Lane labelled with M indicates a 100 bp molecular marker with band sizes in base pairs

Our studies on fungal viruses continue to lead to the discovery of novel viruses. We have recently discovered our first mitochondrial viruses in *Cryphonectria cubensis*. There are probably a great number of viruses waiting to be discovered in the fungal pathogens that we study. Many of them are unrelated although they infect similar hosts. What is interesting is that a small number seem to be present in more than one species. This suggests co-evolution of these viruses with their hosts.

The molecular tools that we employ to study fungi are becoming increasingly sophisticated. A number of fungal genomes have now been sequenced. This has provided a framework for a better understanding of the relationships between different orders not merely at the level of genes but now also at the genomic level. Establishing the degree of synteny between species of closely related fungi will allow us better comprehension of species relationships, as well as enabling a better understanding of species evolution and pathogen differentiation.

Genes for superior fibre

Research Leader: Prof Brenda Wingfield

Research Team: Prof Mike Wingfield
Dr Jolanda Roux

Objectives of the research programme:

- Support of goal-directed research and promote a source of expertise for molecular biology of Forest tree species. Discovery of new genes, which are important in resistance of trees to fungal pathogens
- Provide genetic fingerprinting tools to the forestry companies. Produce microsatellite markers for the forestry industry and investigate the potential of DNA micro-arrays for this purpose.
- Provide marker-aided selection/molecular screening and develop molecular markers to screen specific pedigrees for DNA-based markers linked to disease resistance
- Facilitate accelerated breeding techniques through the production of molecular tools. Through close working relationships with tree breeders, develop the DNA tools for commercial use in tree breeding
- Promote education and capacity building in the field of plant molecular genetics. Provide forestry companies with a ready source of well-trained postgraduate students and assist them in maintaining a high level of competency in this field.

Highlights of research 2002/2003:

This research programme has already provided the forestry industry with access to the latest molecular based technology. A number of the forestry companies are already using these techniques in their own research and development programmes. In the area of molecular biology the technology is changing very rapidly. It is, therefore, essential that this programme be involved in continuous technology development and implementation initiatives.

A number of microsatellite markers have been developed in this programme for *Eucalyptus grandis*. These markers, as well as others developed elsewhere, have been used successfully to fingerprint *Eucalyptus* trees in the forestry industry during 2001 and 2002. The technique that was developed to obtain the *Eucalyptus* microsatellite markers has also been adapted successfully for use on a number of fungal pathogens including *Cryphonectria cubensis*. Understanding the fungal population diversity is an essential component of developing disease resistant *Eucalyptus* clones. Using this technology, we are now confident that the fungus in South Africa is a species different to the one which is found in other parts of the world. This has significant implications when selecting for disease resistant trees for commercial plantations.

The first DNA array using *Eucalyptus* DNA was produced in 2001. This DNA chip has been tested to determine its usefulness in fingerprinting and identification of *Eucalyptus* clones in South Africa. Our preliminary results suggest that the DNA chip that we have produced will be useful for fingerprinting *E. grandis* trees.

Cereal genomics

Research leader: Prof Anna-Maria Oberholster (neé Botha)

Objectives of the research programme:

In this programme we study 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:

- Isolation and characterization of Resistance Gene Analogs (RGAs) from cDNA in bread wheat utilising modern technologies and bioinformatic tools (eg PCR using degenerate primers based on conserved motifs obtained from the *Arabidopsis* and rice genome projects; Suppression Subtractive Hybridisation (SSH) using driver (induced) and tester (non-induced) plant material, and cDNA-Amplified Fragment Length Polymorphisms (cDNA-AFLPs)
- The in-depth study of differential expression of Expressed Sequence Tags (ESTs) and R/DR genes upon RWA infestation using DNA microarray technology. The characterization and mapping of DR genes containing the nucleotide-binding site-leucine rich repeat (NBS-LRR)
- Development of a marker system for mass screening of breeding material using microarray technology
- Map the relevant sequences using segregating wheat $F_{2/3}$ populations

Highlights of research 2002/2003:

In a recent study on feeding behaviour of *Diuraphis noxia* (Russian wheat aphid, RWA) on wheat (*Triticum aestivum* L.), we confirmed that the RWA probed more and feed less on resistant cultivars, resulting in the formation of more lesions in the resistant cultivars. We investigated the possible reasons for this feeding behaviour by studying the leaf morphology and ultrastructure, and transcriptome and protiome expression in RWA resistant and susceptible cultivars.

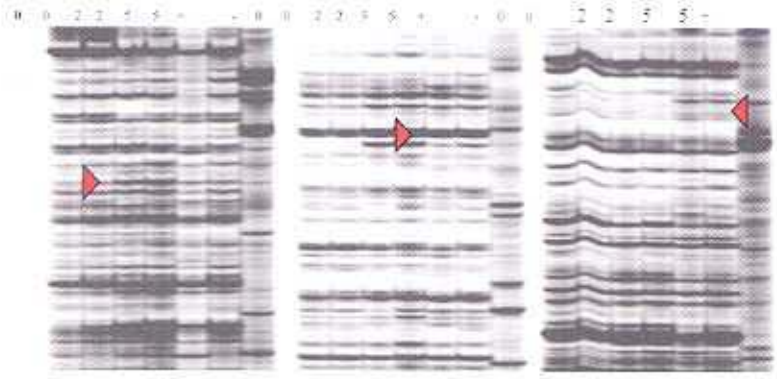
In our study on the morphology and ultrastructure of wheat leaves, we compared the leaf epicuticular wax ultrastructure and leaf trichomes of three bread wheat cultivars (two susceptible and one RWA resistant cultivar). There were no significant differences in the lengths of the trichomes in the three wheat cultivars examined. However, the resistant cultivar ('Tugela DN') had a significantly greater trichome density than the susceptible cultivars. Examination of the position of the trichomes revealed that there were differences for the adaxial and abaxial surfaces. Trichomes on all three wheat cultivars were found to occur mostly on the leaf veins of the adaxial surfaces, and on the leaf veins as well as between them on the abaxial surfaces. Leaf trichome density and position may act as a physical obstacle to Russian wheat aphid feeding as the aphid feeds on leaf veins of the adaxial leaf surfaces. The high trichome density on the leaf veins found in the resistant 'Tugela DN' cultivar could prevent the Russian wheat aphid from finding a suitable feeding site. Comparison of the scanning electron micrographs showed that the epicuticular wax structure was found to be similar for both the adaxial and abaxial surfaces amongst the three wheat cultivars. The wax structure was similar in the Russian wheat aphid resistant and susceptible cultivars and does not seem to affect Russian wheat aphid feeding.

In studies conducted on the intercellular washing fluid of wheat resistant to the Russian wheat aphid ('Tugela DN'), we found that proteins were induced within six days of infestation. These induced proteins were visible as five bands using

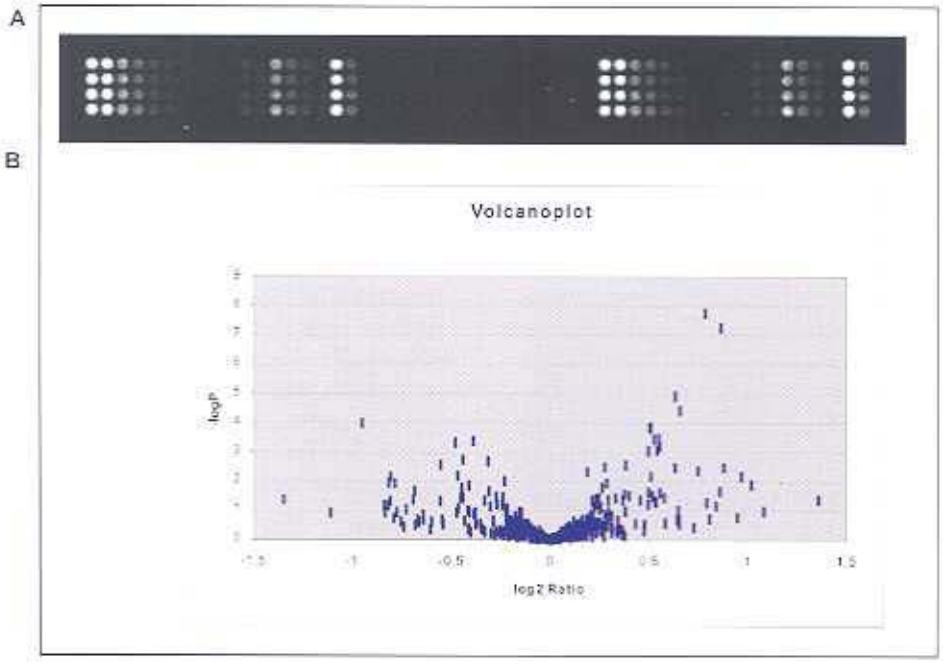
SDS-PAGE analysis. Two proteins disappeared from the protein profile of 'Tugela DN' when the Russian wheat aphid was allowed to feed. Analysis of these proteins using two-dimensional gel electrophoresis showed that the five induced protein bands corresponded to seven proteins. Subsequently, the » 20 kDa band observed with SDS-PAGE analysis, was shown to represent three proteins using two-dimensional gel electrophoresis with pI values of 5.0, 5.2 and 5.8. Unfortunately, the induced proteins could not be sequenced because of their low concentrations in relation to the other proteins. Overexpression and down regulation of proteins were also visible after Russian wheat aphid infestation. Two of the induced proteins (» 36 and 26 kDa) are possibly ß-1,3-glucanases and chitinases, as both the pI and molecular mass corresponds with results obtained previously by the group. What was also evident from these results was that both HR and SAR are involved in the host resistance response against the RWA. In a study on the localization of the PR proteins, a intercellular ß-1,3-glucanase was purified and polyclonal antibodies were raised against it. This was then used to localize the ß-1,3-glucanase *in planta* with the immunogold labelling technique. The antibodies recognized both the inter- and intracellular isoforms of ß-1,3-glucanase. In contrast to dense gold labelling in infested resistant plants, very little labelling was found in infested susceptible plants. Labelling was observed in the cell walls of different cells, but was denser in the vascular bundle cells. Gold labelling was also detected in the chloroplasts and thus, it seems that gold accumulated in tissues that were affected most by the feeding aphids.

Recently, cloning of multiple R genes from various plant species has revealed conserved domains at the amino acid level. The most notable being the presence of nucleotide binding sites (NBS) and leucine repeat regions (LRR). The presence of a NBS and a LRR is consistent with the protein products playing a significant role in signal transduction and having a putative role in protein-protein interactions. Recently, much of the research effort in this research group has been focused on gene sequences containing NBS-LRR motifs. In studies using RWA infested material containing the RWA resistance genes *Dn1*, *Dn2* and *Dn5*, and utilizing degenerate primers sets designed from the consensus NBS motif from other genome studies (eg *Arabidopsis* and rice), subtraction suppression hybridization (SSH), RACE-PCR, and cDNA libraries, several NBS-LRR sequences related to the RWA were obtained. Linkage to the RWA resistance response was verified using cDNA microarray expression profiling, Real-time PCR, Northern and Southern Blot analysis. In a comparative functional analysis, we tested the feasibility of using a degenerate PCR-based approach to obtain sequences of interest. It was found that 18% of all the obtained ESTs showed significant homology to resistance genes from other plants on amino acid level (E value < 10-5) rendering the approach highly feasible. Results obtained in our microarray analysis indicate that wheat homologs to *RGA*-2 and *WIR* pathogen R genes were also induced in the RWA resistance response.

Besides understanding the underlying genetic mechanisms involved in host resistance, the rationale for the programme is also driven by the need for a high through-put marker system (DNA microchip and SSR/AFLP-based), which can be utilized by breeders to select for superior disease resistant material. We are currently testing all the cDNA clones that we identified from our microarray profiling analysis for linkage to RWA resistance using segregating $F_{2/3}$ populations.



A small portion of the first cDNA-AFLP gel recently produced at UP on a LI-COR DNA fragment analyser. Lanes 1-2, 3-4, and 5-6 of each panel are cDNA-AFLP profiles of a wheat line infested with Russian wheat aphids after 0,2 and five days respectively. Lane 7 of each panel contains a tomato positive control cDNA-AFLP profile. Each panel was produced with a different selective primer combination. Arrows indicate differentially expressed cDNA fragments



Results obtained after cDNA clones were spotted on a slide, and then hybridised with Cy3-and Cy5-labelled cDNA. The labelled cDNA was synthesized from mRNA isolated from leaf tissue 2 days post Russian wheat aphid infestation (a). Volcano plot obtained after analysis of the resulting data, which illustrate the significance of data points (b)

Diseases and pests of bananas

Research leader: Dr Altus Viljoen

Research team: Prof Teresa Coutinho
Prof Mike Wingfield
Prof Karl Kunert
Prof Dave Berger
Prof Brenda Wingfield
Dr Prem Govender
Mr Johan van der Waals

Objective of the research programme:

- To develop integrated disease and pest management strategies for the South African banana industry
- To develop biotechnological tools for research on pests and diseases of banana.
- To isolate, identify and manipulate genes in banana with resistance to pests and diseases

Highlights of the research 2002/2003:

The South African banana industry is one of the largest agricultural industries in the country, with an annual turnover of approximately R600 million. The industry not only provides employment for thousands of South Africans, but also provides millions of South Africans with a cheap and very nutritious food source. Although the banana industry is well-developed in South Africa, using high yielding cultivars under optimised horticultural conditions, the local industry has been devastated by the soil-borne disease known as Fusarium wilt (caused by *Fusarium oxysporum* f.sp. *cubense* [*Foc*]), also known as Panama disease. This disease has already caused losses of up to 40% of fields in two of the five banana growing areas of South Africa. It is now again threatening to halt banana production on additional farms in these areas.

Research on Fusarium wilt of banana has been conducted for more than 100 years in almost every banana growing country where the disease occurs. The only effective and semi-permanent solution has been the replacement of Gros Michel, a banana cultivar susceptible to *Foc* race 1 in the tropics, with Cavendish type cultivars. However, Cavendish cultivars are highly susceptible to race 4 of *Foc* in the subtropics, and now also in some tropical countries where a new variant of the pathogen has been discovered. There is no control measure to prevent bananas from being killed by Fusarium wilt once *Foc* has been introduced into fields. The only possible control measure is to find or develop plants with resistance to the pathogen, or to develop a novel control strategy to destroy the pathogen. In our research program on Fusarium wilt of banana, we address both of these strategies. In addition to research on Fusarium wilt, studies are also undertaken on banana leaf diseases and the banana weevil borer.

Studies on the epidemiology and management of *Foc* subtropical race 4

In surveys undertaken in Kiepersol and KwaZulu/Natal, it was found that the introduction of Fusarium wilt into new fields is often associated with infected but symptomless planting material, or machinery and other field equipment that have previously been used in affected fields. Fusarium wilt has recently been discovered in two banana-growing areas that were previously free of the disease. In

both cases, strict quarantine measures assured the isolation of the disease.

Cleaning of field machinery with a disinfectant

Foc has not been found on alternative hosts such as *Strelitzia* spp. *Fusarium oxysporum* has been isolated from irrigation water, and whether these isolates belong to *Foc* is now being determined. Several management strategies have been implemented on new Fusarium wilt-affected fields. Where the disease is already well-established, little can be done other than eventually replacing Cavendish banana plants with other crops. Temperature plays a major role in the development of Fusarium wilt on banana, as has been shown in both field and greenhouse experiments. Several fungicides and sterilants have been tested for effectiveness against *Foc in vitro*. As some of these products are more effective than those used previously, environmentally acceptable and non-corrosive, they have been recommended to farmers for use in future.

Enhancing Fusarium wilt tolerance by means of biological control, plant nutrition and SAR treatment

In order to understand the factors that might contribute to enhanced plant tolerance to Fusarium wilt in Cavendish bananas, disease suppressive and conducive soils were compared. Several species of *Trichoderma*, *Fusarium oxysporum* and bacteria were collected for biological control purposes. The effect of nitrogen and pH on Panama disease development was determined in greenhouse studies. Six different chemicals that induce systemically acquired resistance in plants were evaluated in the greenhouse, and four in the field.

Selection and testing of bananas with resistance to *Foc*

Cavendish plants can be improved for tolerance or resistance in two ways: random mutations and transformation. Random mutation in micropropagated plants is known as somaclonal variation that occurs naturally or is induced in the laboratory. Field selection is probably the fastest and least expensive means to find somaclonal variants with both tolerance/resistance to Panama disease, and acceptable agronomic qualities. Field trials to evaluate Cavendish selections and FHIA hybrids and selections for Panama disease resistance are planted in several locations in South Africa. Preliminary data have shown good resistance in all the FHIA hybrids and selections, and good tolerance in DRS1 (a selection of DuRoi laboratories). Further work is being done to understand and to increase disease tolerance in this Cavendish selection.

Evaluation of banana varieties for resistance to Fusarium wilt

Isolation and identification of resistance genes in Cavendish bananas

In South Africa, only Cavendish banana cultivars are planted, and they are all susceptible to *Foc*. However, tolerance available in DRS1 offers the opportunity to understand the nature of resistance in Cavendish bananas. This knowledge can be used to screen Cavendish selections or somaclonal variants for disease tolerance/resistance, and can eventually be introduced into susceptible plants. In order to understand why tolerance/resistance is expressed in DRS1, Suppression

Subtractive Hybridisation (SSH) was used to isolate differentially expressed genes. mRNA was extracted from Williams (susceptible) and DRS1 (tolerant) plants, and cDNA developed from RNA templates. The cDNA from the tolerant and susceptible plants has been used in the identification of resistance genes that are expressed after infection with *Foc*. Southern blots were performed to validate the efficiency of each subtraction. Subtracted genes were cloned into a vector and two different libraries (each containing 600 clones) were generated for each of the subtractions. Fragments of interest were sequenced and approximately 20 fragments have thus far shown high homology to defence related genes that are available on international databases. Some of the more interesting genes are currently being subjected to additional experimentation to show that they are up-regulated.

Genotypic and phenotypic analysis of *Foc*

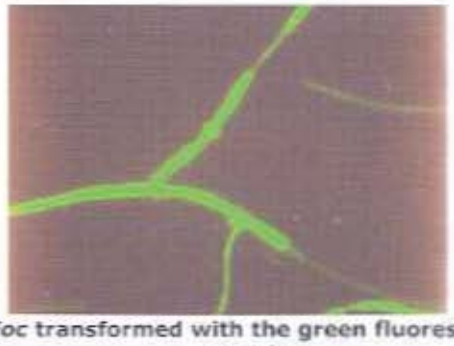
The population structure of *Foc* has been extensively investigated in South Africa. Vegetative compatibility group (VCG) analysis on 160 South African isolates revealed that only VCG 0120, representing subtropical race 4 of *Foc*, occurs in this country. A mating type study showed that *Foc* in South Africa contains only *mat*-2 genes, making it impossible for the fungus to reproduce sexually and diversify in a manner other than by natural mutation. Crosses between different isolates were attempted on Carrot agar, but only pseudothecial structures without ascospores (sexual spores) were produced.

To further determine the phylogenetic relationships of South African isolates of *Foc*, the b-tubulin gene, a-elongation factor, and the mitochondrial region 5 and 7 were compared to isolates of *Foc* from around the world. *Foc* is known to include five independent clonal lineages based on molecular phylogeny. Clonal lineages 2 and 4 fall within clade 1, and clonal lineages 1, 3, and 5 within clade 2. The b-tubulin sequence could not resolve the phylogeny among isolates of *Foc*, because of poor resolution. The other independent loci, however, placed the South African population within clonal lineage 2 and 4, thus clade 1.

The phenotypic diversity of the genotypically homogenous population of *Foc* was investigated. A large diversity in colony appearance and virulence was found. This prompted the group to further investigate pathogenicity factors involved in *Foc* virulence in order to design counter defence strategies to the pathogen armoury.

Transformation of *Foc* with the GFP

Foc isolates from South Africa and other parts of the world were genetically modified using a protein marker called the green fluorescent protein (GFP). This is an excellent tool to study host pathogen interactions inside the vascular tissue of a diseased plant, and it is the first time that *Foc* has been transformed with the GFP protein. This could further be applied in the search for resistance responses that are activated upon host-pathogen recognition. Transformed isolates appear bright green under ultra violet (UV) or blue light. Transformed isolates have not lost pathogenicity and no variation in cultural morphology was observed. The foreign protein was thus shown to have been taken up and it is very stable in the fungal genome.



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

Development of molecular markers to rapidly identify *Foc* race 4

Microsatellite markers for *Foc* have been developed. Sequence analyses and genome walking of the fungal DNA was performed and 12 specific primers to *Foc* were identified through the polymerase chain reaction (PCR). From these a total of eight different polymorphic microsatellite markers have been selected that

differentiates among isolates of *Foc* from different geographic regions. These are currently being used to further describe the population genetics of *Foc*. Microsatellite markers specific for *Foc* will be further used for the analysis of the population genetic structure, to determine the reproductive mode, genetic isolation and gene flow between geographically separated populations.

Training in tissue culture and transformation techniques

A banana tissue culture facility has been established for research purposes. Techniques established include micropropagation through mersitem tip culture, multiplication, rooting and hardening-off of Ladyfinger and Cavendish bananas. Some of these bananas have already been planted in the field. Additionally, experiments to produce callus from immature male flowers have been initiated. From the callus, cell suspensions that can be used in a banana transformation system will be produced. A temporary immersion system for the increased production and rooting of micropropagated plants was developed along with procedures for the long-term storage of shoot tip cultures.

Leaf diseases of banana

To determine the present status of leaf diseases in South Africa, a survey was conducted in the five banana growing regions of the country. Yellow Sigatoka, caused by *Mycosphaerella musicola* and Mycosphaerella speckle, caused by *M. musae*, were the dominant diseases. Cordana leaf spot, caused by *Cordana musae* was also found in all regions, while Cladosporium speckle (caused by *Cladosporium musae*) was reported for the first time in the country, and only occurs in the Levubu area. Various other saprophytic and endophytic fungi were also associated with banana leaves in the country, many of them for the first time. Apart from identifications based on morphology, analysis based on sequences of the ITS region of the ribosomal DNA operon for *Mycosphaerella* spp., and pathogenicity tests were done. In this way, it was confirmed that black Sigatoka (caused by *M. fijiensis*) does not occur in the country, and that Mycosphaerella speckle is caused by two species, *M. musae* and another closely related to *M. colombiensis*.

Fruiting body of *Pseudocercospora musicola* (telemorph: *Mycosphaerella musicola*). causal agent of yellow Sigatoka

Studies on the banana weevil borer

The banana weevil borer, *Cosmopolitus sordidus*, is the most important pest of banana in South Africa and in the world. Since it is most active under moist and warm conditions, its behaviour in the subtropics differ from that known in the tropics. Studies to determine its population dynamics and genetic structure in South Africa, is currently being conducted. This information will be used to design an integrated pest management programme that will consist of cultural, chemical and biological control. In addition, studies are undertaken on the identification and manipulation of genes related to resistance in banana to the weevil (see report by Kunert), and the use of fungal endophytes as biological ontrol agents against the weevil.

Damage caused to the banana pseudostem by the banana weevil

Molecular plant-pathogen interactions

Research leader: Prof Dave Berger

Objectives of the research programme:

- Describe mechanisms whereby plants defend themselves against viral, bacterial and fungal 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

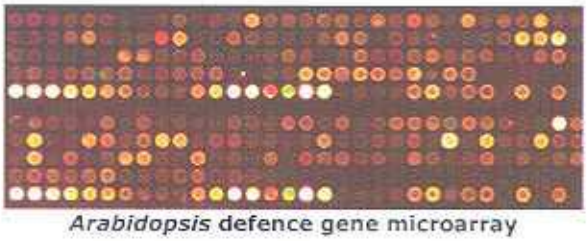
Highlights of research 2002/2003:

The ACGT (African Centre for Gene Technologies) Microarray Facility is situated in the laboratory of Professor Dave Berger of the Botany Department, Forestry and Agricultural Biotechnology Institute (FABI) housed in the Agricultural Sciences building of the Faculty of Natural and Agricultural Sciences. This facility represents a joint venture between the CSIR and UP, which came to fruition in 2002 with the launch of a microarray service in mid-2002 for both internal and external users. A website with pricing and sample preparation instructions has been posted at http://fabinet.up.ac.za/microarray. To date, internal users from the Department of Genetics, Department of Microbiology and Plant Pathology, Department of Botany, FABI and CSIR-Bio/Chemtek have made use of the service. Laboratory protocols for the preparation of microarrays and the multi-step process required to measure gene expression differences in control and experimental plant samples have been optimized in the laboratory of Prof Berger using the model plant *Arabidopsis thaliana*.

***Arabidopsis* plant**

A collaborative project with Dr Y Marco at CNRS-INRA Laboratoire de Biologie Moléculaire des Relations Plantes-Microorganismes in Toulouse, France is under way. The topic concerns the interaction of *Arabidopsis* with the bacterial wilt pathogen, *Ralstonia solanacearum*, particularly isolates from *Eucalyptus* trees. Through exchange visits with the French lab, expertise is being built based on this pathosystem. The aim will be to use microarray analysis to understand the interaction. A PCR-RFLP method has been used for rapid identification of *Ralstonia solanacearum*, which will be particularly useful for diagnosis during outbreaks of this disease in *Eucalyptus* plantations.

A laboratory workshop aimed at developing molecular expertise relevant to Microarray technology was held in April 2002. The workshop was entitled "Differential gene expression profiling and bacterial genome subtraction using Suppression Subtractive Hybridisation (SSH)" and was facilitated by visiting scientists from the Scottish Crops Research Institute. The workshop was held in the Microarray Laboratory at the University of Pretoria and was jointly organized with FABI at UP (Prof MJ Wingfield) and the University of Durban-Westville (Prof G Pillay). Fifteen participants from throughout South Africa attended (workshop report posted at http://fabinet.up.ac.za/ssh).



***Arabidopsis* defence gene microarray**

The SSH technique has been applied in two different research projects in the lab, resulting in the generation of gene libraries enriched for fungal resistance genes from banana and millet. The libraries are currently being characterized using DNA microarrays.

The improvement of maize by genetic engineering has focused mainly on yellow maize varieties, which supply the animal feed industry. Yellow maize makes up 98% of the 700 million tons produced world wide annually. However, in certain regions of the world such as southern Africa, white maize varieties are produced in larger quantities due to the requirements of the local market. White maize used for human consumption makes up 65% of the 10 million tonnes harvested annually in South Africa. Since it is time-consuming to introduce transgenes from yellow maize into local white maize varieties by backcross breeding, an alternative approach for maize improvement in developing countries concerns the identification and isolation of agronomically-useful genes and subsequent introduction of these directly into the genome of selected elite white maize lines.

In collaborative research between the University of Pretoria and CSIR-Bio/Chemtek, a method was developed for genetic engineering of local elite white maize in which stable integration of marker genes was shown. This research was carried out in line with the regulations of the Genetically Modified Organisms Act (#15 of 1997). This success led to a research grant being awarded by the European Union in which both conventional and genetic engineering approaches are being used to improve maize for fungal resistance (for more information, see http://www.up.ac.za/academic/botany/safemaiz.html). This project, co-ordinated by Prof Berger of the Botany Department, Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria, involves co-operation between UP, CSIR-Bio/Chemtek and ARC-Roodeplaat laboratories in Pretoria, and serves as an example for the newly formed African Centre for Gene Technologies (http://www.acgt.co.za/). International partners include Plant Research International in The Netherlands, University of Rome and University of Zambia.

Molecular stress physiology

Research leader: Prof Karl Kunert

Research team: Dr Christell van der Vyver
Ms Louw Gaume

Objectives of the research programme:

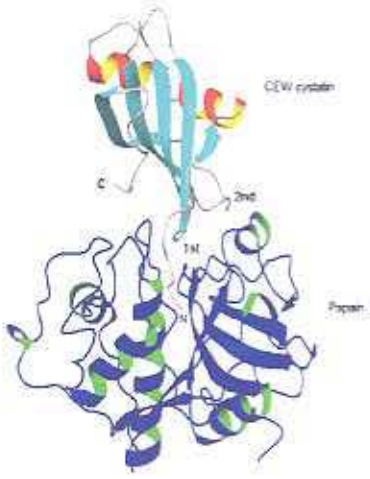
The goal of this programme is to evaluate labile DNA regions present in plant genomes, which vary in response to environmental stress. Research questions concern (1) the identification and isolation of labile DNA regions in plant genomes, which might change to a stressful event and (2) the evaluation of cysteine proteinase inhibitors as protectants against abiotic and biotic stresses in plants. Research on stress-induced changes has focused on tobacco, date palm and an inland wild oat grass.

Highlights of research 2002/2003:

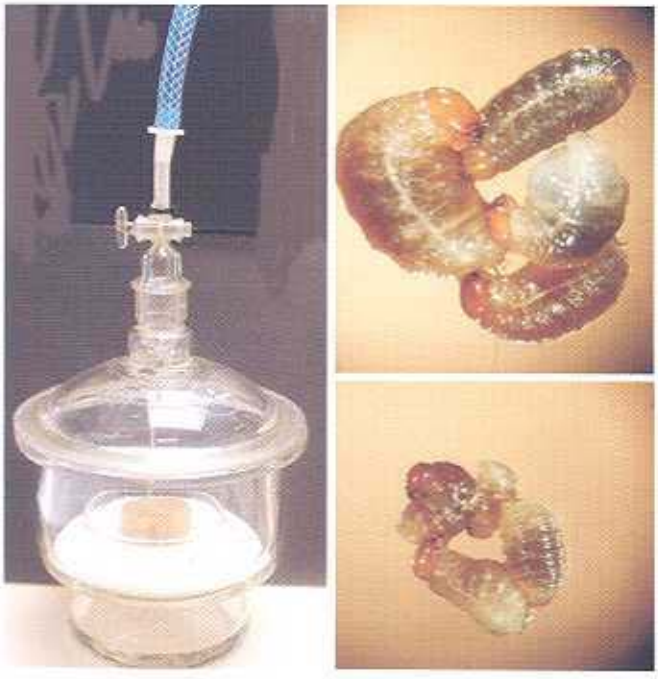
Cysteine proteinase inhibitors

A first research project on cysteine proteinase inhibitors has focused on the evaluation of tobacco plants, expressing an exogenous rice cysteine proteinase inhibitor transgene (OCI) for abiotic stress resistance. Expression of the transgene n genetically modified tobacco, which is stably expressed under severe stress conditions, without any degradation, resulted in improved acclimation to chilling and increased biomass in OCI expressing plants. Inhibition of elongation expressed under low light intensity is currently being investigated in more detail by genome analysis. An interesting phenotype, was further discovered in these plants.

A second research project has focused on the evaluation of a strategy to use cysteine proteinase inhibitors of plant origin as a target gene for transformation of banana to improve resistance/tolerance to the banana weevil stem borer, *Cosmopolites sordidus* (Germar, 1824; Coleoptera: Curculionidae). Through the use of evolutionary guided protein engineering involving protein sequence/structural analysis and site-directed mutagenesis. The project also seeks to optimise the inhibition activity of plant cysteine proteinase inhibitors to obtain novel inhibitors with increased activity against cysteine proteinases in the gut of banana weevils, and to acquire intellectual property rights. Native plant-derived and mutated inhibitors currently under intensive investigation are being produced in large purified amounts by cloning, expression in *E. coli* and purification by affinity chromatography. Inhibitors are tested with both *in-vitro* and *in-vivo* assay systems. A system for the isolation of proteinase enzyme containing gut extracts of the banana weevil and subsequence analysis of activity/inhibition *in-vitro* has recently been developed. Using this system, ysteine proteinase activity was confirmed in both adult and larval banana weevils as has been reported for many other coleopteran insects. In addition, a purified inhibitor recently infiltrated into banana tissue using vacuum infiltration, showed strong inhibition of banana weevil larval growth and development.



[LEFT] A three-dimensional structural plot of the complex between a typical proteinase enzyme (papain; blue and green) and a typical cystatin (chicken egg white cystatin; CEW) coloured light blue, red and yellow (PDB accession No 1STF). The complex is presented in front view to show the V-shaped active site of papain and how the N-terminal region of CEW covers it thus making it unavailable for protein hydrolysis



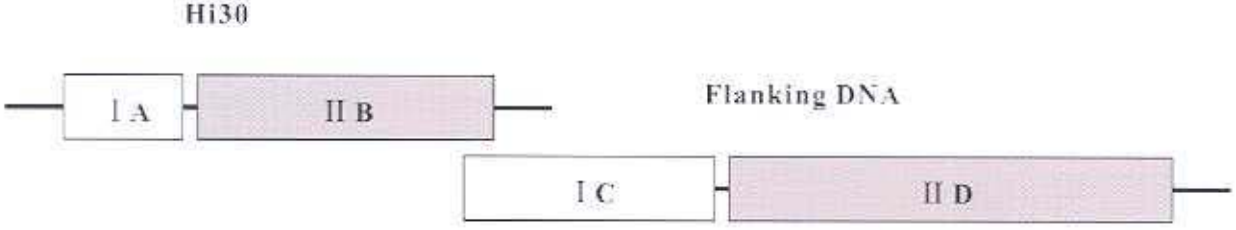
[LEFT] Set up of the apparatus used for vacuum infiltration of banana stems (A) with either cystatin solution or distilled water (control). Ten day old banana weevil larvae after developing in banana stem infiltrated with distilled water (B) and with papaya cystatin solution (C)

Stress-induced genomic changes in plants

Several labile DNA sequences have been isolated from these plants representing a group of labile DNA sequences in the plant genome that easily change under stressful natural or artificial environmental conditions. Their potential of being applied as molecular markers for stress tolerance is currently being evaluated. Research in this programme represents a joint effort between the Case Western Reserve University, Ohio, USA and the University of Pretoria. It specifically focuses on plasticity present in plant genomes when exposed to a stressful event. By applying the technique of "Representational difference analysis" or RDA we were able to successfully isolate both highly (date palm, tobacco) and low repetitive DNA (tobacco, wild oats) with DNA point mutations, deletions and insertions. Detailed information about such

susceptible DNA regions has been obtained in the last two years in tobacco derived from a stressful plant tissue These subtraction products represented possible DNA sequence differences between wild-type non-transformed plants and plants derived from a plant tissue culture/transformation process. Using bioinformatics tools, two methylation-sensitive subtraction products, Hp12 and Hp14, were identified to be similar to part of the tobacco chloroplast genome and the tobacco 18S rRNA gene, respectively. A third non-methylation sensitive DNA subtraction product, Hi30, had no significant homology to any reported DNA sequences.

As a further result, this study allowed for the successful identification of adjacent sequence fragments of these variable DNA sequences in the plant genome. Screening a genomic library derived from a transformed plant confirmed the plastid origin of Hp14 and Hp12, while the Hi30 sequence could be localized in regions with culture/transformation process. Three different DNA sequences from transformed tobacco were isolated and characterized. homology to known repetitive DNA sequence families. By applying Tail PCR it was further determined that the flanking sequence of Hi30 was partially homologous to sequences of a *Shewanella* 16S RNA gene, DNA sequences of different cloning vectors as well as to *Arabidopsis thaliana* mRNA for ATP synthase. These DNA sequences likely indicate DNA insertions at a labile DNA region into the tobacco genome. Recently, we were also able to identify a similar process of bacterial DNA insertion into a variable region of wild oats. In future research, a variety of both wild-type and plant tissue culture/transformation-derived tobacco plants will be screened in this project by PCR for sequence variation in identified labile DNA regions. The aim is to evaluate the potential of these regions to serve as DNA-based stress markers.



Schematic diagram of subtraction product, Hi30 and its adjacent flanking DNA region. A and B represent a variable (30 bp; A) and conserved (125 bp; B) DNA region present within the Hi30 subtraction product whereas C and D represent a variable (90 bp; C) and conserved (186 bp; D) region present within the flanking sequence. Region D showed, in part, significant homology to a *Shewanella* 16S RNA gene, DNA sequences of different cloning vectors, as well as to *Arabidopsis thaliana* mRNA for ATP synthase

Indigenous food crop pathology

Research leader: Prof Terry Aveling

Research team: Prof Lise Korsten
Dr Nico Labuschagne
Prof Teresa Coutinho

Objectives of the research programme:

- Survey of plant pathogens occurring on indigenous food plants
- Collect, isolate and identify plant pathogens reducing yields of these plants
- Establish a reference collection of plant pathogens on these plants
- Study the biology and seed pathology of these pathogens
- Train and educate students with relevant expertise to undertake extension work in disadvantaged communities
- Establish a centre of excellence of diseases of indigenous food plants important for small-scale farmers

Highlights of research 2002/2003:

Prof Aveling and five postgraduate students visited resource-poor on-farm cowpea and bambara groundnut farmers field trials in Mpumalanga during February 2001 and 2002. Diseased plant samples were collected for further laboratory studies. A web page was established. Information on cowpeas, their importance, cultivation, fungal diseases and diagnosis is available at: http://www.up.ac.za/academic/microbio/plant/pr_cowpea.html

Students at a field trip to Maputo, Mozambique, to look at cowpea and bambara groundnut diseases

A collaborative project together with the International Institute of Tropical Agriculture (IITA), Eastern and Southern Africa Regional Center (ESARC), Kampala, Uganda on the viruses of cassava was established. Mr Joseph Ndunguru from Tanzania commenced his PhD conducting research on these viruses on cassava in Tanzania and Uganda. Biological control of *Sclerotium* on bambara groundnut was investigated. A *Trichoderma* formulation provided good control, greatly reducing pre- and post-emergence damping-off. The production of fumonisins in cowpea by *Fusarium proliferatum* was reported for the first time. This is also the first report of this fungus producing fumonisins in legumes. This is an important discovery as these mycotoxins cause adverse health effects in animals and humans.

Different subsistence legume crops

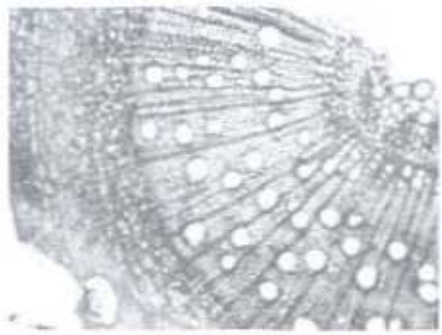
Forest molecular genetics programme:
Designer genes for designer fibre

Research leader: Dr Alexander Myburg

Objectives of the research programme:

The Forest Molecular Genetics Programme is a new industry-supported research programme within FABI and the Department of Genetics at UP. The first phase of this programme (2003 – 2005) has four main objectives:

- *To discover and characterise genes involved in wood formation.* The programme will focus on genes and regulatory sequences that affect lignin biosynthesis, cellulose biosynthesis and vascular development in trees. High-throughput molecular genetic techniques such as microarray analysis and AFLP transcript profiling are being developed to identify genes involved in these biological processes.
- *To establish a model system for functional analysis of tree genes.* The model plant *Arabidopsis thaliana* can be induced to form secondary xylem and can therefore be used as a model system for wood and fibre development. The new FABI building will contain excellent plant growth facilities for *Arabidopsis*, and bioinformatics facilities to harness the wealth of genomic information available for this model system.
- *To characterise allelic (nucleotide) diversity in wood and fibre genes in forest tree breeding populations.* Very little is known about allelic diversity in forest trees (and in plants in general). This information will be used to develop gene and allele-based markers for association genetic studies in forest tree populations.
- *To develop molecular tools for biotechnology-assisted tree improvement.* Gene and allele information acquired under the first three objectives will be used to develop tools for marker-assisted breeding or direct genetic engineering of forest trees. The programme will also focus on the development of general molecular breeding tools for applications such as fingerprinting, paternity analysis, pollen competition studies, and estimation of inbreeding/outcrossing rates.



Cross section through a young *Eucalyptus* stem

Highlights of research 2002/2003:

Dr Myburg joined the University of Pretoria at the end of 2001 after completing a PhD degree programme in Forestry and Genetics at North Carolina State University. He established the Forest Molecular Genetics Laboratory in the Department of Genetics and FABI in 2002. During this year, much needed capacity was established for high-throughput molecular genetic analysis of forest trees. Two automated DNA fragment analysis systems were purchased from LI-COR Biosciences (Lincoln, Nebraska). These two instruments, purchased with partial funding from Sappi Forests, allow a capacity of more than 100 000 molecular

marker determinations per week (enough to completely map most plant genomes in little more than a month). The LI-COR instruments will serve as a technology platform for much of the research performed in the Forest Molecular Genetics programme and other Plant Biotechnology programmes in FABI.

Four BSc Hons student projects were completed in the Forest Molecular Genetics programme in 2002. One of these projects focused on the development of a DNA microarray chip for marker analysis of interspecific hybrids of *Eucalyptus*. This powerful new technology holds the promise of genotyping thousands of markers in a single assay for genomic mapping or fingerprinting of tree genomes. A prototype chip of 384 DNA fragments was produced in this project and will be tested in a follow-up study in 2003.

LI-COR AFLP gel image

Microsatellite or simple sequence repeat (SSR) sequences provide highly informative molecular markers for genetic mapping and fingerprinting of plant genomes. A genome -wide set of microsatellite markers for *Eucalyptus* was recently developed by researchers in Brazil. The Forest Molecular Genetics programme is in the process of transferring these markers (kindly provided by Dr Dario Grattapaglia) to UP. Two BSc Hons student projects applied a set of these markers for comparative genomic mapping and SSR analysis of pollen competition in polymix crosses of *Eucalyptus* in 2002.

Dr Myburg collecting xylem from a *Eucalyptus* tree

The complete genome sequences of *Arabidopsis* and rice, and the soon to be completed sequence of the poplar tree genome, offers a tremendous resource for gene discovery and comparative analysis in other plant species. These resources can be accessed through on-line bioinformatics tools and local analysis packages. The University of Pretoria will host a major node of the National Bioinformatics Network. This facility in the new FABI building will offer valuable support for comparative analysis of wood and fibre genes in *Eucalyptus* and *Arabidopsis*. To position the Forest Molecular Genetics programme for comparative research in *Arabidopsis* and *Eucalyptus*, a local database of wood and fibre development genes in these two species was established in 2002 (focus of a fourth BSc Hons student project). This database is being updated in 2003 by two Bioinformatics research assistants.

Three new MSc projects and two BSc Hons projects were initiated in 2003. These projects are part of a new Wood and Fibre Molecular Genetics programme supported by Sappi Forests and Mondi Forests and THRIP.

Newly emerging plant pathogenic bacteria

Research leader: Prof Teresa Coutinho

Research team: Dr Fanus Venter (Dept of Microbiology & Plant Pathology)
Prof Mike Wingfield
Dr Altus Viljoen

Objectives of the research programme:

- Develop rapid, reliable methods of accurately identifying plant pathogenic bacteria
- Characterise and molecularly type isolates of pathogenic bacteria responsible for economically important diseases of *Eucalyptus*, bananas and other agricultural crops
- Study the epidemiology and biology of selected emerging plant pathogenic bacteria
- Determine the association of pathogenic bacteria with fungal pathogens of plants
- Train and educate students in an important field of plant pathology
- Establish a centre of excellence in phytobacteriology

Highlights of research 2002/2003:

Bacterial blight and die-back is a relatively newly discovered disease of *Eucalyptus* in South Africa. During the course of the last three years the disease has increased in occurrence, importance and distribution. Isolates of the causal agent have been identified and characterized and have been shown to be *Pantoea ananatis*, which is a known pathogen of other crop plants but has never previously been found on *Eucalyptus*. The appearance of *P. ananatis* on different *Eucalyptus* species, hybrids and clones in a range of environmental habitats is of concern. In order to understand the genotypic relatedness between strains from different species, clones and hybrids of *Eucalyptus* and from different environments, a genetic diversity study is being conducted. This study involves the use of a number of techniques such as sequencing of the 16S gene and interspacer region as well as Amplified Fragment Length Polymorphisms (AFLPs). The study does not focus only on isolates from *Eucalyptus* but *P. ananatis* isolates from different hosts (pineapple, onions, cantaloupe fruit, sudan grass, rice, sugarcane and honeydew melons) are included in order to determine their relatedness. This study will provide information on the possible origin and the current distribution of the bacterium will be determined.

Pantoea ananatis is seedborne in onion. There is evidence to suggest that the introduction of the disease into new environments has been via the use of contaminated seed. We are currently investigating methods of rapidly identifying this pathogen using a differential media and molecular-based techniques. A related species, *P. agglomerans*, also occurs on seed and its exact role, if any, in causing a disease in onion is also being investigated.

Preliminary results have shown that *P. ananatis* together with an undescribed *Pantoea* sp. are associated with *Coniothryium zuluensea* fungal canker pathogen of *Eucalyptus*. There appears to be a synergistic relationship between the *Pantoea* spp. and this fungus. Investigations are currently under way to determine the identity of the second *Pantoea* sp. as well as their role in disease expression of what is known as Coniothyrium canker.

Bacterial wilt of enset is an economically important disease in Ethiopia and Uganda. In both countries, large scale losses are being experienced. There is only one published paper on the disease, which described the causal agent as *Xanthomonas campestris* pv. *musacearum*. Studies are currently under way to verify this identification and characterize isolates from both Ethiopia and Uganda.

Industrial mycology

Research leader: Dr Gert Marais

Research team: Mr Lucky Madzivandila
Ms Annelie Lübben

Objectives of the research programme:

- Building collaboration between FABI and CSIR Bio/Chemtek
- Expanding mycological research at FABI
- Finding industrial applications for the FABI fungal culture collection
- Screening local ophiostomatoid fungi for the ability to produce flavours and fragrances
- Promoting mycology as a research discipline through education

Highlights of research 2002/2003:

Through the closer relations between the University of Pretoria and the CSIR, collaboration between FABI and Bio/Chemtek was promoted through the secondment of Gert Marais to FABI in June 2001. One of the identified joined initiatives is the utilisation of the FABI fungal culture collection in the search for metabolites or active compounds applicable in markets such as agriculture, food and pharmaceutical industries.

During two decades of plant pathological research, FABI has obtained a very unique and extensive collection of more than 12000 fungal isolates, including approximately 2000 cultures from South African plants, forests and other environments. Many of these fungi are associated with specific insect vectors and have developed various specialised mechanisms to attract their vectors. This includes the production of pheromones, flavours, fragrances and the development of mutualistic relationships, some of which are so interwoven that the survival of the one is dependant on the other.

Access to this collection, and the expertise at CSIR Bio/Chemtek in the industrial development and commercialisation of microbial products, was seen as an ideal opportunity to join forces. This has led to an agreement that was signed by the two institutions in December 2002, to launch a screening process for active compounds that might be used to combat cancer, bacteria, fungi and insects. In addition, the screening also includes new and interesting flavours and fragrances for the food industry.

Flavours and fragrances

A joint project between FABI, CSIR Bio/Chemtek and an industrial partner in the flavour and fragrance industry was submitted and awarded by the BioPAD BRIC in March 2003. The project includes the commercialisation of the production of blue cheese flavour compounds, a peach flavour, and two other flavours. Production is based on the utilisation of fungi from FABI and CSIR fungal culture collections. The ultimate goal is to establish a venture business that is based on using fermentation processes in the production of bio-flavours.

During a period of four months since the signing of the agreement between FABI and CSIR Bio/Chemtek, 350 ophiostomatoid fungi were screened for their ability to produce aromatic compounds. Of these, approximately 16% were found to produce desirable flavours and were earmarked for further investigation.

Fungi in thatched roofs

The role that fungi play in the deterioration of thatched roofs and their contribution to health risks in South Africa have largely been neglected. Thatched roofs are aesthetically important, especially in the tourist industry, but maintenance costs, insurance and possible health risks for inhabitants make them very costly. A project was launched in collaboration with the Pretoria Technikon to study the role of fungi in the quality and health of thatched roofs. This is part of an ongoing project and covers 38 case studies in 12 weather zones in South Africa. The study has included the determination of the level of fungal infestation in thatched roofs and compares these with the fungal aerosols inside and outside the dwellings.

Fungal growth on the inside of a thatched roof in Durban

Results have shown that thatched roofs in South Africa are infested with plant pathogenic fungi and opportunistic saprophytes. In most of the case studies, environmental conditions seem to contribute significantly to the prevalence of fungi inside the dwellings. *Cladosporium cladosporioides*, *Alternaria alternata*, *Phoma sorghina*, *Epicoccum nigrum* and various *Penicillium* species seem to be predominant in most of the fungal aerosols. *Aspergillus versicolor* seems to occur rather in the environmental aerosols in Mpumalanga and not in the rest of the country. Similar fungi were isolated from the thatch, although *Eurotium* species occurred in significant numbers in the thatch in certain cases.

Fungal aerosol samples showing mainly *Cladosporium* species

It was also shown that the Kruger National Park and the coastal areas of KwaZulu/Natal and the Eastern Cape Province are high-risk areas for fungal bio-aerosols and damage to thatched roofs. In many cases, the surrounding environment contributes significantly to the levels of fungal loads inside the dwellings. However, there were cases where the likely source of fungi could be associated with the degradation of the thatch.

Mycotoxigenic fungi

In March 2003, a project was awarded to FABI, CSIR Bio/Chemtek and the ARC by the Maize Trust. The project covers the evaluation of the most dominant maize cultivars in South Africa to withstand infestation of mycotoxigenic fungi. The project aims to identify molecular markers closely linked to genes responsible for resistance to specifically mycotoxigenic fungi and to lay a platform for developing resistant cultivars in future.

A wide variety of fungi are associated with the staple food of South Africa such as maize. These include both field and storage fungi of which some are known producers of mycotoxins, implicated in the cause of various disorders and cancers in humans and domestic animals. The best known and studied mycotoxin in South African maize is fumonisin B_1. It is associated with oesophageal cancer in humans and the cause of leucoencephalomalacia (LEM) in horses, mules and donkeys. It is also responsible for liver damage in rats and lung disorders

in swine. *Stenocarpella maydis* is also one of the more prominent fungi in South African maize. However, in this case, the mycotoxin is unknown although the fungus is associated with diplodiosis in cattle and sheep, as well as dehydration, growth inhibition and mortality in poultry. The presence of these fungi is mostly associated with the maize kernels due to high humidity and moisture during harvesting and storage. Field fungi are metabolically inactive at water activities lower than 0.85 (moisture content lower than 20%) while storage fungi thrive between 0.65 and 0.8 (moisture contents between 13% and 19%).

Maize kernels infected with *Stenocarpella maydis*

Field fungi such as *Fusarium*, *Alternaria*, and *Stenocarpella* spp. are regularly associated with South African maize kernels and can cause, besides the production of mycotoxins, physical damage that can influence the quality and milling properties. Storage fungi such as *Eurotium*, *Aspergillus* and *Penicillium* species also contribute to this and due to the colour of their spores can cause milled products to be aesthetically unacceptable. The presence of these fungi also results in other problems such as off flavours and odours, lack of germination, mouldy kernels and shortened shelf life of products.

It was found that, during a study for the Department of Health in 2000, mycotoxins such as aflatoxin B_1 and aflatoxin M, beauvericin, citreoviridin, deoxynivalenol, diplodiatoxin, diplosporin, fumonisins, fusaproliferin, fusarin C, fusarenon X, moniliformin, secalonic acid D, trichothecin and zearalenone were positively associated with fungi isolated from maize in South Africa. This information, however, only includes reports and manuscripts published in the scientific and public domains. Many fungi are associated with maize, especially after the milling process. However, not much is published on the presence of fungi during the storage or milling processes of maize. There is also little information on the levels of fungi in the products destined for human and animal consumption. Future work will be based on addressing thse questions.

Diagnostic mycology

In April 2002, a mycological diagnostic clinic was initiated at FABI that addressed the mycological needs of the food and feed industries in South Africa. The services provided by the clinic mainly include the identification of fungi to species level, risk assessments, fungal enumeration, fungal aerosols, environmental impact studies, and various others. More than 150 samples were handled by the clinic in the first 12 months of its existence. Samples were eceived from the food, feed, milling, industrial processes and agricultural industries in South Africa and neighbouring countries.

Citrus rootstock resistance

Research leader: Dr Nico Labuschagne

Research team: Dr Zeno Apostolides (Dept of Biochemistry)
Dr Thierry Regnier

Objectives of the research programme:

- Identify rootstocks with resistance/tolerance to the main fungal root pathogens of citrus
- Develop techniques for rapid screening of rootstocks for resistance
- Elucidation of the mechanisms involved in rootstock resistance

Highlights of research 2002/2003:

Phytophthora species cause severe diseases of citrus worldwide. Tolerance of citrus rootstocks to *Phytophthora* has been amply demonstrated and it offers an excellent means of reducing losses due to *Phytophthora* root and collar rot. Resistance responses are usually characterized by the early accumulation of secondary phenolic compounds that effectively isolates the pathogen at the point of infection. The production of antifungal phenolic compounds has been demonstrated in citrus fruits, peels, leaves and in citrus roots.

The fungicide fosetyl-aluminium (aluminium tris-[o-ethyl phosphonate]) is known to be effective for control of some diseases caused by the Peronosporales. Fosetyl-Al exhibits a complex mode of action acting both directly on the pathogen and indirectly by inducing host defence responses. Despite numerous studies on the fungicide the exact mode of action of fosetyl-Al is not fully understood.

The levels of total soluble phenolics were determined in citrus rootstocks tolerant and susceptible to *Phytophthora nicotianae* following inoculation with the pathogen. The effect of fosetyl-Al treatment on total phenolic concentrations in the various rootstocks was also studied. Phenolic concentrations were higher in the roots of *Phytophthora*-tolerant swingle, macrophylla, troyer and sour orange rootstocks 21 days after inoculation, whereas only minor increases occurred in susceptible rough lemon and volkamer lemon rootstocks. The highest phenolic concentrations were recorded after 21 days in troyer, rendering a maximum of 58.2 mg gallic acid equivalents/gram dry root material, in comparison to 48.1 mg/g in rough lemon. Total phenolic concentrations correlated positively with tolerance to *P. nicotianae*. Treatment with the systemic fungicide fosetyl-Al further elevated phenolic levels in the roots. Total phenolic concentrations were two to three times greater in inoculated rootstocks treated with fosetyl-Al than in uninoculated, untreated rootstocks.

Results of the present study provide strong evidence that the increase in phenolic concentrations in citrus roots plays a key role in resistance of citrus against *P. nicotianae* root rot. The ELISA plate Folin-Ciocalteu method used in this study has potential as a high throughput method for screening citrus rootstocks for resistance. Coinciding with its ability to protect rootstocks against *P. nicotianae*, fosetyl-Al increased total soluble phenolic concentrations even further following inoculation with the pathogen. This provides evidence that elevation of phenolic levels is involved in the mechanism of action of fosetyl-Al in the control of *Phytophthora* root rot, therefore supporting an indirect antifungal mode of action.

Citrus and subtropical fruit research

Research leader: Prof Lise Korsten

Research team: Dr Gina Swart
Dr Thierry Regnier
Dr Petra Labuschagne

Objectives of the research programme:

Citrus

- Determine differences between virulent and avirulent *G. citricarpa* isolates and prove non-infective status of black spot lesions on fruit particularly for export consignments
- Epidemiology of citrus black spot to respond to the European Union's comments on the Risk Assessment study
- To develop an effective, environmentally friendly disease control option for *Guignardia citricarpa*, the causal agent of citrus black spot
- To develop an effective post-harvest disease control strategy using antagonists in a biological control programme and identify and develop new, innovative biological control strategies
- To develop an effective *Alternaria* disease control strategy using bees to disseminate natural antagonists for control of navel-end rot

Mango

- Develop new innovative disease control strategies, such as the use of plastic caps impregnated with copper based fungicides or biocontrol agents, to control fruit disease.
- Epidemiological studies on soft brown rot.

Avocado

- Biological control of avocado fruit diseases using bees to disseminate antagonists to flowers to control stem end rot
- Development of a biological control predictive forecasting program

Highlights of research 2002/2003:

South Africa has 47 422 ha under citrus cultivation, of which Mpumalanga and Limpopo province are the most important production areas (14 138 and 11 997 ha). The South African citrus industry has more than 20 million trees, which produce more than 930 000 tons of fruit annually, with more than 40 million cartons being exported to more than 60 countries around the world. The industry is expected to export more than 60 million cartons of citrus worth R2.5 billion in the year 2003. The South African citrus industry is regarded as one of the largest agricultural industries in the country and plays a significant role in the national economy being worth R1.7 billion annually. Several post -harvest diseases such as green and blue mold contribute significantly to post-harvest losses, but citrus black spot is one of the most important pathogens affecting the citrus industry.

Mangoes and avocadoes are economically important crops cultivated in South Africa for both local consumption, processing and export. These South African industries have developed expertise over the years that enabled the industry to successfully export the bulk of its fruit mainly to Europe. Due to stringent quality

assurance standards, fruits with any blemishes are rejected for export. Control of pre-harvest fruit diseases is thus important in ensuring high quality fruit for export. One of the most important mango pre-harvest diseases is bacterial black spot (BBS) caused by *Xanthomonas campestris* pv *mangiferaeindicae*. In general, it is extremely difficult to control bacterial plant diseases and current practices focus on timely copper sprays. However, new more effective disease control options are required to ensure consistent high levels of quality fruit. For avocado, Cercospora spot caused by *Pseudocercospora purpurea* is a major pre-harvest disease, which can be controlled with timely copper or *Bacillus subtilis* (Avogreen) sprays. The commercial biocontrol agent Avogreen developed in our laboratories, is currently used as a substitute for copper sprays for particular organic farming or integrated with reduced copper sprays in conventional farming. Post-harvest losses on the export market have been significant for both avocado and mango and have resulted in inferior quality fruit and reduced profits. The most important post-harvest diseases of mango are anthracnose caused by *Colletotrichum gloeosporioides*, and soft brown rot (SBR) and stem-end rot (SER) both caused by *Botryosphaeria* spp. With the shift in international trade in terms of food safety standards, more stringent quality and safety of fruit are expected for export. New innovative alternative disease control strategies are thus currently evaluated and developed for the South African mango industry.

The most significant highlights for 2002 and 2003 include the successful use of biocontrol agents to control bacterial black spot in mangoes, particularly the use of the innovative plastic cap with woolly inner linings, which give a slow release effect of both biocontrol agents and copper fungicides. In addition, other application methods including the use of bees to disseminate biocontrol agents to flowers to control stem end diseases in fruit, have shown great promise, both for citrus and avocado. Biocontrol agents and certain plant extracts have also shown promise in controlling citrus black spot and post-harvest diseases.

Several breakthroughs have been made in terms of elucidation of citrus black spot epidemiology and taxonomy, which could provide critical information for the EU response in the risk mitigation arguments, thereby protecting several sensitive export markets for the South African citrus industry. These include the development of PCR primers to detect and distinguish between the pathogenic (*Guignardia citricarpa*) and non-pathogenic (*Guignardia mangiferae*) species. This is of great importance for the citrus industry, both in terms of export and prevention of inadvertent disease spread through infected nursery trees.

Citrus

Determine differences between virulent and avirulent *Guignardia citricarpa* isolates and prove non-infective status of black spot lesions on fruit particularly for export consignments

It is of quarantine importance to distinguish between the citrus black spot pathogen, *Guignardia citricarpa* and the omnipresent endophyte, *G. mangiferae*, if South Africa exporters wish to retain their competitive edge in the European and access the United States of America, markets. Species-specific primers were designed that are able to detect and distinguish between these two species, since *G. mangiferae* is not a sanitary and phytosanitary risk. Application of the primer set Citric 1 and Camel 2 in conjunction with the ITS 4 primer yielded PCR amplicons of approximately 580 bp and 430 bp for *G. citricarpa* and *G. mangiferae* respectively. Results obtained with these primers are in accordance with sequence data and repeated tests verified accuracy. A BLAST search revealed no matches other than *G. citricarpa* and *G. mangiferae*, and no positive PCR results were obtained with *Colletotrichum gloeosporioides*, the most common contaminant in black spot lesions. We are therefore able to distinguish *G. citricarpa*

and *G. mangiferae* unequivocally using a PCR-based technique, thereby shortening the time needed to test fruit for *G. citricarpa* in export consignments.

With the development of this technique, we are now able to accurately and quickly identify *Guignardia* species from both fruit lesions and leaves. This has enormous implications for the citrus industry. The first application of this test is that rejected or suspect fruit may be tested from as little as a single lesion, irrespective of what type of symptom. This implies that growers may test their fruit before consignments are packed for export if they have any doubts about their CBS status, or if fruit have been rejected at the packhouse or harbour with confirmations obtained within eight hours. A second important application is the use of the primers for epidemiological studies and confirmation of the CBS status of production areas. This is due to the optimisation of the test so that *Guignardia* species may be detected in any type of plant material, including degraded leaf litter. To date, nursery material suspected of being infected with CBS has not yet been tested using this technique. Since this material would most probably be asymptomatic, a protocol is now being developed/adapted for this purpose. Furthermore, the identity of ascospores counted in spore traps should also be confirmed, since current prediction models are based on their presence. Testing of trapped ascospores should also be optimised, although the removal from the spore trap represents a challenge. It is clear that there are several applications for this test and they should all be optimised in order to provide a maximum benefit for the citrus industry.

Investigate epidemiology of citrus black spot and explore other control measures

Ascospores are considered the most efficient means of dissemination of CBS in areas where the disease is established. It has been reported that the spread of CBS through conidia could be as important as the role of ascospores in establishing the disease. As age-related resistance in plant hosts to fungal pathogens is a commonly recognised phenomenon, the influence of Valencia leaf age and susceptibility to conidia infection was investigated. Conidia harvested from cultures and prepared as spore suspensions were used to infect the leaves at 30-day intervals. The pathogen could be re-isolated from the leaves consistently up to four months in the preliminary trial and to date the second and currently ongoing trial shows that the spores could be re-isolated from six-month-old leaves. The cultures were identified by the PCR technique. The amount of soluble phenol and sugars do not differ from the control and phytoalexins were not detected.

To date, the effect of leaf age on infection by the black spot pathogen has not been evident. From the two experiments, it seems as if the physiological and chemical barrier found in older leaves is not sufficiently developed in up to six-month-old leaves. This experiment will continue for three more months after which a final conclusion will be made in terms of leaf age and susceptibility. If the pathogen is still recovered from the leaves at the end of this experiment, it will then demonstrate that age does not play a role in protecting the leaf from infection and that spores could survive on the surface of the leaf for a longer time than previously suggested. As leaves can remain on the trees for up to three years, a follow-up experiment needs to be conducted over a period of up to three years.

Determination of optimal environmental conditions for the germination of black spot conidia is the first step in understanding disease development and improving strategies for disease management. This information is also critical for development of accurate disease forecasting models. Since ascospores remain the major source of inoculum, they are often used to test the effect of different parameters on the fungus. The aim of this study was to investigate the influence of temperature, pH and light on the germination of *Phyllosticta citricarpa*. Most germ tubes (GT) and appressoria (AP) developed at mild temperatures between 20°C and 25°C and

lower pH values. It was observed that at 10°C, and 20°C most appressoria were sessile with short germination tubes. At higher temperatures, they was attached to longer germination tubes.

Differences in germination rates were observed in the experiments indicating that light, ambient temperature (25°C) and lower pH values (pH 4.5) enhanced the development of GT and AP. No germination was observed at 4°C while very long GT and a few AP developed at 37°C compared to that observed at 20°C. At 10°C and 20°C the AP tended to be sessile and at 25°C it was attached to a longer germ tube. Germination was lower in distilled water and leaf extract, compared to 2% orange juice. After four days, when using the orange juice, the percentage of GT and AP was ± 15.83% and 62.37% respectively. At 2% dilution of the stock solution, the presence of several minerals such as calcium, magnesium, or ascorbic acid without any inhibiting compounds (phenolic compounds) could provide a good nutrient supply to the spores.

The *in vitro* toxicity of commercial formulations of preventive and systemic products to pathogens is not always well-known. It was postulated that citrus black spot was more severe in cultivars where low levels of antifungal compounds like limonene and citrus oil were found in the rind tissue. All chemicals and natural products tested inhibited fungal germination at commercially recommended concentrations. The minimum concentration required varied according to the product. Scoparone and scopoletin, phytoalexins produced in fruit with black spot symptoms strongly inhibited the germination of the pathogen.

Removal or immobilisation of overwintering inoculum of *Guignardia citricarpa* was investigated in two adjacent 30-year-old Valencia on Rough Lemon orchards near Burgersfort, one 1.36 ha in size and the other 1.03 ha. In both orchards, all leaves on the orchard floor were manually removed and burned. Four blocks of 16 trees each were demarcated in the 1.36 ha orchard and three blocks in the 1.03 ha orchard. The surface under the trees in the blocks in the 1.36 ha orchard was mulched with a layer of wheat straw, whereas leaves were again removed from the 1.03 ha orchard and the unmulched area in the 1.36 ha orchard. Orchards were sprayed with fungicides except for the trees in the demarcated blocks. No ascospores of *G. citricarpa* could be trapped with a Quest spore trap in the 1.03 ha orchard during December 2001 and January 2002. Evaluation of the orchards indicated a CBS incidence of 2.3% in the mulched blocks and 13.2%, almost six times higher, in the unmulched blocks. None of the infected fruit in the mulched blocks had more than five CBS lesions, 26% with 6-50 lesions, and 9% with extensive infection in the unmulched blocks. Virtually no CBS was evident on chemically sprayed fruit.

The decomposition of infected citrus leaf litter was also evaluated on a small scale in the greenhouse. Mature infected leaves were picked on three different occasions and placed in plastic containers in contact with organic material. Treatments included: (1) different organic material: sterilised sand as control, old mango compost, new mango compost, citrus compost, citrus compost mixed with bark, chicken, cattle and sheep manure; (2) placement of leaves: on top of material and underneath material; (3) watering: no water and watering twice a week. Leaves were evaluated weekly for two months. The amount and frequency of watering had the greatest effect on rate of decomposition, followed by duration of leaf wetness and area of contact between the leaves and organic material. There was also a positive correlation between the level of microbial activity of the organic compound and decomposition rate of the leaves. The experiment will be repeated and different organic material will be included.

Development of an effective, environmentally friendly disease control option for *Guignardia citricarpa*, the causal agent of citrus black spot

Garlic (*Allium sativum*) clove and *Coprosma repens* extracts were evaluated for their biological activity against *Penicillium digitatum*, *P. italicum*, and *Guignardia citricarpa* both *in vitro* and on artificially inoculated (in the case of *P. digitatum* and *P. italicum*) and naturally infected (in respect of *G. citricarpa)* Valencia oranges stored at 8±1°C and 90%-95% relative humidity (RH) for four weeks. Garlic was evaluated alone or in a mixture with vegetable cooking oil (0.1% v/v). Both garlic and *Coprosma* exhibited varying degrees of antifungal activity against all pathogens, and all concentrations of extracts were significantly effective when compared with the control in checking disease incidence, but were not as effective as the commercial fungicide, which gave complete control of both *P. digitatum* and *P. italicum*. Mixing garlic extracts with oil remarkably improved its activity. As a result, the treatment comprising garlic extracts (1 000 ppm) mixed with oil was as effective (100% control) as the fungicide treatment in the control of both *P. digitatum* and *P. italicum*. *Coprosma repens* extract on its own was not as effective and the percentage control achieved varied between 67% and 81%. *In vitro* studies indicate that the mode of action of extracts is inhibition of spore germination and germ-tube development.

Development of an effective post-harvest disease control strategy using antagonists in a biological control programme and identify and develop new, innovative biological control strategies

Three *Bacillus subtilis* isolates (F1, L2 and L2-5) were evaluated along with other commercial biocontrol products *Bacillus subtilis* (Avogreen powder and Avogreen liquid), and *Candida saitoana* (Biocure and Biocoat) for their antifungal activity against *Penicillium digitatum,* the cause of citrus green mold, under simulated export conditions in 2000, 2001 and 2002. The *B. subtilis* isolates were evaluated either alone or in combination with sodium bicarbonate (SB) at 1% (w/v). The efficacy of treatment was negatively affected by time of treatment application. Treatments were generally more effective when applied at the beginning of the season than when used later in the season when fruits have started 'ageing'. Neither the *B. subtilis* isolates on their own, nor the formulated products were as effective as the commercial fungicide treatment, which gave complete control of the disease throughout the season. Combining *B. subtilis* isolates with SB resulted in a remarkable improvement in the biocontrol activities of all isolates. Isolate F1 combined with SB was as effective as the fungicide treatment in some instances.

Oranges heavily infested with *P. digitatum* (left) and the control (right)

Development of an effective *Alternaria* disease control strategy using bees to disseminate natural antagonists for control of navel-end rot

The commercial *Bacillus subtilis*, previously screened successfully *in vitro* for antagonism against *Alternaria alternata*, was dusted on citrus flowers at the concentration of 10^7 colony forming units (cfu) per ml with a paint brush. This powder formulation was also placed in pollen inserts in the entrance of a beehive to test the ability of foraging bees (*Apis mellifera*) to disseminate this antagonist to citrus flowers for control of Alternaria rot of citrus. Mean recovery of *Bacillus subtilis* commercial powder sprayed on

flowers was 10^3 cfu per stamen. Based on electron microscopy, this organism multiplied preferentially on the stylar end of the flower. Bees emerging from the hive acquired 10^4 cfu per bee of commercial *Bacillus subtilis* powder. When observed under the scanning electron microscope, the powder was observed on the legs and thorax of the bees. The mean population of *Bacillus subtilis* recovered from flowers visited by the bees was 10^4 cfu per stamen. Trees that were visited were maintained in an enclosure. Electron microscopy studies showed that the organism attached on the stylar end of the flowers. This study showed that *Bacillus subtilis* colonised citrus flowers effectively and that bees can be efficient vectors of this antagonist for control of *Alternaria alternata*.

Mango

Disease control strategy ie plastic caps impregnated with copper-based fungicides or biocontrol agents

In South Africa, mangoes are an important sub-tropical export commodity. Most of these are exported by sea and long shipment times are conducive to the formation of post-harvest diseases like anthracnose, stem-end rot and soft brown rot. These post-harvest diseases result in significant financial losses due to rejection on export markets. Limited control ha s been achieved by the use of existing fungicides. However, pathogen resistance has been reported to certain fungicides, and many are no longer allowed on fruit destined for export due to new EU pesticide regulations. Pre -harvest application of biocontrol agents (*Bacillus licheniformis*) on their own or integrated with copper fungicides were evaluated as alternative strategy to control mango fruit diseases. The use of plastic woolly caps impregnated with the biocontrol agents or copper fungicides were evaluated as alternative method of application to provide sustained disease control throughout the rainy season by means of a slow release effect. The woolly plastic caps provided more effective sun protection to fruit than commercial plastic caps. Althoug h the antagonist could effectively attach, colonize and survive on the plastic caps it could not provide more effective control of mango fruit diseases compared to the field spray applications.

The aim of the current study was to evaluate new and "softer" chemicals for the control of fruit diseases. Trials were performed under semi-commercial conditions. New disinfectants were tested in packhouses, where they replaced existing disinfectants or wash media or were used in combination with chemicals or biocontrol agents. Fruit from the trials were stored in conditions simulating local and export market conditions. Preliminary results showed that a combination of prochloraz with strobulirins added to wax provided the highest levels of control. The use of disinfectants on its own did not produce significant results, but the use of Prasin with prochloraz was relatively effective when compared to the commercial control. Further studies will be conducted to understand the mode of action and optimise the use of these new chemicals.

Several disease management strategies have been applied both pre- and post-harvestly in order to control mango fruit diseases. To date, chemical products have provided some control of these diseases. However, growing concern over food safety issues, build-up of pathogen resistance and the high cost of commercializing new chemicals have resulted in a move towards safer, more environmentally friendly control measures. Biological control has been used successfully in packhouses to control several post-harvest diseases of several food commodities. In this study, *Bacillus licheniformis*, previously tested with success in preliminary trials, was used individually or in combination with standard packhouse treatments, as well as integrated with other chemical treatments. Two packhouses were chosen from different geographical regions using similar packline systems. After treatments, fruits were packed into boxes and one half of the total treatments stored at room temperature and the other half in cold storage, to simulate local and export

market conditions. Results show that the antagonist combined with standard packhouse treatments was more effective than the untreated control. The degree of effectiveness differed between the two packhouses. These results combined with previous trials will give a better indication of the feasibility of incorporating antagonists in commercial packhouse operations. Fruit treated with biocontrol agents have an additional benefit in terms of being acceptable for the organic market.

Epidemiological studies on soft brown rot

Mangoes were introduced from tropical areas into South Africa. South Africa does not have a tropical climate and the tree had to adapt to these climatic conditions. This environment also places the tree under stress making it more susceptible to a wide spectrum of pathogens. One of these used by *Botryosphaeria* cause die-back and can lead to a reduction in yield, since infected inflorescence die and young fruitlets are aborted during the early development stages. In order to investigate die-back, five orchards were chosen at a large mango estate in Mpumalanga. One of these orchards was salt stressed, two orchards had typical and atypical die-back symptoms respectively, and two control orchards were included. Tree samples which consisted of twigs, leaves, bark and fruit were evaluated for the occurrence of *Botryosphaeria* spp. and other known endophytes. *Botryosphaeria* spp. were isolated from all orchards with varying degrees of incidence. The highest incidence was found in the orchard under salt stress conditions, closely followed by the orchard with typical die-back symptoms. This indicates that *Botryosphaeria* spp. were more prevalent than was originally thought. It also confirms that *Botryosphaeria* spp. are opportunistic, endophytic pathogens, which attack trees under stress. A disease cycle is currently being constructed to illustrate the relationship between the host and the pathogen, as well as the spread between and within trees and primary and secondary inoculum resources. The information gained can be important to better manage die-back in mango orchards.

In order to investigate the role nurseries play in the dissemination of the pathogen through infected trees, all commercially important mango nurseries and associated mother blocks were surveyed in the Mpumalanga area. The associated orchards are those from which mother material and rootstock scion material are obtained. In each nursery, two blocks of ten-week-old Kent trees were analysed as well as Kent mother block orchards. In addition a Sabre orchard from which rootstock scion material were used was also included in the study. In all nurseries *Botryosphaeria* spp. were isolated from almost every tree sampled, irrespective of age. *Fusarium* was also isolated from these trees although at a lower frequency. In the Kent and Sabre orchards, *Botryosphaeria* spp. were also isolated but at a higher frequency. This study clearly showed the impact of *Botryosphaeria* spp in mother block orchards and that it could be transferred from infected mother material to new trees. In future, nurseries should give more careful consideration to nursery practices and grafting material should be screened before use.

Avocado

Biological control of avocado fruit diseases

Post-harvest fungicide treatments against latent infections cannot give complete control unless the fungicides have the ability to penetrate through the fruit cuticle and reach the infection site. Besides, there is increasing public pressure against the use of fungicides on harvested commodities. This, together with the increasing appearance of pesticide resistance in plant pathogens, is shifting the focus of plant disease control towards alternative control with a reduced risk to the consumer and the environment. One such alternative is biological control. Although various researchers have reported successful control of post-harvest fruit diseases little has been reported on pre-harvest approaches to control post-harvest fruit diseases. One of the difficult

aspects in pre-harvest biocontrol is the successful delivery of the antagonist to the infection court at the critical stage of infection. It has been shown that an important infection route for fruit pathogens is through flowers. Hence, combating stem-end rot (SER) pathogens at the flowering stage can prove to be effective in suppressing the incidence of the disease. The biocontrol agent must however be able to attach, survive and colonise the flowers so that the pathogens will be prevented from establishing on the flowers. Avogreen (*Bacillus subtilis*) has been successfully tested pre-harvestly against avocado and is currently commercially used for *Cercospora* control.

Bacteria on the surface of an avocado flower

To determine effective attachment and colonisation of antagonist to avocado flowers, Avogreen was used to "inoculate" flowers and samples were prepared for Scanning Electron Microscopy (SEM) immediately and after 1, 2, 4, 6, 12, 24, and 48 hours. Dilution series were also done from inoculated flowers at the same time intervals to determine the survival of antagonist on flowers over time. Results showed that the bacterium can effectively colonise and survive on avocado flowers.

Previously, the potential of bees in disseminating antagonists to citrus flowers were successfully shown. In this study the effective dissemination to avocado flowers was assessed by mixing Avogreen powder formulation with fluorescent powder and monitoring bee dissemination during the evening using portable UV torches. Five beehives on a block of Fuerte were used for the experiment. Dispensers were refilled three times a day ie at 9:00, 11:00, and 13:00. Trees around the hive were selected and marked. Apart from bee dispersal field sprays with Avogreen liquid, spray formulation and copper were used for comparative purposes.

To see the interaction between the antagonist and the pathogens, spores of pathogens (*Dothiorella*, *Phomopsis*, *Pestalotiopsis* and *Colletotrichum*) and antagonistic bacteria were inoculated on flowers in either one of the following patterns: antagonist first followed by the pathogen, pathogen followed by antagonists, antagonist and pathogens at the same time. The flowers were prepared for SEM observation. Excellent results were obtained for *Dothiorella* and *Phomopsis* showing interaction between the pathogen and antagonists.

Due to the increased economic and environmental pressure, research on several aspects of biological control has increased substantially. Integration of disease forecasting models with a biocontrol predictive system may provide growers with a disease control program that adheres to the requirements of organic programmes and EurepGap. This model will also focus on eliminating variable parameters that may influence product performance. These parameters include climatic variables and agricultural practices. During a preliminary study, the effect of certain agricultural practices on the survival of *Bacillus subtilis* (Avogreen) was evaluated. It was found that mi st blower and handgun application methods were equally effective in delivering the antagonist to the phylloplane, but that spray volumes could affect performance. Repeated pre-harvest applications resulted in a higher build-up of bacterial numbers on the leaves and increased the success of post-harvest disease control. Results showed that spreader and sticker agents should be avoided to ensure survival of the bacteria. The compilation of a predictive system for *B. subtilis* will consist of a combination of climatological information and antagonist behavior as influenced by agricultural practices.

SERVICES

Forest health extension

Responsible researchers: Dr Jolanda Roux (Extension and Monitoring)
Prof Teresa Coutinho (Diagnostic Clinic)
Mr Brett Hurley (Pest Monitoring and Extension)
Prof Mike Wingfield
Dr Prem Govender

Activities 2002/2003:

Extension activities form an important component of the Forest Protection Research Programme. These activities are divided into a number of components. They include all activities linked to monitoring of diseases and pests in forest plantations. Monitoring is further sub-divided into efforts to detect new pathogens and pests in a timely fashion and evaluation of the change in status of pathogens and pests that have been present for many years. One of the key components of the monitoring programme is the Di agnostic 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 for the South African forestry industry.

During 2001/2002 the Diagnostic clinic dealt with a significantly increased number of samples compared to previous years. Although this placed pressure on the group maintaining the clinic, the results justified the increasing efforts. Thus, data emerging from diagnoses were not only important to those requesting advice, but also contribute significantly to disease monitoring and the establishment of research priorities.

From January to December 2002, the clinic received a total of 461 samples. This is considerably more than the 271 samples received in 2001. The majority of samples were received in July, November and December. Most samples received were from pine (72%) followed by eucalypts (19%). Fewer samples wattle samples were received (4%). A number of water, growth media, seed samples and samples from indigenous trees (5%) were also tested for the presence of pathogens. Insect samples (5%) are included in this category.

Field extension and monitoring are a crucially important focus of the team leading the Tree Protection Co-operative Programme. Members of the group undertook field studies in all forestry areas of South Africa and spent a total of 636 person days in the field during 2002. This is a record as can be seen in contrast to the 483 person days spent on field work during 2001. An important component of extension and field activities included presentations on forest pests and diseases and training of foresters and farmers at field days.

"Tree Protection News", the newsletter of the research programme, continued to appear twice each year and remains an important means of distributing new information to members of the Programme. This newsletter now firmly incorporates both entomology and pathology activities of the Programme. Our experience has been that the publication of this newsletter results in significant feedback to the programme and that it is generally well received and appreciated by members. "Tree Protection News" continues to be distributed by the Institute for Commercial Forestry Research (ICFR) together with ICFR News, a system that has

functioned effectively during the course of the past three years. In addition to "Tree Protection News", the programme places shorter news items in two other issues of ICFR News. Similarly, news item s are provided to various other members at their request for inclusion in their company newsletters and articles are provided for the two major forestry magazines in the country.

FIELD EXTENTION ACTIVITIES:

TPCP students examining fruiting bodies on an *Eucalyptus* tree

The two photographs above illustrate participants from the major forestry companies at a field day learning about tree diseases and methods used to evaluate them

Microarray service

Facility manager: Prof Dave Berger

Technical assistant: Mr Danie Theron

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 4900 genes/slide on 36 replicate slides in a single spotting run. Arraying is done by a GEN III Array Spotter (Molecular Dynamics, Sunnyvale, California, USA) housed in a controlled-environment room. Arrayed slides are then made available to users who carry out the required experimental procedures in their own laboratories. After this, users return their slides for the scanning service, in which the hybridization signals across the glass slide are measured and quantified using a GenePix 4000B scanner (Axon Instruments, Foster City, California, USA). The results in the form of images and data sheets are then provided to the user electronically.

The Facility is equipped with data capture software and a data analysis pipeline is being established. In future, with completion of the new building adjacent to FABI, which will house a Bioinformatics facility on the third floor, the Microarray Facilty aims to provide microarray bioinformatics support in addition to the current wet-lab service.

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

Microarray spotter

Publications 2001/2003

These lists include only publications that had appeared by the end of May 2003. Manuscripts in press and submitted for publication are not included.

In refereed journals

ADANDONON A., AVELING T.A.S., LABUSCHAGNE N. & AHOHUENDO B.C. 2001. *Pythium/Rhizoctonia* complex causing damping-off of cowpea in South Africa. *African Plant Protection* 7: 111-113.

ALEMU GEZAGHNE, ROUX J. & WINGFIELD M.J. 2003. Diseases of exotic plantation *Eucalyptus* and *Pinus* species in Ethiopia. *South African Journal of Science* 99: 29-33.

BAHLMANN L., GOVENDER P. & BOTHA A-M. 2003. The leaf epicuticular wax ultrastructure and trichome presence on Russian wheat aphid (*Diuraphis noxia*) resistant and susceptible leaves. *African Entomology* 11: 59-64.

BARNES I., GAUR A., BURGESS T., ROUX J., WINGFIELD B.D. & WINGFIELD M.J. 2001. Microsatellite markers reflect intra specific relationships between isolates of the vascular wilt pathogen *Ceratocystis fimbriata*. *Molecular Plant Pathology* 2: 319-326.

BARNES I., ROUX J., WINGFIELD M.J., COETZEE M.P.A. & WINGFIELD B.D. 2001. Characterisation of *Seiridium* spp. associated with cypress canker based on β-tubulin and histone sequences. *Plant Disease* 85: 317-321.

BRITZ H., COUTINHO T.A., GORDON T.R. & WINGFIELD M.J. 2001. Characterisati on of the pitch canker fungus, *Fusarium circinatum*, from Mexico. *South African Journal of Botany* 67: 609-614.

BRITZ H., COUTINHO T.A., WINGFIELD B.D. & WINGFIELD M.J. 2002. Sequenced characterized amplified polymorphic markers for the pitch canker pathogen, *Fusarium circinatum*. *Molecular Ecology Notes* 3: 577-580.

BRITZ H., COUTINHO T.A., WINGFIELD M.J. & MARASAS W.F.O. 2002. Validation of the description of *Gibberella circinata* and morphological differentiation of the anamorph *Fusarium circinatum*. *Sydowia* 54: 9-22.

BRITZ H., STEENKAMP E.T., COUTINHO T.A., WINGFIELD B.D., MARASAS W.F.O. & WINGFIE LD M.J. 2002. Two new species of *Fusarium* section *Liseola* associated with mango malformation. *Mycologia* 94: 722-730.

BURGESS, T., WINGFIELD M.J. & WINGFIE LD B.D. 2001. Comparison of genotypic diversity in native and introduced populations of *Sphaeropsis sapinea* isolated from *Pinus radiata*. *Mycological Research* 105: 1331-1339.

BURGESS, T., WINGFIELD M.J. & WINGFIELD B.D. 2001. Simple sequence repeat (SSR) markers distinguish between morphotypes of *Sphaeropsis sapinea*. *Applied and Environmental Microbiology* 67: 354-362.

CHIMWAMUROMBE P.M., BOTHA A.M., WINGFIELD M.J. & WINGFIELD B.D. 2001. Molecular relatedness of the polygalacturonase-inhibiting protein genes in *Eucalyptus* species. *Theoretical and Applied Genetics* 102: 645-650.

CHIMWAMUROMBE P.M., WINGFIELD B.D., BOTHA A-M. & WINGFIELD M.J. 2002. Molecular analysis of an endopolygalacturonase gene from *Eucalyptus* canker pathogen, *Cryphonectria cubensis*. *DNA sequence* 13: 33-37.

CHIMWAMUROMBE P.M., WINGFIELD B.D., BOTHA A-M. & WINGFIELD M.J. 2001. Cloning and sequence analysis of the endopolygalacturonase gene *Fcpg* from the pitch canker fungus, *Fusarium circinatum*. *Current Microbiology* 42: 350-352.

CHIMWAMUROMBE P.M., WIN GFIELD B.D., BOTHA A-M., & WINGFIELD M.J. 2001. Molecular relatedness of the polygalacturonase-inhibiting protein genes of *Eucalyptus* species. *Theoretical and Applied Genetics* 102: 645-650.

COETZEE M.P.A., WINGFIELD B.D., HARRINGTON T.C., STEIMEL J., COUTINHO T.A. & WINGFIELD M.J. 2001. The root rot fungus *Armillaria mellea* introduced into South Africa by early Dutch settlers. *Molecular Ecology* 10: 387-396.

COETZEE M.P.A., WING FIELD B.D., RIDLEY G.S., KILE G.A. & WINGFIELD M.J. 2001. Phylogenetic relationships of Australian and New Zealand *Armillaria* species. *Mycologia* 93: 887-896.

COUTINHO T.A., PREISIG O., MERGAERT J., CNOCKAERT M.C., RIEDEL K-H., SWINGS J. & WINGFIELD M.J. 2002. Bacterial blight and die-back of *Eucalyptus* species, hybrids and clones in South Africa. *Plant Disease* 86: 20-25.

CROUS P.W., L.I HONG, WINGFIELD B.D. & WINGFIELD M.J. 2001. ITS rDNA phylogeny of selected *Mycosphaerella* spp. and their anamorphs occurring on Myrtaceae. *Mycologia* 105: 425-431.

DE JAGER E.S., HALL A.N., WEHNER F.C. & KORSTEN L. 2001. Microbial ecology of the mango phylloplane. *Microbial Ecology* 42: 201-207.

DE WET J., WINGFIELD M.J., COUTINHO T. & WINGFIELD B.D. 2002. Characterisation of the "C" morphotype of the pine pathogen *Sphaeropsis sapinea*. *Forest Ecology and Management* 161: 181-188.

DOYLE J.H., BOTHA A-M. & WINGFIELD B.D. 2002. Identification of pine hybrids using SSR loci. *South African Forestry Journal* 193: 25-30.

DOYLE J.H., VERHOEVEN R.L., BESTER C., WINGFIELD B.D. & BOTHA A-M. 2002 Germ-furrow morphology and storage conditions determine the degree of viability of *Pinus caribaea* pollen. *South African Journal of Botany* 68: 1-7.

GEZAGHNE A., ROUX J. & WINGFIELD M.J. 2002. First report of pink disease on *Eucalyptus camadulensis* in Ethiopia. *Plant Pathology* 51:

GOLD C.S., KIGGUNDU A., ABERA A.M.K. & KARAMURA D. 2002. Selection criteria of *Musa* cultivars through a farmer participatory appraisal survey in Uganda. *Experimental Agriculture* 38: 29-38

GOLD C.S., KIGGUNDU A., ABERA A.M.K. & KARAMURA D. 2002. Diversity, distribution and farmer preference of *Musa* cultivars in Uganda. *Experimental Agriculture* 38: 39-50

GRIMBEEK E.J., VILJOEN A., & BENTLEY S. 2001. First occurrence of Panama disease in two banana growing areas of South Africa. *Plant Disease* 85: 1211.

GRYZENHOUT M., EISENBERG B.E., COUTINHO T.A., WINGFIELD B.D. & WINGFIELD M.J. 2002. Pathogenicity of *Cryphonectria eucalypti* to *Eucalyptus* clones in South Africa. *Forest Ecology Management.* 176: 427-437.

GWANAMA C., LABUSCHAGNE M.T. & BOTHA A-M. 2001. Genetic effects and Heterosis of flowering and fruit characteristics of tropical pumpkin. *Plant Breeding* 120: 271-272.

HENNING B.J., SNYMAN H.G. & AVELING T.A.S. 2001. Plant-soil interactions of sludge-borne heavy metals and effect on maize (*Zea mays* L.) seedling growth. *Water SA* 27: 87-95.

JACOBS K., WINGFIELD M.J. & WINGFIELD B.D. 2001. Phylogenetic relationships in *Leptographium* based on morphological and molecular characters. *Canadian Journal of Botany* 79: 719-732.

JACOBS K., WINGFIELD M.J., COETSEE C., KIRISITS T. & WINGFIELD B.D. 2001. *Leptographium guttulatum* sp. nov., a new species from spruce and pine in Europe. *Mycologia* 93: 380-388.

JACOBS K., WINGFIELD M.J., JACOBS A. & WINGFIELD B.D. 2001. A taxonomic re-evaluation of *Phialocephala phycomyces*. *Canadian Journal of Botany* 79: 110-117.

JACOBS K., WINGFIELD M.J., UZUNOVIC A. & FRISULLO S. 2001. Three new species of *Leptographium* from pine. *Mycological Research* 105: 490-499.

JACOBY, A., VAN DER WESTHUIZEN A.J. & BOTHA A-M. 2002. Embryonic suspension cultures of *Pinus radiata* Don. *South African Forestry Journal* 194: 53-58.

JANISIEWICZ W. & KORSTEN L. 2002. Biological control of postharvest diseases of fruits. *Annual Review of Plant Pathology* 40: 411-441.

JANSE VAN RENSBURG J.C., LABUSCHAGNE N. & NEMEC S. 2001. Occurrence of *Fusarium*-produced naphthazarins in citrus trees and sensitivity of rootstocks to isomaricin in relation to citrus blight. *Plant Pathology* 50: 258-265.

KRITZINGER Q., AVELING T.A.S. & MARASAS W.F.O. 2002. Effect of essential plant oils on storage fungi, germination and emergence of cowpea seeds. *Seed Science and Technology* 30: 609-619.

KUNERT K., BAAZIZ M. & CULLIS C. 2003. Determination of true-to-type date palm (*Phoenix dactylifera* L.) plants: A literature review. *Emirates Journal of Agricultural Sciences* 15(1).

LABUSCHAGNE N., GULL C., WEHNER F.C. & BOTHA W.J. 2002. Report of root rot caused by *Pythium* Group F on hydroponically grown celery in South Africa. *Plant Disease* 86: 441.

LABUSCHAGNE N., GULL C., WEHNER F.C. & BOTHA W.J. 2002. *Pythium* spp. infecting hydroponically grown lettuce in South Africa. *Plant Disease* 86: 1175.

LACOCK L., VAN NIEKERK C., LOOTS S., DU PREEZ F.B. & BOTHA A-M. 2003. Functional and comparative analysis of expressed sequences from *Diuraphis noxia* infested wheat obtained utilizing the Nucleotide Binding Site conserved motif. *African Journal of Biotechnology* 2: 75-81.

LOTTERING J.M., BOTHA A-M. & KLOPPER R.F. 2002. AFLP and RAPD markers linked to leaf rust resistance gene *Lr41* in wheat. *South African Journal of Plant and Soil* 19: 1-6.

LOUW C.A.M., REGNIER T.J.C. & KORSTEN L. 2002. Medicinal bulbous plants of South Africa and their traditional relevance in the control of infectious diseases. *Journal of Ethnopharmacology* 82: 147-154.

MARAIS G.J. & WINGFIELD M.J. 2001. *Ophiostoma africanum* sp.nov. and a key to other ophiostomatoid fungi associated with *Protea* infructescences. *Mycological Research* 105: 240-246.

MASEKO B., BURGESS T., COUTINHO T. & WINGFIELD M. 2001. First report of *Phytophthora nicotianae* associated with *Eucalyptus* die-back in South Africa. *Plant Pathology* 50: 413.

MASEKO B.O.Z. & COUTINHO T.A. 2002. Pathogenicity of *Phytophthora* and *Pythium* species associated with citrus root rot in South Africa. *South African Journal of Botany* 68: 327-332.

MEYER L., SLIPPERS B., KORSTEN L., KOTZE J.M. & WINGFIELD M.J. 2001. *Guignardia* species associated with citrus in South Africa. *South African Journal of Science* 97: 191-194.

MOLELEKI N., PREISIG O., WINGFIELD M.J., CROUS P.W. & WINGFIELD B.D. 2002. PCR -RFLP and

sequence data delineate several *Diaporthe* species associated with stone and pome fruit trees in South Africa. *European Journal of Plant Pathology* 108: 909-912.

MURRAY S.L., DENBY K.J., BERGER D.K. & LOAKE G.J. 2002. Disease Resistance Signalling in *Arabidopsis*: Applications for the Study of Plant Pathology in South Africa. *South African Journal of Science* 98: 161-165.

MURRAY S.L., THOMPSON G., VISSER A. & BERGER D.K. 2002. Transgenic potatoes (cv Late Harvest) show increased tolerance to potato leafroll virus in greenhouse and field trials. *South African Journal of Science* 98: 97-101.

MYBURG H., GRYZENHOUT M., HEATH R., ROUX J., WINGFIELD B.D. & WINGFIELD M.J. 2002. Cryphonectria canker on *Tibouchina* in South Africa. *Mycological Research* 106: 1299-1306.

MYBURG H., VENTER M., WINGFIELD B.D. & WINGFIELD M.J. 2002. ß- tubulin and Histone 3 gene sequences distinguish *Cryphonectria cubensis* from South Africa , Asia and South America. *Canadian Journal of Botany* 80: 577- 596.

O'KENNEDY M.M., BURGER J.T. & BERGER D.K. 2001. Transformation of elite white maize using the particle inflow gun and detailed analysis of a low copy integration event. *Plant Cell Reports* 20: 731-737.

PAKELA Y.P., AVELING T.A.S. & COUTINHO T.A. 2002. Effect of plant age, temperature and dew period on the severity of anthracnose of cowpea caused by *Colletotrichum dematium*. *African Plant Protection* 8: 65-68.

ROUX J., COUTINHO T.A., MAJUNI BYABASHAIJA D. & WINGFIELD M.J. 2001. Diseases of plantation *Eucalyptus* in Uganda. *South African Journal of Science* 97: 16-18.

ROUX J., STEENKAMP E.T., MARASAS W.F.O., WINGFIELD M.J. & WINGFIELD B.D. 2001. Characterisation of *Fusarium graminearum* from *Acacia* and *Eucalyptus* using ß-tubulin and histone gene sequences. *Mycologia* 93: 704-711.

ROUX J., WINGFIELD M.J. & CIBRIAN D. 2002. First report of Coniothyrium canker of *Eucalyptus* in Mexico. *Plant Pathology* 51: 382.

SANDERS G. M. & KORSTEN L. 2003. Comparison of cross inoculation potential of South African avocado and mango isolates of *Colletotrichum gloeosporioides*. *Microbiological Research* 158: 1-8.

SCHOCH C.L., CROUS P.W., WINGFIELD M.J. & WINGFIELD B.D. 2001. Phylogeny of *Calonectria* based on comparisons of ß-tubulin DNA sequences. *Mycological Research* 105: 1045-1052.

SLIPPERS B., WINGFIELD B.D., COUTINHO T.A. & WINGFIELD M.J. 2002. DNA sequence and RFLP data reflect relationships between *Amylostereum* species and their associated wood wasp vectors. *Molecular Ecology* 11: 1845-1854.

SLIPPERS B., WINGFIELD M.J., WINGFIELD B.D. & COUTINHO T.A. 2001. Population structure and possible origin of *Amylostereum areolatum* in South Africa. *Plant Pathology* 50: 206-210.

SMITH H., COUTINHO T.A., WOLFAARDT F.W. & WINGFIELD M.J. 2002. Relative susceptibility of northern and southern provenances of *Pinus greggii* to infection by *Sphaeropsis sapinea*. *Forest Ecology and Management* 166: 331-336.

SMITH H., CROUS P.W., WINGFIELD M.J., COUT INHO T.A. & WINGFIELD B.D. 2001. *Botryosphaeria eucalyptorum* sp. nov., a new species in the *B. dothidea*-complex on *Eucalyptus* in South Africa. *Mycologia* 93: 277-285.

SMITH H., WINGFIELD M.J. & COUTINHO T.A. 2002. The role of latent *Sphaeropsis sapinea* infection in post-hail associated die-back of *Pinus patula*. *Forest Ecology and Management* 164: 177-184.

STAUFFER C., KIRISITS T., NUSSBAUMER C., PAVLIN R. & WINGFIELD M.J. 2001. Phylogenetic relationships between the European and Asian eight spined larch bark Beetle populations (Coleoptera: Scolytidae) inferred from DNA sequences and fungal associates. *European Journal of Entomology* 98: 99-105.

STEENKAMP E.T., COUT INHO T.A., DESJARDIN S A.E., WINGFIELD B.D., MARASAS W.F.O. & WINGFIE LD M.J. 2001. *Gibberella fujikuroi* population E associated with maize and teosinte. *Molecular Plant Pathology* 2: 215-221.

STEENKAMP E.T., COUT INHO T.A., DESJARDIN S A.E., WINGFIELD B.D., MARASAS W.F.O. & WINGFIE LD M.J. 2002. Cryptic speciation in *Gibberella fujikuroi* mating population E. *Mycologia* 94: 1032-1043.

SURRIDGE A.K.J., VILJOEN A., CROUS P.W. & WEHNER F.C. 2003. Identification of the pathogen associated with Sigatoka disease of banana in South Africa. *Australasian Plant Pathology* 32: 27-31.

VAN DEN BERG N., AVELING T.A.S. & VAN DER MERWE C.F. 2002. Conidial morphology and development of *Alternaria cassiae* from cowpea. *African Plant Protection* 8: 69-74.

VAN DEN BERG N., AVELING T.A.S. & VENTER S.L. 2002. The evaluation of six fungicides for reducing *Alternaria cassiae* on cowpea seed. *Crop Protection* 21: 501-505.

VAN DER MERWE N.A., MYBURG H., WINGFIELD B.D., RODAS C. & WINGFIELD MJ. 2001. Identification of *Cryphonectria cubensis* from Colombia based on rDNA sequence data. *South African Journal of Science* 97: 295-296.

VAN DER VYVER C., SCHNEIDEREIT J., DRISCOLL S., TURNER J., KUNERT K. & FOYER C.H. 2003. Oryzacystatin I expression in transformed tobacco produces a conditional growth phenotype and enhances chilling tolerance. *Plant Biotechnology Journal* 1: 101-112

VAN DER WAALS J.E., KORSTEN L. & AVELING T.A.S. 2001. A review of early blight of potatoes. *African Plant Protection* 7: 91-102.

VAN DER WESTHUIZEN A.J., QIAN X-M., WILDING M. & BOTHA A-M. 2002. Purification and immunocytochemical localization of a wheat ß-1,3-glucanase induced by Russian wheat aphid infestation. *South African Journal of Science* 98: 197-202.

VAN HEERDEN S.W. & WINGFIELD M. 2001. Genetic diversity of *Cryphonectria cubensis* isolates in South Africa. *Mycological Research* 105: 94-99.

VAN HEERDEN, S.W., GELETKA L.M., PREISIG O., NUSS D.L., WINGFIELD B.D. & WINGFIELD M.J. 2001. Characterisation of South *African Cryphonectria cubensis* isolates infected with a *Cryphonectria parasitica* hypovirus. *Phytopathology* 91: 628-632.

VAN JAARSVELD E., WINGFIELD M.J. & DRENTH A. 2002. Effect of metalaxyl resistance and cultivar resistance on control of *Phytophthora nicotianae* in tobacco. *Plant Disease* 86: 362-366.

VAN ZYL L.M., COUTINHO T.A. & WINGFIELD M.J. 2002. Morphological, cultur al and pathogenic characteristics of *Coniothyrium zuluense* isolates from different plantation regions in South Africa. *Mycopathologia* 155: 149-153.

VAN ZYL L.M., COUTINHO T.A., WINGFIELD M.J., PONGPANICH K. & WINGFIELD B.D. 2002. Morphological and molecular relatedness of geographically diverse isolates of *Coniothyrium zuluense* from South Africa and Thailand. *Mycological Research* 106: 51-59.

VENTER M., EISENBERG B.E., COUTINHO T.A., WINGFIELD B.D. & WINGFIELD M.J. 2003. Pathogenicity of *Cryphonectria eucalypti* to *Eucalyptus* clones in South Africa. *Forest Ecology and Management* 176: 427-437.

VENTER M., MYBURG H., WINGFIELD B.D., COUTINHO T.A. & WINGFIELD M.J. 2002. A new species of *Cryphonectria* from South Africa and Australia, pathogenic to Eucalyptus. *Sydowia* 54: 98-117.

VENTER M., WINGFIELD M.J., & COUTINHO T.A. 2001. Molecular characterization of *Endothia gyrosa* isolates from *Eucalyptus* in South Africa and Australia. *Plant Pathology* 50: 211-217.

VILJOEN A. 2002. The status of Fusarium wilt of banana in South Africa. South African Journal of Science 98: 341-344.

VORSTER B.J., KUNERT K.J. & CULLIS C.A. 2002. Use of representational difference analysis for the characterization of sequence differences between date palm varieties. *Plant Cell Reports* 21: 271-275.

WINGFIELD M.J., COUTINHO T.A., ROUX J. & WINGFIELD B.D. 2002. The future of exotic plantation forestry in the tropics and southern Hemisphere: Lessons from pitch canker. *South African Forestry Journal* 195: 79-82.

WINGFIELD M.J., JACOBS A, COUTINHO T.A., AHUMADA R. & WINGFIELD B.D. 2002. First report of the pitch canker fungus, *Fusarium circinatum*, on pines in Chile. *Plant Pathology* 51: 397.

WINGFIELD M.J., RODAS C., MYBURG H., VENTER M., WRIGHT J. & WINGFIELD B.D. 2001. Cryphonect ria canker on *Tibouchina* in Colombia. *Forest Pathology* 31: 297-306.

WINGFIELD M.J., ROUX, COUTINHO T., GOVEN DER P. & WINGFIELD B.D. 2001. Plantation disease and pest management in the next century. *Southern African Forestry Journal* 190: 67-71.

WINGFIELD M.J., SLIPPERS B., ROUX J. & WINGFIELD B.D. 2001. Worldwide movement of exotic forest fungi especially in the tropics and Southern Hemisphere. *Bioscience* 51: 134-140.

WINGFIELD M.J., VAN WYK P.S. & BRYCE KENDRICK 2001. Analysis of conidogenesis: Hel ical conidiotaxis in percurrently extending conidiogenous cells. *South African Journal of Science* 96: 580-584.

XU DONG ZHOU, BURGESS T, DE BEER W., WINGFIELD B.D. & WINGFIELD M.J. 2002. Development of polymorphic microsatellite markers for the tree pathogen and sapstain agent, *Ophiostoma ips*. *Molecular Ecology Notes* 2: 309-312.

XU DONG ZHOU, DE BEER W., WINGFIELD B.D. & WINGFIELD M.J. 2001. Ophiostomatoid fungi associated with three pine-infesting bark beetles in South Africa. *Sydowia* 53: 290-300.

XU DONG ZHOU, DE BEER W., WINGFIELD B.D. & WINGFIELD M.J. 2003. Infection sequence and pathogenicity of *Ophiostoma ips*, *Leptographium serpens* and *L. lundbegii* to pines in South Africa. *Fungal Diversity Series* 10: 229-240.

Books

JACOBS K. & WINGFIELD M.J. 2001. *Leptographium* species. Tree pathogens, insect associates and agents of blue stain. American Phytopathological Society Press, St. Paul, Minnesota, U.S.A.

VILJOEN A. & ROBINSON J. 2002. Leaf diseases and disorders of banana in South Africa. FABI publication ISBN 0-620-28935-X.

Chapters in books and symposium proceedings

BORNMAN C.H., BOTHA A.M., STEYN A., VAN DER MERWE C. & DICKENS O.S.P. 2001. The disadvantage embryo. *Acta Horticulturae* 560: 369-372.

EL GHAOUTH A., WILSON C.L., WISNIEWSKI M., DROBY S., SMILANICK J.L. & KORSTEN L. 2002. Biological control of postharvest diseases on citrus fruits. In: *Biological control of crop diseases*. (Edited by Ghanamanickam, S.S.). New York: Marcel Dekker, Inc.

JANISIEWICZ W.J. & KORSTEN L. 2002. Microbial control of postharvest disease and spoilage. In: *Postharvest Physiology and Pathology of Vegetables.* (Edited by J.A Bartz & J.K. Brecht). Marcel Dekker, Inc.

KRITZINGER Q., AVELING T.A.S., MARASAS W.F.O., SHEPARD G.S. & LEGGOTT N. 2002. Detection of fumonisin B1 in cowpea seeds. In: Challenges and opportunities for enhancing sustainable cowpea production. Proceedings of the World Cowpea Conference III, International Institute of Tropical Agriculture, Ibadan, Nigeria, 4-8 September 2000.

LABUSCHAGNE N. 2001. Disease management in greenhouse crops – the role of technology. Combined Proceedings of the International Plant Propagators' Society 51: 51-54.

OLD K.M., VERCOE T.K., FLOYD R.B., WINGFIELD M.J., ROUX J. & NESER S. 2003. FAO/IPGRI Tec hnical guidelines for the safe movement of germplasm. No. 20 *Acacia* species. Food and Agricultural Organization of the United Nations, Rome/International Plant Genetics Resources Institute, Rome.

PEGG K.G., COATES L.M., KORSTEN L. & HARDING, R.M. 2002. Foliar, fruit and soilborne diseases. In: *Avocado Cultivation* (Edited by Whiley A.W., B. Schaffer & B.N. Wolstenholme). CAB International Press.

REDDY S., GAUME A., WEICH J., DENBY K.J. & BERGER D.K. (2002). DNA Microarrays: A New Tool for Bacterial Wilt Research. Bacterial Wilt Newsletter Issue 17.

ROUX J. 2002. Threats to wattle plantations III. Diseases. In: *Black wattle: the South African Research experience.* Institute for Commercial Forestry Research, Pietermaritzburg, South Africa.

SANDERS G.M. & KORSTEN L. 2002. Use of correlation analysis for the study of anthracnose on avocados and mangoes in South Africa. Proceedings of the International Symposium on Tropical and subtropical fruits, Cairns, Australia 27 November – 1 December 2000. *Acta Horticulturae* 575: 681-687.

WINGFIELD M.J., COUTINHO T.A., ROUX J. & WINGFIELD B.D. 2002. The future of exotic plantation forestry in the tropics and Southern Hemisphere: lessons from pitch canker. Wood For Africa 2002 Congress, Pietermaritzburg, July 1-3 2002.

Papers/posters delivered at international conferences

ADAMS G.C. & WINGFIELD M.J. 2001. Morphology and molecular phylogenetics of *Cytospora* species on *Eucalyptus*. Annual Meeting of the American Phytopathological Society, Salt Lake City, Utah, USA, 25-29 August 2001.

ADANONON A., AVELING T.A.S., LABUSCHAGNE N. & AHOHUENDO B. 2001. Epidemiology and biological control of the causal agent of damping off and stem rot of cowpea in the Queme Valley, Benin. The 2nd International Workshop of African Network of Research on Bruchids: recent developments in crop pre- and post-harvest pest management practices in Africa. Cotonou, Republic of Benin. 12-17 November 2001.

ALEMU GEZAGHNE, ROUX J. & WINGFIELD M.J. 2003. Diseases of plantation forestry species in Ethiopia. The 8th International Plant Pathology Congress, Christchurch, New Zealand. 2-7 February 2003.

AVELING T.A.S. 2001. The International Society of Plant Pathology-Sponsored Instructional Technology Symposium 2001. Online http://www.ispp-itsymposium.org.nz. Participation in discussions.

AVELING T.A.S. 2001. International workshop on seed health testing. National University, Taipei, Taiwan. 3 - 8 December 2001. Participated in workshop.

AVELING T.A.S. & POWELL A.A. 2001. Effect of storage potential and seed coat pigmentation on susceptibility of cowpeas to pre-emergence damping-off. 26th Congress of the International Seed Testing Association. Angers, France. 14-22 June 2001.

AVELING T.A.S. & SNYMAN H.G. 2003. Effect of sewage sludge on seedling growth of soybean in the greenhouse. Joint International Conference of the South African Association of Botanists and the International Society of Ethnopharmacology, Pretoria, South Africa. 7-11 January 2003.

AVELING T.A.S., ADANDONON A., KRITZINGER Q., PAKELA Y.P., SMITH J.E. & VAN DEN BERG N. 2001. Research developments on cowpea diseases in South Africa. The 2nd International Workshop of African Network of Research on Bruchids: recent developments in crop pre- and post-harvest pest management practices in Africa. Cotonou, Republic of Benin. 12-17 November 2001.

AVELING T.A.S., ADANDONON A., KRITZINGER Q., PAKELA Y.P., SMITH J.E. & VAN DEN BERG N. 2001. Research on cowpea diseases in South Africa. The 2nd International Workshop of African Network of Research on Bruchids: recent developments in crop pre- and post-harvest pest management practices in Africa. Cotonou, Republic of Benin. 12-17 November 2001.

AVELING T.A.S., KRITZINGER Q., PAKELA Y.P. & REGNIER T. 2003. Seed pathological aspects of cowpea. The 8th International Congress of Plant Pathology, Christchurch, New Zealand. 2-7 February 2003.

BARNES I., ROUX J., WINGFIELD B.D. & WINGFIELD M.J. 2002. Population structure of *Ceratocystis fimbriata* from Congo, Colombia and Uruguay determined using microsatellite markers. The 7th International Mycological Congress, Oslo, Norway. 11-17 August 2002.

BARNES I., ROUX J., WINGFIELD B.D., DUDZINSKI B.D., OLD K. & WINGFIELD M.J. 2002. A new species of *Ceratocystis* discovered on *Eucalyptus nitens* in Australia. The 7th International Mycological Congress, Oslo, Norway. 11-17 August 2002.

BERGER D.K., O'KENNEDY M.M., OELOFSE D., CAMPBELL B. & VAN RENSBURG J.B.J. 2002. Towards engineering maize for fungal resistance in South Africa.

The 4th Plant Breeding Symposium, Gordons Bay, South Africa.

BESTER C., KUNERT K.J. & CULLIS C.A. 2001. Are transgenic plants normal? Plant & Animal Genome IX Conference, San Diego, CA, USA. 13-17 January 2001.

BOTHA A-M, LACOCK L., VAN NIEKERK C., LOOTS S. & DU PREEZ F.B. 2001. Evaluation of Expressed Sequence Tags (ESTs) from Russian wheat aphid induced wheat cDNA libraries. Annual meeting of the American Society of Plant Biology, Providence, Rhode Island, USA. 21-25 July 2001.

BOTHA A-M, LACOCK L., VAN NIEKERK C., LOOTS S., BAHLMANN L., & DU PREEZ F.B. 2001. Evaluation of Expressed Sequence Tags (ESTs) from Russian wheat aphid induced wheat cDNA libraries. The Quadrennial joint annual meetings of the American Society of Plant Biology and Canadian Society of Plant Physiologists, Providence, Rhode Island, USA. 21-25 July 2001.

BOTHA A-M. 2002. Transfromation of *Arachis hypogeae* L. with a cystatin for improved insect resistance. 4th Plant Breeding Symposium of the Southern African Plant Breeders Association, Gordons' Bay, South Africa. 11-14 March 2002.

BURGESS T., GORDON T. WINGFIELD B.D. & WINGFIELD M.J. 2003. Native *Pinus radiata* at risk from common pine pathogen. The 8th International Congress of Plant Pathology, Christchurch, New Zealand. 2-7 February 2003.

CAMPBELL B.G., MURRAY S., DENBY K.J. & D.K. BERGER 2002. RNA quality control experiments for cDNA microarray analysis. The XIII Conference on Arabidopsis Research in Seville, Spain.

CHIMWAMUROMBE P.M. & WINGFIELD B.D., A-M. BOTHA & WINGFIELD M.J. 2001. Molecular characterization of eucalyptus PGIPs. 10th International Congress of Molecular Plant Microbe Interactions, Madison, Wisconsin, USA. 10-14 July 2001.

COETZEE M.P.A., WINGFIELD B.D., BLOOMER P. & WINGFIELD M.J. 2001. Phylogeny of southern hemisphere *Armillaria* species. Annual Meeting of the American Phytopathological Society, Salt Lake City, Utah, USA. 25 – 29 August 2001.

COETZEE M.P.A., WING FIELD B.D., BLOOMER P. & WINGFIELD M.J. 2002. Biogeography and possible origin of *Armillaria* species. The 7th International Mycological Congress, Oslo, Norway. 11 -17 August 2002.

COETZEE M.P.A., WINGFIELD B.D., KIRISITS T., CHETRI D.B. & WINGFIELD M.J. 2002. Identification of *Armillaria* isolates from Bhutan based on ITS and IGS-1 sequences. The 7th International Mycological Congress, Oslo, Norway. 11 -17 August 2002.

COUTINHO T.A., VENTER S.N., MERGAERT J, SWINGS J. & WINGFIELD M.J. 2003. Is *Pantoea ananatis* a high risk, quarantine pathogen? 8th International Congress of Plant Pathology, Christchurch, New Zealand, 2 – 7 February 2003.

DE WET J., BURGESS T., WINGFIELD M.J. & WINGFIELD B.D. 2001. Characterization of *Sphaeropsis sapinea* morphotypes using multiple gene genealogies and microsatellite markers. Annual Meeting of the American Phytopathological Society, Salt Lake City, Utah, USA. 25-29 August 2001.

DE WET J., MOLELEKI N., PREISIG O., WINGFIELD M.J. & WINGIFELD B.D. 2001. Occurrence of dsRNA elements in isolates of the pine pathogen *Sphaeropsis sapinea* from diverse geographic sources. Annual Meeting of the American Phytopathological Society, Salt Lake City, Utah, USA. 25-29 August 2001.

DE WET J., WINGFIELD M.J., BURGESS T., SLIPPERS B. & WINGFIELD, B.D. 2003. Multiple gene genealogies and microsatellite markers reflect relationships between the morphotypes of *Sphaeropsis sapinea* and identify a new species. The 8th International Congress of Plant Pathology, Christchurch, New Zealand. 2-7 February 2003.

DENMAN S., CROUS P.W. & WINGFIELD M.J. 2001. *Botryosphaeria dothidea* as an endophyte in *Protea magnifica*: A comparison of commercially cultivated and naturally occurring plants. Annual Meeting of the American Phytopathological Society, Salt Lake City, Utah, USA. 25-29 August 2001.

DU PLOOY G.W., VAN DER MERWE C.F., ROBBERTSE P.J. & KORSTEN L. 2003. Morphology of epicuticular layers of mango fruit. Joint International Conference of the South African Association for Botanists and the International Society for Ethnopharmacology, Pretoria, South Africa. 7-11 January 2003.

DU PREEZ F. & BOTHA A-M. 2002. Utilizing degenerate PCR technology to obtain Nucleotide Binding Site-Leucine Rich Repeat (NBS-LRR) proteins from wheat (*Triticum aestivum* L. em. Thell.) linked to pest resistance in plants. 4th Plant Breeding Symposium of the Southern African Plant Breeders Association, Gordons' Bay, South Africa, 11-14 March 2002.

GELDENHUIS M.M., ROUX J., WINGFIELD B.D., DE BEER Z.W. & WINGFIELD M.J. 2001. Ophiostomatoid fungi associated with diseased *Schizolobium parahybum*. Annual Meeting of the American Phytopathological Society, Salt Lake City, Utah, USA. 25-29 August 2001.

GEZAHGNE A., ROUX J. & WINGFIELD M.J. 2002. First report of Coniothyrium stem canker in on *Eucalyptus camaldulensis* in Ethiopia. The 7th International Mycological Congress, Oslo, Norway. 11 -17 August 2003.

GOVENDER P. & VILJOEN A. 2002. The biology and management of the banana weevil, Cosmopolites sordidus in South Africa. 1st Banana weevil worksgroup meeting, Tenerife, Canary Islands, Spain.

GRYZENHOUT M.V., MYBURG H, WINGFIELD M.J. & WINGFIELD B.D. 2002. Reconsideration of the conspecificity of *Endothia eugeniae* and *Cryphonectria cubensis*. The 7th International Mycological Congress, Oslo, Norway. 11 -17 August 2002.

GRYZENHOUT M.V., MYBURG H., WINGFIELD M.J. & WINGFIELD B.D. 2002. *Cryphonectria cubensis* resides in a genus outside *Cryphonectria*. The 7th International Mycological Congress, Oslo, Norway. 11 -17 August 2002.

HEATH R.N., GRYZENHOUT M.V., ROUX J. & WINGFIELD M.J. 2002. The discovery of *Cryphonectria cubensis* on native *Syzigium* spp. from South Africa. The 7th International Mycological Congress, Oslo, Norway. 11-17 August 2002.

HEATH R.N., ROUX J., VAN DER MERWE N.A., WINGFIELD B.D. & WINGFIELD M.J. 2003. Population structure of *Cryphonectria cubensis* in South Africa. The 8th International Congress of Plant Pathology, Christchurch, New Zealand. 2-7 February 2003.

HUNTER G.C., ROUX J., COUTINHO T.A., CROUS P.W., WINGFIELD B.D. & WINGFIELD M.J. 2001. *Mycosphaerella* species causing Mycosphaerella leaf blotch on *Eucalyptus* species in South Africa. Annual Meeting of the Phytopathological Society of America, Salt Lake City, Utah, USA. 25-29 August 2001.

HUNTER G.C., WINGFIELD M.J., CROUS P.W., ROUX J., COUTINHO T. & WINGFIELD B.D. 2003. *Mycosphaerella* species causing Mycosphaerella leaf disease on *Eucalyptus* in South Africa. The 8th International Congress of Plant Pathology, Christchurch, New Zealand, 2-7 February 2003.

JACOBS A., COUTINHO T.A., WINGFIELD M.J., AHUMADA R. & WINGFIELD B.D. 2003. Identification and characterization of the pitch canker fungus, *Fusarium circinatum*, in Chile. The 8th International Congress of Plant Pathology, Christchurch, New Zealand, 2-7 February 2003.

JACOBS A., STEENKAMP E.T., COUTINHO T.A., RAMOTSHODI G., WINGFIELD B.D. & WINGFIELD M.J. 2002. Molecular and morphological comparisons of *Fusarium* species accommodated in the *Fusarium subglutinans sensu lato* complex. The 7th International Mycological Congress, Oslo, Norway. 11 -17 August 2002.

JACOBS K. & WINGFIELD M.J. 2001. *Leptographium* species. Tree pathogens, insect associates and agents of blue stain. Annual Meeting of the American Phytopathological Society, Salt Lake City, Utah, USA. 25-29 August 2001.

KIGGUNDU A., KUNERT K.J., VILJOEN A., GOLD C., & PILLAY M. 2002. Designing proteinase inhibitors for banana weevil control. 3rd Meeting on the Cellular and Molecular Biology of Banana. Leuven, Belgium.

KIRISITS T., KONRAD H., JACOBS K. & WINGFIELD M.J. 2002. Survey of Ophiostomatoid fungi in Austria, Central Europe. The 7th International Mycological Congress, Oslo, Norway. 11-17 August 2002.

KIRISITS T., WINGFIELD M.J. & CHHETRI D.B. 2002. Ophiostomatoid fungi assocaited with the Eastern Himalayan spruc bark beetle *Ips schmutzenhoferi* and other bark beetles in Bhutan. The 7th International Mycological Congress, Oslo, Norway. 11 -17 August 2002.

KORSTEN L. 2003. Current status and future prospects of postharvest biocontrol. Biocontrol of Postharvest Diseases Workshop, Christchurch, New Zealand. 2 February 2003.

KRITZINGER Q., AVELING T.A.S. & MARASAS W.F.O. 2001. Contamination of cowpea (*Vigna unguiculata* (L.) Walp) seed by storage fungi and mycotoxins. British Mycological Society International Symposium on Bioactive Fungal Metabolites - Impact and Exploitation. University of Wales, Swansea, Wales. 22-27 April 2001.

KRITZINGER Q., AVELING T.A.S. & MARASAS W.F.O. 2001. Effect of essential plant oils on the growth of storage fungi associated with cowpea seeds. 26th Congress of the International Seed Testing Association. Angers, France. 14-22 June 2001.

KRITZINGER Q., AVELING T.A.S., RHEEDER J.P. & VAN DER WESTHUIZEN L. 2003. Fumonisin production in cowpea by *Fusarium proliferatum*. The 8th International Congress of Plant Pathology, Christchurch, New Zealand. 2-7 February 2003.

KRITZINGER Q., LALL N. & AVELING T.A.S. 2003. Antimicrobial activity of cowpea (*Vigna unguiculata* (L.) Walp) leaf extracts. Joint International Conference of the South African Association of Botanists and the International Society of Ethnopharmacology, Pretoria, South Africa. 7-11 January 2003.

KUNERT K.J., VAN DER VYVER C., CULLIS C. & FOYER C.H. 2001. Evaluation of oryzacystatin I expressing plants for abiotic stress resistance. Plant Biology 2001. Providence, RI. 21-25 January 2001.

LABUSCHAGNE P.M., KORSTEN, L. REGNIER, T. SANDERS, G.M. & MEYER, L. 2003. Effect of temperature, pH, flavonoids and chemicals on the germination of *Phyllosticta citricarpa* pycnidiospores. The 8th International Conference of Plant Pathology. Christchurch, New Zealand. 2-7 February 2003.

LACOCK L. & BOTHA A-M. 2002. Expressed sequence tags (ESTs) obtained after analysis of cDNA prepared from Russian wheat aphid induced wheat line PI 137739. 4th Plant Breeding Symposium of the Southern African Plant Breeders Association, Gordons' Bay, South Africa, 11-14 March 2002.

LOOTS S., VENTER E. & BOTHA A-M. 2002. Russian wheat aphid induced sequences in PI 294994 identified using suppression substractive hybridisation. 4th Plant Breeding Symposium of the Southern African Plant Breeders Association, Gordons' Bay, South Africa, 11-14 March 2002.

LOUW C.A.M., REGNIER T. & KORSTEN L. 2003. Antimicrobial activity of bulbous plant leaf extracts to control postharvest and foodborne diseases. Joint International Conference of the South African Association for Botanists and the International Society for Ethnopharmacology, Pretoria, South Africa. 7-11 January 2003.

MARIN M., CASTRON B., GAITAN A., PREISIG O., WINGFIELD B.D. & WINGFIELD M.J.. 2002. Phenotypic and molecular vaariability amongst isolates of

Ceratocystis fimbriata, causing coffee tree canker in Colombia. The 7th International Mycological Congress. Oslo, Norway. 11-17 August 2002.

MARIN, M., PREISIG, O., WINGFIELD B.D., T. KIRISITS & WINGFIELD, M.J. 2002. Single sequence repeat markers reflect population diversity and genetic barriers of *Ceratocystis polonica* in Eurasia. The 7th International Mycological Congress, Oslo, Norway. 11-17 August 2002.

MOLELEKI N., PREISIG O., WINGFIELD M.J. & WINGFIELD B.D. 2001. Studies of the effects of *Diaporthe ambigua* RNA virus (DaRV) on naturally infected and transfected isolates of *Diaporthe ambigua*. 6th International Symposium on Postive Strand RNA viruses, Institut Pasteur, Paris, France. 28 May - 2 June 2001.

MYBURG H., GRYZENHOUT M., WINGFIELD B.D. STIPES R.J. & WINGFIELD M.J. 2003. Taxonomic re-evaluation of the genera *Cryphonectria* and *Endothia* based on morphology and DNA sequence data. The 8th International Congress of Plant Pathology, Christchurch, New Zealand. 2-7 February 2003.

NAKABONGE G., BARNES I., ROUX J. & WINGFIELD M.J. 2002. Ceratocystis wilt of *Acacia mearnsii* in Uganda. The 7th International Mycological Congress. Oslo, Norway. 11-17 August 2002.

NAKABONGE G., ROUX J., COUTINHO T.A. & WINGFIELD M.J. 2003. Bacterial blight and die-back of *Eucalyptus* in Uganda. The 8th International Congress of Plant Pathology, Christchurch, New Zealand, 2-7 February 2003.

OBAGWU J., REGNIER T. & KORSTEN L. 2003. Control of citrus black spot with plant extracts. The 8th International Conference of Plant Pathology, Christchurch, New Zealand. 2-7 February 2003.

PREISIG O., MOLELEKI N., WINGFIELD B.D. & WINGFIELD M.J. 2001. A novel RNA virus in the fungus *Diaporthe ambigua* is related to plant *Tombusviridae*. The 6th International Symposium on Positive Strand RNA viruses, Institut Pasteur, Paris, France. 28 May – 2 June 2001.

REDDY S. & BERGER D.K. 2002. DNA Microarrays: A New Tool for Bacterial Wilt Research. 3rd International Bacterial Wilt Symposium (IBWS), White River, South Africa. 4-8 February 2002.

REGNIER T. 2003. Seed pathological aspects of cowpea. The 8th International Congress of Plant Pathology, Christchurch, New Zealand. 2-7 February 2003.

REGNIER T.S., LABUSCHAGNE P.M., SWART G.M. & KORSTEN, L. 2003. Toxicity of flavonoids, natural products and chemicals to *Guignardia citricarpa* Kiely Joint International Conference of the South African Association for Botanists and the International Society for Ethnopharmacology, Pretoria, South Africa. 7-11 January 2003.

ROUX J., HEATH R.N., VAN DER HOEF A. & WINGFIELD M.J. 2001. First report of pink disease on *Eucalyptus* and *Podocarpus* in South Africa. Annual Meeting of the American Phytopathological Society, Salt Lake City, Utah, USA. 25-29 August 2001.

ROUX J., NAKABONGE G., BARNES I., WINGFIELD B.D. & WINGFIELD M.J. 2002. *Ceratocystis albofundus*, an African fungus causing a wilt disease of exotic *Acacia mearnsii*. The 7th International Mycological Congress. Oslo, Norway. 11-17 August 2002.

ROUX J., NAKABONGE G., BARNES I., WINGFIELD M.J. & WINGFIELD B.D. 2001. *Ceratocystis albofundus*, a wilt pathogen of *Acacia mearnsii* in Africa. Annual Meeting of the American Phytopathological Society, Salt Lake City, Utah, USA. 25-29 August 2001.

ROUX J., VAN DER HOEF A. & WINGFIELD M.J. 2003. Pink disease of native and exotic tree species in South Africa. The 8th International Plant Pathology Congress, Christchurch, New Zealand. 2-7 February 2003.

SANDERS G.M., MEYER L. & KORSTEN L. 2003. Application of species specific primers in the South African citrus industry. The 8th International Conference of Plant Pathology. Christchurch, New Zealand. 2-7 February 2003.

SCHROERS H-I., GELDENHUIS M.M., WINGFIELD M.J., SCHOEMAN M.H. WINGFIELD B.D. & SUBRAUMANIAN C.V. 2003. Introduction of *Nalanthanala* for the guava wilt fungus and palm pathogen *Gliocladium vermoesenii*. The 7th International Congress of Plant Pathology, Christchurch, New Zealand. 2-7 February 2003.

SLIPPERS B., COUTINHO T.A., WINGFIELD B.D. & WINGFIELD M.J. 2002. Identifying species in the genus *Botryosphaeria*. The 7th International Mycological Congress, Oslo, Norway. 11-17 August 2002.

SLIPPERS B., COUTINHO T.A., WINGFIELD B.D. & WINGFIELD M.J. 2002. Relationships amongst the fungal symbionts of Siricid woodwasps and their spread in the Southern Hemisphere. The 7th International Mycological Congress, Oslo, Norway. 11-17 August 2002.

STEENKAMP E.T., COUTINHO T.A., DESJARDINS A.E., WINGFIELD B.D., MARASAS W.F.O. & WINGFIELD M.J. 2001. Cryptic speciation in *Gibberella fujikuroi* mating population E. Annual Meeting of the Mycological Society of America, Vermont, USA.

STEENKAMP E.T., COUTINHO T.A., DESJARDINS A.E., WINGFIELD B.D., MARASAS W.F.O. & WINGFIELD, M.J. 2001. Cryptic speciation in *Giberella fujikuroi* mating population E. Annual Meeting of the American Phytopathological Society, Salt Lake City, Utah, USA, 25-29 August 2001.

STRONKHORST L.D., VILJOEN A., CLAASSENS A.S., NEL B., & VAN DER WAALS J.H. 2003. The effect of N-fertilization and pH on the incidence of Fusarium Wilt (Panama disease) of banana in greenhouse trials. 8th International Symposium on Soil and Plant Analysis, Somerset West, 13-17 January 2003.

SURRIDGE A.K.J., VILJOEN A. & WEHNER, F. 2002. Fungi associated with banana foliage in South Africa. 2nd International Workshop on Mycosphaerella leaf spot diseases of Banana. San Jose, Costa Rica. 20-23 May 2002.

VAN DEN BERG N., BIRCH P., VILJOEN A., WINGFIELD M.J., VISSER M. & BERGER D. 2002. Suppression subtraction hybrization used to identify genes associated with resistance to *Fusarium oxysporum* f.sp. *cubense* in Cavendish bananas. 3rd Meeting on the Cellular and Molecular Biology of Banana, Leuven, Belgium. 9-11 September 2002.

VAN DER MERWE M., VAN WYK A.E. & BOTHA A-M. 2002. Towards a phylogeny of *Eugenia* (Myrtaceae): cpDNA variation of species from South Africa and Mauritius. Plant Species-level Systematics: patterns, processes and new applications - Nationaal Herbarium Leiden Special Symposium. Leiden, The Netherlands, November 2002.

VAN DER MERWE N.A., WINGFIELD B.D. & WINGFIELD M.J. 2003. DNA data reveal the population structure of *Cryphonectria cubensis*. The 8th International Congress of Plant Pathology, Christchurch, New Zealand. 2-7 February 2003.

VAN DER WAALS J.E., KORSTEN L. & DENNER F.D.N. 2001. Accuracy of spore dispersal module in the potato early blight forecaster, Plant-Plus, in South Africa. The 8th International Workshop on Plant Disease Epidemiology, Ouro Preto, Brazil. 6-11 May 2001.

VAN HEERDEN S., PREISIG O., WINGFIELD B.D. & WINGFIELD M.J. 2001. Characterisation of mitoviruses associated with the fungal pathogen *Cryphonectria cubensis*. The 6th International Symposium on Postive Strand RNA viruses, Institut Pasteur, Paris, France. 28 May – 2 June 2001.

VAN NIEKERK C. & BOTHA A-M. 2002. Identification of Expressed sequence Tags (ESTs) obtained from Russian wheat aphid induced wheat cDNA libraries to pest resistance. 4th Plant Breeding Symposium of the Southern African Plant Breeders Association, Gordons' Bay, South Africa. 11-14 March 2002.

VAN WYK M., ROUX J., HATTING H., BARNES I., WINGFIELD B.D. & WINGFIELD M.J. 2003. *Ceratocystis* species associated with wounds on *Eucalyptus grandis* in South Africa. The 8th International Congress of Plant Pathology, Christchurch, New Zealand. 2-7 February 2003.

VENTER E, WINGFIELD B.D., WINGFIELD M.J. & BOTHA A-M. 2003. Induction of gene sequence in *Pinus patula* after inoculation with the pitch canker pathogen, *Fusarium circinatum*.8 The th International Congress for Plant Pathology, Christchurch, New Zealand, 2-7 February 2003.

VENTER E., WINGFIELD B.D., WINGFIELD M.J. & BOTHA A-M.. 2001. Induced sequences linked to a resistance response in *Pinus patula* infected with *Fusarium circinatum*. The Quadrennial joint annual meetings of the American Society of Plant Biology and Canadian Society of Plant Physiologists, Providence, Rhode Island, USA. 21-25 July 2001.

VENTER M., MYBURG H., WINGFIELD M.J. & WINGFIELD B.D. 2001. *Cryphonectria cubensis* represents a new genus comprised of three species. Annual Meeting of the American Phytopathological Society, Salt Lake City, Utah, USA. 25-29 August 2001.

VILJOEN A., SURRIDGE A.K.J. & CROUS P.W. 2002. The impact of minor *Mycosphaerella* spp. on banana in South Africa. The 2nd International Workshop on Mycosphaerella leaf spot diseases of Banana. San Jose, Costa Rica. 20-23 May 2002.

VISSER M. & VILJOEN A. 2002. Diversity in *Fusarium oxysporum* f.sp. *cubense*: Molecular biological studies of a clonal lineage of Fusarium wilt pathogen of banana. The VI International Symposium on Plant Biotechnology, Villa Clara, Cuba.

VISSER M., VILJOEN A., WINGFIELD M.J., WINGFIELD B.D. & GORDON T.R. 2002. Mating type genes and the reproductive capability of *Fusarium oxysporum* f.sp. *cubense*. The 3rd Meeting on the Cellular and Molecular Biology of Banana. Leuven, Belgium.

VISSER M., VILJOEN A., WINGFIELD M.J., WINGFIELD B.D. & GORDON T.R. 2002. Transformation of *Fusarium oxysporum* f.sp. *cubense*, causal agent of Fusarium wilt of banana, with the green fluorescent protein (GFP). The 3rd Meeting on the Cellular and Molecular Biology of Banana. Leuven, Belgium.

WINGFIELD B.D., ERICSON L. & BURDON J. (2001). Fungal rust DNA sequences demonstrate new relationships. APS/SON/MSA Joint Meeting. Salt Lake City, Utah, USA. 25-29 August 2001.

WINGFIELD B.D., ROUX J., COUTINHO T.A. & WINGFIELD M.J. 2003. Understanding the threat of pitch canker to exotic plantation forestry in the Southern Hemisphere. The 8th International Congress of Plant Pathology, Christchurch, New Zealand, 2-7 February 2003.

WINGFIELD B.D., S. VAN HEERDEN, VAN DER NEST M. & WINGFIELD M.J. 2001. Development of Molecular markers linked to *Cryphonectria* canker resistance in *Eucalyptus grandis*. Proceedings of the 2001 IUFRO International Symposium: Molecular Biology of Forest Trees, Skamania, Washington State USA. 22-27 July 2001.

WINGFIELD M.J., MARIN M., PREISIG O., KIRISITS T. & WINGFIELD B.D. 2002. Relationships amongst *Ceratocystis polonica*, *Ceratocystis laricicola* and their bark beetle vectors in Europe and Asia. The 7th International Mycological Congress, Oslo, Norway. 11-17 August 2002.

ZEEMAN C.A.M., REGNIER T & KORSTEN L. 2003. Antimicrobial activity of bulbous plant leaf extracts to control postharvest and foodborne diseases. The 8th International Conference of Plant Pathology, Christchurch, New Zealand. 2-7 February 2003.

Papers/posters delivered at national conferences

ADANDONON A., AVELING T.A.S., LABUSCHAGNE N. & AHOHUENDO B. 2001. Epidemiology of the damping-off disease in the Ouémé valley, Benin. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21 -24 January 2001.

AHUMADA R., WINGFIELD M.J., CROUS P.W., HUNTER G. & WINGFIELD B.D. 2002. Description of *Mycosphaerella* spp.associated with *Eucalyptus* leaf blotch in Chile. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

ALEMU GAZAGHNE, HUNTER G.C., ROUX J. & WINGFIELD M.J. 2003. Identification of *Mycosphaerella* species causing leaf blotch on Eucalyptus globolus in Ethiopia. The 41st Annual Congress of the Southern African Society of Plant Pathology, Baine's Game Lodge, Bloemfontein. 19 -22 January 2003.

ALDOUS C.M., VAN DER MERWE N.A., WINGFIELD B.D. & WINGFIELD M.J. 2002. A PCR-RFLP identification technique for *Coniothyrium zuluense*. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

AVELING T.A.S. & POWELL A.A. 2001. Susceptibility of cowpea seeds with different seed coat colours to damping-off. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21-24 January 2001.

BAHLMANN L., GOVENDER P. & BOTHA A-M. 2001. Induction of proteins upon infestation of wheat (*Triticum aestivum* L.) by the Russian wheat aphid (*Diuraphis noxia*). Congress of the Entomological Society of Southern Africa, Pietermaritzburg. July 2001.

BANDOUNAS T., VILJOEN A., & AVELING T.A.S. 2001. Ethograph of *Albugo tragopogonis* on sunflower. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21 - 24 January 2001.

BARNES I., GAUR A., ROUX J., BURGESS T. & WINGFIELD M. 2001. Development of microsatellite markers for *Ceratocystis fimbriata*. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21 -24 January 2001.

BARNES I., ROUX J., WINGFIELD B.D. & WINGFIELD M.J. 2002. Structure and diversity of a South African population of *Ceratocystis albofundus*, determined using PCR based microsatellite markers. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

BARNES I., WINGFIELD M.J., ROUX J., DUDZINSKY M., OLD K. & WINGFIELD B.D. 2002. A new species of *Ceratocystis* form *Eucalyptus nitens* in Australia. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

BERGER D.K. 2002. Gene "mining" the Arabidopsis thalina genome: applications in plant pathology. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

BERGER D.K., O'KENNEDY M.M., OELOFSE D., CAMPBELL B. & VAN RENSBURG J.B.J. 2002. Towards engineering maize for fungal resistance in South Africa. The 4th Plant Breeding Symposium, Gordon's Bay, South Africa. 11-14 March 2002.

BHOORA R., CHIMWAMUROMBE P.M., WINGFIELD B.D., BERGER D.K. & WINGFIELD M.J. 2002. Development of disease tolerant plants using Polygalcturonase-Inhibiting Proteins (PGIP). The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

BUTHELEZI B., COUTINHO T.A., PREISIG O., CROUS P.W. & WINGFIELD M.J. 2002. Development of molecular markers to assess population diversity of *Cylindrocladium pauciramosum*. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

CAMPBELL B.G., MURRAY S.L. & BERGER D.K. 2002. RNA quality control experiments for cDNA microarray analysis. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20 -23 January 2002.

CHIMWAMUROMBE P.M., WINGFIELD B.D., BOTHA A-M. & WINGFIELD M.J. 2002. Molecular cloning of an endopolygalacturonase gene from the *Eucalyptus* canker pathogen, *Cryphonectria cubensis*. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

COETZEE M.P.A., WINGFIELD B.D., BLOOMER P. & WINGFIELD M.J. 2002. Phylogeny of Southern Hemisphere Armillaria species based on LSU sequences. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20 -23 January 2002.

COETZEE M.P.A., WINGFIELD B.D., KIRISITS T., CHHETRI D.B. & WINGFIELD M.J. 2002. Molecular identification of *Armillaria* isoaltes from Bhutan. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

COUTINHO T.A., PREISIG O., MERGAERT J., CNOCKAERT M.C., RIEDEL K-H., SWINGS J. & WINGFIELD M.J. 2001. A new bacterial disease of *Eucalyptus* species, hybrids and clones in South Africa. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21-24 January 2001.

DE BEER W., ZHOU X.D., CROUS P.W. & WINGFIELD M.J. 2001. Taxonomic relationships in the *Sporothrix eucalypti* complex. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21-24 January 2001.

DE BEER Z.W., WINGFIELD B.D. & WINGFIELD M.J. 2002. A new *Ophiostoma* species from hardwoods in the Southern Hemisphere. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

DE MEYER E. & AVELING T.A.S. 2003. Biological control of *Sclerotium rolfsii* on Bambara groundnuts. The 41st Annual Congress of the Southern African Society for Plant Pathology, Baines Game Lodge, Bloemfontein. 19-22 January 2003.

DE WET J & KORSTEN L. 2001. Evaluering van chemikalieë in die na-oes omgewing vir die beheer van na-oes siektes. South African Mango Research Symposium, Tzaneen. 21 June 2001.

DE WET J & KORSTEN L. 2001. Evaluering van chemikalieë in die na-oes omgewing vir die beheer van na-oes siektes. South African Mango Research Symposium, Tzaneen. 21 June 2001.

DE WET J., BURGESS T., WINGFIELD M.J. & WINGFIELD B.D. 2002. The "B" morphotype of *Sphaeropsis sapinea* represents a new species of *Diplodia*. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20 -23 January 2002.

DE WET J., M.J. WINGFIELD, T. BURGESS AND B.D. WINGFIELD 2001. Characterisation of *Sphaeropsis sapinea* morphotypes. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21-24 January 2001.

DENMAN S., CROUS P.W. & WINGFIELD M.J. 2001. Studies on the epidemiology of Botryosphaeria stem canker of *Protea magnifica*. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21-24 January 2001.

DENMAN S., CROUS P.W., SADIE A. & WINGFIELD M.J. 2002. Factors affecting infection of Botryosphaeria stem cankers on *Protea magnifica* in the western Cape. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20 -23 January 2002.

DOMOLA M.J., JERICHO C., STRYDOM H., AVELING T. & THOMPSON G.J. 2002. Survey and characterisation of viruses infecting sweet potatoes grown by resource poor farmers in South Africa. The 40th Annual Congress of the South African Society for Plant Pathology, Dikhololo. 20 – 23 January.

DU PLOOY W. & KORSTEN L. 2002. Changes to the epicuticular layer of mangoes. SA Mango Growers' Research Symposium. Tzaneen Country Lodge, 18 July 2002.

DU PLOOY W., VAN DER MERWE C., ROBBERTSE H. & KORSTEN L. 2003. Lenticel development related to damage of the epicuticular layers of mango fruit. The 41st Annual Congress of the Southern African Society for Plant Pathology. Bain's Game Lodge, Bloemfontein, 19-22 January 2003.

FOURIE A., REGNIER T.J.C., LABUSCHAGNE N. & APOSTOLIDES Z. 2002. Phenolic compounds involved in citrus rootstock resistance against *Phytophthora nicotianae*. The 2nd Citrus Symposium, Stellenbosch. July 2002.

GEIER B., KORSTEN L. & LUDIK H. 2002. Organic market expectations and limitations. Panel discussions moderated and presented. The future of fresh produce: give consumers what they really want Conference and Expo. The Lord Charles Hotel, Somerset West, Cape Town 31 July – 1 August 2002.

GELDENHUIS M.M., ROUX J., WINGFIELD M.J., CILLIERS A.J. & WINGFIELD B.D. 2002. Genetic diversity in populations of *Chalara elegans* from South Africa. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20 -23 January 2002.

GELDENHUIS M.M., WINGFIELD M.J., ROUX J., WINGFIELD B.D. & DE BEER Z.W. 2001. Graphium species associated with diseased *Schizolobium parahybum* in Ecuador. The 39th Annual of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit, South Africa. 21 -24 January 2001.

GEZAHGNE A., COETZEE M.P.A., ROUX J. & WINGFIELD M.J. 2002. Armillaria root rot in Ethiopia. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo Lodge. 20 -23 January 2002.

GOVENDER P. & WINGFIELD M. J. 2001. Effects of slash management on wattle establishment pests in the Natal Midlands. Congress of the Entomological Society of Southern Africa, Pietermaritzburg. July 2001.

GOVENDER V. & KORSTEN L. 2001. Evaluating biological control for mango postharvest diseases control. South African Mango Research Symposium, Tzaneen. 21 June 2001.

GOVENDER V. & KORSTEN L. 2002. Alternative post - harvest control of mango diseases. SA Mango Growers' Research Symposium. Tzaneen Country Lodge, 18 July 2002.

GOVENDER V. & KORSTEN L. 2002. Evaluating biological control systems for mango postharvest disease control. The 40th Annual Congress of the South African Society for Plant Pathology, Dikhololo. 21 -24 January 2002.

GOVENDER V., KORSTEN L. & REGNIER T. 2003. Assessment of *Bacillus licheniformis* as a biological control agent. The 41st Congress of the Southern African Society for Plant Pathology. Bain's Game Lodge, Bloemfontein. 19-22 January 2003.

GRIMBEEK E.J., VILJOEN A., COUTINHO T.A. & WINGFIELD M.J. 2001. The distribution and spread of Fusarium wilt of bananas in South Africa. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21 -24 January 2001.

GROBLER L. & KORSTEN L. 2002. Etiology of *Botryosphaeria* spp. SA Mango Growers' Research Symposium. Tzaneen Country Lodge, 18 July 2002.

GROBLER L. & KORSTEN L. 2003. Propagation material of mango – playing a role in dissemination of *Botryosphaeria* spp. The 41st Annual Congress of the Southern African Society for Plant Pathology. Bain's Game Lodge, Bloemfontein. 19-22 January 2003.

GROBLER L., JACOBS R. & KORSTEN L. (2001) Die etiologie van terugsterwing op mangobome. South African Mango Research Symposium, Tzaneen. 21 June 2001.

GROBLER L., JACOBS R., SWART F. & KORSTEN L. 2002. Die-back of mangoes in South Africa. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 21-24 January 2002.

GROENEWALD S., VILJOEN A., NEL B. & VAN DEN BERG N. 2002. Variation in cultural characteristics and virulence among South African isolates of *Fusarium oxysporum* f.sp. *cubense*. The 40th Annual Congress of the South African Society of Plant Pathology, Dikhololo. 21-24 January 2002.

HARRISON J. DU G., GOVENDER P., WINGFIELD M.J., SCHOLTZ C.H. & WINGFIELD B.D. 2001. Molecular and morphological approaches to forest whitegrub (Scarabaeidae) identification. Congress of the Entomological Society of Southern Africa, Pietermaritzburg. July 2001.

HARRISON J.G., SCHOLTZ C.H., WINGFIELD M.J., GOVENDER P. & WINGFIELD B.D. 2002. An overview of whitegrub (Scarabaeidae) taxonomy in African agriculture. South African Society of Systematic Biologists (SASSB) Congress, Grahamstown. January 2002.

HEATH R.N., VENTER M., ROUX J. & WINGFIELD M.J. 2002. Discovery of *Cryphonectria cubensis* on native Syzigium cordatum in South Africa. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

HUNTER G.C., ROUX J., COUTINHO T.A., WINGFIELD M.J. & CROUS P.W. 2001. *Mycosphaerella* species causing Mycosphaerella leaf blotch (MLB) on Eucalyptus in South Africa. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21-24 January 2001.

HUNTER G.C., ROUX J., COUTINHO T.A., WINGFIELD M.J., WINGFIELD B.D. & CROUS P.W. 2002. *Mycosphaerella* species causing leaf blotch disease on *Eucalyptus* in South Africa. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 19-23 January 2002.

HURLEY B.P., GOVENDER P. & WINGIFIELD M.J. 2001. Biological control of *Gonipterus scutellatus* (Coleoptera: Curculionidae) by *Anaphes nitens* along an altitude gradient. Congress of the Entomological Society of Southern Africa, Pietermaritzburg. July 2001.

JACOBS A., STEENKAMP E.T., COUTINHO T.A., MARASAS W.F.O. & WINGFIELD M.J. 2002. A new *Fusarium* species associated with grass and reeds in South Africa. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 19-23 January 2002.

JACOBS R., SLIPPERS B., WINGFIELD M. & KORSTEN L. 2001. Soft brown rot, tree die-back and other diseases caused by the same pathogen. South African Mango Research Symposium, Tzaneen. 21 June 2001.

JACOBS R., SLIPPERS B., WINGFIELD M.J & KORSTEN L. 2002. Identification of *Botryosphaeria* species from mango in South Africa. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

JOUBERT D. & LABUSCHAGNE N. 2002. Effect of soil compaction on *Phytophthora nicotianae* root rot in rough lemon and Troyer citrange citrus seedlings. The 13th Annual Interdisciplinary Symposium on soilborne Plant Diseases, ARC, Stellenbosch. September 2002.

KORF H.J.G., VAN EYSSEN D., MULDER C.E.G. & KORSTEN L. 2002. Control of CBS with pyraclostrobin. The 2nd Southern African Citrus Research Symposium. Infruitec, Stellenbosch. 23-24 July 2002.

KORSTEN L. 2001. Challenges and opportunities for subtropical farmers. Guest speaker: Sustainable Agriculture Study Group meeting, Riverside Estate, Malelane. 19 April 2001.

KORSTEN L. 2001. Food safety in primary agriculture. University of Durban-Westville, Durban. 6 June 2001.

KORSTEN L. 2001. Food Safety: A practical approach to ensure good quality and safe product. African Women Agribusiness Network Development (AWAND) Workshop. Table Bay Hotel, Cape Town. 16 August 2001.

KORSTEN L. 2001. Role of agricultural regulatory services in ensuring food safety. Ministers Indaba 2001: Ensuring food security and food safety in South Africa through an effective regulatory environment. Kyalami. 5 October 2001.

KORSTEN L. 2001. Bioproducts and control – Fact or Fiction? "From the Seed to the Plate – Global influences on the fresh produce industry" Conference, Midrand. 22–23 August 2001.

KORSTEN L. 2001. Food Safety in Primary Agriculture. Invited presentation to Faculty of Science, University of Durban-Westville, 6 June 2001.

KORSTEN L. 2002. Effects of pre-harvest spraying of *Bacillus licheniformis* on mango disease control. SA Mango Growers' Research Symposium. Tzaneen Country Lodge, 18 July 2002.

KORSTEN L. 2002. Food safety in agriculture – *Quo vadis*? Beef is Best 2002. Indaba Hotel. 14 March 2002.

KORSTEN L. 2002. Food safety, a regulatory framework for South African exporters of fresh produce. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 21-24 January 2002.

KORSTEN L. & DU PLOOY W. 2001. Total quality management systems or food production in South Africa. The 39th Annual Congress of the Southern African

Society for Plant Pathology, Greenway Woods, White River. 21-24 January 2001.

KORSTEN L. 2001 Bioproducts and control - Fact or Fiction? "From the Seed to the Plate - Global influences on the fresh produce industry" Eskom Conference Centre, Midrand. 22-23 August 2001.

KORSTEN L. 2001. Avogreen, the road to commercialisation. Series of presentations for avocado growers at study group meetings in Nelspruit, Hazyview, Tzaneen and Levubu, 15-18 January 2001, Wartburg, 7 February 2001.

KORSTEN L. 2001. Commercialisation aspects of biocontrol products. Series of presentations for avocado growers at study group meetings in Hazyview, Tzaneen and Levubu. 29-31 August 2001.

KORSTEN L. 2001. Food Safety, GAP and HACCP. Fresh Produce Management Workshop. Fresh Produce Management Training Initiative. Overberg Conference Centre, Grabouw. 17 August 2001.

KORSTEN L. 2001. An overview of mango pathological research at University of Pretoria. South African Mango Research Symposium, Tzaneen. 21 June 2001.

KORSTEN L. 2001. Food safety and quality. SAMGA Marketing Day, White River. 5 September 2001.

KORSTEN L. 2002. Alternative post harvest control. SA Mango Growers' Research Symposium. Tzaneen Country Lodge, 18 July 2002.

KORSTEN L. 2002. Combining different schemes to set global safety standards for fresh produce. EurepGAP Africa Conference, Somerset West. 13 March 2002.

KORSTEN L., SWART G.M., LABUSCHAGNE P., MEYER L. & REGNIER T. 2002. Citrus fruit diseases: Research. The 2nd Southern African Citrus Research Symposium. Infruitec, Stellenbosch. 23-24 July 2002.

KORSTEN L., SWART G.M., MEYER L., LABUSCHAGNE P., REGNIER T., SWART F.S. & KOTZÉ J.M. 2002. Towards a solution for citrus black spot. The 2nd Southern African Citrus Research Symposium. Infruitec, Stellenbosch. 23-24 July 2002.

KOTZÉ J.M. & KORSTEN L. 2002. Citrus black spot research plan. The 2nd Southern African Citrus Research Symposium. Infruitec, Stellenbosch. 23-24 July 2002.

KRITZINGER Q., AVELING T.A.S. & MARASAS W.F.O 2002. Control of storage fungi on cowpea seed using essential oils. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 19-23 January 2002.

KRITZINGER Q., AVELING T.A.S., MARASAS W.F.O., RHEEDER J.P., VAN DER WESTHUIZEN L. & SHEPHARD G.S. 2003. Mycoflora and fumonisin mycotoxins associated with cowpea (*Vigna unguiculata* (L.) Walp) seeds. The 41st Annual Congress of the Southern African Society for Plant Pathology, Baines Game Lodge, Bloemfontein. 19-22 January 2003.

KRITZINGER Q., AVELING T.A.S., MARASAS W.F.O., SHEPHARD G.S. & LEGGOTT N.L. 2001. Mycotoxins associated with cowpea seeds. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 19-22 January 2001.

LABUSCHAGNE N., FOURIE A., BURGER C. & REGNIER T.J.C. 2002. An overview of recent research on citrus rootstock resistance to root pathogens. The 2nd Citrus Symposium, Stellenbosch. July 2002.

LABUSCHAGNE P., KORSTEN L., SWART G.M., MEYER L., REGNIER T. & KORF H.G.J. 2002. Fruit pathway of CBS inoculation studies and environmental parameters for germination of pycnidiospores. The 2nd Southern African Citrus Research Symposium. Infruitec, Stellenbosch. 23-24 July 2002.

LABUSCHAGNE P.M., REGNIER T., SWART G.S. & KORSTEN L. 2003. Effect of temperature, pH, flavonoids and chemicals on the germination of *Phyllosticta citricarpa* pycnidiospores. The 41st Annual Congress of the Southern African Society for Plant Pathology. Bain's Game Lodge, Bloemfontein, 19 -22 January 2003.

LEZAR, S., WINGFIELD B.D., WINGFIELD M.J. & BERGER D. 2002. Progress towards developing a DNA microarray system to identify Cryphonectria canker resistance in *Eucalyptus*. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 19-23 January 2002.

LOMBARD L., ROUX J., COUTINHO T.A., CROUS P.W. & WINGFIELD M.J. 2002. A survey of *Cylindrocladium* on *Eucalyptus* cuttings in South Africa. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 19-23 January 2002.

MANSFIELD L. R., GOVENDER P. & MACARTHUR D. 2001. Whitegrubs associated with sugarcane and wattle plantations in the Natal Midlands. Congress of the Entomological Society of Southern Africa, Pietermaritzburg. July 2001.

MARAIS G.J., ROUX M.P., BADENHORST J. & LUBBEN A. 2003. Fungi associated with thatched roofs in South Africa and their role in indoor environments. The 41st Annual Congress of the Southern African Society for Plant Pathology, Baines Game Lodge, Bloemfontein. 19-22 January 2003.

MARIN M., CASTRO B., GAITAN A., PREISIG O. & WINGFIELD M.J. 2002. Phenotypic and molecular variability amongst isolates of *Ceratocystis fimbriata*, causing coffee tree canker in Colombia. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

MARITZ I., OELOFSE D. & BERGER, D.K. 2002. PGIP-mediated resistance to fungal pathogens in potato. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 19-23 January 2002.

MASEKO B.O.Z., BURGESS T., COUTINHO T.A. AND WINGFIELD M.J. 2001. First report of *Phytophthora nicotianae* associated with *Eucalyptus* die-back in South Africa. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21-24 January 2001.

MEYER L. & KORSTEN L. 2001. Market access: A classical case study of trade barriers. Mango Show and Tell, University of Pretoria, 3 May 2001.

MEYER L., KORSTEN L., SLIPPERS B. & WINGFIELD M.J. 2001. *Phyllosticta* species on citrus. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21-24 January 2001.

MEYER L., SLIPPERS B., KORSTEN L., KOTZÉ J.M. & WINGFIELD, M.J. 2002. Distinguishing between two citrus *Guignardia* species. The 40th Annual Congress of the South African Society for Plant Pathology, Dikhololo. 21-24 January 2002.

MOKGATLA R.M,. PREISIG O., WINGFIELD B.D., ADAMS G. & WINGFIELD M.J. 2001. Molecular characterisation of a dsRNA virus of *Leucostoma Persoonii*. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, White River. 21-24 January.

MUTSHEMBELE A.M., WINGFIELD B.D., STEENKAMP E.T. & WINGFIELD M.J. 2002. Analysis of the MAT -1 and MAT-2 idiomorphs in the biological species within the *Giberella fujikuroi* species complex. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

MYBURG H., VENTER M., WINGFIELD B.D. & WINGFIELD M.J. 2002. Beta tubulin and Histone H3 gene sequences distinguish *Cryphonectria cubensis* from South Africa, Asia and South America. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

NAKABONGE G., ROUX J., BARNES I. & WINGFIELD M.J. 2002. Population diversity of *Ceratocystis albofundus* in Uganda. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

NEL B., VILJOEN A., GROENEWALD S. & LABUSCHAGNE N. 2002. *In vitro* evaluation of fungicides and sterilants for effectiveness against *Fusarium oxysporum* f.sp. *cubense*. The 40th Annual Congress of the Southern African Society of Plant Pathology, Dikololo. 19-23 January 2002.

OBAGWU J. & KORSTEN L. 2002. Integrated control of citrus green and blue molds with *Bacillus subtilis*, sodium bicarbonate and hot water. The 40th Annual Congress of the South African Society for Plant Pathology, Dikhololo. 21-24 January 2002.

OBAGWU J., KORSTEN L. & REGNIER T. 2003. Testing potential biocontrol products for control of citrus green mold under simulated export conditions. The 41st Congress of the Southern African Society for Plant Pathology. Bain's Game Lodge, Bloemfontein, 19-22 January 2003.

OBAGWU J., KORSTEN L., WEHNER F.C. & PAUL I. 2001. Inhibitory action of natural epiphytes isolated from citrus fruit surface against *Penicillium digitatum* Sacc. the cause of citrus green mould. The 39th Annual Congress of the South African Society for Plant Pathology, White River. 21-24 January 2001.

OELOFSE D., CAMPBELL B., DUBERRY I.A. & BERGER D.K. 2002. Molecular approaches towards anthracnose in lupins. The 4th Plant Breeding Symposium, Gordons Bay, South Africa. 11-14 March 2002.

OELOFSE D., DUBERY I.A., CERVONE F., DE LORENZO G. & BERGER, D.K. 2002. Molecular approaches towards anthracnose resistance in lupins: testing of the antifungal PGIP gene in plant expression systems. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 19-23 January 2002.

PAUL I., OBAGWU J. & KORSTEN L. 2001. Alternative control of green mould caused by *Penicillium digitatum* Sacc. on valencia oranges. The 39th Annual Congress of the Southern African Society for Plant Pathology, White River. 21-24 January 2001.

PAUL I., VAN JAARSVELD A.S. & KORSTEN L. 2003. An analysis of the suitability of European climate for the establishment of the citrus black spot pathogen *Guignardia citricarpa*. The 41st Annual Congress of the Southern African Society for Plant Pathology. Bain's Game Lodge, Bloemfontein. 19-22 January 2003.

PAUL I., VAN JAARSVELD A.S., ERASMUS B.F.N. & KORSTEN L. 2002. Modelling the global distribution of CBS. The 2nd Southern African Citrus Research Symposium. Infruitec, Stellenbosch. 23-24 July 2002.

RAMATSHODI G.D., STEENKAMP E.T., JACOBS A., WINGFIELD B.D. & WINGFIELD M.J. 2002. Identification of *Fusarium* species using a PCR based technique. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

REGNIER T., KORSTEN L. & LABUSCHAGNE P. 2002. Citrus leaf analysis for detecting resistance to black spot. The 2nd Southern African Citrus Research Symposium. Infruitec, Stellenbosch. 23-24 July 2002.

RODAS C.A., WRIGHT J.A., CROUS P.W., ROUX J., SLIPPERS B. & WINGFIELD M.J. 2002. Diseases of Eucalyptus in Colombia. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

ROUX J. & WINGFIELD M.J. 2001. Ceratocystis wilt of forest trees. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21-24 January 2001.

ROUX J., VAN DER HOEF A. & WINGFIELD M.J. 2002. Pink disease on *Eucalyptus* and *Podocarpus* in South Africa. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

SANDERS G. & KORSTEN L. 2001. Anthracnose on mango - an overview. South African Mango Research Symposium, Tzaneen. 21 June 2001.

SANDERS G.M. & KORSTEN L. 2001. Detection of citrus greening disease from different sources and distinguishing between leaf symptoms using PCR. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, White River. 21-24 January 2001.

SCHERMAN R., SLIPPERS B., KORSTEN L. & WINGFIELD M.J. 2001. *Botryosphaeria* species from mango. The 39thCAnnual ongress of the South African Society for Plant Pathology, Greenway Woods, White River. 21 -24 January 2001.

SILIMELA M. & KORSTEN L. 2001. Evaluating plastic caps and biocontrol in the pre-harvest environment. South African Mango Research Symposium, Tzaneen. 21 June 2001.

SILIMELA M. & KORSTEN L. 2002. Effects of pre - harvest spraying of *Bacillus licheniformis* on mango disease control. SA Mango Growers' Research Symposium. Tzaneen Country Lodge, 18 July 2002.

SITHOLE H., GOVENDER P. & VILJOEN A. 2001. Integrated pest management of the banana weevil, *Cosmopolites sordidus*. Congress of the Entomological Society of Southern Africa, Pietermaritzburg. July 2001.

SLIPPERS B., COUTINHO T.A., WINGFIELD B.D., CROUS P.W. & WINGFIELD M.J. 2001. Taxonomy an d phylogeny of *Botryosphaeria* species. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21 -24 January 2001.

STEYN T.L., KRUGER K. & GOVENDER P. 2001. Complex sensory stimuli influence decisiveness in the whitefly *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae). Congress of the Entomological Society of Southern Africa, Pietermaritzburg. July 2001.

STRONKHORST L.D., VILJOEN A., CLAASSENS A.S., NEL B. & VAN DER WAALS J.H. 2003. The effect of N-fertilization and pH on the incidence of Fusarium Wilt (Panama disease) of banana in greenhouse trials. Golden Jubilee Congress (Soil Science Society of South Africa, South African Society of Crop Production, Southern African Society for Horticultural Sciences), Stellenbosch. 20-23 January 2003.

SURRIDGE A.K.J., VILJOEN A. & WEHNER, F. 2001. Distribution of banana leaf spot pathogens in South Africa in 2000. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21-24 January 2001.

SURRIDGE A.K.J., VILJOEN A. & WEHNER, F. 2001. Fungi associated with banana leaves in South Africa. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21-24 January 2001.

SWANEVELDER Z.H., VAN DER MERWE M., VAN WYK A.E. & BOTHA A-M. 2001. Development of microsattelite markers for application in *Clivia miniata* (Amaryllidaceae). SAAB, Grahamstown, 8-11 January 2003.

SWANEVELDER Z.H., VAN DER MERWE M., VAN WYK A.E. & BOTHA A-M. 2003. Chloroplast DNA variation in *Clivia miniata*8(Amaryllidaceae). SAAB, Pretoria, -11 January 2003.

SWART G. & KORSTEN L. 2001. An investigation into chemical resistance on mango - is it a problem? South African Mango Research Symposium, Tzaneen. 21 June 2001.

SWART G. & KORSTEN L. 2001. Anthracnose on mango - an overview. South African Mango Research Symposium, Tzaneen. 21 June 2001.

SWART G.M. & KORSTEN L. 2001. Detection of citrus greening disease from different sources and distinguishing between leaf symptoms using PCR. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, White River. 21 -24 January 2001.

SWART G.M. & KORSTEN L. 2002. A comparative study of *Colletotrichum gloeosporioides* from avocado and mango. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 21 -24 January 2002.

SWART G.M., MEYER L. & KORSTEN L. 2002. Practical application of species-specific primers in the citrus industry. 2The nd Southern African Citrus Research Symposium. Infruitec, Stellenbosch. 23-24 July 2002.

SWART G.M., MEYER L. & KORSTEN L. 2002. Application of species specific primers in the South African citrus industry. Biotechnology in Africa Conference, University of Pretoria.

SWART S.H., KORSTEN L., SERFONTEIN J.J. & KALINOWSKI J. 2002. Post -harvest control of CBS symptoms. The 2nd Southern African Citrus Research Symposium. Infruitec, Stellenbosch. 23-24 July 2002.

TSHABALALA B., COUTINHO T.A., DE BEER Z.W., BURGESS T. & WINGFIELD M.J. 2002. Phenotypic diversity in a South African population of *Lasiodiplodia theobromae* from *Pinus*. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 19-23 January 2002.

VAN BROEKHUIZEN W., KORSTEN L. & HAMMES P.S. 2002. Development of an alternative method for the detection of *Ralstonia solanacearum* in naturally infested soil. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 21 -24 January 2002.

VAN DEN BERG N. & AVELING T.A.S. 2001. Evaluation of six fungicides for controlling *Alternaria cassiae* on cowpea seeds. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21-24 January 2001.

VAN DEN BERG N., BIRCH P., VILJOEN A., WINGFIELD M.J. & BERGER, D.K. 2003. The identification of genes associated with tolerance/resistance to *Fusarium oxysporum* f.sp. *cubense* in Cavendish bananas. SAAB National Conference, Pretoria, South Africa. 7-11 January 2003.

VAN DER MERWE M., VAN WYK A.E. & BOTHA A.E. 2003. Molecular variation within the southern African Myrtaceae. Joint International Conference of the South African Association of Botanists & International Society for Ethnopharmacology Pretoria, 8-11 January 2003.

VAN DER MERWE M., VAN WYK A.E. & BOTHA A-M. 2003. A phylogenetic study of *Eugenia* (Myrtaceae). Joint International Conference of the South African

Association of Botanists & International Society for Ethnopharmacology Pretoria, 8-11 January 2003.

VAN DER MERWE N.A., WINGFIELD B.D. & WINGFIELD M.J. 2002. Characterisation of *Cryphonectria cubensis* populations using polymorphic DNA markers. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

VAN DER MERWE N.A., WINGFIELD B.D. & WINGFIELD M.J. 2001. Genetic diversity in the South African *Cryphonectria cubensis* population determined using DNA markers. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, White River. 21-24 January.

VAN DER WAALS J.E. & KORSTEN L. 2002. Completing the pyramid. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 21-24 January 2002.

VAN NIEKERK J.M., CROUS P.W., GROENWALD J.Z., VERKLEY G. & WINGFIELD M.J. 2002. Systematic appraisal of the genus *Conielia*, wiht specific reference to species occurring in South Africa. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

VAN WYK M., BARNES I., CHHETRI D.B., KRISITS T., ROUX T., WINGFIELD B.D. & WINGFIELD M.J. 2003. A new species of *Ceratocystis* from Bhutan. The 41st Annual Congress of the Southern African Society for Plant Pathology, Baine's Game odge, Bloemfontein. 19-22 January 2003.

VENTER E., JACOBS A., WINGFIELD B.D. & BOTHA A-M. 2002. What drives *Fusarium circinatum*? Analysis of pathogenicity at the molecular level. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

VENTER E., WINGFIELD B.D., WINGFIELD M.J. & BOTHA A-M. 2002. *Fusarium circinatum*-induced mRNA sequences in *Pinus patula*. Th e 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

VENTER M., MYBURG H., WINGFIELD M.J. & WINGFIELD B.D. 2002. Reconsideration of the conspecificity of *Endothia eugeniae* and *Cryphonectria cubensis*T he 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

VILJOEN A., VAN DER WAALS J., NEL B. & WIESE L. 2002. The potential application of disease suppressive soils in the management of Fusarium wilt of banana. The 13th Annual Soil-borne Disease Symposium, Stellenbosch.

VISMER H.F., MARASAS W.F.O. & COUTINHO T.A. 2001. The effects of fenpropathrin and other compounds on the growth and presence of mites in fungal cultures. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, Nelspruit. 21-24 January 2001.

VORSTER B.J. & KUNERT K.J. 2001. Identification of Genetic " Hotspots" in the Genome of Plants. The 27th Annual Conference of the South African Association of Botanists. Johannesburg, South Africa. 14-18 January 2001.

WEICH J.P., GAUM E A., VAN DER MERWE M., VAN WYK A.E. & BERGER D.K. 2003. Thale cress (*Arabidopsis thaliana*): is it native, introduced or naturalized in South Africa? SAAB (International conference of the South African Association of Botanists and the International Society of Ethnopharmacology South African Association of Botany), Pretoria. 7-11 January 2003.

WEICH J.P., POUSSIER S., TRIGALET-DEMERY D., TRIGALET A., NAKABONGE G., BERGER D.K. & COUTINHO T.A. 2003. Rapid identification of African strains of *Ralstonia solanacearum*. The 41st Annual Congress of the Southern African Society for Plant Pathology), Bloemfontein. 19-22 January 2003.

ZHOU X.D., BURGESS T., DE BEER Z.W., WINGFIELD B.D. & WINGFIELD M.J. 2002. Development of polymorphic microsatellite markers for the tree pathogen and sapstain agent, *Ophiostoma ipsT* he 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002.

ZHOU X.D., DE BEER Z.W., AHUMADA R., CIBRIAN D., WINGFIELD B.D. & WINGFIELD M.J. 2002. Molecular and morphological identification of *Ophiostoma* spp. associated with bark beetles in Mexico and Chile. The 40th Annual Congress of the Southern African Society for Plant Pathology, Dikhololo. 20-23 January 2002

ZHOU X.D., DE BEER .W., WINGFIELD M.J. & WINGFIELD B.D. 2001. Pathogenicity of *Ophiostoma ips*, *Leptographium serpens* and *L. lundbergii* to pines in South Africa. The 39th Annual Congress of the Southern African Society for Plant Pathology, Greenway Woods, White River. 21-24 January.

Seminar presentations

All postgraduate students linked to FABI present two seminars each year on a Thursday morning. Special seminars, presented by invited speakers, are occasionally held. Once a postgraduate student has been awarded a degree, he/she is invited to present a prestige seminar.

Special seminars

Dr Francois Lieutier February 2001	Conifer defences and bark beetle attack strategies
Dr Hugh Glen June 2001	The "nut" parade
Prof Dr Michael Göttfert July 2001	Molecular insights into the *Bradyrhizobium japonicum*/soybean symbiosis – an analysis of the bacterial partner
Prof Michael Wingfield August 2001	Thunder dragon land: a forest pathologist's view of Bhutan
Dr Eddie Mwenje February 2002	Characterization of *Armillaria* in Zimbabwe
Dr Gert Marais July 2002	Fungi and mycotoxins in South African foods and feeds
Prof John Leslie September 2002	Genetic mapping – an example from *Fusarium*
Dr Christiaan Steinberg September 2002	Soil suppression to soilborne diseases: interactions between biotic and abiotic antagonistic modes of action
Dr Marcus Conradt October 2002	Expression profiling tools at Memorec: SAGE (Serial Analysis of Gene Expression) and cDNA microarrays
Prof Pedro Crous January 2003	Life in the fast lane – living with my thumb in the dyke
Dr Paul Krokene January 2003	Bark beetles, blue-stain fungi and conifer defence mechanisms
Dr D Aanen January 2003	The evolution of fungus-growing termites and their mutualistic fungal symbionts
Prof H Davies February 2003	Targeted analysis or profiling approaches to detect unintended effects on GMOs
Dr Karin Jacobs March 2003	Hitch-hikers and parasites: adventures in taxonomy

Prestige seminars

Emma Steenkamp (PhD)
March 2001
Molecular taxonomic studies of selected species in the *Gibberella fujikuroi* complex

Noëlani van den Berg (MSc cum laude)
April 2001
A new disease of cowpea caused by *Alternaria cassiae*

Adriana Jacobs (MSc)
June 2001
The genus *Phialocephala* – a taxonomic study

Percy Chimwamurombe (PhD)
September 2001
Molecular plant pathogen interactions with special reference to *Eucalyptus grandis* PGIPs, which attack fungal polygalacturonases

Irene Barnes (MSc cum laude)
October 2002
Taxonomy, phylogeny and population biology of *Ceratocystis* species with particular reference to *Ceratocystis fimbriata*

Gavin Hunter (MSc cum laude)
November 2002
Mycosphaerella species causing leaf blotch on *Eucalyptus* species in South Africa

Karen Surridge (MSc)
April 2003
Banana leaf diseases in South Africa

Grace Nakabonge (MSc cum laude)
April 2003
Diseases of *Eucalyptus* in Uganda

FABI TEAM 2002/2003

Full time academic & research Staff

Prof Lise Korsten
Prof Karl Kunert
Prof Brenda D. Wingfield
Prof Michael J. Wingfield
Assoc Prof Terry Aveling
Assoc Prof Dave Berger
Assoc Prof Teresa Coutinho
Assoc Prof Anna-Maria Oberholster
Dr Prem Govender
Dr Nico Labuschagne
Dr Petra Labuschagne
Dr Gert Marais
Dr Zander Myburg
Dr Thierry Regnier
Dr Jolanda Roux
Dr Gina Swart
Dr Christel van der Vyver
Dr Altus Viljoen
Mr Brett Hurley

Technical Staff

Ms Trish Beart
Ms Sonja de Beer
Ms Gerda Fourie
Mr Hardus Hatting
Ms Joyce Jakavula
Ms Pritty Khumalo
Ms Amelita Lombard
Ms Eva Müller
Ms Karin Muller
Ms Valentina Nkosi
Ms Amanda Redmond
Ms Anita Steyn
Mr Danie Theron
Ms Lydia Twala
Ms Kerien van Dyk
Ms Martie van Zyl
Ms R. van Zyl

Administrative staff

Ms Elizabeth Attinger
Ms Vivienne Clarence
Ms Helen Doman
Ms Judy Hasset (June – December 2002)
Ms Daleen Muller
Ms Liana Viljoen
Ms Rose Visser

Computer support

Mr Chris Visagie

Information specialist

Ms Marie Theron

Honorary professors/lecturers

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

Sabbatical visitor

Dr Paäl Krokene (2003)

Postdoctoral fellows

Dr Dilzara Agayeva
Insect/fungal pathogen associations

Dr Marcus Conradt
Scientific consultant: plant gene discovery using SAGE (Serial analysis of gene expression)

Dr Alain Gaume
Genetic studies of resistance to the bacterial pathogen, *Ralstonia solanacearum*, in *Arabidopsis thaliana*

Dr Solomon Gebeyene
Studies on *Pissodes nemorensis* and its possible role in vectoring *Fusarium circinatum*

Dr Karin Jacobs
Molecular taxonomic studies on *Ophiostoma* and *Ceratocystis*, particularly of species linked to forest biosecurity

Dr Ntsane Moleleki
Pathogenic determinants of *Fusarium circinatum*

Dr Ana Slaughter
Genetic improvement of maize to enhance food safety by introducing resistance to *Fusarium moniliforme*

Dr Retha Slabbert
The effect of cold stress on Fusarium wilt development in banana

Dr Marlien van der Merwe
A phylogenetic study of the *Eugenia* (Myrtaceae)

Previous postdoctoral fellows

Dr Oliver Preisig (1997-1999)
Dr Dennis Wilson (1998-1999)
Dr Hong Li (1998-1999)
Dr Jingua Chen (1998-1999)
Dr Anupama Gaur (1998-1999)
Dr Treena Burgess (2000-2001)
Dr Gwen Koning (2000-2001)
Dr Thierry Regnier (2000-2002)
Dr Linda Meyer (2000-2001)
Dr Percy Chimwamurombe (2001-2002)

Current postgraduate students

PhD students

Appolinaire Adandonon
Damping-off of cowpea in Benin
Advisors: TAS Aveling & W Hammond

Shahasi Athman
Biological control of the banana nematode *Radopholus similes* with fungal endophytes
Advisors: N Labuschange & A Viljoen

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

Getu Beyene
Expression and the stability of a rice oryzacystatin I in transgenic tobacco under abiotic stress
Advisor: K Kunert

Lesesse Beyene
Genetic diversity in maize inbreds and its association with test cross performances, combining ability and heterosis
Advisors: A-M Oberholster, AA Myburg, K Pixely & T Afriyie

Yoseph Beyene
Characterization of genetic diversity in Ethiopian highland maize (*Zea mays* L.) populations
Advisors: AA Myburg & A-M Oberholster

Mesfin Bogale
Fusarium spp. associated with teff production in Ethiopia
Advisors: BD Wingfield & MJ Wingfield

Bridget Campbell
Elucidation of disease resistance in monocotyledous plants through DNA microarray analysis
Advisor: D Berger

Martin Coetzee
Molecular characterization of *Armillaria* (Basidiomycetous Agaricales Tricholomycetaceous)
Advisors: BD Wingfield, MJ Wingfield & P Bloomer

Chris Cooper
Studies on the bioremediation of oil-based contaminants
Advisors: VS Brözel & TA Coutinho

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

Johan de Graaf
Integrated Pest Management of *Cosmopolitus sordidus* Germar (Coleoptera: Curculionidae) in South Africa
Advisors: P Govender, A Viljoen, A Schoeman & S Bruwer

Elizabeth de Jager
Post-harvest quality standards in the South African litchi industry
Advisors: L Korsten & F Wehner

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

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

Wilma du Plooy
Food safety for fruit crops
Advisors: L Korsten

Alemu Gezaghne
Diseases of plantation forest trees in Ethiopia
Advisors: J Roux, MJ Wingfield & BD Wingfield

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

Marieka Gryzenhout
Revision of the taxonomy of the fungal genera *Endothia* and *Cryphonectria*
Advisors: MJ Wingfield & BD Wingfield

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

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 & J Jaftha

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

Riana Jacobs
Interaction between *Pinus radiata* and the fungal pathogens *Fusarium circinatum* and *Sphaeropsis sapinea*
Advisors: TA Coutinho, I Dubery & MJ Wingfield

Sinnia Kappindu
Mechanisms of banana weevil (*Cosmopolitus sordidus*) biocontrol using fungal endophytes
Advisors: A Viljoen, B Niere, D Coyne & C Gold

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

Barnabas Kiula
Effect of grey spot of testcross performance, combining ability and heterosis of Tanzanian inbred and open-pollinated maize varieties
Advisors: A-M Oberholster, AA Myburg & F Wehner

Quenton Kritzinger
Mycotoxins and medicinal properties of cowpea
Advisors: TAS Aveling & N Lall

Sabine Lezar
Microarray analysis of disease resistance in *Eucalyptus grandis*
Advisors: BD Wingfield, AA Myburg, D Berger & MJ Wingfield

Michael Luttig
Characterisation of a citrus tristeza closterovirus population which interferes with Huanglongbing infection
Advisors: BD Wingfield & B Manicom

Mauricio Marin
Molecular taxonomy of *Ceratocystis polonica sensu lato*
Advisors: MJ Wingfield, O Preisig & BD Wingfield

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

Sissay Mekbib
Identification of citrus (*Citrus sinensis* L.) postharvest pathogens from Ethiopia and its control
Advisor: L Korsten

Sari Mohali
Cylindrocladium spp. in Venezuela
Advisors: MJ Wingfield, TA Coutinho & BD Wingfield

Josephine Mukiibi
Studies of mechanisms of resistance to the banana weevil (*Cosmopolitus sordidus* Germar) within the *Musa* germplasm
Advisors: K Kunert, A Viljoen & M Pillay

Cassi Myburg
Molecular studies on Cryphonectria canker of eucalypts
Advisors: BD Wingfield & MJ Wingfield

Grace Nakagonge
Studies on *Cryphonectria* spp. in Africa
Advisors: J Roux & MJ Wingfield

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

Joseph Obagwu
Developing biopesticides for control of citrus fruit pathogens of importance in global trade
Advisors: L Korsten & T Regnier

Dean Oelofse
Molecular approaches towards anthranose resistance in lupins
Advisors: I Dubery & D Berger

Yolisa Pakela
Interaction between cowpea and *Collectotrichum dematium*
Advisors: TAS Aveling & TA Coutinho

Ida Paul
Mapping and distribution of citrus greening in South Africa
Advisors: A van Jaarsveld & L Korsten

Shadrack Phophi
International accepted best marketing practices based on minimum food safety and quality requirements
Advisor: L Korsten

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

Bernard Slippers
The taxonomy, phylogeny and ecology of Botryosphaericeous fungi on selected woody hosts
Advisors: MJ Wingfield, TA Coutinho, BD Wingfield & PW Crous

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

Noëlani van den Berg
Resistance mechanisms of Cavendish bananas against *Fusarium oxysporum f.sp. cubense*
Advisors: A Viljoen, D Berger & MJ Wingfield

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

Jacquie van der Waals
Implementing a disease forecasting system for early blight for the South African potato industry
Advisors: L Korsten, TAS Aveling & T Regnier

Madel van Eeden
Monitoring biocontrol systems under commercial conditions
Advisors: L Korsten & F Wehner

Lynelle van Emmenes
Gene expression profiling in *Triticum aestivum* line PI 137739 in response to *Diurapsis noxia* feeding
Advisor: A-M Oberholster

Schalk van Heerden
Studies on *Cryphonectria cubensis* in South Africa
Advisors: MJ Wingfield, O Preisig & BD Wingfield

Chantel van Niekerk
Analysis of gene expression in *Triticum aestivum* cultivar "Tugela DN" after *Diuraphis noxia* infestation
Advisors: A-M Oberholster & K Kunert

Eduard Venter
Host resistance in South African *Pinus* spp.
Advisors: A-M Oberholster, BD Wingfield & MJ Wingfield

Marinda Visser
Population biology of the banana panama wilt pathogen, *Fusarium oxysporum* f.sp. *cubense*
Advisors: A Viljoen, MJ Wingfield, BD Wingfield & T Gordon

Gezachew Weidemichael Assefa
Xanthomonas campestris pv. *musacearum* associated with enset in Ethiopia and Uganda
Advisors: TA Coutinho & A Viljoen

Current MSc/MSc (Agric) students

Mohammed Abdo
Molecular markers for *Fusarium circinatum*
Advisors: BD Wingfield, TA Coutinho & MJ Wingfield

Roger Bagnall
Control of Pythium wilt and root rot of hydroponically grown lettuce by means of water sanitizers
Advisors: N Labuschagne & FC Wehner

Tessa Bandounas
Infection studies on white rust of sunflower
Advisors: A Viljoen & TAS Aveling

Raksha Bhoora
Genetic transformation of *Eucalyptus* clones
Advisors: BD Wingfield, MJ Wingfield, D Berger & P Chimwamurombe

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

Alicia Bouwer
Development of a food safety assurance system for the fruit packing industry
Advisor: L Korsten

Carrie Brady
Molecular typing of *Pantoea ananatis* from different hosts
Advisors: SN Venter & TA Coutinho

Brenda Buthelezi
Population study on a *Cylindrocladium* sp. associated with *Eucalyptus* in South Africa
Advisors: TA Coutinho, O Preisig, MJ Wingfield & PW Crous

Minique de Castro
Nucleotide diversity in cellulose biosynthetic genes of *Eucalyptus*
Advisor: AA Myburg

Elsie de Meyer
Fungi associated with utility poles in South Africa
Advisors: MJ Wingfield & ZW de Beer

Besrat Demoz
Honey bee dispersal of antagonist to avocado flowers to control stem-end rot pathogens
Advisor: L Korsten

Oliver Dickens
Somatic embryogenesis in the *P. elliottii x P. caribiae* hybrid
Advisors: A-M Oberholster & C Bornman

Mapula Julia Domola
Survey, indexing and serological detection of sweet potato viruses in South Africa
Advisors: TAS Aveling & G Thompson

Franco du Preez
Analysis and origin of the different classes of nucleotide binding site motifs present in bread wheat
Advisors: A-M Oberholster & AA Myburg

Anton Fourie
Mechanisms of resistance in citrus rootstocks against fungal pathogens
Advisors: N Labuschagne, Z Apostolides & D Berger

Nonnie Geldenhuis
Studies on fungi associated with dying *Schizolobium parahybrum* in Ecuador
Advisors: MJ Wingfield & J Roux

Veloshinie Govender
Evaluating biological control systems for mango postharvest disease control
Advisor: L Korsten & T Regnier

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

Edzard Grimbeek
Management strategies for panama wilt disease of banana in South Africa
Advisors: A Viljoen, TA Coutinho & MJ Wingfield

Leylani Grobler
Pathogens associated with mango die-back
Advisors: L Korsten & G Swart

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

Almuth Hammerbacher
Epidemiology of the pitch canker fungus in South Africa
Advisors: TA Coutinho, MJ Wingfield & BD Wingfield

Wilma Havenga
Mode of action of *Bacillus subtilis* as biocontrol agent of postharvest diseases of avocado
Advisors: L Korsten

Ronald Heath
Disease of Myrtaceous and Melatstomataceous hosts
Advisors: MJ Wingfield, J Roux & BD Wingfield

Zhou Honghai
Functional analysis of *Eucalyptus* wood formation genes in *Arabidopsis*
Advisor: AA Myburg

Stephan Honibal
Biocontrol of False Codling Moth, *Cryptophlebia leucotreta* (Meyr.) (Lepidoptera: Tortricidae)
Advisors: P Govender & A Schoeman

Brett Hurley
Species composition, pathogen interactions and management of fungus gnats in forestry nurseries
Advisors: P. Govender, MJ Wingfield, TA Coutinho & BD Wingfield

Charline Kamburona
Evaluating genetic diversity and performance of peanut (*Arachis hypogaea*) lines

Advisors: A-M Oberholster & A Cilliers

Elizabeth Kola
Seed pathology of bambara groundnuts
Advisors: TAS Aveling & T Regnier

Begashaw Leulseged
The potential of rhizosphere microflora in the biocontrol of root rot and growth enhancement of lettuce (*Laetuca sativa*)
Advisors: L Korsten, F Wehner & N Labuschagne

Natalie Levendall
Delivery of lysozyme to plant cell surfaces using the bean polygalacturonase inhibitor protein (PGIP)
Advisor: D Berger

Lorenzo Lombard
Pathogens associated with hydroponically grown eucalypts in South Africa
Advisors: TA Coutinho, MJ Wingfield & B Janse

Therese Lotter
Characterisation of a polygalacturonase gene encoding a possible virulence factor from the lupin antracnose fungus *Colletotrichum acutatum*
Advisor: D Berger

Lara Mansfield
The bioeconomics and control of scarabaeid pests attacking inland sugarcane and forestry in KwaZulu/Natal
Advisor: P Govender

Lance Maphosa
Taxonomic and population biology on *Armillaria* spp. in Zimbabwe
Advisors: BD Wingfield, MJ Wingfield & E Mwenje

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

Fhumalani Mashau
Risk assessment of fire blight on pears
Advisors: L Korsten & C Pistorius

Lerato Matsaunyane
Isolation and characterization of the apple polygalacturonase inhibiting protein 2 gene (*pgip* 2) from apple and investigation into the proteins' antifungal activity
Advisor: D Berger & D Oelofse

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

Patrick Mphahlele
Honey bee dissemination of *Bacillus subtilis* to citrus flowers for control of *Alternaria*
Advisors: L Korsten & RM Crewe

Awelani Mutshembele
Development of a DNA-based identification technique for *Fusarium circinatum*
Advisors: BD Wingfield & MJ Wingfield

Barbara Nel
Management of Fusarium wilt of banana by means of biological, chemical control and induced resistance
Advisors: A Viljoen, C Steinberg & PS van Wyk

Marie Onanena
Isolation of labile regions from wild oat
Advisors: K Kunert & C van der Vyver

Draginja Pavlic
Botryosphaeria spp. endophytic in eucalypts and *Syzigium* in South Africa
Advisors: TA Coutinho, MJ Wingfield & B Slippers

Anneke Prins
The protective role of oryzacystatin-I during abiotic stress
Advisors: K Kunert & A-M Oberholster

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

Koreen Ramessar
Transformation of maize with antifungal genes towards engineering resistance to *Fusarium verticillioides*
Advisors: D Berger & M O'Kennedy

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

Wayne Rathbone
Development and assessment of biotechnology curriculum for high school scholars
Advisors: BD Wingfield & MJ Wingfield

Carlos Rodas
Diseases of plantation forest trees in Colombia
Advisors: MJ Wingfield, J Roux & TA Coutinho

Mashudu Silimela
Alternative methods for preventing pre- and post-harvest diseases and sunburn on mango fruits
Advisor: L Korsten

Liesl Stronkhorst
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

Dirk Swanevelder
A population study on the genus *Clivia* using microsatellite markers
Advisor: A-M Oberholster, BE van Wyk & M vd Merwe

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

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

Busi Tshabalala
Population and pathogenicity studies of *Lasiodiplodia theobromae* in South Africa
Advisors: TA Coutinho, MJ Wingfield & W de Beer

Itani Tshivhandekano
Water quality in Gauteng contributing to food safety risk in agriculture
Advisor: L Korsten & W du Plooy

Americo Uaciquete
Epidemiology, control and germplasm screening for powdery mildew, *Oidium anacardii*, of cashew in Mozambique
Advisors: L Korsten & TAS Aveling

Marilize van Wyk
Taxonomic and population biology of *Ceratocystis* spp. on *Eucalyptus* and other Myrtaceae
Advisors: MJ Wingfield & BD Wingfield

René van Zyl
Transformation of Cavendish bananas for Fusarium wilt resistance
Advisors: A Viljoen & J-V Escalant

Fanie Verwey
Control of Pythium root disease of hydroponically grown lettuce
Advisors: N Labuschagne & FC Wehner

Juan Vorster
The application of representational difference analysis and plant differentiation
Advisors: K Kunert & A-M Oberholster

Joanne Weich
Pathogenicity of African isolates of bacterial wilt on *Arabidopsis thaliana*
Advisors: D Berger & TA Coutinho

Anita Willis
Status of *Guignardia mangiferae* in South African mango orchards
Advisors: L Korsten & P Labuschagne

4th year and honours students

Kobus de Wet (2001)
Andrew Gallagher (2001)
Leylani Grobler (2001)
Susan Groenewald (2001)
Thuto Maria Matshololo (2001)
Lorenzo Lombard (2001)
Barbara Nel (2001)
Deshni Pillay (2001)
Wimpy Prozesky (2001)
Gladys Ramotshodi (2001)
Jenny Smith (2001)
Besrat Tesfagiorgis (2001)
Gerda Vermeulen (2001)
Kevin Barry (2002)
Carrie Brady (2002)
Elsie de Meyer (2002)
Louise Killen (2002)
Karen Muller (2002)
Ronnie Nelson (2002)
Madelien Wessels (2002)
Aneen Belgrove (2003)
Nicky Creux (2003)
Rosita Endah (2003)
Frank Maleka (2003)
Zelda Pieterse (2003)
Innocentia Phuto (2003)
Bernice Porter (2003)
Robert Walters (2003)

Student assistants

Jake Darby (2001)
Marius Bisset (2002)
Erika Boshoff (2002)
Nicky Creux (2002; 2003)
Robert Walters (2002)
Muhammed Ebrahim (2003)
Vincent Kekana (2003)
Duncan Newman (2003)
Luke Solomon (2003)

Recent graduates

PhD

Percy Chimwamurombe (2001)
Molecular plant-pathogen interactions with special reference to *Eucalyptus grandis* polygalacturonase inhibiting proteins and fungal polygalacturonases
Advisor: BD Wingfield
Co-advisors: MJ Wingfield & A-M Oberholster

Henriette Britz-van Heerden (2002)
Taxonomic, genetic and molecular studies on *Fusarium* spp. within the *Gibberella fujikuroi* complex
Advisor: MJ Wingfield
Co-advisors: TA Coutinho, BD Wingfield and WFO Marasas

Ntsane Moleleki (2002)
Hypovirulence in the pine pathogen, *Sphaeropsis sapinea*
Advisor: MJ Wingfield
Co-advisors: O Preisig and BD Wingfield

Esme van Jaarsveld (2002)
Studies on *Phytophthora nicotianae*, the cause of black shank of tobacco
Advisor: MJ Wingfield
Co-advisor: BD Wingfield

XuDong Zhou (2003)
Ophiostomatoid fungi with reference to those species associated with three bark beetles in South Africa
Advisor: MJ Wingfield
Co-advisor: BD Wingfield

Christell van der Vyver (2003)

Stress induced genomic changes in plants
Advisor: K Kunert
Co-advisor: C Cullis

Prem Govender (2003)
Impact assessment of soil pests affecting the establishment of wattle, eucalypts and pine seedlings in South Africa
Advisor: C Scholtz

Deidre Fourie (2003)
Bacterial diseases of dry beans in South Africa with special reference to common bacterial blight and its control
Advisor: PS van Wyk
Co-advisors: MJ Wingfield

MSc

Adriana Jacobs (2001)
The genus *Phialocephala*: a taxonomic study
Advisor: MJ Wingfield
Co-advisors K Jacobs & BD Wingfield

Jo-Marie Lottering (2001)
Identification and characterization of markers linked to the leaf rust resistance gene *Lr41*.
Advisor: A-M Oberholster
Co-advisor: FR Kloppers

Christiaan Troskie (2001)
Identification and characterization of markers linked to the leaf rust resistance gene *Lr37*.
Advisor: A-M Oberholster
Co-advisor: FR Kloppers

Jackie Doyle (2001)
Determining gene flow, linkage and parental contribution in *Pinus elliottii* x *P. caribaea* hybrids
Advisor: A-M Oberholster
Co-advisor: BD Wingfield

E Botes (2001)
Molecular characterization of toxin-producing and non-toxin producing strains of *Microcystis aeruginosa*
Advisor: JU Grobbelaar
Co-advisor: A-M Oberholster

Lieschen Bahlmann (2002)
Russian wheat aphid (*Diuraphis noxia*) induced gene expression
Advisor: A-M Oberholster
Co-advisor: P Govender

Wilhelm de Beer (2002)
The occurrence of Ophiostomatoid fungi on wood and wood products in South Africa
Advisor: MJ Wingfield
Co-advisor: BD Wingfield

Irene Barnes (2002)
Population, taxonomic and phylogenetic studies on *Ceratocystis fimbriata*
Advisor: MJ Wingfield
Co-advisor: J Roux and BD Wingfield

Gavin Hunter (2002)
Mycosphaerella leaf blotch of Eucalyptus in South Africa
Advisor: MJ Wingfield
Co-advisors: J Roux, TA Coutinho, PW Crous & BD Wingfield

René Jacobs (2002)
Characterisation and identification of *Botryosphaeria* spp. from mango in South Africa
Advisor: L Korsten
Co-advisors: MJ Wingfield and B Slippers

Karen Surridge (2003)
Fungi associated with banana leaf diseases in South Africa
Advisor: A Viljoen
Co-advisor: PW Crous

Rodrigo Ahumada (2003)
Diseases of commercial *Eucalyptus* plantations in Chile
Advisor: MJ Wingfield
Co-advisors: BD Wingfield and G Hunter

Grace Nakabonge (2003)
Diseases associated with plantation forestry in Uganda
Advisor: J Roux
Co-advisors: TA Coutinho and MJ Wingfield

Shilo Loots (2003)
Isolation and characterization of *Diuraphis noxia* induced sequences from wheat line PI 294994
Advisor: A-M Oberholster
Co-advisor: E Venter

Inge Maritz (2003)
Evaluation of polygalacturonase-inhibiting protein (PGIP)-mediated resistance against *Verticillium dahliae*, a fungal pathogen of potato
Advisor: D Berger
Co-advisor: D Oelofse

Anton Jordaan (2003)
Transformation of *Nicotiana tabacum* cv. Samsun with melanin and indigo genes.

Advisor: A-M Oberholster

MSc (Agric)/MinstAgrar

Wilma van Broekhuizen (2002)
Detection and suppression of *Ralstonia solanacearum*, causal agent of potato bacterial wilt, in naturally infested soil
Advisor: L Korsten
Co-advisor: P Hammes
Margareth Schoeman (2002)
Comparative studies on *Dothiorella* on avocado
Advisor: L Korsten
Co-advisor: G Swart
Hendrik Sithole (2002)
Integrated pest management of the banana weevil, *Cosmopolites sordidus* in South Africa: a critical review of the literature
Advisor: P Govender
Co-advisor: A Viljoen
Karin Louw (2002)
Antimicrobial activity of indigenous bulbous plant extracts to control selected pathogens
Advisor: L Korsten
Co-advisor: T Regnier

Prestigious NRF bursary holders

Martin Coetzee
Eduard Venter
Lynelle van Emmenes (neé Lacock)
Marinda Visser
Marieka Gryzenhout
Noëlani van den Berg
Irene Barnes
Gavin Hunter
Almuth Hammerbacher
Dirk Swanevelder
Ezanne Swanepoel
Johan De Graaf
Shadrack Phophi
Franco du Preez

Aaron Klug scholarship

Juanita de Wet

Mellon Foundation grants

Ntsane Moleleki
Bongani Maseko
Martin Coetzee
Bernard Slippers
Jacquie van der Waals
Eduard Venter
Christell van der Vyver
Albé van der Merwe
Lynelle van Emenes (neé Lacock)
Lieschen de Vos
Sanuska Reddy
Gavin Hunter
Irene Barnes
Noëlani van den Berg

NRF scarce skills scholarships

Carrie Brady (2002; 2003-2004)
Elsie de Meyer (2002)
Rene van Zyl (2002; 2003-2004)
Izette Greyling (2003-2004)

Other scholarships

Andrew Kiggundu (Rockefellar Foundation)
Sinnia Kappindu (IITA)
Josephine Mukiibi (Belgium Embassy & INIBAP)
Gizachew Weidemichael Assefa (Ethiopian Agricultural Institute)
Charline Kamburona (DAAD, TUCSAN Scholarship)
Lesesse Beyene (EARO, Ethiopia)
Yoseph Beyene (EARO, Ethiopia)
Mesfin Bogale (EARO, Ethiopia)
Appolinaire Adandonon (IITA, Nigeria)
Joseph Ndunguru (IITA, Nigeria)
Ntsane Moleleki (Claude Harris Foundation)
Karin Jacobs (University of Pretoria; L'Oreal Award)

MANAGEMENT

Management committee

Professor MJ Wingfield (Chairman)
Professor BD Wingfield
Professor K Kunert
Professor L Korsten
Assoc Professor D Berger
Assoc Professor A-M Oberholster
Assoc Professor TAS Aveling
Assoc Professor TA Coutinho
Dr A Viljoen
Dr Z Myburg
Dr G Marais
Dr N Labuschagne
Dr J Roux
Dr P Govender
Mr B Hurley
Eduard Venter (Postgraduate student representative 2001)
Schalk van Heerden (Postgraduate student representative 2002)
Gavin Hunter (Postgraduate student representative 2003)

Advisory committee

Professor R Crewe, 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
Assoc 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 C Machethe, Head of the Postgraduate School for Agriculture & Rural Development
Professor M Wingfield, Chairman

Board of Control

Dr C Seele, Chairman of NCT, Vice-President of the South African Wattle Growers Union, Director of CTC
Mr M Edwards, Executive Director, Forest Owners Association
Prof J Malherbe, Vice-Rector (Research)
Prof R Crewe, Dean of the Faculty of Natural and Agricultural Sciences
Prof MJ Wingfield, Director of FABI

Some social highlights in FABI 2002/2003

Annual SPOOF* meeting

*Society for the Publication of Outrageous Findings

Theme: Vikings

Sonja de Beer, Jana and Bernard Slippers

Rodrigo Ahumada, Sonja and Wilhelm de Beer and Rose Visser (front)

Irene Barnes, Rodrigo Ahumada, Rene Jacobs and Dilzara Agayehu

Year end function 2002

Carlos and Claudia Rodas, Maria-Noel Cortinas and Michael Cunningham

Stéfan Fouché and Joanne Weich, Sanusha and Tyrell Naidoo and Danie Theron

Back row: Irene and Kevin Barnes, Bongani Maseko, Gavin de Vos, Ronald Heath
Front row: Jolanda Roux, Gavin Hunter, Barbara Nel, Lorenzo Lombard and Leon Labuschagne

Is FABI becoming "FABYLON"?

A stranger walking through the passages of the Forestry and Agricultural Biotechnology Institute (FABI) on the main campus of the University of Pretoria, might wonder if he/she has not perhaps rediscovered the Babylon of old? This impression would arise due to the large number of foreign Post-doctoral fellows, Masters and PhD students that populate FABI. Of course, the many South Africans speaking a wide array of local languages contribute to this, not unpleasant, cacophony. In September this year, an informal survey was conducted on the FABITEAM listserver to determine exactly how many languages are currently spoken in the Institute. Of the 66 people who responded to the questionnaire, all but one FABIAN, speaks two or more languages. And it is known that the one person who recorded that she speaks only English, understands Afrikaans perfectly well! The person who speaks the most languages in FABI, is South African PhD student Bongani Maseko, who speaks nine languages. Then there are seven FABIANS who each speak six languages, five speak two languages, four speak four languages, twelve speak three, and the remaining 34 speak two languages. The languages spoken (numbers of people in brackets) included: from South Africa: Afrikaans (30), Zulu (5), Xhosa (4), S-Sotho (4), Tswana (4), N-Sotho (3), Swazi (2), Ndebele (1), Hindi (1). The number of Afrikaans speaking people seems high, but this s mainly because almost all the African language speakers also speak Afrikaans as a second or third language, while very few of the Afrikaans speaking students speaks any of the native African languages. FABIANS from the remainder of Africa speak the following languages: Amharic (3), Oromigna (2), Swahili (1), Luganda (1), Shona (1), Tonga (1), Chewa (1), Ndebele (1), Herero (1). Those from Europe and Asia: German (7), French (3), Azerbaijanian (1), Russian (1), Turkish (1), Serbian (1), Portuguese (1), Italian (1), Chinese (1). FABIANS from South America: Spanish (6). All of the respondents speak English, which is also the operational language in FABI. In celebration of the international flavour in FABI, the FABI Christmas card for the 2002 festive season include the season's greetings in 22 of the 28 languages spoken in this very multicultural institute.

FABI Christmas Card 2002