EXCITING PROJECTS IN THE FIELD OF DISEASES OF NATIVE TREES

Written by Ms Briar Harmer, (MSc student)

An alliance between the Department of Science and Technology (DST) and the National Research Foundation (NRF) has resulted in the establishment of the Centres of Excellence. These centres aim not only to address prominent issues facing the scientific community of South Africa, but also to help shape the next generation of scientists and biologists through high quality training and guidance. The DST/NRF Centre for Tree Health Biotechnology (CTHB), situated at the University of Pretoria, represents just one of the seven centres scattered across the country. The CTHB works in conjunction with the Tree Protection Co-operative Programme (TPCP) and the Forestry and Agricultural Biotechnology Institute (FABI) to promote tree health in the South African region.

Various projects have been established to investigate the influence of pests and pathogens on economically important native forestry crops. Mr Gilbert Kamgan Nkuekan (under the guidance of Prof. Jolanda Roux and Prof. Mike Wingfield) is currently exploring the hazards of infection of both indigenous and exotic hardwood trees by *Ceratocystis* and *Ophiostoma* species. These two fungal pathogens have been previously associated with a variety of diseases that have led to plantation devastation and economic losses. This research has the potential to increase our knowledge of the biodiversity, origin and movement of *Ceratocystis* and *Ophiostoma* species in Southern Africa. This work provides the opportunity to gain a better understanding of how these pathogens might play a role in tree decline, and to develop new, or improve existing disease management strategies.

Mr Gilbert Kamgan Nkuekan at work in the field collecting fungal pathogens from cut timber.
Cultured isolates of (a) *Ceratocystis* spp. and (b) *Ophiostoma* spp.

Although highly concerned with the dilemmas of the forestry industry, pathogenic infections of timber and pulp trees are not the only focus of the CTHB. Waterberry (*Syzygium cordatum*), a native tree of Southern Africa, is important to rural communities, where it is used as a remedy for stomach-ache, diarrhoea and tuberculosis. Recently, numerous trees have been found with malformed inflorescences. No longer comprised of white, fluffy flowers that produce edible purple berries, these inflorescences are now abnormally enlarged, branched and berry-less. Similar symptoms seen in Mango (*Mangifera*

indica) inflorescences have prompted researchers to draw parallels between Waterberries and Mangoes with respect to the pathogens found in the *Gibberella fujikuroi* species complex. A species complex, as intimidating as the term appears, is merely a collection of fungal pathogens that are so closely related to one another it is often hard to tell them apart. The *G. fujikuroi* complex is a collection of *Fusarium* species, fungal pests that attack sugarcane, bananas, rice and other agronomically important crops. Under the supervision of Dr Emma Steenkamp, Ms Marija Kvas is occupied with the identification and characterisation of various *Fusarium* species associated with Waterberry inflorescence malformation. The project has led to the identification of a number of novel lineages in the *G. fujikuroi* complex, amongst these lineages are several unique and as yet undescribed species. In the future these unique species will be fully described and their ability to cause disease in Waterberry will be tested.

Healthy versus malformed Waterberry inflorescence. A healthy inflorescence is characterized by white, fluffy flowers, which bloom from August to November and the appearance of edible berries, which are purple when ripe. Malformed inflorescences are abnormally large, branched and heavy. Over time the inflorescences dry out without ever producing fruit.

The CTHB is a multifaceted group that is enhanced by its diversity of disciplines, which increases as the group matures and grows. The group has its foundations in silviculture, agronomy, genetics, microbiology, entomology and plant pathology. The CTHB now includes the discipline of bioinformatics under the auspices of several exciting projects. Bioinformatics is a computer-based discipline, which uses computers and specialised software programs to analyze and manage data collected from biological systems. Although a relatively new field, when compared to systematics or microbiology, it has contributed much to the field of biology. Bioinformatics allows for the ease in the performance of tasks previously thought of as being highly difficult if not impossible, for example sequence alignments, genome assembly and protein structure prediction can now all be done *in silico*, that is on the computer or online.

One such bioinformatics-based project is "Mitochondrial genomes of plant pathogenic fungi: molecular characterisation and evolution". A collaborative effort between representatives of the CTHB; University of Pretoria; Murdoch University, Western Australia; and the University of Kwazulu-Natal; the project is headed by Dr Martin Coetzee. As described by Dr Coetzee, the project aims to "*Establish the level of genetic variation in the mitochondrial genome of a selection of ascomycetous and basidiomycetous plant pathogeneic fungi relevant to tree health in South Africa*". Mitochondria are organelles found in the cytoplasm of the cell. Described as "cellular power plants', they are responsible for generating usable energy; energy that is employed in the everyday running of the cell. Like the cell nucleus, the mitochondrion contains its own brand of DNA (mtDNA). This mtDNA contains the instructions that drive cell metabolism and must therefore be maintained in a highly conserved state. That is to say that very little change in these instructions will be tolerated by the cell otherwise metabolism would be disrupted and the cell would die. The conserved nature of mtDNA makes it ideal for the study of evolution. Through the study of complete mitochondrial genomes of those fungi mentioned above, it will be possible to gain insight into variation between whole mitochondrial genomes and the evolution of the genes that constitute these genomes. Study of the genes of the mitochondrial genome may further reveal the mitochondrion's role in ageing and virulence of pathogens.

With both an international and local perspective, the CTHB focuses in on the health of native trees. As important constituents of the country's biodiversity, these trees are subject to the negative impact of the environment and a wide range of organisms. Through research into those pathogens and insect pests that threaten tree health, the CTHB remains not only committed to promoting a field of extreme importance, but also to providing the highest possible quality of post graduate education available.