



# DEPARTMENT OF PLANT SCIENCES

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## OVERVIEW OF 2018

The Department of Plant Sciences consists of three divisions: Botany (on both Bloemfontein and Qwaqwa Campuses), Plant Breeding, and Plant Pathology. Our dynamic staff teach and perform research in a diverse range of topics. The undergraduate (BSc and BSc [Agriculture]) and postgraduate training we offer are focused on relevant issues in our country and abroad and are globally competitive. Our collaboration with various national and international

institutions, local councils, and associations is indicative of the relevance and applicability of plant science to industry. Our staff's competence and quality of work is reflected in the South African Research Chairs Initiative (SARChI) Chairs held since 2015, the number of staff with National Research Foundation (NRF) ratings, the increasing number of Postdoctoral Research Fellows, awards received, peer-reviewed publications, and qualifications conferred to students in 2018. Staff members in the department published 57 peer-reviewed articles in 2018 and hosted eight Postdoctoral Research Fellows.

## ACHIEVEMENTS

### Staff Achievements

Prof Louis Scott received a B1-rating from the NRF for 2018-2022.

Profs Botma Visser (Chairperson), Zakkie Pretorius and Liezel Herselman, Dr Willem Boshoff, and Cornél Bender organised the very successful International Cereal Rusts and Powdery Mildews Conference (ICRPMC) in Skukuza from 23 to 26 September 2018. A total of 93 international and national delegates attended the meeting. Prof Pretorius and Dr Boshoff, together with Ms Jianping Zhang (from CSIRO Agriculture and Food in Canberra), were the co-authors of the winning poster, with the title *Isolation of an immune receptor gene from tall wheat grass confers resistance to diverse races of stem rust in common wheat*.

The poster of Prof Zakkie Pretorius on *Innovative manufacturing of a cereal rust inoculation device* won the prize for best poster at the 9<sup>th</sup> Borlaug Global Rust Initiative (BGRI) Technical Workshop in Marrakech, Morocco, while Prof Botma Visser's poster, titled *Gone with the wind: Revisiting stem rust dispersal between southern Africa and Australia*, was the runner-up.

*Prof Botma Visser, Dr Willem Boshoff, Prof Zakkie Pretorius, Prof Liezel Herselman (back row, from the left), and PhD students Howard Castelyn and Martin Chemonges (front row) visiting a field trial during the BGRI Technical Workshop in Morocco*



Prof Maryke Labuschagne participated in the international Agriculture for Food Security (AgriFoSe) in Africa Programme in Sweden in 2018, where a project was undertaken on the impact of plant breeding on food security in Africa. The project concluded with a publication and policy documents for African countries on how to optimise breeding and extension activities for food security.

Members of the department were actively involved in the organisation of the international conference on Sorghum in the 21<sup>st</sup> Century held in Cape Town from 9 to 12 April. The conference was attended by 2 500 delegates from around the globe, and included more than 250 oral presentations and 200 poster presentations. Prof Maryke Labuschagne and Prof Neal McLaren jointly chaired the Local Scientific Programme Committee. Ms Lisa Rothmann

served as chairperson of the Student Chapter of the Sorghum in the 21<sup>st</sup> Century Global Conference.

Prof Labuschagne also served on the scientific committee and as a session chair for the 13<sup>th</sup> International Gluten Workshop in Mexico City, in addition to which she was a plenary speaker. She continued as South African representative of the American Association of Cereal Chemists International, and as a member of the advisory committee to the South African government on genetically modified organisms. She was appointed to the editorial board of the *British Journal of Cereal Science* at the end of 2018.

Dr Lize Joubert obtained third prize during the first Flash Fact competition for staff members in the Faculty of Natural and Agricultural Sciences.



Dr Lize Joubert (third from left) winning third prize during the Flash Fact Competition

Prof Neal McLaren and Lisa Rothmann served on the Sorghum Trust Projects Evaluation Committee. Lisa Rothmann, in collaboration with Grain SA, received funding to expand the South African Sclerotinia Research Network (SASRN), which is aimed at generating a South African Virtual Centre of Excellence and Expertise for *Sclerotinia* research in an international arena. The network is aimed at developing practical management strategies for diseases caused by *Sclerotinia*, through a research consortium and network. At the International Society for Plant Pathology Sclerotinia Subject Matter Committee meeting in Boston, Ms Rothmann was elected to assist in publishing a collaborative article focusing on Sclerotinia diseases.

Dr Sandy-Lynn Steenhuisen received an award for the highest-impact paper (for staff) in 2018 in the research programme run by the Afromontane

Research Unit (ARU) based on the Qwaqwa Campus. This was for a paper, titled *Saurian surprise: Lizards pollinate South Africa's enigmatic 'hidden flower'*, by R Cozien, T van der Niet, SD Johnson, and S-L Steenhuisen, accepted by *Ecology*.

The Department of Plant Sciences on the Qwaqwa Campus has been selected to host the annual conference of the South African Association of Botanists (SAAB) in January 2020. Dr Sandy-Lynn Steenhuisen will serve as chairperson of the local organising committee.

Dr Tom Ashafa received the Prolific Researcher Award in Natural and Agricultural Sciences during the 2018 Qwaqwa Campus Research Excellence Award Ceremony.



## Student Achievements

Lisa Rothmann obtained third prize during the first Flash Fact competition for postgraduate students in the Faculty of Natural and Agricultural Sciences.



Lisa Rothmann being awarded third prize in the Flash Fact competition by Prof Francis Petersen (UFS Vice-Chancellor)

Five postgraduate students (Martin Chemonges, Etienne Theron, Jacques van der Merwe, Danette Strauss, and Stephanie MacDonald) competed in the annual postgraduate symposium of the Department of Botany and Plant Biotechnology at the University of Johannesburg (UJ). While Mr Chemonges was announced as the runner-up in the PhD category, Ms Strauss and Ms MacDonald were announced as the winner and runner-up of the BSc Honours category, respectively.

Alex de Gouveia (supervised by Dr L Joubert and co-supervised by Dr M Jackson) won the EM van Zinderen Bakker prize for an outstanding MSc study in Botany.

Clausanne Esterhuizen won the Botanical Society of South Africa (Free State Branch) prize for best honours student in Botany (supervisor Dr M Jackson), and Gerna Maree won the prize for the best Plant Pathology postgraduate student (supervisor Prof ZAPretorius, co-supervisor Dr R Prins).

Jacques van der Merwe won the Klein Karoo Seed Marketing prize for the best honours student in Plant Breeding (supervisor Dr R van der Merwe).

Nthabiseng Mashamba won the South African Plant Breeders' Association (SAPBA) prize for the best MSc student in Plant Breeding (supervisor Dr A van Biljon, co-supervisors Prof MT Labuschagne and Dr B Wentzel).

Ansori Maré won the Plant Breeding prize for the best PhD student in Plant Breeding (supervisor Prof L Herselman, co-supervisor Dr WHP Boshoff).

Lisa Rothmann was awarded the American Phytopathological Society (APS): Books for the World Prize, through which she is sponsored books from the APS Press to the value of \$500. Ms Rothmann also wrote a popular article for the *Dry Bean Magazine*, titled 'Weather and water matters'.

PhD student Sajjad Akhtar was selected to make an oral presentation at the prestigious Du Pont symposium during the 12<sup>th</sup> Southern African Plant Breeding Symposium in March 2018. During the same symposium, PhD student Julius Siwale won the best student poster award, while MSc student Ntombokulunga



Staff and students attending the Postgraduate Symposium of the UJ Department of Botany and Plant Biotechnology. Front row, from the left: Stephanie MacDonald and Jacques van der Merwe. Back row, from the left: Martin Chemonges, Danette Strauss, Dr Andri van Aardt, Etienne Theron, and Prof Botma Visser

Mbuma received the award for the best oral student presentation.

Dr Rudo Ngara's two students based on the Qwaqwa Campus, Mamosa Ngcala (MSc) and Tatenda Goche (PhD), presented their research at the Sorghum in the 21<sup>st</sup> Century Conference held in Cape Town in April 2018. Mamosa won the first prize for a 3-Minute Thesis competition at the conference.

## SARChI Chair in Disease Resistance and Quality of Field Crops

The SARChI Chair, led by Prof Maryke Labuschagne, had many highlights in 2018. A study on the mixograph and Mixsmart software as predictors of wheat quality for the South African wheat industry was concluded, contributing useful data for all sectors of the wheat industry. In a separate study, solvent-retention capacity of South African wheat cultivars was determined for the first time. A project undertaken in collaboration with the International Centre for the Improvement of Wheat and Maize (CIMMYT) in Mexico, has led to a new study on gluten-protein expression under heat and drought stress conditions in international and South African bread and durum-wheat cultivars. Proteomics protocols for gluten-protein analysis were optimised and are now used as part of the gluten-protein research. Research on biofortification of maize with iron and zinc has continued in collaboration with CIMMYT. Research on biofortification of cassava and banana with provitamin A continued, in collaboration with the International Institute of Tropical Agriculture (IITA) in Nigeria.

The Cereal Rust Group collaborated on several local and international research projects. Locally, several new rust races were described and their potential risk towards grain production was determined through characterising cultivars and breeding lines for their resistance response. These findings were communicated at congresses as well as in popular and scientific papers. International collaboration included projects aimed at cloning and mapping resistance genes and transferring novel sources of resistance to wheat from *Thinopyrum ponticum*, a wild relative of wheat.

### Botany: Palaeo-botany and ecology

Dr Andri van Aardt and Prof Louis Scott investigated the long-term changing patterns in vegetation by studying both fossil and present-day plant material. As part of ongoing research projects with international collaboration, they made progress in the reconstruction of the climate and vegetation of the Quaternary in the central and western parts of the Free State (Florisbad) and Northern Cape (Wonderwerk Cave and Kathu Pan). They also investigated the use of the leaf epidermis as a possible indicator for palaeo-environments at the Pretoria Saltpan (Tswaing Crater), Gauteng.

In addition, they obtained cores from Colbyn Valley Nature Reserve, Rustenburg, and Rietvlei Dam Nature Reserve with the help of Dr Piet-Louis Grundling (Working for Wetlands, Department of Environmental Affairs) for radiocarbon dating and pollen analysis, with the aim of gaining fine resolution samples for the reconstruction of the vegetation and climate of the Savanna and Grassland Biomes during the late Pleistocene and Holocene.

Research on fossil hyrax dung in Namibia was continued, and samples were submitted for radiocarbon dating, while previous palynological results were also processed.

Dr Sandy-Lynn Steenhuisen's research group, based on the Qwaqwa Campus, welcomed Mr Adams as a master's student in April 2018. He is funded by the ARU to work in collaboration with Dr Grant Martin from the Centre for Biological Control (CBC) at Rhodes University, and ARU Director, Dr Ralph Clark, on the invasive potential of *Pyracantha* species on high-altitude lands in the eastern Free State. This opened links with the Centre for Invasion Biology (CIB), an inter-institutional centre of excellence based at Stellenbosch University, and also resulted in an invitation for Dr Steenhuisen to participate in the annual meeting of the National Alien Grass Working Group, held at the South African National Biodiversity Institute (SANBI), Kirstenbosch Gardens, in September 2018. Mr Adams and Dr Steenhuisen participated in a workshop on 'Seed Dispersal by Native Ungulates from Southern Africa' held at the University of KwaZulu-Natal (UKZN), Pietermaritzburg, in July 2018. Collaborations are now being explored with Biological Sciences at UKZN to investigate the viability of *Pyracantha* seeds ingested by frugivorous birds.

Dr Steenhuisen's research on the genetic diversity of *Protea* species that employ different pollinators, is ongoing in collaboration with Prof Jeremy Midgley of the University of Cape Town (UCT), Megan Smith (master's student, UCT), and Dr Rachel Prunier of the Western Connecticut State University (WCSU), USA. In addition, in collaboration with researchers from

UKZN, Ms Ruth Cozien (the project coordinator), Dr Timotheus van der Niet, and Prof Steven Johnson, she started exploring the scent and colour preferences of Drakensberg crag lizards as ongoing research on the lizard pollination system of *Guthriea capensis*, discovered during the 2017/2018 flowering season.



Pollination of *Guthriea capensis* by lizards  
(Photo credit: Ms Ruth Cozien [UKZN])

### Botany: Plant Physiology/biochemistry and molecular biology

Prof Botma Visser leads the molecular genetics laboratory within Botany, where the emphasis is on the genetic characterisation of different pests, rusts, and viruses of cereals. Included are rusts of wheat, sunflower, and oats, as well as viruses of wheat and their associated vectors, and the Russian wheat aphid.

Dr Lintle Mohase and her research team continued their research on plant-defence mechanisms in wheat during aphid (and rust) infestations. She collaborated with plant breeders (Dr Ntjapa Lebaka) and pathologists (Dr Willem Boshoff) from the University of the Free State (UFS), and entomologists from the Agricultural Research Council-Small Grain (ARC-SG) in Bethlehem (in particular Dr Astrid Jankielsohn). Dr Mohase's research concentrated on aphid distribution in wheat-producing regions of South Africa and Lesotho, the impact of aphid infestations on yield and quality, mechanisms of host resistance, as well as the effect of commercial plant activators on crop protection against the aphid *Duraphis noxia*.

Dr Gerhard Potgieter's research topics in the field of ecophysiology focus on plant health. Chlorophyll-a fluorescence for photosynthetic capacity, chlorophyll concentration and Normalised Difference Vegetation Index (NDVI) imaging are the base parameters used for plant health. The effect of different bio-stimulants, such as fish protein, kelp, and *Trichoderma* extracts on plant health and yield, were evaluated on hydroponically grown crops. Additionally, a new approach was developed to identify plants through aerial remote sensing, using both digital (RGB) and NDVI images to create vegetation indexes in support of traditional ecological survey techniques, and to identify early-stress conditions in plants.

Dr Makoena Joyce Moloi was appointed in March 2018 and is currently establishing her research, focusing on the physiology of large-seeded soybean under abiotic stress conditions (e.g. drought, temperature, and nutrients). Her research will be valuable for breeding plants with tolerance to such stressors. She is working closely with Dr Rouxlène van der Merwe, from Plant Breeding.

Dr Marieta Cawood's research focuses on extraction, identification, and utilisation of plant secondary metabolites in agricultural and medicinal fields. In collaboration with the ARC, a PhD student is investigating the chemical composition and allelopathic influence of the underutilised crop, *Amaranthus cruentus*, under abiotic stress conditions. Another PhD study examines control strategies for silverleaf nightshade (*Solanum elaeagnifolium* Cav.), with emphasis on the impact of biological control. An MSc project focuses on the chemical composition and resistance of pecan-nut cultivars in South Africa.



Marlese Meiring (PhD student) conducting ratings for soybean cultivar evaluations of *Sclerotinia stem rot*, caused by *Sclerotinia sclerotiorum*



Dr Rudo Ngara's ongoing research, based on the Qwaqwa Campus, focuses on understanding the adaptive mechanisms of sorghum to drought, salinity, and heat stresses, using a range of 'omics' technologies. She has also started to functionally characterise some of the target genes in *Arabidopsis* plant systems, in collaboration with Dr Chivasa from Durham University, UK.

### Botany: Phytomedicine and ethnobotany

This research is primarily undertaken on the Qwaqwa Campus. Dr Tom Ashafa continued with his research on medicinal plants used in the management of various diseases, particularly those used for diabetes mellitus and associated complications. The ultimate goal is to develop either ameliorative or curative remedies for these diseases. The research group also worked on parasitic (zoonotic) infections, biological materials for wastewater treatment, and antibiotics from plant sources.

Dr Lisa Komoreng continued her research on traditional medicinal plants used in the treatment of tuberculosis, elephantiasis, and ear, nose, and throat infections in South Africa. Her research also focuses on indigenous medicinal plants that are used in the eastern Free State for the treatment of various ailments. Dr Komoreng's research group screens medicinal plants for *in vitro* antimicrobial, anti-inflammatory, antioxidant, anthelmintic and antifilarial, and cytotoxic properties. Active compounds are isolated from plants showing good pharmacological activities without any toxic properties.

### Botany: Plant taxonomy and molecular systematics

Dr Lize Joubert's research focused on combining taxonomic approaches with pollination biology, and flower evolution and development to investigate various aspects of the diversity of South African flowering plants. Her research includes topics such as floral adaptation to pollinator shifts due to climate change, and optimisation of floral characters in crops for higher pollination efficiency and improved yield. Dr Joubert collaborated with Dr Mariëtte Jackson on South African plant systematics, and with Dr Andri van Aardt in developing species circumscriptions to link lineages of extant species to microfossils used in palaeo-vegetation reconstruction.

The Molecular Systematics Research Group is headed by Dr Mariëtte Jackson. Various genera within the family Asteraceae are studied to assess the phylogenetic relationships among these groups. A new field of research is currently being investigated, involving the analysis of fossil pollen from the Prof Louis Scott Collection for its use within phylogenetic studies. A master's student is optimising various molecular techniques to be used to acquire DNA sequences from fossil pollen.

### Plant Breeding: Molecular plant breeding

Prof Liezel Herselman's research continued to make progress towards the introgression of different rust resistance (stem, stripe, and leaf rust), as well as Fusarium head-blight (FHB) resistance genes in South African wheat cultivars. New developments in her research were presented at two international conferences (the BGRI Workshop and the ICRPMC), and two local conferences (Southern African Plant Breeding Symposium and South African National Seed Organisation [SANSOR] Conference). The wheat-resistance breeding programme applies marker-assisted backcrossing, fungal gene-expression analyses, phenotypic evaluations in the greenhouse and field, production of doubled haploid plants, and biochemical screening to develop pre-breeding lines. New promising lines are continuously being developed and identified for use in other breeding programmes.

Postgraduate student projects included characterising and mapping a potential new source of wheat stem-rust resistance, genetic analysis of stem-rust resistance in South African winter wheats, genetics of stem-rust resistance in spring-wheat germplasm from Ethiopia, breeding for disease resistance in a South African context, and improving rust and FHB resistance in South African wheat lines. Progress was made with crosses to transfer one stem rust and three stripe-rust resistance genes into lines that already contain eight other rust and FHB-resistance genes. Research is also continuing to confirm the possible identification of novel stem-rust resistance genes, closely linked to known stem-rust resistance genes, in selected winter wheat varieties. Elite and synthetic spring wheat lines from Ethiopia were also phenotypically and genetically evaluated for resistance against Ug99 and non-Ug99 stem-rust races. Association mapping identified chromosome regions not previously linked to stem-rust resistance. Lines containing three to four stem-rust resistance genes were identified; these can be used in future breeding schemes to develop stem-rust resistant wheat cultivars in Ethiopia.

Dr Adré Minnaar-Ontong continued her research on the genetic variation of *Sclerotinia sclerotiorum* populations on different hosts in South Africa. The outcome of the project contributed towards another research project, which includes the development of resistant cultivars to *Sclerotinia* diseases in economically important oil crops. The NRF-Thuthuka (2019-2020) and Grain SA will fund the resistance-breeding project. South African sunflower and soybean cultivars are evaluated for resistance to *Sclerotinia* diseases to promote the improvement of disease-control strategies. Her research also includes the genetic analysis of soybean resistance to *Fusarium virguliforme*. This project aims to evaluate commercial soybean cultivars for resistance and to improve management strategies for disease control.



## Plant Breeding: Conventional breeding

Dr Rouxlène van der Merwe's research focuses on analysing the stability of Edamame (*Glycine max* L.) in South African production conditions. The research is undertaken in collaboration with the Edamame Development Programme (EDP) project, funded by the Durban City Council and KwaZulu-Natal government). Her PhD student, Armand Smit, delivered a paper on his results during the 12<sup>th</sup> Southern African Plant Breeding Symposium held in Durban during March 2018.

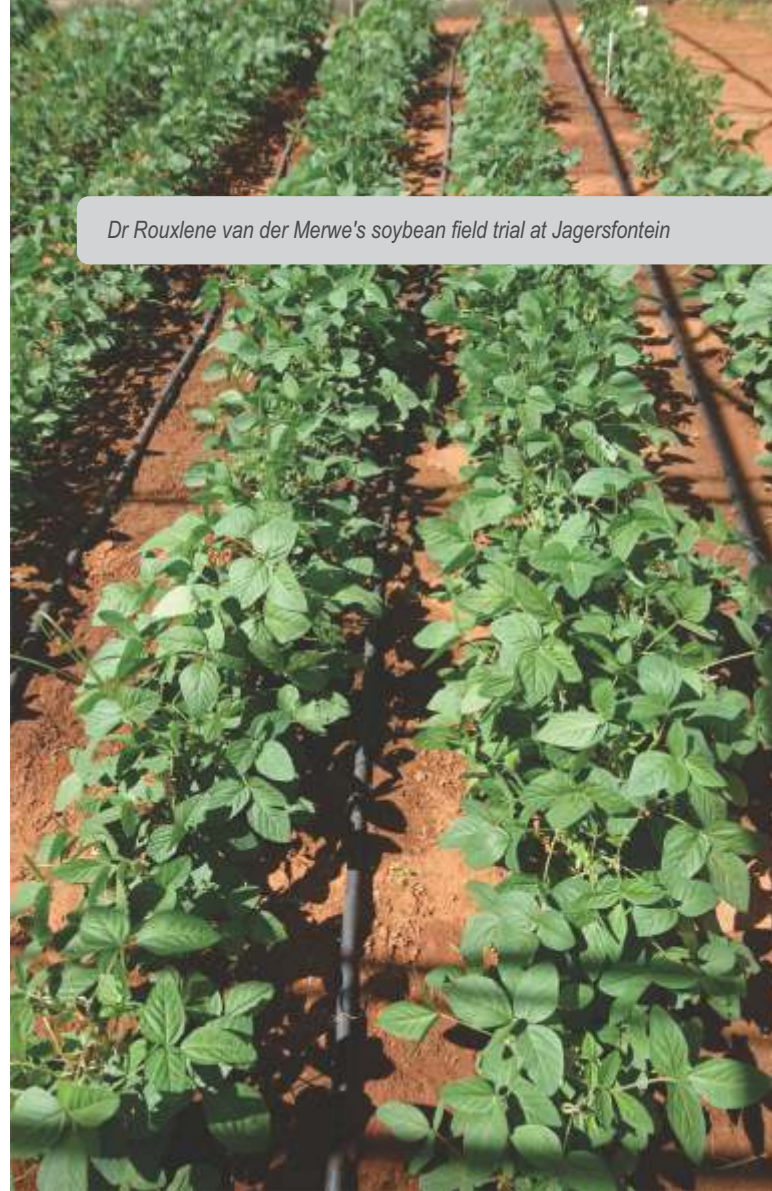
Dr Van der Merwe breeds for resistance to pod dehiscence in vegetable-type soybean, in collaboration with the Northeast Institute of Geography and Agroecology at the Chinese Academy of Sciences. This research continued to make progress towards the development of an improved South African vegetable-type soybean cultivar that shows resistance to pod shattering. This project is also done in collaboration with Dr Adré Minnaar-Ontong, who is responsible for marker-assisted selection. Green pod yield, nutritional content, and selection for drought-stress tolerance in large-seeded (vegetable type) soybean are also investigated. The work is done in collaboration with the EDP, and the project is funded by the NRF-Thuthuka. This research continued to make progress towards the development of an improved South African vegetable-type soybean cultivar that shows high-yield potential and with improved nutritional value, as well as characterisation of vegetable-type soybean cultivars in terms of drought-stress tolerance. The project is done in collaboration with Dr Angeline van Biljon, who is responsible for amino-acid and sugar analyses.

## Plant Breeding: Wheat-quality and crop-nutritional value research

Dr Angeline van Biljon continued her research on the influence of abiotic stress on the nutritional profile and quality of crops, as this information can contribute to the improvement of specific crops and improved food security. Her research focuses on crop plants, including wheat, maize, soybeans, and alternative crops such as amaranth and cleome. The nutritional screening includes the study of storage proteins through size exclusion and reverse-phase high-performance liquid chromatography, as well as the determination of total starch, amylose, tryptophan,  $\beta$ -carotenoids, mineral content (especially iron and zinc), and the bioavailability of minerals.

Dr Ntjapa Lebeka continued his work on improving the nutritional value of indigenous grain legume crops, such as Bambara groundnuts and cowpeas. The study focuses on the evaluation of these crops for adaptation in selected South African environments, as well as evaluation of nutritional quality (protein, lipids, iron, and zinc content) under stress conditions.

Prof Maryke Labuschagne continued her research on wheat quality with a focus on gluten proteins and their expression, and how this affects bread-making quality. Three PhD students were involved in the research, and another completed her studies in 2018. They have optimised a protocol for



Dr Rouxlène van der Merwe's soybean field trial at Jagersfontein

proteomics analysis of durum and bread wheat. This project is done in collaboration with the CIMMYT in Mexico, and the ARC-SG in Bethlehem. In terms of crop nutritional value, a collaborative project with the IITA in Nigeria on the improvement of provitamin A content in cassava is continuing, with a PhD student leading the research. Research on the improvement of maize nutritional value, in collaboration with CIMMYT in Zimbabwe, has led to the completion of two MSc studies, while two PhD students are continuing their work on zinc, tryptophan, and lysine biofortification.



Dr Angeline van Biljon and postgraduate students from Plant Breeding planting amaranth seedlings in a field trial



## Plant Pathology: Cereal-rust diseases

Together with Chinese collaborators, Prof Zakkie Pretorius and Dr Willem Boshoff's research in transferring rust resistance from a related grass species to wheat was expanded, and a scientific paper submitted. Three wheat-mapping populations for leaf- and stripe-rust resistance were screened in South Africa in collaboration with scientists from the University of Sydney, Australia. Collaborative projects with researchers from the USA include barley stem-rust resistance mapping (University of Minnesota) and stem-rust race nomenclature (Agricultural Research Service – United States Department of Agriculture [ARS-USDA]). A collaborative project, funded by King Abdullah University of Science and Technology (KAUST) – which will contribute to the understanding of durable disease resistance in wheat, and stem-rust screening of UK wheat cultivars against stem-rust race PTKST – continued in collaboration with scientists from the John Innes Centre. Satisfactory results were obtained from greenhouse and field work, including screening of commercial South African wheat cultivars and lines for rust resistance. The data from these trials is annually included in the national wheat-production guidelines of ARC-SG. Significant progress was made with projects on studying pathogenic variability in rust pathogens of oats, barley, and rye. One paper from this work has been accepted for publication.

## Plant Pathology: Soil microbial ecology

Prof Wijnand Swart leads the Soil and Microbial Ecology Group (SMEG), whose focus falls on monitoring the rhizosphere microbiome as a bio-indicator of plant health. Research mainly concentrates on underutilised crops such as Bambara groundnuts, cowpeas, and various pseudo-grains such as quinoa, chia, and amaranth, although commercial crops such as soybean, sorghum, and maize are also studied. The genetic and functional diversity of the rhizosphere microbiome of diseased plants is compared with that of healthy plants, using various advanced biochemical and molecular tools. Research is primarily funded by the Ekhaga Foundation in Sweden, the ARC, Nulandis, and the Strategic Research Fund of the UFS.

## Plant Pathology: Mycology

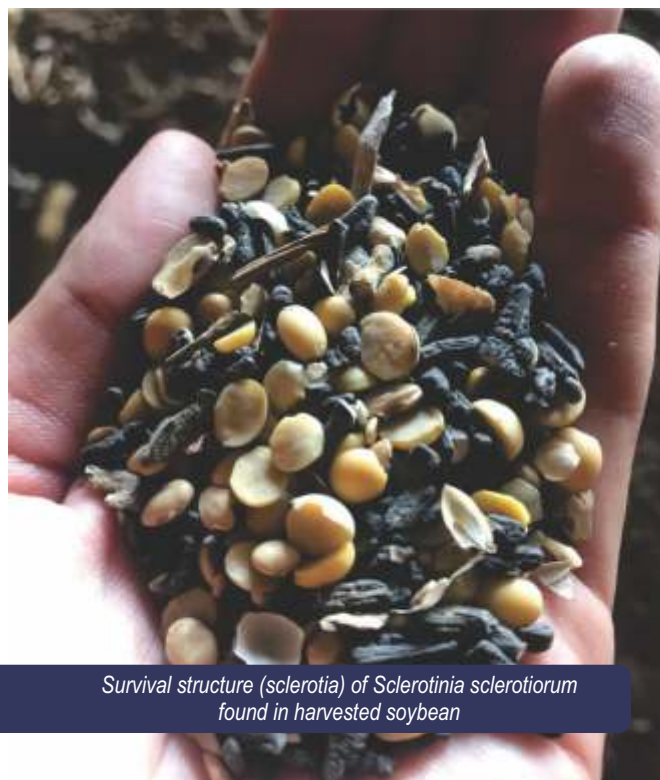
Dr Gert Marais leads the Mycology and Pecan Health Research Group that focuses on the biodiversity of fungi and their role in plant health, as well as their economic importance. A five-year contract was signed in 2017 between the UFS and the South African Pecan Nut Producers' Association (SAPPA) to study pecan diseases and their impact in South Africa. The Pecan Health Research Group, which includes plant pathologists, physiologists, geneticists, and plant breeders, was thus established at the UFS. Seven postgraduate projects are being undertaken, involving research in all nine major pecan-producing areas of South Africa. In addition, 12 farmers' days were held in the Free State, Northern Cape, Eastern Cape, North-West, Limpopo, Mpumalanga, and KwaZulu-Natal. First results reflect a number of fungal diseases associated with pecans, indicating the distribution of these diseases throughout South Africa.

## Plant Pathology: Epidemiology

The field-crops epidemiology programme was led by Prof Neal McLaren and supported by Ms Lisa Rothmann. The programme focuses on epidemiology of *Sclerotinia* stem and head rot of soybean and sunflower, as well as sorghum pathology – including leaf blight, grain moulds, and root rots.

A legume rotation programme that integrates environmental diversity and edaphic variables in legume-rotation systems with sorghum on root health, was continued. This was funded by the ARC Collaborative Consortium: Broadening the Food Base Programme, in collaboration with Dr Maryke Craven at the ARC-Grain Crops (ARC-GC) in Potchefstroom. This research forms the basis of an MSc study and is associated with the ARC-Professional Development Programme.

Research support from the Sorghum Trust continued during 2018. This programme focuses on grain colonisation by grain-mould pathogens and mycotoxigenic *Fusarium* spp., risk-prediction modelling, and identification and quantification of intervention technologies. A parallel study includes prediction modelling and intervention-technology optimisation for sorghum leaf blight, a growing local production constraint. A prediction modelling study initiated in 2017, that is aimed at risk analysis of *Sclerotinia* stem and head rot of soybean and sunflower, was funded by the Sasol Trust. The Sasol Trust also funded a study into the optimisation of inoculation and field-screening techniques for *Sclerotinia* stem rot of soybean and head rot of sunflower, and the quantification of genotype x environment interactions based on multi-environment responses.



*Survival structure (sclerotia) of Sclerotinia sclerotiorum found in harvested soybean*

## COMMUNITY SERVICE

Dr Lize Joubert and her MSc student, Linde de Jager, presented talks on pollination biology at meetings of the Free State branch of the South African Botanical Society (BotSoc), held at the Free State National Botanical Garden in Bloemfontein. BotSoc members also paid a visit to the Geo Potts Herbarium for a talk on the role of the herbarium in society.

The Heidedal Kinderbond, led by Ds Deon Potgieter, visited the Geo Potts Herbarium for a fun day of exploring interesting plants, learning about plant science, and making their own mini-herbarium specimens.

Members of the Lesotho Ministry of Forestry and Land Reclamation, as well as community leaders who aim to establish a new botanical garden and herbarium on tribal land, visited the Geo Potts Herbarium. The aim of the visit was to learn about the contribution of herbaria to the community and how a new herbarium can be established and run.

Dr Andri van Aardt presented a talk at the Bloemfontein Central Gardening club, titled 'What can plant fossils tell us about climate change?'

## NATIONAL AND INTERNATIONAL COLLABORATION

Members of the department collaborated widely during 2018, as part of ongoing collaborative initiatives.

Dr Lize Joubert collaborated with Dr Pieter Bester from SANBI on systematic and evolutionary research of *Nemesia*, a genus endemic to Southern Africa and of significant horticultural and conservational importance, and with Prof Beverley Glover from the University of Cambridge on floral evolution and development research.

Prof Liezel Herselman continued her collaborative research with researchers from the Pannar Seed Company, CenGen, and the ARC-SG.

Dr Andri van Aardt and Prof Louis Scott collaborated with Dr Piet-Louis Grundling (Working for Wetlands at the Department of Environmental Affairs) on palaeoenvironmental reconstructions of the Grassland-Savanna transition, with Dr Liora Horwitz (Jerusalem, Israel) and PhD student Magdalena Sobol (Toronto, Canada) on palaeoenvironments at archaeological sites in the Northern Cape, and with Dr Frank Neumann (University of the Witwatersrand) and Dr Friðgeir Grímsson (University of Vienna) on fossil African Lorantheaceae pollen.

Prof Botma Visser collaborated with Mr Marcel Meyer from the University of Cambridge, Dr Dave Hodson from the CIMMYT in Ethiopia, and Prof Robert Park of the Plant Breeding Institute, University of Sydney, on the movement of stem rust from Africa. He also collaborated with Prof Melania Figueroa of the Department Plant Pathology, University of Minnesota, on the genetic characterisation of oat crown rust. At national level, he collaborated with Drs Tarekegn Terefe, Goddy Prinsloo, and Astrid Jankielsohn of the ARC-SG in Bethlehem on various projects.

Dr Adré Minnaar-Ontong collaborated with breeding companies from industry in South Africa and with researchers from the University of Manitoba, Canada, and the University of Nebraska, USA.

Dr Lintle Mohase collaborated with Dr Astrid Jankielsohn (ARC-SG, Bethlehem) on aphid diversity in South Africa and Lesotho, and with the Lesotho Agricultural Research on wheat germplasm in Lesotho.

Dr Rouxlène van der Merwe has continuing collaboration with Prof Qiuying Zhang from the Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, and the EDP. She also collaborates with breeding companies from industry and with researchers from the University of Manitoba, Canada, and the University of Nebraska, USA.

Dr Willem Boshoff and Prof Zakkie Pretorius conducted research projects in collaboration with researchers from the Chinese Academy of Sciences (Beijing), KAUST (Kingdom of Saudi Arabia), John Innes Centre (UK), the University of Minnesota (USA), ARS-USDA, and the University of Sydney (Australia). They also conducted research with CenGen, ARC-SG, Sensako, Pannar, the Central University of Technology, and Stellenbosch University.

Dr Gert Marais collaborates with SAPPA and the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria, to study diseases in the pecan industry in South Africa. He also worked with Prof Karen Jacobs from Stellenbosch University, studying mycotoxins in abalone feed and co-presenting a Mycology module for honours students at the UFS. Dr Marais, in collaboration with Technology Innovation Agency (TIA), the UFS, and Carbon

Fertilizer Technologies (Pty) Ltd, is developing a plant-growth enhancer, which is in the commercialisation phase.

Prof Wijnand Swart collaborated with researchers from Stellenbosch University, the University of Pretoria, and Utrecht University on a project registered by the South African National Parks (SANParks) on resolving age-old problems with taxonomy and ecology of fungi described before the availability of contemporary molecular techniques, including the description of new species. The two-year project was initiated in November 2018, when all persons involved conducted an extensive fungi-collecting trip in the Knysna forests. Prof Swart visited the Kruger National Park in July 2018, with various researchers from the UFS, to collect data and also participate in a writing workshop as part of a collaboration between the UFS and SANParks, aimed at studying above- and below-ground ecological patterns, catenal processes, and biodiversity of the Granite Supersite ecosystem in the park.

A close working relationship was forged between SMEG and the company Nulandis in 2018. This resulted in Nulandis providing funding for an extensive master's project conducted by Alec Edwards, focusing on the rhizobiome of soybean after the application of salicylic acid to the crop.

Dr Angeline van Biljon's research is done in collaboration with the ARC-SG, ARC-GC, and ARC-Vegetable and Ornamental Plants (ARC-VOP), Roodeplaat, and CIMMYT in Zimbabwe. In 2018, she spent five weeks at the Wheat and Physiological Laboratory of Nanjing Agricultural University (NAU) in China, learning new techniques and giving lectures to postgraduate students. This visit was made possible by the collaboration between Prof Dong Jiang from the College of Agriculture at NAU, Prof Perry Ng from the Department of Food Science and Human Nutrition at Michigan State University, and the SARChI Chair of Prof Maryke Labuschagne.

Prof Neal McLaren and his students collaborated with AgriSeed in Delmas on the evaluation of inoculation techniques for Sclerotinia stem and head rot of soybean and sunflower respectively. Collaboration with the ARC-GC focused on root rot and leaf blight of maize and sorghum, and weather modelling of cob rots and concomitant mycotoxins of maize. This collaboration also included field screening of sorghum for risk analysis of leaf blight and disease-prediction modelling. Prof McLaren also collaborated with the Department of Plant Pathology at Stellenbosch University and the University of Pretoria. Courses were presented on the application of statistics in the analysis and interpretation of field data related to disease assessment.

Dr Tom Ashafa collaborates with various researchers from the Council for Scientific and Industrial Research (CSIR), Cape Peninsula University of Technology (CPUT), the University of Ilorin (UNILORIN) in Nigeria, Al-Hikmah University in Nigeria, Obafemi Awolowo University (OAU) in Nigeria, ARC-Animal Production, ARC-SG, ARC-VOP, and the Mexican Social Security Institute (Instituto Mexicano del Seguro Social – IMSS), Mexico.

Dr Lisa Komoreng collaborated with Profs Oriël Thekisoë and Riale Pieters (North-West University), Prof Roger Coopooosamy (Mangosuthu University of Technology), Dr Buyisile Mayekiso (University of Fort Hare), and Mr Meshack Mofokeng (ARC-VOP).

Dr Rudo Ngara collaborates with Dr Nemera Shargie from ARC-GC and Dr Stephen Chivasa (Durham University, UK). Dr Ngara and two of her students, Mamosa Ngcala and Tatenda Goche, visited Dr Chivasa's laboratory on a Royal Society-funded collaborative project.

Dr Sandy-Lynn Steenhuisen collaborated with researchers from UCT, WSCU, UKZN, and CBC at Rhodes University.



## OTHER ACTIVITIES

### Geo Potts Herbarium (Bloemfontein)

Ms Annemarie van Heerden, from the McGregor Museum in Kimberley, visited the Geo Potts Herbarium to receive training from Ms Magdii Pienaar on the use of the BRAHMS herbarium database programme.

Dr Motlalepula Matsabisa, from the UFS Department of Pharmacology, negotiated an agreement with the herbarium to provide identification and data-basing services for his project which focuses on the pharmacological uses of South African indigenous plants.

Ms Sithandokuhle Jwara, NRF intern stationed at the Geo Potts Herbarium since April 2018, completed processing and data capture for all specimens in the Okavango Collection. This is now one of the most extensive collections of plant specimens from the Okavango Delta.

### Undergraduate modules and excursions

A new third-year Botany undergraduate module in Ecophysiology (Ecophysiology: Plant-environment interactions) was successfully introduced in 2018.

A successful Bloemfontein Campus second-year field excursion in Ecophysiology was held during the October vacation at the Amanzi Private Game Reserve in the Brandfort district, Free State. Students had the opportunity to study adaptations and physiological events, such as transpiration and photosynthetic capacity responses of plants to environmental stress factors in their natural habitat.

The Vegetation Ecology third-year class from the Qwaqwa Campus conducted field surveys with Dr Steenhuisen on trips to Sentinel Peak, Drakensberg Mountain Retreat, and Monontsha Wetlands. The honours Restoration Ecology students were also hosted by Dr Nacelle Collins, from the Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs (DESTEA), on a trip to explore restoration projects in the wetlands of Monontsha, Qwaqwa.

Students and staff attending the second-year field excursion in Ecophysiology to the Amanzi Private Game Reserve



The Vegetation Ecology third-year students on a field survey with Dr Steenhuisen at the Drakensberg Mountain Retreat



## POSTGRADUATE STUDENTS

At the 2018 graduations, six students graduated with the BScHons majoring in Botany (three from each campus), one student majoring in Plant Health Ecology, and a further four students graduated with the BScHons in Agriculture majoring in Plant Breeding, one majoring in Plant Pathology, and one in Environmental Rehabilitation.

Five students graduated with the MSc (Agriculture):

Roean Wessels (with distinction).  
Gerrie Maree (with distinction).  
De Koning Fourie.  
Johannes Husselman.  
Nicolaas Landman.

A further five students graduated with an MSc:

Almari van der Loo (Biochemistry and Plant Breeding).  
Johannes de Jager (Botany).  
Keneilwe Mmereki (Plant Breeding) – with distinction.  
Thumeka Tiwani (Botany).  
Bongani Tshabalala (Botany).

Nine candidates from the Department of Plant Sciences based on the Bloemfontein Campus graduated with the PhD in 2018:

Entiro, Berhanu Tadesse.

Thesis: *Prospects for marker assisted improvement of African tropical maize germplasm for low nitrogen tolerance.*

Promoter: Prof MT Labuschagne.

Miles, Christina Wilhemina.

Thesis: *Relationships between Mixsmart parameters and bread wheat quality characteristics in South African dry land cultivars.*

Promoter: Prof MT Labuschagne.

Mwenye, Obed John.

Thesis: *Root properties and proline as possible indicators for drought tolerance in soybean.*

Promoter: Dr R van der Merwe.

Tapera, Terence.

Thesis: *Expression of tolerance to drought and low nitrogen levels in maize inbred lines and hybrids in Southern Africa.*

Promoter: Prof MT Labuschagne.

Soko, Tegwe.

Thesis: *Stem rust resistance and yield performance of irrigated Zimbabwean spring wheat.*

Promoter: Prof ZA Pretorius.

Van Schalkwyk, Hester Josina.

Thesis: *A pathogenic approach towards characterising the South African population of *Puccinia striiformis* f. sp. *tritici*, the causal agent of wheat stripe rust.*

Promoter: Dr R Prins.

Adendorff, Joan.

Thesis: *Alexin<sup>TM</sup>-mediated defence responses in wheat during Russian wheat aphid (*Diuraphis noxia*) infestations.*

Promoter: Dr L Mohase.

Castelyn, Howard Dean.

Thesis: *Molecular and cellular analysis of adult plant resistance in wheat to *Puccinia graminis* f. sp. *tritici*.*

Promoter: Prof ZA Pretorius.

Vermeulen, Marcelle.

Thesis: *The microbiome of cultivated *Amaranthus cruentus* in South Africa.*

Promoter: Dr M Gryzenhout.



A further two candidates in the Department of Botany based on the Qwaqwa Campus graduated with a PhD in 2018:

Adeniran, Lateef.

Thesis: *Biological and pharmacological activities of root extracts and isolated compounds of Hermannia geniculata.*

Promoter: Dr AOT Ashafa.

Mojau, Pheelo.

Thesis: *Isolation, characterisation and in vitro biological activity of bioactive principles in Hermannia geniculata leaf extracts.*

Promoter: Dr AOT Ashafa.

Mr Martin Chemonges, PhD student in Plant Breeding, received in-depth training at the CenGen laboratory on how to design, set up, and interpret

results of a KASPTM SNP experiment, using the KASP SNPline™ instruments housed at CenGen since 2013. He also represented the department at the BGRI Technical Workshop in Marrakech, Morocco, in March.

Fourteen MSc and PhD students, together with Dr Rouxlène van der Merwe, Prof Marvellous Zhou, and Dr Angeline van Biljon, attended the 12<sup>th</sup> Southern African Plant Breeding Symposium in Durban, KwaZulu-Natal, presenting 13 papers and four posters.

Marlese Bester, a Plant Pathology MSc student, represented the department at the International Conference of Plant Pathology in Boston from 29 July to 3 August 2018, where she shared her Sclerotinia stem and head rot of soybean and sunflower data with the international community.

## POSTDOCTORAL RESEARCH FELLOWS

Five Postdoctoral Research Fellows were hosted by the Department of Plant Sciences on the Bloemfontein Campus during 2018:

Dr Alejandra López (Columbia).

Dr Ansori Maré (South Africa).

Dr Makomborero Nyonni (South Africa).

Dr Marcelo Sandoval-Denis (Columbia).

Dr Brigitta Toth (Hungary).

Three Fellows - Dr S Adebayo (Nigeria), Dr Fatai Balogun (Nigeria), and Dr Chella Palanisamy (India) - were hosted by Dr Ashafa on the Qwaqwa Campus.

Dr Ansori Maré received training on the KASP SNPline™ instruments at the CenGen laboratory. He also attended the NOVA PhD course series, 'Phenotyping technologies in plant-environment interactions - Integrated analysis of omics data', at the Swedish University of Agricultural Sciences (SLU) Alnarp, during June 2018.

## STAFF MATTERS

Dr Makoena Joyce Moloi was appointed as Senior Lecturer in Botany (Plant Physiology).

Dr Pheello Mojau, one of the Professional Officers at Qwaqwa Campus, graduated with a PhD in Botany in May 2018 under the supervision of Dr Tom Ashafa.

Mr Dirk Jansen received a 40-year service reward from the UFS, while both Prof Wijnand Swart and Ms Sadie Geldenhuys received 30-year service rewards.

Prof Neal McLaren retired in December 2018, while Dr Ntjapa Lebaka resigned during the same month.

Prof Pedro Crous, Director of the Westerdijk Fungal Biodiversity Institute in the Netherlands and Secretary General of the International Mycological Association, is an Affiliated Professor in the Department of Plant Sciences (Division of Plant Pathology). He is closely involved in research collaboration with Prof Swart and two postdoctoral fellows, Dr Marcelo Sandoval Denis and Dr Alejandra López.





## RESEARCH OUTPUTS

### RESEARCH ARTICLES

- Ahmad, Z, Waraich, E, Akhtar, S, Anjum, S, Ahmad, T, Mahboob, W, Hafeez, O, Tapera, T, Labuschagne, M and Rizwan, M. 2018. Physiological responses of wheat to drought stress and its mitigation approaches. *Acta Physiologiae Plantarum* 40: 80.
- Akhtar, S, Osthoff, G, Mashingaidze, K and Labuschagne, M. 2018. Iron and zinc in maize in the developing world: deficiency, availability, and breeding. *Crop Science* 58: 2200-2213.
- Alayande, KA, Pohl, CH and Ashafa, AOT. 2018. In vitro assessment of *Euclea crispa* (Thunb.) leaf extracts against *Campylobacter* spp. and *Escherichia coli* - common diarrhoeal agents. *Asian Journal of Applied Sciences* 6: 158-165.
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- Amah, D, Van Biljon, A, Brown, A, PerkinsVeazie, P, Swennen, R and Labuschagne, M. 2018. Recent advances in banana (*Musa* spp.) biofortification to alleviate vitamin A deficiency. *Critical Reviews in Food Science and Nutrition*, DOI: 10.1080/10408398.2018.1495175.
- Ashafa, AOT and Nafiu, MO. 2018. Antidiabetic activity and free radicals modulatory potentials of saponin-rich extract of *Cochlospermum planchonii* (Hook Fx. Planch) root *in vitro*. *Comparative Clinical Pathology* 27: 313-320.
- Bah, S, Labuschagne, M and Van der Merwe, R. 2018. Genetic diversity of improved varieties of intraspecific (*O. sativa* and *O. glaberrima*) and interspecific (*O. sativa* × *O. glaberrima*) rice. *Genetic Resources and Crop Evolution* 65: 797-809.
- Balogun, FO and Ashafa, AOT. 2018. Cytotoxic, kinetics of inhibition of carbohydrate-hydrolysing enzymes and oxidative stress mitigation by flavonoids roots extract of *Dicoma anomala* (Sond.). *Asian Pacific Journal of Tropical Medicine* 11: 24-31.
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- Bonthond, G, Sandoval-Denis, M, Groenewald, JZ and Crous, PW. 2018. *Seiridium* (Sporocadaceae): an important genus of plant pathogenic fungi. *Personia* 40: 96-118.
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- Boshoff, WHP, Pretorius, ZA, Terefe, TG, Bender, CM, Herselman, L, Maree, GJ and Visser, B. 2018. Phenotypic and genotypic description of *Puccinia graminis* f. sp. *tritici* race 2SA55 in South Africa. *European Journal of Plant Pathology* 152: 783-789.
- Botha, NL, Ajibade, PA and Ashafa, AOT. 2018. Synthesis, spectroscopic characterization, antifungal and antibacterial studies of copper (II) dithiocarbamate complexes. *Journal of Pharmaceutical Sciences and Research* 10: 2111-2114.
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- Greeff-Laubscher, MR, Beukes, I, Marais, GJ and Jacobs, K. 2018. The occurrence of mycotoxigenic fungi in abelone feed in South Africa. *African Journal of Marine Science* 40: 383-394.
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#### BOOKS

**Moffett, R.** 2018. *A Field Guide to the Clarens Village Conservancy*. SUN MeDIA, Bloemfontein, South Africa.

#### CHAPTERS IN BOOKS

**Saheed, S, Oladipo, AE, Sunmonu, TO, Balogun, FO and Ashafa AOT.** 2018. The Purview of Phytotherapy in the Management of Gastric Ulcer. In: *Book on stomach disorders*. IntechOpen Publishers. Print ISBN 978-953-51-3729-0. DOI: 10.5772/intechopen.70007.

#### CONFERENCE CONTRIBUTIONS

**Akhtar, S, Labuschagne, MT, Mashingaidze, K and Osthoff, G.** 2018. *Heritability and expression of Fe and Zn and their bioavailability in South African maize under abiotic stress conditions*. Paper delivered at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.

**Allemann, I, Cawood, ME and Allemann, J.** 2018. *Phytochemical characterization and phytotoxicity of leaf extracts from temperature stressed *Amaranthus cruentus* plants*. Poster presented at the Annual Congress on Plant Science & Biosecurity (ACPB-2018), Valencia, Spain. 12-14 July.

**Allemann, I, Cawood, ME and Van der Watt, E.** 2018. *Impact of drought on the allelopathic effects of *Amaranthus**. Paper delivered at the African Combined Congress, Cape Town, South Africa. 15-18 January.

**Bestler, MC and McLaren, NW.** 2018. *Evaluating inoculum source, application and timing in screening for resistance to *Sclerotinia sclerotiorum* on sunflower cultivars*. Poster presented at the 11<sup>th</sup> International Congress of Plant Pathology: Plant Health in a Global Economy, Heyns Convention Centre, Boston, USA. 29 July-3 August.

- Booyse, M, Wentzel, B, Miles, C and Labuschagne, MT.** 2018. *Statistical selection methods for baking quality in summer dryland wheat cultivars*. Paper delivered at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.
- Boshoff, WHP, Bender, CM and Pretorius, ZA.** 2018. *Can field ratings of differential lines be used for wheat stem rust pathotyping?* Poster presented at the 15<sup>th</sup> International Cereal Rusts and Powdery Mildews Conference (ICRPMC), Skukuza, South Africa. 23-26 September.
- Castelyn, HD, Ereful, NC, Visser, B, Boyd, LA and Pretorius, ZA.** 2018. *Two phases of an adult plant resistance response in wheat to Puccinia graminis f. sp. tritici infection*. Poster presented at the Borlaug Global Rust Initiative (BGRI) Technical Workshop, Marrakech, Morocco. 14-17 April.
- Castelyn, HD, Visser, B, Ereful, N, Boyd, L and Pretorius, ZA.** 2018. *Differential expression of effectors in wheat adult plant – Puccinia graminis f. sp. tritici interactions*. Poster presented at the 15<sup>th</sup> International Cereal Rusts and Powdery Mildews Conference (ICRPMC), Skukuza, South Africa. 23-26 September.
- Cawood, ME and Saba, L.** 2018. *Resistance responses of wheat treated with Artemisia afra extracts and their repellent ability against the Russian wheat aphid*. Paper delivered at the Annual Congress on Plant Science & Biosecurity (ACPB-2018), Valencia, Spain. 1-18 July.
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- Combrink, NK, Bijzet, Z, Booyse, M, Labuschagne, MT and Sippel, AD.** 2018. *Breeding for sweeter citrus Mandarin fruit*. Paper delivered at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.
- Craven, M, Abrahams, A, Janse van Rensburg, B and McLaren, NW.** 2018. *Economic viability of fungicide application for northern corn leaf blight on maize cultivars with varying resistance*. Poster presented at the African Combined Congress, Cape Town. 15-18 January.
- Goche, T, Chivasa, S and Ngara, R.** 2018. *Analysis of expression levels of drought responsive genes in sorghum and Arabidopsis under sorbitol and drought stress treatments*. Paper delivered at the South African Association of Botanists (SAAB) Conference, University of Pretoria, South Africa. 9-12 January.
- Goche, T, Chivasa, S and Ngara, R.** 2018. *Gene expression analysis in sorghum under drought stress*. Poster presented at the Sorghum in the 21<sup>st</sup> Century Conference, Cape Town South Africa. 9-12 April.
- Hernández-Pinzón, I, Green, P, Dawson, A, Smoker, M, Taylor, J, Gardiner, M, Hubbard, A, Wan, A, Chen, X, Pretorius, ZA, Comadran, J, Waugh, R and Moscou, M.** 2018. *Map-based cloning of Rps6 implicates NLR-mediated resistance in maintaining stripe rust formae speciales*. Poster presented at the 15<sup>th</sup> International Cereal Rusts and Powdery Mildews Conference (ICRPMC), Skukuza, South Africa. 23-26 September.
- Hiscock, L, Bothma, C, Hugo, A and Van Biljon, A.** 2018. *Development and sensory testing of products containing Amaranthus leaves*. Paper delivered at the Agricultural Research Council/Durban University of Technology/University of the Free State (ARC/DUT/UFS) Collaborative Consortium (Broadening the Food Base) Annual Seminar, Bloemfontein, South Africa. 24 April.
- Hodson, D, Jin, Y, Olivera Firpo, PD, Szabo, LJ, Hovmöller, MS, Patpour, M, Nazari, K, Gilligan, CA, Meyer, M, Hort, MC, Millington, S, Pretorius, ZA, Park, RF, Fetch, TG Jr. and Grønbech Hansen, J.** 2018. *Global wheat rust monitoring: meeting the challenges of a re-emerging threat to wheat production*. Paper delivered at the International Congress of Plant Pathology (ICPP), Boston, USA. 29 July-3 August.
- Katondo, HM, Van Biljon, A and Minnaar-Ontong, A.** 2018. *Genetic diversity of Amaranth genotypes*. Paper delivered at the Agricultural Research Council/Durban University of Technology/University of the Free State (ARC/DUT/UFS) Collaborative Consortium (Broadening the Food Base) Annual Seminar, Bloemfontein, South Africa. 24 April.
- Katondo, HM, Van Biljon, A and Minnaar-Ontong, A.** 2018. *Nutritional diversity in leafy amaranth genotypes*. Paper delivered at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.
- Labuschagne, MT.** 2018. *Ancient grains breeding: current status and future prospects*. Paper delivered at the Sorghum in the 21<sup>st</sup> Century Conference, Cape Town, South Africa. 9-12 April.
- Labuschagne, MT.** 2018. *Proteomics as a tool in sorghum and cereal quality and abiotic stress tolerance breeding*. Paper delivered at the Sorghum in the 21<sup>st</sup> Century Conference, Cape Town, South Africa. 9-12 April.
- Labuschagne, MT.** 2018. *Proteomics in wheat gluten research: where are we standing and where are we going?* Plenary paper delivered at the 13<sup>th</sup> International Gluten Workshop, Hilton, Mexico City. 14-17 March.
- Labuschagne, MT, Lindeque, RC and Van Biljon, A.** 2018. *Relationships between grain yield and protein quantity and quality in commercial wheat*. Paper delivered at the 4<sup>th</sup> Latin American Cereals Conference, Hilton, Mexico City. 11-14 March.
- Labuschagne, R, Terefe, T, Boshoff, WHP, Pretorius, ZA, Venter, E and Visser, B.** 2018. *The development of the Puccinia triticina population in South Africa*. Poster presented at the 15<sup>th</sup> International Cereal Rusts and Powdery Mildews Conference (ICRPMC), Skukuza, South Africa. 23-26 September.
- Li, H, Pretorius, ZA, Boshoff, WHP, Zheng, Q, Li, B and Li, Z.** 2018. *Establishment of new wheat-Thinopyrum ponticum translocation lines with resistance to Ug99 races of Puccinia graminis f. sp. tritici*. Poster presented at the 15<sup>th</sup> International Cereal Rusts and Powdery Mildews Conference (ICRPMC), Skukuza, South Africa. 23-26 September.
- Lindeque, RC, Van Biljon, A and Labuschagne, MT.** 2018. *Matching opposites – defining the association between grain yield and protein content in South African wheat*. Paper delivered at the 13<sup>th</sup> International Gluten Workshop, Hilton, Mexico City. 14-17 March.
- Mabirimisa, A, Bijzet, Z and Labuschagne, MT.** 2018. *Cross compatibility between six promising imported litchi (Litchi chinensis) cultivars*. Poster presented at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.
- McLaren, NW, Bestler, MC and Rothmann, LA.** 2018. *The need to go beyond the pathogen in development of effective disease control strategies for sorghum*. Paper delivered at the Sorghum in the 21<sup>st</sup> Century Conference, Century City Convention Centre, Cape Town. 9-12 April.
- McLaren, NW, Rothmann, LA, Bestler, MC and Steyn, C.** 2018. *Sclerotinia stem rot of soybean: the South African approach*. Poster presented at the 11<sup>th</sup> International Congress of Plant Pathology: Plant Health in a Global Economy, Heyns Convention Centre, Boston, USA. 29 July-3 August.
- Maré, A, Boshoff, WHP and Herselman, L.** 2018. *Doubled haploid wheat lines with combined rusts and Fusarium head blight resistance*. Poster presented at the 15<sup>th</sup> International Cereal Rusts and Powdery Mildew Conference (ICRPMC), Skukuza, South Africa. 23-26 September.
- Mbumba, NW, Zhou, MM and Van der Merwe, R.** 2018. *Estimating breeding values for sugarcane yield of parental genotypes using best linear unbiased prediction (BLUP)*. Paper delivered at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.



- Mbuma, NW, Zhou, MM and Van der Merwe, R.** 2018. *Evaluating breeding values of genotypes in sugarcane breeding using Best Linear Unbiased Prediction (BLUP)*. Paper delivered at the 91<sup>st</sup> Annual Congress of the South African Sugar Technologists' Association (SASTA), ICC Durban, South Africa. 14-16 August.
- Meyer, C, Steyn, C and Minnaar-Ontong, A.** 2018. *Population genetic structure of Sclerotinia sclerotiorum in South Africa*. Paper delivered at the Soilborne Plant Diseases Symposium Agricultural Research Council, Stellenbosch, South Africa. 17-19 September.
- Meyer, C, Steyn, C and Minnaar-Ontong, A.** 2018. *South Africa's big bang pathogen: Sclerotinia Sclerotiorum*. Paper delivered at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.
- Meyer, M, Allen, C, Thurston, W, Burgin, L, Millington, S, Hort, M, Alemayehu, Y, Hodson, D, Seid, J, Derso, E, Visser, B and Gilligan, C.** 2018. *Atmospheric spore dispersal modelling: New insights on wheat rust migration routes and real-time risk assessments*. Paper delivered at the Borlaug Global Rust Initiative (BGRI) Technical Workshop, Marrakech, Morocco. 14-17 April.
- Mishasha, T, Zhou, MM and Van der Merwe, R.** 2018. *Phenotypic correlations among cane quality traits measured from unselected sugarcane breeding family plots*. Paper delivered at the 91<sup>st</sup> Annual Congress of South African Sugar Technologists' Association (SASTA), ICC Durban, South Africa. 14-16 August.
- Mishasha, T, Zhou, MM and Van der Merwe, R.** 2018. *Using quantitative genetic parameters to determine sample size for sucrose content in sugarcane breeding*. Paper delivered at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.
- Mmereki, KP, Minnaar-Ontong, A and Herselman, L.** 2018. *Improved Fusarium head blight resistance in the South African cultivar Krokodil*. Paper delivered at the 12<sup>th</sup> Southern African Plant Breeders' Association Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.
- Mmereki, KP, Minnaar-Ontong, A and Herselman, L.** 2018. *Improved Fusarium head blight resistance in the South African cultivar Krokodil*. Poster presented at the South African National Seed Organization (SANSOR) Annual Congress, Pretoria, South Africa. 9-11 May.
- Mojapelo, PM, Craven, M and McLaren, NW.** 2018. *Sorghum root rot and grain mold pathogen responses to legume rotation systems*. Poster presented at the African Combined Congress, Cape Town. 15-18 January.
- Ngara, R, Movahedi, M and Chivasa, S.** 2018. *Molecular responses of sorghum to drought stress: lessons from proteome and gene expression profiling*. Paper delivered at the South African Association of Botanists (SAAB) Conference, University of Pretoria, South Africa. 9-12 January.
- Ngcala, MG and Ngara, R.** 2018. *Sorghum responses under high temperature stress*. Poster presented at the Sorghum in the 21<sup>st</sup> Century Conference, Cape Town, South Africa. 9-12 April.
- Phakela, K, Labuschagne, MT, Van Biljon, A and Wentzel, BS.** 2018. *Size exclusion high performance liquid chromatography analysis using an ultra-high-resolution column for improved separation of wheat proteins in South African bread wheat cultivars*. Paper delivered at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.
- Phakela, K, Labuschagne, MT, Wentzel, B and Van Biljon, A.** 2018. *Size exclusion-high performance liquid chromatography analysis using an ultra-high-resolution column for improved separation of wheat proteins in South African bread wheat cultivars*. Paper delivered at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.
- Phakela, K, Labuschagne, MT, Wentzel, BS and Van Biljon, A.** 2018. *The association of protein fractions obtained with the wide bore Yarra Sec column with wheat quality characteristics in three production regions of South Africa*. Poster presented at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.
- Pretorius, ZA, Booyesen, GJ, Boshoff, WHP and Joubert, JH.** 2018. *Innovative manufacturing of a cereal rust inoculation device*. Poster presented at the Borlaug Global Rust Initiative (BGRI), Technical Workshop, Marrakech, Morocco. 14-17 April.
- Prins, R, Smit, C, Wessels, E, Boshoff, WHP, Minnaar, H, Pretorius, ZA, Abbrouk, M, Horn, M, Doležel, J, Šimková, H and Krattinger, SG.** 2018. *A step closer to an improved understanding of the partial stripe rust resistance QYr.sgi-4A.1 region of the South African wheat cultivar Kariega*. Poster presented at the 15<sup>th</sup> International Cereal Rusts and Powdery Mildews Conference (ICRPMC), Skukuza, South Africa. 23-26 September.
- Rothmann, LA, Craven, M and McLaren, NW.** 2018. *Developing epidemiologically-based intervention thresholds for sorghum leaf diseases in South Africa*. Paper delivered at the Sorghum in the 21<sup>st</sup> Century Conference, Century City Convention Centre, Cape Town. 9-12 April.
- Rothmann, LA and McLaren, NW.** 2018. *Relationship between weather, colonization and mycotoxins produced by Fusarium graminearum species complex on sorghum grain*. Paper delivered at the 11<sup>th</sup> International Congress of Plant Pathology: Plant Health in a Global Economy, Heyns Convention Centre, Boston, USA. 29 July-3 August.
- Shawa, HC, Van Biljon, A and Labuschagne, MT.** 2018. *Evaluation of quality protein maize hybrids for iron, zinc and its bioavailability under two contrasting soil conditions*. Poster presented at the South African National Seed Organization (SANSOR) Annual Congress, Pretoria, South Africa. 9-11 May.
- Shawa, H, Labuschagne, MT and Van Biljon, A.** 2018. *The influence of low N conditions on iron, zinc and phytic acid in quality protein maize hybrids*. Paper delivered at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.
- Siwale, J, Lebaka, NG, Labuschagne, MT, Gerrano, A, Ostoff, G and Hugo, A.** 2018. *Nutritional diversity of Bambara groundnut germplasm collection at Agricultural Research Council, South Africa*. Poster presented at 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.
- Smit, A, Labuschagne, MT and Van der Merwe, R.** 2018. *Stability of edamame (Glycine max) in South African production conditions*. Paper delivered at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.
- Soko, T, Bender, CM, Prins, R and Pretorius, ZA.** 2018. *Yield loss due to stem rust in wheat varieties with different types of resistance*. Poster presented at the Borlaug Global Rust Initiative (BGRI), Technical Workshop, Marrakech, Morocco. 14-17 April.
- Steenhuisen, S-L and Hobbhahn, N.** 2018. *A test of pollination syndrome theory using the parasitic plant Mystroptalon thomii reveals a surprising outcome*. Paper delivered at the South African Association of Botanists (SAAB) Conference, University of Pretoria, South Africa. 9-12 January.
- Swart, WJ.** 2018. *Factors shaping diversity in the rhizobiome and their relevance to plant health – Invited paper delivered at the 28<sup>th</sup> Annual Symposium of the Soilborne Plant Diseases Interest Group of South Africa, Vredenburg Research Centre, Stellenbosch, South Africa. 17-19 September.*
- Terefe, TG, Labuschagne, R, Boshoff, WHP, Visser, B and Pretorius, ZA.** 2018. *Diversity in Puccinia triticina on wheat and triticale in South Africa*. Paper delivered at the Combined Crops, Soils, Horticulture and Weeds Congress (CCSHWC), Cape Town, South Africa. 14-18 January.

**Terefe, TG, Visser, B, Boshoff, WHP, Herselman, L, Soko, T, Chiuraise, N, Siwale, J, Mutari, B, Hodson, DP and Pretorius, ZA.** 2018. *Evidence of wheat rust inoculum exchange between southern African countries.* Poster presented at the 15<sup>th</sup> International Cereal Rusts and Powdery Mildews Conference (ICRPMC), Skukuza, South Africa. 23-26 September.

**Tóth, B, Moloi, MJ, Steyn, C, Van Biljon, A and Labuschagne, M.** 2018. *The effect of low nitrogen and low phosphorous and a combination of the two on the quantity of HMW-GS in two South African bread wheat cultivars.* Paper delivered at the 13<sup>th</sup> International Gluten Workshop, Hilton, Mexico City. 14-17 March.

**Tóth, B, Moloi, MJ, Steyn, C, Van Biljon, A and Labuschagne, M.** 2018. *The influence of nitrogen and phosphorous deficiency on protein quality and quantity in two bread wheat cultivars in South Africa.* Paper delivered at the 4<sup>th</sup> Latin American Cereals Conference, Hilton, Mexico City. 11-14 March.

**Van Aardt, AC, Scott, L, Brink, J, Toffolo, B, Ochando, J and Carrion, J.** 2018. *Palynological reconstruction of middle Pleistocene environments at Florisbad, Free State Province, South Africa.* Paper delivered at the 20<sup>th</sup> Biennial Conference of the Palaeontological Society of Southern Africa in Bloemfontein, South Africa. 4-6 July.

**Van Biljon, A, Lindeque, RC, Pelser, S, Akhtar, S and Labuschagne, MT.** 2018. *Relationship between iron, zinc and ash content, and loaf volume, flour protein and yield in white flour of commercial bread wheat cultivars.* Paper delivered at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.

**Van der Merwe, JB and Van der Merwe, R.** 2018. *Green yield potential and quality of vegetable-type soybean.* Paper delivered at the 12<sup>th</sup> Southern African Plant Breeding Symposium, Gateway Hotel, Durban, South Africa. 12-14 March.

**Visser, B, Meyer, M, Park, RF, Gilligan, CA, Burgin, LE, Hort, MC, Hodson, DP and Pretorius, ZA.** 2018. *Gone with the wind: revisiting stem rust dispersal between southern Africa and Australia.* Poster presented at the Borlaug Global Rust Initiative (BGRI) Technical Workshop, Marrakech, Morocco. 14-17 April.

**Wentzel, B, Labuschagne, MT, Van Biljon, A and Booyse, M.** 2018. *The effect of the environment on protein composition in selected South African wheat cultivars.* Poster presented at the 13<sup>th</sup> International Gluten Workshop, Hilton, Mexico City. 14-17 March.

**Zhang, J, Hewitt, T, Zhang, P, Pretorius, ZA, Upadhyaya, N, Schnippenkoetter, W, Dundas, I, McIntosh, RA, Mago, R, Periyannan, S, Park, RF, Boshoff, WHP, Kong, X, Hoxha, S, Steuernagel, B, Wulff, BH and Lagudah, ES.** 2018. *Isolation of durable wheat stem rust resistance gene Sr26.* Poster presented at the Borlaug Global Rust Initiative (BGRI), Technical Workshop, Marrakech, Morocco. 14-17 April.

**Zhang, J, Hewitt, T, Zhang, P, Pretorius, ZA, Upadhyaya, N, Schnippenkoetter, W, Dundas, I, McIntosh, RA, Richardson, T, Park, RF, Mago, R, Periyannan, S, Boshoff, WHP, Steuernagel, B, Wulff, BH and Lagudah, E.** 2018. *Isolation of an immune receptor gene from tall wheat grass confers resistance to diverse races of stem rust in common wheat.* Poster presented at the International Cereal Rusts and Powdery Mildews Conference (ICRPMC), Skukuza, South Africa. 23-26 September.



## STAFF (2018)

**Head of Department:** Prof L Herselman

### BLOEMFONTEIN CAMPUS

**Professors:** Prof MT Labuschagne, Prof NW McLaren (retired), and Prof WJ Swart

**Associate Professors:** Prof L Herselman and Prof B Visser

**Affiliated Professors:** Prof PW Crous and Prof PKW Ng

**Affiliated Associate Professor:** Prof M Zhou

**Senior Lecturers:** Dr WHP Boshoff, Dr N Lebaka (resigned), Dr GJ Marais, Dr MJ Moloï, Dr GP Potgieter, and Dr A van Bijljon

**Affiliated Senior Lecturer:** Dr S Ramburan

**Lecturers:** Dr ME Cawood, Dr M Jackson, Dr L Joubert, Dr A Minnaar-Ontong, Dr L Mohase, Dr AC van Aardt, and Dr R van der Merwe

**Lecturer (units):** Ms LA Rothmann

**Senior Research Fellow:** Prof L Scott

**Research Fellows:** Prof PJ du Preez, Prof ZA Pretorius, Dr R Prins, Dr L Rossouw, Dr A Venter, and Prof JHT Venter

**Technical and Support Staff:** Ms CM Bender, Mrs DR Coetzee, Mrs NH Dlamini, Ms S Geldenhuys, Mrs D Jansen, Mr N Janse van Rensburg, Mrs NS Macwili, Mrs LHAM Molale, Ms M Pienaar, Mr HP Pretorius, Dr C Steyn, and Ms Z van der Linde

**Junior Researcher:** Mr G Maree

**Research Assistants:** Miss R Labuschagne, Mr H Minnaar, Mr FS Pelser, and Miss EJ Theron

**NRF Interns:** Miss S Jwara, Miss PT Tau, and Miss S Tyawana

### QWAQWA CAMPUS

**Senior Lecturers:** Dr AOT Ashafa, Dr LV Komoreng (Subject Head), and Dr S-L Steenhuisen

**Lecturers:** Dr R Ngara and Mr TR Pitso

**Academic Facilitator:** Ms D Mosea

**Research Fellow:** Prof R Moffett

**Technical and Support Staff:** Dr PJ Mojau and Mr NP Mzizi





# DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY

## CONTACT DETAILS

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### Prof Aliza le Roux

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## OVERVIEW OF 2018

The Department of Zoology and Entomology focuses on a variety of research aspects and has long-standing collaborations with numerous government departments, as well as good relationships with various partners in the industry. Numerous courses, in both disciplines, were taught to the undergraduate students. In the case of the second- and third-year students, field excursions are part of the course. Dr Candice Jansen van Rensburg and her postgraduate students were instrumental in the successful completion of

the third-year Zoology Ecology excursion to the Gariep Dam, while Dr Vaughn Swart and Mr De Villiers Fourie made sure that the Entomology excursion ran smoothly. Profs Liesl van As and Neil Heideman, as well as Dr Candice Jansen van Rensburg, presented new courses to the undergraduate students as a result of staff reshuffling in the department. Dr Mdu Ndlovu presented Conservation Ecology before he left the university at the end of 2018. Research trips were undertaken by staff and postgraduate students, and conferences of a variety of scientific societies were attended, where papers and posters were presented.

## ACHIEVEMENTS

### Staff Achievements

Prof Aliza le Roux improved her National Research Foundation (NRF) rating from Y2 to C2. She also won the award for Top Academic in the Afromontane Research Unit (ARU), in recognition of her research programme on mammals in the African mountains. She was elected to serve as Co-Chair for the South African Young Academy of Science (SAYAS), and was also awarded funding from the Institutional Transformation Plan to boost mentorship for female academics on the Qwaqwa Campus. Prof Le Roux served as Session Co-Host of the Mountain Solutions World Café at the Adaptations Futures Conference, held in Cape Town in June, and as a Session Co-Host at the Mountains 2018 Conference held in Brazil in December.

Dr Vaughn Swart received the award for Learning and Teaching.

### Student Achievements

Kristen Darker won the award for the best honours presentation at the annual postgraduate seminar day on the Qwaqwa Campus, while Gerard de Jager won the award for the best senior presentation. Mr De Jager also won the Junior Neitz Medal for the Best MSc in Parasitology in Southern Africa at the 47<sup>th</sup> Parasitological Society of South Africa Annual Conference, held at the University of Venda in September. The title of his dissertation was 'Taxonomic status of *Trichodina heterodentata* Duncan, 1977 (Ciliophora: Peritrichia) using standard morphology as well as molecular techniques'.

Serero Modise was elected to serve on the Council for the Golden Gate National Highland Park Forum.