

# DEPARTMENT OF PLANT SCIENCES

## CONTACT DETAILS

### Prof Liezel Herselman

Department of Plant Sciences

Faculty of Natural and Agricultural Sciences  
University of the Free State  
PO Box 339  
Bloemfontein  
9300 South Africa

T: +27 51 401 2514  
E: herselman@ufs.ac.za  
W: www.ufs.ac.za/plant

### Dr Sandy-Lynn Steenhuisen

Department of Plant Sciences

Faculty of Natural Sciences  
University of the Free State  
Private Bag X13  
Phuthaditjhaba  
9866 South Africa

T: +27 58 718 5330  
E: steenhuisens@ufs.ac.za  
W: www.ufs.ac.za/plant

## OVERVIEW OF 2019

The Department of Plant Sciences has three divisions – Botany (both Bloemfontein and Qwaqwa Campuses), Plant Breeding and Plant Pathology. Our staff teach and perform research within the individual divisions, but also in a variety of projects that combine different aspects of the three divisions. Collaboration with various national and international institutions, local councils and associations is indicative of the relevance and applicability of plant science to industry.

Highlights of 2019 include a number of high profile scientific publications in collaboration with both national and international co-workers, postgraduate students who walked away with a number of prizes at various conferences, staff members serving on editorial boards, an increasing number of postdoctoral research fellows, excellent practical experience gained by undergraduate students after participating in excursions and the number of postgraduate students who graduated during 2019 (6 Honours, 14 master's and 10 doctoral students).

## ACHIEVEMENTS

### Staff Achievements

Prof Maryke Labuschagne was appointed to the editorial board of the *Journal of Cereal Science*, a leading British journal on

cereal chemistry. She was also appointed as Specialty Chief Editor for *Frontiers in Sustainable Food Systems*, a journal that is part of the Frontiers group of journals published in Switzerland.

Dr Angeline van Biljon and Prof Maryke Labuschagne, both executive committee members of Cereal Science and Technology-Southern Africa (CST-SA), served on the scientific committee that organised the 3<sup>rd</sup> New Voices symposium, which was held on 11 September at the Grain Building in Pretoria. This association has established itself as a link between students and their future employers in the grain and oilseed industry.

Prof Wijnand Swart, was elected as President of the Southern African Society of Plant Pathology (SASPP).

Dr Lize Joubert was awarded first place at the Department of Plant Sciences' Flash Fact Competition for staff, for her presentation on the three-dimensional elaboration of petal structures in *Nemesia* (Scrophulariaceae).

Dr Sandy-Lynn Steenhuisen was appointed as a subject editor for the *South African Journal of Botany*, South Africa's leading botanical journal. She is also currently the Treasurer of the South Association of Botanists (SAAB) and Chairperson of the Local Organising Committee hosting the 46<sup>th</sup> annual conference of SAAB in January 2020. Dr Steenhuisen was also the recipient of an Afromontane Research Unit (ARU) certificate of recognition for Research Excellence in 2019.

Lisa Rothmann was invited to join the international multi-disciplinary organisation, Open Plant Pathology, in a Junior Leadership position to encourage Open Science practices in Plant Pathology.

### Student Achievements

Mr Alex de Gouveia received the junior Captain Scott medal for the best master's study in Botany from the South African Academy of Science and Arts (SAASA), during a prestigious award ceremony held in Stellenbosch on 10 July 2019. His study leaders were Dr Lize Joubert and Dr Mariëtte Jackson.



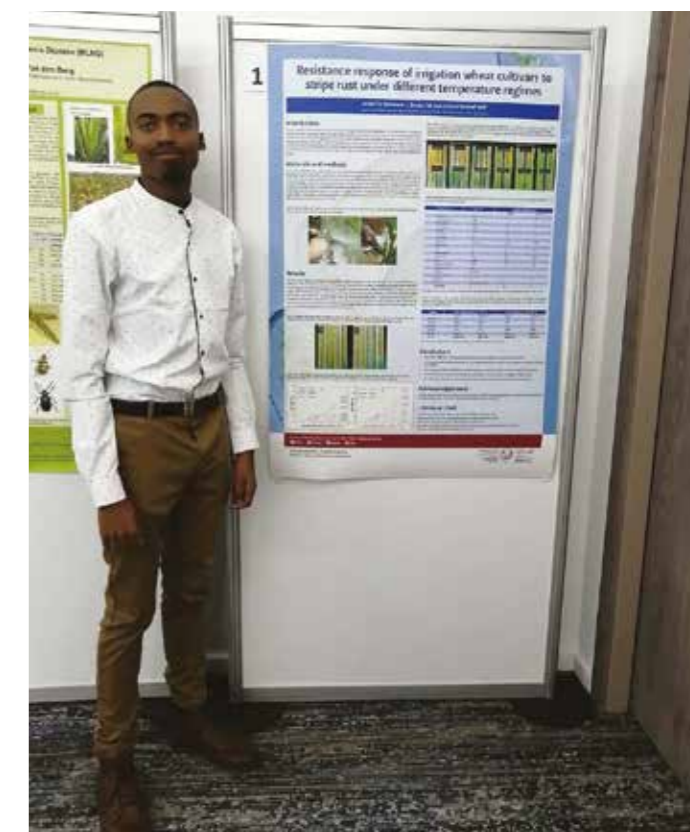
Mr Alex de Gouveia, winner of the SAASA junior Captain Scott medal, with his study leaders Dr Lize Joubert (left) and Dr Mariëtte Jackson (right)

Postgraduate students from the Department of Plant Sciences attended the University of Johannesburg (UJ) Plant Sciences' Annual Student Symposium from 4 to 5 November 2019. The Department walked away with the following prizes: Best PhD presentation – Dr Ntombokulunga Mbuma, Best MSc presentation – Mr Alec Edwards, 2<sup>nd</sup> best Honours presenter – Mr Paul Myburgh and 3<sup>rd</sup> best Honours presenter – Mr Xander Schmidt



Prize winners with staff at the annual UJ Symposium  
Front from the left: Dr Nthomokulunga Mbuma, Dr Ansori Maré and Dr Andri van Aardt  
Back from the left: Paul Myburgh, Xander Schmidt, Mawethu Ndiki and Alec Edwards

Thabiso V Masisi, an MSc (Agriculture) student from Plant Pathology, won first prize for his poster presentation at the South African National Seed Organisation (SANSOR) Annual Conference. His Honours research was titled, 'Resistance response of irrigation wheat cultivars to Stripe Rust under different temperature regimes', supervised by Dr Willem Boshoff.



Mr Thabiso Masisi at the SANSOR Conference

Cereal Science and Technology-South Africa hosted their annual New Voices Symposium, at which postgraduate students are given the opportunity to deliver oral presentations of their scientific findings to a group of their peers and industry members. Lisa Rothmann won the John Taylor Floating Trophy for the first prize for PhD research. Her presentation was titled 'A quantitative summary of a ten-year survey of white mold prevalence in South Africa'. Marlese Meiring was placed in the top three with her presentation titled, 'Screening for tolerance to *Sclerotinia sclerotiorum* in soybean cultivars'.

Laetitia Voua Otomo and Thumeka Tiwani, both PhD students in Botany on the Qwaqwa Campus, attended and presented their research at the 6<sup>th</sup> World Congress on Medicinal and Aromatic Plants for Human and Animal Welfare (WOCMAP VI), held in Northern Cyprus in November 2019. Both students were supervised by Dr Lisa Komoreng.



Thumeka Tiwani and Laetitia Voua Otomo at WOCMAP VI

Howard Castelyn won the EM van Zinderen Bakker prize for outstanding PhD study in Botany titled 'Molecular and cellular analysis of adult plant resistance in wheat to *Puccinia graminis* f.sp. *tritici*' (supervisor Prof ZA Pretorius, co-supervisors Prof B Visser and Dr LA Boyd).

Stephanie McDonald won the Botanical Society of South Africa (Free State Branch) prize for best Honours student in Botany (supervisor Dr M Cawood).

Palesa Mmereki won the South African Plant Breeders' Association (SAPBA) prize for the best MSc student in Plant Breeding (supervisor Prof L Herselman, co-supervisor Dr A Minnaar-Ontong).

Chrissie Miles won the Plant Breeding prize for the best PhD student in Plant Breeding (promoter Prof M Labuschagne, co-promoter Dr A van Biljon).

Lehlohonolo Donald Adams received the award for the top master's ARU candidate from the Afromontane Research Unit (supervisor Dr S Steenhuisen, co-supervisors Dr VR Clark and Dr G Martin).

## TEACHING

The third-year Botany students went on a field excursion to Hogsback in the Eastern Cape in February as part of their Field Excursion module. Students worked on projects including pollination biology, vegetation surveys in forest, grassland, wetland, fynbos and exotic plantations, identification and management of alien invasive plants, and identification of important plant families of South Africa.



Students and staff during the 2019 Hogsback excursion

Mr Anton Swanepoel, a field scientist in product development at Bayer Crop Sciences, gave a lecture on recent developments and advances in agricultural research that have an impact at farm level, to the third-year Plant Pathology class in October.

Botany Eco-physiology second-year students attended a successful field excursion in October to the Amanzi Game Lodge. They were introduced to adaptations in different plants to grow and survive in the Free State environment. They mastered

techniques to measure chlorophyll content and photosynthetic rate in plants under different environmental conditions.

Together with Prof Aliza Le Roux from the Department of Zoology and Entomology, Dr Sandy-Lynn Steenhuisen organised a joint three-night field excursion into the Golden Gate Highlands National Park for third-year students in the biological sciences at the Qwaqwa Campus. Students were exposed to several practical methods of conducting ecological surveys of vegetation and animal behaviour, including transect and plot surveys of plant diversity in different vegetation types, small mammal trapping, light-trapping of insects, camera trapping, and collecting, analysing and reporting on field data.

Dr Willem Boshoff presented an invited lecture on 'Stem rust in wheat – the Southern African perspective' as part of an on-line seminar to MSc students taking the course Plant Breeding and Protection for Sustainable Production at the Department of Plant Protection Biology in the Swedish University of Agricultural Sciences. Prof Botma Visser presented an invited lecture titled 'Out of Africa to Down Under: A study on the proposed inter-continental movement of wheat stem rust' as part of the same on-line seminar.

## RESEARCH

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

This research chair continued with research on quality in field crops, delivering two MSc dissertations on quality protein maize and how it is affected by abiotic stress conditions. In collaboration with the International Institute for Tropical Agriculture (IITA), and a PhD study was completed on biofortification of the banana family with provitamin A. Another PhD study was completed on the inheritance and expression of iron and zinc in South African maize hybrids. Eight papers in accredited journals (three with an impact factor higher than four) and three book chapters were published from the crop quality research in 2019. Five papers on this research were presented at international conferences. In terms of disease resistance, two MSc students completed their dissertations on research related to rust resistance breeding, and 15 accredited papers were published on disease resistance in field crops, with a focus on wheat.

Recent successes of the cereal rust programme include the characterisation and report of the 5<sup>th</sup> variant of the Ug99 stem rust race in South Africa, of which the data was made available to local wheat producers and breeders. The first report of stripe rust in Zimbabwe was also recently documented. The impact of this race on Zimbabwean wheat cultivars, as well as its potential risk to South African wheat cultivars, was assessed and illustrated the relevance of UFS rust programme in the region.

Recent international and local collaboration led to the following achievements:

- The research of Dr Jianping Zhang at Commonwealth Scientific and Industrial Research Organisation (CSIRO), Canberra, Australia resulted in the cloning of two broadly effective stem rust resistance genes *Sr26* and *Sr61*. Dr Zhang completed a significant part of her work at UFS where Prof Pretorius and Dr Boshoff helped with rust phenotyping.

- A collaborative and landmark study between the UFS, the Plant Breeding Institute of the University of Sydney, University of Cambridge and others, addressed the movement of stem rust urediniospores from southern Africa to Australia on high-altitude winds.
- Rust researchers at the UFS contributed to a publication in *Communications Biology* by Dr Diane Saunders from the John Innes Centre in Norwich, describing the first stem rust incursion into the United Kingdom in many years.
- In collaboration with co-workers from the Centre for Rapid Prototyping and Manufacturing at the Central University of Technology (CUT), devices commonly used during collection and application of rust spores to plants, but which are not commercially available, were redesigned and 3D-printed through an innovative additive manufacturing process. This work was awarded the best-on-show poster prize at an earlier international conference and subsequently published in *Frontiers in Plant Science*.
- In collaboration with Dr Jim Kolmer at the Department of Plant Pathology, University of Minnesota, UFS personnel contributed to a publication describing the potential of leaf rust to migrate over long distances.
- Prof Visser collaborated with Dr Terefe and Dr Prinsloo of the Agricultural Research Council-Small Grain (ARC-SG), Bethlehem, to describe the first detection of wheat stripe mosaic virus and *Polymyxa graminis* as its associated vector, in South Africa.
- Given the international emphasis on durable resistance in wheat cultivars to rust diseases, UFS pathologists and co-workers published an article in *Plant Disease* describing a new, repeatable and easy to use method to assess different types of stripe rust resistance in adult plants.
- In a collaborative project with the UFS that was accepted for publication in *Nature Communications*, Dr Melania Figueroa of CSIRO provided the first genomic evidence for somatic hybridisation in rust pathogens. Using next-generation sequencing technology, they confirmed that somatic hybridisation of two different stem rust races that exchanged complete nuclei, gave rise to the Ug99 stem rust race described by Prof Pretorius 20 years ago. Confirmation of one of the races involved in this somatic hybridisation event as Pgt21, found in South Africa nearly 100 years ago before migrating to Australia in the 1950s, is a remarkable discovery.
- Research outputs were popularised through articles in *Wheat Focus*. Topics covered were a paper on the importance of wheat rust monitoring as new rust races made their appearance, and a first report of wheat stripe mosaic virus in South Africa.

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

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

Dr Lintlè Mohase and her research team continued their research on plant-defence mechanisms in wheat during aphid infestations under changing environmental conditions. She collaborated with plant breeder Dr Ntjapa Lebaka from South African Breweries (SAB) Hop Farms in George, Dr Willem Boshoff, a UFS pathologist, and an entomologist from ARC-SG, Bethlehem, Dr A Jankielsohn. Her 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, *Diuraphis noxia*.

Dr Gerhard Potgieter was involved in the evaluation of the bio-stimulant properties of certain secondary molecules isolated from various plant and animal sources. Use of these bio-stimulants in addition to traditional agricultural practices is to improve yield and quality of crops in existing cultivation areas. Dr Potgieter was also involved in developing new approaches in vegetation management, identification of alien plant species and management of crop health using drone technology. These include Normalised Difference Vegetation Index (NDVI) data for plant health monitoring and Red-Green-Blue (RGB) photography to obtain a colour and form signature for plants to enable them to identify alien invasion in a given vegetation type.

Dr Makoena Moloi's research focused on the influence of aspects of climate change, such as drought and temperature stress, on the biochemical responses of crops with agricultural importance. The purpose was to find any biochemical mechanisms that are linked with crop production under stress conditions, and how such information can be used for crop selection in breeding programmes. Furthermore, they focused on the use of biostimulants, phytohormones or nutrients in improving tolerance of crop plants under stress conditions.

Prof Botma Visser collaborated with plant pathologist Dr Willem Boshoff to genotype cereal rust species. During 2019, stem and leaf rust of oat, leaf rust of barley and leaf rust of sunflower were genotyped. He was also involved in the identification of wheat viruses from diseased plants, and he investigated a new potential fungicide that could control stripe rust of wheat.

Dr Rudo Ngara continued with research on adaptive mechanisms of plants to a range of abiotic stresses. In 2019, Dr Ngara recruited one new doctoral and three master's students to work on the project in collaboration with Dr Stephen Chivasa, from Durham University in the UK, and Dr Nemera Shargie, from ARC-Grain Crops (ARC-GC) in Potchefstroom. Dr Ngara's projects are funded by the NRF and the Royal Society of London.

### Botany: Phytomedicine and ethnobotany

Dr Lisa Komoreng continued with her research on traditional medicinal plants used in the treatment of tuberculosis and elephantiasis and its secondary infections in South Africa. Her research also focused on bioprospecting of indigenous medicinal plants that are used in the Eastern Free State for the treatment of various ailments. Dr Komoreng's research group screened medicinal plants for *in vitro* antimicrobial, antimycobacterial, anti-inflammatory, anti-oxidant, anthelmintic and cytotoxic properties. The active compounds were isolated from plants showing good pharmacological activities without any toxic properties. The

project runs in collaboration with Prof Oriël Thekisoë and Prof Rialet Pieters from North-West University.

### Botany: Plant taxonomy and molecular systematics

Dr Lize Joubert's research focused on combining taxonomic approaches with pollination biology, flower evolution and development research to investigate various aspects of the diversity of South African flowering plants. Her research included topics such as floral adaptation to pollinator shifts because of climate change and optimisation of floral characters in crops for higher pollination efficiency and improved yield. In 2019 she conducted field work in the Northern and Western Cape to collect specimens and data for the *Nemesia* floral evolution project. She also collaborated with Dr Jackson on taxonomic revisions and molecular systematic analysis of key South African flowering plant groups.



Field work at Goegap Nature Reserve in the Northern Cape for the *Nemesia* floral evolution project

Dr Mariëtte Jackson is heading the Molecular Systematics research group. Various genera within the family Asteraceae are being studied to assess the phylogenetic relationships among these genera. A new field of research is being investigated, analysing fossil soil sediment from Prof Louis Scott's fossil pollen collection, to obtain ancient DNA that can be used within phylogenetic studies. Ancient DNA was sequenced with Next Generation Sequencing (NGS) technologies.

### Botany: Palaeo-botany and ecology

Dr Andri van Aardt and Prof Louis Scott are currently investigating the long-term change patterns in vegetation by studying both fossil and present-day plant material. Dr Van Aardt is in the process of investigating the relationship between vegetation and soil in the Drakensberg Mountains using drone technology for the identification of alien invasive plants. In terms of palaeoecology, her research included pollen analysis with the aim of getting a better understanding of vegetation changes around certain sites in the Free State (Florisbad) and Gauteng (Colbyn) during the Quaternary. She also investigated the potential use of leaf epidermis as to contribute to previous palaeo-environmental reconstructions from the Pretoria Saltpan (Tswaing Crater). Prof Scott continued research on various projects with international collaborators on palaeoclimatic reconstruction of different biomes

in southern Africa, including modelling of the last glacial maximum in South Africa, reviewing pollen studies in the Southern Kalahari (Wonderwerk and Equus Caves) and the Western Cape (Princess Vlei and Uniondale). Dr Joubert collaborated with Dr Van Aardt in developing species circumscriptions to link lineages of extant species to microfossils used in palaeo-vegetation reconstruction.

Research into the behavioural cues used by lizard pollinators of the 'Hidden flower', *Guthriea capensis*, continued in 2019 with a collaboration between Dr Sandy-Lynn Steenhuisen and researchers from the Pollination Ecology Research Group at the University of KwaZulu-Natal (UKZN) in Pietermaritzburg. The novelty of this pollination system discovered in the Drakensberg Mountains gained much public interest in 2019, resulting in numerous radio and newspaper press releases. Research avenues into plant invasion ecology grew substantially on the Qwaqwa Campus during 2019, with collaborations on high altitude plant invasions continuing between Dr Steenhuisen's research laboratory, the ARU, the Centre for Biological Control (Rhodes University), and a newly formed partnership with the Centre for Invasion Biology at Stellenbosch University.

An interesting project also gained momentum during the year involving the Qwaqwa Departments of Plant Sciences, and Zoology and Entomology, the ARU and BirdLife South Africa. In this project, Dr Steenhuisen and her postdoctoral research fellow, Dr Nicholas Le Maitre, collaboratively investigated the use of sound recorders to determine the diversity of primarily wetland bird species in the Golden Gate Highlands National Park. This project will be expanded to look at seasonal changes and recolonisation of animals in wetland vegetation after fire, with plans to investigate other animal groups such as frogs and insects in future. The project aims to compare plant and animal diversity in various wetlands in protected and disturbed wetlands using methods with minimal disturbance.

### Plant Breeding: Molecular plant breeding

Dr Adré Minnaar-Ontong's research focused on the genetic variation of *Sclerotinia sclerotiorum* populations on different hosts in South Africa – a project funded by the NRF-Thuthuka. The outcome of this project contributed towards her most recent research that includes the development of a breeding programme for resistance to *Sclerotinia* diseases in economically important oil crops and other hosts. South African sunflower and soybean cultivars were evaluated for resistance to *sclerotinia* diseases to promote the improvement of disease control strategies. The research was funded by the NRF-Thuthuka as well as Grain SA. Further research also included the genetic analysis of soybean resistance to *Fusarium virguliforme*, a pathogen responsible for Fusarium Sudden Death Syndrome. This project aims to evaluate commercial soybean cultivars for resistance and the outcomes of these projects is of significant importance to soybean production of South Africa.

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 the First International Wheat Conference in Canada. In 2019 her research focused on the genetic analysis of rust resistance in winter wheat. A PhD student identified a new source of adult plant stem rust resistance in a

South African wheat cultivar on a chromosome not previously associated with adult plant resistance. It is postulated that this resistance is governed by a single major quantitative trait locus. An MSc student characterised a potential new source of stem rust resistance in lines received from an international collaborator. Results indicated that the identified single dominant gene could be *Sr13* or a closely linked gene in its region.

Dr Ansori Maré made progress with crosses to transfer one



From the left, Dr Willem Boshoff, Prof Liezel Herselman, Prof Maryke Labuschagne and Dr Brigitta Tóth at the 1st International Wheat Congress in Saskatoon, Canada

stem rust and three stripe rust resistance genes into lines that already contain eight other rust and FHB-resistance genes. Breeding for resistance against wheat diseases has in the recent past resulted in the release of several lines by the UFS to South African breeding companies for use in their breeding programmes. The double haploid technique was standardised as part of this project at the UFS for routine use on all breeding material developed under the SARChI Chair. This project was recently strengthened by the relocation of the KASP™ SNPLine equipment to the Bloemfontein Campus, which will substantially benefit current and future breeding programmes.



Prof Liezel Herselman and Alexander Jones (LGC Genomics) with the KASPar SNPLine equipment relocated from the CenGen Laboratory

## Plant Breeding: Conventional breeding

Dr Rouxlène van der Merwe's research focused on the stability analysis of Edamame (*Glycine max* L.) introductions in South African production conditions. This research project, undertaken in collaboration with the Edamame Development Program (EDP), funded by the Durban City Council and KwaZulu-Natal Government, was concluded in 2019.

Other research (in collaboration with the Northeast Institute of Geography and Agroecology of Chinese Academy of Sciences), focused on breeding for resistance to pod dehiscence in vegetable-type soybean. This research continued to make progress towards the development of an improved South African vegetable-type soybean cultivar that shows resistance to pod shattering. Dr Minnaar-Ontong collaborated on this project and was responsible for marker-assisted selection. Green pod yield and nutritional content of large-seeded (vegetable-type) soybean were also investigated, in collaboration with the EDP, and funded by the NRF-Thuthuka. This research made progress towards the development of an improved South African vegetable-type soybean cultivar that shows high yield potential and with improved nutritional value. In addition, promising cultivars are being evaluated on agronomic performance and consumer acceptability in order to be promoted for production by small-scale farmers. The projects run in collaboration with Dr Angeline van Biljon, who assisted with amino acid and sugar analysis, Prof Arno Hugo and Dr Carina Bothma (both from the Department of Microbial, Biochemical and Food Biotechnology), who assisted with fatty acid analysis and sensory tests. This research continued to make progress towards the characterisation of vegetable-type soybean cultivars in terms of drought stress tolerance in collaboration with Dr Makoena Moloi and Dr Angeline van Biljon.

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

Dr Angeline van Biljon's research focuses mainly on the influence of abiotic stress on nutritional quality of various staple crops and vegetables. Both size exclusion- and reverse phase-high performance liquid chromatograph (HPLC) techniques were applied to determined storage protein fractions of various wheat cultivars. The carotenoid content of maize and butternuts was determined using HPLC. The genetic enhancement of minerals, such as iron and zinc, in maize and the bioavailability thereof, and zein protein determination remains an important research focus as well. Total starch, amylose and tryptophan determinations also contribute to the quality profile of maize lines that are incorporated into various breeding programmes. These results supported projects in collaboration with the International Maize and Wheat Improvement Centre (CIMMYT) in Zimbabwe, ARC-SG and Starke Ayres.

Within Prof Maryke Labuschagne's research, two PhD projects commenced in collaboration with CIMMYT in Mexico on the influence of heat and drought stress on the expression of gluten

proteins in bread and durum wheat. Other projects are underway on the effect of the *wbm* (wheat bread making) gene in South African wheat cultivars, and one on waxy wheat, in collaboration with CIMMYT in Mexico and the University of Cordoba in Spain.

Maize projects included a PhD study on iron and zinc biofortification of quality protein maize and provitamin A maize. In addition, a PhD project on genetic linkage drag for yield in quality protein maize was initiated. Two more PhD projects with CIMMYT included genetic gain in quality protein maize (QPM) and abiotic stress effects on QPM in Ethiopia.

## Plant Pathology: Cereal rust diseases

Dr Willem Boshoff and Prof Zakkie Pretorius have collaborative projects with researchers from the USA, which include barley stem rust resistance mapping (University of Minnesota) and stem rust race nomenclature (Agricultural Research Service - United States Department of Agriculture [ARS-USDA]). Satisfactory field results were obtained in a project funded by King Abdullah University of Science and Technology (KAUST) that will contribute to our understanding of durable stripe rust resistance in wheat. Greenhouse and field trials were conducted to screen UK wheat cultivars against stem rust race PTKST, in collaboration with scientists at the John Innes Centre. Research in collaboration with Dr Hongwei Li, Institute of Genetics and Developmental Biology, Chinese Academy of Sciences, on the establishment of wheat-*Thinopyrum ponticum* translocation lines carrying new sources of resistance to stem rust was published in the Journal of Genetics and Genomics.

Dr Boshoff was also involved in the Winter Cereal Trust project 'Evaluation of wheat cultivars and lines for genetic resistance to rust disease', carried out annually by the UFS rust pathologists. This research involved greenhouse and field screening with selected races of the three rust pathogens of wheat. Data from these trials is annually included in the national wheat production guidelines of ARC-SG. Significant progress was made with projects studying pathogenic variability in stem rust of oats and rust resistance of forage crops with two scientific papers published.



Prof Maryke Labuschagne, Dr Willem Boshoff and Prof Zakkie Pretorius participated in the ARC-SG planning committee meeting on 11 and 12 July

## Plant Pathology: Soil microbial ecology

The Soil and Microbial Ecology Group (SMEG) is run by Prof Wijnand Swart and the focus of the group's research is on monitoring the rhizosphere microbiome as a bio-indicator of plant health. 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. In 2019, SMEG was joined by two new MSc students, Mr Bongani Mahlangu and Miss Danette Strauss. Apart from being funded by Nulandis and the ARC, the group was contracted by Medigrow in Lesotho to look at the cultivation of cannabis in tunnels.

## Plant Pathology: Mycology

During 2019 the Pecan Health Research Group of Dr Gert Marais conducted six field trips, including the Orange River from Luchhof to Upington, Vaalharts, Schweizer-Reneke, Jacobsdal, as well as various areas in the Limpopo Province, Mpumalanga, Gauteng, KwaZulu-Natal, Eastern Cape and North West. During these trips, nine farmers' days were held where information regarding the newest findings on student projects was shared with pecan producers and other interested parties. This research is part of a five-year project between the South African Pecan Nut Producers Association (SAPPA) and the UFS. A booklet, describing the more important pecan diseases in South Africa was prepared and handed to the industry during the Annual General Meeting of SAPPA in November 2019. This is the first version to serve as a guide for producers in the field, and it is expected that it will be further expanded as research is continued on pecan diseases. Two MSc projects were concluded, confirming that the fungus causing scab on pecans in the USA, namely *Venturia effusa*, is not the same causative agent of scab in South Africa, which is *Cladosporium cladosporioides*. In addition, it was also confirmed that the fungus, *Neofusicoccum parvum*, is the causative agent of die-back in pecans.

## Plant Pathology: Epidemiology

The epidemiology programme was led by Lisa Rothmann and supported by Prof Neal McLaren and Marlese Meiring. The focus of the group is Sclerotinia stem and head rot of soybean and sunflower, as well as sorghum pathology. Prof McLaren retired at the end of 2018 and was appointed as a Research Fellow, operating from the Western Cape. His activities included data science workshops at Stellenbosch University and the University of Pretoria and research collaboration with ARC-GC, Western Cape Department of Agriculture and Sorghum Trust.



Sorghum leaf blight symptoms caused by *Exserohilum turcicum*

Sorghum research focused on grain-mold pathogens and mycotoxigenic fungi, as well as the effects of decortication on grain molds and mycotoxins. Applied epidemiology was applied to identify grain mold and foliar disease driving variables and risk modelling. Ultimately, these studies aim at the identification and quantification of intervention technologies for the management of sorghum diseases. Field trials were conducted in collaboration with Dr Edson Ncube from ARC-GC (Potchefstroom and Cedara). Research support from the Sorghum Trust continued during 2019.

Sclerotinia research focused on soybean and sunflower cultivar evaluations, in field trials in the Eastern Free State and Mpumalanga. These trials aimed at identifying cultivars that can be included into pre-breeding programmes as a result of a higher tolerance to Sclerotinia disease potentials. This research was supported by the Sasol Trust, Oil and Protein Seeds Development Trust (OPDT) and Protein Research Foundation (PRF), under the initiative of Grain SA. A project, in collaboration with Dr Derick van Staden in Mpumalanga, investigated the potential of fungicide interventions for Sclerotinia stem rot of soybean under field conditions. Another study under the mentorship of Prof Emerson del Ponte from the Plant Pathology Department at the Universidade Federal de Viçosa (Minas Gerais, Brazil), was initiated in 2019. This study is aimed at analysing a ten-year Sclerotinia prevalence dataset from across South African soybean and sunflower production regions, using reproducible research practices and a statistical coding platform, R and R Studio, which is new to their research group.



Marlese Meiring, PhD student, with Mr Koos Strydom of Clocolan, on whose farms her research on *Sclerotinia sclerotiorum* is being conducted

## Other research activities

The Geo Potts Herbarium acquired a light box, which is used to digitise all specimens in the main collection. Specimen images are made available online on the Herbarium website (<https://herbaria.plants.ox.ac.uk/bol/blfu>).



Ms Magdil Pienaar using the new light box in the Geo Potts Herbarium

State and Mpumalanga, and were aimed at connecting the producers with the current research being conducted, as well as to hear what the needs of the producers in terms of academia and industry. Through this type of interaction, practical management strategies for diseases caused by Sclerotinia can be developed for and communicated to local producers. Data from surveys among the producers was added to a disease database for the creation of a risk area map for Sclerotinia diseases of oilseed crops.

Scientific communication and popular articles are produced and distributed through the *Dry Bean Organisation Magazine*, *SAGrain Magazine* and the *Oilseed Focus Magazine*. Contributions were made by Lisa Rothmann, Marlese Meiring, Prof Neal McLaren, Alec Edwards, Dr Chrisna Steyn and Dr Adré Minnaar-Ontong, from the Plant Pathology and Plant Breeding divisions of the Department. Topics included sorghum disease management, understanding Sclerotinia diseases and potential interventions as well as interest articles on the importance of soil health, climate and biodiversity.

## NATIONAL AND INTERNATIONAL COLLABORATION

Many of our collaborative research initiatives are reported on in detail in the above sections. In summary:

Prof Labuschagne at Plant Breeding is actively collaborating with CIMMYT in Zimbabwe and Kenya on maize breeding, and with CIMMYT, Mexico and the University of Cordoba in Spain on wheat quality. Further collaboration is with IITA in Nigeria on cassava and cowpea biofortification. Nationally, she collaborates with the ARC-Bethlehem, Pretoria and Potchefstroom on wheat, maize and legume projects.

Dr Mohase collaborated with Dr A Jankielsohn of ARC-SG on aphid diversity in South Africa and Lesotho, who provided guidance on biotype evaluation of aphids collected from field trials and volunteer wheat in Lesotho, and analysis of soil samples from the various study sites in Lesotho. She also co-supervised a PhD student. Together with Dr N Lebaka, a plant breeder from SAB Hop Farms, Dr Mohase guided the design and analysis of data collected from field trials in Lesotho. Dr Lebaka co-supervised a master's student. Dr Mohase also collaborates with Lesotho Agricultural Research on a project on wheat germplasm in Lesotho. The unit provided germplasm that was used in the field trials as well as the agronomic traits of some of the cultivars. They also coordinated their extension officers who provided some land at the study sites.

Lisa Rothmann and Marlese Meiring are collaborating with Dr Derick van Staden from AgriSeed/DMS Genetics in Delmas in terms of soybean and sunflower field trials on the experimental farm, which are aimed at cultivar and fungicide evaluations. The soybean and sunflower national cultivar trial seed are provided by Dr Safiah Maali and Annelie de Beer from the ARC-GC in Potchefstroom.

The Geo Potts Herbarium was acknowledged for its contribution to research papers published by international researchers – Stinka, A. & Mei, G. 2019. *Ehrharta erecta* Lam. (Poaceae, Ehrhartoideae): distribution in Italy and taxonomy of one of the most invasive plant species in the world. *Bioinvasions Records* 8(4): 742-752.

## ENGAGED SCHOLARSHIP

Dr Boshoff and Prof Herselman acted as evaluators for new projects submitted to the Winter Cereal Trust for funding and Dr Boshoff also acted as convenor of the wheat rust consortium. Dr Boshoff represented the UFS at the National Small Grain Cultivar Advisory Committee and as a member of the ARC-SG annual planning committee meeting. Dr Boshoff handled several disease-related enquiries from producers and representatives from agricultural companies during the 2019 wheat season.

Dr Van Aardt gave a talk at the Botanical Society of South Africa's Free State branch in March titled 'Know your shrubs', and Dr Joubert presented a talk to the Free State Branch of Birdlife South Africa in May on the transition from bee to bird pollination.

Dr Mohase presented a guest lecture titled 'Prospects and challenges in wheat production' at the Glen College of Agriculture, Bloemfontein in August, and Dr Marais presented a guest lecture on 'The polyphagous shot hole borer (PSHB) in agriculture' to the Fichardt Park community in October.

During the 2018/2019 growing season, Lisa Rothmann and Marlese Meiring led 12 information sessions on Sclerotinia diseases. These were supported by industry partners under the auspices of the South African Sclerotinia Research Network, supported by Grain SA. They were held primarily in the Free



Healthy soybean plants

During 2019, Lisa Rothmann visited the Universidade Federal de Viçosa (Minas Gerais, Brazil) to be mentored by Prof Emerson Del Ponte, in the Epidemiology division of the Fitopatologia Departamento (Plant Pathology Department). This paved the way for the official MoU between the UFS and the Universidade Federal de Viçosa, which facilitates research collaboration and potential future exchange opportunities between the Plant Pathology departments of each institution.

Dr Moloi and Dr B Tóth, Institute of Nutrition, University of Debrecen, Hungary collaborated on a project which led to a book chapter being published.

Dr Rouxlène van der Merwe collaborated with the Northeast Institute of Geography and Agroecology (Chinese Academy of Sciences), on the breeding for resistance to pod dehiscence in vegetable-type soybean breeding companies. She also collaborated with researchers from the University of Manitoba in Canada and the University of Nebraska in the USA. Dr Van der Merwe continued her collaboration with the EDP, on germplasm maintenance of introduced varieties, base seed multiplication, research and training of students, pre-breeding and new cultivar development for South African growing conditions. Collaboration was also established between Dr Van der Merwe and Dr Potgieter with Stoller Africa with the aim of evaluating their growth enhancement products in statistically designed field trials.

Dr Joubert collaborated with Dr P Bester from the South African National Biodiversity Institute (SANBI) on systematics and evolutionary research of *Nemesia*, a genus endemic to Southern Africa and of significant horticultural and conservational importance. She also collaborated with Prof B Glover from the University of Cambridge on floral evolution and development research.

Prof P Crous, Director of the Westerdijk Fungal Biodiversity Institute in the Netherlands and Secretary-General of the International Mycological Association continued his collaboration with Prof Swart, as an Affiliated Professor in the Department. He was closely involved in research collaboration with Prof Swart and two postdoctoral fellows, Dr Marcelo P Sandoval Denis and Dr Alejandra Lopez.

Dr Boshoff and Prof Pretorius conducted international research projects in collaboration with researchers at the Chinese Academy of Sciences, Beijing (on wheat stem rust), KAUST, Kingdom of Saudi Arabia (on wheat stripe rust), John Innes Centre, UK (on wheat stripe and stem rust), the University of Minnesota (on barley stem rust and oat leaf rust), ARS-USDA (on wheat stem rust), the University of Sydney, Australia (on wheat stem rust), and the Norwegian University of Life Sciences (on wheat stripe rust). Nationally they conducted rust projects in collaboration with CenGen, ARC-SG, Sensako, Corteva Agriscience, Link Seed and Seed Co.



Dr Willem Boshoff and collaborators visiting a wheat rust nursery at the Corteva Research Farm outside Greytown, KwaZulu Natal

Prof Visser was involved in research projects with researchers from the Department Plant Pathology, University of Minnesota (on wheat stem rust) and the John Innes Centre, United Kingdom (on wheat stripe rust). At national level, he collaborated with researchers at the ARC-SG.

Dr Ngara continued with her international collaboration with Dr Stephen Chivasa from Durham University on the Newton Advanced Fellowship-Royal Society grant, and also spent five weeks on a research visit to Dr Chivasa's laboratory. Nationally, Dr Ngara collaborated with Dr Namera Shargie, and Dr Toi Tsilo, from ARC-SG on project funded by the NRF-Thuthuka.



Dr Rudo Ngara at Durham University, UK

Dr Jackson collaborated with Mrs Elmarie van Rensburg from the National Museum in Bloemfontein on the use of molecular systematics to investigate the phylogenetic relationships of genera in the family Aizoaceae.

Prof Scott and Dr Van Aardt collaborated with Dr Piet-Louis Grundling from Working for Wetlands at the Department of Environmental Affairs in order to obtain palaeo-reconstructions of the environments in the Grassland-Savanna transition. Prof Scott and Dr Van Aardt are also involved in a number of ongoing research projects with international collaborators on, including:

- Florisbad (Dr Michael Toffolo, Bordeaux Montaigne University)
- Namib Desert (Prof George Brook, University of Georgia)
- The search for cryptotephra in a fossil pollen sequences in Africa (Prof Cutis Marean, State University, Phoenix, Arizona)
- Dr Magdalena Sobol (University of Toronto) on *Acacia*-type (*Vachellia* and *Senegalia*) pollen morphology
- Pollen analyses of Western Cape Province (Prof Carlos Cordova [University of Oklahoma] and Dr Andy Carr [Leicester University])

Dr Komoreng collaborated with Dr Nomampondomise Mofokeng (UFS Department of Chemistry, Qwaqwa Campus) and Dr Saheed Sabiu (UFS Department of Microbial, Biochemical and Food Technology), Prof Oriel Thekiso and Prof Rialet Pieters (North-West University), Prof Philisiwe Nomngongo (University of Johannesburg), Prof Roger Cooposamy (Mangosuthu University of Technology), Dr Buyisile Mayekiso (University of Fort Hare) and Mr Meshack Mofokeng (ARC-Vegetable and Ornamental Plants [ARC-VOP])

During the course of 2019, a number of collaborative agreements were signed and became operational. These included:

- An agreement on research collaboration was reached between Dr Potgieter and Introlab (SA) to evaluate the bio-stimulant properties of Xcell Boost on different crops under certain stress conditions.
- The official Memorandum of Understanding (MoU) between Grain SA and the UFS (Plant Sciences) was signed for administrating the South African Sclerotinia Research Network (SASRN). Lisa Rothmann is the chairperson driving the Network, which is composed of a community of practice and a research consortium. Academia, industry members and producers are the cornerstone of this Network. The SASRN had its official launch and website release ([www.sclerotinia.co.za](http://www.sclerotinia.co.za)) in September 2019. The three key issues on which the SASRN will focus are: (i) generating a centre of excellence and expertise, (ii) the role South Africa can play in the Sclerotinia research arena internationally, and (iii) developing and communicating practical management strategies for diseases caused by Sclerotinia for our local producers. The latter focus point is reliant on driving parallel, comprehensive and cohesive research to benefit multiple investigators and the public to which the SASRN is committed. The principle investigators of the research consortium, situated at the UFS, include Dr Adré Minnaar-Ontong (Plant Breeding) and Lisa Rothmann (Plant Pathology).
- Lisa Rothmann and Dr Edson Ncube, from the ARC-GC, signed the official MoU for sorghum research focusing on grain mold and foliar diseases. Prof Neal McLaren is the mentor for the project, providing supervision to Lisa Rothmann on administrative, postgraduate and research related matters. Field trials are conducted in KwaZulu-Natal where bi-weekly screenings for foliar diseases are observed. Future research aims to provide risk forecasting models for potential disease risk periods. Lindy Rose from Stellenbosch University will also be involved in this study and will provide valuable mentorship and practical guidance on mycotoxin extractions and analyses of the sorghum grain. Thabiso Masisi is the master's student who is working with these collaborators.
- A collaboration agreement was signed between UFS and the Western Cape Department of Agriculture in 2019.

During July 2019, the Department of Plant Sciences hosted Prof Britt Bousman (Texas State University), Dr Kristen Wroth (University of Tuebingen) and Dr Michael Toffolo (Bordeaux Montaigne University), who focused on different aspects of archaeology at Lovedale in the Free State as part of ongoing collaboration between the UFS, the National Museum and the three universities abroad. Individuals from this collaboration study different environmental proxies (plant and faunal fossils) and archaeological finds.



The group of Quaternary scientists  
 Front from the left: Dr Brigitte Cohen (National Museum), Dr Andri van Aardt (UFS), Prof Britt Bousman (Texas State University)  
 Middle from the left: Dr Kristen Wroth (University of Tuebingen) and Dr Loyd Rossouw (National Museum)  
 Back from the left: Prof Louis Scott (UFS), Prof Maitland Seaman (UFS) and Dr Michael Toffolo (Bordeaux Montaigne University)

Prof Simon Krattinger and Dr Jan Bettgenhaeusar from Kaust University visited the UFS in September 2019. They toured greenhouse and rust laboratory facilities followed by a field trip to trials planted outside Greytown, KwaZulu-Natal.

Prof Robert Park, Head of Cereal Rust Research at the Plant Breeding Institute of the University of Sydney, visited the Department in October 2019 to discuss collaborative research opportunities.



Prof Robert Park (centre) with Prof Botma Visser (left) and Dr Willem Boshoff (right)

## POSTGRADUATE STUDENTS

During 2019, a total of 11 Honours, 49 master's and 53 doctoral students were enrolled for postgraduate studies in Plant Sciences.

At the 2019 graduations, five students graduated with the BScHons majoring in Botany (three on the Bloemfontein Campus and two on the Qwaqwa Campus) and one student graduated with the BScHons in Agriculture majoring in Plant Pathology.

Three students graduated with the MSc (Agriculture):

- Roelène Marx (Plant Breeding)
- Tondani Mishasha (Plant Breeding – with distinction)
- Whelma Mphela (Plant Breeding – with distinction)

A further 11 students graduated with the MSc:

- Harlod Kaondo (Plant Breeding – with distinction)
- Hilda Shawa (Plant Breeding)
- Sifiso Nzama (Plant Breeding)
- Marlese Bester (Plant Health Ecology)
- Mamosa Ngcala (Botany [Qwaqwa Campus] – with distinction)
- Nhlakanipho N Mdletshe (Botany [Qwaqwa Campus])
- Rinette Labuschagne (Botany [Bloemfontein campus])
- Selloane Lehasa (Botany [Qwaqwa Campus])
- Sellwane Moloi (Botany [Qwaqwa Campus])
- Thulani Mthombeni (Botany [Bloemfontein Campus])
- WC Heppell (Botany [Bloemfontein Campus])

Ten candidates from the Department of Plant Sciences graduated with the PhD in 2019 – six in Plant Breeding, three in Plant Pathology, and one in Botany. They were:

Akhtar, Sajjad

Thesis: Heritability and expression of iron and zinc concentration in maize under abiotic stress conditions in South Africa (PhD in Plant Breeding)

Promoter: Prof MT Labuschagne

Allemann, Anette

Thesis: The effect of herbicide formulations and soybean genotype on the relationship between beneficial organisms and root pathogens (PhD in Plant Pathology)

Promoter: Prof WJ Swart

Amah, Delphine Mutanga

Thesis: Genetic variability of carotenoids and polyploidy induction towards vitamin A biofortification in plantain (*Musa spp.*) (PhD in Plant Breeding)

Promoter: Prof MT Labuschagne

Chung, Hung-Yu

Thesis: The influence of sorghum physiology on rhizosphere interactions and their effect on root disease (PhD in Plant Pathology)

Promoter: Prof WJ Swart

Goche, Tatenda

Thesis: Characterisation of the physiological, biochemical and molecular responses of sorghum to drought stress (PhD in Botany – Qwaqwa campus)

Promoter: Dr R Ngara

Mbuma, Ntombokulunga Wedy

Thesis: Evaluating families and breeding values of parental populations in sugarcane (PhD in Plant Breeding)

Promoter: Prof MM Zhou

Müller, Olaf

Thesis: Integration of diverse maize germplasm pools base on genomic and phenotypic analyses (PhD in Plant Breeding)

Promoter: Prof MT Labuschagne

Ndoro, Oswell Farayi

Thesis: Use of exotic germplasm to enhance the performance of local maize (PhD in Plant Breeding)

Promoter: Prof MT Labuschagne

Smit, Armand

Thesis: Yield stability of edamame (*Glycine max* L.) introductions under South African production conditions (PhD in Plant Breeding)

Promoter: Dr R van der Merwe

Van Rooyen, Danelle

Thesis: Relationship between sorghum plant and grain characteristics, colonisation by mycotoxigenic *Fusarium* spp. and mycotoxin levels (PhD in Plant Pathology)

Promoter: Prof NW McLaren

Ms Nelmarie Janse van Rensburg, Senior Assistant Officer, and Dr Lisa Komoreng, Senior Lecturer on Qwaqwa Campus, resigned during 2019 and Dr Marieta Cawood (Lecturer, Botany) and Ms Sadie Geldenhuys (Officer, Plant Breeding) both retired in December 2019.

Dr Gerhard Potgieter received a 35-year service award from the UFS, while both Prof Maryke Labuschagne and Prof Botma Visser received 30-year service awards.

## RESEARCH OUTPUTS

### Research Articles

**Ahmad, T., Cawood, M.E., Iqbal, Q., Ariño, A., Batool, A., Tariq, R.M.S., Azam, M. & Akhtar, S.** 2019. Phytochemicals in *Daucus carota* and their health benefits - Review Article. *Foods* 8: 424.

**Akinuoye-Adelabu, D.B., Steenhuisen, S. & Bredenhend, E.** 2019. Improving pea quality with vermicompost tea and aqueous biochar: Prospects for sustainable farming in Southern Africa. *South African Journal of Botany* 123: 278-285.

**Amah, D., Alamu, E., Adesokan, M., Van Biljon, A., Maziya-Dixon, B., Swennen, R. & Labuschagne, M.** 2019. Variability of carotenoids in a *Musa* germplasm collection and implications for provitamin A biofortification. *Food Chemistry X* 2: 100024.

**Amah, D., Van Biljon, A., Brown, A., Perkins-Veazie, P., Swennen, R. & Labuschagne, M.** 2019. Recent advances in banana (*Musa* spp.) biofortification to alleviate vitamin A deficiency. *Critical Reviews in Food Science and Nutrition* 59: 3498-3510.

**Amah, D., Van Biljon, A., Maziya-Dixon, B., Labuschagne, M. & Swennen, R.** 2019. Effects of *in vitro* polyploidization on agronomic characteristics and fruit carotenoid content; Implications for banana genetic improvement. *Frontiers in Plant Science* 10: 1450.

**Birkenfeld, M., Horwitz, L.K., Bar-Yosef Mayer, D.E., Bond, J., Guttman-Bond, E., Cummings, L.S., Goldgeier, H., Krakovsky, M., Natalio, F., Nebenhaus, K., Neumann, F.H., Porat, N., Scott, L., Simmons, T., Yashuv, T. & Avner, U.** 2019. Investigations at Nahal Roded 110: A Late Neolithic ritual site in the southern Negev. *Antiquity* 93(367): e4. DOI10.15184/aqy.2019.6.

**Birkhofer, K., Addison, M.F., Arvidsson, F., Bazelet, C., Bengtsson, J., Booyesen, R., Conlong, D., Haddad, C., Janion-Scheepers, C., Kapp, C., Lindborg, R., Louw, S., Malan, A., P., Storey, S.G., Swart, W.J. & Addison, P.** 2019. Effects of ground cover management on biotic communities, ecosystem services and disservices in organic pome fruit orchards in South Africa. *Frontiers in Sustainable Food Systems* 3: 107.

**Boshoff, W.H.P., Bender, C.M. & Pretorius, Z.A.** 2019. Reaction of South African rye, triticale and barley forage cultivars to stem and leaf rust. *South African Journal of Plant and Soil* 36(2): 77-82.

**Boshoff, W.H.P., Bender, C.M. & Pretorius, Z.A.** 2019. The value of field ratings of differential lines for pathotyping *Puccinia graminis* f. sp. *tritici*. *European Journal of Plant Pathology* 155(1): 349-352.

**Boshoff, W.H.P., Prins, R., De Klerk, C., Krattinger, S.G., Bender, C.M., Maree, G.J., Rothmann, L. & Pretorius, Z.A.** 2019. Point inoculation method for measuring adult plant response of wheat to stripe rust infection. *Plant Disease* 103(6): 1228-1233. DOI: 10.1094/PDIS-08-18-1312-RE.

**Boshoff, W.H.P., Visser, B., Terefe, T. & Pretorius, Z.A.** 2019. Diversity in *Puccinia graminis* f. sp. *avenae* and its impact on oat cultivar response in South Africa. *European Journal of Plant Pathology* 155: 1165-1177.

**Buwa-Komoreng, L.V., Mayekiso, B., Mhinana, Z. & Adeniran, L.A.** 2019. An ethnobotanical and ethnomedicinal survey of traditionally used medicinal plants in Seymour, South Africa: An attempt towards digitization and preservation of ethnic knowledge. *Pharmacognosy Magazine* 14: 115-123.

**Carrión, J.S., Scott, L. & DeMenocal, P.** 2019. Paleofloras, paleovegetation and human evolution. *Review of Palaeobotany and Palynology* 267: 32-38.

**Chirango, Y., Steenhuisen, S., Bruyns, P.V., Midgley, J.J. & Shuttleworth, A.** 2019. The March fly and the ant: the unusual pollination system of *Eustegia minuta* (Apocynaceae: Asclepiadoideae). *Arthropod-Plant Interactions* 13(5): 745-755.

**Cordova, C.E., Kirsten, K.L., Scott, L., Meadows, M.E. & Lücke, A.** 2019. Multi-proxy evidence of Late-Holocene paleoenvironmental change at Princessvlei, South Africa: The effects of fire, herbivores, and humans. *Quaternary Science Reviews* 221: 105896. DOI: 10.1016/j.quascirev.2019.105896.

**Cozien, R., Van der Niet, T., Johnson, S.D. & Steenhuisen, S.** 2019. Saurian surprise: lizards pollinate South Africa's enigmatic 'hidden flower'. *Ecology* 100(6): e02670.

**Crous, P.W., Wingfield, M.J., Lombard, I., Roets, F., Swart, W.J., et al.,** 2019. Fungal Planet Description Sheets: 951-1041. *Persoonia* 43: 223-425.

**Engelbrecht, F.A., Marean, C.W., Cowling, R., Engelbrecht, C., Nkoana, R., O'Neal, D., Fisher, E., Shook, E., Franklin, J., Neumann, F.H., Scott, L., Thatcher, M., McGregor, J.L., Van der Merwe, J., Dedekind, Z. & Difford, M.** 2019. Downscaling Last Glacial Maximum climate over southern Africa. *Quaternary Science Reviews* 226: 105879.

**Galindo, A.C., López, J.O., Munguía, A.R., Inungaray, M.L.C., Cawood, M., Pérez, G.M., Luqueño, F.F. & Montiel, R.G.C.** 2019. Influence of bioactive compounds incorporated in a nanoemulsion as coating on avocado fruits (*Persea americana*) during postharvest storage: Antioxidant activity, physiochemical changes and structural evaluation. *Antioxidants* 8: 500.

**Gerrano, A.S., Jansen van Rensburg, W.S., Shargie, N.G., Amelework, B.A., Shimelis, H.A. & Labuschagne, M.T.** 2019. Selection of cowpea collections based on grain minerals and protein composition. *Acta Agriculturae Scandinavica, Section B - Plant Soil Science* 69: 155-166.

**Greeff-Laubscher, M.R., Beukes, I., Marais, G.J. & Jacobs, K.** 2019. Mycotoxin production by three different toxigenic fungi genera on formulated abalone feed and the effect of an aquatic environment on fumonisins. *Mycology*. Online. DOI: 10.1080/21501203.2019.1604575.

**Grimsson, F., Shirley Graham, S., Coiro, M., Jacobs, B.F., Xafis, A., Neumann, F., Scott, L., Currano, E.D. & Zetter, R.** 2019. Origin and divergence of Afro-Indian Picodendraceae: linking pollen morphology, dispersal modes, fossil records,

molecular dating and paleogeography. *Grana* 58(4): 227-275. DOI: 10.1080/00173134.2019.1594357.

**Hiscock, L., Bothma, C., Hugo, A., Van Biljon, A. & Jansen van Rensburg, W.S.** 2019. Hedonic evaluation and check-all-that-apply (CATA) question for sensory characterisation of stewed vegetable *Amaranthus*. *Journal of Food Sciences and Technology* 57(2): 1-9. DOI: 10.1007/s13197-019-04073-1.

**Jordaan, E., Van der Waals, J.E. & McLaren, N.W.** 2019. Effect of irrigation on charcoal rot severity, yield loss and colonization of soybean and sunflower. *Crop Protection* 122: 63-69.

**Li, F., Upadhyaya, N.M., Sperschneider, J., Matny, O., Nguyen-Phuc, H., Mago, R., Raley, C., Miller, M.E., Silverstein, K.A.T., Henningsen, E., Hirsch, C.D., Visser, B., Pretorius, Z.A., Steffenson, B.J., Schwessinger, B., Dodds, P.N. & Figueroa, M.** 2019. Emergence of the Ug99 lineage of the wheat stem rust pathogen through somatic hybridisation. *Nature Communications* 10: 5068.

**Li, H., Boshoff, W.H.P., Pretorius, Z.A., Zheng, Q., Li, B. & Li, Z.** 2019. Establishment of wheat-*Thinopyrum ponticum* translocation lines with resistance to *Puccinia graminis* f. sp. *tritici* Ug99. *Journal of Genetics and Genomics* 46: 406-407.

**Manjeru, P., Van Biljon, A. & Labuschagne, M.T.** 2019. The development and release of maize fortified with provitamin A carotenoids in developing countries. *Critical Reviews in Food Science and Nutrition* 59(8): 1284-1293.

**Manjeru, P., Van Biljon, A., MacRobert, J. & Labuschagne, M.T.** 2019. Provitamin A maize hybrid response to drought, heat, low nitrogen and low phosphorous stress. *Crop Science* 59: 2533-2543.

**Maree, G.J., Prins, R., Bender, C.M., Boshoff, W.H.P., Negussie, T.G. & Pretorius, Z.A.** 2019. Phenotyping Kariega x Avocet S doubled haploid lines containing individual and combined adult plant stripe rust resistance loci. *Plant Pathology* 68(4): 659-668.

**Maree, G.J., Prins, R., Boyd, L.A., Castelyn, H.D., Bender, C.M., Boshoff, W.H.P. & Pretorius, Z.A.** 2019. Assessing the individual and combined effects of QTL for adult plant stripe rust resistance derived from Cappelle-Desprez. *Agronomy* 154(9): article 154.

**Mbuma, N.W., Zhou, M.M. & Van der Merwe, R.** 2019. Comparing family with individual genotype breeding parameters for cane yield in sugarcane populations. *South African Journal of Plant and Soil* 36(1): 11-19.

**Mbuma, N.W., Zhou, M.M. & Van der Merwe, R.** 2019. Evaluating parents for cane yield in sugarcane breeding using best linear unbiased prediction analysis of progeny data derived from family plots. *South African Journal of Plant and Soil* 36(1): 21-28.

**Ollerton, J., de Jager, J.C.L., Joubert, L., Steenhuisen, S.-I., et al.** 2019. The diversity and evolution of pollination systems in large plant clades: Apocynaceae as a case study. *Annals of Botany* 132(2): 311-325.

**Pretorius, Z.A., Booyesen, G.J., Boshoff, W.H.P., Joubert, J.H., Maree, G.J. & Els, J.** 2019. Additive manufacturing of devices used for collection and application of cereal rust urediniospores. *Frontiers in Plant Science* 10, Article 639. DOI: 10.3389/fpls.2019.00639.

## POSTDOCTORAL RESEARCH FELLOWS

Dr Howard Castelyn (from South Africa) was appointed as a postdoctoral research fellow in the laboratory of Prof Visser to continue with the bio-informatic analysis of the adult wheat-stem rust interaction.

Three postdoctoral research fellows were affiliated to the SMEG in 2019, namely Dr Makomborero Nyoni from Zimbabwe, Dr Alejandra Lopez from Colombia and Dr Marcelo Sandoval-Denis.

Dr Neila Abdi, from Tunisia, completed her first year as postdoctoral research fellow as part of the SARChI Chair on Disease Resistance and Quality of Field Crops, working on the influence of abiotic stress on gluten protein in wheat.

Under the supervision of Dr Steenhuisen on the Qwaqwa Campus, Dr Nicholas Le Maitre (from South Africa) focused on the introgression between native and exotic *Celtis* species, the use of acoustics to assess bird diversity of wetlands in Golden Gate Highlands National Park, and the population genetics of rare *Protea* species, in collaboration with the Department of Zoology and Entomology and the ARU.

## STAFF MATTERS

Dr Adré Minnaar-Ontong, Lintle Mohase and Dr Rouxlène van der Merwe were promoted to Senior Lecturer positions in the Department and Dr Tom Ashafa (Qwaqwa Campus) was promoted to Associate Professor.

Dr Ansori Maré was appointed as Junior Lecturer in Plant Breeding and Dr Ntombokulunga (Ntombi) Mbuma was appointed as Lecturer in Plant Breeding (as part of the SARChI Chair). Dr Pheello Mojau was appointed as Lecturer in Plant Sciences on the Qwaqwa Campus. He was previously a Professional Officer in the Department.

Ms Lumka Mbingeleli was appointed as Senior Assistant Officer.

Ramulifho, E., Goche, T., Van As, J., Tsilo, T.J., Chivasa, S. & Ngara, R. 2019. Establishment and characterization of callus and cell suspension cultures of selected *Sorghum bicolor* (L.) Moench varieties: a resource for gene discovery in plant stress biology. *Agronomy* 9(218). DOI: 10.3390/agronomy9050218.

Santchurn, D., Badaloo, M.G.H., Zhou, M.M. & Labuschagne, M.T. 2019. Contribution of sugarcane crop wild relatives in the creation of improved varieties in Mauritius. *Plant Genetic Resources* 17: 151-163.

Santchurn, D., Badaloo, M.G.H., Zhou, M.M. & Labuschagne, M.T. 2019. Genetic studies on sugar and fibre accumulation patterns among different types of energy canes in Mauritius. *SugarTech* 21: 879-890.

Saunders, D.G.O., Pretorius, Z.A. & Hovmøller, M.S. 2019. Tackling the re-emergence of wheat stem rust in Western Europe. *Communications Biology* 2: 51.

Scott, L., Van Aardt, A.C., Brink, J.S., Toffolo, M.B., Ochando, J. & Carrion, J.S. 2019. Palynology of Middle Stone Age spring deposits in grassland at the Florisbad hominin site, South Africa. *Review of Palaeobotany and Palynology* 265: 13-26.

Sobol, M., Scott, L. & Finkelstein, S. 2019. Reconstructing biome states using machine language and modern pollen assemblages: a case study from Southern Africa. *Quaternary Science Reviews* 212: 1-17.

Terefe, T., Pretorius, Z.A., Visser, B. & Boshoff, W.H.P. 2019. First report of *Puccinia graminis* f. sp. *tritici* race PTKSK, a variant of wheat stem rust race Ug99 in South Africa. *Plant Disease* 103(6): 1421.

Thackeray, J.F., Scott, L. & Pieterse, P. 2019. The younger dryas interval at Wonderkrater (South Africa) in the context of a platinum anomaly. *Palaeontologia africana* 54: 30-35.

Tóth, B. & Moloi, M.J. 2019. The use of industrial waste materials for alleviation of iron deficiency in sunflower and maize. *International Journal of Recycling of Organic Waste in Agriculture* 8: 145-151.

Tóth, B., Van Biljon, A., Moloi, J. & Labuschagne, M. 2019. Effects of different fertilization levels on the concentration of high molecular weight-glutenin subunits of two spring, hard red bread wheat cultivars. *Cereal Chemistry* 96: 1004-1010.

Venter, S.L., Fouche, H.J., De Wit, M., Mavengahama, S., Coetzer, G., Swart, W.J. & Amonsou, E.O. 2019. The effect of fostering partnerships on broadening the food base: The role of cactus pear, an underutilised crop with unlimited potential and the South African Perspective. *Acta Horticulturae* 1247: 237-244. DOI: 10.17660/ActaHortic.2019.1247.32.

Visser, B., Meyer, M., Park, R., Gilligan, C., Burgin, L.E., Hort, M.C., Hodson, D. & Pretorius, Z.A. 2019. Microsatellite analysis and urediniospore dispersal simulations support the movement of *Puccinia graminis* f. sp. *tritici* from southern Africa to Australia. *Phytopathology* 109: 133-144.

Wessels, E., Prins, R., Boshoff, W.H.P., Zurn, J.D., Acevedo, M. & Pretorius, Z.A. 2019. Mapping a resistance gene to *Puccinia graminis* f. sp. *tritici* in the bread wheat cultivar Matlabas. *Plant Disease* 103(9): 2337-2344.

Yekelo, N., Rothmann, L., Bender, C.M., Pretorius, Z.A. & Boshoff, W.H.P. 2019. Response of an international triticale collection to *Puccinia triticina* and *Puccinia recondita* and assessment of temperature sensitivity in leaf rust isolates. *Cereal Research Communications* 47(3): 496-505.

## Books

Marais, G.J. 2019. *Fungal diseases associated with pecans in South Africa: A field guide*. Xerox, Bloemfontein, South Africa.

## Chapters in Books

Mwenye, O.J., Van Rensburg, L., Van Biljon, A. & Van der Merwe, R. 2019. Seedling shoot and root growth responses among soybean (*Glycine max*) genotypes to drought stress. In: *Soybean biomass, yield and productivity*. M. Kasai (Ed). Intechopen Limited, London, UK. pp 59-68.

## Research Reports

Boshoff, W.H.P. 2019. *Evaluation of wheat cultivars and lines for genetic resistance to rust diseases*. Report delivered to the Winter Cereal Trust.

Boshoff, W.H.P. 2019. *Genomics for resistance*. Report delivered to King Abdullah University of Science and Technology (KAUST) as part of the project 'State-of-the-Art Genomics to Understand Durable Disease Resistance in Wheat and Barley'.

## Conference Contributions

### Conference Papers/Posters

Achilonu, C., Gryzenhout, M. & Marais, G.J. 2019. *Alternaria* spp. associated with anthracnose and leafspot on pecans in South Africa. Paper delivered at the 51<sup>st</sup> Congress of the Southern African Society for Plant Pathology, Langebaan, South Africa. 20-24 January 2019.

Adams, L.D., Martin, G., Clark, V.R. & S. Steenhuisen. 2019. *Following the fate of seeds to investigate the spread of invasive *Pyracantha angustifolia* (Firethorn) in the eastern Free State, South Africa*. Paper delivered at the Annual Conference of the The National Symposium on Biological Invasions, Tulbagh, South Africa. 15-17 May 2019.

Adams, L.D., Martin, G., Clark, V.R. & S. Steenhuisen. 2019. *Reproductive ecology of the invasive firethorn species, *Pyracantha angustifolia* (Rosaceae), in the eastern Free State Province*. Poster presented at the 45<sup>th</sup> Annual Conference of the South African Association of Botanists, Johannesburg, South Africa. 8-11 January 2019.

Adams, Z., Thekiso, M.M.O. & Komoreng, L.V. 2019. *An ethnobotanical survey of traditional medicinal plants used against elephantiasis in the OR Tambo District, Eastern Cape*. Poster presented at the 45<sup>th</sup> Annual Conference of the South African Association of Botanists, Johannesburg, South Africa. 8-11 January 2019.

Bender, C.M., Boshoff, W.H.P. & Pretorius, Z.A. 2019. *The impact of new races of *Puccinia graminis* f. sp. *tritici* on South African wheat cultivars*. Paper delivered at the 51<sup>st</sup> Congress of the Southern African Society for Plant Pathology, Langebaan, South Africa. 20-24 January 2019.

Boshoff, W.H.P., Visser, B., Terefe, T. & Pretorius, Z.A. 2019. *Pathogenic variability in and oat cultivar response to *Puccinia graminis* f. sp. *avenae* in South Africa*. Paper delivered at the 51<sup>st</sup> Congress of the Southern African Society for Plant Pathology, Langebaan, South Africa. 20-24 January 2019.

Cawood, M.E. & Saba, L. 2019. *Bioactivity of *Artemisia afra* essential oil and extracts and their ability to reduce disease symptoms in wheat caused by the Russian wheat aphid*. Paper delivered at the 12<sup>th</sup> International Congress of Plant Biotechnology and Agriculture, Caya Guillermo, Cuba. 27-31 May 2019.

Cawood, M.E. & Saba, L. 2019. *The impact of *Agave attenuata* extracts on biotic resistance responses of wheat and their ability to act as repellents/insecticides against the Russian wheat aphid*. Paper delivered at the 4<sup>th</sup> International Conference on Plant Science & Physiology, Sydney, Australia. 25-26 March 2019.

Chemonges, M., Herselman, L., Boshoff, W.H.P. & Pretorius, Z.A. 2019. *Genetic analysis reveals monogenic resistance to *Puccinia graminis* f. sp. *tritici* in South African winter wheat varieties*. Poster presented at the 1<sup>st</sup> International Wheat Congress, Saskatoon, Canada. 21-26 July 2019.

Coertzen, J., Gryzenhout, M., Slippers, B. & Marais, G.J. 2019. *Botryosphaeriaceae fungal pathogens associated with pecans, with special reference to *Neofusicoccum parvum**. Poster presented at the 51<sup>st</sup> Congress of the Southern African Society for Plant Pathology, Langebaan, South Africa. 20-24 January 2019.

Cozien, R., Van der Niet, T., Johnson, S.D. & S. Steenhuisen. 2019. *Secrets of the Drakensberg's "Hidden flowers" revealed: Discovery of a novel pollination system for continental Africa*. Paper delivered at the 45<sup>th</sup> Annual Conference of the South African Association of Botanists, Johannesburg, South Africa. 8-11 January 2019.

Hlongwane, M.V. & Komoreng, L.V. 2019. *Phytochemical analysis and antimicrobial activity of eight medicinal plants used in the treatment of tuberculosis in the eastern Free State, South Africa*. Paper delivered at the 45<sup>th</sup> Annual Conference of the South African Association of Botanists, Johannesburg, South Africa. 8-11 January 2019.

Jordaan, E., Van Der Waals, J.E. & McLaren, N.W. 2019. *Effect of irrigation on charcoal rot severity, yield loss and colonization of soybean and sunflower*. Poster presented at the 51<sup>st</sup> Congress of the Southern African Society for Plant Pathology, Langebaan, South Africa. 20-24 January 2019.

Kozana, A., Visser, B., Roberts, R., Botha, W., Prinsloo, G. & Terefe, T. 2019. *First detection of *Polymyxa graminis*, a parasite of cereal roots and vector of cereal viruses, in South Africa*. Poster presented at the 51<sup>st</sup> Congress of the Southern African Society for Plant Pathology, Langebaan, South Africa. 20-24 January 2019.

Labuschagne, M.T., Tóth, B. & Van Biljon, A. 2019. *Proteomic analysis of wheat seed in response to low nitrogen and phosphorous stress*. Paper delivered at the 1<sup>st</sup> International Wheat Congress, Saskatoon, Canada. 21-26 July 2019.

Li, F., Upadhyaya, N., Schwessinger, B., Sperschneider, J., Matny, O., Raley, C., Miller, M.E., Silverstein, K., Nguyen-Phuc, H., Hirsch, C.D., Visser, B., Pretorius, Z.A., Steffenson, B., Dodds, P.N. & Figueroa, M. 2019. *Contribution of a somatic hybridization event to the emergence of the Ug99 lineage of the wheat stem rust pathogen, *Puccinia graminis* f. sp. *tritici**. Paper delivered at the International Society for Molecular Plant-Microbe Interactions XVIII Conference, Glasgow, Scotland. 14-18 July 2019.

Liu, Y., Minnaar-Ontong, A. & Labuschagne, M.T. 2019. *Wbm: a gene link to bread making quality in South Africa wheat?* Poster presented at the 1<sup>st</sup> International Wheat Congress, Saskatoon, Canada. 21-26 July 2019.

MacDonald, S., Oosthuizen, G., Marais, G. & Cawood, M.E. 2019. *A comparative study of the chemical composition and bioactivity of extracts from leaves of two Pecan nut cultivars grown in South Africa*. Paper delivered at the 12<sup>th</sup> International Congress of Plant Biotechnology and Agriculture, Caya Guillermo, Cuba. 27-31 May 2019.

Maré, A., Herselman, L. & Boshoff, W.H.P. 2019. *Development of wheat lines with complex resistance to rusts and *Fusarium* head blight*. Poster presented at the 1<sup>st</sup> International Wheat Congress, Saskatoon, Canada. 21-26 July 2019.

Masisi, T.V., Rothmann, L., Bender, C.M., Maree, G.J. & Boshoff, W.H.P. 2019. *Comparative virulence of stripe rust pathotype 6E22A+ and field isolate GWK2015\_56*. Paper delivered at the Cereal Science and Technology SA 3<sup>rd</sup> New Voices Symposium, Pretoria, South Africa. 11 September 2019.

Masisi, T.V., Rothmann, L., Bender, C.M., Maree, G.J. & Boshoff, W.H.P. 2019. *Resistance response of irrigation wheat cultivars to stripe rust under different temperature regimes*. Poster presented at the South African National Seed Organisation Annual Conference, Umlazi, South Africa. 21-24 May 2019. [First prize poster presentation].

Mbumba, N.W., Zhou, M.M. & Van der Merwe, R. 2019. *Family by environment interactions for sugarcane yield in South Africa*. Paper delivered at the 92<sup>nd</sup> South African Sugar Technologists' Association Congress, Durban, South Africa. 20-22 August 2019.

Mdletshe, N.W., Thekiso, M.M.O. & Komoreng, L.V. 2019. *Comparison on pharmacological activity of *Rhoicissus tomentosa* and *Rhoicissus tridentata* for the treatment of elephantiasis in South Africa*. Paper delivered at the 45<sup>th</sup> Annual Conference of the South African Association of Botanists, Johannesburg, South Africa. 8-11 January 2019.

Meiring, M.C. & McLaren, N.W. 2019. *Screening for tolerance to *Sclerotinia sclerotiorum* in soybean cultivars*. Paper delivered at the Third Annual New Voices Symposium, Pretoria, South Africa. 11 September 2019.

Meyer, W.B., Boshoff, W.H.P., Minnaar-Ontong, A. & Visser, B. 2019. *Phenotypic and genotypic variation of *Puccinia helianthi* in South Africa*. Paper delivered at the 51<sup>st</sup> Congress of the Southern African Society for Plant Pathology, Langebaan, South Africa. 20-24 January 2019.

Minnaar, H., Prins, R., Bender, C.M., Maree, G.J. & Boshoff, W.H.P. 2019. *Phenotypic expression of stripe rust resistance using spray and point inoculation*. Poster presented at the 51<sup>st</sup> Congress of the Southern African Society for Plant Pathology, Langebaan, South Africa. 20-24 January 2019.

Mishasha, T., Zhou, M.M. & Van der Merwe, R. 2019. *Using quantitative genetic parameters to determine sample size for sucrose content in sugarcane breeding*. Paper delivered at the 92<sup>nd</sup> South African Sugar Technologists' Association Congress, Durban, South Africa. 20-22 August 2019.

Mohase, L., Adendorff, J. & Jankielsohn, A. 2019. *Foliar application of Alexin™ selectively enhances defence responses to Russian wheat aphid, *Diuraphis noxia**. Paper delivered at the Joint Conference of the South African Association of Botanists,



Southern African Society for Systematic Biology and African Mycological Association, Johannesburg, South Africa. 8-11 January 2019.

**Myburgh, P.P., Maré, A. & Boshoff, W.H.P.** 2019. *Phenotypic and genotypic characterisation of South African winter wheat cultivars for stem rust resistance*. Paper delivered at the Annual Postgraduate Symposium of the Department of Botany and Plant Biotechnology, University of Johannesburg, Johannesburg, South Africa. 3-4 November 2019.

**Ngara, R., Goche, T. & Chivasa, S.** 2019. *Comparative physiological, biochemical and proteomic analysis of two sorghum varieties in response to drought stress*. Poster presented at the Plant Cell and Environment 40<sup>th</sup> Anniversary Symposium, University of Glasgow, Scotland. 4-6 September 2019.

**Ngara, R., Goche, T. & Chivasa, S.** 2019. *Sorghum as a model system in plant stress biology: lessons learnt from drought response studies*. Paper delivered at the Connecting Minds Africa Conference, Nairobi, Kenya. 25-27 September 2019.

**Ngara, R., Ngcala, M.G., Moloi, S.J., Goche, T., Shargie, N.G. & Chivasa, S.** 2019. *Comparative molecular analysis of sorghum in response to abiotic stresses*. Paper delivered at the 45<sup>th</sup> Annual Conference of the South African Association of Botanists, Johannesburg, South Africa. 8-11 January 2019.

**Ngcala, M.G., Chivasa, S. & Ngara, R.** 2019. *High temperature stress triggers molecular responses in sorghum cell suspension cultures*. Paper delivered at the 45<sup>th</sup> Annual Conference of the South African Association of Botanists, Johannesburg, South Africa. 8-11 January 2019.

**Pretorius, Z.A.** 2019. *Are cereal rusts still important?* Invited keynote delivered at the 51<sup>st</sup> Congress of the Southern African Society for Plant Pathology, Langebaan, South Africa. 20-24 January 2019.

**Prins, R., De Klerk, C., Boshoff, W.H.P., Abbrouk, M., Bettgenhauser, J., Minnaar, H., Pretorius, Z.A., Doležel, J., Šimková, H., Wessels, E., Horn, M. & Krattinger, S.G.** 2019. *Pursuing the partial stripe rust resistance QYr.sgi-4A.1 gene of the wheat cultivar Kariega*. Poster presented at the Plant and Animal Genome Conference XXVII, San Diego, USA. 12-16 January 2019.

**Rothmann, L.A., Bester, M.C., Steyn, C. & McLaren, N.W.** 2019. *A community of practice: modelled on Sclerotinia stem rot of soybean*. Paper delivered at the 51<sup>st</sup> Congress of the Southern African Society for Plant Pathology, Langebaan, South Africa. 20-24 January 2019.

**Rothmann, L.A., McLaren, N.W., Dos Santos Alves, K. & Del Ponte, E.M.** 2019. *A quantitative summary of a 10-year survey of white mold prevalence in South Africa*. Paper delivered at the Third Annual New Voices Symposium, Pretoria, South Africa. 11 September 2019.

**Ruiz-Hernández, V., Joubert, L., Rodríguez-Gómez, A., Terry, P.M.J., Weiss, J., Bielza, G.B.J. & Egea-Cortines, M.** 2019. *Visual traits override scent cues in Bombus terrestris floral selection*. Poster presented at the New Phytologist Next Generation Scientists Symposium, Dublin, Ireland. 22-25 July 2019.

**Scott, L., Gil-Romera, G., Neumann, F.H., Sobol, M., Horwitz, L.K., Van Aardt, A. & Fernandez-Jalvo, Y.** 2019. *Diverse modes of pollen taphonomy and late Quaternary palaeo-environments in the Kalahari*. Paper delivered at Session: Wonderwerk Cave

and Related Research Projects in the Northern Cape Province, Association of Southern African Professional Archaeologists, Kimberley, South Africa. 2-4 July 2019.

**Semu, E., Gryzenhout, M. & Marais, G.J.** 2019. *Chaetomium species associated with pecans in South Africa*. Poster presented at the 51<sup>st</sup> Congress of the Southern African Society for Plant Pathology, Langebaan, South Africa. 20-24 January 2019.

**Siwale, J., Gerrano, A., Labuschagne, M.T., Van Biljon, A. & Lebaka, N.** 2019. *Variation in Fe, Zn, protein and anti-nutritional contents in Bambara groundnut (V. subterranea) accessions*. Paper delivered at the First African Plant Breeders Conference, Accra, Ghana. 23-25 October 2019.

**Theron, N., Gryzenhout, M., Swart, W.J. & Marais, G.J.** 2019. *Cladosporium cladosporioides, causative agent of pecan scab in South Africa*. Poster presented at the 51<sup>st</sup> Congress of the Southern African Society for Plant Pathology, Langebaan, South Africa. 20-24 January 2019.

**Tiwani, T., Pieters, R., Horn, S., Thekiso, O.M.M. & Komoreng, L.V.** 2019. *Phytochemical screening, antimicrobial activity and cytotoxicity of Platycarpha glomerata and Tulbaghia alliacea used in the treatment of lymphatic filariasis in the Eastern Cape, South Africa*. Paper delivered at the 6<sup>th</sup> World Congress on Medicinal and Aromatic Plants, Famagusta, Northern Cyprus. 13-17 November 2019.

**Tóth, B., Van Biljon, A., Ammar, K., Sipos, P., Györi, Z., Guzmán, C. & Labuschagne, M.T.** 2019. *Variability in mono- and polymeric proteins in a worldwide collection of commercial durum wheat cultivars and correlations with alveograph W and P/L*. Paper delivered at the 1<sup>st</sup> International Wheat Congress, Saskatoon, Canada. 21-26 July 2019.

**Van Aardt, A.C., Du Preez, P.J. & Scott, L.** 2019. *Major plant communities and physical environment in the catchments of the putative palaeo-Kimberley and palaeo-Modder Rivers, Free State South Africa*. Paper delivered at the 16<sup>th</sup> Biodiversity Research Symposium, Kimberley, South Africa. 18 September 2019.

**Van Aardt, A.C., Scott, L., Theron, E.J., & Rossouw, L.** 2019. *Charred cuticles in Tswaing crater lake deposits: A palaeoenvironmental indicator?* Paper delivered at the XXII Biennial Congress of the South African Society for Quaternary Research, Mossel Bay, South Africa. 28-31 January 2019.

**Van Biljon, A., Miles, C.W., Booyse, M. & Labuschagne, M.T.** 2019. *Mixsmart parameters as possible indicators of bread making quality in wheat cultivars adapted to the South African dryland summer rainfall areas*. Paper delivered at the 1<sup>st</sup> International Wheat Congress, Saskatoon, Canada. 21-26 July 2019.

**Visser, B., Meyer, M., Park, R.F., Gilligan, C.A., Burgin, L.E., Hort, M.C., Hodson, D.P. & Pretorius, Z.A.** 2019. *Out of Africa to Down-Under: a study on the proposed inter-continental movement of wheat stem rust*. Paper delivered at the 51<sup>st</sup> Congress of the Southern African Society for Plant Pathology, Langebaan, South Africa. 20-24 January 2019.

**Voua Otomo, L., Sabiu, S., Thekiso, M.M.O. & Komoreng, L.V.** 2019. *Investigation of antimicrobial properties from plants used in the treatment of non-filarial elephantiasis in KwaZulu-Natal, South Africa*. Paper delivered at the 45<sup>th</sup> Annual Conference of the South African Association of Botanists, Johannesburg, South Africa. 8-11 January 2019.

**Voua Otomo, L., Sabiu, S., Thekiso, M.M.O. & Komoreng, L.V.** 2019. *Phytochemical analysis and anti-oxidant properties from plants used in the treatment of non-filarial elephantiasis in KwaZulu-Natal, South Africa*. Paper delivered at the 6<sup>th</sup> World Congress on Medicinal and Aromatic Plants, Famagusta, Northern Cyprus. 13-17 November 2019.

## Conference Proceedings

**Labuschagne, M.T.** 2019. *Proteomics in wheat gluten research: where are we standing and where are we going?* In: *Proceedings of the 13<sup>th</sup> International Gluten Workshop*. Mexico City, Mexico, 14-17 March 2018. C.Guzman (Ed). University of Cordoba Press. pp. 11-13.

**Lindeque, R., Van Biljon, A. & Labuschagne, M.** 2019. *Matching opposites: defining the association between grain yield*

and protein content in South African wheat. In: *Proceedings of the 13<sup>th</sup> International Gluten Workshop*. Mexico City, Mexico, 14-17 March 2018. C. Guzman (Ed). University of Cordoba Press. pp. 75-77.

**Mbuma, N.W., Zhou, M.M. & Van der Merwe, R.** 2019. *Determining the breeding values of parental genotypes of sugarcane for biomass yield*. In: *Proceedings of the 41<sup>st</sup> Annual Conference of the Australian Society of Sugar Cane Technologists (ASSCT 2019)*. pp. 317-321.

**Tóth, B., Moloi, J., Van Biljon, A., Steyn, C. & Labuschagne, M.** 2019. *The effect of fertilization level on the quantity of high molecular weight glutenin subunits in two South-African spring wheat cultivars*. In: *Proceedings of the 13<sup>th</sup> International Gluten Workshop*. Mexico City, Mexico, 14-17 March 2018. Guzman, C. (ed.). University of Cordoba Press. pp 81-83.

## STAFF (2019)

**Head of Department:** Prof L Herselman

### Bloemfontein Campus

**Professors:** Prof MT Labuschagne and Prof WJ Swart

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

**Senior Lecturers:** Dr WHP Boshoff, Dr GJ Marais, Dr A Minnaar-Ontong, Dr L Mohase, Dr MJ Moloi, Dr GP Potgieter, Dr A van Biljon and Dr R van der Merwe

**Lecturers:** Dr ME Cawood, Dr M Jackson, Dr L Joubert, Dr NW Mbuma and Dr AC van Aardt

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

**Junior Lecturer:** Dr A Maré

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

**Affiliated Associate Professor:** Prof M Zhou

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

**Mentor:** Prof L Scott

**Programme Director:** Prof B Visser

**Chief Officer - Professional Services:** Ms CM Bender

**Officers - Professional Services:** Ms M Pienaar and Mr HP Pretorius

**Senior Assistant Officers:** MP Ms Mbingeleli and Dr C Steyn

**Officer:** Ms S Geldenhuys

**Assistant Officer:** Ms Z van der Linde

**Messenger:** Mrs D Jansen

**Cleaners:** Mrs NH Dlamini, Mrs NS Macwili and Mrs LHA Molale

### Qwaqwa Campus

**Associate Professor:** Prof AOT Ashafa

**Senior Lecturers:** Dr LV Komoreng (Subject Head – resigned) and Dr S Steenhuisen

**Lecturers:** Dr PJ Mojau, Dr R Ngara and Mr RT Pitso

**Academic Facilitator:** Ms D Mosea

**Research Associate:** Prof RO Moffett

**Officer - Professional Services:** Mr NP Mzizi