Faculty of AgriSciences
ANNUAL REPORT 2012

UNIVERSITEIT
STELLENBOSCH
UNIVERSITY

CONTENTS

PREFACE

In 2012 the Faculty again performed well on most of the University's strategic management indicators. Our emphasis remains on quality teaching and applied research in agricultural sciences and related domains. To continue attaining this we had to stem our recent growth in student numbers to focus on quality of output in terms of the success rates of our students, and on enhancing our postgraduate performance. We have managed to sustain academic output whilst incrementally improving our financial sustainability.

In addition we made important contributions to the HOPE Project through the Stellenbosch University Food Security Initiative and the Standard Bank Centre for Agribusiness Leadership and Mentorship Development.

The Faculty of AgriSciences comprises 11 departments: Agricultural Economics, Agronomy, Animal Sciences, Conservation Ecology and Entomology, Food Science, Forest and Wood Science, Genetics, Horticultural Science, Plant Pathology, Soil Science, and Viticulture and Oenology. Several research institutes, centres and chairs resort under these departments.

Our research profile is progressing steadily, as we are benefitting from our relations with industry bodies and government. Our faculty now has four government-funded research chairs as part of the South African Research Chair Initiative (SARChI) – in postharvest technology, plant biotechnology, meat science and wine biotechnology. The accelerated outputs achieved in conservation ecology, food science, animal sciences and plant pathology are testimony to our advances in both traditional and emerging fields of study. Our postgraduate emphasis brought unprecedented numbers of master's and PhD graduates.

We continue to maintain productive relations with the public sector, including the Departments of Science and Technology, Trade and Industry, and of Agriculture, Forestry and Fisheries, as well as with the Agricultural Research Council and several other bodies.

As a result, our third-stream income continues to grow. We also maintain good relations with agricultural industries, which generously fund research programmes or match state funding in our Faculty.

Our strategic association with the Elsenburg Agricultural College has moved from strength to strength. Our Faculty now has seating on the Elsenburg Council. We thus have grown into the role of advancing academic quality through various forms of academic and professional exchanges without affecting their autonomy. Our collaboration with the Western Cape Department of Agriculture remains a priority.

Our diversity profile shows a gradual improvement among students and academic staff. Black students now constitute more than 20% of undergraduate numbers, and more than 30% of postgraduates. Staff appointments from the designated groups also enhanced our diversity profile, but more could be achieved at senior levels. Our efforts to entice learners to the agricultural sciences through schools partnerships are beginning to show dividends as we recruit more students from the designated groups. Postgraduate students from other African countries have become a significant component of our student body and also serve to extend our African footprint.

AgriSciences is committed to the development challenges of our time and pays much attention to community interaction initiatives. These relate to poverty alleviation, food security, biodiversity, sustainability, the rural economy, postharvest technology, pests and diseases, water management, food processing, rural development and the agribusiness complex. Several national and international meetings and conferences have been hosted on our campus and supported by staff in the various agricultural disciplines.

Our marketing efforts in the year under review included industry liaison, a dynamic first-year welcoming programme, schools programmes, recruitment drives, dedicated bursaries, fundraising events, alumni events, student achievement ceremonies, and an annual staff day for all our valued employees. Student support is a high priority and special attention is paid to students with learning, language, social and personal challenges. Through classroom and wider engagements our administrative and academic staff remain in touch with the special needs of our students.

The Faculty has extended its global network of collaboration to more universities and research institutes in various other African countries and in the East, where our academic interests have continued to grow. Our staff and students have gained tremendously from such international exchanges. Renowned scholars from abroad continue to grace our campus and enrich our academic environment. Several international staff appointments also served to enhance our academic offering and international exchanges.

Our staff and students remain our greatest assets. Many of our senior staff play strategic and pivotal roles in providing thought leadership to agricultural industries and the public sector, aimed at pushing knowledge and social frontiers. Our students are encouraged to join this tradition.

Prof Mohammad Karaan

Dean: Faculty of AgriSciences

STUDENT STATISTICS

Degrees awarded 2012*

BAgric	82
BAgricAdmin	10
BSc Conservation Ecology	28
BSc in Forest and Wood Science	9
BSc in Food Science	22
BScAgric	62
HonsBAgricAdmin	3
HonsBSc	8
HonsBSc in Forest and Wood Science	2
MSc	1
MSc Conservation Ecology	6
MSc in Forestry	4
MSc in Food Science	10
MScAgric	42
PhD	7
PhD (Agric)	14
PhD (Forestry)	1
PhD (Food Science)	4

* 2012 statistics calculated according to degrees awarded during the December 2012 and March 2013 ceremonies

TOTAL 315

Department of

AGRICULTURAL ECONOMICS

Overview

The Department of Agricultural Economics was established in 1925, with Prof JFW Grosskopf as first chairperson. The first BScAgric graduates completed their studies in 1926 and the first Master's graduates in 1930. Prof Grosskopf was succeeded in 1935 by Prof FR Tomlinson. One of the better known of the department heads after Prof Grosskopf is, of course, Prof Eckart Kassier (1965–1992), who was appointed as chairperson in 1965. He has had an abiding influence on agricultural policy in South Africa, largely as a result of his chairpersonship of the Kassier Committee of Inquiry into the Marketing Act in 1992. After the publication of the Committee's findings, there was some rearguard action to salvage some of the 'control' of the old control system, but the logic of Prof Kassier's report was devastating and the final dissolution of the old system was inevitable.

Prof Kassier was also granted the opportunity to implement his own proposals when, after his retirement from the Department, he was asked by the new government to become the first chairperson of the new National Agricultural Marketing Council.

Prof Kassier's great innovation at Stellenbosch was the introduction of the three-year BAgric Management degree, and its metamorphosis into the BAgricAdmin degree in 1978. The argument at the time was that, if economists, business economists and transport economists could be adequately trained within three years, this could surely also apply to agricultural economists focusing on management aspects. A BComm degree, with the option of agricultural economics as one of the major subjects, was also introduced in the late 1970s. The combination of agricultural economics and other agricultural disciplines (such as agronomy, horticulture, viticulture and animal science) as major subjects for the four-year degree was also introduced.

Activities and Achievements

The Bureau for Food and Agricultural Policy

The Bureau for Food and Agricultural Policy (BFAP; www.bfap.co.za) is a virtual network linking individuals with multidisciplinary backgrounds to a coordinated research system that informs decision making within the food system. The core analytical team consists of researchers who are affiliated with the Department of Agricultural Economics, Extension and Rural Development at the University of Pretoria, the Department of Agricultural Economics at Stellenbosch University, and the Directorate of Agricultural Economics at the Provincial Department of Agriculture, Western Cape. BFAP is the first of its kind in South Africa and has become a valuable resource to government, agribusiness and farmers by providing analyses of future policy and market scenarios and measuring their impact on farm and firm profitability.

Every year, BFAP produces an outlook of South African agricultural production, consumption, prices and trade trends for the next decade. This outlook is based on assumptions about a range of economic, technological, environmental, political, institutional and social factors. It is generated by the BFAP sector model, which is an econometric, recursive, partial equilibrium model. For each commodity, the important components of supply and demand are identified, and equilibrium in each market is established by means of balance sheet principles where demand equals supply. A number of critical assumptions have to be made for baseline projections. One of the most important assumptions is that average weather conditions will prevail in South Africa and around

the world; yields therefore will increase constantly over the baseline as technology improves. Assumptions with respect to the outlook for macroeconomic conditions are based on a combination of projections developed by the OECD, IMF and the World Bank. Baseline projections for world commodity markets are taken from the OECD-FAO Aglink Cosimo model and the FAPRI 2009 US and World Agricultural Outlook. Once the critical assumptions are introduced into the model, the outlook for all commodities is simulated within a closed system of equations. This, for example, implies that any shocks in the grain sector are transmitted to the livestock sector and the biofuels sector, and vice versa. The baseline is launched annually at prestigious conferences in Pretoria and Stellenbosch (and, as of 2012, also in Lusaka).

As early as 2009, BFAP, along with other regional policy institutes, recognised that although countries in the region are benefitting from the activities of emerging agricultural policy research institutes, their research activities were not coordinated, the institutions largely did not speak to each other or share information, and they had not collaborated on the common problems facing the region. As a result, a group of national institutions, through the coordinating efforts of Michigan State University, began informal discussions centred on the establishment of a regional network of policy institutions. By November 2012, the national policy institutions initiated the Regional Network of Agricultural Policy Research Institutes (ReNAPRI) in order to more effectively coordinate the national policy institutions, share data, collaborate on common problems facing the region and enable national policy makers to learn from the experiences of other countries in the region. The institutions involved include BFAP, the CEPPAG Project of Mozambique, the Centre for Agricultural Research and Development (CARD) in Malawi, the Tegemeo Institute at Egerton University in Kenya, the Department of Agriculture at the University of Kinshasa in the DRC, Bunda College of Agriculture in Malawi, Sokoine University of Agriculture (SUA) in Tanzania, and the Indaba Agricultural Policy Research Institute (IAPRI) in Zambia.

The overall goal of ReNAPRI is to contribute to increased agriculture sector growth and integration in the eastern and southern Africa (ESA) sub-region through active collaboration between independent national and regional research institutes. The network is built on strong collaborative links with international (e.g. Michigan State University, Missouri State University, FAO) and national universities and other regional networks, and will draw upon these links to respond to particular

The presidents of the Agricultural Economics Association over the past 30 years gathered in Pretoria.

analytical requests as needed. Therefore, the network seeks to strengthen collaboration among national policy institutes in the region to provide relevant and timely national and regional policy support to stakeholders such as governments and Regional Economic Communities (RECs).

Dr Jan Lombard is the project leader of the BFAP research modelling for apples and pears, as well as for table grapes. The two industry partners, Hortgro Services (SAAPPA) and SATI, made financial contributions to these respective research projects. The information generated by the medium- to long-term projections from these models can be utilised on different levels and by various role players in quantitative analyses and in evaluating scenarios for the different industries, and for typical farms in various production regions. Dr Lombard is responsible for the annual maintenance, updating and application of the farm-level FinSim model of BFAP for apples and pears. These farm-level FinSim models are linked to the BFAP macromodel and the BFAP sector-level model, and are applied to simulate and project various performance measures for typical farms in various apple and pear production regions. This is one of the Department's community interaction projects, since the producers can incorporate findings into their strategic planning.

Grafting a strawberry plug plant as an alternative to the use of methyl bromide.

The annual launch of the BFAP agricultural outlook for various agricultural commodities is another community interaction project. The launch is hosted in the Western Cape in conjunction with the launch in Pretoria, with the express purpose of catering to the specific needs of the producers, agribusinesses and other role players in the Western Cape. Other community interaction projects include the JADAFA project to promote and develop bi-directional trade between South Africa and the rest of Africa, and to increase agricultural and agro-industrial investment and partnerships in Africa; and the Winelands District Municipality Bio-energy Project, which is aimed at determining the viability of wood production to provide fuel for bio-electricity conversion plants.

Other Activities

Prof Nick Vink was inducted as a Fellow of the American Association of Wine Economists and an Honorary Life Member of the International Association of Agricultural Economists during 2012. Two of his publications also took second prize at the annual conference of the Agricultural Economics Association of South Africa: one for the (second) Best Article in *Agrekon* ('Agricultural Economics: an esoteric or exoteric science?' *Agrekon,* Vol. 51 No. 2, pp. 97-118) en one for the (second) Best Article Published by a Member of the Association ('Food security and African agriculture.' *South African Journal of International Affairs,* Vol. 19 No. 2, pp. 157-177). He also attended the 6th Annual Conference of the American Association of Wine Economists in Princeton, New Jersey, where he read a paper together with Karl Storchmann and Britta Niklas entitled 'Fair trade wine prices?'

The FR Tomlinson Commemorative Lecture of the Agricultural Economics Association of South Africa (AEASA) was hosted by the Department at the Spier Wine Estate, with Dr Dirk Troskie (lecturer extraordinary) as speaker. He argued that South Africa's Constitution bestows certain decision-making and legislative powers on provinces. As a result there is scope for agricultural economists to engage in developing province-specific policy options for the agricultural sector.

Teaching staff took part in several other national and international conferences and forums. Prof Theo Kleynhans attended the International Seminar on Renewable Energy in a Rural and Urban Context in Jevra, District Hisar, Haryana, India in April. He presented a paper titled 'Determining the most viable woody biomass based bioenergy system in the Western Cape, South Africa, using LCA, MCDA, MPB and GIS'. Lulama Traub attended the 28th International Association of Agricultural Economists in Brazil and presented a paper on 'The role of government in levelling the playing field: The case of the South African milling industry'.

Alumnus Dr Dirk Troskie delivers the 2012 FR Tomlinson Commemorative Lecture.

Research

The most important initiative under the banner of BFAP was a report about the sector determination and the minimum wage in agriculture. This report, which raised substantial debate and was praised for its impartiality, was commissioned by the fruit industry, the labour unions and the government. It is the first time that the affordability of specific wage levels in farming was contrasted with the ability to provide a nutritious diet for farm worker families at these wage levels.

Clemens von Doderer finished his PhD study with Prof Theo Kleynhans as his supervisor. This study was done in the Winelands District municipal area and showed that bioelectricity can be generated profitably from wood harvested from short-cycle plantations. Following the life cycle analysis (LCA) approach, 37 lignocellulosic bioenergy systems, encompassing different combinations of type of harvesting and primary transport, type of pretreatment (comminution, drying, and fast pyrolysis) and location thereof (roadside or landing of the central conversion plant), type of secondary transport from the roadside to the central conversion plant, and type of biomass upgrading and conversion into electricity, were assessed against five financial-economic criteria, three socio-economic potential criteria and five environmental impact criteria. The quantitative performance data were then, as part of the multi-criteria decision analysis (MCDA) process, translated into a standardised 'common language' of relative performance. An expert group attached weights to the considered criteria using the analytical hierarchy process (AHP). The 'financial-economic viability' main criterion received a weighting of almost 60%, 'socio-

Prof TE Kleynhans with Clemens van Doderer, who received his PhD.

economic potential' received a weighting of nearly 25%, and 'lowest environmental impact' received around 16%. Taking the prerequisite of financial-economic viability into consideration, the preferred option across all areas of the Cape Winelands District Municipality (despite various levels of productivity) comprises a feller-buncher for harvesting, a forwarder for primary transportation, mobile comminution at the roadside, secondary transport in truck-container-trailer combinations and an integrated gasification system for the conversion into electricity. Alternatively, fast pyrolysis can be used to produce bio-oil from the wood.

Dr Jan Lombard is the supervisor for the PhD study of Hamman Oosthuizen on the modelling of the financial vulnerability of farming systems to climate change in specific regions of South Africa. A paper on this topic was presented in November 2012 at the SANCID symposium on 'Irrigation in a changing environment'. Dr Lombard took the initiative of incorporating apples and wine grapes into the international AgriBenchmark project, which is managed from the Thunen Institute of Farm Economics in Braunschweig, Germany. Dr Lombard headed discussions in this regard between scientists from Hortgro Services, Vinpro, the Department of Agriculture (Western Cape), farmers and three German scientists from the Thunen Institute during September 2012. Dr Lombard is also involved in a project that investigates the cost implications at farm level of EU regulations on the environment and food safety.

Postgraduate students enjoy a wine tasting with Jan "Boland" Coetzee on his farm, Vriesenhof.

Time to relax.

STAFF

ACADEMIC

Dr WH Hoffmann (Farm Management)
Prof TE Kleynhans (Resource Economics)
Dr JP Lombard (Production Economics)
C Punt (International Trade, Macroeconomic modelling)
LN Traub (Agricultural Development)
Prof N Vink (Chairperson; Agricultural Policy)

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Prof L d'Haese
Dr DB Louw
Dr TS Mkhabela
Prof J Piesse
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Department of

AGRONOMY

Introduction

If predictions of the growth of the world population are correct, global food production will have to be doubled within the next 40 years. Like most other countries on the African continent, South Africa is already importing large volumes of important food crops, such as wheat, as well as plant oils for human consumption, and sharp increases in the production of these crops will be needed. However, the increase in food production must be attained without a negative effect on the environment. Agronomists therefore face the formidable challenge of increasing the production of most food and fibre crops consumed and utilised by people and livestock in the face of obstacles such as climate change, dwindling water supplies and pesticide resistance. In addition, increasing amounts of field crops are used annually to produce biofuels. The mission of the Department of Agronomy therefore is to focus on the development of technologies for sustainable increases in food production through relevant research projects, and the transfer of these technologies through teaching, presentations and publications at the scientific and semi-scientific levels. The structuring of the Department into various disciplines facilitates research, teaching and community service.

A wheat field contaminated with Bromus oliandrus*, a weed that is resistant to some herbicides.*

Agronomy students visit a producer of potato minitubers in a greenhouse.

Potato minitubers being cultivated aeroponically as part of an MSc project in the Department of Agronomy.

Overview

The Department's research is focused on soilless production

Wheat is the most important agronomical cereal in the winter rainfall region.

systems; climate management in greenhouses used for vegetable, herb and flower production; sustainable production systems for winter cereals and oilseed crops; and the management of herbicide resistance in field crops. With the emphasis on sustainability, all research projects strive to minimise inputs such as water (greenhouse production), nutrients (greenhouse and field production) and pesticides (greenhouse and field production), while still maintaining and increasing productivity. The main contributors to research projects through funding are the Protein Research Foundation (PRF) and the Winter Cereal Trust. Other contributors include Potatoes South Africa, which sponsored research on sustainable production methods for potatoes, Kynoch Fertilizer, which sponsored the chemical fertilisers for the greenhouse research projects, and Sakata and Hygrotech, which sponsored vegetable seeds.

Training in agronomy provides students with the skills to deal with the sustainable production of field crops, pastures, vegetables and greenhouse crops – skills essential to providing innovative solutions to these challenges. In 2011 an integration process that aims to provide Agronomy and Horticulture students with more exposure to the two disciplines was initiated. The two disciplines were mutually exclusive in the past, which meant that Agronomy students could not enrol for Horticulture modules and vice versa, but since 2011 students in both disciplines may attend third-year modules of the other discipline, with the result that students in both disciplines now have a broader field of knowledge. The integration was completed in 2012, when the students in both disciplines shared two fourth-year modules.

In 2012, scientific contributions were made at the Combined Congress hosted by the Soil Science, Weed Science, Horticultural Science and Crop Science Societies in Potchefstroom, and at the African Society of Horticultural Science Congress in the Kruger National Park. Estelle Kempen went on a study tour to Chile to investigate and compare alternative greenhouse production systems and discuss tulip production in the two countries. Prof André Agenbag was honoured by the South African Agricultural Writers Association for his contribution to the grain industry by being voted the Agricultural Scientist of the Year for the Western Cape in 2012.

Prof André Agenbag of the Department of Agronomy – the Western Cape Agricultural Scientist of the Year.

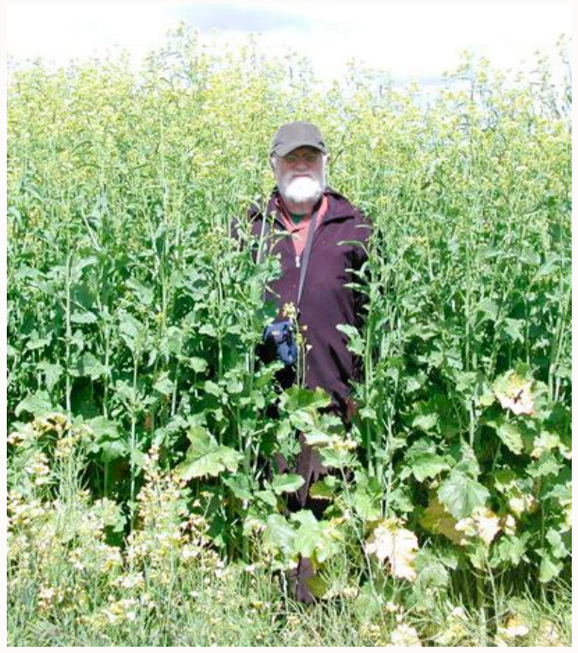
The Department is also closely involved with the industry. Members of the Department are involved in the following institutions: Protein Research Foundation (Prof André Agenbag and Dr PJ Pieterse), Winter Cereal Trust (Prof André Agenbag), National Small Grain Cultivar Evaluation Task Team (Prof André Agenbag), Canola Planning Task Team (Prof André Agenbag), Canola Work Group (Prof André Agenbag), ARC Small Grain Institute Research Task Team (Prof André Agenbag), Intensive Agriculture South Africa (IASA) (Estelle Kempen), Herbicide Resistance Action Committee (Dr PJ Pieterse), South African Society of Crop Production (Estelle Kempen), Southern African Weed Science Society (Dr PJ Pieterse), and Potatoes South Africa (Estelle Kempen).

Partnerships also exist with the ARC (Small Grain Institute, Bethlehem and Infruitec-Nietvoorbij, Stellenbosch) and the Department of Agriculture: Western Cape.

Research

In the disciplines of winter cereals and oilseed crops the focus is on optimal fertilisation levels of wheat and canola, as well as on the long-term effect of soil tillage methods and rotational cropping systems on soil fertility and subsequent wheat and canola productivity and quality. In a project funded by the Winter Cereal Trust, differences in soil chemical and physical characteristics were used to develop a mathematical model to predict the N-mineralisation potential of the soil. In a follow-up study, the efficiency of different application methods and nitrogen fertiliser rates are being evaluated at four localities in the Swartland and Ruens. A PhD(Agric) student was also involved in a study on the N and S requirements of canola (Wonder Ngezimana). MScAgric student Japie Wiese studied the effect of crop rotation and the method of tillage on the development, yield and quality of wheat, and in an ongoing study Beverley-Anne Joseph is studying the effect of sprout management on hops production. MScAgric student John Kadende is studying the effect of paraffin on the germination of several crop species because claims have been made in the past that paraffin could protects seeds and seedlings from predation by insects and animals.

In the discipline of weed science, the main focus is on the herbicide resistance of weeds and the management thereof. Seed and plant samples received from farms



*A lecturer among mustard plants (*Brassica *spp.), a promising alternative crop in the winter rainfall region.*

Agronomy students during a practical in a canola field.

Canola is a crop that is increasing in popularity in the winter rainfall region.

where herbicide efficacy has not been satisfactory were tested for herbicide resistance by Dr PJ Pieterse. In a project funded by the PRF the effect of sowing density of canola on the crop's weed suppression ability was studied. The objective of these studies is to identify alternative techniques to weed management by chemical control that can be used in conjunction with chemical control in an integrated weed control programme. Integrated weed control programmes can decrease reliance on herbicides, thereby reducing herbicide use, which can lead to a cleaner environment and a longer life for the herbicides – in short, increase sustainability in cropping systems. Bontleng Molefe (MScAgric student) is studying different herbicide mixtures that can be used to obtain satisfactory weed control in GM canola.

In the discipline of pasture science, Carien Bester is conducting an MScAgric study on the Elsenburg Experimental Farm to investigate optimal nitrogen fertiliser applications on three different planted pastures, viz. a pure grass mixture, a grass/clover mixture and a grass/lucerne mixture. This project is being carried out in conjunction with Dr Johan Labuschagne of the Department of Agriculture: Western Cape and is funded by the Western Cape Agricultural Research Trust.

The research emphasis in the discipline of intensive plant production systems is on improving the efficiency of resource use. Research is currently being conducted to investigate the water and nutrient use of various greenhouse crops to enable an increase in the application efficiency of water and fertilisers and also to enable the re-use of drained nutrient solutions. A re-circulating hydroponic system for growing tomatoes has been implemented at the experimental farm and is currently being tested and adjusted as part of Estelle Kempen's PhD study. In another study, the effect of additional

Spraying herbicide as part of a weed control project.

A postgraduate Agronomy student enjoying the evaluation of weed control trials in the field.

Mixed clover pastures are an important feed source for cattle in the winter rainfall region.

Weed control trials carried out in the field are an important source of information on sustainable weed management systems.

Medic pastures are an important feed source for sheep and other livestock, and a good rotation crop in wheat production systems.

lighting on the out-of-season production of greenhouse tomatoes has been studied. These trials will be repeated with other high-value crops to determine the feasibility of local year-round production in greenhouses. MScAgric students Geline Derbyshire and Steve Tshishola are studying the effect of different nutrient mixtures on the marketability and vase life of local greenhouse-grown tulips and the effect of different nitrate and calcium concentrations on the production of aeroponically grown seed potatoes respectively. Research is also being conducted for Potatoes South Africa to determine the effect of different calcium and boron application rates during crop growth on the quality and disease resistance of tubers during storage. In conjunction with this, monitoring of the irrigation water quality of some of the Sandveld potato farmers has been initiated to determine whether this could have an effect on the availability of calcium in the soil. Trials were also done to compare different organic production/ fertilisation practices, including the use of vermicompost, to compare crop yields as well as the plants' resistance to pests and diseases.

Community Interaction

The Department of Agronomy is involved in various projects aimed at technology transfer and the support of local producers and the community as a whole. These include lectures at the Roodebloem pre-planting information day and Langgewens "SKOG" day to provide information to commercial and developing producers regarding the fertilisation of crops. Weeds brought in by the agricultural community are regularly tested for resistance to herbicides. Various cultivar evaluations and other trials are conducted on a continuous basis for seed, chemical and other agricultural companies. These include trials on both the experimental farm and at other

Hydroponically cultivated tomatoes in a green-house provide higher production per unit area.

Flowers such as tulips can be cultivated successfully in greenhouses.

An MScAgric student in Agronomy examines aeroponically cultivated potato minutubers for his project.

Agronomy students visit a potato pack-house in the Ceres district during a practical tour.

localities in the region, and these trials are also incorporated into farmers' days and other public training sessions, including the annual Intensive Agriculture South Africa (IASA) symposium, which is attended by greenhouse producers from around the country. The staff frequently provide guidance (free of charge) to producers and prospective producers and also to local school children who are involved in projects such as the Eskom Expo for Young Scientists.

Community outreach projects include support to a project where deaf people will be trained in agriculture, a vegetable garden project where vegetables are provided to a soup kitchen on the Cape Flats, and a project in which vegetables and protein are supplied to poor communities by way of a low-cost recirculating system.

Through close collaboration with ASNAPP (Agribusiness in Sustainable Natural African Plant Products), a registered NGO, the Department of Agronomy is striving to help create and successfully develop African agri-businesses in the horticultural sector in several African countries, such as Senegal, Ghana, Rwanda, Zambia, Malawi, Botswana, Mozambique and Liberia. ASNAPP has worked with several farmer groups in Southern Africa on the production and sale of various vegetables to identifiable market outlets. Highlights of the past year include the following:

- Through interventions made in Livingstone, Zambia, ASNAPP generated sales of various vegetables at farm gate for smallholder growers to the value of US$1.5 mil during the year. This accrued from produce being sold to market outlets in the region, especially Sun International.
- ASNAPP presented a successful Regional Postharvest Training Workshop (Postharvest Physiology and Technology of Horticulture Crops) in Zambia in collaboration with Stellenbosch University. The workshop was attended by researchers, farmers, buyers and extension officers. A total of seven Southern and Eastern African countries were represented at the workshop.
- ASNAPP's flagship greenhouse project in the Northern Cape received their GlobalGAP certificate and was rated at 97.4%. They successfully marketed about R900 000 worth of cucumbers to Freshmark in Bloemfontein during the year.
- Technology transfer activities in South Africa, Namibia, Botswana and Zambia had a significant impact on farmer productivity.

Agronomy lecturers and postgraduate students plan a community vegetable garden in the Faure district.

AGRONOMY STAFF

ACADEMIC

Prof GA Agenbag (Winter Crops, Soil Tillage)
E Kempen (Greenhouse Production)
Dr PJ Pieterse (Chairperson; Weed Science, Pasture Science)

LECTURERS EXTRAORDINARY

Prof ALP Cairns (Weed Science)
Prof MB Hardy (Winter Crops, Rotational Cropping)
Dr E Reinten (Cultivation of Herbs)

ADMINISTRATIVE

S Alexander (Secretary)

TECHNICAL

RL Oosthuizen (Senior technician)
MF la Grange (Technical manager)

SUPPORTING

L Berner
S de Vries#
J Goosen
LR Nicke
KP Williams
FD Casper*
J Goosen#
M la Grange*
CF Oosthuizen#

**Permanent staff paid from outside funds*
#Temporary staff paid from outside funds

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Department of

ANIMAL SCIENCES

Overview

The Department of Animal Sciences was established in 1921 with the appointment of its first lecturer, Prof JHW Th Reimers, who was head of the Department from 1921 to 1952. The Department is one of the oldest of its kind in Africa and celebrated its 91st birthday this year.

The mission of the Department of Animal Sciences is to train animal scientists of excellence in order to fulfil the research, extension and development needs of South Africa so as to improve the quality of life of all its inhabitants.

The Department offers various graduate and postgraduate training programmes in the disciplines of monogastric and ruminant nutrition, development physiology and meat science, animal breeding, livestock management, reproduction physiology, and aquaculture. The respective programmes focus on production systems and management of a variety of domesticated animal species, including sheep and goats, dairy cattle, beef cattle, poultry, pigs, ostriches, and various aquaculture species.

Community Interaction

The various subdivisions within the Department are closely involved with the respective animal industries throughout the country, and technology/ information transfer normally takes the form of farmers' days and industry information days. The Department is currently developing short courses that range from basic information on various subjects pertaining to animal production, to more specialised courses for individuals who want to enrol for a postgraduate qualification.

Activities and Achievements

Staff and postgraduate students of the Department of Animal Sciences attended several national symposia, as well as national and international conferences during 2012. A total number of 37 and seven scientific articles were published in ISI-rated scientific journals and non-rated scientific publications respectively. Four PhD(Agric) and seven MScAgric degrees were awarded during 2012. The Chancellor's Medal was awarded to Megan North. The Department also maintains a number of cooperative agreements at the national and international level.

Most of the academic staff serve on University and/or scientific committees. **Prof K Dzama** is a panel member of the SADC Drought Monitoring Centre (Livestock Committee), convenor of the Animal Breeding and Genetics Forum, and serves on the South African Society of Animal Science Awards Committee. He also serves on the committee of the South African Red Meat Research and Development Trust Project, as well as the Professional Accreditation Committee of SACNASP. He further serves on the NAMC Red Meat Project steering committee and is convenor of the Cape Town Urban Agriculture Forum. He also serves on the University's Employment Equity Forum. **Prof LC Hoffman** serves on the University's Research Committee. He is the chairperson

Ms Megan Kim North, recipient of the Chancellor's Medal, the highest honour the University can bestow on a student.

of the Southern African Wildlife Management Association (member for life), an Associate Editor of the *Journal of the Science of Food and Agriculture*, and serves on the Editorial Board of *Meat Science*. **Prof CW Cruywagen** serves on the Editorial Committee of the *South African Journal of Animal Science* and is a member of various international committees. He is the current Vice-Chair and incoming Chair of the Agricultural Microscopy Division of the American Oil Chemists' Society, and serves on the International Relations Committee and the International Awards Committee of the American Dairy Science Association. He is also registered with the American Registry of Professional Animal Scientists. **Dr WFJ van de Vyver** serves on the University's Animal Care and Use Committee and is a member of the Academic Programme Committee. He is also on the Faculty of AgriScience's Welcoming and Marketing Committees, and is the guardian of the AgriSciences Student Association (ASA). He further serves on the Western Cape Branch of the South African Society for Animal Science. **Dr H Lambrechts** is the current secretary of the South African Reproductive Research Group, and secretary of the Western Cape branch of the South African Society for Animal Science. **Dr E Pieterse** serves as Chairperson of the Western Cape branch of the South African Society for Animal Science and on the Faculty of AgriScience's Timetable Committee.

The 110% Green Award was made to the alternative protein project by the local government. The project is undertaken in collaboration with AgriProtein.

Research

The research undertaken by the Department of Animal Sciences focuses on the nutrition, breeding and physiology of animals, as well as on animal products such as meat. The respective focus areas are as follows:

With regard to ruminant nutrition, the research is aimed primarily at the optimal utilisation of available raw materials to increase the production efficiency of cattle, sheep and goats. Research focuses on improving rumen metabolism and roughage fermentation rates. Aspects such as the effect of rumen pH and particle size on ruminal fibre digestion are being investigated, as well as combinations of different forage and energy sources to increase microbial efficiency. The use of exogenous fibrolytic enzymes to increase the digestibility of roughage has been a focus of research over the past five years. When the world was shocked by incidents of melamine-tainted pet foods (2006) and milk products (2008), the Department introduced a research programme to investigate melamine excretion pathways in animals. The NRF- and industry-funded research programme was completed successfully in 2012.

Regarding small stock the focus is on the efficient production of lambs and sheep in intensive and extensive production systems. For intensive systems, the research focus is directed to both the pre-weaning (creep diets) and post-weaning (finishing diets) age categories, with specific focus on optimising diets in terms of amino acid, non-structural carbohydrate, fibre and mineral content. Attention is also given to alternative feedstuffs, such as silage as a component of feedlot diets or medics grazing as a basis for the fattening of lambs for the market. Where possible, meat quality aspects are assessed, as this is of importance to consumer demands for healthy meat that has been produced in an environmentally friendly manner.

Research on monogastric animals focuses on different aspects of poultry nutrition and management that will ensure the development and health of the gastrointestinal tract and that therefore will have a long-term influence on production efficiency. With regard to management aspects, research focuses on the manipulation of the environment to improve the health and production of poultry.

Animal breeding research focuses on improving the accuracy of selection in the national commercial livestock herds, e.g. dairy cattle, beef cattle and sheep, by developing relevant genetic parameters and using them to develop new selection indices or improve existing ones. Another focus area is on the evaluation of farm animal genetics, using functional genomics. This involves the use of traditional quantitative genetics tools and molecular-based techniques to uncover the livestock genetic code. The main species being evaluated are pigs, chickens, ostriches and cattle. The research aims to characterise the genetic diversity (using molecular biology techniques) and population dynamics of these species in Southern Africa, which is then followed by phenotypic characterisation. The second stage aims to look for quantitative trait loci (QTLs) that are of economic importance to the respective industries. This research is being done in collaboration with the Agricultural Research Council (ARC), the Western Cape Department of Agriculture and the University of the Western Cape.

The meat science research team has focused on increasing output related to the University's Food Security Initiative as part of the HOPE Project. They follow a holistic research approach by researching intrinsic and extrinsic factors that influence the meat quality and composition of various animal species, using a gate-to-plate focus. This has resulted in strong inter-departmental links being formed with the animal nutrition research colleagues in the Department, as well as those situated at the

Dr Elsje Pieterse is involved in a project for the mass-rearing of fly and blowfly larvae in collaboration with AgriProtein, a Cape Town-based animal feed company. It is an excellent alternative to fishmeal, an important ingredient of animal feed, which is becoming increasingly more expensive and scarce since this protein source is being overutilised.

Elsenburg Animal Production Institute. The meat types that have been researched include red meat, poultry and fish, with a strong focus on the traditional farmed species. The research team is also renowned internationally for their research on exotic meats (game and ostrich).

Physiological research focuses on the influence of management on the physiology of both the reproduction and digestive systems, with both aspects that have a significant impact on the profitability of small-scale and commercial systems. Research focuses specifically on the interaction between nutrition and reproduction, and the use of assisted reproduction techniques to increase and optimise the cost-efficiency of commercial systems. One of the primary aims of the research programme is to make these techniques more accessible to emerging and commercial producers. The use of embryos that have been produced in vitro to genetically improve and thus optimise the cost-efficiency of dairy production systems, and to minimise the potential environmental effect of such systems, is one of the primary focus areas and is already being applied in the broader industry.

Animal breeding research focuses on improving the accuracy of selection in the national commercial livestock herds, e.g. dairy and beef cattle.

A training opportunity for Meat Science students.

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Department of

CONSERVATION ECOLOGY AND ENTOMOLOGY

Introduction

The former Departments of Conservation Ecology and Entomology merged on 3 March 2006, to form the Department of Conservation Ecology and Entomology (ConsEnt).

Departmental vision

"To be a world centre of excellence for teaching, research and technology transfer in the field of conservation of natural resources."

Departmental mission

"To undertake teaching, research and technology transfer in ecology, conservation and management of utilised landscapes and their surrounds."

By combining Conservation Ecology and Entomology we brought together a considerable body of teaching and research in the rapidly growing and important field of conservation of utilised landscapes and their surrounds. In principle, the focus of the Department is on the study and development of management plans for agricultural and forestry production, without compromising the natural viability of the agricultural land mosaic. Under this umbrella of conservation in the agricultural and forestry contexts, the range of expertise ranges from integrated pest management, the conservation of natural communities and the management of living resources to conservation policy formulation and technology transfer. The aim is to develop a forward-thinking, dynamic department with a distinct agricultural and forestry address. This aim contributes to meeting the demands of the outside world for trained personnel and research findings in the area of conservation production. In this regard, the joining of the two departments as ConsEnt brought together a naturally complementary set of expertise, which gives a much wider and more meaningful thrust to the conservation of natural communities while at the same time maintaining agricultural production.

Overview

The research focus in the Department of Conservation Ecology and Entomology is on two overlapping areas. These are area-wide pest management and conservation biology. Considerable progress was made in both areas in 2012. The use of entomopathogenic ('insect eating') nematodes for the control of moth pests received considerable attention under the leadership of Dr Antoinette Malan. This research sits side by side with the use of natural enemies such as parasitoids and ladybirds to control various pests in a way that does not affect the environment. This work is being spearheaded by Dr Pia Addison and Dr Ken Pringle. A further facet of area-wide pest management is the use of the sterile insect technique.

Ladybirds, such as the one shown here, are used effectively for pest control in the Seychelles. They are natural enemies of scale insects, which kill the native trees on the islands.

This involves irradiating the males, releasing them into apple orchards and allowing them to mate with the wild females. As the males are now sterile from the radiation, there are no offspring from the matings, with the result that there is a crash in the population level as there is no recruitment. Mr Matthew Addison has tested this in the field with great success. He has also developed a functional and operational commercial unit for doing this on the University's experimental farm.

This research on pest management is complemented by the work of Prof John Terblanche on insect physiology. John has been studying thermal stress in insects and has thrown considerable new light on how thermal tolerance determines the geographical distribution of insects. This research also has made inroads into understanding the weak spots of pests from a control point of view, giving pest management a new approach. Most of the work at Stellenbosch focuses on deciduous fruit and citrus, but work is also undertaken by Prof Des Conlong, who is a professor extraordinary in the Department, on sugar pests, especially the sugar cane borer moth.

The conservation work in the Department has wide implications right across a whole range of disciplines. Various staff have been exploring how perceptions among farmers and other stakeholders affect the realistic issues associated with conservation management. Ms Rhoda Malgas has undertaken social studies in relation to the production of rooibos tea. The point is that the tea must be produced without doing harm to the environment. Professor Karen Esler has also been active in social studies, as well as studies on the restoration of systems. She has paved the way for the more effective restoration of Karoo and fynbos ecosystems in the Western Cape. Dr Shayne Jacobs, in turn, has been studying the dynamics of Western Cape and Kruger National Park river systems, particularly with respect to the impacts of invasive alien plants that capitalise on our river systems. He has been unravelling why it is that these aliens can be so invasive and therefore so noxious.

Dr Francois Roets has made great progress in understanding the mutualistic relationships between fungi, plants and mites, as well as certain insects. He has shown just how important these interactions are, and that much of the world as we see it depends on understanding these mutualisms, where organisms working together enhance ecological function and evolutionary processes. Dr Sonja Matthee has also been working on interactions, especially between fleas and rodents, and has found how important these interactions are for driving the evolutionary development of both.

Dr Alison Leslie has been focusing on the ecology of various large vertebrates, from crocodiles and turtles to rhinos, to gain an understanding of how to maintain their populations at current levels.

Dr James Pryke and Prof Michael Samways, in turn, have been focusing on developing landscapes for the future, especially in the context of timber forestry, with particular focus on refining the effectiveness of large-scale ecological networks. Michael has also been working intensively on the restoration of the Seychelles islands.

Research

Conservation Planning and Management

Agricultural landscapes offer opportunities for integrating conservation into production activities. The Department worked with producers in the Cederberg to identify local insect pests and novel ways of managing them in rooibos plantations. The "pragkewer" beetle was identified as destructive. Natural pest control is favoured widely by most of the farmers, who manually remove insects and make repellent sprays from strong-smelling plants.

The Department has assisted decision makers in implementing conservation activities, including how to prioritise Working for Water's alien plant-clearing activities, determine levels of sustainable plant use and maintain biocultural traditions. Research was also conducted in the Baviaanskloof World Heritage Site to examine how peoples' meaningful experiences of nature can be used to improve environmental education programmes.

Restoration Ecology and Landscape Ecology

Ecological restoration in the Department has several links to national research institutes and organisations (e.g. ASSET research, City of Cape Town, Working for Water, Centre for Invasion Biology, Robben Island Management). One project, on restoring natural capital, found clear evidence that restoration practitioners are failing to signal links between ecological restoration, society and policy, and are underselling the evidence of the benefits of restoration as a worthwhile investment for society.

The Department is concerned with bridging the 'knowing-doing' gap in invasion biology. Recent collaborative research investigated the extent to which invasion ecology literature contributes to the implementation of the knowledge generated by addressing aspects of management, policy and/or implementation; the impact of these papers is indicated by the number of citations they attract, and the geopolitical scale of focus. These findings were then compared with the information needs of conservation practitioners. The knowledge base in the field of invasion biology was found to largely comprise research oriented towards 'knowing', while research aimed at strategically applying or implementing that knowledge is poorly represented in the scientific literature, and the scale of its emphasis is not local.

In the last decades, anthropogenic changes, including climatic change, pollution, invasive species and urbanisation, have impacted heavily on how species interact with their abiotic environment and on the services these ecosystems supply to people. Locally, changing water availability, modified fire regimes and land-use changes have impacted heavily on riparian ecosystems. A pernicious threat is woody invasive species, which have replaced many native species, disrupting water and nutrient cycles. An ongoing focus on understanding riparian ecosystem structure and function in the face of anthropogenic changes has provided new insights that will improve restoration activities in

Alison Leslie on an outing with wildlife officials in the Selous Game Reserve, Tanzania.

these sensitive ecosystems. Other research has investigated native riparian species for their potential value as species for restoration after alien control.

Invertebrate Conservation

With mounting concern for the loss of biodiversity and deteriorating ecosystem services, there has been an increasing push for research on improving the design and management of the landscape to improve conditions for 'the little things that run the world' – the invertebrates. Activities have taken place across South Africa and on certain Western Indian Ocean islands on the control of an alien ant; the conservation of pollinators in the fynbos; the conservation of invertebrates in the grassland biome; the development of new monitoring methods and the development of organic farming; the restoration of the Seychelles; and the improved development of monitoring methods to assess how successful conservation activities have been. One of the most astounding results has been just how well rare endemic species can recover when alien trees are removed, with dragonflies being particularly responsive. Organic farming also benefits indigenous biodiversity. Invertebrates are protected well when good-quality corridors are placed between patches of plantation forestry. A further development has been the design and implementation of an easy-to-use index for measuring freshwater health, which is now being used effectively across a wide range of water systems. A handbook providing the necessary information so that the methodology can be used widely is nearing completion.

The Black Emperor, one of the largest dragonflies in the world, reaching 13 cm in length, was recently discovered in large-scale ecological networks in forested areas in KwaZulu-Natal. This shows how sustainable forestry can contribute to the conservation of biodiversity.

Vertebrate Conservation

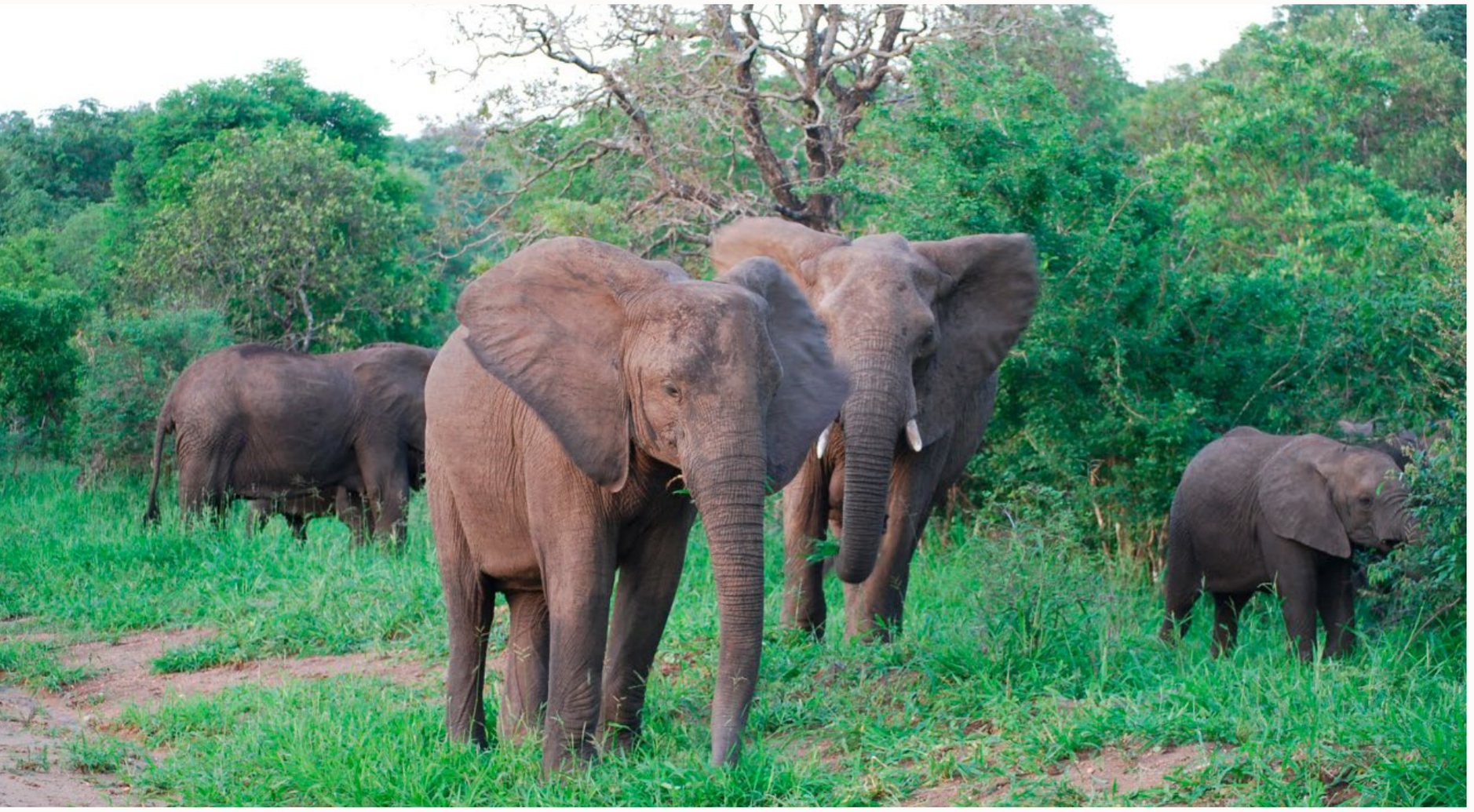
The vertebrate conservation group is involved in a number of exciting conservation projects in various parts of southern Africa. These projects compile management plans for Governmental Departments of Wildlife and other relevant wildlife conservation bodies, and in the case of the warthog, a sustainable-use programme for game and stock farmers in South Africa. The projects range from general ecology, physiology and behaviour to human-wildlife conflict issues, and focus on a range of species including crocodiles, various antelopes, sea turtles, rhinoceros, elephant and buffalo.

The newly established Malawi research programme is part of a trilateral Memorandum of Understanding between Stellenbosch University, the University of Malawi and African Parks (Pty) Ltd. The programme

aims to monitor, understand and manage the impact of large-scale mammal reintroductions at Majete Wildlife Reserve in Malawi. The research programme involves the exchange of graduate students and incorporates a large capacity-building programme in the Chikwawa District. This collaboration conducts and facilitates the development of research, training and extension among faculties, departments and centres of Stellenbosch University and the University of Malawi and the Directorates, Centres, Units and Stations of African Parks Majete.

Conservation of Symbioses

Life conquered the planet by networking. With increased global anthropogenic threats to natural environments, there are increased disruptions to interactions between various organisms. Many of these interactions, particularly those between smaller organisms, are not clearly understood. This research focuses on describing some of these interactions, as well as identifying anthropogenic influences on such specialised systems. One mandate of the group is to understand problems encountered concerning native tree health caused by mutualistic associations between insects and fungi. We also aim to understand the evolutionary principles underpinning these multi-organism interactions. For example, a new fungus was identified as a model organism to identify determinants of the spread of sexually transmitted diseases. Parasite research during 2012 focused on the effects of habitat fragmentation on parasite diversity and species assemblages on *Rhabdomys pumilio*. Studies on *R. pumilio* using evolutionary genetics of parasite taxa are ongoing and were extended to mites, lice and fleas associated



A young breeding herd of elephants in Majete Wildlife Reserve, Malawi.

with *R. pumilio*. Key research findings include novel rodent host-parasite associations and evidence that the fragmentation of natural vegetation has an adverse effect on host species diversity. At the same time, higher parasite abundances are generally recorded on host species that are able to survive and thrive in habitat fragments. Climate change and habitat transformation may thus have strong consequences for current biodiversity, with possible risks of disease transmission and the development of new diseases, especially where wildlife and domestic animals occur together.

Area-wide Pest Management on Tree Crops

Integrated pest management aims to integrate area-wide pest management in deciduous fruit, citrus and wine grapes. A multidisciplinary approach is followed in which various key research foci are utilised, e.g. basic research such as pest identification, advanced molecular methods, population dynamics, insect physiology and ecology, population monitoring, as well as applied research in the laboratory and in the field. Applied research includes the use of biological control agents for managing arthropod pests, postharvest control methods, and the optimisation of the sterile insect technique (SIT). This enables cost-effective decisions to be made about when and where to focus control efforts and therefore to manage pests sustainably while reducing the use of synthetic chemicals. Recent milestones include advancement in the use of entomopathogenic nematodes for controlling various insect pests. Novel methods have been developed for applying these nematodes in the field and on

Virgilia *deaths: Native* Virgilia *trees in the Table Mountain National Park are being killed by an exotic fungus. This is a major conservation concern that is studied by the symbiosis research group.*

fruit storage bins. By supporting basic research, our efforts have now shifted to in vivo and in vitro mass culture of nematodes for commercial application. Research on the applied aspects of the sterile insect technique of codling moth and the sugar cane stalk borer is well advanced. There has also been a focus on quarantine pests for which environmentally-friendly and effective mitigation measures are developed. Collaborative inputs regularly assist Plant Health in international negotiations with other plant protection organisations. Specific information obtained from these projects has been integrated into overall management plans and all information obtained to date has been widely disseminated among peer work groups.

Microbial Ecology Team: Part of the research team investigating the effect of multi-organism symbioses on native forest tree health.

Applied Physiological Ecology

There is increasing interest in the effects of temperature and water availability on insects. This arises from growing concern about the effects of climate change on biodiversity; invasive species movement; pest outbreaks affecting food security; and variation in zoonotic disease distribution and transmission risk. Applied Physiological Ecology research spans a range of interlinked topics of significance to biological and physiological diversity. This work explores the links between physiological processes and animal ecology and evolution in terrestrial environments, and focuses on a range of organisms of agricultural, evolutionary or medical importance. The research includes global climate change; physiological responses to environmental conditions; mechanisms underlying environmental tolerance; and comparative and integrative biology. Importantly, this work also focuses on the principles and applications of physiological ecology to broader issues such as the conservation of rare species and the management of outbreak or pest species. Significant progress through experimental and modelling approaches has recently been made in understanding tsetse fly responses to climate change. In addition, recent studies by postgraduate students in physiological ecology have contributed novel techniques to improve the field performance of laboratory-reared codling moth in the sterile insect technique programme operating in the Western Cape, and finally, several valuable insights into invasive fruit fly thermal biology and population dynamics.

Community Interaction

Initiatives undertaken in the Department, and spearheaded by Dr Shayne Jacobs and Mrs Rhoda Malgas, are used as a vehicle to demonstrate the close link between the health of the environment and human wellbeing to school learners. These initiatives take the form of visits to schools and visits by learners to the Department. The Department also links up with other role players, such as civil society and NGOs, to increase knowledge sharing between the University and holders of indigenous knowledge on the ecology of the region, adaptation to disturbances, the wise use of natural resources, and sustainable agriculture. The interaction is formalised by involving members of civil society in teaching. Students are required to carry out assignments and activities, the outcomes of which are designed to demonstrate interactive learning and improve overall student graduate quality in various ways.

This interaction is to the benefit of students of the Department, both undergraduate and postgraduate, as well as to the benefit of civil society and the University, and has already led to the establishment of more formal research links with local partners.

The Department has consolidated a monitoring, research and training collaboration with Robben Island Management. Currently, the island is listed as a UNESCO World Heritage Site and is a popular destination for domestic and international tourists wishing to visit the former prison that housed Nelson Mandela and other representatives of the anti-apartheid struggle in South Africa. With its long history of use, impacts on the island's biodiversity have been many and varied, but most significant to this collaboration are the introductions of invasive plant and animal species that have significantly altered the structure and function of the island's natural ecosystems.

We now monitor aspects of the recovery trajectory of the ecosystem. The results of the work done by students are already contributing to an understanding of the environmental management of the island. This exciting exercise in community interaction has prospects for educating the next generation of environmental managers through this research.

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Dr AT Knight (Conservation Planning)
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R Malgas (Sustainable Natural Resource Management)
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Department of

FOOD SCIENCE

Overview

The mission of the Department of Food Science is to be a nationally and internationally competitive centre of excellence in Food Science and to supply, through visionary education and innovative research, the South African food industry with cutting-edge technology, knowledge and environmentally friendly products and practices, as well as well-trained role players. The Department of Food Science has a strong research culture based on the application of fundamental scientific principles, and focuses on expanding our understanding of foods and biomaterials.
The research initiatives cover a range of topics including chemical, processing, sensory, microbiological and safety aspects.

The Department prides itself on fostering strong student-staff interactions and thereby creating a stimulating research environment. We attract significant research funding annually – a sign of both the high quality of research we undertake and the relevance of our postgraduate qualifications (MSc Food Sc, PhD (Food Sc) and DSc (Food Sc)) to the needs of today's global food industry. Consequently, the Department's building infrastructure recently was expanded to facilitate improved undergraduate and postgraduate training in food science. The new food science facility was officially opened on 18 April 2012.

Although the Department procures research funding and postgraduate bursaries, it still faces many challenges. The Department is still small in terms of human capacity, with only six academic staff, and we can still expand in terms of research equipment. However, the Department's success rate in terms of number of postgraduate students and research outputs clearly demonstrates the quality of the research and the commitment of the staff.

Activities and Achievements

The Department's research activities are structured in such a way that they cover a broad spectrum of areas within food science and technology, resulting in many interdisciplinary projects. Collaboration on research projects is interdepartmental – on the Stellenbosch University campus, with other national and international tertiary institutions and with science councils. The Department has bilateral research agreements with Sweden (Swedish University of Agricultural Sciences) and co-operation with the Hochschule Osnabrück – University of Applied Sciences (Germany) and the Norwegian Research Institute (Nofima). The food industry and government departments are strongly involved in the research activities, and partners include Distell, Büchi Labortechnik AG, the Winter Cereal Trust, South

Five new research laboratories, an expanded new sensory facility, cold storage rooms, work areas for postgraduate students, computer facilities for undergraduate students and a lecture hall with 126 seats, were officially opened at Stellenbosch University's Department of Food Science in April 2012. Left: Professor Russel Botman, Rector and Vice Chancellor of the University with dr Gunnar Sigge, Departmental Chair.

African Breweries Maltings (SABM), Caledon, Sasko Research and Development, Sensako, the Medical Research Council (MRC), Enviro Services, the National Departments of Agriculture, Forestry and Fisheries (DAFF) and Water Affairs (DWA), the South Africa Rooibos Council, as well as the Department of Agriculture, Land Reform and Rural Development, Northern Cape Province. A considerable amount of research support also emanates from the National Research Foundation, the Water Research Commission and Winetech.

The success of the Department's research activities is influenced greatly by the quality and dedication of its postgraduate students. In 2012 a total of 31 MSc students and 15 PhD students were registered in the Department. Three postdoctoral fellows were also part of the research projects. The postgraduate students and postdoctoral fellows came from Namibia, Zambia, Mozambique, Zimbabwe, Nigeria and Romania. A total of 10 MSc degrees and five PhD degrees were awarded in 2012, and 31 scientific articles were published in international journals. The Department's research was also presented at conferences, with 13 international and three national presentations. Academic staff undertook visits to the following countries for research-related purposes: Sweden, Latvia, Brazil, Ireland, Germany and the USA.

Microbial testing of sprouts.

Sarah Erasmus receives her Rector's Award for Excellent Achievement from Prof Arnold Schoonwinkel, October 2012.

Theresa Beelders and Prof Arnold Schoonwinkel during the Rector's Award for Excellent Achievement, October 2012.

Sarah Erasmus and Theresa Beelders were honoured with Rector's Awards for Excellence. Sarah was one of the top three undergraduate students in the Faculty, while Theresa received the SU medal for the top Master's student in the Faculty of AgriSciences. Dr Gunnar Sigge was invited to attend a two-week Expert Information Seminar on Wastewater and Waste Management in Munich, Germany from 6 to 19 May 2012.

Prof Marena Manley was invited to address the 2nd South African Conference on Chemometrics, held in Pretoria from 9 to 10 May 2012. Dr Gunnar Sigge was invited by the Institute of Food Technologists (IFT) to take part in their Strategic Retreat in Reston, Virginia, USA from 7 to 9 November 2012. The objective of the Retreat was to build on the IFT's commitment to their four strategic goals, which support their mission of ensuring a safe and abundant food supply for healthier people everywhere. Prof Manley, as Conference Chair, hosted AFRODATA 2012 – 2nd African-European Conference on Chemometrics in Stellenbosch from 19 to 23 November 2012.

Research

Food microbiology

The ***food microbiology theme*** focuses on the detection and identification of a diversity of microbial populations present in food products, including fruits, fruit juices, vegetables, cheese and other dairy products, cereals, meat and fermented foods. Traditional microbiological isolation and identification methods, as well as molecular techniques, are used to identify these microbes. Research is focused on spoilage microbes, food-borne pathogenic microbes and the microbes present during food fermentation (with a specific focus on milk fermentation), often using a non-culturing approach to ensure the detection of all viable, although often not culturable, microbes.

Members of the Department of Food Science at Stellenbosch University also have a keen interest in research on milk and milk fermentation and have completed various projects on the production of Kefir, a European fermented milk, and the microbes present during the fermentation process. Kefir differs from other fermented milk products in that it is not the result of the metabolic activities of microbes that are uniformly distributed throughout the milk. Fermentation of the milk is accomplished with various microbes grouped together in a cauliflower-like structure. At the end of the fermentation, the mixed microbial population can be recovered as a solid matrix, referred to as Kefir grains. We evaluated the microbial content of the Kefir grains using traditional microbiological techniques, as well as a non-culturing approach, and also preserved the grains and tested their activity over time in different packaging materials. Research has also been done on the safety of traditionally fermented milk products using milk contaminated with *Mycobacterium bovis*. The specific objective was to determine whether different fermented milks inactivate sufficient numbers of *M. bovis* to prevent the transmission of the zoonosis through contaminated dairy products.

Environmental theme

The ***environmental theme*** focuses on the impact of food processing operations on water usage, wastewater characteristics and treatment options. The application of anaerobic digestion technology

Polluted rivers pose threats to safe irrigation practices.

and the use of ozone and other pre-treatment techniques to improve the efficiency of wastewater treatment systems are also researched.

Water wastage – either the excessive use of water or the unnecessary disposal of large volumes of polluted wastewater – has been a research focus for many years because South Africa is increasingly becoming water scarce, while its population is steadily increasing. Sustainable food production to ensure food security means that more food needs to be produced and preserved, despite ever-dwindling water resources. Therefore research on water minimisation in food processing, wastewater treatment and recycling, and energy recovery from waste and wastewater is becoming increasingly important. Sustainable food and beverage processing, especially in the Western Cape, is crucial for job security, as this sector is a major economic contributor in terms of foreign exchange and job creation.

The research done in the Department focuses on minimising the water used in food-processing environments, although much research is also done on treating various food-processing wastewaters due to the fact that food processing cannot really be done without generating some wastewater. Anaerobic digestion technology, which utilises bacterial consortiums to degrade the organic pollution in the wastewater to carbon dioxide and methane, is a focus of study. The methane generated in this way can be recovered and is a valuable energy source that can offset some energy expenditure. Ozone and other advanced oxidation processes, like UV, can be used as a pre-treatment to anaerobic digestion. A benefit of ozone use is that it leaves no chemical residue in the water.

Berson UV system for the treatment of waste water.

Bottles are checked for safety and hygiene before use in the food and beverage industry.

A postgraduate student doing tests to ensure food safety.

Food safety

The ***food safety theme*** researches the occurrence, identity, survival and control of spoilage and potential pathogens in the pre- and post-harvest processing environment of a variety of foods. Emphasis is placed on the impact of water quality on the safety of agricultural products.

A research programme on the safety of agricultural produce was a national multidisciplinary effort led by Prof Trevor Britz of our Department. Other team members were from Food Science and Medical Virology at the University of Pretoria, Environmental Sciences at the University of Venda and Microbiology at the University of KwaZulu-Natal.

The research focused on investigating the links between irrigation water quality and food safety in commercial and subsistence agriculture. There is growing concern about the safety of agricultural produce that is consumed raw or after minimal processing. If irrigated products are contaminated by microbes they will affect the health of the consumer and have a negative impact on the country's national and international trading status. A better understanding of the presence, survival and decay rates of contaminating microbes is essential for the development of an efficient strategy that will assure the delivery of safe agricultural products to the local and export markets.

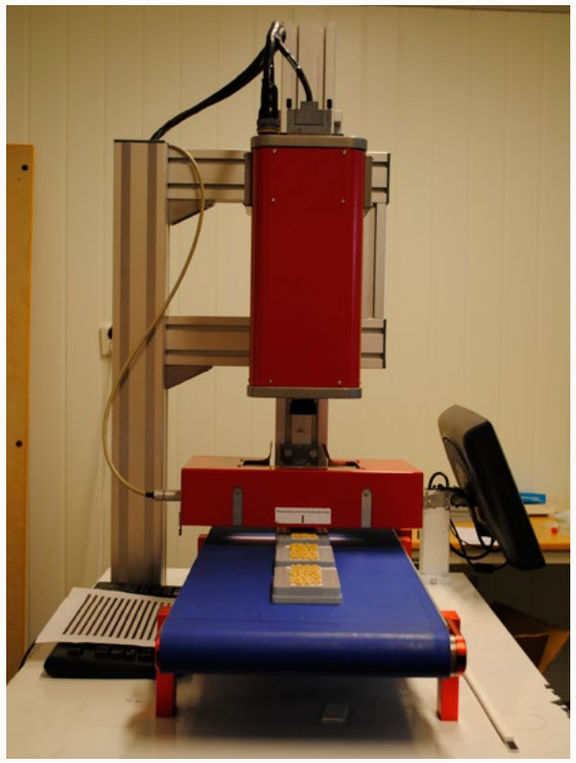
Our research over the last six years has shown clear evidence of poor-quality irrigation water and the risk of pathogens being carried over to agricultural produce. The health risks emanating from the use of such water are setbacks South Africa can ill afford in the present economic climate. The social consequences of the increased risk of disease are equally devastating, especially to the substantial proportion of the population living in poverty.

The success of the abovementioned national study has given rise to further funding from the Water Research Commission to do a scoping study on different on-farm treatment options to reduce the high microbial contaminant loads of irrigation water in order to reduce the related food safety risk. This project commenced in 2012 and will continue until 2016.

Vibrational spectroscopy

The ***vibrational spectroscopy theme*** focuses on the evaluation of bulk near infrared (NIR) spectroscopy and NIR hyperspectral imaging in conjunction with chemometric techniques for quantitative, qualitative and authentication studies of food and food products. NIR hyperspectral imaging research is possible at the Department due to researcher exchanges being funded by a South Africa-Sweden bilateral agreement. The work is done in collaboration with Prof Paul Geladi of the Swedish University of Agricultural Sciences (SLU).

NIR hyperspectral imaging is similar to taking a picture with a digital camera, which shows pixels and colours. In the case of hyperspectral imaging, however, each pixel is also linked to the sample's chemical composition, which provides a chemical map of the sample. This makes it possible to identify plant material that is visually similar but chemically different. Ongoing studies include the evaluation of the potential of NIR hyperspectral imaging to distinguish between different maize kernel hardness categories, as well as the detection of fungi on whole maize kernels before they are visible visually.



The UmBio Inspector provides us with a non-destructive method to analyse cereals.

Cereal quality

Between 25 and 33% of the total gross value of agricultural production in SA is from grain. The quality of grain determines profitability; hence economic growth requires the improvement of cereal cultivars. The improvement of quality monitoring is achieved through the optimisation of existing methods and the implementation of new techniques.

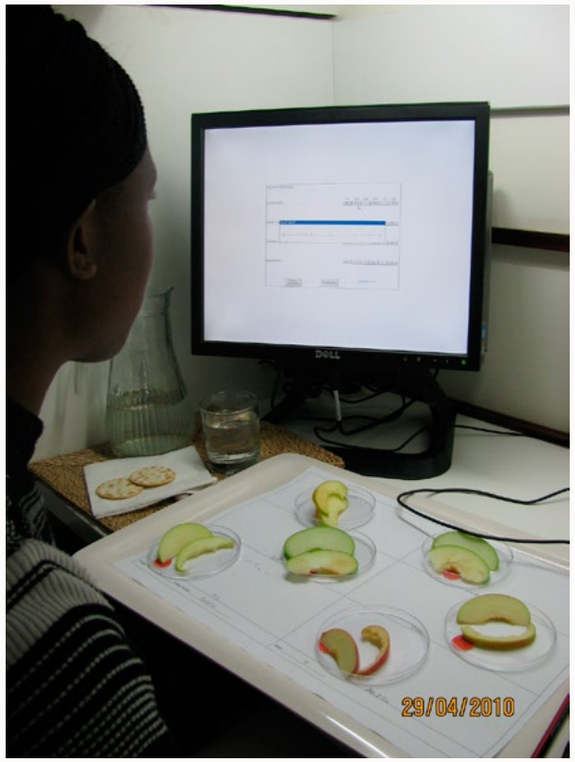
In the ***cereal quality theme*** we aim 1) to develop greater

understanding of the underlying factors determining cereal quality parameters, and 2) to develop rapid methods for the early identification of superior breeding lines. Cereal quality research projects are funded by the Winter Cereal Trust and the Maize Trust. The trusts also support students by providing grants for students working on cereal-related topics.

Sensometrics theme

Within the ***sensometrics theme***, which entails mathematical and statistical methods of analysis, research projects are usually multidisciplinary: chemical, sensory and physical attributes of food products are correlated.

In experimental sensometric studies, three pieces of information need to be linked to each other: information about the samples tested (sensory or extrinsic product attributes), consumer liking of the same samples (liking, choice or ranking) and additional information about the consumers (demographics, attitudes and habits). In this regard, fruitful research collaboration was established in 2012 between SU and Prof Tormod Næs, principal statistician at Nofima, an international food research institute in Norway. This collaboration resulted in novel research in which residual analysis was performed on preference data, resulting in new insights into the analysis of consumer preference data.



A postgraduate student busy with the sensory evaluation of a number of apple cultivars.

Rooibos tea samples kept in a waterbath to maintain the correct temperature for sensory analyses.

Community Interaction

Staff of the Department are involved in several community service actions. Several staff members acted as judges in the food science and technology category at the regional Expo for Young Scientists. Prof Britz was involved in an advisory capacity to the agricultural sector on the food safety risks associated with contaminated irrigation water being used for fresh produce. Staff of the Department are also involved in advisory capacities and for external moderation at other tertiary institutions offering food science and technology courses, and serve in professional industry-related associations. Dr Gunnar Sigge is currently the President of the South African Association for Food Science and Technology (SAAFoST) and also serves on the Joint Advisory Committee of the Food Technology Department and the Agri-Food Technology Station of the Cape Peninsula University of Technology (CPUT). Prof Marena Manley chaired, on invitation, the meetings of the respective wheat breeders with the baking and milling industry, as well as subsequent meeting of the Committee for the Evaluation of Wheat Breeding Lines.

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Prof M Manley (Near Infrared Spectroscopy, Grain Quality)
Ms N Muller (Sensory Science, Sensometrics)
Mr CC Ng'andwe (Cereal Science, Food Chemistry)
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Prof P Geladi (Swedish University of Agricultural Sciences)
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Department of

FOREST AND WOOD SCIENCE

Introduction

The Department of Forest and Wood Science (DFWS) has been in existence since 1932 and has awarded 890 BSc, 210 MSc, 42 PhD and 11 DSc degrees since then. The DFWS was tasked specifically with the enrichment of forest and wood science through basic and applied research, teaching at undergraduate and postgraduate levels, and community outreach. Committed contact with the country's forest and processing industries has been maintained and strengthened through the past 80 years.

Today the DFWS has developed on its original mandate and is recognised as an international leader in the forest and wood sciences. Teaching, research and development services are provided to a full spectrum of stakeholders, both locally and internationally, which include the South African and international commercial forestry sector, government and other public forestry branches, NGOs, and society. The DFWS hosts a small team of dedicated lecturers and researchers supported by knowledgeable and experienced technical and administrative staff. The DFWS's strength lies in the fact that it is the only tertiary education institution in South Africa to provide an educational offering at BSc, MSc and PhD levels in both Forest and Natural Resource Management and Wood Products Science. The union of these two major disciplines under one roof enables the DFWS to address the full forestry value chain, from forest establishment and silviculture, forest management, timber harvesting and transport, to secondary processing for bioenergy, lumber, furniture, and pulp and paper production.

Fish-eye view of 60 year old Euc. grandis *trees at the Langepan CCT planting trial.*

Students receive both theoretical and practical training during their studies. Here a student participates in an arboriculture course.

After eighty-one years the Department is still realising its original goals and has become the preferred supplier of world-class education, research and outreach in Africa to the benefit of all people and industries and society at large, with a primary focus on the sustainable management of tree-based natural resources and the processing thereof.

Overview

The year 2012 was a productive one for the DFWS, and saw some changes, including the retirement of Prof Tim Rypstra after 36 years of service to Wood Sciences and the appointment of prof Thomas Seifert as departmental chair. The DFWS hosted several workshops with international participation, dealing with climate change and other topical issues. Three staff members participated in three EU COST Actions (European Cooperation in Science and Technology) and several short courses were presented to the South African forest industry. Considerable collaborative work was done with partner institutes in Botswana, Mozambique, Namibia, Zambia and Malawi, which resulted in common proposals, projects, and postgraduate supervisions. International links and extended collaboration were maintained with partner institutions in Finland, Sweden, Canada, Germany, Australia and the USA.

The 'Climate-Fit Forests', an EU-financed Marie Curie IRSES mobility programme, launched in 2011, gained considerable momentum during 2012. The programme links the DFWS's efforts to a broad spectrum of climate change-related research activities with partners in Germany, Italy and Switzerland. Topics addressed ranged from wood quality to carbon reduction in timber harvesting. The DFWS increased its access to state-of-the-art technology and world-class equipment for the non-destructive testing of wood and other materials. An industrial microcomputer tomograph (micro-CT scanner) valued at R7.6 million was purchased by the Central Analytical Facility (CAF), based on a successful RISP application in 2011 to the DST/NRF large equipment programme. The CT scanner officially started operating in 2012. A high resolution multispectral sensor was developed in a joint venture with the Agricultural Research Council and has triggered great interest in the field of applied remote sensing for agriculture and forestry.

Conventional tree breeding has also been established successfully as a research field in the Department. The research entails the breeding of pathogen-resistant genotypes, but also the assessment of breeding success in terms of growth and wood quality. The programme has been strengthened with the appointment of Professor Bill Dvorak, the director of CAMCORE, as a Professor Extraordinary.

There was significant growth in research on biomass and bioenergy, spearheaded by an existing DFWS

Second-year chainsaw appreciation course.

initiative, “Power SA”. Among the projects were research on the harvesting productivity of alien invasive species, testing of calorific values of indigenous and exotic shrubs and trees, and the development of biomass models for pines and eucalypts.

The Department’s interest in plantation forestry was documented through several industry-related projects on wood quality, growth and intensive silviculture. These new projects show a continued trend in widening a primarily plantation forestry focus to incorporating research on woodlands and indigenous high forests.

Mondi clonal nursery at Kwambonambi, KwaZulu-Natal.

Research

Scientific work at the DFWS is characterised by a healthy blend of basic and applied research. The DFWS research fields are:

(i) Precision Forestry (PF),
(ii) Integrated Land Use Management,
(iii) Biomass and Biofuel Production,
(iv) Wood Quality from the Plant to the Product, and
(v) Climate Change.

PF provides for additional and sufficient quality information about forests and the manufacturing of forest products. It facilitates planning, site-specific forest management activities, and operations to improve wood product quality and fibre utilisation, to reduce waste and to increase profits. PF makes use of several key technologies, such as geographic positioning systems (GPS), geographic information systems (GIS) and remote sensing (RS).

Tree lengths presented for extraction to a roadside landing.

The Integrated Land Use Management Initiative, or “Green Landscapes”, is a concept that spatially integrates different strategies and economic demands within the same region and includes all land use. In this context, it plays a fundamental role in Africa, as it is understood that not only one, but a variety of treatment options or “management paths” may potentially be suitable for each individual land parcel in the landscape. Each path is characterised by a succession of specific management activities, and the ultimate aim is to identify an optimum combination

of management paths for the landscape as a whole. This form of adaptive management provides a suitable basis for designing forested landscapes.

The Biomass and Biofuel Production Initiative, or "Power SA", aims at providing all the necessary information on biomass and biofuel production in a South African and African context. It covers the value-added chain of production, from the plant to the product of biomass and biofuels. This entails a wide range of expertise, from remote sensing, stand management for biomass production in plantations, agro-forests, harvesting and transport logistics, processing technology and raw material quality considerations, to ecologic implications on the local and global level as well as socio-economic implications. The Department will focus future research work on the integration of these fields of expertise for the concise management of biomass and biofuel production. The aim is to contribute to the optimisation of resource use and the mitigation of climate change.

Wood quality may be the most important aspect of the value added chain of wood production, but is also one that is least understood. The optimisation and effective management of the value added chain and its individual links are only possible with sound knowledge of the factors influencing wood properties during tree growth, harvesting, storage, drying and subsequent conversion processes. It also depends on the quality of the assessment process itself. A holistic approach is therefore required, one that includes modelling, simulation and novel methods of wood quality determination and product performance testing. Thus, the overriding objective is to understand and optimise wood quality throughout the value added chain of wood production. With the addition of conventional tree breeding as a focus area, the Department is now able to monitor wood quality throughout the lifecycle of the tree and timber product.

To effectively address the five interdisciplinary research fields mentioned above, each staff member focuses on his/her specific discipline while also participating in collaborative projects within the DFWS. Ms Hannél Ham focuses on forest ecology, tree improvement and nursery practices. Her projects included the propagation of *Pinus maximinoii*, viability testing of interspecific hybridisation and investigating the reproductive barriers of *Pinus radiata.*

Student practical in the seedling nursery.

Dr Ben du Toit and his postgraduate students focused on forest nutrient dynamics during 2012. The team established field trials with controlled-release fertilisers that have the potential to reduce the environmental impacts of fertilisation. They also researched nutrient input-output budgets to gauge the nutritional sustainability of intensively managed plantation crops. This study covered a wide range of forest management regimes and site types across Southern Africa. A third focus was on tree survival, nutrition and early growth in the re-establishment period. Finally, Dr du Toit also undertook a short study tour to Chile, where he gave presentations at two symposia and interacted with several researchers in academia and in industrial forestry companies.

In forest management, Prof Thomas Seifert focused on CT scanning of wood, forest growth simulation under climate change, and the evaluation of drought-resistant tree species to alleviate poverty in South Africa's arid regions. He also traced the effects of anthropogenic forest habitat change on diversity and pathogen prevalence in bats, and the effects of fire damage on the growth and survival of native and commercial trees in South Africa.

In the field of forest management Mr Cori Ham investigated aspects of enterprise development, forestry promotions and rural forest use. He also specialised in strategy development. Projects included the payment for environmental services as an alternative income source for commercial multiple land-use farms in South Africa. He assessed fuel wood use and sources in remote and adjacent-urban areas in Namibia, investigated the demand, supply and local valuation of *Pterocarpus angolensis* and *Baikiaea plurijuga* timber in the Kavango Region, and developed forest sector strategies for governments.

First-year students receiving instruction in aerial logging procedures.

Mr Pierre Ackerman's research involved the optimisation of value and supply chains through the assessment of fibre balances, primary transport terrain factors and haulage parameters. Projects included the modelling of roundwood transport haulage travel speed for the South African roundwood saw timber supply chain, the assessment of the logistics supply chain and systems for bioenergy harvesting, an investigation of the viability and sustainability of forest-harvesting entrepreneurs, the use of on-board computing systems to optimise mechanised harvesting systems, and productivity studies for the mechanised harvesting of *Eucalyptus* pulpwood stands. Mr Ackerman was also involved in a study on the assessment of the financial viability of local and international harvesting and transport contractors with the Finnish Forestry Institute METLA, the Swedish University of Agriculture (SLU), as well as the University of Helsinki. He is an active member of the Cost Action FP 0902 dealing with the 'Development and Harmonisation of New Operational Research and Assessment Procedures for Sustainable Forest Biomass Supply'.

On the wood science side, Mr Brand Wessels looked at primary wood processing, with studies on non-destructive timber testing, prediction of timber quality, and sawmill processing. Projects included the variation in flexural properties of young SA pine structural timber, the development of a method for three-dimensional stem analysis and its application

in a study on the occurrence of resin pockets in *Pinus patula*, wood properties of some drought-resistant *Eucalyptus* species, and an investigation of selected mechanical and physical properties of young, unseasoned and finger-jointed *Eucalyptus grandis* timber.

Dr Martina Meincken focused on wood physics, with studies on surface degradation, biofuels and fibre analysis. Her projects included the effect of climate change on wood quality, wood-plastic composites, hand-made safety charcoal, and bioenergy systems.

In wood chemistry, Dr Luvuyo Tyhoda worked on the Bio-refinery Concepts for Wood Processing in the South African Pulp and Paper Industry project, which is THRIP funded and undertaken in collaboration with the Paper Manufacturers Association of South Africa (PAMSA). The project arose from the critical need for both technology and human resources development to improve the industry's international competitiveness. The focus is to train tomorrow's decision makers in the pulp and paper industry around biomass processing and bio-refining. Phumla Vena, a PhD student in Chemical Engineering, supervised by Prof Johann Görgens (Department of Chemical Engineering) and Prof Tim Rypstra, focused on the extraction of xylan from South African-grown *Eucalyptus grandis*, giant bamboo and sugarcane bagasse prior to Kraft and sodaAQ pulping to produce paper pulps, value added biopolymers and fermentable sugars. The factors that influence the adhesive bond quality and performance of fingerjointed SA pine are being investigated by Mr Nolte Smit under the supervision of Prof Rypstra. Dr Tyhoda and Prof Tim Rypstra are involved in the elucidation of the properties that increase the resistance of *Eucalyptus cloeziana* to marine borers. The properties that give the woody species their resistance have not yet been described fully.

Mr Barend Lötter addressed topics within secondary wood processing, such as furniture design and construction, wood manufacturing technology and wood finishing. His projects included the investigation of the hydroscopic properties of modified OSB (oriented strand board), and the effect of droplet size and distribution on the quality of surface finishes.

Community Interaction

The DFWS successfully offered a number of short courses to the industry during 2012. Among these were the part-time wood science e-learning courses and an introduction to forestry and wood science for managers. In addition, courses on forest finances, tactical and operational harvest planning, harvesting systems costing, and

Students who assisted with the organisation of the Stihl Lumberjack Festival at Lievland farm.

designing forests to provide multiple services were presented, amongst others. Prof Seifert was involved in a number of studies on behalf of SANPARKS. These related to topics such as the structure and growth of natural forests and a comparison of the abundance of bats in various land-use types. Dr Ben du Toit, President of the SA Institute of Forestry (SAIF), remained a member of the Paarl Mountain Advisory Board. Ms Hannél Ham contributed to the CAMCOR advisory board for tree improvement for the forest industry and was the Western Cape representative for the SAIF. Prof Seifert contributed to the Advisory Board of Saasveld (NMMU). He also remains an active member of the Mensuration and Modelling Research Consortium. Mr Pierre Ackerman retained his close association with Forest Engineering Southern Africa through industry-funded projects and short courses, and in an advisory capacity. He serves on the Fort Cox advisory board and was involved in a number of biomass procurement exercises for NGOs and in Working for Water/Energy bioenergy initiatives with staff members.

One project deserving mention is the formulation of a South African guideline for the recovery and use of plantation residues for energy generation. Mr John de Wet and Mr Pierre Ackerman were involved with the co-generation study for Eskom in collaboration with the CSIR. Furthermore, Pierre Ackerman's relationship with the University of British Columbia continues to facilitate student exchange between the two institutions. Mr Cori Ham took on the task, with several other staff members, of developing a strategy for the future of SAFCOL on behalf of the Department of Public Enterprises. Most lecturing staff served on scientific editorial committees related to their specific fields of interest and are either co-ordinators or members of specific divisions within IUFRO. Staff members retained close ties with industry through a number of completed and work-in-progress projects. With the successful Marie Curie IRSES "Climate-Fit Forests" mobility application, the DFWS continues to influence climate change-related issues, both locally, and internationally with three European institutions. Three staff members, Prof Thomas Seifert, Pierre Ackerman and Ms Hannél Ham, are involved with three Cost Actions within the EU Framework 7 initiative.

Students and staff at the Langepan CCT planting trial.

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P Ackerman (Forest Engineering)
Dr B du Toit (Silviculture)
C Ham (Forest Management)
H Ham (Forest Genetics and Forestry Development)
B Lötter (Secondary Wood Processing)
Dr M Meincken (Wood Physics)
Prof T Rypstra (Wood Chemistry)
Prof T Seifert (Chairman; Forest Management)
Dr L Tyhoda (Wood Chemistry)
B Wessels (Mechanical Properties)

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Prof C Geldenhuys (Forest Ecology and Management)
Prof M Jacobson (Forest Finance and Economics)
Prof R Pulkki (Forest Engineering)
Prof K von Gadow (Forest Management)
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Department of

GENETICS & INSTITUTE FOR PLANT BIOTECHNOLOGY

Overview

The vision of the Department of Genetics is to develop and promote Genetics as a cornerstone of biological science at Stellenbosch University through quality research, creative teaching, and outstanding and responsible service delivery to our community and environment. In order to realise this vision, the Department of Genetics consists of a group of diverse lecturers, researchers and postgraduate students who focus on research opportunities in animal, human and plant genetics that include studies in the quantitative (including biometry), population and molecular genetic fields.

The Department started life as a plant-breeding environment with four academic staff members more than 80 years ago, and was joined by the Institute for Plant Biotechnology (IPB) in 2007. During 2012, the Department (including the IPB) comprised 15 full-time academics and a total staff component of 55 individuals (including research contract staff). Further to this, our postgraduate numbers are in excess of 80 students, and we service several hundreds of undergraduate students through the various undergraduate courses presented by the Department and the IPB in both the Faculties of AgriSciences and Science.

South African Genetics and Bioinformatics Societies Conference.

It was an exceptional year in that Prof Monique Zaahl became the Executive Assistant to the Rector and Prof Danie Brink had to take over the reins as Head of Department from March 2012. It was also the year in which the Department truly excelled in local and international conference participation, with over 60 poster and oral contributions. A very important indication of strategic change within the Department is the Biometry staff, who repositioned themselves as a Unit for Biometry, with increased co-operation with the Department of Statistics and Actuarial Science and the Centre for Statistical Consultation. Several colleagues also received the Rector's Award for Excellence in Service during 2012.

Activities and Achievements

The highlight of the year most certainly was the joint South African Genetics and Bioinformatics Society Conference, with the theme "The Data-mining Revolution". The conference was hosted by the Department of Genetics from 10 to 12 September 2012 and was organised by Prof Rouvay Roodt-Wilding and staff and students of the Department. The Department also is proud of Thia Schultz and Marius Snyman, who won the awards for the best PhD oral and poster presentation respectively. On the staff front, Prof Rouvay Roodt-Wilding was promoted to Assistant Professor in Genetics and was elected President of the South African Genetics Society. Two members of the technical staff were promoted to academic staff, Dr Christelle van der Vyver of the IPB obtained a research position and Dr Aletta van der Merwe was promoted to lecturer in Genetics. Staff members who received the Rector's Award for Excellence in Service during 2012 were George Fredericks and Dr Paul Hills of the IPB, and Lundi Korkie, Martha Kannemeyer and Aletta van der Merwe of Genetics.

Guest speakers at the joint conference of the South African Genetics and Bioinformatics Societies.

The Department's staff also played host to several visiting academics, and a number of staff members visited overseas collaborators and attended several international conferences. Foreign travels included a number of strategic visits, such as that by Prof Danie Brink, who visited several overseas institutions in October 2012 as part of an exercise to benchmark the respective curriculums for Genetics and Biotechnology. Prof Louise Warnich was invited to present a paper and take part in a panel discussion at a regional Workshop on the Promotion of Women in Science in Africa, organised by the African Network of Scientific and Technological Institutions (ANSTI) of UNESCO and held in Johannesburg, while Prof Jens Kossmann of the IPB attended the Annual Plant Biotech Denmark Meeting at the University of Copenhagen, Denmark. Overseas conferences that were attended included the American Society for Human Genetics Annual Meeting in San Francisco, USA; the 17th Meeting of the International Council for the Study of Virus and Virus-like Diseases of the Grapevine (ICVG), held in Davis, USA; the 22nd International Conference on Virus and other Graft Transmissible Diseases of Fruit Crops, held in Rome, Italy; the 8th International Abalone Society Symposium in Hobart, Australia; the International Society for Animal Genetics Conference in Cairns, Australia; the International Society for Genetics in Aquaculture Conference in Alabama, USA; and the 4th International Conference on Quantitative Genetics in Edinburgh, Scotland. Locally, staff and students linked to the Plant Breeding Laboratory (PBL) attended the 9th Southern African Plant Breeders' Conference in the Kruger National Park, while the Vitis group attended the 34th Conference of the South African Society for Enology and Viticulture in Franschhoek. Other local conferences included the Southern African Society for Systematic Biology conference in De Hoop and the Southern African Society of Animal Science conference in East London. The PBL hosted Dr Francois Eudes for a short research visit in April 2012; Dr Thierry Wetzel from the AlPlanta Institute for Plant Research in Germany visited the Vitis group in November 2012; and Emmanuel Nepolo from the University of Namibia visited the IPB.

The postgraduate students of the Department truly excelled in 2012, with the most notable achievements being those of Michelle Coffee, who received the Hofmeyr van Schaik Medal for the most outstanding fourth-year student in Genetics (BScHons or BScAgric), as well as the Merck Prize for the best final-year student in Molecular Biology and/or Biotechnology. Ms Coffee is currently busy with her Master's degree in Human Genetics in the Laboratory of Prof Warnich. Another student who excelled was Britt Drögemöller, a PhD student who is also in Prof Warnich's group, who won the L'Oreal-UNESCO Award for Women in Science in the Sub-Saharan Africa Region.

Michelle Coffee received the Hofmeyr van Schaik Medal for Best BScHons student in Genetics.

Britt Drögemöller received the L'Oreal-Unesco Award for Women In Science In the Sub-Saharan Africa Region.

Research

Genetics

The research focus areas of the Department follow the matrix structure according to which the Department operates. Focus areas within animal, human and plant genetics include studies in the molecular (biotechnology), population and quantitative (breeding) genetic fields. Animal genetics includes research focused on the genetic diversity, population structure, molecular evolution and breeding of various marine (abalone, kob, yellowtail, sharks) and freshwater (trout, tilapia, catfish) species, as well as livestock animals (cattle, sheep), through the application of molecular marker analysis, biotechnology and genetic selection methods for commercial production. With the increased availability of medium- to high-throughput sequencing technologies, the genetic characterisation and population genetic analysis of these species has also been extended to a genome-wide scale in order to identify genomic regions possibly involved in adaptation. Human Genetics research entails the analysis of genetic variation in genes involved in the metabolism of medication and the pharmacogenetic application of this in South African populations (e.g. schizophrenia and variegate porphyria); the analysis of genes implicated in oesophageal cancer, iron regulation, the haem biosynthetic pathway and drug metabolism; and bioinformatic identification and characterisation of genes involved in apoptosis resistance, as well as the metabolic pathways involved. Research on plant genetics includes the molecular epidemiology of grapevine virus disease complexes; molecular interactions between viruses; phytoplasms and their respective grapevine hosts; the genetic modification of grapevines for enhanced virus resistance; molecular breeding of fruit

The triticale cultivar (US2007) that is available commercially through the PBL's licensee partner, OverbergAgri.

Staff of the PBL during the harvesting of the new SU rye cultivar, US3010.

cultivars; molecular interactions between the wheat host, the aphid and endosymbiont; the genetic modification of wheat for enhanced pest resistance and drought tolerance; wheat pre-breeding for improved wheat rust resistance; the triticale breeding programme, which focused on increased bio-ethanol yields; and a rye breeding programme focused on improved cultivars for animal feed.

Institute for Plant Biotechnology

The IPB specialises in the characterisation and manipulation of primary carbon metabolism in plants. Our ultimate goal is to manipulate the relevant metabolic pathways to either improve yield and/or quality, or to produce novel, high-value products in plants. Some projects are aimed at the genetic manipulation of carbon partitioning within plant organs, such as sugarcane culms, grape berries and potato tubers. Our approach is to first get a better understanding of the control of carbohydrate metabolism in these important sink tissues and then to genetically manipulate apparent key enzymes to investigate the effect of these modifications on metabolic flux. In addition to our work on the partitioning of endogenous compounds, we also focus on the improvement of these compounds and the introduction of completely new ones. As part of several international collaborative projects, the IPB has, for example, developed transgenic plants that produce novel, high-value products, i.e. neutraceuticals and pharmaceuticals or biopolymers for industrial application. Finally, we are trying to understand plant growth in relation to abiotic stress factors with the aim of breeding or engineering plants that are more productive with less input.

Britt Drögemöller, James Watson and Galen Wright.

The Vitis laboratory made their own wine!

Community Interaction

The Plant Breeding Laboratory participated in the SKOG farmers' day, visited several producer study groups and introduced recently released triticale cultivars originating from the departmental breeding programme. For most of the year, Thanja Allison, the departmental manager, was involved in the Welgevallen Community Aftercare Project, which provides an aftercare facility for more than 20 schoolchildren from the community, including a number of extramural activities as well as lunch every day. Besides the numerous services of staff members on boards and committees, e.g. the Advisory Committee of Genetically Modified Organisms, community-based services include the PBL, which performs a marker-assisted selection (MAS) service for wheat breeding programmes, forensic DNA analyses of confiscated material associated with abalone poaching, and a service run

by Mandi Engelbrecht of the Vitis group (Vironostix) that tests samples for viruses and phytoplasms. In 2012, the latter service screened samples for the vegetable, fruit and grapevine industries. Staff members of the Department participated in workshops to promote the teaching of Genetics as subject in schools, and five staff members were involved as evaluators during the Eskom Expo for Young Scientists. Ms Faatiemah Higgins of the Human Genetics laboratory tutored at Forest Heights High School for the Eerste River Youth Development Foundation from April until December 2012, and Mrs Lundi Korkie mentored school students during their job-shadowing visits to the Department.

Welgevallen Aftercare Project: All at play.

Welgevallen Aftercare: Skipping is so much fun!

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Prof D Brink (Chairperson; Animal Breeding, Aquaculture)
Prof JT Burger (Molecular Genetics, Virology)
F February (Molecular Genetics, Human Genetics)
PT Pepler (Biometry)
Prof R Roodt-Wilding (Molecular Genetics, Aquaculture)
A Sadie (Biometry)
Dr AE van der Merwe (Molecular Population Genetics)
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INSTITUTE FOR PLANT BIOTECHNOLOGY

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Department of

HORTICULTURAL SCIENCE

Introduction

The export-focused fruit and cut-flower industries play a key role in the South African economy and provide an important source of foreign exchange, while offering sustainable and stimulating employment to large numbers of people in the rural areas. In addition, the growth in the local demand for fresh and processed fruit products and cut flowers results in an increasing support base for many local agrochemical, packaging, transport and export companies. To ensure that these horticultural industries remain competitive in the overseas markets, it is critically important that new technologies are continuously researched and developed. Enhanced profitability is largely dependent on sufficient volumes of high-quality products reaching their target markets without forfeiting environmental sustainability.

Challenges faced by these industries are sub-optimal and increasingly limited environmental resources, such as suitable agricultural soil, access to high-quality water and changing climatic conditions, as well as the need for sustained, cutting-edge research to ensure postharvest product quality during prolonged storage and shipping periods.

The solution to these challenges lies within scientific research that addresses scholarly issues while supplying trained and technically proficient manpower to the fruit and cut-flower industries. As a tertiary institution we strive to be a centre of excellence that offers support to the South African and international horticultural industries.

The Department aims to:

1. Develop, test and improve technologies for the enhancement of pre- and postharvest fruit and cut-flower quality;
2. Introduce and transfer the developed technologies to growers and other horticultural companies for commercial implementation;
3. Supply skilled manpower to the horticultural industries by aiming to deliver graduates from the designated groups, as well as five to eight postgraduate students annually.

Overview

Dr Paul Cronje attended the XIIIth International Citrus Congress in Valencia, Spain during November where he presented a talk entitled ‘Could ethylene influence peteca spot incidence in lemon fruit?’.

Prof Karen Theron was the convenor of the International Society for Horticultural Sciences

Disa *hybrids of the La Motte collection in full bloom.*

(ISHS) Xth International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems held in Stellenbosch in December. The Symposium was attended by 160 researchers from 27 countries. She also visited Slovenia in March to participate in the Euferin thinning workshop. In June she attended the ISHS 10th International Symposium on Vaccinium and other Superfruits held in Maastricht, the Netherlands.

Allison Nicholson with trained sweet peppers at Agrizone, Durban.

Prof Malcolm Dodd was the chairman for the opening session at the Cool Logistics Africa Conference and gave a presentation entitled 'How can South Africa's fruit export cold chain be improved?'. At the Cool Logistics Global Conference in Antwerp he was a member of an expert panel discussion on reefer container operations and technology. He attended the 7th International Post Harvest Symposium in Kuala Lumpur in June, where he presented a paper 'Managing airflow inside reefer containers benefits produce quality'.

The International Protea Association (IPA) Conference and International Protea Working Group Symposium held in Santiago, Chile was attended by Dr Lynn Hoffman. The conference provides a platform for international Proteaceae producers and researchers and Dr Hoffman represented the South African protea industry as chair of Sappex (South African Protea Producers and Exporters).

Another highlight of 2012 was the 2nd All African Horticultural Conference that was hosted by the South African Society for Horticultural Sciences (SASHS) under the aegis of the International Society for Horticultural Science (ISHS). More than 250 delegates from 30 countries attended the conference. The focus was on the horticultural challenges facing Africa and the aim was to bring together scientists involved in diverse horticultural endeavours to encourage communication. Staff and postgraduate students who received awards during the conference include Dr Paul Cronje for the best published paper, Anreza van der Merwe for the best poster presentation and Tarryn de Beer for the best Master's presentation. Tarryn also received the sought-after SASHS Student Travel Grant.

Dr Mariana Jooste attended the 7th International CIGR Technical Symposium in Stellenbosch in November. She was awarded the Hortgro Science Prize for the best presentation at the Hortgro Technical Symposium and was a finalist in the New Voices in Science competition hosted by Stellenbosch University during which final-year PhD students present the findings of their studies.

Dr Michael Schmeisser was invited to attend an international workshop and the subsequent Symposium on Horticulture in Europe (SHE) that took place in France during June and July. The workshop aimed to set up international collaboration between institutes of higher education in Africa, the Pacific and Caribbean countries and their European counterparts. Dr Schmeisser also attended the International Olive Symposium in San Juan, Argentina, during which he presented a talk entitled 'Evaluation of the use of NAA to

thin Barouni olives in the 'on' year to increase fruit quality and to decrease alternate bearing under South African conditions'.

Twenty-four subsidised and non-subsidised articles as well as two research reports were published. Ten students completed their Master's studies, while one student obtained her doctorate.

Research

The Department of Horticultural Science conducts dynamic research for the deciduous fruit, citrus, ornamental cut flower and potted plant industries, providing value-adding technology for industry partners and lending support to new horticultural industries focusing on alternative crop production. A few of the highlights from 2012 were:

Ornamental cut flower and potted plant research

Growing concern over the increasing carbon footprint associated with air freight, as well as the recent drastic rise in fuel costs, necessitates the shift to sea freight as an alternative transport method to deliver fynbos products to the high-value European markets. However, the extended storage periods of approximately 21 days associated with sea freight also increase the associated postharvest risks, such as chilling injury, desiccation and losses due to pathogens such as *Botrytis*.
A study was initiated by Dr Lynn Hoffman in conjunction with the Protea Producers of South Africa (PPSA) to establish the optimum picking and maturity stages of a selected number of *Leucospermum* (pincushion) species and cultivars so that products of high quality can consistently be delivered to export markets, while postharvest losses are reduced at the same time. This project formed part of an existing study by Heleen van Zyl (MScAgric) under the supervision of Dr Hoffman, Dr Mariana Jooste and Prof Marius Huysamer, in which the long-term storage conditions for fynbos products are optimised, while postharvest treatments to reduce and control losses in *Leucospermum* and *Leucadendron* stems are being developed and evaluated.

In view of the predicted temperature increase associated with climate change in the Western Cape, research was conducted by Annaline Smith (MScAgric) under the supervision of Dr Hoffman and Dr Wiehann Steyn to study the relationship between high light and temperature conditions during summer and the presence of bract browning on the involucral bracts of *Protea* 'Pink Ice'. This study, which investigated the role of water stress in the development of bract browning, as well as sustainable methods such as the use of shade netting to reduce this disorder, is in its final phases.

Evaluation of the Hermes harvest system as platform, with air pressure shears for the summer pruning of nectarines.

Research with the aim to promote the successful commercial production of *Disa*, a unique South African orchid, as a potted plant on the international floricultural market was completed by Elri Franken (MScAgric). This study was done under the supervision of Dr Hoffman and Prof Karen Theron, with financial and infrastructure support provided by La Motte Wine Estate.

A project that focuses on production techniques for tulips in hydroponics under protection in the Western Cape is currently being conducted by Geline Derbyshire (MScAgric) under the supervision of Ms Estelle Kempen (Department of Agronomy) and Dr Hoffman. This study addresses the challenges facing all-year-round bulb cut flower production in the southern hemisphere.

Mechanical harvesting of nectarine trees using BAUM.

Citrus research

Fruitsplit in citrus fruit decreases the export quality and value of the fruit. In his MSc study, Jakkie Stander found that applying 15 mg/L 2,4-D after fruit fall in November to December can reduce the occurrence of fruitsplit.

Chilling injury (CI) develops in the rind of citrus fruit if the fruit are stored for a particular period at a temperature below the threshold for a specific cultivar. The MSc study of Jeanine Hordijk, under the guidance of Dr Paul Cronje, indicated that the incidence of CI is related to rind condition and it was shown that implementing optimum production practices is the first step in reducing CI.

Schalk van der Merwe, under the guidance of Dr Cronje and Prof Karen Theron, found the levels of carbohydrate in the leaves of late mandarin trees in April to be a critical factor in avoiding alternate bearing.

Chilling injury in 'Star Ruby' grapefruit is largely eliminated if

only fruit with good rind colour are subjected to a cold sterilisation protocol. In addition, it was shown that susceptibility to CI varies between seasons. Lembe Magwaza has embarked on a PhD project to develop a non-destructive method based on NIR spectroscopy to predict citrus fruit susceptibility to rind breakdown.

Deciduous fruit research

Dr Elmi Lötze is researching the root growth dynamics of apple trees to quantify effects on the uptake of nutrients, tree growth and fruit quality. Another aspect of her research evaluates the effect of high soil temperature on the growth of different apple rootstocks.

The research of Esnath Hamadziripi (MScAgric) under the supervision of Dr Wiehann Steyn, Prof Karen Theron and Nina Muller (Food Science) found that apples in the well-illuminated outside tree canopy are of better quality and taste than apples from the inner tree canopy. However, the difference in taste was larger between orchards than within trees and therefore it is not necessary to harvest and market fruit from the inner and outer canopies separately. The data also shows that it could be feasible to develop a niche market for 'Golden Delicious' fruit with moderate sunburn. Such fruit is usually downgraded for cosmetic reasons, but data show that consumers prefer the taste of these apples above those that are perfect in appearance.

Anreza van der Merwe (PhD in Food Science) did her study on the preference of Western Cape consumers for the taste of apples. This study was done under the supervision of Dr Steyn, Dr Iwan Mabuschagne (fruit breeder at Colorsfruit), Nina Muller (Department of Food Science) and Prof Tormod Næs (statistician at Nofima, Norway). The study revealed that black, coloured and older consumers prefer the taste of sweet apples, while younger and white consumers prefer firmer apples. However, there was considerable overlap between ethnic and age groups, and three consumer groups could eventually be distinguished on the basis of their divergent apple taste preferences. The data originating from the study could be very useful for apple growers and marketers.

Increasing production costs are forcing deciduous fruit producers to be more cost effective. Research done by Prof Karen Theron and Gielie de Villiers (MScAgric) shows that mechanical thinning of stone fruit can reduce costs while improving fruit quality. Dr Steyn, Prof Theron, Dr Jan Lombard (Agricultural Economics) and Gerrit van der Merwe (MScAgric) initiated a project to determine the efficacy of platforms and mechanical harvesting systems. Platforms eliminate the use of ladders and therefore improve

Laetitia *flower clusters after mechanical thinning with the Darwin machine.*

labour productivity. Mechanical harvesting systems can possibly reduce injuries to the fruit during harvesting, as the fruit are handled less frequently.

Alternative fruit crops

Smaller fruit industries, e.g. olives, persimmons, blueberries and macadamia, are also supported through research projects. These projects aim to reduce alternate bearing in olives, improve the postharvest quality of persimmons, develop pruning technology for blueberries and improve low cracking percentages in macadamia nuts.

Postharvest research

In a collaborative study with the Department of Conservation Ecology and Entomology it was found that the packaging of 'Flavor Fall' pluots (a hybrid of a plum and an apricot) in insect-resistant bags in combination with irradiation is an effective, non-toxic alternative for the current phytosanitary protocols that are commercially applied to plums.

In an extensive study to examine cold damage in plums, Dr Mariana Jooste found the following:

- That the cultivar 'Sapphire' is probably more cold sensitive than 'Angelino' due to higher concentrations of polyunsaturated fatty acids that accumulate in the fruit during fruit development.
- That more mature fruit are more sensitive to develop chilling injury during storage than less mature fruit due to higher ethylene-releasing rates, lower antioxidant concentrations and a lower ratio of monounsaturated to polyunsaturated fatty acids.
- That a dual temperature storage regime delays the development of symptoms and reduces the intensity of the disorder significantly in comparison to storage at -0.5°C due to a more optimal membrane composition and higher antioxidant concentration in fruit stored at the dual temperature regime.
- That increased storage temperatures lead to more lipid peroxidation or low ascorbic acid concentrations as well as low fruit quality in comparison to dual-temperature storage.
- That different plum cultivars respond differently to the initial rate and time of forced air cooling in the manifestation of chilling injury.

Community Interaction

The Department of Horticultural Science is closely aligned with the fruit and cut-flower industries of the Western Cape and is involved in community service in various spheres.

A project in which learners from local schools visit the Department is managed together with HortGro Services, an industry partner. During these visits, which are directed at Grade 9 and Grade 11 learners in particular, an effort is made to introduce learners to Horticultural Science as a field of study. Grade 11 learners are provided with further information on career opportunities in Horticultural Science, the minimum admission requirements for the Plant and Soil Sciences programme with Horticultural Science as a major, the subjects offered by the Department, and opportunities for financial assistance. The programme is aimed particularly at schools from disadvantaged areas.

'Maths and Science are great fun!' was the message conveyed to learners in Grades 10 to 12 during

Learners test the level of total soluble solids in a fruit sample.

Dr Paul Cronje, of Citrus Research International, explains the importance of ripeness indexing to determine citrus fruit quality to Grade 11 learners in the Graham Beck Outreach Programme.

Grade 11 learners in the Graham Beck Outreach Programme visit the flower evaluation laboratory where the shelf life of fynbos products is evaluated.

the third Standard Bank Maties Mathematics and Science Week that was held during March for learners taking Physical Science, Mathematics and Life Sciences at school. The Department participated in the form of an interactive workshop during which Dr Paul Cronje discussed and demonstrated various aspects of citrus fruit quality. The aim of this week was to contribute to the development of interest and competencies in the fields of maths, science and technology.

An increasing shortage of skilled expertise is being experienced in all agricultural sectors, but learners remain hesitant to consider career opportunities in horticulture. Ignorance and misconceptions regarding the discipline of Horticultural Science, including negative perceptions about agriculture in general, often are among the reasons why horticulture is not favoured as a career choice. The Department therefore participated in the Graham Beck Foundation Outreach Programme to introduce learners to horticulture and its multiple career opportunities. The focus was on illustrating to learners that horticulture offers an exciting future.

All academic and research staff members are actively engaged in the transfer of technology by presenting seminars or talks during technical field days. The transfer of technology also took place at a national level by means of talks presented on Radio Elsenburg in association with 'Radio Sonder Grense'. The staff of the Department are also involved actively as members of various industry bodies, e.g. the Southern African Society for Horticultural Sciences (SASHS), Hans Merensky Holdings and the Hans Merensky Foundation Research, Development and Environmental Board, ASNAPP, Citrus Research International (CRI), South African Protea Producers and Exporters (Sappex), as well as HortGro.

STAFF

ACADEMIC

Dr E Crouch (Pome Fruit Post-harvest Physiology)
Dr L Hoffman (Fynbos and Cut-flower Production and Post-harvest Physiology)
Dr E Louw (Plant Physiology)
Dr E Lötze (Pome Fruit Quality)
Prof L Opara (Post-harvest Technology)
Dr M Schmeisser (Plant Ecophysiology and Stress Physiology)
Dr W Steyn (Tree Physiology)
Prof K Theron (Chairperson; Tree Physiology)

LECTURERS EXTRAORDINARY

Prof M Dodd (Post-harvest Physiology)
Prof M Huysamer (Post-harvest Physiology)
Dr WJ Steyn (Tree Physiology)

PROFESSOR EMERITUS

Prof G Jacobs (Fynbos Production and Post-harvest Physiology)

RESEARCHERS

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Dr M Jooste (Stone Fruit Post-harvest Physiology)

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Department of

PLANT PATHOLOGY

Introduction

Welcome to the Department of Plant Pathology. Plant Pathology is the study of plant diseases. In order for a disease to occur, there must be a susceptible host plant, a pathogen able to cause disease and an environment conducive to disease. In our Department we study the components of the disease triangle (host, pathogen and environment) in order to manage plant diseases. Our Department was established in 1918, and is the oldest Plant Pathology department in South Africa. We are involved in the teaching and training of students for careers in plant pathology, and offer degrees at both the undergraduate and postgraduate level. Our students are the 'plant doctors' of the future. Besides our teaching role, we are involved in research addressing issues of plant pathological importance. Considering that an estimated 14.1% of crops are lost to plant diseases before harvest, and a further 6% to 12% are lost after harvest, research that helps us to understand the nature and biology of plant pathogens, how diseases spread, and what we can do to manage them, is vital for sustainable crop production today. Our research findings are published in some of the top international journals and therefore have an impact both nationally and internationally. Our researchers also regularly present their findings at local and international conferences. Another important aspect of the Department of Plant Pathology is our interaction with producers (farmers), the agricultural industries (pack-houses) and agro-chemical industries, to name but a few. These interactions involve sharing information, training and collaboration, and providing access to the services of the Disease Clinic in the Department.

Collecting branches from a Pinus pinea *tree in Stellenbosch to determine the cause of die-back.*

Overview

The mission of the Department of Plant Pathology is to be recognised nationally and internationally as an academic department noted for quality training and research in Plant Pathology by creating an environment that supports and encourages the development and productivity of students and staff members; establishing and maintaining alliances with industry through strategically focused research programmes and service delivery; and fostering national and international collaboration for innovative and cutting-edge research aimed at sustainable food production.

Inoculating Vaalharts maize trials in the Northern Cape with a spore suspension of Aspergillus flavus.

The Department has a holistic and interdisciplinary approach to research and training, and makes use of the latest technologies available to reduce the impact of pathogens on plants; to manage these pathogens; and to increase plant resistance to pathogens. Conventional and molecular techniques are used to identify and control plant pathogens that are considered a threat to local crops and export markets in a sustainable and economical way. Students are trained in the detection, characterisation and epidemiology of plant pathogens, and in the use of integrated disease control strategies to control them. Current research programmes focus on diseases occurring in apples, pears, citrus, banana, grapevines, vegetables and cereal crops. Focus areas for research include pathogen identification and detection; integrated disease management (including the optimisation of fungicide application, and sanitation); postharvest pathology of fruit crops (including chemical and biological control); in-field management of mycotoxin production in grain crops; and the understanding of plant-microbe (beneficial and detrimental) interaction.

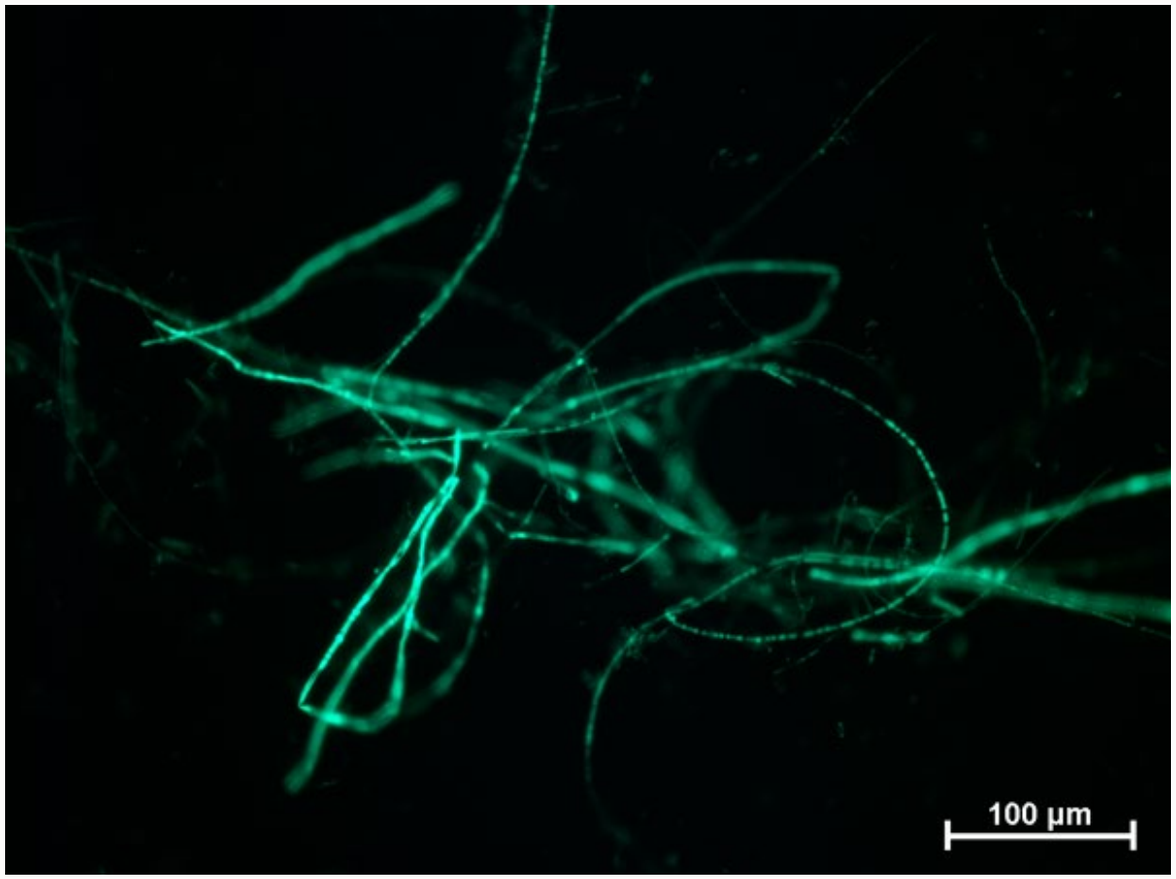
Research funding is obtained from national grower organisations, including Citrus Research International (CRI), Fruitgro Science, the Maize Trust, the Winter Cereal Trust and Winetech, as well as the Bill & Melinda Gates Foundation and the South African Table Grape Industry (SATI). Additional funding is obtained from the National Research Foundation (NRF), THRIP and the Agricultural Research Council (ARC).

Staff and postgraduate students of the Department of Plant

Pathology attended five national conferences and eight international meetings during 2012. Fourteen contributions were made at national and 27 at international meetings. In the same period, staff, in collaboration with postgraduate students, published 11 articles in scientific journals rated by the Institute for Scientific Information (ISI).

The Department has a considerable number of cooperative agreements at the national and international level. Nationally, these include cooperation with Fruitgro Science (phytosanitary pathogen lists for deciduous crops); the Department of Agriculture (pathogen lists for deciduous crops); plant quarantine services on an *ad hoc* basis (quarantine pathogens); the Agricultural Research Council (ARC) Infruitec-Nietvoorbij (grapevine research projects and postharvest diseases of pome fruit); ARC Grain Crops Institute and Plant Protection Research Institute (PPRI) (toxin-producing *Fusarium* species in maize and wheat); Elsenburg Agricultural College (*Fusarium* diseases of wheat); University of Cape Town (genetic manipulation of maize), and Experico (postharvest diseases of pome and stone fruit).

At the international level there is collaboration with the following: CBS, the Netherlands (characterisation of grapevine trunk disease pathogens, characterisation of apple core rot pathogens, characterisation of *Neofabraea* species on pome fruit); Lallemand Group, Belgium (biological control agents for postharvest disease management); Lincoln University, New Zealand (characterisation of *Cylindrocarpon* isolates); Department of Botany and Plant Pathology, Oregon State University, USA (the Fungal Tree of Life (AFTOL) project); School of Botany and Zoology, Australian National University, Australia (characterisation of *Plasmopara viticola* and *Phytophthora* populations in South Africa); USDA-ARS, Wenatchee, USA (the role of *Pythium* and *Phytophthora* in the decline of grapevines, as well as the aetiology of apple replant disease in South Africa); Department of Plant Pathology, Cornell University, USA (the stable transformation of *Phytophthora* species); Department of Botany and Plant Pathology, Oregon State University, USA (the aetiology of apple core rot diseases); Bioversity International, NARO (Uganda) and ISAR (Rwanda) (control of Fusarium wilt of bananas in Africa); Genetwister, Wageningen, the Netherlands (genetic manipulation of maize); International Institute for Tropical Agriculture, Nigeria and Uganda (Plant Health for Africa); Bioversity International, France, the Philippines and Uganda (Fusarium wilt of bananas), and the Guangdong Academy of Agricultural Sciences in China (Fusarium wilt of banana).



Mycelia *of* Eusarium verticillioides *fluorescing bright green after genetic modification.*

One postgraduate student obtained his PhD(Agric) degree, four students their MScAgric degrees and two students their BScHons degrees in Plant Pathology in 2012.

Research

The following research focus areas are addressed by the Department of Plant Pathology: pathogen identification and detection of plant pathogens; integrated disease management, which includes the optimisation of fungicide application and evaluation of sanitation strategies; postharvest pathology of fruit crops; management of mycotoxins in grains and cereals; and plant-microbe interactions.

Research programmes in the Department include:

- **Fusarium diseases of agricultural crops**

Plant pathogens belonging to the fungal species *Fusarium* are of serious importance to continued food production in the world. They are well known to cause disease in important staple food crops such as maize, wheat, sorghum, rice and bananas, and in some instances produce mycotoxins that can be fatal to humans and animals. Many diseases caused by *Fusarium* spp. and their toxins cannot be treated, and have to be prevented. The programme on the *Fusarium* diseases of agricultural crops therefore focuses on the characterisation and management of *Fusarium* spp. associated with Fusarium wilt and mycotoxin production in staple food crops, specifically relating to the identification and characterisation of *Fusarium* spp. through using conventional and molecular techniques; quantitative detection of *Fusarium* spp. and their mycotoxins; the epidemiology and aetiology of *Fusarium* spp.; field management of *Fusarium* diseases and the mycotoxins they produce; biological control of pathogenic *Fusarium* isolates; and understanding the interaction of plants with *Fusarium* spp.

The most effective means to prevent damage caused to agricultural crops by *Fusarium* spp. is by planting resistant material. Such resistance depends on the ability of the fungus to enter, colonise and damage the plant, and the ability of the plant to prevent or resist damage caused by the fungus. A proper knowledge of *Fusarium*, and of its genetics, pathogenicity and toxicity under different environmental conditions, is required to exploit plant resistance as a means of disease management. In this programme, the interaction between

Inoculation of F. graminearum *on wheat cultivars to determine resistance to* Fusarium *head blight.*

Symptoms of Fusarium *head blight on wheat.*

agricultural crops and *Fusarium* spp. is investigated by means of comparative and functional genetics of the *Fusarium*-plant interactions; the isolation and identification of defence-related genes in agricultural crops; the identification of virulence genes in *Fusarium*; studies on the evolutionary biology and phylogenetics of *Fusarium*; and the unconventional improvement of plants for resistance to *Fusarium* spp.

Poor husk coverage (left) and damage caused by insects (right) result in a higher incidence of Fusarium *ear rot.*

- **Fruit and postharvest pathology**

Fruit production plays an important part in the economy of South Africa, both internationally and locally. Unfortunately, plant disease and decay impacts on the profitability of deciduous fruit production, and negatively influences consumer confidence in these products. There is an increasing demand from consumers and, consequently, retailers and marketers for fruit with little or no pesticide/fungicide residues. Producing quality fruit under such constraints is a major challenge for the deciduous fruit industry, which currently relies heavily on pre- and postharvest chemicals for the control of disease and decay. The main objective of the Fruit and Postharvest Pathology Research Programme within the Department of Plant Pathology is to improve disease and decay control in deciduous fruit products through the design of appropriate integrated disease management strategies with reduced reliance on fungicides.

Projects within this programme are: Postharvest decay of pears, with a focus on decay caused by *Botrytis cinerea*; aetiology and epidemiology of core rot of apples; aetiology and epidemiology of bull's eye rot of apples; the efficacy of sanitation practices in reducing apple scab; the occurrence and importance of overwintering of apple scab conidia in the Western Cape; fungicide sensitivity of

Researchers examine 'Cripps Pink' apples for symptoms of rotting.

the South African apple scab population; characterisation of physiological races in the South African apple scab population; and the potential use of essential oils and garlic extracts in the management of postharvest diseases of apples.

- **Phytomycology, biocontrol and grapevine trunk diseases**

The field of phytomycology entails the study of fungal systematics and taxonomy of fungal plant pathogens. This knowledge enables the correct identification of causal agents of diseases. The aetiology of plant diseases is very important as the first step in understanding the disease and aiding in working towards a control strategy. Plant diseases are often complex, being caused by a variety of fungal taxa. The identification and relevance of these taxa are very important. A focus area of research concerns the aetiology and epidemiology of trunk diseases of grapevine, pome and stone fruit trees. Research on the population dynamics of *Botrytis cinerea*, which causes calyx end decay of pears, has shown that both mating types are present in South African orchards. However, from the analyses it is evident that, if sexual recombination does take place, it occurs only rarely.

Phytomycology also entails the development and use of up-to-date molecular identification tools for fungal pathogens to be used to ensure clean planting material, and for early disease warning. Compiling reliable information regarding the status of fungal pathogens in South Africa is very important. This, together with expertise in phytomycology, is of the utmost importance in order to ensure market access within the agricultural sector, as well as food security in South Africa. Phytosanitary support is provided on an ongoing basis to the deciduous fruit industry (Fruitgro Science).

The biological control of plant diseases is important in providing an alternative to chemical control. It allows producers to limit fungicide residues, which is becoming an important market requirement. The biocontrol programme focuses on the use of *Trichoderma* species in the control of grapevine trunk diseases. Various aspects are being researched to understand the mechanisms involved in the process and to optimise the application. These include the formulation, time of application, secondary metabolites produced by the *Trichoderma* strains, and host-*Trichoderma* interactions. Two isolates occurring naturally in grapevines have been tested in vitro and in vivo and we are in the process of developing a product that can be used as a pruning wound protectant.

Fungicides are applied to 'Forelle' pear blossoms to prevent diseases.

Grapevine trunk diseases have an impact on wine and table grape production by reducing the number of productive years of vines. Various new findings were made during the past year. The sexual stage of one of the fungi causing Petri disease and esca was found for the first time on grapevines in commercial vineyards. This inoculum source is very important, and the distribution of the spores is being monitored to follow their occurrence, especially during pruning, which is an ideal infection time for these pathogens. The role of arthropods in the dispersal of trunk disease fungi has been researched over the past three years. A large variety of arthropods were found to carry spores of the trunk disease fungi on their exoskeletons. It was also shown experimentally that millipedes and ants can transfer spores of *Phaeomoniella chlamydospora* to fresh pruning wounds, where the spores are able to cause infection. Therefore integrated management of trunk diseases needs to include the selective control of certain arthropod species, of which millipedes and ants are the most predominant.

- **Citrus pathology – fungicide application technology**

In plant disease control, the use of very effective aqueous remedies (i.e. fungicides, biocontrol agents, GRAS chemicals, etc.) sometimes yields disappointing results from which growers suffer economic losses. In these cases, failure to control disease is often attributed to insufficient application of the remedy. In this research programme, various conventional

The sexual stage, Togninia minima*, has been found for the first time on grapevines in South Africa. Two of these sexual structures (indicated by arrows) are seen on the photo with their distinctive long necks. This fungus is associated with Petri disease and esca of grapevines.*

*Observation of the Portuguese millipede (*O. moreleti*) (left) and cocktail ants (*C. peringueyi*) (right) as disease vectors shortly after pruning vines.*

and novel application technologies are evaluated and optimised in citrus orchards and pack-houses in order to ensure biologically effective residue loading onto susceptible plant parts, without exceeding allowable maximum residue levels. Concomitant aims involve addressing the cost- and time-efficiency aspects of application methods by which production and environmental costs are influenced directly. The methodology employed involves a proprietary deposition assessment protocol using fluorometry, digital photography and image analyses, as well as residue analysis and biological efficacy tests.

Indigenous plant species are inoculated with Acacia cyclops *to test host specificity and hence to determine the risk of this fungus for biocontrol on* Acacia cyclops *(Vredenburg Experimental Farm-ARC).*

- **Citrus pathology – epidemiology of citrus black spot**

Citrus black spot (CBS) is a cosmetic disease of citrus fruit. However, its causal organism, *Guignardia citricarpa*, is regarded as a quarantine organism in certain countries. The South African citrus industry is the second largest exporter of fresh citrus fruit in the world, and CBS therefore is an economically important disease, given the implications for market access. In this research programme at USPP (University of Stellenbosch Plant Pathology), the epidemiology of the disease is studied to understand and predict its behaviour under climatically diverse conditions. It is expected that this will allow improved control programmes, but also assist in ongoing deliberations concerned with market access. In addition, the population genetics of *G. citricarpa* will be studied on a global scale in order to ascertain the global movement of this organism and the relative importance of sexual and asexual reproduction under diverse climatic conditions.

Community Service

The Plant Disease Clinic is a service laboratory situated in the Department of Plant Pathology at Stellenbosch University. The Clinic started its activities in October 2000, and specialists in the field of plant pathology diagnose problems on the samples received. All types of fungal or bacterial diseases on various crops, including trees, shrubs, vegetables, fruit, ornamentals, etc., are diagnosed. In 2012, a total of 728 sick plant samples were received and analysed diagnostically, and reports were sent to the clients.

In collaboration with Hortgro, the Disease Clinic presented a Plant Pathology Short Course on Fruit Crops (citrus, grapevines, stone and pome fruits) at STIAS from 30 May to 1 June 2012. This was attended by 65 people. A lecture on disease diagnosis and the Disease Clinic was also presented to second-year pomology students at Elsenburg Agricultural College in September.

Furthermore, the Department of Plant Pathology is involved in the transfer of knowledge concerning plant health issues to the agricultural and forestry industries on a continuous basis through discussions with the industry, participation in technical training and presentations at farmers' days.

STAFF

ACADEMIC
Dr C Lennox (Fruit and Postharvest Pathology)
Dr A McLeod (Molecular Plant Pathology)
Dr L Mostert (Phytomycology)
L Rose (Disease Resistance in Grain Crops)
Prof A Viljoen (Chairperson; Plant-microbe Interaction, *Fusarium* Pathology)

PROFESSORS EXTRAORDINARY
Prof P Crous
Prof L du Toit
Prof W Marasas

SENIOR LECTURER EXTRAORDINARY
Dr F Halleen

RESEARCHER
Dr P Fourie (seconded; Citrus Pathology)

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Department of

SOIL SCIENCE

Introduction

Soil is the extremely thin but precious skin covering our planet that sustains all terrestrial life forms and contributes nutrients to aquatic and marine environments. Soil Science focuses on the importance of soils as very slowly renewable natural resources. It involves the study of the properties and processes that occur in soils, as well as the sustainable use and management of soils for the benefit of humankind. Soil Science is an indispensable field of study for sustainable food production into the future.

The Department of Soil Science teaches and conducts research in all the major sub-disciplines of Soil Science, which include soil formation and classification (pedology), soil chemistry and fertility, soil physics and soil water management, soil hydrology and remote sensing, soil biology and soil ecology. Undergraduate students are equipped with fundamental scientific knowledge of soils, but also practical experience. This includes learning how to classify soils in the field, and how to conduct and compile a land suitability survey; how to sample soils and determine soil chemical and physical properties in the field and laboratory; and how to interpret the results of the analysis and write up scientific reports. The students are also taught how to plan efficient irrigation and fertilisation schemes for soils by way of assignments. Students who follow Soil Science as their major subject also study more specialised techniques and methods in advanced modules. In the comprehensive specialised postgraduate modules, students are offered enriching scientific soil research knowledge and skills.

Overview

Dr AG Hardie received the Rector's Award for Excellence in teaching for her academic contribution to the training of students. Various staff members of the Department made important contributions to industry- and subject-related organisations. Dr W de Clercq serves as a member of the steering committee of several Water Research Commission (WRC) projects. Dr JE Hoffman is Chairperson of the Winetech technical working group assessing soil research projects, a member of the academic evaluation panel of SACNSP (Soil Science), a member of the peer review group of the Deciduous Fruit Producers' Trust, and serves as a member of the steering committee of several Water Research Commission assessment panels. He makes a further contribution to the scientific community as assistant editor of the *South African Journal of Enology and Viticulture*. Dr AG Hardie is a council member of the Soil Science Society of South

Group photo of the Department of Soil Science delegates at the joint conference of the Soil Science Society in Potchefstroom.

Africa. Dr F Ellis is the chairperson of the Soil Classification Working Group that currently is revising the Soil Classification Taxonomic System of South Africa. Prof JJN Lambrechts also makes a significant contribution to this endeavour. Dr Hoffman presented a research paper on the evaluation of effective soil preparation for vines at the 19th ISTRO Congress held in Montevideo, Uruguay in September 2012, while Dr Hardie presented two research papers at the 4th International Eurosoil Congress held in Bari, Italy in July 2012. A record number of postgraduate students and academic staff (11 in total) of the Department presented their research at the annual Combined Congress of the Soil Science Society of South Africa at Potchefstroom in January 2012. Mico Stander (1st place) and Angelique Zeelie (2nd place) received the OMNIA awards for the best student papers. Dr Ailsa Hardie received the SSSSA price for the best Soil Science paper in the senior category.

Dr Ailsa Hardy receives an award for the best Soil Science paper in the senior category at the 2012 Combined Congress of the Soil Science Society of South Africa.

Research

The research focus of the Department is not only on evaluating or improving soil management practices or soil amendments, but also on elucidating soil processes in natural, agricultural and industrial environments. Research projects included: studying the role of agricultural activities in the salinisation of the Berg River; modelling the effect of soil type on groundwater recharge; carbon sequestration and turnover in soils; assessment of the soil health (soil quality) of agricultural soils;

Makhosazana Sika, current PhD student, does fieldwork at Welgevallen.

and improving water and fertiliser retention in sandy soils using biochar. Research on pollution from old exhausted mines and pollution by agricultural chemicals is also carried out. There further are projects that examine the impact of soils on ecosystems and biodiversity, study the effect of plant hormones in organic soil amendments on the soil biology, compare the water balance of irrigated and dry-land crops, and study the long-term impact of deep tillage soil preparation in vineyards.

The Department of Soil Science has been running a biochar research programme funded by the Food Security Initiative of the Stellenbosch University

HOPE Project since 2009. Biochar is pyrolysed biomass produced with the aim of application in soils as a slowly-degradable carbon amendment. The project has involved collaboration with the Departments of Process Engineering, Microbiology and Botany at Stellenbosch University. Five MSc studies have been completed thus far, and a PhD research project has been initiated to continue the research, investigating the molecular interactions of N fertiliser and different biochars produced from various wastes. This project involves collaboration with Prof Yakov Kuzyakov (Karl-August University, Göttingen, Germany), an expert in stable isotope tracer techniques in soils. Dr Ailsa Hardie, Dr Andrei Rozanov and a PhD student, Ms M Sika, visited Prof Kuzyakov in Germany in September 2012 to establish the research collaboration for the biochar project. The project is funded by the NRF-German South African Year of Science Initiative.

The soil in rooibos tea plantations is compared during the Soil Science Tour in 2012.

Two collaborative research projects between Elsenburg, the Western Cape Department of Agriculture and the Department were initiated in 2012. The one project is investigating the long-term effects of conservation tillage crop rotation practices on soil organic matter stabilisation, and the other project is investigating the long-term effect of different soil tillage practices and cropping rotation systems on the water balance.

A research project has begun to investigate the effect of long-term rooibos tea cultivation on soil quality and rooibos plant quality in the Clanwilliam area. This project involves collaboration between the Departments of Soil Science and Microbiology. The aim of the project is to identify the soil and plant quality factors behind the decline in rooibos production on older rooibos lands by comparing soil and plant quality on recently cleared fynbos soils and long-term cultivated rooibos soils in the area.

A project funded by the WRC and focusing on optimising the monitoring of groundwater, surface water and atmospheric parameters to enable advanced decision making at the local level is being conducted in collaboration with the CSIR. The project concerning the contribution from farming practices to the salinisation of the Berg River is continuing. At present, work is being done on developing a hydrological model for the Sandspruit catchment area to estimate the contribution to the Berg River of the river's salt content that is due to different land uses (farming practices). The hydrological model will make it possible to develop guidelines for future land use. A follow-up project focuses on developing salinisation

management models and methods for the identification of specific salinisation problems, as well as basic studies to facilitate further modelling. One PhD and three MSc studies have been completed as part of this project thus far.

The international research collaboration EAU4Food project between the Department and various participants from the European Union is now in its second year of operation. This project, focusing on optimising the use of scarce supplies of irrigation water for the sustainable production of vegetable crops in areas with meagre resources, is being undertaken with partners in Wageningen in the Netherlands. The project will focus on developing and testing innovative, robust and affordable methods suitable for local conditions. Newly-developed irrigation technology will be used, supported by locally existing traditional practices used by small-scale farmers. The information will be presented simply and in an easily understandable manner for effective use by unskilled people. The project is currently being carried out with farmers in the Giyani District, Limpopo Province.

Master's students determining the soil water content of marshes in Boesmanskloof.

A research project is being carried out to investigate the mobility of metals in polluted arid soils in the vicinity of old copper mines in the Northern Cape. This project involves investigation of the stability of Cu phases that have formed in the soils. Another project is being carried out on the mobility and degradation of the pesticide, atrazine, in soils. The physicochemical adsorption and transformation mechanisms of atrazine by soil minerals are being investigated by an MSc student. Interesting research is being carried out at the low-grade nuclear waste disposal site at Vaalputs, Northern Cape. The research aims to characterise and interpret the palaeosols that formed under previous climate regimes.

Cou Pienaar busy with fieldwork for EAU4Food.

Soil investigations during the 2012 Soil Science Tour to Namaqualand.

An MSc project on the effect of soil texture and NPK fertilisation regime on the optimal production of the African herb, *Mentha*

longifolia, has been completed successfully. The project has made an important contribution to the cultivation of this traditional indigenous medicinal plant. Two MSc projects investigating the effect of a commercial, orange oil-based soil ameliorant on soil physical properties were also completed successfully.

Community Interaction

Staff members of the Department are involved in several community service activities. The Department was involved with the study group that investigated the Table Mountain aquifer and monitored the groundwater content of several marshlands. Organisations were assisted through environmental impact studies, and the suitability of soils for use as cemeteries was investigated. Dr Hoffman served as main judge in the Agricultural category at the regional Expo for Young Scientists. The Department, in collaboration with the SU Department of Agricultural Economics, was involved in the assessment and interpretation of soils for valuation. Staff members of the Department of Soil Science contributed to the wider agricultural community during various farmers' days of the Western Cape Department of Agriculture, and by presenting workshops on surface water management in collaboration with the WRC. The EAU4Food research programme conducted in Giyani held a number of farmers' days, in which information about optimal cultivation and irrigation practices was presented to the local small-scale farmers. Workshops are also presented on a continuous basis.

A postgraduate student installing access tubes for a soil water-measuring instrument at Nuweberg.

STAFF

ACADEMIC

Dr CE Clarck (Pedology, Soil Mapping, Geochemistry)
Dr F Ellis (Pedology, Soil Mapping)
Dr AG Hardie (Soil Chemistry, Soil Fertility)
Dr JE Hoffman (Chairperson; Soil Physics, Water Management)
Dr A Rozanov (Soil Biology, GIS)

PROFESSORS EXTRAORDINARY

Prof MV Fey (Soil Chemistry)
Prof JJN Lambrechts (Pedology)

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Department of

VITICULTURE AND OENOLOGY
& Institute for Wine Biotechnology

Introduction

The mission of the Department of Viticulture and Oenology (DVO) and the Institute for Wine Biotechnology (IWBT) is to be a centre of excellence in wine science that focuses on training and innovative research to provide the South African wine and grapevine industries with well-qualified human resources, cutting-edge technology and the latest scientific knowledge. As the only wine science environment at a South African university, a major focus is on producing well-trained professional graduates and postgraduates who can make major contributions to our industry and to the agricultural sector in general. Research is multidisciplinary, and integrates traditional viticulture and oenology with disciplines such as physiology, biochemistry, molecular biology and biotechnology of grape vine, yeast and lactic acid bacteria, wine chemistry and sensorial sciences, and computational biology. Specific projects investigate the influence of viticultural and oenological practices on berry and wine composition (wine quality), biopreservation, wine ageing and aroma, wood and phenolics, oxidation, and chemical and other taints in wine. Research in viticulture includes grapevine ecophysiology, molecular biology and biotechnology, ecophysiology of berry ripening, influence of abiotic factors on vine physiology and berry composition, harvest potentiality and site, table grape cultivation and nutrition. Funding for research and experimentation is generated through contributions from various sources, including the South African Table Grape Industry, the National Research Foundation, THRIP, Winetech and the Pinotage Association, as well as private companies such as Anchor Yeast/Oenobrands, Lallemand, Chr Hansen and Thales Wine Cellar Services.

Overview of activities and achievements

During September 2012, 19 final-year students in Viticulture and Oenology competed for the sought-after Felco Floating Trophy, which is awarded every year to the student who fares best in practical pruning in the vineyard. After careful evaluation, the following students were announced as the winners: first place and recipient of the Felco Floating Trophy, with shopping vouchers from Felco and Agrimark Stellenbosch, was

The winners of the Felco Floating Trophy competition: first place and recipient of the Felco Floating Trophy and shopping vouchers from Felco and Agrimark Stellenbosch was Neil Bent (right) with 88%, second was Ilana van der Ham (middle) with 86% and third was Niclaas van Rensburg (left) with 84%. The prizes were awarded by Vaatjie Jacobs (back right) of the Department of Viticulture and Oenology and Gys Liebenberg (back left), director of Felco Africa.

Niel Bent with 88%, second was Ilana van der Ham with 86% and third was Niclaas van Rensburg with 84%. The prizes were handed over by Vaatjie Jacobs of the Department of Viticulture and Oenology and Gys Liebenberg, director of Felco Africa.

Ms Anne Alessandri has been assisting the academics with the rollout of the new, extended Oenology and Viticulture internships. So far, feedback from the industry and students has been overwhelmingly positive. Initial results in a research collaboration (between the Division for Community Interaction at SU and the DVO) indicate that the extended internships are enhancing important graduate attributes in our students.

The DVO interns of 2012.

A most successful 'Ancient Wine Mini-Symposium', sponsored by the Department of Viticulture and Oenology and the Institute for Wine Biotechnology, was held on the Stellenbosch Campus in November 2012. The event attracted between 60 and 70 participants from the wine industry, various academic departments at the University and the wider public. Members of the audience consisted of winemakers, industry representatives, microbiologists, historians, museum curators, sociologists, Biblical scholars and horticulturists.

The speakers included Prof Sakkie Cornelius and Dr Samantha Masters of the Department of Ancient Studies – they spoke about 'grape and wine art of the Ancient Near East' and 'the art of the Greek symposium' respectively. Prof Alain Deloire of the Department of Viticulture and Oenology spoke on viticultural practices from the Roman period to late 19th-century France. Dr John Moore of the Institute for Wine Biotechnology, who helped organise the event, discussed the significance of wine-related scenes in the tomb art of Ancient Egypt. The keynote speaker

At the mini-symposium were (from left): Dr John Moore (Institute for Wine Biotechnology), Prof Sakkie Cornelius and Dr Samantha Masters (Department of Ancient Studies), Prof Alain Deloire (Department of Viticulture and Oenology) and Dr Patrick McGovern (University of Pennsylvania Museum, Philadelphia).

was Dr Patrick McGovern of the University of Pennsylvania Museum (Philadelphia, USA), who spoke on 'Uncorking the past: the quest for wine, beer, and extreme fermented beverages'.

Dr Wessel du Toit and Ms Anneli Bosman currently serve on the board of the South African Society for Enology and Viticulture (SASEV). Mr Pieter Raath is Chairperson of the Table Grape Committee and Ms Bosman is chairperson of the Viticulture and Oenology Forum of SASEV.

Conference contributions

The DVO-IWBT environment made 50 contributions to national and international conferences during 2012. The environment contributed significantly to the Thirty-fourth Conference of the South African Society of Enology and Viticulture at Groot Drakenstein, with presentations and posters covering areas as diverse as co-inoculation of malolactic bacteria, grapevine responses to irrigation, bioprocess monitoring, application of new technology (including x-ray tomography, NIR spectroscopy and GIS) in viticulture and sensory studies in wine phenolics. Other national conferences included the SASBMB-FASBMB congress in the Drakensberg, where IWBT members presented new findings in biochemistry and molecular biology. Horticultural and botanical aspects of the IWBT's work were also presented in Pretoria and Skukuza, and chemometric applications were showcased at the 2nd SA Chemometrics Conference in Irene. The pedagogical research (on work-based learning) currently under way in the DVO was also presented at two national conferences during November. The IWBT presented 12 talks and posters at the second African-European Conference on Chemometrics.

International collaboration has been an important aspect of the success of our contributions to conferences, and our collaborators include colleagues in Slovenia, Australia and France. International conferences hosted a number of DVO-IWBT colleagues. Macrowine 2012, in Bordeaux, France, saw a diverse range of subjects, which included aroma in Sauvignon blanc, profiling of carotenoid metabolism, malolactic co-inoculation and chemometric modelling, being addressed by members of the Department and the Institute. Dr Helene Nieuwoudt was an invited speaker at a sensory seminar held at the Department of Food Science, Stellenbosch University, where she spoke about the position of South African Chenin blanc in the global market.

Research

Department of Viticulture and Oenology

Viticulture

The generation of new, innovative and applicable knowledge on the grapevine and its cultivation is the focus of the viticultural research undertaken by the DVO. The focus of the research and experimentation in the field of vine sciences (wine and table grape) is on the effect of abiotic factors (light, temperature, wind and water) on the ecophysiology of vine functioning, berry growth and composition. Vineyard locations and cultivars are chosen according to scientific and practical questions that need to be addressed. Studies focus on the plant, organ and cell levels, so greenhouse and in vitro culture facilities have also been implemented. Remote sensing and the development of new technologies are also used intensively in research and experimentation in viticulture. Most of the studies are done in conjunction with oenology to better understand the effect of the abiotic factors and of cultural practices, including canopy manipulation (training system) and irrigation, on the composition and style of wine. Three MScAgric students graduated from the Viticulture research programme in 2012.

Oenology

The oenological research focuses on the influence of the vinification process (such as oxygen additions), microorganisms (yeasts and bacteria), additives (such as enzymes and CMC) and maturation on wine composition, style and quality, as well as the effects of various factors on wine ageing. Researchers work closely with industry partners and help to resolve issues facing winemakers at both a fundamental and a practical level. Seven MScAgric students and one PhD (Agric) student graduated from the Oenology research programme in 2012. Some students who are busy with their Vintage Master's programme did research on phenolics in grapes.

Antonio Ferreira's research focuses on the flavour chemistry of alcoholic beverages, and in particular the correlation of sensory and chemical data in the perception of quality. Most of his work has been in collaboration with Portuguese wine/beer companies or other research groups in Europe. His research projects have resulted in the development of new methodologies allowing the quantification of flavour-relevant substances in wines that are perceived as off-flavours or in-flavours. The application of hybrid techniques and a holistic approach are used with sensory quality questions concerning aroma, mouthfeel sensations, etc. The research workflow includes integrating the most advanced chemical/sensory techniques and then using the set of information to design a prediction model. This holistic approach should be considered when dealing with sensory quality questions taking into account aroma, mouthfeel sensations and other senses. The non-destructive sensors represent a great opportunity to integrate all these variables when mathematical models are provided and then applied to the development of on(at)line devices during wine production. The ultimate goal would be to provide tools to industry that enable the highly accurate control of desirable sensory attribute(s) from the vineyard to the consumer. In this context Antonio's work also follows an "omics approach"

Bernard Bredell, a student in Viticulture and Oenology, busy making wine at Lourensford Estate.

in order to create models that are applicable to complex issues, such as understanding wine ageing chemistry, wine oxidation or the definition of grape quality. The research workflow includes integrating the most advanced chemical/sensory techniques and then using the set of information to design a prediction model. This vision is only effective with a multidisciplinary research group.

Alain Deloire's research and experimentation focus on the ecophysiology of berry growth and composition in relationship to wine composition and style. The research projects try to understand the effect of abiotic factors (light, temperature, wind and water) on berry growth and composition. In a suitable vineyard the experiments are designed to create extreme conditions at the microclimatic level (bunch and canopy) to study the limit of vine functioning, berry growth and ripening. New decision-making tools to predict the harvest date of red and white cultivars have been calibrated for South Africa. The practical targets of these studies are related to water management, site x cultivar adaptation and the matching of ripening and wine style.

Albert Strever's research focuses on understanding grapevine variability through non-destructive techniques, including field spectroscopy, thermal imaging and multispectral remote sensing. His PhD study also incorporated growth modelling and leaf age determination techniques within a study in which the interaction of plant water status and canopy manipulation was investigated. Other projects include studying the balance between grapevine yield components and growth (**Anneli Bosman**), and using remote sensing in climate studies (also incorporating thermal satellite imagery) (**Tara Mehmel**).

Anneli Bosman specialises in grapevine architecture and alternative trellis systems. Her research is focused on the use of alternative trellis systems in order to optimise productivity in vineyards while preserving or improving grape quality, relative to a specific production goal and price point. This involves observing the vine's compensation mechanism in reaction to the modification of its balances. Sustainable practices include the alteration of grapevine architecture, amongst others to be more environmentally friendly and cost effective, while ways to improve product marketability are also investigated.

Erna Blancquaert's research addresses the environmental factors that have a significant impact on wine grape composition and wine quality and style. Research is currently being conducted on the influence of abiotic factors (light, temperature) on tannin and phenolic development in the berry and the mouthfeel characteristics of the wines.

Oenology 214 students enjoy the results of a food and wine pairing exercise.

Marianne McKay is involved in ongoing research on the so-called 'burnt rubber (BR)' taint. Members of the BR team have conducted many tastings and have isolated some of the factors that may contribute to this off-flavour. Various analytical methods help identify the compounds that could be responsible, and students, including **Anne Alessandri** and **Chris de Vries**, have investigated factors in the vineyard that may enhance the aroma. Marianne is also involved in research on teaching and training in the wine industry, with a focus on looking at methods that enhance professionalism and graduate attributes.

Wessel du Toit's research team (in collaboration with Auckland University in New Zealand) was involved in investigating the effect of different oxygen additions on the chemistry and sensorial quality of Sauvignon blanc wine. Part of this study entails characterising South African Sauvignon blanc wines in terms of their chemical and sensory composition. The effect of different winemaking practices on glutathione in wine was also investigated. Other research projects investigated the tannin and anthocyanin concentrations in red grapes and how these are reflected in the corresponding wines. Advanced analytical techniques, such as GCMS, HPLC and infrared spectroscopy, have been developed and are being used in these studies.

Institute for Wine Biotechnology

The Grapevine Molecular and Biotechnology Programme

Prof Melané Vivier, Dr Philip Young, Dr John Moore and Dan Jacobson are involved in fundamental and applied studies of grapevine in interaction with pathogens and the environment, supported by a grapevine transformation and regeneration platform. The ability to genetically transform grapevine enables in-depth studies of grapevine through overexpression and silencing approaches, as well as a range of other tissue culture applications. The research is progressively being integrated into viticultural field studies to "profile" grapevines growing under different conditions so that the plant's response to these factors can be understood on a plant biological level. Transcriptomic, proteomic, metabolite as well as hormone profiling are used to provide layers of data that are then overlaid with viticultural and oenological data to obtain a holistic view of the grape-growing process and its impact on the vine as a system.

Mr Leonard Adams, Technical Officer in the Department of Viticulture and Oenology, busy with measurements in the Welgevallen vineyards.

The Microbiology Programme

This programme is driven by **Prof Florian Bauer, Prof Maret du Toit, Dr Evodia Setati, Dr Benoit Divol and Ms Anita Smit** and involves fundamental and applied studies of all wine microorganisms, with a specific emphasis on those responsible for alcoholic and malolactic fermentations. Within this extensive research programme, specific attention is given to aspects ranging from the microbial ecology of grape berries and grape juice, to survival strategies of spoilage microorganisms and the impact of non-*Saccharomyces* yeasts on wine composition. Interactions between all microorganisms are also studied. The different research projects make use of

all standard microbiological and molecular biology techniques, as well as genomics-, metagenomics-, transcriptomics-, proteomics- and metabolomics-based approaches. The outcomes of these studies are also used to isolate, select and/or generate yeast and bacteria with enhanced oenological properties.

The Computational Biology Programme

This programme is driven by **Dan Jacobson** and involves the development/application of mathematical, statistical and computational methods to biological data sets in order to yield new insights and thus transform data into knowledge. Areas of mathematics of interest in this programme include the use of network theory, network-based topological clustering, and Markov clustering, wavelet theory and machine learning. Areas of statistics of particular interest to this programme are the use of both frequentist (parametric and non-parametric) and Bayesian methods, as well as the development of new methods in multivariate statistics (chemometrics). These methods are applied to various data sets to better understand the transcriptional, translational and chemical (kinetic) regulatory networks in the organisms and chemical systems involved in wine. This programme is actively involved with undergraduate and postgraduate students from the Biomathematics programme in the Department of Applied Mathematics and the African Institute for Mathematical Sciences (AIMS) and, together with colleagues in Engineering and Information Technology, oversees the High Performance Computing (HPC) facility on campus.

The Chemistry and Sensory Programme

Dr Andreas Tredoux is involved in the development of novel chromatographic methods for the analysis of targeted and untargeted compounds in wine, grapes and grapevine, including the analysis of 57 important volatiles in wine. Solid phase micro-extraction (SPME) with gas chromatography-mass spectrometry (GC-MS) is used for the analysis of odour-active carbonyl compounds and volatile phenols in wine. Ultraperformance liquid chromatography (UPLC) methods for the analysis of non-volatile wine compounds and 2D-GC-MS (GCxGC-MS) methods have been developed in collaboration with Dr André de Villiers (Department of Chemistry). SPME and liquid-liquid extraction (LLE) are used in combination with GC-MS for untargeted analysis of wine volatiles in collaboration with Prof AC da Silva Ferreira (Department of Viticulture and Oenology). Another focus is bioprocess monitoring of wine fermentations and the combination of sensory studies with chemistry in collaboration with Dr Hélène Nieuwoudt and Ms Nina Muller (Department of Food Science). Four MSc students for whom Dr Tredoux acted as co-supervisor and who graduated in 2012 were involved in this ongoing project.

Dr Hélène Nieuwoudt is involved with two research areas: one involves the development of rapid analytical techniques based on near- and mid-infrared spectroscopy and chemometric data analysis tools for qualitative and quantitative applications in wine biotechnology, while the other focus area is the chemical, sensory and consumer profiling of South African wines. For the spectroscopy-based projects, multivariate quantification and classification based on the infrared spectra of grapes, fermenting must and wine are important topics of research. An important application area is bioprocess monitoring of wine fermentations, using both chemistry and infrared spectroscopy. For the sensory and consumer studies, the focus has been on commercial Chenin blanc wine. Together with colleagues from Food Science, the chemical and sensory profiling of some 120 South African Chenin blanc wines was undertaken. This project is part of an international research

collaboration, ConsumerCheck, with Prof Tormod Naes (Technical University of Norway) as programme leader. Achievements include chemical, sensory and consumer profiling of Chenin blanc and noble late harvest wines. A flavour wheel was developed for noble late harvest wines, and four MSc students graduated from this programme in 2012.

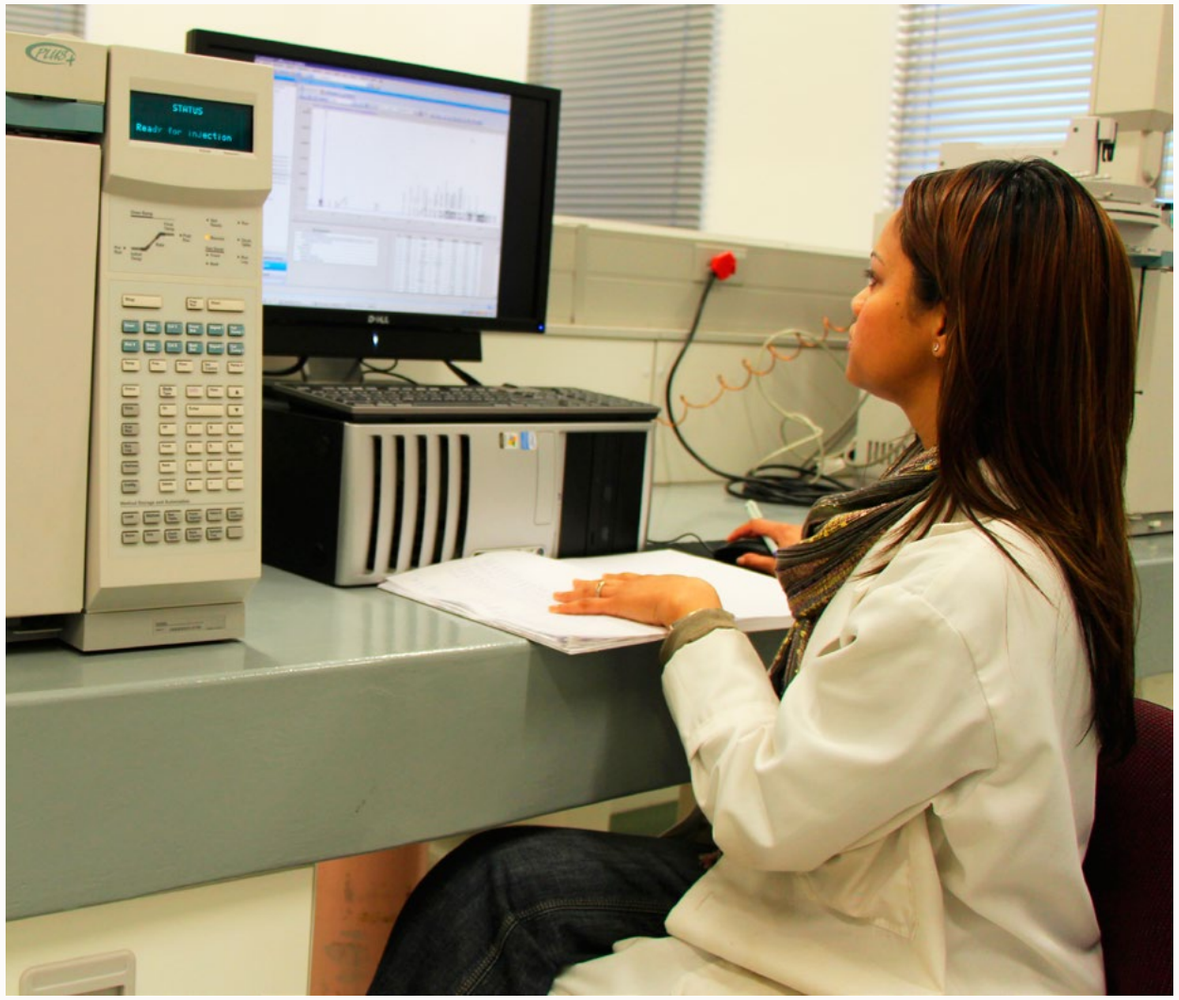
DVO-IWBT: Towards an integrated approach

The NRF-funded Wine Science Research Niche Area Programme (RNA)

The Wine Science RNA embodies a drive for excellence in grapevine and wine research. The programme provides a specific focus on training and research and has contributed significantly to strengthening the postgraduate programmes and outputs of the DVO and IWBT. It provides opportunities to collaborate and integrate knowledge from a range of fields and to develop critically scarce skills. The key partners in this RNA are the Institute for Wine Biotechnology (IWBT), the Department of Viticulture and Oenology (DVO), the Department of Chemistry and Polymer Science and the Department of Food Science (Sensory Division).

Community Interaction

The Department of Viticulture and Oenology makes wine on a small scale for the KWV and other role players in the industry (usually to test different clones). The Department is involved in various projects to transfer technology to the community. Staff members are invited on an ongoing basis to serve on evaluation panels for the wine industry's VinPro Vineyard Block Competition. Workshops are held regularly under the auspices of SASEV for table grape growers in Stellenbosch and Paarl, while the Department also participates in numerous other workshops and forums for SASEV. The STIAS/Perold vineyard project is an ongoing concern that involves a number of players in the wine industry, including the Pinotage Association, and also provides training in young vine development for trainee viticultural workers from underprivileged communities. During 2012 the Department presented a short course for small producers and garagiste winemakers. There also is regular involvement in the Wine Evaluation Committee of the Wine and Spirits Board at Nietvoorbij. In 2011 to 2012 the Department was actively involved



Ms Lynzey Isaacs, Technical Officer in the Chemical Analytical Laboratory, busy with chromatographic analysis of the most important volatile components of wine.

in supporting and advising the Dame Hilary Cropper Foundation, a British charitable trust that is establishing a centre for education and training for young people in the wine industry in South Africa: The Pinotage Youth Development Academy. Marianne McKay was seconded to the Advisory Board for this initiative and has been engaged in curriculum development and support for the programme. The project is now in its implementation phase, the staff have been appointed, and offices have been established at Stellekaya. The curriculum and venue are being finalised and the recruitment process is about to be launched. Furthermore, the PYDA brand and website have been established: http://www.pyda.co.za/home/.

Staff and students of the Department of Viticulture and Oenology and the Institute for Wine Biotechnology made Christmas an unforgettable day for 30 less-privileged children from Idas Valley in Stellenbosch by giving each child a Santa Shoe Box filled with a variety of items. On the photo is Ms Erna Blancquaert, a lecturer in Viticulture and Community Interaction Coordinator of the Department, handing out the gifts to the children.

STAFF

ACADEMIC

Prof FF Bauer (Yeast Molecular and Cellular Biology)
EH Blanquaert (Viticulture); A Bosman* (Viticulture)
Prof AC Da Silva Ferreira (Flavour Chemistry)
Prof AJ Deloire+ (Chairperson, Grapevine Physiology and Berry Ripening)
Dr BT Divol (Wine Biotechnology)
Prof M du Toit (Wine Microbiology and Biopreservation)
Dr WJ du Toit (Wine Chemistry)
D Jacobson* (Computational Biology)
Dr E Kraeva* (Grapevine Histology and Biochemistry)
MA McKay (Wine Chemistry, Wine Aroma, Sensory Evaluation)
TO Mehmel (Viticulture)
Dr JP Moore (Grapevine Biochemistry, Metabolomics)
Dr HH Nieuwoudt* (Spectroscopy)
Prof BA Prior (Microbiology)
Dr ME Setati (Wine Microbiology)
AY Smit* (Yeast Biotechnology)
C Stander* (Grapevine Biotechnology)
Dr AE Strever (Grapevine Cultivation and Remote Sensing)
Dr AJG Tredoux (Analytical Wine Chemistry)
Prof MA Vivier (Grapevine Molecular and Cellular Biology)
Prof MB von Wechmar* (Microbe Biodiversity)
Dr PR Young* (Grapevine Molecular Physiology, Biotechnology).

ACADEMICS EXTRAORDINARY

Prof JJ Hunter* (Viticulture)
Prof MG Lambrechts* (Oenology, Wine Biotechnology)
Dr PJ Raath (Table Grapes)
Prof P van Rensburg* (Wine Fermentation and Processing)

TECHNICAL

WJ Arries*+
ZA Coetzee
L Engelbrecht
SC Fairbairn*
H Hamman*
LO Isaacs*
J Jacobs
HK Jumat*
MB Korkie*
WL Kotobe*
ER Lakey
E Lerm*+
TT Mostert*
M Nell
V Panzeri*
V Premsagar*
H September
W Smith
CM Stilwaney*
A van Wyk
RF Wassüng
EL Willenburg*+
JJ Zietsman*

ADMINISTRATIVE

S Baard
GR Burton
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LP Rambau*
CCA Vergeer

SUPPORTING

EF Februarie
T Jansen
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JP Williams

** Temporary*
+ Resigned/work contract expired

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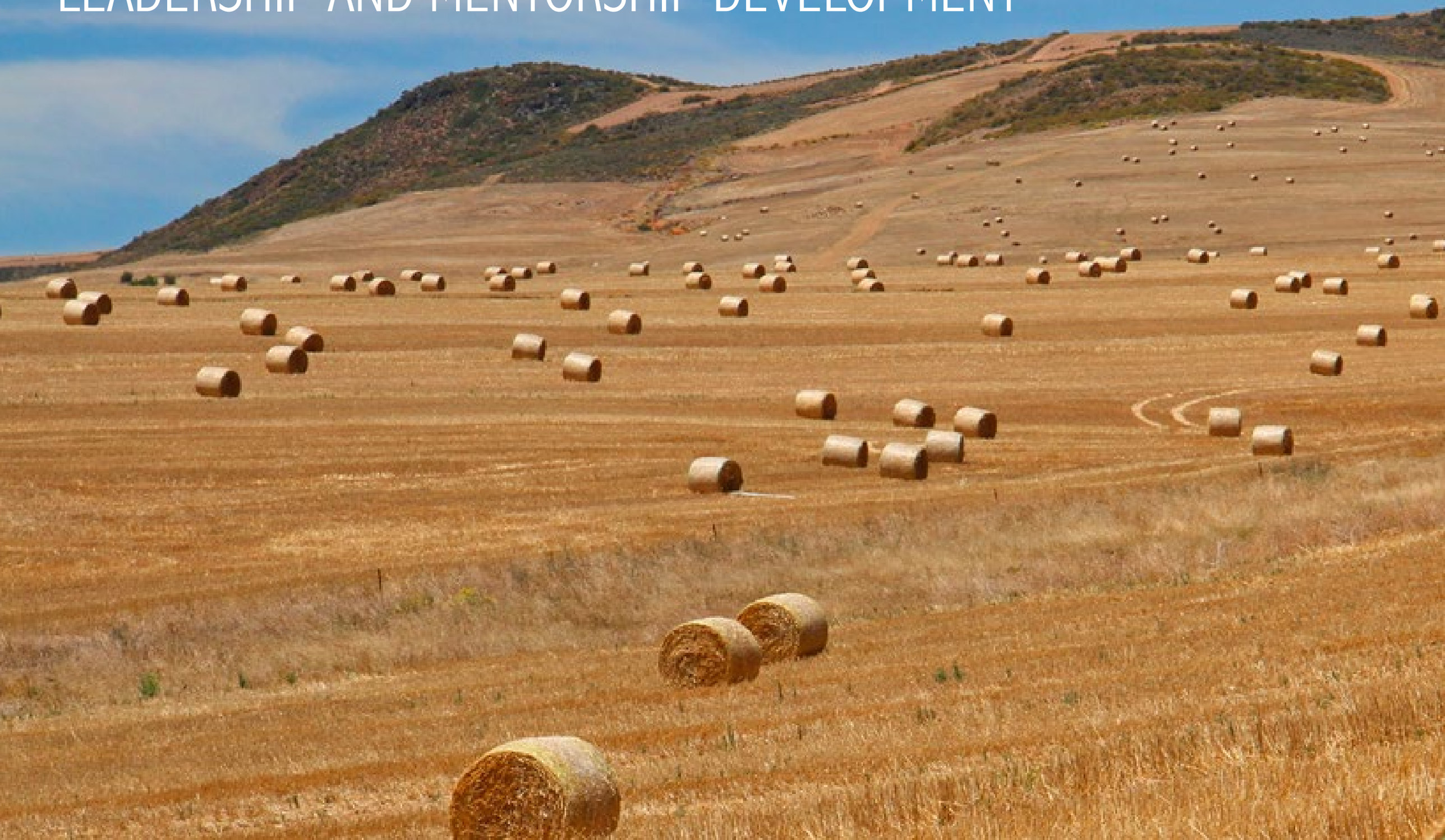
THE STANDARD BANK CENTRE FOR AGRIBUSINESS LEADERSHIP AND MENTORSHIP DEVELOPMENT



Introduction

The Standard Bank Centre for Agribusiness Leadership and Mentorship Development, funded by Standard Bank of South Africa for a three-year period, started its operations as one of the initiatives under the University's HOPE Project in April 2010. The focus is on strategic leadership and transformation in agribusiness. The Centre gained prominence in the wider agricultural environment and agribusiness community through its research activities and leadership laboratories, and is viewed as a well-established entity in the Faculty of AgriSciences. A number of foreign delegations have been received and interesting international networks are being developed.

VISION: To foster agricultural development, growth and transformation through knowledge generation and transfer, with outreach activities directed at agribusiness leadership, extension and mentorship.

MISSION: To be the knowledge partner in successful agricultural transformation and land reform initiatives by providing academic training and research, leadership and advisory support and mentorship development.

Overview

1. The Academic and Research Programme

The Centre participates in postgraduate teaching in agri-management and development at the PhD and Master's level in the Department of Agricultural Economics. Since 2010, twenty-one South African students have been supported through bursaries from AgriSeta and SantamAgri, as well as the Western Cape Department of Agriculture.

The research programme focuses on case studies in agricultural transformation, competitiveness and food security management, and the linking of new farmers/smallholders to commercial agri-food value chains. To date, 30 cases have been developed and are used for teaching purposes.

2. Outreach Activities

Outreach activities were focused on transformational issues in the South African agribusiness environment.

The short course programme – Agri-leadership, management and mentorship development

This programme, presented in collaboration with PwC, is directed at middle management and offers training for agri-mentors and managers/leaders operating in the agricultural transformation and land reform environment. To date, short courses have been conducted in collaboration with the mentorship programme of Grain South Africa. These courses are intended to support capacity development in the land restitution programme in Limpopo Province in collaboration with the Limpopo Agribusiness Development Alliance (LADA). The training of 80 professionals to lead land reform projects in Limpopo is currently under way. The extension of this programme to focus on business development is planned for the future.

The Agri-Leadership Laboratory

This programme focuses on leadership development in the agricultural sector through the staging of "Agri-Leadership Imbizos". Prominent agri-leaders and opinion makers are invited to discuss "hot topics" in agricultural transformation in a "laboratory setting" to stimulate "out-of-the-box" debate and discussion in the attempt to develop new solutions. Only consensus statements ("one-pagers") are formally published on the Centre's website and are communicated to institutions such as the National Planning Council, various representative groups in agriculture, government agencies and other relevant public bodies. Inputs were also made to the National Development Plan. To date, ten Imbizos have been held, covering topics such as:

- Land reform and agricultural development;
- Job creation in agriculture;
- Unity and cooperation in SA agriculture;
- Where to with black commercial farmers?

Two "Young Leaders Laboratories" were presented in collaboration with Standard Bank, GrainSA and Santam Agri, and an Imbizo was held in June 2012 at the request of the secretary-general of the governing party to discuss agricultural matters with leading South African commercial farmers.

The African Agricultural Leadership Programme

This initiative is aimed at prominent young professionals and leaders in the African agricultural environment and provides academic and operational experience in the agribusiness environment. The programme is implemented as a partnership between the Standard Bank Centre for Agribusiness Leadership and Mentorship Development and the Royal Agricultural College in the UK (RAC), and is funded by the African Fellowship Trust (AFT). The programme involves a Master's-level component plus networking

Participants in the Imbizo in June 2012 with Roelf Meyer and Gwede Mantashe, secretary-general of the ANC.

and internship placements with South African agribusiness groups.

To date, seven selected professionals have visited South Africa. After an orientation period at Stellenbosch University, they spent six weeks at selected agribusinesses on an industrial internship basis. Participating institutions were KaapAgri in Malmesbury, TSB in Malelane, Haygrove Tunnels in Grabouw, ZZ2 in Moketsi, Standard Bank Africa, the Stellenbosch Municipality and Pioneer Foods in Paarl.

Prof Johan van Rooyen, Director of the Standard Bank Centre for Agribusiness Leadership and Mentorship Development, in action during the Imbizo.

STAFF

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VITICULTURE AND OENOLOGY & INSTITUTE FOR WINE BIOTECHNOLOGY

DEPARTMENT OF VITICULTURE AND OENOLOGY

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Design and digital publication
by Liezel Meintjes
SUN MeDIA Stellenbosch
www.africansunmedia.co.za