A Century of Biological Control of Invasive Alien Plants in South Africa

Exactly one hundred years have passed since the first, deliberate introduction into South Africa of plant-feeding insects to control a problematic, alien plant species. In this case, the target weed was the drooping or cochineal prickly pear, *Opuntia monacantha*, which was invading the coastal areas of KwaZulu-Natal and the Eastern Cape. The biocontrol agent was a host-specific cochineal species, *Dactylopius ceylonicus* (then commonly known as the Indian Cochineal, despite its Brazilian origin), which was obtained from India via Sri Lanka through the courtesy of the Queensland Prickly Pear Commission. This project, initiated during 1913, has been a complete success and, today, throughout its distribution range in South Africa, the drooping prickly pear is still being controlled by the cochineal without the need for additional control measures. An account of this project by Charles Lounsbury was published in *The Agricultural Journal of South Africa* during June 1915.

Today, South Africa is one of world’s leading countries with regard to weed biological control, with a proud history of solid science and great success in this field. During the 100 years since 1913, some 75 species or biotypes of biocontrol agents have become established in South Africa on 50 invasive alien plant species. Biological control has resulted in complete or substantial levels of control in 30 of these 50 plant species. This means that either no other measures are needed to reduce the weed to acceptable levels, or that less effort is required (e.g. less frequent or less concentrated herbicide applications). In 14 of the target weed species, control still relies entirely on other control measures, despite the damage caused by the biocontrol agents, and in the remaining six plant species it is too soon to determine the level of control.

To achieve these successes, 270 species or biotypes of insects, mites or pathogens were introduced into South Africa of plant-feeding insects to control a problematic, alien plant species. In this case, the target weed was the drooping or cochineal prickly pear, *Opuntia monacantha*, which was invading the coastal areas of KwaZulu-Natal and the Eastern Cape. The biocontrol agent was a host-specific cochineal species, *Dactylopius ceylonicus* (then commonly known as the Indian Cochineal, despite its Brazilian origin), which was obtained from India via Sri Lanka through the courtesy of the Queensland Prickly Pear Commission. This project, initiated during 1913, has been a complete success and, today, throughout its distribution range in South Africa, the drooping prickly pear is still being controlled by the cochineal without the need for additional control measures. An account of this project by Charles Lounsbury was published in *The Agricultural Journal of South Africa* during June 1915.

South Africa’s oldest weeds biocontrol project: A healthy plant of the invasive cactus *Opuntia monacantha* (left), and another plant of the same species about to die due to attack by the cochineal *Dactylopius ceylonicus*, which was first introduced during 1913.
A catalogue of all insects, mites and pathogens that have been used or rejected, or are under consideration for the biological control of alien plants in South Africa was published (Klein 2011) as part of a Special Issue of African Entomology (Volume 19, no. 2), containing 29 papers that review weed biological control in South Africa (1999-2010).

The same Special Issue carries a paper (Van Wilgen & De Lange 2011) that provides perspective on the economic value of weed biological control. The authors estimated the cost of only a few detrimental effects of invading alien plants in South Africa at approximately R6.5 billion per annum (about 0.3 % of the country’s GDP), and added that the costs could rise to more than 5 % of GDP if the invading plants were allowed to reach their full potential. Compared to conventional control measures, it was found that biological control yielded significantly better returns on investment. “By comparing the costs of biological control research and implementation to the benefits of restored ecosystem services, or avoided costs, and avoided ongoing control costs, biological control has been shown to be extremely beneficial in economic terms: estimated benefit:cost ratios ranged from 8:1 up to 3726:1.” This is a persuasive argument in favour of increased funding for weed biological control research and implementation.

References

KLEIN, H. 2011. A catalogue of all insects, mites and pathogens that have been used or rejected, or are under considerations, for the biological control of alien plants in South Africa. African Entomology 19(2): 515-549.


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NEW APPOINTMENTS AT ARC—PPRI

In January 2013, Dr Draginja Pavlic Zupanc joined the Mycology Unit team in the position of Senior researcher: Fungal taxonomist. She completed her BSc (Agric) degree as Graduate Agricultural Engineer for Crop and Food Protection (cum laude) at the Faculty of Agriculture, University of Belgrade, Serbia. She obtained her MSc (cum laude) and PhD degrees in the Department of Microbiology and Plant Pathology, at the Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, with specialisation in Plant Pathology (Mycology). Dr Pavlic Zupanc has published scientific papers in highly rated international journals, and has presented papers at national and international scientific conferences. She has supervised postgraduate students and has conducted research in various national and international research projects. Her research interest is in the areas of taxonomy, phylogenetics and population genetics of fungal plant pathogens. More specifically, her research is focused on the plant pathogens within the species-rich fungal family, Botryosphaeriaceae.

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Ronel Viljoen joined the Virology Unit in December 2012. She replaced Kassie Kasdorf, who retired as chief research technician earlier in 2012. Ronel is currently working on her MSc with the title: “Candidatus Liberibacter” amongst four indigenous Rutaceae species.

Ronel is taking over the collections project, and will assist with some diagnostics as well as some general virology functions. A large part of her time will be spent on a project funded by the Citrus Research International with the objective to identify “candidatus liberibacter” species on indigenous citrus relatives.

Ronel recently relocated to Pretoria from Alberton, and is engaged to be married in October 2013. She enjoys hiking and spending time outdoors. We are excited to welcome her to our Virology family, and look forward to working with her for many years.

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Species and community adaptations, mammal ecology, avian conservation, invertebrate conservation, community studies, climate change, geology, archaeology and heritage were the subjects discussed at the 3rd Annual Diamond Route Research Conference held at the end of October on the De Beers campus, south of Johannesburg.

As part of SANSA, projects are under way to determine the diversity of the Arachnida fauna of South Africa in different floral biomes. One such project is an inventory of the spider fauna of the Savanna Biome that forms part of the newly proclaimed Vhembe Biosphere in South Africa. The Venetia Limpopo Nature Reserve, a 36 000 hectare reserve that has been identified as an important buffer zone around the Mapungubwe World Heritage Site, a core area of the Vhembe Biosphere, was sampled by one of the SANSA teams in 2008.

During this preliminary SANSA survey, five different sampling techniques were used and a total of 484 specimens were sampled, representing 95 species of spiders belonging to 24 families. Based on guild structures, 66.6 % are wanderers and 33.3 % web dwellers. A total of 4.17% of the South African species are protected in this reserve.

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Biosystematics (continued)

3rd Annual Diamond Route Research Conference (continued)

Poster presented at the De Beers Congress on the mygalomorph spiders. Poster designed by Elsa van Niekerk.

Baboon and trapdoor spiders (Araneae: Mygalomorphae) are regarded as primitive spiders, with the oldest fossil records dating back to the Triassic Period. Currently, ten families of these spiders are found in southern Africa. Species of many of these families are terrestrial, and live in silk-lined retreats or burrows of various shapes. The differences between baboon and trapdoor spider burrows were discussed. As predators, they are an important part of the ecological food chain. Potential project concepts to sample these spiders on the De Beers Diamond Route properties were presented.

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THE SOUTH AFRICAN BEE BIODIVERSITY SURVEY (SABBS)

The South African Bee Biodiversity Survey (SABBS) is an initiative to assess bees in natural and agro-ecosystems, and to improve the taxonomy and systematics of the group. Bees are a diverse group of insects, with approximately 1200 species in South Africa. Bees are important pollinators in all ecosystems and are, therefore, responsible for the production of seed and fruit, ensuring plant propagation. In addition, many of the seeds and fruits resulting from pollination are an important food resource for humans, arthropods and animals.

Visitors to Arachnida Unit

Dr Charles Haddad, from the University of the Free State in Bloemfontein, visited the Spider Unit in October to discuss various research projects.

Dr Lorenzo Prendini, of the American Museum of Natural History in New York, visited the Spider Unit in November and December to study the scorpion collection.

Dr Stefan Foord, of the University of Venda, visited the Spider Unit to discuss future projects and new publications.

Elizabeth Archer, from the University of Pretoria, visited Eddie Ueckermann to identify and discuss parasitic mites of small mammals.

Dr Sonja Matthee, of the University of Stellenbosch, and her MSc student visited the Mite Unit to work on some parasitic mites (chiggers).

Entomology students from the University of the Free State in Bloemfontein, visited the ARC-PPRI to see what career opportunities there are in entomology and zoology.
DST/NRF Young Scientist Conference

Robin Lyle (Arachnology) attended the DST/NRF Young Scientist Conference held at the CSIR International Convention Centre from the 16-18 October 2012. The following poster was presented:

LYLE, R. & DIPPENAAR-SCHOEMAN, A.S. 2012. Spiders - as biological control agents?

Biosystematics (continued)

They have an exceedingly high resistance to starvation which enables them to survive and maintain normal reproduction during periods of low prey availability. This is accomplished by an ability to decrease their metabolic rate. During their lifespan which varies from nine months to several years, all instars feed actively as predators. Spiders are polyphagous and feed on a variety of available prey. Spiders are some of the first predators to colonize newly planted crops and research have shown the importance of early season assemblages. A decrease in numbers of pest within a crop can lead to a decrease in pest damage and expenses carried by the farmer. These studies have shown that spiders can acts as natural control agents as part of an integrated pest management plan.

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SPIDER COURSE IN KWAZULU-NATAL

An introductory course on spider identification was presented at Hluhluwe-iMfolozi Park in KwaZulu-Natal from 19-23 November 2012 by Ansie Dippenaar-Schoeman and Robin Lyle of the Spider Unit. A 74-page full colour manual on all the spider families of KZN was specially compiled for the course. The course attendees were KZN Wildlife staff members who have a keen interest in the small, eight-legged wildlife found in the province. The aim of the course was to enable staff members to identify spiders to family level. A variety of presentations was given, ranging from basic spider morphology to an introductory course on the spider families.

Another important part of the course was the practical section. Attendees learned to use various methods, such as sweeping, beating, night hunting and pitfall trapping, to sample spiders at numerous localities within the reserve. Even though the weather was rainy and damp, it didn’t seem to affect the attendees’ spirits. Specimens collected were sorted and identified to family level, thereby putting the theoretical part of the course and manual into practice. Overall, the course was very successful, and has resulted in many new, budding arachnologists. The present checklist of the spiders of Hluhluwe-iMfolozi Park has increased, and presently stands at 24 families and 65 species of spiders recorded from the Park.

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A healthy agricultural industry contributes to the country’s gross domestic profit, food security, social welfare, job creation and ecotourism. In recent years, the growth in the organic farming industry and the use of improved integrated pest management control systems has led to the investigation of "green" or environmentally friendly pest control methods. Reviews on the role of spiders in agro-ecosystems indicate an increasing interest in, and recognition of, spiders as natural control agents of insects and mites in such systems. In the last 25 years, the roles of spiders in agro-ecosystems have been studied at the Agricultural Research Council-Plant Protection Research Institute (ARC-PPRI). Surveys on a variety of crops, such as citrus, avocado, macadamia, tomatoes and pistachio, have shown their abundance and the important role spiders may play as predators. Findings show that spiders are one of the most common predator groups found in agro-ecosystems, and that they have special adaptations towards a predatory way of life. Their distensible abdomens enable them to consume large amounts of food in relatively short periods of time, while their rate of predation may increase greatly during short periods when food is plentiful.

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Some of the participants who attended the course
NEW FACT SHEET SERIES ON SPIDERS

Owing to the large volume of enquiries received about spiders, the Spider Unit has decided to produce a fact sheet series on the spiders most commonly enquired about. Copies of the factsheets will be available online on the SANSA website, from where they can be downloaded directly. The first factsheets are about the rain spider and golden orb-web spiders, and common names are provided in four languages. The fact sheets were designed by Elsa van Niekerk DIPPENAAR-SCHOEMAN, A.S. & LYLE, R. Rain spider (Palystes superciliosus). ARC-Plant Protection Research Institute Factsheet series Biosystematics: Spiders 2013:1


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EU PROJECT (PREDATORY MITES) MEETING IN SOUTH AFRICA

The first European Union project meeting between the South African and Turkish partners was held at ARC-PPRI, Biosystematics during November 2012. Unfortunately, the French partners involved in this project were unable to attend. The Turkish partners were Prof. S. Çobanoğlu of the University of Ankara, Prof. A Kumral and Ms N. Keskin of the Uludag University in Bursa, while the South Africans were Dr L.R. Tiedt of the Electron Microscopy Laboratory at the North-West University in Potchefstroom, and Prof. E.A. Ueckermann of the ARC-PPRI Biosystematics Division. During this visit, matters concerning the project were discussed, and Prof. Ueckermann also presented a three day course on the plant parasitic mite family Tarsonemidae. The remainder of the time was spent doing identifications, and preparing articles on the solanaceous mites of Turkey. These mites include important pests of solanaceous crops, as well as potential predators of these pests.

A day was also spent at the North-West University, to discuss the studies of a local student who will conduct mite surveys on local Solanaceae plants for her MSc. The proposed visit of a South African student of the North West University to Montpellier, France, in March 2013, was also discussed. She will be visiting a French colleague, who is an expert on the molecular studies of mites, to familiarise herself with the preparation of mites for DNA studies. This will be one of three components for the determination of some of the pest and predatory mites that she will collect. Dr. Tiedt also gave the Turkish partners an introduction to the techniques of preparing mite material for SEM studies.

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Imaging specimens and specimen labels for bee database

For quite a few years, botanists have been photographing herbarium specimens to database their plant collections. There are many advantages to doing this, so it was decided to try the same concept with bee specimens.

The task of creating digital images of the bee collection has been undertaken by two technicians, who have been employed specifically for this project. Mr Lavhelesani Mawela and Mr Mmakgetha Johny Chokwe have successfully imaged the labels and specimens of over 6000 bees. There are two processes involved—imaging the label and imaging the specimen.

Advantages of Imaging Specimen Labels
- Safe keeping and preservation - a virtual copy is maintained even if the original label is damaged;
- Off-site digitisation of specimen label information - this is beneficial because it allows the transcription of the information to be done by anybody in the country or anywhere in the world. It offers the choice of using experts, or participation in citizen science where volunteers may transcribe the information;
- Data quality control - the images are attached to the records in a SPECIFY electronic database. Any user is able to double check data with the original label without looking for the specimen in the collection. As with the transcription, it means that the information can be shared worldwide in electronic format almost instantly, and without the risk of loss or damage to the specimen.

Advantages of Imaging Specimens
- Safe keeping and preservation—a virtual copy is maintained even if the original specimen is damaged;
- Off-site identifications - although this may be limited (due to angle or lack of focus on specific characters), an identification—even to family level—may be of use;
- Enables participation in projects such as the International Barcode of Life project (iBOL), which requires an image of the voucher specimens;
- A virtual on-line museum will be created; given the advances in the internet, good accurate information can be provided via such a portal;
- For use in field guides and handbooks; as the awareness of the importance of this group increases, so does the demand for good images.

In addition to all these advantages, specimens are handled only once and, once digital, can be preserved for future generations and researchers.

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German bee specialist works at Biosystematics

Having foreign experts study South Africa’s biodiversity is a great asset to the country. Dr Holger Dathe, past Director of the Senckenberg Deutsches Entomologisches Institut at Müncheberg in Germany, is a specialist in the taxonomy of the bee genus, Hylaeus. He visited Connal Eardley during October and November. The purpose of his visit was a taxonomic revision of the southern African species of Hylaeus. He spent most of his time working at Biosystematics, but also visited the Albany Museum in Grahamstown, the Iziko South African Museum in Cape Town and the Ditsong Museum in Pretoria. He took many specimens with him on loan for further study. He is currently in the process of borrowing type specimens from European museums and writing the manuscript. He was surprised to find that Hylaeus is neither as diverse nor as abundant in Africa as it is on other continents, a factor which will ultimately make the job easier and quicker. His work will contribute to the taxonomic revision of the southern African bees as a whole.

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The Department of Science and Technology (DST) and the National Research Foundation (NRF), in collaboration with the Department of Environmental Affairs, organised a three-day national conference on Global Change (GC). The conference was held at Birchwood Hotel and Conference Centre, Boksburg, during November 2012, under the auspices of the Hon. Minister of Science and Technology.

Following the finalisation of the Global Change Implementation Framework, one of the decisions by the global change research and policy communities was to have an annual event to reflect on the progress in, and showcase products and services emerging from, the implementation of the Framework. These annual events would run from 2011 to 2018, and would consist of dedicated high level publications alternating with national conferences.

The specific objectives of the 2012 conference were:
- to provide a platform for key global change stakeholders to share current South African research and innovation initiatives and interventions that are related to the Global Change Grand Challenge;
- to enhance the uptake of GC-related science/research in support of decision making;
- to facilitate networking for key global change stakeholders in the country and stimulate partnerships to enhance implementation of the Global Change Grand Challenge; and
- to drive the process of building the next generation of young scientists by creating a forum for them to present their research and interact with experienced scientists.

This conference was attended by approximately 250 professional and young researchers of the key global change programmes. Four researchers of the ARC attended (Dr Susan Koch of Microbiology, Prof. Ansie Dippenaar-Schoeman and Mr Michael Stiller of Biosystematics and Dr Rembu Magoba of Weed Research (see pg. 16 for abstract of talk). The following spider paper was presented:

**FOORD, S.H., DIPPENAAR-SCHOEMAN, A.S. & CHOWN. S.** Drivers of spider diversity along an elevational transect in a floristic kingdom sensitive to climate change.

The Arachnology Unit of the Biosystematics Programme is involved in three projects funded by DST-NRF Centre for Invasion Biology (CIB), in collaboration with the Universities of Stellenbosch and Venda, to investigate the response of spiders to global climate change. This is done by investigating the effect of gradient on abundance and maturity of some invertebrate groups such as spiders. This involved largely pitfall trapping, with a view to tracking individual species and community responses to global climate change. Climate disruption will result in the uphill movement of species, this is particularly true for the tropics where latitudinal temperature gradients are small.

In this paper, the results of the Cederberg gradients was discussed. This study represents the first to document the changes of spider assemblages across a 2000 m, east-west, elevational gradient over a period of 7 years using 680 pittraps. Sampling is done in March and October every year at 18 different altitudes ranging from 251 m above sea level to 1919 m. To date, more than 10 000 specimens have been identified from these samples (2004-2010) and they are all housed in the National Collection of Arachnida. They represent 228 species in 42 families, several of which are new.

Preliminary results indicated:
- temporal (annual) turnover in spider diversity is the largest contributor to overall (gamma) diversity;
- as with other taxa in the Fynbos Biome, beta diversity was the most important driver of diversity;
- alpha (site) diversity made no significant contribution.
- no directional changes in either diversity or assemblage structure;
- assemblages abundance is dominated by 5% of the species;
- more than 80% of species enter and exit the transect in a random sequence;
- temperature is an important driver of spider diversity but several other factors, such as habitat structure and soil chemistry, were important;
- the significance of space in explaining spider abundance patterns could be the result of:
  - neutral processes (dispersal),
  - environmental variable that was not measured;
- although temporal turnover was large and significant in determining spider diversity, it was not directional;
- the assemblages remained remarkably stable over the 7 year period;
- a period of seven years may be too short to observe change.

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**Biosystematics (continued)**

**ASCOMYCOTA IN THE SOUTH AFRICAN NATIONAL COLLECTION OF FUNGI (PREM)**

**III: FRUIT BODY OF A PERITHECIUM**

As mentioned in previous editions of *Plant Protection News* (numbers 92 & 93), most of the Ascomycota form some kind of fruit body in which their asci and ascospores are produced. These are the apothecium, perithecium, pseudothecium and cleistothecium.

The “perithecium” (pl. perithecia) is very small, and generally ranges between 250 and 450 µm in diameter (Fig. 1). These perithecia may occur singly or in a stroma. When solitary (single), they are then often packed so closely together that they form a visible layer on the substrate. However, they may also be embedded in a “stroma”, a mass of fungal mycelium forming a structure in which the perithecia are arranged on the outer rim, from where they easily discharge their ascospores. The entire body or stroma may be macroscopic (Figs 2-4), but the individual perithecia and asci are microscopic. Perithecia are mostly flask-shaped, have an opening (ostiole) through which the ascospores are dispersed, and contain a layer of ascus arranged in an organised manner on the inside, and which may contain 2, 4, or 8 ascospores, or even multiples of 8 (Fig. 5). The apical tips of these asci differ; some have a simple pore, while others have a set of rings forming an apical structure through which the ascospores are discharged. In some groups, these apical structures of the ascus tips stain blue in Meltzer’s reagent — a tool used in classification and identification. The walls of all asci formed in perithecia are only one layer thick (“unitunicate”).

Much of the taxonomic research on Ascomycota is focused on this group; many genera and species in this group are important plant pathogens causing disease on fruit, vegetables and forest trees, as well as on indigenous vegetation and various crops such as wheat (Fig. 6). Other examples include mycotoxigenic fungi like *Claviceps* spp. on grasses and sedges, *Giberella* (*Fusarium*) on grain crops, entomopathogenic fungi e.g. *Cordyceps* spp., *Diaporthe* stem canker on soybean and *Valsa* and *Ceratocystis* canker on fruit- and other trees.

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**Fig. 1** Perithecia on dead wood with their openings (ostioles) clearly visible

**Fig. 2** Perithecia embedded in a stroma (*Hypocrea* sp.), with only the openings (ostioles, i.e. black dots) visible on the surface

**Fig. 3** Stromata of *Daldinia* sp. on dead wood in which the individual perithecia are seated

**Fig. 4** Stromata of *Hypoxylon* sp. on dead wood with individual perithecia visible

**Fig. 5** Asci containing the ascospores formed in a perithecium with the ascus pore clearly visible at the top

**Fig. 6** *Gaeumannomyces* sp. disease of wheat (“vrotpootjie”)
Spiders barcoded as part of the iBOL project

Prof. Michelle Van der Bank of the University of Johannesburg invited the National Collection of Arachnida (NCA) to contribute specimens for DNA barcoding as part of the International Barcoding of Life (IBOL) project. This global project is the largest biodiversity genomics initiative ever undertaken, and aims to create a digital identification system for living organisms, using their DNA.

A team of students from the University of Johannesburg visited the Spider Unit to prepare the tissue plates that will be used to analyse the DNA of the spider specimens selected for barcoding. During their visits about 550 specimens were processed. These freshly sampled spiders were new accessions to the NCA database. Images of all specimens sampled were taken locally and sent to Canada where all results will be made available in the iBOL DNA barcode reference library, known as Barcode of Life Data Systems. At the Spider Unit more than 1000 spiders specimens have been barcoded so far, as well as all the pseudoscorpion material that has recently been collected.

Two student projects at the University of Johannesburg are utilising these data to solve various taxonomic problems. Genetic material is used to determine the number of species of the tropical tent-web spiders (Araneidae Cyrtophora spp.) present in the country. The same methods are also used to solve problems with sexual dimorphism in the flower crab spiders (Thomisidae Thomisius spp.). The value of natural history collections and their role in recording biodiversity is illustrated through this type of initiative.

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Visitors to the National Collections of Fungi

In November, representatives of the National Department of Agriculture, Forestry and Fisheries visited the National Collections of Fungi as part of a liaison meeting held at Biosystematics. Apart from discussions surrounding our diagnostic services to DAFF, the representatives were familiarised with the processes followed during the compilation of pest status reports, as well as the fact that these are based on 108 years of documented specimen holdings, housed in the PREM and PPRI collections.

Prof. JC Coetzee paid the National Collections of Fungi a short research visit in December 2012. He is one of the editors of MycoAfrica, the Newsletter of the African Mycological Association (AMA), and programme co-ordinator for Horticulture in the Department of Horticultural Sciences, Cape Peninsula University of Technology. Prof. Coetzee has been a regular visitor to the unit in the past, and his research focuses on the family Calvatiaceae or the puffball group (Gasteromycetes, Lycoperdaceae). In the past, he has contributed extensively to the re-evaluation of the specimen holdings in the PREM collection of the National Collections of Fungi and van der Bijl collections, ensuring that the identifications are verified and the taxonomic classifications are updated.

The Mycology Unit is proud that the third application for seed funding from the South African Biodiversity Information Facility (SABIF) for digitisation of the National Collections of Fungi (PREM) has been successful. The SABIF initiative is driven by the South African National Biodiversity Institute (SANBI), and financed by the Department of Science and Technology (DST).

The first and second rounds of funding (2010-2011; 2011-2012) resulted in the digitisation of primary collection data of 15000 fungal specimens, including all the Deuteromycetous and Ascomycetous specimen holdings. These included material collected in 1817 from Mozambique and surveys done in the Philippines and Brazil, as well as material collected in various parts of South Africa.

The database team faced various challenges during this initiative, including deciphering handwriting and various name changes for the geographical localities. The current round of funding (2012-2013) will be used to capture the information on an additional 9000 specimen holdings, concentrating on the Basidiomycetous material.

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Annual Congress of the South African Academy for Science and Arts

The Annual Congress of the Biological Sciences Division, South African Academy for Science and Arts was attended by 120 people from three universities and the ARC-PPRI. Of much interest was the address given by the keynote speaker, Prof. J. Eloff, from the Phytomedicine Department of the University of Pretoria. He discussed the importance of using the correct method to extract chemical compounds from plants that can function with similar efficacy to antibiotics currently used in animal and plant production. Interesting talks and posters on plant pathology, zoology and soil ecology were presented.

Members of the Arachnida Unit (Prof. E. Ueckermann and Ms Petro Marais) and Nematology Unit (Drs A. Swart, M. Marais & A. Shubane) of Biosystematics attended the Congress and the following papers and posters were presented.

- **SWART, A., KNOETZE, R., TIEDT, L.R., TRUTER, M. & MCDONALD, A.H.** A possible quarantine nematode in the Hartswater area, Northern Cape (PAPER). Lesions on the shells, shrivelled and discoloured seeds and early germination are symptomatic of some groundnuts in the Hartswater area of South Africa. A morphological study revealed the presence of high numbers of the quarantine nematode *Aphelenchoides arachidis* in this material. The base pair sequence, however, does not match *A. arachidis* in Genbank (EF371501). Unfortunately EF371501 has no voucher specimen allocated to it and its real identity can, therefore, never be verified. Two pathogenic fungi, *Thelavipisis basicola* and *Neocosmospora vasinfecta* were also isolated from this material.

- **MARAIS, M.** Meloidogyne enterolobii (= Meloidogyne mayaguensis): a case study of a root-knot nematodes species (PAPER). Meloidogyne enterolobii are currently seen as one of the upcoming plant parasitic nematodes. The progress of this nematode, first reported in 1991 from South Africa, from nearly forgotten to quarantine organism, is discussed.

- **MARAIS, M. & SHUBANE, A.** A technique to extract nematodes from carrots (POSTER). Until now it has been difficult to bring in line the observed symptoms of root-knot nematode infestation of carrots and the number of nematodes observed. A technique was adapted to successfully extract root-knot nematodes not only from carrots but also beetroot, groundnuts and potatoes.

- **UECKERMAN, E., HEYNE, H. & TIEDT, L.** Interesting sea bird parasites (PAPER). Mite parasites of the family Hypoderatidae were found in the pectoral subcutaneous tissue of White-breasted Cormorant, African Darter and Cape Gannet. SEM studies revealed the absence of a mouth opening, a small anal pore and long body and leg setae.

- **MARAIS, P., DIPPENAAR-SCHOEMAN, A., ANDERSON, C., MATHEBULA, S. & LYLE, R.** The National Collection of Arachnida, present status (POSTER). The South African National Survey of Arachnida (SANSA) was initiated in 1997 by the Agricultural Research Council (ARC), with the main aim of documenting the arachnid fauna of South Africa at a national level. The National Collection of Arachnida (NCA) presently contains 59 000 records, representing 210 000 specimens. It forms a very important part of SANSA and contains information on 6 arachnid orders, 94 families, 561 genera and 1734 species. The type collection contains 765 types.

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**National Collection of Arachnida poster presented at the Congress. Poster designed by Elsa van Niekerk**
Microbiology and Plant Pathology

22nd ANNUAL SYMPOSIUM OF THE SOILBORNE PLANT DISEASES INTEREST GROUP OF SOUTH AFRICA

INTERACTIONS AND SOILBORNE PLANT DISEASES

The Soilborne Plant Diseases Unit of the ARC-PPRI hosted the 22nd Interdisciplinary Symposium on Soilborne Plant Diseases on 12-13 September 2012 at the Vredenburg Research Centre of the ARC-PPRI in Stellenbosch. The topic for this year’s symposium was Interactions and Soilborne Plant Diseases.

The following are the conclusions reached by the delegates to this symposium.

1. The world population is growing at an ever-increasing rate—from adding a billion people over approximately 120 years (from 1 to 2 billion), to less than 12 years (from 6 to 7 billion). This doesn’t make sense. This is a net growth (births minus deaths) of more than 200,000 people per day. In addition, many millions of people are freed from poverty every year, thereby increasing the per capita food requirement. This means that agriculture needs to continuously produce more food with the same resources. The contribution of the research community to agriculture is twofold: the generation of new scientific knowledge, and the dissemination of existing scientific knowledge which can be practically applied to increase food production. The challenge for the research community to agriculture is twofold: the generation of new scientific knowledge, and the dissemination of existing scientific knowledge which can be practically applied to increase food production. The challenge for the research community to agriculture is twofold: the generation of new scientific knowledge, and the dissemination of existing scientific knowledge which can be practically applied to increase food production. The challenge for the research community to agriculture is twofold: the generation of new scientific knowledge, and the dissemination of existing scientific knowledge which can be practically applied to increase food production.

2. Most carbon is in the soil, and can be managed through tillage and application of composts. Increased residue in soil may increase some diseases, but reduce others. The mode of action of organic amendments leading to plant disease control and stimulation of microorganisms is complex and dependent on the nature of the amendments of both of these processes.

3. The mapping of agro-ecological zones (AEZs), based on land capability, is a valuable tool that will allow decision makers, including government departments, provincial authorities and municipalities, to assess the natural resources that are available for agriculture in any particular area. This is especially important in conserv-
ing high potential and unique agricultural land for agriculture,
and to address food security, land tenure and sustainable agri-
cultural production.

4. Soils are complex entities. In spite of vertical and lateral
variation in soil properties their functions are very typical.
Therefore, soil maps are effective transfer functions for spatial
land use.

5. Climatic factors are associated with reduced yields in a high-
yielding tomato farm in the Limpopo province. It was found that
total tomato yield and fruit quality are directly influenced by
humidity, moisture, and temperature during the first 10 weeks
after tomato seedlings are transplanted. This emphasises that it
is very important to optimise planting time in accordance with
local climate conditions to avoid conditions that compromise
tomato yield and quality.

6. Evidence indicates that soil yeasts in the rhizosphere may –
either directly or indirectly - enhance root growth. These unicel-
lar fungi may enhance beneficial symbioses such as mycor-
rhizae, inhibit growth of soilborne plant pathogens, or directly
enhance plant growth by facilitating soil nutrient uptake. Not
surprisingly, soil yeasts show potential as components of bio-
fertilisers.

7. The mycorrhizal fungal symbiosis with host plant roots is a
costly arrangement for both partners. Therefore, both fungus
and plant are able to regulate each other in terms of cost-
benefit economics for nutrient acquisition and organic carbon
exchange.

8. Citrus root disease-related tree decline seems to be the
result of interactions between several factors, rather than the
effect of one or two parameters. The interaction between fac-
tors in relation to different levels of decline can be identified
using a multi-parameter approach.

9. Research in the field of plant beneficial bacteria has uncov-
ered a myriad of diverse mechanisms of action and plant-
microbe interactions. Today these investigations are being
fast-tracked by the explosion in molecular tools which have
become available to researchers in recent years.

10. The effectiveness of concomitant biological inoculation of
planting material is determined on their modes of action. Effi-
cacy can be influenced by induced systemic resistance signal-
ing. Endophytes induce signalling that moves both acropedally
and basalpedally through the plant.

11. Biological control of soilborne diseases is gaining in popu-
larity. Much research has been done in this field. More work
needs to be done to improve efficacy and consistency of per-
formance under field conditions.

12. *Trichoderma* spp. were chosen as a biological control
agent and proved effective when tested in vitro on selected
pathogens associated with root rot in sorghum. However,
 greenhouse results were less satisfactory and only small differ-
ences were observed between the effects of *Trichoderma* spp.
treatments and the control on root rot severity. *Trichoderma*
spp. produced volatile and non-volatile substances that exhibit-
ed variable pathogen growth inhibition traits. Further research
is needed to determine optimum conditions for biological con-
trol of soilborne diseases and the influence of the non-target
effects of such control.

**Contact:** Dr Sandra Lamprecht at
LamprechtS@arc.agric.za
Microbiology and Plant Pathology (continued)

Virologists attend international Grapevine virus conference in California

All the South Africans that attended the conference in Davis, California. Front row: Helen Walsh (University of Pretoria), Elize Jooste (ARC-PPRI), Roleen Carstens (ARC-Nietvoorbij), Dirk Stephan (University of Stellenbosch), Yolandi Espach (University of Stellenbosch), Rachelle Bester (University of Stellenbosch). Back row: Gerhard Pietersen (ARC-PPRI), Renate Lamprecht (University of Stellenbosch), Johan Burger (University of Stellenbosch), Hano Maree (ARC-Biotechnology Platform, University of Stellenbosch), Marius Snyman (University of Stellenbosch).

Dr. Elize Jooste and Dr. Gerhard Pietersen from ARC-PPRI attended the 17th Congress of the International Council for the Study of Virus and Virus-Like diseases of the Grapevine (ICVG) that was held in Davis, California, from 7-14 October 2012. The conference was filled with high quality scientific presentations and opportunities to make new connections with fellow grapevine virologists.

Dr. Jooste delivered an oral presentation titled “A survey of red and white cultivars to test an improved detection technique for grapevine leafroll associated virus 3 (GLRaV-3) variants identified in South African vineyards”.

The oral presentation of Dr. Pietersen’s work was done by Helen Walsh with presentation titled “Development of a LAMP technique for control of grapevine leafroll associated virus 3 (GLRaV-3) in infected white cultivar vines by roughing”.

Conference presentations included topics on the most important virus diseases of grapevine, new viruses and diseases of unknown etiology and viroids, diagnostics, the effects of virus, epidemiology of diseases and grapevine certification.

Oral presentations at conference:
PIETERSEN, G. & WALSH, H. Development of a LAMP technique for Grapevine leafroll associated virus type 3 (GLRaV-3) in infected white cultivar vines by roguing. Proceedings of the 17th Congress of ICVG, Davis, California, USA, October 7-14 2012, pg 50-51

Poster presentations at conference:

Summary of work presented at conference:
Real-time RT-PCR high-resolution melting curve analysis and multiplex RT-PCR to detect and differentiate grapevine leafroll-associated virus 3 variant groups I, II, III and VI.

The Ampelovirus, grapevine leafroll associated virus 3 (GLRaV-3), is the most widespread virus in South African vineyards. The molecular variability of the virus was studied in more detail during the past three years from different regions, especially in South Africa, Portugal and the USA.

The availability of more full-length sequences has significantly accelerating the genetic study of GLRaV-3 variants. To date, six genetic variant groups of GLRaV-3 were identified world-wide. Six full genome sequences, representing four of the genetic variant groups of GLRaV-3, were published from South African vineyards. The molecular variability of the virus was studied in more detail during the past three years from different regions, especially in South Africa, Portugal and the USA.

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Another detection technique for GLRaV-3, Loop-Mediated amplification of Nucleic Acid (LAMP) was presented at the conference. This technique does not require expensive equipment and uses isothermal means of amplifying a target sequence by a strand displacing DNA polymerase in conjunction with 4 primers which targets 6 areas on target DNA. The RT-LAMP technique is simple, rapid and sensitive, which may make detection of infected white cultivar vines for roguing purposes more feasible. LAMP has the potential to be used as field diagnostic technique in white vine cultivars.
Weed Research

Helping Heuningvlei community to surmount their cactus dilemma

During February 2012, ARC-PPRI was first alerted to the presence of extensive and exceedingly dense stands of a large variety of cactus species in Heuningvlei, a small, rural settlement approximately 130 km north of Kuruman in the Northern Cape Province. The Northern Cape Department of Agriculture, Land Reform and Rural Development had attempted to clear the infested land, an estimated 400 ha, manually and chemically, but made no headway. Mr Wynand Nel, Assistant Director of that department, then contacted the country’s most experienced cactus control specialist, Dr Helmuth Zimmermann, formerly from ARC-PPRI, for advice.

After visiting the affected area, Dr Zimmermann recommended biological control, because effective biocontrol agents are available against virtually all the invading cactus species. Then he put Mr Nel in touch with Hildegard Klein, of ARC-PPRI, who is currently conducting research on the biocontrol of cactus weeds.

Cochineal biotypes that were specifically selected for use against boxing-glove cactus (the ‘cholla’ biotype of *Dactylopius tomentosus*) and Australian pest pear (the ‘stricta’ biotype of *O. opuntia*) were mass-reared at ARC-PPRI’s Rietondale campus and, during August 2012, Mr Nel was able to pick up a starter colony of each for release in and around Heuningvlei.

Three months later, during November 2012, Mr Nel took Hildegard Klein and Joel Mabotja to Heuningvlei to monitor the establishment of the cochineal biotypes. The cochineal on Australian pest pear had established surprisingly well, had spread to surrounding plants, and was already causing leafpads to turn yellow and drop (Figs 3 & 4). The cochineal on boxing-glove cactus had also become established, but was not yet as abundant or as visible as those on Australian pest pear.

However, the boxing-glove cactus infestations at Heuningvlei exceeded anything we have witnessed before. Although this cactus produces only sterile fruit, it disperses extremely well by shedding thousands of tiny stem segments, which become rooted wherever they drop (Fig. 5).

Continued overleaf
Weed Research (continued)

Helping Heuningvlei community (continued)

Together with the other cactus species, boxing-glove cactus has a major effect on the community’s quality of life. It encroaches on their gardens and homes (Fig. 6), reduces the carrying capacity of the land (Fig. 7), and causes great suffering to humans, livestock and pets that accidentally pick up the spiny segments in their feet, mouths or skin.

Fig. 5. The profusion of easily-detachable segments eventually creates impenetrable thickets of boxing-glove cactus.

Fig. 6. Boxing-glove cactus steadily encroaching on the gardens and homes at Heuningvlei.

During the visit, Ms Klein discussed with Mr Nel how ARC-PPRI can continue to collaborate with the Northern Cape Department of Agriculture, Land Reform and Rural Development to assist the community of Heuningvlei. More cochineal will be reared in Pretoria for release at Heuningvlei, but community members will also have to be trained in biocontrol to enable them to harvest the cochineal from the field and re-distribute it to new areas. The best methods of integrating biological control with the currently used manual clearing and herbicidal control will have to be developed.

In addition, trials must be carried out to determine whether the potential release of other biotypes of the same cochineal species, e.g. the ‘imbricata’ biotype of D. tomentosus for the biocontrol of imbricate cactus, would endanger the efficacy of those biotypes that are already being used. An appropriate funding and collaboration model will also have to be developed with the Working for Water Programme within DEA, which has generously funded the research into cactus biocontrol for the last decade or so.

Contact: Hildegard Klein at KleinH@arc.agric.za

Fig. 7. Invasive cacti make area unsuitable for livestock farming

Presentation at DST Global Change Conference (from pg. 8)

During the 1st National Global Change Conference, held in Boksburg, during November 2012, Dr Rembu Magoba presented a paper titled, “Comparative footprint of alien, agricultural and restored vegetation on surface-active arthropods”. He indicated that invasive alien trees (IATs) significantly reduced arthropod species richness and changed assemblage composition when compared with vineyards, natural sites, and sites cleared of invasive alien trees. IATs were found to be a greater threat to arthropods than vineyards. This lends support to the Working for Water Programme, who recognize arthropods as being major beneficiaries.

Reference:

Contact: Dr Rembu Magoba at magobar@arc.agric.za.

Rembu Magoba surveying fynbos invaded by alien vegetation
Strangler invaders: a new threat

Strangling invasive plants are a new threat in South Africa. Most people are aware of strangler figs, but few think of invasive plants behaving in a similar way.

Several emerging invasive plant species can be either free-standing or can become stranglers. Strictly speaking the stranglers are hemiepiphytes—spending part of their life cycle as epiphytes by growing on other plants, not for nutrients, but for mechanical support. A hemiepiphyte can germinate in the fork of a tree or the base of a palm frond. They send down aerial roots, which wrap around the host plant, and eventually reach the ground. The host plant usually dies, either by girdling or through competition for light.

Four emerging stranglers are known in KwaZulu-Natal. These are Queensland umbrella tree (Schefflera actinophylla), dwarf umbrella tree (S. arboricola), false aralia (S. elegantissima), and pitch apple (Clusia rosea). All have been grown for ornamental purposes and the Schefflera species, in particular, have been very widely planted; the latter two being popular as interior potted plants. The seeds of all four species are attractive to birds which aid in their dispersal to suitable germination sites.

Queensland umbrella tree is well-known as an invasive tree in other parts of the world and is regarded as one of Hawaii’s worst invasive species. Pitch apple is also invasive in Hawaii, and we should heed the warnings to make this an early detection species and try to prevent infestations from developing. All three Schefflera species have been proposed as declared invaders under the draft regulations of the National Environmental Management: Biodiversity Act (NEMBA), and a proposal should also be made for pitch apple. All four species are a serious threat to the conservation of forests in South Africa.

Contact: Lesley Henderson at L.Henderson@sanbi.org.za

Queensland umbrella tree (Schefflera actinophylla)—with bright red spikes of flowers (a) which will produce dark red berries. Seedlings germinating in trees (b & c) and a rock crevice (d)


**Technology Transfer**

**Scientific publications**


**NEW BOOK AVAILABLE SOON**

A new spider book, “Spiders of the Savanna Biome”, will be available soon. This full-colour, 140-page book is the first to provide information on the spider families, genera and 1230 species found in the Savanna Biome, a biome where 308 species are endemic. This book is a joint effort between the ARC and the Universities of Venda and the Free State. It include keys and descriptions of genera and families. It is trichly illustrated by >500 colour photographs

*For more information contact Ansie Dippenaar-Schoeman at DippenaarA@arc.agric.za or Stefan Foord at Stefan.Foord@univen.ac.za*

**NEWSLETTERS**


The Newsletter of the South African National Survey of Arachnida now available and can be downloaded from the ARC webpage.

Some issues discussed:

- What is happening during SANSA III.
- What do we know about spiders in crops?
- Strange spiders invading South Africa.
- A newly reported spider species now in houses in Lowveld not violin spiders.
- National collection of Arachnida received very good report.

HENDERSON, L. 2012. SAPIA News No. 27

The newsletter of the Southern African Plant Invaders Atlas (SAPIA) appears four times a year, and can be downloaded from the ARC webpage.

Inside the current issue:

- Invasive plants stop with you!
- High court action against government
- Tribute to Lynne Thompson of ’Stop-the-Spread’
- Early detection of invasive species
- Water poppy
- Mauritius hemp
- Pitch apple

Baryphas ahenus one of the typical Savanna spiders. Photographer Peter Webb

For more information contact Ansie Dippenaar-Schoeman at DippenaarA@arc.agric.za or Stefan Foord at Stefan.Foord@univen.ac.za
GENERAL

OBITUARIES

Annelize Lubbe passed away on 30 December 2012 after her battle with cancer.

Annelize started her career at ARC-PPRI in 1990 as a technician in the Insect Ecology Programme. She first worked on botanical pesticides, testing extracts of plants with possible pesticidal properties against agriculturally important insect pests. At this time she also studied towards a B.Inst.Agr. degree.

From the mid-1990s she worked in honey bee research on the nationally important ‘Capensis problem’ affecting African honey bee colonies, and was involved in field surveys for Capensis within the African bee colonies, as well as laboratory investigations involving the dissections of thousands of bee samples. She became an important member of the Capensis team and did her MSc degree on the subject, publishing research on the factors facilitating the spread of the parasitic Cape Honey bee in South Africa. Annelize also provided major input into the publication of the famous PPRI ‘Blue Book’ on beekeeping, contributing a chapter on hive products with Martin Johannsmeier, and co-ordinating the entire production and publication.

While working in the research teams, it soon became apparent that Annelize had a special skill as a project co-ordinator and administrator. She was a highly efficient and organised person and, at the drop of a hat, could readily administer large multi-faceted projects, producing spread sheets detailing targets met, money spent and personnel hours worked. These administration skills soon became indispensable to a succession of programme managers at the Insect Ecology programme.

From 2004-2007 Annelize was the ARC-PPRI project administrator for the Innovation Fund project on the development of beneficial insects as biocontrol agents for crop pests. During this time she also did a lot of laboratory work on the biology of the beneficial parasitic wasp, *Trichogramma lutea*.

At the end of 2007 she was transferred to the Weeds Research Programme as project administrator for the ARC-PPRI projects within the large Working for Water contract for the biocontrol of invasive alien plants.

At the end of 2008 her husband was transferred to the Western Cape, and Annelize was transferred to ARC-PPRI Vredenburg in Stellenbosch. Here she worked with Dr Geoff Tribe on the Integrated Pest Management of slugs and isopod pests of canola seedlings, collecting data in the canola fields near Caledon, and assisting Geoff with all the data analysis and report writing. Again, her great technical and support skills soon became indispensable for the success of the project.

Annelize was diagnosed with cancer in January 2011 and battled bravely through a long series of radiation and chemo-therapy treatments. She will be remembered by her colleagues as a cheerful person with a very positive attitude to life. She leaves her husband, Leon, and their two young daughters.

Derrick Lekubu passed away on 9 December 2012 after a robbery and assault on 3 December. He had been working as research support for the ARC-PPRI Weeds Research Programme since March 1989. Derrick assisted with most weed projects over the past 24 years, but spent most of his time growing and caring for test and culture plants for the lantana and crofton weed projects. He was also entrusted with keeping quarantine neat and clean, and also helped with general tasks on all weed projects in quarantine.

Derrick will be missed greatly by all, and remembered for his quiet but very friendly personality. Our thoughts are with his family and friends.

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Barbara Sereda retired from the position as Senior Researcher in the Pesticide Science Programme on 31 October 2012. She joined the Plant Protection Research Institute soon after emigrating from Poland as researcher at the Unit for Pesticide Impact. The great majority of her research from 1990 to 1996 was aimed at insect pesticide resistance. Since then till her retirement Barbara was involved in research aimed at determining pesticide contamination of the water environment in malaria endemic areas and community exposure to pesticides in smallholder farming environments. In collaboration with the University of Pretoria and North West University she conducted studies to determine DDT and pyrethroid levels in breast milk in KwaZulu-Natal and Limpopo Provinces.

We wish her well as she ventures into other areas and we will indeed miss her and her contributions towards the scientific society.