Outbreaks of the brown locust, *Locustana pardalina*, reported from the Karoo

Outbreaks of the brown locust, *Locustana pardalina*, developed in the eastern and south-eastern Karoo in September-October after good early rains induced hatching from overwintering egg concentrations.

Some of the early reports were of large-size and highly gregarious hopper bands, which indicated mass-hatching from overwintering egg beds that had been laid by the previous generation in March-April 2020.

As the ARC predicted, the hopper bands started to fledge into adults from mid-November 2020.

The fledgling swarms then aggregated into large adult swarms that started to migrate by the end of November 2020.

Swarms that develop during early summer (November-December) in the eastern and south-eastern Karoo typically fly east and north-east on the prevailing winds. During such outbreaks, swarms can readily escape the Karoo and invade the cereal crop producing areas of the Free State Province and North West Province. These swarms can also invade neighbouring Lesotho, as they have done in the past.

Young maize crops will be particularly vulnerable to the locust swarms and severe damage to crops can be expected if swarms are not controlled. Local household food security will be under threat.

Any swarms developing in the Northern Cape Province (Central Upper Karoo and Bushmanland) typically fly north at this time of year and pose an invasion threat to Botswana and Namibia.
NEW Diagnostic Seed Health Test Available

Detection of Tomato Brown Rugose Fruit Virus (ToBRFV) using RT-qPCR assay at ARC – PHP

Tomato brown rugose fruit virus (ToBRFV), is a newly-emerging seed-borne virus in the genus Tobamovirus. This virus is causing severe losses within tomato and pepper crops globally. Major symptoms include a mosaic pattern on the leaves, distortion of leaves and brown and/or wrinkly spots on fruits. Due to the potential economic impact of this virus, it is essential that planting material be certified free from this virus, for trade purposes. The Taqman RT-qPCR assay, as described in the International Seed Federation (ISF March 2020), was optimized, and is now readily available at ARC-PHP Virology Laboratory, which is registered with DALRRD. Test results will be available within two weeks after receipt of samples. Standard terms and conditions apply.

Contact: Team Manager, Dr. Elna van Der Linde at VDLindeE@arc.agric.za, or Virologists: Ms Marika van der Merwe at VDMerweMA@arc.agric.za or Ms Nicola Robbertse at WesselsN@arc.agric.za

PHP hosts the FAO and DALRRD to hand over equipment for control of fall armyworm

The ARC – Plant Health and Protection hosted an equipment handover function for the Food and Agricultural Organisation of the United Nations (FAO) and the Department of Agricultural, Land Reform and Rural Development (DALRRD) on 31 August 2020. The small function was held outside at the ARC-PHP campus. The equipment that was handed over will be used in the country’s fight against the fall armyworm (FAW). It ranged from cell phones for use of the FAO FAW Monitoring and Early Warning System (FAMWES) app, to traps to help monitor the movement of this pest on the ground. Equipment was shared between the various provinces and the ARC. As part of the FAO Farmer Field School, which is being implemented by the ARC in the Limpopo and Mpumalanga provinces, this equipment will be used by female and youthful small-holder farmers to monitor FAW in their communities.

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Any swarms escaping control will rapidly mature and will lay eggs by mid-December. A second generation of hopper bands can be expected by Christmas and into the New Year. The further development of the outbreak will be dependent upon the distribution of follow-up rains.

Contact: Roger Price at PriceR@arc.agric.za
The ARC-PHP has established a memorandum of understanding with a local biological products manufacturing company, Victus Bio (Pty) Ltd. towards screening and development of rhizobium as commercial inoculants for the cultivation of economically important legumes. As part of this agreement, strains of *Bradyrhizobium* spp. from the rhizobium collection of PHP (SARCC) were screened for nodulation and nitrogen fixation efficiency in soybean (*Glycine max* L.) under different conditions. The first phase of this trial involved the screening of 25 *Bradyrhizobium* strains. The results indicated that there are a number of *Bradyrhizobium* strains, currently deposited in the SARCC collection, which are specific to soybean nodulation and that result in significant nodulation and nitrogen fixation efficiency compared with the industry standard currently being used in the country. The first strains will be tested under field conditions during the 2020-21 season.

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Rhizobium screening trial on nodulation and nitrogen fixation of soybean using 25 strains of rhizobia from the rhizobium collection showing initial phase (a and b) and second phase (c) of the glasshouse trial.

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**Uncovering the hidden treasure in the Rhizobia Collections**

Ms Vivienne Uys, the termite taxonomist at the National Collection of Insects was subpoenaed by the Magistrate’s Court in the District of Rustenburg to testify as an expert witness in support of a plaintiff who had purchased a house severely infested and damaged by termites. The defendant, the seller of the house, had failed to disclose the termite infestation as required by law. The plaintiff sued for compensation for expenses incurred in repairing the house and ensuring its structural integrity. The Court ruled in favour of the plaintiff following expert testimony provided by the ARC entomologist. The expert testimony was based on a report compiled by Vivienne Uys, following a site inspection of the house. During the site visit, severe termite damage to most of the roof beams was evident, along with characteristic soil deposits, typical of fungus-growing termites (Family: *Termitidae*; Subfamily: *Macrotermitinae*). Soil deposits were also found within the electrical box, mounted on an inside wall. It was clear that the damage had been present for a considerable amount of time. Ms Uys was questioned on her expertise and experience as a termite specialist and gave evidence regarding the identity and life-history of the termites found at the dwelling.

**Contact: Vivienne Uys at UysV@arc.agric.za**

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Termite damage to roof beams
Dr Antoinette Swart of the National Collection of Nematodes found two female nematodes and a number of juveniles of the genus *Ditylenchus* in a garlic sample submitted for analysis by DALRRD. Both females were con-specific with the quarantine nematode, *Ditylenchus dipsaci*. No males were present in the sample, so only female characters could be used to diagnose the species utilizing the *Ditylenchus* identification key, which employs morphology and morphometrics. According to the Diagnostic Protocol of Regulated Pests (2015), molecular identification of the species *D. dipsaci* is required when specimens cannot be distinguished conclusively. Specimens were subsequently sent to Dr Ebrahim Shokoohi (University of Limpopo) for molecular identification, which reached him on 24 August 2020. Molecular identification was deemed the best way to confirm the identity of the specimens. The molecular results were received on 21 September 2020 and confirmed that the specimens were *D. dipsaci* with high similarity of two genes (ITS and 18S rDNA). *D. dipsaci* lives mostly as an endoparasite in aerial parts of plants (stems, leaves and flowers), but also attacks bulbs, tubers and rhizomes. This nematode is seed-borne in *Medicago sativa* (lucerne/alfalfa), *Allium cepa* (onion), *Trifolium* spp. (clovers), *Dipsacus* spp. (teasel) and *Cucumis melo* (melon). Of great importance is the fact that the fourth stage juvenile can withstand desiccation for a long time, sometimes 20 years or more. These nematodes clump together in a cryptobiotic state to form “nematode wool” when the plant tissue begins to dry. The wool can often be observed on the seeds in heavily infested pods and in dry plant debris. The presence of the infective fourth stage juveniles in seed and dry plant material is important in the passive dissemination of the nematode over long distances. The nematode in its desiccated state can survive passage through pigs and cattle on infected seed. Although *D. dipsaci* is regarded as a parasite of higher plants, it was reported that a Californian population of *D. dipsaci* from *Allium sativum* (garlic) could reproduce on soil fungi (*Verticilium* and *Cladosporium*) under laboratory conditions. It is also known that *D. dipsaci* is of potential economic importance on *Agaricus bisporus* (mushroom). *Ditylenchus dipsaci* is known to vector bacterial plant pathogens externally (i.e. *Clavibacter michiganensis* subsp. *insidiosum*, *Corynebacterium insidiosum*), causing alfalfa wilt.

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### Invasive cacti in South Africa: their identification and control

This book was written by Hildegard Klein, who recently retired from her career in weeds biocontrol at ARC-PHP, and Dr Helmut Zimmermann, a former manager of Weeds Research and Assistant Director at ARC-PHP. The main motivation for writing the book was to provide land managers with guidelines for controlling the invasive cactus species, which are a dominant group of invasive problem plants on both agricultural and conservation land in South Africa. The book is written in a style that makes the information readily accessible to the non-scientist, with a simplified classification system that only reflects the groups of cacti that have become invasive in South Africa.

The book provides an introduction to the classification of invasive cacti found in South Africa, with excellent high-quality photographs and descriptive keys.
Fungus that causes disease of papaya newly detected in South Africa

Several papaya plants (Carica papaya L.) with symptoms of extensive crown and root rot, causing plants in orchards to collapse, were received at the ARC-Tropical and Subtropical Crops campus during 2019. Diseased trees were from Malelane (Mpumalanga Province) and Tzaneen (Limpopo Province). Isolates of Phytophthora palmivora, a root and crown rot pathogen, were obtained from diseased tissue from each of the infected plants. The identity of the species was confirmed by molecular identification. P. palmivora infects plant tissue below and above the soil line. It is capable of infecting a variety of hosts, and has been recorded in at least 138 species of many plant families known worldwide mainly in tropical climates. Symptoms include flower, fruit, stem and root rot.

P. palmivora was first detected in South Africa in 2005 in ornamental nurseries at Witrivier and Malelane. The result of our current study is the first record of P. palmivora from papaya in South Africa. Papaya is the most common host to be infected by this fungus in high intensity production areas worldwide. Significant damage and yield loss occur. Phytophthora palmivora is a regulated pathogen in South Africa and must be reported according to the “Reporting Procedure for Quarantine or New Pests of Plants in South Africa” of DALRRD.

Of interest is the simultaneous occurrence of the disease on papaya from two production regions which are more than 400 km apart, in the north-eastern parts of South Africa. This suggests that the disease may be linked to extreme climatic conditions, such as high temperature and severe drought, prevalent in both regions during late 2019. Increasing drip irrigation daily, proved to be ineffective in cooling and reducing stress on the plants, because the rate of evaporation and transpiration exceeded the rate of water absorption by the roots. Extreme temperatures and drought conditions prevailed during November and December 2019, ideal conditions for infections by Phytophthora palmivora.

Contact: Wilhelm Botha at BothaW@arc.agric.za
Thirty continuous years of post-release evaluations of the gall rust fungus

Thirty continuous years of post-release evaluations of the gall rust fungus, *Uromycladium morrisii* on *Acacia saligna*, have been completed. This is the longest monitoring programme carried out on a pathogen biocontrol agent in the world. The Port Jackson gall rust fungus, first introduced in 1987, was renamed as *Uromycladium morrisii*, in recognition of the research undertaken on it by Dr Mike Morris (formerly ARC-PHP).

During 1991, Dr Morris initiated the annual long-term monitoring of the impact of the rust fungus on Port Jackson, which continued until 2020, a total of 30 years of data collection. The average annual decrease in stand density across all sites and years was 8%, though this varied widely between sites and years. At most sites, stand density has declined by 80 to 98% over the course of monitoring.

Individual trees at four sites, monitored between 2011 and 2017, had mortality rates between 49 and 80%. In another study carried out annually for five years, it was shown that the presence of flower galls reduced the number of pods as the number of galls on stems increased.

Contact: Alan Wood at WoodA@arc.agric.za

Monitoring of aphid populations continues unabated

The National Aphid Monitoring Programme forms part of a joint initiative by UP, Potatoes South Africa, the Department of Agriculture: Western Cape, KwaZulu-Natal Department of Agriculture, the Agricultural Research Council (ARC)’s Small Grain Institute, the Winter Cereal Trust, the ARC Plant Health and Protection as well as regional laboratories of the Potato Laboratory Services.

The project aims to track seasonal populations of aphid species capable of spreading plant virus diseases in cereal crops. This involves specimen counts and species identifications for samples of winged aphids obtained each week from three suction traps utilized for monitoring the movement and distribution of aerial populations of aphids. The analysed aphid-monitoring trap information is used to predict the seasonal risk of aphid-transmitted virus disease outbreaks in grain crops, and enables farmers to make informed pest management decisions. The information is distributed to farmers through various portals.

Sorting and identifying the aphids in the trap samples involves accurate species recognition, which requires a high level of experience and expertise. This taxonomic expertise is uniquely available at South African National Collection of Insects (SANC) and is indispensable for the functioning of this project, which demonstrates the value of this taxonomic capability. Three technicians assist with the initial sorting of specimens obtained in the weekly trap samples, and have been trained in the recognition of various important aphid species. During a 12 month period over the years 2019 to 2020, 19 555 aphid specimens involving over 50 species were sorted and identified. The project is continuing in the current financial year.

Contact: Ian Millar at MillarI@arc.agric.za
The balloon vine rust (*Puccinia arechavaletae*) establishes in South Africa

During host specificity testing of the balloon vine rust fungus (*Puccinia arechavaletae*), a potential biocontrol agent of balloon vine (*Cardiospermum grandiflorum*), plants of *Cardiospermum corindum* originating from South Africa proved to be highly susceptible. This is a speciating genotype following a natural extreme long distance dispersal event from South America to Africa. Although this result would typically involve a decision to not introduce a potential biocontrol agent, as an indigenous related plant species (*C. corindum*) would be at risk, it was realized that *C. corindum* occupies much drier habitats than the invasive *C. grandiflorum*. It was therefore speculated that *C. corindum* would not be at risk if the rust was released in South Africa. In late 2018, the first infections of *C. grandiflorum* were observed in coastal KwaZulu-Natal. By March 2019, infections were observed from the Eastern Cape to Limpopo. The original source of these infections is not known, as this control agent was not released by the ARC. The original culture used in host specificity testing done in Stellenbosch had been destroyed in 2012. This is allowing an assessment of whether the speculations made were accurate. This could help develop risk assessments for potential biocontrol agents to include ecological data as well as standard host specificity testing. In addition this case demonstrates how “leaky” our borders are to microorganisms. Invasive microorganisms require much more attention than they are currently receiving.

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The value of collaboration

A small ladybird beetle which is a potential biocontrol agent of various mealybugs and scale insects was recently submitted to the Insect Identification Service at the South African National Collection of Insects (SANC). The beetle was identified as belonging to the genus *Nephus*. With no local expertise available for this group and the world expert, Helmuth Fürsch, in retirement, taxonomists at the Florida State Collection of Arthropods (FSCA) in the USA were approached to assist, and specimens were forwarded to them. Genitalia preparations of these minute beetles, which are only 1.45-1.55 mm long and 1.1 mm wide, were made at FSCA and photographed. Subsequently, and independently, a morphological taxonomist in Italy, Claudio Canepari, was approached by both SANC and FSCA, who identified the beetle as *Nephus kamburovi* Fürsch, based on the images. Meanwhile, specimens of what appeared to be the same species were submitted to the SANC by a different client. Studies of dissections of this material revealed slight differences in the morphology of the male genitalia. In the absence of a specialist, COI barcode sequences of both series of specimens were generated and subsequently analysed by Dr W. Strümpher, who concluded that both these series belong to the same species, i.e. *Nephus kamburovi* Fürsch. This is a good example of how molecular techniques and effective collaboration can contribute to the elucidation of taxonomic queries.

*Contact: Beth Grobbelaar at GrobbelaarB@arc.agric.za or Vivienne Uys at UysV@arc.agric.za*
Advances in Characterization of Rhizobia from the SARCC Collection

A recent initiative towards the development of the South African Rhizobium Collection (SARCC) includes the molecular characterization of beneficial and potentially effective rhizobia and plant growth promoting rhizobacteria (PGPR) strains of major agricultural importance. The characterization that used the 16S ribosomal RNA (16S rRNA) and the housekeeping DNA recombinase (recA) gene sequencing generated unique taxonomic barcodes for 200 isolates in the SARCC collection. Recently, we conducted whole genome sequencing of selected best isolates based on their efficacy on nodulation, nitrogen fixation and plant growth promotion.

Mesorhizobium sp. SARCC-RB16n that nodulates and fix atmospheric nitrogen in rooibos (Aspalathus linearis), Rhizobium tropici SARCC-755 that nodulates pigeonpea (Cajanus cajan) and Bradyrhizobium japonicum SARCC-341 that nodulates soybean (Glycine max) are the selected root nodule bacteria. Burkholderia sp. Nafp2/4-1b and Pseudomonas sp. KBS1-3a both isolated from the rhizosphere of grasses were efficient growth promoters in maize (Zea mays) and were selected for the whole genome sequencing. The genome sequences of Mesorhizobium sp. SARCC-RB16n (Figure 1),
Dr Wilhelm Botha received a request in June 2020 from Dr. Kasem Soytong, the Editor in chief of the International Journal of Agricultural Technology, to review a manuscript titled “Isolation and identification of several Pythium species and related genera in Chanthaburi province, Thailand”. The manuscript was reviewed according to six parameters as required by the Journal Peer Review Process. After careful consideration, Dr Botha recommended a major review of the manuscript because the text, experimental design and discussion lacked sufficient proof to support invalid statements. He also recommended several changes and supplementary work to the journal Editor in order for the authors to revise and resubmit the manuscript. At the conclusion of the review process, the Editor replied that the Journal was now included in the SJR-SCOPUS list and thanked him for his contribution in improving the scientific standard of the International Journal of Agricultural Technology. The SCImago Journal Rank (SJR) indicator is a measure of the scientific impact of academic journals based on the number of citations received by a journal and the status or reputation of journals where the citations originated. Higher SJR values should indicate higher journal prestige. The Editor appreciated his contribution in the format of a certificate of excellence from the Journal.

Contact: Wilhelm Botha at BothaW@arc.agric.za
Sixty year old slides discovered of first plant-parasitic nematode species described in South Africa

Recently, as part of the preparation for the GRAP 103 audit of the National Collections at the ARC, nematology’s collection manager Dr Chantelle Girgan found slides with the entire life cycle of the little-known species *Meloidogyne acronea* Coetzee, 1956. These slides, more than sixty years old, were discovered in a cabinet at the Nematology Unit and are currently being incorporated into the National Collection of Nematodes (NCN). What makes this find so exciting is that *Meloidogyne acronea* Coetzee, 1956 was the first plant-parasitic nematode species to be described in South Africa, and is probably endemic to Africa. It was associated with the galled roots of *Sorghum vulgare*, variety Radar (a variety of sorghum developed in South Africa) on a farm in the Vryburg District of the Northern Cape Province. The main hosts of *M. acronea* seem to be sorghum and cotton, but severe losses due to infestation by this nematode have never been reported from these crops in South Africa. In the 1970’s however, *M. acronea* was found in large numbers on the roots of cotton in Malawi where it was associated with severe stunting of the crop. Interestingly, at about the same time the bacterium *Pasteuria penetrans* was found to infect *M. acronea* in southern Malawi. Glasshouse cultures of *M. acronea* were almost completely destroyed by this bacterium.

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Study shows that *Fusarium oxysporum* species complex populations in the South African grassland biome are genetically diverse

The genetic diversity of pathogenic members of the *Fusarium oxysporum* species complex (FOSC) has been intensively studied worldwide, yet strains occurring from native soils with low anthropogenic disturbance remain poorly understood. The recent study by Mavhunga et al. (accepted for publication in the journal *Phytopathology*) focused on 355 *F. oxysporum* isolates from soils with low anthropogenic activity obtained from the grassland biome of South Africa as part of the South African Soil *Fusarium* Survey. Analysis of the translation elongation factor 1-alpha (tef-1α) gene revealed high levels of sequence type (ST) diversity within the soil population in comparison to the global dataset. Phylogenetic relationships of the South African isolates revealed that only four nested within FOSC Clade 1. The remaining strains nested within Clades 2 to 5. This study contributes significantly to our understanding of the distribution of the FOSC in natural systems as we show that FOSC populations in the South African grassland biome are genetically diverse. This fills in our knowledge gap as previous studies reported only on the occurrence and diversity of the FOSC isolated from plant debris in South Africa. This is the first comprehensive survey of fusaria from grassland soils with low anthropogenic disturbance in South Africa.


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The Elderberry Dilemma

*Sambucus nigra*, the botanical name for the elderberry, is not your typical weed species. It is cherished in its native northern hemisphere, as well as other parts of the globe where it is widely cultivated as a garden ornamental and also as a medicinal plant. The trees are beautiful in flower and fruit, and elderberries are tasty, nutritious and intoxicating when consumed as an alcoholic beverage. Two elderberry species have been propagated as garden subjects in South Africa since the time of early European settlement. They are the European Elder (*S. nigra* subsp. *nigra*) and the American Elder (*S. nigra* subsp. *canadensis*). Both species are so similar in appearance that many botanists feel they should be regarded as the same species separated geographically.

Elderberry is a category 1b invasive species under the National Environmental Management Biodiversity Act (NEMBA). There are more praises of the elderberry, however, than there are vilifications, so it becomes difficult to encourage people to desist from propagating the plant. The horticultural and homeopathic properties make elderberry a wonderful species to cultivate. Elderberry favours damp ground and land that is seasonally flooded. From an environmental perspective, the plant poses a significant threat to wetlands by transforming these marshy habitats into dense elderberry thickets. Birds, especially bulbuls and white-eyes, relish the plump juicy berries and are prolific spreaders of the seed. The seed transit time through the digestive tract of a black-eyed bulbul after ingestion of the fruit is about eight minutes. These birds tend to have comparatively small home ranges, so seed is dispersed over a relatively short distance from trees in fruit. Elderberry trees also produce shoots along their roots, which become clones of the parent plant. Unchecked, a single elderberry plant can become a miniature forest in a decade. Wetlands close to towns can become invaded, with the help of the local bird force, and these open marshlands, thriving with life, are transformed into dense elderberry thickets supporting few species. The average invading elderberry plant has about nine stems, 3-5 cm in diameter, and stands three meters in height. The stumps regrow after cutting down the stems, so they must treated with herbicide immediately after felling. Research shows that elderberry stumps and regrowth are very sensitive to a range of herbicides. Imazapyr, picloram and picloram/fluroxypyr are effective on stumps, killing >90% of treated plants. Triclopyr, metsulfuron methyl, picloram and picloram/fluroxypyr applied as foliar sprays to regrowth are also effective. The use of picloram near water bodies is prohibited and should only be used in non-drainage areas.

Although it is illegal to grow elderberry in gardens it is still a popular garden plant in many parts of the country, and will probably continue to remain so for decades. Homeowners will probably only commit to removing elderberry to comply with NEMBA regulations when they put their houses up for sale. For those who content themselves with home remedies, elderberry pie and homebrewed wine, there is not much incentive to destroy their beloved trees.

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SCIENTIFIC PUBLICATIONS


CHAPTERS IN BOOKS


MASTERS THESES

Langa N.A. 2020. Characterization of fluorescent Pseudomonas species causing foliar diseases of tomato in South Africa. MSc Plant Pathology. UKZN.
**Plant Health and Protection**

**Nematodes**
- Identification to species level
- Database on distribution (SAPPNS)
- Species assessment as indicator for soil health/biodiversity
- Irrigation water testing

**Insects**
- Identification of Vectors (aphids and thrips)
- Identification of chewing insects (beetles and lepidoptera)
- Stored grain pests cultures for product registration
- Quarantine services
- Culture supply of major lepidopteran pests
- Termite research

**Biological Nitrogen Fixation**
- Sale of cultures for research
- Product screening
- Quality testing
- Shelf-life testing

**Fungi**
- Sale of cultures for research
- Identification
- Growing media and soil testing
- Irrigation water testing
- Product screening and development

**Bacteria**
- Sale of cultures for research
- Identification
- Pathogenicity testing
- Selective media sales

**Viruses**
- PCR
- ELISA
- Vector studies

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