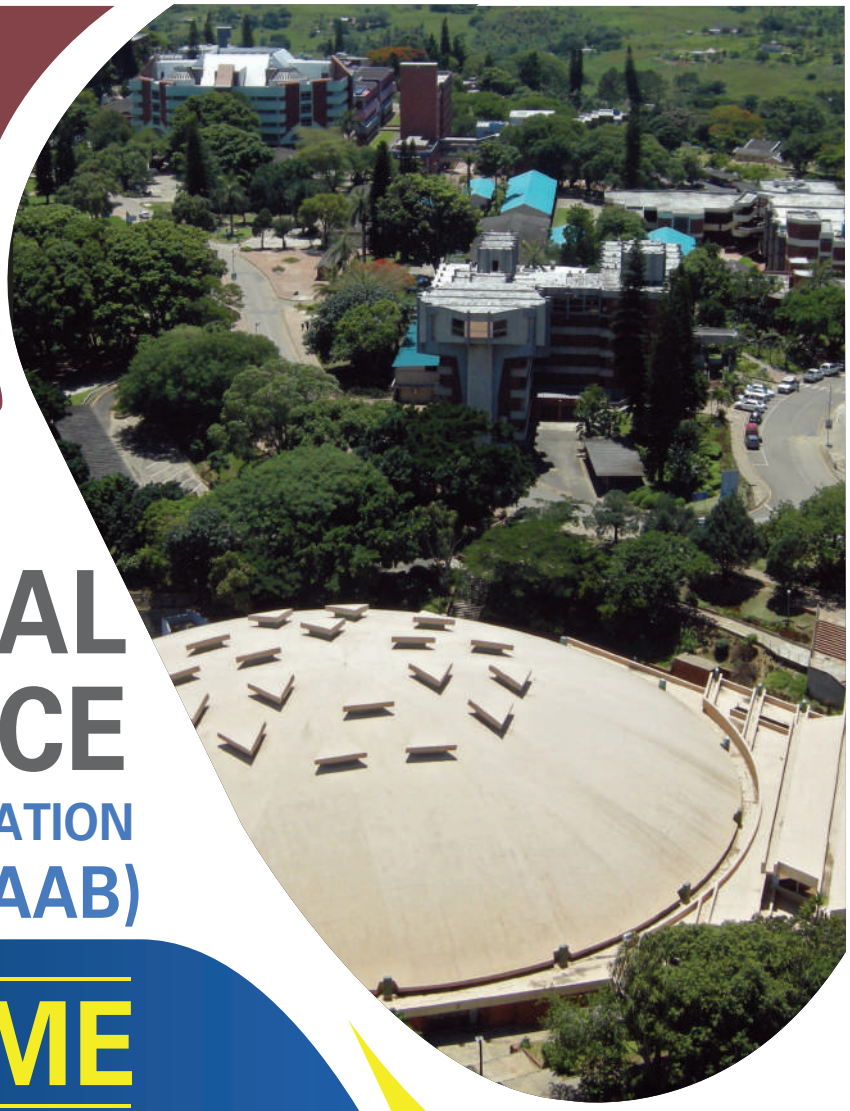
**Vision:** A leading, comprehensive University providing quality education // Mission: To provide globally competitive graduates, relevant for the human capital needs of our country, by providing quality education which upholds high standards of research and academic excellence.



SAGP SAAB

# 49th ANNUAL CONFERENCE

## SOUTH AFRICAN ASSOCIATION OF BOTANISTS (SAAB)

# PROGRAMME

**The conference is themed "Ukunakekela Umhlaba Ukuze Usimamise Okukhulayo" A Zulu phrase that encapsulates the immense intrinsic value of nurturing the earth**

**"Nurturing the Earth for Sustainable Growth"**

**When: 7 - 11 January 2024**
**Where: UNIZULU Richards Bay Campus**

UNIVERSITY OF ZULULAND

*A NODE FOR AFRICAN THOUGHT*

University providing quality education // Mission: To provide globally competitive graduates, relevant for the human capital needs of our country, by providing quality education which upholds high standards of research and academic excellence. // **Vision:** A leading, comprehensiv

**Vision:** A leading, comprehensive University providing quality education // Mission: To provide globally competitive graduates, relevant for the human capital needs of our country, by providing quality education which upholds high standards of research and academic excellence.

## Welcome message from the Deputy Vice-Chancellor – Research and Innovation

On behalf of Management at the University of Zululand (UNIZULU), it is great pleasure to welcome all the delegates for the 49th South African Association of Botanists (SAAB) Annual Conference. We are pleased that the SAAB leadership committee has given the University of Zululand the privilege to host the 2024 SAAB conference. Based on the environmental changes such as the droughts, severe rainfall and heat waves caused by climate change, the theme "Nurturing the Earth for Sustainable Growth" couldn't have come at a better time. The conference brings ideas on a holistic approach on how to improve plant production for food production and other uses, while preserving a sustainable environment. Congratulations to the hosting Departments (Department of Botany and Department of Agriculture) in the Faculty of Science, Agriculture and Engineering at UNIZULU.

I would like to also give a special welcome to the plenary speakers of the conference, and I would like to pass my gratitude for their special contribution to the 49th SAAB conference. The plenary speakers are:

Prof. James Stephen Boatwright (University of the Western Cape, SA)
Dr Karel Dolezal (Palacký University, Šlechtitelu, Olomouc, Czech Republic)
Mr. Kaylan Reddy (Stellenbosch University, SA)
Dr Shakira Shaik (University of KwaZulu-Natal, SA)

I hope you will all have a wonderful and productive conference.

Sincerely
**Prof NW Kunene**
DVC – Research and Innovation

## Welcome message from the Dean of Faculty of Science, Agriculture and Engineering

It is my honour and pleasure to extend a warm welcome to every one of you at the 49th South African Association of Botanists Conference, hosted by the University of Zululand. As the Dean of the Faculty of Science, Agriculture and Engineering, I am delighted to see such a diverse gathering of scholars, researchers, and enthusiasts who share a common passion for the fascinating world of botany.

Our conference theme, "Ukunakekela Umhlaba Ukuze Usimamise okukhulayo" which translates to "Nurturing the Earth for Sustainable Growth" resonates profoundly with the collective strategy of the University of Zululand (UNIZULU) which has positioned itself as a Node for African Thought. We therefore emphasise the importance of Indigenous Knowledge System. For Botanists, COVID-19 pandemic highlighted the importance of nurturing and studying the relationship of plants and their surroundings, in which conservation of diversity becomes paramount. The pandemic also pushed us to dig deep into our Indigenous Knowledge System particularly, Ethnobotany. Local botanists are fortunate to be at the heart of diverse ecosystem, ranging from wetlands to dry sandy soils. Therefore, we are not only trying to understand, protect, and sustain the incredible biodiversity that graces our locality, but we also strive for generation of new knowledge and innovations. In support of UNIZULU strategy we also strive to inculcate entrepreneurship into our learning and research. Therefore, many of the presentations which we will share with you during this conference, highlight conservation, utilisation, domestication and commercialisation of indigenous plants.

As the hosting Faculty of Science, Agriculture and Engineering, we are honoured to witness and listen to many of the presentations from botanists in different fields highlighted in the programme, seeking to find where minds converge and ideas flourish in order to forge collaborations. With diverse presentations lined up, we recognise the pivotal role that botany plays in fostering sustainable growth – growth that harmonises with the delicate balance of our ecosystems, contributes to global food security, and addresses the urgent need for conservation.

To our esteemed presenters, thank you for sharing your insights and discoveries. Your contributions are the building blocks of progress, and we eagerly anticipate the intellectual feast that awaits us.

I extend my deepest appreciation to the South African Association of Botanists for giving us the opportunity to host this prestigious conference. My sincere gratitude to the organizing committee, sponsors, and volunteers who have worked tirelessly to bring this conference to realisation. Your dedication is the foundation upon which this gathering stand, and for that, we are truly grateful.

Welcome to the 49th South African Association of Botanists Conference at the University of Zululand – and remember that "We cannot solve problems with the same thinking we used to create them." – Albert Einstein

Thank you, and I wish you all an enriching and memorable conference.

Sincerely
**Prof KC Lehloenya**
Dean – Faculty of Science, Agriculture and Engineering

## Welcome message from the South African Association of Botanists president

On behalf of the SAAB Council, it is my great pleasure to welcome you to our 49th annual South African Association of Botanists (SAAB) conference at the University of Zululand, Richard Bay Campus, from 7-11 January 2024.

We are delighted that University of Zululand agreed to host our annual conference for the first time. The local organizing committee (LOC), headed by Dr Mbukeni Nkomo has done a great deal of hard work (more than a year of planning) to ensure we have a memorial conference and stay in Richard Bay. We sincere appreciate the effort from the LOC and the University management. Our gratitude also goes to the Conference organiser (XL Millennium), sponsors and volunteers.

The theme for this conference is: "Ukunakekela Umhlaba Ukuze Usimamise Okukhulayo" a Zulu phrase that encapsulates the immense intrinsic value of nurturing the earth (Nurturing the Earth for Sustainable Growth). This theme resonances with the United Nations Sustainable Development Goals (UN SDGs) which is central to the research findings that will be presented during the conference. The relevance of the theme to Africa Union (AU) Agenda 2063 (creating the Africa We want!!!) and South Africa National Development Plan (NDP, 2030) cannot be overemphasised. We are thrilled to provide this platform with a rich pool of the invited speakers, researchers and post graduate students that will be engaging on various topics within the conference theme.

Thank you for taking the time (very early in 2024) and making the effort to participate in the 49th annual SAAB conference. I trust that we will have a memorable conference enriched with new insights, collaboration, opportunities, and long-lasting friendship.

Please enjoy the moment as we journey and interact for the next few days.

Sincerely,
**Prof. Adeyemi Aremu**
SAAB President

## Welcome message from the Local Organizing Committee chairperson

**Dear Esteemed Conference Delegates**,

It is with great pleasure and enthusiasm that I extend a warm welcome to each one of you attending the 49th Annual Conference of the South African Association of Botanists (SAAB). The conference is scheduled to take place from 7-11 January 2024 on the picturesque Richards Bay campus of the University of Zululand. Throughout the 5 days of the conference, we have curated a dynamic program featuring keynote speakers, panel discussions, workshops, and presentations that cover a broad spectrum of topics in the field of plant science. Our aim is to create a platform where ideas can flourish, connections can be forged, and knowledge can be exchanged. We anticipate the gathering of approximately 200 delegates, representing a diverse range of expertise and hailing from at least 10 countries. On behalf of the Local Organizing Committee (LOC), I am thrilled to have the privilege of hosting such a distinguished group of individuals who are at the forefront of the Plant Science field. This conference represents a unique opportunity for us to come together, share insights, and engage in meaningful discussions that will undoubtedly contribute to the advancement of plant science. We encourage you to take full advantage of the networking opportunities available. Whether during coffee breaks, poster sessions, or the scheduled social events, we hope you will engage with your peers, build new connections, and establish lasting relationships.

Please feel free to reach out to any member of the LOC or the event staff if you have questions or need assistance during your time here. We are dedicated to ensuring that your experience is not only professionally enriching but also enjoyable. Thank you for being a part of the 2024 SAAB conference. Your presence will add immeasurable value to this gathering, and we are confident that your contributions will significantly impact the discussions and outcomes of the conference.

Warm regards,
**Dr. Mbukeni Nkomo**
LOC Chair
**49th Annual SAAB Conference**

## SAAB2024 Local Organizing Committee

**Chairperson:** Dr. Mbukeni Nkomo
**Secretary:** Miss. Nqobile Mbongwa
**Scientific Program Officer:** Prof. Nontuthuko Ntuli
**Abstracts Officers:** Prof Ashwil Klein, Dr Corlien Van Jaarsveld, Prof Melusi Sibanda, Prof Godfrey Zharare
**Venue and Facilities Officers:** Prof Melusi Sibanda, Miss Zoliswa Mbhele, Mr Sakhile Fatyi
**Hospitality Officers:** Prof Melusi Sibanda, Miss Zoliswa Mbhele, Mr Sakhile Fatyi
**Adjudication Officers:** Prof Khajamohiddin Syed, Prof Ashwil Klein
**Publicity Officers:** Miss Precious Shamase, Mr Siyanda Mntambo
**IT Officer:** Mr Sakhile Fatyi

**Technical and Logistics Team(s)**
Dr Corlien van Jaarsveld
Dr Fortune Thabethe
Mrs Ruth Phakathi
Miss Zoliswa Mbhele
Miss Zandile Ngcobo
Mr Lungelo Buthelezi
Mr Siyabonga Ngcobo
Mr Prince Sokhela
Miss Samukelisiwe Ngubane
Miss Eunice Maupa
Mr Minenhle Mnukwa
Mr Sibonelo Hlatswayo
Mr Mokhethi Selepe

**Chairperson Assistants**
Miss Ntombifuthi Mabuza
Miss Sibusisiwe Mnembe
Mr. Minenhle Mnukwa
Mr. Leonard Ndou
Mr. Yanga Nontu
Mr. Mokhethi Selepe

## Conference Programme

| SUNDAY, 07 JANUARY 2024 | |
|---|---|
| 14:00 - 18:00 | Registration<br>Dovyalis, UNIZULU, Richards Bay Campus |
| 15:00 - 17:00 | SAAB Council meeting<br>Boardroom, UNIZULU, Richards Bay Campus |
| 18:00 - 20:00 | Meet and Greet<br>Dovyalis / Albizia, UNIZULU, Richards Bay Campus |

| MONDAY, 08 JANUARY 2024 | | |
|---|---|---|
| **Venue:** Dovyalis, UNIZULU, Richards Bay Campus<br>**Chairperson:** Prof Melusi Sibanda | | |
| 07:00 - 07:45 | Registration | |
| 07:45 - 08:00 | Entertainment | |
| 08:00 - 08:15 | Opening address<br>Prof NW Kunene (DVC – RI) | |
| 08:15 - 08:30 | Faculty welcome message<br>Prof KC Lehloenya (Dean FSAE) | |
| 08:30 - 08:50 | Welcome address<br>Prof Adeyemi O. Aremu (SAAB President) | |
| 08:50 - 09:00 | House-keeping announcements<br>Chairperson | |
| 09:00 - 10:00 | Plenary Lecture: Prof. James Stephen Boatwright<br>**The strength of global working groups in taxonomy: Fabaceae as an example** | |
| 10:00 - 10:30 | TEA<br>Albizia | |
| **Mimusops**<br>Ethnobotany / Phytochemistry 1<br>Chairperson: Prof Peter Tshisikhawe | **Strelitzia**<br>Conservation Biology 1<br>Chairperson: Prof Stefan Siebert | **Strychnos**<br>Plant Physiology / Anatomy 1<br>Chairperson: Dr. Makoena Moloi |

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|---|---|---|---|
| 10:30 - 10:50 | **Ms. Ancia Cornelius**<br>The diversity and dynamics of southern African medicinal and ritual plant use | **Dr. Samalesu Mayonde**<br>Understanding the genetic diversity and geneflow of the critically endangered orchid, Brachycorythis conica subsp. transvaalensis – Implications for Conservation | **Prof. Ashwell Ndhlala**<br>Use of crop monitoring technologies in crop production, prediction of yield and phytochemical composition in Moringa |
| 10:50 - 11:10 | **Dr. Caroline Machaba**<br>Medicinal plants used for the management of respiratory infections and related ailments in Vhembe district Limpopo province. | **Miss. Madie Mbayela**<br>Death of a Legacy: Evaluating the health of Protea caffra Meisn. at Melville Koppies Nature Reserve | **Miss. Grace Emmanuella Adoteye**<br>Low-nutrient-induced resilience in growth and yield of chickpea (Cicer arietinum L.) under drought conditions |
| 11:10 - 11:30 | **Prof. Salome Mahlo**<br>Are plant extracts a potential source for the treatment of Oral candidiasis? | **Miss. Samista Rooplal**<br>Modelling current and future distributions of Warburgia species at continental (Africa) and local (South Africa) scales | **Prof. Samson Chimphango**<br>Cloth mulching for enhanced photosynthesis and growth of Aspalathus linearis (Burm.f.) R. Dahlgren (rooibos) in the Cederberg |
| 11:30 - 11:50 | **Prof. Ndivhaleni Masevhe**<br>Antimicrobial efficacy and synergistic properties of selected South African medicinal plants | **Dr. Mariam Adeoba**<br>Utilization of Musanga cecropiodes R.Br. and its implication on the risk of extinction | **Miss. Anneri du Toit**<br>The physiological effect of drought stress on Lessertia frutescens |
| 11:50 - 12:10 | **Dr. Nqobile Masondo**<br>The synergistic and antagonistic effect of combining Moringa extract with African ginger, commercial ginger, and cinnamon extracts | **Mr. Vincent Clarke**<br>Testing the suitability of a medicinal geophyte, Crinum bulbispermum, for the restoration of mine tailings | **Mr. Hlalanathi Gwanya**<br>Bioprospecting glycoside hydrolase influencing RWASA2 and RWASA5 virulence during wheat-aphid interaction. |
| 11:50 - 12:10 | **Dr. Nqobile Masondo**<br>The synergistic and antagonistic effect of combining Moringa extract with African ginger, commercial ginger, and cinnamon extracts | **Mr. Vincent Clarke**<br>Testing the suitability of a medicinal geophyte, Crinum bulbispermum, for the restoration of mine tailings | **Mr. Hlalanathi Gwanya**<br>Bioprospecting glycoside hydrolase influencing RWASA2 and RWASA5 virulence during wheat-aphid interaction. |

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| 12:10 - 12:30 | **Miss. Tshegofatso Mathabe**<br>Investigation of southern African Senecio (Senecioneae, Asteraceae) species for toxicity | | **Miss. Jubilant Vongani Sithole**<br>Improving our understanding of the plant communities, habitat characteristics and changes to Drakensberg Amathole Afromontane Fynbos (Gd6), Golden Gate Highlands National Park. | | **Mr. Jeremiah Hlahla**<br>Combined drought and heat stress affect the photosynthetic efficiency and osmolytes accumulation in edamame |
| 12:30 - 12:50 | **Ms. Maphuti Matlala**<br>In vitro antimycobacterial activity and proteomic profile of selected medicinal plants extracts used traditionally to treat TB-related symptoms | | **Prof. Milingoni Peter Tshisikhawe**<br>The population ecology of Pterocarpus angolensis DC. at Khalavha village in Vhembe Biosphere | | **Miss. Bianca Boshoff**<br>Physiological effect of coal tailings on Kenaf (Hibiscus cannabinus) |
| 12:50 - 13:10 | **Dr. Petunia Mashiane**<br>Knowledge gaps on the quality of Moringa functional food products | 12:50 - 12:55 | **Ms. Anna Fregien**<br>Effect of climate conditions on leaf traits in Protea | 12:50 - 12:55 | **Mr. Charlie Sithole**<br>Physiological and proteomic characterization of drought and salt stress responsive proteins from Pennisetum glaucum (L) cultivar |
| | | 12:55 - 13:00 | **Dr. Tshegofatso Sebitloane**<br>Rural Revival: Biodiversity Conservation through Restoration in Taung, South Africa | 12:55 - 13:00 | **Mr. Gaopalelwe Motshegwa**<br>Frequency matters: the impact of multiple selenium foliar applications on the physio-biochemical responses of drought-stressed edamame |
| | | | | 13:00 - 13:05 | **Dr. Ademola Adetunji**<br>Antioxidants and inorganic salt solutions mitigate ageing in Brassica oleracea L. and Lactuca sativa L. seeds |
| 13:10 - 14:00 | **Lunch** | | | | |

| | **Mimusops**<br>Ethnobotany / Phytochemistry 2 Chairperson:<br>Prof. Ashwell Ndhlala | **Strelitzia**<br>Plant Biotechnology 1 Chairperson:<br>Dr. Mbukeni Nkomo | **Strychnos**<br>Invasive Alien Plant Biology 1 Chairperson:<br>Prof. Nomali Ngobese |
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| 14:00 - 14:20 | **Ms. Scelo Mguni**<br>Phytochemical profiling and antibacterial efficacy of Zanthoxylum chalybeum Engl. leaf and bark extracts against pathogenic bacteria. | **Ms. Thubelihle Mathonsi**<br>Genetic diversity of Bambara groundnut in South Africa | **Ms. Rofhiwa**<br>Ratshibvumo The study of distribution of Calotropis procera (Apocynaceae) in parts of Mopani District, Limpopo Province, South Africa |
| 14:20 - 14:40 | **Ms. Talita Jessica Mnisi**<br>Evaluation of phytochemical, antibacterial, anti-biofilm and cytotoxic effects of selected indigenous plant species used for management of nosocomial infections. | **Ms. Mapula Precious**<br>Magwele Interactive effects of Phytostim biostimulant and storage period of metabolites of Amaranth species | **Miss. Zinhle Sithole**<br>Role of mammals in the seed dispersal of the invasive plant species, Rosa rubiginosa, in the Free State rangelands. |
| 14:40 - 15:00 | **Miss. Keloabetswe Mokgau**<br>Leafy vegetables among local communities in North West, Province: Diversity, use pattern and cultural significance | **Ms. Philisiwe Mhlanga**<br>Supercharged pumpkin: In vitro propagation for enhanced nutrition and yield | **Dr. Claude Moshobane**<br>Public interest and readability analysis of invasive species information: insights from google searches and readability tests |
| 15:00 - 15:20 | **Mr. Maeleletse Mopai**<br>Current and future prospects of ethnomedicinal potential of Mistletoe, an 'intriguing and mystic all-purpose herb' | **Mr. Tyson Tebogo Mokgalabone**<br>In vitro protocols and methods for determination of phytonutrients in Strychnos spinosa | **Ms. Dikonketso Tlaamela**<br>Predicting the occurrence of invasive alien Populus alba L. in South Africa |
| 15:20 - 15:40 | **Dr. Peter Tshepiso Ndhlovu**<br>Assessing the factors influencing the decisions to commercialize medicinal plants used for childhood diseases in the North-West Province, South Africa | **Dr. Semakaleng Mpai**<br>Amino acids, UPLC-MS phenolic metabolites and multivariate approach for elucidating the effect of two growing conditions on growth and yield attributes in okra pods and leaves | **Mr. Duran Chetty**<br>Assessment of the sterility of 'sterile' cultivars of Duranta erecta |

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| 15:40 - 16:00 | **Ms. Tshihumbudzo Ndou**<br>Ethnobotanical study of Pterocarpus angolensis DC. at Khalavha village in Vhembe Biosphere | **Ms. Vuyisile Valencia Ndlangamandla**<br>The indigenous practices and cultivation of Cannabis sativa and its Genome assembly in South Africa | |
| 16:00 - 16:30 | **Tea** | | |
| | **Mimusops**<br>Ethnobotany / Phytochemistry/ Microbiology and Phycology (4 min Poster presentations)<br>Chairperson: Dr. Fikisiwe Gebashe | **Strelitzia**<br>Plant Biotechnology (4 min Poster presentations)<br>Chairperson: Prof Aleksei Oskolskii | **Strychnos**<br>Invasive Alien Plant Biology / Plant Evolutionary Ecology / Plant-Animal Interaction / Conservation Ecology / Plant Systematics and Taxonomy (4 min Poster presentations)<br>Chairperson: Dr. Caroline Machaba |
| 16:30 - 16:35 | **Miss. Grace Emmanuella Adoteye**<br>Low-nutrient-induced resilience in growth and yield of chickpea (Cicer arietinum L.) under drought conditions | **Mr. Joseph Gaorongwe**<br>Characterizing the role of a metalbased manure Nano-fertilizer on salt-stressed Glycine max (L.) Merr. plants | **Mr. Lehlohonolo Donald Adams**<br>The role of mammals in seed dispersal of fleshy-fruited invasive alien plants in the Grassland Biome of South Africa |
| 16:35 - 16:40 | **Dr. Paseka Mabulwana**<br>Watermelon rind enhances physicochemical properties and antioxidant capacity of indigenous and commercial watermelon [Citrullus lanatus (Thunb.) Matsun. & Nakai] juice during pasteurisation | **Miss. Sindiswa Khawula**<br>Evaluating the physio-biochemical responses of two sorghum seedlings varieties exposed to prolonged heat stress. | **Ms. Karabo Thato Moloi**<br>Seed dispersal and germination of Cotoneaster pannosus in Afromontane grasslands of eastern Free State, South Africa |
| 16:40 - 16:45 | **Ms. Dineo Raphasha**<br>Assessing the efficacy of Moringa oleifera seedbased water treatment in river water | **Ms. Elisabeth Khumalo**<br>The metabolomic profiles of two accessions of Amaranthus cruentus cultivated in KwaZuluNatal. | **Mr. Menzi Msizi Nxumalo**<br>Assessment of invasion status of Ulex europeaus (Fabaceae) in South Africa |

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| 16:45 - 16:50 | **Dr. Mapula Razwinani**<br>The future of burnt injuries depends on medicinal plants extracts Hydrocolloid Bandages | **Dr. Nqobile Masondo**<br>The influence of novel cytokinin oxidase/dehydrogenase inhibitors on Lessertia frutescens plant growth and metabolite profile after exposure to salinity stress | **Dr. Stephanie Payne**<br>Review of the invasive, yet economically beneficial, Rosa rubiginosa L. (Rosaceae) within southern Africa |
| 16:50 - 16:55 | **QUESTIONS** | **QUESTIONS** | **QUESTIONS** |
| 16:55 - 17:00 | **Dr. Confidence Semakane Phaahla**<br>Documentation of ethnoveterinary practices and ethnobotany knowledge and alternative practices of cattle ticks control in Sekhukhune district, Limpopo province, South Africa. | **Miss. Nkosingiphile Nyawo**<br>Assessing physio-biochemical markers for studying germination and seedling growth of heteromorphic chia seeds under salinity stress | **Prof. Sandy-Lynn Steenhuisen**<br>Impact and management of range expanding Rosaceae species along elevational gradients in the MalotiDrakensberg |
| 17:00 - 17:05 | **Miss. Midalo Shaka Ntsieni**<br>Evaluation of anti-biofilm, antibacterial, and cytotoxic effects of selected traditional medicinal plants against nosocomial pathogens. | **Miss. Sbonelo Dlamini**<br>Effect of Varying Sugarcane Filter Cake Treatments Rates on Plant Growth and Antioxidant Potential of Bidens pilosa L. | **Mr. Loyd Vukeya**<br>An assessment of ecological integrity of the southern African grassland biome. |
| 17:05 - 17:10 | **Matsilane Mashilo**<br>Identification and characterisation of compounds with antimycobacterial activity from the leaves of Dombeya rotundifolia | **Ms. Mulanga Luscious Mulaudzi**<br>Phytochemical screening, and antioxidant activities of medicinal plant leaves used for dental health. | **Dr. Moleseng Claude Moshobane**<br>Plant size, latitude, and phylogeny explain within-population variability in herbivory. |
| 17:10 - 17:15 | **Dr. Mariam Oyedeji Amusa**<br>Leonotis ocymifolia: An ethnopharmacological review and in vitro antimicrobial assessment | **Dr. Nolitha Nkobole**<br>In vitro antidiabetic effect of wild and cultivated Amaranthus spp. and isolated compounds | **Ms. Selina Ramogohlo Masha**<br>The impact of Alien invasive species to the environment |
| 17:15 - 17:20 | **QUESTIONS** | **QUESTIONS** | **QUESTIONS** |

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| 17:20 - 17:25 | **Dr. Mpho Mafa**<br>Cell wall modification and carbohydrate metabolism: two targets for Biochemical strategies to improve wheat resistance against Puccinia triticina | **Folasade Banji-Onisile**<br>Plant-mediated synthesis of silver nanoparticles using Terminalia phanerophlebia Engl. & Diels root extract and assessment of their antimicrobial and anticancer properties. | **Prof. Glynis Goodman-Cron**<br>Micro-morphological characterization of southern African Senecio sensu stricto and new genera needed from within Senecio sensu lato. |
| 17:25 - 17:30 | **Thabelo Netsianda**<br>Screening and comparison of Lippia javanica and Mentha piperita leaf extracts for antioxidant and antibacterial activities | **Mr. Niel Snyman**<br>Alpha glucosidase and α-amylase activities of Amaranthus spinosus | **Miss. Tshepiso Tsime**<br>Morphological characterization of Amaranthus palmeri invading agricultural land in the Potchefstroom area, South Africa |
| 17:30 - 17:35 | **Miss. Rinae Lucy**<br>Nephawe Assessment of nutraceutical attributes of selected wild edible fruit plants used by Vhavenda people of the Thulamela Local Municipality | **Ms. Siphelele Banele Ndlovu**<br>Cannabis chronicles; a systematic review of tissue culture protocol optimization and comparative techniques | **Mr. Duran Chetty**<br>Perspectives on and the status of sterile cultivars of invasive alien plants in South Africa |
| 17:35 - 17:40 | **Ms. Elisabeth Kola**<br>Contribution of underutilized fruits and vegetables to enhanced food and nutrition security: A review | **Ms. Nkhathutsheleni Maureen Tshikunde**<br>Genotype x Environment interactions of chickpea genotypes in North-Eastern South Africa | **Dr. Thabiso Mokotjomela**<br>The alien and invasive plant species may be a future conservation threat to the Lesotho Afro-alpine Drakensberg area |
| 17:40 - 17:45 | **Mr. Senzo M.M Zwane**<br>The effectiveness of selected botanical insecticides against pineapple pest in Northern KwaZulu-Natal province, South Africa | | **Ms. Xolile Skosana**<br>The impacts of Lantana camara L on understorey shrub layer species of the Lowveld National Botanical Gardens vegetation |
| 17:45 - 17:50 | **QUESTIONS** | **QUESTIONS** | **QUESTIONS** |
| 18:30 - 20:00 | Cocktail function and Poster viewing session<br>**Dovyalis** | | |

| TUESDAY, 09 JANUARY 2024 | | | |
|---|---|---|---|
| **Dovyalis**<br>Chairperson: Prof Khajamohiddin Syed | | | |
| 08:00 - 09:00 | Plenary Lecture: Prof. Karel Doležal<br>New phytohormone derivatives as a modern tool for basic and applied plant biotechnology research | | |
| | **Mimusops**<br>Ethnobotany / Phytochemistry 3<br>Chairperson:<br>Dr. Fortune Thabethe | **Strelitzia**<br>Plant Biotechnology 2 / Phycology 1<br>Chairperson:<br>Prof. Samson Chimphango | **Strychnos**<br>Invasive Alien Plant Biology 2<br>Chairperson: Prof. Sandy-Lyn Steenhuizen |
| 09:00 - 09:20 | **Prof. Godfrey E. Zharare**<br>Yield, physiochemical characteristics and fatty acid composition of vegetable oil extracted from the seed coat of Strychnos pungens Soler. [family Loganiaceae,] | **Mr. Lungelo G. Buthelezi**<br>Phytochemical composition of Lagenaria siceraria fruits from KwaZulu-Natal and Limpopo, South Africa | **Mr. Lehlohonolo Donald Adams**<br>Community perceptions of a fleshyfruited invasive alien plant in the grassland biome of South Africa |
| 09:20 - 09:40 | **Miss. Tswelelopele Mpolokeng**<br>Utilisation pattern of plants for the management of livestock in selected villages in Madibeng local municipality, North-West Province | **Ms. Lucius Mokwena**<br>Effect of different concentrations of Phytostim® biostimulant application on postharvest attributes of tomato | **Mr. Hlamulani Goodman Manganye**<br>Small scale effects of alien plants on native plants in Limpopo Province, South Africa, and their soil and leaf leachate effects on seed germination and seedling establishment of Vigna unguiculata |
| 09:40 - 10:00 | **Miss. Zimasa Busisiwe Dubeni**<br>Exploration of the Use of Moringa oleifera in Aquaculture: A Review | **Mr. Eduardo Muñoz**<br>Promoting growth plant rhizobacteria (PGPR) improves the tolerance to drought stress by modulating biochemical plant metabolism | **Miss. Thembelihle Mbele**<br>Seed germination of naturalised and floristically traded Cortaderia species in South Africa |
| 10:00 - 10:20 | **Ms. Marlette Champion-Venter**<br>Global use patterns of commercialised medicinal plants | **Ms. Philisiwe Felicity Mhlanga**<br>Supercharged pumpkin: In vitro propagation for enhanced nutrition and yield | **Mrs. Sibulele Mtshengu**<br>Understanding the invasiveness of Lemna minor (duckweed) and exploring effective control strategies in the Johannesburg Zoo |

| 10:20 - 10:50 | **Tea** | | |
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| | **Mimusops**<br>Ethnobotany / Phytochemistry 4<br>Chairperson:<br>Dr. Semakeleng Mpai | **Strelitzia**<br>Plant Evolutionary Ecology 1<br>Chairperson:<br>Dr Theo Mostert | **Strychnos**<br>Plant Physiology / Anatomy 2<br>Chairperson:<br>Prof Ashwil Klein |
| 10:50 - 11:10 | **Miss. Keamogela Innocentia Nko**<br>An appraisal on the health benefits and therapeutic importance of indigenous leafy vegetables in South Africa | **Mr. Tendani Mavhila**<br>An analysis of exposure and slope gradient impact on tree layer profile of Maroelakop vegetation in Nylsvley Nature Reserve. | **Ms. Bongiwe Mbombo**<br>The allelopathic effect of Aloe ferox, Aloe marlothii, Anthocleista grandiflora and Pollichia campestris extracts on the germination of the selected plants |
| 11:10 - 11:30 | **Ms. Tryphina Ramavhale**<br>In vitro antimicrobial activity of isolated compounds from bark extract of A. versicolor Welw. ex Oliv | **Miss. Jessica Jaime Minnaar**<br>Pollinators drive floral trait diversification and speciation in Galtonia (Hyacinthaceae): a Drakensberg near-endemic genus | **Miss. Zwoitwaho Mokwevho** The effects of the extent of ringbarking on saplings and juveniles of Burkea africana, Dichrostachys cinerea, Populus alba and Terminalia sericea in the Nylsvley Nature Reserve Savanna Ecosystem |
| 11:30 - 11:50 | **Mr. Ryan Rattray**<br>An overview of southern African Lamiaceae and new insights into several key medicinal species | **Dr. Nora Mitchell**<br>Disentangling evolutionary relationships in Protea using anchored phylogenomics | **Ms. Lindiwe Sondela**<br>Influence of Pseudomonas spp endophytes on the physiological and biochemical responses of drought-stressed edamame (Glycine max (L.) |
| 11:50 - 12:10 | **Ms. Lebohang Bridget Selepe**<br>Multivariate analysis of UVdetected polar metabolites in the metabolome of select species from the South African genus Senecio (Asteraceae) | **Mr. Ross Stewart**<br>Leveraging machine learning to unveil phenological flowering patterns in South African National Botanical Gardens through public databases. | **Dr. Dunja MacAlister**<br>Altered expression of proteins contributes to thermotolerance in rooibos |

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| 12:10 - 12:30 | **Mr. Kutullo Nick Shai**<br>How do small-scale farmers explore the indigenous knowledge systems of plant species for the management of pests and diseases affecting crops in Ehlanzeni district municipality, Mpumalanga Province? | | **Mr. Gaborone Neo Tsuene**<br>Effects of nanoparticles on growth, physiology and proteome profile of Amaranthus cruentus L. under salt stress |
| 12:30 - 12:50 | **Ms. Eunezia Sitoe**<br>Comparative analysis of the Tsonga medicinal plants of Mozambique and South Africa | | |
| 12:50 - 13:10 | **Wanda Shekwa**<br>Antimicrobial activity and molecular docking studies of β-sitosterol isolated from the leaves of Carissa bispinosa | | |
| 13:10 - 14:00 | **Lunch** | | |
| **Dovyalis**<br>Chairperson: Dr Mbukeni Nkomo | | | |
| | **Mimusops**<br>Ethnobotany / Phytochemistry 5<br>Chairperson:<br>Dr. Nqobile Masondo | **Strelitzia**<br>Plant Systematics and Taxonomy 1<br>Chairperson:<br>Dr. Madeleen Struwig | |
| 15:00 - 15:20 | **Dr. Oladayo Amed Idris**<br>Effect of plant biopesticidepolluted soils on soil organisms (Eisenia andrei) and soil enzymatic activity, with biochar as an ameliorant | **Miss. Ndamulelo Mudzielwana**<br>The genus Erythroxylum (Erythroxylaceae) in southern Africa | |

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| 15:20 - 15:40 | **Miss. Thembeni Khumalo** Utilisation of indigenous farming practices and methods for food security among rural communities: A review | **Dr. Oluwayemisi Dorcas Olaniyan** To split or not to split: The Principle of classification and the prickly issue of polyphyly in Gnidia (Thymelaeaceae: Thymeleaoideae) | |
| 15:40 - 16:10 | **Tea** | | |
| | **Mimusops** Ethnobotany / Phytochemistry 5 Chairperson: Dr. John Asong | **Strelitzia** Plant Systematics and Taxonomy 2 Chairperson: Prof Glynis Goodman-Cron | |
| 16:10 - 16:30 | **Dr. Khathutshelo Magwede** A comparative study of medicinal plants found in Bapedi and Vhavenda home gardens: a case study of Tshitungulwane and Ga-Maponto villages in Limpopo Province | **Mr. Thaabiet Parker** Colourful chaos: Species delimitation of the African daisy species complex Dimorphotheca pluvialissinuata using genotyping-bysequencin g data | |
| 16:30 - 16:50 | **Dr. Mokgaetji Mokganya** Study of use patterns of some wild edible plant species of Limpopo Province, South Africa | **Miss. Nqobile Sithole** Identifying Prosopis species invading the Molopo area in North-West Province, South Africa | |
| 16:50 - 17:10 | **Miss. Caroline Mooki** Phytochemical screening and elemental composition of Bersama lucens (Hochst.) Szyszyl: A plant used to manage depression-like condition among local communities | **Dr. Wynston Woodenberg** Rediscovery of Portulaca trianthemoides Bremek. (Portulacaceae) in southern Africa after 89 years | |
| 17:10 - 17:30 | **Mr. Frans Mothupi** Traditional Knowledge and consumption of wild edible plants | **Mr. Benjamin Morris** Reassessing Phylica (Rhamnaceae) as a Cretaceous Living Fossil: A Critical Examination | |

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| 18:30 - 20:00 | Students Function (Dovyalis) / SAJB Meeting (Boardroom) | | |
| **WEDNESDAY, 10 JANUARY 2024** | | | |
| **Dovyalis**<br>Chairperson: Prof. Godfrey Zharare | | | |
| 08:00 - 09:00 | Plenary Lecture: Dr. Shakira Shaik<br>**Nurturing the earth for sustainable growth: Harnessing the potential of the agricultural underdogs, the Orphan Crops** | | |
| 09:00 - 10:00 | SAAB Annual General Meeting | | |
| 10:00 - 10:30 | **Tea** | | |
| | **Mimusops**<br>Ethnobotany / Phytochemistry 6<br>Chairperson:<br>Dr Tshegofatso Dikobe | **Strelitzia**<br>Plant-Animal interactions<br>Chairperson:<br>Dr Mariam Adeoba | |
| 10:30 - 10:50 | **Dr. John Awungnjia Asong**<br>Physical characterization and antimicrobial activity of silver nanoparticles synthesized using acetone leaf extracts of Opuntia ficus-indica, Schkuhria pinnata and Gomphocarpus fruticosus | **Miss. Thulile Buthelezi**<br>Pollination ecology of South African endemic Euphorbia clavarioides (Euphorbiaceae). | |
| 10:50 - 11:10 | **Ms. Elisabeth Kola**<br>Response of Bradyrhizobium japonicum nodule variable to cucurbitacin-containing Nemarioc-AL phytonematicide in cowpea (Vigna unguiculata L.) on Ndeficient soil. | **Dr. Hannah C. Butler**<br>Reproductive assurance in the absence of specialist pollinators in the near threatened Crinum campanulatum (Amaryllidaceae) | |

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| 11:10 - 11:30 | **Mr. Zwivhuya Leonard Ndou**<br>The potential use of topological data analysis in harvesting and storage processes of indigenous ethnomedicinal plant: A comparative study between Venda and Zulu tradition. | **Prof. Karel Doležal**<br>What orang-utans can teach us: plants used for self-medication as a potential source of bioactive substances with antiparasitic activity | |
| 11:30 - 11:50 | **Mr. Kamogelo Pollen Teffo**<br>Interaction effect between accession and fruit maturity stage on untargeted secondary metabolites of Mimusops zeyheri Sond. | **Mr. Tean Joubert**<br>Potentially toxic metals in the environment: from terrestrial plants to arthropods – a review | |
| 11:50 - 12:10 | **Dr. Ebrahiema Arendse**<br>Assessing the nutritional potential of five spineless cactus pear cultivars for sustainable food and feed production | | |
| 12:10 - 12:30 | **Mr. Mdumiseni T. Nxumalo**<br>Community led documentation of plant knowledge by indigenous communities as a catalyst for wisdom towards sustainability –The case of the IKSDC (IKS Documentation Centre) at UNIZULU | | |
| 12:30 - 12:50 | **Mr. Azile Dumani**<br>Taxonomic classification of medicinal Cannabis landraces found in Lusikisiki, Eastern Cape, South Africa | | |
| 13:00 - 14:00 | **Lunch** | | |
| 14:00 - 15:00 | | | |

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| 15:00 - 15:30 | **Tea** |
| 18:00 | **Departure from UNIZULU R/Bay Campus to Gala Dinner venue** |
| 19:00 - 22:00 | **Gala Dinner**<br>Umfolozi Casino, Empangeni |
| **THURSDAY, 11 JANUARY 2024** | |
| 08:00 - 14:00 | **Post-Conference Excursion**<br>Umfolozi Game Reserve, Hluhluwe |

## Plenary speakers

### Prof. James Stephen Boatwright

Completed a B.Sc. (Natural and Environmental Sciences) ***cum laude*** in 2004, B.Sc. Hons. (Botany) ***cum laude*** in 2005, M.Sc. (Botany) ***cum laude*** in 2006 and Ph.D. (Botany) in 2009 all at the University of Johannesburg (formerly Rand Afrikaans University). Thereafter accepted a Postdoctoral Fellowship between the Compton Herbarium (SANBI) and University of Cape Town from February 2009–September 2010. In September 2010, appointed as Taxonomist (Principal Scientist) within the Early Detection and Rapid Response Unit for Alien Plants, based at the Compton Herbarium (SANBI). From July 2012 to December 2014, appointed as Lecturer in the Department of Biodiversity and Conservation Biology (BCB) at the University of the Western Cape. From 1 January 2015 to December 2017 appointed as Senior Lecturer and from 1 January 2018 to 31 December 2022 as Associate Professor at the same institution. From 1 April 2020 to 31 May 2023, served as Head of Department. Promoted to Full Professor from 1 January 2023 to present.

Research interests broadly include the taxonomy and systematics of African legumes (Fabaceae), selected genera of the Aizoaceae, Apiaceae, Asphodelaceae, Asteraceae, Combretaceae, Hemerocallidaceae, Rubiaceae, Scrophulariaceae and Thymelaeaceae, the flora of the Karoo, and the taxonomy and identification of invasive plant species. Active in research since 2006 and author/co-author of 102 scientific papers to date (all in peerreviewed, ISI accredited journals), four book chapters, one book as well as 101 oral presentations at national and international conferences. Actively involved in student supervision and currently serving as supervisor/co-supervisor for 14 M.Sc. and four Ph.D. students. Graduated 20 honours, 14 M.Sc. and six Ph.D. students to date. Awarded a Y1 rating by the NRF in 2014 that was improved to a C1 rating in 2020. Awarded the UWC DVC Academic Excellence Award for Best Emerging Researcher in Natural Sciences for 2018, as well as the DVC Research and Innovation Excellence Award for Best Mid-Career Researcher in 2020.

Editor for the South African Journal of Botany (impact factor = 3.1) since 2011, and appointed as Editor-in-Chief on 1 July 2023. Serves as Fabales Editor for Phytotaxa (impact factor = 1.171) since 2016, and Subject Editor for both Phytokeys (impact factor = 1.635) and Biodiversity Data Journal (impact factor = 1.225) since 2018. Regularly reviews manuscripts for several national and international journals. Member the South African Association of Botanists (SAAB), the Southern African Society for Systematic Biology (SASSB) and the American Society of Plant Taxonomists (ASPT), and served as the President of the SAAB for the period 2019-2020, and as Vice-President in 2021. Currently serves on the Plant Checklist Committee for South Africa, the International Legume Checklist Committee, and as an elected council member of the International Association for Plant Taxonomy (IAPT). Research outputs are well-cited (2884 citations; h-index of 21; i10 index of 38 according to Google Scholar). Research has impacted the taxonomy of many plant groups, including 4 new genera, 9 new sections/subsections, 28 new species and 324 new name combinations.

## Prof. Karel Dolezal

Mgr. Karel Doležal, born on June 26, 1967. He is a distinguished scientist with extensive expertise in the fields of plant hormones, related metabolites, and purine derivatives. His notable contributions span organic synthesis, analytical chemistry, and mass spectrometry. Dr. Doležal's academic journey began to take shape when he pursue a Master's degree in inorganic chemistry from Palacky University, Czech Republic, in 1990. Subsequently, he earned a Ph.D. in molecular biology from the same university in 1996. In 2014, he was honoured with a Research Professorship (DSc.) by the Academy of Sciences of the Czech Republic. Over the years, Dr. Doležal has held various key positions, showcasing his leadership and research acumen. Currently serving as the Deputy Head of the Department of Chemical Biology at Palacky University since 2021, he previously led the Department of Chemical Biology and Genetics from 2013 to 2020 at the Centre of the Region Haná for Biotechnological and Agricultural Research. His international experience includes PostDoc positions at the Swedish Agriculture University in Umeå and Bayreuth University, contributing to the Department of Forest Genetics and Plant Physiology and the Department of Plant Physiology, respectively.

As a researcher, Dr. Doležal has been associated with the Laboratory of Growth Regulators at Palacky University and the Institute of Experimental Botany AS CR since 1996. His early career includes roles at the Research Institute for Fodder Crops and the Troubsko u Brna Research Station, focusing on biochemical markers in breeding and in-vitro cultures of grasses. Dr. Doležal is an esteemed member of the scientific community, actively participating in editorial and reviewer activities. He serves on the Editorial Boards of reputable journals such as Plant Growth Regulation, South African Journal of Botany, International Journal of Molecular Sciences, and Frontiers in Plant Sciences. Additionally, he contributes as an ad hoc reviewer for various scientific journals. His dedication to advancing knowledge is evident through his successful grant applications. Notably, he is the Principal Investigator for projects like "Mass Spectrometry Imaging for Multi-Omics Analysis of Phytohormone Network" and "What orang-utans can teach us: plants used for self-medication as a potential source of bioactive substances with amoebicidal and antigiardial effects."

Dr. Doležal's significant impact on the scientific community is reflected in his publication activities, with over 204 papers in journals with higher impact factors. He has over 8004 citations, and an impressive h-index of 42. Additionally, his intellectual contributions extend to more than 65 granted patents. Throughout his career, Dr. Karel Doležal has demonstrated a steadfast commitment to advancing scientific knowledge, contributing substantially to the understanding of plant hormones, purine derivatives, and related fields.

**Mr. Kaylan Reddy**

Kaylan Reddy is currently a PhD candidate in Botany at the University of Stellenbosch specializing in phytomedicine and plant molecular biology. Kaylan started his academic career in Gauteng, where he completed his BSc in Biochemistry and Chemistry at the University of Pretoria as a first-generation university student. After his undergraduate studies Kaylan travelled to India for a month for an internship in a drug development company researching drugs against HIV and Nonalcoholic fatty liver disease. He returned to South Africa to continue his studies in an Honors (cum laude) in Medicinal Plant Science where he investigated South African plants that may have sedative and anxiolytic activity. He then moved to Stellenbosch University to pursue his MSc in Botany, investigating the chemotypic and genetic diversity in the Sceletium genus, which has noted activity in assisting with anxiety and depression. In his studies he has travelled across South Africa, searching for populations of this elusive medicinal plant, that may hold secrets to improving mental health. The findings from his current work also contribute to the sustainable The MSc was upgraded to a PhD, which he is currently in the final stages of completing. Throughout his studies, science communication and research engagement has been a central pillar of his dream. He has won multiple local and international awards for science communication. Kaylan's ultimate goal through science communication is to demystify science, portray a realistic picture of the challenges in science and make science accessible to the greater public.

## Dr Shakira Shaik

Shakira Shaik is a Plant Biotechnologist by training and holds a Ph.D. from the University of KwaZulu-Natal. Dr Shaik is currently an academic in the School of Life Sciences in UKZN's College of Agriculture, Engineering and Science. As such she has large teaching and research portfolios. She currently teaches final year B.Sc. students in Plant Biotechnology, Seed Biology, and Microscopy, in addition to two Research Project courses. She also teaches an Honours course in Plant Biotechnology.

Dr Shaik's research interests are in Plant Tissue Culture, specialising in the production of high nutrient-accumulating and abiotic stress-tolerant clones of different underutilized or orphan crops, underpinning her concern for matters pertaining to food security. She also has expertise in plant bioreactor technology, and cryopreservation, which direct research focus on the establishment of propagation and cryostorage protocols for 'needy' plant species such as overharvested medicinal species, and vulnerable or endangered horticultural species. Dr Shaik is also involved in studies on seed priming, and is trained in HPLC, GCMS & PCR analyses. Her international collaborators are based in Brazil and India, and nationally she works with other academics and researchers from the Cape Peninsula University of Technology, the University of Zululand, and the Agricultural Research Council. She was also fortunate to work with the esteemed and retired NRF-rated scientists, Professors Paula Watt & Norman Pammenter, and the late Professor Patricia Berjak.

Dr Shaik has completed 3 Doctoral and 8 Masters students to date, and is currently supervising 4 doctoral and 2 Masters students. She has published 27 research articles, with 2 in press, and 2 under review. She has presented at numerous national and international meetings. She has examined Masters and Doctoral dissertations for UKZN, University of Johannesburg, Stellenbosch University, Durban University of Technology, and Federal University of Lavras in Brazil. She was recently guest editor for the Frontiers in Plant Science journal, has reviewed articles for numerous ISI journals, is a grant reviewer for the NRF, and has just started as SAAB Council Member this month.

**Abstracts for plenary speakers**

## The strength of global working groups in taxonomy: Fabaceae as an example

**JS Boatwright**

Department of Biodiversity and Conservation Biology, University of the Western Cape, Private Bag x17, Bellville, 7535, Cape Town, South Africa

The Fabaceae serve as an excellent example of the impact that global working groups can have on the classification of large taxonomic groups. The Legume Phylogeny Working Group (LPWG) was established in 2010 to encourage collaborative studies in order to produce a complete generic-level phylogeny of the family, and ultimately a new subfamilial classification. Studies in the southern African genistoid, millettiod, mimosoid and phaseoloid legumes with students and collaborators over the last two decades have led to major changes in the classification of these groups, revisions of critical genera and a major contribution towards the aims of the LPWG. Southern Africa represents an important center of diversity of the family, and legume taxonomists in the region have contributed to the new subfamilial classification for the family, the recently produced global checklist for legumes and international conferences (both hosting and attending). There is still much work to be done on several groups in the country, providing opportunities for training the future generation of legume taxonomists, a high priority for a hyper-diverse country such as South Africa. An overview of the LPWG, phylogenetic studies, new generic classifications, revisions and ongoing studies in southern Africa will be provided as examples of the value and impact of taxonomic studies in the region, as well the importance and impact of collaboration, locally and globally.

**New phytohormone derivatives as a modern tool for basic and applied plant biotechnology research**

**K. Doležal[1,2], M. Bryksová[2], V. Matušková[2], K. Bieleszová[2], A. Žukauskaitė[2], M. Zatloukal[2], L. Plíhalová[1,2], O. Novák[1], M. Strnad[1]**

*[1] Laboratory of Growth Regulators, Institute of Experimental Botany AS CR, & Palacký University, Šlechtitelu 27, 78371 Olomouc, Czech Republic*
*[2]Department of Chemical Biology, Palacký University, Šlechtitelu 27, 78371 Olomouc, Czech Republic*

Plant hormones cytokinins regulate many growth and developmental processes in plants. 6-benzylaminopurine (BAP) is most frequently used in plant biotechnology. However, its fast *in-situ* N9-glucosylation can also induce negative effects, which complicate micropropagation processes, especially in rare and susceptible medicinal plants. This problem could be suppressed by appropriate substitution by various sugars and protective groups at N9-position have been recently prepared to improve CK specific biological activity and are already routinely used in plant micropropagation. Additionally, the replacement of the 2′ or 3′ hydroxyl groups with a fluorine atom has also showed promising results in enhancing biological activity and chemical or metabolic stability. Moreover, by small change in cytokinin structure, a potent cytokinin antagonists and/or inhibitors of their inactivation have been obtained. Also, auxins have the capacity to determine plant architecture. Therefore, natural and synthetic auxins have been successfully employed to obtain more economically advantageous plants. The crosstalk between auxins and cytokinins determines plant development and thus is of particular importance in the field of plant micropropagation, where the ratios between these two phytohormones need to be tightly controlled to achieve proper rooting and shoot generation. Recently we prepared a set of new PEO-IAA-inspired anti-auxins capable of antagonizing auxin responses in vivo and successfully used them to facilitate hemp micropropagation. Here, recent results of synthesis, characterization and biological activity testing of several new phytohormone groups as well as advances in endogenous phytohormone analysis will be presented and demonstrated that they can be used as an interesting new tool for plant biotechnology and agriculture.

**Peering Into Our Past: Integrative Profiling of Genetic and Chemical Variation Across the Medicinally Important *Sceletium* genus**

**K Reddy[1]; G. I. Stafford[2]; N. P. Makunga[1]**

[1] Department of Botany and Zoology, Natural Sciences Faculty, Matieland, Stellenbosch University, Stellenbosch, South Africa,

[2] Department of Plant and Soil Sciences, The Faculty of Natural and Agricultural Sciences, University of Pretoria, Pretoria, South Africa

The *Sceletium* genus has been of medicinal importance in southern Africa for millennia and *Sceletium tortuosum* (Aizoaceae), one of eight species in the genus has gained pharmaceutical importance as an anxiolytic and anti-depressant due to the presence of mesembrine alkaloids. *S. tortuosum* is used for the manufacture of herbal teas, dietary supplements and other phytopharmaceutical products. There is an absence of information as to the phytochemical and genetic variation between species in the *Sceletium* genus and if this medicinal chemistry is shared. The current study aimed to investigate the trend between genetic and chemical variability at an intra- and inter-species level in the *Sceletium* genus. The study also aimed to provide a robust authentication tool to distinguish between the morphologically ambiguous *Sceletium* genus.

Plants collected across three provinces in South Africa, 20 populations (181 extracts), and eight species in the *Sceletium genus* were tested in a UHPLC-QToF-MS$^E$ system after which metabolite dereplication and annotation was performed by feature-based molecular networking. Morphological traits of plants growth under glass house conditions (associated with leaf morphology, such as leaf aspect ratio, perimeter and specific leaf area SLA) were collected and statistically analysed. Additionally, phylogenetic trees (Bayesian inference and most-likelihood) and haplotype networks were contrasted from wild-populations both at an intra- (*S. tortuosum*) and inter-species level, based on the *nhxF-nhxR* marker.

All plants displayed prominent morphological traits that were more apparent in glasshouse conditions. There was no statistical difference observed in SLA across species which may have indicated an environmental adaptive strategy shared across the genus. At an intra-population level, the environmental condition of elevation played a role in higher total alkaloid content and diversity of alkaloids. Intra-species haplotype networks provided insight into the high genetic diversity between *S. tortuosum* populations which may correlate with the great deal of phytochemical diversity. The study presents a novel hypothesis on the synergism between the betalain and mesembrine biosynthesis pathways upon environmental stress. At an inter-species level, clusters were formed based on bioregion (province) and this signal is

maintained in phylogenetic analyses with a clear formation of a Western Cape and Northern Cape clade.

By combining high-throughput metabolomics, feature-based molecular networking, and phylogenetic analyses a powerful profiling platform that is able to discern chemical and genetic patterns within and between species was established.

**Nurturing the Earth for Sustainable Growth: Harnessing the Potential of the Agricultural Underdogs, the Orphan Crops**

**S. Shaik**

School of Life Sciences, University of KwaZulu-Natal

Orphan crops are a group of edible crops that have potential for large scale agriculture but are neglected in terms of research, development, and investment when compared to major staple crops such as rice, wheat, and maize. They are often well-adapted to local environmental conditions, require less water or specific growing conditions, and are nutritionally dense making them particularly important in mitigating hunger and malnutrition in South Africa and globally. Their role in food sustainability includes biodiversity preservation, adaptation to climate change, efficient use of resources, nutritional security, preservation of cultural and traditional knowledge, diversifying crop markets, soil health improvement, prevention of erosion, water conservation, and innovation through biotechnology. Despite their food sustainability potential, they are considered agricultural underdogs due to limited market demand; inadequate awareness and education among farmers, consumers, and policymakers; and lack of research and development, all of which lead to knock-on infrastructural and processing challenges. As such, there is no formalized seed or crop supply structure, hindering their integration into larger agricultural systems. Most literature on orphan crops report on their potential in agriculture, but do not provide tangible agricultural practices. Biotechnology can unlock the full potential of orphan crops through research, innovation, and integration into agriculture. Therefore, the aim of my talk is to report on the innovative strategies used in our research unit, the Biosciences Research Group, comprising Masters and Doctoral students, based in the School of Life Sciences at the University of KwaZulu-Natal. Our group is informed by the paucity of research in this critical field as well as the National Development Plan, and the United Nations Sustainable Development Goals. To these ends, our research is focused on screening and selecting elite (high nutrient-accumulating or abiotic stress-tolerant) genotypes of selected orphan crops, followed by protocol development for mass-production via micropropagation or germplasm preservation using cryo- and minimal growth-storage techniques. We have also developed conservation methods for vulnerable species. I will highlight the key findings specifically from three selected leafy vegetable families in South Africa, *viz*. Amaranthaceae Cucurbitaceae and Solanaceae, and two selected fruit families from Nigeria, *viz*. Rhamnaceae and Verbenaceae, which were investigated for their nutritional value, climate adaptability or conservation status. This talk will provide strong

arguments for recognizing the value of orphan crops and incorporating them into mainstream agriculture to address food security especially for vulnerable communities.

**Oral Abstracts**

## Conservation Biology

### Utilization of the Umbrella Tree, *Musanga cecropiodes*, and extinction risk from overharvesting

S.O. Bamigboye[1], P.A. Ogunmola[1], M.I. Adeoba[1], T.M. Masebe[3]

[1]Department of Plant Science, Olabisi Onabanjo University, 2002, Ago-Iwoye, Nigeria
[2]UNISA Biomechanics Research Group, Department of Mechanical Engineering, College of Science Engineering and Technology (CSET), University of South Africa, Pretoria, South Africa
[3]Department of Life and Consumer Studies, University of South Africa, Johannesburg, South Africa

Human perception of tree utilization, sustainability and management is important to determine ways in which tree species can be conserved in the face of intense biological resources utilization. This study considered an essential tree species in Nigeria, *Musanga ceropioides* R.Br., which is of conservation concern. This species belongs to a genus containing only two tree species and is endemic to West Africa. An ethnobotanical survey was conducted in Nigeria to unravel human uses that threatens this species. This study revealed that there are many uses of this species which includes paper production, medicinal uses, soap making, source of firewood and timber production. But collection of this plant for traditional medicine is the primary use reported from the indigenous people in the area where this study was conducted. The roots and the stems were the most mentioned for harvesting. Most local people believed this plant species to be rare, which revealed some level of scarcity in nature. Continuous exploitation without regeneration will lead to declining populations of this tree species in the wild. It is recommended that community-based initiatives are initiated by relevant authorities to protect and enhance regeneration of this species and reduce the extinction risk.

**Testing the suitability of a medicinal geophyte, *Crinum bulbispermum*, for the restoration of mine tailings**

C.V. Clarke[1], J. Marcelo-Silva[1], S. Claassens[1,2], S.J. Siebert[1]

[1]Unit for Environmental Sciences and Management, North-West University, Potchefstroom, South Africa
[2]School of Molecular and Life Sciences, Curtin University, Perth, Western Australia, Australia

Grasslands are lost through transformation to agriculture, mining, and urban expansion. Land-use change leads to ecosystem degradation and biodiversity loss. Globally, degraded grasslands are prioritised for restoration to recover lost ecosystem services. Although ecological and social benefits of woody and grass species are well documented, limited research considers the use of forbs, and hardly ever geophytes, for restoration purposes despite their benefits (e.g., carbon sequestration, medicinal uses). The aim of this study was to determine if *Crinum bulbispermum* (Burm.f.) Milne-Redh. & Schweick, a medicinal geophyte, could be used to restore mine soils in grasslands of the South African Highveld. A pot experiment was conducted to assess the performance of *C. bulbispermum* in a random design with three soil treatments with varying levels of degradation and metal contamination. Plants were monitored (12 months), and morphological characters were measured monthly assessing performance and survival. Inductively coupled plasma mass spectrometry (ICP-MS) was used to determine soil and plant tissue concentration of potentially toxic metals. Results indicated that mine tailings negatively affected the growth and development of *C. bulbispermum*. Survival rates indicated they could survive on tailings; its below-par productivity indicated the species is not ideal for phytoremediation unless the tailings are ameliorated with topsoil. Although there was root accumulation of metals (Co, Cd, Cu, Mo, and Zn), there was no translocation to bulbs and leaves, which makes *C. bulbispermum* suitable for medicinal use when grown on metal-enriched soil. These findings underscore the importance of geophytes in grassland restoration strategies, expanding beyond conventional approaches.

**Low genetic diversity reveals the status of the critically endangered orchid, *Brachycorythis conica* subsp. *transvaalensis*: Implications for conservation**

S. Mayonde[1], C.I Peter[2], N. Venter[1]

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The critically endangered *Brachycorythis conica* subsp. *transvaalensis* Summerh. (Orchidaceae) is suggested to occur from five extant populations across the Highveld of South Africa. However, the only 'viable' population (i.e., average of 100 individuals per year) appears at the Walter Sisulu Botanical Garden in Krugersdorp, Gauteng. The reduction in the individual numbers of this endangered orchid is attributed to anthropogenic activities and habitat fragmentation, which have confined the species to small, isolated populations. Understanding the genetic diversity and geneflow of an endangered species is crucial with implications for conservation. Using the genome-wide marker, Amplified Fragment Length Polymorphisms (AFLPs), we investigated the genetic diversity, geneflow and population structure of *B. conica* subsp. *transvaalensis* from Krugersdorp. Results revealed low genetic diversity ($h$ = 0.249) and a lack of genetic structure within the endangered *B. conica* subsp. *transvaalensis* from the single sampled population in South Africa. The lack of genetic differentiation implies high gene flow within the population, suggesting that the population is inbred, which could in turn reduce the genetic fitness. Urgent *Ex situ* and *in situ* conservation practices are needed to conserve the germplasm of the remaining *B. conica* subsp. *transvaalensis* populations in South Africa.

**Death of a Legacy: Evaluating the health of *Protea caffra* at Melville Koppies Nature Reserve**

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Past studies on insects and pathogens affecting members of the Protea family have focused on cultivated proteas, consequently there is limited knowledge about threats to naturally occurring Proteaceae. Concern about increased mortality of *Protea caffra* Meisn. at Melville Koppies Nature Reserve (MKNR) during February 2021 resulted in this study. The aims of the study were to evaluate the health of *P. caffra* at MKNR and determine the geographic extent of infestations, the types of infestation and levels of infection relative to plant age. The geographical position, age class, and level of infestation were recorded for 174 plants. In the sampled population, 58.6% individuals were infested by soft scale and psylla insects and 17.2% had one or more of witches' broom, leaf miner and leafspot. Adult plants were most affected with a positive association found between psylla and soft scale presence. Plant deaths were only associated with soft scale. We found that soft scale reduced photosynthetic ability (reduced chlorophyll). The findings highlight the potential risk of local extinctions of *P. caffra* should the rate of infestation persist. Identification of these insects at species level, understanding their dispersal, origin and formulating effective management strategies for eradication or control are thus important.

**Modelling current and future distributions of *Warburgia* species at continental (Africa) and local (South Africa) scales**

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Understanding where species occur and predicting where they may migrate to due to climate change is essential in conservation biogeography. *Warburgia salutaris* (pepper-bark tree) faces a decrease in suitable habitat due to the threat of climate change. The disjunct range of the tree and over-harvesting for the traditional medicine market has raised concern about the persistence of this ethnobotanically-important species. This study characterises the current (2000) and future (2070) environmental niches of *W. salutaris* and uses species distribution models (SDM) to project current and future distributions and to identify the most influential climatic variables governing the species' distribution. SDMs were conducted with occurrence data and current and future climate data under two emission scenarios (RCP 4.5 and 8.5). The study also used indices to examine how the environmental niche of *W. salutaris* shifts under climate change scenarios. The most influential climatic variables of the distribution of *W. salutaris* were maximum temperature of the warmest month, annual temperature range, mean temperature of the wettest and coldest quarters, monthly precipitation of the wettest, driest, and warmest quarters. The distribution of *W. salutaris* was predicted to contract in eastern Limpopo and parts of Mpumalanga and expand in eastern KwaZulu-Natal. Overall, the distribution of *W. salutaris* contracts from the Indian Ocean Coastal Belt and grassland biomes and into savanna biomes. The results show that conservation strategies, such as novel cultivation sites and protected areas, and prioritizing the monitoring and management of sensitive *W. salutaris* populations, are necessary for the conservation of *W. salutaris*.

# Ethnobotany

## Assessing the nutritional potential of five spineless cactus pear cultivars for sustainable food and feed production

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Cactus pear (*Opuntia* spp.) have gained attention for their potential as a source of food and feed coupled to their ability to thrive in arid environments. This study evaluated the nutritional properties of the cladodes of five spineless cactus pear cultivars (Zastron, Polypoly, Robusta, Corfu, and R1260), for their suitability for food and feed production. Among the cultivars, Zastron exhibited the highest calcium content (3.99%) and starch content (5.05%). Cultivar R1260 had the highest protein content (5.31%), and showed the highest content of amino acids such as alanine, histidine, HO-proline, methionine, arginine, and glutamic acid. The three cultivars, Zastron, Corfu, and R1260, contained similar levels of several essential amino acids, including aspartic acid (0.31-0.32%), threonine (0.14-0.15%), valine (0.21-0.22%), phenylalanine (0.15%), isoleucine (0.16-0.17%), leucine (0.28-0.29%), lysine (0.24-0.25), and serine (0.16-0.18%). Cultivars Polypoly and Robusta had comparable amino acid compositions, albeit relatively lower than Zastron, Corfu, and R1260. Zastron, Corfu, and R1260 exhibited promising nutritional profiles, making them suitable candidates for food and feed production. Their relatively higher protein and starch content, along with well-balanced amino acid profiles, indicate their potential as valuable resources in areas with limited water resources. However, further research into their phytochemistry, anti-nutritional, and cytotoxicity properties is needed to assess their suitability for specific applications and to optimize their processing. To fully exploit the potential of these cactus pear cultivars for food and feed production, future studies should focus on optimizing cultivation practices and exploring processing methods that maximize their nutritional value.

**Physical characterization and antimicrobial activity of silver nanoparticles synthesized using acetone leaf extracts of *Opuntia ficus-indica*, *Schkuhria pinnata* and *Gomphocarpus fruticosus***

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The proliferation of multi-drug resistant pathogens is a major global public health concern. As a result, there has been a concerted multidisciplinary approach to develop new ecofriendly drugs to lessen the burden on global healthcare posed by multidrug resistance. The objective of the current study is to evaluate the therapeutic potential of biosynthesised silver (Ag) nanoparticles (NP) extracted from acetone extracts of *Opuntia ficus-indica* (OF), *Schkuhria pinnata* (SP) *and Gomphocarpus fruticosus* (GF) against clinical strains of Gram negative and Gram-positive bacteria. The biosynthesized AgNPs was characterized using UV-Visible spectroscopy, dynamic light scattering spectroscopy (DLS), Fourier transform infrared spectroscopy (FTIR), and scanning electron microscopy. The UV spectroscopy results revealed the surface plasmon band recorded as follows: OFAgNPs (418 nm), SPAgNPs (416 nm) and GFAgNPs (433 nm). The average size of the AgNPs were OFAgNPs 149.8±85.43 nm and the average zeta potential -21±6.67 mV, SPAgNPs, 115.3±83.22 and the average zeta potential -32.9 ± 5.86 mV, and GFAgNPs, 116.2±76.63 nm and average zeta potential was -31.9±6.18 mV. On-going studies on the biosynthesised AgNPs is exploring their potential to be used as therapeutic agents against selected bacterial strains related to the use of the plants in folk medicine.

## Global use patterns of commercialised medicinal plants

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Using a global database of 960 commercialized medicinal plant species developed by Van Wyk and Wink in 2017, the following research questions were answered: 1; What are the most frequent uses (indications) of commercialized medicinal plants? 2. Do the primary medicinal uses differ between the great healing cultures of the world? 3. Do plant families differ in the frequency of primary uses of their commercially relevant medicinal species? The most frequent uses are diuretics (126x), tonics (117x), expectorants (92x), laxatives (64x), sedatives (61x), stimulants (57x), and skin treatments (52x), from a total of 286 indications. Eight hundred twenty-three medicinal plant species were assigned to 10 traditional medicinal systems. Traditional European Medicine (TEM) ranked highest with 386 species, followed by Traditional Indian Medicine (including Ayurveda) (TIM) (125x), Traditional Chinese Medicine (TCM) (123x), Traditional North American Medicine (109x), Traditional African Medicine (84x), Traditional Central & South American Medicine (82x), Modern Medicine (52x), Experimental Medicine (7x) and Traditional Australian Medicine (5x). TEM had 50 species primarily indicated for diuretics, followed by TIM (5x) and TCM (3x). Tonics were mentioned 25x in TEM, followed by TIM (13x) and TCM (16x). There are pronounced differences between plant families. The study also shows that a clear distinction can be made between severe health conditions and self-terminating or chronic minor ailments. The former is associated with professional health care practitioners, precise dosage levels, and scientific proof of concept. At the same time, the latter reflects primary health care, self-medication, imprecise (often low) dosage levels, and anecdotal evidence of efficacy.

**The diversity and dynamics of southern African medicinal and ritual plant use**

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The Flora of Southern Africa Region (FSA) has a rich ethnobotanical heritage, attracting botanists and anthropologists worldwide. The numerous plant species (many of which are endemic), in combination with the diversity of ethnic groups, resulted in a substantial and growing practice of traditional medicine in this region. The main aim of this study is to provide a birds-eye view of the current state of southern Africa's medicinal systems. We explore the introduction of exotic medicinal and ritual plants into the region by illustrating the documentation of plant use over time. Plant-use patterns are compared across different cultures and biomes of southern Africa. The updated checklist resulted in a total of 3640 medicinal plant species, 1055 ritual plant species and 911 plant species with a dual medicinal and ritual purpose in the region. A total of 1223 new records have been found, compared to the last checklist compiled in 2002. A constant increase in both exotic and indigenous plant use emphasizes the adaptability and resilience of traditional medicinal systems of southern Africa. Distinct differences in medicinal and ritual plant use are evident across several cultures. The Indian Ocean Belt Biome has the highest medicinal and ritual plant use percentage, whereas the Fynbos Biome has the lowest. This broad-scale overview of plant-use patterns provides an essential insight towards nurturing the sustainable management and conservation of medicinal and ritual plants in southern Africa. The updated list is also an important reference point for future studies.

## Exploration of the use of *Moringa oleifera* in aquaculture: A review

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Over the years, global aquaculture development increased rapidly in recent years, and the sector has become one of the fastest-growing industries in the animal-derived food production system. Nevertheless, microbial contamination and lipid oxidation, through an advanced level of intensification remain the main causes of meat deterioration rendering it unacceptable to the consumer. Antibiotics and synthetic antibiotics have been used to prevent meat spoilage throughout the product's shelf-life. However, antibiotics applied have been restricted globally against aquatic disease outbreaks due to their apparent accumulation in the tissues, which imposes on the development of resistant bacteria. The aquaculture industry now considers natural alternatives to control the growth of microbes in fish. Plant extracts, increasingly recognized as consumer-friendly, represent a valuable source of active compounds, mostly polyphenols, with potent anti-microbial and antioxidant activities. This paper aims to provide information on the use of the *Moringa oleifera* plant in the treatment of bacterial and parasitic diseases in fish and other marine species and their preservation. Also, details on the identified secondary metabolites, the mechanisms of action, and various uses of *M. oleifera* in the preservation of *M. oleifera* will be highlighted. Our findings revealed that *M. oleifera* is used in aquaculture as a growth promoter, immunostimulant, antibiotic and antiparasitic agent and as a source of protein in the diets of a variety of fish species. Findings also revealed that, the species of choice, methods of application and formulations are paramount to consider. These findings will aid in the provision of fresh perspectives and sources for upcoming research topics and aquaculture output.

**Taxonomic classification of Medicinal *Cannabis* landraces found in Lusikisiki, Eastern Cape Province, South Africa.**

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Classification, preservation and understanding of landraces is crucial in addressing the current and future agricultural challenges related to medicinal cannabis. Its therapeutic potent and diverse genetic composition caused it to gain significant attention. Hence, the is a crucial need for classification to identify landraces with desired medicinal properties. A study was conducted to classify the Cannabis landraces found in Lusikisiki, Ingquza Hill, OR Tambo District Municipality, Eastern Cape, South Africa. Cannabis landraces were collected in three villages where these naturally grow, within the valley forest agro-ecosystem in Lusikisiki. Prior to specimen collection, each targeted Cannabis were given a unique identifying number to distinguish it amongst the villages and then the plants were tagged for easy identification. Three specimens each were collected from villages 1 and 3, and two specimens were collected from village 2, summing up to a total of eight specimens from the three villages. The sample collection was performed using secateurs and this process was carefully done so that a complete specimen which includes the stem, leaves, and flowers are collected, as these parts are key diagnostic features of the plant. After collection, the samples were placed in a presser for drying for a period of seven days. After the drying process, the specimens were mounted onto a standard 42 cm×29 cm herbarium sheet and deposited for identification and authentication at Selmar Schonland herbarium, Makhanda, Eastern Cape. Taxonomic analysis indicated that all the eight deposited voucher specimens belong to genus *Cannabis* and are of *sativa* specific epithet (binomially known as *Cannabis sativa*). Therefore, the medicinal Cannabis landraces found in the three villages in Lusikisiki are identified as *Cannabis sativa*.

# Utilization of Indigenous Farming Practices and methods for Food Security among rural communities: A review

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The world is faced with an alarming food security challenge. Although various strategies have been put in place to try and enhance food security by conventional farming, many still suffer from food insecurity and malnutrition, especially in rural communities. Therefore, global food supply and food security depend on sustainable agricultural practices. One way of sustainably practicing agriculture is through utilizing indigenous farming methods and practices, which have stood the test for generations. Indigenous farming or agriculture is holistic and practiced across different ethnic groups globally. This review presents the potential of utilizing indigenous farming practices as alternative practices to combat food insecurity and increase food supply. An online database was consulted using various search-recognized engines, including Scopus, Google Scholar, and Science Direct, using key search words such as food security, pest control, indigenous farming, organic farming, soil preparation, harvesting methods, and post-harvest preservation, amongst others from 2010 till present. The inclusion criteria focused on English articles, explicitly indicating indigenous methods of reducing soil and land degradation and biodiversity loss. The review will discuss existing empirical data that outline the preparation of the soil, planting processes, control of pests and diseases during the growing season of the crops, and the methods used to preserve food after harvesting.

**Effects of plant biopesticide-polluted soils on soil organisms (*Eisenia andrei*) and soil enzymatic activity, with biochar as an ameliorant**

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Plant biopesticides could be a sustainable alternative to chemical pesticides. The Asteraceae, *Bidens pilosa* L. and *Tagetes minuta* L. are commonly used biopesticides. However, studies revealed that a few plant-derived compounds exhibited acute toxic effects on humans, suggesting untargeted organisms may be at risk. Thus, this study aimed to profile the phytochemicals of the aforementioned plants, investigate their effects on soil organisms (*Eisenia andrei*), soil enzymatic activity, and biochar efficacy in the amelioration of pesticide-polluted soil. Avoidance behaviour, relative growth rate (RGR), and reproduction success of *E. andrei* were evaluated following OECD guidelines. Genotoxicity of extracts was evaluated with a comet assay, and soil enzymatic activity was assessed by spectrophotometric methods. Phenolic acids (benzoic acids and hydroxycinnamic acids), flavonoids (chalcones and flavonols), fatty acids, coumarins and furanocoumarins were the major classes of phytochemicals identified. The RGR and fecundity of *E. andrei* in fenamiphos-treated soil are significantly lower than in soils treated with plant biopesticides. Surprisingly, earthworms in biochar-supplemented treatments have a lower RGR and reproduction rate than those without biochar. Genotoxicity is higher in fenamiphos treatments, except in biochar-supplemented treatments. Alkaline phosphatase and urease activities in all soil treatments exhibited no significant differences. In contrast, β-glucosidase activity increases in soil treated with 25 and 100 mg/kg of fenamiphos and 250 mg/kg of *T. minuta*. This study found that fenamiphos negatively affects soil organisms more than plant biopesticides. And biochar prevents DNA damage, but it is not an efficient ameliorant for soil polluted with pesticides (*B. pilosa*, *T. minuta* and fenamiphos).

**Response of *Bradyrhizobium japonicum* nodule variable to cucurbitacin-containing Nemarioc-AL phytonematicide in cowpea (*Vigna unguiculata* L.) on N-deficient soil**

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Cowpea (*Vigna unguiculata)* is an important traditionally used African crop for food and for medicine. However, disease control using synthetic nematicides causes toxic effects on both plants and soil, and thus the use of plant extracts at the optimum concentration is preferred. The Curve-fitting Allelochemical Response Data (CARD) had been adopted to develop non-phytotoxic concentration of phytonematicides, technically referred to as the mean concentration stimulation point (MCSP). The MCSP for plant extract, cucurbitacin-containing Nemarioc-AL phytonematicide on *Bradyrhizobium japonicum*-nodulated legume crops had not been documented in low-input agricultural farming systems. The objective of this study was to determine the MCSP value of Nemarioc-AL phytonematicide on *B. japonicum*-nodulated cowpea (*Vigna unguiculata* L.) on nitrogen deficient soils. Inoculated cowpea seeds were sown in 20-cm diameter plastic pots containing steam-pasteurised N-deficient loamy soil and Hygromix at 3:1 (v/v) ratio. The experiment comprised of seven treatments (0, 2, 4, 8, 16, 32 and 64% Nemarioc-AL phytonematicide) which were applied weekly. At 56 days after the application of treatments, MCSP value for Nemarioc-AL phytonematicide on cowpea was 5.4 with overall sensitivity (Σk) of one. In conclusion, the observed MCSP and Σk values suggested that Nemarioc-AL phytonematicide was suitable for *Bradyrhizobium japonicum*-nodulated cowpea production systems on N-deficient soils.

**Knowledge gaps on the quality of Moringa functional food products**

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Innovative food products containing new ingredients are designed to meet nutritional needs of consumers with trendy captions such as ready-to-eat or food-on-the-go products. Recently, the food science and technology industries have increased their interest in the use of medicinal plants as active ingredients in plant-based food products for food-to-food fortification. In this sense, *Moringa oleifera* commonly known as drumstick tree is an important source of essential nutrients, proteins, amino acids, vitamins and minerals which have the potential to meet consumer needs in fortified foods. The current project conducted a literature review on the use of Moringa as a food fortificant in products such as bread, cereals, pastries, snacks, beverages and dairy products with the aim of addressing and identifying knowledge gaps of the developed products. Based on the published studies, addition of higher concentrations of Moringa leaf or seed powder had a negative impact on the consumer acceptance of the final product due to the greenish coloration of the product and changes in the sensory properties such as texture, odor and taste. Also, Moringa contains antinutrients such as oxalate, phytate, tannins and trypsin inhibitors and when ingested can bind with essential nutrients and inhibit their bioavailability and bioaccessibility in body. Therefore, it is important to understand the contents of these compounds in the body in order to ensure that the developed products will supply the recommended daily intake (RDI) of desired nutrients. Furthermore, detailed information on such aspects is essential to create consumer awareness on the benefits of consuming Moringa fortified products and such information can add to value addition and give a competitive advantage in local and global markets.

**A comparative study of medicinal plants found in Bapedi and Vhavenda home gardens: A case study of Tshitungulwane and Ga-Maponto villages in Limpopo Province**

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Recently, several ethnobotanical studies using quantitative methods that aid in accurately documenting qualitative data have gained momentum. It was therefore relevant to investigate medicinal plants found in the home gardens of Vhavenda and Bapedi. The study aimed to highlight the most known medicinal species and uses among the two cultural groups. A total of 72 research participants were surveyed. The data was captured following the matrix method proposed by De Beer and Van Wyk in 2011. The Vhavenda showed more species diversity use than the Bapedi. However, the average ethnobotanical knowledge index (EKI) of Bapedi (0.71) was recorded much higher than that of Vhavenda (0.56). *Schinus molle*, *Punica granatum*, *Portulacaria afra*, and *Ziziphus mucronata* were amongst the popular species used by Bapedi while *Ocimum americanum*, *Moringa olifera*, *Eucalyptus grandis*, *Momordica balsamina* were popular amongst Vhavenda. Only *Citrus limon* and *Psidium guajava* were the most cited among the two groups. Bapedi recorded six most popular treated ailments while Vhavenda had only three. Only stomach troubles and analgesics were found to be common. Although the information gathered was found to be diversified, the most cited species among the two groups reflects either on the effectiveness of the species or information shared over time. It was also interesting to find enigmatic species like *Adansonia digitata* to be among the species growing within the medicinal home gardens. Future broader studies covering more than two cultural groups can give a much more detailed impression of medicinal plants growing within the home gardens.

**Phytochemical screening and elemental composition of *Bersama lucens* (Hochst.) Szyszyl: A plant used to manage depression-like condition among local communities**

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In South Africa, the rich biodiversity and existing ethnobotanical data suggest the potential of the medicinal plants as treatment options for depression-like ailment. The biological effects are often attributed to the rich phytochemical pool. Currently, there is inadequate scientific evidence on phytochemical profile of these medicinal plants. The study aims to characterise the chemical (FTIR, spectrometry) and elemental composition in *Bersama lucens* (Hochst.) szyszyl, a medicinal plant that is traditionally used for management of depression. The bark powder of *B*. *lucens* was extracted using six solvents (water, methanol, acetone, dichloromethane, petroleum ether and hexane) with varying polarity, and the phytochemical constituents of the plant extracts (total phenolics and flavonoids) were screened using the UV/VIS spectrophotometric method, elemental content analysis was conducted using Energy-dispersive X-ray spectroscopy (EDX) and the FTIR method was utilized on a spectrophotometer system to detect the typical peak values and functional groups. Methanolic extract of *B. lucens* had the highest flavonoid content (463 mg GAE/g DW) compared to other solvents extracts, while the acetone extract had the highest phenolic content (5.66 mg GAE/g DW) compared to the other solvent extracts. Calcium, chlorine, magnesium, potassium, and phosphorus were identified in the plant sample. The FTIR spectroscopic studies revealed presence of phytochemicals (alkaloids, flavonoids, phenols, and terpenoids) that are associated with potential anti-depression activity. This preliminary data does not confirm antidepressant effect of the plant but an initial step for antidepressant activity. The results warrant further investigation of the plant and its constituents for the potential treatment of depression

**Assessment of nutraceutical attributes of selected wild edible fruit plants used by Vhavenda people of the Thulamela Local Municipality**

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Wild edible fruit plants are highly valued in many remote rural areas, where they play a significant role in fulfilling the sociocultural and livelihood needs of people. The decline in the use of these plants may be due to a lack of knowledge on their nutritional value, their potential for income generation, and medicinal and cultural uses. Information on wild edible fruit plants was gathered by means of semi-structured interviews, fieldwork, and literature review. A total of 39 wild edible fruit plants from 22 botanical families were recorded during this study, and are used as food, beverage, and folk medicine. Wild edible fruit plants of Thulamela municipality experience challenges due to human activities, resulting in some of the wild edible fruit plants declining, endangered, or even extinct. In this study the UHPLC-qTOF-MS/MS-based in source collision induced dissociation method was utilized to generate fragmentation data to assist in the differentiation of closely related isomers. Thus, in this study, we propose the use of molecular networking to unravel the families using the metabolome analysis of two *Strychnos* species (*Strychnos pungens* and *Strychnos spinosa*) and highlight the relevance of molecular networking in exploring the chemotaxonomy of plants. This allows visualization of chemical classes and the variety of substructures within the molecular families.

**Medicinal plants used for the management of respiratory infections and related ailments in Vhembe district Limpopo province.**

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Medicinal plants have been used in South Africa and across the globe for the treatment of respiratory infections in humans. An ethnobotanical study was carried out in Makhado Local Municipality, Vhembe District, Limpopo, South Africa to identify medicinal plants used by local people and traditional health practitioners to treat respiratory infections and related diseases. The study was designed to gather information on the local names of plants, plant parts used, and the methods of preparation and administration by traditional health practitioners. Fifty-two plant species belonging to twenty-eight families were identified for the treatment of respiratory infections and related ailments such covid-19, cough, sore throat, chest complaint, asthma, and fever. Fabaceae was the most predominant family for managing respiratory conditions followed by Solanaceae. Traditional health practitioners use different plant forms such as trees, climbers, and herbs to treat the ailments. The leaves (48%) were the common plant part used for the treatment of respiratory infections, followed by the roots (25%) and bark (15%). The use of leaves for the preparation of medicines is due to their accessibility and ease of collection. Therefore, priority should be given to sustainable use to conserve medicinal plants.

**Are plant extracts a potential source for the treatment of Oral candidiasis?**

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Oral candidiasis is caused by *Candida albicans*, which is most prevalent in immuno-compromised patients. The study aimed to investigate the antifungal activity of plant species used for oral candidiasis against *C. albicans*. An ethnobotanical survey was conducted to identify medicinal plants used for the treatment of oral candidiasis in Aganang Local Municipality, Limpopo Province. Questionnaires and guided field walks with traditional health practitioners were used to obtain data. A questionnaire was designed to gather information on the names of plants to treat oral candidiasis, the source of the plants, the plant parts used, and other information. The survey revealed that twelve plant species belonging to ten plant families were used by the local people and traditional health practitioners for the treatment of oral candidiasis. The dominating families were Ximeniaceae and Asteraceae. The most frequently used plant species was *Ximenia caffra* Sond. var. *caffra* (65%), followed by *Ximenia caffra* Sond. var. *natalensis* (35%). Noticeably, the roots (43%) and leaves (21.4%) were mostly used by traditional health to prepare their remedies. The mode of administration for their remedies was mainly oral and decoctions were the most preferred method of preparation. The plant species were screened for antifungal activity against *Candida albicans* using micro-dilution method. The leaves of *Artemisia afra* and *Solanum incanum* had excellent antifungal activity against *C. albicans* with minimum inhibitory concentration (MIC) values of 0.02 mg/ml. The excellent activity of the aqueous extracts against *C. albicans* confirms the efficacy of traditional methods for the treatment of oral candidiasis.

**Antimicrobial efficacy and synergistic properties of selected South African medicinal plants**

N.A. Masevhe, N. Nkuna

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Plants selected for this study are used by the local informants to treat different diseases. Aqueous extracts of six plants namely, *Combretum molle* R.Br., *Parinari curitelifolia* Ex Benth., *Elephantorrhiza burkei* Benth., *Synadenium cupulare* (boiss.), *Rhoicissus tridentata* (L.F.) and *Zanthoxylum capense* (Thub.) Harv were tested alone and in combination against *Escherichia coli, Klebsiella pneumoniae, Staphylococcus aureus, Candida albacans* and *Cryptococcus neoformans* using the microdilution method. Gentamicin and Ciproflocin were used as standard references for bacterial and fungal strains respectively. Subsequently qualitative analyses for the phytochemical compounds were conducted. Compared with the data of individual plant extracts, MIC values of the different plant extracts combinations were lower, showing some synergistic effect against the bacterial strains tested. *Cryptococcus neoformans* strain was susceptible to the different plant combinations while *C. albacans* strain was resistant to the same plant extracts combinations. The antimicrobial activity of the standard antibiotic references was superior against all the tested microorganisms. The antimicrobial activities of these plant extracts may be attributed to the presence of the secondary metabolites. This study justifies up to a certain extent the relevance of combining two or more plants in the treatment of different diseases by the local traditional medical practitioners.

**The synergistic and antagonistic effect of combining Moringa extract with African ginger, commercial ginger, and cinnamon extracts.**

N.A. Masondo, M.B. Mabotja, S.O. Amoo

Agricultural Research Council - Vegetables, Industrial and Medicinal Plants, Private Bag X293, Pretoria 0001, South Africa

Medicinal plants such as Moringa (*Moringa oleifera*), African ginger (*Siphonochilus aethropicus*), commercial ginger (*Zingiber officinale*), and cinnamon (*Cinnamonum verum*) contain a diverse array of bioactive compounds with interesting health benefits. More often, medicinal plants are used in combination in traditional medicine. Thus, the current study aimed to determine the α-glucosidase, antioxidant, and antibacterial activities of Moringa leaf extract combined with different plant species. The α-glucosidase inhibitory activity of cinnamon extract (50% MeOH) was relatively high, similar to that of the positive control (acarbose; $IC_{50}$ = 0.15 mg/mL). Likewise, Moringa extract alone or in combination with cinnamon, commercial and African ginger (50% MeOH) showed good α-glucosidase inhibitory activity almost similar to the positive control. Water extracts exhibited weak α-glucosidase activity together with 50% methanol extracts from commercial and African ginger. Moringa extracts (50% MeOH) combined with cinnamon, and commercial ginger resulted in a synergistic antioxidant (DPPH) effect. When using the β-carotene-linoleic assay, Moringa MeOH extract combination with commercial and African ginger had an antagonistic effect while water extracts exhibited indifferent inhibitory effect. Similarly, indifferent inhibitory effect was observed in Moringa extracts combined with commercial ginger and cinnamon for β-carotene analysis. Overall, plant extracts (individually or combined) resulted in indifferent and antagonistic inhibitory activity against the tested bacteria, *Escherichia coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus* and *Bacillus subtilis*. Based on our findings, Moringa with the selected plant extracts possesses good antioxidant, α-glucosidase and antibacterial activity which could be a results of their interesting cocktail of bioactive compounds.

**Investigation of southern African S*enecio* (Senecioneae, Asteraceae) species for toxicity**

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*Senecio* toxicology is important for South Africa due to the many occurrences of poisoning of livestock that occurred in the past and continue to occur. The mortality and symptoms associated with the consumption of toxic *Senecio* species is termed “seneciosis. The presence and concentrations of Pyrrolizidine Alkaloids (PAs) determine the plant’s toxicity levels, which are also affected by seasonal growth differences. *Senecio* species closely related to those known to be poisonous have a high likelihood of also containing toxic PAs. Therefore, this study aimed to investigate the toxicity of southern African *Senecio* species by surveying species closely related to already known toxic species using Liquid Chromatography Mass Spectrometry (LCMS). The data from the LCMS were then analysed using Mass Spectral Fragmentation (MSMSF) to identify the PAs found in the species sampled. From this analysis, it was found that all 27 *Senecio* species tested contain PAs and are thus all potentially toxic. Variation in the PA occurrence was observed by mapping the five most predominant PAs onto a nuclear DNA phylogeny. This variation in PA presence is due to the gain and loss of PAs within clades, caused by homoplasy. The mapping of PAs onto phylogenies aids in identifying potentially poisonous South African *Senecio* species; and understanding the local distributions of these known and previously unknown poisonous species will also contribute to the management of contamination of harvested goods and raised the awareness of farmers, forensic investigators, and traditional herbalists in South Africa.

**_In vitro_ antimycobacterial activity and proteomic profile of selected medicinal plant extracts used traditionally to treat TB-related symptoms.**

M.S. Matlala, K.L.M. Moganedi, P. Masoko

*University of Limpopo, Department of Biochemistry, Microbiology and Biotechnology, Private Bag X1106, Sovenga, 0727*

*Mycobacterium tuberculosis* is a causative agent of tuberculosis and uses specialised mechanisms to evade the immune system to ensure its survival and persistence. This study uses a bottom-up proteomic approach to trace proteomic changes correlated with exposure of *Mycobacterium smegmatis* ATCC 14468 to bioactive extracts from medicinal plants. The leaves and stem extracts of nine plants used traditionally to treat TB- related symptoms and which displayed antimycobacterial activity, were used in differential protein expression assays with treated and untreated *M. smegmatis* cells alongside the antibiotic rifampicin. The phyto-constituents were detected using biochemical tests. Distinct differences in the expressed protein pattern of plant extract treated *M. smegmatis* on SDS-PAGE were observed. Downregulation of several proteins was observed at 6 h, 12 h, and 18 h of the untreated bacterial cells and at 24 h and 48 h of rifampicin and plant extracts treated bacterial cells respectively. The upregulated proteins were observed at 6 h, 12 h and 18 h following rifampicin and plant extracts treatment of the bacterial cells. The band intensity of the differentially expressed proteins demonstrated that the extracts induced expression of some specific proteins at a high level compared to the positive control (rifampicin). This indicates that the plant extracts induced a different response mechanism in M. *smegmatis*. However, much work remains to be done on the systematic assessment of anti-TB efficacy of local plants against pathogenic *Mycobacterium* species, both *in vitro* and *in vivo*.

**Phytochemical profiling and antibacterial efficacy of *Zanthoxylum chalybeum* Engl. leaf and bark extracts against pathogenic bacteria.**

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Bacterial resistance is a major problem that threatens the health systems globally. The problem is compounded by the emergence of Multi Drug Resistant (MDR) pathogens such as *Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumanii, Pseudomonas aeruginosa* and *Enterobacter* spp, (ESKAPE) pathogens. Given the MDR pathogen mortality projections that exceed 10 million per annum by 2050, there is a need to continuously search for new therapies. *Zanthoxylum chalybeum* leaf and bark material was extracted with solvents (hexane, chloroform, dichloromethane, and methanol), to determine its chemical diversity and antimicrobial potential against *Staphylococcus aureus, Pseudomonas aeruginosa* and *Klebsiella pneumoniae*. The leaf acetone and leaf Dichloromethane (DCM) both with average MIC 1.25 mg/ml) extract were found to be more potent, being capable of exerting significant inhibitory activities against all *P. aeruginosa*. Qualitative phytochemical screening was carried out using standard methods, which demonstrated the presence of alkaloids, flavonoids, triterpenoids, and terpenoids. Quantitative analysis revealed a high presence of total phenolic compounds (900 mg/L). Thin layer chromatography and bioautography revealed that spots with Rf values of the inhibiting components were spot A, at Rf values between 0.43 and 0.47 in all but the leaf methanol extract in all bacteria, and spot B at Rf 0.28 in the leaf acetone and leaf DCM extracts in *P. aeruginosa*. The spots represented terpenoids and flavonoids respectively. The results show that the presence of bioactive compounds and the antibacterial activity in *Z. chalybeum* can suggest its possible use in the treatment of infectious diseases.

**Use patterns of some wild edible plant species of the Limpopo Province, South Africa.**

M.G. Mokganya[1], M.P. Tshisikhawe[2]

[1]Science Foundation Department, Faculty of Science, Engineering and Agriculture, University of Venda, Private Bag X5050, Thohoyandou 0950, South Africa.
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Wild edibles are potential sources of food for indigenous people in different areas of the globe. Nevertheless, limited quantitative studies exist on wild edibles in the areas of the Limpopo Province. This has implications for the livelihood sustainability of rural communities, retention of indigenous knowledge, domestication of such plants, and environmental conservation efforts. The current study focused on the use pattern of wild edible plant diversity from four municipalities in the District Municipality. The random sampling method was employed to sample participants in this study. A total of one hundred and sixty participants were interviewed to solicit information on the diversity of plants, growth forms, and their uses. Eighty-seven wild edible plants distributed amongst 34 plant families were documented. The botanical family Malvaceae was the most used, followed by the Cucurbitaceae. Plant parts such as the leaves and fruits were typically used. Due to seasonality, plant parts were normally preserved through a cook and dry, or collect and dry preservation methods. Flowers of other wild vegetables (viz. *Cleome gynandra, Cucurbita pepo,* and *Sonchus asper*) are edible. Noteworthy, the leaves of *Morus alba* var *alba* are used as a leafy vegetable. The results of this research will play a crucial role in the encouragement of continuous utilization of these plants and hence work towards shaping the creation of rural livelihood strategies. Furthermore, the outcomes of this research will enlighten the agricultural-reliant societies of the study area with the domestication of wild edible plants as a way of introducing new crop species.

**Leafy vegetables among local communities in North-West, Province: Diversity, use pattern and cultural significance**

K. Mokgau,[1] T.G. Mpolokeng[1], K.I Nko,[1] J. Mhlanga[1], H. Masote[1], J.A. Asong[2], A.O. Aremu[1]

[1] Indigenous Knowledge Systems Centre, Faculty of Natural and Agricultural Sciences, North-West University, Private Bag X2046, Mmabatho 2790, South Africa.
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Traditional leafy vegetables are a vital part of the local diet and play a critical role in ensuring food security and nutrition in rural communities. However, there is limited documentation and understanding on their diversity, indigenous knowledge, and cultural significance. This study aimed at exploring the importance of indigenous leafy vegetables in the Madibeng local municipality in the North- West, Province. A semi-structured questionnaire designed to capture the different types of indigenous leafy vegetables, method of preparation, cultural value, nutritional value, and conservation practice. We targeted vegetable farmers, subsistence farmers and elderly community members in three selected villages of Madibeng local municipality, who possess knowledge on traditional leafy vegetables. We recorded 12 vegetables belonging to 8 families. Approximately 44,6% were solely consumed as food, while 32,1% were consumed as both food and medicine for diseases such as flu, sinuses, abdominal aches, diarrhoea, boils, bladder infections, diabetes, and heart problems. The families Amaranthaceae (37%), Cucurbitaceae (25%) and Fabaceae (25%) were the dominant families. The most consumed vegetables were *Amaranthus hybridus.* L (42,4%), *Cucurbita maxima* (30,3%) and *Phaseolus vulgaris* (36,3). This study emphasizes the importance of consumption, preservation and promoting the cultivation of indigenous leafy vegetables for food security locally and nationally. Future research is geared at assessing the nutritional value and biological effects of the recorded vegetables that are currently lacking empirical data.

**A review of the current and future prospects of ethnomedicinal potential: A case study of Mistletoe, the 'intriguing all-purpose herb'**

M.G., Mopai, S., Mpai, A.R. Ndhlala

Green Biotechnologies Research Centre of Excellence, School of Agricultural and Environmental Sciences, University of Limpopo, Private Bag X1106, Sovenga, 0727, South Africa.

Mistletoe is a common name for parasitic plant species that belong to the families Loranthaceae and Viscaceae, which are both taxonomically related. The most common Viscaceae genera is Viscum, which comprises of approximately 120 species and an estimate of 100 species under Loranthaceae. Mistletoe plants are known for their ethnomedicinal purpose for treatment of various ailments including cancer, diabetes, epilepsy, asthma, hypertension, headaches, menopausal symptoms, infertility, dermatitis, arthritis, and rheumatism. Mistletoe is abundant in forest regions and orchards as a hemiparasite and has long been used. The aim of this study is to comprehensively generate documentation of the dispersal and establishment mechanism on a host, nutritional and phytochemical composition and ethnomedicinal potential of some Mistletoe species in a consensus. Researchers have reported on the effect of tissue culture on nutritional composition of the most *Viscum* species, in comparison with mistletoe plants and hosts. Moreover, the major phytochemical constituents of some extensively exploited mistletoe plants that have been reported previously include gastric-irritating alkaloids, cardiac toxins (viscotoxins, phoratoxins), saponins, and lectins as well as tannins, flavonoids and phenolic compounds. The morphology, ecosystem and economic impact, and mistletoe-host relationship of some mistletoe species has been intensively studied and documented. Therefore this review will briefly reveal research gaps in relation to the objectives herein.

**Study of use patterns of some wild edible plant species of the Limpopo Province, South Africa.**

M.G. Mokganya[1], M.P. Tshisikhawe[2]

[1]Science Foundation Department, Faculty of Science, Engineering and Agriculture, University of Venda, Private Bag X5050, Thohoyandou 0950, South Africa.
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Green Biotechnologies Research Centre of Excellence, School of Agricultural and Environmental Sciences, University of Limpopo, Private Bag X1106, Sovenga, 0727, South Africa.

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**Traditional Knowledge and Consumption of Wild Edible Plants in the Polokwane and Aganang local municipalities, South Africa.**

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Globalisation, urbanisation, and modernisation all affect traditional knowledge. More specifically, the introduction of cultivated foods, historical policies, stigma attached to consuming wild edible plants (WEPs), changes in lifestyles, and environmental factors are reshaping peoples' uses and knowledge of WEPs. This study assessed the relationship between ethnobotanical knowledge and consumption of WEPs in rural villages in the Polokwane and Aganang local municipalities, Limpopo Province. A total of 120 participants stratified by age and gender were interviewed. A free-list of WEP species known by participants was collected as well as data on the traditional uses of each species. We found that WEPs are generally well known in the area as participants listed an average of 8.4±2.4 species. There was a significant difference between the number of species listed by age group, with the elderly listing a higher mean number of species (9.3±2.6) compared to adults (8.1±2.5) and the youth (7.8±1.7). *Vangueria infausta, Sclerocarya birrea* subsp. *caffra, Ximenia caffra, Amaranthus retroflexus, Citrullus lanatus,* and *Cleome gynandra* were among the most listed species. There was a positive correlation between knowledge of WEPs and consumption rates. Most of the knowledge about WEPs was learned from a family member (89%), own observation (86%) and a village elder (75%). This knowledge was mostly acquired from childhood through oral tradition (63%), through participation (21%), and consumption (12%). Future preservation of WEPs knowledge could be encouraged by formalising Indigenous knowledge in the education system, and promoting WEPs in the media.

**Induction of apoptosis in cancer cell lines by medicinal plants used to treat cancer**

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Nanomedicine is the newest and most important research field of the 21st century due to the possibility of fabricating more efficient instruments for nanomaterial synthesis and characterisation. The purpose of nanomedicine is to detect, treat, and prevent any disease or other traumatic injury to improve human health. According to the International Agency for Research on Cancer (IARC) (2018), lung and female breast cancer are the leading types of cancer worldwide. Therefore, this current study aimed to identify the active extract, isolate, and characterise its phytochemicals, and further assess their biopharmaceutical capabilities using nano platforms against selected cancer cell models. Medicinal plants were identified through a literature review. Plants were collected and extracted using acetone. Thin layer chromatography was used for phytochemical analysis of plant materials. Cell toxicity of the plant extracts, at varying concentrations, was studied against breast cancer cells using the 3-4,5-dimethylthiazol-2-yl-2 5-diphenyltetrazolium bromide (MTT) assay. The anti-metastatic was evaluated using the scratch assay. The results revealed the presence of active compounds with possible medicinal activity. Flavonoids, tannins, saponins and alkaloids were present in all plant materials. The TLC plates showed stable phytochemical compounds. The acetone extract of *Agapanthus africanus* led to the loss of viability comparable to the results observed with the positive control. *Agapanthus africanus* had the best anti-proliferative activity with an IC50 value of 15.9 µg/mL. The toxicity was time and concentration dependent.

# Utilization pattern of plants for the management of livestock in selected villages in Madibeng local municipality, North-West Province

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Ethnoveterinary medicine has a rich history, dating back centuries. In South Africa, there is a shortage of veterinary professionals and access to their services is often limited to metropolitan areas. Hence, local communities have relied on their knowledge of medicinal plants to manage the health and well-being of their livestock. Despite the potential benefits of using medicinal plants for managing livestock diseases, there is limited comprehensive research on the use of ethnoveterinary medicinal plants to manage livestock health. The aim of this study was to investigate the use of ethnoveterinary medicinal plants for livestock management in three villages (Jericho, Bethanie, and Maboloka) within the Madibeng local municipality. Snowball sampling was used to administer a semi-structured questionnaire to owners of livestock who are experienced and knowledgeable in ethnoveterinary medicinal plants. This study involved 25 participants who shared their indigenous knowledge of ethnoveterinary medicinal plants. A total of 14 plants belonging to nine families were recorded by the participants. *Moringa oleifera*, *Drimia sanguinea,* and *Aloe greatheadii* were the most cited species used for alleviating livestock diseases. Bovine mastitis, lumpy skin, and heart water were the most treated diseases. Overall, this study contributed to the ethnobotanical literature on the use of medicinal plants to alleviate the health and well-being of livestock. We recommend further scientific studies to determine the efficacy and safety of the ethnoveterinary uses of the recorded plants.

**Phytochemical content and antioxidant activities of some medicinal plants used for dental health care in Limpopo province**

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Dental infections are a major health problem around the globe. The current study evaluated the phytochemical composition and antioxidant activities of five plants used for oral health care in a community in Limpopo Province. The leaves of *Dicerocaryum eriocarpum (Mukanganyama et al., 2010), Euclea natalensis* (*Lima et al. 2022)*, *Erythrina lysistemon Hutch*, *Aloe falcata Baker,* and *Drimia elata Jacq.* were collected from the Ga-Molepo community, dried, and ground into powder. Extraction was done using four solvents (water, dichloromethane, methanol, and petroleum ether) with varying polarities. Biochemical tests were performed to detect phytoconstituents using colourimetric assays. Thin layer chromatography was used to separate the components in the plants and vanillin-sulphuric acid was sprayed on the plates. Three major constituents (Flavonoids, tannins, and phenolics) were quantified using the folin-ciocalteau method. Antioxidants were evaluated using a DPPH free radical scavenging assay. The results of the TLC exhibited different colours, indicating different compounds and better separation was observed in (Chloroform ethyl acetate) CEF and (Ethyl acetate methanol-water) EMW mobile phases. Antioxidant compounds were detected on the acetone and methanol extracts and were best separated on the EMW mobile system. *Euclea natalensis* leaves exhibited the highest total phenolics and flavonoids in all extractants used. Quantitative DPPH free radical scavenging assay exhibited ethanol leave extracts, water, and methanol extracts exhibited the highest percentage of antiradical activity.

**Assessing the factors influencing the decisions to commercialize medicinal plants used for childhood diseases in the North-West Province, South Africa**

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Globally, medicinal plants are recognised as a potential contributor to livelihoods in many rural areas. However, little is known about the impact of commercialization of medicinal plants used to manage childhood diseases on the livelihoods of indigenous knowledge holders (IKHs). This study was aimed at assessing how commercialization impacts livelihood outcomes, measured in terms of net returns and per capita total expenditure. Data was collected from 101 IKHs in North West Province. The analytical technique was based on Propensity Score Matching to correct for endogeneity bias stemming from observable characteristics. Empirical results show that commercialization of medicinal plants increases net returns and per capita total expenditure by 3.60% and 1.42%, respectively. This contributes positively to the livelihoods of IKHs. Findings revealed that age, education, access to water, and membership in an association positively influence commercialization decisions. Policy efforts that seek to provide support for formal and vocational training, access to irrigation innovation and participation in farmer associations, particularly among the experienced IKHs, may help enhance commercialization of medicinal plants used to treat and manage childhood diseases.

# The potential use of topological data analysis in harvesting and storage processes of indigenous ethnomedicinal plants: A comparative study between Venda and Zulu tradition

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Indigenous ethnomedicinal plants are an important source of traditional medicine and a substantial driver of income for many rural communities in South Africa. The Venda and Zulu tribes are well-versed in the knowledge about the sustainable harvesting and storage of ethnomedicinal plants. Seasonal cues guide harvesting times for use in human health, livestock, and crop protection. This study explores the use of topological data analysis (TDA) to enhance harvesting and storage practices for these plants. TDA, a sophisticated mathematical tool, deciphers complex data to ascertain patterns beneficial for optimizing plant collection. By leveraging persistent homology, a TDA tool, the research decoded key features of indigenous knowledge on plant harvesting times, uncovering cyclic patterns in Venda and Zulu practices. The study pinpointed periods of maximum plant bioactivity using TDA visual representations. The results, corroborated with field observations and tribal elder interviews, confirm TDA's efficacy in optimizing plant harvesting. This integration of age-old wisdom with modern mathematics fosters a sustainable ethnomedicinal plant collection approach, preserving indigenous knowledge while ensuring plant quality.

**An appraisal on the health benefits and therapeutic importance of indigenous leafy vegetables in South Africa**

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Indigenous leafy vegetables are a diverse group of edible plants that have been consumed by local communities for generations. Indigenous leafy vegetables are an essential part of traditional diets in many cultures around the world. These vegetables, often overlooked in modern diets, have been found to offer a wide range of health benefits and therapeutic properties that contribute to overall health and well-being. This review explores the current nutritional value, health benefits, and therapeutic importance of indigenous leafy vegetables. An online search using different search engines including Science direct, Google Scholar, Scopus, EBSCO host using keywords such as leafy vegetables, indigenous, wild, phytochemicals, from 2010 to 2023.We retrieved 12 articles that fulfilled the inclusion criteria. An inventory of 55 plants belonging to 23 families was compiled. Amaranthaceae (70%), Asteraceae (61%), Cucurbitaceae (31%), and Fabaceae (30%) were the most frequently mentioned families. In terms of plant part, utilization of the leaves was dominant (84%) while other parts included fruits (7%), stem (4%), tubers (3%), rhizomes (1%) and seeds (1%). Different phytochemicals present in the indigenous leafy vegetables included phenolic acids, flavonoids, carotenoids, polyphenols, phytosterols and monoterpenes. Indigenous leafy vegetables also contain dietary fibers, minerals, α-linoleic acid, and vitamins. The presence of phytochemicals in these indigenous leafy vegetables are linked to diverse health benefits such as anti-diabetic properties, prevents cardiovascular diseases, anti-hypertensive, anti-carcinogenic, anti-anaemic, and improves gut health.

**Community-led documentation of plant knowledge by indigenous communities as a catalyst for wisdom towards sustainability – The case of the IKSDC (IKS Documentation Centre) at UNIZULU**

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Of all the indigenous knowledges the knowledge of medicinal plants has endured amidst modernization and progressive industrialization. This endurance is due to the value indigenous communities have placed on this knowledge as their source of livelihood. As observed by some scholars, a significant number of South Africans still rely on traditional medicine for their primary health care. However, adequate documentation of medicinal plants and its uses still lacks behind considering the rich diversity of plants species in Southern Africa, which parallels the rich cultural diversity. This paper discusses the ethnobotanical knowledge of local indigenous communities, their willingness to protect their valuable indigenous plants, and to practice sustainable uses. Wisdom of the elders and their commitment to conservation is demonstrated with reference to the experiences of the staff of the IKS Documentation Centre working with some local communities of King Cetshwayo and Zululand District Municipalities. The discussion is based on the project's interaction with focus groups of the communities which provided qualitative data through group discussion as a methodology. The results showed that these communities comprise of a significant number of people who understand a great deal of medicinal plants, coupled with their awareness of a rapid depletion of these plants, including their observed causes of the same. In addition, these community representatives displayed a great will to contribute to initiatives for conservation in their areas. Moreover, possibilities of more community-based research and sustainability projects are highlighted.

**_In vitro_ antimicrobial activity of isolated compounds from bark extract of _A. versicolor_ Welw. ex Oliv.**

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Medicinal plants account for a substantial significant portion of daily medication in South Africa. In the Vhembe District, traditional health practitioners and local people use *Albizia versicolor* to combat “u wela”, tuberculosis, and diabetes. “U wela" is a sexually transmitted disease that affects males due to unprotected sexual encounters with a woman who had an abortion or miscarriage. The study aimed to isolate the active compounds from the bark of *A. versicolor.* The antimicrobial activity of *A. versicolor* extracts was investigated using the micro-dilution and bioautography assay against *Candida albicans, Cryptococcus neoformans*, and *Neisseria gonorrhoeae*. The bark extract of *A. versicolor* had excellent activity against the tested pathogens against the tested microorganisms. The serial exhaustive extraction method was used to extract plant materials using various solvents such as acetone, hexane, chloroform, and methanol. Column chromatography of the acetone fractions led to the isolation of three compounds. All compounds were active against the tested microorganisms with MIC values of 0.02-0.08 mg/ml. In bioautography assay, compounds with similar $R_f$ values (0.31) were observed against *N. gonorrhoeae*. Nuclear Magnetic Resonance and Mass Spectrometry were used for the identification of the isolated compounds. The cytotoxicity of the acetone extracts and isolated compounds was investigated using the MTT assay. Compound 3 was not toxic at the highest concentration with $LC_{50}$ values greater than 200 µg/ml. against the Vero's kidney cells. The study supports the traditional use of *A. versicolor* to combat “u wela” by the local people and traditional health practitioners.

**An overview of southern African Lamiaceae and new insights into several key medicinal species**

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The Lamiaceae is one of the most prominent angiosperm families with ca. 8,037 species, many of which are well-documented in traditional and folk medicines globally. Several species from the genera *Lavandula* L., *Mentha* L., *Ocimum* L., *Salvia* L. and *Thymus* L. are widely used in various industries including the cosmetic, culinary, nutraceutical and pharmaceutical sectors due to their secondary metabolites and aromatic volatile oils. Southern Africa is home to 297 species (in 42 genera), 76 of which have documented medicinal uses. Research on certain *Salvia* species revealed that three species used as Cape Herbal remedies exhibit unique chemical compositions. *Salvia dentata* Aiton, a notable traditional medicine in Namaqualand, is rich in camphor and phenolic acids such as rosmarinic and carnosic acid, which are likely tied to its therapeutic benefits. Despite their medicinal significance as herbal teas, southern African *Stachys* L. species have not yet been thoroughly studied. These species, important from an ethnobotanical perspective, have minimal essential oil although their medicinal effects are likely linked to major phenolics such as verbascoside and apigenin-7-O-(ρ-coumaroyl)-hexoside. DNA-based grouping of *Stachys* species indicates some similarities to their corresponding chemophenetic patterns. The lesser-known *Pseudodictamnus africanus* (L.) Salmaki & Siadati, valued in Cape Herbal Medicine, contains phenolics such as verbascoside and forsythoside B and produces very little essential oil, though aromatic compounds such as viridiflorol, β-caryophyllene, and germacrene-D have been identified.

**Multivariate analysis of UV-detected polar metabolites in the metabolome of select species from the South African genus *Senecio* (Asteraceae)**

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The genus *Senecio* (Asteraceae) comprises many medicinal species, but also contains toxic species that are occasionally mistaken for medicinal species, leading to fatal poisoning of humans. Animals are also commonly poisoned. This highlights the difficulty to accurately identify the numerous different *Senecio* species, which have hitherto been equally challenging for both taxonomists and traditional healers. Our previous work identified several species with high yields of retrorsine *N*-oxide. In the course of High-Performance Liquid Chromatography analysis of over 100 species, a dataset of non-alkaloids was also accumulated. When we combined this dataset with the metrics of pyrrolizidine alkaloids, we were afforded with the opportunity to conduct a preliminary chemophenetic study while looking for taxonomic patterns in relation to chemical profiles. It was realized that morphological characters are not robust in the prediction of chemical profiles of UV-detected polar metabolites. Hence, while some taxonomic correlations to chemistry were observed, our understanding of toxic versus non-toxic species requires further work. We are currently looking more closely at the lipophilic fraction to determine if greater systematic value can be obtained.

**How do small-scale farmers explore the indigenous knowledge systems of plant species for the management of pests and diseases affecting crops in Ehlanzeni district municipality, Mpumalanga Province?**

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Pests and diseases have remained one of the main causes of food insecurity globally. In Mpumalanga Province, most small-scale farmers often apply Indigenous Knowledge Systems (IKS) to manage crop pests and diseases. However, this valuable knowledge is slowly diminishing among different ethnic groups. This study explored the IKS of plants used for the management of crop pests and diseases among farmers in Ehlanzeni District, Mpumalanga Province. Face-to-face in-depth interviews using semi-structured questionnaires were used to document the IKS from 120 purposely selected small-scale farmers and knowledge holders from November 2022 to March 2023. A total of 22 plant species, including *Allium cepa* L., *Allium sativum* L., *Aloe* L. and *Annona* cf. carcans, belonging to 17 families were recorded as remedies for the management of pests and diseases of 28 crops. The methods used in the preparation included decoction and maceration. Other processes of managing the pests by plants were as repellents, smoke and applying wood ash. The life form of the plants used consisted of shrubs (40%), trees (38%) and herbs (22%). The plant parts included whole plant (33%), leaves (20%), and fruits (11%). The most prevalent preparation techniques were decoction and maceration (27%), ashing (23%) and smoking (18%). These management strategies were considered an excellent alternative to synthetic chemicals. However, stringent empirical data to support their efficacies remain pertinent.

**Antimicrobial activity and molecular docking studies of β-sitosterol isolated from the leaves of *Carissa bispinosa***

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*Carissa bispinosa* extracts have been shown to have antimicrobial activity. However, there is limited data on their phytoconstituents. The study aimed to isolate the antimicrobial compound(s) from the leaves of *C. bispinosa* and predict the mechanism of action. The phytochemicals were extracted serially and exhaustively using hexane, dichloromethane, acetone, and methanol. Thin layer chromatography (TLC) was used to develop the phytochemical profile. The antimicrobial activity was evaluated using bioautography and micro-broth dilution assays. Open-column chromatography and preparative TLC guided by the bioactivity observed on bioautography were used to isolate the bioactive compound. The isolated compound was identified using Nuclear Magnetic Resonance (NMR). The tentative mechanism of action was predicted *in silico* using molecular docking software *(*Autodock Vina and Discovery Studios). The dichloromethane and acetone extracts showed antimicrobial activity on bioautography against *Staphylococcus aureus, Enterococcus faecalis, Streptococcus pyogenes,* and *Candida albicans.* The dichloromethane extract had the best minimum inhibitory concentration (MIC) against *S. aureus* (0.31 mg/ml). The isolated compound was characterized based on physical properties (white powder) and identified through NMR as β-Sitosterol. The isolated compound had a MIC of 0.31 mg/ml against *S. aureus.* The isolated compound had poor antimicrobial activity compared to the crude extract. The good antimicrobial activity of the crude extract was probably due to the synergistic effects of the phytoconstituents.

**Comparative analysis of the Tsonga medicinal plants of Mozambique and South Africa**

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The Tsonga people are a distinct cultural group, well-established in South Africa and Mozambique after a series of historical migrations. Considering that the Tsonga people of South Africa and Mozambique speak the same language and have similar cultural practices, this study assumes that there might have existed a transfer of traditional medicinal knowledge between these Tsonga groups. Therefore, the main aim of this study was to determine the differences and similarities between the medicinal ethnobotany of the Tsonga people of South Africa and Mozambique by evaluating the vernacular names, medicinal species used, medicinal uses, the distribution and selection of the overall medicinal flora. Structured interviews following the Matrix Method were conducted in the Tsonga-populated regions of both countries. The study recorded 288 medicinal species for the South Africa Tsonga people and 308 for the Mozambican Tsonga people. Two hundred and twenty-three medicinal species were shared between the two Tsonga populations. One-hundred and ninety-four medicinal uses were shared between 112 medicinal species used by the two Tsonga populations. Rahman's similarity index showed 46% and similarity for the Tsonga people of South Africa and Mozambique. This study provided the first comprehensive study and comparison of the Tsonga cultural groups. Even though the Tsonga seems to be a unit culture, speaking the same language, it is evident that each group has evolved and is accustomed to its natural environment, hence the differences between the traditional medicinal systems of the Tsonga people of South Africa and Mozambique.

**Variation of five accessions at unripe and ripe fruit maturity stages on untargeted secondary metabolites of *Mimusops zeyheri* Sond.**

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*Mimusops zeyheri* Sond. is an indigenous fruit tree in South Africa that belongs to the Sapotaceae family. It is consumed as a healthy snack in most parts of the country. There has been ongoing research based on its commercialisation and propagation, however, metabolites profiling has been lacking. The objective of this study was to investigate whether interaction between five accessions (6E, M7, 3E, HY, and 3L) and two fruit maturity stages: unripe (T1) and ripe fruit (T4) does affect untargeted secondary metabolites using chemometrics analysis. Ultra-performance liquid chromatography quadrupole time of flight mass spectrometer was used for analysis of methanol extracts of *M. zeyheri*. A total of 22 polar metabolites were detected as part of different classes including: polyphenolics and flavonoids. Five major clusters based on the heterogeneity of fruit accession, independent of the maturity stages, were identified by chemometrics analysis based on principal component analysis. A supervised OPLS-DA showed variation in the flavonoid metabolites between maturity stages. The highest amount of specific phenolic compounds was observed to be 3,4-bis(acetyloxy)-5-acetamido-6-(3-nitrophenoxy)oxan-2-yl]methyl acetate and was abundant in accession 3L at the T1 stage (719.90 mg/kg), while Paeonoside was 48.98 mg/kg in T4 maturity stage of 7-oxo-8,9-dihydroxy-4'-N-demethyl staurosporine (122.48 mg/kg). Collectively, the other three flavonoids' metabolites found in *M. zeyheri* that were recorded in high amounts included quercetin, quercetin galactoside, and quercetin glucoside. The results revealed that *M. zeyheri* accessions at T4 maturity stage possess high level of concentration of flavonoids, which could contribute as ingredients for nutraceuticals.

**Yield, physiochemical characteristics, and fatty acid composition of vegetable oil extracted from the seed coat of *Strychnos pungens* Soler. (Loganiaceae) fruits**

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The study analyzed *Strychnos pungens* fruit as a potential vegetable oil source. Ripe fruits were processed, and biomass partitioning was determined. Seeds contributed most to fresh weight, with the seed coat identified as a significant component. The seed coat contained extractable oil (39% of its weight) with high free fatty acids and a moderately high iodine value (83%). It contained carotenoids and tocols, serving as antioxidants. The oil was rich in monounsaturated oleic acid (78.3%), making it stable and healthy and also categorized it as high oleic oil. Its volatile profile had pleasant fruity aromas, enhancing flavour and fragrance. Effective waste management strategies are necessary if *S. pungens* becomes an industrial oil crop due to waste generation during oil extraction, including shells, pulp, cake residue, and seed kernels. In summary, the research revealed *S. pungens*' potential as a high-quality vegetable oil source with good oxidative stability and health benefits, mainly attributed to its high oleic acid content and antioxidants. Proper waste management strategies are crucial for by-products generated during oil extraction.

## Community perceptions of a fleshy-fruited invasive alien plant in the grassland biome of South Africa

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Community perceptions of invasive alien plants has gained attention from environmental managers and researchers; however, many studies are one dimensional, lacking the integrated and holistic understandings required to understand these complex relationships. *Pyracantha angustifolia* (Rosaceae) is a fleshy fruited invasive which is rapidly spreading in the grasslands of South Africa. The objectives of the study were to determine: 1) possible conflicts by assessing plant uses, 2) potential seed or propagule dispersal by users, 3) socio-economic and environmental impacts and 4) present control methods used and their effectiveness recommendations from the community. We administered 208 in-person, telephonic and online questionnaires. Results show that fruits were consumed predominantly by children who act both as seed dispersers and predators by chewing or throwing the seed away. The general urban public do not regard the species as a problem, but all farmers and conservationists regarded the plant as problematic. Grazing and recreation were the most frequent socio-economic impacts reported, while change of vegetation structure was the most frequent environmental impact reported, thereby threatening indigenous grassland vegetation. Regarding management options, fire was reported to be the least effective method although moderate success through prescribed burning was also suggested. Government assistance in form of funding and/or initiatives for clearing was the most desirable assistance the community would like to receive from the government. Results from this study provided integrated and holistic understandings required to understand invasion processes and dynamics, and shows the importance of collating data from the community in southern Africa and abroad.

**Boat-washing as an effective measure in containing *Hydrilla verticillata* (L.f.) at Pongolapoort Dam, South Africa**

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South African National Biodiversity Institute. Directorate on Biodiversity Evidence (SANBI-DBE). KwaZulu-Natal herbarium.

*Hydrilla verticillata* (L.f.) Royle. is an invasive aquatic plant native to Asia and has spread to various global regions due to human activities. The species is considered invasive in some parts of the United States of America, Australia, Asia, Africa, and Europe. In South Africa, it was first recorded during the early 2000s growing in a dam in Tongaat and later recorded at Pongolapoort dam. The most common pathway for *H. verticillata* is through the aquarium trade, birds, and recreational activities which in many cases include boats. *Hydrilla verticillata* was recorded in almost all boat ramps in Pongolapoort dam where it covered at least 600ha of the 13272.8 ha dam, occurring mostly along the edges of the dam in slow-moving waters. The establishment of *H. verticillata* in Pongolapoort which is a dam mostly used for agricultural and recreational activities creates an opportunity for the species to escape to other water bodies and therefore requires a management strategy. This presentation reports the intervention of SANBI, Natural Resource Management (NRM) and various stakeholders in managing the species through the development of a management plan, boat washing, routine monitoring, and awareness at Pongolapoort dam as part of containment efforts since 2009.

**Assessment of the sterility of 'sterile' cultivars of *Duranta erecta***

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Ornamental horticulture is a major pathway for the introduction of invasive alien plant species globally. Sterile cultivars of invasive alien plant species could provide a 'safe' alternative if they have a lower invasion risk. In this study, we assess the sterility of three 'sterile' cultivars of the ornamental plant *Duranta erecta,* "Sheena's Gold" (SG), "Sapphire Showers" (SS) and "Goldmine" (GM), and use a wild type (WT) population as the control. For each cultivar, the number of flowers and fruit per plant was determined. Pollen and seed viability analyses were performed using the fluorescence dilactate staining method and tetrazolium chloride tests, respectively. Seed germination was assessed *in vitro* under two different temperatures (15 and 25 °C). The SS cultivar was the most prolific in flower production (up to 120 flowers per plant) followed by the SG cultivar (up to 44 flowers per plant), and the GM cultivar did not produce any flowers. However, the fruit-to-flower ratio was higher (4:17) in SG than in SS (1:44). Pollen viability was similar between WT plants (72.11 %) and SG plants (69%) whilst both were significantly higher than the SS cultivar (34%). WT seeds had higher germination at both temperatures (21.67% at 15 and 25°C) than SS (3.33% at 15°C and 1.67% at 25°C) and SG (3.33% at 15°C and 1.67% at 25°C). WT seeds also had significantly higher seed viability (17%) than SG (1.5%) and SS (9.5%). In conclusion, the three studied cultivars of *D. erecta* had lower fecundity than WT plants indicating signs of sterility.

**Small scale effects of alien plants on native plants in Limpopo Province, South Africa, and their soil and leaf leachate effects on seed germination and seedling establishment of *Vigna unguiculata***

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Alien plants are typically species that have been introduced either intentionally or unintentionally to an ecosystem through anthropogenic intervention. Once in an area they displace native plant species. An area of six hectares of mixed vegetation of *Lantana camara, Solanum mauritianum, Vachellia sieberana* and *Ziziphus mucronata* was studied. The aim was to establish the potential interaction between alien and native plants. Aliens were more prevalent than natives in cases where quadrats were laid out. Also, greenhouse experiments were carried out as follows: germination of seeds in petri dishes for two days to test their viability; those that germinated were taken to the greenhouse where they were grown in soils from under *L. camara* and *S. mauritianum*, and at distance away. The effects of leaf leachates of the two species were used to spray the seeds of *Vigna unguiculata* that were germinated in a growth chamber and the seedlings that were grown in plastic bags in a greenhouse. The aim was to assess the effects of leaf leachates on seed germination and seedling growth. It was expected that leaf leachates of the two species would suppress seed germination and seedling growth of *V. unguiculata*. The impact of the two aliens on native plants in the field was suppressive by affecting the natives negatively in terms of their numbers and sizes. Allelopathic effects from the two aliens was responsible for poor germination and development of natives, additionally have been seen to be co-existing with each in the study area.

**Seed germination of naturalised and floristically traded *Cortaderia* species in South Africa**

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The *Cortaderia* genus is comprised of 24 species of perennial tussock grasses, commonly known as pampas grass, mostly originating from South America. Two *Cortaderia* species, *C. selloana* (Schult. & Schult. f.) Asch. & Graebn. and *C. jubata* (Lemoine) Stapf. have become invasive in South Africa. Although the National Environmental Management: Biodiversity Act (NEM:BA) (Act 10 of 2004): Alien and Invasive Species regulations (A&IS regs) forbid the trade of pampas grass, the growing popularity of pampas grass inflorescences for home décor and events is a concern. We aimed to test seed viability of naturalised and traded inflorescences of *Cortaderia* in South Africa to understand if the flower trade is spreading and driving invasion of these species. Seeds were collected from inflorescences of naturalised populations from across seven provinces and traded seeds were bought from retail and informal trade. To assess seed viability and germination success, we used (1) a tetrazolium stain, (2) germination trials in a growth chamber, and (3) germination trials in potting soil in a greenhouse. Results from the tetrazolium stain showed that seeds of *C. jubata* and *C. selloana* were viable in all populations surveyed. Seeds of *C. selloana* from naturalised populations and traded plants had non-significantly different viability of 71.7% and 55% respectively. For germination trials in a growth chamber, *C. selloana* and *C. jubata* seeds started germinating at day four with non-significantly different germination of 68% and 59% respectively. We conclude that traded seeds of *Cortaderia* were not found to be sterile and can thus be promoting invasion and further spread of *Cortaderia* species. Effective management of *Cortaderia* species must focus on enforcing legislation to stop this pathway of spread.

**Alien and invasive plant species may be a future conservation threat to the Lesotho Afro-alpine Drakensberg area**

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Alien and invasive plant species are major drivers of biodiversity loss and the associated ecosystem goods and services. In this study, we documented and compared the alien plant species of South Africa, focusing on Free State, Eastern Cape and KwaZulu-Natal (KZN) provinces, and Lesotho Drakensberg area – a strategic water source area for southern Africa. Overall, we collected 7124 records containing 1040 alien plant species belonging to 147 families. Out of 147 plant families, 44 were represented in both countries, 101 families not occurring in Lesotho and only two families were not represented in the provinces. South Africa had a significantly greater number of alien plant species than Lesotho but not the plant families. KZN had a significantly greater number of species than Lesotho, but non-significantly different from Free State and Eastern Cape Provinces. Many species found in KZN and Free State provinces originated from South America and Asia while plants in Lesotho were mainly from South America, Europe and Asia. Woody species were the most dominant plant life form followed by herbaceous species both across the provinces and in Lesotho. Species movements and invasion were associated with the horticultural trade, protected biodiversity areas, and home gardens respectively, and partly because of land use similarities across the borders. Because of the similarity in land use between South Africa and Lesotho, we conclude that biological invasions may threaten the water catchments in the Lesotho Drakensberg area, and the management of woody invasions must be prioritised.

**Public interest and readability analysis of invasive species information: insights from Google searches and readability tests**

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Human activities have caused the proliferation of invasive species, leading to a growing body of research recommending public involvement in studying and managing these species. Public knowledge and awareness are crucial in changing public behaviour regarding invasive species, but the level of public interest and comprehension of public information regarding invasive species is largely unknown. To address this issue, this study used Google Insights for Search (GIFS) to examine the public's interest in invasive species from 2004 to 2020, analyzing the search popularity for eight terms related to invasive species. The study also conducted readability analyses on public sources of information about invasive species using established readability tests. The findings show that the relative search volume for terms related to invasive species has steadily increased over time, indicating growing public interest in invasive species. Most sources of information about invasive species are suitable for readers with junior university degrees and above; the readability of most websites was higher than the recommended level for the public to comprehend, highlighting the need for a balance between public engagement activities on invasive species through popular media and the readability of the information presented. The study concludes that infoveillance using GIFS can serve as a proxy marker for public biodiversity needs and priorities, emphasizing the importance of making public information about invasive species more accessible to a broader audience and aid in planning for public engagement activities related to invasive species.

**Understanding the invasiveness of *Lemna minor* (duc kweed) and exploring effective control strategies in the Johannesburg Zoo**

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The invasiveness of the native *Lemna minor* L. (Araceae) poses a significant ecological threat in various aquatic ecosystems worldwide, including South Africa. The aim of this study was to investigate the effects of duckweed invasion and enhance our understanding of its behaviour, with a focus on identifying effective control strategies. Duckweed is a small floating plant that reproduces rapidly, forming dense mats on the water surface. These mats can have detrimental effects on aquatic ecosystems. Despite its ecological impact, limited research has been conducted on the invasiveness of duckweed in South Africa. To address this knowledge gap, this study aims to assess the distribution and abundance of duckweed populations in a water body of Johannesburg Zoo. The factors contributing to its invasiveness were investigated. By understanding these factors, we developed predictive models to assess the potential spread of duckweed in different aquatic habitats. Furthermore, this study explores control strategies to manage duckweed infestations effectively. We evaluate the efficacy of physical removal methods, such as manual removal and mechanical skimming, as well as the potential use of biological control agents. The findings of this research will contribute to a better understanding of the invasiveness of duckweed and its ecological consequences in South African aquatic ecosystems. Moreover, the identification of effective control strategies will aid in the development of management plans to mitigate the negative impacts of duckweed infestations. Ultimately, we provide valuable insights for stakeholders involved in the preservation and restoration of South Africa's aquatic biodiversity.

**Distribution of *Calotropis procera* (Apocynaceae) in parts of Mopani District, Limpopo Province, South Africa**

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Alien plants are those that grow in places outside their native range. They tend to become invasive when they outgrow the native plants and change the vegetation cover of the invaded places. *Calotropis procera* (Aiton) W.T. Aiton is a spreading shrub or medium-sized tree reaching 2.5 to 6 m in height. This species has invaded some parts of South Africa. Nkomo and Ka-Ngove villages in the Mopani District are some of the villages invaded by *C. procera*. It is in these two villages where the current study was undertaken. The number of *C. procera* plants along the road and in the villages were observed and counted and the nearest neighbour distances between them and native neighbouring plant individuals were measured. Also, the canopies and heights of individuals were measured; the number of flowers and fruits of *C. procera* individuals were also counted. During the study individuals of *C. procera* plant individuals were found in higher abundance at a secondary school at Ka-Ngove village. *C.procera* plants were found aggregated in Ka-Ngove and Nkomo. From this aggregation of *C. procera* plants, it is concluded that this invasive plant spreads by short distance dispersal. The seeds of this plant species were found being dispersed by wind during the period of observation.

## Predicting the occurrence of invasive alien *Populus alba* in South Africa

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Biological invasions are considered among the main drivers causing global biodiversity loss. Invasive alien tree species have an adverse impact on both the environment and economy, altering the ecosystem services. *Populus alba* L. is amongst the woody alien invasive species present in South Africa. *Populus alba* is native to Europe, North Africa and Asia, and was intentionally introduced to South Africa for ornamental purposes. For proper planning and management of invasive plant species, extensive knowledge on their distribution and the likelihood of invasion is required. Therefore, the current study reports the current and potential distribution of *P. alba* in South Africa using three species distribution models. An ensemble model was developed using Maximum Entropy, Generalised Additive Model and Random Forest algorithms. The accuracy of each model was measured by calculating the area under the received operator curve. Based on the model, suitable habitat and climate conditions of *P. alba* are present in Gauteng, Free State, Mpumalanga, and Western Cape provinces. Lower probabilities of occurrence are reported for Eastern Cape, KwaZulu-Natal, Limpopo and North West provinces. Noticeably, there were no predictions of *P. alba* in the Northern Cape. The performance accuracy evaluations of Maxent, Generalised Additive Model and Random Forest projected a more realistic and practical method, with probabilities of 0.9, 0.88 and 0.91 respectively.

# Plant Biotechnology

## Phytochemical composition of *Lagenaria siceraria* fruits from KwaZulu-Natal and Limpopo, South Africa

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*Lagenaria siceraria* (Molina) Standley is a food and medicinal source with anti-proliferative, anti-fertility, anti-HIV and anti-cancerous properties. The current study investigated the phytochemical constituents of *L. siceraria* fruits using gas chromatography/mass spectrometry (GC-MS). Five isoprenoids present in all investigated landraces were 1-Dodecene, 2,3-Dimethyldodecane, E-15-Heptadecenal, Eicosane and Tridecane, 6-propyl. Lighter metabolites such as 1-Dodecene and 2,3-Dimethyldodecane were recorded at a shorter retention time range of 9.08-16.29 min over a lower relative peak area ranging from 1.09-6.97 %. However, heavier compounds (E-15-Heptadecenal, Eicosane and Tridecane, 6-propyl) had longer retention time range of 13.42-18.00 mins over a higher relative peak area range of 2.25-11.41%. Cluster analysis grouped landraces into 5 clusters (I -V) according to their fruit and seed attributes, and isoprenoid units significant to each cluster. Terpenoids were the prominent phytochemicals present in fruits. This is the most comprehensive study on the fruit phytochemical constituents of different *L. siceraria* landraces to date.

**Interactive effects of different concentrations of Phytostim® biostimulant and storage on secondary metabolites of *Amaranthus caudatus* and *Amaranthus cruentus***

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Species of *Amaranth* are an underutilized indigenous leafy vegetable belonging to the Amarathaceae family. The leaves are consumed as a relish in part of Southern Africa to enjoy the benefits of primary and secondary metabolites included. The study was aimed at investigating the effects of different concentrations of Phytostim® biostimulants and storage period interaction on secondary metabolites of *A. cruentus* and *A. caudatus*. The experiments were laid out following the factorial treatments (6 x 3) arranged in a Completely Randomized Design (CRD). Each treatment was replicated three times. Six for Phytostim® biostimulant (0; 0.5; 1; 1.5; 2.5 and 3%) and three for storage days (0, 3, and 6). Untargeted and semi-targeted metabolites profiling was carried out using ultra-high performance liquid chromatography mass spectrometry (UHPLC-MS) analysis. Among the 55 identified metabolites, different classes of chemical compounds such as organic acids, flavonoids, phenolic acids, glucuronic acid derivatives, and coumarin glycosides were detected in the studied samples. Unsupervised and supervised chemometric plots demonstrated variation between the different concentrations of Phytostim® biostimulant and storage period from day three until end of the storage (6d) period at 3% concentration of Phytostim® biostimulant. Therefore 3% of Phytostim® biostimulant at the end of the storage period (6d) were effective in stimulating the phenolic compounds of *Amaranth species* in comparison to control (0%).

**Screening and selection of morphological traits of Bambara landraces under rainfed conditions In Northern Kwazulu-Natal**

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Bambara groundnut [Vigna subterranean (L.)] is an important underutilized, drought tolerant, annual leguminous crop widely cultivated in Africa for its nutritious edible seeds. Despite its nutritional value, Bambara production remains at a subsistence level by small scale famers who use landraces. Bambara landraces have a diverse seed variety that may offer a wide genetic diversity, however still needing both morphological and genetic characterisation. The study aimed at evaluating morphological variations within and among Bambara landraces for drought tolerance by assessing twenty three leaf morphology, pods and seeds related traits. Most landraces displayed Yellowish brown pods (74%) with little groves (47.6%) and point round shape (46%). Most of the seeds were cream with black broad eye patten, cream red with thin black eye and red with plain eye (25 %). Significant differences ($P<0.05$) were detected between landraces and interaction between blocks and plots for all studied agronomic traits. The first three Principal component accounted for a total variation of 72,2%. Correlation analysis revealed positive correlation among studied seed and pod related traits. Cluster-plot analysis grouped and discriminated landraces into 4 clusters, where cluster 1 dominated with cream red and clack landraces had highest values for most studied trait. Therefore, pod and seed related traits could be a useful phenotypic maker in strategic breeding programs over leaf morphology and in genetic diversity studies of Bambara groundnut landraces for future crop improvements.

**Supercharged pumpkin: *In vitro* propagation for enhanced nutrition and yield**

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The United Nations Sustainable Development Goal 2 aims to eradicate world hunger by 2030. One way to address this is by alleviating food insecurity and nutrient deficiencies through dietary diversification, which involves the incorporation of nutrient-dense African leafy vegetables (ALVs) into human diets. The nutrients of ALVs, such as *Cucurbita maxima*, is influenced by stage of maturity and environmental conditions. While the propagation of *Cucurbita* has been established vegetatively through cuttings and *in vitro* approaches, no studies have assessed how leaf nutrient content or plant growth is influenced by different propagation systems or plant age. This study investigated the growth and leaf nutrient levels of *in vitro*-derived (IVD) and seed-derived (SD) populations of *Cucurbita maxima* at different physiological ages. The phenotypic plasticities of the assessed parameters as affected by propagation method and physiological age were also examined. The IVD population was successfully multiplied using shoot tips cultured on 1.5 mg $l^{-1}$ BAP. Shoots were elongated and rooted on 0.5 mg $l^{-1}$ $GA_3$ and 1 mg $l^{-1}$ IBA, respectively. The IVD population had longer shoots, more leaves, and higher leaf fresh weight at 4 and 8 weeks, compared to the SD population. Advancing physiological age positively affected Ca, Mg, Mn, P, and Zn levels but negatively impacted Fe contents in both populations. The populations exhibited different plasticities for the growth parameters and nutrient levels, with the highest observed in the IVD population. Overall, the results suggest that IVD populations of *C. maxima* may be more suitable for breeding programs aimed at developing high-yielding and nutrient-rich ALVs.

# *In vitro* protocols and methods for determination of phytonutrients in *Strychnos spinosa*

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Monkey orange (*Strychnos spinosa* Lam*)* is recognized for its potential health benefits such as treating hypertension, diabetes and inflammation. The study was aimed at providing an overview of *in vitro* protocols and methodologies employed in the determination of phytonutrients in *S. spinosa*. Documenting the methods used in phytochemical analysis of the species involved a systematic review of the literature as guided by Preferred Reporting Items for Systematic reviews and Meta-Analyses. The search revealed that common assays that are used for assessing antioxidant activity in *S. spinosa* were 2,2-diphenyl-1-picrylhydrazyl scavenging and ferric reducing antioxidant power. For the determination of phenolic compounds, the findings revealed the profiling of over 25 compounds through Gas Chromatography-Mass Spectrometry, with around 45 compounds being isolated and structurally identified using various spectroscopic methods including mass spectroscopy. Most of the compounds were extracted from the branches and leaves, with limited attention given to the fruit. This underscores the necessity for further research concentrating on the isolation of bio-actives from the fruit. The insights derived from these varied methodologies contribute significantly to the advancement of our understanding regarding the health-promoting properties associated with phytonutrient-rich compounds in *S. spinosa*. The predominant evidence confirming the presence of phytonutrients in *S. spinosa* comes from *in vitro* studies, limiting our understanding of their bioavailability. This supports the need for ongoing research and method refinement to assess bioavailability of phytonutrients and clinical studies in *S. spinosa*, guiding future directions in product development for functional food products.

**Effect of different concentrations of Phytostim® biostimulant application on postharvest attributes of tomato**

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Tomatoes are climacteric fruits susceptible to perishability at ambient temperature during postharvest. Therefore, usage of eco-friendly and low-cost effective technologies can be an alternative to extend the shelf life of tomato. Phytostim® is a newly commercial biostimulant that derived from *moringa oleifera.* This study aimed at evaluating the impact of different concentrations of *Phytostim*® on postharvest attributes of tomato. Fresh tomato fruits were randomly harvested at pink stage and treated with different concentrations of Phytostim® (0%,0.1%, 0.5%,1%, 2%, 2.5%, 3% and 4%). The treatments were partitioned into 6X8 factorial design, arranged in a completely randomised design (CRD) and stored at ambient temperature condition for 15 days. The postharvest quality was determined on day 0, 6 ,12 and 15. Parameters collected were percentage weight loss, TSS, pH, colour, shelf life and firmness. The effects of different concentrations of Phytostim® biostimulant had significant ($p<0.05$) effects on all the studied parameters during postharvest. The results obtained indicated 0.1% as the best in preserving and extending the shelf life of the tested fruits. The worst was 4% as the fruits started getting spoiled at day 12. To conclude, Phytostim® is effective at low concentration and is an eco-friendly method that can be adopted by farmers.

**Amino acids, UPLC-MS phenolic metabolites, and chemometric approach for elucidating the effect of two growing conditions on growth and yield attributes in okra pods and leaves.**

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Okra (*Abelmoschus esculentus* (L.) Moench) is one of the nutritious indigenized vegetables in Southern Africa. It is predominated by amino acids and specialised phenolic compounds which are directly and indirectly associated with plant growth. The study intended to elucidate the effect of growing conditions (greenhouse and micro-plot under open-field) on growth and yield by determining the levels of amino acid and untargeted phenolic metabolites on the leaf and pod samples of okra. An ultra-performance liquid chromatography-mass spectrometry (UPLC-MS) together with chemometrics plots were used to identify and quantify amino acids and phenolic metabolites profiles. Yield and growth attributes: stem diameter, plant height, number of branches per plant, number of pods per plant, pod weight, pod length, and pod diameter were higher in the micro-plot under open-field conditions compared to those grown in greenhouse conditions. Sixteen amino acids were quantified. From these, arginine, serine, glycine, aspartate, glutamate, alanine, proline, histidine, threonine, methionine, lysine, tyrosine, leucine, valine, and isoleucine were higher in leaf samples grown in micro-plot under open-field. The phenolic metabolites including quercetin 3-galactoside, succinyl adenosine, quercetin 3-lathyroside, isotan b, and icariside F2b were identified in the leaf and pod samples under both growing conditions. The unsupervised Principal Component Analysis (PCA) showed metabolic variation based on the plant part, whilst a good predictive model (86.7%) was achieved when a supervised Partial Least Squares Discriminant Analysis (OPLS-DA) was used for separating both growth conditions. The study showed that growth conditions can be used to manipulate the accumulation of free amino acids and phenolic metabolites.

# Plant Evolutionary Ecology

## Pollinator shifts reinforce reproductive isolation in *Galtonia* (Hyacinthaceae), a Drakensberg near-endemic genus

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*Galtonia* Decne. (Hyacinthaceae) comprises four species mainly distributed in the Drakensberg and KZN Midlands, each species occupying distinct habitats and altitudinal ranges. *Galtonia* species have various tepal colours (viz. pure white, pale green and creamy yellow), typical of insect pollination. Apparent similarity in floral morphology between species suggests that pollinators are unlikely to have played an important role in reproductive isolation in *Galtonia*, however this has not been formally investigated. Therefore, the main floral visitors (and potential pollinators) and floral traits of *Galtonia*, including nectar and scent properties, were investigated to determine if differences between sister species are associated with their likely pollinators. Specialist nectarivores were the main floral visitors to *Galtonia candicans* and *G. princeps* and both have nectar properties consistent with specialized bird pollination. Honeybees were also abundant visitors; however, pollinator-exclusion experiments showed that these species are predominantly bird-pollinated, with honeybees playing a minor role in their pollination. In contrast, *Galtonia viridiflora*, sister to *G. princeps,* has nectar properties typical of insect pollination, and was mostly visited by insects, with considerable pollen loads present on honeybees. *Galtonia regalis* had similar nectar properties to *G. viridiflora*, but Malachite Sunbirds (*Nectarinia famosa*) were the main visitors. Thus, floral reward traits (nectar properties) appear to be associated with the primary pollinators of *Galtonia* and floral trait differences between sister species suggest that pollinators may be instrumental in reinforcing reproductive isolation, with abiotic factors being the primary drivers of species diversification in *Galtonia.*

**Disentangling evolutionary relationships in *Protea* using anchored phylogenomics**

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Estimating phylogenetic relationships in recent evolutionary radiations is challenging. Short branches may lead to poor phylogenetic resolution because there are few changes to reflect shared history or because gene trees conflict with species trees due to phenomena such as incomplete lineage sorting or hybridization. We combined targeted sequencing with coalescent analyses to produce a robust estimate of phylogenetic relationships in the genus *Protea* (Proteaceae), a recent iconic radiation, and we explore the extent to which poor phylogenetic resolution arises from a lack of shared changes, incomplete lineage sorting, and hybridization. We sampled multiple individuals within 60 species of *Protea* and six outgroup species for a total of 183 individuals and obtained sequences for 498 nuclear loci using “anchored phylogenomics”. We compared several approaches for building species trees, and we explored gene-tree species-tree discrepancies to determine potential causes of poor phylogenetic resolution. Phylogenetic estimates from available species tree approaches are similar to one another and recover previously well-supported clades within *Protea,* in addition to providing well-supported phylogenetic hypotheses for many intra-generic relationships that were poorly resolved in earlier studies. Species tree methods using hundreds of nuclear loci provided strong support for many previously unresolved relationships in the rapid radiation at the tips of the angiosperm tree in the genus *Protea*. In cases where support for particular relationships remains low, the cause appears to be a lack of shared changes rather than strongly supported disagreement among gene trees arising from ILS or hybridization.

**The population ecology of *Pterocarpus angolensis* DC. at Khalavha village in Vhembe Biosphere**

T. Ndou, M.P. Tshisikhawe, S.P. Mashile

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Monitoring plant and animal populations is one of the core activities of conservation biology. Population structure and distribution of a species have a great influence on plant diversity of any ecosystem. Population structure is mostly described in terms of number of individuals present in each of the precise girth class distribution of tree species. The purpose of the study was to analyse the population structure of *Pterocarpus angolensis*, a species in high demand. This study was conducted in Khalavha village located within the Vhembe Biosphere found in Limpopo Province. Transect sampling technique was used to document ecological data on the species to analyse its population structure. Transects of 100 m x 10 m were constructed within the population. Ecological parameters recorded included stem diameter, height, and crown health status. Basal stem diameter data recorded on *Pterocarpus angolensis* sampling were grouped into seven size-classes and displayed an inverse J-shaped curve when analysed. The study showed that the population had more individuals (n=60) within the seedlings size-class (0-5 cm) when compared to the bigger size-classes (20.1-25 cm, 25.1-30 cm, and >30.1 cm). Majority (37%) of *P. angolensis* individuals had light crown damage which depict on average an aspect of healthy crowns. Only 1% of sampled individuals had dead crowns. Monitoring of the *P. angolensis* population will assist in making sure that it stays healthy and viable.

**Conservation of economically important Nigerian trees through seed dormancy release and *in vitro* clonal propagation**

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Overharvesting and destruction of wild trees for fuelwood and construction have led to the decline of many economically significant trees in Nigeria such as *Ziziphus spina-christi* and *Vitex doniana.* Barriers to their cultivation and conservation are seed dormancy and a lack of mass propagation methods. Hence, strategies to overcome seed dormancy and for *in vitro* clonal propagation were presently investigated. Seeds of both species were established as non-photoblastic with an optimal germination temperature range of 25-35°C. Physical dormancy was attributed to hard testa, which, when removed and fractured in *Z. spina-christi* and *V. doniana*, respectively, improved germination to 87% in both species compared to their controls (47 and 7%). Direct shoot organogenesis protocols were established using *in vitro*-derived nodal explants. Shoot multiplication was successful in *Z. spina-christi* using MS basal salt medium containing 2 $mgL^{-1}$ zeatin (5 shoots/explant), and with Woody Plant Medium (WPM) containing 0.3 $mgL^{-1}$ benzylaminopurine, for *V. doniana* (4 shoots/explant). In the former, shoots were rooted *ex vitro* using a one-hour pulse treatment in 200 $mgL^{-1}$ indole-3-butyric acid resulting in 80% rooting and 100% plantlet survival post-acclimatisation. In the latter, shoots were rooted on WPM containing 0.5 $mgL^{-1}$ indole-3-acetic acid (IAA) resulting in 80% rooting and 93% plantlet survival post-acclimatisation. Protocol development for somatic embryogenesis (SE) was unsuccessful, as pro-embryos induced with 2,4-dichlorophenoxyacetic acid, picloram, IAA, or naphthalene acetic acid (or combinations of these), failed to develop further, largely attributable to auxin persistence. This warrants further investigation as SE can be used a means of germplasm conservation.

**Leveraging machine learning to unveil phenological flowering patterns in South African National Botanical Gardens through public databases**

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Phenological patterns, representing the timing of recurrent biological events, such as flowering, are essential for understanding plant life cycles, ecological interactions, and how species respond to climate change. However, given the diversity of South African flora (ca. 21,000 species), manually recording species phenology presents an immense challenge. In this study, we explore machine learning (ML) application to data sourced from the iNaturalist database and describe the flowering phenology of plants in the South African National Botanical Gardens. We generated a training dataset from 10,000 photographic images, encompassing a diverse range of species from various locations. Next, we applied a Convolutional Neural Network (CNN) to classify images as flowering versus non-flowering. Using metadata associated with each image, including the date the photograph was taken, we were able to derive the timing of peak flower production and length of the flowering season for each species in the database. Our analysis illustrates how ML can leverage the vast wealth of citizen science biodiversity data in South Africa and describe large-scale phenological dynamics across the region. Applying ML and other advanced data tools to big data provides an opportunity for more informed decision-making and sustainable practices in the context of biodiversity conservation and management.

**The population ecology of *Pterocarpus angolensis* DC. at Khalavha village in Vhembe Biosphere**

T. Ndou, M.P. Tshisikhawe, S.P. Mashile

Faculty of Science, Engineering and Agriculture, Department of Biological, University of Venda, Private Bag X5050, Thohoyandou 0950, South Africa

Monitoring plant and animal populations is one of the core activities of conservation biology. Population structure and distribution of a species have a great influence on plant diversity of any ecosystem. Population structure is mostly described in terms of number of individuals present in each of the precise girth class distribution of tree species. The purpose of the study was to analyse the population structure of *Pterocarpus angolensis*, a species in high demand. This study was conducted in Khalavha village located within the Vhembe Biosphere found in Limpopo Province. Transect sampling technique was used to document ecological data on the species to analyse its population structure. Transects of 100 m x 10 m were constructed within the population. Ecological parameters recorded included stem diameter, height, and crown health status. Basal stem diameter data recorded on *Pterocarpus angolensis* sampling were grouped into seven size-classes and displayed an inverse J-shaped curve when analysed. The study showed that the population had more individuals (n=60) within the seedlings size-class (0-5 cm) when compared to the bigger size-classes (20.1-25 cm, 25.1-30 cm, and >30.1 cm). Majority (37%) of *P. angolensis* individuals had light crown damage which depict on average an aspect of healthy crowns. Only 1% of sampled individuals had dead crowns. Monitoring of the *P. angolensis* population will assist in making sure that it stays healthy and viable.

# Plant Microbiology and Phycology

## An analysis of exposure and slope gradient impact on tree layer profile of Maroelakop vegetation in Nylsvley Nature Reserve.

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Plant ecologists have been eager to consider slope aspect related issues in vegetation communities since the 1850s. The aspect of the slope is crucial in terms of the diversity and distribution of plants. This research was conducted on Maroelakop mountain within Nylsvley Nature Reserve located in Mookgopong, Limpopo Province. The investigation aimed to assess and contrast the vegetation composition on the North-facing slope and the South-facing slope. The specific goals included ascertaining the density and frequency of dominant tree species on each slope, calculating the importance value indices of trees on both slope's gradients, and analysing the population structure in relation to the slope gradient. The Point Centred Quarter (PCQ) method was used in data collection. Diversity was measured using Shannon-Weiner diversity index, Simpson diversity index and Evenness index. A total of 600 trees were recorded and identified by their botanical names. The data represented 21 species belonging to 17 genera and 12 families. The tree layer of the North-facing slope was dominated by *Diplorhynchus condylocarpon*, whereas that on the South-facing slope was dominated by *Burkea africana.* Both tree species had high importance value indices. Shannon diversity index of 2.20 was obtained for the North-facing slope, whereas the South-facing slope had 1.74. The average Simpson diversity index for the North-facing slope was 0.82 and South-facing slope 0.77. Average Evenness index for the North-facing slope was 0.93 and, on the South-facing slope was 0.81. This study concluded that *Diplorhynchus condylocarpon* is the most prevalent species within Maroelakop Mountain in the Nylsvley Nature Reserve.

**Plant growth promoting Rhizobacteria (Pgpr) improves the tolerance to drought stress by modulating biochemical plant metabolism**

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Plant Growth Promoting Rhizobacteria (PGPR) inoculation improves plant growth under drought-stress conditions due to plant growth promotion traits like phosphate solubilization, atmospheric nitrogen fixation, ACC mechanism, and root water retention. To understand how the bacterial traits orchestrate interaction with the plant under drought stress, we used two PGPR strains (*Pseudomonas azotormans* AE14 and *Serratia marcerens* MAS25). We measured ACC-deaminase enzyme activity in vitro and evaluated their PGPR traits. Finally, we conducted a drought stress experiment with tomatoes in pots in which irrigation was decreased by 50%.relative to control.. Several plant growth and biochemical parameters were evaluated after 21 days. Both strains produced indole acetic acid (IAA; 21.77-26.61 $\mu g \cdot mL^{-1}OD600^{-1}$), siderophore activity (2.44-3.89 halo/colony), and volatile compounds. Furthermore, they solubilized phosphate (2.08-3.12 halo/colony), fixed atmospheric nitrogen, and tolerated hydric stress induced by 15% Polyetylenglycol. AE14 presented ACC-deaminase enzymatic activity (6.90 mmol.min*mg $protein^{-1}$). Both strains improved plant growth, e.g., root dry weight and root length in stress conditions. In addition, tomato plants inoculated with the strains decreased proline content and catalase activity relative to the control plants. Besides, the strains increased the total phenolic compounds and antioxidant capacity according to FRAP assays. The MAS25 strain increased ascorbate peroxidase activity and antioxidant capacity according to ABTS assays and decreased the sugar soluble concentration. The AE14 increased the soluble sugar. In summary, both strains generated similar changes in the plant metabolism, contributing to tomato plant growth under drought stress independent of the ACC-mechanism. These results are valuable for understanding plant-bacteria interaction under stress conditions.

## Low-nutrient-induced resilience in growth and yield of chickpea (*Cicer arietinum* L.) under drought conditions

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Plants growing in nutrient-rich soils often have a low root-to-shoot ratio that may lead to susceptibility to drought at later growth stages. This pot experiment investigated whether a high root-to-shoot ratio in low-nutrient soils confers an advantage under drought conditions. Two desi chickpea genotypes, drought tolerant and drought susceptible, were each cultivated under four conditions: non-stressed (watered to 70% field capacity [FC]), drought-only (watering was withheld for 20 days), low-nutrient (grown in low nutrients levels, watered to 70% FC) and combined stress (low nutrients and drought-stressed). The experimental layout was a completely randomised design with four replicates, and plant growth and physiological parameters were measured at physiological maturity. Drought stress led to a significant decrease in stomatal conductance and relative water content over time, with greater reductions recorded in the drought-only plants compared to the plants with the combined stress. Root parameters, including length, surface area, and volume, were higher in the combined-stressed plants than in the drought-only counterparts, which exhibited the lowest values. A similar pattern was observed in the root-to-shoot ratio, with the highest ratio exhibited in the combined-stressed group and the lowest in the drought-only group. Although the combined-stressed plants exhibited a reduction (≈50%) in grain yield compared to non-stressed plants, they significantly outperformed the drought-stressed plants growing in the nutrient-rich soil. These findings highlight the interplay between nutrient availability and drought tolerance in plant adaptation and suggest that chickpea plants are better adapted to drought conditions when grown in low-nutrient soils.

**Physiological effect of coal tailings on Kenaf (*Hibiscus cannabinus*)**

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Kenaf (*Hibiscus cannabinus*) is an industrial crop with the potential to be cultivated on coal tailings. This is attributed to kenaf's ability to thrive in soil contaminated with multiple metals and its economic value stemming from its abundant fibre content used for various industrial applications. The extraction and processing of mineral resources lead to damage to the surrounding environment, resulting in the need for the restoration of ecosystems and mine rehabilitation. South Africa possesses vast hectares of mine tailings, presenting an opportunity for environmental restoration and creating new employment opportunities within these areas. As a result, end land use planning is supported to create an alternate economy. However, plants have trouble growing in coal tailings due to their low pH, nutrient deficiency, and high heavy metal content. Therefore, this study aimed to investigate the effect of coal tailings on kenaf growth and physiology. Kenaf was planted in pots containing coal tailings and a mixture of coal and soil. The physiological health status of the plants was evaluated by means of prompt fluorescence, modulated 820 nm reflection, and gas exchange measurements. The preliminary data indicate that the kenaf grown in coal tailings performed physiologically similar to the kenaf grown in soil alone. No differences were found between the performance indexes ($PI_{ABS}$ and $PI_{TOTAL}$) nor the oxidation or re-reduction rates of photosystem I for the plants grown in coal tailings and that of the control. As a result, kenaf was identified as a possible crop to be grown on coal tailings.

**Cloth mulching for enhanced photosynthesis and growth of *Aspalathus linearis* (Burm.f.) R. Dahlgren (rooibos) in the Cederberg**

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*Aspalathus linearis* (rooibos) vegetative growth peaks-up during the hot, dry summers, where temperatures exceed 35°C, in the sandy soils of the Cederberg. A decrease in rooibos yield is reported from the region, and rooibos reliance on transpiration during the summer months partly for leaf cooling, leads to concerns about sustainable availability of soil water. The objective of the study was to determine whether cloth mulching conserves soil moisture and mitigates against drought and heat stress in rooibos production. Three plots (control, fertilized and cloth mulched), replicated three times were established in September 2021 at Bergh and Smith farms that varied in soil characteristics. The experiment is ongoing, and this report contains results of monthly soil moisture content measured by a diviner probe to a depth of 1 m from April 2022 to March 2023 and 2$^{nd}$ year biomass yield, photosynthetic and leaf pigment data at harvest in March 2023. Cloth mulch increased biomass at both farms relative to the control. However, photosynthetic rate and chlorophyll a concentration increased in plants with cloth mulch relative to the control only at Smith farm. Stomatal conductance and transpiration rate were not influenced by the cloth mulch at both sites. The addition of fertilizer produced inconsistent results. Based on the 2$^{nd}$ year rooibos yield of 2023, cloth mulching was successful at mitigating drought and heat stress in rooibos, allowing the plants to accumulate more biomass.

**The physiological effect of drought stress on *Lessertia frutescens***

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*Lessertia frutescens* (cancer bush) is an indigenous medicinal plant widely spread through South Africa. This hardy plant is adaptable to different growth conditions. This study aims to determine the drought tolerance of *L. frutescens*. The plants were grown in pots and cultivated in a greenhouse. Drought was induced over a specific timeframe while the soil moisture was monitored. During this experiment, the impact of the stress was evaluated by measuring parameters like the water use efficiency, assimilation rate, chlorophyll content and chlorophyll fluorescence to investigate the photochemical- and photosynthetic efficiency of *L. frutescens*. Data derived from the chlorophyll *a* fluorescent (OJIP) transient, together with the water use efficiency and assimilation rate were processed to determine the effects of drought. The most important effects of the drought stress were observed between day 5 and 7 where the soil moisture was between 0.077 and 0.043. On day 5 the OJIP transient loses its typical form which indicate that photosynthesis is not taking place effectively resulting in a decrease in parameters derived from the OJIP transient like the total performance index ($PI_{Total}$) and absolute performance index ($PI_{ABS}$). The assimilation rate and water use efficiency both decrease to zero on day 6. Therefore, it can be concluded that a soil moisture level of 0.047 proves fatal to *L. frutescens*, as it disrupted both light-dependent and light-independent reactions. *L. frutescens* was found to be drought-tolerant when the soil moisture remains above approximately 0.047.

**Bioprospecting glycoside hydrolase influencing RWASA2 and RWASA5 virulence during wheat-aphid interaction.**

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Plant cell wall consists of a complex carbohydrate matrix covered by lignin, making it impermeable to foreign objects. As a result, it plays a protective role during the attack by Russian wheat aphids (RWA). RWA possess cell wall degrading enzymes (CWDEs) secreted as part of saliva during wheat infestation, facilitating style penetration and feeding. We aim to extract, identify and determine the activities of CWDEs produced by RWA-biotypes-2 and 5 (RWASA2 and RWASA5). We hypothesised that these biotypes can be differentiated by CDWEs activities. The susceptible cultivar was used to multiply RWA in the greenhouse. Biotypes were fed using sucrose media to extract saliva or 13 g of aphids were used to extract total protein from the whole aphid (sources of CWDEs). Enzyme activity was conducted using polysaccharides and disaccharides to test for cellulases, xylanases, and β-1,3-glucanases, followed by invertase and amylglucosidase. The results indicated both biotypes had polysaccharide degrading enzymes, namely cellulases, β-1,3-glucanases and xylanases, followed by the disaccharide cleaving enzymes. Characterisation studies demonstrated that enzymes exhibited optimal activities at a broad range pH of 5 and 7 and temperature of **37°**C. RWASA2 saliva and whole-aphid enzyme extracts displayed comparable activity on the polysaccharides and disaccharides. In contrast, only whole-aphid protein extract showed activity on polysaccharides and disaccharides substrates for RWASA5. RWASA2 showed significantly higher activity on polysaccharides, while RWASA5 showed significantly higher activity on maltose and sucrose. Based on our results, we suggest RWASA2 is a slower feed than RWASA5 (disaccharides activity).

# Synergistic effects of drought and heat stress on the photosynthetic efficiency and osmolytes accumulation in edamame (*Glycine max L.* Merril)

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In nature, drought and heat stress often co-exist, however previous studies focused on the effects of such stresses separately. Edamame is a nutritious legume, but sensitive to drought stress. There is a knowledge gap in the physiological and biochemical responses of edamame to combined drought and heat (DH) stress. Therefore, this study compared three edamame cultivars (UVE14, UVE17, AGS429) in terms of their photosynthetic efficiency and some metabolites of osmotic adjustment under drought and heat separately, and DH stress at two growth stages (flowering and pod filling). Non-destructive handheld instruments were used to determine the photosynthetic efficiency in a greenhouse, and destructive methods to quantify the chloroplast pigments, non-structural carbohydrates, and proline content spectrophotometrically. The DH stress affected edamame more negatively at both growth stages than drought or heat stress alone. Chloroplast protection by carotenoids resulted in cultivar AGS429 having more photosynthetic pigments and normalized difference vegetation index (NDVI) and thus the highest photosynthesis rate. Cultivar UVE17 had most of its reaction centers deactivated under DH stress and had the lowest photosynthetic efficiency of all cultivars at both growth stages. The cultivars AGS429, followed by UVE14, performed better than UVE17 because they accumulated starch, trehalose, and proline and maintained glucose balance through starch hydrolysis which resulted in high osmoregulation. In contrast, the cessation of UVE17 to accumulate proline at pod filling could have resulted in reduced osmoregulation and poor photosynthesis. The results obtained in this study can assist plant breeders in selecting traits that confer tolerance to DH stress in adamame.

**Altered expression of proteins contributes to thermotolerance in rooibos**

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One of the most important commercially cultivated crops in the Western Cape, South Africa, is rooibos (*Aspalathus linearis* (Burm.f.) R.Dahlgren). The main growing period for rooibos is in summer, which is usually very hot and dry. This implies that rooibos has a wide range of adaptation mechanisms that aid the plants to cope with drought and high temperatures. This study investigates the expression of proteins in leaf samples of rooibos plants harvested during summer from two relatively cool, and two comparatively hotter sites in the Cederberg Mountain region. A total of 180 proteins were differentially expressed, with 113 proteins more abundant at the cooler sites, and 67 proteins more abundant at the heat stressed (HS) sites. The higher temperatures at the HS sites led to reduced protein abundance, which is associated with plant temperature thresholds for protein production. The HS plants had a higher number of heat shock proteins (HSPs), indicating an enhanced thermotolerance. The plants at the cooler sites had greater photosynthetic rates and biomass accumulation, resulting from higher expression of proteins associated with photosynthesis and photosystem protection. This regulation of proteins involved in chlorophyll synthesis and light protection was prompted by high light and moderate HS conditions at the cooler sites. All plants expressed proteins involved in oxidative stress responses, which was mirrored by high antioxidant levels in the leaves. While photosynthesis-related proteins dominated at the cooler sites thereby optimizing plant growth, thermotolerance in rooibos relies on the expression of HSPs and oxidative stress response proteins.

# The allelopathic effect of *Aloe ferox*, *Aloe marlothii*, *Anthocleista grandiflora* and *Pollichia campestris* extracts on the germination of the selected plants

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Several South African plants are known to improve seed germination in certain crops or to supress the growth of weeds. However, few studies have tested their efficacy or even formulated extracts from them. Therefore, in this study, *Aloe ferox*, *Aloe marlothii* and *Anthocleista grandiflora* leaves as well as *Pollichia campestris* shoots were used to obtain extracts. These species were selected from a literature review citing their traditional use to stimulate germination or as herbicides in various communities. The extracts were applied separately at 100% or 50% concentration to seeds of *Strychnos spinosa*, *Pisum sativum*, *Vigna unguiculata* and *Zea mays* and their germination was recorded. The results showed that the extracts significantly suppressed germination of *S. spinosa*, *P. sativum* and *Z. mays*. Seed germination varied from 24% when the *Anthocleista grandiflora* extract (100%) was applied to *P. sativum* to 52% when *Z. mays* was treated with *Anthocleista grandiflora* compared to 87% germination in the control (no extracts applied) of *P. sativum*. Seed germination of *Vigna unguiculata* was not affected by any of the extracts. Overall, the results suggest the tested extracts (especially *Anthocleista grandiflora*) could be useful as growth suppressors of unwanted species, but more research is needed.

**Comparison of seed traits of indigenous watermelon (*Citrullus lanatus*) landraces from two districts in Limpopo Province, South Africa**

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Watermelon (*Citrullus lanatus*) seeds are a source of natural products that may have food, feed and pharmaceutical applications. Evaluation of the seeds of indigenous watermelon landraces in terms of their chemical composition and morphology may provide useful information for future breeding programmes. In this study, seeds of indigenous watermelon landraces from the Capricorn and the Sekhukhune districts of the Limpopo Province, South Africa, were analysed for their chemical composition, including total phenolics, proteins, oils, minerals, ash and fibre content. The antioxidant activity was measured in a methanol extract using the 2.2-diphenyl-1-picrylhydrazyl (DPPH) assay. The study also assessed the morphological characteristics of the seeds such as their colour, size and shape. The Capricorn district landraces had higher lipid, protein crude fibre and flavonoid content, but lower ash and carbohydrate content than the Sekhukhune district landraces. In addition, the Sekhukhune landraces had a higher total phenolic content (0.59 mg/g) and thus a higher antioxidant activity (46.5%) than the Capricorn landraces. The study also revealed diversity among the landraces of the two areas in terms of their seed traits. These differences may be a valuable source of traits for future genetic improvements of watermelon seeds.

**Effects of increasing temperature on the photosynthesis efficiency, biochemical and yield responses of edamame cultivars**

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High-temperature stress is becoming an increasing problem for crop production globally. This study investigated the effects of varying temperatures on the photosynthesis efficiency, biochemical responses, and yield of three edamame (*Glycine max* (L.) Merr.) cultivars (UVE14, UVE17, AGS354) under well-watered conditions. The study was conducted under controlled conditions in the greenhouse and climate chambers. The temperature regimen included 25°C (day)/18°C (night), 30°C (day)/27°C (night), and 35°C (day)/30°C (night). Although AGS354 had the highest shoot dry mass, root dry mass, total pods, total seed (TSP), total seed mass (TSM), and 100-seed mass at 25°C, it exhibited the highest reduction in these traits at 35°C compared to other cultivars. The TSM for UVE14 was not affected by high-temperature stress, while TSP increased. AGS354 and UVE17 had the highest reduction in the photosynthesis efficiency parameters (stomatal conductance (SC), photosystem II maximum quantum efficiency (Fv/Fm), and total performance index ($PI_{total}$)). UVE14 exhibited increased SC and less reduction in performance index absorbance ($PI_{abs}$) under high temperatures. The total phenolic content increased only in UVE14 under the 35°C treatment. In conclusion, increasing temperatures have a negative impact on the physiological, biochemical, and yield responses of edamame. Cultivar UVE14 copes better than UVE17 and AGS354 under high temperatures because of controlled carbon dioxide fixation and antioxidative responses leading to stabilised TSM and increased TSP. This study needs to be conducted under water-limited conditions to establish if there will be a shift in the responses.

**The negligible contribution of trapping structures to alleviation of $CO_2$ limitation in the submerged aquatic "carnivorous" plant *Utricularia stellaris* L. fil. (Lentibulariaceae)**

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It has been assumed that plants in the genus *Utricularia* produce trapping structures for their ability to capture zooplankton prey. However, recent studies have brought the assumed carnivorous function of tapping structures into question. This study investigates whether the production of trapping structures is important to *U. stellaris* and whether this importance is due to the contribution of trapping structure tissue to photosynthetic output. Biomass allocation to trap, leaf and stolon material was measured, and overall allocation to trapping structures was found to be 30% of total biomass, indicating that traps must provide some benefits to warrant this high resource allocation. One possibility is that they contribute to photosynthetic output. Thus, photosynthetic rates of plant structures were measured, with results indicating that leaf material is the primary photosynthetic tissue, and that the contribution of trapping tissue is negligible. However, these photosynthetic rates are not representative of photosynthetic rates that plants are probable to achieve in situ, where dissolved $CO_2$ limitations are likely prevalent. To reveal true rates of photosynthesis in situ, diel $CO_2$ fluctuations and $CO_2$ diffusive resistances were quantified and used to model true photosynthetic rates of *U. stellaris* in situ. Based on these models, it is evident that *U. stellaris* is severely $CO_2$ limited in situ, a state that is not alleviated by the substantial resource allocation to non-photosynthetic trapping structures. Therefore, traps must provide another benefit to plants to justify this heavy resource allocation to non-photosynthetic structures, potentially being the benefits derived from the trap contents.

**Effect of ringbarking on saplings and juveniles of four indigenous tree species in the Nylsvley Nature Reserve, South Africa**

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Ringbarking is described as the removal of strips of barks of trees, particularly of woody plants. People ringbark trees to remove bark for medicinal purposes, whilst animals, particularly browsers, ringbark trees, and shrubs for feeding purposes. Previous studies revealed that some plants die after ringbarking while others showed that plants regrow slowly following ringbarking. It appears therefore that the response of plants to ringbarking is species and age-dependent. The current study investigated the effect of ringbarking on saplings (young trees with slender trunks) and juveniles (young trees that had not flowered yet) of four plant species (*Burkea africana, Dichrostachy cinerea, Populus alba and Terminalia sericea*) in the savanna ecosystem of the Nylsvley Nature Reserve. These four plant species were chosen due to their dominance in the study area. Eighty plant individuals per species, 40 for saplings (with half where a 2 cm round belt was removed and half where a 10 cm round belt was removed) and 40 for juveniles (with the same treatments as for saplings) were all ringbarked at 20 cm above ground level during wintertime. The number of all resprouts was counted and the canopy cover was measured using a measuring tape four months after the ringbarking was done. The study showed that the saplings and juveniles of all four plant species re-grew following all ringbarking treatments. Thus, ringbarking will not cause the four tested plant species to die if they are ringbarked during the sapling and juvenile stages.

# Use of crop monitoring technologies in crop production, prediction of yield and phytochemical composition in Moringa

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*Moringa oleifera* Lam. is a food and medicinal crop that often grows well under cultivation in the tropics and sub-tropics, hence it is fast gaining popularity in South Africa and the rest of the world. The objective of this study was to explore the potential use of technologies such as crop monitoring using satellite-based software as well as hyperspectral data in predicting the need for irrigation, fertilisation and estimating biomass yield and phytochemical composition of different cultivars of *M. oleifera*. Canopy hyperspectral data were collected on five *M. oleifera* cultivars when they were one month and two months old using a handheld spectroradiometer. First-order derivative was used to transform the reflectance spectra and analysis of variance (ANOVA) as well as random forest (RF) regression and classification algorithm were used to analyse the data. The results showed that the first-order spectra of the five cultivars were significantly different ($p < 0.05$) from each other in most portions of the electromagnetic spectrum. Furthermore, the results indicated that the studied *M. oleifera* cultivars can be discriminated from each other using their first-order derivative of reflectance and RF classifier. Satellite observations using crop monitoring software will be useful in future to predict plant disease as well as access to historic data sets, such as the vegetation indices and weather data to keep track of the development of the crops.

**Patterns of wood structural diversity in mediterranean-climate biomes: comparison between fynbos, chaparral, and maquis**

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Fynbos, a shrubland from the Cape Floristic Region, is one of five mediterranean-climate biomes alongside maquis in the Mediterranean Basin, chaparral in California, matorral in Central Chile, and kwongan in Southwestern Australia. We compiled available information on the wood anatomy of 226 species belonging to 65 genera of 14 fynbos families and compared this dataset with the published wood anatomical data on chaparral and maquis. The association between the presence of fibre-tracheids and low vessel grouping was confirmed for fynbos plants. The lack of ring-porosity and very low incidence of semi-ring-porosity is the most prominent difference of the fynbos from the other two vegetation types. These features are attributed to the paucity of deciduous plants in fynbos which is probably associated with its nutrient-poor soils. The fynbos also differs from chaparral and maquis in a higher percentage of species with no tracheids as well as a lower incidence of helical thickenings on vessel walls. These differences could be explained by lower tolerance of fynbos shrubs to seasonal drought due to its relatively mild dry season. Some differences between fynbos, chaparral, and maquis in the incidence of fibre-tracheids and vasicentric/vascular tracheids associated with large vessel groups can be at least partly explained by different systematic compositions of their floras. The higher percentage of distinct growth rings, greater vessel diameter, and lower vessel frequency in maquis compared with fynbos and chaparral can be attributed to a common occurrence of relatively tall trees in this vegetation.

**Encroaching species are stronger anisohydric "water spenders" under elevated $CO_2$ conditions: Implications for savanna seedling establishment rates**

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Plant water transport systems play a fundamental role in the productivity and survival of terrestrial plants due to the vascular architecture placing a physical limit on metabolic function. Many savannas are seeing a shift towards an increase in the abundance of woody species through a process known as bush encroachment, which has been largely attributed to the fertilising effect of elevated $CO_2$ ($eCO_2$). While there have been multiple studies investigating changes in the physiology of savanna species under $eCO_2$, few have examined how climate affects the fundamental water-use strategies in the seedling stage, a crucial demographic bottleneck. Here, I provide valuable insights into the mechanisms behind bush encroachment in the context of $eCO_2$ using results from a pot experiment at the Rhodes University Elevated $CO_2$ facility. I tested plant hydraulic conductance, xylem vulnerability, and photosynthetic rates in encroachers and non-encroachers under differing water stress and [$CO_2$]. All species were anisohydric "water-spenders", however, the vulnerability to embolism and rates of water-use were different. Encroachers are better at taking advantage of water pulses, particularly under $eCO_2$ and grass competition. This comes at the cost of higher xylem vulnerability during drought, leading to reductions in conductance under to heavy water stress. Thus, I predict the establishment rates of encroachers to increase in most projected future scenarios, except under severe water stress. This research highlights potential hydraulic mechanisms contributing to the increase in bush encroachment, as well as providing important insights into the determinant factors that make a savanna species an encroacher.

**Influence of *Pseudomonas spp* endophytes on the physiological and biochemical responses of drought-stressed edamame (*Glycine max (L.)***

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Climate change induces drought stress, reducing crop yield by affecting the chemical makeup and physiological processes in plants, resulting in food insecurity and economic decline. Edamame crops (*Glycine max*) are naturally cholesterol and gluten-free and low in calories. Pseudomonas species are one of the types of endophytes that help improve plant health. This study investigated the effect of two Pseudomonas species on the physiological and biochemical responses of drought-stressed edamame. Drought-susceptible edamame seeds were colonized with *Pseudomonas* sp. strain cow5 (PR) and *Pseudomonas rhodesiae* strain MSG-15 (LR) endophytes. The seeds were then planted in pots. Drought stress (30% soil water holding capacity) was induced when the plants were at the V1 vegetative stage. The results showed that treatment of drought-stressed plants with both PR and LR upregulated the accumulation of total soluble sugars, proline, total phenolic compounds, relative water content, quantum efficiency of photosystem II (Fv/Fm) and carotenoid reflectance index. Only PR-treated plants had increased the stomatal conductance relative to the control without *Pseudomonas*, which led to increased photosynthesis efficiency. Both LR and PR treatments reduced malondialdehyde accumulation (an indicator of lipid peroxidation) and heat dissipation (Dio/RC), suggesting improved protection of the edamame under drought stress. Thus, inoculation of the edamame with both LR and PR and in particular with PR, improved drought tolerance. In future, the specificity of endophytes to certain plants will be investigated as well as whether these endophytes also improve the morphology and nutritional value in crops that they are colonized with.

**Nutritional water productivity of *Cucumis myriocarpus* leafy vegetables as influenced by planting density per hole drip irrigation**

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Planting density per hole drip irrigation (HDI) should be optimized to improve water use in irrigated crops and nutritional food security. . Nutritional water productivity (NWP) has been used to link the nutrient content with water used. This study determined the influence of planting density/HDI on the NWP of *Cucumis myriocarpus,* a locally important food and medicinal plant. Five-leaf stage seedlings were transplanted at a plant density of 1, 2, 3, 4, 5, 6, 7, 8, or 9 plants per HDI to the field. Treatments were arranged in a randomised complete block design, with eight replications. A PR2 Profile probe access tube (PR2/4 Model, UK) was randomly installed at each drip irrigation station to monitor soil moisture**.** At 56 days after transplant, the leaves were analyzed for their Ca, K, Mg, P, Fe, Na and Zn content. The NWP for each nutrient was calculated as the water productivity (WP) x nutrient content of the leaves. The highest NWP-Ca (11.40), K (10.96), Mg (5.10), and P (4.45) mg/$m^3$ were achieved at 9 planting densities per HDI. However, NWP of Fe (3.03), Na (3.49) and Zn (2.37) mg/$m^3$ were achieved at 7 planting densities per HDI. In contrast, the lowest NWP-Ca (3.00), Mg (1.22), and P (1.26) mg/$m^3$ were observed at 2 planting densities per HDI, whereas, at 3 planting density, K (3.32), Fe (2.34), Na (3.00) and Zn (1.85) mg/$m^3$, were also the lowest. In conclusion, planting *C. myriocarpus* seedlings at a plant density of 9 per HDI resulted in the highest NWP of essential elements.

## The strength of global working groups in taxonomy: Fabaceae as an example

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The Fabaceae serve as an excellent example of the impact that global working groups can have on the classification of large taxonomic groups. The Legume Phylogeny Working Group (LPWG) was established in 2010 to encourage collaborative studies in order to produce a complete generic-level phylogeny of the family, and ultimately a new subfamilial classification. Studies in the southern African genistoid, millettiod, mimosoid and phaseoloid legumes with students and collaborators over the last two decades have led to major changes in the classification of these groups, revisions of critical genera and a major contribution towards the aims of the LPWG. Southern Africa represents an important center of diversity of the family, and legume taxonomists in the region have contributed to the new subfamilial classification for the family, the recently produced global checklist for legumes and international conferences (both hosting and attending). There is still much work to be done on several groups in the country, providing opportunities for training the future generation of legume taxonomists, a high priority for a hyper-diverse country such as South Africa. An overview of the LPWG, phylogenetic studies, new generic classifications, revisions and ongoing studies in southern Africa will be provided as examples of the value and impact of taxonomic studies in the region, as well the importance and impact of collaboration, locally and globally.

## Reassessing *Phylica* (Rhamnaceae) as a Cretaceous 'Living Fossil': A Critical Examination

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In a Nature Plants article, Shi et al. (2022) described fossil flowers from Myanmar mid-Cretaceous amber (ca. 99 million years (Ma)) as two new species (*Eophylica priscastellata* and *Phylica piloburmensis*) attributed to the extant genus *Phylica* (Rhamnaceae) centred in the Cape region. This discovery challenges previous estimations of Phylica's origin, suggesting a radical revision of the evolutionary history of flowering plants. While Onstein et al. (2014) proposed an early Miocene origin for Phylica (ca. 20 Ma), the new dating implies an emergence as early as 99 Ma, prompting a potential revision of the origin of angiosperms from the Permian (ca. 250 Ma) instead of the early Cretaceous (ca. 140 Ma) (Lamont & He, 2022; He & Lamont, 2022). Our analysis revealed distinct differences, particularly in *E. priscastellata*, which exhibited octomerous perianth and basal placentation, features not observed in extant *Phylica* or other Rhamnaceae. Moreover, *P. piloburmensis* displayed imbricate overlapping petals without any stamen-petal complexes, contrary to the valvate, non-overlapping petals enclosing short stamens in modern *Phylica*. Thus, we conclude that the fossil flowers from Cretaceous amber cannot be attributed to *Phylica* or any other Rhamnaceae. In light of this, Shi et al.'s (2022) findings lack sufficient, convincing evidence for a radical revision of the history of *Phylica*, Rhamnaceae, and the angiosperms as a whole. Certainly, *Phylica* is not a "living fossil".

## The genus *Erythroxylum* (*Erythroxyla*ceae) in southern Africa

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The family *Erythroxyla*ceae in southern Africa includes the two genera *Erythroxylum* P. Browne and *Nectaropetalum* Engl. The two genera are readily distinguished by their stigmas; *Erythroxylum* has capitate stigmas, with 3 style rarely 2, free; with small petal- nectaries hidden by sepals and *Nectaropetalum* with flattened or reflexed stigmas, style 2, united, with large petal-nectaries exceeding the sepals. The genus *Erythroxylum* includes four accepted species, occurring in Namibia, Botswana, Limpopo, Mpumalanga, Swaziland, KwaZulu-Natal and Eastern Cape. The genus *Erythroxylum* is economically important as some species are used for ornamental and medicinal purposes; it is believed that in Zimbabwe fence-posts made from this tree can last for years. In some species the leaves contain cocaine and other alkaloids that are extracted and used to make various pharmaceutical drugs. This genus was last revised in Flora Capensis by Harvey (1862). Here we provide a modern taxonomic treatment for the southern African species, including a key to the species, typification, distribution maps and illustrations or photos.

**To split or not to split: The Principle of classification and the prickly issue of polyphyly in *Gnidia* (Thymelaeaceae: Thymeleaoideae)**

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*Gnidia* is a large genus of flowering plants in the family Thymelaeaceae, with about 140 to 160 species distributed in Africa, Madagascar, Arabia, India, and Sri Lanka. The genus has been controversial regarding its classification, as different authors have proposed various segregate genera based on morphological characters. However, recent molecular studies have shown that *Gnidia* is not monophyletic but comprises nine distinct lineages associated with other genera from different regions of the world. This has posed a dilemma for plant taxonomists for the past two decades: should they split *Gnidia* into smaller and more natural genera, or should they maintain a broader concept of *Gnidia* that includes polyphyletic groups? There are arguments for and against both options depending on the principles and criteria of classification one adopts. With an increased sampling of *Gnidia* and related genera, we further explored generic circumscriptions and relationships within Thymelaeoideae, using plastid (*matK, rps16, rbcL*, and *trnLF*) and nuclear (ITS) regions. We will discuss our final resolution to the prickly issue of polyphyly in *Gnidia*.

**Colourful chaos: Species delimitation of the African daisy species complex *Dimorphotheca pluvialis-sinuata* using genotyping-by-sequencing data**

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Evolutionary relationships in the South African daisy genus *Dimorphotheca* Vaill ex. Moench. have long been problematic, with historical taxonomy often being based on potentially labile morphological traits. Here we investigate the *Dimorphotheca pluvialis-sinuata* species complex which have historically been separated based on white vs orange ray colour alone; but show widespread variation in ray colour patterns, disk floret sculpturing and fruit characters. We present an integrated taxonomic approach utilising next-generation sequencing genetic data, morphology, pollinator surveys and assessment of reproductive compatibility. Plants from 191 populations were sampled from 20 a priori morphotypes which encompassed the range of morphological variation in the complex. DNA of 301 individuals were extracted for genotyping-by-sequencing (GBS) and concatenation and coalescent phylogenetic trees were used to assign individuals to hypothesised genetic species. Support for genetic species was further assessed using surveys of phenotypic trait variation and associated pollinator assemblages, as well as cross-pollination experiments. Results showed strong support for at least four species within the complex; with the previous use of ray colour ineffective in delimiting species. While three of the putative species can be clearly identified and grouped based on morphological characters, the remaining species encompasses a wide range of diverse morphotypes which exhibit clinal geographic variation; requiring further investigation to produce formal taxonomic entities. This study illustrates the utility of integrative approaches in untangling complex taxonomic and evolutionary questions in the GCFR.

**Phylogeny and Infrageneric classification of *Lasiosiphon* (Thymelaeaceae: Thymeleaoideae)**

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*Lasiosiphon* (Thymelaeaceae: Thymelaeoideae) was resurrected from the large, polyphyletic genus *Gnidia* L. based on systematic studies of the Thymelaeoideae. It is a medium-sized genus with diverse morphological features, comprising approximately 75 species, with 29 of these species being distributed in southern Africa, 37 in tropical Africa, 13 in Madagascar, and 2 in Asia. A comprehensive taxonomic revision of *Lasiosiphon* is needed to reflect the true diversity within *Lasiosiphon* and improve species identification. Here, we performed a combined phylogenetic analysis of nuclear and plastid molecular datasets to assess the relationships within the genus. Representatives of 30 of the 75 species accepted in *Lasiosiphon* were included. In addition, we evaluate the taxonomic importance of ten morphological traits that could be used to infer subgeneric classification within the genus. The results of our findings will be discussed in this presentation.

**Rediscovery of *Portulaca trianthemoides* Bremek. (Portulacaceae) in southern Africa after 89 years**

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*Portulaca trianthemoides* Bremek. was initially documented in 1931 and was previously known solely from the original site in Soutpansberg, Limpopo. No further collections of this plant were recorded after 1934. However, a recent rediscovery of this species has permitted an enhanced description, including some of the first-ever photographs that showcase its habitat, growth patterns, leaves, and flowers. *Portulaca trianthemoides* appears to be habitat-specific and an endemic to the Soutpansberg region of the Limpopo Province – a region of a relatively high degree of plant endemism in South Africa. The habitat of *P. trianthemoides* consists of open spaces near a salt pan with scattered trees, grasses, and some other species including *Trianthema salsoloides* Fenzl ex Oliv var. *transvaalensis* (Schinz) Adamson. *Portulaca trianthemoides* is easily distinguishable from other *Portulaca* species in southern Africa by its erect to sub-erect growth habit with narrowly obovate-spathulate leaves. A full description and diagnosis of the species is presented. The current study also delves into various aspects of the species' ecology and estimates the population size to be approximately 15,000 to 30,000 individuals. These findings suggest that although *P. trianthemoides* has not been collected in a long time, the population seems stable and a conservation status of "Least Concern" may be appropriate.

## Pollination ecology of South African endemic *Euphorbia clavarioides* (Euphorbiaceae)

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Basic understanding of floral structure, sexuality and flower phenology forms a base for understanding any pollination study. Pollination systems are vital to maintaining biodiversity since pollinators provide valuable ecosystem services and ensure the persistence of plant species. *Euphorbia clavarioides* is a low growing succulent plant with limited information on its ecology, compared to other species in the genus. The study was conducted to understand the pollination ecology of *Euphorbia clavarioides* population in Witsieshoek in Northern-Maloti Drakensberg and De Rots farm in Clarens, Free State. This was achieved by assessing floral visitors and breeding systems through direct observations and use of time-lapse camera traps. We described the morphology, color and insects visiting the inflorescence. The results reveal that *Euphorbia clavarioides* attract a variety of insects including ants, flies, bees, beetles and butterflies. The results also highlight that ants have higher visitation frequency compared to other insects. Additionally, bees carry relatively more pollen on their bodies compared to other insects, due to large body size. The number of floral visitors increases as the number of inflorescences increases on the cushion. Based on the morphology of *Euphorbia clavarioides* and pollinators results we conclude that it has generalist pollination systems, with insects being the main pollinators.

**Reproductive assurance in the absence of specialist pollinators in the near threatened *Crinum campanulatum* (Amaryllidaceae)**

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The near threatened *Crinum campanulatum* Herb. (Amaryllidaceae) has bell-shaped flowers with long tubes, suggesting pollination by hawkmoths. However, we observed floral visitors to be mostly honeybees, some smaller moths, and occasional large bees. A breeding system revealed that this species requires pollinators for reproductive success and only rarely produces fruits and seeds from selfing. We compared the effectiveness of diurnal visitors such as bees to nocturnal visitors such as moths by bagging flowers either during the day or during the night. Flowers exposed to only diurnal visitors produced a significantly higher number of fruits and seeds compared to flowers exposed to only nocturnal visitors. A supplemental treatment was statistically similar to the natural fruit and seed sets, indicating that the species is not pollen limited. These results show that pollen-collecting honeybees, despite not having a good mechanical fit, contribute the most to its reproductive success and play a vital role in the pollination of this rare species. Floral colour changes from white to a dark pink over four days, which is correlated with increased visibility to bees and likely decreased visibility to moths. The potential absence of specialist pollinators may drive the evolution of this species towards a generalist pollination system by smaller insects.

**What orang-utans can teach us: Plants used for self-medication as a potential source of bioactive substances with antiparasitic activity**

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The main aim of this work is the isolation, identification and examination of bioactive plant fractions with potential antiparasitic activity. These extracts are obtained from plants that are routinely eaten by orangutans. Our previous research suggests that the purpose of this consumption is self-medication. The main criteria for the plant selection are the behavioural data of the orangutans and the parasite infections thereof. The effect of these extracts on the progression of significant waterborne protozoal diseases (WBD), namely amoebiasis and giardiasis, is tested using both *in vitro* and *in vivo* methods. Moreover, anthelmintic properties of selected extract are investigated *in vivo* in a model nematode, *Caenorhabditis elegans*. Subsequently, activity-guided fractionation is performed and active substances from these extracts are isolated and characterized their chemical structure (using HPLC-HR MS/MS as well as 1D and 2D NMR methods) and biological activities.

**Poster Abstracts**

## The role of mammals in seed dispersal of fleshy-fruited invasive alien plants in the Grassland Biome of South Africa

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Fleshy-fruited invasive alien shrubs are an increasing problem in the grasslands of South Africa, where they impact vegetation structure and reduce biodiversity. These species are predominantly bird-dispersed in forest systems, but their spread in grassland ecosystems remains understudied, including their dispersal by mammals. Mammals facilitate seed movement and may also promote seed germination and seedling establishment. This study aimed to determine the role of mammals in the seed dispersal of fleshy-fruited invasive alien plants in selected grasslands. The dung of eland (*Taurotragus oryx*), chacma baboon (*Papio ursinus*), domestic goat (*Capra hircus*), and black-backed jackal (*Lupulella mesomelas*) was collected in the grasslands of the eastern Free State during 2022. Seeds were removed from the dung, identified to species level, and planted in a greenhouse setup. Seeds of the invasive species *Cotoneaster pannosus*, *Pyracantha angustifolia* and *Rosa rubiginosa* (all Rosaceae) were identified from the dung. Germination experiments showed no differences in germination between ingested *P. angustifolia* seed and manually de-pulped controls, while there were significant differences in *C. pannosus* seed germination compared with manually de-pulped controls. The ingested seeds had higher germination success than the de-pulped seeds in *C. pannosus*. Overall germination of *R. rubiginosa* seeds from faeces was very low (<2%), similar to controls. Mammals were shown to be significant dispersers of invasive fleshy fruiting plants in the grasslands of eastern South Africa, but the effects of ingestion on germination differed between plant species.

**Assessing the nutritional potential of five spineless cactus pear cultivars for sustainable food and feed production**

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Cactus pear (*Opuntia* spp.) have gained attention for their potential as a source of food and feed coupled to their ability to thrive in arid environments. This study evaluated the nutritional properties of the cladodes of five spineless cactus pear cultivars (Zastron, Polypoly, Robusta, Corfu, and R1260), for their suitability for food and feed production. Among the cultivars, Zastron exhibited the highest calcium content (3.99%) and starch content (5.05%). Cultivar R1260 had the highest protein content (5.31%), and showed the highest content of amino acids such as alanine, histidine, HO-proline, methionine, arginine, and glutamic acid. The three cultivars, Zastron, Corfu, and R1260, contained similar levels of several essential amino acids, including aspartic acid (0.31-0.32%), threonine (0.14-0.15%), valine (0.21-0.22%), phenylalanine (0.15%), isoleucine (0.16-0.17%), leucine (0.28-0.29%), lysine (0.24-0.25), and serine (0.16-0.18%). Cultivars Polypoly and Robusta had comparable amino acid compositions, albeit relatively lower than Zastron, Corfu, and R1260. Zastron, Corfu, and R1260 exhibited promising nutritional profiles, making them suitable candidates for food and feed production. Their relatively higher protein and starch content, along with well-balanced amino acid profiles, indicate their potential as valuable resources in areas with limited water availability. However, further research into their phytochemistry, anti-nutritional, and cytotoxicity properties is needed to assess their suitability for specific applications and to optimize their processing. To fully exploit the potential of these cactus pear cultivars for food and feed production, future studies should focus on optimizing cultivation practices and exploring processing methods that maximize their nutritional value.

**Antioxidants and inorganic salt solutions mitigate ageing in *Brassica oleracea* L. and *Lactuca sativa* L. seeds**

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Seed ageing, the progressive deterioration of seed quality, poses a significant challenge for the seed industry, biodiversity restoration, and global food security. This study explores the effectiveness of antioxidant- and inorganic salt-based invigoration techniques for artificially aged *Brassica oleracea* (cabbage) and *Lactuca sativa* (lettuce) seeds, important for long-term gene bank preservation. Seeds were artificially aged to different viability levels (75%, 50%, and 25%) under identical ageing conditions, enabling a comparative analysis of ageing patterns and rates between the two species. Various antioxidants (ascorbic acid, gallic acid, reduced glutathione, trolox, and glycerol) were applied at varying concentrations, along with treatments using inorganic salts and electrolyzed cathodic water (CW). Fresh and aged seeds underwent these pre-treatments, with assessments covering seedling production, vigour, electrolyte conductivity, oxidative stress markers, and physiological parameters. The study revealed distinct ageing patterns and rates between cabbage and lettuce, underscoring the importance of understanding these differences for effective seed storage and management. Oxidative stress accompanied seed viability loss in both species, with varying mechanisms of deterioration. The results indicate that exogenous antioxidants effectively invigorate aged seeds of both species, enhancing viability and promoting growth parameters. Notably, glycerol had a significant impact on seedling vigour and photosynthesis capacity. Inorganic salt solutions, particularly calcium ions-containing CW, significantly improved seedling production, potentially by enhancing pre-germinative metabolic activities during the early imbibition stage and stimulating tissue repair responses required to preserve genome integrity and enabling normal germination, seedling growth and development, depending on the plant species.

# Plant-mediated synthesis of silver nanoparticles using T*erminalia phanerophlebia* Engl. & Diels root extract and assessment of their antimicrobial and anticancer properties

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Significant advancements in nanotechnology have opened novel possibilities for developing effective, non-toxic drugs to treat various diseases. This study aimed to synthesise silver nanoparticles (AgNPs) from the root extract of *Terminalia phanerophlebia* (Combretaceae) and evaluate their anticancer and antimicrobial properties. The synthesised AgNPs were characterised using different analytical tools. The antimicrobial activity of the biologically synthesised AgNPs was tested against Gram-positive bacteria (methicillin-resistant *Staphylococcus aureus* (MRSA), *Listeria monocytogenes*), Gram-negative bacteria (*Escherichia coli*, *Pseudomonas aeruginosa*, *Vibrio parahaemolyticus*, *Klebsiella pneumoniae*), and fungi (*Candida albicans*, *Cryptococcus neoformans*). In addition, *in vitro* the anti-cancer activity of the AgNPs against the human breast cancer cell line (MCF 7) and Human Hepatocellular carcinoma cell line (HEP G2) was investigated. Cubic and spherical shaped nanoparticles with an average size of 41.7 nm were obtained. The antimicrobial activity revealed that MRSA, *E. coli* ATCC 25922 and *E. coli* were more susceptible to the AgNPs with inhibition zones of 20.00 mm, 20.00 mm, and 20.33 mm respectively, followed by *P. aeruginosa* ATCC 27583 and *C. neoformans* ATCC 204092 while *K. Pneumoniae* ATCC 33495, *C. albicans*, and *V. Parahaemolyticus* showed minimal activity. Furthermore, AgNPs showed cytotoxicity by reducing the viability of HEP G2 and MCF7, with $IC_{50}$ values of 28.37 µg and 16.22 µg respectively. The zeta potential from nanoparticle tracking analysis showed -24.6 +/- 7.19 mV, confirming the stability of the nanoparticles and their suitability in drug delivery. This study contributes to the existing body of knowledge regarding the medical uses of nanotechnology and provides a foundation for further investigation and development of novel therapeutic methods.

**Micro-morphological characterization of southern African *Senecio sensu stricto* and new genera needed from within *Senecio sensu lato***

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The large genus *Senecio* L. (Senecioneae, Asteraceae) is polyphyletic and in urgent need of revision. It is one of the largest genera in South Africa with a significant endemic component. It is a taxonomically challenging genus due to difficulties in morphologically distinguishing the various species and sections within the genus. A major contribution towards a revision and new circumscription of southern African *Senecio sensu stricto* is a recently constructed molecular phylogeny using nuclear ITS and ETS regions, thereby identifying members of *Senecio s.s*. and those species not falling within this clade. Ten micro-morphological features of mature florets of 29 southern African *Senecio* species were examined using a Zeiss dissecting microscope and Desktop SEM (with cameras attached) to characterise the genus and distinguish it from *Senecio* species not placed within *Senecio s.s*. Balusterform filament collars and truncate style apices are confirmed to be characteristic of southern African *Senecio s.s*. species, while anther bases include both rounded and caudate forms. However, the *Senecio* segregates species have a range of filament collar types and style apices, including those present in *Senecio s.s*. Cypselae of *Senecio s.s*. are either cylindrical or fusiform with 8 – 10 ribs, while those of the segregate species are cylindrical or turbinate with 4 – 10 ribs. Comparison of these segregate *Senecio* species with sister genera suggests that new genera will need to be described out of *Senecio sensu lato*.

**Effects of varying sugarcane filter cake treatment rates on plant growth and antioxidant potential of *Bidens Pilosa* L.**

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*Bidens pilosa* L. is a traditional leafy vegetable and a source of natural antioxidants which has great potential as a food security crop with medicinal characteristics. The effect of sugarcane filter cake on *B. pilosa* and total antioxidant potential was investigated in this study by applying different amounts of sugarcane filter cake (FC) (0, 10, 20, 30 and 40 kg/ha), and a blanket NPK application at 10 kg/ha. *B. pilosa* treated with 40 kg/ha sugarcane filter cake produced more flavonoids and tannins relative to the untreated control. However contrasting accumulation of quercetin (bioflavonoid) was observed in response to 30 FC (decreased by 34%) and 40 FC (increased by 26%) relative to the control. Interestingly, 10 and 40 FC caused a slight increase (3%) in catechin concentration whereas a higher increase of 24% as observed for NPK relative to the control. All FC treatments caused a signifincat reduction in gallotannins (hydrolysable tannins) when compared to the untreated control. Furthermore, the concentrations of flavonoids and proanthocydaninis were increased in response to 40 FC. The results suggest that increased availability of antioxidants due to filter cake application (at 40 kg/ha) highlight *B. pilosa* as an essential leafy vegetable suitable for the human diet.

## Effect of climate conditions on leaf traits in *Protea*

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The genus *Protea* is a very diverse group of flowering sugarbush that has radiated quickly to produce over 100 individual species. Previous research has indicated that climate is a major driver in the diversification of this genus. However, this research has not included most of the ground *Protea* species which tend to be harder to find due to their short stature, grass-like appearance, and remote habitat. This study fills this gap by incorporating vegetative traits of up to twenty different ground *Protea* species from the Cape Floristic Region of South Africa, into a reanalysis of climatic drivers of vegetative trait and species diversification using linear mixed effects models. We combined data from this and previous studies to determine the effects of environmental factors, such as precipitation, temperature, and elevation, on vegetative traits in *Protea*. We predict *Protea* will grow taller in response to increased temperatures and lower elevation, while species that grow in cooler habitats of high elevations will be shorter. We also predict that *Protea* grown in areas with high amounts of summer rainfall will exhibit patterns of higher Specific Leaf Area (SLA) compared to species in areas with less summer rainfall. Preliminary results have shown that increased summer rainfall has a positive effect on SLA and that mean annual temperature influences height as predicted. These effects can help us predict and understand how *Protea* species grow and acclimate in response to these climatic conditions.

**Characterizing the role of a metal-based manure nano-fertilizer on salt-stressed *Glycine max* (L.) Merr. Plants**

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Salt stress poses a significant threat to plants, affecting germination, morphology, physiology, and molecular levels. Conventional fertilizers are commonly used to combat this issue in agriculture, but they risk leaching heavy metals into the soil and plants, diminishing nutrient effectiveness. Green synthesis offers a more ecologically friendly alternative. This study explored the use of ZnO nanoparticles synthesized from banana peels as a solution to salt stress. The nanoparticles were characterized using various physicochemical techniques to understand their size, morphology, structural organization, chemical composition, and surface charge. Two experimental sets were conducted, one in petri dishes and one in soil, to assess the impact of banana-synthesized ZnO nanoparticles on *Glycine max* seed germination, early seedling development, and overall plant morphological traits. The priming treatments in petri dish experiment included: water only, 100 mM NaCl only, and 200 mg/L ZnO-NPs + 100 mM NaCl primed for 4 hours. In the petri dishes, priming with ZnO-NPs improved soybean seedling growth, with longer radicles and more root hairs, while salt stress had adverse effects. In the soil experiment, the priming treatments were the same as in the petri dish, but a mixture of soil and chicken manure was at a 30:1 ratio. Salt stress negatively affected plant morphology, physiology, and proteomic expression, while ZnO-NPs priming improved traits and induced high protein expression. The study highlighted how green nanotechnology and manure fertilizers may enhance *G. max* seedling growth while mitigating salt stress. This approach has the potential to address global food scarcity and salinity sustainably.

**Evaluating the Physio-Biochemical Responses of Two Sorghum Seedling Varieties exposed to Prolonged Heat Stress**

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Heat stress (HS) poses a substantial threat to plant production and global food security, particularly when it persists for extended periods at high intensities. This condition is recognized for its capacity to impair photosynthetic activities by increasing the levels of reactive oxygen species (ROS), that ultimately diminish agricultural crop yields. Although sorghum (*Sorghum bicolor* (L) Moench) is generally considered tolerant, heat stress still significantly hampers growth, development and nutritional quality of most sorghum varieties.. This study examined the influence of heat stress (43 & 48 °C) on the physiological and molecular responses of two sorghum varieties (BRS and KSB338). Physiological comparative analysis of the two varieties, revealed that although BRS showed a slight increase in root weight, KSB388 showed a marked increase in shoots weight. While no significant differences were observed in shoot height and root length between the HS treatments (43 & 48 ℃) for both varieties. Chlorophyll metabolites were also significantly reduced in KSB338 when compared to BRS. KBS338 exhibited higher resistance to heat stress, this is due to higher level of chlorophyll content and lower cell viability displayed by KSB338 when compared to BRS under HS treatments. The reduction in chlorophyll metabolites, increase of ROS molecules and lower cell viability for KSB338 when compared to BRS, suggested that BRS might be the potential variety to grow in most areas that are known to be affected by HS as a result of global climate change. Future studies may find it valuable to investigate ion-omics as means of examining nutrient translocation within the two varieties, since HS is known to have an impact on nutrients accumulation.

**The metabolomics profiles of two accessions of *Amaranthus cruentus* cultivated KwaZulu-Natal**

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*Amaranthus* crops are significant for their medicinal properties in addition to their value as sustenance and nutritional sources. Due to the fact that cultivation of *Amaranthus* species is still uncommon and the majority of them are harvested in the wild, efforts are being made to commercialise and market this vital crop. This study investigated the chemical profile of accessions of *Amaranthus cruentus* by multivariate statistical analysis of spectral data deduced by Nuclear Magnetic Resonance (NMR). The preliminary results indicate that the principal component analysis (PCA) failed to identify a clear differentiation between the two *Amaranthus cruentus* accessions. Conversely, the utilisation of the Orthogonal partial least squares discriminant analysis (OPLS-DA) model revealed a clear differentiation between the samples derived from the two accessions. Future analysis will be done to determine the compounds responsible for the separation observed between the two accessions of *Amaranthus cruentus*.

**Phytochemical analysis, antioxidant potential, and antimycobacterial evaluation of selected medicinal plants traditionally used in Limpopo Province**

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Tuberculosis (TB) is a global pandemic that poses health security as the leading cause of death. The application of medicinal plants to treat respiratory infections is being practiced by traditional healers and people in different countries. The study aimed to determine the *in vitro* antioxidant and antibacterial activities of different selected medicinal plants traditionally used in Limpopo province to treat TB-related symptoms. The leaves of the plants were collected, dried, and extracted using solvents (hexane, dichloromethane, acetone, methanol, and water) of varying polarities. Preliminary screening of major-phytoconstituents was determined using standard chemical methods. Qualitative phytochemical composition, antioxidant, and antimycobacterial activity were determined using Thin Layer Chromatography (TLC). Phytochemicals and antioxidants were quantified using a colorimetric assay, while the quantitative antimicrobial activity and synergistic effects of hexane extracts were determined using microbroth dilution assay. Cell viability was determined using the [3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide] MMT reduction assay. All plants lacked alkaloids. Plants had varying concentrations of antioxidant compounds. The antimycobacterial activity of the selected plants had prominent activity when tested against *M. smegmatis* where rifampicin had the lowest minimum inhibitory concentration. Plant combinations had synergistic and antagonistic outcomes. The extracts were not toxic against the treated cells. Therefore, the plant extracts from selected medicinal plants have potent antioxidants and antimicrobial compounds against *Mycobacterium smegmatis*.

**Impact and management of a range expanding Rosaceae species along elevational gradients in the Maloti-Drakensberg**

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Woody plant species in mountain systems worldwide are expanding their elevational ranges, driven by both global warming and human activity. Native and non-native woody Rosaceae species follow this trend in the Maloti-Drakensberg Mountain region of southern Africa. Here we aimed to determine the impact of *Cotoneaster pannosus* Franch, *Pyracantha angustifolia* (Franch.) C.K. Schneid, *Rosa rubiginosa* L., and the native species *Leucosidea sericea* Eckl. & Zeyh., on native biodiversity at different altitudes in Maloti-Drakensberg. In addition, we aimed to determine recovery of the grassland when conventional control measures are implemented. To do this we compared plant species diversity and abundance, and temperature and light conditions of six sets of three treatment plots (invaded, cleared, and natural control) at each of three different elevations (1400, 1500 and 1600 masl). There were significant negative impacts of invasive Rosaceae on native vegetation with reduced native grass biodiversity and abundance in invaded plots. Once cleared we found significant temperature and light intensity differences between invaded and cleared plots which are inferred to contribute to vegetation recovery in previously invaded areas. It is hoped that native biodiversity will return to cleared plots, however, continued monitoring is required to confirm this. Our study's results may contribute to the management of woody invasive native and alien plant species in montane grasslands and adds to our understanding of how climate change and elevation affect the management and recovery of woody encroaching species in this biome.

**The effect of salinity and potassium supplementation on the growth and nodulation of *Vigna subterranea* (L.) Verdc. in two different soils**

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*Vigna subterranea* (L.) Verdc. (Bambara groundnut) is an underutilized African legume crop that is under-researched. Salinity often retards the growth of *V. subterranea* through osmotic stress, ion imbalances, and ion toxicities. Potassium is known to enhance plant tolerance to salinity stress and to improve the nodulation of legumes under saline conditions. A pot experiment was conducted with two NaCl treatments (0 mM and 25 mM) and four potassium treatments (0 mM, 4 mM, 8 mM, and 12 mM) in two soils (red clay soil and brown sandy soil) to test the ability of potassium to counteract the effect of salinity in *V. subterranea.* A completely randomized design was used with seven replicates for each treatment. Serial dilution was done to determine the presence of rhizobia in the soils. Gram staining, Kligler Iron Agar and catalase tests were done to detect the presence of rhizobia. Plant height, leaves and branches were measured every 2 weeks for the duration of the experiment. At the termination of the experiment, nodules per plant were counted and the root, shoot, and nodule fresh and dry biomass per plant were recorded. The results showed that 25 mM of NaCl had a detrimental effect on the growth and nodulation of *V. subterranea*, but when combined with of 4 mM potassium the growth parameters of the crop improved. The application of 12 mM of potassium was detrimental to plant growth. Thus, the application of potassium at 4 mM was able to suppress the negative effects of NaCl on *V. subterranea.*

**The impact of *solanum mauritianum* alien invasive plant and control method.**

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*Solanum mauritianum*, also known as bugweed, is a tiny tree or shrub that can grow up to 4 meters tall and is coated in felty, white hairs. This plant, which is a significant annoyance in Johannesburg, is spreading rapidly across flowerbeds, pavements, and the large dam of Emmarentia at the Johannesburg Botanic Garden. It outcompetes natural vegetation by competing with it for sunshine, nutrients, and water causing the native vegetation not to grow well and attract diseases. In the Johannesburg Botanic Garden, bugweed was managed by pulling seedlings as soon as they were noticed, before they could grow into shrubs. For bugweed that had already taken root, more effective treatment was applied to the stem or stump using glyphosate herbicide mixed with diesel. The application of the herbicide proved to be the most effective method, the chemical method is more effective because the bugweed did not reappear after it was applied, in contrast to the pulling method, which saw the bugweed grow rapidly again after two months. As a result, using herbicides is a more efficient approach than pulling method.

**Identification and characterisation of compounds with antimycobacterial activity from the leaves of *Dombeya rotundifolia***

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Plants are not only an important source of medicines but also play a significant role in drug development for treating diseases such as Tuberculosis (TB). TB is a pulmonary disease caused by *Mycobacterium tuberculosis* complex. The aim of the study was to identify and characterise antimycobacterial compounds from *Dombeya rotundifolia*. The plant was collected from the University of Limpopo. Extraction was done using different solvents that differ in polarity. The extracts were screened and analysed for phytochemicals. The antioxidant activity of the plant was determined using DPPH scavenging activity and ferric-reducing power. The antimycobacterial activity was determined using bioautography and serial microplate broth dilution assay. The isolated compounds were analyzed and identified using nuclear magnetic resonance spectroscopy (NMR). The results obtained in this study showed that water was the best extractant, extracting 57.6 mg of the plant material. Thin layer chromatography phytochemical profiles showed a separation of compounds in all used mobile systems; however, clear separation of compounds was observed in the BEA mobile system indicating their non-polarity. The plant extracts had antioxidant activity, which was confirmed by the quantitative assays. Noteworthy antimycobacterial activity was indicated by MIC values lower than 1 mg/mL. The butanol extract had the lowest MIC value (0.13 mg/mL). The isolated antimycobacterial compounds from *D. rotundifolia* were identified as Eicosanoic acid and Docosanoic. The isolated compounds showed that the plant has a potential to become a source of anti-TB drugs. However, further *in vitro* or *in silico* studies on *Mycobacetrium tuberculosis* H37Rv clinical strain.

**Seed dispersal and germination of *Cotoneaster pannosus* in Afromontane grasslands of eastern Free State, South Africa**

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Several species from the Rosaceae family are becoming invasive alien plants in the grasslands of South Africa. The most common of these species include *Cotoneaster pannosus* and *Pyracantha angustifolia*, ornamental shrubs originating from China. We explored the seed dispersal and germination of *C. pannosus* that has established in montane grasslands of the eastern Free State, notorious for forming dense monocultures which are capable of shading out native plants. This was achieved by seed disperser identification using opportunistic observations and remote cameras; and exploring germination success and rate of *C. pannosus* seeds ingested by birds in experiments with seeds of three treatments: whole fruits, de-pulped seeds, and excreted seeds. Camera trap footage and direct observations revealed indigenous birds and mammals consuming *C. pannosus* fruits. Experiments with birds showed that they ate the fruits whole. The germination success was very low (>8%) over all treatments, with the seeds buried as whole fruits taking the longest to germinate (220 days). In conclusion, birds were confirmed as consumers of *C. pannosus* fruits and therefore seed dispersers, but unlike with other invasive Rosaceae species such as *P. angustifolia*, ingestion by birds is not significant for breaking seed dormancy. However, pulp removal is important for improving germination of *C. pannosus*, regardless of whether this is achieved through bird ingestion or manual de-pulping. Future field studies focusing on seed germination and seedling survival of *C. pannosus* are needed as this will be useful regarding management of this invasive species on an ecosystem level.

**Plant size, latitude, and phylogeny explain within-population variability in herbivory.**

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This paper delves into the intricate dynamics of plant-herbivore interactions, pivotal in ecosystem functioning yet inherently diverse in their intensity. The extent of this variability within ecosystems is believed to wield a profound influence across plant-herbivore biology, shaping ecological stability and fueling the evolution of plant defense mechanisms. However, our comprehension of the factors driving this variability remains constrained by scant data. Employing standardized surveys across 790 sites and encompassing 503 plant species, we applied the Quantifying Variability in Plant-Herbivore Interactions protocol. This comprehensive dataset unveils an intriguing pattern: variability in herbivory within populations increases with latitude, and decreases with plant size, and exhibits a phylogenetic framework. These nuanced differences in variability emerge as pivotal players, sculpting the landscape of plant-herbivore biology across broad gradients. We advocate that a heightened focus on interaction variability promises to propel our insights into Earth's life patterns to new frontiers.

**Public's interest in invasive species: Interest vis-à-vis readability**

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Human activities have caused the proliferation of invasive species, leading to a growing body of research recommending public involvement in studying and managing these species. Public knowledge and awareness are crucial in changing public behaviour regarding invasive species, but the level of public interest and comprehension of public information regarding invasive species is largely unknown. To address this issue, this study used Google Insights for Search (GIFS) to examine the public's interest in invasive species from 2004 to 2020, analyzing the search popularity for eight terms related to invasive species. The study also conducted readability analyses on public sources of information about invasive species using established readability tests. The findings show that the relative search volume for terms related to invasive species has steadily increased over time, indicating growing public interest in invasive species. Most sources of information about invasive species are suitable for readers with junior university degrees and above; the readability of most websites was higher than the recommended level for the public to comprehend, highlighting the need for a balance between public engagement activities on invasive species through popular media and the readability of the information presented. The study concludes that infoveillance using GIFS can serve as a proxy marker for public biodiversity needs and priorities, emphasizing the importance of making public information about invasive species more accessible to a broader audience and aid in planning for public engagement activities related to invasive species.

**Frequency matters: the impact of multiple selenium foliar applications on the physio-biochemical responses of drought-stressed edamame**

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Low agricultural productivity results from drought stress, a complex environmental disturbance that alters the natural metabolic processes of crops, reducing their development and yield. Selenium is one of the elements that can be used to mitigate the negative effects of a variety of abiotic stressors. Previous studies in edamame showed that a once-off foliar application of selenium (50 – 75 mg/L) does not lead to a sustained increase in the physiological and biochemical activities under drought stress which did not translate into improved yield. Therefore, this study aimed to investigate if multiple foliar application of selenium (at vegetative, flowering and pod-filling stages) on a drought susceptible edamame cultivar (UVE 17) can improve the photosynthetic efficiency, antioxidative enzyme responses, total soluble sugars, membrane stability, and ultimately improve the yield responses. The results showed that multiple application of selenium induced better growth and improved yield (increased number of seeds, plant height and pods per plant). Furthermore, compared to drought-stressed plants, foliar multiple application of selenium led to upregulation of APX activity and Fv/Fm at pod filling, proline content at vegetative and flowering stage which could contribute to increased yield. Since most studies show that yield negatively correlates to nutrition, it is necessary to establish further if this improved yield affect seed nutrition?

**Induction of apoptosis in cancer cell lines by medicinal plants used to treat cancer**

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Nanomedicine is the newest and most important research field of the 21st century due to the possibility of fabricating more efficient instruments for nanomaterial synthesis and characterisation. The purpose of nanomedicine is to detect, treat, and prevent any disease or other traumatic injury to improve human health. According to the International Agency for Research on Cancer (IARC) (2018), lung and female breast cancer are the leading types of cancer worldwide. Therefore, this current study aimed to identify the active extract, isolate, and characterise its phytochemicals, and further assess their biopharmaceutical capabilities using nano platforms against selected cancer cell models. Medicinal plants were identified through a literature review. Plants were collected and extracted using acetone. Thin layer chromatography was used for phytochemical analysis of plant materials. Cell toxicity of the plant extracts, at varying concentrations, was studied against breast cancer cells using the 3-4,5-dimethylthiazol-2-yl-2 5-diphenyltetrazolium bromide (MTT) assay. The anti-metastatic was evaluated using the scratch assay. The results revealed the presence of active compounds with possible medicinal activity. Flavonoids, tannins, saponins and alkaloids were present in all plant materials. The TLC plates showed stable phytochemical compounds. The acetone extract of *Agapanthus africanus* led to the loss of viability comparable to the results observed with the positive control. *Agapanthus africanus* had the best anti-proliferative activity with an IC50 value of 15.9 µg/mL. The toxicity was time and concentration dependent.

**Phytochemical profiling and antibacterial efficacy of *Zanthoxylum chalybeum* Engl. leaf and bark extracts against pathogenic bacteria**

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Bacterial resistance is a major problem that threatens the health systems globally. The problem is compounded by the emergence of MDR pathogens such as the ESKAPE pathogens. Given the MDR pathogen mortality projections that exceed 10 million per annum by 2050, there is a need to continuously search for new therapies. *Zanthoxylum chalybeum* leaf and bark material was extracted with solvents (hexane, chloroform, Dichloromethane, and methanol), to determine its chemical diversity and antimicrobial potential against *Staphylococcus aureus, Pseudomonas aeruginosa* and *Klebsiella pneumoniae*. The leaf acetone and leaf DCM (both with average MIC 1.25mg/ml) extract were found to be more potent, being capable of exerting significant inhibitory activities against all *P. aeruginosa*. Qualitative phytochemical screening was carried out using standard methods, which demonstrated the presence of alkaloids, flavonoids, triterpenoids and terpenoids. Quantitative analysis revealed a high presence of total phenolic compounds (900mg/L). Thin layer chromatography and bioautography revealed that spots with Rf values of the inhibiting components were spot A, at Rf values between 0.43 and 0.47 in all but the leaf methanol extract in all bacteria, and spot B at Rf 0.28 in the leaf acetone and leaf DCM extracts in *P. aeruginosa*. The spots represented terpenoids and flavonoids respectively. The results show that the presence of bioactive compounds and the antibacterial activity in *Z. chalybeum* can suggest its possible use in the treatment of infectious diseases.

**Phytochemical content and antioxidant activities of some medicinal plants used for dental health care in Limpopo province**

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Dental infections are a major health problem around the globe. The current study evaluated the phytochemical composition and antioxidant activities of five plants used for oral health care in a community in Limpopo Province. The leaves of *Dicerocaryum eriocarpum (Mukanganyama et al., 2010), Euclea natalensis* (*Lima et al. 2022)*, *Erythrina lysistemon Hutch*, *Aloe falcata Baker,* and *Drimia elata Jacq.* were collected from the Ga-Molepo community, dried, and ground into powder. Extraction was done using four solvents (water, dichloromethane, methanol, and petroleum ether) with varying polarities. Biochemical tests were performed to detect phytoconstituents using colourimetric assays. Thin layer chromatography was used to separate the components in the plants and vanillin-sulphuric acid was sprayed on the plates. Three major constituents (Flavonoids, tannins, and phenolics) were quantified using the folin-ciocalteau method. Antioxidants were evaluated using a DPPH free radical scavenging assay. The results of the TLC exhibited different colours, indicating different compounds and better separation was observed in (Chloroform ethyl acetate) CEF and (Ethyl acetate methanol-water) EMW mobile phases. Antioxidant compounds were detectedi the acetone and methanol extracts and were best separated on the EMW mobile system. *Euclea natalensis* leaves exhibited the highest total phenolics and flavonoids in all extractants used. Quantitative DPPH free radical scavenging assay exhibited ethanol leave extracts, water, and methanol extracts exhibited the highest percentage of antiradical activity.

**Exploring the use of Bambara groundnuts in contribution to food security**

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Indigenous crops have been playing a major role in aiding in food security in rural households in Africa. African legume (*Vigna subterranean* (L.) Verdc.), also known as the bambara groundnut, is a member of the Fabaceae. Bambara groundnut is a small herb with bushy like leaves that can grow to a height of 0,3m, with seeds forming underground. Bambara groundnut is found in sub-Saharan regions which include South Africa, Mali, Niger, Cameroon, Toga, Ghana, Zimbabwe, and Burkina Faso. To gather information on the contribution of Bambara groundnuts in food security a literature search was conducted using available online scientific databases such as Google-Scholar, PubMed, ScienceDirect and Scopus. No time limit was indicated, and examples of search terms included medicinal properties, nutritional properties activities, coupled with Vigna subterranean. These were indicated in the title, keywords, or abstract. Bambara groundnuts are used for human intake though in some cases animals also do feed on bambara groundnuts. Bambara groundnuts are good source of dietary fiber which assists in digestion and has been found to reduce diseases such as cancer, diabetics, coronary heart disease. Bambara groundnut is a rich source such as protein, carbon hydrates, zinc, fiber that can enhance food and nutrition security. Bambara groundnuts plays a vital role in increasing soil fertility with its ability to fix atmospheric nitrogen.

# *Cannabis* chronicles; a systematic review of tissue culture protocol optimization and comparative techniques

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Increased awareness of the industrial, therapeutic, and recreational applications of *Cannabis sativa* L. has highlighted the urgent need to use novel biotechnological approaches to introduce new genotypes with desirable traits and improve secondary metabolite production. Research has documented the development of micropropagation protocols, cell suspension cultures, hairy root cultures, polyploidy modifications, and Agrobacterium-mediated gene transformation in *Cannabis*. However, limitations such as the poor rate of transgenic plant regeneration and the low efficiency of secondary metabolite synthesis in hairy root culture and cell suspension culture have limited their application. Thus, the current systematic review aimed to identify the various strategies that have been used to optimise tissue culture protocols for *C. sativa*. This involved a systematic search of literature databases including Google Scholar, PubMed, Ebscohost and Scopus in order to identify relevant studies that have reported on the development of novel methods to propagate *C. sativa in vitro*. We examined modifications in media composition, and growth regulators to improve the efficiency of tissue culture techniques as well as chemical composition of the plant. Our search between the years 2013 and 2023 yielded 198 relevant publications. Herein we discuss the significant improvements in plant growth and chemical composition for industrial applications of the plant.

**Assessment of nutraceutical attributes of selected wild edible fruit plants used by Vhavenda people of the Thulamela Local Municipality**

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Wild edible fruit plants are highly valued in many remote rural areas, where they play a significant role in fulfilling the sociocultural and livelihood needs of people. The decline in the use of these plants may be due to a lack of knowledge on their nutritional value, their potential for income generation, and medicinal and cultural uses. Information on wild edible fruit plants was gathered by means of semi-structured interviews, fieldwork, and literature review. A total of 39 wild edible fruit plants from 22 botanical families were recorded during this study, and are used as food, beverage, and folk medicine. Wild edible fruit plants of Thulamela municipality experience challenges due to human activities, resulting in some of the wild edible fruit plants declining, endangered, or even extinct. In this study the UHPLC-qTOF-MS/MS-based in source collision induced dissociation method was utilized to generate fragmentation data to assist in the differentiation of closely related isomers. Thus, in this study, we propose the use of molecular networking to unravel the families using the metabolome analysis of two *Strychnos* species (*Strychnos pungens* and *Strychnos spinosa*) and highlight the relevance of molecular networking in exploring the chemotaxonomy of plants. This allows visualization of chemical classes and the variety of substructures within the molecular families.

**Screening and comparison of *Lippia javanica* and *Mentha piperita* leaf extracts for antibacterial and antioxidant activities**

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Medicinal plants have been used from ancient history to treat numerous infections such as those of the respiratory tract and are now being evaluated as potential antimicrobial agents against antibiotic resistant microorganisms. The aim of the study was to evaluate the antioxidant and antibacterial activities of *Lippia javanica* and *Mentha piperita* leaf extracts to validate their use against respiratory tract infections. The plants were extracted using solvents of varying polarity. Thin layer chromatography was used to screen for the presence of phytochemical compounds. Standard tests were done to detect the presence of numerous phyto-constituents. Furthermore major phytochemicals were quantified using the spectrophotometric methods. Qualitative and quantitative antioxidant activity was determined using 2,2diphenyl-1-picrylhydrazyl radical (DPPH) assay. The antibacterial activity of the plant extracts was tested using micro dilution and bioautography assays. Most of the phytochemical compounds were separated on the non-polar mobile phase indicating the presence of mostly non-polar compounds. *Mentha piperita* contain many of the selected phytoconstituents as compared to the *Lippia javanica*. *Mentha piperita* had the highest phenolic and tannin content whereas *Lippa javanica* had the highest flavonoid content. Methanol extracts of both plants had the highest antioxidant activity. *Lippia javanica*(methanol) had the lowest MIC (0.020) against *P.aureginosa* and *S.aureus* whereas *Mentha piperita*(acetone and methanol) had the lowest MIC (0.020) against *S.aureus*. The results obtained in this investigation confirmed high and antioxidant and antibacterial activity which validates the use of *Mentha piperita* and *Lippia javanica* as a medicinal herb and can be investigated further for drug discovery.

## *In vitro* antidiabetic effect of wild and cultivated *Amaranthus* spp. and isolated compounds

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Previously, wild and cultivated *Amaranthus* spp. were investigated for antidiabetic activity in vitro using α-amylase and α-glucosidase enzyme assays. This study reports the antidiabetic effect of leaf extracts of cultivated *Amaranthus cruentus* and *A. hybridus* on glucose uptake in C3A hepatocytes and L6 myoblasts. Moreover, the antidiabetic effects of α-spinasterol and palmitic acid isolated from wild *A. cruentus* were determined. Significant cytotoxicity was observed for palmitic acid at a concentration of 31.3 µg/mL after 24 and 48 hours of treatment in L6 myoblasts. Small but statistically significant increases in glucose uptake were observed in L6 cells after 24 hours of treatment with all the samples. After 48 hours of pre-treatment, the only sample to exhibit a significant increase in glucose uptake was sample α-spinasterol at a treatment concentration of 62.5 µg/mL. Glucose uptake in C3A hepatocytes was significantly increased following 24 hours of pre-treatment with all tested concentrations of α-spinasterol (15.6 – 62.5 µg/mL) and 15.6 µg/mL for *Amaranthus hybdridus*. Palmitic acid also appeared to increase glucose uptake significantly at treatment concentrations of 7.8 and 31.3 µg/mL. After 48 hours of treatment in C3A hepatocytes, statistically significant increases in glucose uptake were observed in α-spinasterol at concentrations of 15.6 and 31.3 µg/mL and 15.6 µg/mL for *A. hybridus*, respectively.

**Evaluation of anti-biofilm, antibacterial, and cytotoxic effects of selected traditional medicinal plants against nosocomial pathogens**

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Drug-resistant bacterial strains in nosocomial settings is a significant public health concern due to diminished antibiotic efficacy. This study aimed to explore the antioxidant, antibacterial, and anti-biofilm potential of *Artemisia afra* and *Diospyros lycioides*. Powdered plant materials were extracted with hexane, acetone, and methanol. Phytochemical constituents were identified through standard tests and thin-layer chromatography, and quantified using colorimetric methods. The plants were tested against *Escherichia coli, Pseudomonas aeruginosa,* and *Klebsiella pneumoniae* using bio-autography and broth micro-dilution assays. Cytotoxic effects were assessed using the brine shrimp assay, while antioxidant activity was detected through scavenging assays. Anti-biofilm activity of acetone extracts was evaluated using the crystal violet assay. Methanol was the most effective extractant. Various phytochemicals, including flavonoids, tannins, alkaloids, terpenoids, and cardiac glycosides, were detected in all plants. *Diospyros lycioides* acetone stem extracts showed no antibacterial activity against *K. pneumoniae* and *P. aeruginosa,* while *A. afra* acetone leaf extracts notably inhibited *K. pneumoniae (*MIC: 0.15 mg/mL). Stem and leaf methanolic extracts showed scavenging activity values compared to ascorbic acid. All acetone extracts had moderate cytotoxicity, with *D. lycioides* stems and leaves and *A. afra* leaves having an LC50 of 250 µg/mL and *Artemisia afra* stem extracts with an LC50 of 100 µg/mL. Although the extracts generally enhanced biofilm formation, good anti-biofilm activity (>50% inhibition) against *P. aeruginosa* for initial cell attachment was detected. *Artemisia afra* acetone extracts exhibited significant antibacterial activity and initial cell attachment against P*. aeruginosa*, warranting further studies on signaling pathway inhibition, such as quorum sensing and efflux inhibitors.

**Assessment of invasion status of *Ulex europeaus* (Fabaceae) in South Africa**

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*Ulex europaeus* L. (gorse) is native to the temperate Atlantic coast of Europe, but *s* was introduced to many countries as a garden ornamental or hedge plant, stabilising highway embankments. It has since become invasive, in various parts of the world including New Zealand, Australia, Chile and Hawaii. Gorse, listed as 1a in the national regulations for biological invasions of 2020, was first recorded in South Africa in the 1930s, and its current distribution is limited to the moist, high-altitude regions of the Drakensberg and Hogsback in the Eastern Cape. It has been recorded invading disturbed pastures, roadsides, open sites, and commercial forests. The predictive model for this species suggests that this species will most likely become established in the eastern part of South Africa, in regions that have moderate climatic conditions (high rainfall and cool temperature). Here we report on the current species distribution, population sizes and eradication efforts by the South African National Biodiversity Institute (SANBI) Early Detection and Rapid Response team over the past five years. These results will serve as a reference point for guiding future planning and revising management options.

**Assessing physio-biochemical markers for studying germination and seedling growth of heteromorphic chia seeds under salinity stress**

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*Salvia hispanica* L. (Chia) is a high nutrition pseudo-cereal crop that produces heterogeneous seeds, which consist of white (WCG) and black (BCG) seeds. Heterogenous seeds production is thought to be a a limited-resource use mechanism for adapting to harsh environments. Despite the nutritional impact of chia, limited information is available regarding its physio-biochemical responses to harsh environmental factors such as salinity. Thus, the study investigated the effect of salinity on physio-biochemical markers of WCG and BCG seeds on their germination and growth. The BCG and WCG seeds were germinated in four concentrations of salinity stress (0 mM, 100 mM, 200 mM and 300 mM) and their germination evaluated daily for 7 days (continuous darkness). Germination percentage decreased with an increase in salinity concentration, but to different extends between the BCG and WCG. There were also contrasting biochemical responses between WCG and BCG seeds. Black genotype showed enhanced salt tolerance (more tolerance), which was characterized by maintained growth (shoot and root length) reduced ROS biomarkers. In contrast, white genotypes showed a greater susceptibility to salinity stress, resulting in reduced growth (shoot and root length) and an increase in ROS biochemical markers. In conclusion, the study revealed that above 300mM NaCl chia seeds germination was inhibited completely. While above 200mM NaCl it slowed their growth although germination occurred. Undoubtedly, the biomarkers identified in this study may also form a basis for future projects that involve the development of new breeding technologies for improving crop yields in saline soils.

## *Leonotis ocymifolia:* An ethnopharmacological review and in vitro antimicrobial assessment

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The genus *Leonotis* (Lamiaceae) is commonly used in Africa as a traditional medicine for various ailments such as respiratory, epilepsy, stomachache, and skin diseases. Most of the *Leonotis* species are found in South Africa, including *Leonotis ocymifolia* (Burm. f. Iwarsson) (klipdagga). Although several medicinal uses of *L. ocymifolia* are known, little is known about its antimicrobial activity. Therefore, this study aimed to investigate the antimicrobial potential of *L. ocymifolia* by reviewing its ethnomedicinal importance and testing extracts and fractions (ethyl acetate, n-hexane, and n-butanol) against six bacteria and three *Candida* pathogens. The results demonstrated that all *Candida* species tested (*C. albicans* (ATCC 10231), *C. glabrata* (ATCC 90030) and *C. tropicalis* (ATCC 14114) were highly susceptible to all extracts. The n-hexane and n-butanol fractions exhibited the most noteworthy antimicrobial activity against all tested pathogens, with a mean MIC value of 0.25–0.06 mg/ml. Moderate activity was observed for all extracts against all bacteria tested, except for *Klebsiella pneumoniae*, where noteworthy activity (MIC value of 0.13 mg/ml) was recorded for the n-butanol fraction. All the extracts showed bactericidal effects against *Candida glabrata* with MBC values of 0.13–1.00 mg/ml. The time-kill effects on *C. glabrata* were recorded by n-butanol fraction at 1xMIC (0.13 mg/ml) after 30 min of contact time and after 60 min at 1/2xMIC. The time-kill effects on *C. glabrata* by the positive control (Nystatin) was after 4 hr. of contact time at 0.13 mg/mL. *Leonotis ocymifolia* has demonstrated promising antimicrobial properties with high potential as an anticandidal agent.

**Review of the invasive, yet economically beneficial, *Rosa rubiginosa* L. (Rosaceae) within southern Africa**

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Invasive species usually have negative impacts on the environments they invade, but in some instances, they can prove to be beneficial. In southern Africa, *Rosa rubiginosa* is one such species. The plant is classified as a category 1B invasive under the National Environmental Management: Biodiversity Act of South Africa, as well as one of the most common invaders in Lesotho. It is responsible for bush encroachment in grasslands, decreasing available farmlands and reducing water availability, and potentially altering soil chemistry. *Rosa rubiginosa* is also a nurse plant for seedlings of other invasive species, and its fruit and seeds appear to be dispersed by native dispersers. A parasitic wasp predates seeds of *R. rubiginosa* and could be considered as a potential biocontrol agent. However, *R. rubiginosa* has become economically important in the region, providing employment for local women and children as its fruits are harvested from wild populations and exported for the production of commercial products such as herbal teas, fruit juices and cosmetics. Scientific experts, landowners and commercial industry have differing perceptions of *R. rubiginosa*. We discuss *R. rubiginosa* as a conflict-generating species through a review of its reproductive ecology, potential for biocontrol, and economic benefits within South Africa and Lesotho. The species is problematic for agriculture by deteriorating rangeland productivity and facilitating the establishment of other invasive species. However, more information is required before management decisions are made by authorities, to ensure effective use of the species while mitigating the risks of invasion and bush encroachment.

**The future treatment of burnt injuries depends on medicinal plant extracts and Hydrocolloid Bandages**

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According to the DC attorney's website, South Africa has a high incidence of serious burn injuries and deaths and is the most common cause of death in children under the age of four. Burns affect about 3.2% of the South African population annually. Therefore, the purpose of this study was to design, formulate and fabricate medicinal plant Hydrocolloid Bandages. The plant extracts were screened for phytochemical, antioxidant and antimicrobial activities and then incorporated with natural polymers to synthesize and then characterize the resulting hydrocolloid dressing. The plant extracts show the presences of alkaloid, saponin and flavonoids; and inhibition of *S. aureus* and *P. putidi* bacteria The synthesized dressing SEM image exhibited irregular, smooth, interwoven, and uniform morphology with fibrous bead shaped and FTIR spectra show that the wound dressings were successfully synthesized, with several similar peaks for each single layer hydrocolloid. Phytochemical screening of plant extracts and pre-formulation study is an essential preliminary study to ensure the successful establishment of an optimum drug delivery system prior to formulation of a novel modality for wound healing dressing.

## Alpha glucosidase and α-amylase activities of *Amaranthus spinosus*

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Diabetes mellitus is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood glucose. Hyperglycemia a condition referring to raised blood glucose, is a common effect of uncontrolled diabetes and, over time, leads to severe damage to many of the body's systems, especially the nerves and blood vessels. Amaranth is well recognised as a highly nutritious superfood with significant nutraceutical characteristics. It has been extensively utilised due to its well-rounded nutritional composition and functional attributes, which have demonstrated notable therapeutic advantages. Amaranth has extreme adaptability to adverse growing conditions, but it is also an edible crop and contains some important antidiabetic properties. The main aim of the study is to report on the antidiabetic properties of *Amaranthus spinosus*. *A. spinosus* showed lower activity than acarbose in the α-glucosidase enzyme ($IC_{50}$= 237.06 µg/mL, acarbose=36.98 µg/ mL). With regard to α-amylase, the crude extract showed good activity ($IC_{50}$=3.37 µg/ mL). In conclusion, *A. spinosus* leaves possess noticeable *in vitro* α-amylase and moderate α-glucosidase inhibitory activities.

**Documentation of ethnoveterinary practices and ethnobotany knowledge for control of cattle ticks in Sekhukhune district, Limpopo province, South Africa.**

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Ethnoveterinary knowledge in Sekhukhune district contributes significantly towards the livelihoods of the community members. A survey was conducted in which a random sample method was used to select the localities and a semi-structured questionnaire employed to collect the data. The data was analyzed using STATA version 17.0. Two hundred fifty participants whose age ranged from 10 to 90, were interviewed of which approximately 60% were male and 40% were women. Most elderly men had practical knowledge in controlling ticks in cattle using herbal acaricides and other control treatments. Nonetheless, females and youth did also show a certain degree of knowledge. The plants used are collected from the wild and used fresh with no evidence of storage. Twenty-eight plant species belonging to 15 families are used in controlling cattle ticks. Selected plants were administrated topically or orally. However, other conventional methods were reported in the district as part of cattle ticks control. The use of herbal acaricides continues to be practiced and are thought to be more efficacious compared to other methods. Furthermore, the use of herbal acaricides has been insufficiently documented in Limpopo province, and no account of description for cattle ticks control has been tapped on, in the Sekhukhune district. The study has attempted to document the fragile ethnoveterinary knowledge.

**Assessing the efficacy of *Moringa oleifera* seed-based water treatment in river water**

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The high cost of purified water leads rural communities to use easily accessible but contaminated water sources, causing waterborne diseases... The study investigated the effectiveness of a simple water purification device involving Moringa *oleifera* seedsin treating water Water samples for the study were collected from three sites (Tierpoort, Mamelodi and Moretele) along the Pienaars River in South Africa during winter and summer. Ground *M. oleifera* seed material of different particle sizes was fixed in a prototype filter with activated charcoal and cotton wool. The river water samples were filtered through the device, and the filtered water was analyzed for microbial content (total coliforms, Escherichia coli, Salmonella spp., and Shigella spp.) using the viable plate count method in triplicate replicates. The filtered and unfiltered water were analysed by ICP-OES for metal elements and Ion Chromatography (IC) for anion detection. Filtered water at Moretele sapling point exhibited the highest colony forming units (17 CFU) of *E. coli*, while the Mamelodi point showed the lowest detection (7 CFU). Winter samples had the highest levels of *E. coli* at Mamelodi sampling point (5 CFU) and no CFU at Moretele and Tierpoort ponits. Total coliforms, *Salmonella* spp. and *Shigella* spp. ($7.0 \times 10^4$, $3.9 \times 10^4$ and $3.2 \times 10^4$ CFU, respectively) were higher in the Mamelodi samples during summer than winter. The physicochemical properties of filtered water during both seasons varied between the sampling points but were within limits set by the SANS 241:2015 standards for drinking water. These findings suggest that *M. oleifera* seeds have potential as a low-cost and sustainable solution for water treatment in developing countries.

**Rural revival: biodiversity conservation through restoration in Taung, South Africa**

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This study investigated brush-packing as a restoration method near Manthestad, Taung in the North-West Province of South Africa, an area previously cleared of brush. The research objectives encompassed (1) evaluating the efficacy of brush-packing as a restoration method in bush-cleared areas, (2) analyzing the diversity of grass species in response to restoration methods post-brush-packing, and (3) documenting community members' perceptions of bush encroachment, bush control, and socioeconomic factors before and after restoration activities. A total of 18 sample plots, each measuring 400 m², were established, with six distinct restoration methods replicated three times. These methods included clearing only, clearing and re-seeding, clearing and brush-packing, clearing, brush-packing, and re-seeding, and clearing, soil disturbance, brush-packing, and re-seeding. The impact of these restoration treatments was monitored over three years (2018–2020). Results revealed significantly higher grass species diversity ($p < 0.001$) and richness ($p < 0.05$) over the years in all restoration treatments involving brush-packing, as per the Simpson and Shannon indices. The highest biomass accumulation occurred in the treatment involving bush clearing, soil disturbance, brush-packing, and re-seeding. In contrast, the lowest grass biomass was observed after the clearing-only restoration treatment. Socio-economic survey results demonstrated that bush encroachment had a significant adverse impact on the socio-economic well-being of livestock owners and households, affecting their livelihoods. The implementation of brush-packing treatments also contributed to job creation and poverty alleviation, improving the livelihoods and well-being of the Manthestad community. This study underscores the importance of long-term commitment to restore encroached and degraded regions effectively.

**Physiological and proteomic characterization of drought and salt stress responsive proteins from *Pennisetum glaucum* (L) cultivar**

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Agriculture plays a pivotal role in sustaining the world's growing population through extensive food production. However, crop plants face numerous challenges in their natural environment, including abiotic stresses such as drought and salt stress. Plants have developed complex survival mechanisms. Understanding pearl millet's response to these stresses is vital for improving resilience in water-deficit and saline environments. Our study subjected pearl millet to separate and combined drought and salt stress for 25 days. The results showed reduced morphological growth traits, including plant height, shoot and root lengths, leaf number and area in stressed plants compared to control plants except for increased stomatal density in salt and dual-stressed plants, indicating adaptation. Physiological processes like relative water content, chlorophyll levels, photosynthesis, transpiration, and respiration rates were significantly affected, with salt-stressed plants showing higher respiration rates. Proteomic analysis revealed altered protein expression in response to stress, suggesting potential upregulation or downregulation of proteins. Gene Ontology analysis identified various unclassified proteins involved in essential biological processes, molecular functions, and cellular components. This study highlighted the adverse effects of drought and salt stress on pearl millet at the morphological, physiological, and proteomic levels. It offers valuable insights for researchers and agricultural experts studying stress responses in pearl millet and related crops, serving as a reference tool for understanding drought and salt stress pathways.

**The impact of *Lantana camara* L on understorey shrub layer species at the Lowveld National Botanical Garden vegetation.**

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There has been an increasing concern about the impact of invasive alien plant species on plant communities along with their role in causing a loss of biodiversity. *Lantana camara* (common lantana) is a species of flowering plants within the Verbena family (Verbenaceae), native to the American tropics. It is an adaptable species, which can inhabit a wide variety of ecosystems. The study examined the impacts in native vegetation abundance and composition following *Lantana camara* invasion on understorey shrub layer species of the Lowveld National Botanical Garden, Mpumalanga Province of South Africa. Using a comparative approach, vegetation abundance and composition were compared in *L. camara* infested and uninfested areas. Quadrats of 10m x 10m were used to collect data of understory shrub layer species subjectively constructed in *L. camara* infested and uninfested areas. Results show that vegetation abundance and composition were significantly higher both in *L. camara* infested and uninfested areas, with shrub species such as *Ochna pretoriensis* showing great abundance in both infested and uninfested plots. The composition of the species was higher in both infested and unifested conditions. The percentage of ground covered by trees and shrubs decreased gradually as the amount of L. *camara* cover increased. Analysis of similarities showed significant separations in vegetation composition among the two sites. The study concludes that invasion by *L. camara* was associated with changes in vegetation abundance, cover, and composition, with observed changes being more visible under L. *camara* infested area compared to uninfested areas. From a management standpoint, the study suggests the removal of *L. camara* however such removal should consider protecting the co-occurring native species. This study offers a baseline for further research to determine mechanisms responsible for native vegetation change associated with *L. camara* invasion.

# Growth performance and yield of spinach (*Spinacia oleracea* l.) As influenced by different growing media ratios under greenhouse conditions

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The use of animal manure is common in South Africa and helps to improve soil fertility when mixed with soil in the correct ratio. Therefore, the study's objective was to investigate which of the growing media mixture (GMM) ratios of sand, Hutton soil, and goat manure would improve the growth and yield of *Spinacia oleracea* under greenhouse conditions. The experiment was laid out in a randomised complete block design (RCBD), with 10 replicates. Six treatments comprised of different ratios of river sand, Hutton soil, and goat manure namely 1:3:0 (control) 1:2:1, 1:1:1, 1:1:2, 2:1:2 and 2:3:2. A week after hardening off seedlings, uniform seedlings at the five-leaf stage were transplanted into 20-cm-diameter plastic pots, filled with 2 700 ml steam-pasteurized (300°C for 1 h) sand, Hutton soil, and non-pasteurised goat manure at different ratios. Plants grown in the 1:2:1, 1:1:1, 1:1:2, 2:1:2 and 2:3:2 GMM were taller than those of the control treatment with treatment 1:1:2 having the tallest plants of all treatments. Leaf number per plants of the 1:1:1, 1:1:2, 2:1:2 and 2:3:2 treatments were higher than the control. In conclusion, findings from this study indicated that GMM ratio 1:1:2 could be the preferred mixture, which promotes the highest growth performance in *S. oleracea*.

# Genotype x Environment interactions of chickpea genotypes in North-Eastern South Africa

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Chickpea is a globally important crop, high in proteins and minerals. Over the years, South Africa has been importing chickpea and its demand is projected to increase thereby necessitating research on its local production. This study focused on identifying chickpea genotypes with desirable agronomic traits, and environment adaptation in a genotype by environment (G x E) experiment. Twelve genotypes consisting of heat or drought tolerant genotypes, and their susceptible counterparts were assessed in the field in Limpopo (Univen) and Mpumalanga (Nkomazi). Univen was cooler with lower annual rainfall and soil nutrients (except N) than Nkomazi. The study was a randomized complete block design, replicated three times. Shoot biomass, chlorophyll fluorescence, and chlorophyll concentration were determined at 50% flowering. A combination of crossover and non-crossover G x E interactions was observed based on biomass yield. Genotypes ICCV97105 and ICCV3111 showed a crossover interaction with all genotypes except ACC#7 and ICCV8101, respectively. The non-crossover interaction was between genotypes ICCV8101 and ICCV92944, ICCV97125, ICCV3110, ICCV07304, and ICCV3110. The genotypes that performed the best at Univen were amongst the lowest at Nkomazi. There was a consistent but medium level performance of genotypes ACC#2 and ICCV07114 across sites. The genotypes maintained high photosynthetic efficiency (Fv/Fm > 0.73). There was a lack of correlation between biomass and photosynthetic efficiency nor chlorophyll concentration Overall, the results showed lack of high yielding and consistent performing genotypes at both sites. The presence of crossover interactions implies the need for breeding for specific adaptation.

**Micro-morphological characterization of southern African *Senecio sensu stricto* and new genera needed from within *Senecio sensu lato***

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The large genus *Senecio* L. (Senecioneae, Asteraceae) is polyphyletic and in urgent need of revision. It is one of the largest genera in South Africa with a significant endemic component. It is a taxonomically challenging genus due to difficulties in morphologically distinguishing the various species and sections within the genus. A major contribution towards a revision and new circumscription of southern African *Senecio sensu stricto* is a recently constructed molecular phylogeny using nuclear ITS and ETS regions, thereby identifying members of *Senecio s.s*. and those species not falling within this clade. Ten micro-morphological features of mature florets of 29 southern African *Senecio* species were examined using a Zeiss dissecting microscope and Desktop SEM (with cameras attached) to characterise the genus and distinguish it from *Senecio* species not placed within *Senecio s.s*. Balusterform filament collars and truncate style apices are confirmed to be characteristic of southern African *Senecio s.s*. species, while anther bases include both rounded and caudate forms. However, the *Senecio* segregates species have a range of filament collar types and style apices, including those present in *Senecio s.s*. Cypselae of *Senecio s.s*. are either cylindrical or fusiform with 8 – 10 ribs, while those of the segregate species are cylindrical or turbinate with 4 – 10 ribs. Comparison of these segregate *Senecio* species with sister genera suggests that new genera will need to be described out of *Senecio sensu lato*.

**Cell wall modification and carbohydrate metabolism: two targets for Biochemical strategies to improve wheat resistance against *Puccinia triticina***

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*Puccinia triticina* (*Pt*) is an important pathogen of wheat. While breeding programmes develop resistant wheat cultivars to mitigate the effects of such rust-causing pathogens, the emergence of new rust races with wider virulence mandates the implementation of other control strategies. In the last four years, my research group (CHEM-LAB) worked closely with the Rust Research Groups at the University of the Free State to elucidate the biochemical responses during wheat-pathogen interaction. The long-term goal of the projects is to provide an alternative strategy (using Biochemistry) to the current Breeding and Molecular approaches to protect wheat against rust. To date, the project's proof of concept has been successful, with two publications in reputable international scientific journals. Follow-up studies demonstrated the cell wall, CAZymes and carbohydrates metabolism play significant physiological and biochemical roles during rust fungi-wheat interaction. We performed several studies using the near-isogenic lines (Thatcher and Thatcher+*Lr9*), which are susceptible and resistant to *Pt* isolate UVPt9, respectively. Findings showed: 1) *Pt* forms a second sink that competes for the soluble carbohydrates with susceptible wheat sink cells; 2) the activities of acidic CAZymes responsible for strengthening the cell wall were higher in inoculated resistant cultivars; 3) oligosaccharides accumulated in the resistant compared to susceptible cultivars. Lastly, the microscopic studies confirmed the cell wall strengthening modifications in the resistant cultivars, while cell wall degradation signs were identified in the susceptible cultivars. We concluded that cell wall strengthening and carbohydrate metabolism in *Pt*-infected wheat are indispensable in plant resistance.

**Effect of nanoparticles on the growth, physiology and proteome profile of *Amaranthus cruentus* L. under salt stress**

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Plants are sessile, autotrophs that perceive signals to determine the requirements of growth, differentiation and stress tolerance. These signals are transduced across membranes from source to sink to induce appropriate adaptative gene expression that modifies the phenotype. Plant protectants are applied to antagonise abiotic and biotic stress effects on traits. Nanobiotechnology uses principles of biological- and nanoscience to produce nano-biomaterials that are effective protectants more than conventional bulk materials. The biosynthesis of metal oxide nanoscale materials (NMs) using zinc precursor and banana peels with biological bottom-up methodology which involved (i) phytochemical infusion, (ii) complexation of metal ions, (iii) calcination of hydrolysed metal to oxide. These novel NMs were used as growth-inputs and ameliorants under salinity stress. *Amaranthus cruentus* L. was used as a model in stress-management classes; the first was represented by seeds primed with either ZnO or bulk-Zn at 50 (low), 100 (mild) and 200 (high) mg/L, the second class was primed with 75 (low), 150 (moderate), 300 (severe) and 600 (extreme) mM NaCl, and the last was primed post the germination assay with treatments showing biotoxicity. The effects of ZnO and bulk-Zn on morpho-physiological traits were evaluated at the vegetative emergence and cotyledon as well as the reproductive stages, showing synergistic and antagonistic relations to uniform seedling establishment, respectively. In the latter stage, most protein expression was exhibited by bulk-Zn. The use of NMs offered functional value and decreased toxicity, thus, they are a prominent choice over bulk materials for use in the environmental-human-animal one health approach.

**An assessment of ecological integrity of the southern African grassland biome.**

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The southern African grassland biome is a hotspot of botanical diversity. However, its condition has been deteriorating because of human-mediated activities which reduce the grassland biome's resilience and adaptation to the impacts of climate change. The study objectives were: (1) To determine the dynamics in the vegetation cover over 37 years (1986-2022); (2) To assess the trends of anthropogenic activities that can possibly threaten the integrity of the grassland biome over 20 years (1990–2020) and; (3) To determine the potential hotspot for alien and invasive plant species (AIS) as the second threats after climate change in the grassland biome. Remote Sensing and GIS - Landsat TM series images (path 170/row 80) analyses were used to detect spatial changes that occurred over time. The South Africa National Land Cover dataset contains 72-73 land-use classes - regrouped into 10 classes that were used to spatially assess the land cover use. We also used the hotspot-Getis-Ord Gi* statistic to predict the vulnerability trends (1900-2023) of AIS in the grassland biome. The results suggest that the "moderate vegetation cover" and "dense vegetation cover" increased by 16.8% and 24.7%, while the sparse vegetation declined by 31.5%. Agricultural activities accounted for 27% of land cover use having increased by 5% since 1990. The high hotspot for AIS increased by 11% since 1900 (21.4 -33.3%) in the grassland biome. The study concluded that the southern African grassland biome continues to be threatened by AIS invasion and land degradation characterised largely by human-mediated activities.

# The influence of novel cytokinin oxidase/dehydrogenase inhibitors on *Lessertia frutescens* plant growth and metabolite profile after exposure to salinity stress

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*Lessertia frutescens* (syn. *Sutherlandia frutescens* R.Br) commonly known as Cancer bush is an important southern African medicinal plant used as an immune booster and helps to treat diabetes, and cancer. Its therapeutic properties are linked to the plant's high triterpene saponins, flavonoids, and L-canavanine metabolites. Environmental stresses such as salinity can affect plant growth and the composition of these compounds. It is therefore necessary to determine how to mitigate such environmental effects on plant growth. Cytokinin oxidase/dehydrogenase (CKX) inhibitors promote growth, and attenuate senescence under stresses. Thus, the study aimed to investigate the potential role of two novel CKX inhibitors in mitigating salinity stress in *in vitro*-cultured *L. frutescens*. Changes in metabolite profile were analysed using GC-MS (sugars and sugar alcohols), LC-MS/MS (biomarker compounds). The overall growth of plantlets exposed to 50, 100, and 150 mM of sodium chloride (NaCl) was significantly reduced (2-3-fold). The highest CKX concentration (1 nM) effectively improved plant growth (leaf number, shoot height, and fresh weight) to comparable levels with the control plants (0 mM NaCl), which can be attributed to the changes in the plant metabolites. Additionally, applying CKX inhibitors at relatively lower concentrations (0.25 nM) could in some cases alleviate salinity stress. The ability of CKX inhibitors to induce metabolome changes might have allowed the plants to survive salinity stress. Based on the observed results, the applied CKX inhibitors (1 nM) have the potential to enhance the growth of *L. frutescens* under salinity stress, which might be beneficial for their prolonged survival in stressful environments.

# The effectiveness of selected botanical insecticides against pineapple pests in Northern KwaZulu-Natal Province, South Africa

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Pineapple (*Ananas comosus* (L.) Merr.) production is an important activity for commercial and small-scale farmers in the Northern KwaZulu-Natal province of South Africa. However, farmers suffer major setbacks from pest infestations threatening the yield and quality of pineapples. Synthetic chemicals are traditionally used to control infestations, but environmental concerns and health-related risks have led to a demand for safer and more sustainable alternatives. One of the viable options involves the use of botanical plant extracts, which are locally available on farms and eco-friendly. This study was designed to evaluate the insecticidal effectiveness of botanical insecticides against pineapple pests. The study was conducted on pineapple farms located in two districts of Northern KwaZulu-Natal province. A total of five pests commonly found in pineapple, including the pineapple mealybug, pineapple aphid, pineapple scale, pineapple weevil, and nematodes, were studied in this research. Four specially derived botanical plant extracts were tested in both the laboratory and field to evaluate their efficacy in controlling the pineapple pests. Preliminary results showed that all the tested extracts were effective in suppressing more than 70% of pineapple pest infestations. In addition, this study offers valuable insight into the prospective benefits of using botanical insecticides for pest control as opposed to traditional synthetic chemicals, particularly for resource-poor pinea

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**Eligible prizes: Best PhD presentation (oral)**
**Best young scientist**

## Phylogeny and infrageneric classification of Lasiosiphon (Thymelaeaceae: Thymeleaoideae)

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The African Centre for DNA Barcoding (ACDB), Department of Botany and Plant Biotechnology, Faculty of Science, University of Johannesburg, PO Box 524, Auckland Park, 2006, Johannesburg, South Africa bDepartment of Biodiversity and Conservation Biology, University of the Western Cape, Private Bag X17, Bellville 7535, Cape Town, South Africa cDepartment of Botany and Plant Biotechnology, University of Johannesburg, PO Box 524, Auckland Park 2006, Johannesburg, South Africa dCompton Herbarium, South African National Biodiversity Institute, Private Bag X7, Newlands 7735, Cape Town, South Africa eResearch Centre for Plant Growth and Development, University of KwaZulu-Natal, Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa Lasiosiphon (Thymelaeaceae: Thymelaeoideae) was resurrected from the large, polyphyletic genus Gnidia L. based on systematic studies of the Thymelaeoideae. It is a medium-sized genus with diverse morphological features, comprising approximately 75 species, with 29 of these species being distributed in southern Africa, 37 in tropical Africa, 13 in Madagascar, and 2 in Asia. A comprehensive taxonomic revision of Lasiosiphon is needed to reflect the true diversity within Lasiosiphon and improve species identification. Here, we performed a combined phylogenetic analysis of nuclear and plastid molecular datasets to assess the relationships within the genus. Representatives of 30 of the 75 species accepted in Lasiosiphon were included. In addition, we evaluate the taxonomic importance of ten morphological traits that could be used to infer subgeneric classification within the genus. The results of our findings will be discussed in this presentation.


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