

Conference Abstracts

South African Association of Botanists

Abstracts of papers and posters presented at the 29th Annual Congress of the South African Association of Botanists and the International Society for Ethnopharmacology held at the University of Pretoria, 8–11 January 2003*The presenter of multi-authored papers is underlined*

★ Awards made to students

Plenary Lectures

Ethnopharmacology as source of new drug paradigms: the case of an Amazonian 'brain tonic',**EE Elisabetsky^{1,3}, IR Siqueira^{2,3}, AL Silva^{1,4}, DS Nunes⁵ and CA Netto^{2,3}**¹ Laboratório de Etnofarmacologia, Departamento de Farmacologia, Universidade Federal do Rio Grande do Sul, CP 5072, 90041-970, Porto Alegre, Rio Grande do Sul, Brazil² Departamento de Bioquímica e PPGs, Universidade Federal do Rio Grande do Sul, CP 5072, 90041-970, Porto Alegre, Rio Grande do Sul, Brazil³ Departamento de Fisiologia, Universidade Federal do Rio Grande do Sul, CP 5072, 90041-970, Porto Alegre, Rio Grande do Sul, Brazil⁴ Departamento de Bioquímica, ICBS, Universidade Federal do Rio Grande do Sul, CP 5072, 90041-970, Porto Alegre, Rio Grande do Sul, Brazil⁵ Universidade Estadual de Ponta Grossa, Paraná Brazil

The pharmaceutical industry regards medicinal plants as potential sources of bioactive unusual molecules, potentially bearing innovative mechanisms of action; for allopathic drug development, even when traditional formulations are taken into consideration, traditional medical systems are very scarcely regarded as such. The herbal industry is more likely to accommodate innovations as well as to accept unconventional concepts of health/disease, maintenance/treatment and drug mode of action, thereby eventually generating useful clinical data. Despite its history, pharmacology as a discipline has been refractory to the potential contribution of ethnopharmacology in terms of different paradigms for drug mode of action or usage. The complex patterns often found in pharmacological studies of medicinal plant extracts suggest that the effects of plant drugs may often be based on a more diverse/complex pharmacodynamic basis than the common drug/effect relationships. In fact, pharmacological properties and clinical effects observed with herbal drugs may result from effects of more than one active ingredient, from drug interactions among ingredients, from active ingredients possessing multiple mechanisms of action, or even from interference with targets not yet recognised by the current biomedical understanding of cell biology modulation. This paper focuses on the neuroprotective profile of an Amazonian 'brain tonic' to explore newer paradigms of psychotropic drug action and therapy. It is suggested that the understanding of traditional medical concepts of health and disease in general, and traditional medical practices in particular, can lead to true innovation in paradigms of drug usage and drug development.

Biodiscovery and development of new phytomedicines and biodiversity conservation in Africa**MM Iwu**

International Centre for Ethnomedicine and Drug Development, Bioresources Development and Conservation Programme, 110 Aku Road, Nsukka, Nigeria

Advances in information and process technology and the avail-

ability of immense biological resources in Africa have provided a feasible platform for the establishment of a 'biology-industrial programme', which focuses on *biodiscovery*. In this approach, biodiversity functions not as raw materials or industrial feedstock but more importantly as an informational input to research development processes. *Biodiscovery* is an inclusive term to describe the collection of biological resources for the identification of valuable molecular or genetic information about those biological resources and to utilise that information in the development of bio-products. Africa possesses a unique advantage in the development of plant genetic materials into consumer goods because of the long history and widespread use of traditional medicine in the continent. The International Centre for Ethnomedicine and Drug Development (InterCEDD) Nsukka has developed a method for rapid scientific validation of traditional remedies that integrates proof of safety with clinical outcome studies to select ingredients that could be standardised as nutraceuticals and/or phytomedicines. This approach leads to the development of products with precisely defined characteristics and consistent quality, as well as the generation of purified phyto-chemicals for drug development. There is also a direct relationship between the value added to these biological resources and the protection of traditional knowledge and biodiversity. In this model, biodiversity is regarded as natural resources to be conserved and sustainably utilised for wealth creation and poverty alleviation. Examples given in the paper will include nutraceuticals used as supplements in the management of chronic disorders, infectious diseases and metabolic disorders.

Plants, peoples and cultures: perspectives from southern Africa**AE van Wyk**

Department of Botany, University of Pretoria, Pretoria 0002, South Africa

An holistic picture is painted of the remarkable position Africa, and particularly southern Africa, occupies in the fields of natural resource and cultural diversity. The existence and subsequent breakup of Gondwana set the scene for the biological, geological and geomorphological evolution of southern Africa. This ancient event still reverberates in the minds and actions of humans who, from the time of their earliest evolutionary emergence, have been an integral part of life in Africa. Geomorphological and biological evolution of southern Africa is closely related to geology, which, considering the size of the region, is unequalled anywhere else in the world. Biologically southern Africa contains three of the world's biodiversity Hotspots, and botanically two of its six Floristic Kingdoms, including one in its entirety. Linguistically the oldest of the world's six language phylums, Khoesaaan, is essentially confined to southern Africa, with significant representation of at least three others. Interaction between humans and plants has resulted in the accumulation of extensive indigenous knowledge relating to the use of plant products. It has taken only 300 years to witness the extinction

of several local cultures and languages, notably those of several Khoesaaan peoples, the oldest human inhabitants of the region. However, for all its biological and cultural diversity, there has been no significant domestication of native plants and animals in sub-Saharan Africa, neither have the peoples in the region developed a culture of using plants for their flowers. Explanations for these anomalies are offered and the contributions Africa can make towards stemming the Sixth Extinction are highlighted.

Papers

Effects of gibberellic acid and benzyladenine pretreatment on six wheat cultivars under salinity stress

M Adam, LM Raitt and J Aalbers

Department of Botany, University of the Western Cape, Bellville 7535, South Africa

Three salt sensitive wheat cultivars (Knoppies, Rooiwol, and Rooigys) and three salt tolerant wheat cultivars (Yecoro Royo, Charchia, and Losper) were examined under five different NaCl concentrations, 0, 100, 200, 300 and 400mMol. Wheat seeds were pretreated with five hormone concentrations, (0, 12.5, 40 and 125 µMol), of Gibberellic acid (GA3) or N6-Benzyl adenine. Root length, shoot length, root mass, shoot mass and percentage seed germination were measured as indicators of hormone effects at different salt levels. Results showed that treatment with GA3 led to significant increases in most parameters measured, particularly the percentage seed germination of salt sensitive cultivars. The result of N6-Benzyl adenine pretreatment was erratic for both cultivars and salt concentrations. The use of GA3 as a wheat pretreatment could reduce the damaging effects of high salt levels on seedlings, particularly in brackish soil.

Bioassay-directed isolation of hypotensive alkaloids from *Holarrhena pubescens*

K Aftab¹, SB Usmani², S Begum² and BS Siddiqui²

¹ Department of Pharmacology and Therapeutics, Islamabad Medical and Dental College, Main Murree Road, Bhara Kahu, Islamabad

² H.E.J Research Institute of Chemistry, University of Karachi, Karachi, Pakistan

Holarrhena pubescens belongs to the family Apocynaceae. Commonly known as 'kurchi' it is highly reputed in traditional medicine as a remedy for amoebic dysentery and other intestinal ailments. Bioassay-directed fractionation of the ethanolic extract of *Holarrhena pubescens* resulted in the isolation of steroidal alkaloids i.e. holamide and pubescinine. In anaesthetised rats, the holamide and pubescinine caused a fall in blood pressure in a dose-dependent manner. Pretreatment of animals with atropine completely abolished the hypotensive response of acetylcholine; whereas the hypotensive effect of holamide and pubescinine were not modified by atropine. Similarly acetylcholine produced contractile effects in guinea-pig ileum, which was antagonised by atropine, however, both failed to produce any stimulant response on guinea-pig ileum. These data indicate that the steroidal alkaloids from *Holarrhena pubescens* mediated hypotensive response through a mechanism different to that of acetylcholine.

Very early events after inoculation of wheat with *Puccinia triticina*

JJ Appelgryn, B Visser and CD Viljoen

Department of Plant Sciences, University of the Free State, Bloemfontein 9300, South Africa

The very early events of plant/pathogen interaction are currently poorly understood. An attempt was made to identify protein kinases involved in the very early stages of the interaction between *Puccinia recondita* and wheat. Resistant and susceptible wheat plants were infected with leaf rust. To confirm the activation of the defence response, β-1.3-Glucanase activity was determined. An increase in activity took place within twelve hours in both resistant and suscep-

tible infected plants, while the uninfected plants showed a similar pattern but at lower levels. The hydrogen peroxide levels in the plants were also measured to determine the earliest response of the plant to the pathogen. The result was increased levels within nine hours after inoculation in the resistant- and within twelve in the susceptible plants, while the uninfected plants showed no significant increases. Hydrogen peroxidase activity correlated with the hydrogen peroxide levels. RT-PCR was finally used to identify possible kinases involved in this early interaction.

Elaeodendron, biogeography, and the *Elaeodendron* complex (Celastraceae) in Madagascar

RH Archer

National Herbarium, National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa

Elaeodendron has always been confused with the South African *Cassine*. Previous studies have elucidated the clear-cut differences between these unrelated groups. *Elaeodendron* s.str. is a well circumscribed, almost cosmopolitan group of species from Central America, Africa, Indo-China to Fiji. However, four remaining taxa from Madagascar, enumerated in Flora of Madagascar (1946), exhibit strange characters for the genus that need to be elucidated. Without fruit no accurate placement is possible. Preliminary studies have revealed additional distinctive characters indicating that each of these may be placed in its own genus. Recent specimens, mainly by the prolific collector and author, René Capuron, provided valuable fruit material. This gives new insight into this complex of species and new genera; some of these new discoveries fit best in *Elaeodendron*. Capuron unfortunately did not publish on the Celastraceae. This study helps to provide new insight into the phylogeny and biogeography of the Celastraceae.

Biochemistry of Russian wheat aphid (RWA) resistance in wheat: involvement of lipid-like products

JM Berner and AJ van der Westhuizen

Department of Plant Sciences: Botany, University of the Free State, Bloemfontein 9321, South Africa

The biochemical defence mechanisms against the RWA were studied in infested and uninfested susceptible (cv. Tugela) and near isogenic resistant (cv. Tugela DN) wheat. Lipooxygenases (LOX's) and oxygenases with homology to mammalian cyclooxygenase are responsible for the synthesis of lipid-like products in plants. These two enzymes might be important regulators in the defence response against the RWA since their products have been widely implicated in defence reactions. The aim of the study was to investigate the possible involvement of these two enzymes and their products in the RWA resistance mechanism. Enzyme assays and Western blot analyses have shown that that LOX and oxygenases are selectively induced in resistant wheat, supporting their involvement in the resistance mechanism. According to GC/MS analyses a number of lipid-like compounds seem to be implicated in the resistance mechanism. A LOX isoenzyme was identified as a possible biochemical marker for RWA resistance. These findings will further assist in the understanding of the defence mechanism of wheat against the RWA.

Fire vs mammal grazers and the nature of Zululand savannas

WJ Bond, W Stock and S Archibald

Botany Department, University of Cape Town, Private Bag, Rondebosch 7701, South Africa

Fire and mammal grazers are both major consumers of grass but the interaction between them is poorly understood. Using a variety of large mammal exclosures at Hluhluwe and Umfolozi, we show that fires spread through grasslands only when grasses taller than 5cm cover >60% of the area, regardless of fire weather conditions. The white rhino is a key species for producing short grass swards in mesic savannas but smaller grazers, especially impala, are equally effective in arid savannas. The ability of grazers to stop the spread

of fire varies depending on annual rainfall. Historically, elimination of short grass grazers following agricultural settlement in South Africa may have caused shifts to fire-prone tall grasslands but probably only in semi-arid regions.

Somatic seed derived from the zygotic embryos of orthodox Norway spruce seed display recalcitrance

CH Bornman, OSP Dickens and A-M Oberholster
Forestry and Agricultural Biotechnology Institute, University of Pretoria, Pretoria 0002, South Africa

In orthodox seed, such as that of most conifers, the embryo during late maturation enters a resting phase that is coincident with progressive dehydration, leading to the acquisition by the zygotic seed of desiccation tolerance. This dehydrated resting phase is lacking in some if not most conventional somatic embryo cultures *in vitro*. The conifer somatic embryo, derived from the immature zygotic embryo, also lacks this quiescent resting phase. If this phase is not induced experimentally, the embryo undergoes continuous growth, resulting in precocious germination. As with recalcitrant seed, somatic embryos of spruce do not survive drying below the relatively high moisture content of 30%. When encapsulated in a hydrogel to form artificial seed, the mature and partially desiccated somatic embryos rapidly lose viability and are unable to survive protracted storage. Since a recalcitrant seed normally does not survive drying and freezing, somatic embryos will require special technology if they are to be handled as artificial seed.

Phloem loading in grasses — an apoplasmic main event with a slow symplasmic sideshow

CEJ Botha
Botany Department, Rhodes University, Grahamstown 6140, South Africa

Grass leaf phloem is complicated by the presence of both early and late-formed metaphloem, which are distinguished from one another by their position, (thick-walled sieve tubes are spatially associated with the xylem) their wall thickness, as well as the fact that the thick-walled sieve elements lack companion cells. These longitudinal veins are linked via cross veins, which usually only contain one sieve tube and that sieve tube is associated with a companion cell, and is thus classified here as a thin-walled sieve tube. Microinjection and electron microscopy revealed that uptake of symplasmically-transported Lucifer yellow (LYCH), does not occur directly into thin- or thick-walled sieve tubes. Yet, application of the fluorophore, 5,6-carboxyfluorescein diacetate (5,6-CFDA) reveals that there is a slow symplasmic pathway, which involves transfer of cleaved 5,6 carboxyfluorescein, which is effected via plasmodesma. The fluorophore is co-localised with the sieve element companion cell complex (thin-walled sieve tubes). The question is how does 5,6-CF arrive at the phloem? This paper explores the structural and functional avenues available for uptake of fluorophores such as 5,6-CF and their transport to the phloem of grass leaf blade vascular bundles, and demonstrates the existence of an important slow symplasmic loading pathway.

The impact of commercial harvesting on *Warburgia salutaris* (pepper-bark tree) in Mpumalanga, South Africa

J Botha¹, ETF Witkowski¹ and CM Shackleton²
¹ Restoration and Conservation Biology Research Group, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, PO Wits 2050, South Africa
² Environmental Science Programme, Rhodes University, Grahamstown 6140, South Africa

Commercially harvested *Warburgia salutaris* (Bertol.f.) Chiov. (*Canellaceae*) (pepper-bark tree) were compared with populations growing on private land or in protected areas in Mpumalanga and Limpopo Province, South Africa. Basal diameters and stem heights of the former were significantly lower than those occurring on private land or protected areas. *W. salutaris* is usually resilient to high

levels of bark harvesting. In this study, 75% of the stems that had been heavily harvested (>10% of the stem below 2m) were still coppicing. However, individuals affected by regular fires or repeatedly harvested appeared prone to disease and high percentage mortality. Populations growing on private land appeared the most vigorous. Commercially harvested populations could be better managed through improved harvesting techniques, monitoring and control of access. Cultivation levels urgently need to be increased. Further research should be conducted on factors limiting regeneration, including the most appropriate fire regime and landowners should be advised on suitable management strategies.

Flora of the Eastern Cape

CL Bredekamp¹, GF Smith¹ and GJ Bredekamp²
¹ National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa
² Department of Botany, University of Pretoria, Pretoria 0002, South Africa

One of the important goals of the National Botanical Institute is to provide a Flora for southern Africa. A useful approach in achieving this goal is to ultimately compile an incremental series of regional Floras. Building on the success of Floras for the Cape Floristic Kingdom and Northern Provinces, we are now well placed to initiate and collaborate on a Flora for the Eastern Cape. This Flora will be coordinated from the National Herbarium and will involve as many stakeholders and contributors as possible. Guidelines concerning the delimitation, format, contents, taxonomic expertise, possible contributors, herbarium work, field trips and funding of the Flora were compiled by botanists of the four Eastern Cape Universities. Floristic regions within the Eastern Cape were delimited by a TWINSPLAN computer analysis using species of the PRECIS data base per quarter degree square.

The vegetation of Gauteng

GJ Bredekamp¹, F Siebert¹, LR Brown² and GF Smith³
¹ African Vegetation and Plant Diversity Research Centre, Department of Botany, University of Pretoria, Pretoria 0002, South Africa
² Applied Natural Sciences, Technikon South Africa, Private Bag X6, Florida 1710, South Africa
³ National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa

To test the suitability of PRECIS data for vegetation classification, floristic data of 61 quarter degree square grids that represent Gauteng were extracted from the PRECIS data base and imported into the TURBOVEG database. The TWINSPLAN algorithm was applied to the dataset and 10 vegetation types were identified from the results. A vegetation map compiled from the classification was ecologically interpreted in terms of various environmental factors, using GIS data, mainly from the ENPAT data base. From the presence of red data species, conservation hotspots in the province could be identified. The results indicate that grids which had been sufficiently sampled, may be useful to indicate vegetation patterns over an area as large as Gauteng. Some limitations are also discussed.

Anti-inflammatory compounds from Mediterranean medicinal plants using targets from the nuclear factor- κ B pathway

PD Bremner¹, D Rivera² and M Heinrich¹
¹ Centre for Pharmacognosy and Phytotherapy, School of Pharmacy, 29–39 Brunswick Square, London, WC1N 1AX, United Kingdom
² Departamento de Biología Vegetal (Botánica), Facultad de Biología, Universidad de Murcia, Campus de Espinardo, 30100-Murcia, España

NF- κ B is a ubiquitous transcription factor found in mammalian cells and plays a pivotal role in the induction pathways of inflammatory stimuli (e.g. TNF- α , IL-1). The identification of small molecule inhibitors of this pathway is currently under investigation by a team of eight international laboratories funded by the European Union. The approach is to screen ethnobotanically used plants in inflammation and to identify active extracts by employing a series of targeted-molecular based assays. Plants are collected under formal agreements with individuals/organisations in the regions of origin, particularly within the Mediterranean. A total of 200 plant species

and 829 extracts have been screened thus far. 10 extracts have matched the criteria of low toxicity and potent NF- κ B inhibitory activity and a further 10 are of interest. An example to be discussed will be *Helichrysum italicum* subsp. *serotinum* (Lamiaceae), collected in Southern Spain, from which an active acetophenone was isolated following bioassay-guided fractionation.

The vegetation of the Ebenaeser section of the Mountain Zebra National Park, Eastern Cape

LR Brown¹, H Bezuidenhout² and J de Klerk³

¹ Applied Natural Sciences, Technikon SA, Private Bag X6, Florida 1710, South Africa

² Department of Research and Development, South African National Parks, PO Box 110040, Hadison Park, Kimberley 8306, South Africa

³ Mountain Zebra National Park, Private Bag X66, Cradock 5880, South Africa

The long-term conservation of viable ecosystems requires a broader understanding of the ecological processes involved. Because ecosystems react differently to different management practices, it is important that a description and classification of the vegetation of an area be done. As part of a vegetation survey programme for the newly acquired farms to be incorporated into the Mountain Zebra National Park, the vegetation of the farm Ebenaeser was investigated. A hierarchical classification, vegetation map, description and ecological interpretation of the plant communities of the study area are presented. A TWINSPLAN classification, refined by Braun-Blanquet procedures revealed eight distinct plant communities. Habitat factors associated with differences in vegetation include topography, soil form and grazing. Descriptions of the plant communities include diagnostic species as well as prominent and less conspicuous species of the tree, shrub, herb and grass strata.

Chinese medicines against viral infections

PPH But¹, YW Zhang¹, XL Deng¹, SC Ma¹, RW Jiang¹, VEC Ooi¹, KHX Xu¹, SHS Lee² and SF Lee²

¹ Department of Biology and Institute of Chinese Medicine, Chinese University of Hong Kong

² Department of Microbiology and Immunology, Dalhousie University, Halifax, Canada

Chinese medicines, particularly those indicated for anti-febrile and detoxifying functions, have long been used to treat viral infections. To evaluate the value of selected Chinese herbs against herpes simplex virus (HSV), influenza virus (Flu), para-influenza virus (PIV), respiratory syncytial virus (RSV), and hepatic B virus (HBV), we have screened a large number of Chinese herbs and bioactive components from various Chinese herbs. Our results indicated that many Chinese herbs and bioactive components exhibited significant anti-viral properties, e.g. flavonoids from *Scutellaria baicalensis* against RSV and HBV, polysaccharide-lignin complex from *Prunella vulgaris* against HSV-1 and -2 both *in vitro* and *in vivo*, cassane furanoditerpenes from *Caesalpinia minax* against PIV, alkaloids from *Sophora flavescens* against RSV, and glycosides from *Ligustrum robustum* against RSV and flu. The results offer partial support to the traditional use of the herbs in viral infections and potential leads for development of therapeutic agents. Partial support was received from Innovation and Technology Fund and from Research Grants Council, Hong Kong.

Syrian traditional herbal tea 'Zahraa': traditional knowledge and new perspective as a potential source of antioxidant health-promoting phenolics

MD Carmona¹, D Rivera¹, R Llorach¹, C Inocencio¹ and C Obón²

¹ Departamento de Biología Vegetal (Botánica), Facultad de Biología, Universidad de Murcia, Campus de Espinardo, 30100-Murcia, España

² Departamento de Biología Aplicada, EPSO, Universidad Miguel Hernández

The herbal teas called 'Zahraa' are complex mixtures of plants that include leaves and flowers. Usually, these teas are consumed in the family and in the restaurants and cafes of Damascus as a

digestive. The HPLC revealed the presence of both flavonoids and hydroxycinnamic acids (caffeic acid and coumaric acid). In sample 1 caffeic acid derivatives such as chlorogenic acid, different flavones such as luteolin and apigenin, and flavonols such as kaempferol and quercetin are present. In sample 2 the caffeic acid derivatives are the main compounds with flavones such as luteolin derivatives in lower amounts. Samples 3 and 4 are similar to sample 2 with high levels of caffeic acid derivatives and flavones, but with apigenin derivatives (sample 3) and luteolin derivatives (sample 4). Samples 5 and 6 showed high levels of flavonols as kaempferol derivatives and quercetin derivatives. In summary, these results suggest that this herbal tea is a potential source of health promoting antioxidants. Obviously, further studies related with bioavailability, toxicity, etc. are necessary.

A study of the domestication and uses of *Cyperus textilis* in selected districts of the Transkei region of the Eastern Cape Province, South Africa

SG Cawe

Department of Botany, University of Transkei, Private Bag X1, UNITRA 5117, South Africa

Domestication of plants began in response to a variety of environmental impulses and has continued in many parts of the world up to the present. Due to dwindling supplies in the wild, various plants have been the focus of many attempts at domestication in South Africa. *C. textilis* is usually obtained from wild sources but is increasingly being cultivated in small homestead gardens to manufacture a variety of artifacts such as mats and baskets. In this study the distribution of *C. textilis* is examined and the reasons for its domestication explored. The extent to which it is grown and tended is also investigated together with the yields obtained from this exercise. Income from the various artifacts produced is estimated.

Extraction of grape seed to produce a proanthocyanidin rich extract

H Chikoto and JN Eloff

Phytomedicine Programme, Botany Department, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa

Free radicals are implicated in a number of disease processes. A critical balance has to be maintained between the production of free radicals and their elimination. Disease, aging and environmental pollutants disturb this balance by either inhibiting the formation of antioxidants and/or increasing the formation of free radicals. To maintain the required balance in the body, plant antioxidants are widely used and are economically important. We investigated the cost-effective extraction of a by-product of grape-seed oil extraction, which is often discarded using non-toxic extractants. Water-ethanol mixtures were used to examine the effects of agitation, time, temperature during extraction and drying of the extract. The highest mass yield was with 40% ethanol, but 80% ethanol yielded the highest antioxidant activity. Boiling during extraction yielded a higher mass but lowered the antioxidant activity. High temperatures during drying decreased the antioxidant activity of the final product.

Bioactivity guided fractionation of *Sutherlandia frutescens* for the isolation of compounds which induce apoptosis

KA Chinkwo, JJM Meyer, G Scott and DJG Rees

School of Pharmacy, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

Apoptosis is a form of programmed cell death that occurs naturally in cells. The activation of apoptosis can be beneficial to cancer therapy because it eliminates potentially cancerous cells from the body. Cell death occurs by disintegration of cells into membrane-packaged units that are phagocytosed by macrophages. *Sutherlandia frutescens* (kankerbos) is claimed by traditional medicine to have anticancer activity. To validate this claim, we sampled

these plants from different geographical locations to test the ability of extracts from these plants to induce apoptosis in Chinese hamster ovary (CHO), Caski (cervical carcinoma) and Jurkat (T lymphoma) cells. Crude extracts were separated based on polarity, using organic solvents yielding partially fractionated secondary metabolites. We assayed and quantified the induction of apoptosis based on morphological changes; various biochemical assays and flow cytometric analysis. Active fractions were further separated and purified using TLC and HPLC. We have demonstrated that extracts from *Sutherlandia frutescens* have the ability to activate apoptosis in cells and that this bioactivity can be traced during the fractionation of the crude extracts. Our data also demonstrates that this bioactivity varies between different geographical collections which can be linked to geographical variation within this species. We anticipate that some of these compounds may be candidates for anti-cancer drug development.

Interactions between herbivores, grazing lawns and nitrogen cycling in the Hluhluwe-Umfolozi Park

C Coetsee¹, W Stock¹ and NJ van der Merwe²

¹ Department of Botany, University of Cape Town, Cape Town 7701, South Africa

² Department of Archaeology, University of Cape Town, Cape Town 7701, South Africa

Large grazing mammals generate strong direct and indirect feedbacks on plant community and structure. Direct feedbacks occur when ungulates have a direct effect on plant community or structure, e.g. through trampling or grazing. Indirect feedbacks occur when ungulates induce changes in the environment and these changes modify conditions for other organisms above and below-ground. Hluhluwe-Umfolozi Park is characterised by areas of tall, ungrazed bunchgrass interspersed with grazed 'lawns' consisting of short horizontally spreading grasses. A variety of different species of large herbivores concentrate their grazing efforts on these lawns and as a result may possibly alter the spatial pattern of energy and nutrient fluxes (i.e. nitrogen cycling). Total nitrogen and the natural ¹⁵N abundance of grass and soil were examined on and off grazing lawns to investigate the effect of ungulates on nitrogen cycling and the persistence of lawngrass.

Physiological changes in *Lupinus albus* L. associated with variation in rhizosphere CO₂ concentration and cluster-root P mobilisation

MD Cramer¹, MW Shane² and H Lambers²

¹ Botany Department and Institute of Plant Biotechnology, University of Stellenbosch, Private Bag XI, Matieland 7602, South Africa

² School of Plant Biology, Faculty of Natural and Agricultural Sciences, The University of Western Australia, Crawley, WA 6009, Australia

Cluster-roots of *Lupinus albus* mobilise P through exudation of organic acids, the synthesis of which requires anaplerotic non-photosynthetic assimilation of inorganic carbon by PEP-carboxylase. The influence of variation of root-zone CO₂ concentration on P mobilisation by roots was determined in plants grown with 0–1 000 µg g⁻¹ sand FePO₄. At 100 µl l⁻¹ root-zone CO₂ the suppression of cluster-root development was correlated with increasing leaf P. However, both 360 µl l⁻¹ and 6 000 µl l⁻¹ CO₂ suppressed the development of cluster-roots, but only at the highest leaf (P). Decreased phloem-sap P concentrations at enhanced root-zone CO₂ concentrations resulted in decreased phloem translocation of P. The decreased concentration of P in the phloem or some other P-limitation associated systemic signal may have been responsible for increased cluster-root initiation at the enhanced CO₂ concentrations. Decreased photosynthetic CO₂ assimilation and electron transport at elevated root-zone CO₂ concentration may reflect partial dependence of photosynthetic carbon metabolism on root-derived organic acids. Changes in the large phloem concentrations of succinate with varying root-zone CO₂ indicated that shoot-derived organic acid may provide an important source of organic acids for nodule and cluster-root functioning.

The *Pinus patula* plantation: a nursery for natural forest seedlings

Cl Delvaux¹ and CJ Geldenhuys²

¹ Department Plant Production, Laboratory of Tropical and Subtropical Agronomy and Ethnobotany, University of Gent, Belgium

² Forestwood cc, PO Box 228, La Montagne 0184, South Africa

Even if the timber plantation presents many negative ecological impacts, it can catalyse regeneration of natural forest biodiversity and consequently it could be used as a management tool to rehabilitate degraded forest. This study has two objectives: 1) to formulate the hypothesis that the diversity and abundance of forest tree regeneration under a plantation stand adjacent to the Nzimankulu forest (Eastern Cape, South Africa) is enough to help to rehabilitate the natural forest; and 2) to establish different experimental systems for the planting of these seedlings — in gaps inside the forest, on the forest margin and near the rural village. Of the eleven target species, two species (*Cussonia spicata* and *Rhus chirindensis*) are found only in the plantation, three species (*Rapanea melanophloeos*, *Ocotea bullata* and *Kiggelaria africana*) are most frequently found in the plantation and three species (*Zanthoxylum davyi*, *Prunus africana* and *Celtis africana*) grow preferentially in the plantation but also in the forest.

Pharmacological evaluation of anti-inflammatory activity of *Cleome viscosa*

BP Devi, R Boominathan and SC Mandal

Division of Pharmacognosy and Phytochemistry, Department of Pharmaceutical Technology, Faculty of Engineering and Technology, Jadavpur University, Calcutta, India 700 032

Cleome viscosa L. (Capparidaceae) is a pantropical annual, erect herb, having 12 species occurring in India. *Cleome viscosa* which is claimed to possess multiple medicinal properties was screened for its anti-inflammatory activities in experimentally induced inflammation in albino rats. Pretreatment of the animals with methanol extract of *Cleome viscosa* in graded doses of 200mg kg⁻¹ and 400mg kg⁻¹ significantly reduced the inflammation induced in the hind paw by carrageenan, dextran, histamine and cotton pouch granuloma models doses using Diclofenac (20mg kg⁻¹) as a standard drug for comparison. Preliminary phytochemical screening of the extract reveals the presence of flavonoids, triterpenoids, steroids, and tannins. The exact mechanism of action is yet to be elucidated. However, our preliminary studies show positive anti-inflammatory properties of the *Cleome viscosa* extract supporting the use of *Cleome viscosa* species traditionally for the treatment of inflammatory conditions.

The prevention of chilling injury and heat stress in bananas: a preliminary report

B de Villiers and CS Whitehead

Rand Afrikaans University, PO Box 524, Auckland Park 2006, South Africa

Banana fruit are sensitive to temperatures outside of their acclimated range. Due to ineffective storage and faulty handling procedures, cold and heat stress is a universal problem in bananas. Large amounts of fruit are lost due to heat and cold stress. Chilling injury occurs when bananas experience or are stored at temperatures below 13°C, for a few hours to a few days. Temperatures slightly above 30°C may cause extensive heat damage. The prevention of cold and heat stress was investigated by monitoring the effect of short-term heat and cold treatment, controlled and modified atmosphere storage, and treatment with ethylene inhibitors on the ripening of the fruit. To determine changes in ripening the following eight ripening parameters were monitored: yellowing, firmness of the pulp, sugar concentration, starch content, ethylene synthesis and sensitivity, respiration rate, acidity and aroma production. The parameters for normal ripening and the effect of heat treatment are discussed. The time and temperature parameters for heat stress induction have been established.

Natural products with erectile-dysfunction activity from *Eriosema kraussianum*

SE Drewes¹, MM Horn¹, OQ Munro¹, JTB Dhlamini², JJM Meyer³ and NC Rakuambo³

¹ School of Chemical and Physical Sciences, University of Natal, Private Bag X01, Scottsville 3209, Pietermaritzburg, South Africa

² 10 Baverstock Road, Pietermaritzburg 3201, South Africa

³ Department of Botany, University of Pretoria, Pretoria 0002, South Africa

From the rootstock of *Eriosema kraussianum* (Papilionaceae) five new pyrano-isoflavones have been isolated. Their structures were established from proton and ¹³C NMR techniques and X-ray crystallography. Two of the compounds showed activity in the erectile-dysfunction test. The more active of these had an activity of 75% of that found for Viagra. Reference will be made to other plants which fall under the broad term 'u Bangalala'.

Morphology of epicuticular layers of mango fruit

GW du Plooy¹, CF van der Merwe², PJ Robbertse³ and L Korsten¹

¹ Department of Microbiology and Plant Pathology, University of Pretoria, Pretoria 0002, South Africa

² Laboratory for Microscopy and Micro Analysis, University of Pretoria, Pretoria 0002, South Africa

³ Department Plant Production and Soil Science, University of Pretoria, Pretoria 0002, South Africa

The epicuticular layer of mango fruit (Anacardiaceae) (cultivar Keitt) has been investigated using light and scanning electron microscopy (FESEM). This layer involves the cutin and the epicuticular wax, which has at least two distinguishable types of wax crystals. The thick cutin envelopes unevenly formed and spaced epidermal cells and consists of smaller, clearly organised cutin subunits. Through a combination of light microscope and FESEM studies it can be shown that pectin-like substances, confluent with the middle lamellae of the adjacent plant cells, separate these subunits. Mature mango fruit have cavernous lenticels, with the epicuticular layer extending into the lenticel cavity. It appears that development of this layer coincides with lenticel development, with the wax crystals diminishing in quantity and complexity into deeper tissue where there is less exposure to external atmospheric conditions. Commercial wax application completely destroys the integrity of the natural wax layer, thereby creating abnormal physiological conditions leading to aesthetically unacceptable export fruit.

Redressing cultural erosion: how relational databases can help relate ethnobiological knowledge

SE Edwards¹, HDV Prendergast² and M Heinrich¹

¹ Centre for Pharmacognosy and Phytotherapy, School of Pharmacy, University of London, 29/39 Brunswick Square, London WC1N 1AX, United Kingdom

² Centre for Economic Botany, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AE, United Kingdom

This paper will address how a relational database can be used as a repository of traditional and scientific knowledge. Taxonomy is the fundamental basis upon which biological data sits. Ethnobiologists need an understanding of local taxonomic systems and how these relate to the scientific model, and vice versa. Medical Ethnobotany and Ethnopharmacology also require cognition of medical paradigms outside the biomedical model. Relational databases can overcome problems of representing the complexity of biological data within different ontologies. This will be discussed specifically with reference to fieldwork undertaken with the Wik and Kugu Aboriginal peoples of Aurukun, (Queensland, Australia) and the development of the Aurukun Ethnobiology Database. It is hoped that this database will prove to be a useful tool to promote inter-generational transmission of knowledge in Aurukun. In addition, it may facilitate inter-cultural communication and understanding between Wik and Kugu peoples and visiting scientists, thus assisting conservation and land management.

Antibacterial assays of plant extracts by agar diffusion assay may give misleading results

JN Eloff

Phytomedicine Programme, Botany Department, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa

Due to the increasing resistance of bacterial pathogens to commercially used antibiotics and the growing interest in herbal medicine more scientists are investigating antibacterial activity of plant extracts and fractions. There are several methods that are used to determine antibacterial activity. The advantages and disadvantages of methods such as agar diffusion, serial dilution and bioautography will be discussed using data from the literature and our own results indicating that there is hardly any correlation between activity of the same extracts by agar diffusion and serial dilution studies. There is a strong growth in the number of papers reporting on antibacterial activity of plant extracts, but it is practically impossible to evaluate the activity found because many papers do not provide quantitative data. A proposal is made on how results should be presented to enable international comparison of results and identification of plants with potential use by rural communities.

What levels of potentially toxic pyrrolizidine alkaloid containing seed should be allowed in grains in South Africa

JN Eloff¹, FWJ van Rijssen², TW Naude³ and JPJ Joubert⁴

¹ Phytomedicine Programme, Botany Department, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa

² Directorate Food Control, Department of Health, Private Bag X828, Pretoria 0001, South Africa

³ Section Toxicology, Department Paraclinical Sciences, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa

⁴ Division of Toxicology, Onderstepoort Veterinary Institute, Agricultural Research Council, Private Bag X05, Onderstepoort 0110, South Africa

There are major differences in the allowable levels of toxic seeds in agricultural grains between different countries. South African regulatory levels are much stricter than the levels in other countries resulting in possibly unwarranted downgrading of grain. Contamination of grain with seeds of plants containing toxic pyrrolizidine alkaloids [PAs] has caused serious intoxications worldwide. Only some PAs are toxic and there are large differences in toxicity of different species of the same genus. In South Africa, apparently the only serious threat for PA intoxication via grain is from *Crotalaria* species. Information collected from literature and unpublished sources, is used with a number of clearly stated assumptions to calculate the level of PA containing seed to be allowed in grain in South Africa. The level found using the strictest guidelines is less restrictive than presently enforced levels. The assumptions made in this calculation will have to be tested to ensure that the recommendations are scientifically valid.

Dendroclimatology in the Western Cape, South Africa

Z Eshetu and EC February

Department of Botany, University of Cape Town, Private Bag, Rondebosch 7701, South Africa

Despite numerous attempts previous dendrochronological research in South Africa has not successfully resulted in climate reconstruction from tree rings. Moving away from indigenous species the present study concentrated on the introduced European oak, *Quercus robur*. To evaluate the dendrochronological potential of *Quercus robur*, discs from stumps as well as cores from standing trees were collected at Welbedacht in the Cedarberg Mountains and Newlands forest at Cape Town. A 150-year ring width index chronology was developed for both sites. This chronology significantly correlates with monthly precipitation for February, April and August and with maximum temperature for September and October. This is the first tree ring chronology for South Africa to correlate significantly with climate suggesting that it is possible to use this species to reconstruct both rainfall and temperature back in time.

Combretastatin B5 isolated from *Combretum woodii* leaves has substantial antibacterial activity

J Famakin, JN Eloff and DRP Katerere

Phytomedicine Programme, Botany Department, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa

Preliminary screening indicated that *Combretum woodii* had substantial antibacterial activity. Several extractants were tested to determine if any preferentially extracted antibacterial compounds and acetone was selected as extractant. Extracts were simplified by solvent-solvent extraction. Bioautography indicated two major antibacterial compounds. These compounds had a reddish-brown colour after TLC and staining. The chloroform soluble fraction had the highest activity and was fractionated by open column silica gel column chromatography. The antibacterial compound was isolated and characterised by NMR and MS. It was Combretastatin B5 previously isolated from *C. kraussii* seed. Related combretastatins isolated from *C. caffrum* roots are important anticancer agents currently undergoing clinical trials. Combretastatin B5 had significant antibacterial activity against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Enterococcus faecalis* and slight activity against *Escherichia coli*. The MIC value for *S. aureus* was 16 µg ml⁻¹, which compares favourably to the MIC values of 80 µg ml⁻¹ and 160 µg ml⁻¹ for ampicillin and chloramphenicol respectively.

The importance of different water sources to the endangered Clanwilliam cedar, *Widdringtonia cedarbergensis*

EC February¹, RJ Newton¹ and AG West²

¹ Department of Botany, University of Cape Town, Private Bag, Rondebosch 7701, South Africa

² Department of Biology, University of Utah, 257 South 1400 East Salt Lake City, UT 84112, United States of America

Widdringtonia cedarbergensis is an endangered species entirely restricted to an altitudinal range between 800m and 1400m in the Cedarberg Mountains of the Western Cape Province. This study is an attempt to gain a better understanding of the water use of this species. The belief is that the spatial and temporal distribution of different water supplies combined with protection from fire, as in the degree of rockiness of the landscape, are the key variables that both directly and indirectly influence the demographic behaviour of the species. Three different methods are used to determine the physiological responses of *W. cedarbergensis* to available water. The results indicate that cedars are not water stressed at any time of the year. Rather, they are using a deep water source independent of both stream and rain. Therefore, it is probably fire rather than water supply that dictates the distribution of this species in the landscape.

Can oxygen isotopes from wood elucidate weather patterns of the past?

EC February¹, RJ Newton¹ and AG West²

¹ Department of Botany, University of Cape Town, Private Bag, Rondebosch 7701, South Africa

² Department of Biology, University of Utah, 257 South 1400 East Salt Lake City, UT 84112, United States of America

The Cedarberg Mountains are situated approximately 200km north of Cape Town on the west coast of South Africa. *Widdringtonia cedarbergensis* is a rare and endangered tree endemic to these mountains. Hydrogen and oxygen isotope analysis of the water extracted from twigs of six of these trees on a monthly basis are comparable with isotopic values for rainfall for that month. Very negative oxygen isotope values for February and March 2000 in both twigs and rain can be related to cyclones Eline and Gloria occurring on the east coast of South Africa. This suggests that oxygen isotope values of the wood from well-dated rings of trees from the Cedarberg may be used to plot cyclonic events in KwaZulu-Natal and Mozambique.

How serious is bark harvesting for traditional medicine from the Umzimkulu forests?

CJ Geldenhuys

Forestwood cc, PO Box 228, La Montagne 0184, South Africa

Commercial bark harvesting for traditional medicine seriously affects the status of forests and species. An inventory was done in 13 forests in the Umzimkulu District, Eastern Cape, using 388 plots of 400m² along 37 transects. A total of 7281 stems were recorded, and 6.1% of these were harvested. Bark was removed from 36 of the 95 tree species recorded. *Ocotea bullata* represented 47.1% of the bark-stripped species, with some bark removed from 57.4% of its 359 stems on 133 plots (on average 32% of bark on the main bole removed). Some trees were stripped to a height of 12m, and others were felled, without utilising the bark or timber. The percentage of bark removed around the stem (ring-barking) had a greater effect on crown condition decline than percentage of total bark removed from the stem. The results provided useful guidelines for sustainable bark harvesting with tree survival.

A comparison of sampling techniques for wetlands with emphasis on releve size

J Gerber and GJ Bredekamp

Department of Botany, University of Pretoria, Pretoria 0002, South Africa

Several sizes of releve were used to sample a wetland on the grounds of the Sagewood School, Midrand. Random 10m X 10m relevés, which are commonly used in floristic surveys, were found to be suitable for determining species composition, but were too coarse for the determination of communities. 5m X 5m relevés also tended to overlap between communities. Random 1m² tended to miss species but did not result in differing communities on a close gradient being accidentally combined. 1m² relevés along a transect were found include some mixed relevés at intersections between communities, but consequently gave a good indication of relationships between adjacent communities. The sharp gradients between communities in many wetlands preclude the use of many common sampling techniques, such as 10m X 10m relevés, and these, when used on wetlands, should not be used to attempt to classify wetlands beyond very broad definitions such as pans or vleis.

Antitussive activity of *Abies webbiana* Lindl (Fam. Pinaceae) leaf with immense potentiality of *A. webbiana*

AK Ghosh¹, T Sen², SP Vishnoi³ and T Jha³

¹ Gupta College of Technological Sciences, Ashram More, GT Road, Asansol-713301, West Bengal, India

² East India Pharmaceutical Works, Kolkata, West Bengal, India

³ Natural Science Laboratory, Division of Pharmaceutical Chemistry, Department of Pharmaceutical Technology, Jadavpur University, Kolkata-700032, West Bengal, India

A. webbiana leaf is used as a drug against rheumatism, conception, glycaemia, chronic bronchitis, etc. in Indian ethnomedicine. Very recently the antitussive activity of a methanol extract of the leaves of *A. webbiana* has been established. Considering the high cost of methanol the antitussive activity of an aqueous extract of leaves of this plant was evaluated and gave very satisfactory results in mice. The experiment was conducted as described by Miyagoshi *et al.* (1986). Phosphate-buffer extract (pH 7.4) was selected for the experiment as that showed maximum percentage of extractive value at 51.0% (w/w). Phosphate-buffer extracts showed antitussive activity in a dose dependent manner when compared to control and standard groups. Not only antitussive activity but also other activities such as anti-tumour, anti-inflammatory, analgesic etc. have been established. Due to its anti-tumour activity and possession of taxine (an alkaloid) the plant may be considered an important one for the next decades.

Ethnopharmacological evaluation of the antihypertensive, antispasmodic and bronchodilator activities of *Carum copticum* seeds

AH Gilani, Q Jabeen, MN Ghayur, F Khimani and SA Saeed

Department of Biological and Biomedical Sciences, The Aga Khan University, Karachi-74800, Pakistan

Carum copticum locally known as 'Ajowan' is a grassy plant, which grows abundantly in south Asia. The small, brownish seeds of the plant are traditionally used in hypertension, abdominal colic, diarrhoea and asthma. This study describes the pharmacological basis for the use of the plant in such disorders. Blood pressure was measured through carotid cannulation of anaesthetised rats and isolated tissue preparations such as rabbit aorta and jejunum, guinea-pig atria and trachea were set up separately in 10ml tissue baths containing the respective physiological salt solution. The aqueous-methanol extract lowered blood pressure (3–30mg kg⁻¹) as well as causing inhibition of spontaneous or K⁺-induced contractions (0.1–1.0mg ml⁻¹). It also shifted dose-response curves of Ca²⁺ to the right suggestive of Ca²⁺ channel blockade (CCB). Activity-directed fractionation revealed that the CCB activity is concentrated in the petroleum fraction. The presence of CCBs in this plant may explain some of the traditional uses of the plant.

Some perspectives on tropical African resource plants: ornamentals

HF Glen and GF Smith

National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa

The PRECIS-cult database was established in 1992. From it, we extracted a checklist which is compared with the list of species with primary and secondary uses as ornamentals generated by PROTA. We examined alternative layouts for a PROTA publication on ornamentals, considering the needs of potential users, who are not only in Africa but throughout the tropics and subtropics. The history of African ornamentals shows that if new taxa are taken into the trade, there must be a mechanism to return benefit to their countries of origin. A brief survey showed a concentration of taxonomic expertise in southern and east Africa, and a general lack of horticultural power in the continent. Actions needed to combat problems with both taxonomic and horticultural expertise are outlined, and some successes already achieved are noted. Finally, we consider steps that need to be taken to convert PROTA's plans for CG: ornamentals into reality.

The chemotaxonomy and biological activity of *Salvia stenophylla* and related species

A Gono-Bwalya¹, AM Viljoen¹ and T De Castro²

¹ Department of Pharmacy and Pharmacology, University of the Witwatersrand, Faculty of Health Sciences, 7 York Road, Parktown 2193, South Africa

² De Castro and Brits Ecology Consultants, PO Box 2145, Cresta 2118, South Africa

Salvia stenophylla Burch. (Lamiaceae) is closely related to *Salvia runcinata* L. f. and *Salvia repens* Burch. with which it forms a species complex. Plant extracts of these taxa are traditionally used to treat urticaria, body sores and stomach ailments. The first objective of this study was to clearly delimit the species complex using chemical characters. Based on traditional uses and the commercial interest in α -bisabolol (an anti-inflammatory compound contained in *S. stenophylla*), a scientific rationale was established for the traditional use by documenting the antimicrobial and anti-inflammatory properties. The study was based on material collected from 22 natural populations. Essential oil and phenolic extracts were subjected to TLC, GC, GC/MS and HPLC analyses accordingly. GC/MS results displayed different chemical profiles for each population. The compound in highest concentration is α -bisabolol (20%) for *S. stenophylla*, α -bisabolol (35%) and ledol (24%) for *S. repens* and E-nerolidol (42%) for *S. runcinata*. Some *S. runcinata* populations however, accumulated 39% α -bisabolol and 26% guaiol. The essential oils exhibited anti-inflammatory activity (COX-2) while phenolic

extracts showed more antimicrobial activity especially for *S. stenophylla*.

Authenticating bark medicines used in South African traditional healthcare: back to basics

OM Grace¹, HDV Prendergast², J van Staden¹ and AK Jäger³

¹ Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

² Centre for Economic Botany, Royal Botanic Gardens, Kew, Surrey TW9 3AB, United Kingdom

³ Department of Medicinal Chemistry, Royal Danish School of Pharmacy, Universitetsparken 2, 2100 Copenhagen O, Denmark

South African traditional healthcare relies heavily upon bark medicines, but difficulties of identification affect their appropriate use. The need for techniques with which to authenticate bark medicines arises from the scenario of inappropriate administration and a lack of standardised authentication protocols. Authentication could be applied in toxicity cases, and facilitate accurate documentation and monitoring of taxa traded. In our preliminary investigation of authenticating barks, Thin Layer Chromatography was considered as a simple, affordable and repeatable technique to yield phytochemical 'fingerprints' whereby eight species' bark, and their medicinal products, could be diagnosed. The technique proved useful in confirming the relationship of bark extracts from a single species, but less so in distinguishing between species. Encouraging results were indicated by authentication experiments. TLC shows potential as a simple yet reliable tool for authenticating medicinal bark products used in South Africa.

Extent of honey bee pollination in the northern parts of Kruger National Park

A Grobler and MW Van Rooyen

Department of Botany, University of Pretoria, Pretoria 0002, South Africa

The detail floristic study of the Punda Maria–Pafuri region (Van Rooyen 1978) of the Kruger National Park is used to determine the extent and distribution of honey bee pollinated plants in the region. The seasonal variation in availability of honeybee forage is also estimated. Roughly one third of all the species in the publication are visited by honeybees. Many of the dominant or semi-dominant species are among the honey bee pollinated species. The percentage area covered by honey bee pollinated plants, is therefore relatively large in relation to the amount of species pollinated by honeybees.

Biological activities of *Aloe excelsa*

M Gundidza¹ and ML Magwa²

¹ Department of Pharmacy, Faculty of Medicine, University of Zimbabwe, PO Box MP 167, Mount Pleasant, Zimbabwe

² Botany Department and Electron Microscope Unit, Faculty of Science, University of Fort Hare, Private Bag X1314, Alice 5700, South Africa

Aloe excelsa is a tree aloe found mainly in the eastern, western and southern parts of Zimbabwe and the north-eastern parts of South Africa and elsewhere in Africa. Traditional healers use it to treat wounds, burns, stomach problems, sick chickens, and other various ailments. The juice was extracted by cutting leaves of the aloe diagonally and letting the juice ooze out into steel containers. The juice was then filtered to remove debris followed by freeze-drying to obtain a bright yellow powder. Guided by the indigenous knowledge systems, and using conventional methods of biological testing for laxative, wound healing, anti-asthmatic, anti-diabetic and tonic activities, *Aloe excelsa* powder exhibited very significant activities against constipation, asthma, diabetes as well as maintaining the ideal tonicity of the body. It was also found that *Aloe excelsa* powder is not toxic when taken in the 0.3–0.7g concentration range. From these studies, *Aloe excelsa* is currently used by practitioners as one of the most important natural remedies in the treatment of HIV/AIDS since it reduces fungal, parasitic and bacterial loads in the gut and blood especially when combined with other treatment regi-

mens. *Aloe excelsa* powder is certainly a very useful product in maintaining general body health.

Biological activity of a few *Plectranthus* species

P Gurlal¹, F Khan², MD Laing¹ and SE Drewes²

¹ School of Applied Environmental Sciences, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

² School of Chemical and Physical Sciences, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

The genus *Plectranthus* L'Herit belongs to the Sage family (Lamiaceae), known for their aromatic and herbal properties. With the knowledge that antibacterial terpenes and flavonoids have been found in *Plectranthus* species, this study was undertaken to screen as many indigenous *Plectranthus* species as were available, and to identify the level of antifungal and antibacterial activity present in the crude extracts. Two solvents were used for extractions, dichloromethane, which is relatively non-polar and therefore suitable for plant extracts containing terpenes, and hexane, which is non-polar. Nine identified *Plectranthus* spp. were screened *in vitro* by the agar-well diffusion bioassay. Activity was compared between species and between varieties within a species by measuring the zones of inhibition. *Bacillus subtilis* B69 (Gram-positive), *Xanthomonas campestris* (Gram-negative), *Candida* spp., *Fusarium oxysporum*, *Pythium ultimum*, *Rhizoctonia solani* and *Sclerotinia sclerotiorum* were used in the screening tests. Many of the extracts exhibited excellent antifungal and antibacterial activity. Extracts of *P. fruticosus* and *P. ecklonii* were effective antifungal agents but exhibited poor antibacterial activity. The crude hexane extract of *Plectranthus hadiensis* proved to be more effective at inhibiting pathogens such as *Xanthomonas* and *Sclerotinia* than the dichloromethane extract. Hexane was used initially for extraction, and dichloromethane used for the second extraction of the same plant. It was deduced that more activity was observed from the hexane extract as it contained more compounds. Three pure compounds, identified as terpenes, were also extracted from *P. hadiensis* and exhibited almost the same amount of biological activity as the crude extracts. *Plectranthus purpuratus* subsp. *purpuratus* and *Plectranthus purpuratus* subsp. *tongaensis* were also screened and produced similar levels of inhibition. Both these extracts inhibited *Rhizoctonia*, *Fusarium* and *Sclerotinia*, showing zones of inhibition ranging from 9mm to 20mm. However, no inhibition zones were produced with *Pythium* and *Xanthomonas*. These screening results indicate that members of the genus *Plectranthus* do possess antifungal and antibacterial activity.

Ectomycorrhizal fungal diversity in South Africa

GL Hawley¹, AFS Taylor² and JF Dames¹

¹ Department of Botany, Rhodes University, Grahamstown 6140, South Africa

² Department of Forest Mycology and Pathology, Swedish University of Agricultural Sciences, Uppsala, Sweden

Fungi have played an important role in the history of mankind as a source of nutrition, medicine and religious beliefs but also as agents of disease. In central Africa, tree species and their related ectomycorrhizal (ECM) fungi have been studied to a considerable degree. However, ECM surveys and collections in South Africa are essentially nonexistent. Little is known about ECM fungal species occurring in South Africa and research in this area is needed. South Africa has an 'imported' ECM fungal flora that was introduced along with the *Pinus* and *Eucalyptus* spp. over the last century. These species are cultivated on a large scale in the Sabie, Mpumalanga province and other forestry regions in the country. Current management practices may have significant impacts on the mycorrhizal communities, potentially influencing human utilisation of fungi. Recent collections show the ECM flora to have a predominantly European origin. Many species have ethnobotanical uses in their countries of origin.

Gene expression in thermoinhibited *Tagetes minuta* L. (Khakibos) achenes

PN Hills and J van Staden

Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

Tagetes minuta is a useful model plant for examining the molecular biology of seed germination, as its achenes become thermoinhibited at temperatures above 35°C. Unlike thermodormancy, thermoinhibition is immediately released when the temperature is reduced below the threshold, without the need for any other treatment. Once the temperature has fallen below the 35°C threshold, the achenes germinate rapidly, with radicle emergence in some achenes occurring after only 4h. Comparative two-dimensional polyacrylamide gel electrophoresis (2D-PAGE) studies of thermoinhibited and germinating achenes have shown that ten polypeptides are expressed specifically in thermoinhibited achenes. The expression of these polypeptides is very tightly linked to the imposition and release of the thermoinhibited state. Using differential display of mRNA, a number of differences have also been detected in the mRNA pools of thermoinhibited and germinating achenes. Several cDNA fragments specific to thermoinhibited achenes have been isolated and cloned. These results suggest that differential gene expression could be involved in the control of thermoinhibition in *T. minuta*.

Studies on Far Eastern plants used to alleviate symptoms of old age

PJ Houghton, MJR Howes, MH Oh and Y Ren

Pharmacognosy Research Laboratories, Department of Pharmacy, King's College London, London SE1 9NN, United Kingdom

Four species of plants and three of animals used in Chinese and Korean medicine for relieving symptoms of ageing, such as memory loss, were tested for choline esterase inhibitory activity using the modified Ellman reaction, using their methanolic or acetone extracts. Inhibition of this enzyme results in elevated levels of acetylcholine in the CNS, considered to improve memory. Three of the plant samples and all the animal extracts gave a significant inhibitory activity at concentrations of 0.25µg ml⁻¹. Bioassay-guided fractionation of Dan-Shen (*Salvia miltiorrhiza* roots) resulted in the isolation of three tanshinone terpenes as the major active constituents. No terpenes have been previously reported as having choline esterase inhibitory properties.

In vitro approaches to the study of plants used traditionally for wound healing

PJ Houghton, J Sampson and AY Mensah

Pharmacognosy Research Laboratories, Department of Pharmacy, King's College London, London SE1 9NN, United Kingdom

Wounds are a common health problem, especially in societies and communities where hospital services are not easily available. A large number of plants have a reputation of helping wounds to heal but *in vivo* tests to investigate these claims present difficulties. Since wound-healing is a complicated process, a battery of *in vitro* tests is necessary to detect activities that may be relevant. Tests for antimicrobial activity, fibroblast stimulation, antioxidant properties, cytoprotection against reactive oxygen species and anti-inflammatory properties have been used to investigate aqueous extracts of leaves and flowers of *Buddleja* species which are used in several different cultures to treat wounds. Phenolic compounds were found to be responsible for a strong antioxidant effect whilst anti-inflammatory activity was shown by several compounds including the diterpene crocetin. The extract also had a weak stimulant effect on fibroblast growth.

Enhancing HIV/AIDS support therapy with indigenous herbal preparations — a clinic experience

A Hutchings

Department of Botany, University of Zululand, Private Bag X101, Kwa-Dlangezwa 3886, South Africa

In 1997 a clinic was started at Ngwelezane Hospital, with the objectives of providing support and clinical care as well as identifying affordable effective management protocols for people living with HIV/AIDS. In 1999 the author was invited to collaborate in the management of patients on the basis of observed effects of two creams she has developed. The remedies also include freshly harvested plant material, an adaptogenic tonic and two other supplements developed by Dr Nigel Gericke of PhytoNova for the relief of opportunistic complications. Patients are regularly monitored and documented effects include frequent gains in weight, appetite and energy levels, improvements in respiratory and skin conditions, relief from pain and improved quality of life. The treatment regimes have been adopted in a local hospice and in some home-based care procedures. Issues of safety, efficacy and accessibility are discussed. Medicinal plants featured are *Artemisia afra*, *Bulbine* species, *Centella asiatica*, *Lippia javanica*, *Siphonochilus aethiopicus*, *Sutherlandia frutescens* and *Warburgia salutaris*.

Local Food as an issue for sustainable development in SE Spain

C Inocencio¹, D Rivera¹, C Obón², A Verde³ and M Heinrich⁴

¹ Departamento de Biología Vegetal (Botánica), Facultad de Biología, Universidad de Murcia, Campus de Espinardo, 30100-Murcia, Spain

² Departamento de Biología Aplicada, EPSO, Universidad Miguel Hernandez, Campus de Orihuela, Alicante, Spain

³ Instituto de Estudios Albacetenses, Albacete, Spain

⁴ Centre for Pharmacognosy and Phytotherapy, School of Pharmacy, 29–39 Brunswick Square, London, WC1N 1AX, United Kingdom

Local wild food and synanthropic weeds (the latter are known, in Mexico as *quelites*, and in south-eastern Spain as *ensala del campo* and *camarojas*) are extremely interesting sources of minor known food. It is important to distinguish scarce esteemed wildfood (*collejas*, *esparragos*, *macucas* etc.) from less preferred food, famine food or seasonal hunger food. These highly esteemed foods are promising in terms of prospective domestication and cultivation. Also many synanthropics associated with spring cereal dry farming or local groves (*camarojas*, *ensala del campo* etc.) are interesting as future crop plants and sources of income for sustainable development in rural areas (mountains and local 'huertas'). A paradigmatic approach is given by the recent development of exploitation of wild mushrooms (fungi) and cultivation in caves of domesticated species in Murcia, south-eastern Spain. These local foods are of great importance and these *niscalos*, *colmenillas* etc. are collect for restaurants making them, for example, an alternative new feature for the tourist industry.

Folk medicinal uses and chemical constituents of melastomataceous plants

JH Isaza Martínez^{1,2}

¹ Department of Botany, University of Pretoria, Pretoria 0002, South Africa

² Grupo Polifenoles UTP, Escuela de Química, Facultad de Tecnología, Universidad Tecnológica de Pereira, La Julita AA 097, Pereria, Colombia

The Melastomataceae (Jussieu, 1789) is the seventh largest family of flowering plants (166 genera, 4 200–4 500 species), belongs to the Order Myrtales and is pantropically distributed. Owing to the size of this family, the internal classification has been reviewed several times. Melastomataceous plants have been long used as traditional medicines for diarrhea, dysentery, leucorrhoea, scrofula, hemorrhoids, dermatitis, leprosy, scabies, athlete's food, snakebites, post parturient abdominal pains, various skin diseases, respiratory illnesses, malaria, bladder calculus and other genito-urinary ailments, as well as febrifuge, diuretic, purgative, refreshment, astringents or haemostatic. Some triperthenoids, alkyl benzoquinones, flavonoids, flavonoid glycosides and acyl glycosides have been isolated. All

anthocyanins from melastomataceous plants are malvidin glycosides or acylglycosides. The mayor constituents belong to hydrolyzable tannins ranging from monomers to pentamers and also C-glycosidic ellagitannins and complex tannins. Some of these constituents have been tested for ichthyotoxicity, anticancer, antiviral, antioxidant, anti-complement, enzymatic inhibition and antitumor promoting activity.

Involvement of culture atmosphere parameters in the process of hyperhydricity during micropropagation of *Aloe polyphylla*

MV Ivanova, AV Ramarosandratana and J van Staden

Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

Hyperhydricity or vitrification is a physiological abnormality frequently affecting plants propagated *in vitro*. This phenomenon causes significant losses to the micropropagation industry because of poor survival of plants when they are transferred from tissue culture to the *ex vitro* environment. Two components of the culture conditions are associated with vitrification: the physical and chemical state of the medium and the culture atmosphere, in particular water vapor, CO₂ and ethylene in the gaseous phase. Attempts at modifying the atmosphere in the tissue culture container were investigated. The effect of the following factors on the culture atmosphere and subsequent hyperhydricity were tested: number of explants in the container, different closure mechanisms of the container, providing differences in gas exchange and water evaporation. An attempt to modify the relative humidity of the outer environment that is interrelated with the culture container environment was done. To evaluate the effect of ethylene on hyperhydricity ethephon was used in various concentrations.

Exploring the flora and vegetation of the Maputo Elephant and Licuati Forest Reserves, Mozambique

S Izidine^{1,2}, AE van Wyk², SJ Siebert^{2,3}, and JE Burrows⁴

¹ Department of Botany, National Institute for Agronomic Research, PO Box 3658, Maputo, Mozambique

² Department of Botany, University of Pretoria, Pretoria 0002, South Africa

³ SABONET, Private Bag X101, Pretoria 0001, South Africa

⁴ Buffelskloof Private Nature Reserve, PO Box 710, Lydenburg 1120, South Africa

One of the activities of the Southern African Botanical Diversity Network (SABONET) is to undertake collaborative plant collecting expeditions to under-collected parts of Centres of Plant Diversity in the region. During November/December 2001 an expedition took place along the northern dune cordons of the renowned Maputaland Centre of Endemism. Collecting was centred south of Maputo, Mozambique, in the Maputo Elephant (MER) and Licuati Forest (LFR) Reserves. These reserves harbour many Maputaland endemics and are well located to conserve the biodiversity of the Maputaland coastal plain, with the MER covering the Dune Forest, Grassland and Wetland of the more recent coastal dune system and the LFR covering various types of Sand Forest on the more ancient inland dunes. Of particular significance is the presence in southern Mozambique of extensive stands of a unique vegetation type for which the name Licuati Sand Thicket is proposed. This paper reports on the progress made towards developing an inventory of the flora of these two reserves, as well as highlighting aspects relating to the plant diversity, endemism, vegetation types and phytogeography of the Maputaland Centre. Opportunities for further collaborative research on the flora and vegetation of the MER and LFR are proposed.

Traditional preparations for bacterial infections — do they work?

AK Jäger

Pharmacognosy, Department of Medicinal Chemistry, School of Pharmacy, 2 Universitysparken, 2100 Copenhagen O, Denmark

Traditional healers worldwide prepare medicines as aqueous

decoctions and infusions. When scientists investigate medicinal plants they often extract the material with a series of solvents of differing polarity. When testing for antibacterial activity the aqueous extracts frequently do not exhibit activity, whereas the more lipophilic extracts are active. Decoctions and infusions of well-known South African medicinal plants (*Artemisia afra*, *Alepidea amatymbica*, *Acorus calamus*, *Jatropha zeyheri*, *Pentanisia prunelloides*, *Tetradenia riparia*, *Warburgia salutaris*) were prepared according to published recipes. All remedies were indicated against infectious diseases. Aqueous extracts were standardised to 4mg ml⁻¹. One daily dose of the aqueous extract was partitioned onto ethyl acetate. The ethyl acetate fractions were taken to dryness and redissolved at 8mg ml⁻¹ in DMSO. The extracts were tested in the MIC microtitre plate assay against *S. aureus* (ATCC 6538) and *B. subtilis* (ATCC 6633). The aqueous extracts had no activity at the concentrations tested. Some of the ethyl acetate extracts showed antibacterial activity. In order to evaluate whether the activity would have medical relevance, the MIC was compared to the amount of dry matter content in one daily dose. In this way it seems unlikely that the extracts would have any effect.

Patenting life? Why not!

C Kahn

Adams and Adams, PO Box 1014, Pretoria 0001, South Africa

Interaction between the intellectual property system and protection of the environment has been the subject of increasing international debate. This debate is fueled by perceptions of inconsistency between the TRIPS Agreement and the Convention on Biological Diversity. For example, the relationship between intellectual property rights and the environment is seen by some as providing a mechanism which may lead to the exploitation and degradation of the environment. There are many advantages to strong intellectual property protection as it promotes innovation resulting in beneficial inventions having various spin-off effects both socially and commercially. Indigenous and local communities are increasingly looking to the intellectual property system to enhance control over their culture, biological resources and traditional knowledge, and to benefit from intellectual property protection. There is a growing wave of concern about the so-called 'Patenting of Life' and the pros and cons thereof are discussed.

Preliminary insights into the population age structure of tree *Euphorbia* species in the Eastern Cape

AI Kamineth, EE Campbell and RM Cowling

Terrestrial Ecology Research Unit, Department of Botany, University of Port Elizabeth, PO Box 1600, Port Elizabeth 6000, South Africa

Tree *Euphorbia* species are useful as indicators of herbivore impacts in Succulent Thicket as plants are unable to sprout after disturbance. We are studying the population age structure of *Euphorbia triangularis*, *E. tetragona* and *E. grandidens* between the Gamtoos and Kei Rivers. Individuals were sampled along transects including steep slopes, flats and near rivers, under three different megaherbivore impact regimes: no impact; historical megaherbivore and contemporary megaherbivore impacted sites. Population structure of unimpacted sites showed a typical J-shaped curve, indicative of continuous recruitment. Historical megaherbivore impacted sites showed a bimodal pattern: the typical J-shaped curve occurs at low ages but there is also a cohort of individuals of c. 150–200 years old. We interpret the latter to be individuals that persisted after the extirpation of megaherbivores. At contemporary megaherbivore impacted sites, a straight curve (equal numbers of individuals in each age class) was observed along the older size classes. This study offers important insights regarding the impacts of megaherbivores on Succulent Thicket ecosystem.

Validation of ethnoveterinary remedies for the control of ticks affecting livestock in arid and semi-arid lands (ASALs) of Kenya

DP Kariuki¹, J Wanyama², L Mpoke²

¹ PO Box 942, Sarit Centre 00606, Nairobi, Kenya

² Intermediate Technology Development Group-Eastern Africa, PO Box 39493, Nairobi, Kenya

For people living in arid and semi-arid parts of Kenya, livestock is a source of food security and capital investment. Since diseases are major constraints to livestock security, the pastoralists have traditionally relied on traditional animal healthcare practices otherwise called ethnoveterinary knowledge (EVK) to take care of their animals. There are, however, few reports of participatory validation of EVK in the literature. Three remedies, *Nicotium tubacum* (tombaco) mixed with *Solanum incanum* (sodom apple), *Psiadia punctata* (Labaai in Samburu) mixed with *Aloe secundiflora* (aloe) and *Olea hochstetteri* (African olive tree) were validated using participatory techniques with the Samburu community. The three remedies were found to be effective against the commonly found ticks in the area. By day seven after application of *Aloe secundiflora* mixed with *Psiadia punctata* or *Olea hochstetteri* mixed with *Cordia purpurea*, (Lkigeriai in Samburu) the tick population on the animal had been reduced to zero. The two remedies also seem to have a residual effect of ten days. As the trial was done with the participation of the community, this has motivated the community to investigate other combinations of the remedies. The also gained confidence to use the remedies and got the impetus to conserve the medicinal plants within the community.

Antibacterial and antioxidant activity of *Sutherlandia frutescens*

DRP Katerere and JN Eloff

Phytomedicine Programme, Botany Department, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa

Sutherlandia frutescens (Fabaceae) is a popular phytomedicine in South Africa recommended for management of HIV/AIDS and cancer. Its anti-cancer and anti-viral properties have been attributed to L-canavanine, a non-protein α -amino acid. There are no published reports of antimicrobial and antioxidant activity. We set out to investigate its possible activity in this regard. A sample of the commercial product (*Sutherlandia*, unwele) was extracted serially with hexane, dichloromethane, acetone and ethylacetate. All the extracts except the acetone fraction inhibited *S. aureus* substantially. The hexane extract was the most active. It also showed two active components, while the other extracts showed a single one each on bioautography. Antioxidant activity measured by DPPH was of slow onset. It was more substantial in the acetone, dichloromethane and ethylacetate extracts. The hexane extract had no activity. The antibacterial activity of *S. frutescens* offers possible new uses in the treatment of wounds, and rationale for its use in topical formulations.

Chalcone dimers from *Combretum albopunctatum*

DRP Katerere¹, AI Gray², RJ Nash³ and RD Waigh²

¹ Phytomedicine Programme, Botany Department, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa

² Department of Pharmaceutical Sciences, Strathclyde Institute for Biomedical Sciences, University of Strathclyde, 27 Taylor Street, Glasgow G4 0NR, Scotland, United Kingdom

³ Molecular Nature Ltd, IGER, Plas Goggerdan, Aberystwyth, Dyfed SY23 3EB, Wales, United Kingdom

As part of a phytochemical and pharmacological survey of African Combretaceae, the leaves and fruit of *C. albopunctatum*, a thicket forming shrub growing in southern Africa were collected from Zimbabwe, extracted with dichloromethane (DCM) and fractionated by size-exclusion chromatography (SEC) and HPLC. Three flavonoids were isolated by SEC on sephadex LH-20™, and two chalcone cyclobutane dimers by HPLC. The structures of the phenolics were determined by NMR and MS. X-ray crystallography was

also useful in determining the relative stereochemistry of the dimers which are reported here for the first time. The dimers showed little biological activity in the antibacterial assays performed. It is interesting, however, to speculate on their possible biosynthesis and their biogenetic significance.

Molecular systematics of the genus *Carpobrotus* (Aizoaceae)

A Khunou^{1,2}, G Reeves¹ and F Weitz²

¹ Compton Herbarium, Kirstenbosch Research Centre, Newlands, Cape Town 7700, South Africa

² Department of Botany, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

Species of *Carpobrotus* (Aizoaceae) are widely spread throughout South Africa and are commonly used for their medicinal properties. The genus consists of 13 species of which seven occur in South Africa, five in Australia and one in Chile. *Carpobrotus* has been placed within the largest subfamily of Aizoaceae, the Ruschiodeae, and within this subfamily it falls under the *Lampranthus* group. A number of investigations on South African species have demonstrated that some of the *Carpobrotus* species have anti-microbial activity. This study involved a molecular phylogenetic reconstruction of all *Carpobrotus* taxa based upon AFLP methodology to elucidate species level relationships within the genus to understand the evolution of anti-microbial activities. AFLP studies have also been carried out to determine the genetic variability within and among populations of two South African species namely *C. edulis* and *C. acinaciformis*. It is anticipated that applying this technique to *Carpobrotus* will help to resolve conflict surrounding species boundaries and will lead to an overall better understanding of the South African species with relation to their taxonomy and biogeography.

Designing proteinase inhibitors for banana weevil control

A Kiggundu^{1,2}, KJ Kunert², A Viljoen³, M Pillay⁴ and CS Gold⁴

¹ National Banana Research Programme, Kawanda Agricultural Research Institute, PO Box 7065, Kampala, Uganda

² Forestry and Agricultural Biotechnology Institute and Department of Botany, University of Pretoria, 74 Lunnon Road, Hillcrest, Pretoria 0002, South Africa

³ Forestry and Agricultural Biotechnology Institute and Department of Microbiology and Plant Pathology, University of Pretoria, 74 Lunnon Road, Hillcrest, Pretoria 0002, South Africa

⁴ International Institute of Tropical Agriculture, East and Southern Africa Regional Center, PO Box 7878, Kampala, Uganda

An attractive strategy to control the banana weevil (*Cosmopolites sordidus*), an important pest of bananas, is the development of pest-resistant banana and plantain cultivars using genetic engineering. Among the genes available for bioengineering are proteinase inhibitors, which, if expressed in bananas, could improve their resistance to the banana weevil. However, any strategy targeting the use of a gene coding for an inhibitor should ideally include a design program for optimising inhibitor action against the target enzyme. So far we have established the presence of cysteine proteinase activity with pH optima ranging from 5.0 to 6.5 in the banana weevil midgut. Midgut cysteine proteinase activity was further effectively inhibited by the cysteine specific inhibitor L-trans-epoxysuccinylleucylamido (4-guanidino) butane (E-64) and purified recombinant oryzacystatin I (OCI-I). We are currently following an evolutionary approach to design oryzacystatin I using site-directed mutagenesis and computer-based protein design for optimal inhibition of the weevil gut cysteine proteinase. This will then be tested in weevil feeding experiments. Ultimately, our goal is to produce genetically enhanced banana plants expressing a cysteine proteinase inhibitor designed for optimal activity against banana weevils.

Systematic conservation planning for the City of Cape Town: development of methods to integrate C-PLAN with spatially explicit mechanisms for planning conservation networks

RS Knight¹ and G Benn²

¹ Department of Botany, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

² Geographical Information Management Systems, PO Box 1286, Milnerfontein 7435, South Africa

No other major city of the world has the responsibility for conserving as much, as unique or as globally significant biodiversity as that of the City of Cape Town, but it is also a rapidly growing city in terms of human population and economic development. In order to balance conservation and development the City has had to develop conservation-planning protocols that are especially rigorous. The most commonly used techniques for conservation planning is C-Plan which was used in the CAPE (Conservation Action, People and the Environment) project. C-Plan is based on the concept of identifying the minimum areas that meet specific and pre-defined targets and uses a series of iterative techniques to achieve a solution. While this is efficient with respect to non-spatial data it does not take into account the spatial arrangements required to safe guard ecosystem processes. We propose a mechanism of spatial modelling to address this issue and to complement C-Plan.

Antibacterial compounds present in *Terminalia sericea* leaves heal bacterial infections on rats

JP Kruger, JN Eloff and DRP Katerere

Phytomedicine Programme, Botany Department, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa

In vitro studies indicated that *Terminalia sericea* leaf extracts have substantial antibacterial activity. An antibacterial pentacyclic triterpenoid was isolated by bioassay-guided fractionation after selective extraction, solvent-solvent fractionation and silica gel column chromatography. Four superficial *Staphylococcus aureus* scarifications were made on the back of the same rat. The lesions were treated with preparations containing the pure compound, a crude acetone extract of *Terminalia sericea* leaves, gentamycin and no active compound. A method of evaluation was developed by comparing the size of the lesion, the exudate formed and the erythema on a daily basis. The preparation containing the crude extract and the pentacyclic triterpenoid proved to be better than the positive control [gentamycin] and negative control on the individual parameters as well as on the combined results. The results indicate that the antibacterial activity of *T. sericea* leaves cannot be ascribed only to tannins as has been postulated.

Early events in the activation of defense responses in *Arabidopsis* when treated with different chemical activators

S Lategan, B Visser and AJ van der Westhuizen

Department of Plant Science, University of the Free State, Bloemfontein 9300, South Africa

The involvement of *At-RLK3*, a putative receptor-like protein kinase (RLK) from *Arabidopsis thaliana*, was analysed in response to treatment with various chemical activators. These activators included benzothiadiazole (BTH), salicylic acid (SA), acetylsalicylic acid (ASA) and 2,6-dichloroisonicotinic acid (INA). The activation of defense responses was detected by means of activity and expression on protein level of β -1,3-glucanases. Once that was established, the earliest initiation of defense responses was determined using hydrogen peroxide levels. The results indicated that the different potential activators induced unique responses. Hydrogen peroxide levels varied between treatments, acting as a marker of the activation of early defense recognition. The possible involvement of the *At-RLK3* in the perception of the signals during early recognition was analysed by Northern Blot analyses, using the *At-RLK3* gene as a probe.

Spatial variability in the size and growth rate of *Azorella selago* Hook. (Apiaceae) on sub-Antarctic Marion Island: phytometric implications

PC le Roux and MA McGeoch

Department of Conservation Ecology, University of Stellenbosch, Matieland 7602, South Africa

Azorella selago is a long-lived, cushion-forming plant, dominating sub-Antarctic fellfield vegetation. This species has been used as a phytometer for estimating landscape age. However, the accuracy of such estimates depend on at least two assumptions being met: 1) size-independent growth rate, 2) comparative insensitivity of growth rate to fine-scale environmental conditions. We tested these assumptions by measuring cushions across Marion Island. Growth rate varied independently of cushion size, although fine-scale variability in cushion characteristics was high and there were significant between-site differences. Cushion size was consistently influenced by nearest-neighbour characteristics, and there was some evidence that epiphyte load and altitude were also important. However, at least 65% of the variability in cushion characteristics remained unexplained. Therefore, while the assumptions for the use of *A. selago* as a phytometer were largely met, the accuracy of the method is highly dependent on a sound understanding of factors influencing growth rate.

The physiology of sprouting and its ecological implications in savanna woodland dynamics

M Ligavha¹, WD Stock² and WJ Bond²

¹ Botany Department, University of Venda, Private Bag X5050, Thohoyandou 0950, South Africa

² Botany Department, University of Cape Town, Private Bag, Rondebosch 7701, South Africa

We investigated whether root/lignotuber/stem reserves are significantly mobilised to support regrowth after cutting/burning above-ground biomass at different frequencies. Frequency of disturbance generally did not have any negative significant effect on the vigour of resprouting of the four tree species that were studied at Nylsvley Research Station. The role of plant organs on root starch allocation was also investigated. We also studied the effect of season of cut/burn on the regrowth of the above-ground biomass. Generally plants that were cut had no difficulty recovering within a 'reasonable' period of time. After the first cut in November/December 1998 species of *Acacia karroo*, *Burkea africana*, *Dichrostachys cinerea* and *Terminalia sericea* were found to recover vigorously within a period of one month. Only 1% of *A. karroo* growing on marshy clayey areas did not recover after a six-month period. We also investigated the relationship between bark thickness and trunk diameter of all four species. Bark thickness was generally found to increase with tree trunk diameter.

Preliminary screening of *Cenchrus ciliaris* for biological activity and the isolation of a compound showing antibacterial activity

ME Light¹, KL Lindsey¹, LJ McGaw¹, SG Sparg¹, DA Mulholland², AK Jager¹ and J van Staden¹

¹ Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

² Natural Products Research Group, School of Pure and Applied Chemistry, University of Natal, Durban 4041, South Africa

Cenchrus ciliaris L. (Poaceae), is a commonly occurring perennial grass in South Africa. In Zulu traditional medicine the underground stolons are used for ailments including 'body pain', menstrual disorders and urinary infections. Water, ethanol and ethyl acetate extracts were prepared from the underground and leaf material of *C. ciliaris* plants. The extracts were screened for anti-inflammatory activity, antibacterial, anthelmintic and antischistosomal activity. The ethanol and ethyl acetate extracts exhibited activity in the COX-1 and COX-2 assays, and against the Gram-positive and Gram-negative bacteria tested. Low levels of anthelmintic activ-

ity were observed against *Caenorhabditis elegans* and no activity was detected in the antischistosomal assay. A bulk hexane extract of the underground material was fractionated with vacuum liquid chromatography and the antibacterial activity confirmed with a bioautographic assay. One of the active fractions was purified using TLC and an antibacterial compound in the fraction identified by ¹H-NMR and GC-MS as palmitic acid.

First attempt to assess vegetation change along a section of the Sabie River after the 2000 flood

R Lorist, F Siebert and MW van Rooyen

Botany Department, University of Pretoria, Pretoria 0002, South Africa

The 2000 flood was reported as the largest in living memory by many observers. Regular tourists to the Kruger National Park (KNP) will recall dense riparian forest along the Sabie River prior to the catastrophic event in February 2000, which left the area desolated. Questions on natural vegetation rehabilitation are, however, still unanswered. Vegetation data recorded by Bredenkamp and Van Rooyen (1991) were therefore compared with a 2002 data set to provide evidence of revegetation. Results showed that there is a remarkable shift in plant species composition, especially in the herbaceous layer. Exotic, pioneer forbs were the first to fill the open niche, but are currently making space for an indigenous forb and graminoid component. Even in the woody stratum, pioneer forest species such as *Trema orientalis* are frequent. The regeneration of the riparian forest trees is still uncertain, since few juveniles were recorded during 2002. *Bretonadia salicina* is one of the success stories, probably due to its potential to establish on exposed bedrock.

Antimicrobial activity of bulbous plant leaf extracts to control postharvest and foodborne diseases

CAM Louw, T Regnier and L Korsten

Department of Microbiology and Plant Pathology, University of Pretoria, Pretoria 0002, South Africa

Microbial infections can lead to substantial losses and be the causal agents of diseases in the food and fresh produce industry. Due to factors such as microbial resistance and food safety issues, chemical applications are restricted, increasing demands for alternative and natural solutions for disease management. Our study involved leaf extracts of four medicinal bulbous plants commonly used by traditional healers against infectious diseases. Four genera of the families Amaryllidaceae and Hyacinthaceae were investigated to determine their antimicrobial effects on postharvest and foodborne pathogens. All extracts showed *in vitro* antibacterial and/or antifungal activity, evident as inhibition zones around wells with plant extracts. Stronger effects were observed against plant pathogenic bacteria compared to human pathogens. The positive antimicrobial results found in the investigation can indicate sustainable use of leaf extracts, since harvest of leaves can ensure conservation of these plants, of which some are endangered by overexploitation.

Discovery of a distinctive new dioecious genus of Cunoniaceae from New Caledonia

PP Lowry II^{1,2}, G McPherson¹, P Sweeney³ and J Bradford^{1,4}

¹ Missouri Botanical Garden, St. Louis, Missouri, United States of America

² Muséum National d'Histoire Naturelle, Paris, France

³ University of Missouri-St. Louis, United States of America

⁴ University of California, Davis, California, United States of America

While conducting field work in unexplored parts of the SW Pacific island of New Caledonia in April–May 2002, we discovered a male and a female individual of a highly anomalous tree whose morphological features did not appear to correspond to those of any known member of the island's flora. Comparison of the flowering and fruiting specimens with available herbarium material suggested possible affinities with Sapindales (e.g. Anacardiaceae, Burseraceae, Sapindaceae, Simaroubaceae) or Cunoniaceae/Brunelliaceae (Oxalidales), but the plant could not be referred unambiguously to

any of these families much less to one of their currently recognised genera. An analysis using *trnL-trnF* and *rbcL* molecular sequence data clearly shows that our plant belongs to the Gondwanan family Cunoniaceae, within which it comprises a distinctive new genus. Our new plant shares many features with other Cunoniaceae, but differs in having a unicarpellate ovary, an asymmetrical drupaceous fruit and oily endosperm; it is also dioecious, a condition previously recorded in only a few other genera of the family. The discovery of a previously unrecorded genus in the botanically rich territory of New Caledonia (c. 3 300 vascular plant species, ~79% endemic; c. 765 genera, 14% endemic) underscores the need for continued exploration.

Development of a GIS system for the management of the Breede River Catchment with specific emphasis to alien plant removal

J Loza and RS Knight

University of the Western Cape, Botany Department, Private Bag X17, Bellville 7535, South Africa

★ **Awarded Van Staden Prize for best oral presentation by an MSc student**

The Breede River catchment is situated in the Western Cape and extends over 12 600km². The aim of this project was to investigate the potential impacts of the alien plant removal programme in the Breede River Catchment. Using colour aerial photos, aliens along the rivers of each selected area of the Breede River catchment were estimated. Black and white historical orthophotos (ranging from 1949 to 1998) of key areas were acquired. Data from these were compared to alien plant data of the colour aerials for possible changes. The time series of the areas was done using AVHRR data (1km NDVI's). Data from these NDVI's was managed in MapInfo. At the end of the project we aim to acquire information pertaining to the changes in the geomorphology of the catchment and the amount of aliens along the river in each area. Finally, all data will be compared to data of previous orthophotos of the area.

Does population genetics of *Barleria saxatilis* suggest that selfing mechanisms enable fitness benefit in perennial species with short distance dispersal?

TM Makholela¹, FH van der Bank² and K Balkwill¹

¹ School of Animal, Plant and Environmental Science, University of the Witwatersrand, Private Bag 3, Johannesburg 2050, South Africa

² Department of Zoology, Rand Afrikaans University, PO Box 524, Auckland Park 2006, South Africa

Genetic variability in *Barleria argillicola* and *B. greenii*, two sympatric and endemic species restricted to Estcourt in KwaZulu-Natal, was compared with *B. saxatilis*, a closely related widespread species inhabiting dry hot areas in KwaZulu-Natal, Mpumalanga, Limpopo and Swaziland bushveld. Three populations from each species were sampled for electrophoretically detectable diversity. In contrast to expectations based on similar surveys in other plants, the widespread species showed reduced within-population gene diversity with respect to its endemic congeners. This is hypothesized to be a result of the existence of a selfing mechanism, such as cleistogamy and agamospermy, enabling establishment in new suitable sites through reproductive assurance.

Application of transgenic technology towards improved thapsigargin production by *Thapsia garganica* L.

NP Makunga¹, AK Jäger² and J van Staden¹

¹ Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

² Department of Medicinal Chemistry, Royal Danish School of Pharmacy, Universitetsparken 2, 2100 Copenhagen O, Denmark

Thapsigargins isolated from fruits and roots of the umbelliferous plant, *Thapsia garganica*, induce apoptosis of TSU-Pr1 prostatic cancer lines. Transgenic hairy root cultures of *T. garganica* would provide an alternative genetically improved thapsigargin source. Our research has produced an efficient *in vitro* regeneration proto-

col for propagation of *T. garganica* as a prerequisite for gene transfer. We investigated an effective transformation method and biolistics-assisted *Agrobacterium* transformation appears to be most efficient for the introduction of the *rol* genes into *T. garganica* plantlets. Transient expression of marker genes and PCR analysis indicated successful transgene delivery into putative transformants. However, it would appear that this plant is recalcitrant with regard to stable genetic transformation with the Ri genes. Limiting factors that may prove to be a barrier in the expression of the Ri T-DNA, including the inactivation or loss of transgenes due to gene silencing or somatic genome rearrangement events, are discussed.

Effect of *Asparagus racemosus* root extract on swimming performance in mice

SC Mandal¹, BP Devi¹ and S Panda²

¹ Division of Pharmacognosy and Phytochemistry, Department of Pharmaceutical Technology, Faculty of Engineering and Technology, Jadavpur University, Calcutta 700 032, India

² Department of Botany, Charu Chandra College, Calcutta University, Calcutta 700029, India

Asparagus racemosus Willd. (Liliaceae) commonly known as satmul (Bengali) and shatavari (Hindi and Sanskrit) is a climbing under-shrub found all over India. All parts of this plant are used by the Indian traditional (Ayurved and Unani) system of medicine for the treatment of various human ailments. Since some of the indications seem to be related to CNS depressant and/or anti-stress activity, the effects of the methanol extract of *Asparagus racemosus* on swimming performance in mice were investigated. The effect of a methanol extract, obtained from the roots of *Asparagus racemosus*, on mouse swimming performance were studied using graded doses. On the basis of our findings a high dose (200mg kg⁻¹, i.p.) of the extract of *Asparagus racemosus* increased the swimming time suggesting a central nervous system stimulant and/or anti-stress activity. The effect produced by the extract was comparable to that of desipramine, an antidepressant drug.

Indigenous knowledge on the utilisation of local trees and grasses: vernacular terms and descriptions used by villagers to evaluate different effects of feed resources on livestock performance

TP Manganyi¹, NM Mollel¹ and LR Ndlovu^{1,2}

¹ School of Agricultural and Environmental Sciences, University of the North, Sovenga 0727, South Africa

² National University of Science and Technology, Ascot, Bulawayo, Zimbabwe

Mechanisms used by farmers to cope effectively with fluctuations in the quality and quantity of feed resources are quite substantial. An investigation using a semi-structured questionnaire guide was conducted to elicit basic information about the utilisation of natural resources, collect vernacular terms and descriptions used by villagers. Groups of farmers from eight villages were asked to name major grasses/trees found in their areas and rank them. Farmers were then asked to describe each grass/tree ranked in terms of its use and effects. Farmers differentiated between grasses/trees on the basis of effects on animal appearance, quantity and appearance of dung, animal productivity, lack of debilitating effects and effects on appetite in addition to therapeutic functions. Consistency of the use of grass/tree names and descriptive terms across the villages was very high. Villagers had detailed knowledge on the utilisation of fodder resources.

Antibacterial, antifungal and antituberculosis activity of *Pelargonium reniforme* and *P. sidoides*

SPN Mativandlela, N Lall and JJM Meyer

Department of Botany, University of Pretoria, Pretoria 0002, South Africa

The antibacterial, antifungal and antituberculosis activities of acetone and ethanol extracts of *Pelargonium reniforme* and *P. sidoides* were investigated. These plant species are used in folk medicine as *Umckaloabo* by the South African native population to treat colds, bronchitis and infection of the lungs including tuberculosis. Acetone

and ethanol extracts of the roots of plants were evaluated against three Gram-positive bacteria, one fungal species (*Fusarium oxysporum*) and *Mycobacterium tuberculosis*. Extracts were tested at concentrations of 0.5, 1.0 and 5.0 mg ml⁻¹. Acetone and ethanol extracts of *P. reniforme* and only the ethanol extract of *P. sidoides* inhibited the growth of the fungal pathogen at 5.0 mg ml⁻¹. Acetone and ethanol extracts of *P. reniforme* showed good activity against *M. tuberculosis* at a concentration of 5.0 mg ml⁻¹. Extracts of *P. sidoides* showed no inhibitory activity against *M. tuberculosis* at the highest concentration tested.

A survey of heavy metal accumulation in irrigation water, soil and vegetables of the Philippi area of the Cape Flats

M Meerkotter¹, J Aalbers¹, LM Raitt¹ and B Cook²

¹ Department of Botany, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

² Physical Sciences Department, Peninsula Technikon, Private Bag 1960, Bellville 7535, South Africa

Heavy metal consumption and subsequent accumulation in the human body has been suspected of leading to the development of different illnesses and cancers. Heavy metal contamination of agricultural land has become a global concern. As Philippi's vegetable farms are major suppliers to Cape Town, it is important to monitor the presence of heavy metals in this area. Past research has shown contamination of soils and underground waters of the Cape Flats. Samples were collected in summer and winter of 2000. Concentrations of Ca, Cd, Cr, Co, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Se, V and Zn were determined in soil, water and vegetable samples from 40 sites. Through linear regression the relationship between the different elements in the three sample types was established. Correlations between the accumulation of various elements in vegetables was examined. Spatial representation of soil and water data identified areas of concern.

What and where are the sources of 'new, ornamental plants'?

L Middleton

Department of Botany, University of Pretoria, Pretoria 0002, South Africa

As consumers, we often see new introductions in the ornamental plant market. With the growing interest in new ornamentals the world over, there is also a constantly growing list of criteria for the evaluation and acceptance of new plants in the market. It is surprising to see that the introduction of new species from the wild is rare, and some authors in fact argue that only relatively few species with exploitable commercial potential remain in the wild. So then, where do all these 'new' plants actually come from? The majority of new plants introduced into the ornamental plant market could be new cultivars; the re-introduction of old known but forgotten plants; plants that went out of fashion, and are trendy again; known plants with a new application and used in a new situation; under utilised plants being newly promoted and stepping up the marketing campaign; plants well known to botanists and plant enthusiasts but unknown to the public; well known plants only becoming available after long periods of experimentation; mutations occurring spontaneously in nature, and of course, new plants from the wild.

Comparison of leaf structure of commercially important *Aloe* species and *Bulbine frutescens*

N Mngoma¹, B-E van Wyk¹, PM Tilney¹ and FR van Heerden²

¹ Department of Botany, Rand Afrikaans University, PO Box 524, Auckland Park 2006, South Africa

² Department of Chemistry and Biochemistry, Rand Afrikaans University, PO Box 524, Auckland Park 2006, South Africa

The leaves of the four commercially important *Aloe* species and *B. frutescens* were compared at different developmental stages with special emphasis on the secretory cells. The species studied showed uniformity in their basic leaf structure. In transverse sec-

tions both leaf surfaces were similar in each species. The mesophyll consists of an outer firm region and an inner soft region. The outer mesophyll of *B. frutescens* is unique in having 1–3 layers of unusual arm-palisade cells. Aloi cells are regularly associated with vascular bundles at the junction of the two regions. In *A. arborescens*, *A. ferox* and *A. marlothii* crystal bundles were observed. In longitudinal section the aloi cells of the young leaves are brick-shaped. Lysis of the cell contents occurs and the transverse walls disintegrate resulting in the fusion of aloi cells to form long, tubular canals. *Bulbine frutescens* has narrower, longer aloi-like cells but nothing is known about the substances produced in these cells. The inner mesophyll cells are large in *A. arborescens*, *A. vera* and *B. frutescens*. This can be partly related to the amount of gel solids.

Pectins as sources of endogenous suppressors of disease resistance mechanisms

BM Moerschbacher, B Graefner, M Mierau, N Wiethöler and J Moldenhauer

Department of Plant Biochemistry and Biotechnology, University of Münster, Germany

Wheat plants possessing the Sr5-gene for stem rust resistance exhibit a typical hypersensitive reaction (HR) upon fungal penetration. In the absence of the pathogen, HR can be induced in healthy intact wheat leaves by the application of a range of biotic elicitors. However, these elicitors induce HR in both resistant and susceptible wheat plants. Pectic fragments produced during host cell wall penetration can act as endogenous suppressors negating the action of the elicitors. We have hypothesised that differences in the methyl ester distribution of the pectins from resistant and susceptible wheat plants may be responsible for the different outcomes of the host-pathogen interactions. We have now compared isolated pectins from two pairs of near-isogenic wheat lines using immunological, chemical, and enzymatic methods. We find that the pectin methyl esters show a blockwise distribution in the susceptible cultivars but are randomly distributed in the resistant, Sr5-bearing near-isogenic lines of these cultivars.

Resistance mechanisms in sunflower induced by rust infection and benzothiadiazole

L Mohase, AJ van der Westhuizen and ZA Pretorius

Department of Plant Sciences, Botany, University of the Free State, PO Box 339, Bloemfontein 9300, South Africa

The effect of sunflower rust (*Puccinia helianthi*) infection on the defence related reactions in susceptible (S37–388) and resistant (PhRR3) sunflower lines was investigated. Rust infection selectively induced the activities of apoplastic pathogenesis related (PR) proteins, β -1,3-glucanase and chitinase, in the resistant plants. Furthermore, rust infection selectively induced the accumulation of the signalling molecule, salicylic acid, which accumulated concomitant to phenylalanine ammonia-lyase activity. Possible signalling events such as the induction of lipoxygenase activity and the production of active oxygen species also occurred selectively in the resistant plants during rust infection. NADPH oxidase, superoxide dismutase as well as peroxidase activities and the level of hydrogen peroxide increased more in the resistant than susceptible plants. In addition, treatment of susceptible plants with benzothiadiazole, the functional analogue of salicylic acid, induced β -1,3-glucanase activity and reduced disease severity in otherwise susceptible plants.

The efficacy of compounds isolated from *Petalidium oblongifolium* against *Cowdria ruminantium*

PW Mokwala and JJM Meyer

Department of Botany, University of Pretoria, Pretoria 0002, South Africa

Petalidium oblongifolium (Acanthaceae) is a herb that is widely distributed in the northern provinces of South Africa, Botswana and Namibia. It is eaten by both livestock and wild animals. It is often claimed that livestock thrives in areas where the plant occurs because of its medicinal properties. The crude extract of the plant

showed antibacterial activity against *Cowdria ruminantium* — the causative agent of heartwater (a disease of domesticated and wild ruminants). Subsequently two bioactive compounds were isolated from the plant. The MIC's of Compounds A and B against *C. ruminantium* are 1 µg ml⁻¹ and 5 µg ml⁻¹ respectively. The structures of the two compounds are being elucidated.

Endod (*Phytolacca dodecandra*) for schistosomiasis control in Zimbabwe

P Molgaard

Royal Danish School of Pharmacy, Denmark

This project aims to facilitate control of the intermediate snail hosts for the widespread, tropical disease schistosomiasis by means of the saponin rich berries of the endod plant, *Phytolacca dodecandra*. Schistosomiasis control is an integrated combination of medical treatment, safe water supply and sanitation, health education, and snail control. Although the cost of medical treatment has dropped recently, application of locally grown endod berries is still an attractive alternative to synthetic molluscicides. The project is carried out as a low cost–low technology programme in northern Zimbabwe as a collaboration between Danish and Zimbabwean institutions. As it has been questioned how much impact the application of endod has on the environment, we have emphasised the persistence of the active compounds and have been able to show that they are readily decomposed. Our latest investigations concern community participation in the project as a locally based self-help programme. The presentation will highlight the present knowledge in an attempt to encourage more groups to make use of the endod berries for schistosomiasis control.

The involvement of reactive oxygen species in the resistance response of wheat to the Russian wheat aphid

MJ Moloj, and AJ van der Westhuizen

Department of Plant Sciences, Botany, University of the Free State, Bloemfontein 9300, South Africa

The effect of Russian wheat aphid (RWA), (*Diuraphis noxia*, Mordvilko) infestation on the activities of the reactive oxygen species generating and scavenging enzymes as well as the hydrogen peroxide concentration were studied in resistant (cv. *Tugela DN*) and near isogenic susceptible (cv. *Tugela*) wheat cultivars. Infestation resulted in an early (6–9h after infestation) induction of the activities of the reactive oxygen species generating enzymes, NADPH oxidase and superoxide dismutase, in the resistant cultivar only. These increased enzyme activities correlated with increased hydrogen peroxide production in the resistant cultivar. The activities of the reactive oxygen species scavenging enzymes, glutathione reductase and ascorbate peroxidase, were induced somewhat later (12h after infestation) in the resistant cultivar only. Results suggest the early involvement of reactive oxygen species and relevant generating and scavenging enzymes in the resistance response of wheat to the RWA.

Generic relationships between African genistoid legumes

A Moteete and B-E van Wyk

Department of Botany, Rand Afrikaans University, PO Box 524, Auckland Park 2006, Johannesburg, South Africa

Taxonomic relationships amongst five mainly African genera *Adenocarpus*, *Argyrolobium*, *Dichilus*, *Melolobium* and *Polhillia* and the more cosmopolitan *Lupinus* of the tribe Genisteae (Fabaceae) have been studied, using morphological, chromosomal, chemical and DNA sequence data (nuclear ITS and *rbcl*). All the genera share a bilabiate calyx having a trifid lower lip. Hypothetical evolutionary relationships are presented in the form of cladograms. The topology resulting from morphological (including chromosomal) data suggests that *Dichilus* is sister to the other genera of the group, and

that *Melolobium* is sister to two other clades (*Adenocarpus-Lupinus* and *Argyrolobium-Polhillia*). Both morphological and chemical data indicate a sister group relationship between *Polhillia* and *Argyrolobium* and between *Adenocarpus* and *Lupinus*. The ITS and *rbcl* trees are not fully resolved but are congruent with the morphological tree.

Gas exchange and leaf traits of selected species on a Fynbos-Renosterveld-Karoo ecotone

N Motete, B Kgope and GF Midgley

Kirstenbosch Research Centre, National Botanical Institute, Private Bag X7, Claremont 7735, Cape Town, South Africa

Plant functional traits such as photosynthetic capacity, dark respiration rate and quantum yield may be useful in predicting vegetation response to stress and disturbance regimes. Stress tolerance and vegetation recovery subsequent to disturbance depends on the ability of species to adapt their form and physiology *in situ*, over a variety of climatic and environmental conditions. Fire plays a significant role in Fynbos vegetation, while drought is a common disturbance in Karoo vegetation. Fynbos-Renosterveld-Karoo ecotones contain a wide variety of vegetation types and physical gradients of moisture and temperature. Our study site at Jonaskop represents an altitudinal gradient of 1 000m to 1 700m above sea level, with a diverse flora representing a wide range of leaf form. Hence the site provides an opportunity to study *in situ* (i) how gas exchange traits co-vary with leaf form along the altitudinal gradient, and (ii) whether there is a consistent pattern of variation between gas exchange traits along the Fynbos-Renosterveld-Karoo ecotone which might shed light on the main factors controlling plant success under this wide range of conditions.

Screening of Mozambican medicinal plants for antibacterial activity

SF Mujovo¹, MT Mphahlele², B Fourie², N Lall¹ and JJM Meyer¹

¹ Department of Botany, University of Pretoria, Pretoria 0002, South Africa

² South African Medical Research Council, Private Bag X385, Pretoria 0002, South Africa

Twenty two plant extracts of species selected through an ethnobotanical survey in Mozambique were investigated by the agar diffusion method for their *in vitro* antibacterial activity against five Gram-positive and five Gram-negative bacterial species. Extracts were tested at concentrations ranging from 0.5–5.0mg ml⁻¹. Several of the extracts showed activity against Gram-positive bacteria at a MIC of 0.5mg ml⁻¹. Only *Adenia gummifera* and *Momordica balsamina* extracts were found to have activity against Gram-negative bacteria, at a MIC of 5.0mg ml⁻¹. Ten plants (*Cassia abbreviata*, *Epaltes gariapina*, *Gladiolus* sp., *Hemizygia bractea*, *Hoslundia opposita*, *Lippia javanica*, *Melia azedarach*, *Salvadora australis*, *Rhoicissus tomentosa* and 'Xivurai') were also tested against *Mycobacterium tuberculosis* (H37Rv strain) at concentrations ranging from 0.5–5.0mg ml⁻¹ using the BACTEC radiometric method. The MIC of four plants was found to be 0.5mg ml⁻¹ and the remaining six ranged from 1.0–2.5mg ml⁻¹.

Bioactive metabolites from higher plants in Botswana

J Mutanyatta¹, DD Shushu² and BM Abegaz¹

¹ Department of Chemistry, University of Botswana, Private Bag 704, Gaborone, Botswana

² Department of Biological Sciences, University of Botswana, Private Bag 704, Gaborone, Botswana

This presentation will focus on the identification, propagation, chemical fingerprinting and phytochemical investigation of medicinal plants sold in traditional markets in Botswana. Taxonomic specimens were obtained from plants grown in our garden/green house by conventional or micropropagation techniques of the materials purchased from the vendors. Plants belonging to the families of Hyacinthaceae and Asphodelaceae have been investigated. Examples include *Scilla*, *Ledebouria* and *Bulbine* species. Many

novel secondary metabolites have been characterised including homoisoflavonoids, flavonoids, stilbenes, xanthenes and anthraquinones. In the case of *L. graminifolia* the secondary metabolite profiles of wild species and bulbs generated via tissue culture were compared. The cytotoxic, antioxidant and antiplasmodial properties of these compounds will be presented.

Effects of coal dust on photosynthesis of selected species in Richards Bay

G Naidoo and D Chirkoot

University of Durban-Westville, Private Bag X54001, Durban 4000, South Africa

In this study, we tested the hypothesis that coal dust adversely affects photosynthetic performance of *Avicennia marina* (Forssk.) Vierh., the dominant mangrove species in Richards Bay harbour. Photosynthetic performance was determined on eight to 10 trees by measuring carbon dioxide uptake and chlorophyll fluorescence parameters during spring and neap tides, at low and high elevation sites and on upper and lower leaf surfaces that were covered or uncovered with coal dust. Coal dust significantly reduced carbon dioxide exchange of upper and lower leaf surfaces by 17% to 39%, the reduction being generally greater on the lower leaf surface that is covered by a dense mat of trichomes and salt glands. The reduction in carbon dioxide exchange by coal dust was higher at the high elevation site that supported isolated dwarfed trees. The chlorophyll fluorescence data indicated that leaves coated with dust exhibited significantly lower photosystem II (PS II) quantum yield, lower electron transport rate (ETR) through PSII and reduced quantum efficiency of PSII (F_vF_m).

Increasing the quality and shelf life of tomatoes

N Niemann

Department of Botany, Rand Afrikaans University, PO Box 524, Auckland Park 2006, Johannesburg, South Africa

Tomatoes (*Lycopersicon esculentum* cv. Santa) are climacteric fruit that continue the ripening process after they have been harvested. Once the fruit are separated from the plant, the physiological reactions that control the ripening process are altered, so that tomato quality is altered. The earlier the time of harvest, the larger the discrepancy between the tomatoes left to ripen on the plant and a tomato that was harvested. Quality is lost as the tomatoes lose moisture, firmness, nutrients and stored energy. This presentation will concentrate on the application of different post harvest treatments that influence the life span of the tomatoes. Certain physiological processes such as respiration, transpiration, ethylene synthesis and -binding will be analysed to see what effect the treatments had on the post harvest ripening process. The effect of treatments such as hormonal manipulation (ethylene and MCP), temperature (heat shock, chilling injury, heat shock treatment and ideal storage temperature) and controlled atmosphere will also be discussed.

Phytogeography of *Lessertia* DC. (Fabaceae, Galegeae)

T Nkonki¹ and B-E van Wyk²

¹ National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa

² Department of Botany, Rand Afrikaans University, PO Box 524, Auckland Park 2006, South Africa

The genus *Lessertia* DC. is subendemic to Southern Africa. More than 30 species occur in the Western, Northern and Eastern Cape Provinces of South Africa, about 15 species are found in the summer rainfall regions of southern Africa and a few extend into tropical South and East Africa. The aim of this paper is to present the distribution of *Lessertia*, and to analyse its geographical distribution in relation to currently defined phytogeographic units. Geographical distribution maps were compiled from herbarium specimen labels and hence known geographical distribution for all of the taxa is presented for the first time.

Investigation of commonly used herbal medicines for antibacterial activity

DT Ntloedibe and JN Eloff

Programme for Phytomedicine, Botany Department, University of Pretoria, Pretoria 0002, South Africa

There is a major problem with the development of bacterial resistance to antibiotics developed in the pharmaceutical industry. Due to the enormous variety of secondary compounds present in plants many plant extracts have some degree of antibacterial activity. It is dangerous to use some of these plants before confirming the safety. We decided to test the antibacterial activity of extracts of medicinal plants that are presently used in the herbal industry and are generally regarded as safe using methods developed in our laboratory. About 60 different medicinal plants received from Biomox Pharmaceuticals were tested for antibacterial activity using the serial plate microdilution assay and bioautography, testing against the following nosocomial bacteria: *Staphylococcus aureus*, *Enterococcus faecalis*, *Escherichia coli* and *Pseudomonas aeruginosa*. Several plants that have not been known to have antibacterial activity were shown to have substantial activity. We are in the process of isolating the bioactive compounds from these plants.

Inducing a polyploid state in *Sparaxis tricolor* and *Sutherlandia frutescens*

L O'Reilly, C Robinson and P Naude

Department of Botany, Rand Afrikaans University, PO Box 524, Auckland Park 2006, Johannesburg, South Africa

Floriculture is always receptive to new crops and since polyploid plants are often more vigorous than their diploid relatives, polyploidy is commonly used in plant breeding. The genus *Sparaxis* (Iridaceae subfamily Ixiodeae) is indigenous to the south western Cape of South Africa. *S. tricolor* is diploid having $2n = 20$ chromosomes and has the potential to become a new Freesia-like cut flower crop. *Sutherlandia frutescens* (Fabaceae) is an important indigenous, but also medicinal plant, due to the presence of canavanine, pinitol and GABA. These active compounds are known to remedy diseases like cancer, fever, indigestion, peptic ulcer, diabetes, cough, asthma, chronic bronchitis, kidney and liver conditions, heart failure, stress and anxiety. *S. frutescens* is diploid. The aim of the study was to induce a polyploid state in *S. tricolor* and *S. frutescens*, and propagate and proliferate the polyploid plants *in vitro*. Results will be discussed.

Phytochemicals as mediators of high-altitude nutritional physiology: antioxidants in Tibetan foods and medicines

PL Owen and T Johns

School of Dietetics and Human Nutrition, Centre for Indigenous Peoples' Nutrition and Environment, McGill University, Montreal, Quebec, H9X 3V9, Canada

Non-nutrient phytochemicals are increasingly recognised as mediators of human physiology, metabolism and health, and may play a role in evolutionary adaptation to diverse ecosystems. Dietary patterns of Tibetan Highlanders offer insight into functional and medicinal foods needed to counteract the pro-atherogenic characteristics of their high-fat and cholesterol, high-sodium, low-fruit and vegetable diet. Despite this, and an elevated hematocrit due to chronic exposure to hypoxia, Tibetans have a surprisingly low incidence of cardiovascular disease (CVD). In a study of Tibetan compound medicines prescribed for cardiovascular complications, we determined that a clear majority are food plants that possess powerful antioxidant activity, able to protect low-density lipoproteins (LDL) from peroxidation. The routine use of these may have arisen as an evolutionary strategy in order to thrive in chronic hypobaric hypoxic environments without suffering the ill-effects of a high fat diet.

Is sustainable use achievable? The case of *Aloe peglerae*

MF Pfab¹ and MA Scholes²

¹ Gauteng Department of Agriculture, Conservation, Environment and Land Affairs, PO Box 8769, Johannesburg 2000, South Africa

² 20 Gavin Avenue, Pine Park 2194, Gauteng, South Africa

Aloe peglerae, an Endangered species restricted predominantly to the Magaliesberg range of South Africa, is threatened mainly by illegal collection. A population of 110 individuals was monitored demographically from 1976 to 1995. Resulting data were used to determine the temporal variation in observed demographic and reproductive parameters on which a stochastic population model was based. The model was used to assess the long-term effects of harvesting both adult plants and seed. Use of *A. peglerae* populations was found to be sustainable only at very low levels. Between 0.10% and 0.12% of an adult population can be harvested annually. With annual harvesting of one plant, a population of 250 adults or less has at least a 96% probability of becoming extinct within the next 500 years. However, a maximum of fifteen percent of the annual seed output can be harvested sustainably.

Weeds, traditional cuisines and ethnopharmacy among Albanians, Greeks and Italians in southern Italy

A Pieroni, C Quave, S Nebel and M Heinrich

Centre for Pharmacognosy and Phytotherapy, The School of Pharmacy, University of London, 29–39 Brunswick Square, London WC1N 1AX, United Kingdom

The gathering and processing of weedy food plants is still a common practice in a few Mediterranean areas. Culinary traditions and women's Traditional Knowledge (TK) are crucial to maintaining both cultural and biological diversity in the region. Indigenous Italians and ethnic Albanians and Greeks in Lucania and Calabria (southern Italy) have for centuries maintained the tradition of gathering non-cultivated food plants and this TK has been transmitted across generations in the region. Non-cultivated food plants often represent a central component of the cultural identity that women perpetuate also through the preparation of ritual foods associated mainly with religious events. Many of the gathered weeds have shown potent *in vitro* antioxidant activity, are not phytochemically well known, and could represent an important source of new nutraceuticals and health supplements. This potential is currently further explored in a consortium of research groups on 'Local Food — Nutraceuticals' sponsored by the European Commission and the overall goals and expected achievements of this consortium will be discussed in the presentation. Anthropological and ethnobiological dynamics of the past and present exchanges between indigenous South-Italian and Albanian and Greek migrant cultures are another focus of the presentation.

Evaluation of different techniques to determine respiratory components in cucumber seeds

GP Potgieter¹ and JC Pretorius²

¹ Department of Plant Sciences, University of the Free State, Bloemfontein 9300, South Africa

² Department of Soil, Crop and Climate Sciences, University of the Free State, Bloemfontein 9300, South Africa

Total oxygen consumption (V_T) is the result of both mitochondrial activity (V_{MITO}) and residual oxygen uptake (V_{RES}). In oil storing cucumber seeds it is believed that residual oxygen uptake (V_{RES}) is mainly represented by the β -oxidation of fatty acids in the cotyledonary glyoxysomes during active mobilisation of the stored lipids. The aim of this investigation was to determine the contribution of V_{MITO} and V_{RES} to V_T during germination and subsequent seedling establishment. Manometry and polarography were evaluated in an attempt to find the most applicable technique to determine V_T , as well as the ratio between V_{MITO} and V_{RES} in intact seed tissue. The fact that manometry clearly outperformed polarography as the best technique in all respects will be discussed.

Purification and identification of antibacterial compounds from *Euclea crispa* subsp. *crispa* (Ebenaceae) leaves

JC Pretorius¹, S Magama¹ and PC Zietsman²

¹ Department of Soil-, Crop- and Climate Sciences, University of the Free State, PO Box 339, Bloemfontein 9300, South Africa

² Bloemfontein National Museum, PO Box 266, Bloemfontein 9300, South Africa

Antimicrobial activity was confirmed in a crude leaf extract of *Euclea crispa* subsp. *crispa* on eleven human pathogenic bacteria and two fungi. The aqueous fraction remaining after distillation of the 95% methanolic crude extract was semi-purified by means of liquid-liquid chromatography. Most of the antimicrobial activity was located in the ethyl acetate fraction. Further purification by means of activity directed multiple preparative thin layer chromatography revealed the presence of a terpenoid, possessing a steroid-like structure, that was active against *Moraxella catharralis*. Also isolated from the ethyl acetate fraction, and showing antimicrobial activity as individual compounds, were five flavonoids identified as catechin, epicatechin, galocatechin, hyperoside and quercitrin. Of these epicatechin and hyperoside were most active in inhibiting the growth of *M. catharralis*, *Streptococcus pneumoniae* and *Haemophilus influenzae*. The activities of the isolated flavonoids seemed, in general, to be lower than that of the ethyl acetate fraction, suggesting that these compounds function in synergy in the latter more complex fraction.

In vitro production of phytoalexins by *Helichrysum kraussii*

G Prinsloo and JJM Meyer

Department of Botany, University of Pretoria, Pretoria 0002, South Africa

This study focused on the production of phytoalexins in *H. kraussii*. To activate the resistance system of the plant and to initiate the synthesis of resistance compounds, jasmonic acid was used as an elicitor. Jasmonic acid is a well-known signaling compound, and its involvement in the resistance system of plants is not a new concept. To eliminate the risk of attack and activation of plants in the field, tissue cultures were initiated with the aim of producing cell suspension cultures, which in turn made the uptake of jasmonic acid by the plant material more effective. Two phytoalexins: α -amyirin and β -amyirin, were subsequently isolated from the activated cell suspension cultures. These are the first compounds of the redirected biosynthetic pathway leading to phytoalexin production and support the findings that the normal mevalonic acid pathway that produce phytosterols are inhibited. These compounds were also active against *B. cereus*, which supports the definition of phytoalexins being antimicrobial compounds in the resistance system.

Antiplasmodial properties of compounds isolated from *Croton steenkampianus*

EA Prozesky¹, AA Hussein¹, Al Louw² and JJM Meyer¹

¹ Department of Botany, University of Pretoria, Pretoria 0002, South Africa

² Department of Biochemistry, University of Pretoria, Pretoria 0002, South Africa

Malaria remains a serious problem in most third world countries around the world. The resistance of *Plasmodium* spp. to currently used drugs has become a serious problem and efforts are being directed towards obtaining new drugs with different structural features. One option favoured is the search for new plant derived antimalarial drugs. Previous studies on the antiplasmodial activity of South African plants yielded excellent results on the extract level and this study focused on isolation of active principles from *Croton steenkampianus* (extract IC_{50} 12 μ g ml^{-1}). Of the compounds isolated one had very good antiplasmodial activity with an IC_{50} value of 4 μ g ml^{-1} for the known antimalarial compound quercetin against a chloroquine resistant strain, RB1 (IC_{50} for chloroquine 140 μ g ml^{-1}). The chloroquine reversal effects of this and quercetin-4'-OMe, with weak antiplasmodial activity (IC_{50} 60 μ g ml^{-1}) were determined and quercetin-4'-OMe showed significant effects in reversing chloroquine resistance (below resistance threshold of 33 μ g ml^{-1}), with an

IC₅₀ value 6.3 times lower than used alone. Quercetin showed antagonistic effects with chloroquine.

Heavy metal accumulation by macrophytes

MIM Qoko, LM Raitt and J Aalbers

Department of Botany, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

Many health problems relate to environmental factors, such as human activities in sewage sludge disposal, metal processing, etc. These factors are a concern all over the world. Plants that can concentrate metals in their tissues are effectively used to remove heavy metals from contaminated water and soil. The macrophytes: *Typha latifolia*, *Phragmites australis* and *Schoenoplectus nodosus* were grown in a random block experiment in a greenhouse and supplied with a series of concentrations of Zn, Cu and Pb with no apparent effect on their growth. The role of species and organs in the accumulation of these metals will be discussed.

Erectile function induced by new xanthenes isolated from the root bark of *Securidaca longependunculata*

NC Rakuambo, AA Hussein and JJM Meyer

Department of Botany, University of Pretoria, Pretoria 0002, South Africa

Four compounds have been isolated from the root bark of *Securidaca longependunculata*. Two of these compounds are new and one of them is the first example of its kind isolated from natural sources. The compounds 2-hydroxy-1,7-dimethoxyxanthone and 1,4-dihydroxy-7-methoxyxanthone were previously isolated from *S. longependunculata* and *Visamia guaramirangae* respectively. The structure elucidations were achieved by a combination of ¹H, ¹³C, HMQC and HMBC nuclear magnetic resonance spectroscopic techniques, ultra violet- and mass spectroscopy. One of the new xanthenes showed the same erectile promotional activity on *Corpus cavernosum* smooth muscle as Viagra.

Studies in southern African Boraginaceae: taxonomic significance of the morphology of leaf trichomes

E Retief¹ and AE van Wyk²

¹ National Herbarium, National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa

² HGWJ Schweickerdt Herbarium, Department of Botany, University of Pretoria, Pretoria 0002, South Africa

Differences in habit, leaf architecture, inflorescences and flower and fruit morphology are most significant in distinguishing genera, species and subspecific taxa within Boraginaceae. However, for quite a long time, leaf morphology has remained a virtually unexploited tool for systematic studies of the dicotyledons; partly because of the lack of a comprehensive and unambiguous classification of leaf morphological features. Trichomes are frequently present, usually easily observed and immensely diverse in shape, size, structure and location — features that can be used for classification purposes. The leaves of members of the Boraginaceae are often described as rough owing to the presence of various types of setae (bristle-like hairs) with multicellular or bulbous bases. Standard hairs and two-armed and glandular trichomes also occur. The trichome complements of the different boraginaceous taxa vary and are indeed of taxonomic significance.

Quantitative Ethnobotany: an instrument for understanding traditional knowledge

D Rivera¹, A Verde², C Inocencio¹ and C Obón³

¹ Departamento de Biología Vegetal (Botánica), Facultad de Biología, Universidad de Murcia, Campus de Espinardo, 30100-Murcia, Spain

² Instituto de Estudios Albacetenses, Albacete, Spain

³ Departamento de Biología Aplicada, EPSO, Universidad Miguel Hernández, Orihuela, Alicante, Spain

Quantitative data can help in discriminating quantitative and qual-

itative features of local traditional knowledge and making comparison between different cultures and areas. Ethnobotanicity was approached by Porteres in terms of Local Ethnoflora vs. Local Flora. Moerman proposed the comparison between medicinally used species vs. total available species within each plant family in certain areas. We have quantified aspects such as: number of species or remedies per informant, rapport ethnoflora vs. medicinal flora, proportion of food plants in the medicinal flora, proportion of toxic plants in the medicinal flora, ethnoflora and local flora, rapport medicinal remedies vs. medicinal plant species, effective use indicators as index of Pharmacoethnobotanicity, consensus indices for remedies and medicinal plants, and assessment of the depth of ethnobotanical exploration. These indices have been used for comparing three mountain areas of central Spain in order to determine patterns of traditional knowledge of plants there.

The new vegetation map of South Africa, Lesotho and Swaziland

MC Rutherford¹ and L Mucina²

¹ National Botanical Institute, Kirstenbosch Research Centre, Private Bag X7, Claremont 7735, South Africa

² School of Life Sciences, University of the North, Qwa-Qwa Campus, Private Bag X13, Phuthaditjhaba 9866, South Africa

We give an overview of a seven-year project aimed at providing a relatively detailed map of the vegetation types of South Africa, Lesotho and Swaziland. This collaborative project is based on newly synthesised data and has resulted in the recognition of more than 300 vegetation types. The units are hierarchically grouped according to biome and also include azonal types such as coastal habitats, freshwater and saline wetlands, and the various corridors of alluvia. A wider concept of the Desert Biome has resulted in a concomitant increase in the area of this biome. The new units are discussed relative to species diversity, environment, conservation status and to the vegetation types recognised in the earlier works. For example, whereas the number of vegetation units in the Cape Peninsula increases only slightly in the new map compared to that in earlier works, the number of units in the Richterveld increases several fold.

Characterisation of a novel antiproliferative diterpene from *Dendrostellera lessertii*

H Sadeghi and R Yazdanparast

Institute of Biochemistry and Biophysics, University of Tehran, PO Box 13145-1384, Tehran, Iran

Two diterpene esters (I and II) with daphnan skeleton were isolated from the leaves extract of *D. lessertii* (Thymeleaceae), a native plant of Iran growing in a very limited area of Iran. The structure of compound II was established by comparison of its spectroscopic data with the corresponding spectra of previously identified structure for gnidilatin, isolated from *Wikstroemia retusa*. The structure of the other purified compound (I) was elucidated using mainly FAB/MS, ¹H and ¹³CNMR. This compound was identified, for the first time, as 12-O-benzyl-3,5-hydroxy-6,7-epoxy-resiniferonol-9,13,14-Ortobenzoate. Cytotoxicity evaluation of compound I and II, using seven different cancer cell lines, indicated both compounds have antiproliferative activities and compound I is almost 2.5 times more active than compound II.

Strategic planning for the conservation of phytodiversity with a biogeographical emphasis on grasslands

CR Scott-Shaw and PS Goodman

Biodiversity Division, Scientific Services Branch, Ezemvelo KZN Wildlife, Box 13053, Cascades 3202, South Africa

This project attempts to address the question of which pieces of land are critical for conserving representative samples of KwaZulu-Natal's phytodiversity. An irreplaceability analysis is used to derive an importance value for each land unit. This is based on goals and targets which are set for each important plant species and plant community. This method is based on that advocated by Margules

and Pressey (2000). Modelled geographic distribution maps of viable populations form the building blocks of the analysis at the species level. Deriving these requires analysis of a taxon's habitat profile and geographic range. In this iteration endemic grassland species are used to red-flag areas of potentially highest conservation priority within an already endangered vegetation type. The project forms part of a larger one incorporating most elements of biodiversity. It acts as the foundation of a systematic and flexible decision-framework which contributes to and complements integrated development planning at the provincial level.

Isolation and characterisation of three antibacterial flavonoids from *Combretum apiculatum* subsp. *apiculatum*

SA Serage, DRP Katerere and JN Eloff

Phytomedicine Programme, Botany Department, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa

The efficacy of several extractants for the extraction of antibacterial compounds from *Combretum apiculatum* subsp. *apiculatum* leaves was determined. Extractants with intermediate polarity were the most effective. After examining the antibacterial activity, chemical complexity of different extracts and the number of antibacterial compounds extracted by autography, acetone was selected as the best extractant. An acetone extract of dried leaves was fractionated by solvent-solvent extraction, silica gel column chromatography and fractional crystallisation. Three compounds were isolated by bioassay-guided fractionation. The chemical structures were determined by NMR and MS. The MIC of these flavonoids alpinetin, pinocembrin and flavokawain-A varied from 40–600 µg ml⁻¹ for *Staphylococcus aureus*, *Enterococcus faecalis*, *Pseudomonas aeruginosa* and *Escherichia coli*.

Asphalatus linearis — a storm in a teacup

M Smith and EJ Jethas

Agribusiness in Sustainable Natural African Plant Products, Department of Agricultural Economics, Stellenbosch University, Private Bag X1, Matieland, Stellenbosch 7600, South Africa

Asphalatus linearis, or commonly known as Rooibos, is one of the Cape Fynbos Region's indigenous fynbos plants and has been used by the indigenous San and Khoi people for many years. The economic potential, because of the exceptional taste and healing properties, was realised as early as 1904. It is around this plant that the oldest indigenous South African industry evolved. Today, the indigenous communities in the Cedarberg are using this crop to establish agribusinesses and earn sustainable livelihoods. Through the use of technology they add value to the crop and market it in new and ingenious ways. Their agricultural practices and yield are comparable to those of commercial farmers. However, the storm in the teacup appears when after almost a century, their Indigenous Knowledge is attacked by a United States company who wants to patent the name ROOIBOS. This will have far reaching effects on the communities and their sustainability.

CNS-affecting plants traditionally used in southern Africa

GI Stafford¹, J van Staden¹ and AK Jäger²

¹Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3201, South Africa

²Department of Medicinal Chemistry, Royal Danish School of Pharmacy, 2 Universitetsparken, 2100 Copenhagen O, Denmark

Southern African traditional mental health has received little attention. Watt published the last review that focused solely on such plant use in southern Africa in 1967. This study serves to identify southern African plants, which are or have been used traditionally for their purported effects on the central nervous system. A detailed Microsoft® Access 2000 database of over 300 plant species has been compiled based on ethnobotanical data. This has

provided useful insight into potentially 'hot' psychotropic plant families and target species for further investigation. Any known chemistry and biological properties of these plants have been included in the database thus enabling cross-searching abilities. The plants have been classified under one or more types of psychotropic activity based on their traditional use. These are (a) anxiolytic sedatives, (b) neuroleptics, (c) antidepressant drugs, (d) psychomotor stimulants and (e) psychodysleptics. *In vivo* and *in vitro* bioassays used to assay the activity of potential psychoactive plants will also be reviewed with an emphasis on the *in vitro* neuro-receptor assays.

The needs of South African users of botanical information

Y Steenkamp¹ and GF Smith²

¹Data Management Section, National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa

²Office of the Research and Scientific Services Director, National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa

Under the auspices of the Southern African Botanical Diversity Network (SABONET), a workshop was held at the National Herbarium of the National Botanical Institute (NBI) in February 2002 to determine the needs of the end-users of botanical information in South Africa. Attended by end-user representatives from agricultural institutions, botanical societies, conservation agencies, environmental consultancies, the ecotourism industry, private and conservation herbaria, universities, as well as traditional healers and ethnobotanists, the workshop succeeded in identifying and prioritising ten information, service, and infrastructure needs. These include regularly updated, annotated lists of correct names; regularly updated, standardised, 'added-value' species lists; an electronic, web or CD-ROM based botanical information system; the expansion of herbarium collections by coordinated collecting trips to ensure that herbaria collections are representative of the southern African flora; the maintenance and improvement of a plant identification service by the National Herbarium. A SABONET Report Series publication resulted from the workshop.

Effects of bark harvest on populations of the African cherry (*Prunus africana*) on Mount Oku, Cameroon

KM Stewart

Keith and Schnars, 4803 NW 9th Avenue, Pompano Beach, 33064, United States of America

The purpose of this study was to develop sustainable harvesting and management strategies, using the African cherry, *Prunus africana* as a model species. I conducted simulations that examined demographic and environmental changes. In addition, I expanded this traditional approach to overlay the variability due to harvest ('people stochasticity'). I estimated extinction risk with differing harvesting intensities and various management scenarios. The time to extinction was reduced as harvesting pressures increased. I overlaid the effect of 'people stochasticity' with differing harvest intensities scenarios. I then modelled scenarios with differing mortalities and harvest frequencies. As harvest became more intense, long-term population growth rates become more unstable. Simulations to examine harvesting frequency indicated the population growth rate returns to pre-harvest conditions if trees are re-harvested after 10–15 years, but only if the large trees are left unharvested. Management simulations of modest enrichment plantings predicted population growth.

Endogenous cytokinin profiles detected in macroalgae

WA Stirk¹, M Strnad², O Novák² and J van Staden¹

¹Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

²Laboratory of Growth Regulators, Palacky University and Institute of Experimental Botany AS CR, Slechtitelu 11, 783 71 Olomouc, Czech Republic

Thirty-one seaweeds were collected from the KwaZulu-Natal and

Cape coasts (South Africa). Frozen material was extracted with 70% ethanol supplemented with deuterium labelled cytokinin standards. Samples were centrifuged and purified by combined DEAE-cellulose x octadecylsilica column and immunoaffinity chromatography and analysed for cytokinins by HPLC linked mass spectrometry and a photodiode array detector. Cytokinin profiles were similar in all the macroalgae. The main type of isoprenoid cytokinin present were Z and iP derivatives with higher concentrations of *cis* to *trans* isomers. DHZ was detected in very low amounts in only nine species. Aromatic cytokinins were detected, with low concentrations of BA. Topolins were present in greater diversity and concentration. For all the cytokinin types, free bases, O-glucosides and nucleotides were the most common with ribosides present at very low levels and no N-glucosides. The results suggest that different pathways of cytokinin biosynthesis operate in macroalgae than in higher plants.

Growth curves and carbon sequestration estimates of three indigenous street tree species in the City of Tswane, South Africa

GH Stoffberg and MW van Rooyen

Department of Botany, University of Pretoria, Pretoria 0002, South Africa

Concern about global warming resulted in a search for methods of ameliorating the greenhouse effect. One of the outcomes was the focus on terrestrial vegetation to act as carbon sinks with the aim of lowering atmospheric carbon dioxide levels. Urban vegetation, in particular street trees have a significant carbon sink potential. In South Africa, little research has been done on urban tree carbon sequestration due to a lack of information available on the growth of urban trees. The aim of this paper is to present growth curves and carbon sequestered estimates for the street trees *Combretum erythrophyllum*, *Rhus lancea* and *Rhus pendulina* growing in the City of Tswane, South Africa.

Scented *Pelargonium* as an essential oil crop for small farmers

KM Swanepoel

Lowveld College of Agriculture, Private Bag X11283, Nelspruit 1200, South Africa

Scented pelargoniums are indigenous to South Africa and have been used for essential oils by pharmaceutical, flavouring and perfume industries since the 17th century. Now in modern times the oil of a *Pelargonium* hybrid, commonly known as rose scented 'geranium', is in demand for aromatherapy, flavouring, and cosmetic purposes. The indigenous people of South Africa use the leaves for earache and headache, as well as for coughs and colds. The aim of this study is to determine the yield of oil ha⁻¹ in order to promote it as a profitable, sustainable and alternative crop. The planting densities, general growth requirements, harvesting techniques as well as the distillation process were investigated. It was attempted to grow these plants under organic production conditions.

Chloroplast DNA variation in *Clivia miniata* (Amaryllidaceae)

ZH Swanevelder¹, MM van der Merwe¹, AE van Wyk² and A-M Oberholster³

¹ Department of Botany, Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, Pretoria 0002, South Africa

² Department of Botany, University of Pretoria, Pretoria 0002, South Africa

³ Department of Genetics, Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, Pretoria 0002, South Africa

The genus *Clivia* (Amaryllidaceae) comprises five described species and is endemic to South Africa and Swaziland. The group is of considerable horticultural importance with *C. miniata* the most successful commercial member. However, little is known about the genetic structure of the genus and intra-specific genetic diversity of the constituent species. We determined if chloroplast variation can be detected with polymerase chain reaction restriction fragment length polymorphism (PCR-RFLP). This variation was then used to

investigate the genetic structure of *C. miniata*. Plant material obtained from the entire natural distribution range of *C. miniata* was used in the analysis. Among the chloroplast DNA regions investigated, several polymorphisms were detected. The majority of these polymorphisms were found to reside within one geographical region. A lower degree of variation was observed within other regions and between the different regions.

The effects of beta-carotene on the germination of spores, development of prothalli and sexual organs in *Adiantum capillus-veneris*

G Tajadod, A Majd, F Fallaian and S Mehrabian

Science and Research Unit, Islamic Azad University, Tehran, Iran

Department of Biology, North Branch of Tehran, Islamic Azad University, Tehran, Iran

Adiantum capillus-veneris belongs to the family Adiantaceae, which is represented in Iran by only one species, *Adiantum capillus-veneris*. This fern, at the beginning of its reproduction cycle, forms sporangia close to the margins of the mature pinnae. Spores released from sporangia, in good conditions, start to germinate in one direction and result in the formation of a 3-cellular protonema. After two weeks the terminal cell changes its direction of division, so that a green, wide plane called a prothallus is produced. Forty-five days later, the nucleus of the cells which are positioned in the middle of the prothallus margin begin their migration to the base of the cells, so their division will be irregular. The result of this division will be the appearance of a sexual notch and the prothallus will become heart-shaped. On the heart-shaped prothallus, close to the sexual notch, female organs (archegonia) and a little farther male organs (antheridia) are produced. The effect of three doses of beta-carotene (5mg%, 10mg% and 15mg%) was studied on the germination, growth and development of the fern's spores and prothalli. At all doses germination of the spores was delayed and the growth of protonemas and prothalli, in comparison with the controls, was slowed down. The groups which were treated with 5mg% and 10mg% of beta-carotene showed an increase in their vacuole system and a decrease in their number of chloroplasts and amount of chlorophyll (these changes were more violent at 15mg%). A dose of 15mg% beta-carotene inhibited the formation of the sexual notch, and 10mg% of it, delayed the formation of a very shallow notch. At these two doses the production of sexual organs was inhibited. 5mg% of Beta-carotene showed little effect on the vacuole system, number of chloroplasts and amount of chlorophyll, but all the prothalli which were treated were very small and had numerous shallow sexual notches which made the prothalli look multi-lobed. These prothalli did not produce archegonia and had only a few antheridia. From these studies we can conclude that: 1) beta-carotene in *Adiantum* prothalli decreases the number of divisions as well as slowing down the rate of division. In fact, many reports indicate that beta-carotene has anticarcinogenic properties in humans; 2) by its effect on cell microtubules and microfilaments beta-carotene can change the place of the nucleus so the cell division will become irregular; 3) 10mg% and 15mg% of beta-carotene inhibit the formation of sexual organs and 5mg% of it will cause the prothalli to produce only a few antheridia.

Xanthine dehydrogenase contributes to control of final avocado fruit size

NJ Taylor¹, AK Cowan² and J van Staden¹

¹ Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

² Department of Plant Biology, Swedish University of Agricultural Science, PO Box 7080, Uppsala, SE-750 07, Sweden

The contribution of xanthine dehydrogenase (XDH) to the control of final fruit size was investigated in 'Hass' avocado fruit and its small-fruit phenotype. Inhibition of XDH by treatment of normal fruit, in the linear phase of growth, with adenine or allopurinol arrested fruit growth. Adenine and allopurinol inhibited XDH activity *in vitro* confirming that arrested development of fruit was due in

part to inhibition of XDH. Time course studies on the activity of XDH in seed and mesocarp tissue from normal and small fruit showed that the enzyme was active in normal fruit and that activity increased in seed tissue with the increase in fruit size. In seed of the small-fruit phenotype XDH activity remained unchanged or declined. Feeding adenine to growing fruit caused a transient decline in fruit growth, which was independent of the effect of adenine on XDH. Thereafter, growth resumed although fruit size was irreversibly affected.

Assessing a newly formulated dual-phase technique in orchid seed culture: conserving the South African *Disa* *in vitro*

DI Thompson¹, TJ Edwards² and J van Staden¹

¹Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

²School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

★ Awarded SAAB Certificate for best overall student oral presentation at the Conference

★ Awarded Van Staden Prize for best oral paper presented by a PhD/Postdoctoral student

The *in vitro* culture of terrestrial orchid seed has historically met with limited success. For *Disa*, South Africa's largest terrestrial orchid genus (163 species), a false notion of germinability exists since a handful of aesthetic species are readily germinable *in vitro*. Realistically germination is unrecorded for 90% of *Disa*s, many of which display testa-imposed dormancy. Immature seeding, liquid cultures, charcoal supplementation and testa scarification all disrupt this dormancy, allowing first time, albeit low percentage (<20%) germination reports for several species. Dual-phase seed culture, a novel orchidology technique, stems from a combination of marginal successes in earlier research. This has been instrumental in achieving first-time germination in several additional species, as well as decreasing the time taken to (8 weeks) and increasing percentage germination (>85%) in others. Dual-phase culture is therefore an invaluable practice if *in vitro* cultivation is to be considered as a valid conservation tool for the genus *Disa*.

Antibacterial and antiviral activity of luteolin isolated from *Senna petersiana*: a plant used in the treatment of sexually transmitted diseases

E Tshikalange, JJM Meyer and AA Hussein

Department of Botany, University of Pretoria, Pretoria 0002, South Africa

Members of the genus *Senna* have previously been reported to contain anthraquinones and flavonoids. In this study a flavonoid was isolated from *Senna petersiana* (Bolle) Lock, a plant used in the treatment of sexually transmitted diseases. The chemical structure of the antibacterial compound was elucidated by spectroscopic methods including ¹H, ¹³C, UV, HMBC and HMQC experiments. The antibacterial activity of luteolin was determined with the agar dilution method and direct bioassays on TLC plates. The compound showed antibacterial activity against *Bacillus cereus*, *B. pumilis*, *Streptococcus aureus* and *Staphylococcus aureus*. One clear zone of bacterial growth inhibition was seen on TLC plates sprayed with *S. aureus*. In the assay to assess the possible antiviral activity of luteolin against *Herpes simplex* virus type 1 (HSV 1), 50% of the virus was inactivated at the concentration of 250 µg ml⁻¹.

A market analysis of indigenous medicinal plants in Venda

MP Tshisikhawe, DEN Mabogo and ADM Mathekgwa

University of Venda for Science and Technology, Private Bag X5050, Thohoyandou 0950, South Africa

Ethnobotanical studies indicate that the growing trade in indigenous medicinal plants in South Africa is posing a threat to the con-

servation and preservation of many plant species. Trade in medicinal plants has become a way of making a living for some people and pharmaceutical companies. In Venda the trade in indigenous medicinal plants in muthi shops is mainly done by local traditional healers.

Patterns of plant diversity in southern African grasslands

RG Uys and WJ Bond

Department of Botany, University of Cape Town, Private Bag, Rondebosch 7701, South Africa

Southern African grasslands represent a wealth of floral diversity, of which little is known. This is because most research has focussed on the few dominant grass species that are important for livestock production, ignoring the forbs that constitute the diversity in these systems. While pastoralists widely acknowledge a division between mesic and semi-arid grasslands based on their grazing potential, similar patterns have not been explored for the plant diversity. In wetter grasslands, biomass builds up faster promoting more frequent fires, while in the drier areas, drought conditions are more frequently experienced. Based on the range of life-form and -history characters recorded for grassland forbs encountered across a broad rainfall gradient in KwaZulu-Natal, South Africa, we identified separate fire and drought floras occurring in the mesic and semi-arid grasslands of this region.

The identification of genes associated with tolerance/resistance to *Fusarium oxysporum* f. sp. *ubense* in Cavendish bananas

N van den Berg¹, P Birch², A Viljoen¹, MJ Wingfield¹ and DK Berger³

¹Department of Microbiology and Plant Pathology, Forestry and Agricultural Biotechnology, University of Pretoria, Pretoria 0002, South Africa

²Department of Fungal and Bacterial Pathology, Scottish Research Institute, Invergowrie, Dundee DD2 5DA, United Kingdom

³Department of Botany, Forestry and Agricultural Biotechnology, University of Pretoria, Pretoria 0002, South Africa

Cavendish bananas in South Africa are highly susceptible to *Fusarium oxysporum* f. sp. *ubense* (*Foc*), the causal agent of fusarium wilt. Although cultivars outside the Cavendish sub-group have tolerance/resistance to *Foc*, they have unsuitable agronomic and fruit qualities. Molecular techniques enable us to identify resistance genes from germplasm that can be used to improve susceptible cultivars. The aim of this study was to isolate and identify genes that are expressed in tolerant, but not in susceptible bananas when challenged with *Foc*. For this purpose, we used Suppression Subtractive Hybridisation (SSH); a novel technique aimed at generating a cDNA library enriched for differentially expressed genes of both high and low abundance. These genes were recovered, cloned and sequenced. Southern Blot analysis assessed the level of enrichment following SSH and evaluated the level of background. Several of the isolated gene fragments show sequence similarities with known defense related genes from other plants.

A phylogenetic study of *Eugenia* (Myrtaceae)

MM van der Merwe¹, A-M Oberholster² and AE van Wyk¹

¹Department of Botany, University of Pretoria, Pretoria 0002, South Africa

²Department of Genetics, University of Pretoria, Pretoria 0002, South Africa

Eugenia (Myrtaceae) is a large genus with a Gondwanan distribution. The bulk of the species are centred in South America. Members of *Eugenia* are characterised by little macro-morphological variation and circumscription of infrageneric taxa has long been problematic. The existence of two groups (X and Y) among species from southern Africa has been indicated with anatomical and morphological data. Nuclear and cpDNA sequence data were used to investigate relationships within and between *Eugenia* in southern Africa and a wider distribution range. Two groups, congruent to the two anatomical and morphological groups (X and Y), were identified among the

southern African species. Molecular data thus supports the division of southern African *Eugenia* into group X and Y. Parsimony and distance analysis show that Mascarene Island species are more closely related to group Y while the smaller but widely distributed group X are more closely related to the species from the Americas.

Stress-induced genomic changes in plants

C van der Vyver¹, KJ Kunert¹ and CA Cullis²

¹ Forestry and Agricultural Biotechnology Institute, Department of Botany, University of Pretoria, 74 Lunnon road, Hillcrest 0002, Pretoria, South Africa
² Case Western Reserve University, Department of Biology, 10900 Euclid Avenue, Cleveland, Ohio 44106, United States of America

Stress can alter the genomic composition of a plant. Among these stresses are the introduction of foreign DNA molecules into the plant genome. In this study representational difference analysis was used to isolate genomic changes that may be associated with genetically modified plants. Three different DNA sequences were isolated. Two methylation sensitive subtraction products, Hp12 and Hp14, were identified as similar to part of the chloroplast genome and the 18S rRNA gene of tobacco, respectively. A third non-methylation sensitive subtraction sequence, Hi30, had no significant homology to any reported DNA sequences. Screening a genomic library for the Hi30 sequence showed that it was located in a number of known repetitive DNA sequence families. Isolated flanking regions of the Hi30 subtraction product also revealed similarities to DNA sequences of the 16S RNA gene in alga. Currently different tobacco lines are being screened for the presence/absence of the RDA subtraction products to evaluate their potential as genetic markers for plant transformation.

Wild craft harvesting of devil's claw

C van der Vyver

North West Province Conservation and Environment Management

Devil's claw (*Harpagophytum procumbens procumbens*) is a medicinal plant, endemic to southern Africa, specifically South Africa, Botswana and Namibia. The plant has been in use for ages by the Indigenous people of southern Africa as a cure for a variety of ailments. The Western World became aware of the medicinal value of extracts from this plant and the demand for plant material is growing rapidly. However, to extract the medicinal particles one needs the plants. The secondary tubers of the plants are being harvested. This process directly impacts on wild crafted populations and can be detrimental to the status of populations. At this stage scientific data is lacking as to the sustainability of the source. Currently artificial cultivation of the plant is still in an initial stage of development. The ecologically sustainable utilisation of this extraordinary plant not only fulfils a medicinal need, but also provides job creation, capacity building, training, empowerment and self-sustainability to disadvantaged communities in the rural areas of southern Africa.

Acetylcholinesterase inhibitory activity of Menispermaceae alkaloids

FR van Heerden¹, H de Wet² and B-E van Wyk²

¹ Department of Chemistry and Biochemistry, Rand Afrikaans University, PO Box 524, Auckland Park 2006, South Africa

² Department of Botany, Rand Afrikaans University, PO Box 524, Auckland Park 2006, South Africa

Alzheimer's disease is a common age-related neurodegenerative disease, and it appears that a decrease of acetylcholine in the brains of Alzheimer patients is a critical element in producing dementia. One of the first drugs on the market for the treatment of Alzheimer's disease is the plant metabolite galanthamine, a reversible inhibitor of the enzyme acetylcholinesterase. Galanthamine is an Amaryllidaceae alkaloid first isolated from *Narcissus galanthus*. As part of our research programme on South African medicinal plants, we are investigating the structures and biological activity of benzylisoquinoline alkaloids of the Menispermaceae, a widely used medicinal plant family of which seven genera and thirteen species occur in South Africa. In this contribution we will discuss the acetylcholinesterase inhibitory effects of some Menispermaceae alkaloids.

The antimicrobial activity of medicinal aromatic plants used in African traditional healing with special reference to method variability and essential oil composition

SF van Vuuren¹, AM Viljoen¹ and ME Klepser²

¹ Department of Pharmacy and Pharmacology, University of the Witwatersrand, Faculty of Health Sciences, 7 York Road, Parktown 2193, South Africa

² College of Pharmacy, Ferris State University, Borgess Medical Center, Department of Pharmacy, Kalamazoo, Michigan 49001, United States of America

★ Awarded best Poster presentation in Ethnobotany

Some of the most widely used indigenous medicinal aromatic plants (*Myrothamnus flabellifolius*, *Osmitopsis asteriscoides*, *Lippia javanica*, *Artemisia afra* and *Helichrysum* species) have been selected to investigate their chemical composition and biological activity. The essential oils of these plants showed varied inhibition, depending on the assay method (disc diffusion, MIC and death kinetic studies). Death kinetic methods appear to be more superior in determining antimicrobial activity of volatile oils as is evident in studies on *Myrothamnus flabellifolius* where the essential oil rapidly reduced viable counts of *Pseudomonas aeruginosa* but regrowth was noted after 240 minutes. Death kinetic studies on *Lippia javanica*, show the killing rate over 24 hours for *Bacillus cereus*, *Klebsiella pneumonia* and *Cryptococcus neoformans*. The variability in antimicrobial activity of the phenolic extracts and essential oils are demonstrated in a study on *Helichrysum* species. For *Osmitopsis asteriscoides* the antimicrobial activity of specific monoterpene identified by GC-MS were investigated by time kill studies. The synergistic antimicrobial activity of (-)-camphor and 1,8-cineole has been recorded. Disc diffusion studies on terpenoids standards identified in *Artemisia afra* show no activity. Time kill assays on *Artemisia afra* show concentration dependent bactericidal activity, indicating a possible synergistic role between chemical constituents.

Ethnobotanical survey of medicinal plants in the south-eastern Karoo, South Africa

B-E van Wyk¹, H de Wet² and FR van Heerden³

¹ Department of Botany, Rand Afrikaans University, PO Box 524, Auckland Park 2006, Johannesburg, South Africa

² Department of Botany, University of Zululand, Private Bag X101, Kwa-Dlangezwa 3886, South Africa

³ Department of Chemistry and Biochemistry, Rand Afrikaans University, PO Box 524, Auckland Park 2006, Johannesburg, South Africa

As a contribution towards a more comprehensive insight into Khoi-San ethnobotany, a rapid ethnobotanical appraisal was conducted in the Graaff-Reinet and Murraysburg districts of the south-eastern Karoo. The aims of the study were to identify the most important plants still in everyday use within the communities, and to evaluate the assumptions that there is a rich but dwindling knowledge on medicinal plants and that the traditional *materia medica* of the region has remained poorly recorded. A systematic documentation of medicinal plants in an area not previously studied seemed important in view of the rapid pace of urbanisation and acculturation that also affect the more remote Karoo regions of South Africa. The study revealed a wealth of information amongst elderly people of Khoi-San and Cape Dutch descent. An overview of the most important plants and their uses is presented, which shows several interesting records that have hitherto remained undocumented.

Growth dynamics and photosynthetic performance of *Microcystis aeruginosa* at different temperatures, light intensities and N:P ratios

A Venter and S du Plessis

School of Environmental Sciences and Development: Botany, Potchefstroom University for Christian Higher Education, Potchefstroom 2520, South Africa

Possible mechanisms triggering phytoplankton blooms can be connected to temperature, light or nutrient availability especially nitrogen and phosphorus. The growth dynamics and photosynthetic response of *Microcystis aeruginosa* growing at temperatures of 18°C

and 25°C, light intensities of 5 $\mu\text{mol m}^{-2} \text{s}^{-1}$ and 15 $\mu\text{mol m}^{-2} \text{s}^{-1}$ and N:P ratio's of 1:1, 16:1 and 160:1 were investigated. Very little growth was measured at a N:P ratio of 1:1 at both temperatures and light intensities. The highest growth rate was obtained at 25°C, 5 $\mu\text{mol m}^{-2} \text{s}^{-1}$ and a N:P ratio of 16:1. The physiological stress levels of photosystem II of the different treatments were compared by using a fluorometer (PEA) with a very high time resolution and data acquisition capacity for measuring the fast fluorescence rise from O-P of dark-adapted *Microcystis* cells. The fluorescence transients were quantified by the JIP-test. The performance index of *M. aeruginosa* growing at 25°C, 15 $\mu\text{mol m}^{-2} \text{s}^{-1}$ and N:P ratios of 16:1 was the highest.

Molecular phylogenetic evidence for the polyphyly of *Tetralia* (Cyperaceae)

GA Verboom and TA Hedderson

Department of Botany, University of Cape Town, Private Bag, Rondebosch 7701, South Africa

Tetralia, an austral sedge genus of about forty perennial species, has its greatest diversity in the fynbos of the Cape region. The Cape species display a remarkable diversity of form, some being robust and having tall multi-noded culms, while others are gracile, with slender culms that lack nodes below the inflorescence. Preliminary phylogenetic analyses based on chloroplast DNA sequence data (trnL-F region) strongly reject the monophyly of the genus, identifying two principal clades that are separated by a range of other schoenoid genera. These clades are morphologically distinct, their members being distinguishable on the basis of culm and leaf sheath characters. Taken together, these data argue for the recognition of a new genus to describe the clade whose membership does not include the type species. Relationships within each of the *Tetralia* clades are poorly resolved and await study using different markers.

Pollen morphology of *Fockea* (Apocynaceae: Asclepiadoideae)

RL Verhoeven

Department of Plant Sciences, University of the Free State, PO Box 339, Bloemfontein 9300, South Africa

In the Asclepiadoideae five tribes are often recognised: Fockeeae, Marsdenieae, Stapelieae, Gonolobeae and Asclepiadeae. Endress and Bruyns (2000) reduced the tribes to three by abandoning Fockeeae and placing it in the tribe Marsdenieae, and abandoning Gonolobeae and placing it in the Asclepiadeae. The Asclepiadoideae are characterised by having five pollinaria, each of which consists of two pollinia, each attached to the corpusculum by a caudicle. The pollinium consists of single, inaperturate pollen grains and is surrounded by a pollinium wall. The general pollinium structure of the genus *Fockea* differs from that found in other Asclepiadoideae in that the pollinium consists of tetrads and, further, it is not covered by a pollinium wall; in addition, the attachment of pollinium to corpusculum is not by a well developed caudicle. However, the distal tetrad wall of *Fockea* shows the typical distal pollinium wall structure of Asclepiadoideae (tectum, thin granular layer and foot layer).

The *in vitro* biological activity of South African medicinal aromatic plants used in traditional healing

AM Viljoen¹, SF van Vuuren¹, H Albert², S Hatch², B Demirci³, KHC Başer³, RL van Zyl¹, KL Lindsey⁴ and J van Staden⁴

¹ Department of Pharmacy and Pharmacology, Faculty of Health Sciences, University of the Witwatersrand, 7 York Road, Parktown 2193, South Africa

² TB Laboratory, National Health Laboratory Service, Johannesburg 0001, South Africa

³ Medicinal and Aromatic Plant and Drug Research Center (TBAM), Anadolu University, 26470-Eskişehir, Turkey

⁴ Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

Aromatic plants are often used in herbal preparations in the form

of infusions or aromatic plant material may be burnt and the smoke inhaled. Ten of the most widely used indigenous medicinal aromatic plants have been selected to investigate their chemical composition and biological activity in an attempt to establish a scientific basis for their frequent use. The decongestant and anti-microbial properties of essential oils explains the use of aromatic plants in treating respiratory ailments. Using time kill methods the minimum inhibitory percentage (MIP) has been determined on pathogens responsible for respiratory ailments. Susceptibility of *Mycobacterium tuberculosis* H37rv to the oils was tested by the BACTEC radiometric method. Many traditional uses of aromatic plants hint at possible anti-inflammatory activity, hence vernacular names such as 'fever tea' or 'fever-berry'. This information prompted us to investigate the *in vitro* inhibition of prostaglandin-synthesis using the cyclooxygenase-2 radiometric assay. Aromatic plants are documented for use in patients with 'fever' or 'flu-like' symptoms; which are the clinical symptoms used to describe a malaria infection. Thus, preliminary results of the *in vitro* antimalarial activity of the essential oils against a chloroquine-resistant *Plasmodium falciparum* strain will be discussed.

The isolation of putative protein kinase genes involved in the perception of Comcat in *Arabidopsis*

B Visser, Y Barski and AJ van der Westhuizen

Department of Plant Sciences, University of the Free State, Bloemfontein 9300, South Africa

Comcat is a natural plant activator with excellent capabilities of initiating defence responses in plants. It is part of the bigger group of Brassinosteroid plant hormones. The mode of action of Comcat in the initiation of plant defence responses is largely unknown. An initial attempt was made to elucidate the very early events of defence initiation in *Arabidopsis* after treatment with Comcat. The longer and shorter-term adaptations were followed using B 1,3-glucanase activity and protein levels of the enzyme. Finally, using RT-PCR, protein kinases that were differentially expressed were identified at various different time intervals. These kinases should play a role in the initial activation of defence reactions through phosphorylation.

Devil's claw in the Kalahari — conservation by cultivation

DJ von Willert¹, J Sanders¹ and G Olivier²

¹ Institut für Ökologie der Pflanzen, Hindenburgplatz 55, D-48143 Münster, Germany

² Farm Avontuur, PO Box 1467, Kuruman 8460, South Africa

The devil's claw is a highly used medicinal plant. Namibia exports about 650t per annum which equals about 10M plants. Most of the plants dug out for export come from wild populations. Main tuber destruction might account for 3M plants lost every year. This puts a tremendous pressure on *Harpagophytum*. Efforts should be undertaken to diminish this threat. One possible way for conservation might be cultivation. We studied the biology of *Harpagophytum* in terms of nutrient, water and irradiation requirements and established a method for its cultivation in the Kalahari. Results show no need for irrigation but competition should be avoided. The performance of cultivated and wild growing plants were compared by measuring their respective carbon and water balance and by means of chlorophyll fluorescence. This comparison revealed a ten fold higher yield under cultivation without any loss in the amount of the medicinally active substances. Cultivation not only guarantees a sustainable utilisation without exploiting the genetical resources it also contributes to conservation and represents an easy method for better yield and income. The whole system is ready to be implemented in the local communities.

Application of RDA in genome analysis

BJ Vorster

Department of Botany, Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, Pretoria 0002, South Africa

The application of Representational Difference Analysis (RDA) for genome analysis and marker development has been well docu-

mented in the medical sciences. Its application towards studying plant genomes is, however, new; one reason being that plant genomes are often very large and complex and thus difficult to work with. In this study RDA was used to compare the genomes of two closely related date palm cultivars. One of the difference products isolated was shown to be present in different copy numbers in the two cultivars and exhibited sequence differences between copies. Although this fragment could not be used as a marker for cultivar-identification, it provides a better understanding of complexities of plant genomes, and what modifications to the RDA protocol might be helpful in order to apply this technique to the study of plant genomes.

Putting a price on Ethnobotanical leads; how to estimate the value of your intellectual property in striking a fair deal with a commercialisation partner

DR Walwyn

CSIR Bio/Chemtek, Private Bag X2, Modderfontein 1645, South Africa

Although the risk of failure is high, there is some precedence for considerable economic returns to be generated from the broad area of bioprospecting and the development of novel pharmaceuticals based on ethno-botanical leads. Consequently a great deal of research and development has been, and will continue to be, undertaken in this field. Initially the costs of screening per botanical extract are low, but the throughput must be considerable. In the later stages of the development, costs per chemical entity become exorbitant, and hence the throughput drops dramatically. Since the two ends of the spectrum require entirely different expertise sets, it is not unusual for discovery companies to seek commercialisation partners to bring a product to market. Indeed drug leads are now traded throughout the development process; intellectual property is generated, valued and sold. In this paper, a method for the valuation of ethno-botanical leads, at all stages of development, will be presented. The technique will be illustrated through its application to a relatively common situation in which a start-up biopharmaceutical entity licenses such a lead to a large pharmaceutical company.

Participatory validation of medicinal plants for livestock diseases: the case of pastoralists of Samburu district — Kenya

J Wanyama¹, L Mpoke¹, Mbaria², Kaburia² and Gathuma²

¹ Intermediate Technology Development Group-Eastern Africa, PO Box 39493 Nairobi, Kenya

² University of Nairobi, Nairobi, Kenya

Traditional animal health care systems, otherwise known as Ethnoveterinary Knowledge and Practices, play an important role in complementing modern approaches in the control of diseases in Kenya. Indeed, livestock keepers throughout the world have utilised traditional animal health care techniques for centuries albeit through trial and error. In Kenya, Samburu and Turkana pastoralists depend on livestock for their livelihood. Since livestock disease poses the greatest challenge to livestock keeping, these communities have accumulated a lot of experience in dealing with diseases. These traditional animal health care practices include the use of medicinal plants in addition to surgical techniques and management practices. In a survey carried out by Intermediate Technology Development Group in Samburu District, it was found that the Samburu and Turkana community use up to 50 plant-based preparations to treat livestock diseases in the area. Of these, 13 plant-based treatments were cited as most frequently used. Despite the important role these practices play in ensuring livestock health there is a lack of information on their validity and use. Without such information, development professionals are hesitant to integrate these practices into conventional animal health care programmes (ITDG and IIRR 1996). This paper presents the process and results of a participatory research that ITDG-EA has used to validate and promote the use of medicinal plants. It shows how by using participatory approaches, effective medicinal plants used among Samburu and Turkana pastoralists were identified, selected and subjected to field trials for validation.

Effect of ethylene and sucrose-pulsing on floret opening and longevity of cut freesia inflorescences

J Weerts, L O.Reilly and CS Whitehead

Department of Botany, Rand Afrikaans University, PO Box 524, Auckland Park 2006, Johannesburg, South Africa

Senescence of freesia florets is characterised by a climacteric pattern in respiration rate, a climacteric-like rise in ethylene production during the later stages and an early increase in ethylene sensitivity. Their longevity was shortened by exposure to ethylene and treatment with inhibitors of ethylene synthesis and action such as STS, MCP and AOA resulted in an increase in flower longevity. Pulsing with 10% sucrose for 24 hours resulted in an increase in longevity and an increase in the number of open florets in the inflorescence. Although sucrose was taken up by the first floret of the inflorescence, it appears that the bulk of the sugar remains in the stems from where it is distributed to succeeding buds, stimulating their opening and increasing the longevity of the florets. Treatment with sucrose was more effective than MCP and STS in increasing floret longevity, and the combination of STS and MCP with sucrose did not show any additional benefit. Ethylene also accelerated the opening of closed buds and treatment with ethylene inhibitors delayed bud opening. Studies on ethylene binding showed that closed buds have a higher ethylene binding capacity than open florets. Ethylene binding increases again during floret senescence. The results of this study clearly show that ethylene stimulates both floret opening and senescence. Treatment with sucrose decreases the sensitivity of the florets to ethylene.

Systematic studies of the genus *Phyllica* (Rhamnaceae)

FM Weitz

Department of Botany, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

Investigations of morphological characters, nuclear ribosomal DNA internal transcribed spacer region (ITS1-5.8S-ITS2) and the non-coding region of the plastid gene *trnL* of a selection of 44 species were used to generate the first phylogeny of *Phyllica*. *Noltea* and *Alphitonia* are presumed sister taxa and were used as outgroups in the analysis. Separate and combined analyses were performed using PAUP* with mulpars and TBR branch-swapping; all characters were specified as unweighted. To ensure that all islands of shortest trees were found, 100 replicate tree searches with random taxon addition were conducted, each analysis beginning with a different taxon addition order. To obtain estimates of reliability for monophyletic groups, bootstrap and decay analyses were conducted. The phylogenies from these results indicate that *Phyllica* is paraphyletic as *Phyllica stipularis* is not nested within it, but comes out as a sister species to *Nesiota*. Strong biogeographical patterns are reflected within the ITS and *trnL* data. These clades agree with the phytogeographical centres of the Cape floristic region.

Gardens for the people: promoting ethno- and economic botany in South Africa, National Botanical Gardens

CK Willis¹, N Crouch² and J Roff³

¹ National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa

² Ethnobotany Unit, National Botanical Institute, PO Box 52099, Berea Road 4007, South Africa

³ Natal National Botanical Garden, PO Box 21667, Mayor's Walk 3208, KwaZulu-Natal, South Africa

South Africa's eight National Botanical Gardens have for many decades described for garden users the close relationships between people and plants. Methods used have included interpretive signs and labels (often in various official languages), guided tours, leaflets and publications, exhibitions and events, environmental education and community outreach programmes, as well as the construction of traditional structures (cooking shelters and huts), medicinal and other theme gardens. More recently audio guides and the internet have been introduced as interpretive media. Whilst much has been achieved in the National Botanical Institute's botanical gardens to date, there is still great potential and opportunity for

further display and interpretation of people-plant interactions, in geographic, historical and cultural contexts. There are also many opportunities for the development of genuine partnerships between the botanical gardens and local communities, NGOs, corporations, conservation and development agencies and tertiary institutions that can help to showcase (a) South Africa's natural and cultural heritage, (b) the interdependence of people and plants, (c) the need to conserve plants threatened by human over-exploitation and (d) plants with a promising commercial future.

The Global Strategy for Plant Conservation: implications for South Africa

CK Willis, JS Golding and GF Smith

National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa

The Global Strategy for Plant Conservation (GSPC) and its implications for South Africa are outlined. The GSPC was adopted by a wide range of organisations and institutions at the 6th Conference of Parties (COP6) to the Convention on Biological Diversity (CBD) in The Hague, Netherlands on 19 April 2002. The Strategy provides a framework to guide plant conservation actions at global, regional, national and local levels such that efforts are not misdirected, resources are well-spent, and conservation successes are more pronounced. The Strategy includes 16 outcome-oriented targets, aimed at achieving a series of measurable goals by 2010. In this paper, the National Botanical Institute presents a series of preliminary recommendations tailored to give effect to the GSPC. This is done by examining the divide between where South African plant conservation is today, and where it should be heading in the terms articulated by the GSPC. An appeal is made to South African botanists to contribute towards developing a National and/or Regional Strategy for Plant Conservation.

Plant conservation priorities and integrated environmental management of the Bushveld Igneous Complex in Limpopo Province and Mpumalanga

PJD Winter

Herbarium, School of Molecular and Life Sciences, University of the North, Private Bag X1106, Sovenga 0727, South Africa

During the course of botanical specialist studies for the EMPR process required for mining development by the Department of Minerals and Energy, it became apparent that there was an urgent need to address the link between taxonomic and conservation priorities in Mpumalanga and Limpopo Provinces. A recent study of the Sekhukhune Centre of Plant Endemism (Siebert 2001) has identified several threatened plants that are edaphically correlated with the eastern limb of the Rustenburg layered suite of the Bushveld Igneous Complex. A large proportion of these were new to science, and require taxonomic description. Renewed interest in the plants of this area currently continues to produce undescribed taxa. The state of flux in knowledge is unsatisfactory for effective environmental management of the area, particularly as the increased mining and increasing population in the Steelpoort subcentre of endemism pose significant threats to undocumented botanical diversity. The taxonomic and conservation issues are discussed.

Interactive effects of post-fire cues, soil nitrate concentration, smoke, soil-surface temperature regime and light intensity, on germination of six savanna woody plant species

ETF Witkowski and BA Mbalo

Restoration and Conservation Biology Research Group, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Private Bag 3, Wits 2050, South Africa

The interactive effects of post-fire germination cues have rarely been tested. Six savanna woody species with hard seed coats (*Acacia karroo*, *A. nilotica*, *A. robusta*, *A. tortilis*, *Burkea africana* and *Mundulea sericea*) were tested for seed germinability in response to smoke (S; zero or 10 minutes), soil-surface tempera-

ture (T; ambient or 50°C) and soil nitrate concentration (N; zero or 10mM) at two light conditions (high versus low) in laboratory simulations in a fully factorial experiment. Full spectrum light conditions were supplied, with 14 hours day and 10 hours night, at $20 \pm 0.2 \mu\text{mol m}^{-2} \text{s}^{-1}$ (low-) or $182 \pm 0.2 \mu\text{mol m}^{-2} \text{s}^{-1}$ (high-light intensity). Seeds were incubated and monitored daily for 40 days in repli-dishes (each seed is thus independent). Initial and final seed viability, percentage germination, and various measures of germination rate were determined. For *A. karroo*, T and T+S resulted in higher germination than the other treatment combinations under high light, while S+T, T+N and S+T+N resulted in higher germination than the rest under low light. Seeds exhibited a higher temperature response relative to an earlier experiment, and thus seed ageing has an effect. For *A. nilotica*, seed germination was enhanced (32%) by T under high light (seed ageing again appears to have increased the response). For *A. robusta*, germination trended $T \text{ and } T+S > T+N \geq S+T+N \geq \text{other treatment combinations}$ under high light, while for low light, $T > T+N \geq T+S+N \geq S+T \geq S+N, N \text{ and } S \geq \text{control}$. For *A. tortilis*, nitrate addition stimulated a small increase in germination relative to the other treatment combinations under low light. For *Burkea*, germination trended $S > S+N \text{ and control} > \text{the rest}$ under high light, while under low light smoke yielded higher germination than all the other treatment combinations. For *Mundulea*, nitrate resulted in a small increase in germination relative to S+T+N, with the other treatment combinations intermediate under low light. Overall, there is a strong germination response to temperature for *A. robusta* > *A. karroo* > *A. nilotica*. In contrast *Burkea* was strongly stimulated by smoke. Finally *A. tortilis* and *Mundulea* showed small increases in germination in response to nitrate. Both seed ageing and light conditions affected the various responses.

Access to plant genetic resources and benefit sharing: lessons learned

MM Wolfson

National Botanical Institute, Private Bag X01, Pretoria 0001, South Africa

This presentation will address some of the basic principles related to access to plant genetic resources and associated traditional knowledge, practices and innovations, for both research and commercial purposes and benefit sharing, as outlined in the Convention on Biological Diversity. Analysis of specific case studies, both local and international indicates that there are certain aspects which are common in all these cases. The lessons learnt will be highlighted and recommendations and suggestions to guide the implementation of ethical 'best practice' will be discussed. The current progress in the South African project on access and benefit-sharing, which is a component of the Southern African Biodiversity Support Programme, will also be discussed.

Optimising benefits from the commercialisation of southern African biodiversity

RP Wynberg

*Graduate School of Environmental Studies, University of Strathclyde Science and Technology Policy Research Centre, University of Cape Town
Current address: PO Box 69, St James 7946, South Africa*

Southern African biodiversity provides important economic opportunities, and this is reflected in a growing commercial interest in the region's biological resources. Several wild plant species have been successfully commercialised, either locally or globally. These include *Agathosma betulina* (buchu), *Aloe ferox*, *Aspalathus linearis* (rooibos), *Cyclopia* sp. (honeybush), *Harpagophytum procumbens* (devil's claw), *Hoodia* sp., and *Sclerocarya birrea* (marula). There has, however, been little analysis as to the ecological, social and economic impacts of commercialisation activities, and the factors that result in the effective conservation of these resources, and desirable and equitable development. To elucidate these factors, several case studies were undertaken of the above species. The research highlights *inter alia* the social and environmental impacts that accompany decisions to cultivate a species; the role of fair trade in supporting primary producers that have been historically marginalised from commercialisation initiatives; and the wide variety

of results that emerge from different commercialisation models that are adopted by the state, non-governmental organisations and the private sector. Some conclusions are made as to common features within these models that result in 'best practice'.

The role of macrophytes in constructed wetlands in winery wastewater treatment

NS Zingelwa¹, LM Raitt², J Aalbers² and PJE Louw¹

¹ Department of Soil Science, ARC-Nietvoorbij, Stellenbosch 7599, South Africa

² Department of Botany, University of the Western Cape, Bellville 7535, South Africa

This project involves the use of constructed wetlands in wastewater treatment in two systems; one at the Spier winery and the other at the Goudini distillery. There are very high levels of sodium and some other elements in the effluent, which could pose an environmental threat. *Phragmites australis* (common reed) and *Typha latifolia* (cattail) planted in the wetlands were used as monitors over the course of a year, as both wastewater components and plant growth stages vary. They were harvested monthly, divided into different organs and analysed for selected heavy metals, anions and cations. From the results the effect of: (a) wetland retention times; (b) position in the wetland; (c) species and organ were analysed.

Posters

Screening of thirty-eight wheat cultivars for salt tolerance

M Adam, LM Raitt and J Aalbers

Department of Botany, University of the Western Cape, Bellville 7535, South Africa

Thirty-eight wheat cultivars were studied for salt tolerance features. Four growth parameters: percentage germination, coleoptile length, root length and root mass, were used as indicators of salt tolerance. Distilled water (control) and four NaCl concentrations (100mMol, 200mMol, 300mMol, and 400mMol) were used as a germination medium. The study showed a range of responses. Differences found between and within the parameters that were measured resulted in a listing of the cultivars from the most to the least tolerant as follows: Flamex, Palala, Palmiet, Losper, Dias, Losper 52, Chokka, Yecoro Royo, Klein Trou, Nantes, SST 65, SST 55, Daeraad, Charchia, K20, SST 825, Kariega, Van Dyk, SST 38, Impala, SST 16, Rooigys, SST 66, Adam Tas, Unie 52, Liesbeeck, Rooi Indies, Sterling, Knoppies, Keniagover, Du Toit, Bona, Sökkies, Rooiwool, Eksteen, SST 57, SST 75, and Drommedaris.

The effect of 'womens bush extracts, on microbial pathogens

S Arendse^{1,2}, F Weitz^{1,2} and Q Johnson^{2,3}

¹ Department of Botany, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

² Applied Herbal Sciences Programme, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

³ Department of Medical Biosciences, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

Extracts of *Geranium incanum* var. *incanum* and *Geranium incanum* var. *multifidum* or 'womens bush', have for centuries been consumed as a herbal tea to remedy menstrual related ailments, venereal diseases and bladder infections. Consequently, the aim of this study was to investigate the anti-infective nature of various populations of these species against four important pathogens using the *in vitro* disc diffusion method to assess the efficacy of these plant medicines. Methanol extracts (80mg ml⁻¹, 40mg ml⁻¹, 30mg ml⁻¹, 20mg ml⁻¹ and 10mg ml⁻¹) of both varieties of plants were evaluated. Exactly 50µL of extract was placed on nutrient agar plates that were inoculated with *Candida albicans*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Mycobacterium smegmatis*. A positive control disc for *C. albicans* (Amphotericin B — 25µl disc⁻¹) and one

for *P. aeruginosa*, *S. aureus* and *M. smegmatis* (Ciprofloxacin — 40µg disc⁻¹) were placed on the plates. The plates that were inoculated with *M. smegmatis* remained incubated for 48hrs, and the others for 24hrs at 37°C, and then checked for zones of inhibition. Methanol extracts of these indigenous herbs inhibited *C. albicans* and *S. aureus* in a concentration dependant fashion. Furthermore, the efficacy of these plant extracts were independent of the populations from which they were chosen. These outcomes may possibly help us to identify the bioactive chemical templates, which could provide us with a basis for the development of anti-infective nutraceutical or topical agents.

Effect of sewage sludge on seedling growth of soybean in the greenhouse

TAS Aveling¹ and HG Snyman²

¹ Department of Microbiology and Plant Pathology, University of Pretoria, Pretoria 0002, South Africa

² ERWAT Chair in Wastewater Management, Water Utilisation Division, Department of Chemical Engineering, University of Pretoria, Pretoria 0002, South Africa

The long-term benefits of application of sewage sludge to land are frequently limited by potentially harmful elements such as heavy metals. A greenhouse experiment was done to characterise plant-soil interactions of the main sludge-borne heavy metals (Pb, Cd, Zn and Cu) to three soil types (clayey, loamy and sandy) on soybean seedlings. The experiment was a randomised block design with three replicates of three pots and three treatments per soil type, namely, addition of sludge at 8t_{dry mass} ha⁻¹, inorganic fertiliser amended as recommended (positive control) and soil unamended (negative control). Soybean seedlings were harvested after eight weeks. Dry mass of the foliage was determined and analysed for heavy metal content. The addition of sludge to clayey and sandy soil significantly reduced the dry mass when compared to the positive control but had no effect on dry mass of plants grown in loamy soil. There was no increase in Cd and Pb and only a slight increase in Cu and Zn levels in the soybean seedlings when compared to the controls.

Anti-bacterial activity of *Ficus racemosa* bark

R Bhaskara Rao¹, K Anand Swaroop¹, M Pal² and SC Mandal²

¹ Sultan-ul-uloom College of Pharmacy, Mountpleasant, Banjara Hills, Hyderabad-34 AP, India

² Department of Pharmaceutical Technology Jadavpur University, Kolkatta 700032, India

The dried stem bark powder of the plant *Ficus racemosa* was used for the study. The dried powder was successively extracted with petroleum ether (60–80), benzene, chloroform, acetone, methanol and sterile water. The solvents were removed under reduced pressure. Dilutions were made by using sterile DMF to get the concentration of 250µg ml⁻¹ of each extract and different concentrations of petroleum ether extract (150µg ml⁻¹, 200µg ml⁻¹, 250µg ml⁻¹, 300µg ml⁻¹ and 350µg ml⁻¹). Chloramphenicol (10mg ml⁻¹) was used as a standard drug. The antimicrobial activity was evaluated by agar diffusion method against five different test organisms *Escherichia coli*, *Bacillus pumilis*, *Bacillus subtilis*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*. The petroleum ether extract was further tested at 150µg ml⁻¹, 200µg ml⁻¹, 250µg ml⁻¹, 300µg ml⁻¹ and 350µg ml⁻¹. It was found that all the extracts of stem bark possessed significant antimicrobial activity against all the tested bacterial strains. Further it was shown that the petroleum ether extract possessed greater activity compared to other extracts.

Regulation of plasmodesmal function and control in *Tradescantia pallida* L. and *T. albiflora* Kunth

PG Barratt and CEJ Botha

Botany Department, Rhodes University, PO Box 94, Grahamstown 6140, South Africa

Transport from cell to cell is a fundamental process carried out in all living tissues. Plasmodesmata, the analogues of gap-junction in

animal cells, are cytoplasmic connections between adjacent plant cells that create an intracellular continuum known as the symplasm which facilitates intracellular transport. Plasmodesmata are primarily formed by the entrapment of strands of ER in the developing cell plate; they may also be formed secondarily in non-division walls. Electrical-coupling experiments have indicated that ions could pass through plasmodesmata. Due to the analogous nature of plasmodesmata and gap-junctions, it has been suggested that they have similar control mechanisms. In gap-junctions transport is regulated among other things by Ca^{2+} . When a trigger event occurs, Ca^{2+} is released from the vacuole causing a voltage spike in the cytosol. Ca^{2+} is released from the vacuole via the L2 voltage dependant channels into the cell cytoplasm. The Ca^{2+} is then bound with calmodulin, which in turn interacts with calcium dependant protein kinase (CDPK). CDPK then brings about the deposition of callose, through interaction with wall associated substances and the enzyme callose synthase. This poster explores the regulation and control of plasmodesmata through the deposition of callose, by studying the effect on cell-to-cell transport by regulating the L2 calcium channel with Ca^{2+} blockers, in the staminal hairs of *Tradescantia pallida* and *T. albiflora*.

Effect of an electro-activated sodium bicarbonate solution on growth, yield and post-harvest quality of tomatoes and lettuce

K Bezuidenhout and CS Whitehead

Department of Botany, Rand Afrikaans University, PO Box 524, Auckland Park 2006, Johannesburg, South Africa

The effect of electro-activated sodium bicarbonate solution (anolyte) on the growth, yield and postharvest quality of hydroponically grown tomatoes and lettuce was investigated, in order to determine whether the ready source of carbonate ions it provided would cause increased photosynthetic activity, and therefore result in an increased biomass and/or sugar content. Postharvest evaluation indicated that anolyte treatment serves to decrease respiration, heat production, transpiration, ethylene synthesis (determined using gas chromatography), and moisture loss. It caused an increased chlorophyll concentration, biomass, and total dissolved sugar content; for produce stored at 4°C, it also increased longevity (at room temperature, tomato longevity was slightly reduced). Although the growth rate was increased, fruit size (in tomatoes) and root growth and development were stunted. The treated produce was also subject to calcium deficiency, due to calcium carbonate precipitation in the hydroponic systems. The positive effects of treatment with electro-activated sodium bicarbonate solution outweigh the negative ones; but further research is required to minimise these.

Diversity of Bankenveld Vegetation

GJ Bredekamp¹ and LR Brown²

¹ African Vegetation and Plant Diversity Research Centre, Department of Botany, University of Pretoria, Pretoria 0002, South Africa

² Applied Natural Sciences, Technikon SA, Private Bag X6, Florida 1710, South Africa

During the last century the term Bankenveld was used by various authors to describe the unique vegetation of the mountainous, hilly and plateau areas that occurs between Lichtenburg in the west and Belfast in the east. This diverse vegetation has been studied by many researchers resulting in various descriptions and classifications of the different sections of the Bankenveld. In order to describe the major vegetation types of the Bankenveld, a total of 220 relevés, representing the major vegetation types from 23 phytosociological studies stored in the TURBOVEG database at the University of Pretoria, were assessed. These relevés were classified by using TWINSpan and then refining the result in MEGATAB. A phytosociological table that was reduced to 120 relevés representing 16 major vegetation types resulted. An assessment was made to relate the vegetation types to various phytochoria and it is concluded that the Bankenveld has definite floristic affinities to the grassland of the interior plateau of South Africa, the savannas of the Sour Bushveld

and Sourish Mixed Bushveld, the Drakensberg Afromontane vegetation and the Kalahari vegetation.

Different life history strategies in Restionaceae species (*Thamnochortus insignis* and *T. erectus*): a matrix modelling approach

TA Campbell¹, KE Esler¹ and D Ward²

¹ Department of Botany, University of Stellenbosch, Private Bag X1, Matieland 7600, South Africa

² Department of Conservation Ecology, University of Stellenbosch, Private Bag X1, Matieland 7600, South Africa

Life history strategies have been well studied within the Fynbos biome, although few studies have focussed on Restionaceae. We aim to determine the effects of life history variation on population structure and dynamics of a sprouting (*T. erectus*) and a non-sprouting (*T. insignis*) restio. We predict that the sprouter relies on persistence of mature individuals, whilst the non-sprouter relies on a seed bank and seedling recruitment to ensure population expansion. Both species are economically important thatching reeds and thus sustainable management of harvested populations is needed. A matrix modelling approach is used to determine population growth rates, stable stage distributions and stage sensitivity and elasticity. The stable stage distribution provides the distribution of individuals between stages for a stable population, while sensitivities and elasticities highlight key stages. Future research focuses on the effect of disturbance regimes such as fire and harvesting.

Ethnopharmacological survey of some plants of Algerian Sahara used in the treatment of urinary tract infections

A Cheriti¹, N Belboukhari¹, K Sekkoum¹, S Hacini² and D El Abed²

¹ Phytochemistry and Organic Synthesis Laboratory, Bechar University, 08000, Algeria

² AOSLab., ESSenia University, 31000, Algeria

In the Algerian Sahara, where medicinal plants are widely used as an alternative to pharmaceutical drugs, the folk medicine represents a very important phenomenon in regional culture. Continuing our effort on the search for bioactive substances from medicinal plants of south-western Algeria, we report the use of 24 species (seven botanical families) of folk drug plants currently used as diuretics, for the treatment of urinary tract inflammation and lithiasis. As regards the form of preparation, decoction is by far the most prevalent method, the treatment is repeated 2–3 times per day. The specified dose per day is prescribed for seven days and prolonged to a specified number of days generally to one month if positive effect is observed.

Ethnobotanical resources in the Alps zone

ML Colombo and C Zanardini

Department of Plant Biology, Faculty of Pharmacy, University of Torino, Italy

The Alps are the most densely populated area in the world being home to eleven million people. The alpine people keep up some ethnobotanic uses, mainly in the highest mountain valleys. These valleys can be geographically isolated during the year and the people use the herbs for some illness or ailment. *Peucedanum ostruthium* (L.) Koch (Apiaceae), is a perennial herb growing wild and used mainly in the western part of the Alps. The roots are employed in folk medicine for their antiphlogistic and antipyretic effects. The coumarins recovered from *P. ostruthium* roots confirmed the ethnomedical data. The blossoms of other plants named 'bitter herb' (*Tanacetum balsamita* L., *Chrysanthemum balsamita* L., *Balsamita vulgaris* Willd.) cultivated in the alpine zone, contain 1.0% of essential oil consisting mainly of β -thujone, but in the plant the bitter substances prevail. The tincture prepared from the aerial parts and the leaves when eaten as vegetables improve gastric secretion.

Carpets of colour or a fairy-land of flowers: possible strategies for the management of the Namaqualand wildflower display

JK Conradie and **MW van Rooyen**

Department of Botany, University of Pretoria, Pretoria 0002, South Africa

The spring display of wildflowers in the arid region of Namaqualand is world-renowned for its beauty and diversity. The display is produced by one or a few species of annual plants growing at high densities on disturbed areas. The natural vegetation of the region is a more diverse assemblage of succulents, geophytes, annuals and perennials, which do not give rise to the same visual effect of a 'carpet of colour'. Tourism into the region to view the mass floral displays is vital to the local economy. However, much of the land is now incorporated into conservation areas where high levels of disturbance are not favoured. This project researches possible management strategies for these flowers to marry the requirements of tourism and conservation. Data from an eight-year ecological survey were used in statistical and mathematical models to understand the dynamics operating within the ecosystem and how they are affected by different management practices.

Population structure and utilisation of mangroves in the Mngazana estuary

V Dayimani¹, **M Magwa**¹ and **JB Adams**²

¹ Department of Botany, University of Fort Hare, Alice 5700, South Africa

² Department of Botany, University of Port Elizabeth, Port Elizabeth 6000, South Africa

The Mngazana is an important estuary in South Africa in terms of biodiversity conservation, as it has the third largest mangrove area in the country (137ha), after the Mhlathuze (652ha) and St Lucia (279ha) estuaries. The total mangrove area in South Africa is approximately 1 688ha. The Mngazana estuary contains the largest area of the red mangrove, *Rhizophora mucronata* in South Africa. The greatest current threat to mangroves in the estuary is removal through harvesting. *R. mucronata* is the species targeted for harvesting since the wood is termite resistant and is more useful in the construction of houses and kraals. GIS mapping surveys and sampling techniques were used in order to give the indication of the population structure of mangroves. The results of this investigation will be presented in this poster.

The impact of dark chilling on chloroplast ultra-structure and key biochemical reactions of photosynthesis in *Glycine max* (L.) Merr.

KR du Plessis, **GHJ Krüger** and **PDR van Heerden**

School for Environmental Sciences and Development: Section Botany, Potchefstroom University for Christian Higher Education, Potchefstroom 2522, South Africa

The impact of dark chilling on ultra-structure and key reactions of photosynthesis was assessed in soybean genotypes of contrasting chilling tolerance. Nodulated soybean was grown in the presence/absence of nitrate supplementation. Given the severe stress sensitivity of symbiotic nitrogen fixation, the aim was to investigate if nitrate supplementation increased chilling tolerance. Rubisco and FBPase measurements indicate a higher sensitivity of photosynthesis to chilling in 'Java 29' (chilling sensitive) than in 'Maple Arrow' (chilling tolerant). In concurrence chilling-induced disruption of chloroplast ultra-structure was only observed in 'Java 29'. Measurement of nitrogen content suggests that chilling induced N-limitation in leaves of 'Java 29'. Based on the response of Rubisco and FBPase, addition of nitrate considerably improved the chilling tolerance of 'Java 29'. Gas exchange analysis supports the ameliorating effect of nitrate on photosynthesis. It is concluded that nitrate increases the dark chilling tolerance of photosynthesis in the chilling sensitive soybean genotype.

Conservation threats and the current status of South African terrestrial orchids with respect to *in vitro* germination

TJ Edwards², **S Piper**² and **DI Thompson**¹

¹ Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

² School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

★ **Awarded Local Organising Committee Book Prize for best Poster presentation in Ecology**

The vast majority of South African orchids belong to the tribes Orchideae and Deseae, with the latter containing 250 terrestrial species in five sub-tribes and 11 genera. Conservation here is hampered by our ignorance regarding germination and cultivation requirements *ex situ*. A false notion of germinability exists for the genera *Satyrium* and *Disa*, where a handful of aesthetic species are tractable *in vitro*. However, the vast majority of the Deseae are ungerminated *in vitro*, which does not bode well for the conservation of the tribe. We overlay land usage (GIS) data and orchid distribution to highlight those species vulnerable to urban sprawl, silviculture and agriculture. Additionally we consolidate the current knowledge of *in vitro* germination in the South African Deseae and include several new germination records from the genus *Disa*. This research forms the basis for future orchid studies on *in vitro* germination, population dynamics and management and conservation strategies.

Crinums and conservation

CW Fennell, **EE Elgorashi** and **J van Staden**

Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

Crinums, with their large lily-like flowers, are gathered from the wild to make decoctions and poultices for treating a variety of ailments. Increasing urbanisation has transformed muthi into a commodity; placing enormous pressures on plants in the wild, such that several species have been placed in various categories of endangerment. Efforts to conserve the plants are, however, limited by biological factors. Biotechnologically derived solutions for plant and secondary metabolite production in *Crinum moorei*, may offer alternatives to the plant and molecule hunters. Mass propagation occurs *in vitro* through the proliferation of meristematic clusters in a liquid-shake culture medium. Buds inoculated onto hardening media form bulblets that may be conveniently stored, planted *ex vitro* or used as a source of secondary metabolites. Those isolated from *Crinum moorei*, including the nine alkaloids detected in micropropagated bulblets, are known to be biologically active with prospects for the clinical treatment of Alzheimer's disease.

Analysis of global conservation of biodiversity in relation to socio-economic climates

L Gaika and **RS Knight**

Department of Botany, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

Protected areas have been established as the most important means of conserving biodiversity globally and are seen as vital instruments for the preservation of biodiversity. Due to increase in global population size, which has exceeded six billion, there are concerns that global biodiversity is at risk if insufficient land is put aside for conservation within formal protected areas. The study aims to globally compare investment in Protected Areas in relation to socio-economic conditions. Various datasets were compiled from Internet for 1996 and 2000 on population demography, socio-economic conditions, investment in protected areas, species richness and red data species. Multivariate analyses were used to identify countries with similar socio-economic profiles and conservation investment within each of the world's continents. The results show that countries with highly developed economies have significant

investments in protecting biodiversity through using protected areas, whereas those countries that are poorly developed are accompanied by relatively low investments in protected areas.

The prokinetic effect of radish seed extract is mediated through activation of muscarinic receptors

AH Gilani, MN Ghayur and A Anwar

Department of Biological and Biomedical Sciences, The Aga Khan University Medical College, Karachi, Pakistan

Radish (*Raphanus sativus*) is an edible plant taken raw, cooked or as salad. This study describes the pharmacological basis for its traditional uses in GI disorders, such as constipation and indigestion. The aqueous extract caused dose-dependent (0.1–3mg ml⁻¹) spasmogenic effect in different isolated gastrointestinal preparations, followed by relaxation at high dose. Pretreatment of tissue with atropine abolished the contractile effect and the relaxant component was more marked. The extract at the dose of 100–300mg kg⁻¹ enhanced the gastrointestinal transit time of charcoal meal in mice. Activity-directed fractionation revealed that spasmogenic cholinergic component is concentrated in the aqueous fraction while ethyl acetate fraction was found rich in spasmolytic effect. These results justify the folk use of radish in melancholic gut while the additional spasmolytic component, which prevents the spasmogenic effect going beyond limits, might be playing a role to offset any undesirable cramps.

The presence of antispasmodic and bronchodilator constituents in *Apium graveolens* seeds

AH Gilani¹, MN Ghayur¹, I Chaudhary², F Shaheen² and AA Khan²

¹ Department of Biological and Biomedical Sciences, The Aga Khan University, Karachi-74800, Pakistan

² HEJ Research Institute of Chemistry, University of Karachi, Karachi, Pakistan

The seeds of *Apium graveolens* (Celery) have been traditionally used in different disorders such as colic, asthma and bronchitis. This investigation describes the pharmacological basis for some of its folk uses. Segments of rabbit jejunum, guinea-pig ileum, and trachea were suspended separately in 10ml tissue baths containing Krebs' or Tyrode's solution at 37°C. Responses were recorded on Grass Polygraph. The aqueous-ethanol extract caused dose-dependent (3–30µg ml⁻¹) relaxation in spontaneous and K⁺ (80mM)-induced contractions of rabbit jejunum, suggestive of calcium channel blockade (CCB). The CCB activity was confirmed when pre-treatment of tissue with extract (3.0–30.0µg ml⁻¹) shifted the Ca⁺⁺ dose-response curves to the right. In guinea-pig trachea, the extract (1.0–30µg ml⁻¹) also suppressed K⁺ (80mM) and carbachol (1µM)-induced contractions. This study shows the presence of CCB constituent(s) in the crude extract of *Apium graveolens* seeds, which provides sound mechanistic basis for its use in abdominal colic and asthma.

Vegetation classification and restoration recommendations for the la land type in the Vhembe-Dongola National Park, Limpopo Province

AR Götze¹, SS Cilliers¹, H Bezuidenhout² and K Kellner¹

¹ School of Environmental Sciences and Development, Section Botany, Potchefstroom University for Christian Higher Education, Potchefstroom 2531, South Africa

² Scientific Services, SA National Parks, Kimberley, South Africa

The establishment of the Vhembe-Dongola National Park to become a major component of a Trans-frontier National Park is an important objective of the South African National Parks. This is mainly based on the rich biodiversity of the area and the cultural importance of the archaeological treasures of Mapungubwe. As a sound knowledge of the vegetation ecology for areas of conservation significance is essential in the establishment of efficient management programs, a study was conducted in which plant communities were described and ecologically sound management units

mapped. Further aims included the identification of areas showing high levels of degradation and to recommend restoration strategies for these areas. Focus is placed on the la land type which is mainly situated in the riparian zone. This zone warrants special attention due to its positioning in the landscape and it includes the most disturbed parts of the Park. Four plant communities with several sub-communities, which are included in three different management units, have been identified for the la land type. Recommendations for restoration activities of the degraded natural rangelands, cultivated lands, old lands and other disturbed areas, will be discussed.

Authentication of South African medicinal barks with Thin Layer Chromatography

OM Grace¹, HDV Prendergast², J van Staden¹ and AK Jäger¹

¹ Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

² Centre for Economic Botany, Royal Botanic Gardens, Kew, Surrey TW9 3AB, United Kingdom

³ Department of Medicinal Chemistry, Royal Danish School of Pharmacy, Universitetsparken 2, 2100 Copenhagen O, Denmark

Bark products are an important source of medicine in South African traditional healthcare. However, misidentification and adulteration increasingly affect their appropriate use, due to inherent difficulties of identifying dried material. In our preliminary study, we investigated the suitability of Thin Layer Chromatography for authenticating bark medicines. Eight bark species, deemed by a traditional medical practitioner to be of problematic identity, were assessed. TLC-generated phytochemical fingerprints of ethanol and hexane bark extracts, and medicinal products purportedly of each species, were compared. At the intraspecific level, TLC was useful in confirming the relationship of bark extracts, but was less meaningful in distinguishing between fingerprints of different species at the interspecific level. The technique proved useful in confirming the identity of several medicinal bark products. TLC may be an appropriate tool for the authentication of medicinal bark products used in South African traditional healthcare.

A hypothetical prostaglandin-cyclic AMP model for flowering in *Pharbitis nil*

EG Groenewald and AJ van der Westhuizen

Department of Plant Sciences, University of the Free State, Bloemfontein 9300, South Africa

It has been known for a long time that prostaglandins occur in *Pharbitis nil* (a short-day plant) and are possibly involved in flowering of the same plant. A hypothetical model is presented where a phytohormone, gibberellin, (first messenger) interacts with prostaglandin F_{2α}, situated in the plasma membrane of the leaf. As a result adenylyl cyclase (adenylyl cyclase) is activated with the formation of cyclic-AMP (c-AMP) from ATP with the further result that a cascade of reactions is started in the cytosol. The c-AMP is the second messenger. The product(s) of the cascade could be the flowering stimulus, which travels to the apex and is responsible for flowering. During short-days the above mentioned reactions may take place and during long-days, when flowering is inhibited, a low molecular weight phenolic acid (salicylic acid) could be the inhibitor by inhibiting the synthesis of prostaglandin F_{2α} in the membrane.

The role of kinetin in salinity tolerance of *Erucastrum strigosum*

N Gxaba, LM Raitt and J Aalbers

Department of Botany, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

A randomised-block experiment was conducted to examine the ameliorative effects, if any, induced by a series of kinetin concentrations (0µM, 4µM, 12.5µM, 40µM, 125µM) in salt treated (0mM, 100mM, 200mM, 300mM, 400mM NaCl) *Erucastrum strigosum* plants grown under greenhouse conditions. Growth was reduced by

both salt and kinetin. The concentrations of the cations Ca^{2+} , Mg^{2+} and K^+ were decreased with increasing salinity while Na^+ concentration increased. In nonsaline controls, treatment with kinetin accentuated the selective uptake and distribution of K^+ over Na^+ but this was reversed by salt application. Mg and Ca contents were not significantly affected. These results do not support the use of kinetin to alleviate salt induced adverse effects.

The influence of ecological interrelations of forestry and meadow vegetation on the upper boundary of the forest of the Caucasus

VD Hajiyev

Institute of Botany, Azerbaijan National Academy of Sciences, Patamdar sh. 40, Baku-370073, Azerbaijan

The modern upper boundary of the forest in the Caucasus is greatly dependent on the geographical latitude of the locality, on the character of the mountain, also on the influence of anthropogenic and natural factors. Anthropogenic factors such as the grazing of cattle, hay-mowing, road building, felling, tourism and other have a negative influence on natural renewal of the forest and favor the lowering of its upper boundary. Under the influence of physical factors deeper soil erosion occurs. The tree vegetation is found in a complicated independent relation with the brushwood's of bushes, high grass, also subalpine and alpine groupings. In places where there is contact between birch wood and brushwood of Caucasian rhododendron there is mutual penetration. In this case the broadening of birch woods is being lost at the expense of spreading fruit specimens. In favourable conditions the Caucasian rhododendron is displacing the tree and grass vegetation, allowing the expansion of *Narducetum*, *Geranietum* and *Alchimilietum* meadows. With regard to keeping and restoring the upperclimatic boundary of the forest it is necessary to consider the increasing influences of anthropogenic factors.

Comparison of the distribution and expression of heterophylly among native woody species of the Mascarenes and the Seychelles

I Hansen¹, M Sørensen¹, P Mølgaard² and L Brimer³

¹ Department of Ecology, The Royal Veterinary and Agricultural University, Copenhagen, Denmark

² Department of Medicinal Chemistry, The Royal Danish School of Pharmacy, Copenhagen, Denmark

³ Department of Pharmacology and Pathobiology, The Royal Veterinary and Agricultural University, Copenhagen, Denmark

The native, woody flora of the Mascarenes is characterised by a high percentage of heterophyllous species. The heterophylly is classified as juvenile-adult dimorphism, typically expressed as narrow or dissected juvenile leaves vs. elliptic simple adult leaves. The cause of the widespread occurrence of heterophylly is not yet known or understood. With regard to the origin of the native plant material and the composition of the fauna the Seychelles is comparable to the Mascarenes, the occurrence of heterophylly is, however, not very common among the native, woody species of this archipelago. The possible reasons for this difference will be discussed. The investigation is based on studies of the national flora works as well as personal field observations in the Mascarenes.

Strengthening of ethnopharmacological resources in a shipibo area, Peru in western Amazonia

A Hansson and J Maldonado

Ametra-Ucayali, Apartado 210, Pucallpa, Peru

The shipibo people of eastern Peru with about 30 000 inhabitants live along the Ucayali River and its tributaries. They have a rich pharmacopoeia woven into the concepts of their traditional medicine. The indigenous health organisation Ametra-Ucayali has been very active in strengthening the use of traditional resources, including medicinal plants, through education, although it has now finished this role. With minor economic resources and in close collaboration with a shipibo village, Alfonso Ugarte, it has now started a

project of reforestation with mainly woody species. In a first experimental plot of 3ha about 35 species, including *Banisteriopsis caapi*, *Copaifera reticulata*, *Ficus insipida*, *Mansoa alliacea*, *Spondias mombin*, *Uncaria tomentosa*, have now been planted, mainly from wild or nursery saplings. The focus is on local sustainable resources to benefit the environment, health, ecological tourism and the supply of primary or processed plant material for sale.

Morphological variation in leaves of *Avicennia marina* in response to hypersalinity under natural conditions

O Hiralal¹, G Naidoo¹ and Y Naidoo²

¹ Department of Botany, School of Life and Environmental Sciences, University of Durban-Westville, Durban 4000, South Africa

² Electron Microscope Unit, University of Durban-Westville, Durban 4000, South Africa

★ Awarded Local Organising Committee Book Prize for best Poster presentation in Taxonomy

Variation in leaf morphology in response to salinity was examined in *Avicennia marina*, a dominant, highly salt tolerant species in Richards Bay Harbour. Leaves from a saline site (35‰) were compared with those from a hypersaline site (50‰) using morphometric measurements, Scanning Electron (SEM) and Light Microscopy (LM). Hypersalinity increased leaf thickness by 27.6%, reduced water content per gram dry mass by 26%, reduced specific leaf area by 10.9% and increased cuticle thickness. Hypersalinity reduced salt gland frequency on the adaxial surface by 32%. Generally, salt glands protruded from crypts in leaves from the saline site whilst they appeared sunken and occluded by cuticular material in those from the hypersaline site. On the abaxial surfaces, salt glands were located at the base of the dense mat of overlapping, multicellular peltate trichomes.

Floral induction in *Protea* cv. 'Carnival',

EW Hoffman¹, MD Cramer² and G Jacobs¹

¹ Department of Horticulture, University of Stellenbosch, Private Bag X1, Matieland 7600, South Africa

² Department of Botany, University of Stellenbosch, Private Bag X1, Matieland 7600, South Africa

A better understanding of the physiology of the transition to reproductive growth and development in *Protea* is essential in order to facilitate expansion of the *Protea* floriculture industry. Elucidation of the physiological mechanisms which trigger floral induction and initiation will allow the manipulation and extension of natural flowering times to ensure product availability during the favourable marketing periods. In this investigation the nature and timing of the floral stimulus in *Protea* cv. 'Carnival' was investigated by analysing phloem and xylem sap and by disbudding and defoliation. Samples taken throughout the transition to the reproductive phase of the plants were analysed for soluble carbohydrates, total amino acids and cytokinins. From this data the time of floral induction and the dependence on the presence of leaves was established and correlated with changes in phloem and xylem composition.

Fungitoxic activity (*in vitro*) of six plants used in Kenyan traditional medicine for treatment of skin diseases

PJ Houghton¹ and R Kariba²

¹ Department of Pharmacy, King's College London, Franklin-Wilkins Building, 150 Stamford Street, London SE1 9NN, United Kingdom

² Department of Botany, University of Nairobi, Kenya

Methanolic extracts of six plants used traditionally in Kenya to treat skin diseases were investigated for antifungal activity against four dermatophytic fungi, *Trichophyton mentagrophytes*, *Microsporium gypseum*, *Trichophyton interdigitale*, *Epidermophyton floccosum* and the yeast *Candida albicans*. The antifungal activity was investigated by the disc diffusion assay and by serial dilution to determine the Minimum Inhibitory Concentration (MIC). The extract from *Margaritaria discoidea* fruits exhibited the highest inhibitory effects against all the test fungi with MIC of 0.625–2.5mg ml⁻¹ but

was not so active against *C. albicans*. Extracts from *Pergularia daemia* aerial parts did not inhibit the growth of any of the test pathogens.

NF- κ B inhibitors from *Valeriana officinalis* L., an important European medicinal plant

NJ Jacobo-Herrera, PD Bremner, S Gibbons and M Heinrich
Centre for Pharmacognosy and Phytotherapy, The School of Pharmacy, University of London, 29–39 Brunswick Square, London WC1N 1AX, United Kingdom

Valeriana officinalis L. is a well-known European medicinal plant. Among its historical uses is the treatment of inflammatory conditions such as throat inflammation, rheumatism, and varicose veins. However, its use in modern phytotherapy is restricted to the treatment of nervous conditions. So far, around 150 compounds have been isolated from this plant, and the search for their therapeutic profiles is still in progress. We have shown that *V. officinalis* is an inhibitor of the transcription factor NF- κ B, which is an important mediator of inflammation. One single isolated active compound, the sesquiterpene acetylvalerenolic acid, and several fractions with at least two compounds were found to be inhibitors of NF- κ B. Thus, this study provides biochemical evidence for the species anti-inflammatory traditional use in Ancient Europe.

Antioxidant activity of aloes

AK Jäger¹, KL Lindsey² and AM Viljoen³

¹ Department of Medicinal Chemistry, Royal Danish School of Pharmacy, 2 Universitetsparken, 2100 Copenhagen O, Denmark

² Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

³ Department of Pharmacy, University of the Witwatersrand, Faculty of Health Sciences, 7 York Road, Parktown 2193, South Africa

Aloes have been used medicinally since ancient times, often to cure burns and skin problems. Part of the activity could be due to antioxidant activity. Gel exudates of South African *Aloe* species were tested for inhibition of lipid peroxidation and in the diphenylpicrylhydrazyl (DPPH) free radical TLC assay. Most species had no inhibition of lipid peroxidation. *A. claviflora* had the highest inhibition at 57%. *A. thraskii*, *A. saponaria* and *A. cryptopoda* exhibited inhibition of 30% or higher. This level of inhibition is not very encouraging. Most of the species contained several compounds with free radical scavenging abilities according to the DPPH free radical assay. *A. claviflora* and *A. saponaria*, which inhibited lipid peroxidation, did not contain radical scavenging compounds. Based on these results aloes do not seem to be candidate plants to be exploited for antioxidant activity.

Micropropagation of *Geissorhiza radians*

AK Jäger, BG McAlister and J van Staden

Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

Geissorhiza radians (Thunb.) Goldbl. (Iridaceae) is a small species restricted to the winter-rainfall region of the Cape Province, South Africa. The inflorescence of the species is usually branched, about 16cm long and bears up to six flowers. The flowers are exceptional and will be exquisite in any garden, or in indoor bulb arrangements. *G. radians* was once fairly common, but is now rare and occurs only in protected wild flower reserves. As the plant is of economic importance, a micropropagation protocol was established. Corms, surface sterilised in 70% ethanol, 0.2% Benlate and 3.5% NaOCl, and sterile-grown seedlings were used as explants. The explants were placed on Murashige and Skoog medium supplemented with 30g l⁻¹ sucrose, 100mg l⁻¹ myo-inositol, 1mg l⁻¹ NAA and 2mg l⁻¹ kinetin, solidified with 0.8% agar. Multiple shoots developed from the corms and hypocotyl sections of the seedlings. Shoots were separated and rooted on hormone-free medium. Plantlets were successfully acclimatised in Genulite in the mist house for 10

days, then transferred to a soil:sand:vermiculite (1:1:1) mixture and subsequently grown in a green house.

A taxonomic revision of the *Gymnosporia mossambicensis* complex (Celastraceae: Celastroideae)

M Jordaan¹ and AE van Wyk²

¹ National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa

² HGWJ Schweickerdt Herbarium, Department of Botany, University of Pretoria, Pretoria 0002, South Africa

The *Gymnosporia mossambicensis* complex is considered monophyletic and ranges from Kenya to the Eastern Cape. Members are characterised by 3-locular capsules and seeds completely enveloped by an orange aril. Plants are suffrutices, shrubs or small trees, usually with spines, occasionally with conspicuous thread-like stipules. Twigs and peduncles are puberulous or glabrous. The flowers are white or red and the capsules globose, pyriform, or obconic-trigonous. Eleven species and four subspecies are recognised. Taxonomic changes include: *G. harveyana* Loes. [previously considered conspecific with *Maytenus mossambicensis* (Klotzsch) Blakelock] is reinstated and recognised as a distinct species; two species and one subspecies from Tanzania are newly described; *M. mossambicensis* var. *stolzii* N. Robson is treated as a subspecies of *G. harveyana* and *M. mossambicensis* var. *ambonensis* (Loes.) N. Robson becomes *G. gracilis* Loes.; five species and two varieties previously considered as belonging to *Maytenus* Molina s.l. are transferred to *Gymnosporia* and the two varieties raised to species level.

Antibacterial and antioxidant activity of some *Acacia* spp. in South Africa

DRP Katerere and JN Eloff

Phytomedicine Programme, Botany Department, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa

Acacia (Leguminosae) is an important genus in Africa, as a source of building timber, firewood, tannins and gums and animal feed especially during the drought periods. Despite their widespread occurrence, their use in traditional medicine appears to be restricted to a few species used widely in the treatment of abdominal and chest complaints. Little scientific work has been done to investigate the biological activity of *Acacia* species. We report here preliminary work to assay for the antibacterial and antioxidant activity of acetone and chloroform extracts of four species *A. karroo*, *A. xanthophloea*, *A. galpinii* and *A. sieberiana* growing in Pretoria. *A. sieberiana* extracts showed activity against *Staphylococcus aureus* at 2.5mg ml⁻¹, while *A. galpinii* extracts were active at 5mg ml⁻¹ against *S. aureus* and 2.5mg ml⁻¹ against *E. coli*. The acetone extracts showed antioxidant activity with DPPH. There is little intraspecific variation in chemical profiles on TLC.

Development of the City of Cape Town's Online Environmental Geo-database

RS Knight¹, L Smit² and G Benn³

¹ Department of Botany, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

² Environmental Management, City of Cape Town, PO Box 16548, Vlaeberg 8018, South Africa

³ Geographical Information Management Systems, PO Box 1286, Milnerton 7435, South Africa

For a number of years the City Administrations have been collecting large quantities of environmental and biological information, and are committed to make this information available to the broader scientific and environmental consulting communities. In 2000 the 'Environmental Significance Mapping' data were first released on CD for comment. Feedback indicated a need for metadata descriptions, and rationalisation of information into a smaller number of coverages and to make it more widely available. In July 2002, the City of Cape Town appointed UWC and GIMS to develop an Internet version, based on a MS SQL relational database. This Internet ver-

sion provides a full range of spatial tools (including identify features, standard query building, selecting features that intersect a line/rectangle/polygon, selecting within user-defined distance buffers and a full metadata description for each coverage), specific searches based on erf, street and suburb inputs and for the results to be overlaid onto high-resolution 1998 colour aerial photography.

Antimicrobial properties of cowpea (*Vigna unguiculata* (L.) Walp) leaf extracts

Q Kritzinger¹, N Lall² and TAS Aveling¹

¹ Department of Microbiology and Plant Pathology, University of Pretoria, Pretoria 0002, South Africa

² Department of Botany, University of Pretoria, Pretoria 0002, South Africa

Cowpea (*Vigna unguiculata* (L.) Walp), an indigenous African legume crop, is used to treat epilepsy, chest pains and constipation in children. Acetone and ethanol extracts of the leaves of Bechwana White (BW) and Kpodjigugue (Kpod) cultivars were investigated for their antimicrobial properties against bacterial and fungal pathogens. With the exception of *Fusarium equiseti*, all extracts significantly inhibited growth of the fungal pathogens at 5mg ml⁻¹. *Alternaria alternata* was significantly reduced by both BW extracts at 2.5mg ml⁻¹ whereas only the ethanol extract showed antifungal activity against *Fusarium proliferatum* at the same concentration. The acetone extract from Kpod significantly inhibited the growth of *Penicillium chrysogenum* at 2.5mg ml⁻¹. The acetone and ethanol extracts showed no inhibitory activity at 1.0mg ml⁻¹, except for *A. alternata*, which was inhibited significantly by the Kpod ethanol extract. No extracts showed any inhibitory activity against the Gram-positive and Gram-negative bacteria tested.

Traditional herbal medicine in community health care: the example of the Ch'orti, region in eastern Guatemala

JK Kufer and M Heinrich

Centre for Pharmacognosy and Phytotherapy, University of London, 29–39 Brunswick Sq., London WC1N 1AX, United Kingdom

The Ch'orti Maya in eastern Guatemala have been exposed to heavy pressure towards acculturation for centuries. However, much of their cultural traditions remain alive and show very interesting parallels to Mayan cultures. During 15 months of fieldwork, the use of medicinal plants as home remedies, by traditional healers and in a modern context was documented. In the town of Jocotan, a local program for natural medicine was initiated by the Belgian mission. Activities include medicinal plant gardens with regular group meetings and the small-scale production of phytotherapeutic preparations. The program has been successful, however it also faces challenges such as geographical variability of vernacular plant names, poor acceptance of phytotherapy and ethnomedical traditions by biomedical health care providers, and lack of information on the phytotherapeutic profile of most native medicinal plant species. The chances and challenges of integrating traditional phytotherapy into community health care will be discussed.

Microscopic identification of Chinese patent medicine — Wu Zi Yang Zong Wan

PW Lau, Y Peng and ZZ Zhao

School of Chinese Medicine, Hong Kong Baptist University, Kowloon Tong, Hong Kong, China

Wu Zi Yang Zong Wan is a classic Chinese medicine formula first recorded in 'Dan Xi Xin Fa' (AD1481) for treating deficiency syndrome of the kidney. It is now accepted by Chinese Pharmacopoeia, and is made by five pure, powdered Chinese *materia medica*. A microscopic study was carried out in order to contribute in establishing its quality control method. The standard crude drugs were supplied by the Herbarium of Chinese *materia medica* of Hong Kong Baptist University and the products of five manufacturers were checked. The following were selected as key characters for identification: stone cells of testa (*Fructus Lycii*), stone cells of epidermis of testa (*Fructus Schisandrae Chinensis*), Palisade cells of testa

(*Semen Cuscutae*), Hypodermal cells of testa (*Semen Plantaginis*), non-glandular hairs (*Fructus Rubi*). All the above named characters can be found in the products of five manufacturers and they were recorded by digital colour photography.

Gene cloning of a potential fungal virulence factor involved in anthracnose of lupin plants

T Lotter and DK Berger

Department of Botany, Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, Pretoria 2002, South Africa

Lupin plants (*Lupinus albus* and *Lupinus angustifolius*) play a crucial role in the feed industry of South Africa. Anthracnose disease, caused by a race of *Colletotrichum gloeosporioides* highly specific to lupins, can cause total crop loss. This work forms part of a study to understand the relationship between the lupin plant and the fungal pathogen. Polygalacturonases (PGs) produced by various phytopathogenic fungi, such as *C. gloeosporioides*, are often implicated as potential virulence factors. Degenerate PCR primers were designed from aligned conserved regions of different fungal PG sequences. Internal PG gene fragments were isolated from three *C. gloeosporioides* isolates. Sequence similarities, between the isolates, of cloned and direct PCR sequenced PG fragments, were as high as 91%. Similarity levels to other fungal PGs varied from 40–50%. Southern Blot analysis, performed with an internal PG fragment as probe, indicated that the gene was present as a single copy in the genome. Cloning of the full length PG gene by inverse PCR will facilitate testing the hypothesis that it is a virulence factor by interaction studies with plant PG inhibiting proteins.

Determination of patchouli alcohol in patchouli oil by GC/MS/MS

J Lu^{1,2}, ZH Jiang¹, ZZ Zhao¹

¹ School of Chinese Medicine, Hong Kong Baptist University, Kowloon Tong, Hong Kong.

² Department of Traditional Chinese Pharmacy, Liaoning College of Traditional Chinese Medicine, Liaoning 110032, Peoples Republic of China

A sensitive method for the determination of patchouli alcohol in patchouli oil has been established with the application of capillary GC/MS/MS. Quantitative analysis was carried by measuring the abundance of product ions of specific fragment of patchouli alcohol. The enhanced selectivity in the MS/MS eliminated the possible chromatographic interference in GC/FID measurement. Experimental conditions: capillary GC/MS/MS; ion trap mass spectrometer; precursor ion: m/z = 138, width: 1.0; product ion scan mass range: 50–150(m/z); LOQ: 0.099ng ml⁻¹; calibration range: 0.495–49.5µg ml⁻¹, correlation coefficient: 0.9996; the CV of intra-assay is 1.6% (four points in eight hours); the stability and repeatability of the method is good enough to satisfy determination. Result: the content of patchouli alcohol in Chinese patchouli oil is 15.2% (g/g). Conclusion: the application of capillary GC/MS/MS is convenient and accurate for the determination of patchouli alcohol in complex volatile oil.

Screening *Tulbaghia violacea* extracts for the presence of apoptotic compounds

SSL Lyantagaye and DJG Rees

Department of Biotechnology, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

★ Awarded joint first prize for best Poster by ISE

There are two ways in which cells die: either they are killed by injurious agents, or they are induced to commit suicide (apoptosis). Apoptotic cells shrink, develop bubble-like blebs on their surfaces, have the DNA in their nucleus degraded, and break into small, membrane-wrapped, fragments. Apoptosis is needed to destroy cells that represent a threat to the integrity of the organism, such as cells infected with viruses, cells with DNA damage, and cancer cells. Some DNA damaged cells develop ways of preventing apoptosis, leading to the formation of tumours. We are screening the plant

Tulbaghia violacea (bush garlic) for anti-cancer compounds. Scientific justification on the anti-cancer activity of this plant is crucial. We show the occurrence of apoptotic killing in CHO cells treated with extracts from *Tulbaghia violacea*, based on four analyses: 1) microscopy for cell shrinkage and membrane blebbing, cytometry for 2) phosphatidyl-serine translocation to the outer surface of the cell membrane and 3) caspase-3 activation and 4) agarose gel electrophoresis for fragmentation of chromosomal DNA. We are currently verifying the mechanism by evaluating cytochrome-c release from mitochondria to cytoplasm and PARP cleavage using flow cytometry. Purification towards characterisation of compounds that can be used in the development of anti-cancer drugs, using chromatography and spectroscopy is underway.

Treatment of HIV/AIDS using local plants

ML Magwa¹ and M Gundidza²

¹ Botany Department and Electron Microscope Unit, University of Fort Hare, Private Bag X1314, Alice 5700, South Africa

² Department of Pharmacy, University of Zimbabwe, PO Box MP 167, Mount Pleasant, Harare, Zimbabwe

Studies were carried out over the past 18 years to identify plants with HIV/AIDS activities. Those with biological activities were processed, the extracts formulated into finished products and then used for the treatment of patients inflicted with HIV/AIDS. Six major disease states were targeted, namely, the bacterial infections, fungal infections, suppressed immune system, the depressed body energetics, parasites, viruses as well as other opportunistic infections. The following plants were shown to be very useful in the treatment of HIV/AIDS programme: *Aloe excelsa*, *Swartzia madagascariensis*, *Kigelia africana*, a combination of *Holarrhena pubescens*, *Vernonia ampla* and *Bolusanthus species*; *Cassia abbreviata*, *Adansonia digitata*, *Alepidea amatymbica* and *Hypoxis optusa*. These plants are very useful when combined with other treatment programmes such as nutrition with special emphasis on mineral and vitamin supplements and regular intake of the right raw and well-cooked foods as well as fruit and vegetable juices, all of which can easily be obtained from local communities.

The chemical composition and antimicrobial properties of South African *Plectranthus* (Lamiaceae) species

K Maistry¹, AM Viljoen¹, SF van Vuuren¹, B Demirci² and KHC Başer²

¹ Department of Pharmacy and Pharmacology, Faculty of Health Sciences, University of the Witwatersrand, 7 York Road, Parktown 2193, South Africa

² Medicinal and Aromatic Plant and Drug Research Center (TBAM), Anadolu University, 26470-Eskişehir, Turkey

The genus *Plectranthus*, a member of the mint family, has a cosmopolitan distribution of 300 species worldwide of which 50 are indigenous to South Africa. Many members of this highly aromatic group of plants are used extensively by the Zulu to treat various respiratory disorders. Guided by both traditional use and chemotaxonomic criteria, 12 indigenous species were selected, the leaves hydrodistilled and the essential oils analysed by gas chromatography (GC) and GC coupled to mass spectrometry. Antimicrobial assays incorporating four bacteria, two yeasts and two fungi were performed on the essential oils. Disc diffusion assays on *Bacillus cereus* showed *P. grandidentatus* being the most active essential oil exhibiting inhibition (at 50mg ml⁻¹) comparable to that of the Neomycin control. Three species showed promising activity against *Bacillus* species; *P. ciliatus* accumulates bicyclo-germacrene (17%) and spathulenol (16%), *P. hadiensis* produces T-cadinol (27%), *d*-fenchone (18%) and cubenol (15%) as major compounds while *P. porphyranthus* produced cubenol (36%) as the major metabolite. A TLC bioautographic assay indicated that several essential oil compounds contribute to the observed antimicrobial activity.

Planar chromatography can be used to evaluate traditional phytomedicines

JV Manana and JN Eloff

Phytomedicine Programme, Botany Department, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa

There are problems in the herbal market with plants incorrectly identified by mistake or for financial reasons. It is difficult to identify a plant from the piece of bark, root or ground leaves that is sold in the market. A chemical fingerprint may however, have sufficient diagnostic characters to identify a plant species. We did a survey of plants sold in Pretoria traditional medicine (muthi) markets. Using standardised TLC (Thin Layer Chromatography) techniques involving three solvent systems with different polarity and pH as well as two spray reagents we could show that the bulk of plant material sold in muthi markets are the species they are purported to be. TLC analysis of bark of overexploited trees illegally collected can be identified for nature conservation control purposes. As least as far as *Artemisia afra* is concerned environmental factors had little effect on the chemical fingerprints of extracts.

In vivo and in vitro propagation of *Solanum retroflexum*

MC Mathabe¹, RV Nikolova¹, HJ Meyer² and PC Keulder²

¹ Botany Discipline, School of Molecular and Life Sciences, University of the North, Private Bag X1106, Sovenga 0727, Limpopo Province, South Africa

² Botany Department, School of Life Sciences, University of The North (Qwa-Qwa), Private Bag X13, Phuthaditjhaba 9866, Free State, South Africa

Solanum retroflexum, an indigenous species of the Solanaceae in South Africa, is of economic importance because of the edible and medicinal properties of its fruits and leaves. This study reports on *in vivo* and *in vitro* propagation findings of *S. retroflexum* and their possible commercial applications. *In vivo* propagation was achieved from seeds and stem cuttings. The percentage of seed germination showed dependence on light availability and the temperature of imbibition. Rooted stem cuttings proved suitable for hydroponics culture. Multiple shoots were induced *in vitro* from seeds when cultured on MS medium supplemented with 1mg l⁻¹ BA. High numbers of adventitious buds were induced from leaf explants cultured on MS medium containing 2µM BA. Rooting of elongated adventitious shoots was achieved on a hormone free ½ MS. *In vitro* plantlets were successfully acclimatised under controlled conditions. All *in vivo* and *in vitro* produced plants were established until fruit production stage.

Ex situ conservation of *Kniphofia leucocephala* via micropropagation

SA McCartan and J van Staden

Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

In South Africa, the density, distribution and genetic diversity of certain wild populations of plants are under threat from land use patterns. The red-hot poker, *Kniphofia leucocephala*, for instance, is now only found at one location, which is threatened by afforestation and grazing. *Ex situ* conservation through cultivation may alleviate pressures on wild populations whilst serving conservation interests. Thus, a continuous culture system was established as part of a programme for the propagation and re-introduction of plants into the wild. The efficiency of the system, however, was strongly influenced by the concentration of benzyl adenine (BA) in the shoot multiplication medium. The optimum shoot multiplication medium for subsequent root initiation contained 2mg l⁻¹ BA alone. The shoots were successfully rooted and acclimatised. Approximately 200 shoots can be produced from one shoot after five 4-week cycles.

Anatomy and morphology of *Nicotiana glauca*

ZM Mhinana¹, RM Cooposamy¹, ML Magwa¹ and M Gundidza²

¹ Department of Botany, University of Fort Hare, Alice 5700, South Africa

² Department of Pharmacy, University of Zimbabwe, Harare, Zimbabwe

Nicotiana glauca (Family Solanaceae) is one of the species of *Nicotiana*, of which *N. tabacum* and *N. rustica* are the best known sources of tobacco. *N. glauca* attains its greatest concentration and diversity in Central Argentina where it is considered native, and it has been known as a weed in South Africa since the 19th century. Extensive work on the toxic effect of secondary metabolites extracted from this plant was conducted but their sources of origin and structure were not known. The leaves of *N. glauca* were characterised by the presence of solitary crystals and crystal-sand which originated from the cytosol and vacuoles. The presence of the compact tissues, isobilateral leaf with thick-cuticular epidermis and abundant crystals was assumed to be of ecological importance as this species appeared to be adapted to the xeromorphic habitats. Anatomy and morphology of *N. glauca* are discussed in this paper.

The Manie van der Schijff Botanical Garden: a training facility in science education

L Middleton

Manie van der Schijff Botanical Garden, Department of Botany, University of Pretoria, Pretoria 0002, South Africa

The Manie van der Schijff Botanical Garden provides a wide range of material, facilities and space for the training of students in several departments of the Faculty of Natural and Agricultural Sciences. The garden plays an important role in the conservation of Southern African cycad species. Research on the horticultural potential of indigenous plants is an ongoing project. The garden creates a pleasant green environment for the recreation of staff, students and visitors, and the campus is beautified in a special way. The garden is open to individuals and groups other than university students. The new Discovery Centre of the university is surrounded by the garden, and the functioning thereof is complimented and enhanced by the Botanical Garden.

A study of aloin and gel cells in *Aloe* species and *Bulbine frutescens*

N Mngoma¹, B-E van Wyk¹, PM Tilney¹ and FR van Heerden²

¹ Department of Botany, Rand Afrikaans University, PO Box 524, Auckland Park 2006, Johannesburg, South Africa

² Department of Chemistry and Biochemistry, Rand Afrikaans University, PO Box 524, Auckland Park 2006, Johannesburg, South Africa

Two medicinal products (aloe bitters and aloe gel) are obtained from the leaves of *A. arborescens*, *A. ferox*, *A. marlothii* and *A. vera*. *Bulbine frutescens* lacks bitters but also contains a valuable gel. A comparative study was done to investigate the origin and structure of the secretory cells in the commercially important species. Similarities and differences are illustrated. Leaf phenolics were separated out using TLC and compared. The amount of gel solids was determined as an expression of the percentage of original mass. *Bulbine frutescens* showed the highest yield of gel solids followed by *A. arborescens*. *Aloe vera* and *A. ferox* had more or less the same yield and *A. marlothii* had the lowest yield.

Microscopic identification of Chinese patent medicine — Po Chi Pill

K Mok, WJ Zhang and ZZ Zhao

School of Chinese Medicine, Hong Kong Baptist University, Kowloon Tong, Hong Kong, China

Po Chi Pill is a commonly used Chinese patent medicine with an effect against gastrointestinal problems, and it is popular in South-east Asia. It is composed of 15 pure powdered Chinese *materia medica*. In order to authenticate its composition and establish the quality control method, microscopic identification was carried out.

The standard crude drugs were supported by the Herbalium of Chinese *materia medica* of Hong Kong Baptist University and samples of patent medicine were collected from HK market manufactured by Li Chung Shing Tong and five lots were observed. Microscopic characteristics of each crude drug were recognised in the pill and were recorded by color photography. The characteristics are: Herba Pogostemonis, non-glandular hair; Radix Angelicae Dahuricae, druses of calcium oxalate; Cortex Magnoliae Officialis, ramiform stone cell; Rhizoma Atractylodis, corky sclereid, raphides of calcium oxalate etc.

Relation between the tannin and carbohydrate content and the resistance of nine *Eucalyptus* species against *Gonipterus scutellatus*

R Moleki¹, I Regnier² and P Govender¹

¹ Department of Zoology and Entomology, University of Pretoria, Pretoria 0002, South Africa

² Department of Microbiology and Plant Pathology, University of Pretoria, Pretoria 0002, South Africa

The *Eucalyptus* species are of great economic importance in South Africa. They represent major timber resources. In Kwazulu-Natal some of the species are susceptible to insect damage, which decrease the productivity of the plantation. Plants have an extraordinary array of chemicals (tannins), which are thought to defend plants from herbivores. This study is a report on the importance of tannin and carbohydrates content in resistance of *Eucalyptus* against *Gonipterus scutellatus*. Nine *Eucalyptus* species were screened in the experiment. Soluble tannins were quantified with the Hagerman test and carbohydrates with a refractometer. During 2002, *Eucalyptus* species with a high level of tannin appeared to be more resistant to defoliation than species with low tannin content. In contrast low carbohydrate content was found in the resistant species. These results should be repeated over the year 2003.

Distribution of inorganic solutes in leaves of *Sporobolus virginicus* using multiple techniques

Y Naidoo¹ and G Naidoo²

¹ Electron Microscope Unit, University of Durban-Westville, Durban 4000, South Africa

² Discipline of Botany, University of Durban-Westville, Durban 4000, South Africa

Sporobolus virginicus L. (Kunth) (Poaceae), a halophytic, stoloniferous, perennial grass that is widely distributed along the coast of South Africa, possesses salt glands that actively secrete salt. Information on the elemental distribution of Na⁺ and Cl⁻ could provide clues on the localisation and pathway of ion transport and contribute to an understanding of salt tolerance mechanisms in halophytes. In this study, the subcellular distribution of elements in the leaf blade tissues was determined by means of nuclear microprobe analysis. Cross sections of the mid-region of living flag leaves were cut by hand with dry razor blades, frozen rapidly in isopentane, cooled with liquid nitrogen and freeze-dried at -60°C at a vacuum of 10⁻² Torr for 5d. Elemental distribution maps of Na⁺, Cl⁻, K⁺, Mg²⁺ and Ca²⁺ were made with two complementary techniques, Proton Induced X-ray Emission (PIXE) and Proton Back-Scattering (BS). The leaf surface of *S. virginicus* is undulating with ridges alternating with deep grooves. On the ridges are numerous trichomes, as well as secreted salts. Salt glands occur predominantly on the adaxial surface and are uniformly localised along the flanks of the veins. PIXE and BS analysis revealed that Cl⁻ was present in all leaf tissues, the concentration being highest in the mesophyll tissue on the adaxial side in close proximity to the salt glands. High concentrations of Cl⁻ were also found on the abaxial side of the leaf in close proximity to the groove where glands are located. Sodium, like Cl⁻, was distributed throughout the leaf blade, concentrations being highest on adaxial and abaxial leaf tissues where glands occur. There was heavy enrichment of K⁺ in all leaf tissues. Calcium and Mg²⁺ were present in lower concentrations than those of Cl⁻, Na⁺ and K⁺. This study demonstrated that Na⁺ and Cl⁻ occur in high concentrations in close proximity to the salt glands.

Optimisation experiments for *Arabidopsis* cDNA Microarrays

S Naidoo¹, D Theron¹, S Walford², SL Murray², KJ Denby² and DK Berger¹

¹ Department of Botany, Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, Pretoria 0002, South Africa

² Molecular and Cell Biology Department, University of Cape Town, Private Bag, Rondebosch 7701, South Africa

We are interested in the global gene expression patterns in the model plant thale cress (*Arabidopsis thaliana*), particularly in response to pathogen attack. For this purpose, cDNA microarrays are being employed. It is important that the microarray procedure is robust as results between diverse research groups should be comparable. To date, collaborative experiments between the two Microarray facilities in South Africa indicate that high throughput 96-well PCR directly from bacterial culture, and subsequent purification using the Millipore MultiScreen^{PCR} system works optimally. Excellent spot morphology was attained using filter-sterilised 50% (v/v) DMSO as spotting buffer and DNA concentrations above 250ng µl⁻¹. First strand fluorescent labelling is favourable from purified total RNA, while Post-labelling works optimally on isolated mRNA. Using a selection of 500 *Arabidopsis thaliana* genes involved in plant defence response, experiments are being conducted to compare gene expression between wild-type *Arabidopsis* plants and a mutant, which shows enhanced disease resistance.

Ethnobotanical studies in ethnic minority communities in southern Italy

SM Nebel, A Pieroni and M Heinrich

Center for Pharmacognosy and Phytotherapy, The School of Pharmacy, University of London, 29/39 Brunswick Square, London WC1N 1AX, United Kingdom

Ethnic minorities in Europe are, as on other continents, a social-cultural asset in development and require support for their sustainable development. In two such communities in southern Italy ethnobotanical research has been carried out focusing on the use of wild food plant species: Arbereshe Albanian communities in Lucania, and Greek communities in Calabria. In both ethnic groups, with diverse historical background, their ancestral language is, next to the local Italian dialect, still spoken by a few elderly inhabitants. More than one hundred botanical species used as food have been identified with the Arbereshe. Additionally, some of the wild food plants used in the traditional diet are considered to be healthy because of their bitterness, as for example young leaves of *Cichorium intybus* and *Chondrilla juncea*, and bulbs of *Leopoldia comosa*. The tradition-based nature of these ethnic islands is likely to offer important inputs for further inter- and intra-ethnic comparative studies.

Towards transgenic *Pinus patula* with *uidA* and *bar* genes resulting from microprojectile bombardment of embryonal suspensor masses (ESM)

SA Nigro¹, NP Makunga¹, NB Jones² and J Van Staden¹

¹ Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

² Sappi Forests Research, PO Box 473, Howick 3209, South Africa

★ Awarded Local Organising Committee Book Prize for best Poster presentation in Physiology

Deforestation has prompted scientific and commercial focus to improve genetic stocks of timber. *Pinus patula* is one of the most important softwood species for pulp production with 375 000ha planted. We established a protocol for the introduction of herbicide resistance to *Pinus patula* embryogenic tissue through particle bombardment with the pAHC25 plasmid. This construct contains the GUS reporter gene and the herbicide resistance gene, *bar*, each under the control of a maize ubiquitin promoter (*Ubi1*). Diphasic selection was achieved using solid MSG3 supplemented

with BASTA[®] herbicide. Bombarded material was regenerated through to maturation stages I, II, III and IV. Transgene delivery was more efficient when pre-bombardment medium and higher vacuum and pressures were utilised. PCR analysis indicated the transformation of *Pinus patula* embryonal suspensor masses by the pAHC25 plasmid.

A comparative study of *Lippia javanica* and *Lippia triphylla*

NR Nogayi¹, PV Cimi¹, ML Magwa¹ and M Gundidza²

¹ Botany Department and Electron Microscope Unit, Faculty of Science and Technology, University of Fort Hare, Alice 5700, South Africa

² Department of Pharmacy, University of Zimbabwe, Harare, Zimbabwe

The South African flora is very rich and diverse, and the indigenous population has a vast heritage of traditional healing with medicinal plants. With South Africa's remarkable bio-diversity and cultural diversity, it is not surprising to find that approximately 3 000 plant species are used as complementary medicines more often than the orthodox medicines. Commodities such as botanical pesticides, herbs, essential oils and medicinal plants have long been valued for their unusual chemical components, known as secondary metabolites, which give the plants their specific characteristics such as the flavor, the odour and medicinal qualities. Unfortunately, such information has been gradually disappearing with the advancing tide of Western civilisation, which came with its synthetic products. It is only very recently that most people have realized how rich African lore is in its indigenous plant utilisation. It is on this basis that we directed our research towards the comparative study of *Lippia javanica* and *Lippia triphylla*. The preliminary comparative study is reported in this poster.

Relation between the soluble phenolic content and the resistance of nine *Eucalyptus* species against *Gonipterus scutellatus*

S Ntiyantiya¹, T Regnier² and P Govender¹

¹ Department of Zoology and Entomology, University of Pretoria, Pretoria 0002, South Africa

² Department of Microbiology and Plant Pathology, University of Pretoria, Pretoria 0002, South Africa

In South Africa the genus *Eucalyptus* plays an important role as a major economic component in the forestry and mining sector. Unfortunately this genus has problems due to damage by pests. There are many susceptible and resistant species but no early screening can be done to select the right clone. The present study is a report on the importance of the amount of phenolic compounds in the resistance of *Eucalyptus* against *Gonipterus scutellatus*. Nine species were used for the experiment. Total soluble phenols were quantified with Folin Ciocalteux reagent. Over the year, *Eucalyptus* species with a high level of soluble phenols appeared to be more resistant to defoliation than species with low soluble phenolic content. These preliminary results for the year 2002 need to be repeated over the year 2003. This technique could help the forestry industry to improve the selection of eucalyptus species.

Isolation of DNA sequences indicative of tolerance to temperature stress from the inland grass *Monocymbium cerasiiforme*

MC Onanena, C van der Vyver, MM van der Merwe and KJ Kunert

Forestry and Agricultural Biotechnology Institute, Botany Department, University of Pretoria, Pretoria 0002, South Africa

Stress can alter the genomic composition of a plant and a genome change might be vital for a plant in order to survive in a stressful environment. In this study Representational Difference Analysis (RDA), which is a subtractive DNA technology, has been used to identify DNA sequences indicative of temperature tolerance in the genome of the inland grass species *Monocymbium cerasiiforme* from a non-frost and severe frost area in South Africa.

Genomic differences have been found in the genomes of the two types of grasses and isolated DNA sequences representing these differences are currently characterised using bioinformatic tools. One product characterised so far showed homology to the part of the LTR region of the wheat retrotransposon *Tar1*. This LTR sequence might have changed due to exposure to temperature stress during evolution. All identified difference sequences are ultimately tested for their potential as genetic markers for temperature tolerance.

Ethnobotany of Sikkim Himalaya (India)

S Panda¹ and SC Mandal²

¹ Department of Botany, Charu Chandra College, 22 Lake Road, Calcutta 700029, West Bengal, India

² Division of Pharmacognosy and Phytochemistry, Department of Pharmaceutical Technology, Jadavpur University, Calcutta 700032, West Bengal, India

An ethnobotanical survey in the Sikkim Himalaya (altitudinal range 1 500–2 500m) was carried out covering areas, such as, Gangtok, Vortuk, Rongli, Shishni, Mangan, etc. The investigation recorded the use of 45 plant species, based on information given by the tribal medicine-men, old villagers and resourceful individuals. Various uses of these angiospermic plants, for example, medicinal, food and beverage, fodder, magico-religious, dye, paper making, poison, etc. were accounted for. Flowering and fruiting time, local names, etc. were also noted. Medicinally very rich species were: *Acorus calamus* L., *Drymaria cordata* (L.) Willd. ex Roem. Et Schult., *Eupatorium adenophorum* Spreng., *Hydrocotyle nepalensis* Hook., *Hydrocotyle sibthorpioides* Lam., *Mahonia napaulensis* DC., *Sonchus wightianus* DC. subsp. *wightianus*, *Zanthoxylum armatum* DC., etc. The study will facilitate better understanding of the impact of tribal acculturation on their surrounding vegetation and natural resources, socio-biology, medical botany, ethno-pharmacology and various other traditional and emerging disciplines, and indeed, will back the conservation and management programmes of these species.

Fructus Lycii (Gou Qi Zi): from its ethnopharmacology study towards modern utilisation

Y Peng¹, ZZ Zhao¹ and PG Xiao²

¹ School of Chinese Medicine, Hong Kong Baptist University, Kowloon Tong, Hong Kong, China

² Institute of Medicinal Plant Development, Chinese Academy of Medical Sciences, Beijing 100094, Peoples Republic of China

Fructus Lycii (Gou Qi Zi) is the dried fruit of *Lycium barbarum* L. which belongs to the family Solanaceae. It has been used as both food and medicine for more than two thousand years in China, and it is officially listed in the Chinese Pharmacopoeia. Ethnopharmacologically, this drug is widely used as a tonic for the treatment of general debility with deficiency of vital essence. Its main function is to replenish vital essence and improve eyesight. In traditional Chinese medicine, it has been extensively documented as a favourite ingredient in recipes for elderly people. Chemically, it contains polysaccharides, which are the active principles with immunostimulating activities, and carotenoids representing eyesight improvement. Modern pharmacological studies have demonstrated its immunological functions and antiaging activities. Modern utilisation of Fructus Lycii includes its use as a health food and its further preparation could be used as immuno-stimulating, immuno-modulatory agents and eyesight improvement agent.

Cell proliferation of cancer cells in the presence of essential fatty acids combined with steroids and phytoestrogens

SE Prinsloo, V Steenkamp and MS Bornman

Department of Urology, Faculty of Health Sciences, University of Pretoria, Pretoria 0002, South Africa

Consumption of the omega-3 and -6 as well as phytoestrogens

could play a preventative role or have beneficial effects during treatment of prostate and breast cancer. Hormone therapy is still a gold standard in the treatment of certain cancers and therefore the aim of this study was to investigate the possible synergistic or antagonistic effect of essential fatty acids (EFAs) and phytoestrogens combined with estrogens and androgens on prostate and breast cancer cells *in vitro*. The estrogens, estradiol and diethylstilbestrol at high concentrations decreased the cytotoxicity of eicosapentanoic and γ -linolenic acid. In contrast, tamoxifen, an antiestrogen did not show any effect and nor did testosterone, dihydrotestosterone or the anti-androgen flutamide. No effect was seen with the parent EFAs α -linolenic acid (n-3), linoleic acid (n-6) or the non-essential oleic acid. Phytoestrogens inhibited cell proliferation in both cancer cell lines. Phytoestrogens and EFAs seem to be beneficial in inhibiting prostate and breast cancer cell proliferation.

Toxicity of flavonoids, natural products and chemicals to *Guignardia citricarpa* Kiely

T Regnier, PM Labuschagne, G Swart and L Korsten

Department of Microbiology and Plant Pathology, University of Pretoria, Pretoria 0002, South Africa

Citrus black spot (CBS) is one of the most serious fungal diseases affecting citrus fruit. It was postulated that CBS was more severe in cultivars where low antifungal compounds like limonene and citrus oil were found in the rind tissue. Latent infections increase the risk of contamination to countries where CBS doesn't occur, such as Europe. The optimal temperature for pycnidiospore germination was 20–25°C. All chemicals and natural products tested inhibited germination at the commercially recommended concentrations. The minimum concentration required varies according to the type of compound but indicates that leaf and fruit flavonoids are definitely part of the citrus defence system against CBS. The use of natural products with antifungal activities could improve disease management strategies, especially at the postharvest level. Further studies on the effectiveness of the natural products under semicommercial packline conditions could be useful and will provide a better understanding of the control of CBS.

Extensive pharmacological and phytochemical investigation of the Sterculiaceae

KA Reid¹, AK Jäger² and J van Staden¹

¹ Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3201, South Africa

² Department of Medicinal Chemistry, Royal Danish School of Pharmacy, 2 Universitetsparken, 2100 Copenhagen O, Denmark

The family Sterculiaceae is an important group of medicinal plants, with well documented traditional usage in southern Africa and the rest of the world. Little is known about the pharmacology and phytochemical properties of the South African species. Seven species were investigated, these were *Dombeya rotundifolia*, *D. burgessiae*, *D. cymosa*, *Cola greenwayi*, *C. natalensis*, *Hermannia depressa* and *Sterculia murex*. Anti-bacterial (MIC) and anti-inflammatory (COX-1) activity was determined for all species, and several anti-bacterial compounds were isolated.

Analysis of *Hypoxis hemerocallidea* (African potato) and related phytomedicines for industrial and clinical applications

AC Retief¹, JN Eloff¹ and R van Drummelen²

¹ Phytomedicine Programme, Botany Department, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa

² Biomox Pharmaceuticals, PO Box 26033, Gezina 0031, South Africa

Phytosterols are plant-derived compounds with many therapeutic indications e.g. immune modulation, hypercholesterolaemia and benign prostatic hyperplasia. We used TLC to determine optimal extraction method of sterols and HPLC to quantify sterols in plant material, products and serum. Chloroform was the best extractant

for sterols from plant material and serum. The extracts were dried and redissolved in methanol before HPLC analysis. Sterol levels were determined in *Hypoxis hemerocallidea*, *Pygeum africanum*, *Serenoa repens* and related products stored at 40°C for up to 12 months and gamma irradiated at different levels up to 28.5 kGray. Sterols were stable in pure form, but degraded in complex plant mixtures over time, with increased temperature and when irradiated. The HPLC-UV method to determine the bioavailability of β -sitosterol in *Pygeum africanum* extract in human serum was not sensitive enough with a detection limit of 2 $\mu\text{g ml}^{-1}$. We could determine shelf life and expiry date of phytosterol products.

The genus *Wellstedia* in southern Africa

E Retief¹ and AE van Wyk²

¹ National Herbarium, National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa

² HGWJ Schweickerdt Herbarium, Department of Botany, University of Pretoria, Pretoria 0002, South Africa

Balfour described *Wellstedia* in 1884 following a visit to Socotra. He believed that *W. socotrana* Balf.f., the only species recognised at the time, had its closest affinity with Boraginaceae. Six more species are now recognised in Somalia, Ethiopia, Namibia and South Africa (Northern Cape). Only one species, *W. dinteri* Pilger with two varieties, *W. dinteri* var. *dinteri* and *W. dinteri* var. *gracilior* Hunt, occurs in southern Africa. The genus is usually treated as a subfamily within Boraginaceae, but is sometimes placed in a separate family, Wellstediaceae. *Wellstedia* is characterised by a dwarf shrub habit, densely hairy leaves, 4-merous flowers, a terminal style and a 1- or 2-seeded capsule. Morphological characters show strong similarity to genera of the Ehretioideae and also to members of the family 'Hydrophyllaceae'. The disjunct distribution pattern of the genus is usually explained by the postulation of an arid corridor that existed during arid phases of the Pleistocene.

The effect of treatment (spray) with electrically activated sodium bicarbonate on growth and quality of hydroponically grown tomatoes and lettuce

I Risenga and CS Whitehead

Department of Botany, Rand Afrikaans University, PO Box 524, Auckland Park 2006, Johannesburg, South Africa

Lettuce (*Lactuca sativa*) and tomatoes (*Lycopersicon esculentum*) are important commercial crops. Most high quality lettuce and tomatoes grown for the local and export markets are grown hydroponically. In this study, electrically activated sodium bicarbonate solution was used as a spray-on solution to improve growth of hydroponically grown butter lettuce and tomatoes. This solution also has anti-microbial properties that may reduce the need for treatment with fungicides. Sodium bicarbonate is a ready source of carbon dioxide. By using a novel technique developed by Radical Waters, ionised bicarbonate can be produced from sodium bicarbonate and applied to plants to stimulate photosynthesis to improve yield and postharvest quality. The effect on growth, yield and postharvest quality was studied by measuring growth rate, total yield, respiration, ethylene production, heat production, moisture loss, sugar content, longevity and moisture retention. The effect of treatment on growth, yield and postharvest quality will be discussed.

Inducing a polyploid state in *Sparaxis tricolor*

C Robinson and L O'Reilly

Department of Botany, Rand Afrikaans University, PO Box 524, Auckland Park 2006, South Africa

The genus *Sparaxis* belongs to the family Iridaceae subfamily Ixioidae and comprises 15 species, which are indigenous to the South Western Cape of South Africa. All *Sparaxis* species have attractive flowers united in several flowered spikes with a great array of colours, but relatively short scapes. *S. tricolor* is diploid having $2n = 20$ chromosomes and has the potential to become a new Freesia-like cut flower crop. Floriculture is always receptive to new

crops and since polyploid plants are often more vigorous than their diploid relatives, polyploidy is commonly used in plant breeding. A polyploid can be larger flowered and more intensely coloured. Since we have seen that polyploid plants can be superior, it is a natural instinct to use the technology we have developed to chemically alter the chromosome counts. Polyploidy was induced by treating *S. tricolor* seeds with an antimetabolic agent that blocks or suppresses cell division by inhibiting mitosis. Tetraploid ($2n = 4x = 40$) plants were obtained and used in a comparative anatomical study with diploid plants. Promising results have been obtained and will be presented.

In vitro multiplication of *Colophospermum mopane*

T Rubuluzi¹, RV Nikolova¹, DCJ Wessels¹ and MT Smith²

¹ Botany Discipline, School of Molecular and Life Sciences, University of the North, Private Bag X1106, Sovenga 0727, Limpopo Province, South Africa

² School of Life and Environmental Sciences, University of Natal, Durban 4041, South Africa

Colophospermum mopane (Leguminosae) is one of the most economically and ecologically important shrub/tree species distributed in sub-tropical southern Africa where it is known under different vernacular names for its ethnobotanical and medicinal uses. Non-sustainable harvesting of mopane throughout SADC countries has contributed to land degradation and desertification. This study was undertaken to produce an effective protocol for multiplication of plants of *C. mopane*. Multiple shoots were induced from seeds in tissue culture on MS medium after imbibition with GA_3 (100 mg l^{-1}) for 24 hours. The rooting ability of adventitious shoots were tested using either elongated shoots on a hormone-free 1/8th strength MS medium or in the presence of kinetin and benzyladenine, at different concentrations, in a hormone grid experiment. Best results were achieved by direct rooting of elongated shoots on 1/2 strength MS medium containing 5 mg l^{-1} IBA. *In vitro* rooted plantlets were successfully hardened off on sterile vermiculite under controlled conditions.

Assessing the risk for increased invasion of the giant reed, *Arundo donax*, in South Africa

I Samuels and RS Knight

Department of Botany, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

The giant reed, *Arundo donax*, is a potentially serious invader of South African aquatic ecosystems and a known ecosystem transformer in other countries where it has invaded. Although proclaimed a Category 1 invader species under the Conservation of Agricultural Resources Act of 1983, which requires landowners to eradicate it from their properties, it is a common feature of our river systems. Its superficial similarity to the naturally occurring reed *Phragmites australis* has possibly allowed its invasion to be largely undetected. Nevertheless its known distribution in the Southern African Plant Invaders Atlas (SAPIA) illustrates its potential to invade almost every river in South. Using its known distribution patterns from the SAPIA in relation to climatic information extracted from the South African Atlas of Agrohydrology and Climatology, we investigated using raster GIS and regression techniques whether it can have the potential to invade all parts of South Africa.

Heavy metal accumulation by plants in Sekhukhuneland, South Africa: a preliminary report

SJ Siebert¹ and AE van Wyk²

¹ SABONET, Private Bag X101, Pretoria 0001, South Africa

² Department of Botany, University of Pretoria, Pretoria 0002, South Africa

Heavy metal soils, and associated plant accumulation or exclusion mechanisms, are thought to be one of the main forces driving plant evolution and resultant endemism in areas underlain by ultramafic rocks. Studies were conducted in the Sekhukhuneland Centre of Endemism (SCE) to determine whether the plant species growing on its ultramafic substrates accumulate heavy metals. Common heavy metals in the rocks of this region were investigat-

ed and analytical techniques were used to determine their concentrations in selected plant and soil samples. The analyses included Cr and Ni (surface rocks in the SCE contain the world's highest concentrations of these two elements), Al (most abundant metal in the world's soils), Fe, Mn and Va (extensively mined in the SCE), Ca and Mg (ultramafic soils have high concentrations), and N, P and S (ultramafic soils have low nutrient levels). No plants were found to accumulate Cr and Ni, but some taxa hyper-accumulated Fe and Al.

Harvesting of woodland resources by 'outsiders, in ten rural villages in South Africa

MV Siphugu¹ and WC Twine²

¹ Department of Biological Sciences, University of Venda, Private Bag X5050, Thohoyandou 0950, South Africa

² Centre for African Ecology, Wits University Rural Facility, Private Bag X420, Acomhoek 1360, South Africa

The impact of non-local harvesters on woodland resources from ten rural villages in South Africa was investigated. In all the ten villages the communities were concerned at the rate in which 'outsiders' (harvesters from other villages or towns) were drawing resources from their communal land. The most commonly harvested resources were wood for fuel and medicinal plants. Harvesters predominantly came from the neighbouring villages, although in the case of medicinal plants and wood for carving and making furniture, urban collectors were reported. The outflow of resources from the villages was reported to be increasing since the 1994 democratic elections. This uncontrolled and increasing outflow of resources seems to be unsustainable, and the implications thereof will be discussed in this poster.

Comparison of the antibacterial activity of *Pinus nigra* seed cones and foliage

ECJ Smith, CM Priestley, S Gibbons and EM Williamson

Centre for Pharmacognosy and Phytotherapy, The School of Pharmacy, University of London, 29–39 Brunswick Square, London WC1N 1AX, United Kingdom

Plants from the *Pinus* genus have been used in traditional medicine as antiseptics and to treat respiratory complaints, colds and sore throats. Pine resin, cones and needles are known to contain various types of antimicrobial and antiviral compounds. We have investigated the antibacterial activity of *P. nigra* seed cones and leaves (needles) against multidrug-resistant and sensitive *Staphylococcus aureus*. A cone extract showed the highest antibacterial activity, whereas surprisingly the leaf (needle) extracts were inactive. Using TLC, partial purification of the major band followed by NMR showed that abietic acid is the likely main active component. Abietic acid is known to have anti-inflammatory and some antimicrobial activity. Minimum inhibitory concentration assays on pure abietic acid and the cone hexane extract gave very similar values (50–64 µg ml⁻¹) indicating that other compounds contribute to this activity. Investigations into their nature and interaction are underway, including tests against other pathogenic staphylococci.

Studies on the effect of human impact on soil and vegetation in Potchefstroom, following an urbanisation gradient approach

JP Smith, SS Cilliers and L van Rensburg

Section Botany, School of Environmental Sciences and Development, Potchefstroom University for Christian Higher Education, Potchefstroom 2520, South Africa

Urban ecological studies have increased immensely over the last decade, mainly caused by an increase in the population density of cities. Although several studies have been conducted on the biodiversity of urban biota, not enough emphasis was placed on the relation between biota and important edaphic characteristics. The aim of this project was to establish the existence of possible correlations

between physical and chemical soil properties that typify differentially urbanised environments to assess both their potential phytotoxicity and movement due to ecological processes. A comparative approach was followed, using an urbanisation gradient. Gradient theory is well-established and fundamental in ecology providing a powerful analytical tool for comparing ecosystem structure and function. The historic zonation of South African cities makes it difficult to clearly establish the gradients along areas which are urban, suburban and rural. The urban biotope mapping approach based on land-use and vegetation structure, was additionally followed to select areas to be studied. After analysing the data by means of multivariate statistics clear correlations were found to exist, amongst others, between the presence of specifically copper and boron in environments acidified by industrial activity.

Affects of storage and accelerated ageing on the chemical composition and biological activities of frequently used South African medicinal plants

GI Stafford¹, J van Staden¹ and AK Jäger²

¹ Research Centre for Plant Growth and Development, School of Botany and Zoology, University of Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

² Department of Medicinal Chemistry, Royal Danish School of Pharmacy, 2 Universitetsparken, 2100 Copenhagen O, Denmark

Plant materials from eight popular South African medicinal plants were stored for three and twelve months respectively and changes in chemical composition and biological activity then determined using TLC-fingerprinting and *in vitro* bioassays. The COX-1 anti-inflammatory bioassay, minimum inhibitory concentration microtitre-plate antibacterial bioassay and the bio-autographic bioassay were used to determine changes in biological activity. Changes in chemical composition and biological activity were mainly observed after one year of storage. In general there was a marked decrease in anti-inflammatory activity and in most cases no change or even an increase in antibacterial activity. This was accompanied by visual changes in chemical composition on TLC-fingerprints and antibacterial bio-autographic plates. Accelerated ageing studies (storage at high temperature and high humidity) were subsequently conducted on two plants. This method proved successful in speeding up the ageing process and provided further insight into the changes that occurred during storage.

Structure elucidation of chromone c-glycoconjugates in a toxic herbal remedy

V Steenkamp¹, MJ Stewart², VA Luyckx³, W Wang⁴ and M Claeys⁴

¹ Department of Urology, University of Pretoria, Pretoria 0002, South Africa

² University of the Witwatersrand Medical School, Johannesburg 0001, South Africa

³ Departments of Chemical Pathology and Renal Medicine, South Africa

⁴ University of Antwerp, Department of Pharmaceutical Sciences, B-2610 Antwerp, Belgium

Herbal remedies (muthi) are traditionally used in South Africa for various health purposes. The present study deals with the phytochemical characterisation of a muthi of unknown plant origin that caused severe vomiting. For structure elucidation, mass spectrometry (MS) was used in combination with nuclear magnetic resonance (NMR) spectroscopy. Based on detailed interpretation of MS and NMR data, the major components of the muthi were characterised as: 2-carboxyl-8-β-D-glucopyranosyl-7-hydroxy-5-methylchromone and its 2'-O-p-coumaroyl derivative. These compounds are structurally closely related to aloesin and aloeresin A (or 2'-O-p-coumaroyl aloesin), which are chemotaxonomic markers of *Aloe capensis*. Since the compounds characterised in the muthi have previously not been reported in *Aloe* species, we propose that they were formed from aloesin and aloeresin A by oxidation during preparation or storage of the muthi from *Aloe capensis* powder. These data indicate again the difficulties in characterising the active principles of South African traditional remedies.

The effect of traditional remedies on oxidative DNA damage

V Steenkamp¹, MJ Stewart², S Makhubela³ and M Gulumian³

¹ Department of Urology, University of Pretoria, Pretoria 0002, South Africa

² Department of Chemical Pathology, University of the Witwatersrand, Johannesburg, South Africa

³ National Centre for Occupational Health, South Africa

The use of traditional remedies as alternative medicines plays a significant role in South Africa. The majority are harmless, however, a few are toxic and some may be carcinogenic. One of the factors which can lead to carcinogenesis is damage to DNA by active radicals. Oxidative damage can also be produced by the reactive products of lipid peroxidation. We wished to investigate the possible genotoxic and carcinogenic properties of traditional remedies by measuring their ability to damage DNA. Traditional remedy extracts were tested for toxicity to human peripheral blood mononuclear cells assessed by trypan blue and for genotoxicity by the Comet assay. The peroxidation of cellular membrane lipids was assessed with diphenyl-1-pyrenylphosphine. There were profound differences between the different extracts. The range of effects, which varied from highly toxic to protective, indicates that much more investigation is required to be done before each of these remedies is given official approval.

Uses of the African cherry (*Prunus africana*) in the region of Mount Oku, Cameroon

KM Stewart

Keith and Schnars, 4803 NW 9th Avenue, Pompano Beach, 33064, United States of America

I studied the uses of the African cherry (*Prunus africana*) among four ethnic groups near the Kilum-Ijim Forest Preserve on Mount Oku, Cameroon. *P. africana* is an important wildlife food and it is valued for its timber, which is used for tool handles and for firewood. By far, its greatest value is as a traditional medicine for human and animal ailments. Its bark and leaves are used for over 30 human ailments and it is the most important plant used by traditional healers. This study is the first to document the species' use in the treatment of domestic animal diseases. My other studies have shown bark harvest is detrimental to the species. Demand for the herbal product is only expected to increase, putting additional pressure on remaining populations. This demand could reduce the numbers of trees and threaten traditional uses. Management research is needed to protect the species for both western and traditional uses.

The effect of the atropinically produced phytotoxic C₂-chlorohydrocarbon metabolite, trichloroacetic acid, on photosynthesis of crop plants

AJ Strauss, PDR van Heerden and GHJ Krüger

School for Environmental Sciences and Development, Section Botany, Potchefstroom University for Christian Higher Education, Potchefstroom 2520, South Africa

TCA which was used as a herbicide in the 1950's, is still produced today as a byproduct of various industrial activities which release C₂-chlorohydrocarbons such as tetrachloroethene and trichloroethane into the atmosphere. During their transport through the air, these compounds are exposed to oxidative, photolytic and hydrolytic processes resulting in the formation of phytotoxic TCA, which is deposited on vegetation. On the other hand, volatile TECE or TCE may be converted to TCA in the plant itself. TCA inhibits the growth of both roots and shoots, but little is known about its effect on susceptible processes such as photosynthesis. When exposed to different TCA-concentrations under controlled growth conditions, *Phaseolus vulgaris* and *Zea mays* exhibit initial stimulation in both growth and primary photochemistry at very low concentrations, but large decreases at higher concentrations. Assaying the activity of the key-enzyme Rubisco, revealed decreases in activity upon exposure to TCA. These findings suggest that TCA has an inhibitory effect on crucial processes in photosynthetic metabolism.

Antimicrobial properties and geographical variation in essential oil composition of fever tea, *Lippia javanica* (Verbenaceae)

S Subramoney¹, SF van Vuuren¹, AM Viljoen¹, B Demirci² and KHC Başer²

¹ Department of Pharmacy and Pharmacology, Faculty of Health Sciences, University of the Witwatersrand, 7 York Road, Parktown 2193, South Africa

² Medicinal and Aromatic Plant and Drug Research Center (TBAM), Anadolu University, 26470-Eskişehir, Turkey

Lippia javanica is extensively used in herbal preparations as a decongestant, for colds and coughs. The essential oil chemistry varies dramatically both within and between natural plant populations. As the antimicrobial activity is directly related to the specific composition of the oil, the activity also fluctuates. The essential oils were analysed by GC-MS and a cluster analysis performed. From sixteen samples (representing five natural populations), five chemotypes were identified (myrcenone, carvone, piperitenone, ipsenone and linalool). The oil showed minimal activity against *Staphylococcus aureus*, *Escherichia coli* and *Bacillus cereus*, and no apparent activity against *Pseudomonas aeruginosa* in disc diffusion assays. The oil did have activity against *Candida albicans* and *Cryptococcus neoformans*. Time kill studies were performed on three microbial respiratory isolates (*Klebsiella pneumoniae*, *Cryptococcus neoformans* and *Bacillus cereus*) and the strongest bacteriostatic effect was observed for *Klebsiella pneumoniae*.

An assessment of the antimicrobial activity of indigenous medicinal plants from the southern Overberg

T Thring¹, FM Weitz¹ and Q Johnson^{2,3}

¹ Department of Botany, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

² The Applied Herbal Sciences Programme and ³ Department of Medical Biosciences, University of Western Cape, Private Bag X17, Bellville 7535, South Africa

★ Awarded joint first prize for best Poster by ISE

The southern Overberg region of the Western Cape in South Africa has many individuals who have a vast amount of indigenous knowledge about the use and value of medicinal plants. In this study, interviews were conducted with people from this region, who still use plants regularly for a variety of chronic ailments. The following plants are widely used in the region, and were selected for an assessment of their anti-infective characteristics: *Conyza scabrida*, *Bulbine lagopus*, *Dodonaea angustifolia* and *Chironia baccifera*. These indigenous medicinal plants were collected and extracted in water, methanol, ethanol and ethyl acetate, using either fresh or dried material, depending on which way the community utilises these natural remedies. A variety of different concentrations of the extracts were then screened against *Candida albicans*, *Mycobacterium smegmatis*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*, using the agar disc diffusion method. We used 40g per disc of Ciprofloxacin against *S. aureus*, *P. aeruginosa* and *M. smegmatis*, and 25g per disc of Amphotericin B against *C. albicans*. In addition, TLC and HPLC analyses will also be conducted in an attempt to determine which bioactives have anti-infective value. Ultimately, all of this data could potentially add great value to the drug development platform that underpins our discovery of important antimicrobial therapeutics.

Identification, distribution and utilisation of the indigenous medicinal plants at Owen Sitole College of Agriculture (OSCA), KwaZulu-Natal

JP van der Linden¹ and DP Ferreira²

¹ Owen Sitole College of Agriculture, KwaZulu-Natal, South Africa

² University of Zululand, Private Bag X1001, Kwa-Dlangezwa 3886, South Africa

OSCA is situated in the Bioclimatic subgroup 1 of KwaZulu-Natal, which has been described as the Coastal Lowland. Elevation varies from 23 to 120 metres and the farm consists of a series of hills. The Cwaka river divides the campus into approximately equal parts.

Forty four plots were selected to study the indigenous flowering plants in a randomly stratified manner. Stereo aerial photographs (1:50 000) were used to demarcate the different ecotypes on OSCA. Herbarium specimens were collected and identified at the National Botanical Institute. A large number of indigenous medicinal plant species were identified and their utilisation for medicinal purposes by the rural communities were determined and compared to the known uses according to the literature. Suggestions are made for the future management of the farm to protect and conserve the medicinal plant bio-diversity and to ensure sustainable utilisation.

Rehabilitation of co-disposed diamond tailings generated at a diamond mine: growth medium rectification procedures and indigenous grass establishment

L van Rensburg, MS Maboeta and TL Morgenthal

School for Environmental Sciences and Development, Potchefstroom University for Christian Higher Education, Private Bag X6001, Potchefstroom 2526, South Africa

Since the reclamation of mine tailings is a challenging task, the type and optimum concentration of organic materials, viz. vermicompost, chicken manure, sewage sludge and peat, to be applied for the rehabilitation process was evaluated by doing pot and field trials. In both the pot and field trials *Cenchrus ciliaris* and *Cynodon dactylon* were the most successful species, although their densities were low. The field amelioration that has shown the best results was a 60 tons ha⁻¹ vermicompost application with a fertiliser treatment of CaNO₃ (25kg ha⁻¹) and MgNO₃ (12.5kg ha⁻¹). Overall the results indicate that initial vegetation establishment during the first six months on the co-disposed material was slow even under large applications of organic fertilisers, but it is clear that without proper seeding of the plots no vegetation will establish on the co-disposed material.

Rehabilitation of co-disposed material generated at a diamond mine: quantifying physical and chemical properties from a rehabilitation perspective

L van Rensburg and MS Maboeta

School for Environmental Sciences and Development, Potchefstroom University for Christian Higher Education, Private Bag X6001, Potchefstroom 2526, South Africa

Rehabilitation of mine tailings is a complex process since they are largely devoid of organic matter and highly variable in terms of their chemical and physical properties. To examine these factors, co-disposed tailings material was tested with regard to plant growth and development. Results indicated that the high Na concentration represents the most serious and severe elemental challenge, whereas the high alkalinity, low Ca and Mg as well as potentially chelatable Mn concentrations pose slight limitations that can be overcome by means of inorganic ameliorant application. From a possible environmental ground or surface water pollution point of view the samples analysed do not pose any serious risk health risks. Another concern is the dispersive properties due to the high Na concentration as well as the expansive and shrinking properties of the smectite clay fraction contained within the samples. The test work also recommended organic materials tested could be used for the rehabilitation process. It was concluded that, with the exception of a couple of chemical difficulties that can be addressed, the tailing material constitutes a growth medium that can be rehabilitated to sustain vegetation over the long term.

The evaluation of water treatment sludge as ameliorant for acid mine waste rehabilitation

L van Rensburg and TL Morgenthal

School for Environmental Science and Development, Potchefstroom University for Christian Higher Education, Potchefstroom 2520, South Africa

The study investigated the liming effect of water treatment sludge on acid mine spoils. Chemical analysis indicated that the sludge is suitable as alkalising agent because of its alkaline pH (8.08), high

bicarbonate concentration (3mmol dm⁻¹) and low salinity (76mS m⁻¹). The high cation exchange capacity of 15.47cmol(+)kg⁻¹ and elevated nitrate concentration (1.18mmol dm⁻¹) also increase its value as ameliorant. According to experimental results, application of 10 tons ha⁻¹ sludge to acid gold tailings increased the leach water pH from 4.5 to over 7.5 and also increased the medium pH from 2.4 to 7.5. The alkalising tempo was the highest through the coal discard profile and took the longest through the gold tailings, which is a function of the particle size distributions of the materials. The conclusion from the study is that the specific water treatment sludge are suitable as a liming agent for rehabilitation of acid mine waste.

The use of woodchips for the organic amelioration of platinum slime dams

L van Rensburg, TL Morgenthal and P Nel

School of Environmental Science and Development, Potchefstroom University for Christian Higher Education, Potchefstroom 2520, South Africa

Woodchips and slimes produced during platinum extraction pose an environmental liability that must be mediated. Woodchips created during underground blasting have, however, the potential as organic ameliorant of platinum slimes. The aim of the study was to evaluate the use of woodchips as ameliorant with different revegetation practices on platinum slimes dams. Results indicated that *Cenchrus ciliaris*, *Eragrostis lehmanniana* and *Eragrostis curvula* were the best-suited species for rehabilitation. The chemical properties for plant growth improved considerably during the duration of the study but were not necessarily affected by the application of woodchips. The biggest concern regarding the soil nutrient status of the amended slime material is its continuing low fertility and the potential phytotoxicity of copper. Plots treated with woodchips had a higher biomass production, basal cover and improved nutrient status (P and K). Early photographic records illustrated the benefit of using woodchips to improve the early establishment of a grass cover.

The antimicrobial activity and death kinetics of the essential oil and chemical components of the South African endemic, *Osmitopsis asteriscoides*

SF van Vuuren¹, AM Viljoen¹, E Ernst², B Demirci³, T Ozek³ and KHC Bager⁴

¹ Department of Pharmacy and Pharmacology, Faculty of Health Sciences, University of the Witwatersrand, 7 York Road, Parktown 2193, South Africa

² College of Pharmacy, The University of Iowa, Iowa City, Iowa 52242, United States of America

³ Medicinal and Aromatic Plant and Drug Research Center (TBAM), Anadolu University, 26470-Eskişehir, Turkey

★ Awarded Local Organising Committee Book Prize for best Poster presentation in Ethnobotany

The essential oil composition and anti-microbial activity of *Osmitopsis asteriscoides*, a medicinal plant used in traditional herbal preparations in South Africa was investigated. A preliminary screening was done using the disc diffusion method on nine bacterial and four fungal isolates. Time kill studies indicated a more detailed bacteriostatic progression with the antimicrobial determination of *Candida albicans*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*. A strong fungicidal activity against *Candida albicans* was found at concentrations ranging from 0.5% to 2%. Sixty-six compounds were identified by GC-MS in the hydro-distilled essential oil, which contained (-)-camphor and 1,8-cineole as the main constituents. The high concentration of these two terpenoids are presented as a possible explanation for the traditional use of *Osmitopsis asteriscoides* for treating microbe-related illnesses. A comparative antimicrobial time kill study of *Candida albicans* with 1,8-cineole and camphor standards as well as in combination were compared with the pure *Osmitopsis asteriscoides* essential oil. The time-kill method is presented as a superior assay to determine antimicrobial properties of essential oil and its constituents.

Quantifying the effect of the dispersive nature of gold mine tailings on grass species seedling establishment

SJ van Wyk and L van Rensburg

School for Environmental Science and Development, Potchefstroom University for Christian Higher Education, Potchefstroom 2520, South Africa

The impact of gold tailings erodibility, and more specifically the dispersibility of the media, on slope sediment delivery processes and its implications for plant establishment and succession, is poorly described. In this study, the dispersivity of gold tailings media is quantified, and the effect of this erodibility parameter on the establishment of grass species establishment is explored. The poor textural material properties, combined with the effect of the extremely steep slopes of the tailings dams, render it impossible to protect slopes indefinitely from severe water erosion, risking long-term geotechnical instability and possible future pollution. Rill and inter-rill incision are the main contributing water erosion forces that result in the degradation of gold tailings dams and can only be limited through slope stabilisation by means of a persistent vegetation cover. A self-perpetuating ecological system will only develop to a sustainable extent if successional processes are recovered, implicating that the hostile soil-seed contact area on tailings dams, posed by the combination of the high dispersivity indices of tailings material and detrimental slope characteristics, is seriously addressed.

The contribution of revegetation to restored landscape success of gold tailings dams

SJ van Wyk and L van Rensburg

School for Environmental Science and Development, Potchefstroom University for Christian Higher Education, Potchefstroom 2520, South Africa

Until recently, little attention was given to the quantification of terrestrial restoration projects' success. Few studies have described the dynamics of restored biospheres, and developed and applied ecological success criteria objectively, leading to uncertainty about variables used to conduct requisite assessments of ecological restoration projects. The measurement of the adequacy of restoration of gold tailings dams, and more specifically, to what degree various biological spheres and ecological functions and values of habitats have been restored and returned, is addressed in this study. Quantifying soil and vegetation dynamics and identifying indicators of chosen habitat functions through statistical representations of natural, local reference sites for comparison to the functional development of the restored habitat, is used to evaluate ecological restoration success. A Functional Success Index (FSI) is proposed accordingly.

Antimalarial activity and essential oil composition of South African medicinal aromatic plants

RL van Zyl and AM Viljoen

Department of Pharmacy and Pharmacology, Faculty of Health Sciences, University of the Witwatersrand, Parktown 2193, South Africa

Aromatic plants are documented for use in patients with 'fever' or 'flu-like' symptoms; which are the clinical symptoms used to describe a malarial infection. A number of aromatic plants were harvested and the volatile essential oils extracted by hydro-distillation. A chloroquine-resistant strain of *Plasmodium falciparum* and transformed human kidney cells were maintained in culture for the antimalarial and toxicity assays. Tritated hypoxanthine and the MTT tetrazolium salt were used as indicators of the antimalarial activity and toxicity properties of the various essential oils. Of the 11 species tested, *Myrothamnus flabellifolius* and *Artemisia afra* were the most active, with IC_{50} values (concentration required to inhibit 50% growth) of $2.46 \pm 0.22 \mu\text{g ml}^{-1}$ and $3.87 \pm 0.62 \mu\text{g ml}^{-1}$, respectively. *Osmitopsis asteriscoides* and *Lippia scaberrima* were the least toxic with IC_{50} values of $105.99 \pm 4.15 \mu\text{g ml}^{-1}$ and $73.27 \pm 4.73 \mu\text{g ml}^{-1}$, respectively. The sesquiterpenoid, nerolidol was 8-fold more potent than the monoterpenoid, linalool; but was 120-fold more toxic. However, the safety index of *Artemisia afra* is the most favourable and warrants further research. The composition of the hydrodistilled essential oil has been recorded using GC-MS and the major compounds for each of the species are presented.

Vegetation change on rehabilitated peatland on Rietvlei Nature Reserve

CE Venter, GJ Bredekamp and PL Grundlingh

African Vegetation and Plant Diversity Research Centre, Department of Botany, University of Pretoria, Pretoria 0002, South Africa

Natural peatlands occur on the Rietvlei Nature Reserve. Ditches were constructed to drain the peatland for mining. Later the area was proclaimed and managed as a nature reserve. Rehabilitation of the peatland started in 2000 as a Working for Water project. The aim of the rehabilitation was to close the ditches and rewet the peatland, to enable possible revival. A baseline vegetation survey was undertaken during 2001 to determine the nature of the pioneer communities and a monitoring survey during 2002 to detect changes in the vegetation. The pioneer vegetation was mostly composed of weedy annuals. Three communities were identified. DECORANA ordination showed a clear disjunction between the communities on the mined and on the drained areas. The 2002 floristic data were added to the baseline data and an ordination indicated that the vegetation had already started to change in the direction of the climax communities.

A study of the indigenous medicinal plant, *Typha capensis*, as a potential antimicrobial agent

NA Vlotman^{1,2}, F Weitz^{1,2}, L Cyster^{1,2} and Q Johnson^{2,3}

¹ Botany Department, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

² Applied Herbal Sciences Programme and ³ Department of Medical Biosciences, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

Typha capensis, an indigenous herb, has for centuries been used traditionally to heal venereal diseases, dysentery, diarrhoea, dysmenorrhoea, and ease delivery during pregnancy as well as to enhance male potency and libido. Five different populations of *Typha capensis* were collected in areas of the Western Cape between March 2001 and June 2002. Extracts of these plants were assessed for their antimicrobial characteristics, because the indiscriminate use of antibiotics has resulted in the development of many resistant strains of bacteria. The expense of orthodox drugs and their lack of efficacy compels us to seek affordable, effective and safe preventative agents and therapeutics. Methanol extracts of these populations were prepared at increasing concentrations of 10mg ml⁻¹, 20mg ml⁻¹, 30mg ml⁻¹, 40mg ml⁻¹ and 80mg ml⁻¹. These concentrations were tested against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Candida albicans* and *Mycobacterium smegmatis* using the agar disc-diffusion method. 40µg disc⁻¹ of Ciprofloxacin was used against *S. aureus*, *P. aeruginosa* and *M. smegmatis* and 25µg disc⁻¹ of Amphotericin B was used as a positive control against *C. albicans*. Results indicated that the microbes were strongly inhibited by the conventional antibiotics and that the methanolic extracts of *T. capensis* also showed activity against *Staphylococcus aureus* and *Mycobacterium smegmatis*. Further TLC and HPLC analyses of all five extracts were also completed, and we anticipate that the isolated bioactives may well provide us with novel chemical templates for the development of anti-infective therapeutics.

Thale cress (*Arabidopsis thaliana*): is it native, introduced or naturalised in South Africa?

JP Weich^{1,2}, MM van der Merwe^{1,2}, AE van Wyk¹ and DK Berger^{1,2}

¹ Department of Botany, University of Pretoria, Pretoria 0002, South Africa

² Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, Pretoria 0002, South Africa

Arabidopsis thaliana (Brassicaceae) is the first plant for which the complete genome was sequenced. This self-fertile model dicotyledon has a generation time of as little as six weeks. Several old herbarium specimens, identified as *A. thaliana*, have been collected from South Africa. The aim of this study was to determine the taxonomic status of the *Arabidopsis* taxon in South Africa. Taking a molecular approach, DNA was extracted from an ecotype of *A. thaliana*, and subjected to PCR using primers designed to ampli-

fy a 200bp fragment of the *matK* chloroplast gene located within the *trnK* intron. Alignment of the sequenced PCR products showed a 100% similarity to the *matK* gene of *A. thaliana* available on Genbank. These *matK* primers will now be used to confirm the identity of the herbarium material collected in South Africa. Field collections of *A. thaliana* have been attempted, but to date no material could be traced at any of the original collecting localities. The opportunity has nevertheless been used to collect material from related taxa native to South Africa, including members of *Helioiphila*.

Fate, inorganic contents and mutation rates of seeds derived from *Acacia* trees growing on gold slimes-polluted versus unpolluted soils

IM Weiersbye and ETF Witkowski

Restoration and Conservation Biology Research Group, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Private Bag 3, Wits 2050, South Africa

The genus *Acacia* is well represented on gold mine tailings dumps ('slimes' dams) and polluted soils in southern Africa, suggesting inherent tolerances to the prevailing environmental conditions. *Acacia karroo*, *Acacia hebeclada* subsp. *hebeclada* and *Acacia hereroensis* are the dominant indigenous acacias growing on and around gold slimes dams in the Witwatersrand Basin. We compared seed fate and inorganic composition, germination and seedling morphology in acacia trees growing on gold slimes-polluted soils to that of trees growing in unpolluted soils (i.e. beyond the influence of slimes run-off and surface acid mine drainage). *Acacia* trees growing on slimes-polluted soils suffered less seed predation than trees on un-polluted soils, but produced less viable seed, and seed of lower mass. Even when viable, seeds from *A. karroo* and *A. hebeclada* growing in slimes-polluted soils exhibited lower germinability than seeds from unpolluted sources. Seed embryo's derived from slimes-impacted trees contained lower levels of N and P than trees on unpolluted soils, but accumulated K and Mo despite the low availability of these elements in acid slimes. Seeds from polluted sources also contained higher concentrations than those from unpolluted sources of elements known to be more available in acid slimes, specifically S, Mn, Fe, Co, Ni, Cu and Zn. The seed testa generally contained more Cl and Ca than the embryo, and appreciable amounts of S, K, Mn, Fe, Ni, Zn, Rb, Sr and Mo. However the total concentrations of all inorganics in seeds were below the levels normally considered toxic. Eleven seedling mutations were identified during germination: five associated with radicle development and five associated with cotyledon development. Twin seedlings were also observed. No plumule abnormalities were observed. The frequency of seed mutations was higher for trees growing on slimes-polluted soils than for trees on unpolluted soils. The frequency of radicle mutations was in the order of *A. karroo* > *A. hereroensis* > *A. hebeclada*, whereas that of cotyledon mutations was highest in *A. hereroensis*. However, despite their lower mass, normal seedlings derived from parents growing in slimes-polluted soils exhibited higher survival rates when planted in acidic slimes material than those derived from parents in unpolluted soils. A few slimes-associated mutations were also apparently advantageous, contributing to faster seedling growth: twin radicle, branched radicle and tricotyledon seedlings emerged more rapidly than normal seedlings, and had higher relative growth rates.

Trees growing on polluted aquifers in the Free State goldfields have high inorganic contents, and reduced seed regeneration capacity in comparison to trees on unpolluted substrata

IM Weiersbye and ETF Witkowski

Restoration and Conservation Biology Research Group, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, PO WITS 2050, South Africa

Mining activities can impact on even distant natural ecosystems via wind and water-borne pollution. Saline and acidic mine drainage has impacted heavily on shallow unconfined aquifers draining mines in the Free State goldfields. Deep-rooted plant species accessing

polluted aquifers have been subjected to intense selection pressures and the surviving land races are exhibiting a remarkable combination of tolerances — to salinity, acidity, nutrient imbalances, excessive transition metal availability as well as to extremes of climate (frost, seasonal aridity, heat etc). The two dominant indigenous phreatophytes growing over a large groundwater plume on the Free State goldfields (*Acacia karroo* and *Rhus lancea*) were assessed for their stem and crown dimensions, inorganic contents (foliar, wood, bark and fruit) and for seed mass, viability and germinability. Inorganic concentrations in the sub-canopy litter layer, topsoil and subsoil were also measured. Twenty trees per species were assessed, 10 trees growing on plume 'hotspots' at distances of up to 20km from the point sources, and 10 growing on apparently uncontaminated groundwater at distances of up to 35km from the point sources, but on similar soils and underlying geology. Depth to groundwater was less for 'on plume' trees than for 'off plume' trees. Maximum concentrations of major inorganic pollutants in boreholes of the mining-impacted aquifer system in the vicinity of sampled trees were 50 000mg l⁻¹ TDS, 9 000mg l⁻¹ sulphates, 18 000mg l⁻¹ chlorides, 1 800mg l⁻¹ Mg and 12 000mg l⁻¹ Na. Concentrations of Al, Cr, Fe, Mn, Ni, Co and Pb in solution were also elevated. Geochemical backgrounds for groundwater in the vicinity of 'off-plume' trees were much lower: 570 ± 154mg l⁻¹ TDS, 19 ± 14mg l⁻¹ sulphates, 103 ± 48mg l⁻¹ chlorides, 25 ± 5mg l⁻¹ Mg and 85 ± 26mg l⁻¹ Na. The foliage of 'on plume' trees contained higher concentrations of S, Mg, Cl, Fe, U, Al, Cr, Zn and Pb than 'off plume' trees. The litter layer and soil surface beneath 'on plume' trees also showed evidence of inorganic enrichment. Overall, the above-ground portion of large *R. lancea* trees growing on the plume contained 3.00.7% minerals (approximately 2.2kg dry mass per 121kg tree) and large *A. karroo* trees contained 3.20.6% minerals (approximately 2.4kg dry mass per 99kg tree). The concentrations of inorganics associated with the AMD plume in both species were in the order of foliage > bark > wood > fruit. Although seeds contained lower concentrations of inorganic pollutants than other above-ground plant portions, levels in 'on plume' seeds were still higher than in 'off-plume' seeds. Levels of seed abortion were higher, whereas seed mass and seed viability was reduced in both species in comparison to 'off plume' trees.

Seed fate and practical germination methods for 46 perennial species that colonise gold mine tailings and acid mine drainage-polluted soils in the grassland biome

IM Weiersbye and ETF Witkowski

Restoration and Conservation Biology Research Group, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, PO WITS 2050, South Africa

Indigenous perennial plants (woody, semi-woody and herbaceous re-sprouters) comprise the dominant naturally-colonising and persistent flora of gold mine tailings and polluted soils in the grassland and savanna biomes. In order to determine which of these species had potential for the sustainable rehabilitation of gold mine tailings we characterised seed production, seed fate and patterns of seed dormancy and germination. This report lists seed fate and viability for 46 species (excluding annuals and grasses) common on gold slimes dams and the adjacent polluted soils, and practical germination methods for viable seed. Only data for plants growing on veld sites beyond the known influence of mine pollution is presented. All species examined produced viable seed. Most seed classed as non-viable or of low viability had been obviously predated or contained insect larvae. Seeds that had been predated or contained larvae were invariably also infected by fungi during germination, whereas few non-predated viable seeds and aborted seeds were infected. Two germination treatments killed endogenous insect larvae, and prevented or delayed seed-coat infection by fungi and bacteria in a dose-dependent fashion (smoke and transient incubation in hot water at 94°C). The viability status of untreated seeds could be directly related to trends in their dry mass and in the relative proportion of water they imbibed over 48 hours. The dry mass of seeds of all species increased from non-viable to high viability seeds, whereas untreated seeds of most species took up water in the trend

of high viability < low viability < non-viable. The exceptions to this pattern of water uptake were untreated seeds of *Mundulea sericea* (no imbibition) and *Asclepias fruticosa* (viable seeds imbibed proportionately more water than non-viable seeds). Dormancy-breaking treatments that were assessed included removal of fruit tissues, seed scarification, long day light exposure, burial depth, exposure to water, aerated water, a reducing agent, organic matter, human saliva, fermentation, as well as dose responses to heat and plant-derived smoke. A number of germination indices were determined: mean days to germination, time of peak germination, duration of germination lag and time taken to achieve 50% germination. The majority of species could be germinated with relatively simple cues. Germination of all hard seed-coated legumes was achieved by mechanical disruption of the seed coat (by scarification or heat). Smaller legume seeds generally required longer exposure to heat than larger legume seeds. Germination percentages approaching or equalling 100% (of viable seeds) were achieved for most tree species, most shrubs and succulent forbs. Most perennial herbs and herbaceous resprouters had low levels of seed viability and germinability in comparison to trees, shrubs and forbs. Some treatments influenced the timing and rate of germination without necessarily resulting in changes in the overall percentage germination.

The *Solanum nigrum* complex (Solanaceae) in southern Africa

WG Welman

National Herbarium, National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa

Members of the *Solanum nigrum* complex occur worldwide and have important economic potential because of the small, dark, edible berries. Unfortunately the taxonomy of this weedy group of mainly annual herbs has always been problematic. At least seven taxa of this complex occur in southern Africa; most of them are common and widespread. This poster shows illustrations and distribution maps of the majority of the species. Only *S. retroflexum* is indigenous to Africa.

Effects of nitrate concentration and light on germination of six savanna woody plant species

ETF Witkowski and BA Mbalo

Restoration and Conservation Biology Research Group, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Private Bag 3, Wits 2050, South Africa

Increased post-fire soil nitrate concentrations enhance the germination of many species from mediterranean-type ecosystems. Six savanna woody species with hard seed coats were tested for seed germinability in response to five levels of nitrate incubation (0mM, 1mM, 5mM, 10mM and 100mM, supplied as KNO_3) and two light conditions (high versus low) in laboratory simulations. Full spectrum light conditions were supplied, with 14 hours day and 10 hours night, at $20 \pm 0.2 \mu\text{mol m}^{-2} \text{s}^{-1}$ (low-) or $182 \pm 0.2 \mu\text{mol m}^{-2} \text{s}^{-1}$ (high-light intensity). Seeds were incubated and monitored daily for 40 days in repli-dishes (each seed was thus independent). For *A. karroo*, nitrate levels of 100mM, and 10mM and 100mM, reduced germination (percentage) under high and low light respectively. Germination was unaffected by nitrate in *A. nilotica* and *Mundulea*. For *A. robusta* under high light, 1mM increased germination slightly relative to the other concentrations, with control seeds intermediate. For *A. tortilis*, germination trended $5 > 1 = 10 = 100\text{mM}$, with control intermediate under high light, and $1 = 5 > \text{control} = 10 > 100\text{mM}$ under low light. For *Burkea*, control germination was higher than with 100mM, with the other concentrations intermediate under high light, while for low light 100mM significantly inhibited germination. Germination was inhibited in response to 100mM nitrate in all species, except *A. nilotica* and *Mundulea*. Final seed viabilities were significantly affected in all the species, with 100mM nitrate generally resulting in the lowest viabilities. Germination value, peak value, and mean and first day to germinate were unaffected by nitrate

when analysing species individually. However, there was a significant decrease in time to last day of germination with increasing nitrate concentration in all the species (although $P = 0.0754$ for *A. karroo*), which is interpreted as loss of viability as nitrate accumulates over time. In conclusion, increased post-fire soil nitrate concentrations stimulated germination in *A. robusta* (high light) and *A. tortilis* (high and low light), while large concentrations inhibiting germination and/or final viabilities in all species.

Effects of simulated post-fire soil surface temperature regimes and light on germination of six savanna woody plant species

ETF Witkowski and BA Mbalo

Restoration and Conservation Biology Research Group, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Private Bag 3, Wits 2050, South Africa

Soil surface temperatures vary greatly over the course of a day and extreme temperatures are intensified in the more exposed post-fire environment. Fluctuating diurnal temperatures, particularly close to the soil surface are well known germination cues for a wide range of plant species. Six savanna woody species with hard seed coats (*Acacia karroo*, *A. nilotica*, *A. robusta*, *A. tortilis*, *Burkea africana* and *Mundulea sericea*) were incubated for 30 days under four high soil surface temperature regimes (with maximum daily temperatures of 40, 50, 60 and 70°C, all declining to ambient at night). 'Control' seeds were maintained at ambient. Thereafter, seed germinability was tested under two light conditions (high versus low) under controlled conditions for 40 days. Full spectrum light conditions were supplied, with 14 hours day and 10 hours night, at $20 \pm 0.2 \mu\text{mol m}^{-2} \text{s}^{-1}$ (low-) or $182 \pm 0.2 \mu\text{mol m}^{-2} \text{s}^{-1}$ (high-light intensity). Seeds were placed in repli-dishes (each seed was thus independent) and monitored daily for 40 days. Except for *Burkea*, the treatments induced higher germination (percentage) than control, but the specific stimulatory temperatures were species-specific. Under high light, 40°C and 50°C stimulated higher germination than control, with 60°C and 70°C intermediate for *A. karroo*. For *A. nilotica*, 50°C yielded higher germination than control and 40°C, with 60°C and 70°C intermediate under high light. For *A. robusta*, germination trended $50 \geq 60 \geq 70 > 40^\circ\text{C} = \text{control}$, under high light. While for low light, $50 = 60 > 70 = 40^\circ\text{C} = \text{control}$. Comparing between species, germination was highest for *A. robusta*, at about 80% under high light and 60% under low light at 50°C and 60°C. In contrast, *A. tortilis* required more heat, with 70°C stimulating a small increase in germination (<20%) relative to control and 40°C, with 50°C and 60°C intermediate under high light. For *Burkea*, under both high and low light, germination percentage was significantly higher under control conditions relative to the other treatments (soil surface temperatures are lower in shady, broad-leafed *Burkea*-veld relative to *Acacia*-veld). For *Mundulea*, 70°C resulted in a small significant increase in germination relative to 60°C, 40°C and control under low light. These results show that soil surface temperature fluctuations are a strong cue for *A. robusta*, *A. karroo* to a lesser extent, and *A. nilotica* to an even smaller extent, while inhibiting germination in *Burkea*. *A. tortilis* and *Mundulea* were intermediate, but requiring the higher 70°C regime to stimulate a small increase in germination. These stimulating conditions are achieved in the post-fire environment, but also patchily in microsites within savannas in the absence of fire.

Effects of plant-derived smoke and light on germination of six savanna woody plant species

ETF Witkowski and BA Mbalo

Restoration and Conservation Biology Research Group, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Private Bag 3, Wits 2050, South Africa

Plant-derived smoke, typically generated during wildfires, has been shown to stimulate the germination of a diverse range of plant species, mostly in mediterranean-type ecosystems. Six savanna woody species with hard seed coats (*Acacia karroo*, *A. nilotica*, *A. robusta*, *A. tortilis*, *Burkea africana* and *Mundulea sericea*) were

tested for seed germinability in response to five levels of exposure to plant-derived smoke (0, 5, 10, 20 and 40 minutes smoking) and two light conditions (high versus low) in laboratory simulations. Smoke was produced from burning the foliage and stems of grasses, namely *Hyparrhenia hirta* and *Cymbopogon* spp. and a woody species, *Acacia karroo*. Thereafter, seeds were placed in repli-dishes (each seed was thus independent), incubated under controlled conditions and monitored daily for 40 days. Full spectrum light conditions were supplied, with 14 hours day and 10 hours night, at $20 \pm 0.2 \mu\text{mol m}^{-2} \text{s}^{-1}$ (low-) or $182 \pm 0.2 \text{ m}^{-2} \text{s}^{-1}$ (high-light intensity). There was a small significant increase in germination in *A. karroo* (10 minutes smoking), *A. robusta* (5 minutes), and *A. tortilis* (5 and 10 minutes) with smoke under high light, relative to control (un-smoked) conditions. In contrast, increasing levels of smoke progressively reduced percentage germination of *Burkea* under high light. There was no discernible effect of smoke on germination under low light conditions in any of the species, or under high light in *A. nilotica* and *Mundulea*. Percentage germination was very low under control conditions (<10%) for all species except *Burkea*, which had high levels (60–80%). Seed viabilities at the end of the experiment were lower than initial viabilities, but were higher with exposure to smoke in *A. karroo* and *A. tortilis* relative to control seeds, under high light. In contrast, seed viabilities were lower with exposure to smoke under high light in *Burkea* and under low light in *A. nilotica*, relative to the control. Exposure to smoke, especially at high levels, tended to decrease seed viabilities under low light for *A. nilotica* and *A. tortilis*. Although smoke does not stimulate mass germination in seeds of these savanna woody species, it does either increase, has no effect or inhibits germination to some extent, depending on species. Smoke also has a considerable effect on seed viability.

Microscopic identification of Chinese patent medicine — Bo Ying Compound

YW Wong, HJ Liu and ZZ Zhao

School of Chinese Medicine, Hong Kong Baptist University, Kowloon Tong, Hong Kong

Bo Ying Compound is a well-known Chinese patent medicine for pediatric use; it comprises mainly 18 pure powdered Chinese *materia medica*. The formula makes use of mineral, animal and plant originated crude drugs. Microscopic identification was carried out in order to authenticate its composition as well as establishing a quality control method. Due to the complexity of formula, polarised light microscope and other microscopic techniques had to be used to obtain a precise result. Experimental materials, which included voucher crude drugs and the patent medicine, were provided by the Eu Yan Sang Company, five lots of the patent drug were inspected. The result showed: mycelium (*Bombyx batryticatus*), oil tube (*Radix saposchnikoviae*), fragments of body wall (*Scorpio*), dermal parenchyma (*Ramulus Uncariae cum Uncis*), starch grains (*Bulbus Fritillariae Cirrhosae*), etc. The five lots of medicine showed genuine consistency. The result also showed some other additives were detected in the drug.

Structure of vesicular- arbuscular-mycorrhiza in *Tetrapanax papyriferus* (Hook.) K. Koch (Araliaceae)

WY Wu, HC Weber, S Imhof and B Kendzior

Spezielle Botanik und Mykologie, Department of Biology, Philipps-University, 35032 Marburg, Germany

Tetrapanax papyriferus (Hook.) K. Koch (Araliaceae), a widely planted species for its medical, technical ('rice-paper') and ornamental properties, was investigated with respect to its mycorrhiza. Roots

of plants from the Botanical Garden Marburg (Germany) were collected at eight times over the year. As a second experiment *Glomus* sp. inoculated root offshoots, which in contrast to seeds or cuttings from the stem were able to produce young roots, were investigated. Fungal penetration occurs either into rhizodermis cells under developing appressoria, or via root hairs. The subsequent colonisation of the root cortex parenchyma extends by exclusively intracellular, coiled hyphae, which can produce bladder-like vesicles, and shrub-like arbuscules as lateral branches. This pattern is known as a Paris-Type VAM. Extent of colonisation as well as the production of vesicles and arbuscules peaked at summer to autumn. Whether the mycorrhiza has an influence on the plant's content of medically active substances will be the subject of future studies.

Biomass accumulation in *Gunnera perpensa* L. in response to increasing soil moisture

T Xuma¹ and G Naidoo²

¹ Electron Microscope Unit, School of Life and Environmental Sciences, University of Durban-Westville, Durban 4000, South Africa

² Discipline Botany, School of Life and Environmental Sciences, University of Durban-Westville, Durban 4000, South Africa

G. perpensa (Family Gunneraceae), a medicinal plant that grows in marshy areas, is used traditionally to induce labour during childbirth and as an antenatal medication to tone the uterus. The objective of this study was to determine optimal soil moisture conditions for maximal plant biomass accumulation. Young uniform plants obtained from terminal portions of rhizomes were selected for treatment in a randomised complete block design with four treatments and six replications per treatment. Potted plants were subjected to four soil moisture treatments, field capacity (FC), 20%, 40% and 80% flooded. After 12 weeks, plants were harvested and dry biomass, determined in the various plant organs. Total dry biomass increased with increase in soil moisture from FC to 20% flooded. Further increase in soil moisture from 40% to 80% resulted in a decrease in total dry biomass. There were no differences in total dry biomass between the 20% and 40% flooded treatments. Leaf blade and petiole dry biomass followed trends similar to that of total dry biomass. Rhizome dry biomass increased with increasing soil moisture from FC to 40% flooded and thereafter decreased when soil moisture was increased to 8% flooded. There were differences in root dry biomass amongst treatments. Maximal biomass was accumulated in the 20% flooded treatment.

Microscopic identification of Chinese *materia medica*

ZZ Zhao¹, WJ Zhang¹ and DM Wei²

¹ School of Chinese Medicine, Hong Kong Baptist University, Kowloon Tong, Hong Kong, China

² The University of Aizu, Japan

Microscopic identification is a method which uses a microscope to identify the characters of tissues, cells or cell contents in sections, powders of crude drugs and Chinese patent medicines. A systematic study was carried out which aimed to establish a database comprising 97 CMM and 15 CPM. The results showed that using the plariscope is a quick and accurate way to measure the purity and the ingredients in the Chinese crude drugs. The study also provides source material for enhancing documents such as the Chinese Pharmacopoeia and Hong Kong Chinese *materia medica* Standards.