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Feeding smarter:

How alternative animal feed resources can transform small ruminant farming in South Africa

Compiled by: Aluwani Nemukula[1], Ebrahiema Arendse[1], Thamsanqa Mpanza[2], Nqobile Masondo[1] and Stephen Amoo[1]

Ruminants have a unique digestive system that allows them to effectively use humanly inedible feed sources like grass and agro-waste by-product to produce human edible food, e.g. meat and milk. These agro-waste by-products include brewer's spent grain (BSG) from breweries (Fig. 1), oil-seed meals from food processing, and fruit or root crop residues (e.g. potato and sweet potato peels) from agro-processors that would otherwise be discarded as waste. These agro-wastes are rich in protein, fibre and fermentable carbohydrates (Ikram et al., 2017). When properly processed and incorporated into balanced animal diets, such material can serve as high-value feed ingredients rather than environmental waste streams.

Figure 1. Brewers spent grains prepared for sun drying, which reduces moisture content from 75% to 10%.

Animal feed costs have been reported to account for approximately 60–70% of total production expenses in most ruminant farming systems (Piszcz et al., 2022). This creates a major barrier to profitability for smallholder farmers in South Africa. Rising commodity prices (e.g. maize, soybean meal and other conventional ingredients), often linked to global commodity volatility, have necessitated the search for locally sourced alternatives. Agro-waste-based feeds offer a powerful solution for building environmentally sustainable, cost-effective, and profitable smallholder production systems. These seemingly low-value by-products, when incorporated into balanced animal diets, can maintain or improve growth performance, feed conversion efficiency, and carcass quality in sheep and goats (Sime & Duguma, 2025). As a result, natural recycling system keeps resources in use for longer, reduces environmental waste, and strengthens rural economies. Therefore, beyond the economics, ARC research plays a pivotal role in closing nutrient loops and driving more sustainable, circular food systems, particularly for smallholder farmers. In addition, agro-waste based feeds reduce methane emissions and minimize competition between feed and food crops, while the feeding intervention focuses on supplementing top grass or grazing systems, which are key priorities under climate-smart agriculture frameworks. Working with local partners such as breweries and agro-processors can solve challenges of the triple bottom-line by offering a smart solution that lowers cost for resource-constrained farmers. Brewer's spent grain, for example, demonstrates comparable nutritional value to conventional protein sources when included at appropriate levels, based on our ongoing research at the ARC.

Innovation in animal feed development is central to the research mandate at ARC-Vegetable, Industrial and Medicinal Plants (VIMP) and ARC-Animal Production (AP) campuses. We believe that small ruminant farming (sheep and goats) is the cornerstone of rural livelihoods in South Africa, particularly for emerging and communal farmers.

General enquiries

ARC-Vegetable, Industrial and Medicinal Plants
Private Bag X293
Pretoria
0001
South Africa

e-mail: vopiinfo@arc.agric.za
website: http://www.arc.agric.za

The research work conducted at ARC-VIMP and ARC-AP is at the intersection of agriculture, waste management, and sustainable food systems. The two campuses are part of the research AgriHub for feed and food innovation focusing on ensuring that alternative feed resources are not just supplementary, but a strategic tool for sustainable, cost-effective, and profitable animal production systems in South Africa.

The 'Food and Feed AgriHub' at ARC

The Food and Feed AgriHub at the ARC agro-processing facility represents a strategic investment by the Department of Agriculture (DoA) in South Africa's agricultural innovation ecosystem. The AgriHub serves as a centre for postgraduate training, skills development and technology transfer, while also providing services to smallholder farmers. Services offered include milling, quality control, feed formulation, pellet manufacturing, and product development (Figs. 2 and 3). Most importantly, the AgriHub will strengthen the agro-processing value chains by formalizing partnerships with breweries, fruit and vegetable processors, oilseed industries, and local feed suppliers, amongst other stakeholders. The partnership is expected to create job opportunities across the value chain – from waste collection and transport to processing, packaging and distribution. The ARC Food and Feed AgriHub research activities position alternative feed resources as a cornerstone for sustainable livestock production in South Africa. Through science-driven innovation, strategic partnerships and capacity building, agro-waste feeds can unlock new pathways to profitability, food security and environmental stewardship for emerging farmers, thereby stimulating local economies.

Figure 2. Pellet production line at ARC-VIMP and agro-waste-based pellet products.

Figure 3. Feed products developed in the agro-processing facility at ARC-VIMP

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Author affiliations:

[1]Agricultural Research Council-Vegetable, Industrial and Medicinal Plants (ARC-VIMP), Roodeplaat, Pretoria

[2]Agricultural Research Council-Animal Production (ARC-AP), Irene, Pretoria

Contact: Dr Ebrahiema Arendse at Arendsee@arc.agric.za and Dr Thamsanqa TDE. Mpanza at MpanzaT@arc.agric.za

Plant Breeder's Rights granted for new sweet potato variety ARC-SP-12

Compiled by: Mmapaseka Malebana, Sunette Laurie, Yvonne Hadzhi, Tumelo Ratlabala and Michael Bairu

The Agricultural Research Council (ARC) remains the pillar for sweet potato breeding in South Africa, having acquired Plant Breeder's Rights (PBR) for the registration of an additional sweet potato cultivar. Characterized by a darker cream flesh, moderate resistance to Fusarium wilt and slight tolerance to nematodes, the new cultivar known as ARC-SP-12, is a Blesbok cultivar type that stands out for its high yields which ranges from 40-50 t/ha. The variety has an average growing period of approximately 4 to 4.5 months. The storage roots are characterized by uniformity and attractive appearance, displaying an attractive purple skin and yellowish flesh. An additional advantageous characteristic is its high dry matter content of approximately 23%, which gives it a nice drier taste in comparison to Blesbok, which has a dry matter content of less than 18%. The cultivar is deemed suitable for both the commercial and informal markets. It has been included in the ARC semi-commercial evaluation scheme where five farmers/companies will ascertain its viability for commercialization across various provinces in South Africa. The formal registration of ARC-SP-12 presents a viable alternative for farmers encountering yield losses attributed to Fusarium wilt, particularly those planting Blesbok, which is notably susceptible to the wilt pathogen. Furthermore, this development serves to mitigate the risks associated with the commercialization of imported varieties by farmers capable of acquiring licenses, thereby alleviating potential disadvantages faced by emerging farmers.

Contact: malebanem@arc.agric.za

Circular Economy in Agriculture: Practical Applications from the Agricultural Research Council-VIMP

Compiled by Christiaan J Malherbe, Ebrahiema Arendse, Stephen Amoo

Circular economy is often associated with recycling and upcycling, particularly in industrial systems. In practice, it is a broader framework aimed at reducing waste, keeping resources in use, and restoring natural systems. In the agricultural industrial sector, it is focused on three noble objectives (Fig. 1) (UNIDO report, 2020):

- Elimination of waste
- Circulation of products
- Restoration/maintenance of nature

Together, these objectives form a continuous loop that seeks to reduce the environmental footprint of production and consumption. Their success depends on careful implementation and sustained commitment. Achieving this requires timely action and careful implementation, as partial or poorly applied interventions can limit the effectiveness of the circular systems.

Figure 1. Closing the Loop — A Circular Economy Approach in Agriculture

In agriculture, the principles of circular economy take on additional importance. While farming is inherently connected to natural systems, it also places pressure on land, water, and biodiversity. This creates both an opportunity and responsibility to apply circular practices more deliberately. Building on the industrial framework, the agricultural circular economy expands these principles to include the following key focus areas (DSTI Circular Economy Science, Technology and Innovation Strategy, 2025):

1. Conservation of resources through precision agriculture, improved control on irrigation, and the re-use of water where possible.
2. Making use of agro-processing techniques to add value to by-products and thereby diminishing waste.
3. Improving post-harvest processes, including sustainable packaging material, to prolong food storage and diminish waste (currently up to a third of agriculture produce are considered to be lost due to spoilage)
4. Alternative uses of the unavoidable waste fraction, e.g. as fertilizer or as feedstock for sustainable energy production.
5. Where possible, making use of fertilizers and pest control systems that are biological in nature to lessen their environmental impact.

At the center of this system is the need for sustainability that is both environmentally friendly and economically viable. Circular approaches that are not economically viable are unlikely to be adopted or sustained over time. Therefore, the driving force behind the sustainability of such an approach to agriculture, through minimizing impact on natural resources and conserving the environment, is that it must be done in a way that is still economically attractive. Without economic feasibility, such attempts are doomed to fail.

At the Agricultural Research Council, in the Medicinal Plants and Industrial Crops Division, circular economy principles are applied through a range of practical research and development activities. For example, cactus pear cladodes are being explored for upscaling into beverage products, extending value beyond the fruit and making use of underutilized biomass that would otherwise remain largely unused. Processing by-products such as peels are incorporated into fortified flour, reducing waste while enhancing nutritional value and functionality (Fig. 2A).

In parallel, agricultural wastes including spent grains from agro-processing activities at breweries are repurposed for the development of animal feed pellets, contributing to more efficient and integrated food–feed systems (Fig. 2B). Post-harvest losses are further reduced through preservation approaches such as solar drying, which extends the shelf life of harvested crops using low-cost, renewable energy (Fig. 2C). Together, these examples demonstrate how circular economy concepts are being practically embedded within the ARC research activities to support sustainability, resource efficiency, and long-term productivity.

Figure 2. Several circular economy research activities within the ARC Medicinal Plants and Industrial Crops Division

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Contact: Dr Christiaan Malherbe at MalherbeC@arc.agric.za and Dr Ebrahiema Arendse at ArendseE@arc.agric.za

Preliminary evaluation of onion germplasm for phenotypic quality traits

Compiled by Mantshiuwa Lephuthing, Karabo Khiba, Amelework Assefa and Michael Bairu

Genetic variation is a pre-requisite for any breeding program as it provides the necessary raw material for selecting superior genotypes, enabling adaptation to changing environments, and improving traits like yield and stress tolerance. Assessing phenotypic diversity within the germplasm is essential for understanding the plant adaptation, characterizing, improving crops through breeding, and broadening the genetic variation. It serves as a bridge between genetic resources conservation and breeding to develop superior and resilient cultivars.

This process involves analyzing the variation in observable qualitative and measurable quantitative traits to identify superior and desirable genotypes. By analyzing diverse germplasm collection, breeders can access a wider range of genetic characteristics, which is crucial for overcoming the limitations in yield, quality and adaptability traits.

Onion (*Allium cepa* L.) is an invaluable crop that has become a key component of human diet and cuisines for over many centuries. It is highly appreciated for its unique flavor, pungent aroma, and medicinal properties (Lee et al., 2018).

It is an important source of vitamins (B and C), minerals (Ca, P, and Fe), carbohydrates, protein, dietary fibre, and sulphur in the human diet (Bal et al., 2020). Despite its global importance, its productivity and marketability are limited by significant postharvest losses (30 to 40%) caused by its semi-perishability, poor shelf-life, and susceptibility to pests and diseases. Studying the agronomic and quality traits in a wide range of onion germplasm is a critical and foundational step for modern breeding programs, enabling the identification of diverse, superior genotypes for further development. Onion crop improvement lags behind other vegetable crops due to its biennial cycle, high inbreeding depression, and cross-pollinated nature. Germplasm characterization is necessary to boost genetic gain in yield, quality, and stress resistance. Morphological descriptors such as bulb color, shape, size, neck thickness and average bulb weight are used as major criterion in onion breeding for classifying cultivars and determining which germplasm to advance. Therefore, the investigation was carried out to evaluate the phenotypic quality traits on imported onion genotypes and to identify potential germplasm for parental selection.

A total of 195 onion accessions were imported from the World Vegetable Centre. The accessions were planted in a randomized complete block design in the greenhouse at Roodeplaat. The multifeed and NPK 2:3:4 fertilizers were applied to the seedlings according to South African onion production guidelines (ARC, 2013). Data was collected on bulb colour, shape, size (represented in diameters), neck thickness and average bulb weight.

The results revealed significant and wide range variation among the evaluated onion accessions for average bulb weight, bulb colour, shape, equatorial and polar diameters. The bulb colour ranged from white, brown, red to reddish brown, while the bulb shape ranged from circular, rhombic to obovate and elongated forms. Table 1 and Fig. 1 represent the variation of some accessions within the germplasm. Eight genotypes (ARC-AC12, ARC-AC16, ARC-AC121, ARC-AC127, ARC-AC156, ARC-AC162, ARC-AC173 and ARC-AC175) showed promising potential in terms of average bulb weight that was greater than 39 g and equatorial diameters that were higher than 4 cm (Fig. 2). Multi-location and multi-seasons evaluations of onion hybrid cultivars for morphological traits are important due to their genetic make-up. Most of the morphological traits are polygenic thus the phenotypic expression of these traits is expected to vary in different locations, seasons and years resulting in change in morphology and generally the performance of genotypes. Previous studies indicated that morphological characteristics such as bulb size, shape, colour, and neck thickness often show significant environmental effects (Gupta et al., 2024; Brahimi et al., 2022). This requires multi-location field evaluation trials to accurately identify superior and stable genotypes to recommend for cultivation or to use as potential parents for further breeding improvement.

Table 1. Variation in bulb shape and color of onion accessions

Accession	Bulb colour	Bulb shape
ARC-AC153	Brown	Broad elliptic
ARC-AC74	Brown	Circular
ARC-AC142	Brown	Transverse elliptic
ARC-AC179	White	Broad elliptic
ARC-AC76	White	Rhombic
ARC-AC05	White	Elliptic
ARC-AC160	Reddish brown	Elliptic
ARC-AC156	Reddish brown	Broad ovate
ARC-AC141	Red	Broad obovate

Figure 1. Variation in bulb shape and color of onion accessions in the germplasm collection

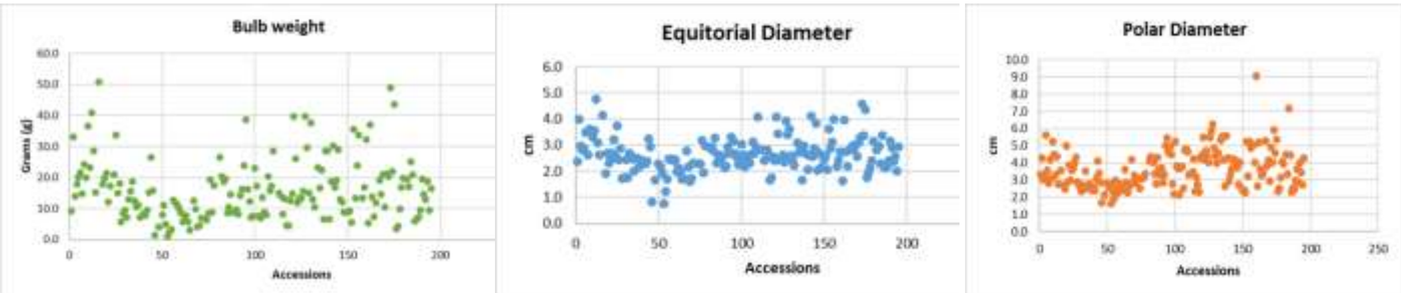

Figure 2. Evaluations of onion bulb equatorial and polar diameters, and average bulb weight

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Contact: Ms Mantshiuwa Lephuthing at LephuthingM@arc.agric.za

Freeze-Drying: Principles, Applications, and Service Provision at the ARC-VIMP Agroprocessing Facility

Compiled by: Ebrahiema Arendse, Christiaan J Malherbe, Nqobile Masondo, Sylvia Neluheni, Muvhuso Mutshinyani, Stephen Amoo

Freeze-drying, also referred to as lyophilization, is a preservation technology widely used in agro-processing to extend the shelf life of perishable goods while maintaining product quality. In contrast to conventional drying methods that rely on elevated temperatures, freeze-drying removes moisture at low temperatures under vacuum conditions (Waghmare et al., 2024). This helps maintain both the physical quality of the product and its nutritional value, making it particularly suitable for various perishable crops including fruits, vegetables, and medicinal plants.

Basic Principles of Freeze Drying

Freeze-drying process is based on the principle of sublimation; whereby frozen water is converted directly from ice to vapor without passing through the liquid phase. The process begins with freezing the raw material to stabilize its structure and immobilize water contained within the product. This is followed by primary drying, during which a vacuum is applied and controlled heat is introduced to enable the sublimation of ice. The final stage, known as secondary drying, involves a controlled and gradual increase in product temperature under continued vacuum to remove residual bound moisture through desorption. This stage reduces the moisture content to low levels, resulting in a low-moisture, microbiologically stable product. Careful control of temperature, pressure, and time throughout these stages is essential to preserve the physical structure, nutritional composition, and bioactive components of the material (Waghmare et al., 2024). Examples of freeze-dryers at our agro-processing facility are presented in (Fig. 1).

Figure 1. Freezer dryers used at our agro-processing facility.

Applications of Freeze Drying in Agro-processing

Freeze-drying is increasingly applied in agro-processing due to its ability to preserve heat-sensitive compounds and maintain the sensory attributes of raw materials. This technology is particularly valuable for products where colour, flavour, texture, and nutritional quality are of critical importance. Freeze-dried materials are lightweight, have an extended shelf life, and demonstrate excellent rehydration properties, making them suitable for use in functional foods, nutraceuticals, herbal products, and ingredient formulations. These characteristics have positioned freeze-drying as a preferred preservation technology in production of high-value agricultural products and specialty ingredients.

Freeze-Drying Activities at the Agro-processing Facility

Freeze-drying is routinely applied to fruits, vegetables, and medicinal plants to support value addition and product development. Fresh produce is processed into freeze-dried slices, powders, and ingredients, depending on the intended application. Medicinal and aromatic plants are freeze-dried to preserve sensitive phytochemicals and ensure product stability for further processing or formulation. The facility supports both experimental and pilot-scale batches, enabling process optimization, quality evaluation, and product validation. In addition to processing raw materials, the facility actively develops freeze-dried products for commercial and research purposes. These products are designed to meet specific functionality, quality, and market requirements, demonstrating the versatility of freeze-drying across different agro-processing value chains. Examples of freeze-dried fruits, vegetables, and medicinal plants products are shown in (Fig. 2).

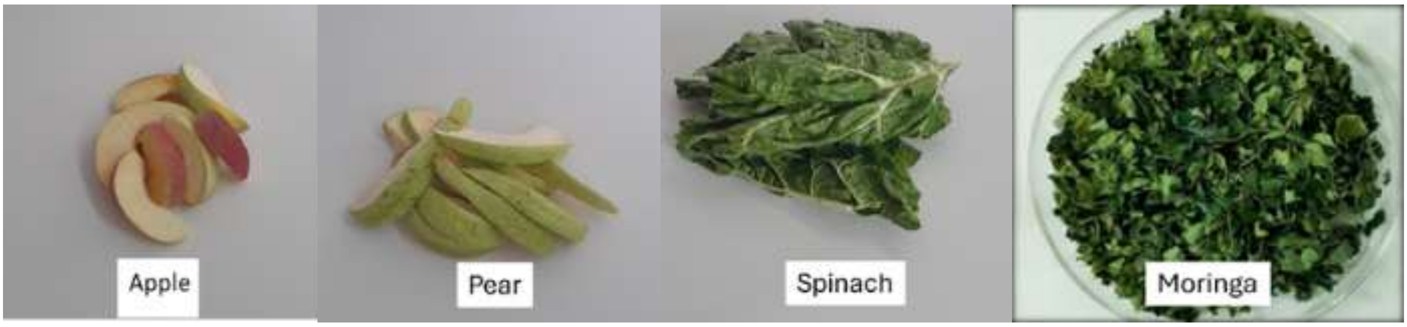

Figure 2. Examples of freeze-dried fruits, vegetables, and medicinal plant products.

Freeze-Drying as a Service

The Agro-processing Facility provides freeze-drying services, giving researchers, small and medium-sized enterprises, and industry partners access to specialized equipment, technical expertise, and process support. Clients may utilize the service to process their own raw materials or to collaborate on the development of customized freeze-dried products. This service-oriented approach supports innovation, increases access to technology, and enables the production of high-quality freeze-dried products without the need for significant capital investment. The integrated approach strengthens agro-processing innovation and contributes to the development of sustainable, high-value agricultural products.

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Contact: Ms Sylvia Neluheni at NeluheniM@arc.agric.za and Mr Muvhuso Mutshinyani at MutshinyaniM@arc.agric.za

Natural Colourants: Applications in the Food, Cosmetic, and Pharmaceutical Sectors

Compiled by: Sylvia Neluheni, Muvhuso Mutshinyani, Ebrahiema Arendse, Nqobile Masondo, Stephen Amoo

Most food or cosmetic products use dye either from natural or synthetic pigments. A pigment is a substance occurring in animal tissue, plant or synthetically produced and gives a characteristic colour. Natural colourants have grown in popularity because they are regarded to be safer and more environmentally friendly than synthetic equivalents. Natural pigments derived from plants, microorganisms, animals, and minerals, provide bright colours for various uses. With the rise in consumer demand for natural ingredients, researchers, food, pharmaceutical, and cosmetic industries are investing extensively in developments that improve the functionality and appeal of natural colourants.

The increasing consumer preference for clean-label products and natural ingredients has driven research and innovation towards natural colourants. Most natural dyes have inherent antimicrobial, antioxidant and other medicinal properties (Fig. 1). Natural dyes have been applied not only in the food industries, but also in pharmaceutical and the cosmetic sectors.

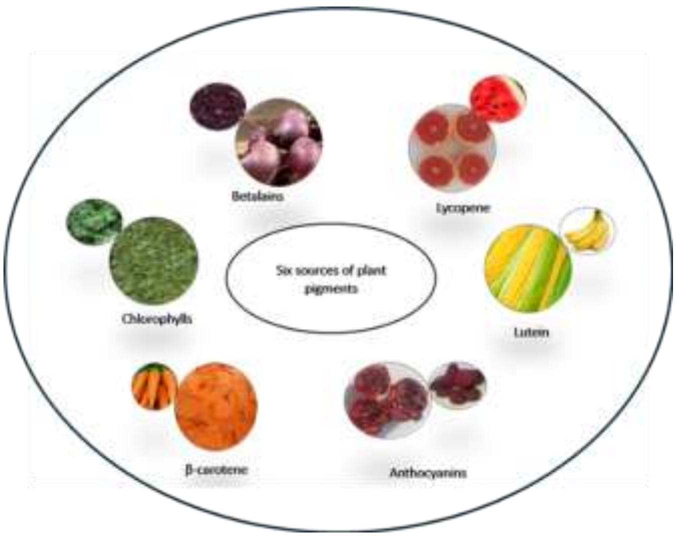

Figure 1. The common plant-based pigments

Types of Natural Colourants
Natural colourants can be broadly categorized based on their sources (Fig. 2). Plant-based colourants include carotenoids from carrots and anthocyanins from berries which are well known for their bright and diverse colour properties. The cactus pear and beetroot are particularly noted for their high betalain content, producing red and purple hues (Fernández-López et al., 2018). Microbial colourants are produced by some fungi and bacteria. Examples include beta-carotene from *Blakeslea trispora* and astaxanthin from microalgae, which are known for their vibrant colours (Mohammad Azmin et al., 2022). Animal-derived colourants include cochineal (*Dactylopius coccus*) extract derived from insects, which has been traditionally used to produce rich red colours. Mineral-based colourants are derived from iron oxides that provide a range of colours, including red, brown, and yellow.

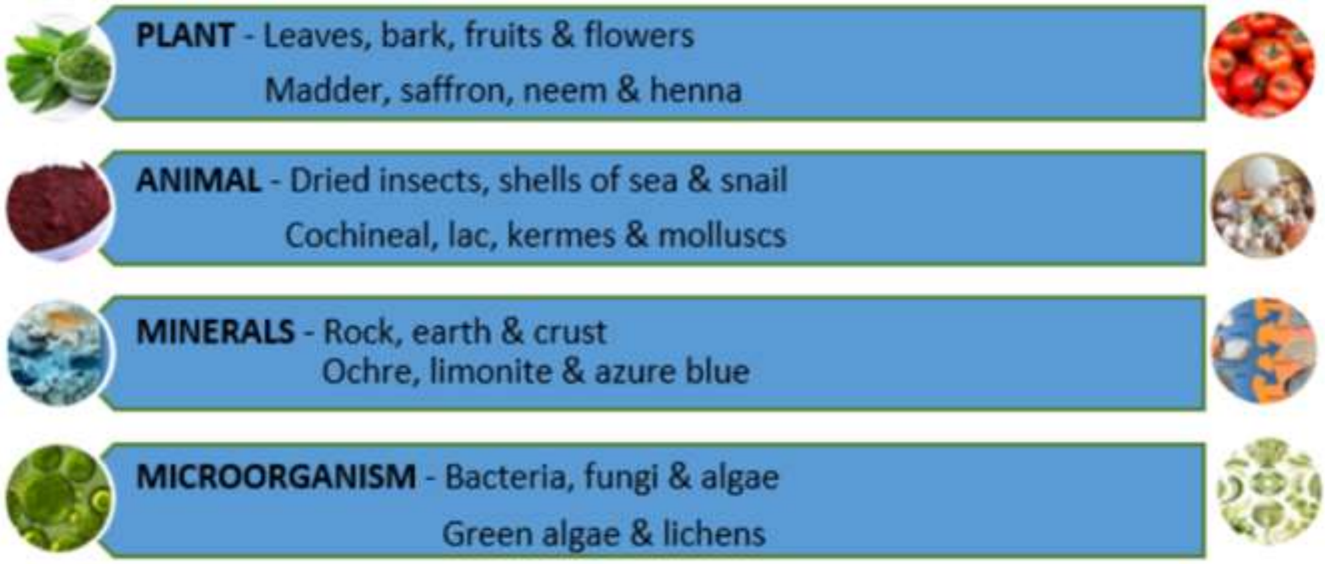

Figure 2. Natural colourants and pigments used in the food, cosmetic, and pharmaceutical industries (Tripti et al., 2023).

Applications in the Food Industry
Natural food colorants can have a significant impact on human health due to their range of therapeutic benefits, including antioxidant, anti-inflammatory, antimutagenic, and anti-rheumatic properties. Consequently, the use of food colourants has expanded in the food industry to improve the visual appeal and perceived quality of food products. Recent advances have centered on improving extraction processes and formulations. Encapsulation and nano-emulsion technologies have improved the durability and colour intensity of natural pigments, making them more useful in a variety of food matrices. Six primary plant pigments: lycopene, β-carotene, betalains, anthocyanins, chlorophylls, and lutein (Fig. 1) are widely utilized in food formulation due to their natural colouring properties and potential health benefits. Lycopene, a predominant carotenoid, constitutes approximately 80–90% of the total pigment content in ripe tomatoes. β-Carotene, an isoprenoid compound with strong antioxidant properties, is primarily found in carrots, apricots, asparagus, Chinese cabbage, chili, and paprika. Betalains, a class of water-soluble red and yellow pigments, are typically present in cactus pear, red beet, dragon fruit, Swiss chard, cactus flowers, and various other plant species. Extracts of betalains have been traditionally employed as natural colourants in dairy products, beverages, confectionery, and certain livestock-derived products (Georgiev et al., 2010). Anthocyanins, belonging to the flavonoid class of secondary metabolites, are widely recognized as natural colourants in the food industry. They are commonly found in red cabbage, elderberry, black currant, sweet potato, purple carrot, cherry, and red radish, where they impart characteristic red to purple hues. Anthocyanins are extensively used in fruit juices and wines (Wahyuningsih et al., 2017). Chlorophyll, a green pigment essential for photosynthesis, is abundant in all green plants. It is frequently incorporated into food products such as dairy items, soups, and beverages as a natural pigment. Lutein, a xanthophyll carotenoid, imparts a bright yellow coloration and is prevalent in leafy vegetables, fruits, and pigmented vegetables, including peas, egg yolk, sweet corn, and sweet peppers. Among plant sources, maize is known to exhibit a high lutein content, accounting for approximately 60% of its total pigment composition. These naturally derived pigments contribute not only to the visual appeal of food products but also align with current trends emphasizing their potential health benefits.

Applications in the Cosmetic Industry
Most pigments used in cosmetic products are derived from consumable sources such as fruits and vegetables. The demand for natural ingredients in cosmetics has been increasing, driving the application of plant-based pigments in various formulations. Colour plays a crucial role in cosmetics, particularly in products for the face, nails, and hair. Most of the pigments applied in cosmetic products come from consumable sources such as vegetables and fruits. Commonly used plant-derived pigments in cosmetics include anthocyanins (found in grapes, blueberries, plums, purple cabbage, and blackberries), chlorophyll (e.g. from avocados, cucumbers, spinach, broccoli, lettuce, and kiwis), anthoxanthins (e.g. from cauliflower, potatoes, ginger, onions, and bananas), carotenoids (e.g. from papayas, pineapples, pumpkins, carrots, and oranges), and lycopene (e.g. from beetroots, tomatoes, strawberries, watermelons, and pomegranates) (Mohammad Azmin et al., 2022).

Anthocyanins, valued for their bioactive properties and deep purple-blue hue, are frequently used in lipsticks, and skin-care formulations. Chlorophyll, derived from sources like cucumbers and avocados, are known for their soothing and protective benefits in skincare. Anthoxanthins, which impart a subtle white-to-tan shade, are commonly found in lotions and sunblocks. Carotenoids, recognized for their antioxidant properties, are often included in skincare and haircare products. Lycopene, with its striking red pigment, is a key ingredient in many lipsticks, contributing to their bold and vibrant colour.

Applications in the Pharmaceutical Industry

Natural colourants play a crucial role in the pharmaceutical sector, aiding in drug identification and improving patient compliance. The most commonly used colours in pharmaceutical products are from caramel, cochineal, riboflavin, anthocyanins, annatto and curcumin group of colours. Recent studies have explored the medicinal properties of natural colourants, such as curcumin from turmeric, known for its anti-inflammatory and antioxidant effects. These colourants are used in tablet coatings, syrups, and topical preparations for their functional and aesthetic benefits. Other colour pigments obtained from minerals mainly yellow and red iron oxides (E172) have been used as dye in medicine. Titanium dioxide (E170) is used to colour and opacify hard gelatin capsules.

Advantages and Challenges

Natural colourants offer several advantages over synthetic ones, such as biocompatibility and lower environmental impact due to their renewable resource. However, natural pigments are typically more expensive than synthetic ones and require a greater quantity of raw materials. They are also highly sensitive to environmental factors such as oxygen, light, and heat, which can lead to colour degradation or hue alterations. Additionally, natural dyes may react with or be influenced by organic compounds, pH levels, metal ions, or proteins, further affecting their stability. These limitations have made synthetic dyes a more reliable option in some product development due to their enhanced durability and consistency. Challenges such as sensitivity to pH, light, and temperature are being addressed through advancements in extraction and processing techniques, including supercritical fluid extraction and microwave-assisted extraction, improving the stability and usability of natural colourants by increasing their yield and purity.

Conclusions and Future Directions

The future of natural colourants depends on their sustainable supply and innovative applications. The agro-processing team at the ARC continues to conduct research advancing sustainable harvesting and processing methods, adding to innovations in, and development of natural pigments that can be applied in food, feed, and cosmetics products. Emerging technologies, such as biotechnology and synthetic biology, offer promising solutions for enhancing the efficiency and sustainability of natural colorants production. Additionally, expanding research into novel applications, including textiles and bioplastics, can further broaden their market potential.

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Contact: Dr Ebrahiema Arendse aArendsee@arc.agric.za *or* ***Ms S Neluheni at neluhenim@arc.agric.za***

ARC-VIMP Supports the Maluti Transport and Career Expo in Free State Province

Compiled by SF Maphosa, MM Mofokeng, L Khoza and SO Amoo

he Maluti Transport and Career Expo (Fig. 1) was hosted by the Free State Province in Qwaqwa, Thabo Mafutsanyana District, organised by Maluti Bus Depot Services on the 23rd and 24th of October 2025. The Leguminous, Leafy, and fruit Vegetables (LLFV) and Medicinal Plants and Industrial Crops (MPIC) Divisions collaborated to attend the career expo. The aim of the expo was to create networking opportunities for local business and industry professionals, providing career information to learners, and profile Qwaqwa as an emerging hub for economic development.

The ARC shared with learners, various research activities and opportunities to assist the learners in making right choices in the field of Agriculture especially in the aspects of Research & Development (Fig. 2). The products from LLFV, MPIC and Root and Tuber Crops (RTB) divisions were displayed during the exhibition to showcase the product development aspects in agriculture value-chain (Fig. 3).

With around 800 attendees over the two days, Maluti Transport expressed sincere gratitude for Agricultural Research Council participation as an exhibitor, showcasing the significant intersection between agriculture and research, and providing students with important exposure to scientific and technical information in relation to career opportunities.

Figure 1. Different stakeholders participating in the Maluti Career Expo

Figure 2. Learners visiting the ARC exhibition stall to engage ARC officials

Figure 3. Community members showing interest in agro-processing to develop products

Contact: Ms F Maphosa at Maphosaf@arc.agric.za

The African Cannabis Legacy Project in support of cannabis traditional growers

Compiled by SF Maphosa, MM Mofokeng, MC Masemola, I Gazendam and SO Amoo

South Africa is blessed with unique Cannabis strains that have been used traditionally in treating patients in certain therapeutic areas. While there may be reasons to believe that cannabinoids, which are compounds in cannabis, may be efficacious for several diseases and syndromes, there is a need to conserve the different strains.

Cannabis sativa has been used both medicinally and recreationally for many centuries in South Africa and other countries. The discovery of the chemical structures of their unique active components especially the cannabinoids (CBDs) provided an impetus for, and new insights into cannabis research. To date, approximately 108 cannabinoids have been discovered in *C. sativa* (Bala *et al,* 2019). Even though much is known from other regions of the world, studies have demonstrated that different Cannabis varieties offer rare medicinal properties exclusive to the areas where they grow. The Cannabis industry is not only financially rewarding, but it can also create new jobs, wealth, develop new industries and improve the health of South Africans. Thus, the African Cannabis legacy project, funded by the Department of Science, Technology and Innovation (DSTI), is aimed at supporting traditional cannabis growers with characterization and conservation of their germplasm, and improvement of products developed by the communities for them to meet market standards. This project is implemented in collaboration with the Council for Scientific and Industrial Research CSIR, and the overall objective is to support government initiatives in industrializing cannabis.

The ARC cannabis team engaged with different communities and conducted site visits in the Eastern Cape, Western Cape, Free State, North-West, Mpumalanga and Limpopo provinces. The communities welcomed the project and were willing to share their germplasm, with proper procedure being followed. The project emphasizes inclusivity, thus all communities of practice in cannabis were included in the visits. The communities included traditional growers, traditional health practitioners, and Rastafarian communities (Fig. 1).

Figure 1. Some of the communities visited in various provinces of South Africa.

The ARC team also conducted genetic and morphological characterization of 32 collected accessions. The *C. sativa* species-specific 13 simple sequence repeat (SSR) panel from Houston *et al.* (2017) was applied to characterize the genetic diversity of landrace populations collected from nine distinct locations. Much individual genetic diversity was detected, with strong variation between most of the landraces. Discriminant Analysis of Principal Components (DAPC) was performed to differentiate individuals into genetic clusters. Most of the different landrace populations formed tight but overlapping clusters, but a landrace collected from Limpopo emerged as the most genetically distinct population. The research will contribute to the development and possible inclusion of local landraces in the cannabis industry. Meetings were arranged to share the results of the characterization work (Fig. 2). Morphological variations were easier to understand by the communities and some of them were confirmed as what they also observed.

The communities appreciated the project, and some have indicated their intentions to register the landraces as cultivars. The continued support to the cannabis growing communities will ensure an inclusive industry.

Acknowledgements

The Department of Science, Technology and Innovation (DSTI) and the Agricultural Research Council are acknowledged for funding and institutional support.

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Contact: Dr Meshack Mofokeng at MofokengM@arc.agric.za or Dr Inge Gazendam at IGazendam@arc.agric.za for DNA fingerprinting requests.

Figure 2. Meetings with the communities to give feedback on the characterization and discussion on the morphology of the plants.

ARC participates in the launch event of the Capricorn District Hemp & Cannabis Farmers Association (CDHCFA)

Compiled by: Boitumelo Mogale and Meshack Mofokeng

The ARC-Medicinal Plants and Industrial Crops (MPIC) Division and cannabis team participated in the launch of the Capricorn District Hemp & Cannabis Farmers Association (CDHCFA), held on the 14th of November 2025 in Polokwane, at Mapungubwe City Lodge, Limpopo Province.

Figure 1. Attendees at the launch of the CDHCFA held in Polokwane on the 14th of November 2025. Executive stakeholders in the front row, left to right: Jeniffer Badane (Founder, LHCFA), Joel, Cecil Matlou (CDHCFA leadership), Dr Rudzani Mathobo (LDARD), Boitumelo Mogale (ARC-VIMP representative), Sam Mokoena (CDHCF Vice-Chairperson).

The event aimed to unite, support, and advocate for local hemp and cannabis farmers by providing resources, education, and communication platforms. The attendees for the day comprised a diverse group of stakeholders, including emerging farmers, permit holders, municipal and government representatives, university experts, researchers, and leadership and members of the CDHCFA (Fig.1). Their expertise spanned from farming, agro-processing and product development, microbiology, sales, economic development and environmental support to cannabis legislation and regulation and many others. An exhibition stand was set to showcase some of the work the ARC-VIMP is conducting on the hemp and cannabis value chain, specifically on propagation and cultivation, agro-processing and product development as well as handing out flyers on some of the services the ARC specializes in, including quality control in cannabis (Fig. 2).

A talk was presented by Ms Boitumelo Mogale regarding the Limpopo Province Hemp cultivar and agronomic trials as well as the seed multiplication in the Sekhukhune District (Loskop). Opportunities for the province to be productive in hemp and cannabis cultivation despite being a non-traditional growing area was also highlighted (Fig. 3).

Figure 2. Exhibition stand at the launch event of the CDHCFA showing hemp products such as hemp seed oil, hair food (D), hemp seedlings (A), biochar, fibre, hurd, and feed pellets (B & C).

The launch of the Capricorn District Cannabis and Hemp Farmers Association was a success and stakeholder engagements and relationships were established to work together in driving the cannabis industry to commercial scale.

Contact: Ms Boitumelo Mogale at mogaleb@arc.agric.za

Figure 3. Ms Boitumelo Mogale briefing the attendees on ARC-VIMP's involvement in developing hemp and cannabis in Limpopo Province.

Ethnoveterinary Practices in QwaQwa

Compiled by Makgwatla Makhuvha[1], Peter Mohlake[1], Ndzalama Shikwambana[1], Tswelelopele Mpolokeng[1,2], Keamogela Nko[1,2], Faith Malope[1], Mojabeng Sebotsa[1], Nqobile Msimango[1], Stephen Amoo[1], Oladapo Aremu[2], Muneiwa Rumani[1], Andiswa Motshele[1], Elvis Chekwane[1], Meshack Mofokeng[1], Nqobile Masondo[1]

Introduction

Livestock farming remains very important in many rural African communities for socio-economic and cultural reasons, among others. This is why animal diseases cause significant economic losses for farmers (McGaw & Eloff, 2008; Van der Merwe et al., 2001). For many smallholder farmers, modern veterinary care is hard to access and too costly when available. As a result, they continue to rely on ethnoveterinary practices, where medicinal plants are the main option for the management of animal health.

Medicinal plants are widely utilized due to their accessibility, affordability, and cultural acceptance within rural communities. In places such as QwaQwa in Free State, medicinal plants play a key role in the treatment of animal diseases, thereby supporting household income generation, ensuring food safety, and improved nutrition. The knowledge of medicinal plants is passed down orally from one generation to the next. Unfortunately, such invaluable knowledge is at risk of being lost as the younger generation becomes less engaged in farming and traditional practices. Documenting such knowledge is crucial as it will contribute to the preservation of cultural heritage/practices, future scientific developments on plant-based remedies, and supports biodiversity conservation by encouraging communities to manage medicinal plants sustainably.

Documenting ethnoveterinary practices

As part of the Department of Agriculture (DoA)-funded Indigenous Knowledge Systems (IKS) project, a team of students, research technicians and interns conducted an ethnoveterinary survey in Namahadi, QwaQwa, Free State Province (Fig. 1). Surveys were conducted with knowledgeable livestock farmers and traditional healers through face-to-face interviews using semi-structured questionnaires (in Sesotho) and field walks. Consent was requested from the participants before conducting surveys and taking pictures.

Figure 1. Survey interviews conducted with participants from Bakwena and Batlokoa communities in QwaQwa

An estimated 60 participants were interviewed between the ages of 20-73 years (Fig. 2). Majority of the participants had only primary school education or had not completed formal schooling, yet demonstrated extensive practical knowledge. Our observation aligns with previous studies conducted in other areas, which indicated that ethnoveterinary practices are declining among younger generations due to urbanization, migration to cities and lack of interest, while the use of medicinal plants continue to serve as a primary form of first aid for animal health (Meena et al., 2024). The survey documented over 40 medicinal plant species used to treat various livestock ailments. These plants are mostly collected from the wild populations and prepared as decoctions (boiled extracts), powders, or pastes. Other observations from the study includes:

- Preparation: Mostly boiling (decoction), some plants are dried and ground into powder or made into paste.
- Dosage: Based on experience, the knowledge is passed on between generations.
- Administration: Mainly oral, with topical use for eye infections, wounds, and skin problems.

Figure 2. Participants from Bakwena and Batlokoa communities

Feedback to the Communities

Following data collection, feedback sessions were held with the participants that were involved in the project within the Bakwena and Batlokoa communities (Fig. 3). This included poster presentations, in English and Sesotho, summarizing key findings (plant names, livestock type and diseases treated).

Farmers and traditional healers present during the feedback sessions engaged in open discussions, validating and clarifying the documented information. Documentation of indigenous knowledge systems related to ethnoveterinary practices is an important step in the implementation of the Nagoya protocol. Such knowledge provides a knowledge reservoir or resource pool for access and benefit-compliant bioprospecting research towards medicinal plant value chain development.

Figure 3. Posters used for feedback meeting with participants from Bakwena and Batlokoa communities

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Acknowledgements

The authors gratefully acknowledge the Bakwena and Batlokoa Tribal Councils, and the community members who participated in the study. We also extend our appreciation to the National Department of Agriculture for funding and the ARC institutional support.

Author affiliations:

[1]Agricultural Research Council-Vegetable Industrial and Medicinal Plants (ARC-VIMP), Roodeplaat, Private Bag X293, Pretoria 0001, South Africa

[2]Indigenous Knowledge Systems Centre, Faculty of Natural and Agricultural Sciences, North-West University

Contact: Dr Nqobile Masondo at MasondoN@arc.agric.za and Ms Makgwatla Consolerlia Makhuvha at MakhuvhaM@arc.agric.za

ARC Medicinal Plants and Industrial Crops Division supports the Arbor Day Celebration at Mamelodi

Written by the Sindisiwe Mzobe, Karane Nkoana, Meshack Mofokeng and Stephen Amoo

Heritage Month serves as a reminder of South Africa's rich and diverse cultural history. In celebration of this heritage, Mothong African Heritage, in collaboration with the Gauteng Provincial Legislature, hosted the 2025 Arbor Day Celebration on 03 October 2025, under the theme *"Growing Greener Together."* The event gathered learners from diverse grade levels, university students from Faculties of Natural Sciences, and delegates from various institutions. The primary objective of the celebration was to promote environmental awareness, education, and sustainable practices, while also exposing learners to potential career paths within the environmental and agricultural sectors.

Furthermore, the celebration provided platform to share knowledge, discuss innovative research ideas and potential projects with a wide audience, and strengthen collaboration among academic, research, and community stakeholders.

Staff members of the Medicinal Plants and Industrial Crops Division (Fig. 1) of the Agricultural Research Council (ARC) participated alongside several higher education and innovation institutions, including the University of South Africa (UNISA), Tshwane University of Technology (TUT), the University of Pretoria (UP), and the Innovation Hub. These institutions showcased their work and expertise through exhibition stalls.

Mr. Cebisa Mabena, a well-known traditional healer and the founder of Mothong African Heritage, presented an exhibition

Figure 1. The ARC team preparing the exhibition stall.

of traditional medicines (Fig. 2), which included *Hypoxis hemerocallidea* (African potato), amongst others. This aligned closely with the ARC's research focus on value-chain development and sustainable use of indigenous and/or economically important medicinal plants such as *Artemisia afra* (Lengana), *Moringa oleifera* (Moringa), *Hypoxis hemerocallidea* and others (Fig. 3). These plants are among commonly used species by traditional healers and form part of ARC's ongoing research and development initiatives.

Many learners expressed familiarity with Lengana, particularly due to its widespread use during the COVID-19 pandemic (Fig. 4). The exhibition sparked strong interests among learn-

Figure 2. The exhibition stall of traditional medicines, agro-processed medicinal plant products and consultation room as presented by Mr. Mabena.

Figure 3. Some of the medicinal plants researched by the Agricultural Research Council.

Figure 4. Learners visiting the ARC exhibition stall to engage on careers in Agriculture.

ers, many of whom indicated an intention to pursue careers related to agriculture and natural sciences. In addition to the exhibition, learners were taken on an educational excursion to Mr Mabena's herbarium, allowing them to gain practical exposure. Such experiences are critical in enabling learners to make informed career choices based on real-world exposure.

The 2025 Arbor Day Celebration successfully highlighted the intersection of heritage, environmental awareness, and scientific innovation. By bringing together learners, students, researchers, and traditional practitioners, the event fostered knowledge sharing, career exploration, and appreciation for South Africa's rich cultural and botanical heritage. Collaborations between institutions like the ARC, higher education establishments, and community stakeholders remains important to co-develop sustainable practices for indigenous plant conservation and the development of value-added agricultural products for the benefit of current and future generations.

Contact Sindisiwe Mzobe at MzobeS@arc.agric.za and Karane Nkoana at NkoanaK@arc.agric.za

Recognizing Indigenous Knowledge in Livestock Health Management: Community Engagement in QwaQwa, Free State

Compiled by Makgwatla Makhuvha, Faith Malope, Mojabeng Sebotsa, Nqobile Msimango, Muneiwa Rumani, Muvhuso Mutshinyani, Andiswa Motshele, Siphosanele Moyo, Nompumelelo Mapangula, Bongisiwe Shelembe, Odwa Gonyela, Fhatuwani Tshikulumela, Meshack Mofokeng, Dashnie Naidoo-Maharaj, Stephen Amoo, Nqobile Masondo

Indigenous knowledge (IK) is broadly defined as the knowledge developed and refined by communities over centuries and often transmitted orally across generations to achieve stable livelihoods. Indigenous knowledge systems (IKS) encompassing diagnostic, disease prevention, and treatment practises for livestock form part of the rich traditional knowledge heritage in most rural communities. This knowledge varies between and within Provinces, which form part of multiple communities, and is largely influenced by the availability or natural distribution of plant species. Despite long-term use by communities, valuable knowledge on readily available indigenous plants with traditionally "proven efficacies" is currently not well documented.

Within the framework of the Department of Agriculture (DoA) - funded project, the Medicinal Plants and Industrial Crops Division (MPIC) in the Agricultural Research Council (ARC) conducted surveys, feedback reporting and training in QwaQwa, Free State, South Africa (Fig. 1). The engagements formed part of an ongoing initiative aimed at recognising, supporting, and promoting IKS, while advancing sustainable livestock health practices at community level. collaboration between ARC and the community, ensuring transparency, mutual respect, and knowledge exchange.

The engagement provided feedback to the Tsheseng and Namahadi communities in Qwaqwa on the outcomes of the surveys conducted and showcased how their shared knowledge informed research and product development. This engagement also served as a platform to strengthen

As part of the engagement, certificates and souvenirs were presented to community members who participated in the survey (Fig. 1). This recognition was an important gesture of appreciation for their willingness to share knowledge, participate in discussions, and support the research process. The presentation of certificates symbolised respect for indigenous knowledge and acknowledged the vital role played by the community in contributing to research outputs. The recognition ceremony was well received and fostered a sense of pride and ownership among participants. It also encouraged continued collaboration and openness towards future research and development initiatives within the community.

Figure 1. Feedback engagement in Tsheseng and Namahadi, Thabo Mofutsanyane District Municipality, Qwaqwa, Free State, South Africa.

Development and Exhibition of Medicinal Plant Prototypes

Using information obtained from the survey, the ARC-MPIC team developed a range of medicinal product prototypes based on selected plants traditionally used by community for livestock health (Fig. 2). These products were prepared for exhibition during the feedback engagement to demonstrate the practical application of indigenous knowledge. The products displayed included herbal capsules, tonic sachets, pellets, and ointments; all formulated using medicinal plants identified by the Tsheseng and Namahadi communities. The exhibition allowed community members to observe how traditional knowledge can be transformed into standardised, user-friendly products while maintaining its original purpose and cultural relevance. Community members showed great interest in the exhibited products, engaging in discussions around

Figure 2. Feedback engagement with training on product development in Tsheseng and Namahadi, Thabo Mofutsanyane District Municipality, Qwaqwa, Free State.

formulation, usage, storage, and potential benefits. The exhibition helped bridge the gap between traditional practices and scientific processing approaches, highlighting opportunities for innovation rooted in indigenous knowledge.

Community Training and Skills Development

In addition to the exhibition, hands-on training sessions were conducted to build local capacity in basic product development and processing techniques (Fig. 2). Community members were trained on how to prepare products, including capsules, tonic sachets, and ointments, using their own medicinal plant resources. The training focused on simple, practical methods that can be implemented at community level, with emphasis on hygiene, basic processing steps, and safe handling of plant materials. Participants actively took part in the preparation process, gaining valuable skills and confidence in producing medicinal products derived from their traditional knowledge. This capacity-building component aimed to empower community members by enhancing their skills and opening possibilities for small-scale production, income generation, and improved livestock health management within the community.

Strengthening Collaboration and Knowledge Preservation

The engagement in QwaQwa marked an important milestone in strengthening collaboration between the ARC and the Tsheseng and Namahadi communities. It demonstrated a commitment to ethical research practices by ensuring that communities benefit directly from the knowledge shared.

The engagement highlighted the importance of preserving indigenous knowledge while promoting its responsible and innovative use. By combining traditional practices with basic processing and product development, the initiative supports sustainable livestock health solutions and contributes to rural development.

Overall, the engagement reaffirmed the value of community-based knowledge systems and their role in addressing real-world challenges. It also underscored the importance of continued engagement, mutual learning, and empowerment to ensure that indigenous knowledge remains recognised, respected, and beneficial for future generations.

Acknowledgements
The authors gratefully acknowledge the Bakwena and Batlokwa Tribal Councils (Tsheseng and Namahadi) in Qwaqwa, and the community members who participated in the study. We also extend our appreciation to the National Department of Agriculture for funding and the ARC institutional support.

Contact: Dr Nqobile Masondo at MasondoN@arc.agric.za and Ms Makgwatla Consolerlia Makhuvha at MakhuvhaM@arc.agric.za

The ARC hemp seed distribution in support of hemp industry

Compiled by the Medicinal Plant and Industrial Crops - Cannabis team

After many years of breeding research, two ARC hemp cultivars (ARC-CAN-01 and ARC-CAN-03) were registered in 2024. The cultivars were tested and evaluated under local conditions and proven to be locally adapted for good fibre yield. These are the first locally bred cultivars that are currently registered. Following this milestone, the ARC increased their seed multiplication capacity and in the 2025/26 planting season, provinces were afforded an opportunity to request seeds. Gauteng province and Limpopo province received about 600 kg seed of the two cultivars, for distribution to hemp permit holders (Fig. 1). The distribution of the seeds was as a result of the partnership with the National Department of Agriculture as the current funder of the cannabis research program in the ARC.

Figure 1. Preparation of ARC hemp seeds for distribution to provinces.

The distribution of the seeds was followed by a planting demonstration in Gauteng at one of the permit holders' farms. The demonstration was attended by permit holders and government officials (Fig. 2). The ARC breeding program on hemp cultivars continues with the objectives of improving the agronomic performance and yield, amongst others. The program will contribute immensely to the development of the cannabis industry as access to locally adapted seeds has hitherto been a challenge for permit holders. Accelerated multiplication of these and other cultivars is expected to revolutionize hemp farming, and its value chain for local economic development.

Figure 2. The planting demonstration day for planting the ARC hemp cultivars in Gauteng.

Contact: Dr MM Mofokeng at MofokengM@arc.agric.za and Prof SO Amoo at AmooS@arc.agric.za

Showcasing ARC research and innovation on cannabis and essential oil crops at the 2026 Combined Congress

Compiled by Manare Masowa and Meshack Mofokeng

The ARC team made a significant contribution to the Combined Congress 2026, held from 19-22 January at the North-West University, Potchefstroom campus, through a series of high-quality presentations focused on cannabis and essential oil crop research. The special session on cannabis was facilitated by Dr Meshack Mofokeng (Fig. 1), and the ARC cannabis team members presented research projects that attracted strong interest from the scientific community, highlighting the growing relevance of cannabis studies within the agricultural science.

Figure 1. Dr Meshack Mofokeng chairing the special session on cannabis

The ARC team members contributed extensively to the special session on cannabis, including the chairing role, which indicated ARC's continued contribution and recognition in this research area. Given the positive reception of the session and feedback from the congress organizers, the ARC may be invited to chair a similar session in 2027.
The ARC presentations relating to cannabis research were delivered by Ms Luvhengo Muleya, Ms Precious Mbara, Ms Boitumelo Mogale, Dr Patrick Nyambo, Ms Bongi Madonsela, and Mr Malesela Sepuru (Fig. 2A-F), collectively demonstrating ARC's strong research commitment to advancing scientific research and innovation on cannabis. The ARC presentations covered research fields of nematology and agronomy, reflecting a cross-disciplinary approach to cannabis research.

The presentation by the Master's student Ms P Mbara was ranked in the top four in the student category, with a marginal 5% difference from the overall winner. With regards to essential oil crop research, Mr Masemola presented a poster on mulching strategies to improve growth, yield, and essential oil quality in rose geranium (*Pelargonium graveolens*). Among the treatments, black plastic mulch consistently outperformed other mulching materials in terms of plant growth (e.g. plant height), physiological performance (e.g. chlorophyll content), and yield (biomass). The study demonstrated that mulching significantly influences the growth, physiological performance, and yield of rose geranium under field conditions while reducing production cost.

Contact: Dr Manare Masowa at masowam@arc.agric.za and Dr Meshack Mofokeng at mofokengm@arc.agric.za

Figure 2. ARC research team delivering presentations at the 2026 combined congress

ARC-VIMP Quality Control Facility Showcases Excellence in Natural Product Research at SACI-45

Compiled by Dashnie Naidoo-Maharaj, Polette Masiela and Stephen Amoo

The ARC-VIMP Quality Control Facility continues to position itself as a leading national role player in advanced analytical chemistry, natural product research, drug discovery support, and the development of standardised natural ingredients. This leadership was recently highlighted at the 45th National Convention of the South African Chemical Institute (SACI-45), where the facility's expertise received national recognition. Ms Polette Masiela was awarded 1st place for the PhD Poster Presentation (Fig. 1) at SACI-45 for her research titled "Identification and Isolation of Metallo-β-Lactamase Inhibitory Compounds from South African Medicinal Plants," and her poster (Fig. 2) was further recognised by ChromSA, underscoring the scientific merit, innovation, and impact of the project. This prestigious recognition affirms the strength and novelty of the research direction and the high-level analytical methodologies applied, including SPE fractionation, UPLC-QTOF-MS, and molecular docking. Ms Masiela's PhD project forms part of a collaborative initiative between the ARC and the University of Pretoria, funded by the National Department of Agriculture, and contributing to the development of novel therapeutic strategies to combat antimicrobial resistance (AMR), which is one of the most pressing global health challenges.

The research has already demonstrated significant progress in identifying natural metallo-β-lactamase inhibitors from indigenous South African plant species and integrating plant chemistry, enzyme inhibition assays, and computational drug-discovery tools within a cohesive research framework. Participation in SACI-45 strengthened scientific communication, expanded exposure to cutting-edge analytical technologies, and enhanced national visibility for both the project and the ARC. The integrated chemistry–biochemistry approach showcased at the conference highlights the technical depth and interdisciplinary expertise housed within the ARC-VIMP Quality Control Facility, which continues to attract interest from researchers across and outside South Africa and stimulate collaborative opportunities in natural product drug discovery.

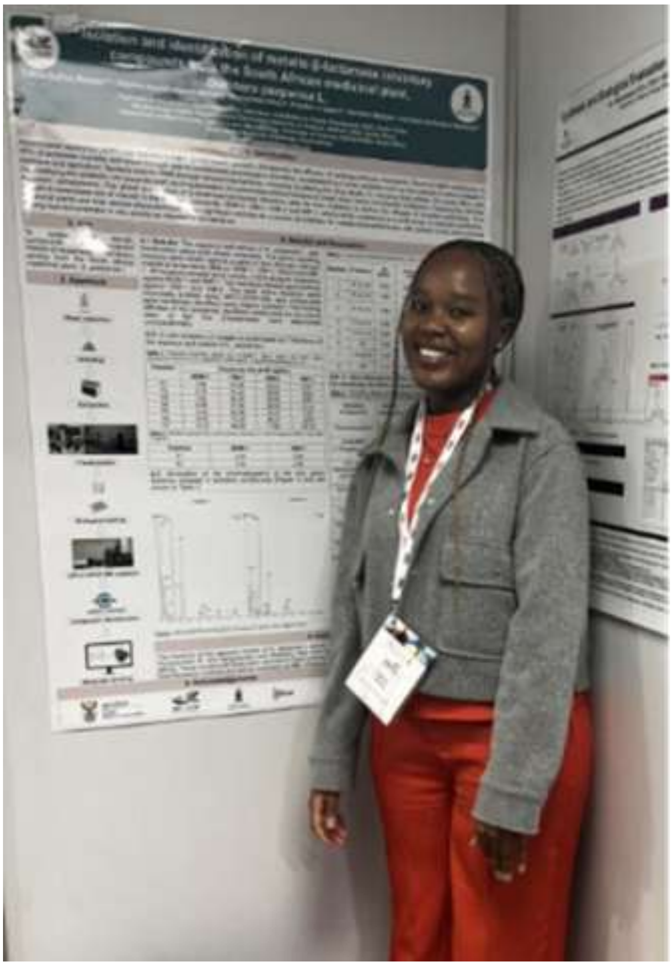

Figure 1. Ms Polette Masiela with her poster at the SACI-45 conference

Figure 2. Poster presented at the 45th South African Chemical Institute (SACI-45) Conference

Contact: Dr Dashnie Naidoo-Maharaj at NaidooMaharajD@arc.agric.za

Building skills: ARC plant breeder attends a Genomic Data Analysis workshop–Conservation Genetics (ConGen2025)

Compiled by Mantshiuwa Lephuthing

Breeding techniques have advanced over time, making it possible for accurate and efficient prediction of yield and quality attributes. The application of these techniques hold potential to speed up crop improvement and cultivar developments, as well as enhance crop resilience against environmental stress. These advances in sequencing technologies have made it possible for plant breeders to study plant genomes, and researchers need to have practical knowledge of the new developments to conduct quality research.

The workshop and course on conservation genomics (ConGen Africa 2025) and analysis of genomic data was held from 7–12 December 2025 at the Plant Science building in Hatfield, Pretoria and hosted by the University of Montana, Department of Plant and Soil Sciences-University of Pretoria (UP), and South African National Biodiversity Institute (SANBI), in collaboration with American Genetic Association (AGA), the National Aeronautics and Space Administration (NASA), and National Science Foundation (NSF). Participants were advanced undergraduates and technicians, postgraduate students, postdoctoral fellows, plant and animal breeders, and conservation, wildlife and plant managers involved in population genetic studies, DNA data analysis, and conservation genetics.

Ms Lephuthing, a breeder from the onion breeding programme in the Roots, Tubers, and Bulbous Crop Division of the ARC-VIMP attended the workshop and will use the information gained to improve the research system and transfer the knowledge to other researchers and postgraduate students. Prior to the workshop, pre-course meetings were held once a week from 5th November to 3rd December 2025, for the participants to learn basic R Studio and Linux command line skills, bioinformatics concepts and technical skills, NanoPore sequencing and genotyping for diversity studies, and the probability, Bayesian statistics, MCMC, and genotype likelihoods.

The workshop was intended to train the participants to understand and use population genetics principles and DNA data to improve biodiversity conservation and management. The goal was to help bridge the gap between researchers and managers to improve conservation and address the critical global biodiversity crisis. The workshop offered tailored modules and hands-on sessions involving instructors from the UP, SANBI Pretoria and Cape Town, Colorado State University, University of California Riverside, University of Montana, University of the Free State, University of Idaho, National Oceanic and Atmospheric Administration-National Marine Fisheries Services, National Centre for Biological Sciences in Bangalore-India, University of Washington, University of KwaZulu-Natal, as well as companies such as Inqaba Biotec and Diplomics.

Microsatellites (SSR) and single nucleotide polymorphism (SNP) datasets were discussed and analysed with an emphasis on next-generation sequence (NGS) data analysis including restricted-site associated DNA (RADseq) and genome sequencing/resequencing, and the interpretation of the output from fundamental and novel statistical approaches and software programs such as R Studio and Linux command line. The course promoted interactions among early-career researchers, mid-career faculty and agency researchers, and leaders in population genomics to help develop "next generation" of conservation and evolutionary geneticists. Special lecture sessions and hands-on exercises, working in groups, were conducted on assessing population structure, testing for Hardy-Weinberg equilibrium proportions, detecting selection, genetic monitoring, inbreeding detection, phylogeny construction and phylogenomics (Fig. 1).

Moreover, developments required to improve data analysis approaches to advance the field of genetics were identified and discussed. This combination of theory and hands-on exercises helped Ms Lephuthing not only to understand the principles of population structure and genetic diversity studies but also build confidence to conduct genomic data analyses independently.

Figure 1. Attendees participating on a group hands-on activity

The participants were taught about the genome assembly and how to take raw sequencing reads through to genotyping (with and without a reference genome). On the final day, the instructors discussed the prospects for future research, teaching directions, and advice to upcoming researchers, as well as publishing a ConGen review describing the course's main topics, course outcomes, genome assembly, and recent advances in population genetics and phylogenetics worldwide (Fig. 2).

The course equipped Ms Lephuthing to understand, analyse, and interpret genetics datasets including microsatellites, SNP markers, and genome-scale sequencing datasets. She learned the genomic data analyses skills, and fundamental statistical and computational approaches. Moreover, Ms Lephuthing has gained new insights to incorporate genomics tools in the breeding programmes at ARC-VIMP, which will help carry forward the ARC's mission of advancing agriculture through science.

Figure 2. Instructors discussing prospects for future research

Contact: Ms Mantshiuwa Lephuthing at LephuthingM@arc.agric.za

Annual student Capacity-Building Seminar/Workshop: ARC-VIMP

By Dr Julia Mulabisana and Dr Nqobile Masondo, and the ARC-VIMP postgraduate committee

The postgraduate committee of the ARC-VIMP held a student seminar for the postgraduate students on the 05 December 2025. In the event, students were given an opportunity to present their research (Fig. 1 and 2) to fellow students and supervisors/mentors. The seminar provides students with a platform to interact and learn about the diverse research conducted at ARC-VIMP.

The platform gives students an opportunity to be exposed to public speaking, enhancing presentation and communication skills, fostering constructive discussion and collaborative learning.

The seminar continues to serve as an important platform for skills development to postgraduate students, interns, technicians and researchers. The platform also offered a cheerful interaction, fostering constructive discussion and collaborative learning. As a token of appreciation for their participations, the 4 best presenting students were awarded with goody bags (Fig. 2).

Figure 1. Presentation by students and other speakers, participation and interaction by students, technicians and researchers.

The presentations were evaluated by a panel of adjudicators for the content, communication aids used, presentation delivery, time management and presentation defence. Winners are as follows:

- Winner of the first prize-best presenter: Ms Thobeka Mzimela
- Winner of the second prize-best presenter: Mr Bishop Ramagoma
- Winner of the third prize-best presenter: Mr Setho Sebitsang
- Winner of the fourth prize-best presenter: Ndzalama Shikwambana

Figure 2. Handing over of prizes to the winners

Presentation titles and authors

1. Mzimela, T.L.S, Duong, T.A Cruywagen, E.M & Engelbrecht, J. Survey and molecular characterization of powdery mildew disease with a focus on Erysiphe species in South Africa.
2. Nemukula, A., Mpanza, T.D.E, Arendse, E. & Gololo, S. Effect of drying methods on the chemical composition of agro-wastes as a potential feed source for livestock.
3. Ramagoma, B., Sibuyi, N., Amoo, S.O., McGaw, L.J, & Masondo, N. Biogenic silver nanoparticles as potent antimicrobial agent against Bovine mastitis strains.
4. Sebitsang, S.S., Nxitywa, A., Stokwe, N.F. & Visser, D. Evaluating Entomopathogenic fungal strains for the management of *Phthorimaea operculella* populations under laboratory and Green-house conditions
5. Sekhula, T.W., Ogola, J.B & Gerrano, A.S. Preliminary study on the influence of environment on Agro-Morpho-physiological characteristics of pigeon pea genotypes.
6. Matlou, M.L., Gouws-Meyer, R. & Sutherland, R. The evaluation of South Africa plant growth-promoting Rhizobacteria (PGPR) on potato (*Solanum Teberosum* L.).
7. Hadebe, N.P., Gubba, A., Dlamini, P., Mahlanza, T. & Mulabisana, M.J. The presence of virus and viroid infections on hemp and cannabis in South Africa.
8. Mohlake, M. P., Amoo, S.O., Lion, G.N., Masondo, N.A. Ethnoveterinary survey, metabolite profile and biological analysis of plants used to manage animal diseases in two selected districts of KwaZulu-Natal.
9. Shikwambana, N., Masondo, N.A., Amoo, S.O & McGaw L.J. *In Vitro* biological activity of medicinal plants used for managing gastrointestinal diseases in ruminants.
10. Chepape, L.N.D, Coutinho, T. & Sutherland, R. Antagonistic activity of plant growth-promoting rhizobacteria from *Cannabis sativa* against *Agroathelia rolfsii*.

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Figure 3. A group photo consisting of attendees (interns, researchers and technicians)

Contact: Dr Julia Mulabisana at MJMulabisana@arc.agric.za

ARC Researchers at the 54th Biennial Southern African Society for Plant Pathology (SASPP) congress

Complied by Rene Sutherland, Elsie Cruywagen and Julia Mulabisana

Figure 1. Group photo of the ARC employees (ARC-VIMP and ARC-PHP) attending the conference

Southern African Society for Plant Pathology organized their biannual conference at The Premier Hotel, Umhlanga from 18 -21 January 2026. The theme of this year conference was “Ensuring a Sustainable Future through Plant Health”. The conference is one of the most prestigious conferences in the field of Plant Pathology in southern Africa. The congress was opened by Honourable Mayor of eThekwini, Cllr Cyril Xaba while Prof. Neil Koorbanally from UKZN gave the welcoming address.

The JE Vanderplank Memorial Address was presented by Prof. Karen Garrett (University of Florida) and her work focussed on epidemiology, ecology, systems analysis, and analyses for decision support, including machine learning approaches. The Ethyl M. Doidge Memorial Address was given by Dr. Alan Wood (ARC-PHP), which is an expert in rust fungi and has discovered new species across South Africa.

Keynote speakers from all over the world as well as experts from South Africa were invited. Prof. Carolee Bull from The Pennsylvania State University, USA enlighten the audience on mushrooms, metabolites, and microbiomes. Prof. Tafadzwanashe Mabhaudhi from London School of Hygiene and Tropical Medicine focussed on linking plant health to water, food and nutrition under climate change. Dr. Jesús Navas-Castillo from the Institute for Subtropical and Mediterranean Horticulture in Spain gave a presentation titled "From the smallest to the largest: Lessons from Begomoviruses and Criniviruses in plant pathology”. Dr. Eugene Rogozhin from Russian Academy of Sciences gave insight peptide technologies in plant protection, whereas Prof. Gueguim Kana presented climate-pathogen interactions - generative & agentic ai for climate–pathogen interaction modelling. Prof. Mark Laing presentation focussed on biological control – opportunities and constraints.

Several researchers, technicians, assistants and students from various ARC campuses including VIMP attended. Colleagues from the LLFV presented posters on various topics including 1) The Centre of Excellence in Plant Health at the Agricultural Research Council (Dr. Mariette Truter); 2) A survey of fungal pathogens affecting cannabis in South Africa (Dr Elsie Cruywagen); 3) Confirmation of virus seed transmission and the effects on fresh and dry weight of Swiss chard and mustard spinach (Dr Julia Mulabisana); 4) Survival of the bacterial wilt pathogen (Dr René Sutherland), 5) Analysis of seed surface disinfection techniques for the detection of seed-borne bacterial pathogens in underutilized crops (Ms. Sherly Mabena); 6) Fusarium populations causing dry and stem-end rot of potato in the Free State (Ms Brightness Nkosi); 7) Molecular identification of *Erysiphe* species causing powdery mildew from vegetable crops in South Africa (Ms Thobeka Mzimela); 8) Identification and characteriza-

Figure 2. Dr. Jesús Navas-Castillo (Institute for Subtropical and Mediterranean Horticulture) Photo supplied by SASPP

Figure 3. Dr Georgios Vidalakis (University of California) Photo supplied by SASPP

tion of viruses infecting cowpea and Bambara groundnut in South Africa (Ms Nosihle Sithole); 9) Characterisation of *Bipolaris, Curvularia* and *Septoria* species associated with leaf spots on cannabis (Ms Mukondeleli Khethani); 10) Detection of Sweet potato chlorotic stunt virus and its relationship with potyviruses: the South African experience over the past 10 years (Ms Midana Marageni); 11) Survey of potato late blight in South Africa to recap on mating types and assess fungicide sensitivity of *Phytophthora infestans* isolates (Ms Reneilwe Mohale); 12) The development of translation initiation factor-based resistance to sweet potato virus disease using Crispr/Cas9 technology (Ms Otlotleng Moloto); 13) Identification of seed-borne fungi in underutilized crops: Bambara groundnut, amaranth and kenaf (Ms Mulanga Munzhelele); 14) Isolation and characterisation of plant growth-promoting rhizobacteria (PGPR) from *Cannabis sativa* (Ms Lesedi Chepape); 15) The study of plant growth-promoting rhizobacteria (PGPR) in South Africa and their effects on potato plants (Ms Lethabo Matlou); 16) The antagonistic effect of plant

Figure 4. Prof. Karen Garrett (University of Florida) presenting JE Vanderplank Memorial Address. Photo supplied by SASPP

growth-promoting rhizobacteria against soil-borne pathogens of potato (Ms Anza Muthabi); 17) Identification and characterization of Fusarium species from diseased cannabis buds, stems and roots (Ms Benedicta Swalarsk-Parry). Ms Taryn Armfield presented a talk on the impact of crop rotation and cover crops on soil health in a dryland cropping system in the Eastern Free State, South Africa

Attendance of the biannual conference gave the researchers the opportunity to network with the industry and other universities. Several new collaborations were initiated.

Contact Dr Rene Sutherland at SutherlandR@arc.agric.za

Figure 5. Presenters at the SASPP congress