SOUTH AFRICAN SUGARCANE RESEARCH INSTITUTE

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PROGRESS REPORT 2021/22

Contents

Chairman's Report

Rex Talmage

Amidst the industry's slow recovery, setbacks, and survival during the period under review, SASRI has forged ahead under trying circumstances to deliver on its mandate to the South African sugar industry and its associated stakeholders by continuing to produce high quality research outcomes that delivered significant value to all.

This is in true testament to the exceptional resilience, fortitude, and adaptability of the SASRI personnel at all levels, outstanding leadership from the Director and the astute guidance of the Sugarcane Research and Sustainable Agriculture (SRASA) Committee.

Notwithstanding the unprecedented challenges that COVID-19, the July 2021 unrest and the devastating floods during April and May 2022 thrust upon the industry and specifically in context of SASRI, the institute worked tirelessly to continue delivering on its overall functions, which are to:

- Develop and deliver new sugarcane varieties that provide increased economic returns for all sectors of the industry.
- Serve as the expert guide to understanding agricultural research opportunities and requirements that will advance sugarcane productivity and profitability.
- Undertake research and provide services that advance nutritional, agronomic and engineering practices and pest and disease control measures.
- Transform research outputs into practical knowledge and technology products.
- Facilitate the adoption of technology and best management practices that encourage responsible and sustainable land use and deliver optimal productivity and profitability.
- Provide biosecurity assurance for the sugarcane industry.
- Generate new ideas with the potential to enlarge the scope of sugarcane agriculture and sustain the industry into the future.

Ukubheka phambili... Looking ahead!

As the South African sugar industry, in the context of the Master Plan, takes steps away from the survival mode that has dominated recent years towards a more sustainable future, SASRI's invaluable work will continue to underpin agronomic performance which amongst others is such a critical component of both growers' and the industry's sustainability into the future.

Finalisation of an agreed SASRI five-year strategic plan (2022-2027) was approved by the SASA Council for adoption at its June 2021 meeting.

The strategic plan includes six key critical success factors that provide clear direction to SASRI, namely:

- Sustainable Sugarcane Production;
- Small-scale Grower Sustainability;
- Enhancing and Enabling Adoption;
- Biosecurity;
- Commercial Opportunities; and
- Smart Agriculture.

A key aspect will be the translation and commercialisation of research, with a need to focus on economic and social impact and not on academic outcomes alone.

SASRI's greatest assets are the highly committed world-class scientists and specialists with all their individual and combined IP (intellectual property) who continue delivering exceptional value to the domestic industry.

On behalf of the SRASA committee I would like to extend our heartfelt appreciation to every one of the outstanding women and men of SASRI, 'thank you - we commend you!'.

Director's report

Dr Terry Stanger

It would be amiss of me if I didn't state upfront that 2021/2022 was a trying year. As the third and fourth waves of the COVID-19 pandemic swept across the country, SASRI continued to ensure continuity of its operations whilst maintaining a safe workplace for its employees. Sadly, however, two of our colleagues succumbed to COVID-19 during the deadly Delta wave, our condolences and thoughts are with all those families that lost loved ones. With the relaxation of the Covid restrictions between the successive waves, SASRI, whilst observing the required safety protocols, returned to having more face-to-face meetings, and after nearly a two-year absence the Junior and Senior Certificate courses and the modular courses are back on SASRI's calendar.

Thankfully, during the week of unrest in July 2021 there were no security breaches at Mount Edgecombe or our Research Stations, but we did not escape unscathed. In a most unfortunate incident, the SASRI biosecurity office in Eshowe was looted and burnt to the ground with the adjacent Coastals hardware being the main target. In addition, KwaZulu-Natal experienced devastating floods in April and May 2022 that had a significant impact on the Sugar Industry. Fortunately, neither the Mount Edgecombe site nor the SASRI research stations incurred any significant damage. What more can I say, it was quite a year!

Following the Sugarcane Research and Sustainable Agriculture (SRASA) Committee directives at the June meeting in 2021, SASRI, through a series of engagements with members of the SRASA Working Group, finalised an agreed five-year strategic plan (2022-2027) which was approved by the SASA Council for adoption.

The strategic plan includes six key critical success factors, namely: Sustainable Sugarcane Production, Small-scale Grower Sustainability, Enhancing and Enabling Adoption, Biosecurity, Commercial Opportunities, and Smart Agriculture; that provide clear direction to SASRI. Each critical success factor is underpinned by several focused objectives, which will guide future research projects. The 2022/2023 Programme of Work was aligned to the new strategic plan and in a significant shift to take advantage of new technology, eight of the 17 new projects included an element of smart agriculture.

Priorities for the reporting year included the initiation of twelve new projects, five of which aim to develop tools to: (a) assist in the management of high-yielding new varieties, particularly in the Midlands; (b) potentially use imaging data, captured via drones, in cane quality management decision-making; (c) enable comparison the economics of various seedcane production options;

(d) optimise fertiliser application decision-making; and (e) potentially predict yellow sugarcane aphid outbreaks.

There has been some exciting progress in the development of decision-support tools for our Extension Specialists to use in guiding their growers. A new web web-based app, called the Variety Guide was released to the SASRI Extension Specialists. This is a visually appealing, user-friendly tool that facilitates the swift comparison of the characteristics of varieties that are suitable for the growing conditions on farms. A customisable Excel-based tool to enable Extension Specialists to advise growers on the effects of various lodging scenarios on their revenue was also released. With this tool, Extension Specialists will now be able to advise their growers on previously unaccounted lodging-associated losses in their estimates. Time-and-motion studies revealed that removal of smut-infected stools could be accomplished more quickly by chemical roguing than by hoeing. Following this, a simple calculator was developed to enable growers to estimate the time and cost associated with roguing fields of different sizes and levels of infection using either physical or chemical methods. The continued development and refinement of decision-support tools like these will significantly enhance the ability of SASRI's Extension Specialists to provide support and guidance to their growers.

The recent entry of crop spraying drones into the industry provides chemical ripening opportunities to the small-scale grower (SSG) sector due to the ability of these drones to operate effectively within fragmented small-field environments. During the year, there was considerable focus on drone deployment in the SSG sector. Trials using drones to apply chemical ripeners conducted in collaboration with coastal SSG's demonstrated potential gross margin benefits of ripening. Several workshops were held with key SSG community stakeholders in rain-fed regions to share ripening economic findings from demonstration trials and facilitate planning the way forward for drone ripening on a wider scale in the various SSG communities.

Pests and diseases continue to pose a major threat to the industry. In November 2021, cane cutters found several longhorn beetle larvae in a sugarcane field being harvested in the Entumeni containment area, this was very close to the area where last year at the same time a similar outbreak occurred. Intensive surveys in adjacent fields revealed the outbreak was most probably confined to the first 17-hectare field where it was found. Eradication orders were issued on this as well as adjacent potentially high-risk fields. The situation continues to be monitored. Fortunately, no adult beetles have been seen to emerge.

Orange rust was identified on sugarcane in South Africa for the first time in February 2022 on the north coast and has subsequently been observed across much of the industry. Preliminary inspections indicate that several varieties have some degree of susceptibility to the disease, although no symptoms have been detected thus far on 14 newer releases. Ongoing activities include notification of key contacts in southern Africa and industry-wide surveys to determine prevalence and varietal susceptibility.

In mid-February serious outbreaks of yellow sugarcane aphid (YSA) at similar levels to those which have occurred in this region in recent years, once again became evident on the North Coast. Although not as severe as the North Coast outbreaks, yellow sugarcane aphid is currently present across all regions of the local industry. Mozambique, Zambia, Zimbabwe, Eswatini and Tanzania have also all reported serious out breaks of this pest. A series of Growers Days and one-on-one meetings with growers was undertaken. The complexities and biology of this pest continue to frustrate both researchers and growers.

In an important next step for the genetic modification (GM) project, a workshop was convened in March 2022. This workshop aimed to gain consensus amongst industry participants on the identity of varieties to be used for genetic modification for increased insect and herbicide tolerance with a view to the commercial release of one genetically modified variety to the rain-fed regions and another to the irrigated regions. The proposed GM varieties will contain two *cry* delta-endotoxin genes effective against lepidopteran (moth) insect pests and a modified acetolactate synthase (*mALS*) gene to increase sugarcane tolerance of the herbicide active ingredient, imazapyr. The *cry* genes were anticipated to be effective against *Eldana saccharina* (eldana), a major production constraint in rain-fed regions, as well as *Chilo sacchariphagus*, a significant biosecurity risk to the northern irrigated regions. The herbicide tolerance trait was included in the proposed GM varieties, as weed management is identified as an important production constraint for small-scale growers. Current focus is on developing new knowledge for use in the preparation of the regulatory dossier that will be required for the future release of an insect-resistant and herbicide-tolerant genetically modified sugarcane variety.

This annual report provides an overview of our achievements in the past year and offers some insight into the activities and noteworthy outcomes produced in support of our industry - I hope you enjoy reading it.

Research, Technology Development and Knowledge Exchange

Dr Derek Watt
Research Manager

SASRI research, technology development and knowledge exchange activities during 2021/2022 continued to deliver outcomes to support sugarcane growers in their efforts to maintain and improve the profitability of their farming enterprises. Progress was good, with advances made in the development of several technologies, including those relating to the support of: (a) biosecurity functions; (b) the agro-technical self-sufficiency of small-scale grower communities; (c) grower decision-making; and (d) growers in the effective management of their crops through improved access to refined and updated recommendations.

Key Focus Areas

Priorities for 2021/2022 were research, technology development and knowledge exchange activities within four key areas: (a) technology development for small-scale growers; (b) technology development for large-scale growers; (c) technology development to support the functions of the biosecurity inspectorate; and (d) foundational activities in variety improvement, crop protection, crop performance and management, systems design and optimisation, and knowledge exchange.

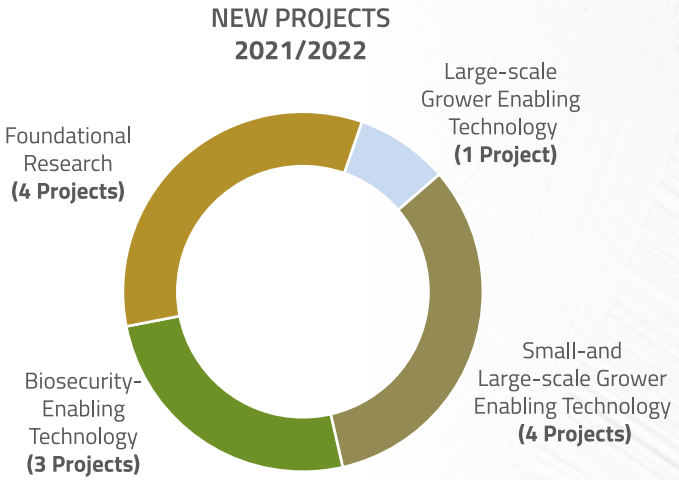
Small-scale Grower Enabling Technologies	Small-scale grower facing research, technology development and knowledge exchange in 2021/2022 focused on expanding knowledge and developing technologies to assist small-scale grower decision-making for the management of their crops, either directly or mediated through SASRI extension services and the KwaZulu-Natal Department of Agriculture and Rural Development of the Extension Venture Agreement. Projects in this area strove to use participative research methodologies as a means to empower growers in their decision-making.	
Enabling Technologies for Large- and Small-scale Growers	Emerging state-of-the-art technologies have the potential to be of value to all growers but particularly to large-scale cane growers wishing to implement precision agriculture approaches to improve efficiencies, reduce production costs or proactively manage adverse production conditions.	
Biosecurity Enabling Technologies	SASRI research, technology development and knowledge exchange play a crucial role in enabling and supporting the effective operation of the SASRI Biosecurity Inspectorate through the development of knowledge resources, management tools and monitoring and diagnostic technologies.	
Foundational Research, Technology Development and Knowledge Exchange	This Key Focus Area encompassed activities aimed at the delivery of foundational technologies, resources and knowledge products that are of benefit to all South African cane growers, including the investigative and developmental activities managed within four research programmes: (a) variety improvement; (b) crop protection; (c) crop performance and management; and (d) systems design and optimisation. Knowledge exchange initiatives form an integral part of the research and technology development process.	
	Variety Improvement	To develop and release varieties with high sucrose yield, achieved through increased biomass and sucrose yield, which have pest and disease resistance, adaptability, ratooning ability and agronomic and milling characteristics desirable to both millers and cane growers.
	Crop Protection	To develop integrated management strategies that minimise the effects of pests, diseases and weeds on crop production in a sustainable manner.
	Crop Performance and Management	To develop models and better management practices to sustain and enhance sugarcane production.
	Systems Design and Optimisation	To investigate, develop and transfer innovative systems that optimise industry performance.
	Knowledge Exchange	To facilitate the exchange of agro-technical knowledge through the design and implementation of various mechanisms and interventions in collaboration with industry participants and stakeholders.

Project Portfolio Composition

The 2021/2022 portfolio consisted of twelve new projects that commenced in April 2021 and 49 ongoing projects that continued from 2020/2021.

The composition of new and ongoing project portfolio for 2021/2022 has been informed and guided by several factors, including:

- *an analysis of grower needs conducted in March 2020 using the formal Research, Development and Extension (RD&E) process to promote portfolio alignment with regional small-scale and large-scale grower priority issues;*
- *the need for progressive research arising from the outcome of projects completed on or before 31 March 2020;*
- *opportunities for the transformation of research outputs into practical knowledge and technology products, with associated initiatives to promote adoption;*
- *advances in science and technology that have the potential to provide innovations in sustainable sugarcane production; and*
- *national economic, socio-economic, and socio-political factors influencing sugarcane agriculture.*



RD&E Committees' Workshop discussion group.

New Projects

The 2021/2022 portfolio included nine new projects that commenced in April 2021.

Enabling Technologies for Large- and Small-scale Growers

Scoping the development of Fertiliser Optimiser Software	To develop a fertiliser optimisation software application that will allow users to evaluate and develop optimal nutrient plans to meet nutrient requirements for their fields.	 PROJECT MANAGER Dr Louis Titshall	
Promoting adoption of BMPs for improved yield and sustainable production	To encourage growers to adopt best management practices (BMPs) through participatory grower information sharing using demonstration plots ("seeing and doing are believing").	 PROJECT MANAGER Dr Louis Titshall	
Investigating alternative energy supplies to assist with load shedding	a) To determine load shedding effects on irrigation operations and practices on SSG and LSG farms in Mpumalanga; (b) to model the yield loss and economic impact for typical load shedding scenarios; and (c) to investigate and cost back-up or alternative energy supplies and other load shedding solutions.	 PROJECT MANAGER Dr Peter Tweddle	
Evaluation and refinement of a labile carbon method for use in a commercial laboratory	Evaluating and refining the rapid permanganate oxidisable labile carbon method, under routine commercial laboratory conditions, as an indicator of land use and management changes in sugarcane production.	 PROJECT MANAGER Dr Louis Titshall	

Enabling Technologies for Large-scale Growers

Midlands variety management	To develop and implement decision support for optimising agronomic management of high yielding varieties in the Midlands, focusing on variety choice, harvest age and cane quality management.	 **PROJECT MANAGER** Natalie Hoffman	

Enabling Technologies for Biosecurity

YSA Risk Index	To develop a computer-based tool for predicting likely yellow sugarcane aphid (YSA) outbreaks in advance using weather and crop management data, thereby providing additional guidance for pro-active treatment decisions.	 **PROJECT MANAGER** Matthew Jones	
YSA and thrips control manual	To provide practical guidelines for YSA and Thrips control through the creation of a manual. The manual is to contain information on: (a) basic aphid biology and effect on the plant; (b) the optimal use of varieties; (c) measures to avoid drought risk (e.g., sub-soil sampling, access to subsoil water through reduction of subsoil acidity, control of nematodes, reduced soil compaction, reduced weed competition); (d) optimal N and K nutrition; (e) scouting/survey methods; and (f) use of insecticides.	 **PROJECT MANAGER** Dr Stuart Rutherford	
Economics of establishing certified nurseries with different plant sources	(a) To conduct a full economic evaluation of using conventional hot-water treated (HWT) seedcane, HWT transplants, and NovaCane® to establish a nursery seedbed under different scenarios; and (b) to develop an MS Excel-based calculator to allow annual updates of the economics of producing seedcane under different scenarios.	 **PROJECT MANAGER** Sharon McFarlane	

Foundational Research and Technology Development

Biotechnological investigations to improve sugarcane drought stress tolerance	• Renewal of research agreement with the Institute of Plant Biotechnology, Stellenbosch University for a further three-year funding cycle (2021/2022 to 2023/2024). • To obtain proof-of-concept that the drought tolerance of sugarcane can be increased through the overexpression of selected genes encoding protective proteins and factors involved in the regulation of gene expression.
UAV multi-spectral imaging for precision sugarcane quality management	To assess the feasibility of aerial multi-spectral imagery, captured via cameras mounted on unmanned aerial vehicles (UAVs), for precision sugarcane quality management in: (a) crop maturity assessment; (b) ripener chemical efficacy assessment; (c) harvest prioritisation; and (d) predicting yield and cane quality from vegetation indices.
Development of Datasets for Multi-Scale Water Resource Assessments	To develop a pre-packaged database of quinary catchment level attributes for application to water resource related assessments through hydrological and agricultural modelling and implement an online data portal system to store and provide access to the datasets (Project funded by the Water Research Commission and led by the Centre for Water Resources Research at the University of KwaZulu-Natal, with collaboration from several organisations, including SASRI).
The eldana microbiome	To investigate the microbial community structure associated with eldana eggs, larvae, pupae and adults, as an improved understanding of the relationship between eldana and its microbiome may aid in the development of a novel control strategy as a component of eldana integrated pest management (IPM).

PROJECT MANAGER
Natalie Hoffman

PROJECT MANAGER
Phillemon Sithole

PROJECT MANAGER
Nongcebo Memela

Outcomes from completed projects

In the 2021/2022 project portfolio, six projects were completed on 31 March 2022. Primary outcomes are provided, with more detailed information given in the relevant research programme reports.

Enabling Technologies for Large- and Small-scale Growers

Crop estimates computer application for effective decision-making	A simple web-based decision support program (DSP) was developed to assist rainfed growers with their crop estimates. The tool considers: (a) climatic effects on the size (tons cane) of the standing crop at the time of the estimate; (b) three-month climate forecasts; and (c) carryover area. Required inputs include: (a) region (homogeneous climate zone number); (b) a qualitative estimate of soil water holding capacity; (c) long-term farm yield, carryover fraction, and age at harvest; and (d) the current season's carryover fraction, age at harvest and expected climatic condition for the coming three months. The DSP was developed specifically for rainfed conditions and is expected to benefit sugarcane growers and their Extension Specialists in these areas.		 **PROJECT MANAGER** Matthew Jones
Review of best practices for Si and grower-based survey	A meta-analysis of available data and a grower survey revealed that: (a) sugarcane response to Si application were best in high organic matter soils associated with poorly drained conditions; (b) broadcast application of high rates of Si amendments with subsequent incorporation, possibly in combination with furrow application at planting, appear most likely to improve crop responses and increase Si uptake. Future studies in 2023/2024 will examine the benefit of co-mixing of organics with slags to mimic conditions observed in the high organic Histosol soils for possible superior crop responses to Si application.		 **PROJECT MANAGER** Dr Louis Titshall

Assessing the water footprints of selected fuel and fibre crops in South Africa	This collaborative, Water Research Commission funded project estimated the water footprint of sugarcane production (volume of water consumed to produce one ton of sugarcane) in the different agroclimatic regions of South Africa, as influenced by current and future climate, soil type and management practices. Blue (irrigation) and green (rainfall) water footprint values were calculated from simulated cane yield and crop water use. The study provided context specific estimates of the water footprint for SA sugarcane production. Due to increasing demand on limited water resources in SA this information will be useful to have when competing for a limited resource, and to justify use of a limited resource.	 **PROJECT MANAGER** Dr Abraham Singels
Implementation of the Drought Irrigation Program	The Drought Irrigation Program (DRIP) was developed previously by SASRI to assist growers with irrigation management during times of limited water supply. The tool is intended to enable users to evaluate the impact of farm irrigation strategies on crops and profitability. DRIP, however, has significant barriers to adoption in terms of ease of use and compatibility, particularly in terms of populating model inputs with the required baseline data. The outcome of an internal consultation process revealed that: (a) automated input of baseline data into DRIP from existing databases would be necessary to promote adoption and widespread use of the decision support tool; and (b) partnerships with commercial entities, as well as growers and miller-*cum*-planters that use such products, would be required to facilitate DRIP articulation with cane production data bases. Should such partnerships not materialise, SASRI would retain custodianship of the DRIP tool, with the following roll-out options: (a) implementation on a restricted number of case study farms annually with partnership between SASRI scientists and extension specialists: (b) SASRI scientists would apply the model for growers through their Extension Specialists on a request basis; and (b) the model be the subject of an advanced modular course held on an annual basis for interested growers upon request	 **PROJECT MANAGER** Dr Ashiel Jumman

Enabling Technologies for Biosecurity

Species diversity of natural enemies of yellow sugarcane aphid	Field surveys of potential natural predators of the yellow sugarcane aphid (YSA) revealed a total of only ten different species, across three families. These were classified into six ladybird species, two lacewing species, and two syrphid fly species. The prevailing dominant species of possible YSA predators in the Midlands North and Midlands South regions appeared to be from the order Neuroptera, particularly lacewings. Dominant predator species in the other regions (Coastal, Umfolozi, Zululand, Lowveld) appeared to be a variety of coccinellids plus syrphid flies (mainly larval stages). A follow-on project is to focus on encouraging growers to increase biodiversity on their farms and to test soil amendments that may improve the resistance of sugarcane to YSA.		 **PROJECT MANAGER** Dr Iona Basdew
Roguing for smut: economics and alternate methodologies	Time and motion studies indicated that applying glyphosate (10% v/v) to smut-infected stools was fourfold quicker than physical stool removal. The amount of soil and plant material removed from the field during the chemical roguing operation was substantially lower than physically removing the stool, saving time, and reducing costs associated with the disposal of the infected material. A simple Excel calculator was developed to estimate the cost of the two methods of roguing in fields with different levels of smut. Glyphosate (360 or 450 g/L; 10% v/v) was confirmed to be the most efficient registered chemical currently available for chemical roguing. In addition, it reduced smut spore viability within a day of application. This will allow some modification to the current chemical roguing procedure.		 **PROJECT MANAGER** Sharon McFarlane

Chemical ecology and microbiome of the longhorn beetle and eldana pheromone	*Longhorn beetle and eldana pheromones* Volatile organic compounds emitted by adult female longhorn beetles were trapped and characterised with a view to identifying a pheromone that could be used for management of the pest. While strong electroantenogram detector (EAD) responses were obtained from longhorn beetles, the corresponding coupled gas chromatogram (GC) peaks were small, making it almost impossible to obtain quality mass spectra. Consequently, the pheromone could not be identified, although it was suggested that the active pheromone, which was detected, is likely to have a similar precursor to that of prionic acid but with a larger molecular weight. Calling eldana males were found to emit an EAD detectable blend of trans-eldanolide, cis-eldanolide, 6,10,14-trimethyl-pentadecan-2-ol and vanillin. These blend ratios have not been reported previously and could potentially be critical for behavioural activity of female *E. saccharina*.  *Longhorn beetle shift onto sugarcane* The shift by the longhorn beetle onto sugarcane can possibly be attributed to several potential mechanisms, including abiotic and biotic factors. The possible polyphagia of this species could result from changes and modulations of its gut microbiome composition, depending on the host. Composition of longhorn beetle diet was shown to influence the bacterial microbiota of the larval gut. Interestingly, the insect performed as well on sugarcane as on wattle in terms of mass gain and had a microbiome diversity index similar to field larvae from sugarcane and to that on wattle (although actual bacterial species may vary), which may indicate that some adaptation to sugarcane has taken place.

PROJECT MANAGER
Dr Stuart Rutherford

Research and knowledge exchange highlights

Highlights and achievements from the 2021/2022 project portfolio were as follows. Additional details are presented in the research programme reports that follow.

Enabling Technologies for Small-scale Growers

Weed Management	*Deploying Imazapyr-tolerant N12 Zapyr*[1]	• Observations revealed that the required waiting period before replanting after imazapyr application to soils for weed eradication might not be required for N12-Zapyr. The manufacturer of an imazapyr-based herbicide commonly used within the industry indicated that potential exists for a label amendment to enable this practice, conditional on further confirmatory results in 2022/2023. • In multi-location demonstration plots of N12 Zapyr, foliar application of imazapyr at four months after planting had no visible effect on the canopy, although conventional N12 planted as the control succumbed to the negative effects of the herbicide.
Cane Quality Management	*Drone Deployment in SSG Sector*	• Trials using drones to apply chemical ripeners and conducted in collaboration with coastal small-scale growers demonstrated potential gross margin benefits of ripening of R2,842/ha (Umbumbulu, N54), R3,481/ha (Umthwalume, N39), R5,074/ha (Amatikulu, N39), R5,675/ha (Umzimkulu, N39), R9,116/ha (Richards Bay, N41) and R11,100 (Amatikulu, N58). • Several workshops held with key small-scale grower community stakeholders in rain-fed regions to share ripening economic findings from demonstration trials and facilitate planning the way forward for drone ripening on a wider scale in the various SSG communities. 

[1] N12 Zapyr is the variant of N12 resistant to imazapyr developed by SASRI using mutagenic breeding approaches.

Enabling Technologies for Small- and Large-scale Growers

Facilitating Variety Choice	A digital application developed to enable extension specialists serving small-scale and large-scale growers to easily compare variety information to facilitate the decision-making of their growers regarding variety choice.

Managing Eldana	*Establishing Sterile Insect Technique*	• Insect-rearing and insect transport arrangements for off-site irradiation were developed to support proof-of-concept demonstration of the efficacy of a novel F1 sterile insect technique (SIT) for eldana population management. • A proof-of-concept study of the SIT on potted cane provided early but encouraging evidence that the SIT F1 approach is effective in limiting eldana population growth and consequent sugarcane damage. Follow-on testing of the approach in a pilot field study will commence in 2022/2023.

Improving Crop Nutrition and Soil Health	*Knowledge Resources*	SASRI Information Sheets on crop nutrition and soil management updated and revised and new sheets developed as required.
	Managing Salinity and Sodicity	Tools and knowledge resources developed to assist growers in improving their awareness of the negative effects of salt build-up in soils under irrigated sugarcane production.
	Managing Root Development	Guidelines developed to serve as a knowledge resource for growers and their advisors on the management of fields to optimise root development.
	Investigating Si Soil Amendments	Meta-analyses of available data revealed that: (a) slag, slagment and cement as Si sources are likely to provide the most consistent positive crop responses; (b) broadcast incorporation at planting may achieve best responses, with good residual effect in ratoon crops; (c) application rate may have less of an impact than application method and Si-type; and (d) combining Si-amendments with organic materials before application may enhance Si uptake.

Evaluating Impacts of Lodging	A customisable Excel-based tool developed to enable Extension Specialists to advise growers on the effects of various lodging scenarios on their revenue.

Improving Weather Data Access	SASRI WeatherWeb online tool updated and an application to enable use of the site on smart phones to be released in 2022/2023.

Biosecurity Enabling Technologies

Managing Eldana	*Knowledge Resources*	Progress made in updating existing information sheets on pests, diseases, and weeds, and publishing new sheets where knowledge gaps were identified.

Managing Sugarcane Yellow Aphids	*Communicating with Growers*	In response to ongoing grower concerns regarding the extent of yellow sugarcane aphid (YSA) infestations, a series of Growers Days and one-on-one meetings with growers was undertaken.
	Establishing Variety Reponses	Variety 'resistance ratings' for YSA (average percent leaf area damaged) were calculated for 35 varieties from data collected from several trials and surveys conducted in rain-fed and irrigated regions of the industry.
	Monitoring Natural Predators	Monitoring of natural predators of the yellow sugarcane aphid matured into broader concepts around the importance of on-farm biodiversity management, which are to be evaluated in 2022/2023 in a project that will aim to encourage grower-led testing of the approach.

Managing Diseases	*Improving RSD Hygiene Practices*	Although the lengthy mechanical harvester decontamination procedure developed and tested reduces ratoon stunt (RSD) spread into healthy cane from infected stools, it is unable to eliminate the risk of transmission.
	Improving Smut Control	• Time-and-motion studies revealed that removal of smut-infected stools could be accomplished more quickly by chemical rogueing than by hoeing. A simple calculator was developed to enable growers to estimate the time required to rogue fields of different sizes and levels of infection using either physical or chemical methods. • Fungicides with the active ingredients of tebuconazole: azoxystrobin: prochloraz and flutriafol: fluoxastrobin showed great promise for smut management, particularly when used in combination with good field hygiene management.
	Monitoring Rust Occurrence	• Monitoring of rust outbreaks ongoing and the accuracy of PCR-based diagnostics tests for rusts was improved. • Orange rust was observed on sugarcane in Angola in October 2020. However, no spores or symptoms of this fungal pathogen were detected in the South African industry in 202/2022.

Foundational Research and Technology Development

Releasing Superior Varieties	• Released two new varieties, N76 and N77, with superior yield and agronomic performance for coastal rainfed short-cycle (12 month) growing conditions. • Recommended N78 for gazetting and bulking for cultivation on an 18 to 24 month cutting cycle in the midlands and high-altitude regions of the industry. • Delivered 421,500 hardened off NovaCane® plants of varieties N12 Zapyr, N69, N73, N74, N75, N76 and N77 and 7 tons of hot water treated seedcane of N73 to bulking co-operators.
Expanding Genetic Base of Varieties	Progeny of thirty-six crosses undertaken on behalf of SASRI by the West Indies Central Sugar Cane Breeding Station in Barbados received. Crosses used N14, N16, N25 and N53 as female parents and desirable Barbados or West Indies lines as males. The populations entered multilocation trials at the SASRI Bruyns Hill (Midlands), Gingindlovu (Coastal Long Cycle) and Pongola (Irrigated) research stations.
Developing Insect and Herbicide Tolerant Varieties	• Bioassays revealed that 75% of proof-of-concept transgenic lines that were engineered to express the Bt insecticidal protein were significantly more resistant to eldana when compared with the susceptible control plants. • In proof-of-concept studies, a novel in vitro screening method developed to assess responses rapidly and cost-effectively to exposure of sugarcane lines genetically modified for tolerance to the imazapyr herbicide.
Improving Variety Stress Tolerance	• During water stress treatments, proof-of-concept epigenetic mutants[2] of N41 recovered after a period of drought, which may be attributable to the delayed onset of permanent wilting and plant death, a characteristic absent in the non-mutant N41 controls. • Genetic engineering and mutation breeding approaches to improve sugarcane water-deficit stress tolerance yielded promising preliminary results under glasshouse and poly-tunnel conditions (research contract with Stellenbosch University).
Enhancing Breeding Efficiencies for a Changing Climate	Proof-of-concept phenotyping of sugarcane for photosynthetic capacity and drought tolerance using drone captured imaging data yielded promising results in plant and first ratoon crops of 54 genotypes grown under well-watered and water-deficit conditions.
Evaluating Variety Performance	In a Malelane (northern irrigated regions) variety evaluation trial, N53 observed to consistently outperform N49, with a 16% increase in tons RV/ha and improved gross margins when transport costs of R30/t are considered.

[2] SASRI has developed a novel protocol for inducing epigenetic mutations in sugarcane under stress-induced selection pressure. These mutations confer heritable changes in gene expression that are not due to changes in the underlying sequence of the DNA but, nevertheless, are aimed at conferring improved stress tolerance.

Managing Eldana	*Testing New Chemistries*	A promising combination of two currently unregistered active ingredients, pyriproxyfen + lufenuron, appeared to be effective in reducing eldana damage and increasing RV yield, and could be useful in eldana population suppression ahead of sterile moth releases in sterile insect technique (SIT) approach.
	Examining Timing of Sprays	Novel interpretation of eldana data from a white grub trial at Tugela Mouth raised an interesting possibility that a once-off spraying of cane with a registered insecticide (which activates eldana ryanodine receptors) in late February, targeting early stalk elongation and the Mar-Apr-May eldana moth peak, may have long-lasting beneficial effects on eldana control, including: (a) reduced damage to predator populations; (b) ease of spraying of young cane; (c) higher insecticide "load" per unit plant biomass; and (d) enhanced plant coverage. Further investigations to be conducted in 2022/2023.
	Studying Eldana Gut Microbiome	Investigation of the eldana gut microbiome identified the presence of *Gordonia*, a rare actinomycete, which has been applied elsewhere to environmental improvement and protection via its biological degradation ability.
	Discovering Genes Associated with Variety Eldana Resistance	Further evidence obtained of the involvement of the induced expression in sugarcane of a dirigent domain-containing gene (*DIR*) in the response of an eldana-resistant variety to eldana attack. In the long-term, knowledge of genes expressed in response to eldana attack on the sugarcane stalk and associated with susceptibility or resistance may lead to more precise breeding approaches.

Examining Harvest Cycles	Analysis of extensive commercial production data from Komatipoort (northern irrigated regions) revealed that: (a) ageing sugarcane beyond twelve months might benefit growers in terms of RV yield responses; (b) harvesting cane older than twelve months may also be beneficial in terms of gross margins from ratoon crops; and (c) ageing crops further than 16 months may not to be beneficial when cumulative gross margins cash flows over the whole crop cycle are considered.

Managing Cane Quality	*Drones in Cane Quality Assessments*	Proof-of-concept study revealed that image data collected by drone may be suitable for estimating Brix, Pol and RV% in standing cane (New Project: Commenced 1 April 2021).
	Testing New Ripener Combinations	Two field trials conducted in Pongola revealed that a combination treatment of trinexapac-ethyl and fluazifop-p-butyl was highly profitable across a range of irrigated varieties grown in the region.

Managing Cane Nutrition	*Improving Leaf Nutrient Diagnostics*	Research continued to evaluate the quality of predictions by infra-red scanning technologies of levels of key leaf nutrients (B, Ca, Mg, P, S, Cu, Mn, Zn).
	Refining P Testing	Attempts to refine calibration of the Resin test for soil P were confounded by a high variability in crop response to P treatments and, as a result, the current P threshold range is to remain.

Refining Crop Forecasting	High-resolution spatial framework developed for crop simulation modelling that may result in improved fidelity of the monthly crop forecast issued by the Canesim Crop Forecasting System, as well as that of other decision-support tools, including the My Canesim real-time irrigation scheduling tool and the StalkGro growth increments tool.

Project Portfolio Management

The 2021/2022 research and technology development project portfolio was administered within four programmes, and the knowledge exchange portfolio under the auspices of the SASRI Knowledge Management Unit.

Variety Improvement	Developing and releasing sugarcane varieties with high sucrose yield, achieved through increased biomass and sucrose content, which have pest and disease resistance, adaptability, ratooning ability, and agronomic and milling characteristics desirable to both millers and growers.
Crop Protection	Developing integrated management strategies that minimise the effects of pests and diseases on sugarcane production in a sustainable manner.
Crop Performance and Management	Developing models and preferred management practices that sustain and enhance sugarcane production.
Systems Design and Optimisation	Developing and sharing innovative systems that optimise industry performance.
Knowledge Exchange	Facilitating the exchange of agrotechnical knowledge through the design and implementation of a variety mechanisms and interventions in collaboration with industry participants and stakeholders.

RESEARCH PROGRAME MANAGER
Dr Sandy Snyman

RESEARCH PROGRAME MANAGER
Dr Stuart Rutherford

RESEARCH PROGRAME MANAGER
Dr Riekert van Heerden

RESEARCH PROGRAME MANAGER
Dr Rian van Antwerpen

KNOWLEDGE MANAGEMENT UNIT MANAGER
Michelle Binedell

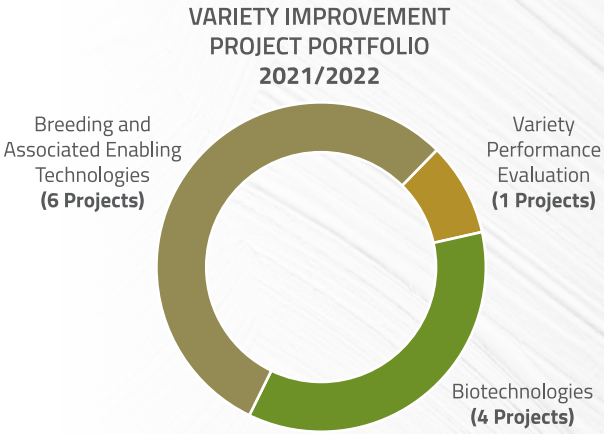
Dr Sandy Snyman
Research Programme Manager

Variety Improvement Research

Developing and releasing sugarcane varieties with high sugar yield, achieved through increased biomass and sucrose yield, which have pest and disease resistance, adaptability, ratooning ability and agronomic and milling characteristics desirable to both millers and growers.

Research Focus Areas

Breeding and Associated Enabling Technologies	• *Developing and releasing varieties with sucrose, yield, pest and disease, agronomic and milling characteristics desirable to both millers and growers.* • *Developing innovative technologies to expedite breeding, including genetic markers and introgression breeding.*
Variety Performance Evaluation	*Providing accurate, comprehensive, and timely variety information that assists growers in making the best variety choices.*



Biotechnologies	*Developing key innovations, including those involving genetic engineering and mutagenic breeding that enable the production of varieties with novel and improved trait*

Project Portfolio

The 2021/2022 portfolio included 11 projects.

Breeding and Associated Enabling Technologies

Breeding

Developing and releasing varieties with sucrose, yield, pest and disease, agronomic and milling characteristics desirable to both millers and growers.

PROJECT MANAGER
Dr Marvellous Zhou

Introgression breeding

Developing and implementing breeding strategies to broaden the genetic base of South African sugarcane varieties to improve pest and disease resistance, stress tolerance, vigour, and yield.

PROJECT MANAGER
Dr Shailesh Joshi

***In vitro* germplasm conservation**

Developing technologies for the long-term preservation of valuable breeding-related germplasm, including that derived from the application of novel genetic engineering and mutation breeding methods.

PROJECT MANAGER
Dr Sandy Snyman

Setting-up of a generic bioinformatics pipeline to analyse genomics and transcriptomic data

Refining and maintaining a generic bioinformatics pipeline to support genomics and functional genomics research that aims to develop genetic markers for valuable sugarcane characteristics, such as eldana resistance.

PROJECT MANAGER
Robyn Jacob

Transcriptomics of eldana-inoculated sugarcane plants

Identifying genes that are expressed as part the resistance or susceptibility response of sugarcane to eldana boring with the ultimate goal of developing genetic markers for eldana resistance and susceptibility for use in breeding.

PROJECT MANAGER
Robyn Jacob

Investigation of genome structure, diversity and phylogenetic relationship of *Saccharum* species, and the part of this diversity already incorporated in modern cultivars

- *Research project conducted by CIRAD and co-funded by ten member countries of the International Consortium for Sugarcane Biotechnology.*
- *(a) elucidating the genome structure, diversity and phylogenetic relationships of the Saccharum species involved in modern cultivars; and (b) characterising the S. spontaneum part of the genome present in current modern cultivars, in term of proportion and diversity.*

INTERNATIONAL CONSORTIUM FOR SUGARCANE BIOTECHNOLOGY

Variety Evaluation

Variety Evaluation

Providing accurate, comprehensive, and timely variety information that assists growers in making the best variety choices.

PROJECT MANAGER
Thobile Nxumalo

Biotechnologies

Proof-of-concept of the development of Bt GM sugarcane for possible future commercial deployment

Developing a genetically modified (GM) sugarcane variety that has improved insect resistance and herbicide tolerance for potential commercial release.

PROJECT MANAGER
Dr Sandy Snyman

Genetically modified sugarcane: Preparative research for regulatory dossier requirements

- *Project funded by Biosafety South Africa, a unit of the Technology Innovation Agency of the national Department of Science and Innovation.*
- *Developing new knowledge for use in the preparation of the regulatory dossier that will be required for the future potential release of an insect-resistant and herbicide-tolerant genetically modified sugarcane variety (Bt GM sugarcane).*

biosafety SOUTH AFRICA

PROJECT MANAGER
Dr Sandy Snyman

Production and characterisation of stress resistant sugarcane mutants

Developing epigenetic variants by means of: (a) in vitro treatments that alter DNA methylation patterns; and (b) generation of epigenetic variation in conjunction with in vitro selection for stress tolerance. The long-term goal is to develop sugarcane varieties with novel types of stress tolerance, which will become increasingly valuable in a changing climate.

PROJECT MANAGER
Dr Stuart Rutherford

Biotechnological investigations to improve sugarcane drought stress tolerance

- *Research agreement with the Institute of Plant Biotechnology, Stellenbosch University).*
- *Obtaining proof-of-concept that the drought tolerance of sugarcane can be increased through the overexpression of selected genes encoding protective proteins and factors involved in the regulation of gene expression.*

Stellenbosch
UNIVERSITY
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Research Highlights

Breeding and Associated Enabling Technologies

Releasing Superior Varieties	• Released two new varieties, N76 and N77, with superior yield and agronomic performance for coastal rainfed short-cycle (12 month) growing conditions. • Recommended N78 for gazetting and bulking for cultivation on an 18 to 24 month cutting cycle in the midlands and high-altitude regions of the industry. • Delivered 421,500 hardened off NovaCane® plants of varieties N12 Zapyr, N69, N73, N74, N75, N76 and N77 and 7 tons of hot water treated seedcane of N73 to bulking co-operators.
Expanding Genetic Base of Varieties	Progeny of thirty-six crosses undertaken on behalf of SASRI by the West Indies Central Sugar Cane Breeding Station in Barbados received. Crosses used N14, N16, N25 and N53 as female parents and desirable Barbados or West Indies lines as males. The populations entered multilocation trials at the SASRI Bruyns Hill (Midlands), Gingindlovu (Coastal Long Cycle) and Pongola (Irrigated) research stations.

Variety Performance Evaluation

Evaluating Variety Performance	• In a Malelane (northern irrigated regions) variety evaluation trial, N53 observed to consistently outperform N49, with a 16% increase in tons RV/ha and improved gross margins when transport costs of R30/t are considered. • Variety trials conducted over several years to test ratoonability confirmed that older varieties are not superior to newer varieties in terms of ratoonability.

Biotechnologies

Developing Insect and Herbicide Tolerant Varieties	• Bioassays revealed that 75% of proof-of-concept transgenic lines that were engineered to express the Bt insecticidal protein were significantly more resistant to eldana when compared with the susceptible control plants. • In proof-of-concept studies, a novel in vitro screening method developed to assess responses rapidly and cost-effectively to exposure of sugarcane lines genetically modified for tolerance to the imazapyr herbicide.
Improving Variety Stress Tolerance	• During water stress treatments, proof-of-concept epigenetic mutants[3] of N41 recovered after a period of drought, which may be attributable to the delayed onset of permanent wilting and plant death, a characteristic absent in the non-mutant N41 controls. • Genetic engineering and mutation breeding approaches to improve sugarcane water-deficit stress tolerance yielded promising preliminary results under glasshouse and poly-tunnel conditions (research contract with Stellenbosch University).
Deploying Imazapyr-tolerant N12 Zapyr[4]	• In multi-location trials, conducted for research and development purposes, foliar application of imazapyr to N12-Zapyr at four months after planting had no visible effect on the canopy, although conventional N12 planted as the control succumbed to the negative effects of the herbicide. • Observations revealed that the required waiting period before replanting after imazapyr application to soils for weed eradication might not be required for N12-Zapyr. The manufacturer of an imazapyr-based herb • icide commonly used within the industry indicated that potential exists for a label amendment to enable this practice, conditional on further confirmatory results in 2022/2023.

[3] SASRI has developed a novel protocol for inducing epigenetic mutations in sugarcane under stress-induced selection pressure. These mutations confer heritable changes in gene expression that are not due to changes in the underlying sequence of the DNA but, nevertheless, are aimed at conferring improved stress tolerance.

[4] N12 Zapyr is the variant of N12 resistant to imazapyr developed by SASRI using mutagenic breeding approaches

Topical Research Updates

Breeding and Associated Enabling Technologies

Sugarcane Crossing

Procedural refinements and investigations were instituted in 2021/2022 to address the disappointing crossing efficiencies experienced over the past few seasons. Emphasis is being placed on optimising environmental conditions in the crossing glasshouse and photoperiod house. Intended parent varieties for the 2022/2023 crossing season were placed on non-nitrogen fertiliser in preparation for photoperiod treatments.

Dr Marvellous Zhou | Dr Shailesh Joshi | Moipei Lichakane | Tondani Mishasha

SASRI BREEDING RESEARCH TEAM

Preservation of Valuable Germplasm

In 2021/2022, i*n vitro* sugarcane explants currently used in the SASRI cryopreservation protocol have been in culture for six months or more, which may be having negative effects on the efficiency of the process. To mitigate some of the challenges experienced, the use of an alternative explant source was investigated, namely shoots produced directly from immature leaf roll discs. The use of shoots produced directly from immature leaf roll discs reduces the culturing time from about three months to approximately six weeks, which may offer advantages in the successful cryopreservation of sugarcane germplasm.

PROJECT MANAGER

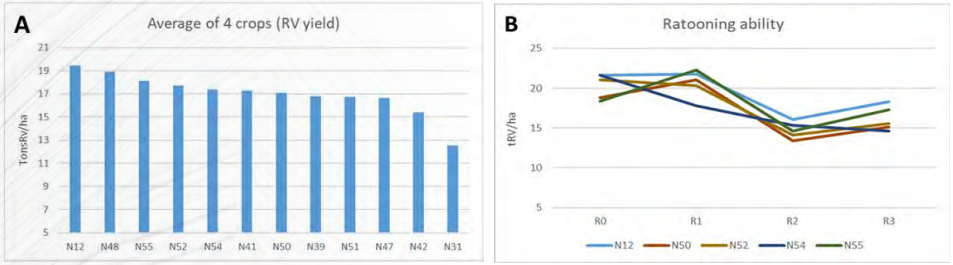
Dr Sandy Snyman

Variety Performance Evaluation

Variety Ratoonability

PROJECT MANAGER
Thobile Nxumalo

There is a perception amongst some growers that the newer varieties developed by SASRI do not ratoon as well as the older varieties, such as NCo376 or N12; a view which may negatively influence the adoption of new varieties. Over several years, SASRI research on variety ratooning ability has clearly demonstrated that variety (genetics) is only one factor influencing ratooning ability and that environmental conditions and management practises often have more predominant effects on ratoon performance. In response to grower concerns, a Midlands variety trial was established in the Table Mountain region in 2013 to compare the performance of the dominant older variety, N12, with new varieties. Additionally, previous trial data demonstrated that newly released varieties mature faster than the older varieties, which has led to debate over the harvest age of the newer varieties. Data obtained in 2021/2022 from the Table Mountain trial have shown that harvesting cane before 20 months will change the ranking of varieties, with N55, N54 and N52 outperforming N12. However, N12 outperformed all the other varieties in the trial and showing good ratooning ability when harvested at 24 months. Also, in 2021/2022 three new trials were planted in the Midlands region to specifically address the issue of harvest age. The data obtained from the trials were shared with regional extension specialists for discussion with their growers.



Variety performance in a Midlands North variety trial established in the Table Mountain area. (A) Average RV yield of twelve released varieties and (B) ratooning ability and for the third ratoon crop of five varieties.

- *Recent data from a trial conducted in the Table Mountain area in the Midlands North revealed that harvesting cane before 20 months changes the ranking of varieties in terms of RV yield performance, with N55, N54 and N52 outperforming N12. However, it is noteworthy that N12 outperformed all the other varieties in this trial, showing good ratooning ability when harvested at 24 months.*

- *A further trial conducted in the Harding area of the Lower South Coast region revealed the superior RV yield performance of N62, N61, N55 and N48 when compared with N12.*

Biotechnologies

Proof-of-concept of GM Bt Cane Variety Development for Potential Commercialisation

In 2021/2022, a relatively rapid pre-screening method was used to test the eldana resistance levels of transgenic sugarcane lines that have been genetically modified to express the Bt gene. Encouragingly, in two assays conducted in the Biotechnology containment glasshouse and poly-tunnel, 62% and 74%, respectively, of the lines produced were significantly more resistant to eldana than the wild-type untransformed controls, 88H0019 and N71, with the latter being considered susceptible to eldana.

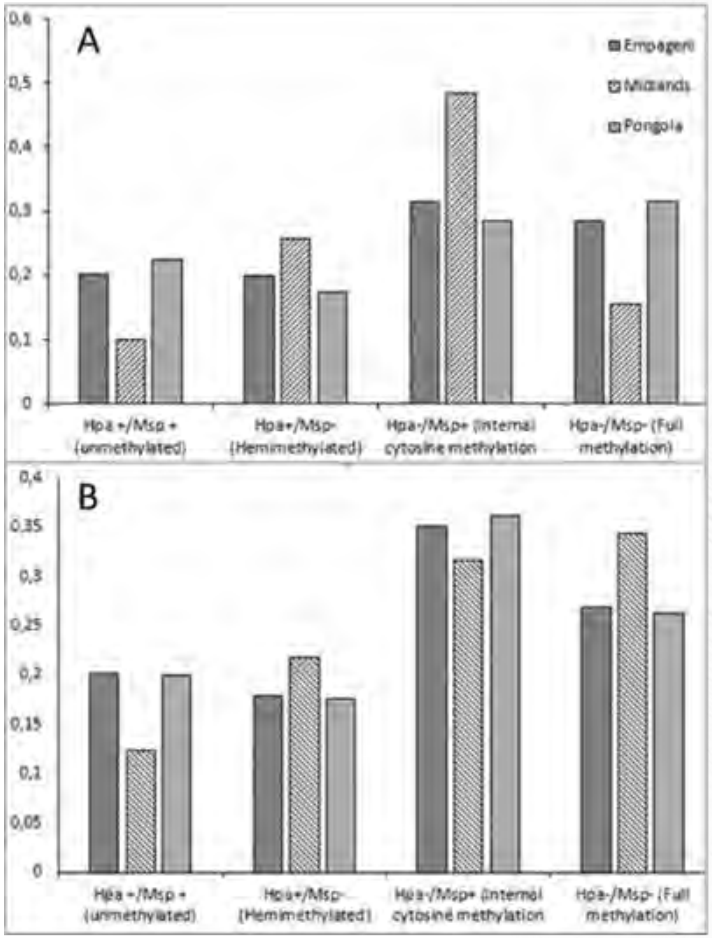
PROJECT MANAGER
Dr Sandy Snyman

Sugarcane Epigenetics[5]

PROJECT MANAGER
Dr Stuart Rutherford

In 2021/2022, an investigation into global DNA methylation patterns of sugarcane was conducted to understand how some adaptable sugarcane cultivars (e.g. N41 and NCo376) perceive and adapt to different agro-climatic conditions. Sugarcane material collected from Empangeni, Pongola, Midlands, Mount Edgecombe, and Umzimkhulu was examined for changes in DNA methylation[6]. Changes in DNA methylation has been reported as one of the causes of variation in plants resulting in changes in gene expression. The investigation was prompted by the observation that under these different environments, the said cultivars grow and look different [e.g. the same variety (confirmed by fingerprinting) may have slightly altered phenotypic characteristics], and it is hypothesised that this could be due to differences (polymorphisms) in their methylation profiles. These results will provide insight into how to better manage the crop and inform the breeding programme, although a more immediate application may be the importance of sourcing seedcane grown in the same regions for comparative purposes. To trace differences due to methylation, genomic DNA was extracted, and PCR amplification performed using methylation sensitive enzyme combinations (EcoR1/HpaII and EcoR1/MspI). Analysis of ABI 35000 sequencer-generated electropherograms were via GeneMapper® 5 software to generate binary matrices. Revealing differences in methylation percentages in NCo376 and N41 in three environments. It is hypothesised that the study will provide insights into how to better manage the crop and inform the breeding programme, although a more immediate application may be the importance of sourcing seedcane grown in the same regions for planting.

- *Investigation of global DNA methylation patterns of sugarcane varieties was conducted to understand how some adaptable sugarcane cultivars (e.g. N41 and NCo376) perceive and adapt to different agro-climatic conditions.*
- *It is hypothesised that the study will provide insights into how to better manage the crop and inform the breeding programme, although a more immediate application may be the importance of sourcing seedcane grown in the same regions for planting.*



Methylation susceptible loci (%) of NCo376 (A) and N41 (B) from different agroclimatic zones in KwaZulu-Natal.

[5] Plants depend on epigenetic processes for proper function. Epigenetics has been defined as "the study of changes in gene function that are mitotically and/or meiotically heritable and that do not entail a change in DNA sequence"

[6] DNA methylation is an epigenetic event in which a methyl group is added to DNA cytosine to form 5-methylcytosine

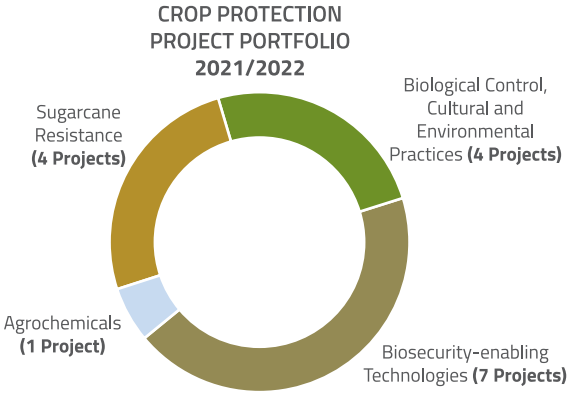
Dr Stuart Rutherford
Research Programme Manager

Crop Protection Research

Developing integrated management strategies that minimise the effects of pests and diseases on sugarcane production in a sustainable manner.

Research Focus Areas

Biosecurity and Associated Enabling Technologies	*Developing: (a) improved procedures to ensure that varieties released or introduced into the industry are free of pests and diseases; and (b) proactive threat-specific countermeasures and biosecurity incursion plans.*
Agrochemicals for Pest and Pathogen Control	*Partnering with relevant stakeholders to facilitate the registration of effective pathogen and pest control agents that are agriculturally, environmentally, ecologically and economically sustainable.*



Sugarcane Resistance to Pests and Pathogens	*Generating knowledge of the biological basis of resistance to pests and diseases and developing improved resistance screening techniques for commercial breeding.*

Biology and Ecology of Pests and Pathogens	*Generating knowledge on the biology and ecology of pests and diseases and facilitating knowledge exchange.*

Biological, Cultural and Environmental Control Practices	*Developing effective integrated management strategies and models that combine variety choice, optimal nutrition, use of agrochemicals and biological control agents with beneficial cultural and environmental management practices.*

Project Portfolio

The 2021/2022 Crop Protection research and technology development portfolio consisted of 16 projects.

Biosecurity and Associated Enabling Technologies

Sterile Insect Technique for eldana management: Resource development and pilot release programme

Demonstrating proof-of-concept of the ability of F1 sterile insect technique (SIT) to reduce eldana damage to cane grown in pots within containment enclosures.

PROJECT MANAGER
Dr Lawrence Malinga

Chemical ecology and microbiome of *Cacosceles newmanii* and *Eldana saccharina* (completed)

Developing new knowledge on the chemical biology of the longhorn beetle and eldana may contribute to the development of chemical attractants.

PROJECT MANAGER
Dr Stuart Rutherford

Development of an eldana risk index for GM sugarcane deployment and monitoring

Developing an eldana risk index to inform: (a) the roll-out Bt genetically modified (GM) cane to regions most at risk; and (b) the development of a monitoring system for pest numbers once GM cane is deployed (project funded by Biosafety South Africa, a unit of the Technology Innovation Agency, Department of Science and Innovation).

PROJECT MANAGER
Matthew Jones

Yellow sugarcane aphid risk index (new)

Developing a computer-based tool for predicting likely yellow sugarcane aphid (YSA) outbreaks in advance using weather and crop management data, providing additional guidance for pro-active treatment decisions.

PROJECT MANAGER
Matthew Jones

Development of a user-friendly, in-field test for Ratoon Stunt

Developing a lateral flow device for use at the field edge by relatively unskilled staff to diagnose Ratoon Stunt (RSD) quickly and reliably.

PROJECT MANAGER
Sharon McFarlane

Roguing for smut: Economics and alternate methodologies (completed)

Providing a comparison of costs of two standard methods of roguing under different scenarios and improve the efficacy of chemical roguing with alternative chemistries.

PROJECT MANAGER
Sharon McFarlane

Economics of establishing certified nurseries with different plant sources (new)

- *Conducting a full economic evaluation of using conventional hot water treated (HWT) seedcane, HWT transplants, and NovaCane® to establish a nursery seedbed under different scenarios.*
- *Developing an MS Excel-based calculator to allow annual updates of the economics of producing seedcane under different scenarios.*

PROJECT MANAGER
Sharon McFarlane

Agrochemicals for Pest and Pathogen Control

Additional chemistries and strategies for sugarcane pest, nematode, disease and weed control

Collaborating with manufacturers and suppliers of agrochemical products, the Agricultural Inputs Control Directorate of the Department of Agriculture, Land Reform and Rural Development and cane growers to facilitate the registration new active ingredients for the sustainable area-wide integrated management of current and emerging pests, diseases, nematodes, and weeds.

PROJECT MANAGER
Dr Stuart Rutherford

Sugarcane Resistance to Pests and Pathogens

Variety evaluation: BANDITO (combined nematode, thrips, yellow sugarcane aphid and plant physiological effect)

Using existing trials from the variety nematode resistance project, which was terminated in 2015 due to the ongoing inconsistencies of results generated, to assign a likelihood of a variety responding to Bandito application (combined nematode, thrips, yellow sugarcane aphid and plant physiological effects).

PROJECT MANAGER
Slindile Nqayi

Variety evaluation: Disease resistance

- *Generating additional information on the reaction of late stage and newly released varieties to diseases (that are not included in the routine screening during breeding).*
- *Confirming smut and mosaic ratings in commonly grown varieties.*
- *Providing information on the effect of selected diseases on cane yield and juice quality.*

PROJECT MANAGER
Sharon McFarlane

Prediction of quantitative resistance to pests and diseases using near infrared spectroscopy

Developing: (a) fibre-optic near infra-red spectroscopic methods to predict sugarcane resistance to pests and pathogens using reflectance spectra from intact plant surfaces; and (b) genetic markers for quantitative resistance to rusts. Both goals are intended to ultimately enhance the efficiency of breeding for pest and disease resistance.

PROJECT MANAGER
Dr Stuart Rutherford

Yellow sugarcane aphid varietal susceptibility

Developing updated information on variety susceptibility to the yellow sugarcane aphid through the intensive surveying of existing SASRI research trials located throughout the KwaZulu-Natal and Mpumalanga sugar belt to enable the development of pro-active and sustainable area-wide integrated management solutions for the pest

PROJECT MANAGER
Dr Malcolm Keeping

Biological, Cultural and Environmental Control Practices

Species diversity of natural enemies of yellow sugarcane aphid (completed)

Enabling more effective management of the yellow sugarcane aphid through widening the knowledge base regarding: (a) key predator species present in different agro-ecological regions; and (b) effects of insecticide usage on these predator communities. Through widespread surveying, rain-fed and irrigated regions and commercial versus small-scale operations will be compared to enable the development of sustainable area-wide integrated management solutions.

PROJECT MANAGER
Dr Iona Basdew

Fungicidal, nematicidal and biological control of *Fusarium* associated with eldana

Determining whether exclusion of Fusarium from planting material, with subsequent replacement with a microorganism that is not advantageous to eldana, offers a potential means for eldana biocontrol.

PROJECT MANAGER
Dr Stuart Rutherford

Integrated weed management

Integrating and streamlining existing integrated weed management information and developing decision-support resources and tools that will be of practical use to all cane growers.

PROJECT MANAGER
Anushka Gokul

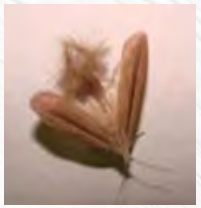
Eldana microbiome (new)

Investigating the microbial community structure associated with eldana eggs, larvae, pupae and adults, as an improved understanding of the relationship between eldana and its microbiome may aid in the development of a novel control strategy as a component of eldana integrated management.

PROJECT MANAGER
Nongcebo Memela

New Research

Three new projects were initiated in 2021/2022.

YSA Risk Index	To develop a computer-based tool for predicting likely yellow sugarcane aphid (YSA) outbreaks in advance using weather and crop management data, thereby providing additional guidance for pro-active treatment decisions.	 **PROJECT MANAGER** Matthew Jones	
Economics of establishing certified nurseries with different plant sources	(a) To conduct a full economic evaluation of using conventional hot-water treated (HWT) seedcane, HWT transplants, and NovaCane® to establish a nursery seedbed under different scenarios; and (b) to develop an MS Excel-based calculator to allow annual updates of the economics of producing seedcane under different scenarios.	 **PROJECT MANAGER** Sharon McFarlane	
Eldana microbiome	Investigating the microbial community structure associated with eldana eggs, larvae, pupae and adults, as an improved understanding of the relationship between eldana and its microbiome may aid in the development of a novel control strategy as a component of eldana integrated management.	 **PROJECT MANAGER** Nongcebo Memela	

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Outcomes from Completed Research

Three research projects were completed, which aimed to provide knowledge and technologies to enhance biosecurity.

Biosecurity and Associated Enabling Technologies

Species diversity of natural enemies of yellow sugarcane aphid	Field surveys of potential natural predators of the yellow sugarcane aphid (YSA) revealed a total of only ten different species, across three families. These were classified into six ladybird species, two lacewing species, and two syrphid fly species. The prevailing dominant species of possible YSA predators in the Midlands North and Midlands South regions appeared to be from the order Neuroptera, particularly lacewings. Dominant predator species in the other regions (Coastal, Umfolozi, Zululand, Lowveld) appeared to be a variety of coccinellids plus syrphid flies (mainly larval stages). A follow-on project is to focus on encouraging growers to increase biodiversity on their farms and to test soil amendments that may improve the resistance of sugarcane to YSA. 
Chemical ecology and microbiome of the longhorn beetle and eldana pheromone	*Longhorn beetle and eldana pheromones* Volatile organic compounds emitted by adult female longhorn beetles were trapped and characterised with a view to identifying a pheromone that could be used for management of the pest. While strong electroantenogram detector (EAD) responses were obtained from longhorn beetles, the corresponding coupled gas chromatogram (GC) peaks were small, making it almost impossible to obtain quality mass spectra. Consequently, the pheromone could not be identified, although it was suggested that the active pheromone, which was detected, is likely to have a similar precursor to that of prionic acid but with a larger molecular weight. Calling eldana males were found to emit an EAD detectable blend of trans-eldanolide, cis-eldanolide, 6,10,14-trimethyl-pentadecan-2-ol and vanillin. These blend ratios have been not reported previously and could potentially be critical for behavioural activity of female *E. saccharina*.  *Longhorn beetle shift onto sugarcane* The shift by the longhorn beetle onto sugarcane can possibly be attributed to several potential mechanisms, including abiotic and biotic factors. The possible polyphagia of this species could result from changes and modulations of its gut microbiome composition, depending on the host. Composition of longhorn beetle diet was shown to influence the bacterial microbiota of the larval gut. Interestingly, the insect performed as well on sugarcane as on wattle in terms of mass gain and had a microbiome diversity index similar to field larvae from sugarcane and to that on wattle (although actual bacterial species may vary), which may indicate that some adaptation to sugarcane has taken place.

PROJECT MANAGER
Dr Iona Basdew

PROJECT MANAGER
Dr Stuart Rutherford

Roguing for smut: economics and alternate methodologies	Time and motion studies indicated that applying glyphosate (10% v/v) to smut-infected stools was fourfold quicker than physical stool removal. The amount of soil and plant material removed from the field during the chemical roguing operation was substantially lower than physically removing the stool, saving time, and reducing costs associated with the disposal of the infected material. A simple Excel calculator was developed to estimate the cost of the two methods of roguing in fields with different levels of smut. Glyphosate (360 or 450 g/L; 10% v/v) was confirmed to be the most efficient registered chemical currently available for chemical roguing. In addition, it reduced smut spore viability within a day of application. This will allow some modification to the current chemical roguing procedure.

Time-and-motion study in progress to compare manual (A) and chemical roguing (B) methods


PROJECT MANAGER
Sharon McFarlane

Research Highlights

Managing Eldana	*Knowledge Resources*	Progress made in updating existing information sheets on pests, diseases, and weeds, and publishing new sheets where knowledge gaps were identified.
	Establishing Sterile Insect Technique	• Insect-rearing and insect transport arrangements for off-site irradiation were developed to support proof-of-concept demonstration of the efficacy of a novel F1 sterile insect technique (SIT) for eldana population management. • A proof-of-concept study of SIT on potted cane provided early but encouraging evidence that the SIT F1 approach is effective in limiting eldana population growth and consequent sugarcane damage. Follow-on testing of the approach in a pilot field study will be undertaken in 2022/2023.
	Testing New Chemistries	A promising combination of two currently unregistered active ingredients, pyriproxyfen + lufenuron, appeared to be effective in reducing eldana damage and increasing RV yield, and could be useful in eldana population suppression ahead of sterile moth releases in sterile insect technique (SIT) approach.
	Examining Timing of Sprays	Novel interpretation of eldana data from a white grub trial at Tugela Mouth raised an interesting possibility that a once-off spraying of cane with a registered insecticide (which activates eldana ryanodine receptors) in late February, targeting early stalk elongation and the Mar-Apr-May eldana moth peak, may have long-lasting beneficial effects on eldana control, including: (a) reduced damage to predator populations; (b) ease of spraying of young cane; (c) higher insecticide "load" per unit plant biomass; and (d) enhanced plant coverage. Further investigations to be conducted in 2022/2023.
	Studying Eldana Gut Microbiome	Investigation of the eldana gut microbiome identified the presence of *Gordonia*, a rare actinomycete, which has been applied elsewhere to environmental improvement and protection via its biological degradation ability.
	Discovering Genes Associated with Variety Eldana Resistance	Further evidence obtained of the involvement of the induced expression in sugarcane of a dirigent domain-containing gene (*DIR*) in the response of an eldana-resistant variety to eldana attack. In the long-term, knowledge of genes expressed in response to eldana attack on the sugarcane stalk and associated with susceptibility or resistance may lead to more precise breeding approaches.

Managing Sugarcane Yellow Aphids	*Communicating with Growers*	In response to ongoing grower concerns regarding the extent of yellow sugarcane aphid (YSA) infestations, a series of Grower Days and one-on-one meetings with growers was undertaken.
	Establishing Variety Reponses	Variety 'resistance ratings' for YSA (average percent leaf area damaged) were calculated for 35 varieties from data collected from several trials and surveys conducted in rain-fed and irrigated regions of the industry.
	Monitoring Natural Predators	Monitoring of natural predators of the yellow sugarcane aphid matured into broader concepts around the importance of on-farm biodiversity management, which are to be evaluated in 2022/2023 in a project that will aim to encourage grower-led testing of the approach.

Managing Diseases	*Improving RSD Hygiene Practices*	Although the lengthy mechanical harvester decontamination procedure developed and tested reduces ratoon stunt (RSD) spread into healthy cane from infected stools, it is unable to eliminate the risk of transmission.
	Improving Smut Control	• Time-and-motion studies revealed that removal of smut-infected stools could be accomplished more quickly by chemical rogueing than by hoeing. A simple calculator was developed to enable growers to estimate the time required to rogue fields of different sizes and levels of infection using either physical or chemical methods. • Fungicides with the active ingredients of tebuconazole: azoxystrobin: prochloraz and flutriafol: fluoxastrobin showed great promise for smut management, particularly when used in combination with good field hygiene management.
	Monitoring Rust Occurrence	• Monitoring of rust outbreaks ongoing and the accuracy of PCR-based diagnostics tests for rusts was improved. • Orange rust (*Puccinia kuehnii*) was identified on sugarcane in South Africa for the first time in February 2022.

Topical Research Updates

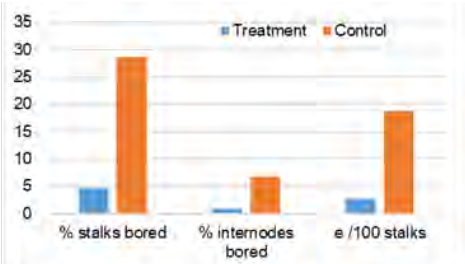
Biosecurity and Associated Enabling Technologies

SIT for eldana Management

PROJECT MANAGER
Dr Lawrence Malinga

In 2021/2022, the F1 eldana colony established at SASRI from eggs received from the irradiated male/unirradiated female crosses undertaken at the XSIT facility in Citrusdal continued to demonstrate that aims of F1 sterility are being attained. The sex ratio continued to be male biased, with at least two males to one female emerging from the neonate larvae inoculated. Eldana surveys of the oldest sugarcane in the large treatment and control cages revealed that stalk damage and eldana populations in the former cage (where the F1 and mother colony adults were released), compared to the latter (where only mother colony adults were released) was lowest. This was an early but encouraging sign that the sterile insect technique (SIT) F1 approach is working.

Eldana surveys of the most mature sugarcane in the sterile insect technique (SIT) treatment and control cages revealed that damage to sugarcane and eldana populations in the treatment cage, in which the F1 and wild-type adults were released, compared to the control, in which only wild-type adults were released, was lower. This was early but encouraging evidence that the novel SIT F1 approach developed by SASRI is effective in limiting eldana population growth and consequent sugarcane damage.



Comparison of % stalks bored, % internodes bored and eldana infestation (e/100 stalks) in the oldest four rows of sugarcane in the SIT treatment and control cages.

Orange Rust

SHARON MCFARLANE
Senior Pathologist

Orange rust (*Puccinia kuehnii*) was identified on sugarcane in South Africa for the first time in February 2022, after being detected periodically on spore traps located in Mpumalanga since 2016. This is the third rust pathogen to infect sugarcane in South Africa.

The disease was first observed in a bulking plot of N76 (moderate to severe symptoms) near Shakaskraal on the North Coast (29°23'45"S; 31°10'04"E) and in an adjacent field of N75 (moderate symptoms). Mild symptoms were also observed on N41 on the same farm. Orange rust has since been observed across much of the industry).

An inspection of variety propagation plots at Mount Edgecombe indicated that several of current commercial varieties have some susceptibility to orange rust. However, no symptoms were observed on N40, N46, N48, N54, N58, N59, N61, N62, N67, N69, N70, N72, N74 and N78 at the time of the inspection.

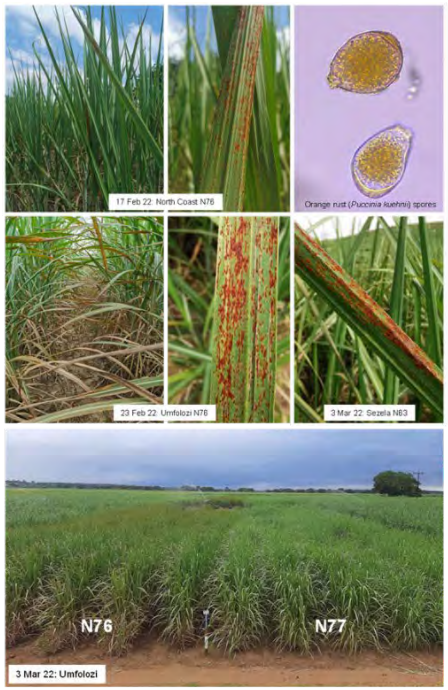
Orange rust distribution and varieties affected

P&D area	Variety	Confirmed rust ID
N Coast	N76, N75, N41	Orange
Umfolozi	N23, N36, N41, N49, N60, N76, N77	Orange
Sezela	N12, N41, N45, N47, N63, N76	Orange
Amatikulu	N76	Orange
Eshowe	N75	Tawny, Orange
Umzimkhulu	N76	Orange
Pongola	N73	Orange

- *Orange rust was identified on sugarcane in South Africa for the first time in February 2022 on N41, N75 and N76 growing on the north coast and has subsequently been observed across much of the industry.*
- *Preliminary inspections indicate that several varieties have some degree of susceptibility to the disease, although no symptoms have been detected thus far on 14 newer releases.*
- *An Emergency Response Plan, developed by SASRI in anticipation of an orange rust incursion in South Africa, proactively provided: (a) the PCR diagnostic test necessary for the positive identification of the pathogen; and (b) a fungicide registered for management of the pathogen on sugarcane.*
- *Ongoing activities include notification of key contacts in southern Africa and industry-wide surveys to determine prevalence and varietal susceptibility*

The Australian sugarcane industry suffered very significant financial losses during an orange rust epidemic between 2000 and 2002 period. These losses were greatly contributed to by certain mill areas planting around 70% of their area to a single, high yielding variety, Q124, that proved susceptible to the pathogen. The Australian experience lends credence to the view that the widespread planting of a single variety will undoubtedly lead to a disease epidemic, driven either by an existing pathogen or a newly emergent one[7].

SASRI recommends limiting any single variety to 30% of the total farm or mill supply area to protect against losses that could be incurred from sudden pest or disease outbreaks[8]. Before the Australian experience, orange rust was considered a minor pathogen. It has since spread through the Americas and much of Africa, including Mauritius and Reunion.



Orange rust symptoms observed in the industry from February 2022.

An Emergency Response Plan, developed in anticipation of an orange rust incursion in South Africa, guided the industry's initial response. This included confirmation of pathogen identity through direct sequencing using primers Pk2-F and Pk2-R targeting the internal transcribed spacer (ITS1-5.8S-ITS2) region, the application of a fungicide (active ingredients: azoxystrobin / cyproconazole) pre-emptively registered for orange rust on sugarcane in South Africa in infected fields, notification of key contacts in southern Africa, and ongoing industry-wide surveys to determine prevalence and varietal susceptibility.

[7]Magarey R (2010). Proc Intl Soc Sugar Cane Technol 27: 1-9.

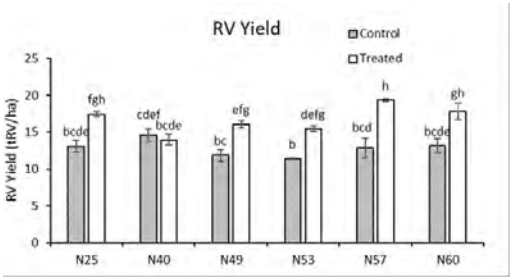
[8]Ramburan S et al. (2010) Proc S Afr Sug Technol Ass 83: 106-116

Agrochemicals for Pest and Pathogen Control

Agrochemicals for YSA management


PROJECT MANAGER
Slindile Nqayi

A trial planted in Pongola in September 2017 was used to evaluate the performance of six sugarcane varieties, with and without Bandito. The trial is normally harvested on a twelve-month cycle. However, due to circumstances, for this third ratoon it was carried over and harvested at 15 months. For this ratoon, Bandito was applied one month after harvesting in August. YSA/thrips ratings were not conducted as the trial was blanket treated with drip irrigated imidacloprid by the collaborating grower in December 2020, when the cane was five months old, before ratings could be conducted. Nevertheless, Bandito still appeared to have had a positive effect on RV yield. **F**or N57, which is known to be YSA susceptible, an increase of 6 tRV/ha was realised with an approximate value of R32,000 /ha. Of concern, however, was the extent of eldana damage at harvest, most likely due to carryover.



' Yield (tRV/ha) obtained at 15 months at third ratoon. The cane was treated with Bandito. There was significant difference (p <0.001) in RV yield between treated and untreated cane for all varieties except N40.

Agrochemicals for weed management

PROJECT MANAGER
Anushka Gokul

Megathyrsus maximus (*Panicum maximum* was renamed as *Megathyrsus maximus* in 2003) is a perennial, tufted grass with a short, creeping rhizome. The stems of this robust grass can reach a height of up to 2m. As the stems bend and nodes touch the ground, roots and new plants are formed. It grows well in cultivated areas and in shade such as that in sugarcane fields. It produces large seed heads, and the seeds are dispersed by wind and birds.

On the South Coast of KwaZulu-Natal, giant *M. maximus* has been identified which shares the same genus and species with the common *M. maximus* yet is phenotypically different. Intraspecific phenotypic variability in polyploid apomictic species is known to be large. Differences include the thickness and hardness of the stalks and the height to which giant *M. maximus* grows (3m+). In sugarcane fields, giant *M. maximus* grows vigorously in competition sugarcane competing for water and nutrients resulting in reduced sugarcane yield. Management of this weed is difficult, and it is recommended that young giant *M. maximus* be removed before it matures, preventing seed development and dispersal. Mature plants should be excavated, which is an intense and lengthy process.

Alternatively, mowing has been reported to be partially effective. There are no herbicide products specifically registered for giant *M. maximus*. However, pre-emergent herbicide control of common *M. maximus* includes Ametryn 500, Hexazinone 240, Velpar 750, Diuron, Metribuzin 480, Acetochlor 900, Authority and Falcon gold.

Ametryn 500, Diuron, MSMA, Basta and Roundup Turbo are registered as post-emergent herbicides for common M. maximus. Growers are applying Roundup Turbo in attempts to suppress giant M. maximus. This however could lead to the development of plant resistance to the active ingredient glyphosate. Therefore, an integrated weed management strategy should be implemented to manage this weed effectively and sustainably. In a glass-house trial, control was best achieved by mowing, and spraying with Roundup Turbo 15 weeks later, followed by Basta a further 10 weeks after the Roundup Turbo application.

In a glass-house trial, control of Megathyrsus maximus (Panicum maximum was renamed as Megathyrsus maximus in 2003) was best achieved by mowing, and spraying with Roundup Turbo 15 weeks later, followed by Basta a further 10 weeks after the Roundup Turbo application.

***Megathyrsus maximus* (*Panicum maximum* was renamed as *Megathyrsus maximus* in 2003).**

Sugarcane Resistance to Pests and Pathogens

Variety Responses to YSA

PROJECT MANAGER
Dr Malcolm Keeping

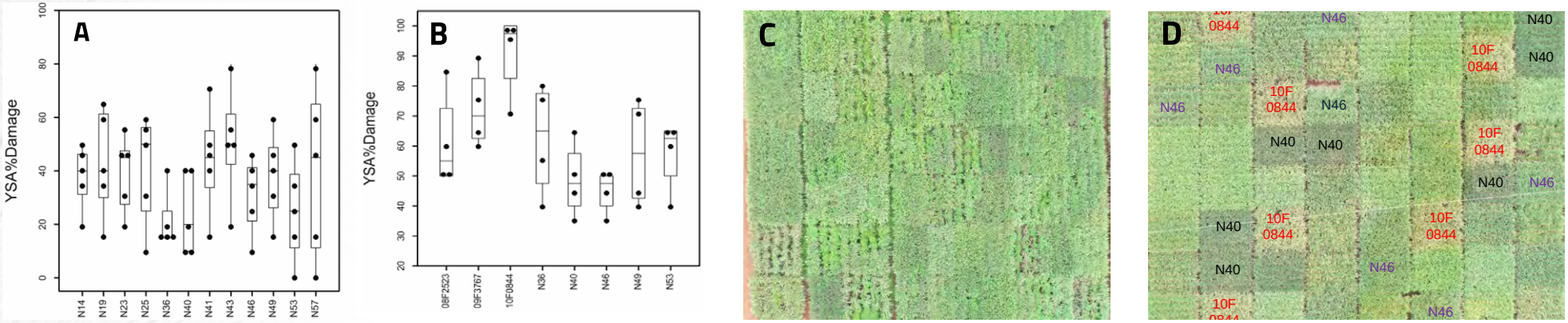
Fifteen SASRI trials in rain-fed irrigated regions were assessed for yellow sugarcane aphid (YSA) leaf damage. A database of all YSA (and sugarcane thrips) leaf damage and presence / absence information of these pests from all surveyed trials, and a series of surveys conducted in 2019 / 2020, is being compiled for use in generation of overall variety YSA susceptibility ratings. Variety 'ratings' for YSA (= average percent leaf area damaged) have been calculated for as many varieties as possible based on all data collected.

The potential of drone imagery for detecting and estimating differences between varieties in YSA damage has been investigated in two trials located in the Mpumalanga Lowveld. Images were captured at the time that the trials were surveyed for YSA damage on the ground by SASRI technicians. For Trial EO(KM)1-13, varieties did not differ significantly in leaf damage (p=0.088), even though overall damage levels were intermediate. Of interest, N57, noted for its susceptibility to YSA in grower fields, did not incur heavier damage than other varieties, suggesting that localised conditions may influence differences in damage among varieties.

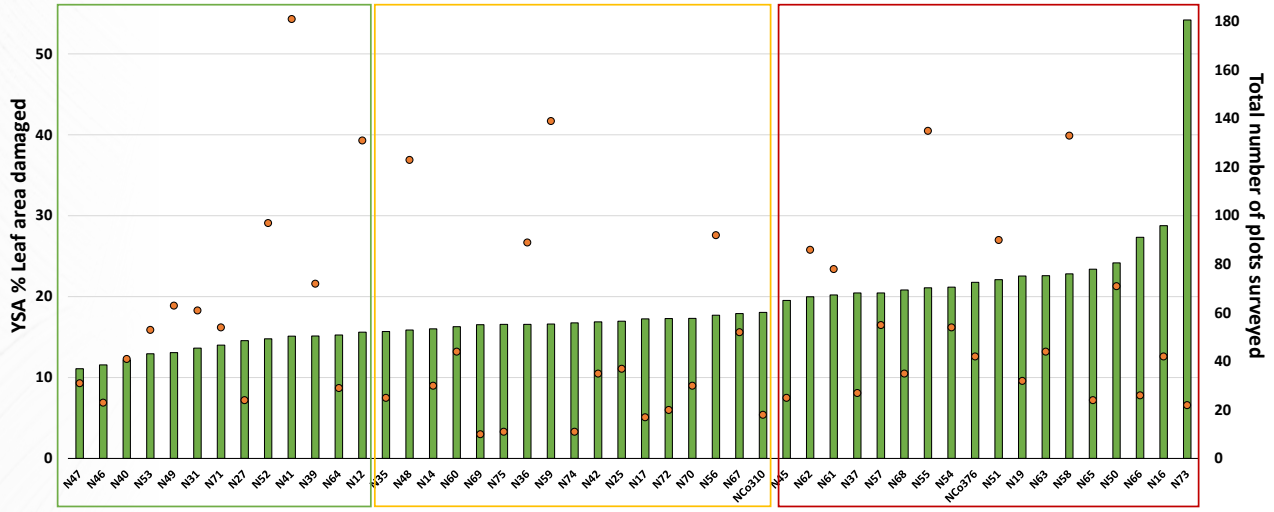
During 2021/2022, growers in all regions reported the presence of yellow sugarcane aphid (YSA), with concern expressed over the presence despite the cooler weather. In response, two Grower Days were hosted at Pongola and Umfolozi, respectively, while one-on-one meetings took place on the North Coast and Midlands. Varieties N57, N19, N26, and N36 in the irrigated regions, appeared predisposed to more severe infestation than most other varieties.

In contrast, in Trial EO(ML)1-18 at Malelane, varieties differed significantly in YSA leaf area damaged as determined from a ground survey, while visual differences in plot colouration in the drone image were clearly apparent. From the ground survey data, Genotype 10F0844 was clearly the most damaged variety, while in the drone image plots of this variety showed up consistently as being the most yellowed. By contrast, the least damaged varieties from the ground survey (N40, N46) also had the greenest colouration.

The images are being digitized to produce NGRDI values for further analysis in relation to the ground survey data. This information indicates the strong potential for using UAV-captured data for detecting and quantifying YSA damage, and possibly for early detection of infestations before damage becomes more severe, as well as for quantifying differences in susceptibility between varieties.



Drone images captured on two trials conducted in the Mpumalanga Lowveld. These preliminary investigations were undertaken to explore the potential of drone imagery for detecting and estimating differences between varieties in YSA damage.



Mean leaf area damaged across 35 varieties (left axis) and total number of plots surveyed across trials to obtain these values.

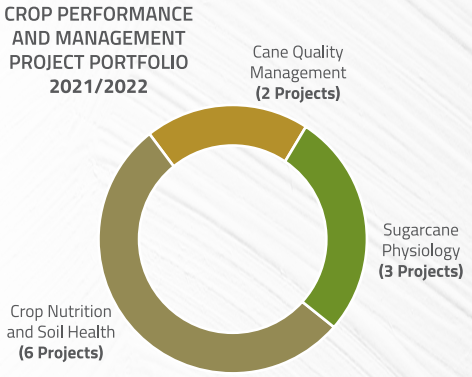
Dr Riekert van Heerden
Research Programme Manager

Crop Performance and Management Research

Developing models and better management practices that sustain and enhance sugarcane production.

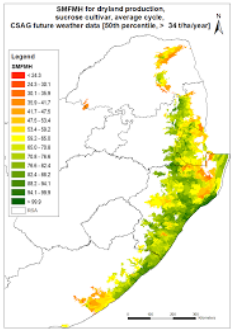
Research Focus Areas

Sugarcane Physiology	*Collecting and using crop physiological data in models that:* • *assist sugarcane breeding for current and predicted future climates; and* • *enable refined crop yield forecasting.*
Sugarcane Nutrition and Soil Health	• *Generating knowledge and developing technologies and resources that increase accuracy of fertiliser recommendations and enabling the maintenance of and where necessary, the restoration of soil health.* • *Testing of various sources of nutrients, fertiliser formulations and application rates that enhance the cost-effectiveness of recommendations.*



Cane Quality Management	*Generating knowledge and developing technologies and resources that enable and demonstrate effective sugarcane cane quality management practices in the industry.*

Climate Change (no active projects in 2021/2022)	• *Predicting climate change impacts on crop water-use and yield for current and future potential agroclimatic situations.* • *Developing appropriate resources to enable climate change adaptation and mitigation.* • *Developing best management practices to maximise yield under a predicted mid-century climate.*



Project Portfolio

The 2021/2022 Crop Performance and Management research and technology development portfolio consisted of 11 projects.

Sugarcane Physiology

Development of aerial imagery methodology to inform crop stress and high throughput phenotyping

Developing a remote spectral-sensing technology for the detection of sugarcane crop stress (particularly water stress) to assist in the development of a practical screening method during sugarcane breeding and selection.

PROJECT MANAGER
Dr Riekert van Heerden

Optimal harvest ages for different production regions

Determining the agronomic and economic optimal harvest ages for different regions of the industry and developing guidelines for harvest-age decision-making, accounting for production conditions and whole-cycle economics.

PROJECT MANAGER
Thobile Nxumalo

Midlands variety management (new)

Developing and implementing decision support for optimising agronomic management of high yielding varieties in the Midlands, focusing on variety choice, harvest age and cane quality management.

PROJECT MANAGER
Natalie Hoffman

Sugarcane Nutrition and Soil Health

Near and mid infra-red spectral libraries for rapid, routine diagnostics and analysis of soil fertility and salinity and plant nutritional status

Expanding the application of near- and mid-infrared spectroscopy technologies to the estimation of a wider range of important soil- and leaf-related factors through developing and refining existing spectral libraries, developing new libraries, and implementing the technology to improve soil health and crop nutrition recommendations to all cane growers.

PROJECT MANAGER
Dr Louis Titshall

Review of best practices for Si and grower-based survey (completed)

Evaluating and demonstrating the value of adopting best practices on improving crop performance, with a particular emphasis on silicon (Si) uptake, through building knowledge from: (a) a quantitative review (meta-analysis) of pertinent scientific literature; and (b) cane grower source-data evaluation (grower survey).

PROJECT MANAGER
Dr Louis Titshall

Long-term effects of burning, mulching, and fertiliser application

Demonstrating the long-term effects of fertiliser application, burning and mulching on soil quality, yield, and crop health.

PROJECT MANAGER
Dr Rian van Antwerpen

Development of Fertiliser Optimiser Software (new)

Developing a fertiliser optimisation software application that will allow users to evaluate and develop optimal nutrient plans to meet nutrient requirements for their fields.

PROJECT MANAGER
Dr Louis Titshall

Promoting adoption of BMPs for improved yield and sustainable production (new)

Encouraging growers to adopt best management practices (BMPs) through participatory grower information sharing using demonstration plots ("seeing and doing are believing").

PROJECT MANAGER
Dr Louis Titshall

Evaluation and refinement of a labile carbon method for use in a commercial laboratory (new)

Evaluating and refining the rapid permanganate oxidisable labile carbon method, under routine commercial laboratory conditions, as an indicator of land use and management changes in sugarcane production.

PROJECT MANAGER
Dr Louis Titshall

Cane Quality Management

Variety responses to ripening

Developing recommendations for each commercially important variety regarding use of chemical ripening and late-season quality maintenance agents and/or chemicals applied in tandem and to stimulate cane grower adoption of these recommendations through appropriate knowledge exchange initiatives including participatory demonstration trials, cane grower days and popular press articles.

PROJECT MANAGER
Dr Riekert van Heerden

UAV multi-spectral imaging for precision sugarcane quality management (new)

Assessing the feasibility of aerial multi-spectral imagery, captured via cameras mounted on unmanned aerial vehicles (UAVs), for precision sugarcane quality management in: (a) crop maturity assessment; (b) ripener chemical efficacy assessment; (c) harvest prioritisation; and (d) predicting yield and cane quality from vegetation indices.

PROJECT MANAGER
Natalie Hoffman

New Research

Five new projects were initiated in 2021/2022.

Sugarcane Physiology

Midlands variety management	To develop and implement decision support for optimising agronomic management of high yielding varieties in the Midlands, focusing on variety choice, harvest age and cane quality management.	 PROJECT MANAGER Natalie Hoffman

Crop Nutrition and Soil Health

Development of Fertiliser Optimiser Software	To develop a fertiliser optimisation software application that will allow users to evaluate and develop optimal nutrient plans to meet nutrient requirements for their fields.	 PROJECT MANAGER Dr Louis Titshall
Promoting adoption of BMPs for improved yield and sustainable production	To encourage growers to adopt best management practices (BMPs) through participatory grower information sharing using demonstration plots ("seeing and doing are believing").	 PROJECT MANAGER Dr Louis Titshall
Evaluation and refinement of a labile carbon method for use in a commercial laboratory	To evaluate and refine the rapid permanganate oxidisable labile carbon method, under routine commercial laboratory conditions, as an indicator of land use and management changes in sugarcane production.	 PROJECT MANAGER Dr Louis Titshall

Cane Quality Management

UAV multi-spectral imaging for precision sugarcane quality management	To assess the feasibility of aerial multi-spectral imagery, captured via cameras mounted on unmanned aerial vehicles (UAVs), for precision sugarcane quality management in: (a) crop maturity assessment; (b) ripener chemical efficacy assessment; (c) harvest prioritisation; and (d) predicting yield and cane quality from vegetation indices.

PROJECT MANAGER
Natalie Hoffman

Outcomes from completed research

One research project was completed, which aimed to provide knowledge on silicon nutrition.

Review of best practices for Si and grower-based survey	A meta-analysis of available data and a grower survey revealed that: (a) sugarcane response to Si application were best in high organic matter soils associated with poorly drained conditions; (b) broadcast application of high rates of Si amendments with subsequent incorporation, possibly in combination with furrow application at planting, appear most likely to improve crop responses and increase Si uptake. Future studies in 2023/2024 will examine the benefit of co-mixing of organics with slags to mimic conditions observed in the high organic Histosol soils for possible superior crop responses to Si application.

PROJECT MANAGER
Dr Louis Titshall

Research Highlights

Crop Physiology

Examining Harvest Cycles	Analysis of extensive commercial production data from Komatipoort (northern irrigated regions) revealed: (a) ageing sugarcane beyond twelve months might benefit growers in terms of RV yield responses; (b) harvesting cane older than twelve months may also be beneficial in terms of gross margins from ratoon crops; and (c) ageing crops further than 16 months appears not to be beneficial when cumulative gross margins cash flows over the whole crop cycle are considered.
Enhancing Breeding Efficiencies for a Changing Climate	Proof-of-concept phenotyping of sugarcane for photosynthetic capacity and drought tolerance using drone captured imaging data yielded promising results in plant and first ratoon crops of 54 genotypes grown under well-watered and water-deficit conditions.

Crop Nutrition and Soil Health

Knowledge Resources	SASRI Information Sheets on crop nutrition and soil management updated and revised and new sheets developed as required.
Refining P Testing	Attempts to refine calibration of the Resin test for soil P were confounded by a high variability in crop response to P treatments and, as a result, the current P threshold range is to remain in effect.
Investigating Si Soil Amendments	Meta-analyses of available data revealed that: (a) slag, slagment and cement as Si sources are likely to provide the most consistent positive crop responses; (b) broadcast incorporation at planting may achieve best responses, with good residual effect in ratoon crops; (c) application rate may have less of an impact than application method and Si-type; and (d) combining Si-amendments with organic materials before application may enhance Si uptake.
Improving Leaf Nutrient Diagnostics	Research continued to evaluate the quality of predictions by infra-red scanning technologies of levels of key leaf nutrients (B, Ca, Mg, P, S, Cu, Mn, Zn).
Managing Salinity and Sodicity	Tools and knowledge resources developed to assist growers in improving their awareness of the negative effects of salt build-up in soils under irrigated sugarcane production.

Cane Quality Management

Drones in Cane Quality Assessments	Proof-of-concept study revealed that image data collected by drone may be suitable for estimating Brix, Pol and RV% in standing cane (New Project: Commenced 1 April 2021).
Testing New Ripener Combinations	Two field trials conducted in Pongola revealed that a combination treatment of trinexapac-ethyl and fluazifop-p-butyl was highly profitable across a range of irrigated varieties grown in the region.

Crop Physiology

Optimal harvest ages for different production regions

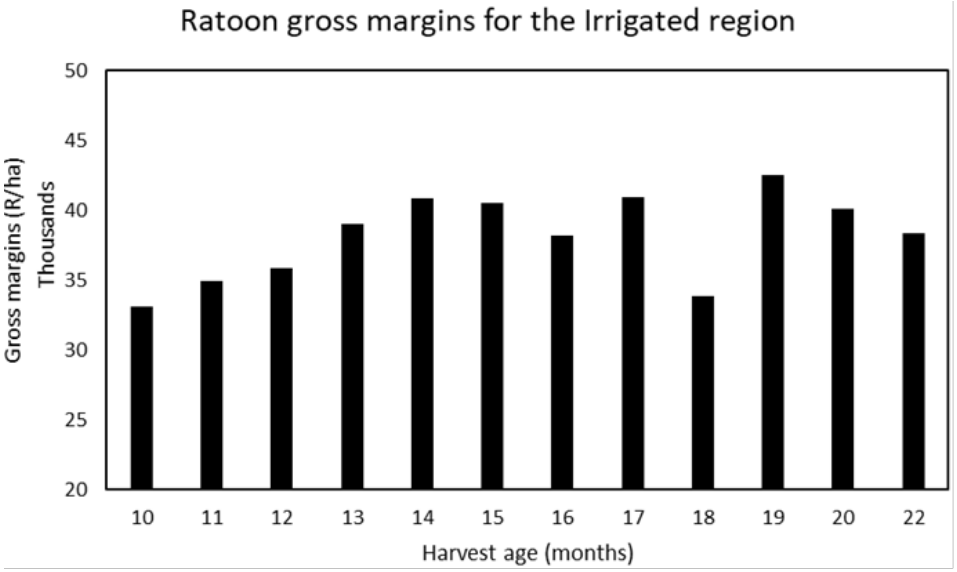
PROJECT MANAGER
Thobile Nxumalo

Currently, uncertainty exists regarding optimal harvest age in different regions of the industry. In the irrigated region, growers have queried the value of harvesting older cane. In the coastal region, many growers are actively ageing their cane beyond 12 months, using eldana resistant varieties and eldana spraying programs. In the midlands region, growers are querying the harvesting of younger cane i.e., 18 to 20 months. Most of the newer varieties lodge after 18 months in the midlands, so growers are questioning the need to age these varieties any further. In all three regions, issues such as harvesting and transport costs, agronomic issues (lodging, eldana, flowering), variety choice, and whole cycle economics need to be considered to identify the optimal harvest age. The aim of this research is to determine the optimal harvest age of cane in different regions of the industry. Three sources of data are used to analyse the effects of harvest age on yields: (a) simulated crop model data; (b) commercial production datasets; and (c) trial data.

In 2021/2022, the agronomic effects investigation of trial data was completed, while simulated crop model data were revisited for further analysis. Validation of the commercial production datasets remains to be finalised and are currently under investigation. Commercial production datasets were received for Komatipoort, Midlands, and Lower south coast mill areas.

In 2020/2021, an analysis of an extensive commercial production dataset from the Komatipoort region revealed the following.
Ageing sugarcane beyond twelve months might benefit growers in terms of RV yield responses.
In terms of gross margins from ratoon crops, harvesting cane older than twelve months may also be beneficial.
Ageing crops further than 16 months appears not to be beneficial when cumulative gross margins cash flows over the whole crop cycle are considered.
These trends do not account for potential effects of lodging and pest and diseases, which are to be incorporated into the economic model in 2021/2022.

The extensive dataset received from Komatipoort was provided in a convenient format for processing and analysis. The data span 2009 to 2021, with more than ten crops harvested per area. Harvest age in months was grouped into different harvest age categories in one-month increments. The datasets excluded harvest age categories below eight months as it doesn't represent SASRI's current recommended harvest age in the irrigated and lowveld areas. Harvest age categories were then plotted against average RV yields.



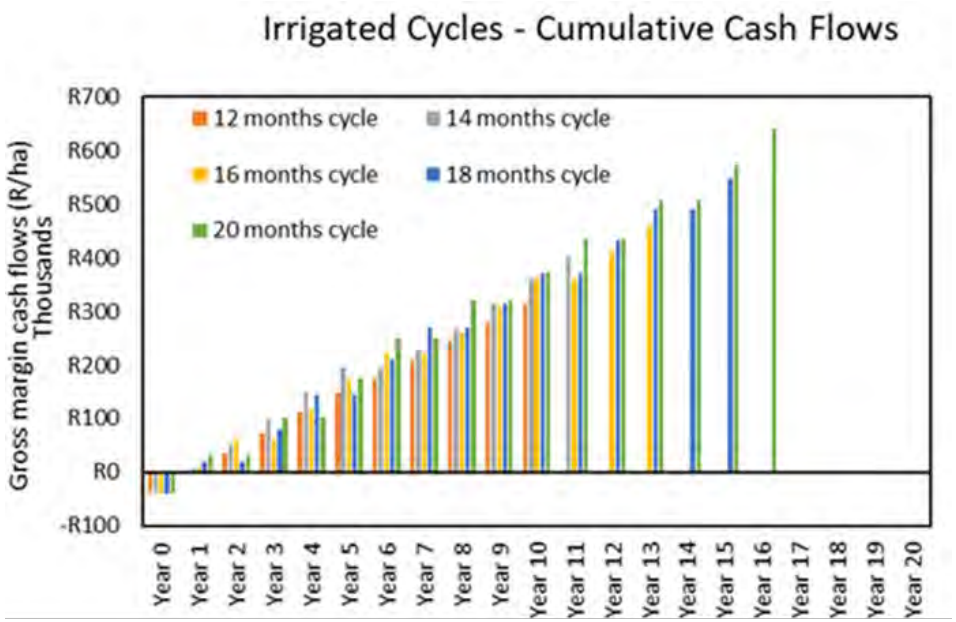
Cumulative gross margin cash flows (R/ha) against the whole crop cycle in years for the Komatipoort mill area

The RV yield responses to harvest age in the Komatipoort mill area, representing the irrigated region, revealed that ageing sugarcane beyond twelve months might be beneficial to the grower. Third order polynomials have a good R^2 value (0.9125) suggesting that the optimal harvest age can be determined between 14-16 months of harvest age categories.

Analysis of gross margins from the ratoon crops against harvest age categories revealed that harvesting cane older than twelve months may benefit the grower, especially if the cane is harvested between twelve to 16 months. However, ageing crop further than 16 months will be of no benefit to the grower when cumulative gross margins cash flows over the whole crop cycle are considered. Five harvest age scenarios were tested and compared of several crops/

years. Cane harvested between 14 and 16 months will give a grower positive cash flows over five crops, ageing the crop further won't have any difference in cash-flows.

The economic model has helped in exploring some of the complex and diverse issues regarding the harvest age in different regions. The model requires refining, as the current analyses do not consider some of the factors influencing the harvest age of the crop. Further analysis will be undertaken once the lodging and pests and diseases factors are built into the model.



Cumulative gross margin cash flows (R/ha) against the whole crop cycle in years for the Komatipoort mill area

Crop Nutrition and Soil Health

Near and mid infra-red spectral libraries for rapid, routine diagnostics and analysis

PROJECT MANAGER
Dr Louis Titshall

Near and mid infra-red (NIR and MIR) spectroscopy offers the potential to replace conventional, wet chemistry laboratory techniques for soil and leaf fertility testing (which are costly, laborious, and sometimes hazardous) with a rapid, low-cost diagnostic method. The basic principle is that each soil has a unique infra-red spectral signature that relates to specific properties of the sample. With calibration, it is possible to simultaneously estimate these properties (e.g. texture, nutrient levels, carbon content) from sample spectra without the need to undertake conventional analysis. The research aims to evaluate and refine spectral diagnostics for common soil fertility and leaf nutrient parameters to identify those properties that can be accurately estimated by infra-red scanning, with the outcome of providing growers a more cost effective and rapid soil fertility diagnostic service from the SASRI Fertiliser Advisory Service. Further development aims to deploy the technology to remotely based (e.g. irrigated-north, or out-of-country sites) diagnostic services complementing the existing laboratory service based at Mount Edgecombe.

During 2021/2022, two chemometric techniques, partial least squares regression (PLSR) and support vector machine regression (SVMR), were explored for their usefulness to calibrate and validate sugarcane leaf nutrients from NIRS spectra. Results from this study provided mixed results to the usefulness of the regression techniques for the different elements. While PLSR calibrations indicated high predictive potential for K, Mg, Ca and S, validation modelling yielded poor performing models. Nitrogen and P did not perform particularly well with PLSR calibration and validation modelling. Micronutrient calibrations and validation by PLSR were also poor, though this appears to be a consistent finding across a range of species. It was found that calibration performance of PLSR models were similar to SVMR for Ca, Mg, K, P, S, B Cu, slightly better for N, but much poorer for Fe, Mn and Zn that had greatly improved model fits for SVMR.

Validation performance of the SVMR models, while generally poorer than their respective calibrations (except Mn) were considerably improved over PLSR models. This indicates that SVMR regression was able to generate models that better handled variability in the data and may be a more robust approach than PLSR for this dataset. The reason could be that SVMR handles nonlinearity well, and the nonlinearity in the spectral data could have led to better performance

of the SVMR model. No studies on leaf nutrient analysis were found in the literature, suggesting this technique has not been widely used in this type of work.

- *In recent progress, the potential of near infra-red spectroscopy (NIRS) continued to be evaluated as a diagnostic method for the measurement of concentrations of key macro- and micronutrients (other than N).*
- *During 2021/2022, two chemometric techniques, partial least squares regression (PLSR) and support vector machine regression (SVMR), were explored for their usefulness in calibrating and validating sugarcane leaf nutrient concentrations from NIRS spectra.*
- *Indications are that SVMR regression can generate validation models that better accommodate variability in the data and may present a more robust approach than PLSR for the current dataset.*

Cane Quality Management

Evaluation of variety responses to chemical ripening

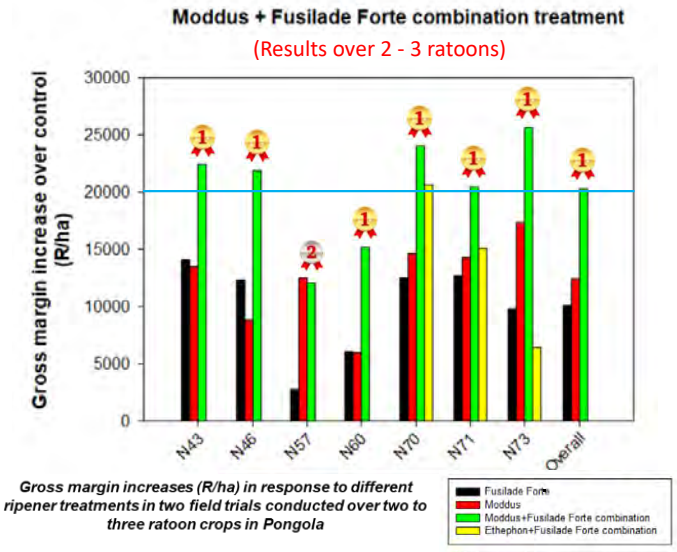
PROJECT MANAGER
Dr Riekert van Heerden

Research in 2021/2022 sought to establish the efficacy and economics of a new combination treatment between trinexapac-ethyl and fluazifop-p-butyl in a range of irrigated varieties under the growing conditions in Pongola. To this end, two randomised and replicated field trials were conducted over two to three ratoon crops at the SASRI research station in Pongola. The older of the two trials was conducted over three ratoon crops and included four treatments: unsprayed control, Moddus®, Fusilade Forte® and a combination treatment with Moddus® and Fusilade Forte®. The trial included four irrigated varieties: N43, N46, N57 and N60. The second trial, which is currently still in progress, has been conducted over two ratoon crops to date and includes six treatments: unsprayed control, Ethephon®, Moddus®, Fusilade Forte®, the current combination treatment with Ethephon® and Fusilade Forte® and the new combination treatment with Moddus® and Fusilade Forte®. This trial includes the three latest irrigated varieties: N70, N71 and N73.

The Ethephon®, Moddus® and Fusilade Forte® in the individual and combination treatments were applied twelve, ten and six weeks before harvest, respectively. A CO_2 pressurised knapsack with a hand-held spray boom was used to apply the products at rates of 1.5 l/ha (Ethephon® for both the individual and combination treatments), 0.8 l/ha and 1.0 l/ha (Moddus® for the combination and individual treatment respectively) and 0.2 l/ha (Fusilade Forte® for both the individual and combination treatments). At harvest, a twelve-stalk sample was collected from rows two and five in each plot for determination of relative value percent (RV%) in the Pongola millroom. Rows three and four in each plot were harvested and weighed to determine cane yield (tc/ha). RV yield (tRV/ha) was calculated as the product of tc/ha and RV%. Data were statistically analysed using Genstat® (18th edition).

- *Results from two field trials conducted in Pongola during 2021/2022 revealed that the new combination treatment between trinexapac-ethyl and fluazifop-p-butyl is highly profitable across a range of irrigated varieties grown in the region.*
- *This observation has been shared at recent grower days in Pongola and Mpumalanga.*
- *Considerable interest was shown by growers and, based on the ripening orders that RCL has received for next season so far, there will be widespread evaluation of the new combination treatment by growers in Mpumalanga and Pongola.*

Commercial ripening costs (R/ha) specific to Pongola, general industry harvesting and cane haulage costs (R/tc), and the April 2021 RV price (R/tRV) were used to estimate gross margins (R/ha) for each treatment. Economic analysis revealed that in all the varieties tested, except for N57, the new combination treatment was the most profitable with increases in gross margins over the control treatment ranging between R12 088 – R25 591/ha. Of note is that in previous ripener trials conducted at Pongola, observations of gross margin benefits exceeding R20 000/ha are very rare. However, the new combination treatment achieved this milestone in several varieties in these two field trials. So far, the new combination treatment was only compared with the current Ethephon® + Fusilade Forte® combination treatment in varieties N70, N71 and N73. At least in these three varieties, the new combination treatment appears to be much more profitable than the current combination treatment.



Gross margin increases (R/ha) in response to different ripener treatments in two field trials conducted over two to three ratoon crops in Pongola

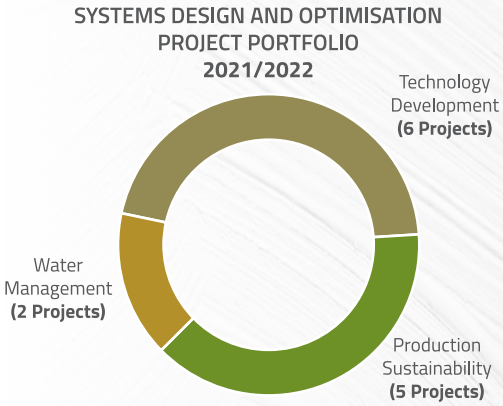
Dr Rian van Antwerpen
Research Programme Manager

Systems Design and Optimisation Research

Developing and sharing innovative systems that optimise industry agricultural performance.

Research Focus Areas

Production Sustainability	• *Assessing the impacts of agronomic and mechanisation issues on production efficiencies and sustainability.* • *Identifying opportunities for on-farm energy savings and reducing carbon dioxide emissions.* • *Deploying novel technologies that improve operational efficiencies and service offerings.* • *Developing new and improvement of existing technologies and approaches that enhance alignment between research and industry requirements.*
Water Management	• *Developing recommendations and advice that promote effective water management and technology deployment, both in terms of irrigation practices and surface water management.* • *Developing guidelines to determine the footprint of water usage in irrigated regions.* • *Maintaining or improving soil quality in irrigated regions where the parent material is the source of salts.*



Technology Development	*Developing, adapting, and deploying technologies that focus on enhancing internal efficiencies and the quality-of-service provision, with a focus on small-scale growers.*

Project Portfolio

The 2021/2022 Systems Design and Optimisation research and technology development portfolio consisted of 13 projects.

Production Sustainability

Capacitating SSG extension roll-out of the demonstration plot methodology through gathering soil data

Capacitating small-scale grower extension specialists and KwaZulu-Natal Department of Agriculture and Rural Development agricultural advisors in soil fertility, thereby promoting small-scale grower learning.

PROJECT MANAGER
William Gillespie

Soil conservation learning resources for small-scale extension

Capacitating small-scale grower extension specialists and KwaZulu-Natal Department of Agriculture and Rural Development agricultural advisors in soil conservation management, thereby promoting small-scale grower learning.

PROJECT MANAGER
Thulani Masondo

Advancing cane quality management in the small-scale grower sector

Advancing cane quality management in the small-scale grower sector by customising ripening decision-making and harvest scheduling, deploying state-of-the-art drone ripening technology and creating learning opportunities for small-scale grower extension specialists and KwaZulu-Natal Department of Agriculture and Rural Development Agricultural Advisors.

PROJECT MANAGER
Dr Riekert van Heerden

Investigating alternative energy supplies to assist with load shedding (new)

(a) Unpacking the effects of load shedding on the irrigation operations and practices of small- and large-scale growers; (b) developing an understanding of the interventions envisaged by the grower community; (c) quantifying the yield loss and economic impact for typical/historical load shedding scenarios using computer models; and (d) investigating and determining the costs of alternative energy or back-up energy supplies and other load shedding solutions.

PROJECT MANAGER
Dr Peter Tweddle

Crop estimates computer application for effective decision-making (completed)

Developing an easy-to-use tool for generating objective crop estimates either by growers themselves or with guidance from Extension Specialists and Agricultural Advisors.

PROJECT MANAGER
Matthew Jones

Water Management

Assessing the water footprints of selected fuel and fibre crops in South Africa (completed)

Collecting and using crop physiological data in modelling to assess the water footprint of sugarcane in the context of current climate and projected future climate change scenarios in South Africa (project funded by the Water Research Commission and led by the University of the Free State, with SASRI as a collaborator).

PROJECT MANAGER
Dr Abraham Singels

Development of Datasets for Multi-Scale Water Resource Assessments (new)

Developing a pre-packaged database of quinary catchment level catchment attributes for application to water resource related assessments through hydrological and agricultural modelling and implementing an online data portal system to store and provide access to the datasets (Project funded by the Water Research Commission and led by the Centre for Water Resources Research at the University of KwaZulu-Natal, with collaboration from several organisations, including SASRI).

PROJECT MANAGER
Phillemon Sithole

Technology Development

Refining the crop forecast database and model

Improving the quality and sustainability of the backend of the industry crop forecasting system.

PROJECT MANAGER
Aresti Paraskevopoulos

Small-scale grower technology development: Variety choice and management

Adapting and implementing a participatory research methodology and developing teaching resources to create learning opportunities for small-scale growers regarding the benefits that may be realised through the implementation of SASRI management practices in variety choice and management.

PROJECT MANAGER
Lindani Mchunu

Small-scale grower technology development: Weed control

Adapting and implementing a participatory research methodology and developing teaching resources to create learning opportunities for small-scale growers regarding the benefits that may be realised through the implementation of SASRI management practices in weed control.

PROJECT MANAGER
Anushka Gokul

Small-scale grower technology development: Disease control

Adapting and implementing a participatory research methodology and developing teaching resources to create learning opportunities for small-scale growers regarding the benefits that may be realised through the implementation of SASRI management practices in disease control.

PROJECT MANAGER
Tholoana Mofurutsi

Small-scale grower technology development: Pest control

Adapting and implementing a participatory research methodology and developing teaching resources to create learning opportunities for small-scale growers regarding the benefits that may be realised through the implementation of SASRI management practices in pest control.

PROJECT MANAGER
Khanyisile Buthelezi

Small-scale grower technology development: Irrigation management

Adapting and implementing a participatory research methodology and developing teaching resources to create learning opportunities for small-scale growers regarding the benefits that may be realised through the implementation of SASRI management practices in irrigation management.

PROJECT MANAGER
Dr Ashiel Jumman

New Research

Two new projects were initiated in 2021/2022.

Investigating alternative energy supplies to assist with load shedding	a) To determine load shedding effects on irrigation operations and practices on SSG and LSG farms in Mpumalanga; (b) to model the yield loss and economic impact for typical load shedding scenarios; and (c) to investigate and cost back-up or alternative energy supplies and other load shedding solutions.

PROJECT MANAGER
Dr Peter Tweddle

Development of Datasets for Multi-Scale Water Resource Assessments	To develop a pre-packaged database of quinary catchment level catchment attributes for application to water resource related assessments through hydrological and agricultural modelling and implement an online data portal system to store and provide access to the datasets (Project funded by the Water Research Commission and led by the Centre for Water Resources Research at the University of KwaZulu-Natal, with collaboration from several organisations, including SASRI).

PROJECT MANAGER
Phillemon Sithole

WATER RESEARCH COMMISSION

Outcomes from completed research

Two research projects were completed in 2021/2022.

Production Sustainability

Crop estimates computer application for effective decision-making	A simple web-based decision support programme (DSP) was developed to assist rainfed growers with their crop estimates. The tool considers: (a) climatic effects on the size (tons cane) of the standing crop at the time of the estimate; (b) three-month climate forecasts; and (c) carryover area. Required inputs include: (a) region (homogeneous climate zone number); (b) a qualitative estimate of soil water holding capacity; (c) long-term farm yield, carryover fraction, and age at harvest; and (b) the current season's carryover fraction, age at harvest and expected climatic condition for the coming three months. The DSP was developed specifically for rainfed conditions and is expected to benefit sugarcane growers and their Extension Specialists in these areas.

PROJECT MANAGER
Matthew Jones

Water Management

Assessing the water footprints of selected fuel and fibre crops in South Africa	This collaborative, Water Research Commission funded project estimated the water footprint of sugarcane production (volume of water consumed to produce one ton of sugarcane) in the different agroclimatic regions of South Africa, as influenced by current and future climate, soil type and management practices. Blue (irrigation) and green (rainfall) water footprint values were calculated from simulated cane yield and crop water use. The study provided context specific estimates of the water footprint for SA sugarcane production. Due to increasing demand on limited water resources in SA this information will be useful to have when competing for a limited resource, and to justify use of a limited resource.

PROJECT MANAGER
Dr Abraham Singels

Research Highlights

Refining Crop Forecasting	High-resolution spatial framework developed for crop simulation modelling that may result in improved fidelity of the monthly crop forecast issued by the Canesim Crop Forecasting System, as well as that of other decision-support tools, including the My Canesim real-time irrigation scheduling tool and the StalkGro growth increments tool.

Facilitating Variety Choice	A digital application developed to enable Extension Specialists serving small-scale and large-scale growers to easily compare variety information to facilitate the decision-making of their growers regarding variety choice.

Evaluating Impacts of Lodging	A customisable Excel-based tool developed to enable Extension Specialists to advise growers on the effects of various lodging scenarios on their revenue.

Improving Weather Data Access	SASRI WeatherWeb online tool updated and an application to enable use of the site on smart phones to be released in 2022/2023.

Cane Quality Management	*Drone Deployment in SSG Sector*	• Trials using drones to apply chemical ripeners and conducted in collaboration with coastal small-scale growers demonstrated potential gross margin benefits of ripening of R2,842/ha (Umbumbulu, N54), R3,481/ha (Umthwalume, N39), R5,074/ha (Amatikulu, N39), R5,675/ha (Umzimkulu, N39), R9,116/ha (Richards Bay, N41) and R11,100 (Amatikulu, N58). • Several workshops held with key small-scale grower community stakeholders in rain-fed regions to share ripening economic findings from demonstration trials and facilitate planning the way forward for drone ripening on a wider scale in the various SSG communities.

Topical Research Updates

Production Sustainability

Advancing cane quality management in the small-scale grower sector

PROJECT MANAGER
Dr Riekert van Heerden

In the large-scale grower community, chemical ripening has been a long-standing strategy to increase cane quality (RV%) in immature crops. In contrast, small-scale growers (SSGs) are generally not able to benefit from chemical ripening, largely because fields tend to be small, spatially fragmented and frequently surrounded by other forms of land-use, such as livestock or vegetable farming, which makes the deployment of fixed-wing aircraft or helicopter difficult. However, the recent entry of crop spraying drones into the industry brings provides chemical ripening opportunities due to the ability of these drones to operate effectively within fragmented small-field environments.

The objectives of this technology development are to:

- develop regional partnerships between all the relevant role players (SASRI Ripener Specialist, EVA specialists, SAFDA and SACGA representatives, regional mill/CTS representatives, crop spraying drone contractor, harvesting/transport contractors, relevant government departments) needed to advance cane quality management in the small-scale grower sector;
- collaborate in developing an approach consisting of informed ripening decision-making, ripener application via drones and harvest scheduling;
- implement this approach on a pilot scale in selected small-scale grower communities, spanning the coastal and midlands regions and the Pongola (Northern Zululand) and Mpumalanga areas through a series of demonstration trials; and
- quantify the economic benefit of the approach to small-scale grower communities.

Excellent project progress was made during 2021/2022. Several workshops were convened with key stakeholders in the various regions (Zululand-North, Zululand-South and South Coast/Midlands-South). Participating in the workshops were SAFDA/SACGA representatives, DARD agricultural advisors, miller representatives, local SSG leadership and staff from the agricultural drone company, PACSys (PTY) Ltd.

The purpose of the interactions was for SASRI to share the main economic findings emanating from the demonstration trials and to facilitate discussions about the way forward for drone ripening on a wider scale in the various SSG communities.

The workshops resulted in a common understanding and agreement on the value that drone ripening could potentially bring to SSGs, identification of logistical and social-economic barriers currently preventing wider roll-out of drone ripening, and preliminary action steps to be taken by stakeholders to overcome some of these barriers.

Water Management

Development of datasets for multi-scale water resource assessments

PROJECT MANAGER
Phillemon Sithole

SASRI is a participant in a Water Research Commission (WRC) funded project that aims to develop: (a) a pre-packaged database of Quinary Catchment level catchment attributes for application in water resource related assessments through hydrological and agricultural modelling (Water Resource Assessment (WRA) Quinary Catchment Database): and (b) an online data portal system to store and provide access to the datasets (WRA Data Portal).

In 2021/2022, progress was made in completing the necessary data sharing agreements and in the sourcing and quality control of data. Three sets of climate data sharing agreements were signed between UKZN and SASRI/Mondi, the South African Environment Observation Network (SAEON) and South African Weather Service (SAWS). Consequently, meta data for the weather stations that will be used in the projects were provided from each of these organisations. The meta data provided has each station's type (e.g. automatic weather stations (AWS), tipping bucket) location (latitude and longitude in degrees decimal), altitude (in metres above sea-level), list of variables measured (e.g. rainfall, temperature, RH, wind speed etc.) and time resolution (e.g. event, 5/30 minutes, hourly, daily).

- *SASRI is a participant in a Water Research Commission (WRC) funded project, led by the University of KwaZulu-Natal (UKZN) that aims to develop: (a) a pre-packaged database of quinary catchment level attributes for application in water resource related assessments through hydrological and agricultural modelling (Water Resource Assessment (WRA) Quinary Catchment Database): and (b) an online data portal system to store and provide access to the datasets (WRA Data Portal).*
- *In 2021/2022, data sharing agreements were signed amongst UKZN, SASRI/Mondi, the South African Environment Observation Network (SAEON) and the South African Weather Service (SAWS).*

Daily rainfall data was obtained from SASRI for the Gledhow region (coastal KZN) and SAEON provided data for Cathedral Peak (KZN) and Jonkershoek (Western Cape). These three regions were selected as they contain a dense network of rain gauges that provide rainfall data for at least 20 years and will be used to test the infilling technique for missing data. Data quality checks are in progress after which data will be stored in a single database and in one common format. Literature review undertaken confirmed that the project will use the Dynamic Copula Regression method developed by Bárdossy and Pegram in 2014 to infill missing rainfall data.

Assessing the water footprints of selected fuel and fibre crops in South Africa

PROJECT MANAGER
Dr Abraham Singels

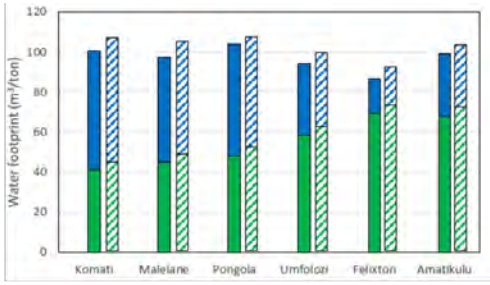
South Africa is a water scarce country with several sectors competing for the available freshwater resources. Significant amounts of water are used in the agricultural sector to produce food, feed, and fibre to meet the ever-increasing demands. About 60 percent of fresh water in South Africa is used by irrigated agriculture, making it the largest single user of water.

This Water Research Commission funded project, led by the University of the Free State and in which SASRI participates, aims to quantify the water footprint of irrigated sugarcane at the farm level, with particular emphasis on the impact of irrigation systems and mulching practices on water footprint estimates.

Good progress was made during 2021/2022 as follows.

- Yield and crop water use data from a previous SASRI climate change study (Project Reference: 08RE14) were used to calculate the green (water derived from rainfall) and blue (water derived from irrigation) water footprint (in m^3 water per ton of cane produced) for selected irrigated and rainfed production sites.
- The data were generated using the Canegro crop model with historic weather data for the baseline period (1971-1990) and weather data derived from three empirically downscaled global circulation models for the future period (2046-2065), and assuming perfect agronomic management. Preliminary results for irrigated production areas were obtained in 2021/2022.
  - The median total water footprint for the baseline period ranged from 86 m^3/ton for Felixton, to 102 m^3/ton for Pongola.
  - The variation between areas is due to variations in yield potential, temperature and atmospheric evaporative demand (all generally declining from north to south).
  - The median blue water footprint for the baseline period ranges from 17 m^3/ton for Felixton to 59 m^3/ton for Komati, comprising 20 and 60% of the total water footprint respectively.
  - This variation is due to the variation in the extent to which rainfall meets crop demand for water.
  - The median total water footprint is expected to increase under a future climate by 3-7 %, assuming adequate irrigation supplies. The reason is that expected increases in yield (due to elevated temperatures and atmospheric CO2) is much smaller than expected increases in crop water use (due to elevated temperatures).
  - The expected changes in blue water footprint range from nil for Pongola to 12% for Felixton, largely depending on uncertain projections of changes in rainfall (10% increase for Pongola and 1% increase for Felixton).
  - It is noteworthy that expected yield increases in Komati and Malelane are very small (2%), while demand for irrigation water will increase by about 8%, despite expected increases in rainfall of about 7%, resulting in an increase in the blue water footprint of about 7%.

It should be noted that these water footprint estimates are probably the best-case scenario because ideal agronomic management and irrigation efficiency were assumed. In practice the actual water footprint could be much larger due to practical constraints and suboptimal crop and water management. These estimates are based on simulations and should ideally be augmented by measurements of actual yields and water use.



Simulated blue and green water footprint of irrigated sugarcane production under the baseline (solid bars) and future (hashed bars) climate for different production areas.

It is important for the industry to implement practices to improved water use efficiencies to constrain the water footprint of irrigated sugarcane production. These include implementing efficient irrigation systems, accurate irrigation scheduling, making use of soil mulching where appropriate to limit wasteful evaporation, and optimal agronomic management of high potential cultivars to achieve high yields.

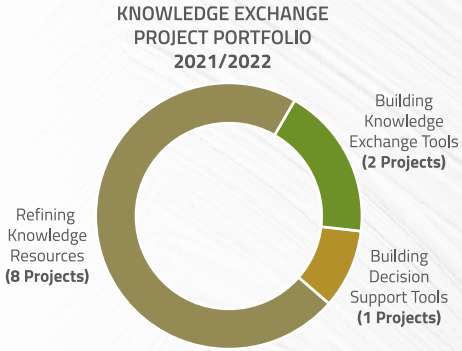
Michelle Binedell
Knowledge Manager

Knowledge Exchange

Promoting adoption of sustainable best practice amongst growers remains an ongoing priority for SASRI. Key knowledge exchange activities include: (a) empowering staff, though skills development, to plan and conduct effective knowledge with growers to promote adoption of best practice; (b) maximising the accessibility and value of existing knowledge assets to promote implementation of best practice by growers.

Knowledge Exchange Focus Areas

Building Knowledge-exchange Tools	Developing and implementing knowledge exchange tools to assist researchers and extension specialists to plan and conduct knowledge exchange campaigns more effectively.
Building Decision-support Tools	Developing tools, including online resources and smartphone apps, to ease grower decision-making.



Refining Knowledge Resources	Maximising the value of existing knowledge by consolidation of the suite of knowledge resources that contain SASRI recommendations, updating when required and ensuring coherence and easy access by growers.

Project Portfolio

The 2021/2022 Knowledge Exchange portfolio consisted of 11 projects.

Building Knowledge-exchange Tools

Annual update of SUSFARMS® *Ongoing updating of the SUSFARMS® tool following benchmark exercises, legal reviews and/or feedback from users.*	 **PROJECT MANAGER** Michelle Binedell
Refining SASRI's KE platform *Developing a knowledge exchange toolkit that will assist researchers in planning and conducting more effective knowledge exchange campaigns.*	 **PROJECT MANAGER** Dr Ashiel Jumman

Building Decision-support Tools

Implementation of the Drought Irrigation Program *Refining and rolling out of Drought Irrigation Program (DRIP) model to facilitate implementation by stakeholders.*	 **PROJECT MANAGER** Dr Ashiel Jumman

Refining Knowledge Resources

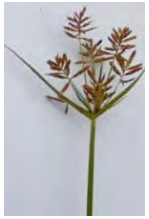
Yellow sugarcane aphid and thrips control manual (new)

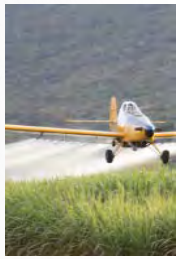
To provide guidelines for YSA and Thrips control through the creation of a manual.

PROJECT MANAGER
Dr Stuart Rutherford

Revision of SASRI publications containing best management practices

Reviewing and developing the suite of knowledge resources that encapsulate SASRI recommendations within discipline areas.

Insect pests		 **PROJECT MANAGER** Dr Stuart Rutherford
Weeds		 **PROJECT MANAGER** Anushka Gokul
Diseases		 **PROJECT MANAGER** Sharon McFarlane
Planting and harvesting		 **PROJECT MANAGER** Dr Peter Tweddle
Irrigation		 **PROJECT MANAGER** Dr Ashiel Jumman
Varieties		 **PROJECT MANAGER** Dr Marvellous Zhou

Cane quality management		 PROJECT MANAGER Dr Riekert van Heerden

New Projects

One new project was initiated in 2021/2022.

Yellow sugarcane aphid and thrips control manual	*To provide guidelines for YSA and thrips control through the creation of a manual.*	

Outcomes from completed projects

One Knowledge Exchange project was completed in 2021/2022.

Building Decision-support Tools

Implementation of the Drought Irrigation Program	The Drought Irrigation Program (DRIP) was developed previously by SASRI to assist growers with irrigation management during times of limited water supply. The tool is intended to enable users to evaluate the impact of farm irrigation strategies on crops and profitability. DRIP, however, has significant barriers to adoption in terms of ease of use and compatibility, particularly in terms of populating model inputs with the required baseline data. The outcome of an internal consultation process revealed that: (a) automated input of baseline data into DRIP from existing databases would be necessary to promote adoption and widespread use of the decision support tool; and (b) a partnerships with commercial entities, such as SQR Software (Pty) Ltd which markets CanePro Farmer and CanePro Estate, as well as growers and miller-*cum*-planters that use CanePro products, would be required to facilitate DRIP articulation with cane production data bases. Should such partnerships not materialise, SASRI would retain custodianship of the DRIP tool, with the following roll-out options: (a) implementation on a restricted number of case study farms annually with partnership between SASRI scientists and Extension Specialists: (b) SASRI scientists take would apply the model for growers through their Extension Specialists on a request basis; and (b) the model be the subject of an advanced modular course held on an annual basis for interested growers upon request. DRIP DROUGHT IRRIGATION PROGRAM FOR SUGARCANE


PROJECT MANAGER
Dr Ashiel Jumman

CONTRACTED-OUT RESEARCH

On behalf of the industry, SASRI enters into contracts with specific research service providers for investigations for which the institute does not have the requisite skills or infrastructure.

In 2021/2022 research agreements were in place with Stellenbosch University and the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD).

Biotechnological investigations to improve sugarcane drought tolerance	SASA/SASRI has contracted the Institute of Plant Biotechnology at Stellenbosch University to conduct proof-of-concept research into enhancing sugarcane drought-stress tolerance using mutation breeding and genetic modification approaches. In 2021/2022, a second three-year funding cycle from April 2021 to March 2024 was approved by SASA Council. Some of the proof-of-concept studies have yielded promising preliminary results under glasshouse and poly-tunnel conditions, which will be continued in the further three-year funding cycle.

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Investigation of genome structure, diversity and phylogenetic relationship of *Saccharum* species, and assessment of diversity incorporated into modern cultivars	• This research is being conducted by Dr Angélique D'Hont and her team at the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) in Montpellier, France. The project is co-funded by ten member countries and organisations of the International Consortium for Sugarcane Biotechnology, which includes SASA/SASRI. • The investigation will generate new knowledge on the genome structure, origin, and phylogenetic relationships of the *Saccharum* species involved in modern cultivars for introgression breeding applications and facilitating exploitation of available sugarcane genome sequence information for variety development purposes.

cirad LA RECHERCHE AGRONOMIQUE POUR LE DÉVELOPPEMENT

INTERNATIONAL CONSORTIUM FOR SUGARCANE BIOTECHNOLOGY

RESEARCH GRANTS

In 2020/2021, SASRI secured and gratefully acknowledges grants from funding agencies to support research, technology development and knowledge exchange.

NATIONAL RESEARCH FOUNDATION	Two fellowships were sourced from the National Research Foundation to support doctoral and post-doctoral research in the development and application of breeding-enabling technologies and biotechnologies to variety improvement. NRF Professional Development Programme: One post-doctoral (Dr Motselisi Koetle) and one doctoral placement (Ms Khethumusa Cele).
INTERNATIONAL ATOMIC ENERGY AGENCY	A research grant was received from the International Atomic Energy Agency (Vienna, Austria) over a five-year period, with the last tranche paid in 2020/2021. The grant supports investigation of insect-rearing and insect transport arrangements for off-site irradiation required to support proof-of-concept demonstration of the efficacy of a novel F1 sterile insect technique (SIT) for eldana population management.
WATER RESEARCH COMMISSION	SASRI collaborated in two research projects funded by the Water Research Commission. • Water footprint of fuel and fibre crops (Lead Organisation: University of the Free State) • Development of datasets for multi-scale water resource assessments (Lead Organisation: University of KwaZulu-Natal)
BIOSAFETY SOUTH AFRICA	A research grant was received from Biosafety South Africa (Technology Innovation Agency, Department of Science and Innovation) for developing new knowledge for use in the preparation of the regulatory dossier that will be required for the future potential release of an insect-resistant and herbicide-tolerant genetically modified sugarcane variety (Bt GM sugarcane).

Awards and Achievements

National Research Foundation (NRF) Ratings

SASRI researchers Dr Marvellous Zhou and Dr Stuart Rutherford were awarded NRF ratings for another five-year cycle (2021-2025).

SAPBA Best Poster Award

Dr Shailesh Joshi was awarded the best poster at the South African Plant Breeders' Association symposium in March 2022. He co-authored the contribution, "*Discovering the Relationships between Ancestors of Modern Sugarcane: Impact on Future Breeding Strategies*", with Dr Dyfed Lloyd Evans.

Technology Transfer

Michelle Binedell
Knowledge Manager

Popular Publications

In the 2021/22 year, SASRI continued to disseminate information through its suite of publications. *The Link* and *Ingede* magazines are aimed at our English/Afrikaans and isiZulu speaking growers respectively. These editions focussed on many of the technical issues pertinent to specific growing regions of the industry.

The Link

Three editions of *The Link* were published in 2021/22. The May 2021 edition acknowledged the leadership of Dr Carolyn Baker as out-going Director of the Institute and welcomed Dr Terry Stanger into the position. Technical content focussed on managing soil erosion and surface crusting, provided topical tips on seedcane planning, pest and disease management and the delivery of fresh clean cane during a favourable climate. For our iIrrigated growers, guidelines were provided for selecting an irrigation system as well as detailing the possible soil limitations for different irrigation systems.

The September 2021 edition contained articles detailing the outcomes of several SASRI research projects, the first being a decontamination procedure for mechanical harvesters against RSD. The impact of lodging on grower revenue was further discussed with the mention of a revenue loss calculator that can be used by SASRI specialists and Extension to assist growers with harvest management decisions. There was an article on salinisation of irrigated land providing useful recommendations for reducing salinity.

The occurrence of giant *Panicum maximum* (a robust tufted grass) was noted along with recommendations for its control. Finally, an early alert of Orange Rust on sugarcane in Angola was also provided with detailed descriptions of its appearance and forms of control.

The January 2022 edition provided extensive advice on the management of carry-over cane at a time of reduced milling capacity. An early-application recommendation for the control of eldana was discussed, along with confirmation of soil P thresholds. Finally, an introduction to the Sterile Insect Technique for eldana control was given, showing its application as a tool in the Area-Wide Integrated Pest Management programme against eldana.

The Ingede

The popular isiZulu publication, *Ingede* is distributed by hand to small-scale growers by Extension Specialists, Agricultural Advisors and other industry stakeholders. In addition to the printed copy, narrated *Ingede* articles (voice notes) were recorded and sent out to growers via WhatsApp.

The May 2021 edition focussed on important aspects of sugarcane agriculture for the small-scale grower (SSG). These included Topical Tips (a regular feature of each *Ingede*), appropriate for each month in the farming calendar, as well as an update on the Longhorn beetle, the importance of variety diversification, SSG and contractor roadshows and recent changes in the Extension team.

The September 2021 and January 2022 editions contained twelve articles of interest focussing on planting, weed management, managing carry-over cane, drone ripening, training opportunities and an Orange Rust alert.

Other Newsletters and Articles

Direct communication to growers in the numerous regions took place through the development of sixteen *Extension newsletters*. These communicated upcoming events, alerts and latest trial results.

Four articles were produced for *Coastals News*, once again showcasing SASRI's achievements and promoting best practice.

Booklets and Guides

Mechanisation reports

Annual updates of the Mechanisation Reports were completed and posted to the SASRI website.

Tools

PurEst®

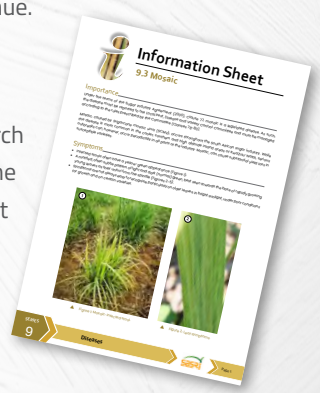
In August 2021 a minor repair was made to the Pur*Est*® smartphone app to ensure that users did not lose previous records when updating to later versions of the app. A new update was then released in March 2021 to assist in ripener decision-making and included a specific recommendation for crops sampled in the second half of July as well as an update to the variety response tables.

Lodging Revenue Loss Calculator

Besides the known negative impacts in crop productivity and yield, the phenomenon of lodging affects the efficiency of harvest and transport operations, including many other management decisions. A customisable Excel-based tool was developed to enable Extension Specialists to advise growers on the effects of various lodging scenarios on their revenue.

Information Sheets

Information Sheets provide a platform for the communication of research outcomes, as well as guidelines and advice on the management of the sugarcane crop. Several information sheets were updated with latest recommendations arising from research projects as well as expert knowledge.



Radio

During 2021/22, radio broadcasts continued to reach many of the rural communities in South Africa. Due to the Covid pandemic, there was a shift once again in terms of how broadcasts were done. Telephonic interviews were conducted allowing listeners to phone in, once again promoting interaction between presenters and listeners. Shows focused mainly on agronomic issues, with one of the most interesting being the ripening project being implemented by SASRI, which aims to use drones to ripen small-scale sugarcane grower fields.

Radio broadcasts (supported through a Radio Forum) are incredibly important tools that enable communication between specialists/advisors and farmers, with an ability to reach the deepest parts of our country.

Grower Interaction

Unfortunately, the continuation of the COVID pandemic into 2021/22 limited face-to-face interaction with industry stakeholders. However, the level of contact with industry stakeholders increased significantly through more frequent telephone calls, emails and online discussions. Extension Specialists and researchers received 538 visitors, hosted 3 041 industry field visits and online communications, hosted 179 grower days and exhibitions, engaged in 327 conferences, workshops, refresher courses, seminars and demonstrations (many of which were online), and attended 352 Industry meetings.

Postgraduate symposia

A full day of presentations by postgraduates working in research projects within the SASRI programme of work was held on 7 December 2021. This symposium comprised four sessions chaired by SASRI Programme Managers involved in student supervision. The talks covered 3 MSc, 7 PhD and 2 post-doc topics. It proved to be a valuable platform for exposing innovative outcomes that have been generated by young, developing scientists.

A similar symposium was hosted for SASRI's intern cohort involved in projects that add value to the industry. Thirteen interns delivered papers and reflected on the experience gained during their time at the Institute.

The quality of all presentations was consistently high, reflecting SASRI's ongoing commitment to maintaining the highest levels of scientific excellence.

Certificate Courses

The Covid pandemic had a huge impact on SASRI's ability to conduct regular classroom-based Certificate Courses. Unfortunately, both the April 2021 Junior and June 2021 Senior Courses were cancelled due to Covid restrictions. However, a Junior Course in November 2021 was held for 44 students. The pass rate was 93%.

The start of the 2022 year was promising with our ability to host a Senior Course class of 57 students in the SASA Auditorium. An 89% pass rate was achieved. Once again, a Junior Course was hosted in March 2022 for 50 students with a 72% pass rate being achieved.

Social Media

In 2021/22 social media was used more frequently to share latest research findings and published outcomes. The professional platform LinkedIn was used to highlight grower days, achievements and published content.

SASRI Website

At the end of the 2017/18 financial year, a new website was released which contained more user-friendly features and content, with the addition of an eLibrary in the 2019/20 year. In the 2021/22 year, the website was continuously updated with new content and serves as a one-stop site for all SASRI publications, videos, decision-support-tools and services provided to the industry.

Extension

Rowan Stranack
Extension and Biosecurity Manager

Types of Extension Services offered

Large-scale

SASRI provides a levy-funded extension service in eleven of the twelve mill areas. This service involves primarily on-farm visits and other personal contact by the local SASRI Extension Specialist providing one-on-one advice on specific aspects of sugarcane agronomy, as well as group-learning activities in the form of grower days, study groups and written media such as newsletters.

Visits and group events often involve SASRI Specialists enabling growers to better understand and implement new technologies.

Valuable technical support is given to the many local grower structures operating in the industry, for example, Local Pest Disease and Variety Control Committees (LPD&VCCs), and local grower structures such as Mill Group Boards.

Private

The local milling company in the UCL cane supply area delivers a private extension service to growers.

Small-scale

Extension is delivered to small-scale growers through a joint venture with the KZN Department of Agriculture and Rural Development (KZN DARD). Under this Extension Venture Agreement (EVA), five SASRI Extension Specialists support 30 DARD Agricultural Advisors ensuring they are trained and equipped with all new SASRI research outcomes thereby enabling them to assist small-scale growers to farm more effectively and profitably.

A joint Monitoring Committee comprising DARD and SASRI oversees the work programme of the EVA through quarterly meetings. DARD local managers are contacted regularly to ensure operational issues are addressed.

A notable addition to extension services to small-scale growers was the appointment of an extension specialist in the Mpumalanga Lowveld. This marked the return of small-scale grower extension to this area, a service which growers there had been requesting for some time. The incumbent was promoted from the Biosecurity Inspectorate indicating career path opportunities which exist within the department.

Research, Development and Extension (RD&E) Committees

A key function performed by Extension Specialists is to identify and gather specific research needs in their respective areas. This is enabled through locally elected RD&E Committees in each Extension area. This link with the SASRI research programme provides a platform for growers to have their specific research issues addressed. In many instances, growers assist in this process by providing land to conduct trials. Growers also provide important local context to the research, as well as advice on the practical implementation thereof. In addition, SASRI Extension Specialists are members of the project teams conducting research in their Extension areas, and offer guidance in making these trials as relevant as possible.

Once new research outcomes are generated, RD&E Committees assist in facilitating the transfer of these technologies to growers, thereby completing the exchange of technology between grower and research. RD&E committees gather annually to review research needs from the wider industry and to prioritise these needs accordingly, forming the basis for the SASRI research programme for the following year. These central workshops alternate between the irrigated and rainfed regions.

In March 2022, it was the turn of the irrigated regions to hold an RD&E workshop. This took place in Komatipoort and along with the workshop several other engagements with growers and stakeholders were planned to make maximum use of specialist's time. A good cross-section of the growing and milling sections was present at the workshop. Feedback on progress with research projects developed out of the 2020 workshop was provided. Participation by those present at the 2022 workshop was both lively and positive. Several critical research needs were identified for consideration; amongst others yellow sugarcane aphid, seedcane and the need for SASRI's continued role as an independent source of advice on irrigation issues. From the feedback from growers, it was also clear that on many issues the research had already been carried out, and a requirement was a communication strategy to ensure research outcomes reached the growers.

The 2020/2021 Season

The final crop for the 2021/2022 season was 17.2 million tons which was significantly lower than the previous season's 18.3 m tons. However, this was not necessarily a true reflection of yields during the season as there was, like the previous season, a significant area of unplanned carryover cane at the end of the 2021/2022 season, due mainly to restrictions in milling capacity in the southern rainfed regions. Yields were lower than the previous season in the Mpumalanga cane growing region, also contributing to the reduced crop.

In late January and early February of 2021, the industry received widespread soaking rains due to the presence of a tropical cyclone positioned over the northern parts of KwaZulu-Natal and Mpumalanga. Widespread flooding occurred in Mpumalanga and there was damage to fields and infrastructure. On the Umfolozi Flats, cane lands on the lower parts of the Flats were under water, and some places remained so into the winter of 2022. The good rains immediately filled up all the storage dams and river systems in Mpumalanga and with continued good rains throughout 2021 and into 2022, water supplies remained more than adequate keeping the soil profile generally full throughout the period. At Pongola, the Bivane Dam filled up and the Pongola River flooded, ultimately adding to the inflow to the Pongolapoort Dam which had been relatively low for some years.

Water supplies across the industry remained good throughout the season and there were no restrictions in the irrigated northern regions. Although yields were relatively lower than the previous season, the drier conditions in winter and spring in the northern regions contributed to excellent cane quality and a steady flow of cane from field to the mill. As a result, the Pongola, Komati, and Malelane mills harvested all available cane and there was no carry over into the 2022/23 season.

Whilst the rainfall was very welcome it also brought long periods of cloudy cooler weather during the peak growing season in the irrigated regions, and this coupled with a relatively cold winter the previous year, resulted in yields being lower than in the previous season.

In the Midlands regions there were two severe frost events resulting in emergency harvesting and unfortunately leading to a significant area of damaged cane being left unharvested at the end of the season. A rare snowfall also occurred in August and even though many cane areas were affected there was no damage to the crop.

Along the coast and Midlands, rainfall remained either at or above long-term mean throughout the year. Flowering was again profuse resulting in difficult harvesting decisions having to be made towards the end of the season when growers were hard pressed to harvest as many flowered fields as possible. Due to the generally good rains in these regions, eldana did not cause significant damage to the crop, despite a large area of older cane being present. The older cane was however often severely lodged and resulted in difficult harvesting conditions for cutters, and payloads were also negatively affected. Sour rot was also a factor affecting quality in the older cane.

The civil unrest in July 2021 affected all mills in KwaZulu-Natal. Crushing was temporarily halted, and arson fires were widespread. Towns and villages which form the backbone of the rural economy and support much of the industry were devastated causing considerable hardship for the rural population many of whom were employed by the sugar industry. Cane quality was affected negatively by the excessive delays in processing.

There were also other disasters such as a fire at the Komati mill sugar store and extensive storm damage to the Gledhow mill, both events disrupting deliveries to these mills. Difficulties were also experienced at other mills on the coast, causing disruptions to deliveries and excessive harvest to crush delays.

Dealing with limited milling capacity and a sizeable crop forced some Mill Group Boards to restrict deliveries during the milling season. Furthermore, estimates for the following season were to be governed by milling capacity. Extension was active in assisting growers with final decisions regarding fields suitable for carrying over.

Yellow sugarcane aphid (YSA) continued to have significant impact on the crop in some parts of the Lowveld during the season, although towards the end into 2021 populations decreased somewhat. At the of 2022, in those areas of the North Coast where the problem has existed for some years, populations to increase dramatically causing a noticeable effect on In response, two grower days were held in March 2022 SASRI specialists addressed growers on the problem. out of these interactions SASRI developed a prototype mobile application for growers and Biosecurity to outbreaks and to aid in research and implementing measures.

In the Lowveld the varieties N57 and N23 were severely by YSA, and it is unlikely that further expansion of varieties will take place in that area. A successful virtual day on this pest was held in September 2021 aimed Lowveld growers. This was the first of its kind to be Efforts at control of the pest in these areas through application of insecticides has met with variable results long-term varietal resistance and crop management are provide the solution.

Varieties and Seedcane

The promotion of new SASRI varieties remained a high priority with Extension. Being one of the most common questions from growers, choosing the correct varieties is becoming increasingly complex with a wider range of varieties available. This was also a busy year for the release of varieties. The irrigated regions received N73 into bulking; the Midlands received two long-cycle varieties N74 and N75 and the coastal regions two short-cycle varieties, N76 and N77.

In addition, the variety N12 Zapyr, a product of mutagenic breeding with resistance to the herbicide active ingredient imazypr, was released to those areas where N12 was currently grown. All the varieties released were propagated as NovaCane®. Unfortunately, the new variety N64 did not perform well on the north and south coast post-release and showed symptoms of the fungal disease pokkah boeng. As a result, the Sezela uMzimkhulu and North Coast LPD&VCC regions have requested that N64 be removed from the approved list of varieties for their areas.

The variety disposition across the industry is dominated by a handful of varieties. Over 50% of deliveries in the 2021/22 season were comprised of just four varieties: N41, N36, N12 and N39. Whilst these are excellent all-round performers, there are ample choice of varieties available to growers to exploit specific conditions on the wide range of soils and growing conditions across the industry. Growers are beginning to see the benefits of this choice and varieties such as N52, N53, N54, N55, N57 and N59 may soon become more widely grown. Later releases such as N61 and N62 are also proving popular in the Midlands.

SASRI variety trials are used extensively by Extension and Researchers to promote the effective use of varieties. In addition to field days, the results of these trials are often publicised in Extension newsletters and in other forums.

Ensuring adequate supplies of certified and approved seedcane continued to be a major challenge in many regions. Several regions made good efforts to comply with the 2023 deadline by which all commercial fields need to be planted using either certified or approved seedcane. An assessment of progress towards this goal found that less than half of the LPD&VCC regions were likely to be compliant, necessitating a review of the deadline date.

Extension Activities

Although still restricted by Covid-19 restrictions there was a slow return to normal extension activities as the year progressed. The backbone of extension activity remained, which were the individual farm visits and these had continued throughout the lockdown period. However, with an easing of restrictions, grower days and study groups could resume. Taking advantage of lessons learned during lockdown-communication with growers via email, telephonic and messaging applications such as WhatsApp have become more widely used. A total of 3041 individual farm visits were made during the year, these being by far the most preferred means of delivering extension with both Extension Specialists and growers.

Education remained curtailed due to the Covid-19 pandemic and the first Senior Certificate Course since lockdown was only possible in February 2022.

Grower days are an excellent tool to communicate better management practices with all growers. Often centered on SASRI trials these gatherings encourage a less formal environment for growers to interact with Extension and specialist researchers. Study groups with smaller groups of growers, also sometimes involving specialists are a means for deeper engagement with subjects and are highly effective.

Extension also communicates with growers via newsletters and publications such as the The Link and Ingede. The SASRI Knowledge Management Unit and EVA Extension also had an active and comprehensive community radio outreach programme that proved to be a highly effective means of interaction with growers and an opportunity to communicate new technology.

SUSFARMS® and Conservation

Growers in the Noodsberg, UCL and Eston mill supply areas continued their participation in the SUSFARMS® 2018 Collaboration. Extension has provided active support to the development and implementation of SUSFARMS® and the associated Progress Tracker as an environmental sustainability management tool. Growers on the South Coast submitted SUSFARMS® Progress Trackers during 2021 as part of their recent commitment to participation in this environmental management system.

Extension continued to provide support to growers in soil conservation and land use planning. Although not offering a planning service, SASRI Extension assisted growers in implementing new field layouts and conservation structures. Whilst this work often is done in the context of a full Land Use Plan (LUP), significant ad hoc advice on field layout is given at individual field level. Extension also delivers the farm planning module on the Senior Certificate Course training students in the essentials of field layout and design of conservation structures. This area of expertise rests almost entirely within Extension at SASRI.

Renewed focus on the management of wetlands and watercourses was initiated during the year as part of the Memorandum of Agreement between SASA and the Department of Water and Sanitation (DWS). A Joint Implementation Committee (JIC) between DWS and SASA was formed and SASRI Specialists and Extension are represented along with representatives of the growing and milling sections. This area is likely to become more prominent in time as the JIC begins its work in the industry.

Soil Health and Crop Nutrition

One of the main aims of Extension is to promote the use of the Fertiliser Advisory Service (FAS). To this end, two Extension Specialists serve on the FAS Steering Committee to contribute their expertise and to represent the interests of their growers in the delivery of the service. A dramatic increase in fertiliser prices necessitated efforts to assist growers in deciding how the most cost-efficient ways to allocate their fertiliser budgets and there have been on-going efforts to encourage growers from areas where previously few samples were received to send soil and leaf samples to FAS.

Promotion of sampling amongst the small-scale grower sector also remains a challenge and a project was launched in the Midlands to attempt to focus on the identification of soils, their yield potential and critical management factors. This project has been running for a year and it is intended to extend it across the whole industry.

Pest and Disease control

In their support to LPD&VCCs, Extension Specialists assist committees in guiding general pest and disease strategies in their areas. SASRI Extension Specialists also carry out line management responsibilities in the management of Biosecurity staff.

Yellow sugarcane aphid *(Sipha flava)* has developed as a major biosecurity threat to the industry. The Lowveld regions, including Pongola continued to contain outbreaks although towards the end of 2021 and early 2022 populations subsided somewhat,emphasising the unpredictable nature of the pest. This pest remained a persistent problem in parts of the North Coast but tends to flare up dramatically and disappear equally rapidly in other parts of the coastal belt and Midlands. Difficult to control using chemicals alone and despite a careful strategy being followed and with proactive spraying the pest frequently re-establishes itself after initial control.

In an ongoing effort to contain an outbreak of the longhorn beetle (*Cacosceles newmannii),* SASRI Extension continued to be closely involved in monitoring the area at Entumeni area where the outbreak occurred. Unfortunately, as in November of 2020, in November 2021 more longhorn beetle larvae were recovered from sugarcane fields in the Entumeni area not previously identified with the pest. This necessitated further eradication and long fallow, increased from two to three years. Although some plans were made to return previously infested areas to sugarcane, the entire containment area remains fee of sugarcane.

Smut continued to be a major threat in the Pongola area. The moratorium on the planting of the variety N41 imposed in 2020 had a positive effect on reducing the area under this variety although numerous roguing and eradication orders still had to be issued, mainly in fields of N41. Further south in the industry smut levels in two popular new varieties, N54 and N59 remains a concern. Although not at levels requiring eradication continuous roguing and the use of smut-free seedcane remains an imperative.

The Extension Venture Agreement

SASRI and the Department of Agriculture and Rural Development (DARD) have an Extension Venture Agreement (EVA) that has been in place since 1996. Over the years, this agreement has proved an excellent example of a private-public sector partnership, delivering value to both partners. The EVA model is widely held, both nationally and internationally, as a practical and workable framework for delivering Extension to many recipient farmers. Currently, there are approximately 21 000 small-scale growers in the South African sugar industry making the delivery of individual Extension impractical. However, through group interactions, and with additional Extension staff accessed through the DARD, effective Extension is achieved.

Under EVA, SASRI employs five sugarcane Extension Specialists, jointly funded by SASRI and DARD, to provide support to DARD Extension staff working with small-scale and land reform sugarcane growers in KwaZulu- Natal. This support provides for assistance in planning of work programmes for sugarcane-related extension, regular updates on new technology and better management practices for sugarcane. Specialist advice is also given to DARD Extension staff and where necessary, SASRI subject specialists are engaged to help diagnose and remedy farm or area specific problems.

Increasingly, the EVA has become involved in delivering Extension to land reform grower beneficiaries. In this respect, regional levy-paid Extension also provides support under the broader SASRI umbrella. On the North Coast, a regional levy-funded Extension Specialist works specifically with land reform farmers and in that region extension is managed and deployed regionally as a unified team. In so doing, the EVA has access to a wide range of advice and support.

To deliver an effective and relevant Extension service, the EVA team relies heavily on demonstration plots and the farming calendar to guide the timing of field events. Learning events with growers are timed strategically to coincide with activities in the cropping cycle (for example, crop estimating at the beginning of the season, and planting and weed control

in springtime). Demonstration plots which function both as living field schools and sources of approved seedcane have been established across KwaZulu-Natal.

The standout success of both the 2020/2021 and 2021/2022 years in terms of small-scale grower interactions was the drone ripening project carried out on small-scale grower farms across the industry. Grower days were held to introduce the concept, followed by others when the ripener was applied. Results from these fields were then processed and feedback provided. Significant quality benefits were demonstrated, and this method of application has the potential to contribute greatly to the economic sustainability of small-scale growers if commercialised.

The EVA team also held a series of roadshows with contractors in all areas of the industry. These roadshows emphasised the impact contractors can have on cane quality of the cane they harvest and deliver and the success of operations such as ripener application, depend largely on the efficiency of contractors.

Although not under the EVA umbrella, an Extension Specialist was appointed to service Small-scale growers in the Mpumalanga region. Starting in August 2021 there has already been a significant impact on extension delivery in this region, following largely the same model and work programme employed in KwaZulu-Natal with the EVA team. Establishing extension in this region was a significant achievement with more than a decade having passed since SASRI Small-scale Extension had a presence in that region.

Biosecurity

Rowan Stranack
Extension and Biosecurity Manager

The SASRI Biosecurity inspectorate comprises 24 field inspection teams with attendant officers and technicians. The inspectorate operates in all regions of the industry but is managed centrally together with SASRI Extension, providing management and technical support. The industry biosecurity function is driven by twelve Local Pest Disease and Variety Control Committees (LPD&VCCs) situated across the industry having representation from both the milling and the two grower associations, with SASRI staff providing technical and administrative support to the committees.

During the Covid-19 lockdown period regular meetings of LPD&VCCs were not possible. Some committees took to virtual platforms to hold meetings, and these were successful in instances where they were used. However, in some areas, such as at Makhathini, such meetings were simply not possible, and growers and committee members relied on feedback from SASRI Biosecurity Officers to keep them informed of the pest and disease status in the areas. Due to the necessary safety protocols the inspection teams daily operations were also affected. It was gratifying to note that a relatively low number of positive cases were recorded amongst biosecurity employees although frequent testing and isolation was necessary.

Committee Operation and Activities

Representation on LPD&VCCs includes members from the South African Farmers Development Association (SAFDA), SA Canegrowers Association (SACGA) and the South African Millers Association (SAMA). SASRI Extension and Biosecurity staff are ex-officio members of LPD&VCCs and provide an administrative and technical advisory service to LPD&VCCs, as well as managing the field survey programme.

Where necessary, LPD&VCCs liaise with other grower structures and industry bodies such as Mill Group Boards to fulfil their responsibilities.

Represented on LPD&VCCs are both small- and large-scale growers as well as the milling companies operating in the LPD&VCC control area. Wherever possible, representation from the various geographic areas or wards within the control area is also sought.

LPD&VCCs report to the Sugarcane Research and Sustainable Agriculture Committee (SRASA) who, in turn, report to the Council of the South African Sugar Association. The SRASA Committee has a Pest and Disease Working Group who meet to discuss and approve various issues such as changes to LPD&VCC rules and standards and any other pressing matters relating to pest, disease, and variety control. This Working Group then provides recommendations to the SRASA Committee who then act upon the advice given to provide recommendations to SASA Council.

Pest Occurrences in 2020/21

Yellow sugarcane aphid (*Sipha flava*)

Yellow sugarcane aphid (YSA) Sipha *flava* was first recorded in the South African sugar industry in 2013, when it was found infesting cane growing on the Umfolozi Flats. The pest was very soon found in all areas in the industry where it caused damage to cane to varying degrees in the years following.

Severe outbreaks of YSA occurred in the summer of 2020, mainly in the Komati area and these persisted throughout until late 2021 and early 2022 when they decreased somewhat. Noticeable effects on yields were reported and the pest continued to attack the crop as it matured. The varieties N57 and N23 were particularly badly affected. In consultation with SASRI Specialists, a strategic approach to control was initiated. Active scouting and spraying of insecticide were implemented. This met with some success although it was found the conventional treatments had a relatively short-lived effect.

A particularly intense outbreak occurred in the North Coast in early 2022 in certain of the areas inland of the coastal belt. Outbreaks also occurred in the Umfolozi region. Following the heavy rains and onset of autumn however, populations subsided.

Biosecurity teams record observations of YSA during their routine surveys for eldana and diseases in commercial cane. These have helped growers and SASRI monitor populations and serve to inform control measures.

Extension continues to co-operate with SASRI Specialists undertaking trials and other research work on this pest. Importantly, a series of grower days were undertaken to facilitate knowledge exchange between SASRI Specialists and growers who were experiencing the problem. These events were held in all the major regions where the pest was a serious problem and one of these took the form of a virtual grower day which proved to be an efficient method of exchanging knowledge.

Longhorn Beetle (*Cacosceles newmanniii*)

No emergence of adult beetles in the containment area was reported during the summer and autumn months of both 2020/2021 and 2021/2022.

In November 2021 cane cutters found several longhorn beetle larvae in a sugarcane field being harvested very close to the area where the previous a similar outbreak occurred a year before. Intensive surveys in adjacent fields revealed the outbreak was most probably confined to the first field where it was found. Eradication orders were issued on this and adjacent high-risk fields and these will remain fallow for three years.

Research into the pest has proved problematic in that adult female beetles have been scarce and are key to the development of a pheromone which could be used in a trap-and- kill strategy in the future. Monitoring for the pest in commercial sugarcane fields in the Entumeni area is on-going.

Eldana

The SASRI Biosecurity Inspectorate undertakes eldana surveys with three primary objectives in mind: monitoring the overall threat posed by the pest to the LPD&VCC control area; assisting growers with decisions relating to fields to carry over, and linked to that, determining the need for and success of spraying operations. During 2021 and 2022 a total of 104 012 hectares was surveyed for eldana of which 2 716 hectares (2.6%) were above the local hazard level requiring remedial action, either harvesting or spraying of insecticide. The total area surveyed was 3 834 hectares more than that surveyed the previous year and 39 000 hectares greater than the minimum required, emphasising the importance of this threat. The area of hazard cane remains encouragingly low despite the increased cane age in the southern regions and was lower than the previous year.

Apart from the off-crop when it is important to prioritise fields for harvest at the start of the season, eldana surveys in the rest of the season are now focused on cane for harvest in the following year as this cane has potentially the highest risk of losses caused by eldana damage.

Effectively managing eldana is complex, involving several factors, some of which, such as the weather, are beyond the control of growers. SASRI Extension Specialists and Biosecurity Officers play an important role in assisting with advice to LPD&VCCs and individual growers, balancing the influence of the weather, soils, the local environment, varietal susceptibility and the biology and ecology of the pest on management decisions.

As planting infested seedcane has been shown to not only affect germination but also helps spread the pest it has been necessary to introduce hazard levels for seedcane, at a threshold which does not affect the overall availability of seedcane.

Monitoring exotic pests and diseases

Monitoring for the stem borer (*Chilo sacchariphagus*) continues to be carried out under contract by Crop Watch Africa who maintain a series of pheromone traps along the KZN and Mpumalanga borders with Mozambique. To date, no positive specimens have been identified. Any suspicious interceptions are sent to SASRI for identification and if necessary, DNA from the sample is analysed.

Also, in the interests of regional biosecurity, SASRI, annually collects information on biosecurity threats found on sugarcane on estates in the SADC region. This information is shared amongst all interested parties with estates rating their threats and providing information on control measures being implemented.

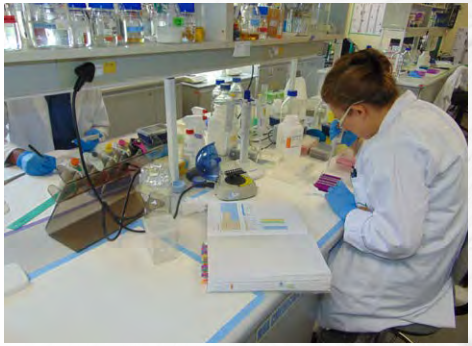
Disease Occurrences in 2020/21

Smut and Mosaic

These diseases continue to remain generally at low levels across the industry. The total area of commercial fields surveyed was 68% of that required to obtain a fully representative sample. Although, in the regions where diseases, specifically smut, are a major threat, these committees exceeded their targets. A total of 40 491 hectares of commercial fields was surveyed for diseases across the industry. Of these 639 hectares (1%) were above the local hazard level. Most of these problem fields (75%) were infected with smut and were either in Pongola, Mpumalanga and KZN north of the Tugela River. Roguing, and where necessary, eradication orders were issued.

Mosaic was mainly confined to the southern and high-altitude regions of the industry and on average only at trace levels on a relatively small area of cane. High levels of off-types remained a problem in some commercial fields indicating ineffective crop eradication and volunteer control.

Ratoon Stunt (RSD)



All LPD&VCC areas are required to submit a quota of samples to be tested for RSD, based proportionately on the area under cane in each control area.

Of the 7 408 commercial fields tested for RSD during the 2021-2022 season, 4.2% were found to be infected. This was higher than the previous year (3%) but below the 5-year average. Of all the regions, Pongola recorded the highest level of infection in commercial fields tested (17.3%), followed by Umfolozi (7.2%) Entumeni (4%) uMzimkhulu (3.9%) and Midlands South (3.4%). Of the 1 591 RSD samples extracted from seedcane fields, only 5 of these fields were found to be positive. Compulsory testing of all seedcane fields has largely prevented any infected seedcane from being planted out and this requirement should contribute to an overall reduction in RSD as seedcane sources are improved over time.

Seedcane

Certified and approved seedcane

All LPD&VCCs have been challenged in terms of the requirements of the industry LPD&VCC Rules, to have in place adequate supplies of certified and approved Seedcane before March 2023. Most LPD&VCCs are now actively investigating the establishment of seedcane schemes to benefit all growers. Whilst in a few areas, mainly those where long-standing seedcane schemes are in place, this objective is close to being achieved, there are other regions where schemes are either non-existent or only starting up. The provision of sufficient good quality seedcane therefore remains one of the most important challenges facing grower communities.

During 2021/22, a total of 829 hectares was approved for use, this being far more than the minimum 590 hectares the industry requires. However, there were only 2 452 hectares of approved seedcane approved cleared for use out of 6 620 hectares that is required, being was less than 40% of the total industry requirement. This indicates that there is a significant area of certified seedcane not being used to plant approved nurseries and being sent to the mill and of greater concern that approximately 60 percent of the material used to plant commercial fields in the industry, does not meet the standards for approved seedcane, that it is commercial cane in other words. This places the industry at considerable risk, and as this situation has prevailed for many years, the industry is vulnerable to any new incursions.

The industry therefore remains poorly prepared to meet the deadline and significant work will have to be carried out over the next two years for areas to be compliant.

Status of seedcane schemes

There were several regional initiatives aimed at starting formal seedcane schemes. At Sezela, it was decided to implement a compulsory scheme, supporting both the transplant nursery and private co-operators, and at Pongola certified seedcane nurseries were established. In Mpumalanga the Komati Cane Growers Association established a heat treatment plant on the SASRI Research Station. Also, in Mpumalanga the RCL mother-blocks continue to generate certified seedcane for growers. The Felixton, Amatikulu and Entumeni areas still operate their long-standing seedcane schemes providing certified seedcane to plant approved nurseries. On the North Coast, producers of certified seedcane and heat treatment facilities are limited. In the Midlands North, certified seedcane for the area is produced on a farm at Harden Heights but efforts are being made to develop satellite schemes as the area is extensive. The Umfolozi area has had a heat-treatment facility for many years and certified seedcane is produced, however, the area lacks any formal seedcane scheme. The areas of most concern are the Mkhuze/ Makhathini, uMzimkhulu and Midlands South regions where there are no schemes and only limited heat-treatment facilities available to start up a scheme.

Other Pests and Diseases

Orange rust (*Puccinea kuehnii*) was positively identified on sugarcane in the South African sugar industry for the first time in January 2022. Orange rust spores had been detected on a spore trap in the Mpumalanga Lowveld periodically from as early as 2016, but this was the first time the disease had been positively identified on sugarcane in the field.

First identified on three varieties (N41, N75 and N76) on a farm near Shakaskraal on the North Coast, the disease was subsequently identified at Mt Edgecombe, on the Umfolozi Flats and Sezela. More varieties were found to be infected, including N23, N36, N49, N60 and N77.

In accordance with the emergency response plan, the SASRI Biosecurity Inspectorate undertook a survey across the industry to determine the prevalence and severity of the incursion. Although present in most areas, the disease was not identified in the Midlands and Lowveld regions. To date, outbreaks have not been that severe but, should conditions prove favourable, the disease could spread rapidly with possible serious effects on certain susceptible varieties.

Registered fungicides were applied successfully to outbreaks of the disease. Orange rust was gazetted as a hazardous disease and should control measures be required to limit the spread of the disease then these can be implemented. Both brown and tawny rusts were recorded during the report period with orange rust being a recent addition. The Biosecurity Inspectorate routinely records the presence and severity of the three rusts, as well as damage caused by thrips and YSA. Extension Specialists received rust alerts from SASRI when conditions were favourable for the development of the disease.

White grub continued to cause damage to sugarcane roots on cane in the Midlands and some parts of the coastal regions. A survey of white grubs, carried out in the Midlands North and South regions, confirmed the widespread and continued presence of the pest. Mainly *Schizonycha spp* being recovered, surveys revealed that on average at least one grub per pit is typically found in a survey. A pit being a spade width square and deep.

Strange symptoms on the leaves of some fields of the variety N61 in the Midlands North region were eventually identified as eye spot (*Bipolaris sacchari*). Eye spot had not been observed in SA for many (30+) years. It is usually considered a minor disease but sometimes can cause yield loss.

Across the entire reporting period, sour rot was frequently reported by Biosecurity teams during routine eldana surveys in the Midlands regions. Typically associated with older cane which has undergone some stress, these conditions were common across the Midlands and in some parts of the coast where there were large areas of unplanned carry-over cane.

Biosecurity Inspectorate

Employees of the Inspectorate are employed and managed by SASRI and work on behalf of the LPDD&VCCs providing them with data which is used to make decisions regarding the control of various biosecurity threats. Routine farm visits to inspect commercial fields for pests, diseases and off-types were undertaken and certified and approved seedcane sources inspected as required in the LPD&VCC Rules. Other surveys and samplings are also undertaken when necessary. For example, an area-wide survey for white grub was undertaken in the Midlands. Other surveys such as RSD, thrips and longhorn beetle inspections are routinely carried out. Regular in-service and specialist training of inspection teams are carried out and driver training and development are also on-going. Some inspectors and supervisors were able to attend the SASRI Junior and Senior Certificate Courses as part of their personal development. Encouragingly, there have been promotions amongst employees within the Inspectorate and to other posts at SASRI. Staff turnover is not high, and some long-serving and experienced employees have developed exceptional skills and knowledge in their work. There has been an on-going project to introduce electronic data capture in the field and this continues to progress well, using the ArcGis Survey123 application. This same platform was used to develop an application for growers to monitor outbreaks of yellow sugarcane aphid (YSA).

Advisory and Support Services

Kerry Redshaw
Operations Manager

Specialist Advisory Services

SASRI researchers and specialists provide essential sugarcane agriculture services and support to the local sugarcane industry, as well as, to several external customers (local and international). This expertise is offered as specialist advisory services to external clients for a consultancy fee when specialist capacity is available.

The income generated from the delivery of these services is used to offset operational expenses. These requests include specialist advice, technical support and training to Southern African Development Community (SADC) partners, SA agrochemical companies and other external clients. Specialist advice includes, but is not limited to, variety choice and evaluation, data analyses, crop nutrition, irrigation advice, pest and disease identification, control and management, crop forecasting, ripener advice and decision-making, soils management and crop performance and management.

The number of Specialist Advisory Requests (SARs) received during 2021/2022 was higher than the previous year, with 33 requests received. Of the requests received, twenty-two SARs were completed during this reporting period while a few continued into the next financial year. One of these SARs included an online soil nutrition training course provided to Compañia Agricola Industrial Santa Ana, S.A. in May 2021. The feedback from the customer was extremely positive and this continues to open up possibilities for online training going forward for SASRI.

Extension Requests for Advice

SASRI received six requests for advice from Extension Specialists during 2021/2022. These services were provided to growers in addition to and as part of the ongoing service provision to the SA sugar industry.

Fertiliser Advisory Service

The Fertiliser Advisory Service (FAS) is a user-pays entity that uses state-of-the-art laboratory instrumentation and methods to provide growers with unbiased, customised advice based on their farm management practices and attainable yields. The FAS is SABS ISO 9001:2015 certified and provides accurate, sugarcane-specific fertiliser advice to ensure growers achieve sustainable and cost-effective returns from their input costs. FAS uses a Laboratory Information Management System to improve efficiencies in the delivery of accurate and reliable results and recommendations to customers.

FAS continued with the double-shift system to assist with and increase the efficiency of processing samples and to ensure the recommended health and safety practices related to Covid-19 were followed.

The Covid-19 pandemic continued to negatively impact on the samples received from countries outside of South Africa as foreign samples were withheld regularly for inspection by South African customs. FAS received and analysed a lower number of samples during 2021/2022 (30 979) compared to 2020/2021 (33 006).

A breakdown in sample numbers for 2021/2022 is provided here:

	2021/2022				2020/2021
	SA Growers	SASRI Research	Outside SA	Total	Total
Soil	20 217	1 215	4 612	26 044	26 996
Leaf	2 053	218	1 541	3 812	4 287
Fertiliser	1 040	3	4	1 047	1 635
Water	76	0	0	76	88
All				30 979	33 006

The continuing decline in leaf sample numbers remains a cause for concern due to the importance of growers being able to identify and adjust their management practices were necessary to prevent harmful soil conditions (e.g., acidity, salinity and nutrient imbalances) from developing. Soil testing forms an essential part of sustainable farming practice.

	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022
SA Growers	23 987	20 288	19 603	22 249	20 217
SASRI Research	2 004	741	2 175	929	1 215
Outside SA	4 449	3 948	5 490	3 818	4 612
Total	30 440	24 977	27 268	26 996	26 044

While there was a decrease in the number of soil samples received from South African growers during 2021/2022, there was an increase in the sample numbers received from estates outside South Africa.

FAS attracted 348 new customers during 2021/2022. These new customers included small-scale farmers, existing clients with new farms and customers outside of the sugarcane industry.

During 2021/2022, FAS conducted numerous trials on alternative methods of analysis and on samples of alternate anion exchange membranes for soil phosphorus and sulphur.

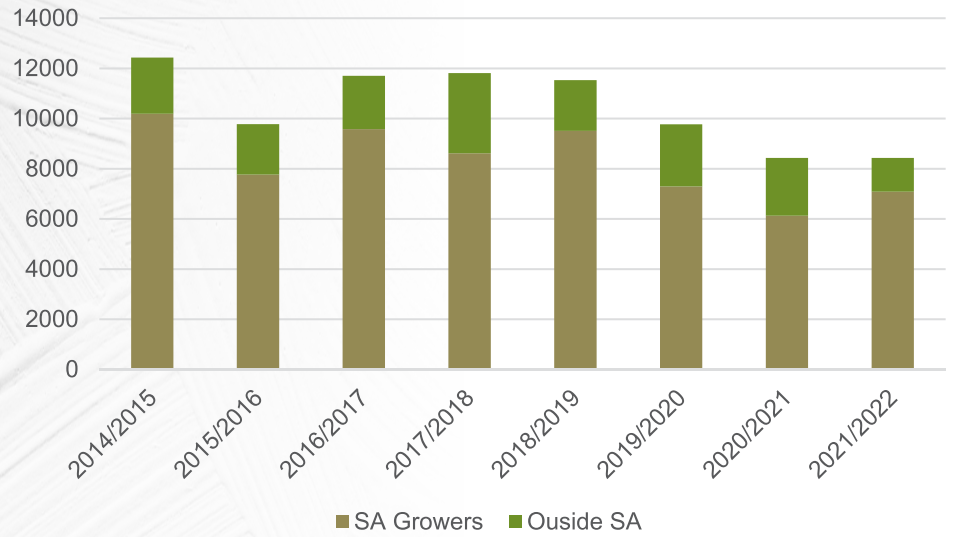
FAS continued to investigate the implementation of the South African National Accreditation System (SANAS) (ISO17025) for leaf and fertiliser analysis as this accreditation is a requirement for many agricultural crops/products that are exported.

Disease Diagnostics

SASRI provides a disease diagnostics service for local and SADC growers to assist in mitigating risk and preventing yield loss associated with a range of diseases. The main focus areas of the disease diagnostic services are Ratoon Stunt Disease (RSD) and Yellow Leaf Virus (YLS). During 2021/2022, a total of 8 623 RSD samples were analysed with 7 089 of these samples coming from SA growers and 1 342 from other countries.

The graph shows the number of RSD samples analysed for South African growers and growers from outside of South Africa from 2014/2015 to 2021/2022.

SASRI was unable to conduct training outside of South Africa during 2021/2022 due to Covid-19 travel restrictions.



Quarantine

SASRI has a DAFF-approved, world-class quarantine facility located at Mount Edgecombe for all sugarcane varieties imported into and exported from South Africa. Sugarcane varieties from foreign countries are imported into South Africa to broaden the genetic base of the parental breeding material. Imported varieties are also evaluated as potential commercial varieties.

Through Variety Evaluation and Licence Agreements, SASRI controls the distribution of South African varieties into Africa to protect SASRI's Plant Breeders' Rights. SASRI is responsible for obtaining phytosanitary certificates from the Plant Health division of the Department of Agriculture, Forestry and Fisheries for the export of any sugarcane from South Africa.

During 2021/2022, SASRI exported disease-free varieties to Australia, Barbados, Brazil, Malawi, Mauritius, and Mozambique. Du Roi Laboratory, Dube Agrilab and Visacane (France) supplied SA varieties to countries where there are Variety Licence Agreements in place. Sugarcane fuzz was exported to Zimbabwe.

SASRI also imported varieties from Zimbabwe, Uganda, Australia and Mauritius as well as fuzz from Barbados.

Weed Biocontrol

SASRI entered into a Memorandum of Agreement (1 April 2018 to 31 March 2021) with the Department of Forestry, Fisheries and Environment (DFFE) to mass-rear, supply and deliver specified biological control agents for a range of identified invasive alien plant species for the Natural Resource Management Programmes.

DFFE did not issue a new contract to SASRI for mass rearing of biocontrol agents during 2021, however, the existing contract was extended for a further nine months. Operations at Weed Biocontrol were halted and terminated on 30 September 2021 when funding stopped.

During the extension period, SASRI mass-reared and distributed 145 396 biological control agents. The target number of biological control agents for the three-year contract was 643 900 agents. SASRI exceeded this target by producing a total of 684 916 agents over the contract period.

The ten different control agents produced by SASRI are effective for the control of *Pereskia aculeata* (Barbados Gooseberry), *Tecoma stans* (Yellow bells), *Parthenium hysterophorus* (Famine weed), *Salvinia molesta* (Kariba Weed), *Eichornia crassipes* (Water hyacinth), *Pistia stratiodes* (Water lettuce) and *Chromolaena odorata* (Triffid weed).

Genetic Analysis

SASRI provides a genetic analysis service to SASRI researchers for research projects, Quarantine, Biosecurity and to external clients as specialist advisory requests (SAR). This genetic analysis service includes DNA sequencing and DNA fragment analysis. During 2021/2022, a total of 631 DNA sequence and 1 604 DNA fragment analysis runs were conducted. It is standard procedure for all pre-release varieties being considered for bulking to be fingerprinted by DNA fragment analysis. All South African commercial varieties have been fingerprinted. DNA sequence analysis is used to identify pathogens infecting sugarcane, as well as insects collected from sugarcane fields. The genetic analysis service is regularly used by researchers, Quarantine and Biosecurity for the accurate identification of varieties, pests, and diseases.

Mechanisation and Advisory Service and Machinery Development

SASRI provides advice and recommendations on mechanisation alternatives on a request basis, as well as costings and system optimisation. Annually, SASRI prepares two Mechanisation cost reports for the industry. The first report provides the costing of different equipment and machinery systems, and the second report provides the costings of a range of system scenarios including land preparation, planting and ratoon management. These reports are made available on the SASRI Website.

Many stakeholders make use of these mechanisation reports. Growers use these reports for annual budget preparation while SA Canegrowers and SAFDA economists use the reports for updating the industry cane salvage rates and industry budgets. SASRI Specialists use these reports for the sugarcane certificate courses and for updating various Decision Support Tools.

When necessary, SASRI investigates the need for machinery development and, where appropriate, initiates and collaborates in the development of new machinery.

Policy Development and Implementation

SASRI offers specialist advice on policy development and implementation. In addition, SASRI provides specialist technical advice on specific requests pertaining to irrigation, transport, mechanisation and energy-related issues and industry initiatives. Examples include:

- monitoring and providing comments on the development and implementation of the national government's water policy on behalf of the sugar industry;
- monitoring and providing comment on the development, amendment, and implementation of transport-related legislation such as: Haulage tractor; Consignee/consignor, etc; and
- energy tariff changes and impacts thereof.

Weather Information

SASRI collects, collates, and processes meteorological data continuously from a grid of automatic and manual weather stations distributed across the industry. This also involves the maintenance and calibration of the automatic weather station network and data processing system and the provision of summaries of meteorological data for comparative purposes.

This data and related weather applications can be accessed via SASRI's WeatherWeb (www.sasri.org.za). It is possible to view and download all information in the form of maps, graphs or reports.

Users can view current weather information on the WeatherWeb from a range of weather stations. Rainfall and temperature figures are updated every five minutes, and the site also provides evapotranspiration values and a fire danger index. Real-time weather information is useful for decision-making regarding irrigation, chemical application and harvesting operations.

SASRI offers an Automatic Weather Station (AWS) installation and maintenance service both within and outside the borders of South Africa. SASRI provides support to Mondi for the installation and maintenance of 29 AWS weather stations. This AWS service was also provided to customers in Eswatini, Malawi, Mozambique, and Tanzania, during 2021/2022. All installations are conducted according to established standards and include programming of data loggers to suit user needs and setting up automated data collection. All data from the AWS is processed to ensure integrity.

Maintenance routines include regular on-site calibration of sensors and equipment, any repairs or replacements required and general site maintenance. Calibration reports and certificates of compliance are issued with each visit.

Crop Forecasting

SASRI provides the industry with operational forecasts of the sugarcane crop, monthly from October of the preceding year to August of the current year, on a mill and industry level. Specialists make use of weather and irrigation water supply data, climate forecasts and the Canesim® crop model for these forecasts. Detailed cane yield forecast information is made available to registered users, while industry estimates of cane production are shared widely within the industry.

Information from Canesim® crop forecasts is also used by the SASA RV Forecast Committee to provide monthly forecasts from April onwards, of seasonal average RV content of cane for each mill area, to guide Mill Group Boards. These estimates are used to calculate growers' remuneration for cane deliveries.

Publications and Presentations

Scientific Journal Publications

Camargo MS and Keeping MG (2021). Silicon in Sugarcane: Availability in soil, fertilization, and uptake. *Silicon*. doi:10.1007/s12633- 020-00935-y.

Christina M, Jones MR, Versini A, Mézino M, Le Mezo L, Auzoux S, Soulie JC, Poser C, and Gérardeaux E (2021). Impact of climate variability and extreme rainfall events on sugarcane yield gap in a tropical Island. *Field Crops Research*, 274, 108326.

Deeb M, Grimaldi M, Aroui H, Mthimkhulu S, Van Antwerpen R and Podwojewski P (2021). Long-term effect of residue management and chemical fertilization on soil physical properties in South Africa. *Soil Science Society of America Journal*. Published online – 19 Aug 2021, DOI: 10.1002/saj2.20326.

Javal M, Terblanche J, Conlong DE and Delahaye N, et al (2021). DNA barcoding for bio-surveillance of emerging pests and species identification in Afrotropical Prioninae (*Coleoptera, Cerambycidae*). *Biodiversity Data Journal*, Pensoft, 9, pp. e64499 https://bdj.pensoft.net/article/64499/

Jumman A, van Heerden PS, van Antwerpen R, van Rensburg LD, Adendorff, Radzilani T, Searle A (2021). The knowledge levels, perceptions and practices of irrigation farmers in the context of soil salinity management in the South African sugarcane industry. *Irrig. and Drain*. 2021:1-13

Lehmann P, Javal M, du Plessis A and Terblanche JS (2021). Using µCT in live larvae of a large wood-boring beetle to study tracheal oxygen supply during development. *Journal of Insect Physiology*, 130, 104199, https://doi.org/10.1016/j.jinsphys.2021.104199

Lehmann P, Javal M, du Plessis A and Terblanche JS (2021). X-ray micro-tomographic data of live larvae of the beetle *Cacosceles newmannii*. *Gigabyte*, 1, https://doi.org/10.46471/gigabyte.18

Malinga L and Laing M (2021). Role of microbial biopesticides as an alternative to insecticides in integrated pest management of cotton pests. In: *Rebolledo Ranz R E (ed.), Insecticides.* ISBN 978-1-83969-027-3.

Mdlambuzi T, et al (2021). Nitrogen fertiliser value of biogas slurry and cattle manure for maize (*Zea mays L.*) production. *Heliyon7* (2021) e07077.

Myeni L, Mdlambuzi T, Paterson DG, de Nysschen G. and Moeletsi ME (2021). Development and evaluation of pedotransfer functions to estimate soil moisture content at field capacity and permanent wilting point for South African soils. *Water*, 13, 2639, https://doi.org/10.3390/w13192639

Ngomane NC, Pieterse E, Woods MJ and Conlong DE (2022). Formulation of artificial diets for mass-rearing *Eldana saccharina* Walker (Lepidoptera: Pyralidae) using the Carcass Milling Technique. *Insects* 13: 316. https://doi.org/10.3390/insects13040316

Ngomane NC, Terblanche JS and Conlong DE (2022). The addition of sterols and cryoprotectants to optimize a diet developed for *Eldana saccharina* Walker (Lepidoptera: Pyralidae*)* using the Carcass Milling Technique. *Insects* 13: 314. https://doi.org/10.3390/insects13040314

Smit C, Javal M, Conlong DE, Hall G and Terblanche JS (2021). Host range determination in a novel outbreak pest of sugarcane, *Cacosceles newmannii* (Coleoptera: *Cerambycidae, Prioninae*), inferred from stable isotopes. *Agricultural and Forest Entomology*, https://doi.org/10.1111/afe.12439

Smit C, Javal M, Lehmann P and Terblanche JS (2021). Metabolic responses to starvation and feeding contribute to the invasiveness of an emerging pest insect. *Journal of Insect Physiology*, 128, 104162, https://doi.org/10.1016/j.jinsphys.2020.104162

Van Antwerpen R, Laker MC, Beukes D, Botha JJ, Collet A and du Plessis M (2021). Conservation agriculture farming systems in rainfed annual crop production in South Africa. *South African Journal of Plant and Soil* (Published online: 15 May 2021). https://doi.org/10.1080/02571862.2020.1797195.

van Antwerpen R, Otim D, Smithers J, Senzanje A and Thornton-Dibb SLC (2022). Development and assessment of an updated tool for the design of soil and water conservation structures in the sugar industry of South Africa. *Agricultural Engineering International: CIGR Journal* 23(4):1-16.

van Heerden PDR, Ayele IN, Tana T, Tsadik KW and Alemayehu Y (2021). Ripening response of sugarcane varieties to chemical ripeners and economic benefits during the early period of harvesting at Wonji-Shoa and Metahara sugarcane plantations, Central Rift Valley of Ethiopia. *International Journal of Agronomy*, vol. 2021, Article ID 6645913, 9 pages.

Zhou M (2022). History and current status of sugarcane breeding: Germplasm development and supporting molecular research in South Africa. *Sugar Tech* 24:86-96.

Conferences Proceedings

Conlong DE, Rutherford RS (2021). The tactics needed to succeed in the F1 race to become a winner in the sterile insect technique programme against *Eldana saccharina* Walker (Lepidoptera: Pyralidae). *Online Symposium: "Improved field performance of sterile male Lepidoptera to ensure success in SIT programmes" hosted by the IAEA, Vienna,* 18 to 21 May 2021.

Nqayi S (2021). Varietal and nematicides trial in sugarcane on Fountainhill Estate. *Fifth Fountainhill Estate Research Symposium*, 20 to 21 October 2021.

Theses and Dissertations

Ngomane NC (2021). Optimization of formulated artificial diets with the addition of sterols and cryoprotectants for effective rearing and fitness of *Eldana saccharina* Walker (Lepidoptera: Pyralidae). MSc Dissertation, Stellenbosch University. Supervisor: Professor DE Conlong; Co-supervisors: Professor JS Terblanche and Dr E Pieterse.

Osborne C (2021). *In vitro* chemical epimutagenesis for the production of Al3+ -tolerant epilines under conditions of low nitrate and pH in *Saccharum spp.* hybrids. MSc Dissertation, UKZN. Supervisors: Professor MP Watt (UKZN), Drs RS Rutherford and SJ Snyman (SASRI).

Serfontein AJ (2021). Development of handling and transport protocols for *Eldana saccharina* (Lepidoptera: Pyralidae) sterile insect technique (SIT) programme. MSc Dissertation, Stellenbosch University. Supervisor: Prof DE Conlong; Co-supervisor: Prof P Addison.

SASTA Publications

Adendorff MW, Jumman A, Paraskevopoulos A (2021). Improving the adoption of irrigation scheduling: A demonstration trial case study in Pongola, South Africa. *Proceedings of the South African Sugar Technologist's Association* 93: 100

Cele TG, Rutherford RS and Dames J (2021). Impact of three *Fusarium oxysporum* isolates on the growth and development of the African sugarcane stem borer, *Eldana saccharina* (Walker) (Lepidoptera: Pyralidae). *Proceedings of the South African Sugar Technologist's Association* 93: 225

Hoffman N, Singels A, Joshi SV and Moodley D (2021). Can drone phenotyping aid plant breeding? Preliminary results. *Proceedings of the South African Sugar Technologist's Association* 93: 153

Jones MR, McFarlane SA, Sithole P, Basdew I, Stranack RA and Nicholson RJ (2021). Annual review of sugarcane production in the 2020/21 season. *Proceedings of the South African Sugar Technologist's Association* 93: 100

Joshi SV and Evans DL (2021). Unexpected revelation of narrow genetic diversity in *Saccharum spontaneum*: Impact on future sugarcane breeding. *Proceedings of the South African Sugar Technologists' Association* 93: 162

Jumman A and Bezuidenhout CN (2021). The influence of social dynamics on the adoption of better management practices. *Proceedings of the South African Sugar Technologist's Association* 93: 81

Koch AC, Kistan CJ, van Antwerpen T, McFarlane SA and Govender R (2021). Molecular disease diagnosis and monitoring in the South African sugarcane Industry. *Proceedings of the South African Sugar Technologist's Association* 93: 231

Lichakane ML and Zhou M (2021). Crop year effects on selection of families with low eldana damage for the coastal long cycle breeding program populations. *Proceedings of the South African Sugar Technologist's Association* 93: 232

Madiope KW, Keeping MG and Fourie DV (2021). Quantifying yield loss to yellow sugarcane aphid in potted sugarcane. *Proceedings of the South African Sugar Technologist's Association* 93: 145

McFarlane SA, Kistan CJ, Koch AC and Ismael AR (2021). Efficacy of mechanical harvester decontamination procedures to reduce the risk of ratoon stunt (RSD). *Proceedings of the South African Sugar Technologist's Association* 93: 129

Memela NS, Rutherford RS and Stefan S (2021). Plant-endophyte-pest interactions: investigating biological control of *Eldana saccharina* and stem rot disease in sugarcane. *Proceedings of the South African Sugar Technologist's Association* 93: 139

Meyer GM, Rutherford RS and Snyman SJ (2021). Linking *Eldana saccharina* biology and *Bacillus thuringiensis* Cry protein expression in transgenic sugarcane. *Proceedings of the South African Sugar Technologist's Association* 93: 233

Otim D, Smithers J, Senzanje A and Van Antwerpen R (2021). Impacts of soil and water conservation structures on stream flow reduction in the Sugar Industry of South Africa. *Proceedings of the South African Sugar Technologists' Association* 93: 87

Paraskevopoulos A, Rutherford RS and McFarlane SA (2021). Development of a model to predict smut risk. *Proceedings of the South African Sugar Technologist's Association* 93: 234

Ramouthar PV, Du Preez G, Titshall LW, Fourie H and van Antwerpen R (2021). Soil nematode community analysis in a long-term sugarcane trial: An indication of soil ecosystem structure and function. *Proceedings of the South African Sugar Technologist's Association* 93: 187

Singels A, Nicholson RJ and Naidoo G (2021). The forecast accuracy of seasonal average cane quality for South African mills and the financial impacts thereof on sugarcane growers. *Proceedings of the South African Sugar Technologist's Association* 93: 39

Stranack RA (2021). A review of the regularisation and centralisation of the biosecurity function in the South African sugar industry: 2015-2019. *Proceedings of the South African Sugar Technologist's Association* 93: 25

Titshall T, Mitku A, Maduray R (2021). Can near infrared spectroscopy replace conventional sugarcane leaf nutrient analysis? *Proceedings of the South African Sugar Technologist's Association* 93: 208

Tweddle PB (2021). Replant decision support tool: An update. *Proceedings of the South African Sugar Technologist's Association* 93: 236

van Antwerpen R and Stranack RA (2021). Soil conservation practices used in the SA Sugarcane Industry over the last 80 years – A review. *Proceedings of the South African Sugar Technologist's Association* 93: 172

van Heerden R and Ramusandiwa T (2021). Comparative efficacy and economics of the two hormonal mode-of-action ripeners Ethephon® and Moddus® in selected irrigated sugarcane varieties. *Proceedings of the South African Sugar Technologist's Association* 93: 158

Zhou M (2021). Genotype by location effect on sugarcane flowering in South Africa. *Proceedings of the South African Sugar Technologist's Association* 93: 167

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