Progress Report 2019/20

2019/20 Highlights

PurEst® smartphone app update

New and updated publications

- Ripener poster showing timing of application.
- Updated Pest & Disease pocket guide in isiZulu.
- SUSFARMS® version 4 released.

Capacity development

- Regional modular courses continued successfully in Midlands and Felixton.
- 91 students attended the Senior Certificate Course.
- 110 students attended the Junior Certificate Course.

Contact events

- 1 695 Visits to growers.
- 812 Visitors hosted at SASRI.
- 139 Grower days 276 Conference presentations, workshops, refresher courses, seminars and demonstrations given.

Several radio broadcasts on local and national radio stations

Varieties

- 4 New varieties [N69, N70, N71 and N72] with increased RV yields and improved pest and disease resistance released.
- Across the industry, varieties N52, N53, N54, N57, N58 and N59 gained popularity due to general good performance. Newer varieties N61 and N62 also gained attention due to excellent growth.
- A project revealed that ERC and biomass yield in plant and ratoon crops were unaffected by the NovaCane® tissue culture process.

Contour spacing design tool

Developed for the design of soil and water conservation structures using updated conservation norms.

Soil sample submission

Numbers to FAS during 2019/2020 were higher than 2018/2019.

Pests, diseases and seedcane

- New research projects launched into control options for Yellow Sugarcane Aphid, following widespread infestations of this new pest in the industry.
- Established that Yellow Sugarcane Aphid is not a vector of the Mosaic virus.
- Longhorn beetle containment continued successfully through the year with no new infestations reported.
- 2 436 hectares of certified and approved seedcane nurseries were approved for use. However, this is only approximately 50% of the area needed to meet the requirements of the 2023 deadline.
- Task group continued to address Yellow Sugarcane Aphid and set up two trials in spring 2019.

Eldana surveys

- Overall average level of eldana across the industry in 2019 was the lowest for the last three seasons and also below both the five- and fifteen-year average.
- 87 253 hectares were surveyed.

Personal achievements

- 6 researchers won awards for conference presentations.
- 2 NRF ratings were awarded to SASRI scientists.

Small-scale grower extension

- 13th year of successful DARD partnership with SASRI for delivery of small-scale grower Extension.
- Living field schools in excess of 100 hectares of demonstration plots have been established across KwaZulu-Natal for SSG growers.

SRASA Committee

1 April 2019 – 31 March 2020

SRASA COMMITTEE	
Chairman	S Naidoo
Vice-Chairmen	HR Hackmann
	LO Hlubi

SACGA Representatives	
Current	Outgoing
KM Hurly	TB Funke
M Kadwa	D Lütge
TJ Murray	S Mashaba
S Repinga	AM Russell
GD Stainbank (Alternate)	S Sharma
T Sibisi (Alternate)	REG Talmage
	F Willis
	GDP Littley (Alternate)

SAFDA Representatives	
Current	Outgoing
M Govender	GC Spalding
NR Mbuyazi	GW Taylor
SA Mnguni	
PV Moodley	
TR Pilusa	
M Mkhabela (Alternate)	
TG Sibiya (Alternate)	

SASMA Representatives	
Current	Outgoing
EA Brüggemann	JPM de Robillard
J Dewar	N Dlodlo
FM Eggers	AJ Harris
TNF Maseko	D van Rooy
PM Ngcobo	RB Lütge
DP Rossler	GD Sparks
W Visser	D Sutherland
JM du Plessis (Alternate)	
MM Mbelu (Alternate)	
AT Wynne (Alternate)	
JDP Erasmus (Alternate)	
E Naidoo (Alternate)	

SASA REPRESENTATIVES	
Current	
CM Baker	MK Trikam
P Mpofu	DA Watt
R Stranack	R Mahadeo (Secretary)

SASRI Management

SASRI MANAGEMENT TEAM
Executive Committee
Director: CM Baker
Research Manager: DA Watt
Operations Manager: KA Redshaw
Finance and Admin Manager: R Mahadeo
Human Resources Manager: C Botes

Programme Managers
Variety Improvement: SJ Snyman
Crop Protection: RS Rutherford
Crop Performance and Management: R van Heerden
Systems Design and Optimisation: R van Antwerpen

Resource Managers
Crop Biology Resource Centre: D Sweby
Plant and Environment Resource Centre: B Naidoo
Diagnostic and Analytical Resource Unit: KA Collings
Breeding and Field Resource Unit: S Ramgareeb
Extension and Biosecurity: RA Stranack
Knowledge Management: ML Binedell

Contents

Chairman's Report

Suresh Naidoo

In 2018/2019, I reported that the sugar industry continued to grapple with a number of serious challenges which had a serious effect on its overall financial status. One generally expects tough times to end, however additional adverse factors beleaguered the industry, placing it in a precarious position.

The 2019/2020 season saw a significant reduction in revenue in the sugar industry, brought about by consecutive below average rainfall years, low world sugar prices, low cost imports and the industry's inability to take price increases to sustain itself.

The nature and extent of support for SASRI became a focus of considerable attention as it is one of the larger budget items in the SASA budget. It is disappointing for me that a SASA Council-appointed Task Team debated, at length, a number of operational models for SASRI, its role and structure, its function, the value and scope of its offerings and the specific merits of all of its activities that are directed towards delivering useful technologies to all sugarcane growers. These protracted discussions revealed the specific interests of each of the key stakeholders: the miller association (South African Sugar Millers Association) and the two grower associations (South African Farmers Development Association and the South African Canegrowers Association) and served to guide the establishment of a funding model that secured the operations of the research institute for the 2020/2021 season. I say disappointing, since these protracted discussions yielded no constructive way forward for the financing of the SASRI budget.

At the same time and throughout this period of debate, the industry imposed a restriction on release of funds to SASRI with the budget being approved on a quarterly basis only, an untenable position to be placed in. It is remarkable therefore that, despite these 'financial handcuffs', SASRI continued to function as best it could under the circumstances and deliver on as much of the agreed 2019/2020 Programme of Work as possible. Nevertheless, it is unfortunate that as a result of this approach, several projects proceeded more slowly than planned, while a few others were placed on hold. The uncertainty associated with this *modus operandi* exerted a toll not only on the Programme of Work but also on morale, and several valuable young scientists elected to move on to other institutions that were perceived to offer better prospects with greater security. This loss of young talent is regrettable especially since there had been considerable effort towards developing them as the new generation of agricultural scientists for the sugar industry.

Throughout the year, the SRASA Committee sustained its oversight role and met on six occasions to provide the requisite guidance and support to SASRI. Whilst most of the committee's attention focused on dealing with the status of SASRI, several notable matters associated with the research and specialist service programmes were also considered.

An external review of integrated pest management research (IPM) to assess the actions and tactics associated with reducing the negative impacts of eldana on yields was successfully conducted and provided some useful feedback on aspects of the research programme. In particular, the recommendation that we should continue with the approaches already deployed to mitigate the impact of the pest while continuing to work on the approaches that are still in the early stages of development, was as welcome as their advice on potential areas of expansion.

In keeping with the recognition of the value of the superior sugarcane varieties developed and released by SASRI, there was considerable discussion around increasing the levies associated with their commercial use outside the South African industry, such that the varieties be provided at a rate that is competitive with other variety service providers. This new approach that recognises the value of SASRI's expert advice and products is important, and is attributable to the remarkable specialist skills and expertise that are resident at the institute.

The quarterly summary highlighting specific outcomes from the research programme presented at each SRASA Committee meeting is of particular value and ensures that stakeholders are kept abreast of all research developments during the year. This reporting serves as an essential communication tool and is one that is often undervalued during the course of the year. It is therefore particularly fortunate that this Progress Report provides a succinct summary of key research outcomes delivered by SASRI during the year, and gives stakeholders a 'second chance' to engage with the significant value that SASRI delivers to the sugar industry.

SASRI is considered to be a world-class research institute. I remain hopeful that in the forthcoming year constructive discussions continue amongst industry leadership to find an appropriate funding model for SASRI such that it maintains this status.

Director's Report

Dr Carolyn Baker

Never before has SASRI been through such uncertain times, as in this past year. Prolonged discussions amongst industry leaders on the nature and scope of SASRI's programmes in the context of diminishing resources were unsettling and the release of funds on a quarterly basis had a serious impact on productivity.

For any research institute, the importance of developing programmes in alignment with an agreed strategic plan that extends for at least five years is obvious. Not only does it provide all researchers with some level of clarity regarding the vision for their area of work, it also enables project planning and demonstrates the shared commitment amongst researchers and their funders that there will be delivery on agreed milestones and outcomes. This accountability is important since research, by its very nature, entails investigations into the unknown and both successes and failures contribute towards progress.

Without a strategic plan, it is almost impossible to set out research priorities, and hence delineating the scope of work becomes very difficult. In 2020, SASRI's strategic plan covering the period from 2015 to 2020 comes to an end, and the development of a new five-year plan will be required. Given the difficulties that have been experienced in the industry over the past few years, and the changing expectations regarding the function and focus of our research institute, it has become more important than ever that a new five-year plan is developed. Without consensus amongst all stakeholders on the nature and scope of the research institute, it becomes very difficult to set and plan a programme of work that will meet general approval. For this reason, considerable effort is being put into agreeing the strategic objectives for SASRI in the forthcoming years.

Despite the various setbacks in the past year, SASRI has delivered a range of outputs from the RD&I programmes, each of which are aligned with the articulated needs of our stakeholders. The details of research projects that are ongoing or have been completed are presented in this report, and their specific and tangible outcomes described. Amongst these exciting outcomes, a project designed to investigate observations regarding the morphology and performance of plants propagated using the NovaCane® technique, confirmed that, contrary to anecdotal evidence, ERC and biomass yield in plant and ratoon crops were unaffected by the tissue culture process. Given that newly released varieties originate from NovaCane® and are then subsequently bulked up for the industry, these results are particularly welcome.

On the biosecurity front, preliminary results associated with assessing the yield loss following yellow sugarcane aphid infestations have been achieved and will be helpful in guiding the strategy for managing this very difficult pest. Further, the longhorn beetle containment strategy that was implemented in the infested area in the industry, has to date been effective. It provides an excellent example of successful co-operation amongst SASRI specialists and the affected growers, and for the benefit of protecting the whole industry from this devastating pest.

More practically, a tool designed to assist growers in planning their soil and water conservation structures that is based on sound sustainability principles (and that limits soil erosion and run-off) has been updated and is being verified by our Extension service. Furthermore, a project aimed specifically at small-scale growers that focused on the cost-effective production and dissemination of short videos concerning several aspects of sugarcane husbandry, has proved successful and has been well-received. It provides the platform for production and roll-out of many more user-friendly and social media-compatible tools for our growers.

As a knowledge intensive organisation, the importance of maintaining, securing and managing all of the research outcomes and recommendations is obvious. For this reason, an accessible and regularly updated set of documents pertaining to all of SASRI's recommendations has been made available for growers through the e-Library on the SASRI website. We are continuing our strengthened focus on realising the value of our outcomes by encouraging adoption of our recommendations through several initiatives, not least of which is upskilling our specialists in the 'art' of participative engagement. If the knowledge that SASRI generates is to realise value amongst growers, the importance of ensuring diffusion of that knowledge is essential for problem-solving and for improving productivity.

As in past years, I would like to acknowledge the remarkable resilience and contributions of all individuals that make up the SASRI team. Their ability to remain focused and dedicated to delivering and achieving SASRI's goals through thick and thin, demonstrates their commitment to our purpose and determination to serve our stakeholders. This undoubtedly stems not only from our enduring history of engaging with our sugarcane growers and understanding their challenges, but also from our commitment to science and the inherent curiosity and loyalty of our people.

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 Report

Dr Derek Watt
(Research Manager)

Research Impact Areas

SASRI research, development and innovation during 2019/2020 was tailored to target seven impact areas identified by the industry as being key to profitability and sustainability.

Research Impact Areas

1. Longhorn Beetle containment
2. Eldana control
3. Higher RV Yields
4. Climate change adaptation
5. Bioenergy applications
6. Crop and soil health
7. Mechanisation information

Research Impact Targets

1 Longhorn Beetle
Containment of the localised longhorn beetle infestation and integrated management technologies for the sustainable, long-term management of the pest.

2 Eldana control
Reduced negative impacts of eldana on yields through development and facilitation of adoption of eldana IPM guidelines and new technologies.

3 Higher RV Yields
Increased RV yields through the production of superior varieties with improved pest and disease resistance by conventional, introgression and molecular breeding and genetic engineering for higher RV yields, achieved through improved sucrose content and biomass per hectare as well as through facilitation of the correct placement, disposition and management of these varieties.

4 Climate change adaptation
Reliable predictions of climate change impacts on crop water use and yield for existing and potential agro-climatic situations (soil-crop-management-climate), and identification of the best management adaptations to maximise yield and profitablility under expected mid-century climate.

5 Bioenergy applications
Suitability of SA varieties for profitable bioenergy applications determined, accounting for associated biomass harvesting and transport options and costs.

6 Crop and soil health
Technologies to optimise soil health and crop nutrition to maximise efficiencies for production and long-term industry sustainability.

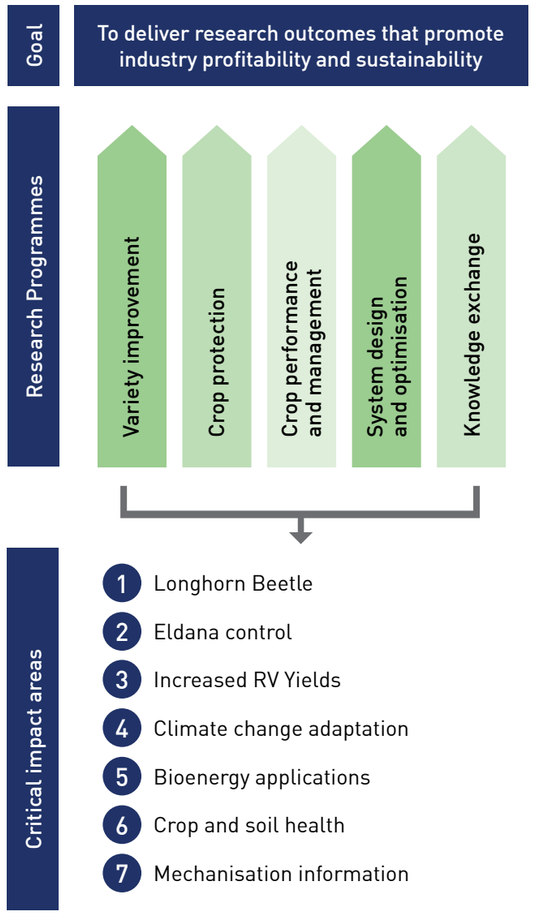
7 Mechanisation information
An on-line database of nationally- and internationally-available mechanical harvesting and planting options to assist grower decision-making.

Research development and innovation

The research, development and innovation (RDI) within the seven impact areas were administered in five programmes.

Research Impact Areas

1. Variety improvement
2. Crop protection
3. Crop performance & management
4. Systems design & optimisation
5. Knowledge exchange



1 Variety improvement
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.

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

3 Crop performance & management
Developing models and preferred management practices that sustain and enhance sugarcane production.

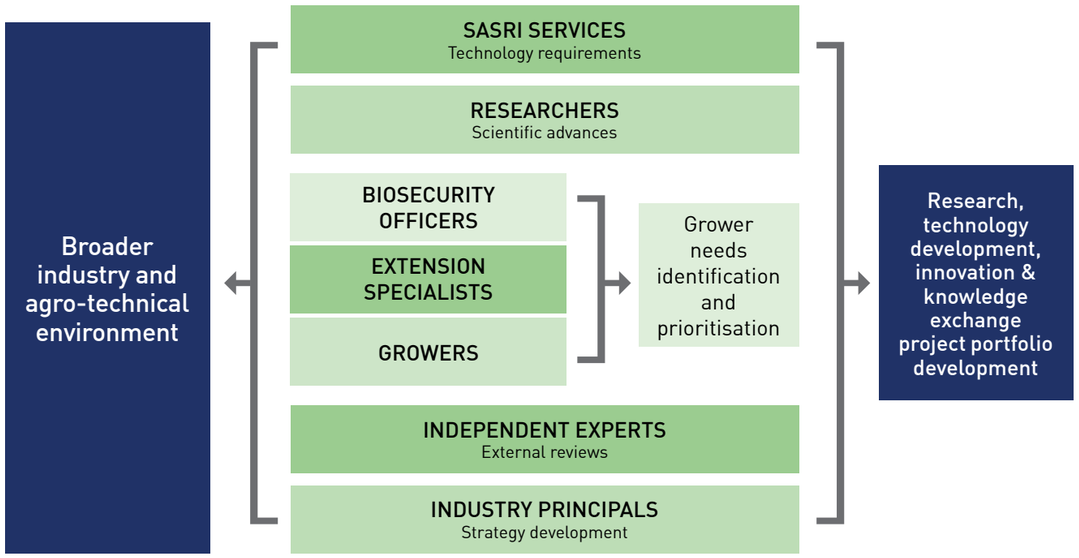
4 Systems design & optimisation
Developing and sharing innovative systems that optimise industry performance.

5 Knowledge exchange
Facilitating the exchange of agro-technical knowledge through the design and implementation of a variety of mechanisms and interventions in collaboration with industry participants and stakeholders.

Determinants of the 2019/2020 RDI and knowledge exchange portfolio

The composition of the 2019/2020 RDI and knowledge exchange programme was determined by strategic guidance from the industry leadership, industry stakeholder requirements and scientific advances.

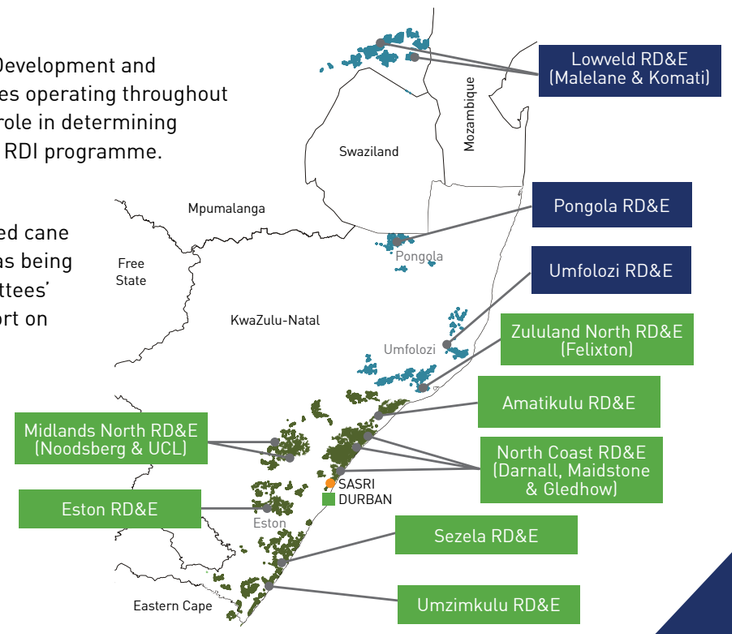
SASRI's RDI and knowledge exchange programme for 2019/2020 was founded on knowledge of the broader industry and agro-technical environment gained from a variety of industry participants through the implementation of several processes.



Participants and processes

The ten industry Research, Development and Extension (RD&E) Committees operating throughout the sugar belt play a strong role in determining priorities for SASRI's annual RDI programme.

SASRI's RDI programme for 2019/2020 addressed irrigated cane production topics identified as being of priority in a RD&E Committees' Workshop held in Komatipoort on 8 March 2018.



Impact area	Measure	Target
Longhorn Beetle containment	Containment of the localised longhorn beetle infestation and integrated management technologies for the sustainable, long-term management of the pest.	**DELIVERY TARGET:** By 2019/2020, technologies and strategies developed for use by affected growers and Local Pest, Disease and Variety Control Committee to contain the spread of the longhorn beetle.
Eldana control	Reduced negative impacts of eldana on yields through development and facilitation of adoption of eldana IPM guidelines and new technologies.	**DELIVERY TARGET:** Through phased release of new technology and adoption of cultural practices from 2015 through to 2030, decrease eldana levels to below 1e per 100 stalks in all areas, including those with currently high incidence.
Higher RV Yields	Increased RV yields through the production of superior varieties with improved pest and disease resistance by conventional, introgression and molecular breeding and genetic engineering for higher RV yields (via improved sucrose content and biomass per hectare) and through facilitation of the correct placement, disposition and management of these varieties.	**DELIVERY TARGET:** Genetic gains in RV yields for plant breeding trials in all regions by 0.5% per annum relative to one or more reference varieties, measured over a ten-year period. Potential for the realisation of such genetic gains under commercial conditions demonstrated by data derived from the variety evaluation programme and the records of selected growers following recommendations and best management practices.
Mechanisation information	An online database of nationally- and internationally-available mechanical harvesting and planting options to assist grower decision-making.	**DELIVERY TARGET:** From 2017, 30% of growers for whom mechanisation information is relevant access/download database and upon release of database updates.
Climate change adaptation	Reliable predictions of climate change impacts on crop water use and yield for existing and potential agro-climatic situations (soil-crop-management-climate), and identification of the best management adaptations to maximise yield and profitability under expected mid-century climate.	**DELIVERY TARGET:** By 2019, reliable projections of mid-century crop productivity, water use, irrigation requirements and profitability (margin above specified costs) for feasible adaptation strategies for various agro-climatic scenarios.
Bioenergy applications	Suitability of SA varieties for profitable bioenergy applications determined, accounting for associated biomass harvesting and transport options and costs.	**DELIVERY TARGET:** By 2019, bioenergy revenue calculators provided to estimate bioenergy-associated revenue from biomass per unit area and the costs associated with biomass harvest and transport to the mill-gate. By 2020, collaborative research partnerships established on alternative products derived from sugarcane.
Crop and soil health	Technologies to optimise soil health and crop nutrition to maximise efficiencies for production and long-term industry sustainability.	**DELIVERY TARGET:** By 2018, improved N fertiliser advice to growers as a result of enhanced knowledge of soil N contributions and leaf N thresholds. By 2018, improved recommendations for the amelioration of top- and sub-soil acidity, as evidenced by an increasing trend in the number of soil samples analysed by FAS that display lower levels of soil acidity/Al saturation from the fields of growers following such recommendations. By 2018, Soil Health Index is part of the standard FAS reporting package.

Impact areas – highlights from 2019/2020

Longhorn Beetle containment

In 2019/2020, SASRI continued research, development and innovation (RDI) to progress the creation of knowledge and development of tools for the effective immediate containment and long-term management of the localised longhorn beetle outbreak.

- **Suppression and monitoring technologies**

In consultation with affected growers and the industry leadership, a longhorn beetle containment strategy was developed to suppress longhorn beetle infestations and prevent the spread of the insect to areas outside of the eNtumeni region. The strategy was built around the eradication and plough-out of longhorn grub-infested fields and the implementation of a long fallow of up to two years due to the long larval development period, as well as the application of certain insecticides. The strategy required the prioritisation of fields to be eradicated, which in turn required some fields to be harvested prematurely. These strategies were aimed at directly killing grubs within the soil/stool of eradicated and harvested fields, thereby depriving larvae of their food source (i.e. cane roots and stool material). Eradication was extended to uninfested 'buffer' fields (adjacent or in proximity to infested fields) to reduce the risk of adult beetles flying into new areas. Overall, the infestation appears to have been contained, but vigilance and surveys for grubs in negative fields are to continue beyond 2019/2020.

- **Biology**

Biological traits under study during 2019/2020 included: (a) species resistance to environmental stress such as temperature, desiccation or oxygen limitation; (b) population phenology; (c) population genetics; and (d) gut microbiome composition.

- **Ecology**

The ecology of the insect is being characterised in terms of how the longhorn beetle interacts with its environment at multiple scales using three different approaches: (a) measurement of the microclimate encountered by each life stage in both their identified original and invaded host plants, and determination of whether one is more suitable than the other; (b) use of stable isotopes to understand what each life-stage feeds on and building food webs to determine the community of pathogens, predators and parasitoids; and (c) characterisation of the dispersal potential of adults in field and laboratory trials, complemented with indirect estimates of dispersal through the determination of the genetic structure of the populations.

- **Chemical ecology**

Species-specific traps and sampling techniques are under development for use in adult and larval population monitoring. Included is the development of a lure based on sex pheromones of the longhorn beetle species, as well as plant kairomones used by the pest to locate host plants.

- **Modelling**

This aspect of the study aims to parameterise and test an existing biophysical model for a destructive pest insect on sugarcane. This model will then be used to answer key questions surrounding longhorn beetle management including: (a) accurate predictions of phenology (life-cycle timing), estimations of the environmental conditions that trigger host shift, and delimitation of the risk area; and (b) defining various management scenarios and testing their efficiency in controlling the pest.

Eldana control

In 2019/2020, SASRI continued research, development and innovation (RDI) to progress the development of tools to enable the effective integrated pest management (IPM) of eldana.

- **New pesticide active ingredients**

Multi-stakeholder research resulted in the identification of two new active ingredients with different modes of action against eldana from those currently registered. Agrochemicals with four modes of action are currently available to growers to serve as part of their IPM approaches for eldana control. The potential addition of a further two will greatly reduce the potential for the development of resistance to any one mode of action.

- **Manipulation of endophytic microbial community**

Investigations continued into eldana control through management of endophytic *Fusarium*. The fungus, *Fusarium*, which occurs naturally within sugarcane plants has been found to increase eldana damage. SASRI researchers hypothesise that exclusion of *Fusarium* from planting material with subsequent replacement with a microorganism that is not advantageous to eldana offers the potential for eldana bio-control. The method could potentially be implemented as part of a hot-water treatment procedure for planting material. Previous research identified four strains of *Brevibacillus* as potential candidates for the displacement of *Fusarium* from the endophytic ecological niche with sugarcane stalks. In current research, the most promising isolate was identified as *Brevibacillus reuszeri* and epoxiconazole and prochloraz were found to be the most effective fungicides for the control of *Fusarium*.

- **Sterile insect technique**

Growers have expressed interest in the potential role that the sterile insect technique (SIT) might play in eldana IPM and SASRI during 2019/2020 continued with a proof-of-concept study. Eldana F1 generation eggs, produced through the crossing of irradiated male moths with normal female moths at XSIT Pty (Ltd) in Citrusdal, were inoculated to diet and mass reared at SASRI. Upon emergence from F1 pupae, adult F1 male moths were sampled and tested for fertility by crossing with normal laboratory-reared females. Similarly, F1 females were tested in crosses with normal laboratory-reared males. Both levels of fertility proved to be acceptable for establishing proof-of-concept. During 2019/2020, 4 346 male and 1 476 female moths of the F1 generation (male:female ratio of 3:1) have been released into the SIT test cage that is being used for the proof-of-concept study.

Higher RV yields

- **New varieties**

Three new varieties (N73, N74 and N75) with superior yield and agronomic performance were approved in 2019/2020 for gazetting and bulking.

- N73 is recommended for late season planting and harvesting in all soil types on a twelve-month cutting cycle in the Northern Irrigated regions (Lowveld, Pongola, Mkuze and Makhatini).
- N74 is recommended for planting and harvesting in humic soils on a longer cutting cycle of 18 to 24 months in the rainfed high altitude regions (Midlands North, Midlands South, Entumeni, North Coast [Melmoth)], Sezela [Harding] and Umzimkulu [Highflats]).
- N75 is recommended for planting and harvesting in humic and sandy soils on a longer cutting cycle of 18 to 24 months in the rainfed high altitude regions (Midlands North, Midlands South, Entumeni, North Coast [Melmoth], Sezela [Harding] and Umzimkulu [Highflats]).

- **Performance of newly released varieties**

After release, new varieties are cultivated under commercial conditions in several trials to assess their performance under a wide range of agroclimatic conditions. This network of variety evaluation trials also provides an opportunity for growers to observe the new varieties and learn about their performance from their peers who host the trials, SASRI Extension Specialists and researchers.

During 2019/2020, data from variety evaluation trials in the low-lying Table Mountain area of the midlands region revealed that N48 outperforms the commonly-grown N12 in terms of cane stalk and RV yield in the first ratoon. Additionally, ongoing evaluation continued to reveal the promise of N61 under diverse conditions, including in the midlands and on the lower south coast.

Mechanisation information

During 2019/2020, SASRI continued mechanisation-related investigative activities. Mechanisation accounts for about 50% of the total cost of sugarcane production, even when cane is cut manually. With agricultural profit margins decreasing continuously, it is crucial that every effort is made to use farm machinery as efficiently as possible. Small savings on production costs can translate into large increases in net profit.

- **SASRI website**

During the year, SASRI continued to support growers through the provision of up-to-date mechanisation information on the SASRI website (https://sasri.org.za/mechanisation/), including mechanisation reports, a list of products and suppliers of agricultural machinery and equipment, mechanisation posters, mechanisation-related information sheets and a repository of articles from elsewhere considered of benefit to growers.

- **Yield mapping**

SASRI concluded a study on yield mapping technology that resulted in outcomes that will be of value to growers with an interest in mechanised sugarcane production. The study indicated that remote sensing offers the advantage of rapid wide-scale field scouting and for trend analysis to indicate intra-field yield variances. Initial results based on two independent field studies revealed that photogrammetric surface differentials pre- and post-harvest have the potential to be used as a proxy for relative yield differences, but are not suitable for determining or modelling actual yields accurately. Retrospective adjustment of the variance of yields (using crop height as the proxy) about the average field yield (obtained from field delivery data) can be used towards developing yield maps for variable rate application and management responses.

Climate change

- **Sugarcane physiology data for impact assessment**

A study to investigate the effects of elevated atmospheric CO^2 levels and water stress on the performance of sugarcane was completed in 2019/2020. The findings of the study indicate that, in future climates, the presence of elevated atmospheric CO^2 concentration may partially mitigate the negative impact of periods of limited soil water availability on sugarcane production. Further studies are needed to investigate the consequences that might be introduced by the interplay of elevated temperature with elevated atmospheric CO^2 and soil water interactions. These results will be key in improving the simulation capability of Canesim® in climate change impact assessments for the sugar industry.

- **Socio-economic Impact**

A study to investigate the socio-economic impacts of climate and other changes on sugarcane production in South Africa was planned for implementation in 2019/2020 but was placed on-hold due to capacity constraints. Once implemented and upon completion, the study is planned to estimate: (a) sugarcane biomass yields for current and potential new agro-climatic regions for current and adapted production strategies using future (2040-2060) climate and water supply projections; and (b) grower- and MCP-specific socio-economic impacts at regional level for different scenarios as defined by tariff, tax, input and product price, cane production and processing strategies and industry size. The study will make use of the Integrate Information System developed by the Bureau for Food and Agriculture Policy in industry scenario evaluation using simulated crop data. The primary outcome of study will be broad indications for growers and MCPs of the impact of a changed future climate and water supply on the economic viability of the sugar industry for given sets of circumstances relating to import tariff, taxes, electricity and water prices, and processing options (sugar / electricity co-generation / bioethanol production).

Crop and soil health

During 2019/2020, good progress was made in three areas of importance to the management of crop and soil health, namely:
(a) understanding the long-term effects of burning, mulching and fertilisation;
(b) development of near and mid infra-red spectral libraries for soil fertility and leaf nutrient diagnostics; and
(c) development of guidelines for managing salinisation of irrigated land under sugarcane.

Considerable focus during the year was placed on knowledge exchange in this important area of crop management. Consequently, four new knowledge-based projects were implemented, namely: (a) updating and revision of crop nutrition and soil management information sheets; (b) development of a guide for the management of fields to optimise root development; (c) understanding how soil acidity-related processes affect management practices; and (d) a review of copper as a micronutrient in sugarcane production and a re-evaluation of the associated interpretive criteria.

- **Information sheets**

In this new project, information sheets on crop nutrition and soil health are to be updated to include new content, where required, and a user-interface designed to enable growers and MCPs to more easily access content. It is envisaged that readily-accessible and comprehensive information on crop nutrition and soil management will assist grower and MCP decision-making.

- **Root development**

The planned outcome of this project is a booklet describing sugarcane root development and documenting the factors that affect root growth and distribution. The availability to growers, MCPs and Extension Specialists of reference work describing field management options will assist in promoting practices that improve root development and distribution and therefore also sustainable yield production.

- **Soil acidity-related processes**

This review of state-of-the-art information is aimed at providing answers to three key management questions: (a) how quickly does lime and gypsum neutralise acidity of soils with varying characteristics; (b) how long does their effect on acidity persist; and (c) what are the factors influencing the movement of these compounds, particularly gypsum, into the subsoil? The anticipated benefits of this project include improved lime and gypsum recommendations that are site-specific.

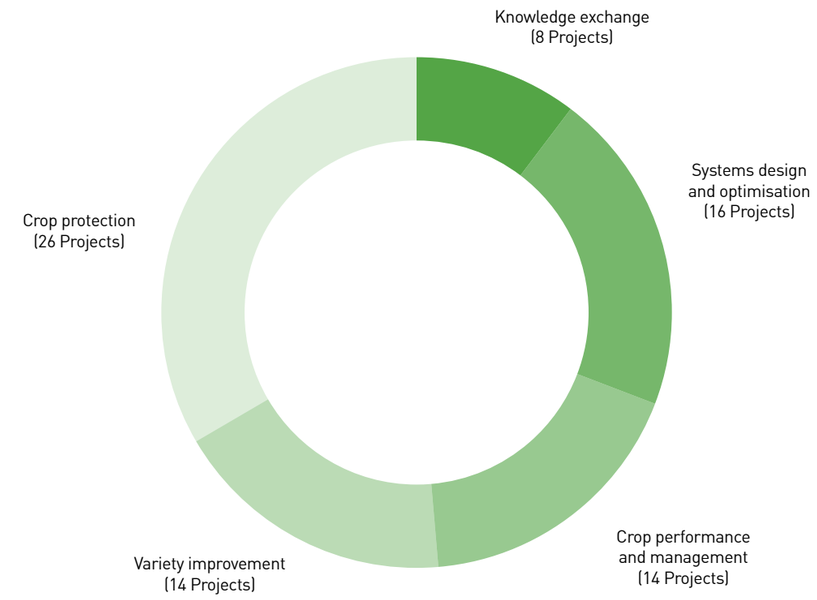
- **Copper as a micronutrient in sugarcane production**

The status and typical ranges of copper (Cu) concentrations in soil and sugarcane in the SA industry are to be re-evaluated from existing databases and soil and plant Cu norms and thresholds will be reviewed according to national and international best practice. It is anticipated that the project will result in improved Cu norms and thresholds that will permit growers and MCPs to more accurately identify true deficiencies to target remedial actions and optimise Cu applications.

Composition of 2019/2020 project portfolio

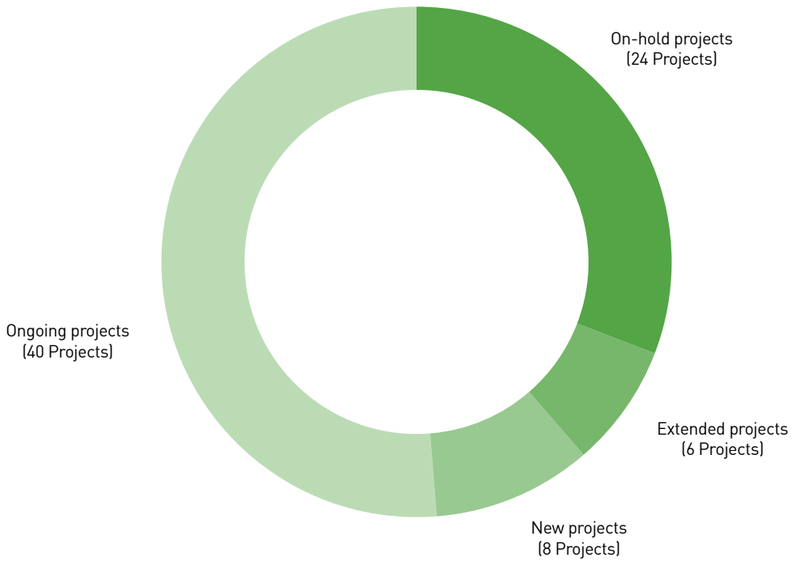
The 2019/2020 portfolio comprised 78 research, development and innovation (RDI) and knowledge exchange projects administered across five programmes.

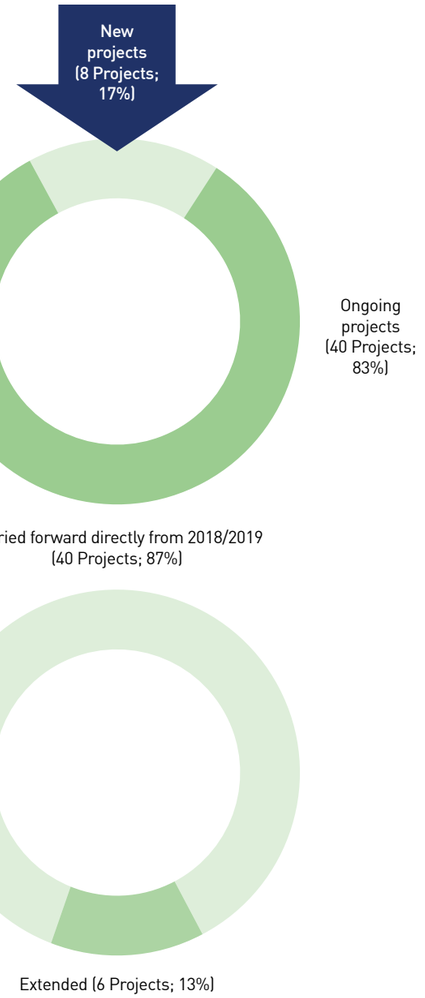
Projects per progamme



Of the 78 projects in 2019/2020, 8 were new, 40 were ongoing and 24 were placed on-hold for a variety of reasons. Six projects which were to have closed by 31 March 2019 were granted extensions and carried forward into 2019/2020.

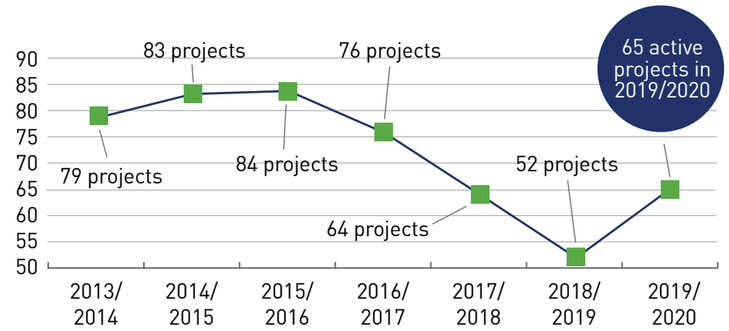
Project status





PROJECT NUMBERS

A slight upward inflection in project numbers was apparent in 2019/2020



New projects

Eight new projects were implemented in 2019/2020.

Copper in South African sugarcane production: Industry review and interpretive criteria

(Project Reference: 18CM02)

(Project Manager: Lwazi Poswa)

Update and revision of crop nutrition and soil management Information Sheets

(Project Reference: 18KE01)

(Project Manager: Dr Louis Titshall)

Defining protocols and procedures for effective management and dissemination of SASRI BMPs

(Project Reference: 18KE03)

(Project Manager: Poovie Govender)

Management of fields to optimise root development

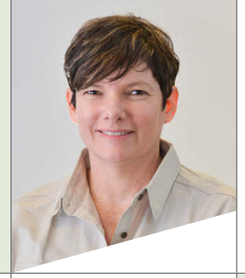
(Project Reference: 18KE05)

(Project Manager: Dr Rian van Antwerpen)

Short video clips for small-scale growers

(Project Reference: 18KE06)

(Project Manager: Winile Shelembe



Roguing for smut: economics and alternate methodologies

(Project Reference: 18TD02)

(Project Manager: Sharon McFarlane)

Revamping the SASRI WeatherWeb

(Project Reference: 18TD03)

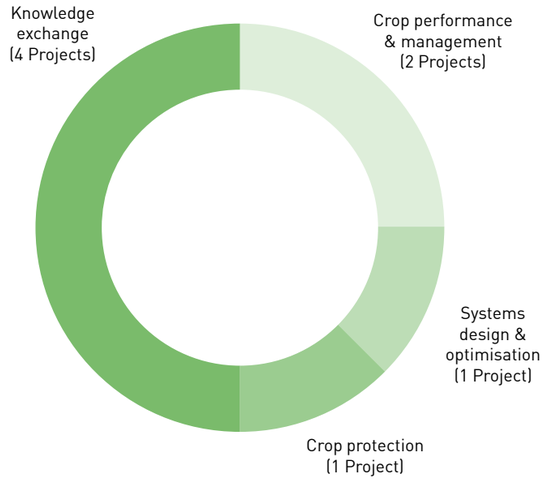
(Project Manager: Phillemon Sithole)

Development of near and mid infra-red spectral libraries for rapid, analysis of soil fertility and salinity and plant nutritional status

(Project Reference: 18TD09)

(Project Manager: Dr Louis Titshall)

Considerable focus for the new projects was placed on Knowledge Exchange, with 4 new projects (50%) starting in this area of SASRI activity.



Ongoing projects

Forty projects were ongoing 2019/2020. These projects were previously identified during the RD&E process and were guided by the SASRI strategic strategic plan for 2015-2020.

Variety improvement: Ongoing projects

Breeding

(Project Reference: 00VI01)

(Project Manager: Dr Marvellous Zhou)

Variety Evaluation

(Project Reference: 00VI01)

(Project Manager: Thobile Nxumalo)

Introgression breeding

(Project Reference: 00VI05)

(Project Manager: Dr Shailesh Joshi)

Synteny analysis and genome mapping in sugarcane by identifying genes present on trait-associated haplotypes through exploitation of the sorghum genome sequence

(Project Reference: 12VI01)

Identification, development and screening of validated transcript-based stress response markers against SASRI germplasm

(Project Reference: 17VI01)

Commercial development of Bt GM sugarcane

(Project Reference: 00VI06)

(Project Manager: Dr Sandy Snyman)

Field analysis and maintenance of transgenic sugarcane lines with altered sucrose content and biopolymer composition

(Project Reference: 00VI03)

Evaluation of an *in vitro* mitigation treatments to reduce NovaCane® phenotype anomalies in the field

(Project Reference: 15VI04)

Development of an integrated field programme for deploying imazapyr-tolerant sugarcane

(Project Reference: 16VI02)

Production and characterisation of stress resistant sugarcane mutants

(Project Reference: 16VI01)

(Project Manager: Dr Stuart Rutherford)

Validation of tissue specificity of a selection of SASRI promoters

(Project Reference: 17TD02)

(Project Manager: Robyn Jacob)

Variety improvement: ongoing projects (Contracted-out RDI)

Sugarcane sucrose enhancement by genetic modification

(Project Reference: 14VI1C)

(Professor Jens Kossmann, Stellenbosch University)

Biotechnological investigations to improve sugarcane drought stress tolerance

(Project Reference: 17VI1C)

(Dr Christell van der Vyver, Stellenbosch University)

Crop protection: Ongoing projects

Variety Evaluation: Nematodes

(Project Reference: 00CP01)

(Project Manager: Prabashnie Ramouthar)

Variety Evaluation: Phytotoxicity of selected herbicides to new varieties

(Project Reference: 00CP03)

(Project Manager: Surashna Huripurshad)

Integrated weed management

(Project Reference: 17TD03)

(Project Manager: Dr Peta Campbell)

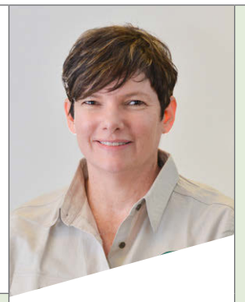
Longhorn beetle suppression and monitoring technologies

(Project Reference: 16TD08)

(Project Manager: Dr Malcolm Keeping)

Use of potted cane to determine yield loss to yellow sugarcane aphid

(Project Reference: 16CP01)



Variety Evaluation: Diseases

(Project Reference: 00CP02)

(Project Manager: Sharon McFarlane)

Decontamination of mechanical harvesters to minimise RSD transmission

(Project Reference: 16TD02)

Development of a user-friendly, in-field test for RSD

(Project Reference: 16TD03)

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

(Project Reference: 00CP04)

(Project Manager: Dr Stuart Rutherford)

Fungicidal, nematicidal and biological control of Fusarium associated with eldana

(Project Reference: 16CP03)

Chemical ecology and microbiome of *Cacosceles newmanii* (Longhorn beetle)

(Project Reference: 16CP04)

The development of an eldana risk index on the SASRI WeatherWeb

(Project Reference: 16TD04)

(Project Manager: Matthew Jones)

Crop protection ongoing projects (Contracted-out RDI)

Research into long-term sustainable integrated pest control of *Cacosceles newmannii* (Longhorn beetle)
(Project Reference: 16CP1C)
(Prof. John Terblanche, Stellenbosch University)

Crop performance and management: Ongoing projects

Ripener x varieties evaluation project
(Project Reference: 00CM01)
(Project Manager: Dr Riekert van Heerden)

Burning and mulching project
(Project Reference: 00CM02)
(Project Manager: Dr Rian van Antwerpen)

Field calibration of the resin soil P tests for irrigated areas
(Project Reference: 12CM02)
(Project Manager: Lwazi Poswa)

Development of aerial imagery methodology to inform crop stress and high throughput phenotyping (HTP)
(Project Reference: 15CM02)
(Project Manager: Dr Abraham Singels)

Crop performance and management: Ongoing projects (Contracted-out)

Interactive effects of elevated CO_2 and water deficit on sugarcane nutrition, water use and yield - an experimental and crop modelling study
(Project Reference: 16CM1C)
(Dr Jacques Berner, North West University)

Crop performance and management: Ongoing projects (Externally funded)

Modelling world-wide GXE interaction
(funded by the International Consortium for Sugarcane Modelling)
(Project Reference: 10CM03)
(Project Manager: Dr Abraham Singels)

Systems design and optimisation: Ongoing projects

Developing a participatory RD&E process for small-scale growers in the South African sugar industry
(Project Reference: 14SD02)
(Project Manager: Poovie Govender)

Ratoon longevity
(Project Reference: 16TD05)
(Project Manager: Dr Peter Tweddle)

Improving spatial upscaling for modelling regions
(Project Reference: 16TD06)
(Project Manager: Matthew Jones)

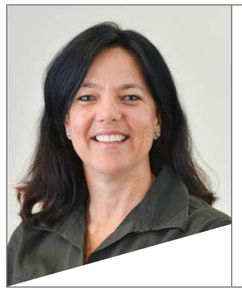
An interactive variety information tool
(Project Reference: 17TD01)
(Project Manager: Kerry Redshaw)

Systems design and optimisation: Ongoing projects (Externally-funded)

Management guidelines for technology transfer to reduce salinisation of irrigated land under sugarcane
(funded by Water Research Commission)
(Project Reference: 15SD1E)
(Project Manager: Dr Rian van Antwerpen)

Assessing the water footprints of selected fuel and fibre crops in South Africa
(funded by Water Research Commission)
(Project Reference: 15SD3E)
(Project Manager: Dr Abraham Singels)

Knowledge exchange: Ongoing projects

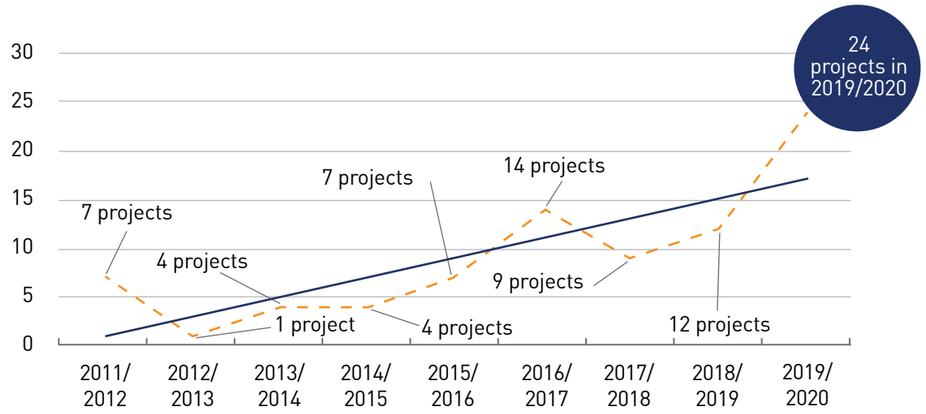


Annual update of SUSFARMS®
(Project Reference: 00KT01)
(Project Manager: Michelle Binedell)

Refining SASRI's Knowledge Exchange platform
(Project Reference: 17KE01)
(Project Manager: Dr Ashiel Jumman)

Projects on-hold

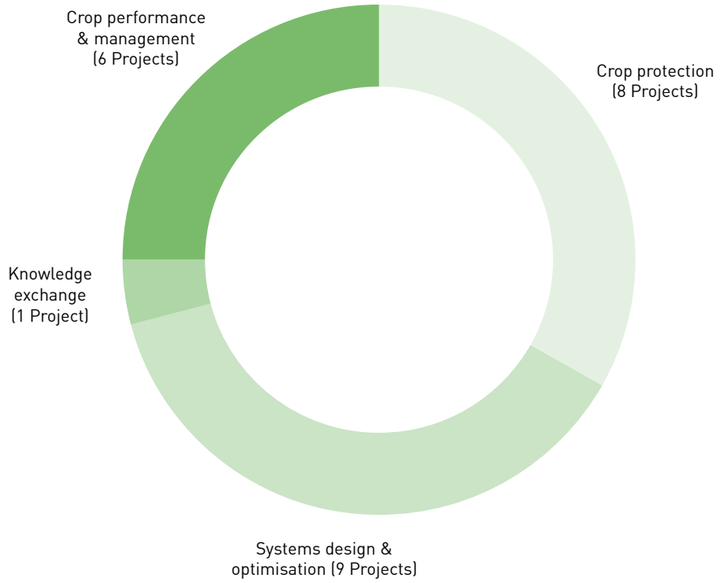
Twenty-four projects were placed on-hold in 2019/2020 largely due to budget pressures on SASRI resulting from the highly and persistently unfavourable economic conditions within the industry.



A trend towards increasing numbers of on-hold projects is apparent between 2011 and 2019, with 24 projects on-hold in 2019/2020.

A prioritisation process was used to limit negative effects on RDI outcomes delivery to the industry.

On-hold projects



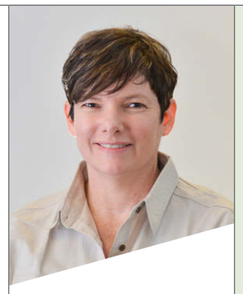
Although budget constraints were a major contributing factor, projects were also placed on-hold due to technical hurdles, including difficulties in locating appropriate trial sites.

Crop protection: On-hold projects

Mating disruption and attract-and-kill as IPM tools for *Chilo sacchariphagus* suppression in Mozambique

(Project Reference: 09CP02)

(Project Manager: Dr Des Conlong)



Effect of major diseases on yield under irrigated conditions

(Project Reference: 11TD03)

(Project Manager: Sharon McFarlane)

Impact of *Tylenchorhynchus* on sugarcane growth

(Project Reference: 18CP01)

(Project Manager: Prabashnie Ramouthar)

Prediction of quantitative resistance to sugarcane pests (eldana, yellow sugarcane aphid, thrips) and diseases (brown rust, tawny rust, smut) by means of near infra-red spectroscopy

(Project Reference: 14CP07)

(Project Manager: Dr Stuart Rutherford)

Can TaqMan qPCR Assays be used as a diagnostic tool to screen sugarcane varieties for disease resistance?

(Project Reference: 18TD07)

(Project Manager: Ewald Albertse)

Crop protection: On-hold projects (Contracted-out RDI)

Vacant

Eldana trap development

(Project Reference: 15CP1C)

(Project Manager: Vacant)

Is South African sugarcane protected by climatic and host-plant barriers from invasion by *Chilo sacchariphagus* and *C. partellus*?

(Project Reference: 18CP1C)

(Project Manager: Prof. John Terblanche, Stellenbosch University)

	The role of Insectivorous bats for *Eldana saccharina* control in the Midlands North and North Coast regions of KZN (Project Reference: 18CP2C) (Project Managers: Dr Anna Bastian and Dr Dalene Vosloo)

Crop performance and management: On-hold projects

	Crop modelling principal project (Project Reference: 00CM03) (Project Manager: Matthew Jones)		Characterising past climate change and its impacts on yield (Project Reference: 15CM03) (Project Manager: Matthew Jones)
	Modelling of chemical ripener responses (Project Reference: 11CM04) (Project Manager: Dr Riekert van Heerden)	Vacant	Optimal harvest ages for different production regions (Project Reference: 16CM02) (Project Manager: Vacant)
Vacant	Understanding how soil acidity related processes affect management practices used in sugarcane: A review (Project Reference: 18CM01) (Project Manager: Vacant)	Vacant	Infield determination of sugarcane quality and nutritional status using spectral analysers (Project Reference: 18TD01) (Project Manager: Vacant)

Systems design and optimisation: On-hold projects

Vacant	Best management practice guidelines for low flow sub-surface drip irrigation systems (Project Reference: 13SD03) (Project Manager: Vacant)		The impact of lodging on sugarcane revenue (Project Reference: 13TD19) (Project Manager: Dr Peter Tweddle)
	Profiling on-farm and mill area direct energy and CO^2 emissions in the sugar industry in South Africa (Project Reference: 14TD01) (Project Manager: Dr Ashiel Jumman)		Resource operations software for SASRI (Project Reference: 14TD10) (Project Manager: Dr Sumita Ramgareeb)
Vacant	Validation of industry dry-off recommendations (Project Reference: 14TD14) (Project Manager: Vacant)		Socio-economic impacts of climate and other changes (Project Reference: 18SD01) (Project Manager: Dr Abraham Singels)
	Refining the crop forecast database and model (Project Reference: 18TD04) (Project Manager: Aresti Paraskevopoulos)		Creating a crop estimates computer application for effective decision-making (Project Reference: 18TD05) (Project Manager: Matthew Jones)
	Capacitating SSG extension roll-out of the demonstration plot methodology through gathering soil data (Project Reference: 18TD08) (Project Manager: William Gillespie)		

Knowledge exchange: On-hold projects

	Implementation of the Drought Irrigation Program (Project Reference: 18KE04) (Project Manager: Dr Ashiel Jumman)

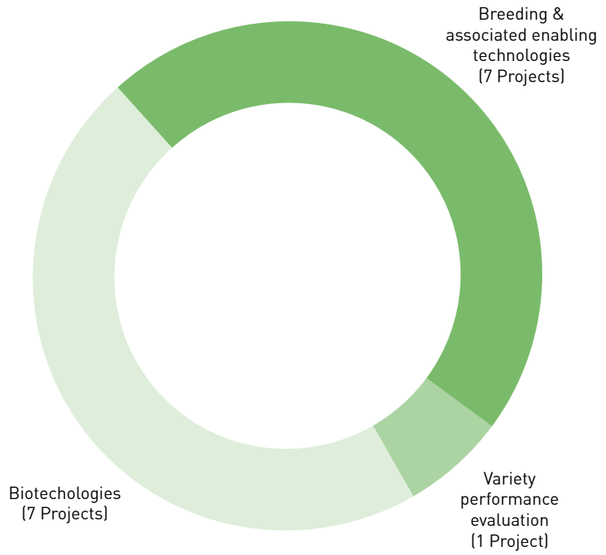
Variety Improvement Research

Dr Sandy Snyman
(Programme Manager)

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

1. Breeding & Associated Enabling Technologies
2. Variety Performance Evaluation
3. Biotechnologies



Focus areas

1 **Breeding & Associated Enabling Technologies**

- Developing and releasing varieties with sucrose, yield, pest and disease, agronomic and milling characteristics desirable to both millers and growers; and
- Developing innovative technologies to expedite breeding, including genetic markers and introgression breeding.

2 **Variety Performance Evaluation**

Providing comprehensive variety information that assists growers in making optimal variety choices.

3 **Biotechnologies**

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

Outcomes from completed projects

Sugarcane Breeding and Associated Enabling Technologies

Synteny analysis and genome mapping in sugarcane by identifying genes present on trait-associated haplotypes through exploitation of the sorghum genome sequence

(Project Reference: 12VI01)

(Project Manager: Dr Shailesh Joshi)

The main outcomes of the study were as follows.

- Other species of the *Saccharinae, viz. Sarga, Miscanthus, Miscanthidium, true Erianthus, Narenga* and *Saccharum* were demonstrated as being superior references for sugarcane genomics research than Sorghum, the genome of which has been used routinely to-date as reference in international sugarcane genomics studies.
- Novel structural models of acetolactate synthase, a key enzyme in the biosynthesis of branched chain amino acid and the target of imazapyr, were developed and which are currently being used in the design of sugarcane and other crop varieties tolerant of the herbicide active ingredient, imazapyr.
- Cytoplasmic Male Sterility (CMS) factors were identified in sugarcane and rescue factors that negate the effect of the *CMS* gene were assembled and annotated. This discovery could be employed to render sugarcane pollen sterile, which will have positive implications in sugarcane breeding and also in the release of transgenic sugarcane to the industry to minimise gene flow.
- Novel analysis of Internal Transcribed Spacers (ITS)/45s ribosomal precursors resulted in the development of sequence-based molecular 'super' barcodes that are proving invaluable in the analysis of sugarcane ancestry and detection of inter-specific hybridity, both of which are essential in introgression breeding (genetic base-broadening).
- A comparison of low copy number genes and whole chloroplast genome phylogenies demonstrated that reticulate (network) evolution is common in grasses but has never occurred in genus *Saccharum*, and this being the first report of this nature for sugarcane (*Saccharum sensu stricto*).
- A bioinformatics pipeline for metabolic pathway reconstruction was developed which resulted in the identification of: (a) 4 954 stress response genes, 1 381 resistance genes and 23 cytotoxic genes (effective against bacteria, fungi, herbivores and viruses); and (b) pathways for lignin biosynthesis and regulation, auxin biosynthesis, brown rust resistance-related glycan biosynthesis and dhurrin biosynthesis. These genetic resources have the potential for use in improving sugarcane resistance to various biotic and abiotic stresses, along with making it an improved candidate for biomass and biofuel generation.

An investigation into factors affecting NovaCane® plant phenotype

(Project Reference: 15VI04)

(Project Manager: Dr Sandy Snyman)

- This research aimed to investigate potential causes of the altered stalk morphology in NovaCane®-derived sugarcane plants. Two potential factors were investigated: (a) ethylene build-up in the vessels during *in vitro* culture; and (b) compounds produced by endophytic microbes.
- Removal of ethylene, which is known to increase tillering, from culture vessels through the addition of cobalt chloride ($CoCl_2$) to the *in vitro* plant growth medium did not alleviate the thinner stalks and profuse tillering observed in NovaCane®-derived plants in the field.
- Bacterial endophytes present in shoot tip explants used for establishing NovaCane® cultures could not be easily excluded and may have subsequent beneficial effects on plants in the field, viz. improved height, biomass and possibly survival, but these are cultivar-dependent.
- NovaCane®-derived plants may be expected to have thinner stalks that tiller more profusely compared with conventional cane, but there is no negative effect on yield (ERC and biomass) in either plant cane or first ratoon.
- Genotype-specific information is to be communicated to growers from the release of N74 onwards.

Sugarcane biotechnologies

Validation of tissue specificity of a selection of SASRI promoters

(Project Reference: 17TD02)

(Project Manager: Robyn Jacob)

- A leaf-specific gene promoter and four root-preferential gene promoters were isolated and validated in driving the expression of a foreign transgene in the desired tissue-specific manner in sugarcane.
- Transcript expression of a bovine lysozyme reporter gene (BvLz), codon-optimised for use in monocots, was detected in transgenic lines using the qRT-PCR technology.
- Tissue specific BvLz expression levels were higher in the leaf promoter transgenic lines than in any of the root promoter transgenic lines.
- The promoters may be used in the SASRI genetic modification programme to drive genes of interest or licensed to interested third parties.

Highlights from ongoing research

Sugarcane breeding and associated enabling technologies

Sugarcane breeding

- Three new varieties (N73, N74 and N75) with superior yield and agronomic performance were approved for gazetting and bulking.
  - N73 is recommended for late season planting and harvesting in all soil types on a 12-month cutting cycle in the Northern Irrigated regions (Lowveld, Pongola, Mkuze and Makhatini).
  - N74 is recommended for planting and harvesting in humic soils on a longer cutting cycle of 18 to 24 months in the rainfed high altitude regions (Midlands North, Midlands South, Entumeni, North Coast [Melmoth]], Sezela [Harding] and Umzimkulu [Highflats]).
  - N75 is recommended for planting and harvesting in humic and sandy soils on a longer cutting cycle of 18 to 24 months in the rainfed high altitude regions (Midlands North, Midlands South, Entumeni, North Coast [Melmoth], Sezela [Harding] and Umzimkulu [Highflats]).
- Procedures were implemented to enhance resistance screening for recently emerged pests and diseases, including thrips, yellow sugarcane aphids and tawny rust.

Variety evaluation

- Data from variety evaluation trials in the low-lying Table Mountain area of the midlands revealed that N48 outperforms the commonly-grown N12 in terms of cane and RV yield in the first ratoon.
- Ongoing evaluation continued to reveal the promise of N61 under diverse conditions, including in the midlands and on the lower south coast.

Introgression breeding

- An effective DNA barcoding technology was developed in-house to resolve phylogenetic relationships amongst key sugarcane relatives. Knowledge of these relationships is central to the goal of broadening the genetic base of parents used for sugarcane breeding. A broadened genetic base will permit access to genes for pest and disease resistance and stress tolerance that are not currently available.
- Ongoing bioinformatics analyses continued to reveal important information on the genetics and genomics of sugarcane that will influence sugarcane breeding tactics.
- The relationship with the West Indies Central Sugar Cane Breeding Station in Barbados continued to provide impetus to SASRI's introgression breeding objectives. Progenies from 41 crosses conducted in Barbados on behalf of SASA/SASRI were sown at Mount Edgecombe and are currently under evaluation.

Sugarcane biotechnologies

Germplasm cryopreservation and cryotherapy

Opportunities were identified for the expansion of in-house capacity for germplasm cryo-storage to expand preservation of important GM and breeding lines, investigation of cryo-therapies for virus elimination and the long-term storage of pollen for breeding purposes.

Mutation breeding

- The benefits of an imazapyr-tolerant N12 variant (N12 Zapyr) in weed control were showcased in demonstration plots. These plots assisted in exploring the potential for roll-out of N12 Zapyr, particularly amongst small-scale growers who identify weed management as one of their major production challenges.
- Investigation of transmission patterns of an acetolactate synthase gene variant (mALS), developed in-house to confer tolerance to imazapyr (N12 Zapyr), was conducted using classical breeding approaches. These studies will ultimately guide the development of new sugarcane varieties that are tolerant of the herbicide.

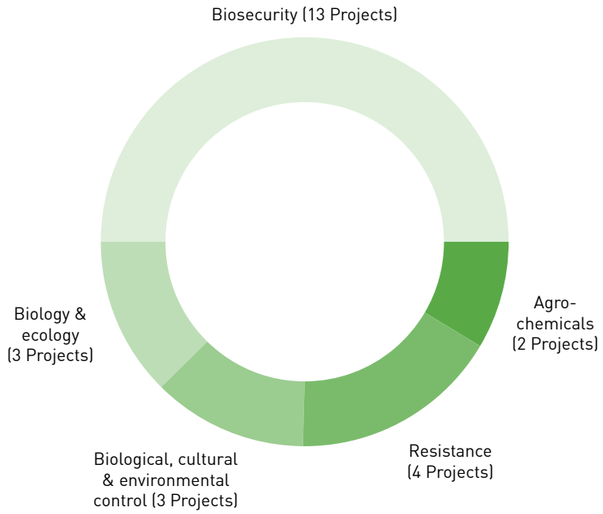
Crop Protection Research

Dr Stuart Rutherford (Programme Manager)

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

Research focus areas

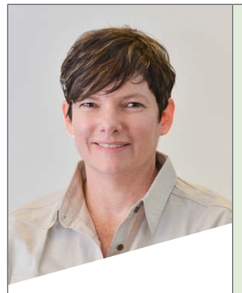
1. Biosecurity and associated enabling technologies
2. Agrochemicals for pest, disease and weed control
3. Sugarcane resistance to pests and pathogens
4. Biology and ecology of pests and pathogens
5. Biological, cultural and environmental control practices



Focus areas

1. **Biosecurity & 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 counter-measures and biosecurity incursion plans.
2. **Agrochemicals for pest, disease & weed control**
   Partnering with relevant stakeholders to facilitate the registration of effective pathogen, pest (including nematodes) and weed control agents that are agriculturally, environmentally, ecologically and economically sustainable.
3. **Sugarcane resistance to pests & diseases**
   Generating knowledge of the biological basis of resistance to pests, diseases and nematodes and developing improved resistance screening techniques for commercial breeding.
4. **Biology & ecology of sugarcane pests & diseases**
   Generating knowledge on the biology and ecology of pests, diseases, nematodes and weeds and facilitating knowledge exchange.
5. **Biological, cultural & 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.

New project



Roguing for smut: Economics and alternate methodologies

(Project Reference: 18TD02)

(Project Manager: Sharon McFarlane)

Anticipated outcomes
Updated recommendations for manual and chemical roguing of smut.

Anticipated benefits
- Growers better placed to make a choice between manual and chemical roguing based on cost estimates.
- Alternative chemistries identified for chemical roguing and any methodologies derived from this research will improve the efficacy and efficiency of roguing.

New project (On hold)

Can TaqMan® qPCR assays be used as diagnostic tool to screen sugarcane varieties for disease resistance?

(Project Reference: 18TD07)

(Project Manager: Ewald Albertse)

Anticipated outcomes
Proof-of-concept as to whether the state-of-the-art DNA diagnostic technology (TaqMan® qPCR) is able to provide information on sugarcane variety responses to the pathogens causing ratoon stunt, sugarcane mosaic and sugarcane yellow leaf.

Anticipated benefits
Should proof-of-concept be obtained, the technology may be further developed for early-stage screening of variety resistance to the pathogens causing ratoon stunt, sugarcane mosaic and sugarcane yellow leaf.

New project (On hold)

The impact of *Tylenchorhynchus* (ectoparasitic nematode) on sugarcane growth

(Project Reference: 18CP01)

(Project Manager: Prabashnie Ramouthar)

Anticipated outcomes
- Determination of whether *Tylenchorhynchus* is of economic importance, given that the abundance of this ecto-parasitic nematode has been steadily increasing in the industry and which is frequently associated with poor root growth.
- If determined as being of economic importance, *Tylenchorhynchus* will be included in routine nematode management recommendations to growers and MCPs.

Anticipated benefits
Nematode management recommendations that account for all identifies damaging nematode species negatively affecting agricultural economic performance in the industry.

New project (Contracted-out RDI) (On-hold)

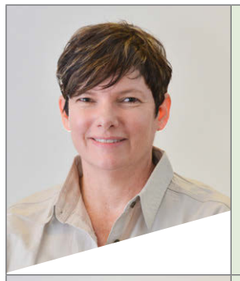
	Analysis of Chilo sacchariphagus and C. partellus biorisks to the industry (Project Reference: 18CP1C) (Project Manager: University of Stellenbosch/ University of Venda)	**Anticipated outcomes** • Map of sugarcane growing area and stem borer distribution in Limpopo and northern Mpumalanga, up to the Zimbabwean border, depicting the geographical extent of the potential biorisk posed by the two chilo stem borers. • Identification of stem borers and their parasitoids for potential future use as biological control agents of the two *Chilo* species. • Identification of potential invasion pathways for *C. sacchariphagus* into the SA industry. • Knowledge of the role that thermal and nutritional requirements of the insects may play in the potential spread of *C. sacchariphagus* into the SA industry from Mozambique and the potential host-switch of *C. partellus* from maize to sugarcane. **Anticipated benefits** • Improved understanding of how: (a) geographical spread of *C. sacchariphagus* into the SA industry may be managed; and (b) how change of host of *C. partellus* to sugarcane may be avoided and managed.

New project (Contracted-out RDI) (On-hold)

	The role of insectivorous bats for eldana control in the midlands north and north coast regions (Project Reference: 18CP2C) (Project Manager: University of KwaZulu-Natal/University of Venda)	**Anticipated outcomes** • Documentation of insectivorous bat species active on selected sugarcane farms in the midlands north and on the north coast. • Determination of the contribution of the sugarcane boring insects, eldana and sesamia, to the diets of these bat species. • Recommendations on how the presence of eldana- and sesamia-feeding bat species on sugarcane may be encouraged. **Anticipated benefits** An additional sustainable ecological service in the IPM programme decreasing eldana and sesamia populations, thereby increasing the profitability of sugarcane production.

Outcomes from completed projects

Biosecurity & Associated Enabling Technologies

	**The efficiency of *Sipha flava* as a vector of SCMV** (Project Reference: 14CP01) (Project Manager: Sharon McFarlane)	Outcomes from the study confirmed that the yellow sugarcane aphid does not transmit Sugarcane mosaic virus (SCMV - mosaic). Similar experiments recently completed by Dr F Garces in Ecuador support these results.
	**Application of qPCR in smut epidemiology research** (Project Reference: 15TD02) (Project Manager: Aimee Koch)	Molecular methods have been developed to monitor smut spore aerial inoculum levels (spore traps), inoculum levels in the soil and to identify smut infection in sugarcane stalk material prior to the development of whips. These techniques are being used to investigate the dynamics of smut spore dispersal and epidemiology, which will support the refinement of recommendations to manage this serious sugarcane pathogen.
	**Longhorn beetle suppression and monitoring technologies** (Project Reference: 16TD08) Project Manager: Dr Malcolm Keeping	• In consultation with growers and the industry leadership, a longhorn beetle containment strategy was developed to suppress longhorn beetle infestations and prevent the spread of the insect to areas outside of the eNtumeni region. • The strategy was built around the eradication and plough-out of longhorn grub-infested fields and the implementation of a long fallow of up to two years due to the long larval development period, as well as the application of certain insecticides. • The strategy required the prioritisation of fields to be eradicated, which in turn required some fields to be harvested prematurely. • These strategies were aimed at directly killing grubs within the soil/stool of eradicated and harvested fields, thereby depriving larvae of their food source (i.e. cane roots and stool material). • Eradication was extended to uninfested 'buffer' fields (adjacent or in proximity to infested fields) to reduce the risk of adult beetles flying into new areas. • Overall, the infestation appears to have been contained, but vigilance and surveys for grubs in negative fields are to continue.

Biology & ecology of sugarcane pests & diseases

Use of potted cane to determine yield loss to yellow sugarcane aphid

(Project Reference: 16CP01)

(Project Manager: Dr Malcolm Keeping)

Studies conducted within containment cages on potted sugarcane indicated that plants suffering from 50-60% leaf area damage after exposure to yellow sugarcane aphids showed an average yield reduction of 44% in stalk dry mass. Although this provides a guideline, it is recognised as an overestimate of the effects of YSA, as the cages prevent the natural dispersal behaviour of the aphids when population levels increase.

Biological, cultural & environmental control practices

Endophytic *Beauveria* for the control of eldana, chilo and yellow sugarcane aphid

(Project Reference: 14CP05)

(Project Manager: Dr Stuart Rutherford

- The insect pathogen *Beauveria bassiana* is a natural endophyte of *Eldana saccharina* (eldana) wild host plant species.
- *B. bassiana* is also a symptomless endophyte in different sugarcane genotypes (22 of the 28 surveyed).
- Of the 130 *B. bassiana* colonies isolated, 16 were found to: (a) be virulent against eldana third instar larvae; (b) repel first instar larvae; and (c) have a negative effect on larval development and survival in artificial diet. The virulence of the isolates varied.
- The two best performing isolates (TL-leaf and N41TIS1) were not able to inhibit the growth of four *Fusarium* strains.
- *B. bassiana* was able to colonise internal sugarcane tissues for up to four months, However, persistence was not observed at 16 months. Endophytes naturally present in the plant, such as *Fusarium* spp., may have limited the growth and colonisation of *B. bassiana* in plant tissues.
- Endophytic inoculation of *B. bassiana* into sugarcane plants followed by allowing aphids to feed on plants did not decrease aphid numbers (population).
- Since no *B. bassiana* colonisation of inoculated sugarcane was detected at 16 months post inoculation, and *Fusarium* spp. were isolated (even though not artificially inoculated), it seems unlikely that *B. bassiana* can be developed as a viable biocontrol option for eldana control.

Highlights from ongoing research

Biosecurity & associated enabling technologies

Chemical ecology of the longhorn beetle and eldana

- Good progress was made in research to identify the pheromone emitted by female longhorn beetles to attract males.
- Actively calling eldana males have been observed to emit a blend of volatile organic compounds: trans-eldanolide; cis-eldanolide; 6,10,14-trimethyl-pentadecan-2-ol; and vanillin.
- This is the first ever observation of a blend ratio for the potential attraction of eldana females by calling males and may prove to be an important step forward in the development of a chemical attractant for eldana moths.

Development of a user-friendly, in-field test for RSD

- In the bacterium that causes ratoon stunt, specific features of the cell membrane have been identified that will enable the development of a monoclonal antibody for diagnostic purposes.
- Peptides (small protein segments) reflecting two of these key features have synthesised and inoculated into mice for antibody production.

Agrochemicals for pest, disease & weed control

New chemistries for management of pests, diseases and weeds

Insecticides and nematicides

- The product Bandito® was registered for use against nematodes, thrips and YSA on plant and ratoon cane.
- In SASRI trials, Bandito® yielded the biggest increases in revenue (up to R20 000/ha for N52) across three sites whilst standard nematicides resulted in decreased revenue at two of the sites (in the case of decreased revenue, increased yield did not cover costs of chemical, application and additional transport).
- This soil applied granular product is registered for both plant and ratoon application and up to four months control of thrips and YSA has been observed.
- The product has also been shown to have increased activity against nematodes in Petri dish motility assays relative to oxamyl alone. Unfortunately, it has been given a red label, although a slight reduction in the oxamyl component might permit re-categorisation as a blue label product.
- Some fungicides (imidazoles e.g. prochloraz; and triazoles e.g. epoxiconazole) are able to inhibit insect P450 monoxygenases that detoxify some insecticides. This interaction is being explored for nematodes and it has been shown that prochloraz may increase the efficacy of Bandito® such that the content of oxamyl might be reduced.
- As an added benefit, prochloraz is active against *Fusarium*. *A Fusarium*-nematode interaction has been demonstrated whereby inoculation of cane plants with *Fusarium* SC17 (beneficial to eldana) increases nematode populations. It is thought that root damage allows this endophytic fungus entry into the plant and that the fungus inhibits plant defence against both nematodes and eldana.

Herbicides

- A new coded active ingredient formulated either as a liquid or as a granule, was tested for suppression of *Cynodon*.
- The trials aimed to assess whether both formulations of the new active ingredient could serve as a less dangerous replacement for paraquat, which carries negative health and safety risks.
- The aim is to replace paraquat + diuron for knockdown control/suppression of *Cynodon*.
- Both coded active ingredient + diuron formulations proved at least as effective as paraquat + diuron.
- Therefore, they are to be more extensively tested under varying field conditions.
- The new formulations could be a very valuable substitute for suppression of *Cynodon* in the event that paraquat is withdrawn from the market.

Sugarcane resistance to pests & diseases

Variety tolerance of nematodes

- Gains in revenue from nematicide treatments are observed to be highly variable amongst varieties and across environments.
- Hence, growers are to be encouraged to conduct their own simple on-farm trials to assess variety responses to nematicides under their specific conditions.
- The expertise of the SASRI Extension service is available to assist growers in this important decision-making process.

Variety resistance to diseases

- In an irrigated RSD yield loss trial conducted in Pongola, RV yield (t/ha) was reduced in infected plots of N49 and N57, while N14, N40, N41, N46 and N53 were not significantly affected.

Biological, cultural & environmental control practices

Eldana control through management of endophytic *Fusarium*

- The fungus, *Fusarium,* which occurs naturally within sugarcane plants has been found to increase eldana damage.
- It is hypothesised that exclusion of *Fusarium* from planting material with subsequent replacement with a microorganism that is not advantageous to eldana offers the potential for eldana bio-control.
- This method could potentially be implemented as part of a hot-water treatment procedure for planting material.
- Previous research identified four strains of *Brevibacillus* as potential candidates for the displacement of *Fusarium* from the endophytic ecological niche with sugarcane stalks.
- In current research, the most promising isolate was identified as *Brevibacillus reuszeri* and epoxiconazole and prochloraz were found to be the most effective fungicides for the control of *Fusarium*.

Sterile insect technique for eldana management (resource development and pilot release programme)

- Eldana F1 generation eggs, produced at XSIT Pty (Ltd) through the crossing of irradiated male moths with normal female moths, are returned to SASRI for mass rearing.
- Upon adult emergence from pupae, the F1 males are sampled and tested for fertility by crossing with normal laboratory-reared females.
- Similarly, F1 females are tested in crosses with normal laboratory-reared males.
- Both levels of fertility have proven to be acceptable for establishing proof-of-concept.
- During 2019/2020, 4 346 males and 1 476 females of the F1 generation (male:female ratio of 3:1) have been released into the SIT test cage that is being used for the proof-of-concept study.
- The 3:1 male bias in the released moths is better than the predicted 2:1.
- This ratio, and an over-flooding ratio, ensures that F1 female x laboratory male matings in the cage will be rare.

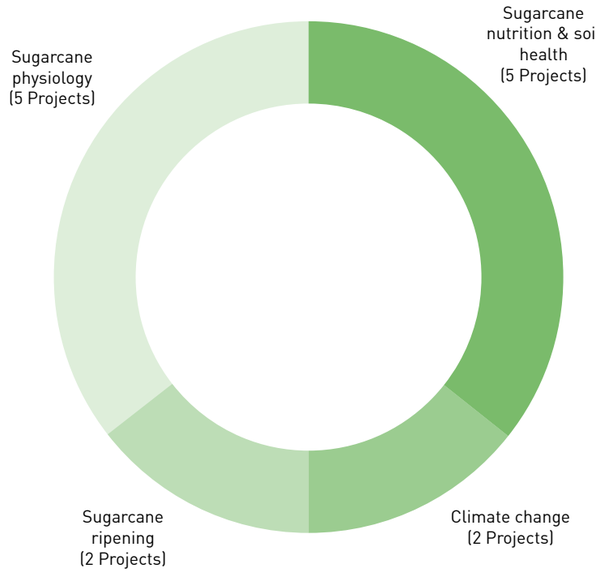
Crop Performance and Management Research

Dr Riekert van Heerden (Programme Manager)

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

Research focus areas

1. Sugarcane physiology
2. Sugarcane Nutrition and soil health
3. Sugarcane ripening
4. Climate change



Focus areas

1 Sugarcane physiology

Collecting and using crop physiological data in models that: (a) assist sugarcane breeding for current and predicted future climates; and (b) refine crop yield forecasting.

2 Sugarcane nutrition & soil health

(a) 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; and (b) testing of various sources of nutrients, fertiliser formulations and application rates that enhance the cost-effectiveness of recommendations.

3 Sugarcane ripening

Generating knowledge and developing technologies and resources that enable and demonstrate effective sugarcane chemical ripening practices in the industry.

4 Climate change

(a) Predicting climate change impacts on crop water-use and yield for current and future potential agro-climatic situations; and (b) developing appropriate resources to enable climate change adaptation and mitigation; and (c) developing best management practices to maximise yield under a predicted mid-century climate.

New project

Copper in South African sugarcane production: Industry review and interpretive criteria

(Project Reference: 18CM02)

(Project Manager: Lwazi Poswa)

Anticipated outcomes

- Re-evaluated status and typical ranges of copper (Cu) concentrations in soil and sugarcane in the SA industry.
- Soil and plant Cu norms and thresholds based on national and international best practice.

Anticipated benefits

Improved Cu norms and thresholds will permit growers and MCPs to more accurately identify true deficiencies to target remedial actions and optimise Cu applications.

New project

Development of near and mid infra-red spectral libraries for rapid analysis of soil fertility, salinity and plant nutritional status

(Project Reference: 18TD09)

(Project Manager: Dr Louis Titshall)

Anticipated outcomes

New and refined near- and mid-infrared spectral libraries for diagnostic analysis of soil and plant samples by the SASRI Fertiliser Advisory Service, including routine soil fertility parameters, soil salinity assessment and plant nutrient analysis.

Anticipated benefits

- A quicker and more cost-effective spectral-based diagnostics package for fertility and salinity assessments.
- Leaf analysis with a wider range of nutrients measured.
- Support for growers and MCPs wishing to submit higher numbers of samples more frequently for improved fertiliser and site management optimisation.
- The potential for remote diagnostic services that do not require samples to be sent to the central FAS laboratory.

New project (On-hold)

Vacant

Understanding how soil acidity-related processes affect management practices

(Project Reference: 18CM01)

(Project Manager: Vacant)

Anticipated outcomes

A review of state-of-the-art information is aimed at providing answers to three key management questions: (a) how quickly does lime and gypsum neutralise acidity of soils with varying characteristics; (b) how long does their effect on acidity persist; and (c) what are the factors influencing the movement of these compounds, particularly gypsum, into the subsoil?

Anticipated benefits

Improved lime and gypsum recommendations that are site-specific.

Outcomes from completed projects

Climate change

Interactive effects of elevated CO_2 and H_2O deficit on sugarcane water use and yield - an experimental and crop modelling study

(Research Contract: North-West University)

(Project Reference: 16CM1C)

(SASRI Project Manager: Dr Riekert van Heerden)

(North-West University Project Manager: Dr Jacques Berner)

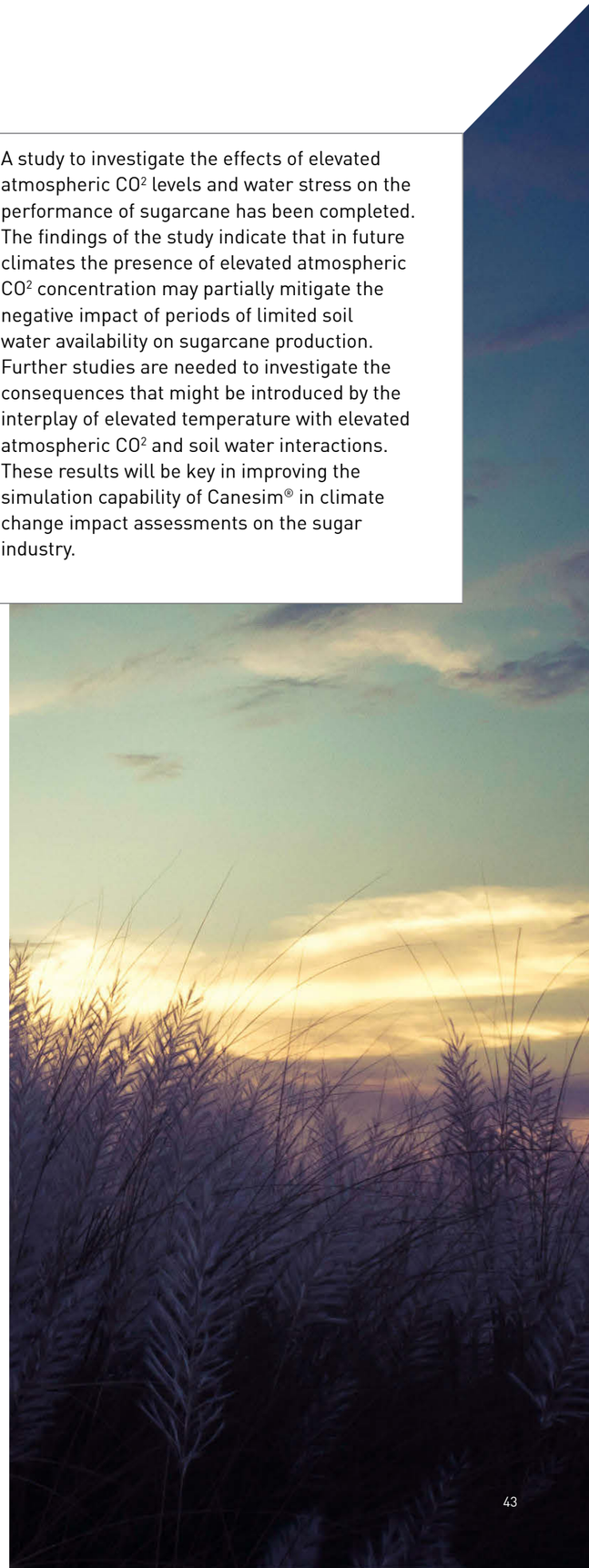
A study to investigate the effects of elevated atmospheric CO^2 levels and water stress on the performance of sugarcane has been completed. The findings of the study indicate that in future climates the presence of elevated atmospheric CO^2 concentration may partially mitigate the negative impact of periods of limited soil water availability on sugarcane production. Further studies are needed to investigate the consequences that might be introduced by the interplay of elevated temperature with elevated atmospheric CO^2 and soil water interactions. These results will be key in improving the simulation capability of Canesim® in climate change impact assessments on the sugar industry.

Highlights from ongoing research

Sugarcane physiology

Modelling world-wide GXE interaction

- Research conducted across four countries (France [Réunion Island], South Africa, USA, Zimbabwe) has demonstrated that varieties bred for local conditions outperform those bred in other countries. Investigations were able to distinguish between genetic and environmental influences on variety performance, which further enhances the potential for applying crop models to enhance sugarcane breeding.
- The study revealed that the impact of genotype-specific base temperature for germination and canopy development processes on growth and yield may have been previously underestimated. Base temperature appears to be a key genetic trait determining genotype adaptation to specific environments. This new knowledge, together with other knowledge gained from the research, will be used to improve simulating of genetic x environment effects at the process level, which will increase the usefulness of crop models in supporting sugarcane breeding.



Sugarcane nutrition & soil health

Long-term effects of burning and mulching

- Research based on an 80 year-old burning-mulching trial has revealed that images captured by a drone-mounted visible spectrum camera can be used effectively in comparative yield variability mapping on a field-scale.
- Highest cane yields (95 tc/ha) were observed with mulching and fertilisation, while the lowest (← 20 tc/ha) occurred with burning in the absence of mulching and fertilisation.
- Preliminary investigations revealed that burning, mulching and fertilisation affect the numbers of plant parasitic and free-living nematodes present in the soil.
- Electrical resistivity mapping of the trial site revealed valuable information, including:
  - the presence of two different soil types on the trial site; and
  - high resistivity in plots fertilised with potassium chloride, which led to decreased soil aggregate stability.
- The study illustrated the effectiveness of geophysical mapping in: (a) revealing detailed information on soil spatial variability; and (b) developing an understanding of relationships between soil fertility and soil physical properties.

Copper in South African sugarcane production

- Progress was made in the development of a database containing information on Cu in crop nutrition obtained from national and international science journal articles.

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

- Preliminary results of research into the use of near and mid infra-red spectral diagnostics for common soil fertility and leaf nutrient parameters indicate that:
  - properties which occur at very low levels (such a P and micronutrients) or that occur as readily exchangeable components (exchangeable and solution K and Na) have limited scope for accurate prediction; and
  - elements that interact more strongly with organic and mineral components at moderate levels (e.g. total N, Ca, Mg, pH, CEC, clay and organic matter) have greater predictive potential (i.e. with potential to replace wet chemistry analysis).
- A good calibration model (R^2 = 0.94; error estimate = 0.256) was obtained for near infrared spectroscopic determination of soil pH. The model promises to be particularly useful as it is able to provide estimates across a very wide range of pH values (3.5 to 8.5), thereby representing the majority of samples received for analysis by FAS. The 1 200 soil samples used to derive the model also constitute a wide range of textural and mineralogical classes, giving the model wide applicability to a range of soil types. The mid infrared calibration model for soil pH is to be tested by FAS within routine operations.
- Further research is underway to reduce spectral noise resulting from sample preparation variation, as this negatively affects the predictive capability of the model.

Sugarcane ripening

Evaluation of variety responses to chemical ripener application

- Responses of N55, N56 and N58 to chemical ripening treatments were established. The outcomes of the research confirmed the importance of variety-specific ripener treatments as contributors to profitability on both on-farm gross margin and factory sucrose recovery perspectives.
- Chemical-induced ripening of N58 in a grower-managed trial on the South Coast resulted in highly significant increases in RV% and sucrose% but did not have significant effects on non-sucrose%, fibre% and stalk moisture%.

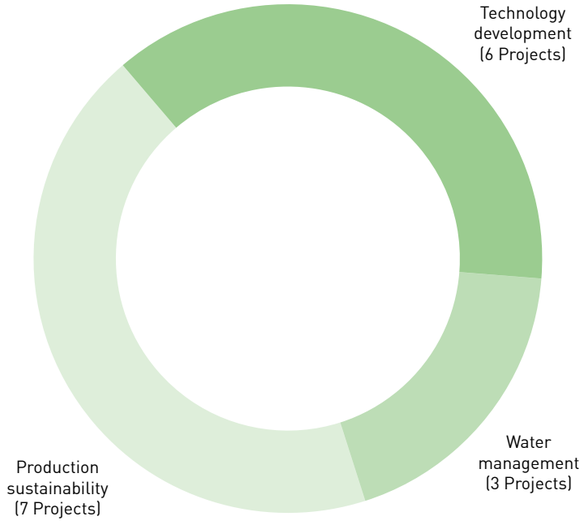
Systems Design and Optimisation Research

Dr Rian van Antwerpen (Programme Manager)

Developing and sharing innovative systems that optimise industry performance.

Research focus areas

1. Production sustainability
2. Water management
3. Technology development



Focus areas

1. **Production sustainability**
   (a) Assessing the impacts of agronomic and mechanisation issues on production efficiencies and sustainability; (b) identifying opportunities for on-farm energy savings and reducing carbon dioxide emissions; (c) deploying novel technologies that improve operational efficiencies and service offerings; and (d) developing new and improvement of existing technologies and approaches that enhance alignment between research and industry requirements.
2. **Water management**
   (a) Developing recommendations and advice that promote effective water management and technology deployment, both in terms of irrigation practices and surface water management; (b) developing guidelines to determine the foot-print of water usage in irrigated regions; and (c) maintaining or improving soil quality in irrigated regions where the parent material is the source of salts.
3. **Technology development**
   Developing, adapting and deploying technologies that focus on enhancing internal efficiencies and the quality of service provision.

New project

Revamping the SASRI WeatherWeb

(Project Reference: 18TD03)

(Project Manager: Phil Sithole)

Anticipated outcomes

- Improved efficiency and design of the on-line SASA/SASRI WeatherWeb.
- Migration of important WeatherWeb functions onto a smartphone-compatible platform.
- Improve integration between the WeatherWeb and other SASRI decision-support tools and services.

Anticipated benefits

The upgraded SASA/SASRI WeatherWeb will enhance grower and MCP decision-making (e.g. planting, ripening, burning, harvesting) with the convenience of smartphone compatibility.

New project (On-hold)

Socio-economic impacts of climate and other changes

(Project Reference: 18SD01)

(Project Manager: Dr Abraham Singels)

Anticipated outcomes

- Estimation of sugarcane biomass yields for current and potential new agro-climatic regions for current and adapted production strategies using future (2040-2060) climate and water supply projections.
- Estimated grower- and MCP-specific socio-economic impacts at regional level for different scenarios as defined by tariff, tax, input and product price, cane production and processing strategies and industry size (use will be made of the BFAP Integrate Information System for industry scenario evaluation using simulated crop data [as above]).

Anticipated benefits

Broad indications for growers and MCPs of the impact of a changed future climate and water supply on the economic viability of the sugar industry for given sets of circumstances relating to import tariff, taxes, electricity and water prices, and processing options (sugar/electricity co-generation/bioethanol production).

New project (On-hold)

A crop estimates decision-support program

(Project Reference: 18TD05)

(Project Manager: Matthew Jones)

Anticipated outcomes

An easy-to-use, web-based tool for generating objective crop estimates.

Anticipated benefits

Growers, MCPs and Extension Specialists will have access to an on-line tool that will enable objective estimation of crop yields, downloadable in a consistent data file format (CSV).

New project (On-hold)

Capacitating small-scale grower Extension roll-out of the demonstration plot methodology through a structured soil analysis campaign

(Project Reference: 18TD08)

(Project Manager: William Gillespie)

Anticipated outcomes

In collaboration with the KZN Department of Agriculture and Rural Development, establishment of the successful demonstration plot extension methodology in regions across KZN by means of a structured soil analysis campaign.

Anticipated benefits

- Establishment of demonstration plots in additional regions in KZN will enhance small-scale grower extension under the Extension Venture Agreement between SASA/SASRI and KZN DARD.
- Improved level of knowledge amongst SASRI Small-scale Extension Specialists and the KZN DARD Agricultural Advisors of the soil under small-scale production in KZN.
- Improved characterisation of soils used for sugarcane production by small-scale growers in KZN.

Outcomes from completed projects

Production Sustainability

A method of identifying small-scale grower needs

(Project Reference: 14SD02)

(SASRI Project Manager: Poovie Govender)

A survey amongst small-scale growers has revealed that awareness campaigns are required in all regions to enlighten small-scale growers about the importance of the industry research, development and Extension (RD&E) platform and the manner in which it functions in allowing SASRI to tailor research, development and innovation (RDI) to meet the needs of growers. A further recommendation was that SASRI Extension Specialists and KZN DARD agriculture advisors be reminded of their strategic roles in the RD&E process.

Development of updated design norms for soil and water conservation structures

(Research Contract: University of KwaZulu-Natal)

(Project Reference: 15SD2C)

(SASRI Project Manager: Dr Rian van Antwerpen)

(UKZN Project Manager: Prof. Jeff Smithers)

The purpose of this research was to develop updated design norms for soil and water conservation structures in the sugarcane industry to replace the outdated nomograph developed previously by SASRI in the 1980s. The Modified Universal Soil Loss Equation (MUSLE), which is embedded in the Agricultural Catchments Research Unit (ACRU) model, was used to update the design norms. The ACRU model was used to conduct simulations for the different practices in the sugar industry and the results used to build an updated tool for the design of soil and water conservation structures. The updated tool is embedded in MS Access with a background database and a graphical user interface. It is robust, based on sustainable soil loss limits, includes regional variations of climate and their impact on soil erosion and runoff and the vulnerability during the period from crop eradication to replant. It is also more representative of conditions in the sugarcane industry and therefore recommended for use in place of the current sugar industry design norms.

Ratoon longevity

(Project Reference: 16TD05)

(Project Manager: Dr Peter Tweddle)

This project examined ratoon yield decline trends in extensive research and commercial datasets from southern Africa to assess whether newer SASRI varieties are underperforming in terms of ratoon longevity. Findings from the study included the following: (a) all datasets revealed quadratic cane yield ratoon decline trends; (b) in most instances, stabilisation of yields occurred at the third ratoon; (c) differences in ratoon decline between irrigation systems were evident on some estates but not consistent across estates; (d) with the exception of one irrigated estate, varietal effects on ratoon decline were generally negligible; (e) late-season harvesting generally displayed sharper ratoon decline rates than early harvesting, particularly under irrigated conditions; (f) under scenarios of slower rates of ratoon decline, longer ratoon cycles are more profitable; (g) under scenarios of faster rates of ratoon decline, shorter ratoon cycles are more profitable; and (h) high potential systems showed higher rates of ratoon decline than lower potential systems. The analysis revealed strong dependencies of profitability on the overall ratoon decline rate and suggests that site-specific decisions, aided by a decision support system, would be most appropriate. To this end, revision of the SASRI Replant Decision Support Tool was undertaken, which is undergoing further verification.

Technology development

Revamping MyCanesim®

(Project Reference: 13TD10)

(Project Manager: Dr Abraham Singels)

The SASRI MyCanesim® sugar simulation system, available for use by growers at www.sasri.org.za, was upgraded to include recent scientific advances and computing technology. The upgrade was undertaken to improve the accuracy and relevance of model predictions and advice, and to make the system more user-friendly. New features include: (a) enhanced capability for simulating and predicting climate change impacts on sugarcane production and for investigating adaptation options; (b) enhanced capability to simulate genetic trait effects on sugarcane crop growth and yield, with the promise of eventually aiding plant breeding; and (c) improved operational application with regard to irrigation scheduling, yield benchmarking and crop forecasting, for both irrigated and rainfed conditions.

Highlights from ongoing research

Production sustainability

Yield mapping

The use of remote sensing offers the advantage of rapid wide-scale field scouting and for trend analysis to indicate intra-field yield variances. Initial results based on two independent field studies indicate that photogrammetric surface differentials pre- and post-harvest have the potential to be used as a proxy for relative yield differences, but are not suitable for determining or modelling actual yields accurately. Retrospective adjustment of the variance of yields (using crop height as the proxy) about the average field yield (obtained from field delivery data) can be used towards developing yield maps for variable rate application and management responses.

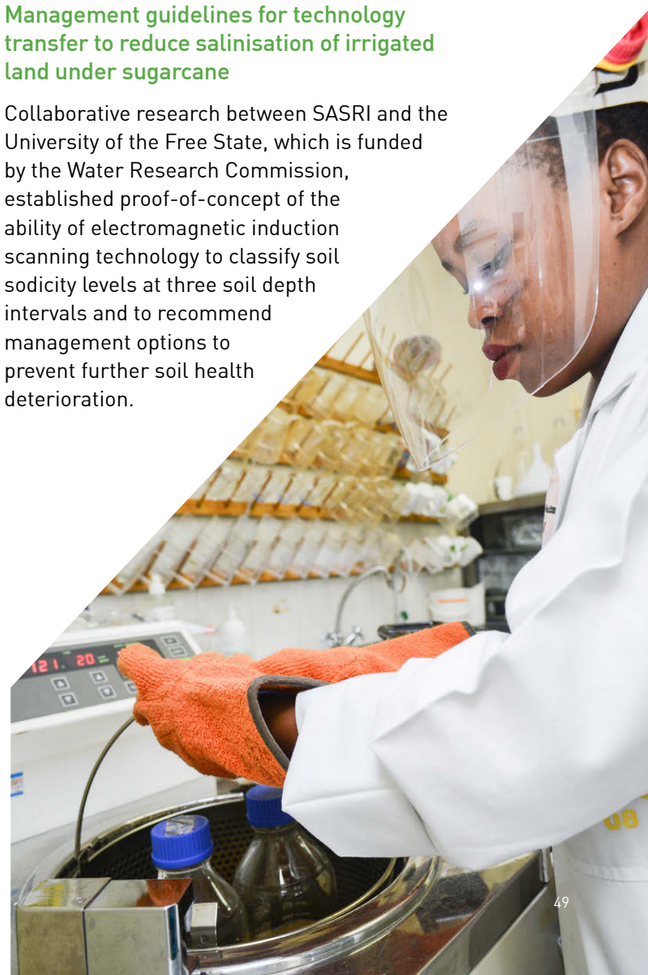
Ratoon longevity

Good progress was made in the: (a) detection of trends in variety yield performance over successive ratoons from commercial production data; and (b) revision of the SASRI Replant Decision Support Program to improve accuracy and ease-of-use.

Water management

Management guidelines for technology transfer to reduce salinisation of irrigated land under sugarcane

Collaborative research between SASRI and the University of the Free State, which is funded by the Water Research Commission, established proof-of-concept of the ability of electromagnetic induction scanning technology to classify soil sodicity levels at three soil depth intervals and to recommend management options to prevent further soil health deterioration.



Knowledge Exchange

Michelle Binedell
(Knowledge Manager)

Developing tools, smartphone apps and products that can be used to facilitate decision-making and encourage rapid adoption of best management practices.

New projects

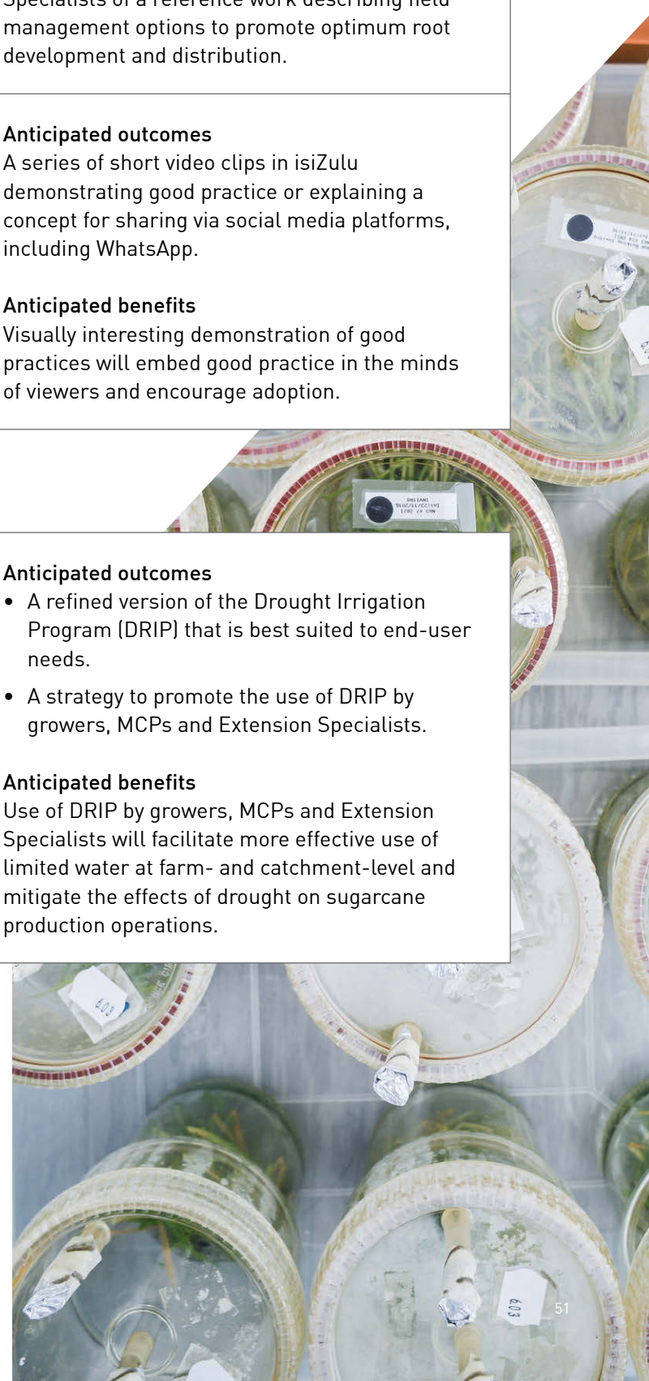
	**Update and revision of crop nutrition and soil management information sheets** (Project Reference: 18KE01) (Project Manager: Dr Louis Titshall)	**Anticipated outcomes** • Information sheets on crop nutrition and soil health updated to include new content, where required. • User-interface designed to enable growers and MCPs to more easily access content. **Anticipated benefits** Readily-accessible and comprehensive information on crop nutrition and soil management will assist growers and MCP decision-making.
	**Defining protocols and procedures for effective management and dissemination of SASRI Better Management Practices** (Project Reference: 18KE03) (Project Manager: Poovie Govender)	**Anticipated outcomes** • A single repository serving as the authentic source of all SASRI Better Management Practices (BMPs) documentation. • Protocols to ensure the ongoing and effective curation of BMP documentation. • Systems enabling the accessibility and usefulness of BMP documentation to growers and MCPs. **Anticipated benefits** A user-friendly, online BMP resource will result in more widespread adoption of SASRI-recommended BMPs by growers and MCPs.

New projects

	**Guide for the management of fields to optimise root development** (Project Reference: 18KE05) (Project Manager: Dr Rian van Antwerpen)	**Anticipated outcomes** A booklet describing sugarcane root development and documenting the factors that affect root growth and distribution. **Anticipated benefits** Availability to growers, MCPs and Extension Specialists of a reference work describing field management options to promote optimum root development and distribution.
	**Short video clips for small-scale growers** (Project Reference: 18KE06) (One-year project) (Project Manager: Winile Shelembe)	**Anticipated outcomes** A series of short video clips in isiZulu demonstrating good practice or explaining a concept for sharing via social media platforms, including WhatsApp. **Anticipated benefits** Visually interesting demonstration of good practices will embed good practice in the minds of viewers and encourage adoption.

New project (On-hold)

	**Implementation of the Drought Irrigation Program (DRIP)** (Project Reference: 18KE04) (Project Manager: Ashiel Jumman)	**Anticipated outcomes** • A refined version of the Drought Irrigation Program (DRIP) that is best suited to end-user needs. • A strategy to promote the use of DRIP by growers, MCPs and Extension Specialists. **Anticipated benefits** Use of DRIP by growers, MCPs and Extension Specialists will facilitate more effective use of limited water at farm- and catchment-level and mitigate the effects of drought on sugarcane production operations.



Outcomes from completed projects

Irrigation scheduling demonstration trial

(Project Reference: 13KT01)

(SASRI Project Manager: Marius Adendorff)

A demonstration trial was established in Pongola to illustrate the gains available to growers should they choose to use irrigation scheduling technologies. Three methods of scheduling irrigation were demonstrated: a continuous logging soil-water capacitance probe; the weather-based SASRI Canesim® crop model; and a combination of Canesim® informed by data from a capacitance probe. Fixed irrigation cycles (standard farm practice) served as the control treatment. Performance was evaluated in terms of cane yield and quality, quantity of irrigation water applied and financial benefits.

The combined financial benefits (cost saving plus yield benefit) of irrigation scheduling were as follows: R7 201/ha, R9 603/ha and R10 351/ha for the use of MyCanesim®, a capacitance probe and the MyCanesim® capacitance probe combination, respectively. It is estimated that the combined financial benefit for one hectare will cover the initial cost of buying a capacitance probe and telemetry software. The data generated by this Extension-managed demonstration trial will be used in knowledge exchange efforts to encourage the use of readily-available and affordable irrigation scheduling technologies.

Defining protocols and procedures for effective management and dissemination of SASRI BMPs

(Project Reference: 18KE03)

(SASRI Project Manager: Poovie Govender)

A formal and sustainable system has been developed and operationalised to ensure that all documentation pertaining to SASRI Best Management Practices (BMPs) is regularly updated, effectively curated and made available to growers through the e-Library on the SASRI website (www.sasri.org.za).

Short video clips for SSGs

(Project Reference: 18KE06)

(Project Manager: Winile Shelembe)

Social media platforms (WhatsApp and YouTube) have been explored as vehicles for expanding the reach of Extension to the many small-scale growers operating in the industry. Scripts for twelve practices of importance to these grower communities have been prepared and the short video clips are in various stages of production. Two videos on cane yield estimation, each about a minute in length, have been distributed via SASRI Extension, KZN DARD Extension and the grower associations. To-date the video clips have been shared with 621 growers and uploaded onto the SASRI YouTube channel. This proof-of-concept exercise has demonstrated the feasibility and cost-effectiveness of the in-house production and subsequent distribution via social media platforms of useful videos that aim to up-skill small-scale growers on key aspects of sugarcane husbandry. Videos on the remaining topics will be disseminated in a similar fashion over the remainder of 2020.

Highlights from ongoing projects

Annual SUSFARMS® updates

- SUSFARMS® Version 4, 2019 was released to the industry.
- Two workshops on the South Coast were conducted to update growers on the new features of the tool.

Refining SASRI's Knowledge Exchange Platform

Significant progress was made in creating awareness of a knowledge exchange framework that is being designed to assist researchers in planning and conducting more effective knowledge exchange campaigns. It is expected that these campaigns will aid in encouraging adoption of research outcomes.

Defining protocols and procedures for effective management and dissemination of SASRI BMPs

- Work in this area focused on establishing a framework and enabling environment for the ongoing collation, curation and updating of SASRI knowledge assets which currently exist as recommendations in various locations and formats. Further objectives include the development of: (a) a single central repository that will serve as the authentic collection of SASRI best management practices (BMPs); and (b) a clear system and rules for maintaining and updating the BMP collection.
- Eight new projects have been created recently from this project to provide the impetus required for the curation and updating of SASRI BMPs and recommendations. These projects are scheduled for implementation in 2020/2021, with each to be managed by a senior discipline expert who will guide the consolidation and review of the suite of knowledge resources that encapsulate SASRI recommendations in that particular discipline.

Contracted-out Research

Stellenbosch University

North West University

University of Illinois at Urbana-Champaign

Hawaii Agriculture Research Centre

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.

Sugarcane sucrose enhancement by genetic modification

Over-expression of the *Arabidopsis thaliana* vacuolar pyrophosphatase gene in sugarcane (Institute for Plant Biotechnology Stellenbosch University)	The *Arabidopsis thaliana* vacuolar pyrophosphatase gene was successfully cloned and expressed in sugarcane. Initial drought-stress screening revealed that the transgenic lines perform better than the control plants during stress. This potentially valuable phenotype is the focus of further studies.
Over-expression of a glucoronokinase gene from *Arabidopsis thaliana* in sugarcane	The *Arabidopsis thaliana* glucoronokinase gene was successfully cloned and expressed in sugarcane. The transgenic lines were observed to have variable phenotypes, with some appearing grass-like. No obvious differences in cell wall composition between the control and transgenic lines were detected as had been hypothesised. Consequently, this line of investigation has been discontinued.
Up- and down-regulation of trehalose metabolism genes in sugarcane	Transgenic sugarcane plants were developed in which trehalose-6-phosphate synthase activity was either up- or down-regulated. Preliminary screening detected transgenic lines in which sucrose, glucose and fructose concentrations differed from the wild-type control plants. These potentially valuable phenotypes are currently the focus of further study.
Over-expression of tonoplast monosaccharide transporter genes in sugarcane	Transgenic sugarcane plants expressing the *Arabidopsis thaliana* tonoplast monosaccharide transporter genes, TMT1 and TMT2, were produced. Carbohydrate analyses detected no significant difference in the sucrose levels when comparing the control with the transgenic lines. Consequently, this line of investigation has been discontinued.

Biotechnological investigations to improve sugarcane drought tolerance

Constitutive over-expression of a group 1 LEA protein from the desiccated leaves of the resurrection plant *Xerophyta humilis* in sugarcane (Institute for Plant Biotechnology Stellenbosch University)	Transgenic sugarcane lines expressing the resurrection plant LEA gene under the control of either a constitutive or stress-inducible gene promoter were developed. The lines are currently under testing in pot-based drought tolerance trials under glasshouse conditions.
Over-expressing NF-Y nuclear binding transcriptional factors in sugarcane	Genetic transformation vectors have been developed to enable either the constitutive or stress-inducible expression in sugarcane of the Arabidopsis thaliana NF-Y transcription factor genes. Current research is focused on the genetic engineering of sugarcane to express these transcription factors, after which lines confirmed to be transgenic will be subjected to drought stress trials under glasshouse conditions.
Manipulating cytokinin levels to determine a possible role in enhancing drought tolerance in sugarcane	The sugarcane CKX gene is to be silenced by means of RNA interference (RNAi) technology to increase endogenous cytokinin levels in sugarcane with a view to reducing leaf senescence under drought conditions. To-date, silencing of the gene has been confirmed in five transgenic sugarcane lines and these lines are currently being subjected drought tolerance trials under glasshouse conditions.

	Unravelling the secrets of SUMOylation and the possible link to abiotic stress tolerance in sugarcane	The goal of this research is to increase drought tolerance in sugarcane by altering the SUMOylation pathway through the expression of three key stress reponse regulators from Arabidopsis thaliana. Preliminary screening has identified several promising lines which are currently being subjected to drought tolerance trials under glasshouse conditions.
	Over-expression of volatile organic compound biosynthetic genes for enhanced growth and drought tolerance	Sugarcane was genetically engineered to express a genetic transformation vector containing the *a*-acetolactate decarboxylase (ALDC) and 2,3-butanediol dehydrogenase (BDH1) genes, attached to the ferredoxin-NADP+ reductase (FNR) transit peptide sequence from spinach. This genetic engineering strategy is designed to increase emission of the volatile organic compounds acetoin and 2,3-butanediol which have been shown to promote plant growth and enhance the ability of the plant to deal with pathogen infection. Preliminary in vitro and glasshouse testing indicated that the transgenic lines were not more tolerant of drought stress than the control lines. In depth testing of the lines is currently under way.

Research into long-term sustainable integrated pest control of *Cacosceles newmannii*

	(Department of Conservation Ecology & Entomology Stellenbosch University)	The goal of this research is to characterise some of the relevant biological and ecophysiological traits of the longhorn beetle *(Cacosceles newmannii)* to understand the causes of the outbreak and to propose management practices for sustainable pest control. This host shift reveals the ability of the insect to invade new ecosystems and highlights the pressing need to quantify the impact it could have on crops if it keeps spreading. During 2019/2020, good progress was made in achieving research milestones in the following areas. • **Longhorn beetle biology** Biological traits studied include: (a) species resistance to environmental stress such as temperature, desiccation or oxygen limitation; (b) population phenology; (c) population genetics; and (d) gut microbiome composition. • **Longhorn beetle ecology** The ecology of the insect is being characterised in terms of how the longhorn beetle interacts with its environment at multiple scales using three different approaches: (a) measurement of the microclimate encountered by each life stage in both their identified original and invaded host plants, and determination of whether one is more suitable than the other; (b) use of stable isotopes to understand what each life-stage feeds on and building food webs to determine the community of pathogens, predators and parasitoids; and (c) characterisation of the dispersal potential of adults in field and laboratory trials, complemented with indirect estimates of dispersal through the determination of the genetic structure of the populations. • **Longhorn beetle population monitoring and chemical ecology** Species-specific traps and sampling techniques are under development for use in adult and larval population monitoring. Included is the development of a lure based on sex pheromones of the longhorn beetle species, as well as plant kairomones used by the pest to locate host plants. • **Modelling** This aspect of the study aims to parameterise and test an existing biophysical model for a destructive pest insect on sugarcane. This model will then be used to answer key questions surrounding longhorn beetle management including: (a) accurate predictions of phenology (life-cycle timing), estimations of the environmental conditions that trigger host shift, and delimitation of the risk area; and (b) defining various management scenarios and testing their efficiency in controlling the pest.

Interactive effects of elevated CO_2 and water deficit on sugarcane water use and yield

	(School of Biological Sciences North West University)	This study, which investigated the effects of elevated atmospheric CO_2 levels and water stress on the performance of sugarcane, has been completed. The findings of the study indicate that in future climates the presence of elevated atmospheric CO_2 concentration may partially mitigate the negative impact of periods of limited soil water availability on sugarcane production. Further studies are needed to investigate the consequences that might be introduced by the interplay of elevated temperature with elevated atmospheric CO_2 and soil water interactions. These results will be key in improving the simulation capability of Canesim® in climate change impact assessments on the sugar industry.

Dissecting *S. spontaneum* genomic fraction in sugarcane hybrid cultivars

ILLINOIS HARC	(University of Illinois at Urbana-Champaign and affiliated with Hawaii Agriculture Research Centre)	In this international research collaboration, the *Saccharum spontaneum* genome fraction of cultivars from around the globe, including a selection of important SA varieties[1] , will be dissected to identify a minimum fraction of the *S. spontaneum* genome shared by the hybrid cultivars. Importantly, a core set of resistance (R) genes and stress tolerance genes will be identified for integration into the SASRI breeding programme. During 2019/2020, good progress was made towards meeting project milestones including the following: • Dissecting the integrated *S. spontaneum* genome fraction in hybrid cultivars in comparison with progenitor species genomes, such as the 'Wonder Cane' variety POJ2878, and other re-sequenced hybrid cultivar genomes. • Re-sequencing of additional hybrid cultivars from project collaborators using Illumina technology. • De novo sequencing of hybrid cultivars from collaborators using the single molecule long-reads PacBio®[2] technology. The identification of a core set of resistance and stress tolerance genes could potentially accelerate sugarcane breeding programmes by shortening the standard 13-year breeding cycle and maximise the potential benefit of genomic technologies that have been lagging behind for so long in sugarcane breeding. This development could set the stage for eventual implementation of genomic selection[3] in sugarcane breeding within each partner country participating in the research.

[1] Varieties N25, N49 and NCo376 have been selected for sequencing due to the important role they play as parents in the SASRI breeding programme.

[2] PacBio® sequencing captures sequence information during the replication process of the target DNA molecule. The template, called a SMRTbell, is a closed, single-stranded circular DNA that is created by ligating hairpin adaptors to both ends of a target double-stranded DNA (dsDNA) molecule.

[3] Genomic selection is a method in plant breeding to predict the genetic value of untested lines based on genome-wide marker data.

Research Grants

In 2019/2020, SASRI secured five grants from funding agencies to support research, development and innovation.

Post-graduate and Post-doctoral Fellowships

NRF National Research Foundation | RISA Research and Innovation Support and Advancement	**National Research Foundation**	• NRF Professional Development Programme: One post-doctoral and two PhD placements • NRF Post-doctoral Fellowship Programme: One post-doctoral fellowship
UNIVERSITY OF KWAZULU-NATAL INYUVESI YAKWAZULU-NATALI	**University of KwaZulu-Natal**	UKZN Post-doctoral Fellowship Programme: One post-doctoral fellowship

Research grants

IAEA	**International Atomic Energy Agency**	Research Project Grant Funding: SIT field release logistics (fourth year of five-year funding cycle)
WATER RESEARCH COMMISSION	**Water Research Commission**	Research Project Grant Funding: • Irrigation soil salinisation risk (Lead Organisation: University of the Free State; fourth year of five-year funding cycle) • Water footprint of fuel and fibre crops (Lead Organisation: University of the Free State; fourth year of five-year funding cycle)
biosafety SOUTH AFRICA	**Biosafety SA**	Research Project Grant Funding: • Evaluation of the likelihood of gene flow from commercial sugarcane hybrids to compatible wild relatives. Principal investigator: Dr S Joshi (SASRI) • Refugia planning in a Bt GM sugarcane scenario in combination with sterile insect releases. Principal investigator: Dr L Potgieter (Stellenbosch University) • Development of an eldana risk index. Principal Investigator: M Jones (SASRI) • Development of a communication strategy for GM cane. Principal investigator: Prof J Limson (Rhodes University).

International Conference Participation

In 2019/2020, the SASRI Director and five scientists participated in four international conferences and workshops. Participation was enabled through travel grant funding from SASRI, the National Research Foundation, the University of KwaZulu-Natal and the International Consortium for Sugarcane Modelling.

Dr Sandy Snyman [2,3]
Plant and Animal Genome Conference 2020
San Diago, USA
11 -15 January 2020

Matthew Jones [1,4]
Decision Support System for Agrotechnology Transfer (DSSAT) Development Sprint.
Muscle Shoals, Alabama, USA
15 -19 July 2019

Matthew Jones [1,4]
iCROPM2020 Crop Modelling Symposium and Crop Model Development Workshop.
Montpelier, France
3 - 12 February 2020

Dr Carolyn Baker [1]
Dr Abraham Singels [1]
Dr Marvellous Zhou [1,2]
Dr Stuart Rtherford [1,2,3]

30th ISSCT Congress.
Tucumán, Argentina
31 August -
5 September 2019

Travel and conference participation funded by:

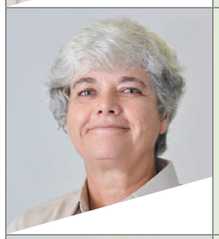
1 SASRI

2 NRF National Research Foundation | RISA Research and Innovation Support and Advancement

3 University of KwaZulu-Natal ™ Inyuvesi YaKwaZulu-Natali

4 International Consortium for Sugarcane Modelling ICSM

Awards and Achievements

	Kynoch Award, Highly Commended at the South African Sugar Technologists' Association 2019 Congress: Dr Louis Titshall	The second best paper in the Agricultural session of congress. **TITLE:** Evaluation of a reduced extraction time to improve the efficiency of routine analysis of resin extractable phosphorus and sulphur.
	Poster Award at the South African Sugar Technologists' Association 2019 Congress: Dr Peter Tweddle	The best poster in the Agriculture session at congress. **TITLE:** Use of remote sensing to determine intra-field yield variability.
	Poster Award, Highly Commended at the South African Sugar Technologists' Association 2019 Congress: Prabashnie Ramouthar	The second best poster in the Agriculture session at congress. **TITLE:** Update on nematicide screening within the South African sugar industry.
	Presentation and Poster Award at the 2019 South African Society for Agricultural Extension Symposium: William Gillespie	Double award for best presentation and best poster at the symposium. **TITLE:** Extension: To serve and protect - How to achieve sustainable rural development.
	Scientific Poster Award at the 2019 South African Society for Agricultural Extension Symposium: Dr Peta Campbell	The best scientific poster at the symposium. **TITLE:** SASRI Weed Research Principles – How can we support farmers with different levels of experience?
 	Two NRF ratings were awarded.	These ratings are indicative of established researchers who, on the basis of the high quality and impact of their recent research, are regarded by some reviewers as already enjoying considerable international recognition. • Dr Sandy Snyman received a NRF C Rating after re-evaluation for January 2019 to December 2023. • Dr Louis Titshall received a NRF C Rating.

Extension

Rowan Stranack
(Extension and
Biosecurity Manager)

Research development and extension (RD&E) committees

One of the key functions 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 comprised of local growers and other role players. This links with the SASRI research programme and 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, offering 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. In addition to attending local meetings, RD&E committees gather annually to review research needs from the wider industry. These needs are prioritised and provide the foundation of the SASRI research programme of work for the coming year. These central workshops alternate between the irrigated and rainfed regions.

In March 2020, it was the turn of the irrigated regions to hold an RD&E workshop. This event was hosted at Malelane and addressed several topical issues relevant to that region.

Present at the workshop were representatives from both the large and small-scale growing sectors as well as the milling company. Breakaway sessions enabled all views on potential research areas to be heard and deliberated. Arising out of the discussions SASRI compiled a communique of responses to the RD&E Committee and began work on preparing research proposals and technology development and knowledge exchange projects arising from issues raised at the workshop.

The 2019/2020 Season

It was another good season in most parts of the industry and the final crop of 19.3 million tons was the biggest since the 2013 season. The past two seasons have seen crops of quite similar size and cane quality. The good yields in the 2019/20 season were due to good summer and autumn rains in most parts of the industry in 2018 through into 2019. A dry, relatively warm winter followed which was ideal for natural ripening of the crop, helped along by widespread flowering in the irrigated regions and coastal belt, perhaps the most widespread flowering for many years. Although helping to improve quality, the flowering forced growers to include much of this cane in their estimates for the season rather than carry the flowered cane over to the following season.

Water supplies were generally maintained overall. Pongola had no restrictions and apart from the Crocodile system in the Mpumalanga Lowveld, there was adequate water in that region. Water supply from the Umhlatuze and Umfolozi systems in KwaZulu-Natal was, however, restricted. Through the spring of 2019, most of the coastal belt and Midlands experienced below average rainfall and it was not until November that there was some relief through good, soaking rains. The dry spell placed some cane under stress but the good rains in November and December 2019 provided impetus to the summer growing period. Although many areas experienced a relatively dry start to the new year in January, good rains again in February and April increased prospects for another good crop in 2020.

There was relatively little frost in the Midlands regions during the winter of 2019. In the irrigated north, the mills there were still experiencing the negative after-effects of carryover cane in the previous seasons in the form of relatively high levels of eldana damage and sour rot. Harvesting all the flowered cane proved a challenge for the growers in the Lowveld where the popular variety N36 flowered heavily. Even shy-flowering varieties such as N49, N53 and N57 exhibited flowering.

Following the good rains in autumn 2019, there was an increase in the area that was chemically ripened, not only in the irrigated areas but also across many rainfed regions of the industry. Extension made good use of the Pur*Est*® app to assist growers with decisions regarding ripener application. The app also found another use in determining the relative maturity of fields, an area of potential use amongst all growers, assisting with harvest planning. Through the early and mid-season, yields in many areas in the rainfed part of the industry were excellent, particularly along the coastal belt and in the Midlands. However, overall yields were slightly lower in the Mpumalanga region made slightly worse by the severe water restrictions in the Crocodile River system.

The dry winter and spring had negative consequences in the irrigated North where yellow sugarcane aphid *(Sipha flava)* populations increased dramatically and remained so into the summer and autumn months of 2020. The dry months also caused an increase in eldana in some of the southern rainfed regions and, of some concern, in the Midlands North region where, once again, growers were challenged to contain the spread of the pest. The severe economic climate also resulted in some growers being unable to complete their eldana insecticide spray programmes, the consequences of which were experienced in the early part of the 2020/21 season.

The dry winter and spring also made conditions ideal for the spread of smut, and in the Pongola region in particular, controlling this disease was a major challenge and several roguing and crop eradication orders had to be issued. Smut was also recorded in most areas north of the Tugela River, and, whilst not always at hazard levels, served as a warning to manage smut-susceptible varieties with caution in these areas.

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. In 2019, the varieties N69 (Midlands), N72 (coastal) and, for the first time in almost ten years, two new varieties N70 and N71, were sent to the irrigated North to be bulked. At the same time varieties N73, N74 and N75 were approved for gazetting and bulking.

There remains widespread interest and appreciation for the superior quality of recent variety releases. Of note was the continued general good performance of N52, N53, N54, N57, N58 and N59. The more recently released varieties N61 and N62 also gained some attention due to their excellent growth and both these varieties continued to perform well in SASRI variety trials. These trials are used extensively by SASRI 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 public forums. In the rainfed coastal regions and Midlands, the very rapid growth and early-maturation of some of the new varieties posed a challenge to growers in the management of cane grown on a shorter harvest cycle as compared to the full two-year cycle they were used to. The application of ripeners was an obvious strategy to improve quality and was quite frequently implemented.

Ensuring adequate seedcane supply continued to be a major challenge for SASRI Extension and Biosecurity. Together with this effort is the requirement to comply with the 2023 deadline by which all commercial plantings need to be done using

either Certified or Approved Seedcane. Areas where seedcane schemes are not operative have a particularly significant challenge in this regard. Encouragingly, a seedcane scheme has been established in Pongola and efforts have been made to formalise a scheme in the Sezela mill area. Only the Umzimkhulu and Midlands South areas are without seedcane schemes. Considerable attention was paid to the need to facilitate access to seedcane by small-scale growers and this will become a key focus area going forward.

Education and group activities

SASRI Extension Specialists deliver modules on the SASRI Senior and Junior Certificate Courses. These learning platforms provide Extension with valuable grower interaction at all levels and from all sectors of the growing community. It is also an opportunity to keep up to date with the latest technology. Extension deliver lectures and practical instructions on irrigation, land use planning, weed control and management. A modularised Senior Course continued to be delivered to growers in the Felixton and Midlands. The success of these courses held on one day per month over 10 months is proving a highly effective model for instances where growers cannot leave their farms for extended periods. Further courses are being planned for more areas in the future.

Grower days are an excellent tool to communicate better management practices with all growers. A total of 139 of these events were held with large and small-scale grower groups. 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 communicate with growers via newsletters and publications such as the Ingede. In addition, other ad hoc forms of communication are employed such as email and participation in social media groupings. 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 extensive support to the development and implementation of SUSFARMS® and the associated Progress Tracker as an environmental sustainability self-assessment and management tool. Growers on the Lower South Coast are to begin submitting SUSFARMS® Progress Trackers during the coming season.

A significant component of the work Extension does is in the area of land use planning and growers were assisted in implementing new field layouts and conservation structures. Whilst this work is often done in the context of a full Land Use Plan (LUP), significant *ad hoc* advice on field layout is given at individual field level.

At industry level, SASRI Extension assisted in a project undertaken by the Institute of Natural Resources (INR) to examine the issue of buffer-zones and desirable cane-free areas on farms which would guarantee adequate surface-water runoff to supply the water reserves necessary to sustain the country's needs.

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. There have been continued efforts to encourage growers from areas where previously few samples were received to send soil and leaf samples to FAS. To this end, there has been a focus on the irrigated Northern regions. Grower interactions, both personal and group activities, have been targeted towards these growers and some success has already been achieved. To add further value to FAS, at the request of growers, Extension spends time customising recommendations to meet individual farm's needs and objectives. Adjusting lime recommendations to accommodate liming to lower acid saturation levels is an example. The benefits to be gained from lower potassium applications considering the soils' reserves of this important nutrient has also been a recent focus.

An extensive history of soil nutritional status is essential to plan crop nutrition effectively. Promotion of sampling amongst the small-scale grower sector also remains a challenge and a project has been planned to focus on the identification of soils, their yield potential and critical management factors specifically in these areas. Unfortunately due to capacity constraints, this project is on-hold until resources become available.

Other crops

With growers increasingly diversifying into other crops, there has been some demand upon Extension to assist with certain aspects of husbandry and nutrition related to these crops. The move into macadamia production has been widespread in almost all areas for some years. However, other sub-tropical crops have also enjoyed attention from growers. Already, nutrition recommendations and advice are being provided to sugarcane growers with other enterprises. As an attempt to gain a better grasp of the need from growers in the area of other crops, part of the annual Extension and Biosecurity Indaba was devoted to exploring opportunities for collaboration and assistance. It transpired that there were many avenues where SASRI and SASRI extension could assist and, in future, more work will be needed in building a knowledge base around other crops suited to conditions in the sugar industry.

Pest and disease control

In their support to LPD&VCCs, Extension Specialists assist in guiding general pest and disease strategies in their areas. SASRI Extension Specialists also carry out certain line management responsibilities in the management of Biosecurity staff. Some of the pests and diseases managed by Extension during the 2019/20 season included yellow sugarcane aphid, eldana, longhorn beetle, smut and sugarcane yellow leaf virus. The details of these interventions as well as others are highlighted in the Biosecurity section.

The extension venture agreement

SASRI and the Department of Agriculture and Rural Development 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 a large number of 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 and, under the broader SASRI umbrella, 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). Living field schools in excess of 100 hectares of demonstration plots have been established across

KwaZulu-Natal. This provides instruction and learning on various farming operations. These plots are also sources of good quality seedcane for growers in the immediate area. The quantity of seedcane was estimated to be in excess of 7 000 tons.

There has been some work in the direction of adapting SUSFARMS® to the small-scale farming environment, in that there is merit in its use as a guide to better management practices (BMPs) as well as its use as a monitoring tool.

The sustainability of small-scale growers is an on-going priority for Extension. Key areas where growers required assistance to remain viable were identified and Extension activities have been tailored to address these. Seedcane, planting, varieties, crop nutrition, weed control, crop estimating, and cane quality were common subjects addressed during grower days, modular courses and individual farm visits.

SASRI's EVA Sugarcane Extension Specialists assisted significantly in the exercise to allocate funds for seedcane purchases under the sugar industry's transformation initiative. This initiative returned R20 million to small-scale growers across the industry to assist with funding seedcane acquired in the previous planting season. The same EVA team also assisted in the planning of further similar initiatives across the industry utilising transformation funds.

The key role of the SASRI EVA sugarcane Extension specialists is to equip and train DARD Extension staff to deliver advice to growers in their areas. Regular refresher courses focused on the farming calendar are held, often with SASRI specialists present to facilitate this learning. Local DARD Extension officers have then been able to present courses themselves to their growers, and this is in keeping with one of the primary goals of the EVA programme. Overall, the close co-operation and effective communication between the EVA partners has resulted in maintaining a highly effective Extension service to small-scale growers.

Extension services structure

Large-scale

SASRI provides a levy-funded Extension service in twelve of the fourteen mill areas. This service consists of on-farm visits by the local SASRI Extension Specialist providing one-on-one advice on specific aspects of sugarcane agronomy, as well 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 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), Environment Committees, and local grower structures such as Mill Group Boards.

Private

The local milling companies in the UCL and Malelane cane supply areas deliver a private 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 (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 EVA through quarterly meetings.

DARD local managers are contacted regularly to ensure operational issues are addressed.

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, who provide 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 growing sectors with SASRI staff providing technical and administrative support to the committees.

Regular meetings of LPD&VCCs enable growers to remain abreast of new outbreaks and to make appropriate decisions to effect control of these threats, based on data and technical support provided by the SASRI Biosecurity inspectorate. Committee members, in leading by example, exercise peer pressure on their neighbours to carry out control measures.

Committee operation and activities

LPD&VCCs are required to meet a minimum of four times in a year with most achieving this target. Two committees, Sezela and Mkhuze/Makhathini reconvened again after an extended period of not being able to meet. Representation on LPD&VCCs has changed during the past two seasons to include members from the South African Farmers Development Association (SAFDA) who, together with the SA Canegrowers Association and the South African Millers Association make up the three entities represented on LPD&VCCs. SASRI Extension and Biosecurity staff are ex-officio members of LPD&VCCs and provide an administrative and technical advisory service to LPD&VCCs and manage 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.

A round of induction presentations for committee members was given to most LPD&VCCs during the year and this will be on-going to accommodate new members joining the committee.

At the annual meeting of LPD&VCC Chairmen held in July 2019, the customary reports on the status of biosecurity in the industry were delivered. There was also occasion for local committees to report on activities and to raise either technical or governance issues.

Pest occurrences in 2019/20

Yellow sugarcane aphid *(Sipha flava)*

During the latter part of 2018 and early 2019, the industry was hit by the most serious and widespread outbreak of yellow sugarcane aphid (*Sipha flava*) since its arrival in the South African sugar industry in 2013. Worst affected was the North Coast region where very severe outbreaks caused yield loss and, in extreme cases, stool mortality. By early 2019, outbreaks of the pest had occurred in all regions. During the winter of 2019, populations declined but there was a resurgence again in spring, with severe outbreaks in the areas previously affected. The focus changed to the irrigated Northern regions where severe outbreaks occurred in the Komatipoort area, particularly on variety N57, requiring intervention by SASRI Extension and specialists in providing advice on control. The pest also emerged on the South Coast and Midlands areas and was severe in isolated patches.

Scouting for the pest proved critical in efforts to control outbreaks and work continued in developing a suitable, practical method of monitoring fields for infestations.

A task group had been formed at SASRI to address the problem. Two trials were put down in spring 2019 and these hopefully will provide some answers in the area of suitable control methods. Trials proved notoriously difficult to establish due to the elusiveness and transient nature of the pest. The long-term solution is likely to be a more integrated approach once key research has been carried out along with a greater understanding of the biology of the pest.

Longhorn Beetle *(Cacosceles newmannii)*

The managed and co-ordinated approach to the longhorn beetle containment effort has been largely successful. The 1 130 hectares identified for eradication has been cleared of sugarcane and is currently either under permanent pasture cover or fallow. Some recoveries of larvae were associated with volunteer sugarcane regrowth during 2019, but for the most part, previously infested areas appeared free of the pest. For the first time in the five-year infestation period, no adult beetles were reported during the summer of 2019 and 2020. This can possibly be interpreted as some success in the containment effort. 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 ongoing.

Eldana

The largest proportion of time was, as in most years, spent on the management of eldana. In areas such as Pongola and the Mpumalanga Lowveld, where eldana problems are largely unknown, the residual effects of pest populations in carryover cane has been a problem in recent seasons. However, this season saw all three mill areas crushing the entire crop, and without older cane harbouring large populations of eldana, the potential for infestation of the subsequent crop was much reduced. Unfortunately, with high levels of eldana at the beginning of the 2019/20 season came the associated poor quality, dead-stick and sour rot. The importance LPD&VCCs place on managing eldana in their control areas is evident in that the area surveyed in 2019/2020 was approximately 30% above the minimum required.

The SASRI Biosecurity Inspectorate undertakes eldana surveys with three primary objectives in mind:

1. monitoring the overall threat posed by the pest to the LPD&VCC control area;
2. assisting growers with decisions relating to fields to carry over; and, linked to that,
3. determining the need for, and success of, spraying operations.

During the report period, a total of 87 253 hectares was inspected for eldana, of which 3 054 hectares (3.5%) were above the local hazard level requiring remedial action, either harvesting or spraying of insecticide. The area of hazard cane remains encouragingly low and similar to previous years. The overall average level of eldana across the industry in 2019 was the lowest for the last three seasons and also below both the five- and fifteen-year average.

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 pest management decisions.

There are success stories from both growers and regions in the effective control of eldana particularly following the use of targeted applications of insecticide. In some cases, spraying is coordinated at regional level. Currently, the area most under threat is the Midlands North although strong efforts are in place to encourage effective scouting and appropriate control where required. Awareness and the implementation of remedial action such as pre-emptive harvesting and spraying insecticide are becoming the order of the day in this region. The protracted dry spring period encouraged the development of eldana populations. Managing varietal susceptibility to eldana is a major consideration for Extension and helping growers manage newer high-producing but sometimes eldana-susceptible varieties has required Extension to provide advice on a balanced approach to farm variety dispositions. A newly registered stubble treatment was being used where high infestations in previous crops were heavily infested. Some success in this regard has been reported.

In most of the coastal regions where eldana had been problematic for many years, significant inroads were achieved in the control of the pest through targeted spraying of insecticide. Areas such as Zululand and the North Coast recorded very low numbers of hazard fields and the average age of cane at harvest has been extended somewhat due to the effectiveness of spraying.

Disease occurrences in 2019/20

Smut and mosaic

These diseases continue to remain at low levels across the industry. As in previous seasons, the total area of surveys in commercial fields continues to be below that required due to the pressure to carry out additional eldana surveys. However, there was an encouraging increase in the area surveyed for diseases with a further approximately 8 000 hectares being surveyed this season compared to the previous year making a total of 34 073 hectares surveyed. Of this surveyed area, 640 hectares (2%) were above the local hazard level. A major problem area was Pongola where 57% of fields inspected recorded smut. Numerous roguing and plough out orders were issued and the majority of these were in fields of the variety N41. This led the Pongola LPD&VCC to request a moratorium on the planting of N41 and to encourage the planting of newer more smut-resistant varieties to reduce the overall smut pressure in the area. In the Mpumalanga Lowveld, the situation remained much improved and no plough out orders were issued. Further south at Umfolozi, Empangeni and Amatikulu, the dry conditions which prevailed in winter and spring proved favorable for the spread of smut and isolated problems were experienced with the smut-susceptible variety NCo376.

Mosaic was mainly confined to the southern and high-altitude regions of the industry. However, overall, mosaic was recorded in only 1% of the total area surveyed and the disease was at very low levels.

High levels of off-types remained a problem in some commercial fields pointing to ineffective crop eradication and volunteer control.

Ratoon Stunt (RSD)

Of the 5 371 commercial fields tested for RSD, 4% were found to be infected. This was lower than the average infection found in the previous season of 5% and lower than the 5-year average of 6.2% fields infected. Of all the regions, Pongola recorded the highest level of infection in commercial fields, an area where an official seedcane scheme only got off the ground in 2019. Of the 1 573 RSD samples taken in seedcane, only 1% of these fields were found to be positive. Compulsory testing of all seedcane fields has largely prevented any infected seedcane 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 within eight years. LPD&VCCs are now actively investigating the establishment of seedcane schemes to benefit all growers. Whilst in a few areas this objective has already been achieved, there are a significant number of other regions where only embryonic seedcane schemes are in operation. The provision of sufficient good-quality seedcane therefore remains the most important challenge facing grower communities.

Current status of seedcane shemes

During the LPD&VCCs Chairmen's meeting, seedcane was once again one of the key focus areas. Each regional committee reported back on progress towards compliance with the 2023 deadline, by which time all commercial fields are to be planted using either LPD&VCC Certified or Approved Seedcane. There were several regional initiatives aimed at starting formal seedcane schemes. Areas such as Malelane, Komati, Pongola, Sezela, Midlands North and Umzimkhulu all held workshops or discussions around establishing schemes. At Sezela it was decided to implement a compulsory scheme and at Pongola heat-treatment tanks were installed for the establishment of certified seedcane nurseries. Efforts were also made to ensure that small-scale growers were able to access new varieties and good quality seedcane in the absence of them establishing their own on-farm nurseries.

During the 2019/20 planting season, 2 436 hectares of Certified and Approved Seedcane Nurseries were approved for use. However, this is only approximately 50% of the area needed to meet the requirements of the 2023 deadline. As an indication of the extent of the shortage of seedcane, the Biosecurity Inspectorate surveyed a further 3 019 hectares of emergency planting material for use giving indication that the industry is currently poorly prepared to meet the deadline and significant work will have to be carried out over the next three years for areas to be compliant.

Other pests and diseases

Both brown and tawny rust were recorded during 2019. The Biosecurity Inspectorate now routinely records the presence and severity of both types of rust, as well as damage caused by thrips and yellow sugarcane aphid. The appearance of sugarcane yellow leaf virus (SCYLV) in sugarcane on the South Coast, particularly in the Sezela area and mainly on variety N12 was again a focus. This disease appears periodically and can affect yield in some fields. There are no effective known control measures once cane is infected with the virus and the only long-term solution would be the introduction of virus-free tissue culture material. However, since insect vectors spread the disease, any clean seedcane would be vulnerable after planting.

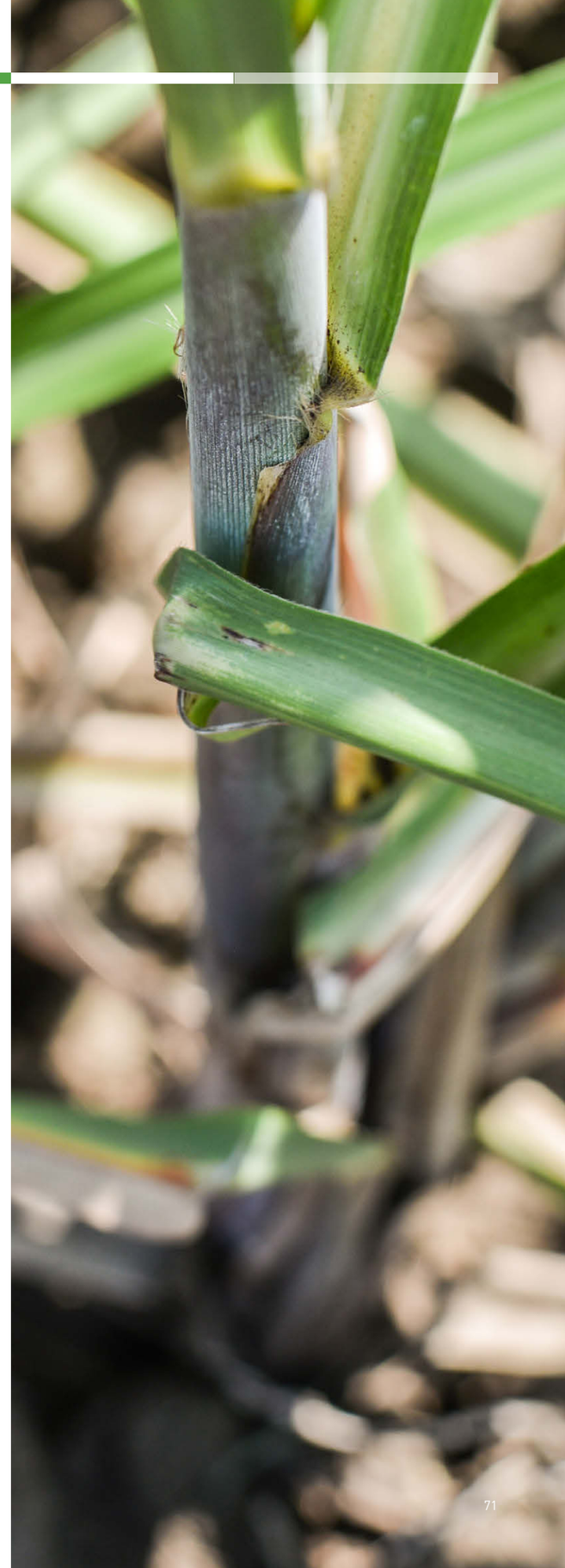
As expected, when there are good autumn rains there were isolated outbreaks of armyworm *(Spodoptera exempta)*. No further incursions of *Spodoptera frugiperda* or fall armyworm in sugarcane were recorded.

White grub caused damage to sugarcane roots in the Midlands and some parts of the coastal regions.

The stem borer *Chilo sacchariphagus* present in sugarcane in central Mozambique and a major threat to the sugar industry in South Africa, is monitored on behalf of SASA by Crop Watch Africa. Possible incursions are intercepted by means of several pheromone moth traps positioned along the KwaZulu-Natal and Mpumalanga borders with Mozambique. Fortunately, there have been no interceptions to date.

Inspectorate

Employees of the Inspectorate are employed by SASRI and work on behalf of the LPD&VCCs providing them with data which is used to make decisions regarding the control of various biosecurity threats. Regular training of employees is undertaken and 2019 saw a round of training revision and evaluation in all areas. Staff turnover is not high and some long-serving and experienced staff members have developed exceptional skills and knowledge in their work. Training in other areas such as supervision, health and safety and discipline management are also undertaken. There has been a project to introduce electronic data capture in the field and this has progressed well enough to start a roll-out over the wider group. The Inspectorate also took delivery of a new fleet of vehicles, accompanied by training and evaluation. The new vehicles have been designed for maximum safety and mobility in the field with the characteristic red-coloured canopy, chosen for ease of identification on farms.



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 a number of external customers, both locally and internationally. 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 SADC partners, South African 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, nematode analyses, crop forecasting, ripener advice and decision-making, soils management and crop performance and management.

SASRI addressed 37 Specialist Advisory Requests (SARs) during 2019/2020.

Extension requests for advice

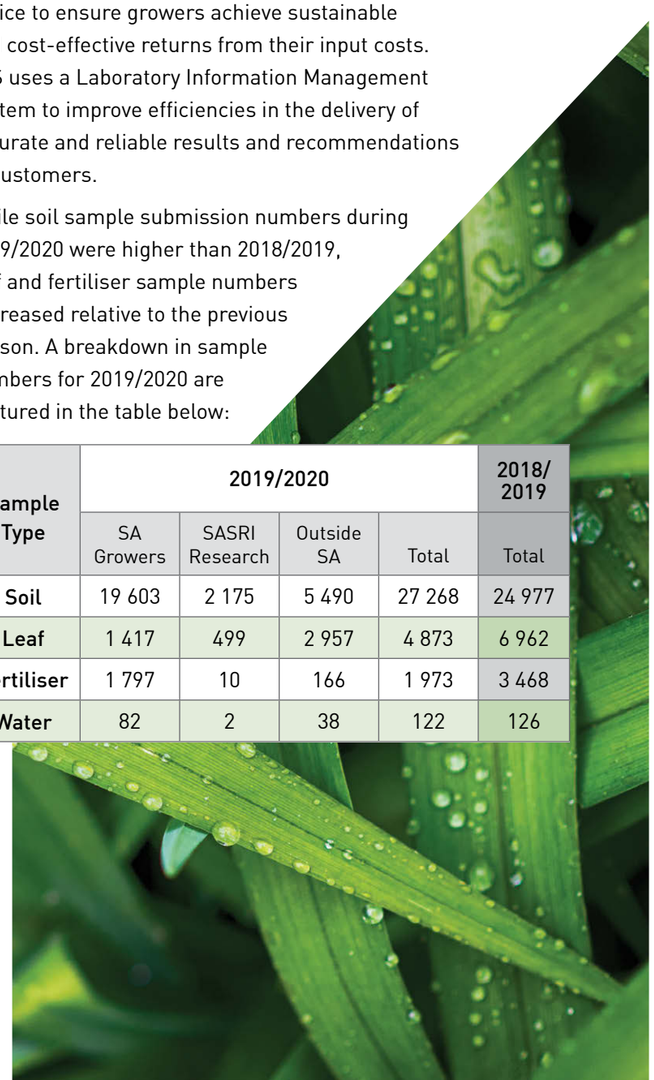
SASRI received 10 requests for advice from Extension Specialists during 2019/2020. These services were provided to growers in addition to and as part of the ongoing service provision to the SA sugar industry.

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.

While soil sample submission numbers during 2019/2020 were higher than 2018/2019, leaf and fertiliser sample numbers decreased relative to the previous season. A breakdown in sample numbers for 2019/2020 are captured in the table below:

Sample Type	2019/2020				2018/2019
	SA Growers	SASRI Research	Outside SA	Total	Total
Soil	19 603	2 175	5 490	27 268	24 977
Leaf	1 417	499	2 957	4 873	6 962
Fertiliser	1 797	10	166	1 973	3 468
Water	82	2	38	122	126



The higher soil sample number received by FAS during 2019/2020 compared to 2018/2019 was mainly attributed to an increase in samples received from estates outside of South Africa and from SASRI research samples. Of the 19 603 samples received from local growers, 3 827 of these were non-cane samples (compared to 2 715 non-cane samples received in 2018/2019). The decline in soil sample numbers received from local sugarcane producers might be a reflection of sugarcane farmers switching to alternative crops. The overall decline in numbers is however still a cause for concern due to the importance of growers being able to identify and adjust their management practices where necessary to prevent harmful soil conditions (e.g. acidity, salinity, nutrient imbalances) from developing. Soil testing forms an essential part of sustainable farming practice.

	2017/2018	2018/2019	2019/2020
SA Growers	23 987	20 288	19 603
SASRI Research	2 004	741	2 175
Outside SA	4 449	3 948	5 490
Total	**30 440**	**24 977**	**27 268**

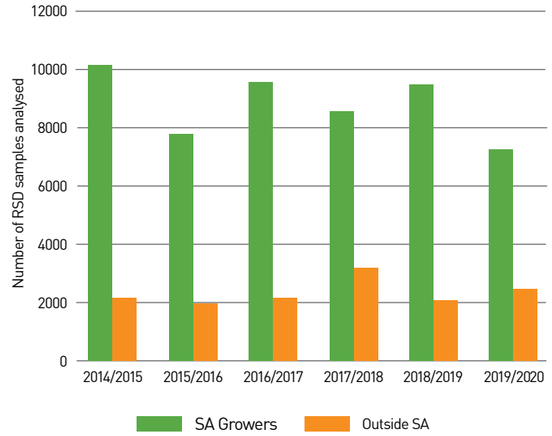
FAS was able to reduce the turnaround time for soil analysis from 10 to 8 working days towards the end of 2019 in an effort to improve service delivery and customer satisfaction.

During 2019/2020, FAS embarked on a marketing campaign. This involved the development of a marketing strategy for FAS with the assistance of an external marketing firm, leading to the launch of the new FAS website (www.fasagrilab.co.za) and the use of social media to market FAS services to a wider farming community.

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 is Ratoon Stunt Disease (RSD) and Yellow Leaf Virus (YLS). During 2019/2020, a total of 9 770 RSD samples were analysed with 7 298 of these samples coming from SA growers and 2 472 from other countries.

The graph below shows the number of RSD samples analysed for South African growers and growers from outside of South Africa from 2014/2015 to 2019/2020.



SASRI also conducted training on a user-pays basis in Malawi and eSwatini on RSD disease surveys, sample collection and diagnostic techniques.

Quarantine

SASRI has a Department of Agriculture, Forestry and Fisheries (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 in order to protect SASRI's Plant Breeders' Rights. SASRI is responsible for obtaining phytosanitary certificates from the Plant Health division of DAFF for the export of any sugarcane from South Africa.

During 2019/2020, disease-free varieties were exported to eSwatini, Sudan, Zambia, Malawi and Tanzania. Du Roi Laboratory, Dube Agrilab and Visacane (France) supply SA varieties to countries where there are Variety Licence Agreements in place. Sugarcane fuzz was exported to Barbados and Zimbabwe.

Weed biocontrol

SASRI entered into a Memorandum of Agreement (1 April 2018 to 31 March 2021) with the Department of Environmental Affairs 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.

During 2019/2020, SASRI mass reared and distributed 157 320 biological agents. The agents are effective for the control of *Pereskia aculeate* (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 2019/2020, a total of 550 DNA sequence and 1 692 DNA fragment analysis runs were conducted. It is standard procedure for all pre-release varieties being considered for bulking to be fingerprinted. All South African commercial varieties have been fingerprinted and this service is regularly used by researchers, Quarantine and Biosecurity for the accurate identification of varieties, pests and diseases.

Mechanisation 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 comment 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;
- transport-related sugar industry RTMS and Smart Trucks (PBS) meetings; 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 are able to 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 during 2019/2020. 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.

During 2019/2020, SASRI provided a service to the Institute of Commercial Forestry Research (ICFR) to patch weather data.

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 are 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.

Technology Development and Knowledge Exchange

Michelle Binedell
(Knowledge Manager)

"An investment in knowledge always pays the best interest"
Ben Franklin

Moving scientific outcomes into practice on the ground requires a team of dedicated practitioners who are adept at transforming outcomes into understandable and appealing products.

This is the responsibility of the Knowledge Management Unit, a small group who work closely with SASRI scientists and Extension Specialists to ensure that research outcomes are accessible, easy-to-use and appealing to engage with.

Popular publications

In the 2019/20 year SASRI continued to produce *The Link* and *Ingede* magazines aimed at our English/Afrikaans and isiZulu speaking growers respectively. These editions focussed on many of the issues that were raised by the industry during our annual Research, Development and Extension workshop that took place in March 2019, along with issues that were pertinent to specific regions. A particular focus was on Yellow Sugarcane Aphid and the approaches used to manage its impact.

The Link

Four editions of *The Link* were published in 2019/20 with a focus on pest and disease control, nutrient management, ripener application, soil compaction, irrigation, environmental sustainability and alien invasive plant control.

The Ingede

The *Ingede* focussed on important aspects of sugarcane agriculture for the small-scale grower. Topical tips (a regular feature of each *Ingede*) are appropriate for each month in the farming calendar and provided clear guidance on management interventions and necessary activities to ensure a good crop.

Three editions contained 16 articles of interest focussing on green cane harvesting, disease control, seedcane production, pest control (particularly Yellow Sugarcane Aphid), cane quality, nutrient management, yield estimates, herbicide efficacy and the effectiveness of roadshows and youth programmes in encouraging adoption of good practice.

Other newsletters and articles

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

Eight articles were produced for *Coastals News*, once again showcasing SASRI's achievements and promoting best practice and a further three articles were published in the *South African Sugar Journal*.

Booklets and guides

Mechanisation reports

Annual updates of the Mechanisation Reports were completed and posted to the SASRI website. These provide the costings of different equipment and machinery systems as well as the costings of a range of system scenarios including land preparation, planting and ratoon management.

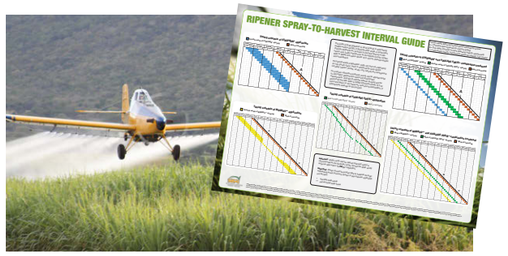
Identification of pests and diseases

A 2020 update of the Pest & Disease pocket guide was published and translated into isiZulu. The guide contains a collection of pictures and identifiable traits enabling easy identification of all common pests and diseases found in the South African sugar industry. This pocket guide is useful for on-farm scouting teams, Biosecurity teams and growers who require a quick reference in the field. The updated version includes new information on pests such as Yellow Sugarcane Aphid and nematodes.

Ripener poster

A new poster guide was created to assist sugarcane growers with deciding on appropriate times of the year for applying chemical ripeners, either to ripen sugarcane or for late-season quality maintenance. These timings have been done for all individual and combination chemical treatments with the consideration of the different harvest months.

Selecting the correct timing for chemical treatments is crucial to ensure efficacy of treatments and is dependent on many factors including location, climate, variety, crop maturity and management.



SUSFARMS®

The sugar industry's Sustainable Sugarcane Farm Management System, SUSFARMS® is a management system that has evolved into a useful tool for facilitating the production of sugarcane in a profitable, sustainable and environmentally responsible manner.

The 4th edition of SUSFARMS® was released in 2019. The system includes two useful resources –

- A **Manual**, which serves as a repository of better management practices and legal requirements. This acts as a guide to growers on how to implement practices that reduce negative impacts on the environment, maintain worker health and safety while encouraging financial compliance.
- A **Progress Tracker** in the form of an Excel spreadsheet that allows growers to perform a self-assessment. This helps to establish the extent to which best practices have been implemented.

The system can be used effectively by farm managers to evaluate their current best farming practices and, more importantly, consider other practices they can implement in the future to improve their farms.

Tools

MyCanesim Lite

A new mobile app called MyCanesim Lite was launched. The app is a simplified version of the MyCanesim model, requiring only eight inputs from drop down lists, for quick simulation of sugarcane crop growth, water use and yield. Potential applications of the tool include benchmarking and forecasting of sugarcane yields and water use.

Pur*Est*®

A new update to the Pur*Est*® smartphone app was released in February 2020 to assist in ripener decision-making. This update refines the spray date guide so that there are no inconsistencies between the smartphone app recommendations and SASRI Information Sheets 12.3 – 12.5. In addition, the spray-to-harvest interval is also provided with the recommended spray date.

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. A series of five information sheets on chemical ripening were updated with latest information as well as four information sheets on the newly released varieties N69, N70, N71 and N72. A further information sheet was created on irrigation water quality.

Radio

During 2019/20, radio broadcasts continued to reach many of the rural communities in South Africa. Broadcasts focussed on important agronomic issues facing isiZulu speaking small-scale growers. Phone-in question-and-answer sessions proved very useful in addressing specific issues raised by radio listeners. These broadcasts were also used to advertise resources available to growers and encouraged growers to contact their nearest Agricultural Advisor for support.

Grower interaction

Significant face-to-face interaction with industry stakeholders in 2019/20 served to effectively transfer best practice, research outcomes and technical know-how, thereby informing the industry of new advancements. Extension Specialists and researchers conducted over 1 695 visits to growers, hosted 139 grower days and exhibitions and were involved in 276 conferences, workshops, refresher courses, seminars and demonstrations. SASRI hosted 812 visitors to our site and Extension Specialists attended 373 Industry meetings.

Certificate courses

The demand for skills development and training in sugarcane agriculture has continued to increase into 2019/20. SASRI responded to this demand again by delivering two three-week Junior Certificate Courses in Sugarcane Agriculture in April and October 2019. A total of 110 students attended the Junior Courses, 78% from South Africa and the balance from Eswatini and Malawi.

Two Senior Certificate Courses, which are aimed at tertiary-level students, were held in June 2019 and February 2020 with 91 students attending. Over 67% of students were South African applicants while the balance of students were from Eswatini, Zambia, Tanzania, Zimbabwe and Malawi.

Online presence

At the end of the 2017/18 financial year, a new website was released which contained more user-friendly features and content. In the 2019/20 year, the website was further updated and now hosts an eLibrary that has replaced the former InfoPack CD. This addition allows instant access to immediately published updates and serves as a one-stop site for all SASRI publications, videos, decision-support-tools and services provided to the industry.

SASRI has furthered its reach by implementing a "news alert" feature on the website to which industry stakeholders are encouraged to subscribe. This ensures that stakeholders are alerted as soon as content is published, or important information needs to be shared.

Furthermore, more frequent use of social media platforms such as LinkedIn and WhatsApp have proved valuable for disseminating SASRI outcomes and products.

Publications and Presentations

Scientific Journal Publications

Conlong DE, Bam A and Addison P (2020). Acridid ecology in the sugarcane agro-ecosystem in the Zululand region of KwaZulu-Natal, South Africa. *Journal of Orthoptera Research 29:9*.

Evans DL, Hlongwane TT, Joshi SV, Riaño Pachón DM (2019). The sugarcane mitochondrial genome: assembly, phylogenetics and transcriptomics. *PeerJ 7*:e7558.

Hovhannissian G, Podwojewski P, Le Troquer Y, Mthimkhulu S, and Van Antwerpen R (2019). Mapping spatial distribution of soil properties using electrical resistivity on a long term sugarcane trial in South Africa. *Geoderma*, 349:56-67.

Javal M, Thomas S, Lehmann P, Barton MG, Conlong DE, Du Plessis A and Terblanche JS (2019). The effect of oxygen limitation on a Xylophagous insect's heat tolerance is influenced by life-stage through variation in aerobic scope and respiratory anatomy. *Front. Physiol.* 10:1426.

Jones MR, Singels A, Chinorumba S, Patton A, Poser C, Singh M, Martiné J-F, Christina M, Shine J, Annandale J and Hammer G (2019). Exploring process-level genotypic and environmental effects on sugarcane yield using an international experimental dataset. *Field Crops Research* 244:107622.

Mbuma N, Zhou MM and van der Merwe R (2020). Estimating breeding values of genotypes for sugarcane yield using data from unselected progeny populations. *Euphytica* 216:2.

Otim D, Smithers JC, Senzanje A and Van Antwerpen R (2019). Assessment of trends in run-off and sediment yield from catchments under sugarcane production and management practices. *International Sugar Journal* 121: 216-219.

Otim D, Smithers JC, Senzanje A and Van Antwerpen R (2019). Design norms for soil and water conservation structures in the sugar industry of South Africa. *Water SA* 45: 29-40.

Santchurn D, Badaloo GMH, Zhou MM and Labuschagne MT (2019). Genetic studies on sugar and fibre accumulation patterns among different types energy canes in Mauritius. *Sugar Tech* 21(6):879-890.

Singels A, Paraskevopoulos AL and Mashabela ML (2019) Farm level decision support for sugarcane irrigation management during drought. *Agricultural Water Management* 222: 274-285

Singels A, Sithole P, Van Niekerk A and Muller SJ (year). Assessing the fidelity of Landsat based fAPAR models in two diverse sugarcane growing regions. *Computers and Electronics in Agriculture* 170:105248.

Snyman SJ, Naidoo M, MP Watt and Rutherford RS (2019). An in vitro screening system to assess aluminium toxicity in sugarcane (Saccharum spp.) *In Vitro Cellular and Developmental Biology – Plant* 55:403-408.

Van Heerden PDR (2019). Response of selected South African coastal sugarcane varieties to chemical ripeners: Active ingredient effectiveness and associated impacts on grower and miller sustainability. *International Sugar Journal* 121: 902-904.

Conferences proceedings

Hoffman N and Singels A (2019) Evaluating the use of aerially captured spectral data for characterising drought-tolerance traits in sugarcane. *Proceedings of the Australian Society of Sugar Cane Technologists*, Australia. 30 April - 3 May 2019.

Hoffman N, Singels A and Joshi S (2020). Remote sensing of physiological traits with drones to assist sugarcane breeding: Preliminary results. *Combined Congress of the South African Society for Crop Production, Soil Science Society of South Africa, Southern African Society for Horticultural Sciences and Southern African Weed Science Society*, Bloemfontein. 20-23 January 2020.

Jacob RM (2019). Use of the CHPC to uncover resistance mechanisms in sugarcane. *Centre for High Performance Computing 2019 National Conference*, Johannesburg. 4 December 2019.

Javal M, Chapuis M-P, Benoit L, Smit C, Conlong DE and Terblanche JS (2019). Does host plant drive variations in microbial gut communities in a recently shifted pest? *Proceedings of the 21st Congress of the Entomological Society of Southern Africa*, Umhlanga. 8 - 11 July 2019.

Jones MR, Singels A, Chinorumba S, Patton A, Poser C, Singh M, Martine JF, Christina M, Annandale J, Hammer G (2020). Assessment of two sugarcane models for predicting genotype by environment interactions, using an international dataset. *Proceedings of the International Crop Modelling Conference iCropM*, France. 3 to 5 February 2020.

Madiope KW, Keeping MG, de Villiers F (2019). Estimation of yield loss to yellow sugarcane aphid *Sipha flava* Forbes in South African sugarcane varieties. *Proceedings of the 21st Congress of the Entomological Society of Southern Africa*, Umhlanga. 8 - 11 July 2019.

Masukume S, Berner JM, van Heerden PDR and Singels A (2020). Effects of elevated carbon dioxide and water deficit interaction on sugarcane water use and yield: an experimental and crop modeling study (oral presentation). *46th congress of the South African Association of Botanists. Phuthaditjhaba*, South Africa, 7 - 10 January 2020.

Ramouthar P and Joshi SV (2019). Towards improved resistance to nematode in sugarcane: Preliminary studies. *Twenty-second Symposium of the Nematological Society of Southern Africa*, Mpumalanga. 12 - 15 May 2019.

Rutherford RS, McFarlane SA, Memela NS and Snyman SJ (2019). Harnessing the sugarcane microbiome for improved resistance to the stalk borer *Eldana saccharina Walker. Proceedings of the 21st Congress of the Entomological Society of Southern Africa*, Umhlanga. 8 - 11 July 2019.

Rutherford RS (2019). Host-mediated microbiome engineering for the control of soilborne plant disease. *29th Annual Soilborne Plant Diseases Symposium*, Stellenbosch. 18 - 19 September 2019.

Rutherford RS, McFarlane SA, Memela NS and Snyman SJ (2019). Harnessing the sugarcane microbiome for improved resistance to the stalk borer *Eldana saccharina Walker (Lepidoptera: Pyralidae). Proceedings of the International Society of Sugarcane Technologists*, Argentina. 3 – 5 September 2019.

Rutherford RS (2019). Host-mediated microbiome engineering for the control of soilborne plant disease. *29th Annual Soilborne Plant Diseases Symposium*, Stellenbosch. 18-19 September 2019.

Singels A, Jones MR and Lumsden TG (2019) Potential for sugarcane production under current and future climates in South Africa: Sugar and ethanol yields, and crop water use. *Proceedings of the International Society of Sugar Cane Technologists*, Argentina. 3 – 5 September 2019.

Singels A, Jones MR and Hoffman N (2020) Can crop physiology knowledge enhance sugarcane breeding? *Combined Congress of the South African Society for Crop Production, Soil Science Society of South Africa, Southern African Society for Horticultural Sciences and Southern African Weed Science Society*, Bloemfontein. 20-23 January 2020.

Smithers JC, Otim D, Senzanje A and Van Antwerpen R (2019). Surface water control with contour structures – using the CoSDT calculator and its design. *South African Sugar Industry Agronomists' Association Symposium*, Mount Edgecombe. 24 October 2019.

Smit C, Javal M, Lehmann P, Conlong DE and Terblanche JS (2019). Determination of potential host plants, and the metabolic costs of digestion on alternate hosts, in an emerging pest of sugarcane, *Cacosceles newmannii. Proceedings of the 21st Congress of the Entomological Society of Southern Africa*, Umhlanga. 8 - 11 July 2019.

Zhou MM (2019). Potential of exploiting additive and nonadditive genetic effects in sugarcane breeding. *Proceedings of the International Society of Sugarcane Technologists*, Argentina. 3 – 5 September 2019.

Theses and dissertations

Maharaj L (2019). Characterisation of the acetolactate synthase gene in herbicide-resistant sugarcane and across grass species. MSc thesis, University of KwaZulu-Natal. Supervisors: M Ghai and S Joshi.

Masukume S (2020). Effects of elevated carbon dioxide and water deficit interaction on sugarcane water use and yield: an experimental and crop modeling study. MSc Thesis, North-West University. Supervisors: J Berner (NWU) and PDR van Heerden (SASRI).

Mishasha T (2019). Family evaluation for quality traits in sugarcane. MSc thesis, University of the Free State. Supervisors: M Labuschagne, MM Zhou and R van der Merwe.

Mndzawe DM (2019). Spatial variability of salts in soil: a case study of centre pivot irrigated sugarcane. MSc thesis. University of the Free State. Supervisors: R van Antwerpen, JH Barnard and LD van Rensburg

Otim D (2020). Development of updated design norms for soil and water conservation structures in the sugar industry of South Africa. PhD thesis, University of KwaZulu-Natal. Supervisors: JC Smithers, A Senzanje and R van Antwerpen.

SASTA Publications

Campbell PL and Govender P (2019). The SASRI Herbicide Guide goes digital! *Proceedings of the South African Sugar Technologists' Association* 92:31.

Campbell PL and Tweddle PB (2019). Calculators to assist with calibrations for herbicide application in the South African sugarcane industry. *Proceedings of the South African Sugar Technologists' Association* 92:35

Dube S and Singels A (2019). The effect of soil water deficit on primary shoot emergence of two sugarcane varieties grown on bare and mulched soil. *Proceedings of the South African Sugar Technologists' Association* 92:56 – 59.

Elephant DE, Titshall LW and Mthimkhulu SS (2019). Sulphur status of soils from Southern African sugarcane-producing regions. Proceedings of the South African Sugar Technologists' Association 92:69-72.

Gumede S, van Antwerpen T, Sweby D and Rutherford RS (2019). Development of real-time quantitative polymerase chain reaction to detect and quantify smut infection in sugarcane varieties. *Proceedings of the South African Sugar Technologists Association* 92:37.

Jacob RM, Potier BAM, Keeping MG and Rutherford RS (2019). Use of genomics data to uncover herbivore-induced resistance mechanisms in sugarcane. *Proceedings of the South African Sugar Technologists' Association* 92: 34.

Jones MR, Singels A, Chinorumba S, Patton A, Poser C, Singh M, Martine JF, Christine M, Shine J, Annandale J and Hammer G (2019). Exploring process-level genotypic and environmental effects on sugarcane yield using a global growth analysis experimental dataset. *Proceedings of the South African Sugar Technologists' Association* 92:51 - 55.

Jumman A and Bezuidenhout C (2019). Proposing a theoretical framework to explain adoption dynamics within a community. *Proceedings of the South African Sugar Technologists' Association* 92:58-61.

Khubeka PPN, Thompson IB and Gillespie D (2019). Investigating the influence of moisture stress on the normalized difference vegetation index on the Entumeni sugar estate. *Proceedings of the South African Sugar Technologists' Association* 92:30.

Lichakane ML and Zhou MM (2019). Realised selection gains for Eldana saccharina borer resistance in the coastal long cycle regional breeding programme of South Africa. *Proceedings of the South African Sugar Technologists' Association* 92:171-175.

Mbuma NW, Zhou MM and Van der Merwe R (2019). Determining the breeding values of parental genotypes of sugarcane for biomass yield. *Proceedings of the South African Sugar Technologists' Association* 92:74-78.

Mbuma NW, Zhou MM and Van der Merwe R (2019). Family by environment interactions for sugarcane yield in South Africa. *Proceedings of the South African Sugar Technologists' Association* 92: 162-166.

Mishasha T, Zhou MM and Van der Merwe R (2019). Using quantitative genetic parameters to determine sample size for sucrose content in sugarcane breeding. *Proceedings of the South African Sugar Technologists' Association* 92:43-46.

Msani F and Zhou MM (2019). Effect of tramline and continuous row spacing on cane yield traits and brix of sugarcane families. *Proceedings of the South African Sugar Technologists' Association* 92:176-178.

Mthimkhulu SS, Titshall LW, van Antwerpen R, Lerch TZ and Podwojewski P (2019). Effect of sugarcane residue retention and fertiliser application on soil microbial abundance and community structure. *Proceedings of the South African Sugar Technologists' Association* 92:64 - 68.

Nxumalo PD and Zhou MM (2019). Phenotypic correlations of leaf-shedding and fibre content with yield and quality traits in sugarcane genotypes. *Proceedings of the South African Sugar Technologists' Association* 92:167-170.

Otim D, Smithers J, Senzanje A and Van Antwerpen R (2019). Verification of runoff volume, peak discharge and sediment yield simulated using the ACRU model for bare fallow and sugarcane fields. *Proceedings of the South African Sugar Technologists' Association* 92:77-81.

Poswa LZ, Titshall LW and Elephant D (2019). Current acid saturation status of the soils in rainfed regions of the South African sugar industry soils and the frequency of subsoil sampling. *Proceedings of the South African Sugar Technologists' Association* 92:60-63.

Ramouthar PV and Pillay U (2019). Update on nematicide screening within the South African sugar industry. *Proceedings of the South African Sugar Technologists' Association* 92:36.

Shandu NM, Zhou MM and Sibiya J (2019). Effect of genetic background on phenotypic correlations in sugarcane breeding. *Proceedings of the South African Sugar Technologists' Association* 92: 47-50.

Shinga L, Zhou MM and Sibiya J (2019). Genotype by environment interaction effect on genotypes selection among regional variety trials in South Africa. *Proceedings of the South African Sugar Technologists' Association* 92: 39-42.

Singels A, McFarlane SA, Basdew I, Keeping MG, Nicholson R, Pilusa T, Sithole P and Titshall LW (2019). Review of South African sugarcane production in the 2018/19 season: Too much of a good thing? *Proceedings of the South African Sugar Technologists' Association* 92: 1-16.

Sithole P, Singels A, Muller SJ and van Niekerk A (2019). Evaluating the accuracy of satellite-derived sugarcane canopy cover estimates for two diverse production regions in South Africa for potential use in crop estimation (Short Communication). *Proceedings of the South African Sugar Technologists' Association* 92:200-204.

Thompson IB, Mchunu LN, Zhou MM, Van Antwerpen R, Mchunu M, Jalisa M and Collings K (2019). Usefulness of soil apparent electrical conductivity (ECa) as an indicator of soil properties in research trials. *Proceedings of the South African Sugar Technologists' Association* 92:32.

Titshall LW, Elephant DE and Magagula N (2019). Evaluation of a reduced extraction time to improve the efficiency of routine analysis of resin extractable phosphorus and sulphur. *Proceedings of the South African Sugar Technologists' Association* 92:82-85.

Tweddle PB and Harris AJ (2019). Use of remote sensing to determine intra-field yield variability. *Proceedings of the South African Sugar Technologists' Association* 92:33.

Van Antwerpen R and Mthimkhulu SS (2019). Comparing the effect of fertiliser with no fertiliser on soil properties to 600 mm depth after 79 years of sugarcane cultivation. *Proceedings of the South African Sugar Technologists' Association* 92:73 - 76.

Van Heerden PDR (2019). Response of selected South African coastal sugarcane varieties to chemical ripeners – Active ingredient effectiveness and associated impacts on grower and miller sustainability. *Proceedings of the South African Sugar Technologists' Association* 92:18 – 21.

SASA
SOUTH AFRICAN SUGAR ASSOCIATION

SOUTH AFRICAN SUGARCANE RESEARCH INSTITUTE

170 Flanders Drive, Mount Edgecombe, 4300

Private Bag X02, Mount Edgecombe, 4300

Tel: (031) 508 7400 Fax: (031) 508 7597

ISSN: 978-1-990989-41-4

www.sasri.org.za