



2018/19

PROGRESS REPORT



2018/19 Highlights



New and updated mobile applications

- MyCanesim Lite, PurEst® update



New desktop decision support tool

- Herbicide Selector



New and updated publications

- Booklet on Sugarcane Pests of Southern Africa
- Illustrative Guide to Sugarcane farming (English and isiZulu)
- Updated Pest & Disease pocket guide



Capacity development

- Regional modular courses continued successfully in Midlands and North Coast
- 116 students attended the Senior Certificate Course
- 113 students attended the Junior Certificate Course



Contact events

- 1 640 Visits to growers
- 919 Visitors hosted at SASRI
- 147 Grower days
- 315 Conference presentations, workshops, refresher courses, seminars and demonstrations given



Radio

- 80 programmes at 10 radio stations



3 New varieties [N66, N67 and N68] with increased RV yields and improved pest and disease resistance.



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.



New research projects launched into control options for Yellow Sugarcane Aphid, following widespread infestations of this new pest in the industry.



Longhorn beetle containment continued successfully through the year with no new infestations reported.



Low eldana numbers and a visibly successful reduction of its negative impacts on yields continued. Approximately 85 000 hectares were surveyed.



Several blue-label agrochemicals registered for eldana control greatly assisted coastal growers to age their cane and achieve improved yields.



A commercially available DNA-based technology successfully tested for the detection of SCMV, SCYLV and RSD in sugarcane.



Registration of a new agrochemical that can be used as a nematocide, thripicide and aphicide.



South Coast growers demonstrated a keen interest in the SUSFARMS® Progress Tracker resulting in SASRI-led meetings and workshops in their area.



- 1 PhD and 4 MScs awarded to students at SASRI.
- 14 Honorary academic positions held at South African universities.



6 researchers won awards for conference presentations.



12th 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.



Deadline launched for compulsory seedcane schemes to be in place in all areas by year 2023.

SRASA committee and SASRI management

(1 April 2018 – 31 March 2019)

SRASA COMMITTEE

| | |
|---------------|--|
| Chairman | S Naidoo |
| Vice-Chairmen | HR Hackmann (until May 2018 but resumed in November 2018 to current) LO Hlubi (from November 2018 to current) PW Russell (from August until October 2018) |

SACGA Representatives

TB Funke
D Lütge (from August 2018 to current)
S Mashaba
TJ Murray
S Repinga (from August 2018 to current)
AM Russell
S Sharma
GD Stainbank
REG Talmage
F Willis
KM Hurlly (alternate)
GDP Littlely (alternate)
GW Taylor (until May 2018)

SASMA Representatives

EA Brüggemann
JPM de Robillard
J Dewar
N Dlodlo
FM Eggers
AJ Harris
DP Rossler
PW Russell (from November 2018 to current)
D van Rooy
JDP Erasmus (alternate)
RB Lütge (alternate)
D Singh (alternate)
D Sutherland (alternate)
AT Wynne (alternative)
RS Ninela (until May 2018)
CJ Galloway (alternate until May 2018)

SAFDA Representatives

NR Mbuyazi
PV Moodley
BC Ngidi
TR Pilusa (from November 2018)
TG Sibiya
MT Gumede (alternate)
M Mkhabela (alternate from August 2018)
SS Ripinga (alternate until May 2018)

SASA Representatives

CM Baker
M Govender (until November 2018)
P Mpofo
R Stranack
MK Trikam
DA Watt
R Mahadeo (Secretary)

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: S Buthelezi (until end November 2018) /
D Sweby (from March 2019)
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



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CHAIRMAN'S REPORT

SURESH NAIDOO



The past year has been a particularly difficult one for the sugar industry as it continued to grapple with a number of serious challenges. SASRI was not unaffected by these pressures, however it continued to perform effectively and remained responsive to industry requirements.

During the course of 2018/2019, the Sugarcane Research and Sustainable Agriculture (SRASA) Committee met on five occasions to consider and make recommendations on various matters.

■ Curtailment of budgets meant that several specialist and scientist positions could not be filled, and where there were capacity constraints, some projects were placed on hold. The increasing trend of projects being placed on hold, escalated from one in 2012/2013 to 12 in the 2018/2019 season, and is of concern. It largely reflects the resource constraints and expertise gaps that are consequences of budget pressures. Further, considerable strain on SASRI operations and the roll out of the R&D programmes was exerted by the unprecedented interim approval of the annual 2019/2020 budget, while the industry associations considered the future, functions and affordability of the sugarcane research institute.

■ Extensive discussions around the land requirements required to support the research and development (R&D) programmes at Mount Edgecombe and at SASRI's other research stations, resulted in agreement that all available arable land at Mount Edgecombe was necessary and should be secured. Amongst the remote research stations, the earlier agreement to relinquish the Kearsney station to a land claim resulted in completion of the conversion of the station into a commercial farm at the end of 2018. The decision to curtail the extent of the land on the leased research stations in the Midlands (approximately 50 hectares in size), culminated in agreement that one of them (Glenside) be returned to the owner in 2023 when the lease expires. Fortunately, an alternative 50-hectare site required to sustain the plant breeding programme has been identified in the area.

■ Increasing demand for production of land-use plans raised the debate around the delivery of this service, once again. Since the SASRI resources required to produce these plans were curtailed in 1997, and its capacity to produce the plans ceased, a significant backlog of requests for land use plans had accumulated. The Committee called for and considered an estimation of the requirements for delivery of the service, but were unable to recommend a way forward.



- The SRASA Committee was required to serve as the Local Pest, Disease and Variety Control Committee (LPD&VCC) in the Sezela area in an interim capacity, while it intervened in resolving the impasse regarding local representation on the LPD&VCC. It is pleasing to report that the matter was resolved and local representation and leadership were restored.
- The requirement for the industry to comply with the industry's Local Pest, Disease and Variety Control Rules that were set out in 2015 was highlighted in the discussions around the campaign launched to achieve the 2023 deadline for deployment of approved and certified seedcane for all new sugarcane plantings. Considerable discussions around the need for certified and approved sources of seedcane were also held.
- In support of the newly launched Genetic Modification (GM) programme, the Committee recognised the importance of a comprehensive communication strategy associated with the development and release of a GM product, and participated in a GM communication workshop in April 2018. This resulted in an agreement on the approach and management of the strategy.

Over the past decade, SASRI has defined and refined its operations to meet the needs expressed by South African sugarcane growers. However, in the

ever-changing landscape in which the industry finds itself, the importance of being agile and responsive to changing technology needs in the sector is becoming apparent. Emphasis on serving the wide spectrum of sugarcane growers and their diversified operations is likely to become increasingly important, and it is anticipated that this will influence future programmes of work.

This annual Progress Report outlines a range of accomplishments over the past season, and demonstrates the value and contributions made by SASRI towards the sustainability of the sugarcane industry. As we move forward into the 2019/2020 season, the challenges facing the industry continue unabated, and it is expected that SASRI will respond to these and position itself to deliver innovative technologies in a creative and responsive manner.

DIRECTOR'S REPORT

Dr Carolyn Baker (SASRI Director)



Research, development and innovation (RDI) is SASRI's core business. Over the past year, and amidst the significant challenges facing the industry, we have continued to deliver on our mandate to serve the South African sugar industry and provide profitable and sustainable solutions to all of our growers.

A significant proportion of SASRI's resources is focused on developing and delivering varieties that have enabled the development of the sugar industry in South Africa, and which are bred specifically to withstand the marginal conditions in the industry. To ensure that our Variety Improvement programme is efficient and cost-effective, an external review of the Variety Improvement programme was conducted in late 2017. The results provided valuable assurance and direction for planning the re-organisation of the plant-breeding programme to achieve significant savings. At the same time and prompted by the requirement to withdraw from the Kearsney Research Station, a detailed RDI investment analysis of the plant breeding function and associated research stations was conducted. It provided industry stakeholders with the least-risk disinvestment options for plant breeding that would not jeopardise delivery of new varieties. In the past season, SASRI released three varieties (N66, N67 and N68) and the industry approved a further four for bulking and gazetting (N69, N70, N71 and N72).

SASRI's role in developing and delivering solutions that promote the viability and profitability of every crop begins at planting and includes addressing soil health problems. Over the past year, several initiatives to unlock the full potential of sugarcane received considerable focus.

- A campaign to achieve compliance with industry regulations associated with the use of certified or approved seedcane for all new commercial plantings of sugarcane by 2023 was launched.
- The registration of several blue-label agrochemicals and their implementation in a well-defined spray programme made a significant contribution to enabling embattled coastal growers to control their eldana levels and age their cane to achieve improved yields.
- Efforts to encourage and inform growers of the benefits of ripening under specific conditions continued, and adoption of SASRI's **PurEst**® app to determine crop maturity and aid in ripening decision-making was widespread.

The importance of remaining abreast of all biosecurity threats was greatly enhanced by our close relationship with the activities of the Local Pest, Disease and Variety Control Committees (LPD&VCCs). Good progress was made in containing the longhorn beetle incursion in Entumeni, and there was renewed focus on the yellow sugarcane aphid invasion, particularly in the coastal regions. This pest remains widespread throughout the industry and is particularly difficult to control, mainly due to the lack of knowledge



regarding its ecology and biology. An ephemeral pest with a significant capacity to reproduce exponentially, it seldom remains long enough in one field to enable trials to investigate the environmental characteristics that trigger their explosion.

In this past year, a number of projects closed out, with several focused on aspects of genetic modification (GM), achieving valuable outcomes. In particular, the successful demonstration under glasshouse conditions of improvement in drought tolerance through the over-expression of genes with drought responsive promoters provided a firm basis for future field studies. In the biosafety studies for GM Bt sugarcane, a low likelihood of cross-pollination between a GM variety and surrounding vegetation was established. This has provided guidelines for the extent of the refugia required when planting up a GM crop, to avoid the development of resistance to the Bt protein.

Despite the acknowledged importance of good soil health and the recognition that knowing your soil is fundamental for achieving optimal yields, the extent to which all growers make use of the Fertiliser Advisory Service was disappointing. The number of samples being analysed continued to decrease, raising serious concerns about the viability of the service. A renewed interest in farming with the aid of a land-use plan led to serious consideration of how this particular service could be re-introduced. For most of the growers in the industry, the cost of a land-use plan is prohibitive, as are the costs associated with soils analysis. Promoting the understanding of

the specific value of these two activities are the subject of several technology exchange initiatives and projects in the forthcoming season.

Work with SUSFARMS® continued, with a specific focus on its adaptation to meet the needs of all sugarcane growers. This has been achieved by enabling small-scale growers in particular, to de-select sections of the assessment tool that are not relevant to their farming enterprises. To ensure full understanding of SUSFARMS®, it is intended that the updated version be translated into preferred languages accompanied by explanations of technical terms.

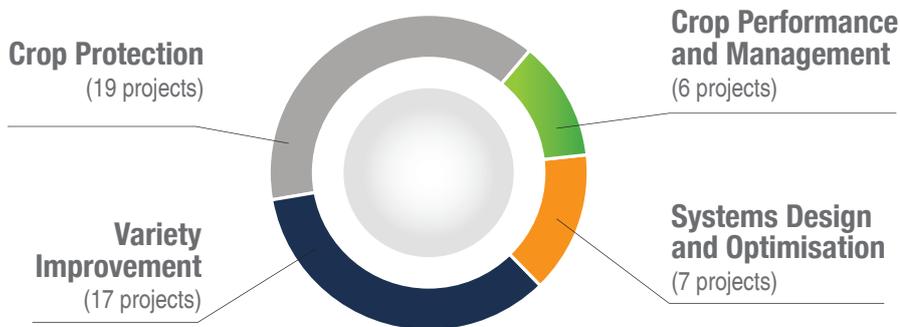
Sustaining research and development in the face of significant industry landscape challenges is not easy. Nevertheless, the resilience and innovation demonstrated by SASRI's people has been notable, and despite curtailment of a number of projects due to resource constraints, their steadfastness and commitment to SASRI, its RDI programmes and the industry has been commendable. Looking forward, SASRI's commitment to rigorous and responsive science that delivers useful outcomes for sustainable farming will continue to serve sugarcane growers in meeting their agricultural challenges.

2018/2019 RESEARCH PROGRESS REPORT

Dr Derek Watt (Research Manager)

Delivering research outcomes and technologies that promote industry profitability and sustainability.

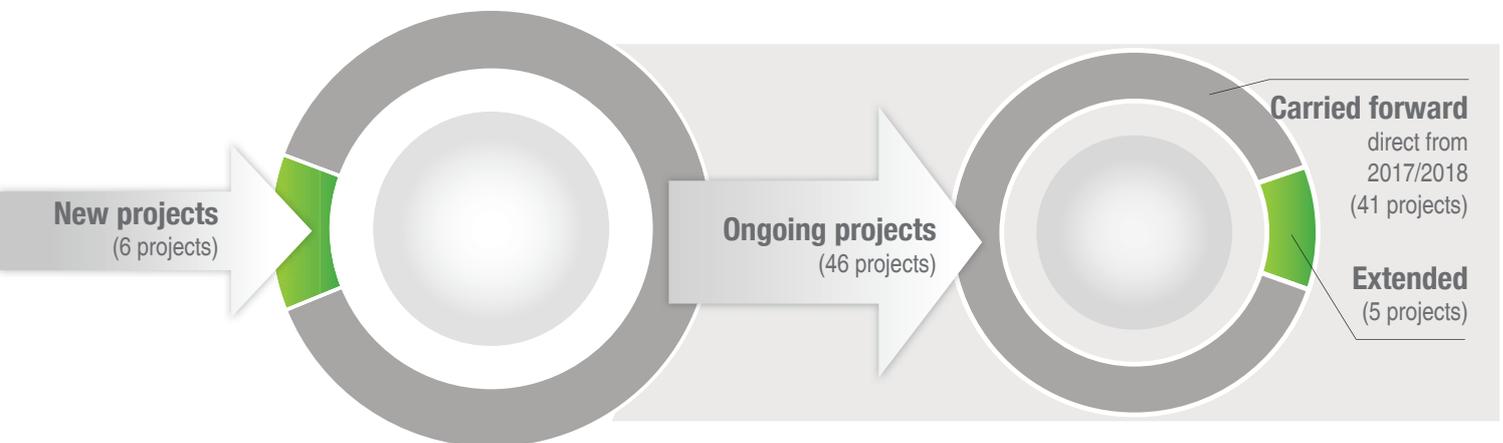
2018/2019 project portfolio



Motivation For Portfolio Of New Projects

Projects were initiated primarily as responses to Grower and Miller requests mediated through the industry Research, Development and Extension (RDE) process





FOCUS AREAS

Variety Improvement Research

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

Crop Protection Research

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

Crop Performance and Management Research

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

Systems Design and Optimisation Research

Developing and sharing innovative systems that optimise industry performance.

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.

FOCUS AREAS

1. Sugarcane Breeding and Associated Enabling Technologies
2. Sugarcane Variety Performance Evaluation
3. Sugarcane Biotechnology

Highlights

Sugarcane breeding and associated enabling technologies

- Varieties N69 (midlands and high altitude 18-24 month cycle on humic and sandy soils), N70 (irrigated 12-month cycle for late season), N71 (irrigated 12-month cycle for late season) and N72 (coastal rainfed 12-14 month cycle on average and high potential soils) were approved for bulking.

- Novel evolutionary, domestication and genetic relationships of sugarcane have been uncovered to guide the successful future breeding of stress-resilient varieties.
- The relationship between SASRI and the West Indies Central Sugar Cane Breeding Station in Barbados continues to provide impetus to introgression breeding objectives.
- A more effective DNA barcoding technology has been developed in-house to resolve phylogenetic relationships amongst key sugarcane relatives.
- A bioinformatics pipeline developed in-house has enabled the identification of genes potentially associated with eldana resistance and susceptibility. The sequences of these genes will ultimately be used in the development of DNA markers of eldana resistance for use in breeding.

Sugarcane variety performance evaluation

- N58, N59, N61 and N62 demonstrated under commercial conditions to potentially deliver benefits of up to 6 tons RV per hectare in the hinterland compared to N12.
- N61 outperforms other varieties under a wide range of commercial conditions at higher altitudes, including in frost-pockets.
- A study revealed the advantages of growers focusing on recommended crop management practices and appropriate variety placement rather than variety choice when striving to improve the longevity of ratoon crops.

Sugarcane biotechnology

- A refined sugarcane genetic engineering protocol was developed that enables a four-fold increase in transformation efficiencies and an increase in the proportion of functional transgenic lines containing a single copy of the foreign gene, which is in keeping with the requirements for commercial deregulation of transgenic crop plants in South Africa.

- An imazapyr-tolerant line of N12 has been produced by mutagenic breeding that is, in all other respects, the same as conventional N12. A potential commercial role of the mutated N12 variety is under discussion.
- Proof-of-concept was demonstrated for improving sugarcane drought tolerance and nitrogen-use efficiency by genetic engineering.
- A farm-level annualised gross margin for 14-16 month and 18-month old insect-resistant and herbicide-tolerant GM cane was shown to exceed that of conventional cane of the same ages by R5,637/ha and R4,325/ha, respectively.
- A low likelihood is predicted for potential cross-pollination between a GM sugarcane variety and surrounding vegetation within the SA sugar belt.
- Available models predict that between 30 and 50% of an area will need to be planted to conventional sugarcane varieties to reduce the risk of the target insect population developing resistance to an insect-resistant GM variety.
- Planning of a Bt GM cane communication strategy commenced with collaboration and funding from Biosafety SA, a unit of the Technology Innovation Agency (Department of Science and Technology).

SUGARCANE BREEDING AND ASSOCIATED ENABLING TECHNOLOGIES

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

Classical breeding

Main Findings

COMPLETED ✓

Varieties N69 (midlands and high altitude 18-24 month cycle on humic and sandy soils), N70 (irrigated 12-month cycle for late season), N71 (irrigated 12-month cycle for late season) and N72 (coastal rainfed 12-14 month cycle on average and high potential soils) were approved for bulking.



New Sugarcane Varieties

Varieties N69 (midlands and high altitude 18-24 month cycle on humic and sandy soils), N70 (irrigated 12-month cycle for late season), N71 (irrigated 12-month cycle for late season) and N72 (coastal rain-fed 12-14 month cycle on average and high potential soils) were approved for bulking in 2018/2019.

Main Findings To-date

ONGOING

- Through collaboration with local grower structures and water authorities, improved irrigation water security was achieved for breeding selection trials conducted on the SASRI Komati Research Station in Mpumalanga.
- Variety release decision-making processes are under discussion to address promising high-yielding genotypes that do not meet all pest and disease resistance standards.
- Loose leaf attachment to the stalk is being investigated as an additional trait for selecting improved eldana resistance. Evidence supports the hypothesis that the loose leaf trait may offer an alternative eldana-resistance breeding target.
- Varieties with high breeding values across environments have been identified to assist in improving breeding efficiencies.

Sugarcane genetics

Main Findings

COMPLETED

The outcomes of research completed in 2018/2019 will influence the design of strategies for classical and introgression breeding at SASRI, which will ultimately assist in developing cultivars with improved tolerance of abiotic and biotic stresses.

The primary observations include the following:

- The new relationships uncovered between sugarcane and its relatives will greatly enhance the ability of SASRI to select parents for the breeding of specific varieties for biomass-based applications.
- The study revealed that the current SASRI collection of *Saccharum spontaneum* is genetically narrow, emphasising the importance of either importing sugarcane ancestral germplasm or collecting new genotypes in the wild.
- From a genomics perspective, the study demonstrated that sorghum is a poor genomic template for sugarcane and *Miscanthus* is far better model to be used. This novel finding has significant implications for international sugarcane genome mapping and annotation efforts.

Marker-assisted breeding

Summary of Planned Research

NEW

SASRI has recently assembled, verified and functionally annotated more than 1 000 sugarcane genes by means of a novel functional gene annotation platform that was developed in-house. Of these, more than 500 are stress-related sugarcane genes that gives SASRI a potential two-year lead time over other institutes working on the sugarcane genome. This represents an unparalleled opportunity to develop informative expression-based screening markers for marker-assisted breeding (MAB) for stress tolerance and resilience.

New research to commence in 2018/2019 represents a first attempt internationally to derive and utilise the sequence of these stress-related genes in sugarcane along with their transcripts, representing an innovative and efficient methodology for genome profiling. Development of expression-based markers for use in MAB offers the potential for significant cost-reduction and efficiency benefits over currently available marker technologies.

Main Findings To-date

ONGOING

Comparison of genes expressed in resistant and susceptible varieties in response to eldana boring is providing novel insights into pest-plant interactions that will be useful in developing DNA markers for eldana resistance.

Introgression breeding

Main Findings To-date

ONGOING

- The relationship with the West Indies Central Sugar Cane Breeding Station in Barbados continues to provide impetus to SASRI's introgression breeding objectives.
- A more effective DNA barcoding technology has been developed in-house to resolve phylogenetic relationships amongst key sugarcane relatives (members of the Andropogoneae tribe). 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.
- The Agricultural Research Council was commissioned to determine the chromosome numbers of 261 genotypes from the SASRI germplasm collection, comprising both imported varieties and related species of sugarcane. This information will assist in estimating the range of variation present in the SASRI germplasm collection and identify compatible parents within the germplasm collection for introgression breeding.

SUGARCANE VARIETY PERFORMANCE EVALUATION

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

Variety ratooning dynamics

Main Findings

COMPLETED ✓

The results of a dedicated trial and detailed meta-analysis of data from extensive variety selection and post-release evaluation trials suggest that varieties generally do not differ genetically in ratooning ability. From the data obtained, the over-riding influences on ratoon longevity appear to be agro-climatic conditions and management practices. However, certain traits are associated with ratooning ability under rainfed and irrigated conditions for which selection may be imposed during the breeding process.

Variety performance

Main Findings To-date

ONGOING ●●●

- N58, N59, N61 and N62 demonstrated under commercial conditions to deliver benefits of up to 6 tons RV per hectare in the hinterland compared to N12.
- N61 outperforms other varieties under a wide range of commercial conditions at higher altitudes, including in frost-pockets.

SUGARCANE BIOTECHNOLOGY

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

Drought tolerance

Main Findings

COMPLETED ✓

The outcomes of the research provided proof-of-concept that sugarcane drought tolerance can be improved under glasshouse conditions by genetically engineering the over-expression of a specific transcription factor gene that is under the control of a drought-responsive gene promoter.

Nitrogen-use efficiency

Main Findings

COMPLETED ✓

Genetic engineering of sugarcane with a gene obtained under commercial licence from Arcadia Biosciences (Davis, California) resulted in improved nitrogen-use efficiency (NUE) and biomass, as determined in pot trials at low-level N supply. However, the positive benefit was restricted to a variety

with low native NUE and did not exceed projected improvements obtainable by classical breeding, as was evident in an inherently high NUE variety that did not display improved NUE when genetically modified with the NUE gene. Due to these results, the high level of industry investment that is required to commercialise a GM high-NUE variety and the need to focus currently available SASRI resources on the production of a GM Bt variety for borer resistance, no further research is planned at this time.

Herbicide tolerance

Main Findings To-date

ONGOING ●●●

- An imazapyr-tolerant line of N12 has been produced by mutagenic breeding.
- In all other respects, the herbicide-tolerant line is the same as conventional N12.
- A potential commercial role of the mutated N12 variety is under discussion.



Development of herbicide-tolerant N12

Conventional N12 and mutated N12 (Mut 6) 13-weeks after application of imazapyr (300 g ai/ha; with Interlock as a spray retardant) over the cane canopy. The cane was 4 months-old when sprayed. The plot is situated at Inyaninga farm, North Coast, on a 41% clay soil.

Biosafety studies

Main Findings

COMPLETED ✓

Biosafety-related studies pertaining to the future commercialisation of a stalk-borer resistant and herbicide tolerant sugarcane variety revealed the following:

- A low likelihood is predicted for potential cross-pollination between GM sugarcane variety and surrounding vegetation within the SA sugar belt.

- Current models predict that between 30 and 50% of an area will need to be planted to non-GM Bt sugarcane varieties to reduce the risk of the target insect population developing resistance to the Bt protein. Further models are under development to refine these estimates.
- An annualised gross margin for 14-16 month and 18-month old GM cane exceeded that of conventional cane of the same ages by R5,637/ha and R4,325/ha, respectively.
- A survey of SA consumer attitudes to sugar derived from GM sugarcane revealed that the willingness to consume GM food is increasing, with higher proportions of the public agreeing that they would buy GM foods if they were healthier (59% to 77%), cost less (51% to 73%) and had a lower environmental impact (50% to 68%).

GM lab protocols

Main Findings

COMPLETED ✓

A refined sugarcane genetic engineering protocol was developed that enabled a four-fold increase in transformation efficiencies and an increase in the proportion of functional transgenic lines containing a single copy of the foreign gene, which is in-keeping with the requirements for commercial deregulation of transgenic crop plants in South Africa.

The refined protocol was used in the development of transgenic sugarcane lines expressing genes for improved nitrogen-use efficiency and the construction of genetic transformation.

Tissue-specific gene promoters

Summary of Planned Research

NEW

Promoters are the regions of plant DNA that regulate and localise gene expression within a plant such as sugarcane. They may be constitutive (express a gene in all tissues), tissue-specific (express a gene in a specific tissue) or inducible (express a gene under certain conditions e.g. in response to stress). Tissue-specific promoters are desirable for genetic engineering programmes as they enable expression of novel genes (transgenes) in only those tissues in which the transgenic trait is required (e.g. expression of the Bt gene for insect resistance in the stalk where eldana occurs).

In previous research, SASRI developed gene promoters that are designed to express transgenes in the leaf (three promoters) and roots (five promoters) of sugarcane.

This research aims to determine the tissue-specific functionality of these promoters and should proof-of-concept be obtained, protection of the intellectual property represented by promoters will be sought.

¹ *Miscanthidium* spp.

² *Narenga porphyrocoma*

³ *Eldana saccharina*

⁴ *Sesamia calamistis*

⁵ *Chilo partellus*

FEATURED RESEARCH

GM sugarcane: examining biosafety issues

In light of the interest the industry has in the potential future commercialisation of a GM Bt sugarcane variety, research has been undertaken by SASRI to gather essential biosafety-related knowledge within a Biosafety SA-Technology Innovation Agency (TIA)-funded project. SASRI collaborated with the universities of KwaZulu-Natal, North West, Pretoria and Stellenbosch in a three-year project which examined the potential for cross-pollination amongst the GM variety and surrounding vegetation, ways to minimise the development of resistance to the Bt protein in the target insect populations and socio-economic aspects of the commercialisation of an insect-resistant and herbicide tolerant sugarcane variety.

Although the formal phase of the project was completed in 2018/2019, aspects of the research form the basis of post-graduate student dissertations that are to be finalised in the latter part of 2019.

Gene Flow

The risk of the Bt gene flowing from a GM sugarcane variety to other plant species was found to be low. This finding was based on the observations that:

- although two close relatives of sugarcane (a genus¹ and a species of another genus²) occur in the SA sugar belt, it is possible for sugarcane to cross-pollinate with only one of these;
- although occurring as a weed on sugarcane estates, the species with which sugarcane could potentially cross-pollinate is not invasive like typical weed species; and
- although sugarcane does produce some fertile pollen, particularly in the northern irrigated regions, cross-pollination is unlikely as sugarcane does not flower at the same time as this close relative.

Funding



Department of science and technology



Technology Innovation Agency



Biosafety SA

Bt Protein Concentration - Managing Resistance Build-up in Target Insects

Preliminary laboratory studies have determined a broad range of concentrations of the Bt protein that causes 50% and 90% death of the larvae of the African sugarcane borer³ (eldana), African pink stalk borer⁴ and the spotted stalk borer⁵. Based on these broad ranges, precise lethal doses are to be established between February and June 2019 in further studies at North West University.

Knowledge of the dose of the Bt protein that is lethal to the target insect population is essential to develop strategies to minimise the risk of the insect developing resistance to the Bt protein. Specifically, the knowledge will be used to:

- establish the level of production of the Bt toxin protein that is required within the GM variety to be effective against the stalk borers; and
- estimate the proportion of sugarcane planting that should be non-GM to act as a field refuge for insects.

Research Partners



North-West University



University Of Kwazulu-Natal



Stellenbosch University



Pretoria University

An annualised gross margin of 14-16 month and 18-month old GM cane exceeded that of conventional cane of the same ages by R5,637/ha and R4,325/ha, respectively.

- Industry-level impacts and product segregation

For potential industry-level impacts, the Brazilian industry will serve as a useful future case-study, as the Centro de Tecnologia Canavieira (SA⁶) have deregulated a Bt sugarcane variety, which is set for commercial production in 2019. As Brazil is the biggest world exporter of sugar and ethanol, the international market responses to the production of these commodities from feedstock that includes GM biomass will provide useful insights and leads for the SA industry. For example, the US and Canada have already approved the importation and sale of Brazilian sugar derived from GM cane in their countries, but it is still unclear how other countries will respond to the product. Countries in the EU and Japan currently require non-GM certification for their sugar imports.

A coarse assessment of the possibility to segregate GM from non-GM sugar in the South African sugar industry shows that it would likely require specific industry level agreements and collaboration and a stringent segregation system. The direct and indirect costs of these agreements and segregation systems, and the potential loss of certain sugar markets need to be weighed against the benefits the technology can bring.

Refugia Size - Managing Resistance Build-up in Target Insects

Population dynamics and completion approaches were applied to modelling the optimum area of non-GM cane (refugium) required within an area cultivated with Bt cane.

The population-based model predicted refugia requirements between 30 and 50% of the planted area depending on the level of eldana infestation (e.g. 5-15 e/100 stalks) and the inheritance patterns of insect resistance.

However, the population-based model does not account for the spatial movement of the insects and, as a result, may overestimate the refuge area requirement. Consequently, current modelling activities at Stellenbosch University use an individual-based simulation modelling approach, which combines an agent-based approach with a cellular automaton approach to reduce the computational burden of the simulation when modelling large areas over multiple years. The development of this has been finalised and validated and results will be available in June 2019.

Bt GM Sugarcane Adoption - Socio-economic Forecasts

- Farm-level socio-economic impacts

A farm-level socio-economic study revealed that growers could realise major savings by planting a borer-resistant and herbicide-tolerant GM sugarcane variety, particularly through reduced costs of chemical control of eldana and weeds at planting and during ratoon management.

Consumer Perceptions of GM Sugarcane

A South African consumer survey was conducted to establish how sugar derived from GM sugarcane would be received.

Trends were consistent with those reported in the Public Understanding of Biotechnology (2016) survey, viz. willingness to consume GM food is increasing, with higher proportions of the public agreeing that they would buy GM foods if they were healthier (59% to 77%), if they cost less (51% to 73%) and if they had a lower environmental impact (50% to 68%).

⁶ Sociedade Anônima (SA) designates a type of corporation in countries that mostly employ civil law. Depending on language, it means anonymous company, anonymous partnership, share company, or joint-stock company, roughly equivalent to public limited company in common law jurisdictions. It is different from partnerships and private limited companies.

CROP PROTECTION RESEARCH

Dr Stuart Rutherford (Programme Manager)



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

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

Highlights

Biosecurity and associated enabling technologies

- A commercially-available DNA-based technology was successfully adapted and tested for the detection in sugarcane of Sugarcane Mosaic Virus (SCMV), Sugar Cane Yellow Leaf Virus (SCYLV) and Ratoon Stunt (RSD).
- Research revealed that the Entumeni longhorn beetle species has a pheromone biology different from that of other longhorn beetle species,

which represents vital information in the development of integrated pest management methods.

- Evidence suggests that the low number of longhorn beetles emerging in Entumeni during summer 2018 and spring 2019 is likely to be an indicator of the success of the containment measures implemented.
- Results from ongoing research indicate that, while yellow sugarcane aphid appears to be able to acquire the SCMV, the aphid appears not to transmit the virus.
- A trial methodology has been developed to assess the extent of RSD spread during mechanised harvesting and to test various mechanised harvester decontamination protocols. Results indicate the severity of RSD spread by mechanised harvesters and the promise that decontamination holds for limiting the spread of the disease.

Agrochemicals for pest, disease and weed control

- BANDITO GR is soon to be registered as a nematicide, thripicide and aphicide. Developed specifically for the sugar industry, BANDITO GR will serve as a 'stop gap' for five years until new blue label chemistries are registered.
- A new unregistered fungicide has been shown to be effective for smut control, with no significant impact on bud germination, when applied as a cold soak or as part of a hot-water treatment regime.
- A new unregistered active ingredient, formulated either as a liquid or as a granule, shows potential for the late post-emergence control of tillered barbi grass (*Panicum maximum*).

Sugarcane resistance to pests and pathogens

- A commercially-available DNA-based technology was demonstrated to be effective in quantifying the extent of smut infection of sugarcane tissues and is to be used in the development and calibration of a near infrared spectroscopical method for smut resistance screening in the early stages of the variety breeding and selection process.
- Experimental determination of variety tolerance of nematodes has proven to be intractable and further advice to growers is to be based solely on variety responses to nematicide application.



BIOSECURITY AND ASSOCIATED ENABLING TECHNOLOGIES

- Developing improved procedures to ensure that varieties released or introduced into the industry are free of pests and diseases.
- Developing proactive threat-specific counter-measures and biosecurity incursion plans.

Pathogen diagnostics

Main Findings

COMPLETED ✓

A commercially-available DNA-based technology was successfully adapted and tested for the detection in sugarcane of Sugar Cane Mosaic Virus (SCMV), Sugar Cane Yellow Leaf Virus (SCYLV) and Ratoon Stunt (RSD). The test proved to be rapid, sensitive, specific and reliable and superior to current SASRI tests for these pathogens. Unfortunately, the tests for the pathogens causing orange rust and sugarcane streak disease could not be optimised. These DNA-based tests have the potential to add-value to SASRI pathogen diagnostics, particularly for the purposes of quarantine.

Integrated weed management

Summary of Planned Research

NEW

Chemical control options are widely used in the industry for managing difficult weed species, of which *Cyperus rotundus* (purple nutsedge [Eng.], rooi uintjies [Afr.], Inqoba [Zul.]) is arguably the most difficult. While some non-chemical control options are used, their use is not widespread and not always deployed to their full potential. To identify knowledge exchange requirements and knowledge gaps requiring attention, the objectives of this research will be to integrate and streamline existing integrated weed management (IWM) information and develop a technology toolkit that will be of practical use to all end-users.

Longhorn beetle

Main Findings

ONGOING

- Research during 2018/2019 revealed that the Entumeni longhorn beetle species has a pheromone biology different from that of other longhorn beetle species, which represents vital information in the development of integrated pest management methods.
- Evidence suggests that the low number of longhorn beetles emerging in Entumeni during summer 2018 and spring 2019 is likely to be an indicator of the success of the containment measures implemented.

Aphids in pathogen spread

Main Findings To-date

ONGOING

Results from ongoing research indicate that, while *Sipha flava* (yellow sugarcane aphid) appears to be able to acquire the Sugar Cane Mosaic Virus (SCMV), the aphid appears not to transmit the virus.

Mechanical harvester decontamination

Main Findings To-date

ONGOING

- A trial methodology has been developed to assess the extent of ratoon stunt (RSD) spread during mechanised harvesting and to test various mechanised harvester decontamination protocols.
- Results indicate the severity of RSD spread by mechanised harvesters and the promise that decontamination holds for limiting the spread of the disease.

AGROCHEMICALS FOR PEST, DISEASE AND 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.

Testing new chemistries

Main Findings To-date

ONGOING

- BANDITO GR is soon to be registered as a nematicide, thripicide and aphicide. Developed specifically for the sugar industry, BANDITO GR is intended to serve as a 'stop gap' for five years until new blue label chemistries are registered.
- A new unregistered fungicide has been shown to be effective for smut control, with no significant impact on bud germination, when applied as a cold soak or as part of a hot-water treatment regime.
- A new unregistered active ingredient, formulated either as a liquid or as a granule, shows potential for the late post-emergence control of tillered barbi grass (*Panicum maximum*).

SUGARCANE RESISTANCE TO PESTS AND DISEASES

Generating knowledge of the biological basis of resistance to pests, diseases and nematodes and developing improved resistance screening techniques for commercial breeding.

Determining variety smut resistance

Main Findings

COMPLETED

Outcomes of research concluded in 2018/2019 established that the TaqMan® real-time PCR technology is accurate for the early quantification of the extent of smut infection of sugarcane tissues. The technique is intended to be used in the development and calibration of a more cost-effective near infrared spectroscopical method for smut resistance screening in the early stages of the variety breeding and selection process.

Variety nematode tolerance

Main Findings To-date

ONGOING

Experimental determination of variety tolerance of nematodes has proven to be intractable and further advice to growers is to be based solely on variety responses to nematicide application.

Variety responses to nematicides

Main Findings To-date

ONGOING

In the Eston region, N54 displayed the largest RV yield response (27.4 tRV/ha) to nematicide application (Vydate at 30 kg/ha), while three varieties (N54, N59 and N62) resulted in increased revenue, ranging from R4 010 (N62) to R22 717 (N59) per hectare.

Variety responses to fungicides

Main Findings To-date

ONGOING

Ongoing research in 2018/2019 continued to highlight:

- the value of selected fungicide treatments in improving RV yields in the presence of brown and tawny rust infections; and
- variety-specific differences in the negative effects of rust on RV yield under both rainfed and irrigated conditions.

BIOLOGY AND ECOLOGY OF SUGARCANE PESTS AND DISEASES

Generating knowledge on the biology and ecology of pests, diseases, nematodes and weeds and facilitating knowledge exchange.

Pest-endophyte interactions

Main Findings To-date

ONGOING

- The fungus, *Fusarium*, which occurs naturally within sugarcane plants (ie endophytic) has been found to increase eldana damage.
- It is hypothesised that the 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.

- To-date, four isolates of the bacterium, *Brevibacillus*, appear to be promising.

BIOLOGICAL, CULTURAL AND ENVIRONMENTAL CONTROL PRACTICES

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

Sterile insect technique

Main Findings To-date

ONGOING

- The irradiation dose to which eldana males are being exposed at the XSIT (Pty) Ltd facility in Citrusdal was increased during 2018/2019 to 200 Gy.
- The F1 colony established at SASRI from these irradiated males possessed the expected male bias which will result in savings on F1 SIT rearing costs.
- Despite the F1 males displaying a residual level of fertility, XSIT have reported excellent results in the field studies they have conducted.
- Consequently, as from August 2018, SASRI commenced releasing the F1 adults developing from the eggs received from XSIT (that is, the parental 200 Gy treated male X normal female cross) into large cages containing potted sugarcane plants at Mount Edgecombe.

FEATURED RESEARCH

Testing new agrochemicals

SASRI partners 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.

During 2018/2019, ongoing research continued to test unregistered nematicides, fungicides and herbicides to assess the economic value that they might add to the industry.

Nematicides

- SASRI continues to investigate the potential of unregistered nematicidal products for nematode control.
- The effect of seven new products on RV yield was compared with: (a) an untreated control; (b) the currently registered granular



Prabashnie Ramouthar
Nematologist

formulations of Curater® and Vydate®; and (c) the liquid formulation of Vydate®, which is currently not registered for use on plant cane.

- Trials conducted in Umfolozi, Eston, Umhlali and Umfolozi were harvested in October 2017 at 12-months after planting.
- Additional trials conducted in Eston and Umhlali were harvested in July and May 2018, at 21- and 20-months after planting, respectively.
- Two products contain new blue-label nematicidal active ingredients and hence, are products that could be available in the future, due to their low environmental impacts compared with currently registered chemistries.
- Of the seven products tested, only one product resulted in a significant increase in RV yield compared to the untreated control.
- This product is due to be registered in sugarcane should be available to growers by the end of 2019.

Fungicides

- A fungicidal formulation containing tebuconazole:azoxystrobin:prochloraz was tested for its effect on the germination of smut spores in agar plate assays.
- Germination was completely inhibited at all concentrations (0.025-0.3%) tested.
- Two new fungicide formulations, Flutriafol:fluoxastrobin (1.15 mL/L) and tebuconazole:azoxystrobin:prochloraz (2.5 mL/L) were assessed for their effect on the germination of sugarcane setts when applied as a 10-minute cold soak after hot-water treatment (50°C for 2 hours) and when added to the hot-water treatment tank for the 50°C/2 hour treatment.
- Triadimefon (25% WP), a generic formulation of Bayleton, which was the first fungicide registered for smut control but is no longer available, was also tested.
- The rates were adjusted so that the concentration of the main active ingredient of each fungicide was equivalent to the 250 ppm triadimefon contained in Bayleton 25% WP.
- The experiments indicated that Flutriafol:fluoxastrobin (1.15 mL/L) and Triadimefon 25%WP could be applied as a cold soak and in a hot-water treatment tank at 50°C for 2 hours with no significant impact on germination.
- Germination was significantly lower when tebuconazole: azoxystrobin: prochloraz (2.5 mL/L) was added to the hot-water treatment tank (P<0.001).



Sharon McFarlane
Pathologist

Herbicides

- A new active ingredient, formulated as either a liquid or as a granule, was tested for control of late post-emergence tillered barbi grass (*Panicum maximum*) grown in pots with two soil types, a loamy sand (8% clay) and a sandy loam (19% clay) collected from the field.



Dr Peta Campbell
Weed Scientist

- The trial aimed to assess whether the new chemistry could serve as a replacement for paraquat, which carries negative health and safety risks.
- Results in the 19% clay soil showed no significant differences between either formulation or with paraquat, with respect to % green stalk material.
- However, there were significant differences in the sandy loam.
- In this soil, results at 9 weeks after application showed: (a) no significant differences between formulations; (b) both formulations lost efficacy compared with the control; and (c) paraquat had significantly lower % green stalk material than the new treatments and the control.
- Based on results from an earlier field trial conducted in Pongola, hexazinone + clomazone was added to each of the products.
- The addition of hexazinone + clomazone aimed to provide some residual activity in soil.
- Only when combined with paraquat was % green stalk material reduced compared with the control.
- Also, adding this product significantly enhanced the performance of paraquat, when compared with paraquat application on its own.

- After further testing, discussion will be held with the relevant agrochemical company to determine the viability of future registration of this chemistry for barbi grass control.



CROP PERFORMANCE AND MANAGEMENT RESEARCH

Dr Riekert van Heerden (Programme Manager)



1. Sugarcane Physiology
2. Sugarcane Nutrition and Soil Health
3. Sugarcane Ripening
4. Water Management
5. Climate Change

Highlights

Sugarcane physiology

- Research outcomes demonstrated that image data captured by means of drone-mounted thermal cameras holds promise for estimating variety differences in stomatal conductance under moderate to severe water-stress conditions and when combined with NDVI-estimated canopy cover, the thermal data may theoretically be used to estimate canopy conductance, which has been shown to be closely related to sugarcane yield.
- A meta-analysis of data from an eldana management research trial clearly illustrated the benefits to ERC yield of ageing cane on the coast, provided that eldana is effectively controlled. Meta-analyses of data from other sources are also to be conducted to derive broad best management principles regarding eldana control and cane age.

Sugarcane ripening

Formal recommendations for the use of the new ripener, Moddus®, in selected irrigated varieties, were finalised in 2018/2019. The recommendations are based on the responsiveness of the varieties to Moddus®, which was determined from multiple-year trial data in combination with economic analyses that considered income from RV yield (using an RV price of R3 783/t), as well as chemical and application costs and harvesting, loading and haulage costs typical of the northern irrigated region.

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.

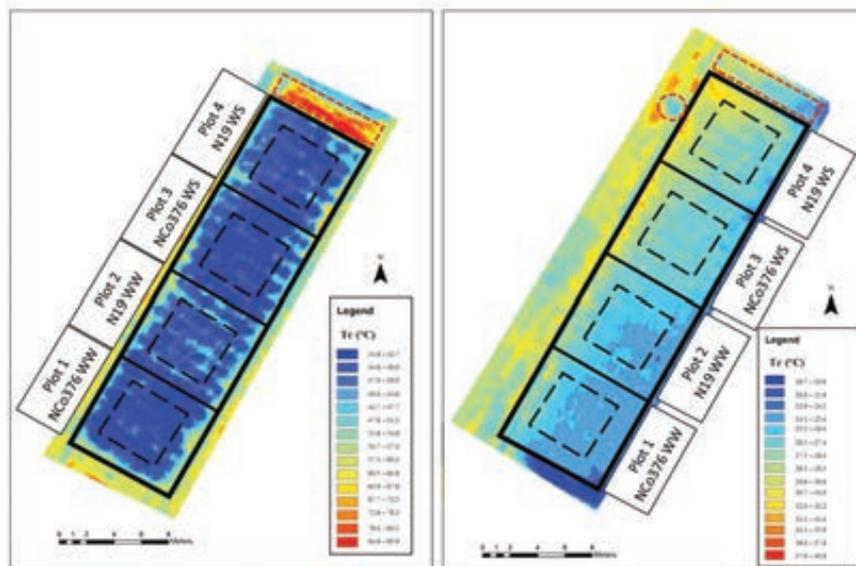
High-throughput phenotyping

Main Findings To-date

ONGOING



- Recent research outcomes demonstrate that image data captured by means of a drone-mounted thermal camera may hold promise for estimating variety differences in stomatal conductance under moderate to severe water-stress conditions.
- When combined with NDVI-estimated canopy cover captured by a drone-mounted visible and near infrared camera, the thermal data may theoretically be used to estimate canopy conductance, which has been shown to be closely related to sugarcane yield.
- Further investigation is underway: (a) to develop a more sophisticated processing pipeline for thermal data with improved plot segmentation and filtering of non-green leaf pixels from images; and (b) to test on larger, multi-environment trials with more varieties, with a view to developing the technique for practical use in sugarcane breeding.



Investigating remote sensing to assist in breeding for stress tolerance

Thermal images obtained during two drone flights of a water-stress trial: (A) before imposition of water stress; and (B) after imposition of water stress. Reference bare soil (both images) and water bath (right image only) were used as temperature targets for calibration (indicated by a red rectangle and circle, respectively).

Crop models for breeding

Main Findings To-date

ONGOING

- This research, which is funded by the International Consortium of Sugarcane Modelling (ICSM), aims to improve understanding of physiological mechanisms underlying the genetic control of sugarcane response to environmental factors.
- The performance of a set of common cultivars (N41, R570 and CP88-1762) has been evaluated in field trials in South Africa, Zimbabwe, Réunion Island (France) and the USA.
- The data obtained will guide further model development to improve capabilities for simulating genetic control of the sugarcane crop response to environmental factors.

Optimising harvest age

Main Findings To-date

ONGOING

- A recent meta-analysis of data from an eldana management research trial clearly illustrate the benefits to ERC yield of ageing cane on the coast, provided that eldana is effectively controlled.
- Meta-analysis of data from other sources is also to be conducted to derive broad best management principles regarding eldana control and cane age.

SUGARCANE NUTRITION AND SOIL HEALTH

- Generating knowledge and developing technologies and resources that increase accuracy of fertiliser recommendations and enabling the maintenance of, and where necessary, the restoration of soil health.
- Testing of various sources of nutrients, fertiliser formulations and application rates that enhance the cost-effectiveness of recommendations.

Burning and mulching

Main Findings To-date

ONGOING

- Although sulphur has never been applied to the long-term SASRI burning and mulching trial (BT1), the levels of the nutrient have increased significantly in fertilised treatments, when compared with the unfertilised treatments.
- At this stage, it may be speculated that this increase is a result of interactions with other nutrients applied with fertiliser, which offers a potentially valuable preliminary insight into sulphur nutrition within the industry.

SUGARCANE RIPENING

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

Variety ripening responses

Main Findings To-date

ONGOING

■ Moddus®: A new ripener for the industry

After three years of field trial research, formal recommendations on the use of the new ripener, Moddus®, in selected irrigated varieties are now available. The recommendations are based on the responsiveness of the varieties to Moddus®, which was determined from multiple-year trial data in combination with economic analyses that considered income from RV yield (using an RV price of R3 783/t), as well as chemical and application costs and harvesting, loading and haulage costs typical of the northern irrigated region.

■ Importance of informed ripening decision-making

Data from a recent trial have demonstrated the pitfalls associated with following general chemical ripening recommendations, without using refractometers to fine-tune spray-to-harvest intervals for specific environments and varieties. The data were widely shared with growers and MCPs to create awareness of the value of using refractometer data to guide ripening decision-making.

FEATURED RESEARCH

Moddus®: A new ripener in the SA sugar industry

In September 2016, Moddus® (trinexapac-ethyl) was registered in South Africa as a sugarcane ripener and hence, variety-specific recommendations on the use of this new ripener were required. Consequently, the efficacy and economics of using Moddus® were evaluated by means of field trials on a suite of 21 SASRI varieties under irrigated (Pongola, Komatipoort and Malelane) and rainfed (Umfolozi, North Coast and Midlands) agro-climatic conditions.



Dr Riekerk Van Heerden
Programme Manager

After three years of field trial research, formal recommendations on the use of Moddus® in selected irrigated varieties are now available. In these field trials, the responsiveness of the varieties to Moddus® was determined from the multiple-year trial data in combination with economic analyses that considered income from RV yield (using an RV price of R3 783/t), as well as chemical and application costs and harvesting, loading and haulage costs typical of the northern irrigated region.

Varieties N36, N49 and N53 were grown in field trials at both Pongola and Komatipoort. In terms of RV% and gross margin, the Pongola trial data indicate that N36 responds positively to Moddus®, with an increase in gross margin of R3 001/ha compared with the unripened treatment. Due to large variation between replicates, a statistically significant increase in RV% in response to Moddus® was not achieved in N36 at Komatipoort. Despite this, economic analysis of the Komatipoort trial data predicts a large increase in gross margin in excess of R5 500/ha over the unsprayed N36 treatment. Variety N49 did not show a positive response to Moddus® at either locations. Variety N53 achieved positive RV% responses to Moddus® at both locations, but only at Pongola did this translate into an increase (R4 801/ha) in gross margin. Trial results suggest that N53 might be susceptible to excessive cane yield loss in response to Moddus® depending on the growing conditions.

Under the more marginal growing conditions experienced during the Komatipoort trial (shallower soils, irrigation water restrictions during drought and less-efficient irrigation systems), the Moddus® treatment caused cane yield loss to a level not experienced in the Pongola trial, which was conducted under more favourable growing conditions (deep Hutton soil with efficient surface drip irrigation).

Varieties N23, N25 and N43 were grown in the Komatipoort field trial. In terms of RV% and gross margins, the trial data indicate that both N25 and N43 respond positively to Moddus®, with gross margin increases of R4 645/ha and R4 104/ha, respectively. Due to large variation between replicates, a significant increase in RV% in response to Moddus® was not achieved in variety N23. Economic analysis of the trial data also did not indicate any benefit in terms of gross margin.

Varieties N41 and N57 were grown in the Pongola field trial. In terms of RV% and gross margins the trial data indicate that both these varieties respond positively to Moddus®, with gross margin increases of R4 846/ha and R9 233/ha, respectively.

Moddus® Recommendations

| Variety | Cutting cycle (months) | Moddus® Recommendation |
|---------|------------------------|------------------------|
| N23 | 12 | Not recommended |
| N25 | 12 | Recommended |
| N36 | 12 | Recommended |
| N41 | 12 | Recommended |
| N43 | 12 | Recommended |
| N49 | 12 | Not recommended |
| N53 | 12 | Recommended |
| N57 | 12 | Recommended |

The formal recommendations on the use of Moddus® in the varieties included in the Pongola and Komatipoort field trials are summarised in the table above.

Modelling genetic-by-environment interactions

This research, sponsored by the International Consortium of Sugarcane Modelling (ICSM), aims to improve our understanding of physiological mechanisms underlying the genetic control of sugarcane response to environmental factors. To this end, field experiments have been undertaken in four countries with a set of common cultivars.



Dr Abraham Singels
Principal Agronomist

The objective is to use the data to improve simulation of genetic effects on sugarcane growth, with a view to enhance plant breeding.



Eight field experiments were conducted between 2014 and 2017, consisting of plant and ratoon crops at four sites: Pongola, South Africa; La Mare, Réunion Island, France; Belle Glade, Florida USA; and Chiredzi, Zimbabwe. Three cultivars (N41, R570 and CP88-1762) were common to all sites, while HoCP96-540, Q183, ZN7 and NCo376 were grown

at some of the sites. The eight experiments cover a range of temperatures (4000-5500 °Cd (base 10°C) per season), radiation (6000-8500 MJ/m²) and water availability (minimal to significant water stress) environments.

During 2018/2019, experimental observations were processed, analysed and used to derive key model parameters. A preliminary evaluation of two sugarcane models have been conducted as well.

The main findings to date include the following:

- Accurately determining the actual time of primary shoot emergence was very challenging and yet also very important, as many crop phenology parameters are defined with this event as a reference.
- The start of stalk growth is a key parameter for determining yield, and is better predicted using a thermal time than an aerial biomass threshold.
- Although no genotype differences were detected, there was a strong negative correlation between average solar radiation intensity and the thermal time requirement.
- It was not always possible to reliably estimate interception of radiation by the canopy due to sparse observations. This hampered the calculation of maximum radiation use efficiency, a key parameter defined as dry biomass produced per unit of intercepted radiation under ideal conditions. Nevertheless, results suggest that this parameter represents a key genotype specific trait.
- The data analysis and parameter derivation have revealed gaps in the understanding of certain processes previously understood to be driven primarily by thermal time accumulation under fully-irrigated and well-fertilised conditions. These include tillering / canopy development, and the timing of the start of stalk elongation. Discrepancies in thermal time-related parameters were at least partly explained by solar radiation differences between experiments.

- The simulation of the experiments for a single cultivar produced reasonably accurate results for DSSAT-Canegro for plant and ratoon crops, and for Mosicas with ratoon crops only. The default parameter values for plant crops in Mosicas appear problematic. Calibration of the models is necessary to demonstrate their full potential. Additionally, the models ought to be assessed at a process level, for example by forcing state variable values from observations and then assessing the accuracy of 'downstream' process output variables.

Modelling work is set to continue. APSIM will also be evaluated and model parameters for the different cultivars will be estimated from the experimental data. This will guide further model development to improve capabilities for simulating genetic control of sugarcane crop response to environmental factors.



SYSTEMS DESIGN AND OPTIMISATION RESEARCH

Dr Rian van Antwerpen (Programme Manager)



Investigating developing and transferring innovative systems that optimise industry performance.

FOCUS AREAS

1. Production Sustainability
2. Technology Development
3. Water Management

Highlights

Production sustainability

Bias in the yield estimates by the Canesim® crop forecasting system may be reduced by correcting simulated canopy cover with Landsat-8 derived estimates. A prototype procedure to incorporate remote sensing data into the operational Canesim® crop forecasting system was developed. Consistent industry procedures are required for the accurate capture of critical field information, together with the corresponding GIS data, before the prototype procedure can be implemented widely with the desired outcomes.

Technology development

- The study concluded in 2018/2019 revealed that the only legal alternative method for ground applying chemical ripeners in a more cost-effective way than current aerial application methods, remain hand-held spray booms. High clearance tractor boom sprayers and self-propelled sprayers should be able to be calibrated to conform to label requirements, but such equipment is costly and highly specialised and therefore would not be considered economically viable at this stage.
- SUSFARMS® has been adapted to meet the needs of all South African sugarcane farmers, primarily through enabling growers to de-select sections of the assessment tool that are not relevant to their farming enterprises. Remaining work involves the translation of the updated SUSFARMS® version into preferred languages and the explanation of overtly technical or unfamiliar terminology.

SUGARCANE PRODUCTION SUSTAINABILITY

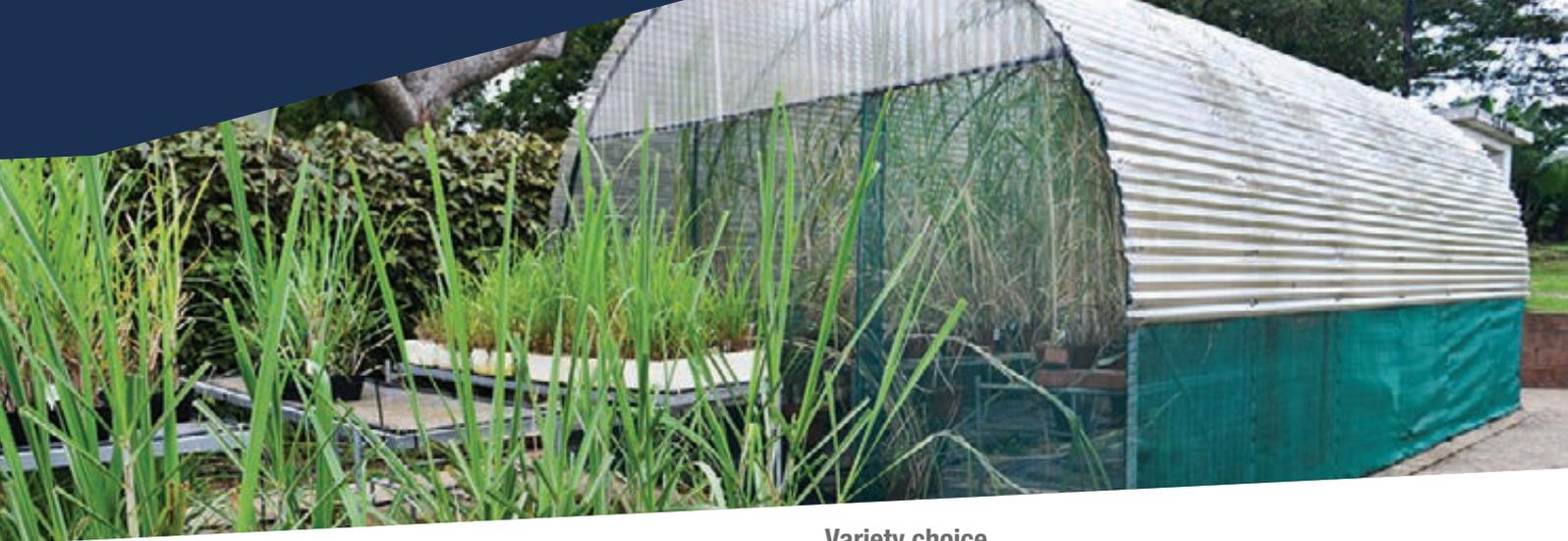
- Assessing the impacts of agronomic and mechanisation issues on production efficiencies and sustainability.
- Identifying opportunities for on-farm energy savings and reducing carbon dioxide emissions.
- Deploying novel technologies that improve operational efficiencies and service offerings.
- Developing new and improvement of existing technologies and approaches that enhance alignment between research and industry requirements.

Operational crop forecasting

Main Findings

COMPLETED ✓

Bias in the yield estimates by the Canesim® crop forecasting system may be reduced by correcting simulated canopy cover with Landsat-8 derived estimates. A prototype procedure to incorporate remote sensing data into the operational Canesim® crop forecasting system was developed. Consistent industry procedures are required for the accurate capture of critical input field information, together with the corresponding GIS data, before the prototype procedure can be implemented widely with the desired outcomes.



Ratoon longevity

Main Findings To-date

ONGOING

Results obtained during 2018/2019 from investigations into ratoon longevity suggest that the relative profitability of different ratooning strategies are highly dependent on the yield potential conditions and more importantly, on the rates of ratoon decline. These outcomes highlighted the importance of a decision-support system (DSS) for growers to enable such context specific calculations. Once developed, the DSS will be used to test a wider range of growing conditions and ratoon decline rates to establish when and where the shorter ratooning strategy will be superior.

SUGARCANE TECHNOLOGY DEVELOPMENT

Developing, adapting and deploying technologies that focus on enhancing internal efficiencies and the quality of service provision.

Ground application of chemical ripeners

Main Findings

COMPLETED

The study revealed that the only legal alternative method for ground applying chemical ripeners in a more cost-effective way than current aerial application methods, remain hand-held spray booms. High clearance tractor boom sprayers and self-propelled sprayers should be able to be calibrated to conform to label requirements, but such equipment is costly and highly specialised and therefore would not be considered economically viable at this stage.

SUSFARMS® for small-scale growers

Main Findings

COMPLETED

SUSFARMS® has been adapted to meet the needs of all South African sugarcane farmers, primarily through enabling growers to de-select sections of the assessment tool that are not relevant to their farming enterprises. Remaining work involves the translation of the updated SUSFARMS® version into preferred languages and the explanation of overtly technical or unfamiliar terminology.

Variety choice

Summary of Planned Research

NEW

In response to increasing requests from growers for easily accessible and concise variety information to enable rapid comparisons, this project is to develop a web-based variety information resource of all SASRI varieties. The online tool that is to be hosted on the SASRI website will consist of: (a) a basic variety selector to view recommended varieties per region; (b) a variety comparison functionality to allow for specific variety traits to be compared in desired formats; and (c) a variety performance tracker (map-based yield data).

Yield estimation

Summary of Planned Research

NEW

Existing SASRI databases will be explored to identify biomass parameters that could potentially be used by small-scale growers in the estimation of stalk yield. The impact of varieties and region on these parameters will be assessed. A decision regarding the development of a calculator will be dependent upon the complexity of the derived-yield estimation method.

Yield mapping

Main Findings To-date

ONGOING

Various technologies have been evaluated for their accuracy, availability and ease of use in yield variability mapping. Intra-field yield maps are central to the deployment of precision agriculture approaches. Studies conducted in 2018/2019 have shown that in-field yield maps may be developed using measurements from a commercially available on-board weighing system fitted to a grab loader with data processing on a 7.5 x 7.5 m raster.

Model spatial resolution

Main Findings To-date

ONGOING

- An early valuable outcome of this project in 2018/2019 has been the generation of daily rainfall data at a fine spatial resolution from 1950 to early 2018 for a considerable portion of the rainfed parts of the SA sugar industry.
- Doing so has increased both the spatial resolution of daily weather data tenfold, and the historical reach of the weather data to a minimum of nearly 70 years for every quinary catchment area comprising the industry.

- This wealth of historical data will be extremely valuable for applications such as tracking climate change, detecting productivity trends and verifying simulation models.

WATER MANAGEMENT

- Developing recommendations and advice that promote effective water management and technology deployment, both in terms of irrigation practices and surface water management.
- Developing guidelines to determine the footprint of water usage in irrigated regions.
- Maintaining or improving soil quality in irrigated regions where the parent material is the source of salts.

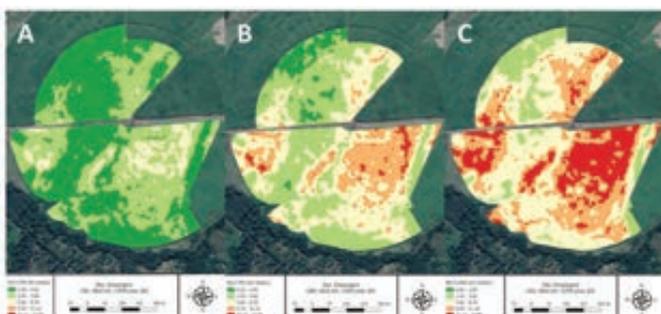
Soil salinity and sodicity

Main Findings To-date

ONGOING



Collaborative research between SASRI and the University of the Free State, which is funded by the Water Research Commission, has developed a technology to map soil salinity and sodicity.



Developing a soils mapping technology

A mapping technology has been developed in a collaborative project between SASRI and the University of the Free State which was funded by the Water Research Commission. In this example, the spatial distribution of Na is indicated: A = 0-300 mm depth; B = 0-700 mm depth; C = 0-1400 mm depth). Key (meq/L Na): ■ = 0.20 -2.93; ■ = 2.93-5.66; ■ = 5.66-8.93; ■ = 8.93-11.12; ■ = 11.12-13.85.

Crop water footprints

Main Findings To-date

ONGOING



- The SASRI MyCanesim[®] sugarcane simulation system was used to simulate the impact of irrigation system and soil mulch cover on crop growth and water use of irrigated sugarcane in Malelane.

- Results obtained during 2018/2019 suggest that using efficient irrigation systems (drip irrigation) may significantly reduce the water footprint (by about 9m³/t) and increase economic productivity of irrigation (by about 18%), compared to overhead irrigation systems.
- Results also suggest that using a heavy mulch soil cover (green harvesting) only marginally reduces the water footprint for this specific case study, compared to a light mulch cover of scattered tops.
- It may be necessary to use actual crop production and water use data in conjunction with simulations to obtain more realistic estimates of water footprint and economic productivity indicators.
- Results from the study nevertheless are indicative of what can be achieved for sugarcane production using best agricultural practice.
- The developed methodology will from 2019/2020 be applied to more agro-climatic regions in the industry, and it will also be used to assess water footprint and economic productivity of irrigation water under a future climate.

FEATURED RESEARCH

Ground application of ripeners

On an industry-wide scale, over 60 000 ha of sugarcane are ripened in South Africa in a season with normal rainfall. At the current commercial aerial application cost per hectare, the application of ripeners could cost the industry up to R30 million per season. Driven by the recent, and ongoing, economic challenges facing the industry, requests were received from stakeholders to investigate more cost-effective alternative ground-application methods for ripening sugarcane crops.



Dr Riekert Van Heerden
Senior Scientist

The objectives of research were to:

- evaluate the suitability of alternative ground-application methods for chemical ripening purposes in terms of legal compliancy and on-farm practicality;
- if deemed suitable, define for each alternative the hardware and operating costs, operating specifications and thresholds, and protocols for use; and
- evaluate the in-field efficacy of these alternative methods in collaboration with extension and growers in the form of commercial demonstration trials.

The product label specifications (e.g. minimum or maximum water volume per hectare) that any alternative ground application method had to adhere to were confirmed. The Registrar of Act No. 36 of 1947 was consulted to gauge his stance on the legality of each method and to obtain permission to evaluate any unregistered methods, where applicable. Hardware and operating specifications were obtained from the suppliers to assess the suitability for ripener application with each method. It was further envisaged that, for each method that passed these initial legal considerations, the hardware and operating cost would be determined to derive an estimated application cost/ha to benchmark economic viability against the current commercial aerial application method. Once the economic viability of a method was established, the in-field efficacy of the method needed to be established by means of a conventional commercial ripener strip trial approach.

It was confirmed with the Registrar of Act No. 36 of 1947 that all alternative ground application methods needed to adhere strictly to the 50 - 200 l/ha water volume threshold stipulated on the ripener product labels. The Registrar warned that when water volumes exceed 200 l/ha, loading of chemicals into the environment becomes a key issue. In terms of registration of new application methods, environmental and occupational health and safety issues are considered a higher priority than the ripening efficacy of these alternative methods per se. All pollution/toxicity issues must be dealt with before any field-testing of these alternative methods are started.

Within this context, the main findings of the research were as follows.

- In the case of Venturi's in overhead sprinkler systems, a desktop evaluation revealed that for the range of typical sprinkler flow rates (including newer low flow sprinklers) the maximum allowable water volume will be exceeded. An infield evaluation of an existing Venturi unit confirmed that the water volume threshold was far exceeded.
- Centre pivots typically apply 2.5 – 3 mm of water at the fastest speed setting. This is ten times greater than the maximum allowable water volume for chemical ripeners. Hence, centre pivots (on their own) were ruled out as a legal application option.
- Desktop evaluation of a secondary lateral with low-flow micro sprayers mounted on a centre pivot also resulted in exceedance of the water volume threshold by substantial amounts (as much as 20 times greater at the inner towers of the pivot). The minimum application rate of a secondary lateral, averaged across all micro sprinklers, was 907 l/ha (0.0907 mm/ha).
- It was concluded that the use of any form of overhead irrigation for purposes of applying ripeners would result in excessive chemical loading on the environment and serious occupational safety and health hazards for people on the farms/fields.
- High clearance tractor boom sprayers and self-propelled sprayers should be able to be calibrated to conform to label requirements through the correct selection of equipment and boom swaths, nozzle sizes, pump delivery and associated nozzle outputs. Technological advancements are catering for: much wider boom spans and boom stability; boom sections fitted with sensors for section height adjustments for constant spraying height above the crop despite variable sloping ground; night spraying; automated and variable spray controllers with GPS section controls; nozzle section controls and much more. Such equipment options would be considered costly and highly specialised and therefore would not be considered for general recommendation at this stage.
- Mist blowers generally convey chemicals at low volume applications, below label requirements, via cannon sprayers across wide swaths in the field. Certain models of mist blowers, however, may be able to achieve higher rates to theoretically comply with the label requirements. Issues around equipment selection, setup, calibration and application necessitate a high level of constant infield monitoring and management which makes this method of application a high-risk technique and potentially difficult to conform to label requirements in terms of application rate and furthermore in terms of uniformity across the swath.
- It was confirmed that hand-held spray booms are commercially available for growers to purchase and that the application method conforms to the specifications on the product labels. If used in conjunction with a tracking unit ripener application with hand-booms, it is much more accurate than aerial application. Walking speeds can be monitored and corrected and the productivity of spray operators can be monitored. However, lodging prevents the use of hand-held booms, making the method only suitable for erect crops.

The study revealed that the only legal alternative method for ground applying chemical ripeners in a more cost-effective way than current aerial application methods, remain hand-held spray booms. High clearance tractor boom sprayers and self-propelled sprayers should be able to be calibrated to conform to label requirements, but such equipment is costly and highly specialised and therefore would not be considered economically viable at this stage.

On-farm yield mapping

Rapidly deployable and cost-effective yield mapping techniques and strategies are needed for the deployment of precision agriculture approaches. This research investigated a variety of techniques that may potentially enable local growers and miller-cum-planters to assess yield variability within their fields.

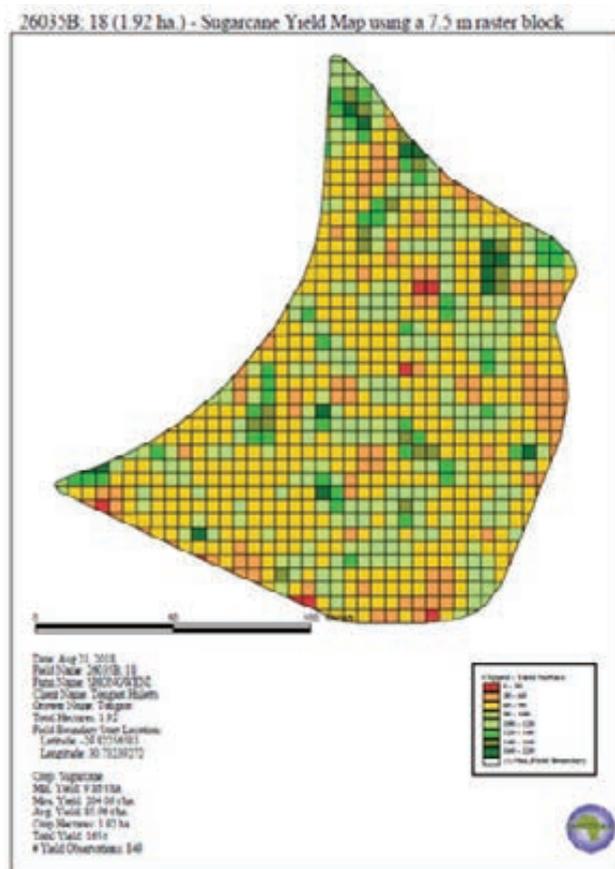


Dr Peter Tweddle
Agricultural Engineer

Using manual surveying of individual cutter fields is not suitable for wide-scale deployment as the labour and equipment requirements to delineate individual task areas and the manual processing of the data are too onerous. The approach was, however, useful in determining and illustrating the magnitude of yield variations across fields of a commercial harvesting operation, thereby reinforcing the need and importance of yield mapping. Geo-referencing of the stack positions infield may provide another technique to indicate yield differences without affecting existing management of cutter tasks.

The existing on-board weighing systems traditionally used in the construction and mining sectors may be adapted for cane loading operations. The on-board weighing system is a potentially useful technology that is better suited for the industry's predominant commercial practice of cut-and-windrow loading operations. Preliminary investigations indicate that this technique is highly accurate. However, there is a strong reliance on service providers to calibrate the equipment and to conduct data processing and post processing that are required to produce a useful yield map.

Weighing of individual grab loads is a commercially available technology used in the precision agriculture sector for various agricultural commodities, as well as the mining and construction sectors. Overall, this study indicated that field outputs compare well to independent load measurements which were gathered on the trans-loading zone during intensive sampling of loads extracted from the field. During normal field loading operations, the georeferenced position and weight of each grab load is automatically captured and cumulated for the field. Upon completion, the data are processed to generate yield maps. Rasterized grids are used as a data processing technique for generating yield maps. A rasterized grid of predetermined dimensions is first created across the field/farm map, independent of the data collected. The georeferenced load data occurring within each grid is then summed to create the yield map. The use of different grid sizes varies the results considerably, as various smoothing and dilution effects may occur. The most accurate results match that of the loader swath, but the yield transitions are more abrupt than when a larger grid is used.



Screenshot of image created using commercially-available equipment to construct field yield maps

Yield map obtained using a commercially available on-board weighing system fitted to a grab loader with data processing on a 7.5 x 7.5m raster

Remote sensing⁷ provides a snapshot that is useful for field scouting and trend analysis to identify yield variances intra-field. Remote sensing, however, was not sufficiently accurate to model actual yield directly. In this study, the results indicated that photogrammetric surface differentials prior and post-harvest would be similar to using measured height as a proxy for yield with rapid deployment and wide scale applicability.

The case studies confirmed that yield variation exists within fields and that yield mapping is a worthwhile exercise (even if only to evaluate the need for precision agriculture). The most promising and readily available techniques for yield mapping are as follows:

⁷ visual imagery through to photogrammetric modelling

- Photogrammetry provides an indication of intra-field variability and may be conducted on any harvesting system, if the field is weed-free and the cane is neither lodging nor flowering. Visual imagery used in the photogrammetry process also provides a snapshot of the condition of the crop and is useful for field record-keeping. This technique requires the use of UAVs⁸ to facilitate the surveying of ground control points with appropriate cameras and subsequent data processing with software to stitch and geo-reference the images. Photogrammetry and GIS⁹ modelling software and skills are required to create the surface and surface differential models. Two flights are generally required to create a pre- and post-harvest model. The differentiation between the two models provides a crop height model which is used as a proxy for yield variability across the field.
- Cut-and-stack systems can make use of the georeferenced position (GNSS¹⁰ equipment required) of the stack and corresponding stack weights from the loading records. This technique requires GNSS equipment, a system to match field and zone records, GNSS and GIS skills to process the data into a yield map using georeferenced stack weights as the proxy for differential yields intra-field.
- On-board weighing systems are available for cut-and-windrow harvesting systems to measure georeferenced grab load weights. The technique requires the initial installation of the GNSS linked on-board weighing system. Calibration of the on-board weighing system is required. The data are automatically captured and processed into a rasterised yield map during and following the loading operation. This service is offered by the service providers of the on-board weighing system.
- LIDAR¹¹, although currently prohibitively expensive and not readily available on UAV platforms, may be a technology to consider in the future. It requires fewer flights and is reported to be less onerous and superior when compared to photogrammetry in terms of modelling and accuracy.

During 2018/2019, a study was conducted in the Shongweni region to compare the accuracy of cane weights obtained by means of a commercially available on-board weighing system fitted to a grab loader with those weights obtained with a cane scale operated in the trans-loading zone. Results revealed that the cumulative mass of the grab loads per trailer load corresponded well to the mass measured with the crane scale in the trans-loading zone. During the operations with the grab loader, weight positions were georeferenced and used to generate yield maps. One approach to map the yields obtained with a grab loader is to create a rasterised grid of predetermined dimensions and sum the load data within each rasterised block. Different grid sizes were shown to vary the results considerably due to the various smoothing and dilution effects that may occur. In this study, the

most accurate results were obtained using the loader swath of 7.5 m. The yield transitions were shown to be more abrupt than when a larger grid is used. The 7.5 m x 7.5 m raster used indicated that the field yielded between 10 and 204 t/ha with a total field yield of 165 tons. This corresponds well with the 168 tons measured directly with the loader.



8 Unmanned aerial vehicles (drones)
 9 Geographical Information Systems
 10 Global Navigation Satellite System
 11 Light Detection and Ranging is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth.

RESEARCH GRANTS 2018/2019

Eight external grants were received in 2018/2019 to support post-doctoral research associates, post-graduate students, research interns and specific projects.

FELLOWSHIPS, BURSARIES AND INTERNSHIPS

National Research Foundation



- NRF Professional Development Programme: One post-doctoral and two doctoral research placements (second year of three-year funding cycle)
- NRF Internship Programme: Three internship placements in 2018

University of Kwazulu-Natal



- UKZN Post-doctoral Fellowship Programme: One post-doctoral fellowship (second year of three-year funding cycle)

RESEARCH GRANTS

Biosafety South Africa/Technology Innovation Agency



Pre-commercialisation biosafety-related research on Bt GM sugarcane (third year of three-year funding cycle)

Department Of Agriculture, Forestry and Fisheries



Sterile Insect Technique logistics research (third year of three-year funding cycle) (Research Technology Fund)

International Atomic Energy Agency



Sterile Insect Technique proof-of-concept research (third year of five-year funding cycle)

Water Research Commission



- Irrigation soil salinisation (third year of five-year funding cycle)
- Water footprint of fuel and fibre crops (third year of five-year funding cycle)

CONTRACTED-OUT RESEARCH 2018/2019

Six projects were contracted-out to research service providers in 2018/2019.

Institute for Plant Biotechnology, Stellenbosch University

- Biotechnological approaches to improve sugarcane drought tolerance (first year of three-year contract)
- Enhancing sugarcane sucrose content through genetic engineering (second year of three-year contract)

School Of Entomology And Conservation Ecology

Longhorn beetle biology and ecology (second year of three-year contract)



School Of Engineering, University Of Kwazulu-Natal

Soil and water conservation structures (third year of three-year contract)



School Of Biological Sciences, North-West University

High CO₂ effects on sugarcane water-use and yield (second year of three-year contract)



University Of Illinois And Hawaii Agricultural Research Center

Sugarcane variety genome sequencing (first year of two-year contract) (project funded under the auspices of the International Consortium for Sugarcane Biotechnology)



ACHIEVEMENTS & AWARDS

Best Paper award: Ntombokulunga Mbuma won this award at the 12th SAPBA symposium for her paper titled, “Estimating breeding values for sugarcane yield of parental genotypes using best linear unbiased prediction (BLUP)”. She co-authored this paper with Prof MM Zhou and Dr R van der Merwe.

Student Prize: Agriculture: Ntombokulunga Mbuma won this award at the 2018 South African Sugar Technologist’s Association for her paper “Evaluating breeding values of genotypes in sugarcane breeding using Best Linear Unbiased Prediction (BLUP)”. Her co-authors were Prof MM Zhou and Dr R van der Merwe.



Ntombokulunga Mbuma

Poster Award: Agriculture: Peter Tweddle won this award for his poster titled, “Estimating traffic induced sugarcane losses for various infield cane extraction systems” at the 2018 South African Sugar Technologist’s Association. He co-authored this poster with Prof PW Lyne.

Kynoch Award: Sanesh Ramburan was awarded the prestigious Kynoch Award for his paper, “Post-release variety testing: A key activity to ensure commercial value of genetic improvements” at the 2018 South African Sugar Technologist’s Association.



Peter Tweddle



Sanesh Ramburan

Kynoch Award: Highly Commended: Louis Titshall received this award for his paper, “Copper, iron, manganese and zinc in soil and leaf samples from southern and eastern African sugarcane-producing regions” at the 2018 South African Sugar Technologist’s Association. He co-authored this paper with Dr NM Miles and Dr SS Mthimkhulu.

Jubilee Award: Neil Miles won the highly-esteemed Agricultural Jubilee Award for his paper, “Prediction of soil nitrogen mineralization to crop fertiliser nitrogen requirements” at the 2018 South African Sugar Technologist’s Association. The prize included a trip to the 2019 ISSCT Congress in Argentina. He co-authored his paper with Mrs R Rhodes and Dr A Weigel.



Louis Titshall



Neil Miles

EXTENSION

Rowan Stranack (Extension & Biosecurity Manager)

Extension is currently delivered to growers under three models:

Extension services

Large-scale

Regionally-funded SASRI Extension service consisting of on-farm visits by a SASRI Extension Specialist to provide one-on-one advice on specific aspects of sugarcane agronomy, group learning activities in the form of grower days/study groups and written media such as newsletters.

Often include SASRI Research Specialists who present research results enabling growers to better understand and implement new technologies.

Valuable technical support is given to the many local grower structures operating in the industry, for example Local Pest Disease and Variety Control Committees, Environment Committees, local farmer associations and 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), 5 SASRI Extension Specialists support 30 DARD agricultural advisors ensuring they are trained and equipped with all new SASRI research outcomes.

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.



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 link with the SASRI research programme provides a platform for growers to have their specific research issues addressed. In many instances, growers assist in this process by providing land to conduct trials. Growers also provide important local context to the research as well as advice on the practical implementation thereof. In addition, SASRI Extension Specialists are members of the project teams conducting research in their Extension areas, offering guidance in making these trials as relevant as possible.

Once new research outcomes are generated, RD&E Committees facilitate the transfer of these technologies to their growers, thereby completing the exchange of technology between grower and research. In addition to attending local meetings, RD&E committee 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 2019, it was the turn of the rainfed regions to hold an RD&E workshop. This event was hosted at Mt Edgecombe and addressed the recent widespread outbreak of yellow sugarcane aphid (*Sipha flava*). A

panel discussion was held on this subject. SASRI management, subject specialists and a grower made up the panel and considerable knowledge and experience with the pest was shared with the audience. As yellow sugarcane aphid affected all areas of the industry growers attending the workshop expressed their desire to see research focused on this pest, and a number of topics were carried forward for consideration in the 2020/2021 SASRI Programme of Work.



THE 2018/2019 SEASON

Most areas, with the exception of the South Coast of KwaZulu-Natal experienced a good season with increasing crop estimates and good to excellent cane quality. In the irrigated North, the water supply improved compared with previous seasons although the Crocodile River system remained under pressure.

Rainfall followed the normal pattern in late 2017 but unfortunately the peak growing months of January and February 2018 were relatively dry in some parts. In autumn, good rains fell in the Zululand and North Coast regions and heavy rains in May repeated a pattern of good but unseasonal winter rains, which have characterised previous years. There was relatively little frost in the Midlands regions during the winter. Normal rains in most areas resumed in spring but again the South Coast received lower than normal rains and their crop estimates decreased as the season progressed as opposed to most other areas where estimates either held or in most cases increased. Of particular note was the good cane quality maintained in most areas throughout the latter part of the season with little evidence of the usual late season decline in quality that accompanies the onset of warmer and damper conditions.

Response to chemical ripeners was generally good in the early part of the season as a result of the late rains. Extension made good use of the **PurEs®** app to assist growers with decisions regarding ripener application.

Eldana damage affected cane quality in the Irrigated North due to high levels of eldana found on dry, stressed carryover cane early in the season. Later in the season, sour rot was also noted in excessively dry mature cane, also causing problems for the mill. However, despite the challenges experienced in some areas, the season was generally characterised by good yields and good cane quality.

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 the 2018 year the varieties N66 (Midlands),

N67 (coastal short-cycle) and N68 (coastal long-cycle) went into bulking for release in 2019 and 2020. The decision was taken to withdraw the recently released variety N65 due to excessive stool-tipping. The varieties N63 and N64 were released to growers or bulked further depending on the decision taken in the local area.

There was widespread interest and appreciation for the superior quality of recent variety releases. Of particular 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 Extension and researchers to promote the effective use of varieties. In addition to field days, the results of these trials are widely publicised in Extension newsletters and in public forums.

Ensuring adequate seedcane supply continued to be a major challenge for 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. Particular efforts were made in the Lowveld, Pongola, Midlands North and Umzimkhulu LPD&VCC areas where schemes are not in place with some progress and acceptance. 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 on the North Coast and Midlands. The success of this course 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 147 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 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.

Extension also played a very active role in supporting the Eston Show, and the Monzi, Pongola and Malalane Agric Expos.

SUSFARMS®

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 management tool. A process of verification of progress Tracker reports was begun to verify responses recorded on the Tracker with what had been implemented on the ground.

This year saw efforts to seek alignment of SUSFARMS® to international certification systems in particular BONSUCRO. Discussions were also held around the unit standards used in SUSFARMS® to obtain comparable and objective standards for the industry to use. There was interest shown by the South Coast growers in implementing SUSFARMS® and some time was spent introducing and explaining the SUSFARMS® Progress Tracker to these growers. It is intended that the current SUSFARMS® initiative in the Midlands North and South regions be extended to the entire South Coast region in time.

Soil Health and Crop Nutrition

One of the primary 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 to send soil and leaf samples from other crops and with increased diversification on farms, this could be a lucrative and highly beneficial service in future. A fertiliser calculator for tree crops was developed during the year to support advice given on the soil sample results. There were a number of opportunities to present FAS to the wider farming public. Extension assisted with this at three agricultural expos held in the Northern parts of the industry. At two of these events, presentations on crop nutrition by researchers accompanied the exhibits.

Extension continues to make efforts to promote soil and leaf sampling amongst all cane growers and in particular, those areas where historically FAS has not enjoyed much support. An extensive history of soil nutritional status is essential to effectively plan crop nutrition. Promotion of sampling amongst the small-scale grower sector also remains a challenge and a project was launched in an attempt to focus on the identification of soils, their yield potential and critical management factors, specifically in these areas.

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.

Yellow sugarcane aphid (*Sipha flava*) developed as a major biosecurity threat during 2018 and early 2019. Initially, the pest was mainly confined to parts of the North Coast, and eventually recorded in all parts of the industry. Some outbreaks were particularly severe causing yield loss. Numerous meetings with growers and awareness efforts were launched by Extension and a task group comprising researchers, Extension and SASRI management was convened to attempt to develop effective control methods. This pest is notoriously difficult to control using chemicals alone. The long-term solution is likely to be a more integrated approach once key research has been carried out along with a greater understanding on the biology of the pest.

The largest proportion of time was, as in most years, spent on the management of eldana. Even in areas such as Pongola and the Mpumalanga Lowveld where eldana problems are largely unknown, this pest is now a management factor to be considered, particularly in instances where carryover cane was necessitated. The areas most under threat during the year were the Midlands regions. Despite considerable successes in control in parts of the southern Midlands and South Coast, the pest continued to spread in the Midlands North area. To promote awareness of the pest and its control, a round of grower interactions was held where IPM was promoted extensively. Accompanying these talks on the aspects of sugarcane agronomy were presentations by a specialist in bats, which are well-known to be a highly effective control agent of eldana. In addition to efforts toward habitat management as a means of controlling eldana, insecticide spraying was also recommended where appropriate. A newly registered stubble treatment was also used this season and the benefits of this should be evident in the following season.

In the ongoing effort to contain an outbreak of the longhorn beetle *Cacosceles newmannii*, SASRI Extension continued to be closely involved in monitoring the harvesting and eradication of more than 1 000 hectares of cane in the Entumeni area. Extension and Biosecurity also continued the monitoring of damage and adult beetle flights as and when these were identified. It was encouraging that during 2018 only two additional fields in the containment areas were found to be infested. The adult beetle emergence in both 2018 and 2019 were also greatly reduced and restricted.

Smut disease was a problem in certain parts of the Irrigated North, in particular the Pongola region where the popular variety N41 was under threat. An effective seedcane scheme reduced dependence on N41 and more active preventative roguing by growers should contribute significantly to reducing the threat posed by smut disease in this region. In the Mpumalanga Lowveld, 2018/19 was a particularly successful year in terms of smut control and no plough out orders needed to be issued. Awareness, clean seedcane and monitoring of potential problem fields, planting more resistant varieties as well as regular roguing of commercial fields have all contributed to reducing the problem.

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 sugarcane 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.

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.



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 sugar industry as well as a number of external customers (local and international). These expertise are 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, SA agrochemical companies and other external clients. Specialist advice includes, but is not limited to, variety choice and evaluation, data analyses, crop nutrition, irrigation advice, pest and disease identification, control and management, nematode analyses, crop forecasting, ripener advice and decision-making, soils management and crop performance and management.

SASRI addressed 57 Specialist Advisory Requests (SARs) during 2018/2019.

EXTENSION REQUESTS FOR ADVICE

SASRI received a number of requests for advice from Extension Specialists. These services were provided to growers as part of the ongoing service provision to the SA sugar industry.

SASRI received 22 Extension Requests for Advice (ERA) during 2018/2019. While the majority of these ERAs were for Land Use Plans (LUPs) and farm maps, there were requests for advice on creeping grasses, weed

identification, weed control, soil sampling, soil fertility, ripener application and varieties. Due to limited staff capacity in GIS, SASRI continued to try to work through the backlog of LUP requests from previous years. These requests are being completed as and when staff capacity permits. Further adoption of SUSFARMS® in the industry has contributed to growers understanding the importance of a LUP for effective management of their farms. Spatial management planning services have resulted in better management of grower fields and consequently higher yields through better spatial planning and mapping of fields.

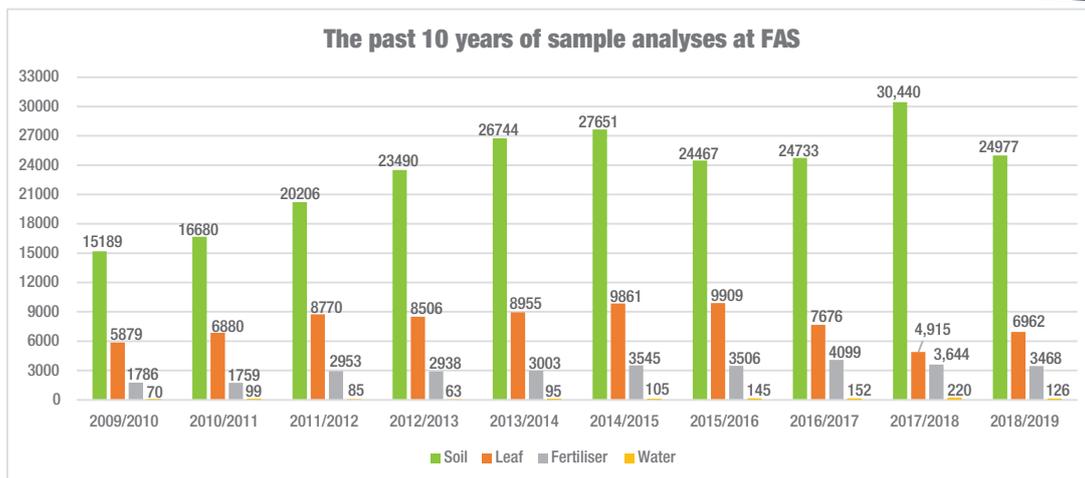
FERTILISER ADVISORY SERVICE

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 management practices and attainable yields. The FAS is SABS ISO 9001 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 leaf sample submission numbers during 2018/2019 were higher than 2017/2018, soil, fertiliser and water sample numbers decreased relative to the previous season. A breakdown in sample numbers for 2018/2019 is captured in the table below.

| | 2018/2019 | | | | 2017/2018 |
|------------|------------|----------------|------------|--------|-----------|
| | SA Growers | SASRI Research | Outside SA | Total | Total |
| Soil | 20 288 | 741 | 3 948 | 24 977 | 30 440 |
| Leaf | 2 013 | 609 | 4 340 | 6 962 | 4 915 |
| Fertiliser | 3 467 | 1 | 0 | 3 468 | 3 644 |
| Water | 119 | 1 | 6 | 126 | 220 |

The lower sample number, particularly for soil samples, received by FAS during 2018/2019 compared to 2017/2018 was concerning. When the sample numbers were tracked over a longer period of time (the previous 10 years), the data indicated that there had been a steady increase in soil sample numbers received by FAS up until 2014/2015. However, since then soil sample numbers declined. This decrease in number was most likely due to the severe drought experienced by the sugar industry in 2015/2016.

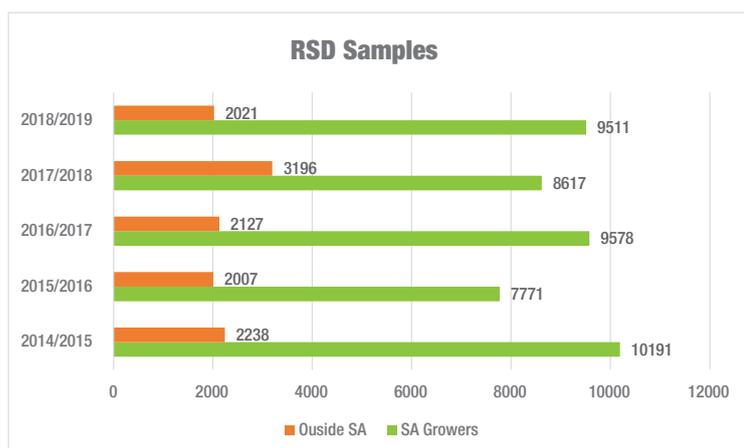


SASRI and FAS continued to focus on encouraging growers to take soil samples as this information will enable growers to identify and adjust management practices where necessary to prevent harmful soil conditions (e.g. acidity, salinity, nutrient imbalances) from developing. Soil testing forms an essential part of sustainable farming practice.

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. Focus areas of the disease diagnostic services is Ratoon Stunt (RSD) and Yellow Leaf Virus (YLS). During 2018/2019, 11 791 RSD samples were analysed with 9 511 of these samples coming from SA growers and 2 021 from other countries. The remaining number of samples (259) were from SASRI research trials. The number of RSD samples analysed for SA growers increased by 894 samples in the 2018/2019 season.

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 2018/2019.



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

QUARANTINE

SASRI has a DAFF-approved, world-class quarantine facility located at Mount Edgecombe for all sugarcane varieties imported into and exported from South Africa. Sugarcane varieties from foreign countries are imported into South Africa to broaden the genetic base of the parental breeding material. Imported varieties are also evaluated as potential commercial varieties. Through Variety Evaluation and Licence Agreements, SASRI controls the distribution of South African varieties into Africa to protect SASRI's Plant Breeders' Rights. SASRI is responsible for obtaining phytosanitary certificates for the export of any sugarcane from South Africa from the division of Plant Health from the Department of Agriculture, Forestry and Fisheries.

During 2018/2019, disease-free varieties were exported to Eswatini, France (for Reunion), Sudan and Zambia. Du Roi Laboratory and Dube Agrilab supply SA varieties to countries where there are Variety Licence Agreements in place. Sugarcane fuzz was exported to 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 2018/2019, SASRI mass reared and distributed 180 788 biological agents. The agents are effective for the control of *Pereskia aculeate* (Barbados Gooseberry), *Parthenium hysterophorus*, *Salvinia molesta* (Kariba Weed), *Eichornia crassipes* (Water hyacinth), *Pistia stratiodes* (Water lettuce) and *Chromolaena odorata* (Triffid weed).

GENETIC ANALYSES

SASRI provides a genetic analysis service internally to 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 2018/2019, 913 DNA sequence and 2 597 DNA fragment analysis runs were conducted. It is standard procedure for all pre-release varieties 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.

SASRI received SAR requests to analyse and generate DNA sequences for SMRI and UKZN. There were also a few requests from the Department of Conservation Ecology and Entomology at the University of Stellenbosch to analyse fruit fly specimens.

MECHANISATION AND ADVISORY SERVICE AND MACHINERY DEVELOPMENT

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

Many stakeholders make use of these mechanisation reports. Growers use these reports for annual budget preparation while SA Canegrowers 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 to this, 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 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 Malawi, Mozambique and Eswatini. 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 2018/2019 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 are 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.

BIOSECURITY

Rowan Stranack (Extension & Biosecurity Manager)

The SASRI Biosecurity inspectorate comprises of 24 field inspection teams with attendant officers and technicians. The inspectorate operates in all regions of the industry but is managed centrally together with Extension, who also 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. Every year brings with it new challenges and the 2018/19 period was no exception.

PEST OCCURRENCES IN 2018/19

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. Varietal susceptibility was evident and some effort was devoted to identifying the most sensitive varieties so that growers could monitor these more closely.

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

A group of North Coast growers whose farms were seriously affected by yellow sugarcane aphid met with SASRI specialists and Extension on a number of occasions to discuss challenges in controlling the pest. In response to the threat, a task group was formed at SASRI to address the problem. Various strategies were investigated and a number of trials and research projects were proposed. Chemical control of yellow sugarcane aphid proved particularly problematic as outbreaks were found to be highly transient and erratic, often only affecting patches within fields and then moving off unpredictably, making planning of trials very difficult. The pest was also the main focal point of the 2019 rainfed region Research Development and Extension Workshop where growers across all regions identified the control of this pest as being a high priority.

Longhorn Beetle (*Cacosceles newmannii*)

The threat posed by this pest is arguably one of the most serious to face the industry in a long while. First recorded late in 2015 on three farms in the Entumeni area of Zululand the pest was identified on a further two farms over the next two years, all the while spreading on the original properties where it was first found. By the beginning of the 2017/18 season more than 500 hectares of sugarcane was found to be infested with the pest. Interventions to control and limit the spread of longhorn beetle included:

- placing the affected farms under quarantine,
- halting all seedcane movement from affected farms,
- the issuing of eradication orders for infested fields,
- early eradication of all cane roots,
- an extended fallow period on eradicated fields,
- transporting of commercial cane from these farms only to the Amatikulu mill in specially constructed enclosed trailers,
- planting of suitable cover crops,
- a long-term research project which included the appointment of a Post-Doctoral researcher and a dedicated SASRI Entomologist to study various aspects of the long horn beetle, and
- approval of compensation and financial assistance for the affected farmers.

By the end of 2017, the total area requiring harvesting and eradication had risen to 1 099 hectares. With considerable effort and commitment, all of the infested sugarcane on the affected farms was harvested and delivered to the mill.

The project launched to attempt to control this pest continued through 2018 and into early 2019. With the bulk of the crop eradication and planting of cover crops having been completed in 2017 and the first half of 2018, where 914 hectares was eradicated and planted to pasture, a smaller area of 215 hectares required attention in 2018. By March 2019, a total of 1 129 hectares had been eradicated. Only two additional fields were found positive during 2018, and the emergence of adult beetles during January and February 2019 was largely restricted to a couple of fields that were not at a level to cause concern.

The managed and co-ordinated approach to the longhorn beetle containment effort has been largely successful. Research into the pest has proved problematic in the sense 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

A further success story was effective suppression of eldana populations in certain LPD&VCC control areas. Again, this was achieved through a co-ordinated and committed approach by LPD&VCCs and growers and their associations, supported by SASRI Extension, SASRI Biosecurity and the agrochemical trade. Particularly in the Zululand, North Coast and Lower South Coast regions, there was a steady and significant reduction in eldana numbers. In the Midlands regions, the recent droughts resulted in an upsurge and spread of eldana, but these too appear to have been arrested through extensive monitoring, scouting and the implementation of remedial spraying, where required.

Across the industry, there was once again considerable emphasis on eldana surveys during 2018. As in the previous year, all committees exceeded their minimum requirement for eldana surveys. Approximately 85 000 hectares were surveyed for eldana, very similar to the area surveyed in 2017. These surveys were put to good effect in that overall, across the industry only 3% of fields were above local hazard levels requiring action either in the form of spraying or premature harvest. This was a slight improvement over the previous season where 4% of fields surveyed required remedial action. This is confirmation that growers are managing the pest effectively.

The regions where eldana posed a particular challenge were Midlands North and the Irrigated North. In the Irrigated North, at Pongola in particular, the forced carrying over of fields from the previous season resulted in high levels of eldana, which required urgent harvesting. In the Midlands North area, the levels of eldana remained low overall but the pest continues to spread. Growers responded rapidly and decisively to any occurrence with either spraying or harvesting. Changes to the local rules were introduced permitting the delay of harvest until crop maturity in fields with low levels of eldana, provided the field was sprayed.

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.

Under the guidance of SASRI Extension Specialists, an Integrated Pest Management (IPM) approach to eldana control continued to be promoted in areas where eldana is a threat. Careful management of varieties and specifically the introduction of eldana resistant varieties remains a cornerstone of this approach. To this end, the new varieties N54, N55, N58, N59, N61 & N62 have all proved their worth as promising replacements for older, more susceptible varieties.

DISEASE OCCURRENCES IN 2018/19

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 was below requirement due to the pressure to carry out more eldana surveys. Approximately 26 000 hectares was surveyed, of which 640 hectares (2.5%) was above the local hazard level. Of these hazard fields, the vast majority were in the Pongola area where more than 30% of the fields surveyed had levels of smut requiring remedial action; either roguing or plough out in some cases. The varieties N41, N25 and N19 were the most affected.

Mosaic was recorded in only a small number of commercial fields during the year and overall the percent fields infected was below both the 5- and 10-year mean levels. Seedcane fields were largely free of the disease across all areas with only the variety N12 recording some mosaic in a small number of seedcane fields.

Ratoon Stunt (RSD)

Of the 6 671 commercial fields tested for RSD, 5% were found to be infected. This was higher than the average infection found in the previous season of 3.2% but lower than the 5-year average of 6.2% fields infected. Of all the regions, Pongola and Umfolozi recorded the highest level of infection in commercial fields, both areas where there are no official seedcane schemes. Of the 1 342 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 some areas this objective has already been achieved, there are a number of other regions where only embryonic seedcane schemes are in operation. The provision of sufficient good-quality seedcane therefore remains a major challenge into the future.

Current status of seedcane schemes

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 a number of regional initiatives during the year 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. Efforts were also made to ensure that small-scale growers are able to access new varieties and good quality seedcane in the absence of them establishing their own on-farm nurseries. During the 2018/19 planting season, 3 750 hectares of Certified and Approved Seedcane Nurseries were approved for use. This is still only 60% of the required area to meet the requirements of the 2023 deadline. Some significant work will have to be carried out over the next three years for areas to be compliant, particularly in those areas where there are no seedcane schemes.

OTHER PESTS AND DISEASES

Both brown and tawny rusts were evident during 2018. Brown rust continues to affect the varieties N27, N37 and N42 quite severely with some indications of N59 being moderately susceptible. Tawny rust affected N57 quite severely and as this variety is becoming more widely planted in the Irrigated North, so too is the spread of tawny rust.

Of note during the year was the appearance of sugarcane yellow leaf virus (SCYLV) in sugarcane on the South Coast, particularly in the Sezela area and mainly on variety N12. Whilst this disease appears periodically, this year it had an effect on 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 material. However, since insect vectors spread the disease, unfortunately any clean seedcane would be vulnerable after planting.

There were isolated outbreaks of armyworm (*Spodoptera exempta*) following late summer and autumn rains but very little damage was recorded.

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

REGIONAL BIOSECURITY

Monitoring for the possible incursion of *Chilo sacchariphagus* continued along the borders of South Africa and Mozambique using a grid of pheromone traps. A SADC regional database of biosecurity threats was maintained during the year. This revealed, amongst other things, the common threat posed by yellow sugarcane aphid to most of the sugar estates within the region. The presence of orange rust in Mauritius was also noted and although spores have been found in traps in Mpumalanga, this disease is yet to manifest in commercial sugarcane in South Africa.



TECHNOLOGY DEVELOPMENT AND KNOWLEDGE EXCHANGE

Michelle Binedell (Knowledge Manager)



The wealth of knowledge that is generated by SASRI specialists each year is enormous but its value is only realised once it leaves the lab bench and finds application elsewhere. Much effort goes into developing a range of mechanisms and products for communicating research outcomes and good practices to all industry stakeholders.

POPULAR PUBLICATIONS

In the 2018/19 year SASRI continued to produce *The Link* and *Ingede* magazines aimed at our English/Afrikaans and isiZulu speaking growers. The three editions of each focused on many of the issues that were raised by the industry during our annual Research, Development and Extension workshop, along with issues that were pertinent to specific regions.

The Link

Two editions of *The Link* contained 22 articles of interest but a special edition in January 2019 was published with a focus on seedcane and the legislated 2023 deadline wherein each grower should ensure that they either establish their own seedcane nurseries, or that they arrange to purchase their seedcane from a registered co-operator.



Apart from the useful Topical Tips enclosed in every edition of *The Link*, a strong focus was placed on correct nutrition practices. On the disease front, the detection of Orange Rust spores on spore traps at the Komati Research Station raised some concern, however the disease was not observed on cane.

New chemistries for pest and disease control, including roguing for smut were covered, as well as articles on water management, mechanical cropping and cane quality.

Once again, a grower-focused article (this time on Rob Gurney from Eston), provided such valuable insights into the challenges and triumphs experienced by growers. Rob shared his top 10 “back-to-basics” principles for successful farming.

On the technology front, SASRI launched a further update of the **PurEs**® mobile app and advertised the various knowledge resources and applications that are available on our newly launched website.

The Ingede

The *Ingede* focused 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 13 articles of interest focusing on disease control, seedcane production, crop residue management, soil sampling, prevention of compaction and the effective use of demonstration plots in encouraging adoption of good practice.

Other newsletters and articles

- Direct communication to growers in the numerous regions took place through the development of thirteen *Extension newsletters*. These communicated upcoming events, alerts and latest trial results.
- Nine articles to *Coastal News*, once again showcasing SASRI's achievements and promoting best practice were produced along with six articles in the *South African Sugar Journal*.
- Three electronic newsletters for the Fertiliser Advisory Service continued to deliver information on the latest FAS services available to growers through a series of articles.

BOOKLETS AND GUIDES

- Annual updates of the Mechanisation Reports were completed and posted to the SASRI website.
- Marketing Flyers were updated with current prices and advertised the services available to industry members.
- A booklet on *Sugarcane pests in southern Africa* was created to provide a reference guide to common pests in sugarcane and how to control them and the existing Pest and Disease pocket guide was updated with the latest pests.
- Finally, an Illustrative Guide to Sugarcane Farming was published and provides a pictorial overview of sugarcane production practices that can be used for information or training purposes.



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. Four information sheets were published containing new and updated information on varieties and leaf sampling and analysis.

TOOLS

An interactive Herbicide Selector tool and printable pdf were created to replace the annual Herbicide Guide. This tool takes into account weed spectrum, weed growth stage and clay% and suggests a range of active ingredients that will work for the chosen criteria. At the touch of a button, one can see a list of commercial products (with notes) that are available for each active ingredient.

A new update to the **PurEst**® smartphone app was launched to assist in ripener decision-making for late season quality maintenance.

A new smartphone application, MyCanesim Lite, was launched as a simplified version of the MyCanesim model. It provides a quick simulation of sugarcane crop growth, water use and yield from only eight inputs selected. The app can be used for both benchmarking and forecasting of sugarcane yields and water use.

RADIO

During 2018/19, over 80 radio programmes were broadcast at 10 radio stations within KwaZulu-Natal. Since much of the rural population in South

Africa has access to radio, this medium is being used very successfully to broadcast agronomic advice to isiZulu speaking growers.

GROWER INTERACTION

Significant face-to-face interaction with industry stakeholders in 2018/19 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 1 640 visits to growers, hosted 147 grower days and exhibitions and were involved in 315 conferences, workshops, refresher courses, seminars and demonstrations. SASRI hosted 1 102 visitors to our site and Extension Specialists attended 426 Industry meetings.

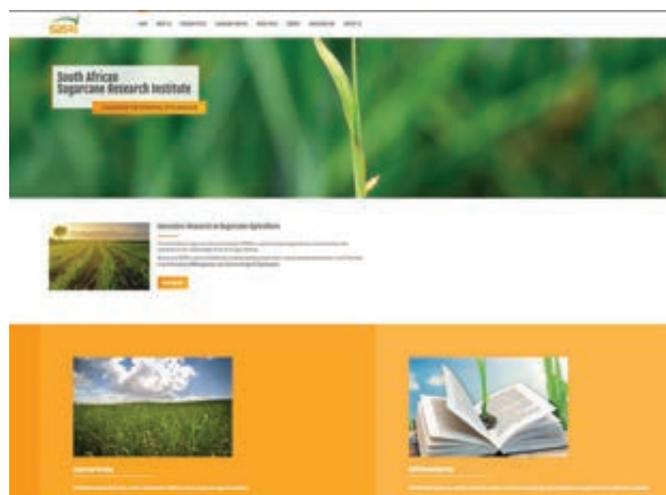
CERTIFICATE COURSES

The demand for skills development and training in sugarcane agriculture has continued to increase into 2018/19. SASRI responded to this demand again by delivering two three-week Junior Certificate Courses in Sugarcane Agriculture in April and October 2018. A total of 113 students attended the Junior Courses, 81% from South Africa and the balance from Eswatini and Zimbabwe.

Two Senior Certificate Courses, aimed at tertiary-level students, were held in June 2018 and February 2019 with 116 students attending. Over 75% of students were South African applicants, while the balance of students were from Eswatini, Zambia, Mozambique, Tanzania, Zimbabwe and Sudan.

SASRI WEBSITE

At the end of the 2017/18 financial year, a new website was released which contained more user-friendly features and content. It has continued to be used as a one-stop site for all SASRI publications, decision-support-tools and services provided to the industry.



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