Sugar Research Australia

SRA Performance Report 2016/17

Australia's sugarcane industry fast facts

4,000

There are about **4,000** cane farming businesses supplying **24** mills owned by **8** milling companies

95%

Approximately **95%** of Australia's sugarcane production is in Queensland and the remainder in New South Wales

30%

Approximately **30%** of sugarcane businesses are greater than **125** hectares and account for about **70%** of total production

36.5Mt

The **2016** season yielded **36.5 million** tonnes of cane, across **372,000** hectares

3rd

Australia's sugar industry accounts for **2.8%** of world sugar production and is the world's 3rd largest exporter of sugar

4.8Mt

Approximately **4.8Mt** of sugar was produced, with nearly **80%** being exported to the value of **$1.7 billion**

Sugar Research Australia Limited

Head Office: 50 Meiers Road, Indooroopilly QLD 4068, Australia

Mailing Address: PO Box 86, Indooroopilly QLD 4068, Australia

Phone: 07 3331 3333

Email: sra@sugarresearch.com.au

Web: www.sugarresearch.com.au

Front cover: Denis Pozzebon operating his automated furrow irrigation system.

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Australian Government
Department of Agriculture and Water Resources

Queensland Government

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Executive summary

150

SRA's research, development and adoption portfolio included approximately **150 projects** in 2016/17, with impacts across the value chain

2

2 new SRA varieties were released: SRA9 and SRA10. Local industry identified these varieties as having potential to enhance productivity

10%

Positive grower sentiment towards SRA's performance has increased by **over 10%** in the past two years

69

69% of growers are using SIX EASY STEPS to calculate their fertiliser use to reduce input costs, and improve profitability and sustainability

5:1

Independent evaluations have shown estimated returns on R&D investment of **5:1** for new germplasm to enhance resistance to pachymetra root rot and smut and **2:1** for maximising rate of parental improvement in the Australian sugarcane breeding program

38%

38% of growers changed weed and/or pest management practices in the last two years to improve farm productivity and sustainability

3.8/5

SRA research updates, field days and workshops were rated by growers as **3.8 out of 5** on average

14

14 harvesting groups have been optimised in line with SRA's harvesting best practice recommendations, increasing shared industry value through reduced sugar loss

76%

SRA's performance rating increased to 76% (up from 74% in 2016) according to the latest grower survey

000's

SRA diagnostics labs analysed over **1,000 pachymetra**, **150 nematode** and **20,000 ratoon stunting disease samples** to support industry pest and disease management and limit the impact on profitability

1,000

SRA's chemistry lab conducted phenotypic analysis on approximately **1,000 samples** to aid selection of high performing varieties in the plant breeding program

600

600 near infrared (NIR) spectroscopic calibrations were developed across the sugar industry network, informing factory control decisions and increasing mill efficiency

2,000

Approximately **2,000 field samples** were subjected to nutrient analysis in SRA's chemistry lab to assist grower decision making and reduce input costs

2,000

SRA's Woodford pathology lab screened approximately **2,000 clones** against eight sugarcane diseases to inform selection of disease resistant varieties

55,000

SRA received **55,000 autumn** and **84,450 spring tissue culture plantlets** orders to distribute clean seed and improve productivity

000's

SRA ran **8,997 Clonal Assessment Trials** and **1,313 Final Assessment Trials** in the breeding program, ensuring rigorous selection delivers high-performing varieties

600

600 sugarcane samples from Australia and Papua New Guinea were collected for endophyte DNA isolation and sequencing to potentially improve sugarcane abiotic stress and disease resistance

5.5B

SRA analysed **5.5 billion RNA sequences** in the search for the cause of yellow canopy syndrome, allowing viruses and fungi to be ruled out as causal factors

Introduction

SRA was established in 2013 as a sugarcane grower and miller owned company and the declared Industry Services Body for the Australian sugarcane industry under the *Sugar Research and Development Services Act 2013* (Cth). As the declared Industry Services Body, SRA is required to provide and manage research, development and adoption (RD&A) activities, for the benefit of the sugarcane industry and for the wider public good.

SRA invested $34.8 million in RD&A activity in 2016/17, which was made possible through sugarcane grower and miller levy contributions; Commonwealth and Queensland Government co-investment; and collaborative funding partnerships with other research organisations, industry organisations and agri-businesses.

This investment was guided by SRA's 2013/14 – 2017/18 Strategic Plan and the 2016/17 Annual Operational Plan, that set the key focus areas (KFAs), intended outcomes and performance measures that SRA worked towards during the past year. This Performance Report provides an overview of SRA's performance in delivering on these plans.

The Performance Report is by no means exhaustive but rather provides a selection of SRA's research highlights and performance. SRA's 2016/17 Annual Report will further outline the research activities and outcomes invested in and/or delivered by SRA during the past year. In addition, SRA's website and periodical publications, such as ***Cane****Connection*, ***Milling****Matters* and electronic newsletters, provide further information on SRA's research portfolio and the impact this research is having on the Australian sugarcane industry.

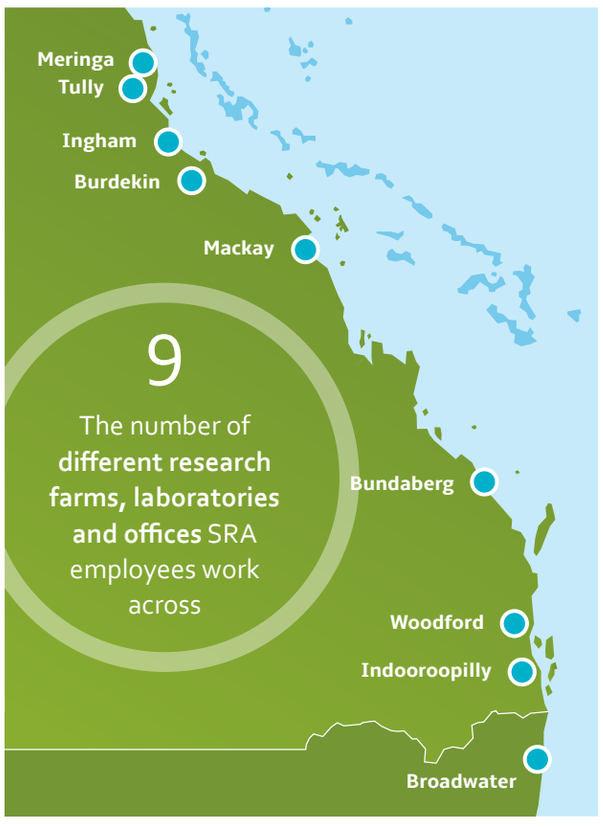
SRA is continuing to embed a logic-model approach for monitoring, evaluating and reporting on research outputs, outcomes and impacts, including the implementation of a contemporary system for capturing and monitoring adoption, practice change and resulting impacts across the industry. This impact-focused data will be reflected in future SRA Performance Reports.

Looking forward, SRA has developed, in collaboration with industry and government investors, a new five-year Strategic Plan that commenced in July 2017.

The new plan focusses on delivery of tangible outputs and outcomes for SRA's investors and is underpinned by four impact-driven goals of profitability, improved sustainability, enhanced capability and organisational excellence. Current and future performance will be assessed against achievement of these goals.

The Performance Report is presented for the interest of SRA's industry and government investors, our research collaborators and broader stakeholders.

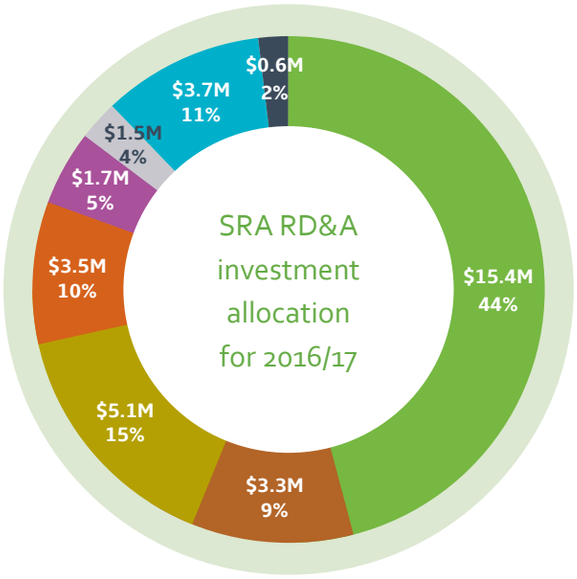
168 The number of **staff** SRA employs



9 The number of **different research farms, laboratories and offices** SRA employees work across

Performance

SRA performance against plan for 2016/17



SRA invested $34.8 million in 2016/17 in research, development and adoption activities across SRA's eight industry-focused KFAs. The above graph details the actual expenditure in each of the KFAs. Reflective of investor expectations and SRA's 2013/14 – 2017/18 Strategic Plan, the majority of the investment has been in the areas of: variety development and plant breeding; pest and disease control, including yellow canopy syndrome (YCS); on-farm production; and adoption.

KFA	
	Key Focus Area 1 Optimally-adapted varieties, plant breeding & release
	Key Focus Area 2 Soil health & nutrient management
	Key Focus Area 3 Pest, disease & weed management
	Key Focus Area 4 Farming systems & production management
	Key Focus Area 5 Milling efficiency & technology
	Key Focus Area 6 Product diversification & value addition
	Key Focus Area 7 Knowledge & technology transfer & adoption
	Key Focus Area 8 Capability development, attraction & retention

An assessment of SRA's performance against the suite of 34 measures reported in SRA's 2016/17 Annual Operational Plan is provided in Appendix 1. In summary, SRA has successfully achieved or is on-track to achieve all of the set measures.

76%

of measures have been achieved

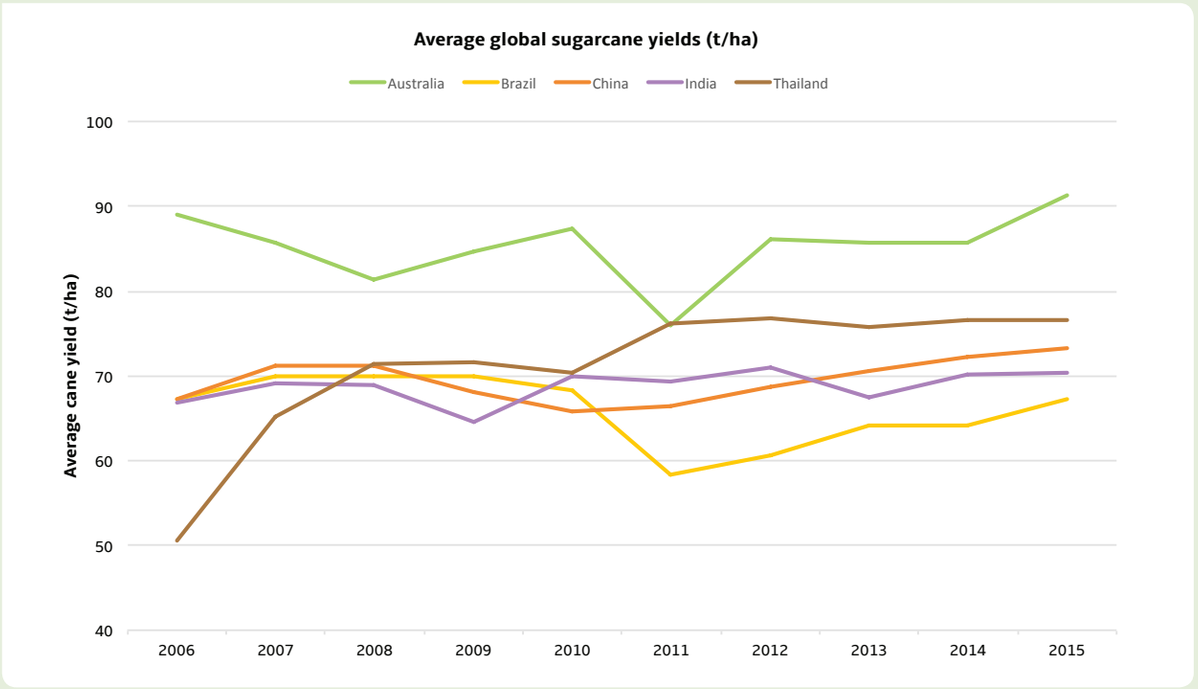
24%

of measures are on track with progress/improvement made but further activity or research required to fully achieve objective

0%

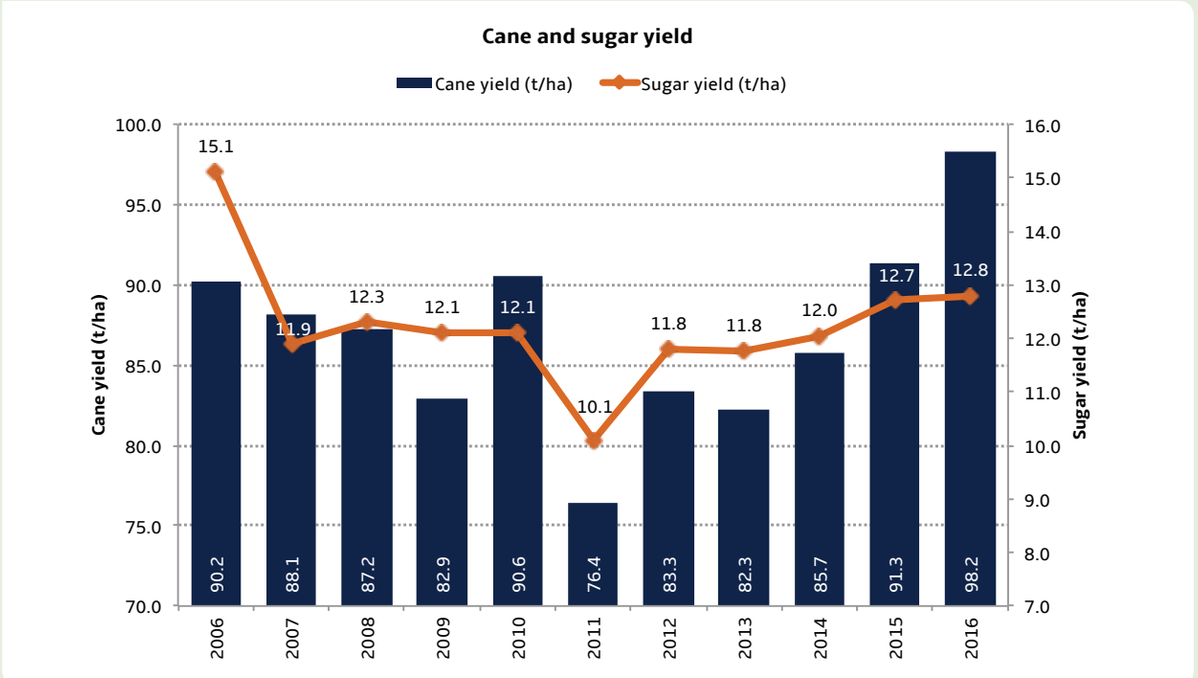
no measures have failed to be achieved nor require significant action to reach objective

Productivity — Global yields



Australia continues to be a world leader in terms of sugarcane tonnes per hectare. *Source: OECD.*

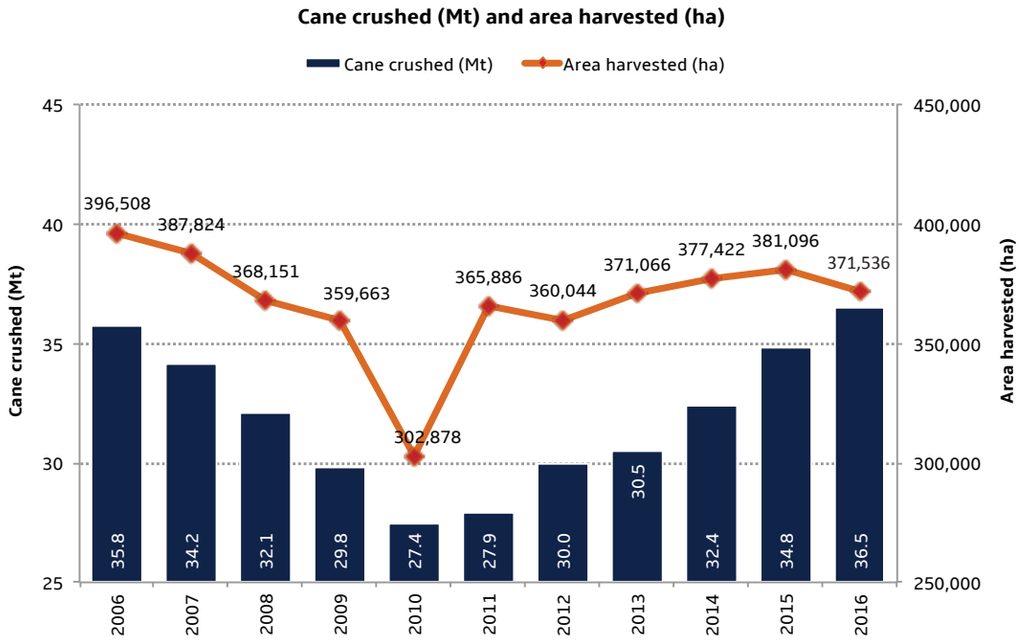
Productivity — Australian cane and sugar yield



Australia's cane and sugar yields have steadily increased over the last four years. *Source: Australian Sugar Milling Council (ASMC).*

Productivity

Australian cane crushed and area harvested



The total tonnes of cane crushed in Australia has been steadily increasing in recent years with the 2016 season of 36.5 million tonnes being the largest since 2005. *Source: ASMC.*

Adoption and practice change

According to SRA's 2017 Grower Survey[1], **66%** of growers changed farming practices within the last two years.

Adoption of controlled traffic systems was the most common practice change in the last two years, with **17%** of growers implementing change – up from 13% in 2016.

38% of growers made changes to weed and/or pest management.

Changes to fertiliser application (15% in 2017, was 23% in 2016) and tillage methods (9% in 2017, was 18% in 2016) were significantly less widespread than in 2016.

No real change over the past 12 months in the proportion of growers using SIX EASY STEPS (69% in 2017, was 70% in 2016). There is evidence however of an upward trend in the Herbert (82% in 2017, was 75% in 2016) and Far North (90% in 2017, 84% in 2016) regions.

[1] Down to Earth Research, 2017, Grower Survey 2017 Report for Sugar Research Australia.

Researcher and grower collaborative trials reveal SIX EASY STEPS nitrogen guidelines maintain productivity and maximise profitability

On-farm, replicated and randomised large-scale strip trials conducted in conjunction with grower collaborators under the RP20 project revealed that SIX EASY STEPS application guidelines maintain cane productivity and improve profitability.

The 57 trial sites were run across a whole crop cycle and encompassed 12,000 hectares of the four major Burdekin soil types across both the Delta and Burdekin River Irrigation Area.

Converse to participating grower opinions at the start of the trial, the trials demonstrated that the SIX EASY STEPS method of calculation provides adequate nitrogen to grow their cane to its maximum potential and economic **case studies indicated increases in profitability over 100 hectares of between $8,000 to $63,000**.

The results also highlighted that good farming management is a key component of achieving high yields and that high nitrogen rates do not compensate for poor management.

> "We were steadfast in that belief that we needed 290 units of nitrogen to grow good crops of cane, which we don't. It's proven now".
>
> **Eric Barbagallo**

> "... This project has inspired me to continue challenging the norms and strive for continuous improvement. I know I can add to what I got out of this".
>
> **Frank Catalano**

RP20 is exemplary of the power of grower collaboration and on-farm trials to validate research results, change attitudes and beliefs and promote adoption and practice change.

The RP20 Burdekin nitrogen trials were awarded overall winner of the Queensland Premier's Award for Excellence and winner of the Sustainability Award.

RP20 is a collaborative project between participating growers, SRA, Queensland Department of Science, Information Technology and Innovation (DSITI), Queensland Department of Agriculture and Fisheries (DAF) and Queensland Department of Environment and Heritage Protection (EHP).

All trial results and case studies can be obtained by contacting SRA by telephone on (07) 3331 3308.

> "As far as losses go, we've learned a lot about that and have modified our farming operation to control those and get the best benefit from the nitrogen we do put on. It's keeping the farm well managed and with the use of SIX EASY STEPS that shows us the benefit of financial returns".
>
> **Steve Pilla**

Impact and return on investment

2:1
Aggregated average return on investment

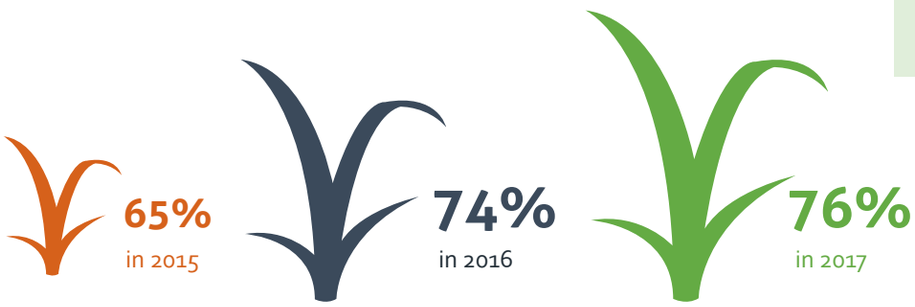
In 2016/17, evaluations were undertaken by independent analysts[2] on a small sample of research projects to assess the current and future industry-level benefits[3] and relative investment return of the investments.

The aggregated ratio of benefits relative to cost was estimated at just over 2:1, given aggregated present value benefits of $27.81 million relative to present value costs of $12.89 million.

SRA performance rating: Fairly high to very high[4]

Year	Southern	Central	NSW	Herbert	Burdekin	Far North
2015	61%	62%	67%	66%	66%	70%
2016	78%	73%	76%	69%	68%	80%
2017	72% ↓	78% ↑	92% ↑	77% ↑	73% ↑	74% ↓

Since 2015, the proportion of growers rating SRA's performance **fairly high to very high** has risen significantly from **65% to 76%**



Levy paying comfort: Comfortable to extremely comfortable[5]

The majority of growers report that they are **comfortable to extremely comfortable** paying the levy, **up 4%** in 2017

[2] Evaluations undertaken by Agtrans Research on behalf of the Queensland Department of Agriculture and Fisheries.

[3] Note the reported returns on investment are estimated industry-level returns. They are not the returns that individual growers might expect if they adopt these technologies.

[4] Down to Earth Research, 2017, Grower Survey 2017 Report for Sugar Research Australia.

[5] Down to Earth Research, 2017, Grower Survey 2017 Report for Sugar Research Australia.

SRA Independent Performance Review

SRA's inaugural Independent Performance Review was completed in late 2016 by Scott Williams Consulting, in association with Miracle Dog and Harrison Business Strategies. The review is a requirement of both SRA's Constitution and 2013/14-2016/17 Statutory Funding Contract with the Commonwealth Government.

The review entailed an extensive review of over 150 documents and consultations with over 40 stakeholders, including: sugarcane growers and millers; industry body representatives; SRA Board, management and staff; Research Funding Panel members; Commonwealth and Queensland Government representatives; and research providers.

The review findings detailed in the Independent Performance Review Report[6] provided a strong endorsement of SRA's governance, strategic management, and research investment programs.

The Report also provided recommendations for enhancing SRA's operational and strategic management in the areas of: culture; planning and reporting; RD&A management; adoption processes; and communication and reporting.

The SRA Board endorsed the review findings, accepted all of the recommendations and implemented a response plan[7] to put the review recommendations into action. Of the 33 action items detailed in the response plan, 26 have been completed and the remaining actions are expected to be finalised by November 2017.

"The review found that SRA is a very well-run company."

"The company has the foundations in place to be a high-performing RDC."

"Some relatively minor opportunities for improvement to governance were identified..."

"Independent analyses demonstrate that SRA has delivered value to investors."

[6] Sugar Research Australia Independent Performance Review: Final Report, October 2016, available at https://sugarresearch.com.au/sra-information/investor-information/.

[7] Available at https://sugarresearch.com.au/sra-information/investor-information/.

Snapshot of research outputs and outcomes delivered in 2016/17

KFA1: Optimally adapted varieties, plant breeding and release

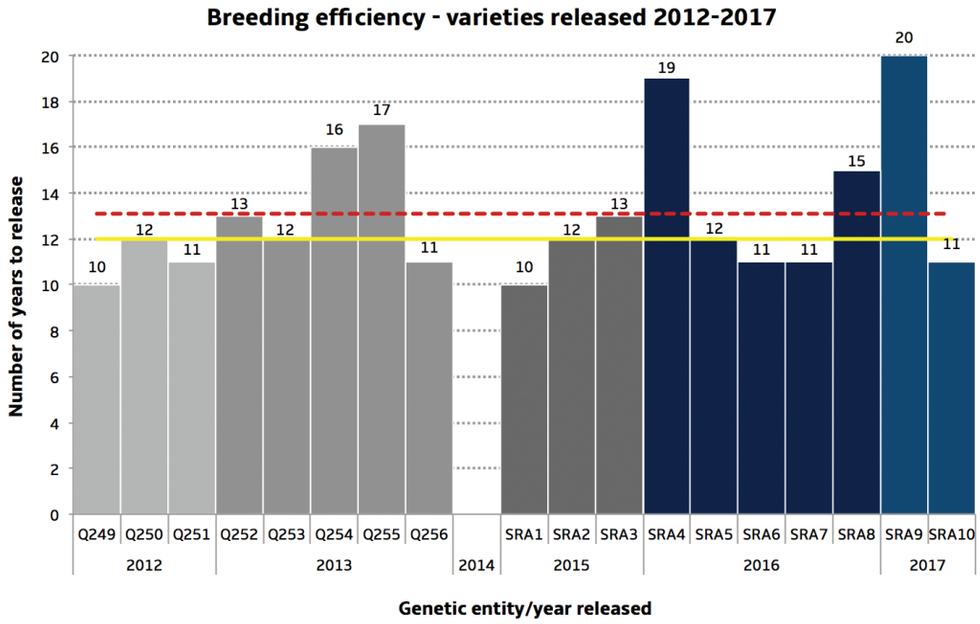
- Two new varieties released – SRA9 in Central and SRA10 in the North.
- Demonstration of use of DNA markers as a more efficient tool than using phenotypic information to select sugarcane parental clones at early selection stage. Indicating that marker assisted breeding could be an efficient tool to accelerate SRA's breeding program.
- Development of markers from bacterial artificial chromosome (BAC) clones linked to traits of agronomic importance, including sucrose accumulation. These markers have been converted to high throughput single nucleotide polymorphism (SNP) and simple sequence repeats (SSR) markers and are currently being tested in the SRA breeding material.
- Uptake of clean cane has increased from 200 to 1,800 tonnes of cane annually in the Herbert region as a result of communication of recent research results that identified major productivity drivers.
- The effects of soft canes on factory operation and performance were identified aiding Regional Variety Committees during annual variety selection.
- A gene controlling accelerated growth and development of sugarcane was identified in a SRA and University of Campinas (UNICAMP, Brazil) joint project, potentially providing for the first time, an effective tool to shorten the sugarcane crop cycle.
- SNP markers have been identified for resistance to both smut and pachymetra using a combination of association analysis, genetic mapping and RNA sequencing. High throughput methods have been developed for screening these markers and are currently being trialled in the SRA breeding program.
- A baseline description of healthy root systems in unrestricted conditions was completed, and a genotype-specific variation has been identified. New methods have been developed for measuring root health including a DNA-based diagnostic and root respiration assays.

Sugarcane breeding hub

The Sugarcane Hub was successfully launched in May 2017. The Hub will allow researchers access to genetic and molecular data that has been generated over the last 10 years.

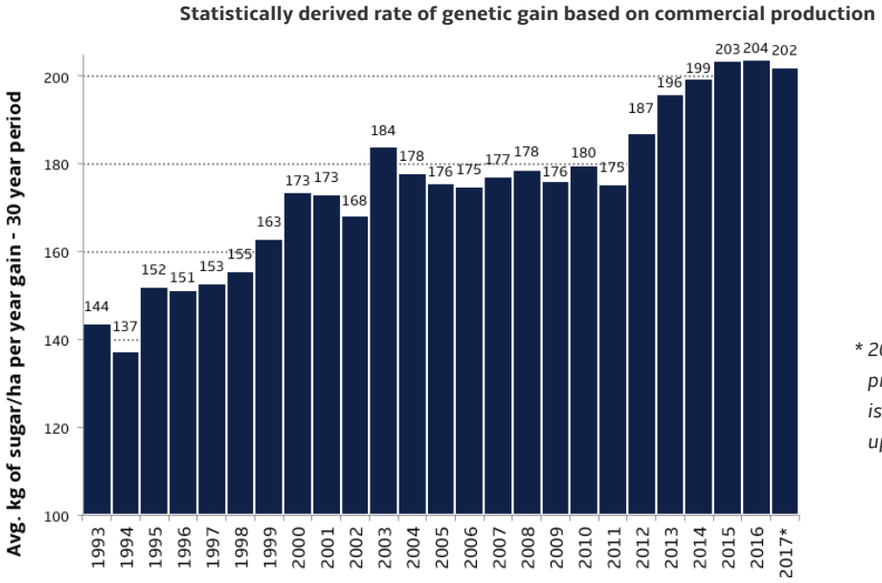
This data is now available in a format that links the current sugarcane genome sequence assembly to expression data and genetic marker data and will be a valuable tool for future sugarcane research.

Varieties and plant breeding — Breeding efficiency



The time taken for a variety to be released is one measure of breeding efficiency. Two new varieties were released by SRA in 2016/17 and the 2012-2017 average time to release was 13.1 years. SRA9 took 20 years to release because, at the time it was originally considered, other varieties for smut resistance were preferred for release. SRA 9 has been subsequently resurrected for release because of its acceptable productivity, resistance to pachymetra and low levels of smut observed in the field. *Source: SRA.*

Varieties and plant breeding — Rate of genetic gain

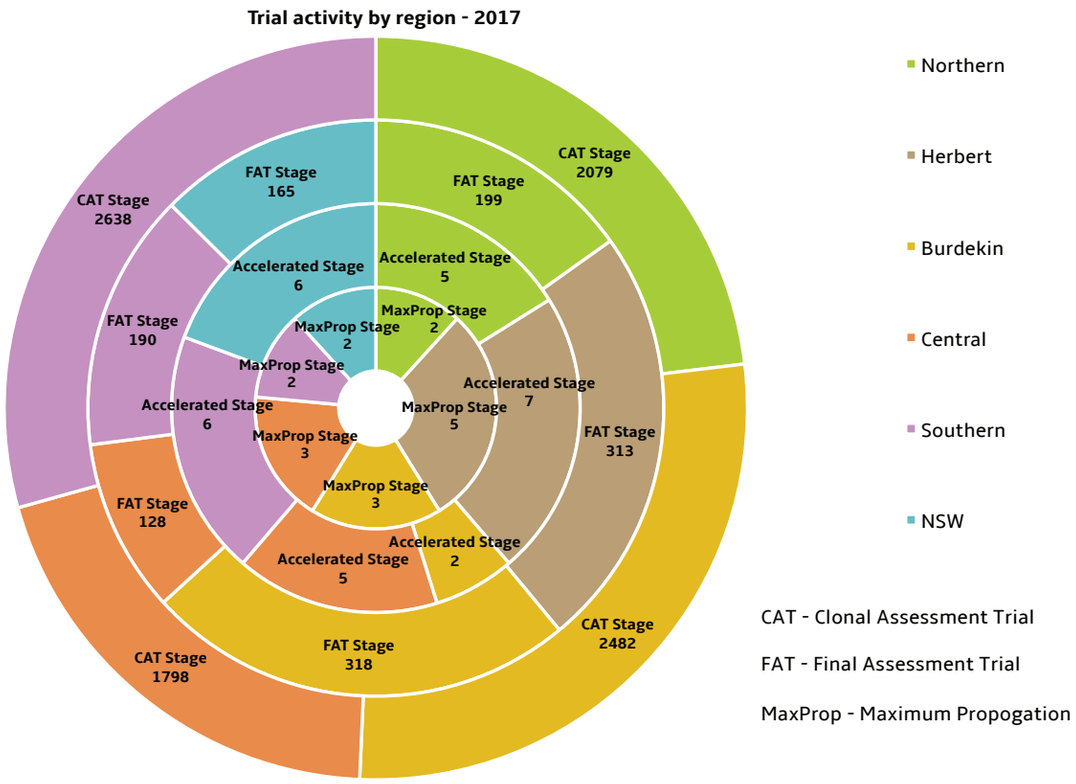


** 2017 result is a prediction. Analysis is based on an updated equation.*

The rate of genetic gain is based on a 30-year rolling average of measured potential gain in different production traits – in this case sugar per hectare. This assessment was based on an analysis of commercial production data that was developed many years ago. Recent analysis has demonstrated that adoption characteristics potentially artificially inflate the relative performance of new varieties in commercial production regardless of the statistical treatments applied to the data, resulting in overestimation of genetic gain. The SRA Board has now approved the development of new metrics based on direct performance comparisons of new elite clones with established benchmark varieties. The new approach, to be reported from 2018 onwards, will provide a more accurate measure of underlying genetic gain and allow interrogation at a regional level in real time. *Source: SRA.*

Varieties and plant breeding

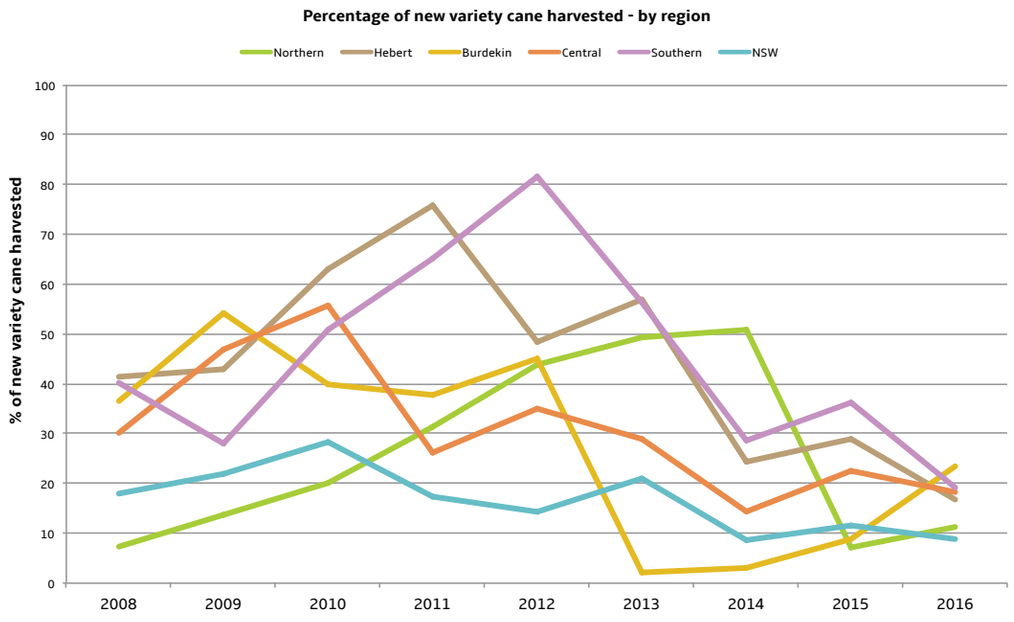
Trial activity by region 2017



The numbers represent the number of clones in each breeding stage trial per region. 2017 trial activity is within normal expectations for the plant-breeding program. *Source: SRA.*

Varieties and plant breeding

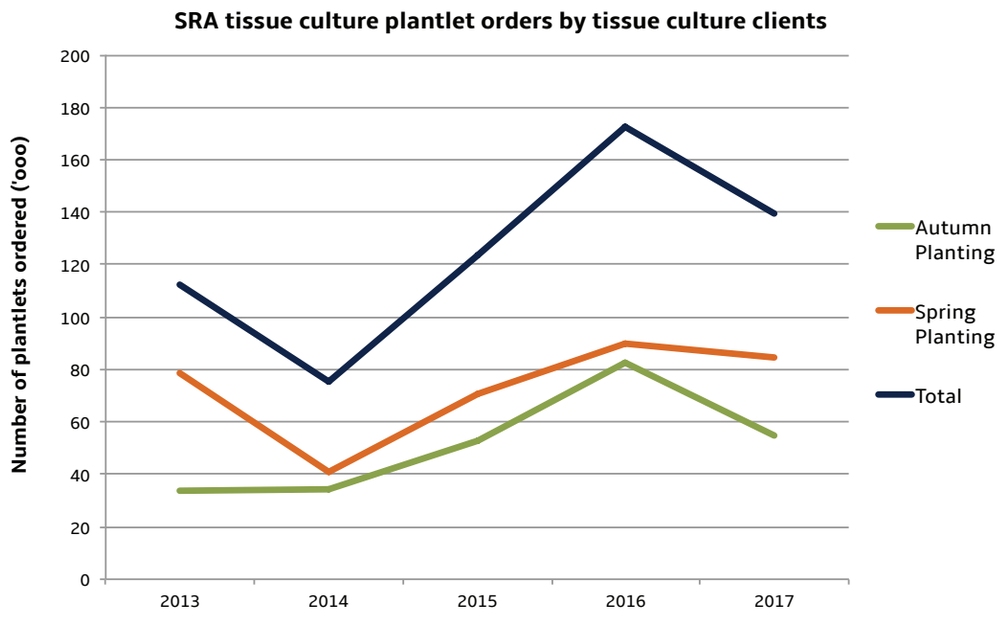
New varieties in production (by region)



New varieties are those that have been released in the previous seven years. The slight drop in area planted to new varieties in the Herbert, Central, Southern and New South Wales (NSW) regions is explained in part by three varieties grown in these regions (Q238$^{\phi}$, MQ239$^{\phi}$, Q240$^{\phi}$) becoming declassified to 'old varieties'. The substantial drop in the Northern region between 2014 and 2015 was due to the declassification of Q208$^{\phi}$. *Source: SRA.*

Varieties and plant breeding

Tissue culture plantlet orders



The use of tissue culture is a method to propagate new, clean seeds. Tissue culture plantings are more uniform and produce more sticks than conventional plantings so larger quantities of commercial-scale productive new varieties are achieved faster. Orders for SRA tissue culture plantlets have moderated slightly in 2017 following two years of consecutive growth. Orders for the spring 2017 planting were 84,450 plantlets and 55,000 for the autumn planting. *Source: SRA.*

KFA2: Soil health and nutrient management

- Fertfinder tool developed allowing advisors and growers to quickly determine which commercially available fertiliser blend is best suited to their crop requirements and available in their region.

- Research indicated that increasing soil carbon levels by at least 0.5%, increasing organic matter and reducing management impacts can have beneficial outcomes for boosting the naturally regulatory disease suppressive functions of soil biology. This can increase crop production and lower nitrogen inputs rates. This research underpins future investment to produce a suite of management tools to optimise soil health and improve sugarcane productivity.
- Research findings indicate that the environmental and production benefits of enhanced efficiency fertilisers are determined by complex factors. These findings may inform the development of a decision support tool to manage the complexity of decision making for the appropriate use of these products. This would improve synchrony of nitrogen supply to better fit crop demand, reducing nitrogen losses and improving nitrogen use efficiency.

SRA and EHP nitrogen use efficiency co-investment program

SRA and the Queensland Department of Environment and Heritage Protection (EHP) are working collaboratively on a number of projects addressing soil health, nitrogen use efficiency and water quality in order to protect the economic and ecological benefits of the Great Barrier Reef and the productivity and profitability of the Australian sugarcane industry.

Research within the program revealed a number of interesting results in 2016/17, including:

- Laboratory incubation studies using soils from field trials indicated two potential strategies for conserving nitrogen-rich crop residues and reducing losses from leeching and denitrification. The results showed that leaving legume residues on the soil surface significantly slowed the release of legume nitrogen into the soil and spraying a nitrification inhibitor onto crop residues prior to soil incorporation increases the proportion of nitrogen in the less mobile ammonium form.
- Soil nitrogen mineralisation studies revealed correlations between different soil tests methods and soil mineral nitrogen indicating that archived and fresh soil samples can be interrogated together when required. Identification of the best correlations will allow future service provision using different tests and procedures to be undertaken with confidence and for historical data sets to be interrogated with current tests and samples.
- Soil grouping based on productivity constraints commenced for the Central region following analysis in Tully. The process utilised historical productivity records and productivity constraints identified from routine soil analysis records and revealed sodicity and waterlogging to be the key productivity constraints. The data will continue to be refined and inform guidelines for determining appropriate Nitrogen rates given specific yield constraints across a range of soil types.
- Yield maps generated from productivity data for the Herbert River district have revealed stable patterns of variation across seasons and crop classes, which may have possible implications for fertiliser management.
- Assessments of field trial data, soil type, time of harvest, seasonal climatic conditions and crop modelling shows that there is no straightforward relationship between crop yield and crop nitrogen requirement; rather the analysis of the data presents a ‘cloud’ of associations. This analysis supports other research findings and has implications for using crop yield potential as the sole determinant of crop nitrogen requirement.
- A conceptual risk management tool has been developed for crop optimum nitrogen. The co-learning tool, under development for growers and advisors will help to operationalise Steps 5 and 6 of the SIX EASY STEPS.

KFA3: Pest, disease and weed management

- The Biosecurity Manual for Sugarcane Producers and updated Industry Biosecurity Plan were released providing growers and industry stakeholders with access to information required to identify endemic threats, implement farm biosecurity measures and meet regional quarantine obligations.
- The new Weed Management in Sugarcane Manual was released providing the latest information on effective weed control in the Australian industry, including indicative control costs per hectare.
- A machine-vision detection system for weed spot-spraying was developed revealing an acceptable degree of accuracy detecting grass weeds. A prototype sensor module will be field tested in late 2017.
- The value of Spot-6 satellite imagery has been assessed in the Herbert and Mulgrave regions as a method of developing cheaper canegrub risk maps with comparable accuracy to higher resolution but more expensive Geo-eye imagery.
- 12 trials have been established to assess a range of insecticides against canegrubs in Southern and Central regions, with a number of products under evaluation showing promise.
- Research into Sugarcane Streak Mosaic Virus has continued with two alternative pathways for development of a rapid diagnostic test identified and under investigation in an effort to determine the best commercial assay.
- A study to determine the efficacy of *Pasteuria penetrans*, a bacterial biocontrol agent, for controlling root-knot nematodes is revealing that when high concentration of bacterial endospores were maintained in the root zone of the sugarcane plant, artificially or naturally, *P. penetrans* significantly reduced the population of root-knot nematodes, one of the most damaging pests of sugarcane.
- Research into downy mildew in Papua New Guinea has determined three species, including one undescribed taxon. This may have implications for control of the disease in the event of an incursion in Australia.

Quarantine activity at SRA 2016/17

Domestic quarantine

61 clones were processed through domestic quarantine for the SRA Final Assessment Trial (FAT) tentative selections and accelerated pachymetra resistance screening for the Southern and Central districts. These clones were sent to Northern region, Herbert, Burdekin and Tully for inclusion in SRA plant breeding and resistance trials.

International quarantine

61 new varieties were received into SRA's international quarantine from Brazil, Vietnam, USA, Barbados, Reunion and China.

24 varieties completed testing and were released from Biosecurity control.

30 foreign disease-free varieties from the USA, Barbados, Guatemala, Guadeloupe and Colombia were distributed to the SRA breeding program.

KFA3 (continued)

Grower groups investigate improved pesticide management strategies for reduced off-site herbicide movement

Grower groups were established in the Mulgrave, Tully and Innisfail districts in late 2016 for participatory on-farm evaluation of improved pesticide strategies. Demonstration sites were set up to compare standard and improved herbicide management strategies for weed control effectiveness and off-site movement of herbicides.

Three rainfall simulation demonstration sites were used to highlight opportunities of improved management strategies in worst case rainfall intensity events. Simulations were conducted at both 3 days and 20 days after herbicide application and validated previous Paddock to Reef research trials that found **timing of application provides great opportunity for reducing losses of chemicals to the environment by at least 50%**. Additional simulation demonstrations validated Paddock to Reef and James Cook University (JCU) findings that banded application of residual herbicides also reduces losses by at least half.

In addition, two replicated field demonstrations showed the effectiveness of banded application of residual herbicides in real life situations. One of these included water quality sampling that again showed banded application of residual herbicides will reduce losses to the environment.

These on-farm, participatory driven results promote thinking and strategising amongst participating growers to devise their own circumstance-specific solutions to mitigate contributions to pesticide catchments loads.

The project is a partnership between SRA, EHP, DAF, JCU, Bayer, Nufarm, Tully Cane Productivity Services Limited (TCPSL) and Tully Sugar and continues in 2017/18.

Yellow canopy syndrome: Research to-date

Yellow canopy syndrome (YCS) remains a key research priority for SRA and remains challenging to decipher. However, a number of crucial observations have been ascertained in the past 12 months throughout each of the four major research projects tackling the problem.

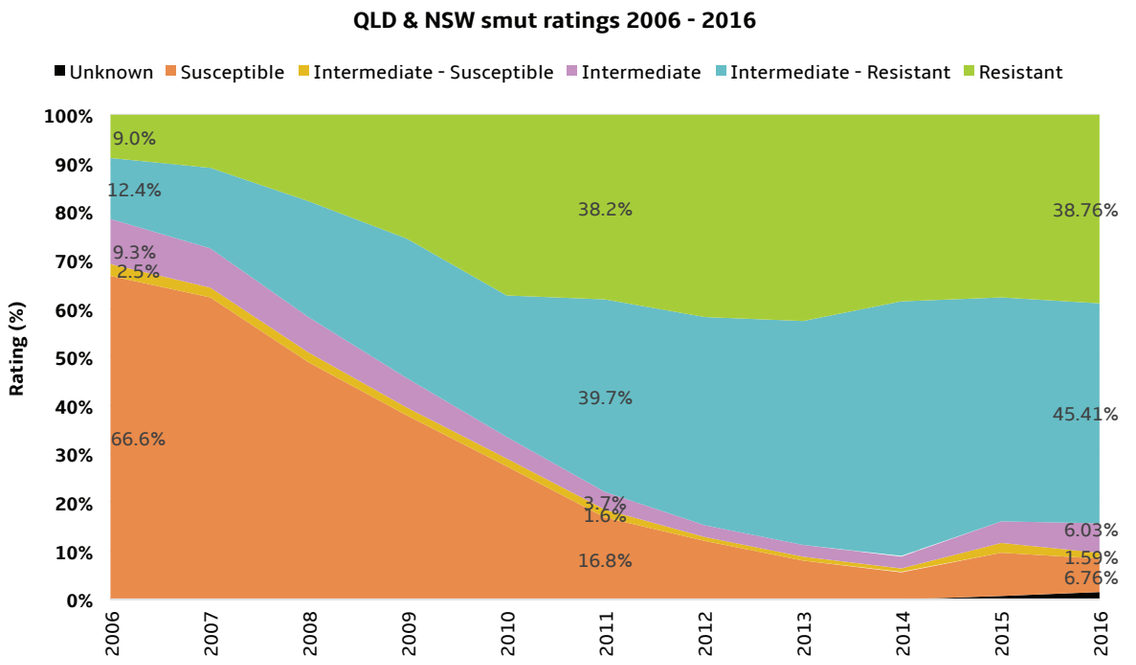
Researchers at SRA, Western Sydney University, the University of Queensland and CSIRO have revealed the following in 2016/17:

- There do not appear to be any viruses hidden within the sugarcane genome, possibly confirming that YCS is not caused by an endogenous virus.
- YCS severity is influenced by plant growth rate and canopy size. Late crops are more susceptible to the YCS season in the early months of the year.
- Phytoplasmas have been identified as requiring further investigation. Phytoplasmas are a type of bacteria that are parasites of plant phloem.
- There are elevated levels of starch and sugars in YCS-affected leaves. Investigations are continuing around the disruptions in energy flow out of the leaves, and whether symptom expression is triggered by abiotic (non-biological) stress.

Research will continue in 2017/18 in pursuit of the causal factor(s) and building on the understanding of the physiological effects of YCS ascertained so far.

Pests and disease management

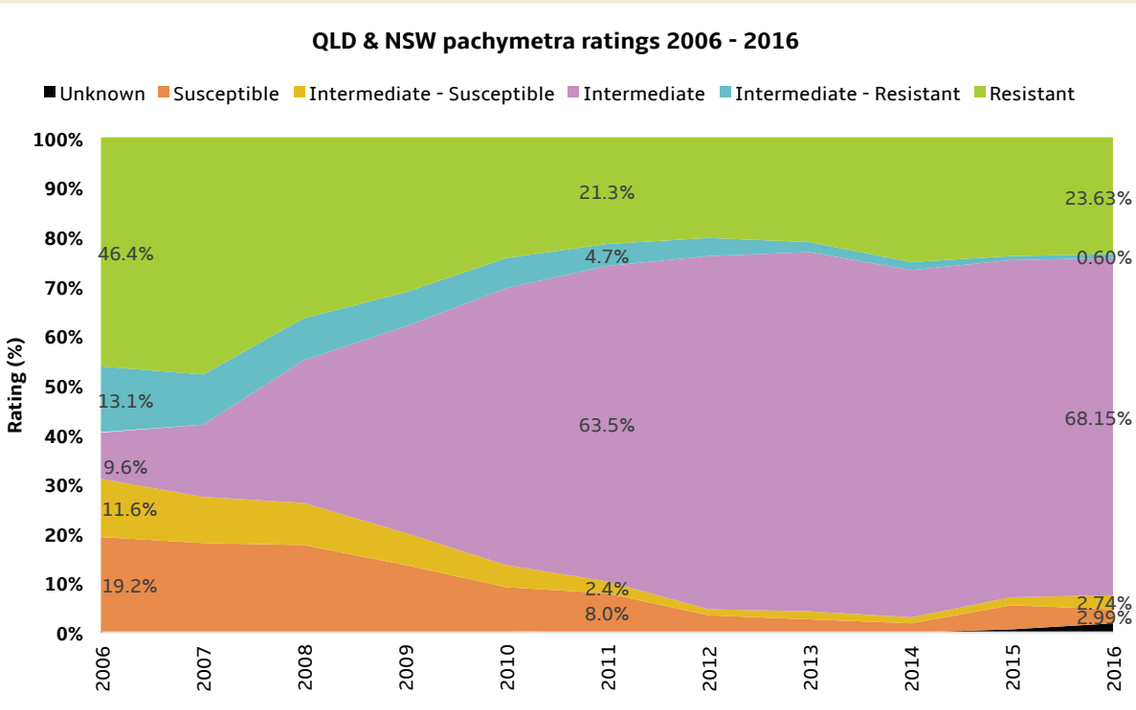
New varieties smut disease ratings



SRA continues to focus on and contribute to keeping smut susceptibility of sugarcane varieties to a minimum. *Source: SRA.*

Pests and disease management

New varieties pachymetra root rot ratings



SRA maintains pachymetra root rot resistance as a priority in the breeding program and continues to contribute to reducing industry susceptibility. *Source: SRA.*

KFA4: Farming systems and production management

- Completed economic analysis showed sugarcane farming systems in the Burdekin that incorporated fallow cash crops can potentially be more profitable for growers than a traditional bare fallow. Results showed that profitability following short fallows were improved over and above the bare fallow in all cases regardless of planting time. For example, April planting of a mung bean fallow outperformed the bare fallow by $118/ha on average.
- Three automated furrow irrigation demonstrations sites on Burdekin properties, totalling 162 hectares, demonstrated the value these systems can have when tailored and integrated into sugarcane farm management. Major value is achieved through savings to water, energy, and labour time according to grower Denis Pozzebon who had 27 hectares installed on his farm and is now fully confident in this system.
- Procedures and a software tool were developed to automate the data handling processes associated with the generation of yield maps from harvester-mounted yield monitors.
- Software was developed to automate the process for downloading and pre-processing satellite images and production of crop vigour maps at the regional and block level for the Tully and Mackay regions.

Above: Denis Pozzebon operating his automated furrow irrigation system.

Above: Russell Jordan at his automated furrow irrigation demonstration site.

Harvesting efficiency research trials

- Fan speed trials during the 2016 season provided further evidence that high fan speeds adversely impact cane, sugar loss and grower return.
- Trials conducted both in-field and using a stationary harvester showed a reduction in billet damage and a reduction in sugar loss using 'EHS Manufacturing' chopper drums.
- Sunshine Sugar completed a series of trials investigating harvesting best management practice (BMP) in NSW. Use of EHS chopper drums gave a higher recovered yield of 3.4% relative to standard drums.
- Burdekin Productivity Services completed a series of harvesting BMP trials in the Burdekin. The trials did not detect a significant effect on harvest speed on subsequent ratoon yields and it is possible that other components of the farming system masked the effects.
- Norris Energy Crop Technology made improvements to the user interface of Sugarcane Harvesting and Logistics Optimisation Tool (SCHLOT) and monitoring equipment was installed on a JD 350 harvester as a first step to developing a near real-time version of SCHLOT, SCHLOT Live.

SRA Harvesting Program 2016/17: Pathway to impacts

SRA's harvesting research indicates greater efficiencies and benefits can be obtained from adopting harvesting best practices. Throughout the 2016 season and 2017 offseason, SRA has identified tangible harvesting best practice management changes amongst the industry that contribute to improved productivity and profitability. While these results are not an exhaustive list of the impacts of the program, they are indicative of positive industry impact driven by evidence-based research.

Note that results recorded in 2016/17 have been realised due to many years of harvesting research. SRA would like to acknowledge the collaboration with industry partners and local stakeholders that have contributed to the success of the harvesting program to date.

Inputs	Outputs	Outcomes	Impacts
• Project 2014/048 *'Increased Harvest Recovery: Reducing sugar loss and stool damage'* • Project 2016/955 *'Adoption of practices to mitigate harvest losses'*	• 8 harvesting forums with 274 attendees total • 15 demonstration trials • 2 eight and ten blade chopper drum trials • 1 NSW EHS chopper drum technology trial • Workshops held for farm managers and harvesting groups	• **90 EHS chopper drums installed** (worth $50/ha in reduced losses) • **18 harvester feed trains optimised** (worth $70/ha in reduced losses)	• **$2.4M** total industry gain per annum for 90 EHS chopper drum installations in 2016 season, **$3.7M** industry gain per annum thereafter • **$1.2M** total industry gain per annum resulting from optimisation of feed trains

** Assumptions: Assumed sugar price $450/tonne. Assumes minimum of 19% reduction in sugar losses as a result of EHS chopper drum installation and minimum 1% reduction in sugar losses as a result of harvester feed train optimisation.*

KFA5: Milling efficiency and technology

- Successful calibration of benchtop near infrared (NIR) systems was conducted in mills throughout the 2016 season. The development of these well-performing global calibration models allows real-time rapid analysis of sugar factory products informing factory control decisions and improving mill efficiency.
- A technique was developed to manage the analysis of fresh raw sugar by NIR spectroscopy.

Above: Example of a turn-key diode array benchtop NIR spectroscopy system.

- Computational fluid dynamics (CFD) models were developed to provide insights into the flow of air through the shredder and the flow of prepared cane through the grid region of the shredder. This modelling enables further research to inform improved grid design recommendations.
- Computer modelling and lab scale experiments were used to better understand the flow processes in the centrifugal wet scrubbers widely used in the sugar industry for controlling emissions from boilers. Design modifications based on this improved understanding have been proposed that should reduce factory down time and improve the environmental performance of the sugar industry.
- Sucrose loss measurements in 2015 and 2016 across the evaporation stations at five Australian mills showed that losses in steam-efficient mills could be substantial, even under normal operating conditions. This information will be incorporated into a blueprint for Factory Managers and Senior Technologists to guide process improvement strategies and to help prioritise the introduction of new processing technologies.
- A technique to clad the grooves of Spheroidal Graphite (SG) iron mill roll shells was developed. The laser cladding technique intends to lengthen the life of the rolls and reduce whole of life costs. So far, the technique has produced a smooth clad surface and is expected to achieve the desired result of a one-layer cladding process with no post treatment.

Cane Analysis System (CAS)

SRA, as the industry's CAS administrator, conducts a number of routine activities and certification to ensure cane analysis results can be used with confidence by all stakeholders. SRA routinely conducts the preseason setup, provides ongoing seasonal support and post-season treatment of data. During 2016/17, SRA undertook additional activity to support the adoption of new NIR instruments in Australia sugar factories, including:

- Validation and updating of cane nutrient calibrations for the CAS.
- 3 CAS units updated with ProFoss instruments.
- Trialling of the Perten DA7300 as an alternative instrument for CAS, with the instrument performing well and available for use.

In addition, throughout 2016/17 SRA worked with the Australian Sugar Milling Council (ASMC) and the Commonwealth Government to progress the certification of CAS for cane payment by the National Measurement Institute (NMI).

KFA6: Product diversification and value addition

- Successful demonstration of conversion of sugarcane bagasse into nutritious animal feed ingredients was conducted. Demonstrated technologies include increased digestibility of bagasse as a ruminant feed, production of sugar syrups for pig production, and the production of probiotic oligosaccharides from sugarcane bagasse.
- A new and unique collection of microbes isolated from Australian sugarcane bagasse has been functionally screened for feed enzyme, micronutrient and probiotic applications.
- Demonstration of the production of microbial oil by filamentous fungi from sugarcane by-products was conducted at a pilot scale with the conversion of these products into bio crude oils, which has been demonstrated as a hydrocarbon fuel.
- A pilot scale demonstration of a potassium-based pulping process for the production of marketable bagasse pulp was conducted and the bagasse derived pulp was comparable to commercial bleached pulp in terms of brightness.

KFA7: Knowledge and technology transfer and adoption

- SRA commissioned an independent review of adoption and extension advisory services in the sugarcane industry with a view to implementing a collaborative strategy to accelerate adoption of new technologies and practice change.
- Sugar production analysis reports were created to inform strategic farm planning and tactical decision-making for Herbert growers participating in a project to develop tools for enhanced farm business intelligence.
- Tissue culture seedlings ordered in Tully have increased from 5,000 to 17,000 and the number of growers ordering tissue culture plantlets has increased since the development and implementation of a local propagation pathway that identified local impediments to adoption in the region.

Case studies illustrate the positive impacts of best management practice (BMP) on profit and the environment

SRA continues to support the Queensland Department of Agriculture and Fisheries (DAF) economists and Life Cycle Strategies in the investigation of six case studies investigating the economic and environmental impact of adopting BMP. Each case study, from a farm in the Wet Tropics, calculates the impact of management practice change on farm profitability and environmental outcomes. Practice changes included shifting to wider row spacing, fallow cropping, reduced tillage, mound planting and SIX EASY STEPS nutrient management as well as changes to weed management practices.

Below, the economic and environmental results for the 2016/17 case studies are presented. Despite the variation between farms, the annual benefit (which takes into account capital investment) was positive for all farms, suggesting that the change toward BMP added value to these farming businesses. In terms of the environmental indicators from the Life Cycle analysis, the adoption of BMP resulted in a reduction in the potential losses of pesticides and nitrogen equivalents. It also reduced the annual fossil fuel use and CO_2 emissions quite significantly. In the case of the Doug Crees' case study, the reduction in greenhouse gas emissions was equivalent to taking 40 passenger cars off the road each year.

Grower	Doug Crees	Adrian Darveniza	Chris Bosworth
Farm size	167 ha	240 ha	150 ha
Cost of implementation	$28,300	$2,200	$100,475
Payback period	2 years	6 years	8 years
Annual benefit ($/ha/yr)	$100/ha	$58/ha	$25/ha
Reduction in pesticides (kg/yr)	9kg	41kg	7kg
Reduction in nitrogen equivalents (kg/yr)	650kg	833kg	1,250kg
Reduced fossil fuel use (t over crop cycle)	14 t	28 t	11 t
Reduced CO_2 emissions (t/yr)	123 t	205 t	87 t

For a copy of the full case study including details of practice changes and economic and environmental analysis, please contact the DAF Customer Service Centre on 13 25 23 or the Townsville DAF office on (07) 3330 4560.

SRA engagement: Events

- Approximately 400 growers, millers and industry stakeholders participated in consultation activities for the development of SRA's new 2017/18 – 2021/22 Strategic Plan.
- Over 160 growers and advisors attended seven field days showcasing research on herbicide strategies and cover cropping for field control.
- Well-received introductory and advanced disease training workshops up-skilling over 100 participants in hands-on identification and management of important sugarcane diseases and information on exotic pests and diseases took place.
- A roadshow across the industry in late 2016 updated industry stakeholders on the current and potential outcomes of Chlorotic Streak research and successfully identified biosecurity opportunities in each of the regions generally.
- Growers and advisors were upskilled in 20 BMP workshops in irrigation essentials, improving soil health, cane grub, weed and drainage training and chemical accreditation.

SRA grower updates	5	Field walks	>10
Harvesting forums	8	SIX EASY STEPS workshops	5
Harvesting demonstration trials	15	Soil health masterclasses	3
Harvesting chopper drum trials	2	Pest management workshops	2
BMP workshops	20	Milling research seminars	1
Biosecurity roadshow	1	Milling Webinar	1
Canegrub monitoring and rat workshops	4	Other workshops	4

SRA engagement: Publications

SRA products and services were rated highly by growers for the third consecutive year at **3.6/5**

** CaneClip videos produced for SRA's Youtube channel: The Australian Cane Learning Centre*

On average, growers accessed between **4 and 5** SRA information products in 2016/17, and a number of products were accessed significantly more than the previous year, including:

Product	2016	2017
Technical manuals	50%	↑ 55%
Factsheets	73%	↑ 76%
CaneClips	44%	↑ 48%
***Milling**Matters*	24%	↑ 28%

Soil Health/Biology Masterclass

A series of masterclasses, funded by SRA and developed in collaboration with Dr Graham Stirling (Biological Crop Protection), Dr Jay Andersen (University of Queensland) and Dr Anthony Young (University of Southern Queensland), were delivered to three Sugarcane regions (NSW, Herbert and Central).

Bringing together experts in the field of soil biology and extension allowed for the delivery of masterclasses that has '*…driven significant progress in knowledge and understanding, which is now driving change in our operations*' (Trevor Crook, MSF Sugar). In addition to delivery of the masterclasses, this project supports attendees through ongoing monitoring of the changes made on farm following the classes.

91 participants, including 39 growers and 52 advisors, took part in these hands on classes that introduced soil organisms such as fungi, bacteria, nematodes, microarthropods and root pathogens and their role in maintaining soil health. It highlighted the impact of farming practices on soil biology and broader soil health, which was supported by 3 growers who were on hand to present their farming system, experiences and discuss practical application in the field.

This project continues in 2018 with masterclasses to be held in the Far North, Burdekin and Southern regions.

"We have had 5 of our people attend the course (In Mackay and in Ballina) and there has been significant progress in knowledge and understanding which is now driving change in our operations. Given the pivotal time in the evolution of the MSF Cane Production System I would welcome the opportunity to host 2 more of these classes."

Trevor Crook, MSF

"The Soil Health and Soil Biology Masterclass was by far one of the best workshops I have attended in quite a while. The format of the class was excellent. It was wonderful to be able to go and have a look at what we were discussing through the microscopes."

Jodie Tubb (DAF)

KFA8: Capability development, attraction and retention

A number of Australian sugarcane industry professionals leveraged collaborative thought power both domestically and internationally through SRA's capability program comprising of travel and learning grants, postgraduate scholarships and early and mid-career awards.

Some 2016/17 examples are:

1. Zofia Ostatek-Boczynski attending the International Symposium of Soil and Plant Analysis (ISSPA) in China to present her recent findings related to the role of nutrients in YCS.

2. Annelie Marquardt, presenting and receiving feedback on her YCS work at the International Plant and Animal Genome Conference (PAG).

3. Adam Frew graduating with his PhD from Western Sydney University funded in part through a Sugar Industry Postgraduate Scholarship (SPRS).

4. Brad Pfeffer meeting with the South African Sugarcane Research Institute (SASRI) and the International Federation of Agricultural Journalists.

5. Eloise Keefe presenting at the International Conference on Near Infrared Spectroscopy.

6. Kathy Braithwaite visiting researchers and studying the tissue culture labs at the Animal and Plant Health Inspection Service facility in Maryland, USA.

7. Phil Patane on his study tour of harvesting manufacturers in Brazil and the USA.

Collaboration

National collaboration

- In 2016/17, SRA and six other Research Development Corporations (RDCs) formed the **Plant Biosecurity Research Initiative (PBRI)**, led by Horticultural Innovation Australia. The partnership will increase research coordination, fill gaps in plant biosecurity research and development and increase the connection between research and the national biosecurity systems.
- SRA also maintains ongoing research, development and extension partnerships with over 30 providers including universities and productivity service organisations and cross-sectorally with Australia's 14 other research and development corporations.

Rural R&D for Profit

SRA participates in and leads a number of cross-sectoral projects funded through the Commonwealth Government's Rural R&D for Profit Programme.

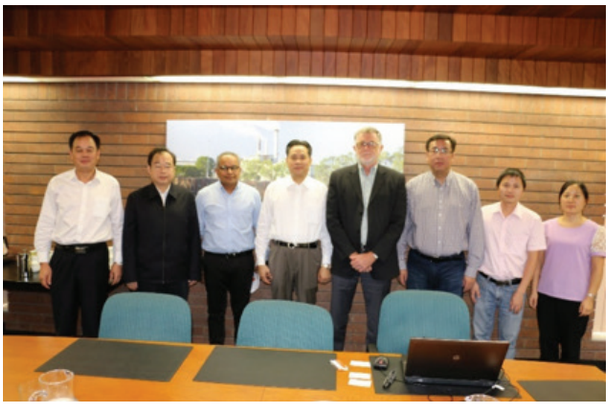
Project	Lead organisation
A Profitable Future for Australian Agriculture: Biorefineries for Higher-Value Feeds, Chemicals, and Fuels	Sugar Research Australia
Stimulating private sector extension in Australian agriculture to increase returns from R&D	Dairy Australia
Next Generation fertilisers and Feed: delivering productivity and profitability to Australian farmers	Australian Pork Limited
Designing extension for farmers and fishers	AgriFutures

Project	Lead organisation
Increasing farmer profitability through improved use of seasonal forecasting	AgriFutures
Smarter irrigation for profit	Cotton Research and Development Corporation
Enhancing the sugar industry value chain by addressing mechanical harvest losses through research, technology and adoption	Sugar Research Australia
Accelerating precision agriculture to decision agriculture	Cotton Research and Development Corporation
More profit from nitrogen: enhancing the nutrient use efficiency of intensive cropping and pasture systems	Cotton Research and Development Corporation

International collaboration

- A new partnership between SRA and the Sugarcane Breeding Institute (SBI) in India is in the process of being formalised, jointly funded by India and the Australian governments, SRA and SBI. The partnership seeks to identify and pursue key areas of collaboration that are of mutual benefit.
- In addition to receiving international visitors to the SRA facilities regularly and maintaining variety exchange agreements with more than 15 countries, SRA collaborates with a number of international research organisations on a range of research, including:
    - University of Campinas, Brazil – molecular controls of sugarcane growth;
    - Yunan Sugarcane Research Institute, China – sugarcane germplasm development for drought tolerance;
    - University of Texas, USA – transcriptome analysis; and
    - University of Stellenbosch, South Africa– metabolite analyses.

Above: SRA CEO Neil Fisher with Dr Bakshi Ram, Director of the Sugarcane Breeding Institute, Coimbatore, India.



Above: The Guangxi Sugarcane Research Institute (GXSRI) from China visit SRA, pictured with SRA's Peter Allsopp.

Above: Visitors from the USDA Agricultural Research Service Sugarcane Field Station with SRA's Priya Joyce and Nicole Thompson.

Above: Visitors from the Guangxi Provincial Government Department, China with SRA's Kate Wathen-Dunn.

Appendix 1: KFA measures

2016/17 Annual Operational Plan Measures	Status	Comments
SRA's key performance indicators		
Alignment of research, development and adoption portfolio with investor priorities.	●	Completion of annual portfolio gap analysis. Highly-consultative strategic planning process to identify investor priorities, resulting in endorsement of new Strategic Plan by industry and government investors.
Economic returns from research, development and adoption investments.	●	Aggregated benefit cost ratio (BCR) of 2:1, below target ratio of 4:1. Note ratio influenced by small number of evaluations undertaken - five projects with BCRs ranging from 0:1 to 5:1.
SRA performance rating.	●	Increased from 74% 'high' to 76% 'high', exceeding target of 70% 'high'.
Compliance with statutory obligations and requirements.	●	Met target of 100% compliance.
KFA1: Optimally-adapted varieties, plant breeding and release		
Release of improved varieties, with a target of 3 new varieties released per 5-year period for each region.	●	At least 3 varieties have been released in each region during the past five years. The release of SRA10 in 2017 makes for a total of 14 varieties commercialised in the Northern region during the 5-year period.
Percent production from new varieties.	●	Increased for the Burdekin and Northern regions and moderated slightly for all other regions mostly reflecting the declassification of Q238$^{\phi}$, MQ239$^{\phi}$, Q240$^{\phi}$ to 'old' variety status.
Rate of genetic gain (TCH, CCS, TSH).	●	202 kg sugar/ha/year (over a 30 year rolling-average), down from 204 kg in 2016, reflecting a slight moderation in rate of genetic gain[1].
Weighted average disease ratings for varieties in each region.	●	>84% of crop resistant/moderately resistant to smut, >92% at least intermediate resistance to pachymetra root rot.
Plant Breeder's Rights (PBR) secured for new commercial varieties.	●	PBR applications have been accepted or granted for all varieties up to SRA8$^{\phi}$. Applications have been submitted to IP Australia for the registration of SRA9 and SRA10.
KFA 2: Soil health and nutrient management		
Grower uptake of SIX EASY STEPS.	●	69% of growers using SIX EASY STEPS, slightly under target of 70%.
Adoption of new and/or best practice fertiliser application or management.	●	15% of growers adopted new fertiliser application or management practices over the last two years, below target of 25%.
KFA 3: Pest, disease and weed management		
More efficient application and management of chemicals, sprays, herbicides or pesticides.	●	12% of growers adopted new chemical application or management practices over the last two years, below target of 20%.
Capability to provide entomology, pathology and weed expertise to meet the pest, disease and weed diagnostic and management needs of the industry.	●	Leader Entomology appointed maintaining full complement of professional staff within SRA. Weed manual produced and distributed to advisor community. Disease management and identification provided to 52 industry field staff.
Up-to-date dossiers to support contingency plans to minimise threats and impacts of key exotics.	●	Dossiers reviewed and updated.
Diagnostic testing to ensure that sugarcane diseases are not imported or spread within Australia.	●	1,574 diagnostic tests conducted during 2016/17, meeting target of >1,000.
Quarantine protocols completed for import/export of sugarcane varieties.	●	Quarantine protocols completed for 40 new varieties imported from four countries. 44 varieties exported to six countries as part of variety exchange program.
KFA 4: Farming systems and production management		
Adoption of new and/or best practice farming techniques and technology.	●	66% of growers adopted new farming practices over the last two years, exceeding target of 60%.
Adoption of harvesting best practice.	●	Increased participation in harvesting efficiency trials across sugarcane regions.

[1] Note that previous years' figures have been revised since 2016 to reflect updated prediction equation.

2016/17 Annual Operational Plan Measures	Status	Comments
KFA 5: Milling efficiency and technology		
Adoption of improved or novel milling processes and technology.		Milling adoption measurement and monitoring yet to be established. Project to develop a blueprint for the introduction of new processing technologies in mills will conclude in 2017/18.
Adoption of laboratory near infrared (NIR) systems.		SRA continues to develop and trial benchtop NIR systems, assisting mills with advice and assistance in their use and adoption.
KFA 6: Product diversification and value addition		
Identification of new opportunities in product diversification and innovation.		Large current investment focussing on biorefining opportunities and producing value adding materials from residual fibre.
KFA 7: Knowledge and technology transfer and adoption		
Industry-supported model to focus on facilitating measurable practice change and appropriate R&D to increase profitability, productivity and sustainability of Australian sugarcane growers and millers.		SRA commissioned an independent review of adoption and extension delivery in the sugarcane industry. Review findings and recommendations currently under consideration by SRA Board with a view to implementing a collaborative industry adoption strategy in 2017/18.
Satisfaction rating for SRA updates and publications.		Maintained rating of 3.6 out of 5, just under target of 3.8 out of 5.
Satisfaction rating for SRA events and field days.		Maintained rating of 3.8 out of 5, just under target of 4 out of 5.
SRA performance rating.		Increased from 74% 'high' to 76% 'high', exceeding target of 70% 'high'.
Economic returns from research, development and adoption investments.		Aggregated benefit cost ratio (BCR) of 2:1, below target ratio of 4:1. Note ratio influenced by small number of evaluations undertaken - five projects with BCRs ranging from 0:1 to 5:1.
KFA 8: Capability development, attraction and retention		
Scholarships awarded to current and future industry participants.		Maintained target of a minimum of 6 active postgraduate scholarships and 2 early-career research awards per year.
Development of schemes for training of undergraduate students in factory (engineering) and field sectors.		Maintained target of a minimum of 2 awards for factory sector, schemes for field and/or laboratory disciplines are under development.
SRA participation and investment in relevant collaborative and cross-sectoral RD&E programs and the Commonwealth Government's Rural R&D for Profit Programme.		Ongoing participation in numerous programs, e.g.: Rural R&D for Profit projects and cross-sectoral programs on climate change, precision agriculture, big data, soils, water use, plant biosecurity, and value-adding through biofuels and bioenergy.
Centrally-managed research and corporate support		
Employee performance and values-based KPI targets achieved, as defined in employee performance plans.		100% of SRA staff have KPIs in place with clearly defined measures for Living, Lifting and Leading.
Financial and budgetary control.		Operational expenditure for 2016/17 was within 3% of 2016/17 Budget. Income was higher than budget due to high crop production in 2016 season.
Investor feedback.		Positive industry and government representative feedback reflected in SRA's Independent Performance Review and Grower Survey. Some challenges and opportunities for SRA were raised during investor consultation forums (e.g. adoption and extension) and have been directly addressed in SRA's new Strategic Plan 2017/18 - 2021/22.
Compliance with statutory obligations and requirements.		Met target of 100% compliance.
Alignment of research, development and adoption portfolio with investor priorities.		Completion of annual portfolio gap analysis. Highly-consultative strategic planning process to identify investor priorities, resulting in endorsement of new Strategic Plan by industry and government investors.

of measures have been achieved

of measures are on track with progress/improvement made but objective not yet fully achieved

no measures have failed to be achieved nor significant action is required to reach objective

Appendix 2: 2013/14-2017/18 Strategic Plan Summary

Our vision	Delivering valued solutions for a growing Australian sugar industry			
Our purpose	Undertaking targeted research, development and adoption programs for the sugar industry			
Our key focus areas	**1. Optimally-adapted varieties, plant breeding and release**	**2. Soil health and nutrient management**	**3. Pest, disease and weed management**	**4. Farming systems and production management**
Our objectives	• World-class variety development. • Enhanced variety breeding, selection and release. • Collaborative, interdisciplinary and systems approach to RD&E.	• Understood and improved soil health issues. • Understood impacts of on-farm practices on water quality. • Improved methods and tools to enable, or improve, cane production on poor performing or marginal soils.	• Enhanced biosecurity capability. • Minimised economic and environmental impacts of pests, diseases and weeds through targeted research.	• Research leading to the optimal use of inputs on-farm. • Research on planting technologies, ratoonability, break-crop and fallow practices to optimise yields. • Practical application of the value chain model to enhance grower, harvester and miller interfaces and improved adoption of harvesting best-practices.
Our deliverables	• Locally-adapted cane varieties. • Enhanced collaboration with growers, millers and productivity services groups. • Increased regional trials and releases. • Earlier communication and dissemination of information, including variety selection tools. • Diagnostic and advisory services. • Research collaborations.	• Identification of soil health factors. This will include R&D covering crop nutrition; soil biology; soil fertility; regional soil factors; chemical utilisation; and reduction of soil pathogens and nematodes. • Practices to reduce chemical inputs and nutrient losses. • Review of Six Easy Steps ™. • Rapid soil screening technologies.	• Plant and molecular screening. • Integrated pest and weed management systems. • Pest and weed control strategies and technologies. • Herbicide-resistant cane varieties. • Alternative chemical treatments. • Updated management dossiers on key exotic threats.	• Precision-agriculture techniques and resources. • Best-practice information. • Improved planting technology and crop establishment. • Harvesting best-practice regional trials and demonstration.
Our measures of success	• 3 varieties which meet the above expectations released per 5-year period for each region. • Percent production from new varieties (<7 years since release). • Rate of genetic gain (tonnes of cane per hectare (TCH), commercial cane sugar (CCS), tonnes of sugar per hectare (TSH)). • Weighted average disease ratings for varieties in each region.	• Soil health indicators developed for sustainable sugarcane production. • Guidelines, mechanisms and/or varieties identified for increasing nutrient use-efficiency within plant and ratoon crops. • Guidelines and mechanisms developed for minimising chemical and nutrient losses and understanding water quality. • SIX EASY STEPS™ nutrient management program reviewed with improvements made where necessary. • Guidelines for implementation of PA developed.	• Industry supported through effective pest, disease and weed diagnostic capabilities and awareness and training programs. • Development and adoption of SRA-developed packages for integrated management of key pests, diseases and weeds. • Weighted average disease ratings for varieties in each region. • Up-to-date dossiers to support contingency plans to minimise threats and impacts of key exotics. • Capability to provide entomology, pathology and weed expertise to meet the pest, disease and weed diagnostic and management needs of the industry.	• Methodology for more rapid and efficient bulking of sugarcane varieties. • Adoption of a better sugarcane planting technology. • Improved crop performance over longer cropping cycles. • Better crop management under conditions of water stress (too much and too little). • Adoption of PA technology and techniques. • Adoption of harvesting best-practice.
Industry benefits	• Increased cane and sugar yields. • Climate tolerant varieties. • Pest and disease resistance. • Reduced inputs. • Improved ratoonability. • Increased regional trials and releases. • Faster varietal adoption.	• Improved soil health. • Reduced impact of off-farm run-off. • Improved production on marginal soils. • Improved reputation and relationship with community and environmental groups.	• Enhanced capacity to deal with incursions of exotic pests, diseases and weeds. • Minimised economic and environmental impacts.	• Adoption of agronomic and harvesting best-practices. • Optimised yields. • Optimised use of inputs. • Reduced operational costs.

Our values	 **Innovation** — Through adaptability, creativity and goal orientation **Investor satisfaction** — Through strategic alignment, active communication and commitment **Accountability** — Through personal accountability, including health and safety, honesty, active communication and integrity **Teamwork** — Through shared goals, cooperation and trust			
Our key focus areas	**5. Milling efficiency and technology**	**6. Product diversification and value addition**	**7. Knowledge and technology transfer and adoption**	**8. Capability development, attraction and retention**
Our objectives	• Review of logistics management to reduce operational costs and improve mill capacity utilisation. • New or improved processes, technology and/or infrastructure to increase mill processing efficiency. • Possible solutions to address quality issues.	• Ongoing research to identify and/or develop alternative products or uses for sugarcane and determine the basic requirements for adoption. • Economic feasibility studies of identified industry by-products, their use and likely market viability.	• Coordinated extension that optimises innovation and adoption at the farm level and encourages research that meets the needs of the industry. • Inclusion of extension mechanisms in research proposals. • Enhanced communication and transfer tools to disseminate research findings to end-users and facilitate their uptake by growers and millers. • Assessment of the uptake of developed technologies and evaluate the effectiveness of technology transfer tools.	• Review of current and future RD&E skills and capacity needs for the sugarcane industry. • Development and retention of current industry participants, as well as attraction of new participants to the sugarcane industry. • Fostered collaboration for cross-industry and cross-sectoral skill development, innovation and networks.
Our deliverables	• Optimised milling processes and technology.	• Industry supply chain analysis. • Exploration of alternative processing options and products. • Feasibility analysis of alternative products.	• Translational research approach. • Collaborative extension. • Enhanced research and technology extension. • Multi-media extension.	• Industry RD&E skills and capability assessment. • Scholarship program. • Participative and collaborative partnerships. • Succession planning. • Performance management framework.
Our measures of success	• Adoption of improved or novel milling processes and technology.	• Sugar industry supply chain analysis completed. • Identification of new opportunities in product diversification and innovation.	• Joint planning of research translation and extension programs with other stakeholders. • Effective delivery of extension messages, as demonstrated through research uptake. • Increased awareness of technological innovations, locally and internationally. • Research outputs' key RD&E messages are promoted in a timely manner through various channels. • Increased support for and participation in SRA delivery networks, events and extension programs.	• Published results of industry RD&E skills and capability assessment and recommended strategies in National Sugarcane Industry RD&E Strategy. • SRA participation and investment in relevant collaborative and cross-sectoral RD&E programs. • Increased availability of skilled industry personnel. • SRA sponsored Young Industry Participants' Forum held annually. • Development and uptake of new and existing knowledge transfer or training programs or resources. • Scholarships awarded to current and future industry participants.
Industry benefits	• Improved mill capacity utilisation. • Improved mill processing efficiency. • Improved quality. • Optimised mill transport and logistics.	• Alternative products or uses for sugarcane. • Economic feasibility of industry by-products.	• Skilled advisory sector that drives the adoption of new technology and practices. • Improved collaboration and coordination of extension services. • Improved communication, knowledge transfer and adoption.	• Attraction and retention of industry participants. • Highly-skilled industry workforce. • Cross-industry and cross-sectoral collaboration. • Connected and respected.

Appendix 3: Acronyms

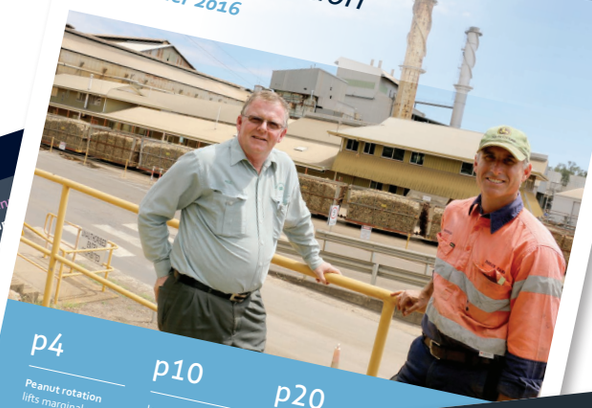
Abbreviation	In full
ASMC	Australian Sugar Milling Council
BCR	Benefit cost ratio
BMP	Best management practice
CAT	Clonal assessment trial
CCS	Commercial cane sugar
CO_2	Carbon dioxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cth	Commonwealth
DAF	Department of Agriculture and Fisheries (Queensland)
DNA	Deoxyribonucleic acid
EHP	Department of Environment and Heritage Protection (Queensland)
FAT	Final assessment trial
ha	Hectares
IP	Intellectual property
KFAs	Key focus areas
kg	Kilogram
m	Million
Mt	Million tonnes
NIR	Near infrared
NSW	New South Wales
PBR	Plant Breeder's Rights
PhD	Doctor of Philosophy
QLD	Queensland
R&D	Research and development
RD&A	Research, development and adoption
RDC	Research and development corporation
RSD	Ratoon stunting disease
SBI	Sugarcane Breeding Institute (India)
SCHLOT	Sugarcane Harvesting Logistics Optimisation Tool
SNP	Single nucleotide polymorphism
SRA	Sugar Research Australia Limited
t	Tonnes
t/ha	Tonnes per hectare
TCH	Tonnes of cane per hectare
TSH	Tonnes of sugar per hectare
yr	Year
YCS	Yellow canopy syndrome

Sugar Research Australia™

Our quarterly magazine bringing research to the field

CaneConnection

Summer 2016



p4 Peanut rotation lifts marginal soil production

p10 Improving sugarcane harvest efficiency through collaboration

p20

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Weed Management in Sugarcane Manual

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ty Guide 2016/17

rn and NSW regions

YCS update

June 2017

Sugar Research Australia

SRA committed to unearthing the cause of YCS

SRA has appointed a new chair, Dr Joanne Daly, to lead the scientific reference panel (SRP) that oversees the yellow canopy syndrome (YCS) research program.

This panel is an independent group of expert scientists that is responsible for providing scientific opinion to the direction of the research.

Dr Daly comes to this role as a former Group Executive of Agribusiness and Chief of Division at CSIRO. She has worked in CSIRO for over 30 years originally as a researcher in entomology.

The SRP met with researchers in December 2016, and will meet again in August 2017, as part of their role of working with researchers to assess what causes YCS and how to manage it.

The SRP will also call in external scientific experts to assist to ensure that they are seeking a wide opinion.

Following her first meeting, Dr Daly said: "I am strongly encouraged by the quality of work, the progress made by the researchers and their collaborative spirit."

"After three years of research, it is becoming clear that YCS will not be an easy problem to solve," she said.

"We still do not know whether YCS is caused by a biological agent, or by environmental factors, as results are not fully consistent with either cause. We cannot explain its occurrence and distribution from field-to-field and from year-to-year. My instinct is that YCS is an interaction of both biotic and abiotic factors which is why tracking down the cause will be challenging."

Notable results reported at the recent meeting included:

- Sucrose and starch accumulates in YCS affected leaves rather than the sucrose being transported into the rest of the cane plant.
- A simple dye test for starch would be is an easy diagnostic test. Work is in progress to establish how specific this test is for YCS.
- Field trials have excluded soil or fungal pathogens, and water stress by itself, as causes of YCS.
- The severity of YCS seems related to the age of the pl and its growth rate at the time YCS first appears.
- Not all plants that have YCS suffer a yield penalty.

Dr Daly and SRA Executive Manager, Technology, Dr Botha, also recently discussed with the SRA Board t shape of YCS research investment.

SRA is moving to yearly work-plans for the four YC projects, and the Board supported another year o for YCS, taking note of the SRP's recommended research.

There will be an increased emphasis on the role particularly as vectors of pathogens that might

Large scale field trials will assess management reducing the impact of YCS on yields, includ breeding material for resistance to YCS.

Laboratory studies will examine mechanis and will look for visual signs of possible pa

Mulgrave grower John Ferrar displaying severe YCS symptom He has had YCS in the past, b been the worst.

Varieties and plant breeding update

ne 2017

ontinues to

ce plant breeding

r added additional expertise and arcane breeding program with f experienced plant breeder,

Dr Jason Eglinton.

Re-development of SRA's plant breeding database system: SPIDNET version t

By Steven Comerford and Dion Appo, SRA

Information management is a critical part of all plant breeding programs. Every year, plant breeders generate large amounts of data and make selection decisions based on multiple sources of information. Australia was one of the leaders in data management for sugarcane breeding with computerised records initiated in the 1980s. During the next decades, computing become more advanced and the computerised records evolved into the development of SPIDS database system (Sugarcane Plant Improvement Database System).

SPIDNet is SRA's current plant-breeding information management system. It was originally developed in 2003 to use all available information to help create better crosses.

Trial performance and mill productivity data captured in SPIDNet also provides information to SRA's public variety recommendation and reporting program QCANESelect™.

SRA has embarked on a key initiative to redevelop this application to support all of SRA research and selection activities in the coming years. The redevelopment is aimed at:

- Supporting other research activities within SRA, such as entomology, weeds and agronomy.
- Collecting and displaying spatial information for observations to improve validation and add other analysis methods.
- Allowing trial data to be collected and analysed for more than one purpose.
- Allowing data to be stored and analysed at a more flexible hierarchy than a field trial, such as at the stalk or leaf level or within laboratories.
- Supporting more modern data collection tools, such as Android smartphones connect to external GPS devices.
- Supporting quarantine processes whilst moving samples between regions.
- Scheduling activities to be performed during field trials.

This work is due to be completed by early 2018. Once completed, it will provide a solid foundation for further enhancements to QCANESelect™.

Sugar Research Australia™

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Sugar Research Australia Limited
ABN 16 163 670 068

Head Office
50 Meiers Road
Indooroopilly QLD 4068
Australia

Postal Address
PO Box 86
Indooroopilly QLD 4068
Australia

Tel 07 3331 3333
Fax 07 3871 0383
Email sra@sugarresearch.com.au
Web sugarresearch.com.au