Sugar Research Australia™

SRA Performance Report 2015/16

Australian sugar industry fast facts

3rd

Australia's sugar industry accounts for only **2.7%** of world sugar production but is the world's **3rd** largest exporter of sugar

4,000

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

30%

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

4.5%

The top **25%** ranked growers had an average rate of return of **4.5%** in 2013/14 according to the ABARES sugarcane farm businesses financial performance survey

36M

To meet the industry target of **36 million** tonnes or more per year by 2017, Australia's sugarcane production will have to increase by **3.37%**

30

SRA is the primary RD&E provider for the Australian sugarcane industry, working in partnership with over **30** public and private research organisations

$1.8B

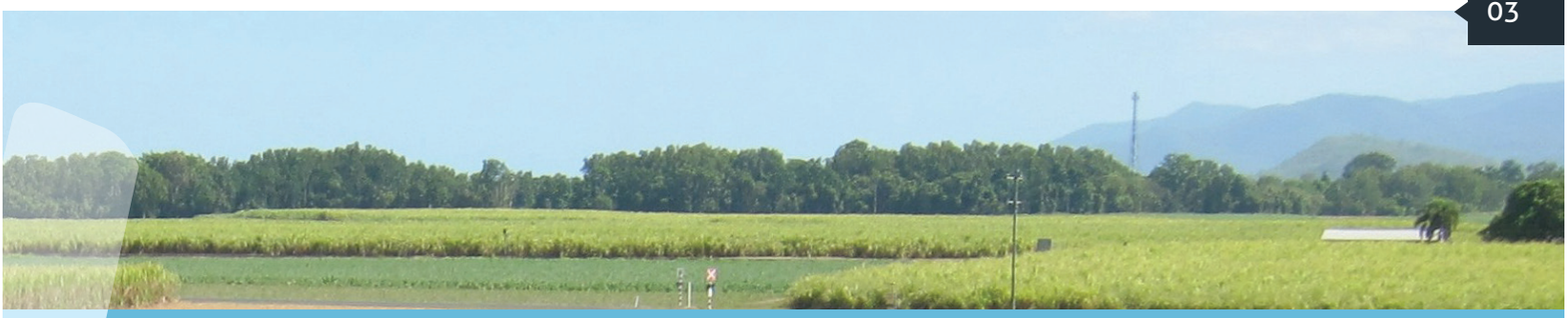
The value of Australia's sugar exports was **$1.8 billion** in 2015/16

4.8M

The 2015 season yielded **4.8 million** tonnes of sugar from **34.8 million** tonnes of cane, across **381,000** hectares

159

SRA has **159** employees working across **9** regional research stations



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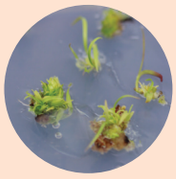
Executive summary



A record **89,950** tissue culture plantlets were ordered for Spring 2016 planting

5 new SRA varieties were released: SRA4(1), SRA5, SRA6, SRA7, and SRA8

SRA's **performance rating increased to 74%** (up from 66% in 2015) according to the latest grower survey

A **40K Canechip** for genomic prediction is now being used in the sugarcane breeding program to select clones from the SmutBuster population to generate high-yielding resistant varieties faster

SRA has been successful at leveraging **$3.5m in funds** through the second round of the Commonwealth Government's Rural R&D for Profit Programme and will lead the project into harvest losses with a number of industry partners

SRA has expanded international collaborations with **new variety exchange agreements** with Thailand, USA, Vietnam and the Sugarcane Breeding Institute in India, home of the largest sugarcane germplasm collection in the world

Australia continues to **lead the world** in average cane yield per hectare

SRA information **products and services were rated by growers as 3.7 out of 5** on average

62% of growers changed farming practices in the last two years to 2016 (up from 58% in 2015)

"I think SRA's work has been really good in terms of targeting what the industry needs. From a farmer's point of view, if we don't do research then we will stagnate and we will fall behind the rest of the world.

Australia has been at the cutting edge with technology and I think if we keep research going, the industry will benefit and our competitive edge will continue to be there.

I am very happy with the new varieties. It is hard to get new varieties to work properly for everybody, but the research into them has been spot on and they are doing it very well."

Len Parisi
Fishery Falls, Far North Queensland

70% of growers are using SIX EASY STEPS™ to calculate their fertiliser use (up from 63% in 2015)

Independent **project** evaluations have shown estimated returns on R&D investment of **5:1** for SRA's climate forecasting to improve nitrogen management and **2:1** on SRA's remote sensing management strategy for canegrubs

Independent **program** evaluations have shown estimated returns on R&D investment of **34:1** for SRA's Smut preparedness and **5:1** for the SIX EASY STEPS™

A worldwide review of overseas Kestner and falling film tube evaporators compared to Australian Robert Evaporators has been conducted and a detailed assessment of the suitability of these **alternative designs** has been completed

Yellow Canopy Syndrome (YCS) is SRA's **#1 priority** and research has ruled out a number of possible causal agents; research continues to investigate the root cause and evaluate possible future management strategies

Following the **landmark scientific discovery** of the pathogen responsible for Chlorotic streak by SRA in 2014/15, SRA researchers have now isolated and established the organism in pure tissue culture and conclusively proved that the organism is the cause of the disease

23% of growers changed fertiliser application or management in the last two years

SRA researchers built a novel **rainfall simulator** for simulating climatic events during experimental trials

SRA facilitated and/or collaborated in over **90 industry events, forums and workshops**

Introduction

Sugar Research Australia (SRA) is an industry-owned company that was established in 2013 by Australia's sugarcane growers and millers to deliver cost-effective research, development and adoption-related services for the benefit of the Australian sugarcane industry and the broader community.

SRA invested $30.2 million in research and adoption activity in 2015/16. This investment was made possible through sugarcane grower and miller levy contributions; Commonwealth and Queensland government contributions; and collaborative funding partnerships with other research organisations, industry organisations and agri-businesses.

SRA's 2013/14-2017/18 Strategic Plan outlines the Key Focus Areas (KFAs) that currently guide SRA's research, development and adoption investment, activities and services in order to address the priority issues of our investors.

The 2015/16 Annual Operational Plan set the key deliverables, research project portfolio and performance measures that SRA worked towards during the past year.

Both of these key planning documents are available on SRA's website at www.sugarresearch.com.au/page/About_SRA/Corporate_publications/.

This is the second Performance Report published by SRA and provides an overview of SRA's performance in delivering on our plan objectives for 2015/16.

The Report builds on the previous year's report with year-on-year comparisons, where available, and the addition of snap-shot case studies that demonstrate a cross-section of our research and adoption activities. The Performance Report is by no means exhaustive but rather provides a selection of our research highlights and performance. SRA's 2015/16 Annual Report, which will be published in October 2016, will further outline the research activities and outcomes invested in and/or delivered by SRA during the past year.

SRA's website and periodical publications, such as ***Cane****Connection*, *MillingMatters* and electronic newsletters, also 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 an outcome-focused measurement and evaluation framework and is working towards implementing more robust, quantifiable and meaningful performance measures that will demonstrate progress and achievements in research and adoption and, most importantly, inform SRA's investors on the value being returned from their investment in SRA.

We have established a logic model approach for monitoring, evaluating and reporting on research outputs, outcomes and impacts. This framework has been further strengthened with the development and implementation of a new suite of key performance indicators and tangible targets that have been set in the 2016/17 Annual Operational Plan.

Looking forward, the 2016/17 Performance Report will report against these new measures as well as the findings of SRA's inaugural Independent Performance Review which is due to be completed in late 2016.

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

SRA welcomes feedback on this Performance Report. If you would like to provide any comments or recommendations for improvement of this Report, please address them to Ms Leigh Clement, SRA's Executive Manager Investor Relations, via email, post or telephone to:

Email

lclement@sugarresearch.com.au

Postal

PO Box 86, Indooroopilly QLD 4068

Telephone

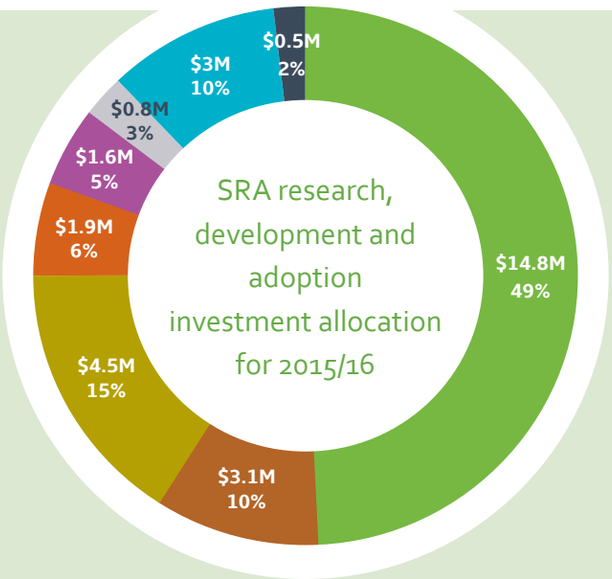
07 3331 3329

Queensland Government

Australian Government
Department of Agriculture and Water Resources

SRA acknowledges and thanks its funding providers, including levy payers (sugarcane growers and millers), the Commonwealth Government and the Queensland Government (Department of Agriculture and Fisheries).

Performance against plan for 2015/16

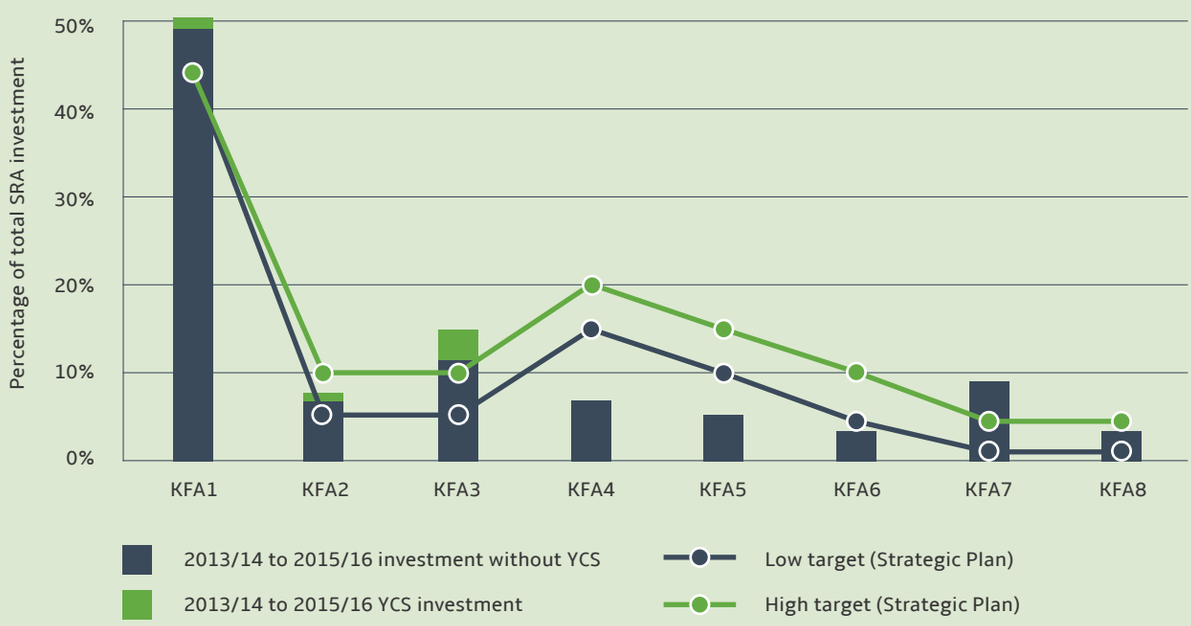


SRA invested $30.2 million in 2015/16 in research, development and adoption activities across SRA's eight KFAs. The above graph details the actual expenditure in each of the KFAs. Reflective of investor expectations and SRA's 2013/14 – 2017/18 Strategic Plan, the majority of the investment has been in 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

The graph below details the rolling average expenditure in both contestable and core RD&E in each of the KFAs against the planned investment allocation targets in the Strategic Plan.

Post allocation rolling average investment distribution by Key Focus Area, 2013/14 to 2015/16



The three-year rolling average expenditure shows we are falling short in meeting the planned investment allocation high and low targets in the areas of farming systems (KFA4), milling (KFA5) and product diversification (KFA6). It is important to note that while SRA has been cognisant of the set targets in determining its investment portfolio over the last three years, we are also intent on responding to key issues as they emerge, and not sacrificing the quality and impact of our research in order to achieve a quantitative measure. The inability to meet the investment allocation targets for these KFAs has largely been due to the redirection of investment and focus to SRA's critical Impact Areas, particularly YCS, plant breeding and adoption.

SRA will be working closely with its investors and industry representative bodies during 2016/17 to review the investment allocation targets and prioritise future research, development and adoption investment in preparation for a new five-year Strategic Plan commencing in 2017/18.

Delivering on 2015/16 Annual Operational Plan measures and targets

An assessment of SRA's performance against the suite of 34 measures reported in SRA's 2015/16 Annual Operational Plan is provided in Appendix 2. 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

Return on investment

Benefit cost analysis

- In 2015/16, a number of reviews and evaluations for specific research programs and projects were conducted to assess the benefits provided to industry by SRA's investment in research to-date and to estimate future industry-level returns on R&D investment, given various adoption and net benefit assumptions.

- Four new evaluations were completed by independent analysts, with estimated future returns[1] on investment summarised below, using Benefit Cost Ratio (BCR) and Net Present Value (NPV) as measures of estimated return. As detailed in the table, at a 5% discount rate, five of the projects yield positive returns on investment across the 20 and 30-year investment horizons.

Summary table of estimated industry-level returns on R&D investment[2]

Project	Years from last year of investment							
	0		10		20		30	
	BCR	NPV ($m)	BCR	NPV ($m)	BCR	NPV ($m)	BCR	NPV ($m)
Developing sugarcane for production systems utilising total biomass[(a)]	0.0:1.0	-3.9	0.7:1	-1.4	0.7:1.0	-1.4	0.7:1.0	-1.4
Climate Forecasting to Improve Sugarcane Nitrogen Management in the Wet Tropics	0.0:1.0	-0.4	2.1:1.0	0.5	3.8:1.0	1.1	4.8:1.0	1.6
Remote Sensing to Implement an Effective Pest Management Strategy for Canegrubs	0.0:1.0	-1.2	0.9:1.0	-0.2	1.9:1.0	1.1	2.5:1.0	1.8
Solving the Yellow Canopy Syndrome	0.0:1.0	-0.8	1.7:1.0	0.6	4.9:1.0	3.1	6.8:1.0	4.6

(a) This biomass project (funded 2009/10 to 2013/14) is independent of the 'Biomass Accumulation' project (2012/13 to 2013/14) reported in the Sugar Research Australia 2014/15 Performance Report.

- The biomass project found that there was no response to biomass yield from increasing nitrogen rates and given this finding the option to produce greater biomass from increasing nitrogen application would not appear to be financially viable. As such, this project did not yield a positive return across the investment criteria. However, it does provide useful information for any future investigation of biomass diversification in the Australian sugarcane industry.

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[1] Note the reported returns on investment (BCR and NPV) are estimated industry-level returns. They are not the returns that individual growers might expect if they adopt these technologies.

[2] Agtrans Research, 2016, *Evaluation of the Queensland Government Research and Development & Extension Investment in Sugarcane via the 2012/13 Memorandum of Understanding between BSES and DAFF (DAF15093).*

- The specific research project impacts that contributed to the positive returns on investment include:

  - ***Climate Forecasting to Improve Sugarcane Nitrogen Management:*** Potential for more profitable use of nitrogen fertiliser due to use of seasonal climate forecasting and tailoring of nitrogen applications; potential yield savings by not reducing nitrogen fertiliser in ratoon crops; potential reduced nitrogen fertiliser applications in some years in the Wet Tropics leading to reduced off-farm environmental impacts; potential greenhouse gas reductions due to reduced nitrogen application; and associated spill-overs of increased incomes in sugarcane communities.

  - ***Remote Sensing to Implement an Effective Pest Management Strategy:*** Potentially increased grower profitability due to reduced yield losses and reduced canegrub control costs due to the use of canegrub risk maps; potential for reduction in off-farm environmental impact due to more efficient and targeted use of pesticides; and potential for enhanced cooperation between growers in understanding canegrub infestations and better management given potential of an empirical source of canegrub distribution and risk information through mapping.

  - ***Solving the Yellow Canopy Syndrome:*** Potential for avoided yield losses in future by provision of effective control measures; potential for industry savings due to earlier avoided unnecessary expenditure on ineffective treatments; potential reduction in agricultural run-off caused by chemicals used as unproven YCS controls; and improved stability of farming communities due to decreased uncertainty surrounding YCS.

- The Queensland Department of Agriculture and Fisheries recently commissioned an evaluation of its investment in SRA's research programs, evaluating 10 random projects between 2009-2015. The review identified that important outcomes and impacts have been successfully delivered. At the individual project investment level, eight of the ten investments were estimated to produce positive Net Present Values (NPVs) and BCRs greater than one at a 5% discount rate. In aggregate terms, the Queensland Government investment of just over $10 million (present value terms) was found to have produced benefits valued at just under $40 million (4:1 approximately). BCR benefits from the ten projects more than paid for the total Queensland Government investment in the first three years of the investment agreement with SRA.

Industry profitability and productivity benchmarking - ABARES

SRA and the Queensland Department of Agriculture and Fisheries commissioned a financial performance review of the Australian sugarcane industry.

The economic survey of the industry by ABARES analysed sugarcane farm financial performance in 2013/14 and revealed **the top 25 percent of businesses had an average rate of return of 4.5 percent,** not including capital growth in their land.

The bottom 25 percent of farms had a negative 9 percent rate of return and had to rely on off-farm income to survive.

This data provides the industry with a baseline from which future productivity and profitability improvement can be measured against.

RD&E reviews

- In November 2015, eight international experts (covering various plant biology disciplines) conducted an independent review of the entire YCS integrated program of research. The integrated program and individual projects were reviewed favourably by the expert panel and eight recommendations were made. SRA and researchers have evaluated the recommendations in the context of on-going project work and all of their recommendations have been incorporated into the current research program. An important outcome has been a strong and unanimous support to bolster research into biotic factors involved in YCS. A new proposal is being developed to thoroughly investigate the role of biotic factors in YCS.

- A review of the investment in the SRA molecular breeding and marker discovery has found that full implementation of molecular marker technologies into the Australian breeding programme will take a number of years. The review identified R&D gaps around marker implementation and provided recommendations to guide the process. Significant progress has already been made towards implementing some review recommendations. The 2016/17 project call reflected the review recommendations and specifically sought projects with a stronger focus on pre-breeding strategies and the implementation of molecular and cytogenetic markers to improve parental selection and clonal selection efficiency.

- In June 2015, SRA conducted a Soil Health workshop with 52 participants drawn from all sectors of the sugarcane industry, stakeholders and other RDC representatives. The workshop outcomes identified that soil condition and capability is a multi-faceted problem and cannot be improved without changing the way the crop is grown. Fulfilling the key objectives in the strategic plan will require a concerted effort across key focus areas involving farming management, nutrient management and pest weeds and disease management. The problems that need to be addressed require high priority action to develop a Resource Hub and building of extension capacity and capability, building on existing innovation nodes to foster faster adoption of the key recommendations embodied in the Modern Farming System developed by the Yield Decline Joint Venture and to develop strategies and tools to better manage the build-up of soil pests and pathogen loads. The review's recommendations are currently being considered by the SRA Board for incorporation into SRA's strategic planning and new investments in 2017.

- A review of trait use efficiency for water and nitrogen was completed by AbacusBio Pty Ltd (NZ) and IDA Economics Pty Ltd and key recommendations were delivered to SRA's Research Funding Panel and the SRA Board in December 2015. The approach involved extensive consultation and workshops with sugarcane breeders and researchers, industry economists, other experts, consultants and staff from productivity services organisations and industry peak bodies. The business case prioritises investment in nitrogen-use efficiency (NUE) over water-use efficiency (WUE) as a higher industry benefit, but recommends that research into pre-breeding components of WUE and NUE continues to better understand how these traits may contribute to different modes of WUE and NUE. Until WUE/NUE traits are taken through a full cycle of the sugarcane variety improvement program, it will not be possible to gain a more accurate assessment of the economic breeding values for these traits. New investments have been made by SRA in 2016 to further trait development in these areas.

- A review of investment in Precision Agriculture (PA) recommended that the highest priority is to encourage adoption of proven precision technologies, e.g. by demonstrations, financial analyses, showcasing of advanced growers and formation of a PA community of interest. A similar conclusion regarding lack of adoption was reached from a workshop in 2016 on soil health. A project addressing soil health that is not specifically about PA but will encourage adoption of many PA technologies is being assembled for the Commonwealth's Rural R&D for Profit Programme Round 3 call to be submitted later in 2016.

- Three harvesting workshops were held in late 2015, one with sugarcane millers in August and one with each of growers/contractors and technology providers in December. One outcome of the workshops was an application to the Commonwealth for funding of RD&E to reduce harvesting losses and damage, which resulted in the successful Rural R&D for Profit Programme Round 2 project 'Enhancing the sugar industry value chain' that commenced in July 2016.

- SRA will continue to undertake regular reviews and cost-benefit evaluations at research program and project levels.

Ex-post program evaluations

Smut preparedness and SIX EASY STEPS™ program evaluations[3]

Two programs were evaluated, dating back to R&D investment made prior to SRA formation through the Bureau of Sugar Experiment Stations (BSES) and the Sugar Research Development Corporation (SRDC). These programs comprised of three projects within the Sugarcane Smut Preparedness program dating from 2003 to 2010 and four projects within the Appropriate Nutrient Management program, later rebranded SIX EASY STEPS™, from 2000 ongoing to 2017. The BCRs and NPVs over three investment horizons are presented in the table below.

Outcomes and impacts leading to the positive return on investments included:

- ***Preparedness for Sugarcane Smut program:*** Economic impacts from avoidance of losses due to higher yields from smut-resistant varieties and information about existing varietal resistance and resistance in forthcoming varieties; increased confidence in the sugarcane breeding program to combat smut; and strategic knowledge regarding pathogen variability with implications for Australian quarantine risks. Environmental impacts include reduced plough out of susceptible varieties and associated reduced soil losses on farm and export to waterways. Social impacts include reduced social impact on the industry and community due to smut preparedness.

- ***SIX EASY STEPS™ program:*** Economic impacts include increased profitability of the industry through more efficient nutrient management practices and maintenance of profitability through avoidance of harsher regulation and license to operate. Environmental impacts include improve water quality in waterways due to reduced nutrient run-off and recued Greenhouse Gas emissions from reduced nitrogen fertiliser applications. Social impacts include increased viability of sugarcane farming in Australia and improved public image.

Summary table of estimated industry-level returns on R&D investment

Program	Years from last year of investment							
	0		10		20		30	
	BCR	NPV ($m)	BCR	NPV ($m)	BCR	NPV ($m)	BCR	NPV ($m)
Preparedness for Sugarcane Smut	0.0:1.0	-3.4	33.7:1.0	111.5	33.7:1.0	111.5	33.7:1.0	111.5
SIX EASY STEPS™	1.5:1.0	5.9	3.4:1.0	31.1	4.6:1.0	47.4	5.4:1.0	57.4

[3] Agtrans Research, 2016, *An Economic Analysis of DAF R&D Investment in Six Easy Steps™ and* Agtrans Research, 2016, *An Economic Analysis of DAF R&D Investment in Preparedness for Sugarcane Smut.*

Snapshot of RD&E delivered in 2015/16

KFA1: Optimally adapted varieties, plant breeding and release

- 5 new SRA varieties were released – SRA4(ϕ) for the Southern region, SRA5 for the Herbert, SRA6 and SRA7 for the North and SRA8 for the Burdekin.
- New economic weightings for trait selection were introduced into the breeding program.
- Key traits for improving water use efficiency in sugarcane have been identified in pre-breeding germplasm research and are now entering into evaluation in the SRA breeding program.
- A 40K Canechip is now available for genomic prediction and the array is being used to select clones from the SmutBuster population in the sugarcane breeding program to generate new high-yielding resistant varieties faster.
- QCANESelect™ was modified to include a Whole-of-Farm-Planning module, allowing growers to manage their suite of varieties to minimise the risk of disease and improve productivity.
- New variety agreements were signed with Thailand, USA, Vietnam and India providing new opportunities for sugarcane variety and germplasm development.

Project snapshot

Project

2014/054

Optimising productivity and variety recommendations through analysis of mill data

Dates

1/7/14 – 1/10/16

R&D provider

Sugar Research Australia Limited

Description

The purpose of this project was to identify groups of farms of similar size with similar productivity over time and factors associated with this through multivariate cluster analysis of mill data.

This information was then utilised to develop a Decision Support System (DSS) to optimise variety recommendations and increase productivity.

2015/16 project activities and output highlights

Herbert mill data from 2014 and 2015 was analysed and project results successfully identified groups of Herbert farms with similar productivity over time and the major factors associated with these groupings. The major finding of the study was that those growers who have adopted new farming systems had significantly higher productivity than those who use traditional practices. The impact of the pachymetra resistance of previous varieties on yield of the current crop was also significant, suggesting this may be a major factor contributing to poor ratooning in the Herbert. In the small farm size groups, low and high performing growers had similar percentage levels of plant, young crops, old crops and old varieties. However, the low and high performing groups varied significantly in terms of new varieties, suggesting that the small farm size low performing group were not adopting the new, more productive varieties to the same extent as the small farm size high performing group. These findings were used to enhance the DSS and improve variety selection in the Herbert region.

Project outcomes and impacts

Results from this research has allowed the Herbert Cane Productivity Services Limited (HCPSL) to design targeted extension strategies with the region. This will result in better variety recommendations and increase productivity. This research will now continue and expand its scope in a new project running until 2018.

Identification of factors affecting productivity in other regions (Burdekin, Tully and South Johnstone mill areas) through analysis of mill data will commence with the intention of bringing the benefits of such analysis and targeted extension strategies for productivity to other regions.

KFA2: Soil health and nutrient management

- Nitrogen rates recommended using the SIX EASY STEPS™ methodology were validated in commercial scale trials across the Burdekin. The nitrogen trial results and case studies investigating the estimated increase in profitability of adopting nitrogen rates based on the SIX EASY STEPS™ methodology were published and presented at five workshops across the Burdekin.
- SRA researchers identified climate zones and groups of soils that behave similarly under different climatic conditions for the Tully mill area. This will assist in the determination of productivity performance zones which could be used to adjust yield potential across the region.
- Numerous field trials and experiments were established across the regions, including assessment of sub-soil placement of ameliorants on marginal soils, pot trials to assess waterlogging tolerance of sugarcane varieties, nitrogen-rate field experiments and establishment of trials to assess the ability of enhanced efficiency fertiliser products to improve nitrogen use efficiency.
- A nitrogen management workshop was conducted in Townsville in May 2016 to gain an understanding of stakeholder perspectives, an update on research, development and adoption activities and develop a way forward to improve nitrogen management in the sugarcane industry.

Application of agricultural calcium-magnesium blend

- Agricultural Production Systems sIMulator (APSIM) was used to simulate cane yield responses to nitrogen fertiliser for two previous nitrogen response trials conducted in Tully. This will allow crop response to nitrogen to be simulated for a wider range of soil and climatic conditions and will be used to refine nitrogen recommendations for the Tully mill area.

Project snapshot

Project

RP20/14C

Nitrogen fertiliser requirements for representative soils of the Lower Burdekin cane growing district

Dates

07/2010 – 06/2017

R&D provider

Sugar Research Australia Limited[1]

Description

'RP20' is a collaborative research project investigating the effectiveness of SIX EASY STEPS™ guidelines for applying nitrogen in the Burdekin through on-farm trials. 23 large-scale randomised strip trial sites have been established over the course of the project covering full four-year crop cycles and are representative of all major soil types in the region. The trials are comparing the adequacy of nitrogen application rates at the SIX EASY STEPS™ prescribed rate relative to the farmer's previous rate and a higher rate of application.

2015/16 project activities and output highlights

In 2015, four new trial sites were established and 14 trials were harvested.

Results to-date show that the method for calculating nitrogen fertiliser application rates under SIX EASY STEPS™ produces the optimum level of tonnes and sugar in the majority of cases and that the industry can have confidence in widespread adoption of the methodology.

A financial analysis on five of the trials found potential increases in profitability in all cases due to reduced fertiliser application costs at the SIX EASY STEPS™ application rate. For example, in one case study there is a potential increase in profitability of $29,600 per annum over 100 hectares. These case studies and trial results were published by SRA in March 2016[2].

Trials will continue until 2017 at which time final results will be presented in full.

Project outcomes and impacts

The major outcome for the industry thus far is increased evidence and validation of the benefits of the SIX EASY STEPS™ nutrient management methodology, particularly in the Burdekin.

In a number of cases, the growers have noted that the trials have also reinforced that efficient nitrogen use is only one component of determining productivity and successful farm management.

Whilst it is an important component, it needs to be coupled with best practice in all areas of farm management, such as crop establishment, irrigation and weed management.

In addition to these positive grower observations, an independent benefit cost analysis of the suite of key projects under the 'SIX EASY STEPS™ program' (including the RP20 project) was completed in 2016 and determined a 5:1 return on Research and Development (R&D) investment over 30 years.

[1] *Funded by the Queensland Department of Environment and Heritage Protection.*

[2] *www.sugarresearch.com.au/icms_docs/243579_Burdekin_Nitrogen_Trials_-_Case_studies_and_trial_results.pdf.*

KFA3: Pest, disease and weed management

- Yellow Canopy Syndrome (YCS) remains SRA's #1 priority. Research has ruled out a number of possible causal agents and a number of trials have been established, in collaboration with productivity services organisations, to evaluate potential management options for YCS.
- Molecular studies of sugarcane downy mildew in Papua New Guinea have revealed high pathogen diversity, with the possibility of a new species being discovered.
- A pre-commercialisation study to evaluate a new diagnostic for ratoon stunting disease (RSD) was started in conjunction with support of productivity services organisations.
- SRA research in Indonesia is revealing important information about Sugarcane streak mosaic virus (SCSMV), such as transmission, and is leading to progress on new diagnostic tests and understanding spread in the field.
- SRA commenced a series of new trials to combat the pest, soldier fly, in collaboration with productivity service organisations in Bundaberg, Isis, Maryborough and Mackay regions.
- Researchers conclusively validated the 2014 breakthrough finding of the causal agent for chlorotic streak disease by establishing the organism in pure culture and then re-infecting plants using various methods.
- A portable rainfall simulator has been designed and trialled for use in measuring the run-off following different pesticide or nutrient applications under a set amount of artificial rainfall.

Indonesian SCSMV experimental fields

Project snapshot

Project

2013802

Integrated disease management of sugarcane streak mosaic in Indonesia

Dates

1/10/2014 – 31/12/2018

R&D provider

Australian Centre for International Agricultural Research (ACIAR)

Description

The research aims to find out information about a newly recognised viral disease, Sugarcane streak mosaic virus (SCSMV), which has become widely distributed in South and South-East Asia; the focus of the project is Indonesia.

Findings will be used to develop an effective integrated disease management (IDM) program aiming to minimise yield losses caused by the disease.

2015/16 project activities and output highlights

Research in 2015/16 focused on several important areas:

- The development of a rapid, cheap and reliable diagnostic test.
- Identification of the main forms of disease transmission (mechanical/insect vector).
- Speed and pattern of spread in commercial fields – which will also provide clues to how the disease is transmitted.
- Yield losses – an experiment that aims to assess yield and monetary losses from SCSMV.

Progress has been made in each of these areas with research undertaken in Australian and Indonesian laboratories, as well as in infested cane fields in Indonesia.

Project outcomes and impacts

The project is still in its early days and basic information about the disease is still being collected.

As project and results progress, benefits to the Australian sugarcane industry will be: diagnostic tools that will provide certainty of identification should suspect SCSMV-infected plants be detected during an incursion; knowledge of how quickly the disease is likely to spread should an incursion occur; and an understanding of the most effective control measures that should be applied in the event of a disease outbreak – leading perhaps to possible eradication, or at worst – minimisation of losses caused by the disease.

Finally, the project will lead to knowledge of the resistance of Australian commercial varieties to SCSMV, thus providing a guide to the risk to the Australian industry posed by SCSMV.

KFA4: Farming systems and production management

- A pilot data hub for mill productivity data has been established with data from several mills. The data hub imports, translates and cleans data into a standard code from different mills and may become an industry standard database for the collation and optimal use of industry spatial data.
- Economic analysis of six harvest speed trials in 2015 showed that harvesting costs decreased with increasing speeds up to 8-9 kilometres per hour but then levelled off, reinforcing the need for a system to compensate harvester operators for harvesting at slower optimal speeds to minimise cane loss and stool damage.
- Automated furrow irrigation system trials have been established in the Burdekin which allow control, scheduling and monitoring of the system from anywhere with internet access.
- Demonstration of SCHLOT (Sugarcane Harvesting Logistics Optimisation Tool) by Norris ECT commenced and information on the physical characteristics of major Australian varieties was collected to improve its accuracy. The tool will be used to calculate optimal harvester operating conditions to maximise quality and minimise losses.
- SRA published the Precision Agriculture Manual, collating and summarising the best research and information regarding Precision Agriculture technologies available to the Australian sugarcane industry.
- Software has been developed for automation of the procedure for developing reliable yield maps from harvester-mounted yield monitors. The prototype software tool will be tested in future harvesting seasons.

Program snapshot – harvesting efficiency

Projects

Various – 2014/035, 2014/048, 2014/091, 2014/092, 2015/080, 2015/079

R&D providers

Sugar Research Australia Limited, Norris Energy Crop Technology Pty Ltd, Burdekin Productivity Services Ltd, Sunshine Sugar, Queensland University of Technology

Description

Within Key Focus Area 4, SRA has a number of projects provided by both SRA and external research providers in the area of harvest efficiency – a key Impact Area. Projects within this Impact Area are further trialling and developing tools to improve harvesting efficiency and working to promote the adoption of harvesting best outcomes across the Australian industry for greater productivity and profitability.

2015/16 activities and output highlights

- Various demonstrations and workshops communicating harvesting best practice were held including 7 Harvesting forums, 10 introductory harvesting workshops and 4 harvest operators' and service suppliers' meetings.
- A number of field trials were conducted including assessing the EHS chopper drums (5 trials), pour rate trials assessing cleaning rate through the harvester (9 trials), impact of ground speed and the effect on following ratoons (2 trials), effect of basecutter height on following ratoons and assessing 4 and 5 blade chopper configurations and post-harvest cane cleaning.
- Development of SCHLOT (the Sugarcane Harvesting and Logistics Optimisation Tool) by Norris ECT continued.
- A feasibility study was undertaken to investigate industry requirements for harvester-mounted sensors for real-time quality monitoring and reporting.
- Economic analysis of different harvest speed trials was conducted by Burdekin Productivity Services.
- Sunshine Sugar continued work on the effect of harvest speed, cutting height and row profile on harvesting efficiency.
- QUT is developing a non-pneumatic cane cleaning plant which, if successful, would be able to remove trash from cane after harvest, even under moist conditions.

Project outcomes and impacts

SRA's harvest efficiency program continues to develop and demonstrate the greater efficiencies and benefits that can be obtained through better harvesting practices – a major outcome for the industry.

Upon widespread adoption, the entire value chain will benefit from improved productivity and profitability.

Notably, the existing research will soon be complemented by a large collaborative project taking a holistic approach to harvesting efficiencies.

This project, to be led by SRA, is supported by substantial funds from the Commonwealth Government's Rural R&D for Profit Programme – Round 2, in recognition of the significant opportunity posed by recapturing harvest losses.

KFA5: Milling efficiency and technology

- Significant improvement in the applicability of Near-Infra-Red (NIR) spectroscopic models has been made, with several trials held in multiple mills.
- Experimental investigations on different lengths and diameters of tubes in Robert evaporators has allowed the development of improved engineering designs and estimation of the capital cost for preferred designs in different situations.
- A review of Australian Robert evaporators compared to evaporators used elsewhere in the world was conducted and a detailed assessment of the suitability of these alternative designs was completed.
- Progress has been made towards upgrading Real-Time Scheduling Software (RTSS) to support marshalling yards, managing marshalling yard issues and storage location of empty bins for scheduling purposes.
- Computational fluid dynamics modelling of scrubber design modifications were completed. Five wet scrubber design modifications were proposed and design modifications were implemented in a scrubber scale model. The proposed design modifications are currently being considered by a scrubber manufacturer. Feedback received will be incorporated into further design modelling.
- A survey of industry was conducted to learn more about industry requirements for real-time sensors in the harvesting environment and will be used to inform a feasibility study. Real-time sensors have the potential to significantly reduce harvest losses, improve return from growing and harvesting and provide mapping and monitoring of harvesting performance across the industry.

Broadwater Mill

Project snapshot

Project

2015/051

Improving mill efficiency through rapid analysis methodologies

Dates

01/07/2014 – 01/09/2017

R&D provider

Sugar Research Australia Limited

Description

The project is developing turn-key, laboratory-based NIR spectroscopic systems for rapid analysis of factory products, with the aim of improving mill efficiency.

These systems can analyse multiple constituents (e.g. brix, pol) in products (cane, bagasse etc.) in less than one minute per sample. The fast analysis time means more samples can be analysed, on more products within current resource allocations. This provides near real-time data upon which to make and assess factory control decisions.

2015/16 project activities and output highlights

The 2015/16 period saw significant developments in the applicability of laboratory NIR spectroscopic systems.

Amalgamation of data from a large number of mills has allowed global calibration models to be developed for the first time on laboratory instruments.

During the 2015 crushing season, two different instrument platforms were installed in six different mills for several weeks at a time to trial the systems under real-world operating conditions.

The validation data reflects that the FOSS DA1650 instruments are approaching turn-key status, which means they will deliver an immediate return on investment for any mill.

A majority of the global calibration models are generating predicted values with errors inside the limits of control requirements within days of installation.

This is a considerable improvement from the 1-2 year delay previously expected. There has been strong positive feedback for the outcomes of this project, with several mills requesting access to the technology for the 2016 season and one mill already using it to make operational decisions.

Project outcomes and impacts

The major outcome for industry will be improved mill efficiency as a result of near-real-time feedback and the consequent tighter control of factory processes.

In particular, improvements will be expected across milling train extraction, pan stage crystallisation, low grade sugar recovery, raw sugar production and mill mud processing.

Additionally, the reduced staff and capital cost of implementing these systems will facilitate their integration into standard factory operations.

KFA6: Product diversification and value addition

- The pre-treatment reactor at a Mackay Pilot Plant has been used for bagasse pulping process to produce black liquor that will be tested as a fertiliser in pot trials. The pulp will be evaluated for production of tissue paper.
- SRA is contributing to the Rural R&D for Profit Programme's Biorefineries project that is engaging Australia's leading researchers in biorefining to develop the technologies needed to convert Australian agricultural and forestry feedstocks into new value-added animal feeds, chemicals and advanced fuels.

Project snapshot

Project

2015/902

A profitable future for Australian agriculture: Biorefineries for higher-value animal feeds, chemicals and fuels

Dates

22/06/2015 – 01/03/2019

R&D provider

Queensland University of Technology

Description

This is a major collaborative project led by SRA and funded through the Commonwealth Government's Rural R&D for Profit Programme.

The purpose is to develop the technologies needed to convert Australian agricultural and forestry feedstocks into new value added animal feeds, chemicals and advanced fuels and build value chain knowledge to capture future biorefinery opportunities.

2015/16 project activities and output highlights

With respect to sugar related project activities, in 2015/16 preliminary research and preparation has begun for laboratory-scale trials of new technologies to enhance sugarcane products for use as animal feed ingredients; initial research identifying microbial populations in bagasse in effort to develop technologies for enhanced nutritional characteristics of sugarcane is underway; experiments related to the development of advanced fuels from sugarcane products that can be used as a carbon source have commenced; and a preliminary assessment of the factors influencing adoption in Australian sugar mills has been completed.

23 researchers and post-graduate students are currently engaged in this project with further appointments anticipated.

Project outcomes and impacts

The major impact of this project will be the opening-up of new opportunities for products and biorefineries in a number of Australian rural industries to safeguard competitiveness and long-term profitability and productivity.

The Australian sugarcane industry in particular will benefit from the development of a number of new technologies and identification of pathways to biorefinery development in the industry through detailed understanding of innovation and adoption in Australian sugarcane mills.

KFA7: Knowledge and technology transfer and adoption

- SRA facilitated and/or collaborated in over 90 industry events, forums, and workshops etc. during 2015/16. These included harvesting forums, research forums across the regions, farm visits and trial field days, Best Management Practice (BMP) training sessions and SIX EASY STEPS™ workshops, among others.
- SRA regularly published on-line, email and hard-copy manuals, guidelines, newsletters, industry magazines, factsheets, video clips and webinars communicating research, development and adoption activities and outcomes.
- SRA conducted its second grower survey of 400 farmers, with improvement in all key performance measures relative to 2015 results.
- The first of a series of economic case studies on the adoption of BMP was completed for a multi-farm enterprise in Far North Queensland.
- Preliminary farm business analysis in the Herbert has identified profit drivers for the region and revealed that input costs are well managed but overhead costs are trending upwards and machinery and labour costs are relatively high, leaving less for growers to spend in other areas of their business and also reducing profit to growers. The research continues in 2016/17 and will improve farm business intelligence in the region.

Project snapshot

Project

2014/015

Measuring the profitability and environmental implications when growers transition to Best Management Practice (as defined by the Smartcane Best Management Practice (BMP)

Dates

01/07/2014 – 02/05/2018

R&D provider

Queensland Department of Agriculture and Fisheries

Description

The Queensland Department of Agriculture and Fisheries' economists, with support from Life Cycle Strategies, are undertaking six case studies investigating the economic and environmental impact of changing farm management practices to SmartCane BMP.

Each case study from a farm in the Wet Tropics calculates the impact of management practice change on farm profitability and environmental factors.

2015/16 project activities and output highlights

In 2015/16, the first case study (Salmec) was completed and published[1]. The 830 hectare farming business transitioned to SmartCane BMP over eight years by making substantial changes to their nutrient, soil and pest management. The farming business invested in new machinery and equipment to facilitate these changes. Assuming yields are maintained, the case study results show that the change provides the operators with an increase in operating return of $124,000 per year ($150/ha) largely due to lower operating costs. Results of an investment analysis show that cost savings from BMP adoption have more than offset the capital investment required to make the change. Summary statistics from the analysis are presented in the table below.

Cost of implementation ($)	$338,700
Annual Benefit ($/ha/yr)	$101
Payback Period	5 years
Internal Rate or Return	29%
Investment Capacity ($)	$999,320

The case study estimated that with these practice changes around 124kg less pesticide active ingredients and 1 tonne per year less nitrogen will run-off into waterways.

The changes also reduce annual fossil fuel use (including that embodied in farm inputs) by 15%. A risk analysis undertaken considered the impact of cane yield variability on economic and environmental benefits and found that the benefits are fairly robust.

Project outcomes and impacts

This project enhances decision-making for cane growers and advisors by demonstrating profitability and environmental implications and will aid informed grower adoption of SmartCane BMP across the industry.

Crucially, this project provides supporting research on the economics and environmental implications of SmartCane BMP not investigated in such detail elsewhere.

[1] *For a copy of the full case study including details of practice changes and economic and environmental analysis, please contact the Department of Agriculture and Fisheries' Customer Service Centre by telephone on 13 25 23.*

KFA8: Capability development, attraction and retention

- 2 Early/Mid-career research awards in 2015/16 provided for research into reducing excessive and ineffective use of fertiliser and the delivery of a novel DNA-based diagnostic for root health.
- 15 new travel and learning awards were provided in 2015/16 including SRA's first sponsorship of an industry internship.
- 3 new postgraduate research scholarships were provided to support ongoing industry research capability.
- SRA sponsored the attendance of one senior sugar industry leader to attend the Training Rural Australians in Leadership (TRAIL) Blazers course.
- SRA sponsored the first group-based shared learning and travel award. In early 2016, 14 Next Generation Participants toured from Mossman to the Burdekin to learn about harvest losses and value chain improvements and build valuable network connections with other next generation people in the Australian sugar industry.
- SRA completed a comprehensive Research, Development and Extension (RD&E) sugarcane industry capability audit of research providers in November 2015. The audit results will be used to inform the development of industry capability strategies under the new National Sugarcane Industry RD&E Strategy (currently under development by a Strategy Working Group comprising representatives from research organisations, industry and government).

Project snapshot

Project

2011/062

Danielle Skocaj – Climate forecasting to improve sugarcane nitrogen management in the Wet Tropics

Dates

1/1/2011 – 1/06/2016

R&D provider

Sugar Research Australia Limited

Description

This postgraduate research scholarship jointly supported SRA researcher, Danielle Skocaj, in obtaining her doctorate for her research 'Improving sugarcane nitrogen management in the Wet Tropics using seasonal climate forecasting'. Undertaken through James Cook University, Danielle's research significantly advances the application of climate forecasting indices for nitrogen fertiliser management in agricultural crops and improves understanding of nitrogen recovery by sugarcane.

2015/16 project activities and output highlights

Danielle completed her PhD thesis and graduated in March 2016. One of the key findings of her research was that nitrogen fertiliser requirements are on average, 25% lower in wet years (defined as the June to August Oceanic Niño Index being in the La Niña phase) for ratoon sugarcane crops grown on the Bulgun series soil. The chance of experiencing high spring-summer rainfall at Tully increases in La Niña years. This means Tully sugarcane growers could consider reducing nitrogen fertiliser application rates to ratoon sugarcane crops grown on the Bulgun series soil in La Niña years.

Project outcomes and impacts

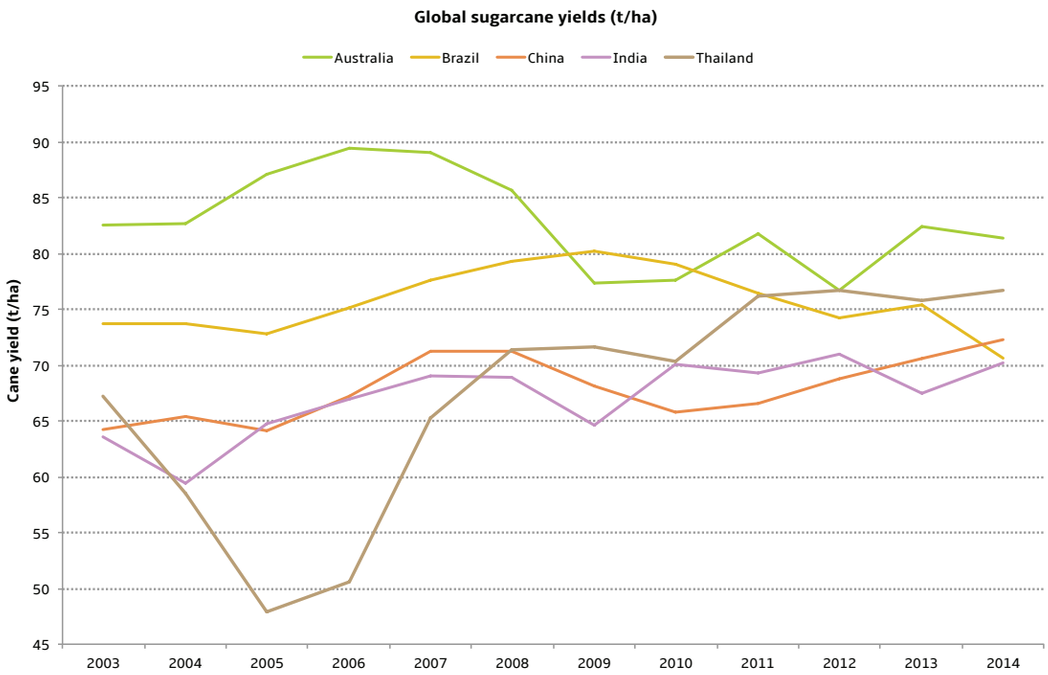
Danielle is continuing her career with the Australian sugarcane industry and SRA as a researcher in the soils, nutrients and farming system focus areas. She continues in both Chief and Co-Investigator roles for projects dealing with improving nitrogen-use efficiency for crops with constrained yield, understanding the impact of climate variability on productivity and nitrogen fertiliser requirements and analysing mill productivity data to optimise productivity and variety recommendations.

This postgraduate scholarship has enhanced research capability within the Australian sugarcane industry and contributes to the delivery of ongoing high-quality research and development.

Dr Danielle Skocaj

Research outcomes

Productivity | Global yields

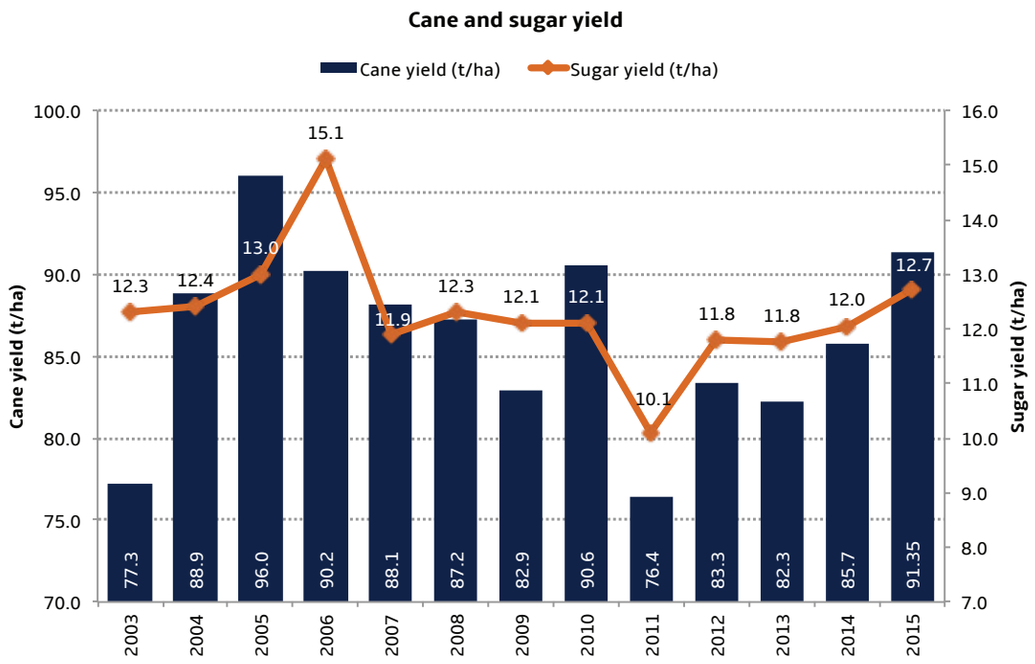


Australia continues to be a world leader in terms of sugarcane tonnes per hectare.

Source: Food and Agriculture Organisation of the United Nations, Statistics Division, http://faostat3.fao.org/home/E;

Sugar Year Book 2014, International Sugar Organisation London, 2014.

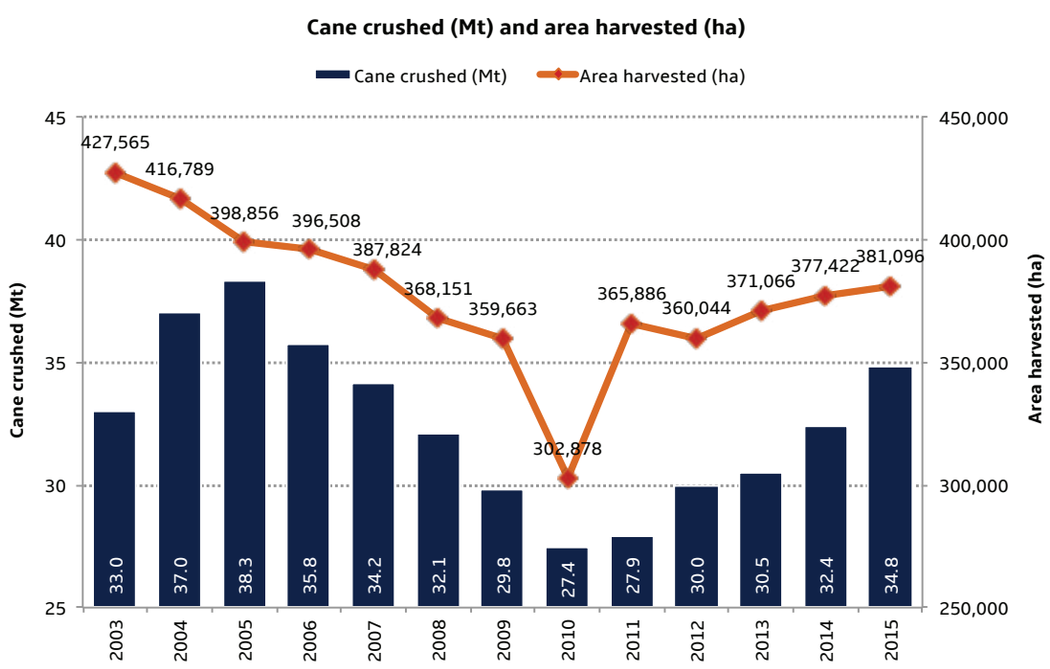
Productivity — Australian cane and sugar yield



Australia's cane and sugar yields have been steadily recovering following the smut incursion in the mid-late 2000's and significant weather events during 2008-2011.

Source: Australian Sugar Milling Council; Australian Sugar Year Book, Rural Press Ltd, Brisbane.

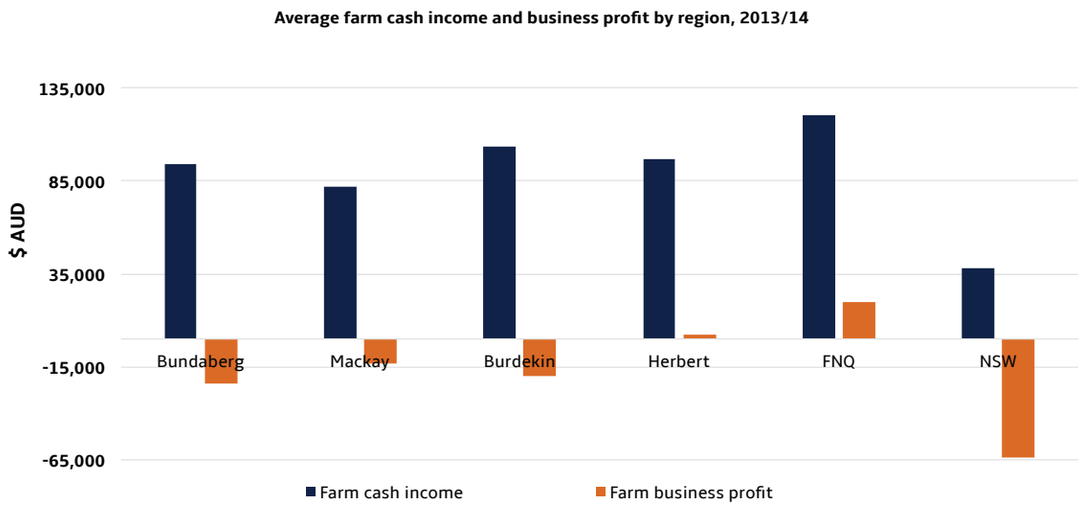
Productivity — Australian cane crushed and area harvested



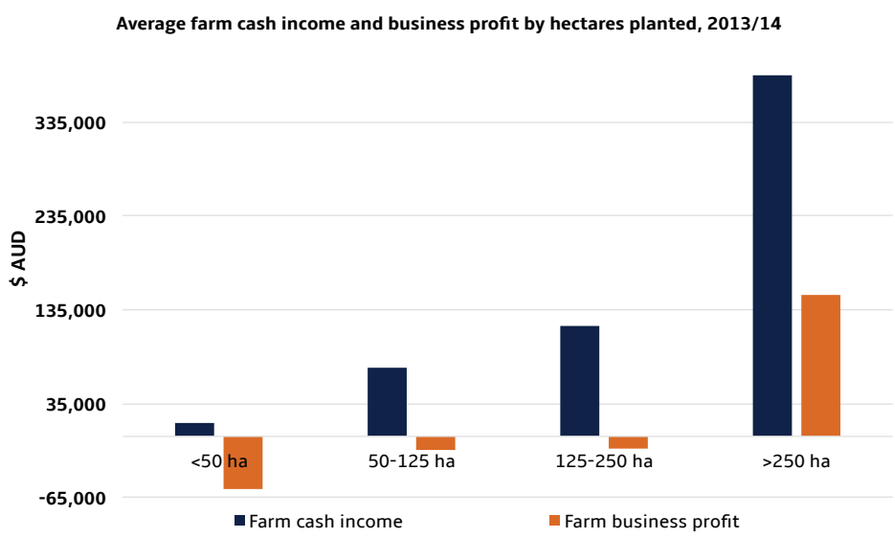
The total area harvested increased in 2015 to 381,000 hectares. The area harvested has steadily been increasing since poor climatic conditions in 2010 and timber plantations returned to sugarcane production. With improved productivity over the last couple of years and more area under cane, the industry is now substantially closer to meeting the industry goal of 36Mt per annum. *Source: Australian Sugar Milling Council.*

In December 2015, the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) published the results of the Australian sugarcane farm businesses survey that was commissioned and jointly-funded by SRA and the Queensland Department of Agriculture and Fisheries[1]. The survey results provide useful baseline information about industry practices, costs, returns and profitability at the farm level to assist in improving the understanding of productivity and profitability drivers for RD&E in the Australian sugar industry.

On-the-whole, the survey results were positive with all regions and property sizes returning a positive farm cash income on average in 2013/14 – indicating that on average the industry returned a 2013/14 'operating profit'. As illustrated in the graph below, the size of farm cash income is proportional to farm size.



Source: ABARES



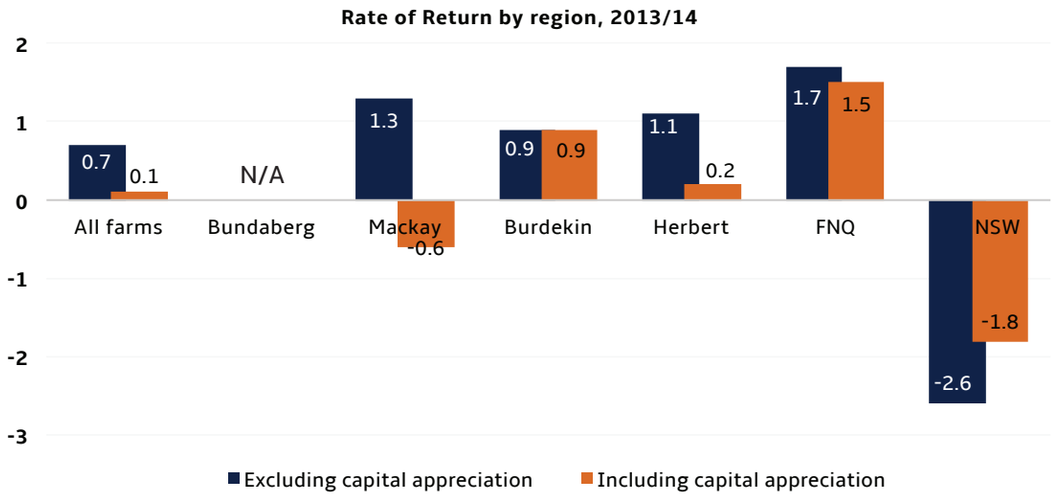
Source: ABARES

However, a positive business profit – a measure of longer-term business profitability and return on resources – was not achieved on average other than in the Herbert, Far North Queensland and on properties greater than 250 hectares. This suggests that smaller properties in some regions did not have enough surplus cash in 2013/14 to cover all of their annual capital depreciation and unpaid family labour and finance costs in addition to the annual sugarcane cash costs. The survey shows smaller sugarcane businesses supplemented a greater proportion of income with off-farm labour.

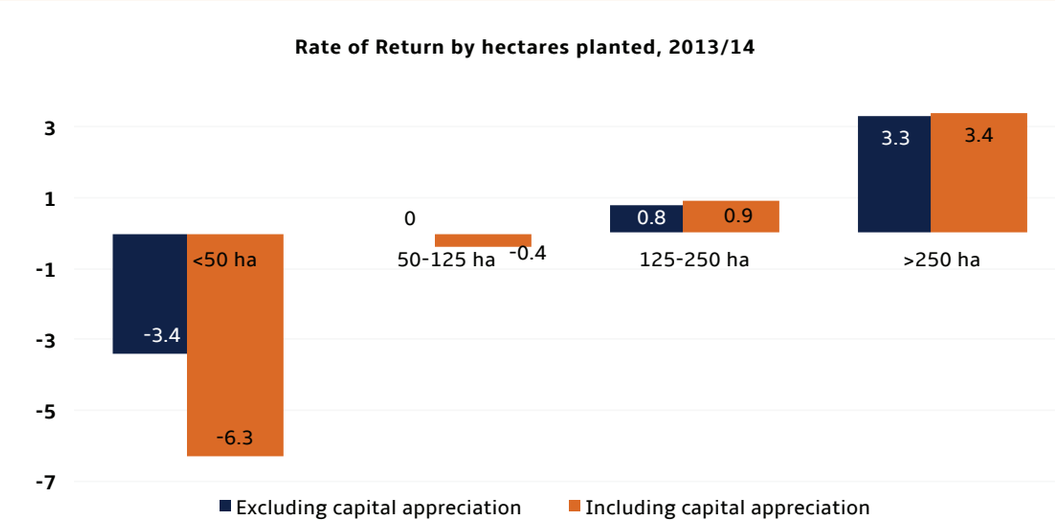
[1] *Australian sugarcane farm businesses: financial performance, 2013–14, H. Valle and P. Martin, ABARES research report prepared for Sugar Research Australia and the Queensland Government Department of Agriculture and Fisheries, Canberra, December 2015.*

Financial performance

ABARES survey



Source: ABARES

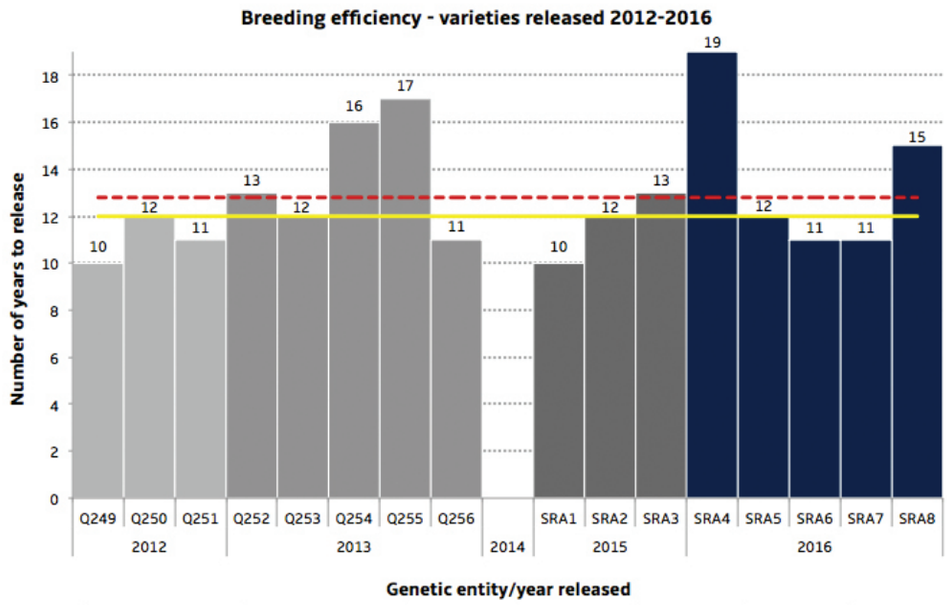


Source: ABARES

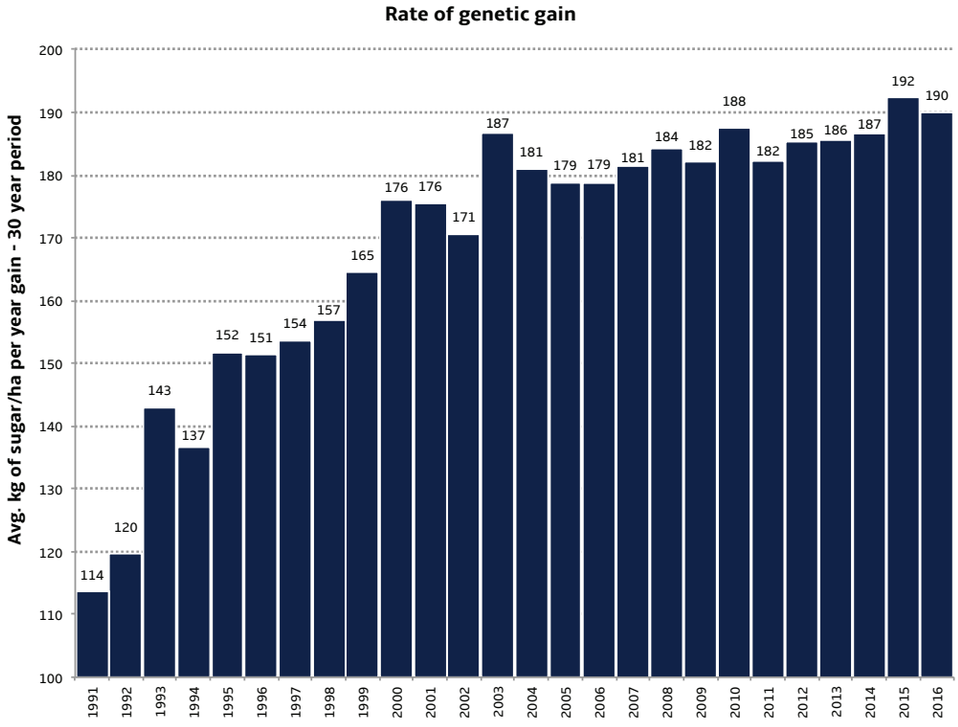
The average rate of return – a measure of efficiency of the whole farm business in generating a return on all resources – was positive at 0.7 per cent for all farms surveyed, excluding capital appreciation and 0.1 including capital appreciation. Rates of return however varied across regions but were directly proportional to property size.

The generally low rate of return and farm profit is the result of small farm businesses with low profitability relative to capital value, typical of an industry with a high proportion of small farms. Farms greater than 125 hectares had positive rates of return and sugarcane farms greater than 250 hectares have rates of return comparable to average medium-term returns for grain farms with similar total capital investment.

In summary, 2013/14 financial results are not positive for all groups of the Australian sugarcane industry but the cyclical nature of external factors affecting the industry mean that financial performance and business sustainability is best monitored over time. Future surveys of financial performance will gauge productivity and profitability improvements of the industry against this baseline.

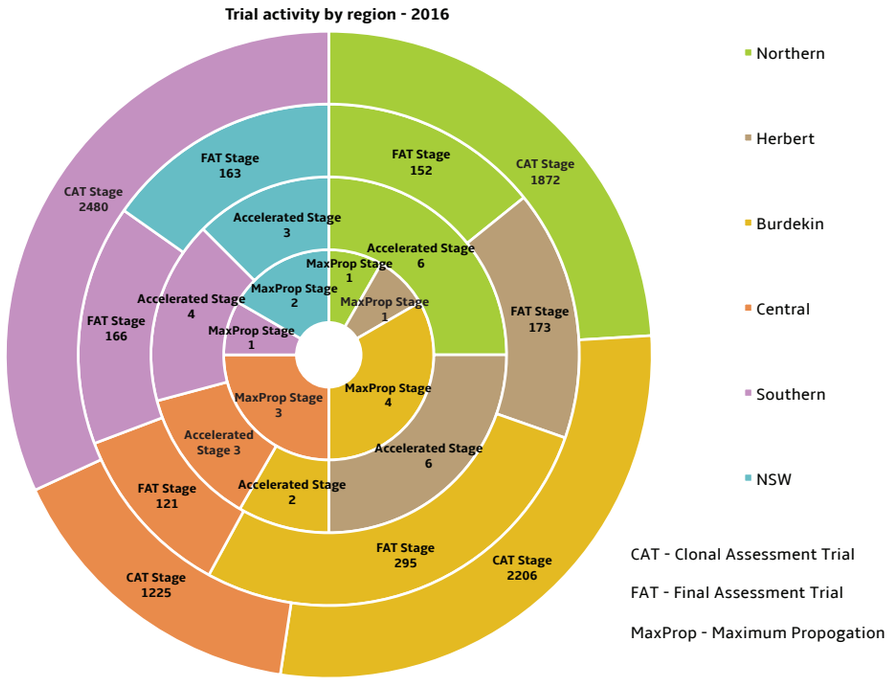


The time taken for a variety to be released is one measure of breeding efficiency. Five new varieties were released by SRA in 2015/16, with SRA4$^{\phi}$ taking a longer than usual time to release due to early propagation failures and eventual release due to demonstration of potential for resistance to solider fly. The release of SRA4$^{\phi}$ has increased the average time to release to 12.8 years (red line), above the industry benchmark of 12 years (yellow line). Two of the new varieties, SRA6 and SRA7, were released in 11 years. *Source: SRA.*



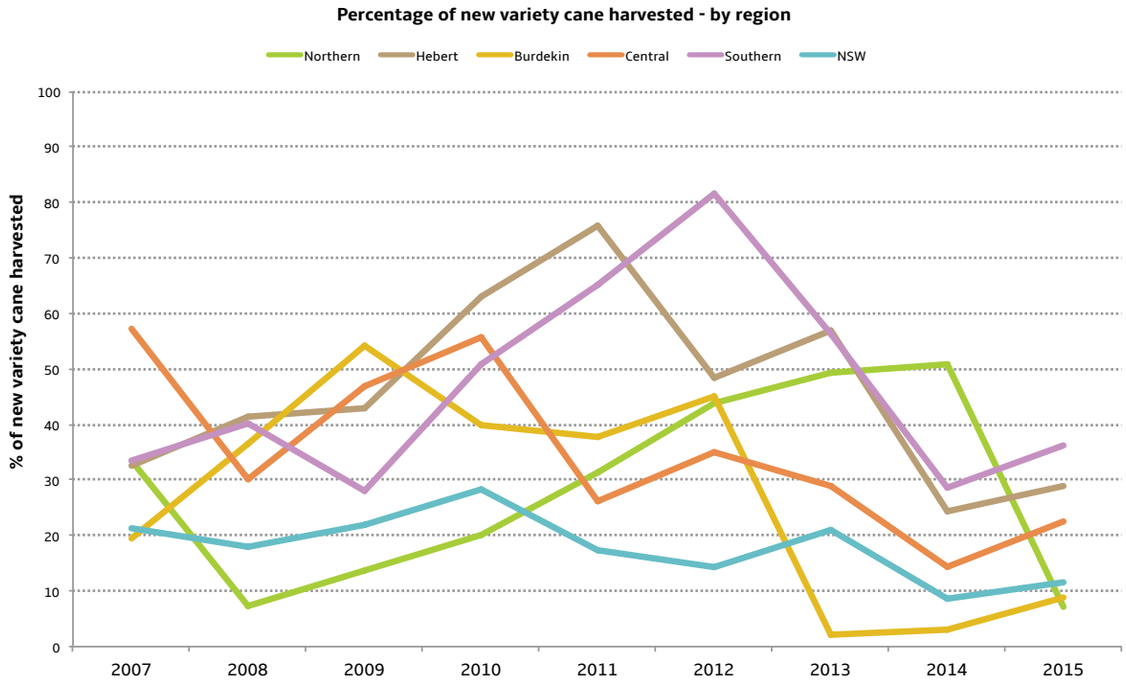
The rate of genetic gain is based on a 30-year rolling average of measured potential gain in different production traits – in this case sugar/ha. Genetic gain is essentially a measure of the 'health' of SRA's breeding program and the 190 kg of sugar per hectare result in 2016 is indicative of a program that is continuing to delivery varieties of high-value to the industry. *Source: SRA.*

Varieties and plant breeding — Trial activity by region 2016

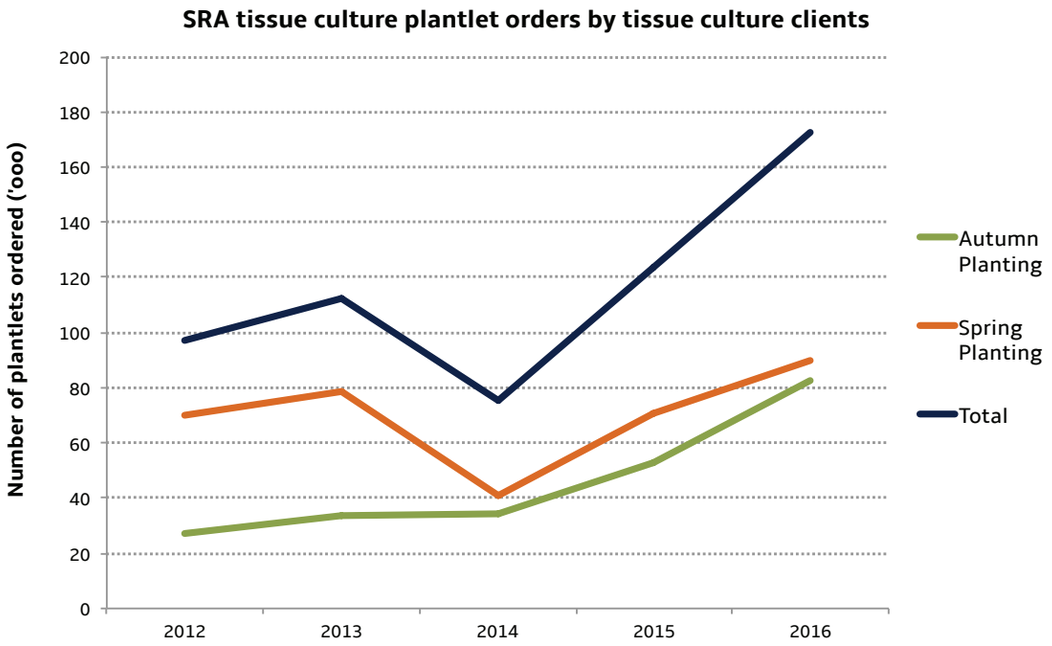


The numbers represent the number of clones in each breeding stage trial per region. 2016 trial activity is within normal expectations for the plant breeding program. The Burdekin FATs program reflects the integrated breeding program with Wilmar Sugar. *Source: SRA.*

Varieties and plant breeding — New varieties in production (by region)



New varieties are those that have been released in the previous 7 years. It takes time for those varieties to be commercially bulked-up and used. All regions except for the Northern region increased the percentage of cane harvested from new varieties in the 2015 season. In the Northern region the substantial drop is due to the declassification of Q208$^{\phi}$ to 'old variety'. *Source: Mill statistics; SRA.*



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 been steadily increasing since 2014. Orders for the spring 2016 planting were a record 89,950 plantlets of which, 24% and 32% were for new varieties SRA1$^{\Phi}$ and SRA2$^{\Phi}$ respectively. *Source: SRA.*

Tissue culture plantlets

Varieties and plant breeding

R&D highlights

- Five new varieties were released in 2015/16 (SRA4$^{\Phi}$, SRA5, SRA6, SRA7, and SRA8) – SRA4$^{\Phi}$ for the Southern region, SRA5 for the Herbert, SRA6 and SRA7 for the North and SRA8 for the Burdekin.
- SRA1$^{\Phi}$ and SRA3$^{\Phi}$ were approved for release in the Northern region and Q247$^{\Phi}$ was approved for release in the Southern region.
- A total of 13 advanced clones were propagated for possible release in 2017.
- Over 150 clones from the SmutBuster program were repeated in FATs and several hundred clones are to be propagated in 2016 for possible inclusion in 2017 FATs.
- 70 introgression families were planted in a trial at Macknade.
- 351 field crosses were made in 2015 from 143 of 780 parents available.
- 1,176 photoperiod facility crosses were made in 2015 from 350 of 415 parents available.
- Pre-breeding germplasm research has identified traits for improving water use efficiency in sugarcane and these traits will now be assessed in SRA's breeding program.
- Collaboration with Brazil's University of Campinas identified commercially useful genes and germplasm for shortening the sugarcane cycle.
- Collaboration with Yunnan Sugar Research Institute in China identified new germplasm suitable for improving yield in water-limited environments.
- SRA's QCANESelect™ was modified to include a Whole-of-Farm Planning module which will allow growers to manage their suite of varieties to minimise the risk of disease and improve productivity.
- SRA established the use of a 40K Canechip for genomic prediction and selection of clones from the SmutBuster population to generate new high-yielding resistant varieties faster. The array will also be used to assess the diversity in the Indian breeding program and inform which germplasm to introduce into the Australian breeding program.
- Herbicide-tolerant genetically-modified (GM) sugarcane with cane and sugar yield comparable to leading commercial varieties was identified. Multi-location trials showed excellent trait expression and yield in all the major sugarcane production areas in the Australian sugar industry.
- Better understanding of the genes that respond to day length and lead to flowering and an understanding of the implications of hormones on developmental pattern was revealed with possible future applications for sugarcane breeders.
- SRA imported 10 sugarcane varieties from Brazil, six varieties from Japan, 13 varieties from Barbados and Reunion (via France), and 10 varieties from Vietnam. These were the first imports from RIDESA (a consortium of Brazilian Universities), Japan, and Vietnam under new exchange agreements.
- New industry-agreed economic weightings for trait selection were introduced into the breeding program.
- A project analysing mill data in the Herbert River area identified many factors affecting productivity including adoption of new varieties, modern farming technologies, use of clean seed, and management of soil borne diseases. Recommendations from this research have been implemented by local advisory groups to design targeted extension strategies with the region, in order to increase productivity.

Meringa
Crossing Shed

Years 12+

Bulking up, Distribution and Adoption

Local productivity service organisations carry out bulking-up to supply true-to-type material free of systemic diseases for planting (starting as early as 2-3 years before commercial release). Commercial tissue-culture facilities similarly provide planting material according to SRA recommend procedures.

Approval and Release

The selection team annually prepares a list of elite clones for consideration by industry – these must meet biosecurity thresholds. Regional Variety Committees (RVCs) review each clone's performance in SRA trials using a combination of individual productivity traits, $ return to industry, disease information, ratoonability, milling qualities, etc. The RVCs select and approve new varieties for commercial release within each region, with approximately **3** new SRA varieties released every 5 years for each region across the Australian sugar industry.

Years 5-12

Final Assessment Trials (FATs)

Approximately **600** clones are tested in FATs across different sites in each of 6 regions. Clones are assessed again on productivity, disease and milling traits. Promising clones are identified to repeat in another series of FATs, to obtain data over multiple sites and multiple harvests. For promising clones, the bulking-up process commences 2 years prior to possible commercial release while still being assessed for productivity, disease and milling traits.

Years 3-5

Clonal Assessment Trials (CATs)

Approximately **10,000** clones selected from seedling families in PATs progress to CATs, propagated and planted at SRA stations and off-site. Selections to proceed to FATs are based on cane yield, CCS and fibre content, and visual assessment. These selections are also sent for smut and Fiji leaf gall virus disease screening.

Years 1–2

Progeny Assessment Trials (PATs)

Approximately **100,000** seedlings germinated from seed are planted and harvested across four SRA stations. Best individuals within the top performing families are selected on cane yield, CCS and fibre content, and visual assessment.

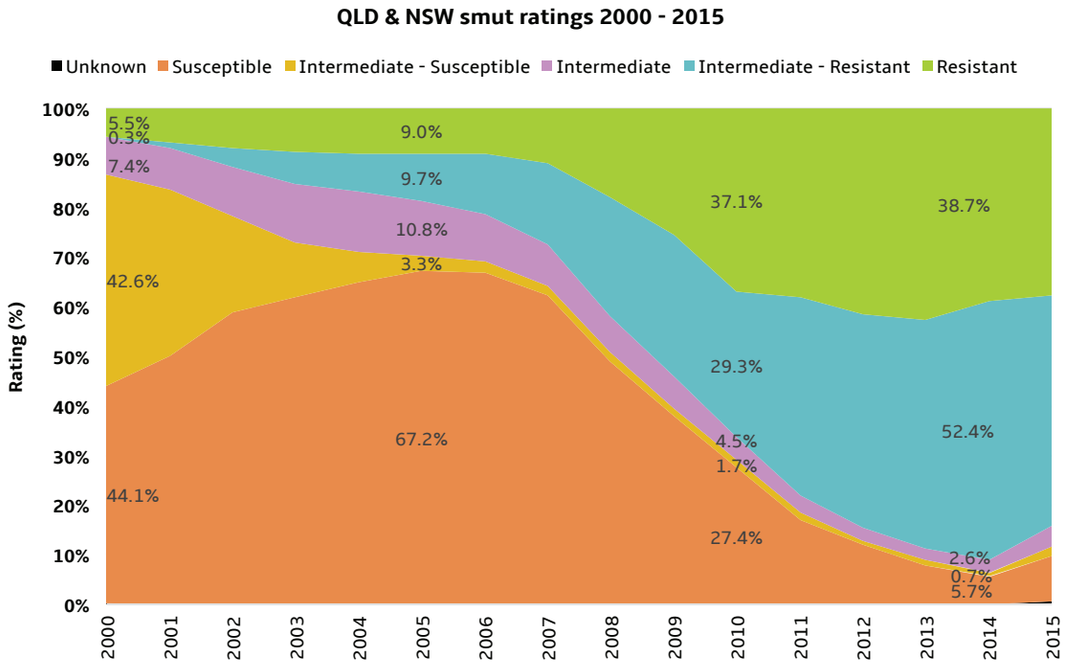
Year 0

Parental Selection and Crossing

2,200 – 2,500 cross combinations are made annually in May/June (1,200 – 1,500 from field crossing) and July-September (1,000 from photoperiod crossing) at the SRA Meringa station from approximately 750 different parents.

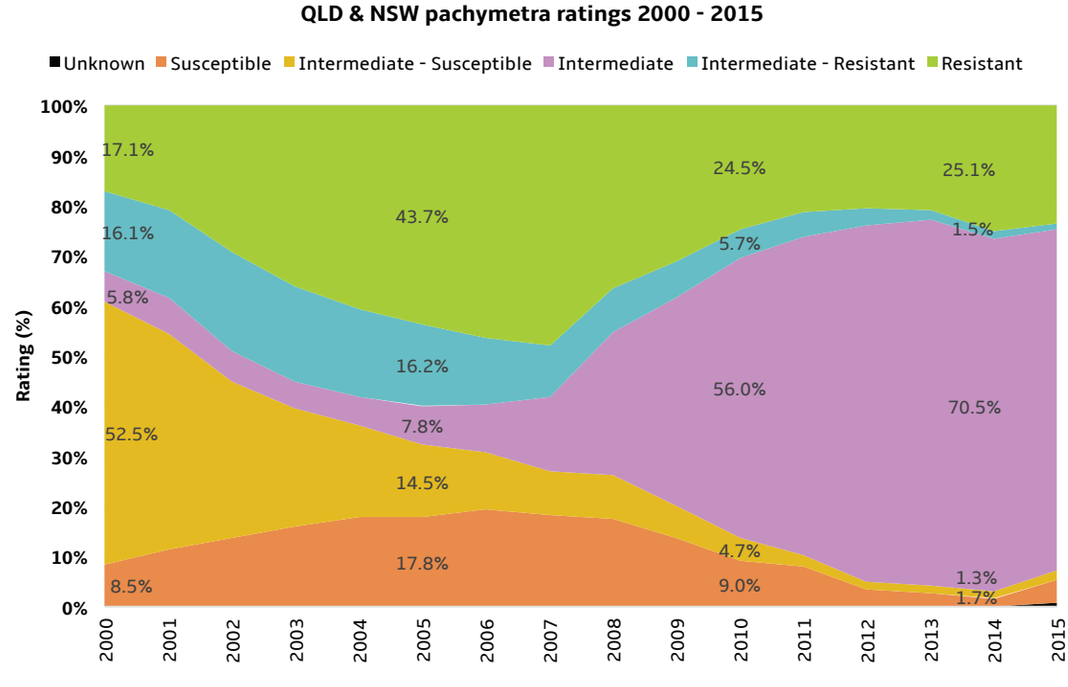
Note that this is a generalised timeline of the SRA crossing and selection process, there are annual variations and variations amongst the regional programs to account for disease limitations, resource availability and environment.

Pests and disease management — New varieties smut disease ratings



There has been an almost complete replacement of smut-susceptible varieties with intermediate-resistance varieties since smut was found in 2006. SRA continues to focus on and contribute to keeping smut susceptibility to a minimum.
Source: Mill Statistics; 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: Mill Statistics; SRA*

- Research on Sugarcane streak mosaic virus (SCSMV), currently being conducted by SRA in Indonesia, has revealed key information that is leading to progress on new diagnostic tests and understanding the transmission of the virus in the field. SCSMV is one of the most threatening diseases facing the Australian industry and the research will help prepare the industry for a possible incursion.

- The Bacterial biocontrol agent, Pasteuria penetrans, has been shown to significantly reduce root knot nematode numbers in naturally infested soil. These results indicate that natural infestations of Pasteuria are limiting the population of root knot nematodes in some sugarcane fields, and may be reducing populations of other widely distributed nematode pests.

- A number of commercial clones have shown resistance to root knot nematodes in a glasshouse trial. This research will be repeated and verified under field conditions in the future.

- Research into sugarcane downy mildew in Papua New Guinea has revealed high pathogen diversity, with the possibility of a new species being discovered.

- SRA, in collaboration with productivity services organisations, commenced a pre-commercialisation study to evaluate a new diagnostic for Ratoon Stunting Disease (RSD). The new assay will significantly reduce costs to productivity services organisations and SRA by a quicker and simpler sampling method, with productivity services organisations potentially saving up to $200,000 per year in sampling costs.

- SRA organised and facilitated an Advanced Pest Management Workshop in Ingham connecting productivity service staff and other advisors with entomological, scientific and agronomical experts.

- SRA contributed to the revised Industry Biosecurity Plan that has been released by Plant Health Australia and endorsed by the industry and by the state and federal governments.

- Analysis of the ability of a SPOT-6 image to detect canegrub damage in the Mackay region was found to be similar to that of the higher resolution but more expensive GeoEye-1 imagery that has been used previously. This cheaper alternative is being evaluated in the Herbert and Mulgrave regions in 2016.

- Following on from the discovery in 2015 by SRA researchers of the causal agent of chlorotic streak disease, researchers established pure cultures of the organism and then used the cultures to re-infect plants using a variety of different methods. This allowed researchers to demonstrate conclusively that the organism is the cause of the disease and thereby presenting an opportunity for future development of rapid screening testing for varietal resistance to chlorotic streak.

- In response to an independent review into soldier fly research, SRA commenced a series of new trials to combat the pest in collaboration with productivity service organisations in Bundaberg, Isis, Maryborough and Mackay regions.

- SRA has constructed a portable rainfall simulator that can be used to measure the run-off following different pesticide or nutrient applications under a set amount of artificial rainfall. Based at Meringa, the simulator will be used in both research and extension activities to minimise off-farm impacts.

Greyback beetle

Yellow Canopy Syndrome

R&D highlights

Research to-date on YCS has ruled out a number of possible causal agents. Research continues to investigate the root cause and evaluate possible future management strategies.

- In November 2015, eight international experts (covering various plant biology disciplines) conducted an independent review of the entire YCS integrated program of research. The project was reviewed favourably by the expert panel and all of their recommendations were incorporated into the current research program.
- A number of possible causes of YCS have largely been ruled out – herbicide application, linear bugs, nutrient deficiency or toxicity, any known sugarcane pathogens and crop age.
- Progress has been made towards an understanding of the effect YCS has on key plant processes such as photosynthesis and sugar transport.
- 10 field trials and numerous pot trials have been established to evaluate causal agents, environmental influences and trigger mechanisms.
- Importantly, the SRA research team has been successful in inducing YCS symptoms in non-affected plants.

Collaboration, engagement & adoption

INTERNATIONAL COLLABORATION

Thailand

SRA signed new variety agreements and renewed its collaborative agreement with Mitr Phol

Vietnam

SRA signed a 10-Year Memorandum of Understanding with the Vietnam Sugar Research Institute for the exchange of genetic material

Indonesia

SRA secured research permits to conduct research on sugarcane mosaic virus

SRA currently has variety exchange agreements in place with more than 15 countries

Brazil

Ongoing collaboration with Brazil's University of Campinas has identified commercially useful genes and germplasm for shortening sugarcane crop cycles

China

Ongoing collaboration with Yunnan Sugarcane Research Institute on trait development and germplasm exchange including improving yield in water-limited environments

USA

A new variety agreement has been signed with the USDA Canal Point and Houma

India

A new research partnership was established with the Indian Sugarcane Breeding Institute (SBI), opening up substantial opportunities for variety and germplasm development with the SBI having the largest sugarcane germplasm collection in the world. The partnership is supported by funding under the Commonwealth Government's Australia-India Strategic Research Fund, which will enable SRA to work with SBI over the coming years to identify genetic markets in sugarcane varieties.

NATIONAL COLLABORATION

Private

SRA partners with both international and Australian private chemical and agribusiness companies in the area of pest management

Cross-sectoral

SRA collaborates with other Research and Development Corporations on:

- Plant biosecurity
- Soils
- Nitrogen-use efficiency
- Novel fertilisers and feeds
- Harvest losses
- Climate change and managing climate variability
- Seasonal forecasting
- Water use in agriculture
- Smarter irrigation for profit
- Precision agriculture
- Biofuels and bioenergy
- Biorefineries for higher-value animal feed, chemicals and fuel
- Targeted and practical extension services and stimulating private sector extension

AWI Australian Wool Innovation Limited · Wine Australia · Dairy Australia · LiveCorp · Australian Pork · AMPC

Rural Industries Research & Development Corporation · Forest & Wood Products Australia – Knowledge for a sustainable Australia · Horticulture Innovation Australia · FRDC Fisheries Research & Development Corporation

mla Meat & Livestock Australia · GRDC Grains Research & Development Corporation · Australian Government Cotton Research and Development Corporation · Australian Egg Corporation Limited

SRA partners with over **30** research and extension providers!

Including CSIRO, universities and productivity service organisations

University of Southern Queensland · CSIRO · QUT · The University of Queensland Australia

SRA ENGAGEMENT

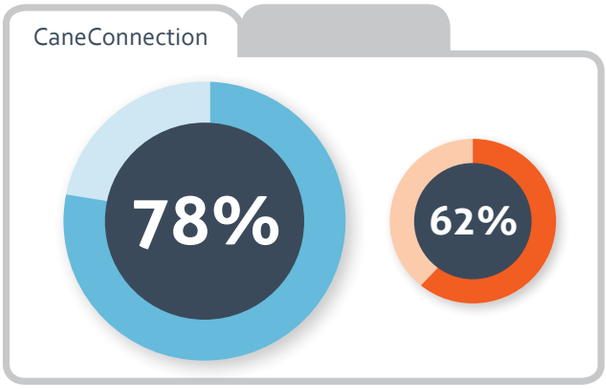
SRA publications

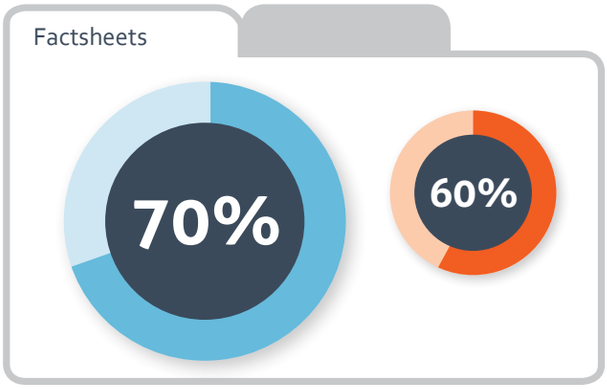
SRA products and services were rated highly by growers for the second consecutive year at **3.7/5**

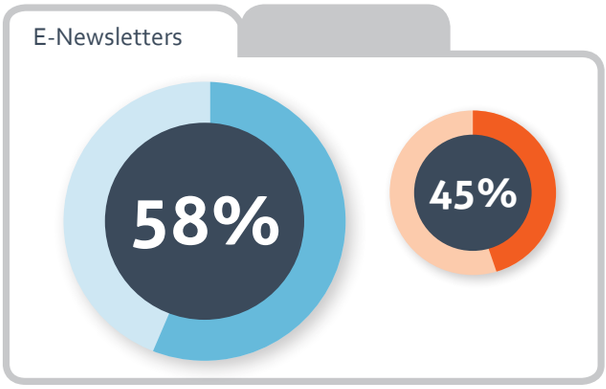
2	2	17	3	4	4
Guides/Manuals published	MillingMatters	E-newsletters	Variety Updates	CaneConnection	YCS Updates

On average, growers accessed between **4 and 5** SRA information products in 2015/16, and a number of products were accessed significantly more than the previous year, including:

2015/16 2014/15







SRA events and activities

SRA Research Forums	4
Milling Research Seminars	5
Sugar Quality workshop	1
Milling webinar	2
Introductory harvesting workshops	10
Harvesting Forums	7
Introductory sugar advisor workshop	1

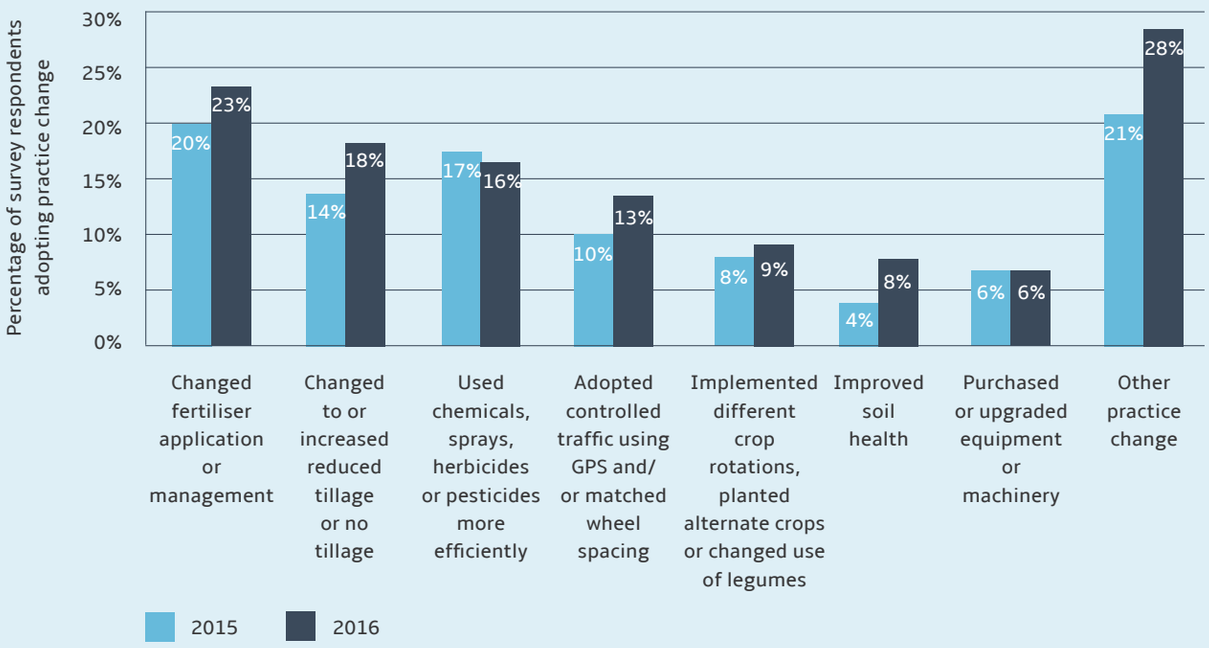
Harvesting operators and service supplier meetings	4
SIX EASY STEPS™ nutrient refresher workshops	7
SIX EASY STEPS™ nutrient workshops	3
Herbicide workshops	4
BMP training	23
BMP advisor updates	9
Advanced pest Management Workshop	1

ADOPTION

Practice change

"SRA continues to encourage practice change among growers and survey data reveals the information products and services developed are having an impact"[1].

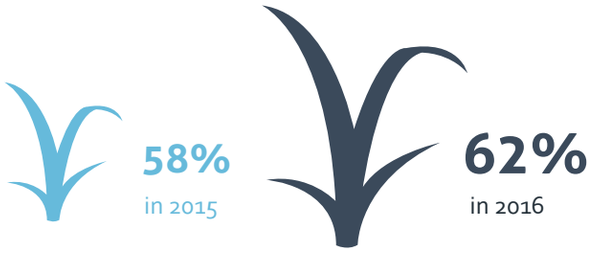
Practice change adoption over the last 2 years



According to SRA's 2016 Grower Survey, the main areas of practice change are illustrated in the graph above. Changing fertiliser application or management remains the most mentioned change by percentage. Notably, 'improved soil health' increased substantially in 2016. 'Other practice change' includes changes to row spacing, irrigation, drainage, mound planting, trash blanketing, precision agriculture and introduced new varieties.

[1] *Down to Earth Research, 2016, Grower Survey 2016 Report for Sugar Research Australia.*

In 2016, **62%** of growers stated that they changed farming practices within the last two years – an increase from **58%** in the 2015 survey



Changed farming practices over past 2 years **by region**

Year	Southern	Central	NSW*	Herbert	Burdekin	Far North
2015	53%	54%	43%	72%	65%	58%
2016	66%	59%	24%	72%	78%	56%

**Note: Small sub-sample*

Changed farming practices over past 2 years **by farm size**

Year	Small	Medium	Large	Extra large
2015	56%	54%	57%	65%
2016	60%	51%	65%	71%

Practice change is significantly more likely to have occurred amongst farms producing large (7,001-14,000) or extra-large (>14,000) tonnages relative to their smaller counterparts

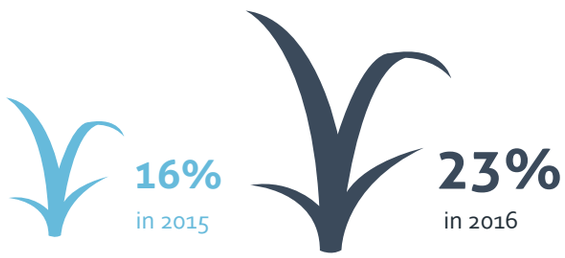
Survey results confirm Precision Agriculture methods are more likely to be used on larger farms

81% of younger growers (aged 18-39) changed practices over the past two years, significantly higher than those aged 40-59 (64%)

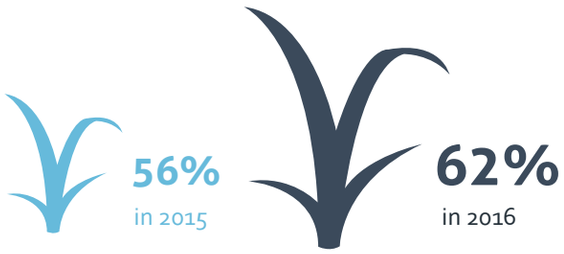
93% of grower survey respondents planted a new variety within the last two years

Use of SIX EASY STEPS™

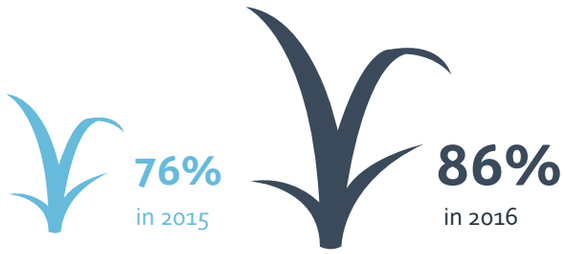
Use of Block Yield Potential



Applying mill mud



Reduced tillage



ADOPTION

Examples from the field

SRA's Advanced Pest Management Workshop participant Clare Gersch from Mackay Productivity Services (MAPS) says that her highlight of the workshop was working through a number of canegrub scenarios.

"I got a lot out of this activity where we were given a number of scenarios and we had to work through and identify all the considerations we need to take into account in making canegrub management decisions", Clare said.

"I'm now much more confident in talking through management options with my growers, especially when making a risk-based decision based on monitoring and risk of infestation. Strategic application of insecticide based on risk, rather than blanket application across a farm even if there is a low risk of infestation is important".

Clare Gersch
Mackay Productivity Services (MAPS)

Greg Shannon
Tully Sugar

Greg Shannon, from Tully Sugar, who works closely with SRA's variety adoption team says "The new varieties now available to the industry are of a high standard and there are a lot of choices to be made for adoption."

"We see it as important to work with SRA and the whole value chain to fine tune the recommendations by adding local knowledge gained though the Tully Variety Management Group."

"In this way growers can make informed decisions and adoption can be achieved as quickly as possible according to local conditions".

Southern region growers Mitch and Tony Chapman farm at Bundaberg and have had extensive interaction with SRA researchers and its Adoption Group.

"I appreciate the support I receive from SRA to evaluate new and improved practices on farm," Tony Chapman said.

"I also value my interaction with the Southern Group, as it allows me to discuss issues with other members of the group and to identify possible solutions."

Mitch and Tony Chapman
Bundaberg

SRA performance rating & review

SRA performance rating: **Fairly high to very high**[1]

Year	Southern	Central	NSW	Herbert	Burdekin	Far North
2015	61%	62%	67%	66%	66%	70%
2016	78%	73%	76%	69%	68%	80%

Since 2015, the proportion of growers rating SRA's performance **fairly high to very high** has risen significantly from **65% to 74%**

Levy paying comfort: **Comfortable to extremely comfortable**[2]

The majority of growers report that they are **comfortable to extremely comfortable** paying the levy, **up 3 per cent** in 2016.

SRA Independent Performance Review

In 2015/16, SRA commissioned its first Independent Performance Review which is a requirement of both SRA's Constitution and the Statutory Funding Agreement (SFA) between SRA and the Commonwealth Government. This comprehensive review is focused on reviewing SRA's performance against the provisions of the SFA and the extent to which the company is delivering benefits to its investors. The review includes consideration of SRA's role as both a research funder and provider and an assessment of SRA's governance; operations; planning and reporting; and interaction with investors and broader stakeholders. The review is expected to be completed in late 2016, with the Report and SRA's response to be published in early 2017.

[1, 2] Down to Earth Research, 2016, Grower Survey 2016 Report for Sugar Research Australia.

Appendix 1: KFA measures

2015/16 Annual Operational Plan Measures	Result	Comments
KFA1: Optimally-adapted varieties, plant breeding and release		
Release of improved varieties, with targeted 3 varieties per 5-year period.	●	5 varieties released in 2015/16 (SRA4ф, 5, 6, 7 and 8).
Percent production from new varieties.	●	Increased for all regions except the Northern region, reflecting the continued preference for Q208ф (which is no longer considered a new variety) in this region.
Rate of genetic gain (TCH, CCS, TSH).	●	190 kg sugar/ha/year (over a 30 year rolling-average).
Weighted average disease ratings for varieties in each region.	●	>89% of crop resistant/moderately resistant to smut, >96% at least intermediate resistance to pachymetra root rot.
Availability of Investment Review documents.	●	Review on investment in molecular breeding, nitrogen-use efficiency and water-use efficiency have been completed and the review findings are currently under consideration of the SRA Board.
Sugarcane Hub accessed by sugarcane breeders.	●	First version developed and access provided to SRA breeders and scientists.
345K SNP chip implementation tested in the breeding program.	●	After further testing, a subset consisting of 40K SNPs were used for evaluating breeding material.
KFA 2: Soil health and nutrient management		
Soil health indicators developed for sustainable sugarcane production.	●	Level of labile carbon and other soil carbon stocks identified as one of the key indicators of soil health and management of pathogen levels. Soil health review recommends that a 'tool box' be developed for use in all regions.
Guidelines, mechanisms and/or varieties identified for increasing nutrient use-efficiency within plant and ratoon crops.	●	Soil health guidelines and workshops delivered. Project underway to develop tools that will rapidly screen varieties in the field for nutrient use efficiency, identify clones useful for breeding high nutrient-use efficiency and better understanding of traits underpinning nutrient-use efficiency and preference of nitrogen supply.
Guidelines and tools developed for better accounting for soil fertility and minimise impacts of nutrients and chemical losses on water quality.	●	Projects aimed at refining nutrient inputs and improving chemical stewardship in progress.
SIX EASY STEPS™ nutrient management program refined for management zones as information becomes available.	●	Refinements to SIX EASY STEPS™ have been proposed and are being evaluated based on performance groups of soil to move industry to finer scale nitrogen management. Research in precision agriculture, working with harvesting and mill data and remote sensing, will assist in identifying variable management zones.
Approval for reuse of mill mud is secured to 2017 so growers and millers have access to low-cost soil treatment and beneficial use of sugar mill by-products.	●	Approval for use of mill mud is secure for immediate future. New research is to be initiated for on-line measurement of nutrient content in mill mud in real-time as well as development of indexes for plant availability and mobility as part of overall risk management and better fertiliser application.
Improved understanding of how climatic conditions influence cane yield potential and crop nitrogen demand in the Wet Tropics.	●	Research underway in the Wet Tropics has identified "performance groups" of soil based on physical and chemical properties and prevailing climatic conditions to model and predict crop nitrogen requirements. Principles being developed will have application in other sugarcane growing regions to better identify climate signal in yield variability.
KFA 3: Pest, disease and weed management		
Industry supported through effective pest, disease and weed diagnostic capabilities and awareness and training programs.	●	Pest management training workshop hosted by SRA completed, targeting industry advisors including resellers, government extension staff and productivity board staff.
Development and adoption of packages for integrated management of key pests, diseases and weeds.	●	Six new chemical actives screened against cane grubs with five promising actives identified for field evaluation. Impact of cover crops as weed suppression tools evaluated with promising outcomes.
Weighted average disease ratings for varieties in each region.	●	>89% of crop resistant/moderately resistant to smut, >96% at least intermediate resistance to pachymetra root rot.
Up-to-date dossiers to support contingency plans to minimise threats and impacts of key exotics.	●	Dossiers reviewed and up to date.
Capability to provide entomology, pathology and weed expertise to meet the pest, disease and weed diagnostic and management needs of the industry.	●	All industry requests dealt with within 48 hours.

76% of measures have been achieved

24% of measures are on track with progress/improvement made but objective not yet fully achieved

0% no measures have failed to be achieved nor significant action is required to reach objective

2015/16 Annual Operational Plan Measures	Result	Comments
KFA 4: Farming systems and production management		
Improved crop performance over longer cropping cycles including developing endophytes to enhance sugarcane varieties.		Research initiated on amelioration strategies for marginal soils, harvest best management practice and endophytes. Soil health review has made key recommendations to develop a resource hub and build extension capability and capacity to improve farming practices over 10 year period.
Better crop management under conditions of water stress (too much and too little).		Differences in varieties' tolerance to waterlogging in both pot and field experiments is currently being assessed. The use of enhanced efficiency fertilisers to improve nutrient-use efficiency, most likely during excessively wet periods, is currently underway.
Adoption of precision agriculture technology and techniques to better predict, monitor and measure crop performance and yield.		Active usage in some areas, slow adoption in others. SRA working with industry advisors to develop collaborative industry adoption strategy.
Adoption of harvesting best-practice.		Workshops and harvesting forums were conducted from Meringa to Broadwater covering majority of the 35 million tonne for the Australian sugar industry, updating industry on harvesting best outcomes and current and past research. Currently SRA is conducting harvesting demonstration trials in Isis/ Maryborough, Tully, Innisfail, NSW, and the Herbert district. These trials are being conducted from August 2016 until the end of harvest season.
KFA 5: Milling efficiency and technology		
Adoption of improved or novel milling processes and technology.		Adoption measurement and monitoring yet to be established. Project in progress to develop a blueprint for the introduction of new processing technologies that may provide options for measuring new technology adoption in mills.
Financial analysis to demonstrate benefits of technology adoption.		Project developing a blueprint for introducing new processing technologies will begin this process.
KFA 6: Product diversification and value addition		
Identification of new opportunities in product diversification and innovation.		Some technologies identified and feasibility tested, but remains low industry priority. Current emphasis is on biorefining and producing value adding materials from residual fibre.
KFA 7: Knowledge and technology transfer and adoption		
Joint planning of research translation and extension programs with other stakeholders.		Regional groups formed with representatives from growing, milling, productivity services, contracting and SRA Delegates.
Effective delivery of extension messages, as demonstrated through research uptake and practice change.		Ongoing publication, communication and adoption activities for new R&D however adoption uptake remains low in some sectors of the industry. SRA is working with industry advisors to develop a collaborative industry adoption strategy.
Increased awareness of technological innovations, locally and internationally.		Practical manuals, guidelines, webinars and factsheets released. Papers published in industry journals and presented to national and international conferences.
Research outputs' key RD&E messages are promoted in a timely manner through various channels.		Regular promotion of research outputs via SRA and industry communication tools and channels.
Increased support for and participation in SRA delivery networks, events and extension programs.		SRA has increased its participation in and facilitation of events across all production regions that are targeted towards improved adoption, focusing on regional needs and specific target areas (for example, targeted programs for improving harvest best practice).
KFA 8: Capability development, attraction and retention		
SRA participation and investment in relevant collaborative and cross-sectoral RD&E programs.		Participation in numerous programs, e.g.: Rural R&D for Profit projects and cross-sectoral programs on climate change, soils, water use, plant biosecurity, and biofuels and bioenergy.
Increased availability of skilled industry personnel.		Scholarship, training and adoption programs provided.
Development and uptake of new and existing knowledge transfer or training programs or resources.		Various adoption programs, guidelines and tools developed.
Scholarships awarded to current and future industry participants.		Scholarship, grant and support programs provided.

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
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ACIAR	Australian Centre for International Agricultural Research
APSIM	Agricultural Production Systems sIMulator
AUD	Australian Dollar
b	Billion
BCR	Benefit Cost Ratio
BMP	Best Management Practice
BSES	Bureau of Sugar Experiment Stations
CAT	Clonal Assessment Trial
CCS	Commercial Cane Sugar
DAF	Queensland Department of Agriculture and Fisheries
DSS	Decision Support System
DNA	Deoxyribonucleic Acid
EHP	Department of Environment and Heritage Protection
FAT	Final Assessment Trial
GM	Genetically Modified
GXAAS	Guangxi Academy of Agricultural Sciences
ha	Hectares
HCPSL	Herbert Cane Productivity Services Limited
IDM	Integrated Disease Management
KFAs	Key Focus Areas
kg	Kilograms
m	Million
MAPS	Mackay Area Productivity Services
MoU	Memorandum of Understanding
Mt	Million Tonnes
N/A	Not Available
NIR	Near-Infra-Red
NPV	Net Present Value
NSW	New South Wales

Abbreviation	In full
NUE	Nitrogen Use Efficiency
NZ	New Zealand
PA	Precision Agriculture
PAT	Progeny Assessment Trial
QLD	Queensland
QUT	Queensland University of Technology
R&D	Research and Development
RD&E	Research, Development and Extension
RIDESA	Rede Interuniversitária o Desenvolvimento do Setor Sucroenergético
RSD	Ratoon Stunting Disease
RTSS	Real-Time Scheduling Software
RVCs	Regional Variety Committees
SBI	Sugarcane Breeding Institute (India)
SCHLOT	Sugarcane Harvesting Logistics Optimisation Tool
SCSMV	Sugarcane streak mosaic virus
SFA	Statutory Funding Agreement
SRA	Sugar Research Australia Limited
SRDC	Sugar Research Development Corporation
t	Tonnes
t/ha	Tonnes per Hectare
TRAIL	Training Rural Australians in Leadership
WUE	Water Use Efficiency
YCS	Yellow Canopy Syndrome

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CaneConnection

Summer 2015

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MillingMatters

Issue 4 | 2016

Varieties and plant breeding update

December 2015

Sugar Research Australia™

An introduction to *Varieties and plant breeding update*

By Dr Peter Allsopp, Executive Manager, Development

Welcome to the first edition of the *Varieties and plant breeding update*. This newsletter has been created to bring you the latest information about the SRA breeding program and SRA varieties. For both growers and millers, SRA's work on varieties is a fundamental foundation of helping to build a profitable and productive Australian sugarcane industry.

Following the formation of SRA in 2013, we have worked with the industry to identify your priorities for investment of your levy. That feedback confirmed the development of optimally adapted varieties as one of our eight Key Focus Areas (KFAs) of investment for SRA. The SRA plant breeding program is the single biggest area of investment across SRA and we have set high benchmarks for measuring our performance.

Our goal is to release at least three varieties in each five-year period for each region, to increase the percentage of production from new varieties, and to increase the rate of genetic gain in relation to cane yield, CCS, and sugar yield. We also continue to improve the resistance of varieties to each region's diseases – more than 90 percent of the crop is resistant to smut and 97 percent of the crop has at least intermediate resistance to pachymetra root rot.

SRA's recent grower survey also confirmed variety development and improvement as a top priority for the industry into the future. The survey found that the area planted to new varieties is about 38 percent of all cropping hectares, and new varieties have been grown by 93 percent of respondents at some time in the last five years.

However, we know that there is scope to continually produce improved varieties at a lower cost and we are continuing R&D and working with industry on improvements.

We have also seen this season that when the right varieties combine with good management and some luck from the weather, then there is potential for some impressive cane [illegible] have boasted impressive

We have already started this process already with the release earlier this year of the first SRA-branded varieties, SRA1[©], SRA2[©], and SRA3[©]. This work will continue, and this newsletter is focussed on keeping you informed about these activities.

SRA announces new staff appointments in the Herbert region

SRA has started improvements to the sugarcane plant breeding program in the Herbert with the appointment of two new staff in Ingham.

The appointments follow the recommendations of a review into SRA's plant breeding activities in the Herbert, with one of the recommendations being the appointment of additional staff to assist with SRA's work in this area.

SRA announces the appointment of Andrea Bryan as farm manager for SRA's Herbert station and new planting breeding technician, Melanie Adams. They join the current Herbert SRA team of Heidi Clements, Fulvio Gori, Vince Blanco, Glen Park, Megan Zahmel, and Phil Patané, with the breeding program overseen by SRA breeder Dr Felicity Atkin (Meringa).

The appointments are a response to increased workload in the variety selection program and the new staff form part of the bigger picture of improving the Herbert plant breeding program.

Farm manager Andrea Bryan will have responsibility to manage the SRA farm operations on station plus provide farm services for SRA research trials including those off-station. Andrea was a breeding technician at SRA Meringa, and she has a strong background in all facets of breeding. She has also acted in the role of farm manager at Meringa.

Plant-breeding technician Melanie Adams is a Herbert local whose family has been heavily involved in the cane industry. Melanie holds a science degree in plant biology from James Cook University and has been working as an ecologist. She comes with great skills in conducting detailed field observations and data collection, which are skills that are vital to successful screening of potential new varieties.

YCS update

December 2015

YCS research effort focused on answers

By Professor John Lovett, Chair, Scientific Reference Panel

In November, researchers working on the Yellow Canopy Syndrome (YCS) research program met for an annual review meeting to progress the collective effort being devoted to solving this problem facing the Australian sugarcane industry.

There are more than 30 researchers working on YCS in some capacity, approaching the problem from different angles and across four projects in multiple locations.

Therefore, these meetings are vital to ensure that the researchers are all moving in the same direction toward common goal of solving YCS.

This work ranges from diverse activities that include f… in local regions in collaboration with productivity ser… organisations, to high-end scientific analysis at the… of Western Sydney, and to further technical work … laboratories in Brisbane.

The meeting is also vital for the Scientific Refer… comprising myself, Dr Geoff Inman-Bamber, P… Helens and Professor André Drenth – to und… progress that has been made and continue t… research toward the goal of understanding …

This year's meeting was also strengthene… a panel of eight scientific experts, who v… ideas and discussion regarding the YCS … the story on page three).

The Expert Panel provided some ve… scientists working on YCS, and the … providing recommendations to th… future directions of the research.

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CaneConnection

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p04 Alternatives to diuron in the Wet Tropics

p12 ABARES survey reveals financial performance

p18 New RSD sampling and analysis method

Varieties and plant breeding update

March 2016

Kind season helps boost CCS levels

Bundaberg grower **John Bonaventura** recorded a peak CCS of 19 in 2015 in Q208[18].

"I really want to see how they perform on my conditions and my soils," he said.

Mr Bonaventura farms a mix of soils including red forest, grey forest and clay and has a strong emphasis on green cane harvesting and making sure he is on top of pests such as army worms.

SRA2[21], Q252[18] and SRA1[20] on display at a Bundaberg field day last year. Mr Bonaventura said he plans to plant a small area to SRA1[20] and SRA2[20] in 2016.

New leadership for SRA breeding program

SRA has announced the appointment of Dr Bert Collard to lead the sugarcane industry's plant breeding program. He is based at SRA Meringa.

The SRA breeding program is the single biggest area of research investment that SRA makes on behalf of SRA investors, delivering new and improved varieties that are suited to local regions and that meet the requirements of growers and millers.

Dr Collard fills the leadership role in this Key Focus Area following the retirement of Dr Mike Cox in 2015.

Dr Collard's PhD involved plant breeding, pathology and genetics and he completed his Bachelor of Science majoring in Biotechnology and Botany at the University of Melbourne. Prior to taking on this role with SRA, he was a Senior Scientist in the Plant Breeding, Genetics and Biotechnology (PBGB) area at the International Rice Research Institute (IRRI), Los Banos in the Philippines. He formerly held the position of durum wheat breeder/program leader in the NSW DPI.

A full profile on Dr Collard will be published in the winter plant breeding and varieties update.

Precision Agriculture for the Sugarcane Industry

YCS update

March 2016

Response to YCS program review

The panel reported that, for on-going management of YCS research effort, SRA's Scientific Reference Panel continues to have a significant role to play, by providing excellent input into the YCS Integrated research program.

The independent panel also made other recommendations which were considered by a meeting of the SRP with senior SRA Management in January. These are:

- Increase focus on a systematic approach to determine whether a biotic agent (pest and/or pathogen) is the cause, focusing particularly on plant physiology and entomology;
- examine the association of water stress with YCS;
- multiple approaches need to be investigated to develop a "clean cane source" – a key issue has been whether a cane supply currently not displaying YCS symptoms is, in fact, already affected by YCS;
- the information collected so far needs sophisticated evaluation;
- more effort is needed to develop a way of diagnosing YCS in a reliable way, and
- SRA breeding teams need to evaluate potential varietal responses to YCS across their existing trials.

The YCS IRP is a collaborative process, involving four major research projects (two at SRA, one at CSIRO and another at Western Sydney University). It also enlists the help of laboratories and scientists around Australia and internationally.

As well as a gigantic effort in the lab, there are also numerous field and pot trials occurring in strong collaboration with growers and productivity services organisations.

These include four field trials and two pot trials in the Burdekin, at Ingham there are insect, soil biology and a YCS management trial; and there are also YCS management trials at Mackay, Proserpine and Mulgrave near Cairns.

You can read more about this work within this YCS update or otherwise contact SRA's YCS Adoption Officer, Belinda Billing, on bbilling@sugarresearch.com.au or 4783 8602.

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Annual Operational Plan 2015-16

Annual Report 2015–16

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