

CanecONNECTION

Summer 2018

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(Cover page) SRA Meringa Farm Manager Jeff Smith (pictured here with SRA Variety Officer Rhylee Pendrigh) is retiring from SRA after more than 45 years working for SRA and BSES before that. He is currently SRA's longest-serving employee and has made an immense contribution to the Australian sugarcane industry, both locally at Meringa, and across the regions through mentoring other farm managers and staff. We thank Jeff for his service and wish him all the best in his retirement.

Design: Catherine Jorissen, SRA.

Welcome to the Summer 2018 edition of *CaneCONNECTION*

The harvest has wrapped on another season and the machines are now tucked away in the shed, but before they were, a group of growers and millers from the Herbert made the trip to Rocky Point and Childers to talk harvesting efficiency. You can read more about this trip and what the group heard from pages 10-14. Harvesting optimisation continues to be a hot topic across the industry and you'll be hearing more about some of the outcomes from the 2018 field trials in the next edition of *CaneConnection* early in 2019.

In this issue we also talk to Tully grower David Singh about Smartcane BMP adoption and its economic benefits, we visit Far North Queensland growers working in the Cane to Creek project, and we learn how the Rocky Point region is having SIX EASY STEPS guidelines developed.

This edition is also looking at three of the major projects that form part of SRA's soil health program of investment. This program spans multiple projects and represents a long-term commitment from SRA to bridge the gap between soil health, profitability and sustainability. We have a closer look at projects occurring within SRA and CSIRO.

This edition also explains the outcomes of a research workshop looking at fibre quality measurements in the industry. You can read more about this on page 30.

Brad Pfeffer

Executive Manager, Communications

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\$74 million

The potential increase in shared industry revenue by adopting harvesting best practice recommendations

Page 10



\$107

The improved operating return per hectare, per year, for David Singh, through the adoption of improved farming practices

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By the numbers

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The number of soil pits dug as part of work underway to develop SIX EASY STEPS guidelines for Rocky Point

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The number of organisations involved in a collaboration to sequence the sugarcane genome

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The number of fungicides being looked at as part of pineapple sett rot demonstration near Tully

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SRA welcomes Mr Peter Russo and Mr Sam Bonanno to Board of Directors

SRA has announced the appointment of two new Board members and the re-election of two existing Directors at its Annual General Meeting (AGM) in Brisbane.

Mr Peter Russo and Mr Sam Bonanno join the Board alongside existing Directors Dr Ron Swindells (Chairman), Mr Steve Guazzo, Dr Helen Garnett, Ms Lindy Hyam, and Dr Guy Roth.

Dr Ron Swindells and Dr Guy Roth were re-elected to the Board at the AGM.

The Board recommendations were made by an independent Director Selection Committee (DSC), which was led by independent Chair Ms Kathryn Adams and included sugarcane milling representatives Mr John Pratt (Wilmar

Sugar) and Mr Stewart Norton (MSF Sugar), and sugarcane growing representatives Mr Paul Schembri and Mr Allan Dingle. The recommendations of the DSC were accepted by SRA Members at the SRA AGM.

New Director Mr Peter Russo has over 40 years of experience in sugarcane growing and milling.

Working in a farming partnership with his two sons in the Childers region, he is knowledgeable in all aspects of sugarcane farming and is particularly passionate about the adoption of innovative practices ranging from irrigation to land management to harvesting. He is Chairman of the Board at the Isis Central Sugar Mill and has served on the Board since 1990.

New Director Mr Sam Bonanno is an independent management consultant with more than 35 years' experience in ports, logistics, infrastructure and mining operations in Australia and overseas. His experience has encompassed strategic planning and implementation, commercial negotiations, business planning, operations management, asset management, project management, materials processing and bulk supply chain management.

SRA Chairman Dr Ron Swindells welcomed Mr Russo and Mr Bonanno to the Board.

"Both of our new Directors bring specific and valuable expertise to the Board and they will assist SRA to continue to deliver productivity, profitability and sustainability outcomes for growers and millers," Dr Swindells said. ■



BMP adoption delivering outcomes at Tully

THE SINGH FAMILY GROW CANE AND BANANAS ON JUST OVER 830 HECTARES SOUTH OF TULLY. THEY HAVE FOUND THE ADOPTION OF SMARTCANE BMP HAS ADDED TO THEIR PROFITABILITY AND SUSTAINABILITY.

Tully grower David Singh was already experienced with record keeping through growing bananas alongside his sugarcane.

So when he started his transition to improved farming practices over the last two decades (well before the Smartcane BMP program was initiated) he found that it was a relatively easy transition toward Smartcane Best Management Practice (BMP) accreditation.

He had seen the economic benefit and importance of improving farm practices that aligned with BMP, so he said the record keeping was just the extra step that he needed to become BMP accredited.

He said that, for him, BMP adoption wasn't just about profitability, but also setting the record straight about the industry's commitment to sustainable farming.

"Whatever type of business you are in, things are changing all the time," David said. "BMP is a way of staying a step ahead of things. Demonstrating our commitment to sustainability may be more important in the future with sugar marketing as well, and also for maintaining the industry's social licence."

The Singh family farm just over 750 hectares of sugarcane in the Kennedy area (830ha total), south of Tully. Changes to the farming system have included shifting from 1.58 metre to 1.8 metre row spacings, GPS guidance, reduced tillage, substantial improvements to drainage, reducing the use of some chemicals (while maintaining weed control) and using a variable rate spray controller.

They use mill mud, follow the SIX EASY STEPS nutrient management guidelines and also vary their lime rate between fallow blocks. Fallow ranges between 10 percent to about 18 percent of their area, depending on the year and conditions.

They are also planning to start their own harvesting in 2019.

The Singh family's transition towards Smartcane BMP has been the subject of an economic analysis by the Queensland Department of Agriculture and Fisheries, as part of an SRA-funded project called *Measuring the profitability and environmental implications when growers transition to Best Management Practice*. The project looked at six very different farming businesses across the Herbert and Far North Queensland, several of

which you may have already read about in previous issues of CaneConnection.

For the Singh family, the analysis found that the cost of the improved practices within the study was \$967/hectare, which included, in particular, gradual laser levelling and earthworks as blocks moved through the crop cycle.

The analysis assumed that yield stayed the same over the production cycle and, even in that scenario, it indicated that the farm's operating return increased by \$107/ha/year, mostly through reduced labour and input costs.

David said, however, that he felt that the returns were even higher than this, because of the improved yield over the crop cycle that came with adopting practices in line with BMP and the modern farming system.

An environmental analysis, completed with the help of an organisation called Lifecycles, shows that the changes have also resulted in:

- 370kg less pesticide active ingredients (52 percent decrease) and 434kg less eutrophying substances (nitrogen and phosphorous)



potentially being lost to waterways annually

- Annual fossil fuel use reduced by 10 percent (or 35 tonnes of oil equivalent over the crop cycle)
- Greenhouse gas emissions reduced by 7 percent annually (equivalent to taking 56 cars off the road each year).

Lower operating costs through BMP adoption included fertiliser and ameliorant, fuel, oil and labour, herbicide and insecticide costs. This was partially offset by higher capital goods costs, laser levelling and drainage maintenance (David undertook earthworks and installed underground pipes and spoon drains).

David added that improved farming practices, along with careful variety selection, was also helping getting more ratoons in the crop cycle, which was adding to overall profitability.

“We’re averaging about five ratoons now, whereas before the average was closer to three and a half. A big part of that has been with the controlled traffic,” he said.

His main varieties are Q208[®] and Q200[®], but he said newer varieties that are working well for him included Q253[®] and Q252[®] (in some conditions). He is also starting out with the new variety SRA7[®] to see how it performs.

This year – like most parts of the industry – has seen excellent harvesting conditions, but dry weather for trying to establish next year’s crop. He said the higher CCS in 2018 would go a small way to helping with the pressure being applied via the low sugar price. ■

DAF’s Farm Economic Analysis Tool (FEAT) is a free online tool to help growers consider the economics of their farming business. To access FEAT and explanatory resources, visit www.daf.qld.gov.au/plants/field-crops-and-pastures/sugar/farm-economic-analysis-tool.

The six project case studies can be downloaded from www.publications.qld.gov.au/dataset/sugarcane-economics

SRA acknowledges the funding contribution from the Queensland Department of Agriculture and Fisheries towards this research activity.

Improved farming practices, along with careful variety selection, was also helping getting more ratoons in the crop cycle, which was adding to overall profitability.

(Over page) Tully grower David Singh. (Above left) David Singh and Tully Sugar Cane Productivity and Development Manager, Greg Shannon, checking one of the variety plots on David’s farm. The plot contributes to the work of the Tully Sugar-led Tully Variety Management Group. (Above right) Talking varieties and BMP adoption on-farm.



This sort of real monitoring – as opposed to modelling – is being accepted by growers. Monitoring can't just be done in a small snapshot of time. It has to be done over a series of years so that we can develop numbers that apply to each and every one of our differing wet seasons, and then we can relate that to what happened in the harvesting season prior to that, then through the growing season, and then the wet season. We can then get a set of figures that relates to that practice over that period.

PAUL GREGORY



Farmers always want to know what's coming off our own farms and whether we can change any of our practices or reduce our costs. So by getting a trial done and trying out different practices you can find out exactly what's coming off your farm. Farmers learn more on their own farm. It reinforces what we've learnt in the workshops, seen in the training, and read in the magazines. That way we are reducing our nitrogen and learning a bit more about our own soils.

GLEN ANDERSON

It's interesting to learn the real facts of what is actually coming out of our fields. As we get more data, we can continue to modify our practices, and then we can know that we're stopping run-off of nutrients into the waterways. The only way we're going to do that is to do this work with Cane to Creek, getting some real data, sitting down, having a look at it. SRA is doing a good job of doing that by implementing this project, and from here we can educate everybody where we're going with it because we are in a pretty sensitive area. We want to save the reef as well, like everybody else.

LEN PARISI



Looking at the big picture with water quality

A GROUP OF WET TROPICS SUGARCANE GROWERS IS WORKING WITH SRA AND THE LOCAL COMMUNITY TO EXAMINE THE LINKS BETWEEN SUGARCANE FARMING AND WATER QUALITY. THEY ARE LOOKING CLOSELY AT WHAT IS HAPPENING IN THEIR PADDOCKS AND LOCAL WATERWAYS TO IMPROVE OUR UNDERSTANDING OF THE SITUATION.

Sugarcane growers in the Russell and Mulgrave catchments of Far North Queensland are shedding light on the complex relationship between sugarcane farming and water quality, via a project called Cane to Creek.

This project first began as a pilot in the Fig Tree Creek catchment in 2016 when growers there identified that they wanted to better understand the link between farm practices, activity in the catchment, and water quality.

Today, the project has expanded through investment from the Queensland Government Department of Environment and Science, and is working with about 12 core growers and a further 30 who regularly attend events related to the project.

"The Cane to Creek Project is about refining nutrient management and also helping to break down some of the barriers between growers and water quality science," explained SRA Adoption Officer Gavin Rodman, who is working on the project with SRA Principal Researcher for Water Quality, Belinda Billing, and Technician Chris Sterling.

"Within the project we have 10 demonstration sites looking at nutrient management practices. These include placement of nutrients, such as sub-surface versus surface application, as well as looking at things like mill mud and mill ash applications, and our plant cane crops after a legume fallow.

"When we started talking to growers who were very interested to become involved, we began with a nutrient management plan to identify whether there were any opportunities to refine their nutrient management.

"We found that in plant cane, accounting for nutrients from other sources was a really big factor. Seven of our demonstrations are looking at accounting for legume crops or accounting for nitrogen from mill by-products."

The 'creek' aspect of Cane to Creek sees the team focussed on regular water quality monitoring at multiple sites, and is proving to be vital in giving everyone a clear understanding of what is happening in the catchment.

This includes sampling upstream of the cane.

"One of the first questions in the project was 'what's coming out of the rainforest?'," Gavin explained. "An important part of the project is to be higher in the catchment to see what is coming out of that natural system so that when we get to the bottom of the catchment we can see what differences have occurred and what impact some of the farming may have had on that as well."

Across the catchment, the sampling occurs at regular intervals to pinpoint different activities that might be having an impact.

Weekly grab samples taken by the research team plot water quality trends over a long period of time. In addition, the project also has a real-time water quality monitoring trailer, sampling every hour. Despite the challenges of operating complex equipment next to a flood-prone creek, and with solar power in a high-rainfall (and cloud-cover) region, Gavin said the trailer was a vital component of the project.

"If we see a spike in our grab samples we can look at the trailer and see what might have been driving that," he said. "Was

there a change in the stream height? Was rainfall involved? This is important context that we can't get from taking our weekly routine grab samples, and which we couldn't do without the help of the trailer."

When CaneConnection visited and these photos were taken, simple water quality monitoring equipment called KP Samplers were being installed on Glen Anderson's farm at Mount Sophia.

As the wet season sets in, these samplers will be crucial in learning more about the mill mud / ash mixture that was applied on Glen's plant cane, and also the contribution of nitrogen from the legume fallow. The site has also seen a transition to wider rows, with the beans planted on the previous narrower row spacing and the cane now at 1.8 metres.

The trial is looking at a range of different nitrogen rates accounting for the mud / ash and the legume fallow.

Glen Anderson said that the project had already helped inform practice change such as widening rows, zonal tillage, and modifying herbicide application.

"Cane to Creek is helping us see the results of our work and have confidence that we are reducing our expenses and our environmental footprint," Glen said.

"The family has owned this farm for 75 years and we've always swam in these creeks and caught fish here. I have five kids and they've lived in the creeks all their life, too, so we want that to continue to happen in the future. To do that, we want to reduce our environmental footprint and be profitable in doing so."

Gavin said a crucial part of the project was discussion among the group.

"The whole idea around us collecting this water quality information is certainly not around pointing fingers at growers. It is about having a conversation and our growers are actually now discussing this without us being involved. Together, we are identifying opportunities for improvement, and practices that can help with continued improvement, looking at the whole catchment." ■

"Together, we are identifying opportunities for improvement, and practices that can help with continued improvement, looking at the whole catchment." GAVIN RODMAN



Herbert growers and millers head south to learn more on harvest efficiency

A GROUP OF GROWERS AND MILLERS FROM THE HERBERT HAS RECENTLY TRAVELLED TO ROCKY POINT NEAR THE GOLD COAST AND CHILDERS IN THE SOUTHERN REGION TO DISCUSS HARVESTING EFFICIENCY AND OPTIMISATION.

Thanks to an initiative by Sugar Research Australia (SRA) and Wilmar Sugar, the trip saw millers, growers and harvesting contractors in these southern parts of the industry discover how they are adopting practices that are helping them to optimise harvesting efficiency.

The trip was jointly funded through an SRA Travel and Learning Award and Wilmar Sugar.

SRA Adoption Officer for Harvesting, Phil Patane, said that the trip was a chance to visit during the harvest season, which put everything into context for making harvest best practice work.

"Through research and demonstration trials, we know that there is potential to improve harvesting efficiency and therefore put more revenue into the value chain," Mr Patane said.

"From trial results in 2017, it was identified that the industry could potentially obtain a 5.5 percent increase in harvested tonnes with no cane land increase and a \$74 million increase in shared industry revenue if operating at harvesting best practice recommendations.

"However, we also know that optimising harvesting is complex and a range of factors have to be considered. This is why it is so valuable for the group from the

Herbert to engage with their peers in the southern region.

"We are all operating in one Australian industry, but also across a vast geographic distance, so this trip was a rare and valuable opportunity for the millers and growers from the Herbert.

"This was a chance for them to ask questions and consider how their own operation compares."

Ingham grower Paul Marbelli said he had not had the chance to visit the Rocky Point and Childers regions before, so this was a unique opportunity.



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More observations from growers
and harvester operators over page.

"The trip has been interesting to see how other districts are doing things," Mr Marbelli said. "We can't compare everything between regions, as there are unique conditions down here, but it has been interesting to learn how these farmers and contractors are dealing with their situations."

This work adds to existing industry engagement on harvesting efficiency through a project through the Rural R&D for Profit program funded by the Australian Government Department of Agriculture and Water Resources, SRA, and the Queensland Government. ■

"Through research and demonstration trials, we know that there is potential to improve harvesting efficiency and therefore put more revenue into the value chain." PHIL PATANE



Australian Government

(Above) The group at Rocky Point.



OBSERVATIONS FROM THE FIELD

Childers grower and harvesting contractor **Michael Russo** harvests 105,000 tonnes of cane using best practice strategies.

"Some of the main changes have been slowing our ground speed down, changing the parameters on our primary extractor fan and slowing the fan down to suit different field conditions," Michael said.

"This has resulted in much better quality of cane supply going to the mill. For the grower it represents more profit because there's less wastage in the field."

Mr Russo said the changes had resulted in better yields, higher CCS and better ratooning.

Paul Nicol is the Chief Field Officer with the Isis Central Sugar Mill and he said that with the district continuing to face pressure from horticultural crops, the mill wanted to ensure "every stick of cane possible was finding its way into the factory". They also needed to improve ratoon life from two or three ratoons, to at least four, not just for profitability, but also to improve cane supply.

The journey began in 2015 when they manually dissected an average cane bin, and found about 14 percent extraneous matter.

That led to the development of the "clean team" and widespread collaboration to improve harvesting efficiency across the district. This has seen a range of education programs, collaborations with growers, and even initiatives such as subsidising the cost of purchasing after-market chopper drums.

Rocky Point grower and harvester, **Josh Keith**, has done a trial with SRA in 2018 and said he was looking forward to the results to help validate a number of improvements that they had already made.

"We know that there is a line between efficiency and profit, and we need the data from the trials to determine where that line is," Josh said. "There is always a trade-off between hours in the paddock and return from your crop from the mill, and this will tell us where that line is."

"I hope that the data will validate what we are doing, and also serve as a guide for the harvester driver, so that we can know what parameters he should follow with factors such as fan speed and ground speed."

He said with the industry facing uncertainty around the price of sugar and input costs such as fertiliser, he saw that the trials were a way of improving certainty around at least one part of the business.



Herbert grower-contractor **Darren Reinaudo** said growers need hard data from local field trials to determine whether there were financial benefits to changing harvest practices.

"We need to measure the difference between the existing harvesting practices and the recommended best harvesting practices to understand whether the benefits in one area outweigh the costs in another," Mr Reinaudo said.

"We've participated in a trial with SRA and we're looking forward to working through the economic analysis from that trial (conducted by DAF Queensland)."

Mr Reinaudo said economics had been a core driver of current farming and harvesting practices.

"If SRA's data demonstrates that there's a better way, it's important we all work together to improve our situation."

Another Herbert grower and contractor, **Charles Girgenti**, said he was keen to participate in a SRA harvesting trial in order to get some solid data about the potential gains.

"Based on what we learned on the trip, the biggest benefits to growers are better CCS levels and reduced harvesting losses.

"If I can send more tonnes of cane to the mill and get improved CCS, that's a big win." ■

(Over top left) SRA Agricultural Engineer Joe Bonassi, Herbert Regional Operations Manager Adam Douglas, Herbert grower Sam Patane and Rocky Point grower Josh Keith at Mr Keith's farm.

(Over middle left) Rocky Point grower Josh Keith with Rocky Point Productivity Officer Victor Schwenke and Herbert SRA Regional Coordinator Caroline Coppo.

(Over bottom left) Childers grower Jack Russo with Isis Productivity Board member and grower Mark Weiss and Herbert grower Darren Reinaudo.

(Over right) Josh Keith and Darren Reinaudo discuss billet length and quality.

(Top left) Michael Russo (right) talks harvesting optimisation with Herbert growers and millers.

(Top right) Herbert growers Paul Marbelli (left) and Charles Girgenti (centre) spoke with Rocky Point harvesting contractor Nick Skopp about how he had adjusted his harvesting practices to reduce cane losses in the field.

(Bottom left) Rocky Point grower Josh Keith with Herbert grower Charles Girgenti, SRA Harvesting Best Practice Project Leader Phil Patane, Victoria Mill Production Superintendent Luis Rodriguez and Herbert grower Clay Romano.

(Bottom right) Michael Russo (Dicanna Harvesting) and Paul Nicol (Chief Field Officer, Isis Mill) check out just how good base-cutter blades are for cutting cane, after bolting them to the handle of a cane knife.



A COLLABORATIVE PROJECT SPANNING MULTIPLE INDUSTRIES AND ORGANISATIONS IS LOOKING TO ADD VALUE TO A RANGE OF AGRICULTURAL BY-PRODUCTS, AND BAGASSE IS A MAJOR FOCUS.

Feeding bagasse to livestock is not new. The concept has been experimented with for decades and usually attracts a lot of attention during drought.

However, feeding bagasse to livestock has always faced challenges: bagasse is very high in fibre and livestock can't extract much energy from raw bagasse. Anything more than a few percent of raw bagasse in livestock feed starts to reduce daily weight gains. Even if bagasse is treated with existing technology, it remains a high-fibre product.

And bagasse is by-product; not a waste product. Even though it has higher commercial value in some mills than others, all projects on bagasse value-adding have had to ensure that any new use for bagasse makes economic sense.

A current research project builds on previous SRA investments and is taking the existing value of bagasse into account. It is also exploring the challenges and opportunities to present practical outcomes for adoption by the industry. Importantly, the project is developing ways to improve the digestibility of bagasse and make it into a more complete feed for a wide range of livestock.

COLLABORATION AND DELIVERY

Queensland University of Technology (QUT) Senior Research Fellow Dr Mark Harrison is leading one component of the project and he said that the entire project was focused on delivering practical outcomes.

"Assuming the technical challenges are overcome, we are very interested in where in Queensland and NSW it makes sense to make animal feed from bagasse," Dr Harrison said. "Obviously there is heightened awareness during drought, but long-term development has to align with where livestock are concentrated."

"For example, there could be an opportunity for southern sugar mills to target cattle feedlots on the Darling Downs."



Putting bagasse on the feed menu for livestock

As well as understanding potential markets, Dr Harrison also said the project had been working closely with the fodder industry through the Australian Fodder Industry Association and Feed Central, one of Australia's largest online buying and selling platform for hay, straw, silage, and grain.

"These relationships have been pivotal to the project and over the last 12 months have improved our understanding of where bagasse sits among other fodder sources," he said.

"We started the project benchmarking bagasse against high quality forages like vetch and lucerne, but we now understand that it's difficult for bagasse – raw or treated – to compete against those fodders when there's enough rain to keep fodder production at normal levels.

"So, we are benchmarking against lower quality forages like straw and stubble and looking at the potential role for treated bagasse during drought."

However, one part of the project is taking steps to turn bagasse into a product with similar feed value to high-quality forages.

IMPROVING THE VALUE

Growing microbes on the bagasse is one way to increase its nutritional value as a stockfeed.

"Even when bagasse is pretreated, it is still only adding fibre to the ration," explained QUT Associate Professor, Robert Speight.

"But we are looking at using the bagasse as a food-source for microbes such as fungi and bacteria, and then they do the work of converting that fibre into 'themselves'.

"For livestock, these microbes are a great source of protein and can also add essential nutrients to the bagasse. This can help make the bagasse a more complete feed.

"If we can boost the protein content, then that adds a lot of commercial value to the bagasse."

This part of the project is also investigating the potential of providing the animals with probiotics, which could help them better digest the fermented bagasse, and has already identified several potentially valuable probiotics by searching through the microbes that live in bagasse piles.

It is hoped that these probiotics will work with the existing microbes in the gut of the animal to improve digestion.

The project has begun feeding trials with chickens to assess whether the pro-

biotics are safe. The second feeding trial, which was due to get underway at the time of writing of *CaneConnection*, will add bagasse to the ration to determine the impact of these probiotics on digestion and growth. The long-term goal is to move into sheep, pig, and cattle feeding trials.

UNDERSTANDING THE ANIMAL

Dr Harrison said that this worked linked with another crucial component of the project; establishing a clear picture of bagasse digestion inside animals. Ms Mahsa Abbasabadi, a QUT PhD student, is working closely with the University of Queensland to undertake animal feeding and rumen fluid fermentation trials.

"The project is using cutting-edge genetic technology to identify the way the microbes in the gut change when the animal eats raw, treated, or fermented bagasse. Then, we can look how to grow the right microbes on bagasse so that they work in partnership with the existing gut microbes to extract more energy from the fibre," Dr Harrison said.

FUTURES FORUM

The topic of industry diversification drew significant attention at the industry's Future Forum held in April through facilitation by SRA.

The key message from the forum was that the sugar will remain a core output of our industry, but that diversification is critical to future profitability and sustainability with diversification of revenue streams across food, fuel, energy, and fibre products.

Mackay grower Joe Muscat attended the Futures Forum and was also interviewed by ABC Landline on a segment specific to the research project led by QUT.

Mr Muscat told Landline that the Australian industry needs to look at different end products.

"Relying on one product is hard," Mr Muscat said. "85 percent of what we produce in sugar goes into the world market and that is a very volatile market.

"We need to do more work on adding value to our commodity. With our input costs always increasing, we have to find ways to manage that and keep a profitable business. I see value adding as an opportunity going forward." ■

This project is funded by the Commonwealth Department of Agriculture and Water Resources and SRA as part of the Rural R&D for Profit Program. SRA also acknowledges the funding contribution from the Queensland Department of Agriculture and Fisheries towards this research activity.

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To view the Landline segment on this project visit www.abc.net.au/news/2018-07-29/sugar-spinoff-sugarcane-growers-take-on-their-own/10049548



Australian Government
Department of Agriculture
and Water Resources

(Over page top) QUT Senior Research Fellow Dr Mark Harrison is investigating ways of using bagasse to create higher-value animal feeds. (Over page bottom) SRA CEO Mr Neil Fisher discusses industry value-add opportunities with Mackay district growers Joe and Stephen Muscat.

Engagement and collaboration in action with SIX EASY STEPS

SRA IS WORKING WITH THE LOCAL INDUSTRY AT ROCKY POINT TO DEVELOP SIX EASY STEPS NUTRIENT MANAGEMENT GUIDELINES FOR THE AREA.

Until recently, Rocky Point grower Josh Keith had not heard of the SIX EASY STEPS nutrient management guidelines.

It was only when he attended a local industry workshop that he had the chance to learn more about the industry's guidelines for nutrient management and the work that occurs to ensure the science behind the guidelines is robust and credible.

"I heard about SIX EASY STEPS a second time as we made our way through Smartcane BMP accreditation. I kept hearing that when people use SIX EASY STEPS they are saving money and are more profitable," Josh said. "So, I thought 'that's what I want!'"

Josh then contacted SRA Regional Coordinator for New South Wales and Rocky Point, Sebastian Garcia-Cuenca, to initiate the process of developing guidelines for the Rocky Point district.

Rocky Point is the final district to have SIX EASY STEPS guidelines developed.

As part of that process, some of the SIX EASY STEPS team has been in the region in recent months, digging 11 soil pits and collecting samples on a range of different soil types and conditions. This information will be used to create a soils booklet for the district and the local SIX EASY STEPS nutrient management guidelines for growers.

Following the development of the soils booklet and nutrient management guidelines, events and training for growers will be organised to learn more about the guidelines and how to put them into practice on their own farms.

SRA Principal Technician John Panitz spoke to some of the local growers during this initial field work, and said that the process of developing the guidelines for a district begins by looking at existing soil maps and information, as well as current fertiliser practices, and then moves onto collecting samples.

He added that as the guidelines were developed and introduced to a district, the team also looked to instigate strip trials on growers' farms to validate the findings and ensure that the growers were engaged through the process.

Professor (Farming Systems) with the University of Southern Queensland, Bernard Schroeder, also spoke to growers and he said that the pits were a useful tool for informing the science of nutrient management, and also for having a conversation with growers.

"The pits start a discussion about the soil types in the district, and the samples we collect from these reference sites will also be used in future workshops," Prof Schroeder said. "Rocky Point is a relatively small area, but it contains a similar diversity of soil types to many large districts."

Josh Keith said that growers were very interested in SIX EASY STEPS and having a tool that is backed by science to help them make decisions.

"All the small factors, including managing your nutrients, add up to that extra bit of profit," he said. "This is especially important for us at Rocky Point as we face pressures from issues like sand mining and urban encroachment."

"Through this work from SRA developing guidelines for our district, we will have information to make better management decisions." ■

Growers across the industry can access more information about SIX EASY STEPS for their local district via the SRA website www.sugarresearch.com.au/growers-and-millers/farming-systems/

The SIX EASY STEPS team consists of Bernard Schroeder, John Panitz, Gavin Rodman, Barry Salter, Danielle Skocaj, Eric Kok, Alan Hurney, David Calcino, Andrew Wood, and Zofia Ostatek-Boczynski.

(Above) The team working on developing the guidelines for Rocky Point: Sebastian Garcia-Cuenca, Bernard Schroeder, John Panitz, Victor Schwenke, and Gavin Rodman.

(Over - clockwise from top) Bernard Schroeder explaining the soil type at one of the sites used to develop SIX EASY STEPS guidelines for Rocky Point.

Rocky Point grower Lindsay Mischke and New South Wales SRA Regional Coordinator, Sebastian Garcia-Cuenca.

Sebastian Garcia-Cuenca and Gavin Rodman collecting soil samples.

Managing Director of Rocky Point Mill, David Heck, with Professor Bernard Schroeder (University of Southern Queensland) and SRA Adoption Officer Gavin Rodman.



WHAT IS SIX EASY STEPS?

SIX EASY STEPS is a science-based nutrient management tool that enables the adoption of best practice nutrient management on-farm. It is acknowledged as industry best-practice for nutrient management to optimise productivity and profitability without adversely influencing soil fertility or causing off-farm effects. SRA's participation in this research ensures that the industry has a credible and science-based voice at the table that can inform policy discussions. SRA continues to collaborate with a range of research partners to see SIX EASY STEPS further validated across a range of soil types, farming systems and climatic conditions.

The SIX EASY STEPS to improved nutrient management

1. Knowing and understanding our soils
2. Understanding and managing nutrient processes and losses
3. Soil testing regularly
4. Adopting soil specific fertiliser recommendations
5. Checking on the adequacy of fertiliser inputs
6. Keeping good records and modifying nutrient inputs when and where necessary

The concept of SIX EASY STEPS means combining a number of possible actions to ensure sustainable nutrient usage on the farm. This combination forms a 'whole system' approach to nutrient management.



An information sheet on pineapple sett rot is available under the diseases section of the SRA website. Visit www.sugarresearch.com.au.

Stopping the rot: demo trials delivering local information

A DEMONSTRATION TRIAL IN THE WET TROPICS IS LOOKING AT DIFFERENT FUNGICIDE TREATMENTS FOR PINEAPPLE SETT ROT, TO GIVE GROWERS MORE LOCALISED INFORMATION TO INFORM THE DECISION MAKING PROCESS.

El Arish district farmer Danny Pantovic farms in one of the wettest districts of the industry, so he understands the risk from Pineapple sett rot.

He has seen severe impacts from the disease in the past, and therefore he always ensures that his planting contractor uses a fungicide treatment.

"After it hits, you are always wondering if you should knock the block out, even though it might be young," he said. "I hope for five or six ratoons, but I've had to knock blocks out on the third ratoon when the yield hasn't been there."

Pineapple sett rot is a soil-borne disease and is favoured by conditions that slow germination of cane – cold, wet soil, or excessively dry soil. It gets its name from the smell of freshly split billets, which have an odour like an over-ripe pineapple.

To understand more about the pineapple sett rot, Danny has been working with Tully Sugar Limited (TSL) on a demonstration plot on his farm, assessing three of the registered fungicides that are on the market – Sinkers, Shirtan, and Tilt.

It is important that growers follow the label. For Sinkers, this means using adjuvant. Nufarm suggest Activator at 50ml/100L, but any good quality wetter will suffice.

"I am very interested in these trials and especially to see them in my conditions," Danny said. "There are a few options with treatment, so with Tully Sugar's help this is helping us make more informed decisions."

Cane Productivity and Development Manager for TSL, Greg Shannon, is doing the work in collaboration with Nufarm Australia and planting contractor Gab Camilleri, and Greg said that the work came about because the local industry was keen to learn more about their fungicide options. These demonstrations commenced in 2016.

Greg said that two out of the last three years – both 2016 and 2018 – had been very dry after planting and therefore the risk of pineapple sett rot was low. This means it is still early days for their assessments.

He said the overall conclusion from the last three years was that good billet

coverage with fungicide is essential, no matter what type of fungicide is used.

He said they had also seen the benefit of using a fungicide even when the risk was low. "It also highlights the need to regularly check the spray application nozzles for blockages, which would be the only practical reason a fungicide would not be applied at plant," Greg said.

At the time of writing, the demo had been assessed at 45 days and all treatments were performing well – but again the dry conditions proved less-than-ideal for a fungicide demonstration plot.

Most of the rain gauges at Tully gathered dust from August to October this year.

The cane in these pictures was photographed in early October and had no herbicide applied after planting.

"It has been a cheap crop this year, and there's been nothing to germinate weeds," Danny said. "Here we are in October and this crop hasn't had any residual, 2-4,D, anything."

Another important component of Danny Pantovic's farming system is the use of



a mixed species fallow crop (again with Greg's help) which includes plants such as sunflower, millet, and various legumes. He said he does this to help keep on top of weeds, for the yield benefit, and also because it helps control diseases.

He grows a range of varieties across his 270 hectares, including Q253[®], Q208[®] and Q250[®], as well as having planted out some SRA10[®], SRA6[®], and SRA7[®]. Danny is part of the TSL led Tully Variety Management group, and has hosted variety trials in El Arish since 2014. This year he has planted a trial plot of 4ha of SRA1[®] to test its millability in 2019, as part of the ongoing Tully Variety Management Group work. This will be one of the first blocks of this variety to go through the rollers at the Tully mill as a trial. ■

(Over page) El Arish district farmer Danny Pantovic said on-farm demonstrations were a great way of improving local information and understanding of different farm practices. (Above) Cane Productivity and Development Manager with Tully Sugar, Greg Shannon, discussing results at about 45 days after planting with Danny Pantovic.

PREVENTION AND CONTROL

- Use a registered fungicide to thoroughly cover the sett, particularly the cut ends.
- If possible, plant when weather conditions favour rapid germination and soil temperatures are above 18°C.
- Because pineapple sett rot is carried in the soil, you should try to reduce the number of spores to limit the potential for the disease. You can do this using a rotational crop or fallow period between cane crops. Don't plough out replant because it is an ideal food for the fungus which would only create high numbers of spores in the soil.
- You will increase the chance of germination if you use two or three bud setts. The nodes act as a barrier, which can slow the spread of the fungus in the sett. They also protect the buds sufficiently until they germinate.
- Ensure that base-cutter and chopper box blades on harvesters cutting billets are sharp to give a clean cut and prevent cracking of setts. Rubber coated and synchronising feed-rollers will reduce damage to the rind of setts, which can provide entry points for the fungi.
- Ensure soil has a good tilth and that there is good soil-sett contact – try pressing the rollers to compact the drill after planting.
- If using fungicide dip type planters, ensure the dip tank is cleaned regularly to reduce contamination of the fungicide with dirt.



SRA'S SOIL HEALTH PROJECT BRINGS TOGETHER PEOPLE WITH DIFFERENT SKILLS TO DEVELOP KNOWLEDGE, MATERIALS AND TOOLS THAT WILL ADVANCE THE WAY IMPROVED FARMING SYSTEMS PRACTICES CAN BE IMPLEMENTED. THE INDUSTRY CAN CAPTURE MAJOR PRODUCTIVITY GAINS BY IMPROVING THE HEALTH OF OUR SOILS.

**BY DAVEY OLSEN,
SENIOR RESEARCHER**

Soil health describes the physical, chemical and biological conditions of soil and its capacity to support a profitable and sustainable farm. Soil is the foundation of a healthy and productive sugarcane crop. While cane is a hardy plant, it needs healthy soil to maximise its yield potential across the crop cycle.

Cane soils can deteriorate due to intensive farming practices over several decades with compaction and low levels of organic matter as big contributors.

Soil health relates to the whole farming system and is a consequence of almost all the actions on farm. Science can bridge the gap between soil health and farming systems. As a result of current work underway by SRA and our partners, we are working on tools that will give growers the confidence to adopt practices that improve soil health and overall profitability.

The Sugar Yield Decline Joint Venture (SYDJV) provided sound advice on soil health but the take up of the recommended practices was low. The four main practices were fallow rotation crops and continuous cropping; zonal tillage; controlled traffic; and crop residue/organic matter retention.

To build on the knowledge from the SYDJV, a project was developed to assist sugarcane growers with the adoption of these practices and improve their soils. This five-year project started in 2017 at sites across the Burdekin and Herbert and will validate these practice changes.



**Soil health tools
of the trade**

This data will enable researchers to identify a subset of key soil health indicators that can be used to identify soil constraints and measure soil health. A soil health toolbox of measuring instruments is currently being developed for extension providers and growers so they can make a quick assessment of paddock soil health. This will enable the industry to quickly identify and address soil health constraints such as low pH, sodic horizons, compaction, and low labile carbon as well as understanding the impact of farming practices on soil health.

The project is one of a number which come under the umbrella of the SRA Soil Health Program, a ten year commitment by SRA to invest in and conduct research, development and extension activities into industry soil health constraints and provide solutions to optimise yield and profitability outcomes for growers.

Having an understanding of what a healthy soil is, combined with better testing and measurement tools, will offer advantages in farming sugarcane including delivering yield gains.

The soil health extension kit is comprised of tools with an accompanying instruction manual so the user can compare sustainable management practices, monitor changes in soil health over time and identify soil constraints.

Each kit will contain items such as a pH/EC meter; sodium meter; pocket colorimeter – labile carbon; bulk density rings; water infiltration rings; penetrometer; split soil auger (for roots and sub-soil sampling); and worm sampling rings.

We are currently developing protocols for each instrument to produce instructions on how to use the kit and interpret the results. All of the tools are being used by the research team, and the protocols are being developed and therefore not yet ready for release to industry advisors.

"It's very important to have confidence in the measurements being generated," said Anthony Curro, SRA Regional Coordinator.

The toolbox will be ready for trial by industry advisors by the end of 2018 and will undergo further development and refinement. It is expected the kit in its final form will be released in 2019.

Armed with the kit, growers and extension officers will identify the key soil constraints that are limiting productivity; develop an action plan to fix the problems; modify the farming

system in some way and then check up on the farm to confirm the benefits have been obtained. Extension officers will visit, take a soil sample, and test it on the spot so you can evaluate the soil health and get answers straight way. This also means you don't need to purchase the equipment.

One standout soil health indicator is labile carbon. The team is finalising a protocol of sampling labile carbon in the field which takes 15 minutes. This rapid turnover carbon is a prime food source for soil biology and plays an important role in nutrient cycling, water retention, root health, and soil structure. High labile carbon soils promote a diverse biological ecosystem, which greatly increases the resilience of the soil to act as a buffer against soil borne diseases.

Labile carbon is fertiliser for your soil biology.

It is a sensitive indicator of soil biological health and is rapid and easy to measure.

Labile carbon has fast turnover and it is punching above its weight in terms of contribution to the soil health and crop health.

The good news is that growers can improve the level of labile carbon in their soils. For example, mill mud, particularly applied sub surface, and legume rotational crops have a beneficial effect to labile carbon and positive effects on biology and overall soil health.

While some may argue that mill mud is expensive to transport from the mill, the question for growers is do they see enough bang for their buck and, yes, for some it will be too costly if they are located a distance away from the mill.

Tillage is another factor that continues to have a huge impact on soil structure, and promotes compaction in the plough-pan horizon. The more you till, the worse off for the physical structure of your soil. The implications to the soil biology due to the loss of factors such as soil fungi are huge.

Some paddocks will not function without the use of laser levelling for effective irrigation and drainage. While we acknowledge that laser levelling can cause a loss of carbon from the farming system, we also acknowledge that a farm will not function unless it is on the correct slope with the correct irrigation and drainage. In these circumstances, we should try to remediate the loss of carbon in the system through the use of mill mud and planting of fallow legume crops.

These practices need to be looked at from a whole farming system approach, not just space and fallow. These changes can impact the economics of your farming practices because your root health will result in extra ratoons and lower pathogen loads will reduce the time spent in the tractor. ■

To learn more about farming systems advice contact Soil Health Officers:

Richard Hobbs (Herbert)
M 0400 544 301

Terry Granshaw (Burdekin)
T 07 4783 1101

If you would like to find out more about the project please contact:

Caroline Coppo (Herbert)
T 07 4776 8218

Anthony Curro (Burdekin)
T 07 4783 8602

SRA acknowledges the funding contribution from the Queensland Department of Agriculture and Fisheries towards this research activity. The SRA Soil Health Project of the Herbert and Burdekin regions is kindly supported by Herbert Cane Productivity Services Limited (HCSPL), Burdekin Productivity Services (BPS), Wilmar Sugar, University of Queensland and University of Southern Queensland.



(Over page top) SRA Research Technician, Robert Verrall, with tools from the Soil Health Toolbox testing soil in Macknade. (Over page bottom) Each tool in the Soil Health Toolbox measures for a specific soil constraint that is holding back productivity.



Herbert workshops dig dirt on soil health

IN SEPTEMBER, SRA'S INVESTMENT IN SOIL HEALTH WAS SHOWCASED TO OVER 80 GROWERS AT A SERIES OF HERBERT CANE PRODUCTIVITY SERVICES LIMITED (HCP SL) 'DIGGING THE DIRT' SHED MEETINGS.

Growers throughout the Herbert have discussed soil constraints and potential solutions while looking at real scenarios through a recent series of soil pits, field walks and presentations.

"We need to think deeper than our topsoils," said SRA Researcher Davey Olsen, who is leading one of SRA's soil health investments. The soil pits help explain the full picture for cane plant health by looking at the conditions of the root environment including soil profile characteristics, soil compaction and other restrictions to root penetration. Growers already understand that soil is compacted under the wheel traffic area but, depending on harvesting conditions, the area in the row can be compacted as well.

The six project demonstration sites which have been functioning for a year compare the soil health, productivity and economics of conventional farming systems to new farming systems in a side by side comparison. The sites compare practices such as mounding versus furrow planting, various break crop

systems, and 1.65 metre to 1.8 metre wide rows. During the trial, extension officers will measure the nutritional, physical, chemical and biological levels within the blocks at various stages. The team will conduct soil tests, root sampling, water infiltration, bulk density, penetrometer and gravimetric soil tests and six month bio-mass sampling of the cane. Importantly, a full costing of the different farming systems is being conducted by economists at the Queensland Department of Agriculture and Fisheries. These sites will run for five years (plant and four ratoons). The trial is not to say one system is better than the other, but to see the benefits of adjustments to farming systems and how they can improve soil health resilience and manage costs.

The project will also test and analyse soils collected from long term paired site farms. These farms are located close to each other where one farmer has implemented an improved farming system for the past ten plus years, while the other has maintained a conventional

farming system. The project team will measure the long term changes on soil health and farm economics arising from these contrasting farming systems.

With collaboration from growers, productivity services, millers, harvester operators, university researchers and SRA, this project brings experts from various fields together to determine what chemical, physical and biological indicators are the most relevant to our soils and crop. The project aims to benchmark soil health based on specific regional conditions. ■

SRA acknowledges the funding contribution from the Queensland Department of Agriculture and Fisheries towards this research activity.

(Above) Soil Health Project lead, Davey Olsen examines the soil from a soil pit at the Kicking the Dirt Shed Meetings.

Establishing sugarcane farming systems for better soils and improved production

IT IS WIDELY RECOGNISED THAT IMPROVING SOIL HEALTH IN SUGARCANE FARMING SYSTEMS IS CRUCIAL TO ACHIEVING A PRODUCTIVE, PROFITABLE AND SUSTAINABLE CANE INDUSTRY. BY BEENA ANIL-BISWAS

The long-term monoculture of sugarcane has led to detrimental effects on soil health, resulting in declining cane yields.

Modern farming systems including controlled traffic, permanent beds, minimum tillage, legume break crops and crop residue retention have helped to overcome some of the adverse impacts caused by conventional management practices.

However, according to Key Focus Area Leader, Dr Barry Salter, soil health remains poor and soil carbon levels are generally low. Root systems below the top few centimetres of soil are in poor condition, with a prevalence of pathogenic organisms such as nematodes.

To address these issues, new practices that complement the modern farming system need to be explored. These practices need to deliver an improvement to soil carbon (C) and biological condition while enhancing profitable sugarcane production.

A new SRA project, *Establishing sugarcane farming systems to improve soil health*, assesses a range of practical farming practices that may improve soil condition through the addition and management of organic matter. Three

farming system trials will be conducted in the project to:

- Assess the impact of management practices that include mixed cover cropping and other management strategies such as intercropping, organic matter application and incorporation to improve sugarcane crop performance and soil condition
- Develop methods of managing intercrops to reduce competition with the developing sugarcane crop
- Quantify whether mixed species cover cropping is more beneficial than a legume monoculture
- Assess the impact of trash management (green cane trash blanketing (GCTB) compared to burnt trash) and tillage treatments (full tillage compared to zero tillage) on soil C.

The trial sites are located in the NSW, Central and Wet Tropics regions. It has been a busy time for the research team on the ground, led by SRA's Dr Barry Salter, NSW DPI researcher Dr Lukas Van Zwieten and Mr Rob Slugggett from Farmacist.

"The purpose of the project is to explore and promote new farming systems that improve soil condition, ultimately resulting in more resilient soils that are


better able to withstand stress and often require reduced chemical and other management inputs," said SRA Key Focus Area Leader, Dr Barry Salter.

"Yield response to fumigation is in order of 42 percent for plant crops and 18 percent in the following ratoon; whereas longer fallow periods have been shown to improve plant crop yields by 20-30 percent.

"This quantifies the effect that soil biological condition has on productivity. Given the magnitude of these responses, it is not unrealistic to assume that yields could be improved through the refinement of farming systems while also maintaining the principles of the Sugar Yield Decline Joint Venture, which are GCTB, reduced tillage, controlled traffic, and breaking the monoculture." ■

SRA acknowledges the funding contribution from the Queensland Department of Agriculture and Fisheries towards this research activity.

(Above) Intercropping will be one of the farm practices assessed as part of a new project that has just begun at SRA.

An aerial photograph of a sugarcane field. The field is divided into two main sections. The left section is covered with a thick layer of green cane trash, which is a green cane trash blanket (GCTB). The right section is a burnt trash trial, where the cane trash has been removed and the soil is exposed. The rows of sugarcane are clearly visible, and the contrast between the green trash and the brown soil is prominent.

Reduced tillage establishment of sugarcane at SRA Mackay

A LONG-TERM GREEN CANE TRASH BLANKET (GCTB)
VS BURNT TRASH TRIAL IS CONTINUING AT THE
SRA MACKAY STATION AS PART OF A NEW
SRA-FUNDED PROJECT. BY DR BARRY SALTER



Through a new project called *Establishing sugarcane farming systems to improve soil health*, SRA is using a trial site that has had either a trash blanket or trash burnt after harvest since the early 1990s. As part of the new project, the site is being used to assess whether tillage between crop cycles, in order to establish plant cane, affects accumulation of soil carbon and therefore soil health.

To do this, a number of treatments have been established. These are:

1. Long-term trash burning, sugarcane planted after one pass of a wavy disc
2. Long-term trash burning, sugarcane planted after one pass of a bed renovator, and one pass of a wavy disc
3. Long term GCTB, sugarcane planted after one pass of a wavy disc
4. Long term GCTB, sugarcane planted after one pass of a bed renovator, and one pass of a wavy disc.

In all treatments, a coulter was also run down the centre of each bed to loosen soil in the planting zone while also applying phosphorus before planting.

Even though treatments that were worked with the bed renovator would also be considered reduced tillage, this treatment imposed significantly more tillage and soil disturbance than the wavy disc on its own.

A single-row double-disc opener was used to plant SRA9[®] on 8 August 2018. Some observations were:

- Prior to any tillage, the bed profile in plots with a history of trash being burnt was almost flat. This was most likely due to beds slumping over time due to a lack of soil cover. Planting these plots, with only one pass of a wavy disc, was possible, but the soil was hard and compacted and it was difficult to achieve reasonable planting depth. It should be noted that a combination of trash burning and near zero tillage is not a recommended practice and is only being used in the experiment to compare against other treatments.
- Planting into GCTB plots with only one pass of a wavy disc was easier than where trash was burnt. The soil was less compact and allowed greater planting depth. Significant organic matter remained on the soil surface using this method.
- Planting plots following one pass of a bed renovator and a wavy disc was more practicable and there was no issue achieving good planting depth. Despite the increased tillage, trash and organic matter from the previous crop cycle was still evident and some soil structure remained.
- While this trial was planted in August, one of the benefits of reduced tillage planting systems is the increased chance of planting in Autumn as less land preparation is required following the wet season. Doing this would also capture soil moisture that is almost always present in Autumn.

The trial site was irrigated (50mm) a week after planting, using a lateral irrigator that has been installed at the station, to ensure good crop establishment. Crop growth will be monitored and soil samples will be collected to determine whether there are differences in soil condition between treatments. ■

SRA acknowledge the funding contribution from the Queensland Department of Agriculture and Fisheries towards this research activity.

For more information contact
Dr Barry Salter
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T (07) 4963 6802.

(Over page - top) Renovated beds following planting. (Over page - bottom) Long-term burnt trash plots tilled with one pass of a wavy disc and planted with a double disc opener planter. Note the flat, hard beds and limited organic matter. (Above left) Cane billet planted into long-term trash blanketed plots following one pass of a wavy disc. Note the presence of organic matter and soil cover. (Top right) Bed renovator. (Middle right) Condition of beds following one pass of a bed renovator and one pass of a wavy disc. (Bottom right) Planting into long-term trash blanket plots following one pass of a wavy disc. These beds were more pronounced than where trash was burnt.



Research gets to the root of the matter

SUGARCANE ROOTS MAKE UP A LARGE PART OF THE SUGARCANE PLANT, AND RESEARCH WORK IS UNDERWAY TO HELP LIFT THE UNDERSTANDING OF ROOTS IN LINE WITH OTHER PARTS OF THE CROP.

Roots are the foundation of your crop. They anchor the crop in the ground, they provide nutrient for the plant, and they are a point of contact for pathogens. It is estimated that the roots also consume around half of the energy produced through photosynthesis each day.

But, until recently, there has been only a limited scientific understanding of this important part of sugarcane, especially in comparison to other agricultural crops.

This is now changing through the work of a recently completed research project led by CSIRO, which has filled important gaps on sugarcane root knowledge for the Australian sugarcane industry and is leading to further research activity.

Led by CSIRO scientists Dr Anne Rae and Dr Johann Pierre, the project has gathered practical information on sugarcane root systems and examined specific issues including anatomy, the structure, varietal differences, and the roots' response to different stress situations.

The researchers have used techniques for analysing roots in other industries and applied them to sugarcane, which has been vital for dealing with a crop with a large biomass – both above- and below-ground.

The complexity and size of sugarcane root systems meant that the project developed innovative ways of measuring and analysing roots, while also determining which measures were relevant to the industry.

“Our new methods for assessing root system structure and architecture compare key features, including root/shoot ratios, root opening angle, root length, proportion of fine roots, branching density and average diameter,” explained Dr Pierre. “The first project has been mostly glasshouse based with some field work, and we are extending that information further, including with more field work, to determine how we can use this information to provide valuable information for the industry.”

This information from this research will be used in several ways, including for the sugarcane breeding program through SRA, as practical information for growers that can guide practice change, and to form the base for future research that will drive these outcomes even further.

Dr Rae said that one of the important findings from the project was that there were no significant reductions in root system size or quality in sugarcane varieties over time.

“We saw differences between varieties that we are investigating further, but there is no evidence that the work of breeders in selecting for yield has biased current and new varieties toward having smaller root systems than older varieties,” she said. She said that this highlighted the range of complex factors that influence ratoon length in the industry.

Future experiments are planned to look at how roots respond over several ratoons.

The work of CSIRO is linking with several other projects within SRA's investment



portfolio, and especially within SRA's Soil Health Program. This program is a 10-year commitment by SRA to work with the industry on building our knowledge around the links between soil health, the farming system, and profitability, and translating this into practical outcomes for growers.

For example, this roots project is linking with the project 2017/015 (*Measuring soil health, setting benchmarks and driving practice change in the sugar industry*) and using some of the paired sites in this project to help understand the baseline of what a good, healthy root system looks like (see page 22).

This information will be useful for growers in understanding the response and role of roots in relation to sugarcane soil health.

In addition to that, the project is also collaborating with other projects to look at ways of easily gathering information on root health.

It has also linked with an Early-Career Researcher award investment by SRA, where Dr Pierre investigated the use of DNA-based technology to investigate a test to diagnose root health. This work through the ECR and the broader roots projects is also collaborating with other

activity led by SRA to develop an overall DNA-based diagnostic – called Predicta – for the sugarcane industry.

Run through the South Australian Research and Development Institute (SARDI), the Predicta test is hoped to incorporate a range of factors that could include pathogens and roots. This has the potential to link back to the other research activities within this program. ■



SRA acknowledges the funding contribution from the Queensland Department of Agriculture and Fisheries towards this research activity.

(Over page / Above) Working in the field as part of the CSIRO-led and SRA-funded project investigating root systems in Australian sugarcane.

SOME KEY FINDINGS:

- The research found significant differences between varieties but there were no significant trends towards particular features in the industry's varieties over time.
- Compared to other crops, sugarcane roots appear to be very efficient in terms of the energy cost to maintain a large root system.
- Current varieties have a consistently high proportion of fine roots when grown in optimal conditions, and there is a strong overall relationship between above-ground mass and root volume. These relationships were maintained when the shoot growth was artificially restricted.
- Insufficient nitrogen supply caused stunted shoot growth but directed a larger proportion of resources into the root systems. To maximise the root system length, plants decreased the root average diameter and tended to decrease branching.



2,4-D: New labelling for sugarcane

NEW 2,4-D LABELS CAME INTO EFFECT IN
OCTOBER THIS YEAR AS A RESULT OF THE 2018
2,4-D ENVIRONMENTAL ASSESSMENT.

BY PHIL ROSS AND BELINDA BILLING

The new mandatory instructions for 2,4-D include downwind no spray zones for aquatic and terrestrial areas and use of nozzles that produce very coarse droplets.

There are also advised recommendations when used in fallow from 1 October to 15 April.

INSTRUCTIONS FOR ALL 2,4-D PRODUCTS RELEVANT TO SUGARCANE

Mandatory requirements

Conditions and surroundings:

DO NOT allow bystanders to come into contact with the spray cloud.

DO NOT apply unless the wind speed is between 3 and 15 kilometres per hour at the application site during the time of application.

DO NOT apply if there are surface temperature inversion conditions present at the application site during the time of application.

DO NOT apply if crop or weeds are stressed due to dry or excessively moist conditions.

DO NOT use if rain is likely within 6 hours.

Apply minimum distance for downwind mandatory no spray buffer zone as required.

SPRAY EQUIPMENT SET UP FOR BOOM SPRAY

DO NOT apply with spray droplets smaller than VERY COARSE spray droplets for standard nozzles.

Boom heights should be a minimum of 0.5 of a metre above the target canopy (weeds or crop canopy).

A lack of suitable weather conditions for spraying over extended periods is not an excuse for spraying in unsuitable conditions.

DOWNWIND MANDATORY NO SPRAY ZONES

Downwind spray windows are specific to each 2,4-D product group, depending on active ingredient concentration and the formulation.

For sugarcane it is most likely you will be using products with the following concentrations and formulations (check your label to confirm):

Boom spray mandatory downwind buffer zones:

CONCENTRATION AND FORMULATION	TERRESTRIAL BUFFER & AQUATIC BUFFER
625g/L concentration as dimethylamine/diethanolamine salts UP TO 1.8L/ha	20m
700g/L g/L concentration as dimethylamine and monomethylamine salts UP TO 1.5L/ha	20m
720g/L 2,4-D concentration as dimethylamine salt. UP TO 3L/ha UP TO 1.5L/ha	20m
680g/L concentration as 2-ethylhexyl ester UP TO 2.4L/ha	30m

For higher rates the mandatory buffer zone extends to 30 metres.

AERIAL APPLICATION INSTRUCTIONS

Follow conditions and surroundings instructions listed above and:

DO NOT apply with spray droplets smaller than VERY COARSE spray droplets for standard nozzles.

Release heights should be a minimum of 5 metres above the target canopy (weeds or crop canopy).

Apply minimum distance for downwind mandatory no spray window as required. For sugarcane it is most likely you will be using products with the following concentrations and formulations (check your label to confirm):

Aerial application mandatory downwind buffer zones

Concentration and formulation	FIXED WING		HELICOPTER	
	Terrestrial	Aquatic	Terrestrial	Aquatic
625g/L concentration as dimethylamine/diethanolamine salts UP TO 3.5L/ha	180m	170m	150m	140m
700g/L g/L concentration as dimethylamine and monomethylamine salts UP TO 3.1L/ha	180m	170m	150m	140m
720g/L 2,4-D concentration as dimethylamine salt. UP TO 3L/ha	180m	170m	150m	140m
680g/L concentration as 2-ethylhexyl ester – UP TO 1.15L/ha	75m	110m	70m	100m
680g/L concentration as 2-ethylhexyl ester – UP TO 2.4L/ha	130m	250m	120m	180m

DEFINITIONS:

Terrestrial: sensitive crops, gardens, landscaping vegetation, protected native vegetation or protected animal habitat.

Aquatic: sensitive aquatic and wetland areas including aquacultural ponds, surface streams and rivers.

RECORD KEEPING:

Make an accurate written record of each spray application within 24 hours of application and keep the record for a minimum of two years.

The record should include:

- Date of use with start and finish times.
- The location including address and block/sprayed
- Product trade name (full name) and active ingredient
- Rate of application including the amount of product used per hectare and number of hectares sprayed
- Situation, crop or commodity
- Weather conditions: wind speed and direction, temperature, relative humidity and Delta T
- Nozzle brand, model, size, type, and spray system pressure
- Height of spray boom from ground
- Name and contact details of person applying the product

Advisory instructions (i.e. not mandatory) for use in fallow from 1st October to 15th April

- Use nozzles that produce extremely coarse to ultra coarse droplets
- Use higher water rates to give better efficacy
- Use slower application speeds to allow operators to lower boom heights. ■

Funding for this work was provided by the United States Department of Energy, the Energy Biosciences Institute, Fujian Agriculture and Forestry University, the International Consortium for Sugarcane Biotechnology, the National Natural Science Foundation of China, the National Science Foundation, the Program for New Century Excellent Talents, and the 863 Program. The paper is available at www.doi.org/10.1038/s41588-018-0237-2.

Thank you to the Carl R. Woese Institute for Genomic Biology for providing this article.

SRA is using this *S. spontaneum* genome data in our sugarcane activity here at SRA and in partnership with the Queensland Alliance for Agriculture and Food Innovation.

SRA has contributed to this work through our contribution to the International Consortium for Sugarcane Biotechnology and also through research project investment at CSIRO.

Success is sweet: researchers unlock the mysteries of the sugarcane genome

FOR CENTURIES, SUGARCANE HAS SUPPLIED HUMAN SOCIETIES WITH ALCOHOL, BIOFUEL, BUILDING AND WEAVING MATERIALS, AND THE WORLD'S MOST RELIED-UPON SOURCE OF SUGAR. NOW, RESEARCHERS HAVE EXTRACTED A SWEET SCIENTIFIC PRIZE FROM SUGARCANE: ITS MASSIVE AND COMPLEX GENOME SEQUENCE, WHICH MAY LEAD TO THE DEVELOPMENT OF HARDIER AND MORE PRODUCTIVE CULTIVARS.

Producing the sugarcane genome sequence required a concerted effort by over 100 scientists from 16 institutions; the work took five years and culminated in a publication in *Nature Genetics*. But the motivation to tackle the project arose long before.

Modern sugarcane cultivars are polyploid interspecific hybrids, combining high sugar content from *S. officinarum* with hardiness, disease resistance and ratooning of *S. spontaneum*. The sequenced genome is a haploid accession AP85-441 generated by anther culture from octoploid *S. spontaneum* SES208. Modern sugarcane cultivars are polyploid interspecific hybrids, combining high sugar content from *S. officinarum* with hardiness, disease resistance and ratooning of *S. spontaneum*. The sequenced genome is a haploid accession AP85-441 generated by anther culture from octoploid *S. spontaneum* SES208.

"Personally, I waited for 20 years to get this genome sequenced," said Ray Ming, a University of Illinois plant biology professor who instigated and led the sequencing effort. "I dreamed about having a reference genome for sugarcane when I worked on sugarcane genome mapping in the late 1990s." Ming is a member of the IGB's Genomic Ecology of Global Change research theme, one of a group of researchers interested in developing sugarcane and related crops to boost food and biofuel production.

The complete genome sequence was well worth the wait and the effort because of its potential to aid the effort to improve sugarcane. The sugarcane grown by most farmers is a hybrid of two species: *Saccharum officinarum*, which grows large plants with high sugar content, and *Saccharum spontaneum*, whose lesser size and sweetness is offset by increased disease resistance and tolerance of environmental stress. Lacking a complete genome sequence, plant breeders have made high-yielding, robust strains through generations of crossing and selection, but this is an arduous process relying on time and luck.

"Sugarcane is the fifth most valuable crop, and the lack of a reference genome hindered genomic research and molecular breeding for sugarcane improvement," Ming said. "... Sequencing technology was not ready to handle large autopolyploid genomes until 2015 when the throughput, read length, and cost of third generation sequencing technology [e.g. that developed by biotechnology company Pacific Biosciences] became competitive enough."

Why was sequencing the sugarcane genome so difficult? A naturally occurring phenomenon common in plants created a significant technical barrier. Sometime during the evolutionary history of sugarcane, its genome had been duplicated twice, resulting in four slightly different versions of each pair of chromosomes all crammed into the same nucleus together.

These events not only quadrupled the size of the genome (and therefore the sheer volume of DNA sequence), they also made highly similar sequences from the genome wide duplication much more difficult to assemble into distinct chromosomes. Genomic DNA is typically sequenced, or read, in small, overlapping fragments, and the sequence data from those fragments become overlapping pieces of an enormous linear puzzle. As the sugarcane genome size doubled, then doubled again, this puzzle didn't just get larger; it took on repeated but not-quite-identical elements into which those many tiny pieces were difficult to correctly fit.

To conquer this challenge, the sequencing team used a technique called high-throughput chromatin conformation capture or Hi-C. This method allows researchers to discover what parts of the long, tangled strands of chromosomal DNA lie in contact with one another inside the cell. When analysed using a customized algorithm called ALLHIC developed by the team, the resulting data served the purpose of the picture on the lid of a jigsaw puzzle box, providing a rough map of which sections of sequence most likely belonged to which chromosome.

"The biggest surprise was that by combining long sequence reads and the Hi-C physical map, we assembled an autotetraploid [quadrupled] genome into 32 chromosomes and realized our goal of allele-specific annotation among homologous chromosomes," Ming said. In other words, the researchers now knew which gene sequences belonged to each of the four variations on the original, pre-duplications genome—a much higher level of detail than they expected to attain.

With this information, the researchers could form better hypotheses about the mysteries of the sugarcane genome's evolutionary history.

Through comparison with the genomes of related species, researchers knew that at some point the number of unique chromosomes had dropped from 10 to eight. To the team's surprise, the

new sequence data revealed that two different chromosomes had split apart, and all four halves had then fused to different existing chromosomes, a more complex set of events than the one they hypothesised.

How does understanding these physical changes help? Along with these large physical rearrangements within the genome come changes to the genes in the affected regions. For example, Ming and his colleagues found that the large chunks of chromosome that had been moved to new locations contained many more genes that help plants resist disease than were found in other locations.

"It resolved a mystery why *S. spontaneum* is such a superior source of disease resistance and stress tolerance genes," Ming said. "The chromosomal rearrangements are likely the cause, not the consequence of this enrichment, although the underlining mechanism of this enrichment remains to be investigated. This discovery will accelerate mining effective alleles of disease resistance genes that have incorporated into elite modern sugarcane hybrid cultivars, and subsequently the implement of molecular breeding [of sugarcane]."

The high quality of the genome sequence also allowed researchers to identify possible origins of modern sugarcane's incredible sweetness: even in the less sweet *S. spontaneum*, mutations that produced multiple copies of genes for sugar-transporting proteins have accumulated. They were also able to observe that in the hybridisation between *S. officinarum* and *S. spontaneum*, the *S. spontaneum*-derived DNA sequence is scattered randomly throughout the hybrid genome.

"The ALLHIC method has already proven to be effective for the construction of the autopolyploid sugarcane genome," Ming said. He anticipates that the techniques used successfully for the sugarcane genome will also assist researchers in sequencing other complex genomes. ■



Fibre Quality Measurement gets a 30-year review

A RECENT INDUSTRY WORKSHOP, COMPLEMENTED BY RESEARCH INVESTMENT, HAS LOOKED AT A RANGE OF ISSUES AROUND FIBRE QUALITY AND MEASUREMENT, TO HELP CONTINUE TO DELIVER OPTIMUM VARIETIES FOR THE INDUSTRY.

The Australian sugar industry relies on the performance of its cane varieties to sustain profitable businesses throughout the value chain.

SRA's variety development program targets key attributes important to achieving industry expectations for both agronomic performance and milling performance. The key "millability" characteristics of these varieties are defined principally by the percentage of fibre in the cane, and the particular characteristics of that fibre as determined by a set of standardised Fibre Quality Measurements (FQM) which include impact resistance, shear strength and the percentage of short fibres.

These measurements were established in the mid 1980s, and allowed varieties to be assessed with regard to suitability for milling. Varieties showing FQM characteristics outside a "normal" range were generally classified as "hard" or "soft" canes as a generalisation of their physical response during milling.

Soft canes generally had FQM attributes which included low fibre content and hard canes had high fibre content.

In recent years, a small number of varieties have been released with low fibre, such as SRA1^ϕ and SRA4^ϕ, which exhibited characteristics attributed to soft canes in the milling process. This presented particular challenges to achieving adequate factory performance.

To respond to this issue, SRA has invested in research to better understand these soft cane varieties, and capture more knowledge about the development history, FQM assessment and measurable variations in processing these varieties.

In addition, SRA has also responded by convening an industry workshop to discuss the path forward for fibre quality and what research is needed to provide improved variety outcomes.

The workshop was chaired by SRA Research Funding Panel (RFP) Chairman, Mr Gary Longden, and attended by representatives from SRA, CSIRO, QUT,

CANEGROWERS, the Australian Cane Farmers Association, milling organisations, the Australian Sugar Milling Council, and productivity services companies.

A key topic at the workshop was discussion on the current system for determining FQM in the breeding program and opportunities to measure fibre quality earlier in the variety development process. The current FQM system is not suitable for evaluating the large number of clones examined throughout the variety development program and is undertaken with only those clones within the final assessment trials (FATs).

The ability to identify at-risk varieties sooner could save significant effort in progressing preferred varieties through the breeding program, but comes with the challenge of implementing these measures against a greater number of clones.

The workshop also discussed adapting new technology for measuring fibre attributes, and methods of providing more information to regional variety



committees (RVCs) so that this could better inform their discussions around future potential varieties.

The workshop reviewed preliminary investigations into adapting near infrared spectroscopy (NIR) systems currently used by SRA as a suitable means of large scale screening across multiple clones for FQM attributes.

There was general agreement that establishing suitable calibrations for FQM attributes using NIR analysis was possible, and investigations to achieve this should be given a high priority. This technology could inform earlier stage breeding decisions, and the current standardised testing methods would remain as a last stage evaluation and for ongoing calibration of the NIR based analysis system.

The workshop also identified future research investigations that could provide value to the industry, and considered that a standardised system for ongoing reporting of milling characteristics of varieties would be beneficial to an improved understanding of varietal characteristics and potential breeding applications.

In response, the SRA Board will invest in research to address the workshop

outcomes, focusing on a project to develop and assess NIR calibrations for SpectraCane implementation to accelerate FQM data development and adaptation within the breeding program.

The workshop has been informed by several research projects within SRA's investment portfolio, including the most recent project led by Dr Geoff Kent at the Queensland University of Technology, with a project called Reviewing and extending knowledge of fibre quality assessment and effects of cane varieties.

This project had a number of objectives including re-evaluation of the "safe range" for existing FQM values as indicated by measured conditions within factory operations, and assessing factory operating performance for different varieties across multiple seasons. The work also identified several approaches for better presentation of fibre quality data to RVCs to aid in the selection of new varieties for release.

In addition, the project provided SRA with information on the cost of measuring fibre quality at an earlier stage in the breeding program, and the potential benefits if satisfactory SpectraCane calibrations for fibre quality could be made.

Dr Kent's research has also proposed further analysis of the effects of different varieties on factory operation and performance, with a view to gaining better information on the cost implications of varieties with extreme fibre quality and placing an economic value on fibre quality.


An alternative line of research to consider how to manage low fibre and soft canes to minimise the impact on factory processing is proposed, involving managing crop maturity and ripeness to elevate fibre content and controlling cane preparation to limit fibre quality impacts. ■


The project has recently submitted its final report, which will soon be published in the SRA eLibrary www.elibrary.sugarresearch.com.au/.


(Over page / Above) Work is underway to better understand fibre quality measures and variety performance.


TOTAL RESEARCH AND DEVELOPMENT INVESTMENT


PROJECT TITLE	PROJECT NUMBER	R&D PROVIDER(S)	CHIEF INVESTIGATOR	END DATE
Key Focus Area 1 (Optimally-adapted varieties, plant breeding and release)				
AISRF: Genetic control and genomic selection for important traits in sugarcane	2016/803	SRA, Sugarcane Breeding Institute - Coimbatore	Anthony O'Connell	30/06/2019
Exploiting introgression for the development of productive & regionally adapted varieties for NSW	2013/022	Sunshine Sugar	Roy Parfitt	01/05/2020
Applying the genome sequence for variety improvement: validation and implementation	2013/030	CSIRO	Karen Aitken	01/03/2019
Licence to Farm: Nitrogen use efficient varieties to meet the future environmental targets	2016/044	SRA	Jaya Basnayake	01/07/2019
Improving early stage selection of SRA breeding program by indirect selection of plant vigour	2016/028	SRA	Jaya Basnayake	01/07/2019
Leaf sucrose: The link to diseases, physiological disorders such as YCS and sugarcane productivity	2015/016	SRA	Gerard Scalia	30/06/2019
Generation of a high throughput SNP chip for introgression of resistance genes from wild germplasm into sugarcane	2015/025	CSIRO	Karen Aitken	01/03/2019
Selecting high value chromosomes from wild introgression material to deliver more resistant varieties faster	2015/026	CSIRO	Karen Aitken	01/03/2019
Optimising productivity, variety recommendations and mill operations through analysis of mill data	2016/032	SRA	Jo Stringer	01/02/2021
New approaches to identify and integrate Pachymetra resistance genes from Erianthus into SRA breeding program	2016/039	SRA	Nathalie Piperidis	31/12/2019
Implementing and validating genomic selection in SRA breeding programs to accelerate improvements in yield, commercial cane sugar, and other key traits	2017/002	UQ	Ben Hayes	01/07/2022
Compendium of sugarcane traits and their associated genes	2018/001	CSIRO	Donna Glassop	01/06/2019
Validating root system traits for enhanced nutrient capture in challenging environments	2018/002	CSIRO	Anne Rae	01/09/2021
Impact of stool architecture on ratooning: extending current trial to 4R to strengthen correlations	2018/004	CSIRO	Anne Rae	01/03/2021
Genetic analysis and marker delivery for sugarcane breeding	2018/005	CSIRO	Karen Aitken	30/06/2022
Selecting high value chromosomes from Saccharum species - extension to 2015/026	2018/006	CSIRO	Karen Aitken	30/06/2020
Key Focus Area 2 (Soil health, nutrient management and environmental sustainability)				
Strategies to manage soil-borne fungi and mitigate sugarcane yield decline	2013/101	CSIRO	Paul Harvey	01/11/2018
More profit from nitrogen: enhancing the nutrient use efficiency of intensive cropping and pasture systems	2015/907	CRDC	Multiple	30/06/2020
SIX EASY STEPS - continuing perspectives in time and space	2017/004	USQ	Bernard Schroeder	01/02/2022
Measuring soil health, setting benchmarks and driving practice change in the sugar industry	2017/005	SRA	Dave Olsen	01/08/2022
Unravelling the impact of climate and harvest time on nitrogen fertiliser requirements	2017/009	SRA	Danielle Skocaj	04/03/2022
Seeing is believing: managing soil variability, improving crop yield and minimising off-site impacts in sugarcane using digital soil mapping	2017/014	UNSW	John Triantafilis	01/10/2020
Decision support for choice of enhanced efficiency fertilisers - Herbert catchment pilot study	2017/015	CSIRO	Kirsten Verburg	28/02/2019


PROJECT TITLE	PROJECT NUMBER	R&D PROVIDER(S)	CHIEF INVESTIGATOR	END DATE
 Key Focus Area 2 (Soil health, nutrient management and environmental sustainability - continued)				
Implementation of root system diagnostics to deliver a field-based measure for root health	2018/003	CSIRO	Anne Rae	01/08/2021
Greenhouse gas emissions from sugarcane soils: strategies for increasing NUE and reducing environmental pollution	2018/007	QUT	Peter Grace	30/06/2021
Establishing sugarcane farming systems to improve soil health	2018/008	SRA	Barry Salter	01/03/2023
Development of commercial molecular biological assays for improved sugarcane soil health and productivity	2018/009	SRA	Rob Magarey	01/06/2020
SIX EAST STEPS Tool Box development for refined on farm nutrient management	2018/013	SRA	Barry Salter	01/02/2020
Complete nutrient management planning for cane farming (Funding provider: Queensland Government DES)	2016/804/ RP161	SRA/Farmacist	Jayson Dowie	30/12/2020
Improved water quality outcomes from on-farm nitrogen management (Funding provider: University of Queensland)	2016/805/ UQ_NESP	SRA	Danielle Skocaj	10/12/2020
Cane farmer trials of enhanced efficiency fertiliser in the catchments of the Great Barrier Reef (Funding Provider: Commonwealth Department of Environment and Energy and Queensland Government Great Barrier Reef Innovation Fund (Reef Trust 4))	2016/807	CANEGROWERS / SRA	Barry Salter	31/12/2021

 Key Focus Area 3 (Pest, disease and weed management)				
Integrated disease management for sugarcane streak mosaic in Indonesia (Funding provider: Australian Centre for International Agricultural Research)	2013/802	SRA	Rob Magarey	30/06/2019
Soldier fly management	2015/804	SRA	Andrew Ward	31/12/2019
Cane to creek: Russell Mulgrave growers and the nitrogen story (Funding provider: Queensland Government Department of Environment and Science)	2017/801	SRA	Belinda Billing	31/07/2019
Feeding behaviour of Soldier fly	2017/808	SRA	Andrew Ward	11/12/2019
Development for an improved commercial assay for ratoon stunting disease (RSD)	BIOBRSD	SRA	Rob Magarey	30/06/2019
Modern diagnostics for a safer Australian Sugar Industry	2017/809	SRA	Nicole Thompson	01/06/2022
Solving Yellow Canopy Syndrome	2014/049	SRA	Dave Olsen	30/06/2019
Using Remote Sensing to improve canegrub management in North Queensland cane fields	2015/038	SRA	Kevin Powell	01/02/2019
Identifying new-generation insecticides for canegrub control as contingency for loss of amenity with the existing product	2016/003	SRA	Andrew Ward	01/01/2020
Investigation of biotic causes of yellow canopy syndrome	2016/064	UQ	Andrew Geering	01/12/2019
Keeping our chemicals in their place - in the field	2017/008	SRA	Emilie Fillols	01/07/2021
Delivering solutions for chlorotic streak disease	2017/010	SRA	Kathy Braithwaite	01/07/2020
Development of commercial molecular biological assays for improved sugarcane soil health and productivity	2018/009	SRA	Rob Magarey	01/06/2021
Moth Borers – how are we going to manage them when they arrive?	2018/010	SRA	Andrew Ward	01/08/2021

 Key Focus Area 4 (Farming systems and harvesting)				
A non-pneumatic cane cleaning system with no cane loss.	2014/035	QUT	Floren Plaza	01/06/2019
Increased Harvest Recovery: Reducing sugar loss and stool damage	2014/048	SRA	Joseph Bonassi	01/05/2019
Assessment of new management strategies for marginal soils	2015/007	SRA	Barry Salter	31/12/2019

PROJECT TITLE	PROJECT NUMBER	R&D PROVIDER(S)	CHIEF INVESTIGATOR	END DATE
 Key Focus Area 4 (Farming systems and harvesting - continued)				
Bio-prospecting for beneficial endophytes of sugarcane	2015/051	AgResearch	Stuart Card	01/02/2019
Sugar from space: improved data access, yield forecasting and targeted nitrogen application for the Australian Sugar industry	2016/062	UNE	Andrew Robson	01/01/2020
Understanding Interactions Between Basecutters and Other Forward-feed Components with the Cane Stalk, and Determining Practical Strategies to Minimise Damage as Harvester Speed Increases	2016/952	Norris ECT	Chris Norris, Phil Hobson	01/05/2020
Commercial Scale Economic Evaluation of Post-Harvest Cane Cleaning to Maximise the returns to the Supply Chain	2016/953	QDAF	Stephen Ginns	01/05/2019
Adoption of practices to mitigate harvest losses	2016/955	SRA	Phil Patane	01/04/2019
Southern Sugar Solutions	2017/012	DAFQ	Neil Halpin	01/01/2021
Improved irrigation system selection and operation for increased sugarcane productivity and profitability	2018/011	USQ	Michael Scobie	01/04/2019

 Key Focus Area 5 (Milling efficiency and technology)				
Real time harvest and transport system	2014/037	QUT	Geoff Kent	01/01/2019
Investigation into modifying pan boiling techniques to improve sugar quality	2015/013	QUT	David Moller	30/05/2019
Increasing capacity to undertake cane preparation research through modelling and experimentation	2015/018	QUT	Geoff Kent	01/05/2019
Online analysis systems to measure the available nutrients in mill mud	2016/019	SRA	Steve Staunton	01/06/2020
Reducing boiler maintenance costs and deferring capital expenditure through improved technology	2016/020	QUT	Floren Plaza	01/06/2021
Evaporator Liquor Brix Sensor	2017/003	Wilmar	Robert Stobie	01/01/2019
Managing aspects of raw sugar quality in the Australian sugar industry Part II	2017/006	Griffith University	Chris Davis	01/11/2019
Investigations to mitigate the effects of juice degradation in factory evaporators on sugar recovery and quality, corrosion and effluent organic loading	2017/007	QUT	Darryn Rackemann	01/12/2020
Pan design and operational changes to suit Australian pan stages operating on low pressure vapour	2018/012	QUT	Ross Broadfoot	01/11/2021
Evaluation of the Neltec Colour Q for measuring the purity of magma from C centrifugals	2018/201	Isis Central Sugar Mill Company Ltd	David Pike	01/05/2019
Improving the impact of evaporator calandria noxious gas bleeding arrangements on evaporator rate and condensate quality at Racecourse Mill	2018/202	Mackay Sugar Limited	Brett Bampton	01/06/2019
Understanding the cause of high colour sugar - intrinsic cane colour, extraneous matter or factory practices?	2018/203	Wilmar Sugar	Robert Stobie	01/05/2019
Activated Sludge Plants – Optimising Operations and Technology	2018/204	Wilmar Sugar	Robert Stobie	01/05/2019

 Key Focus Area 6 (Product diversification and value addition)				
A profitable future for Australian agriculture: Biorefineries for higher-value animal feeds, chemicals and fuels	2015/902	QUT	Ian O'Hara	01/04/2019
Manipulation of carbon partitioning to enhance the value of sugarcane (ARC LINKAGE UQ collaboration with SRA contribution)	2016/801	UQ (SRA contribution)	Frikkie Botha	08/12/2018
Establishing a strategic roadmap for product diversification and value addition	2018/014	Lazudi	Eris O'Brien	01/04/2019

PROJECT TITLE	PROJECT NUMBER	R&D PROVIDER(S)	CHIEF INVESTIGATOR	END DATE
 Key Focus Area 7 (Knowledge and technology transfer and adoption)				
A boiler simulator for improved operator training	2016/001	QUT	Anthony Mann	01/12/2018
Protecting our chemicals for the future through accelerated adoption of best management practice	2016/002	SRA	Belinda Billing	01/08/2019
Development of an Intelligent Tool to allow real time evaluation of harvesting practices as part of a framework for improved harvester payment systems	2016/951	Norris ECT	Stuart Norris, Rob Crossley	01/05/2019
Productivity improvements through energy innovation in the Australian sugar industry	2017/011	Ag Analytics	Jon Welsh	01/07/2020
Pathways to water quality improvements in the Myrtle Creek sub catchment (Funding provider: Queensland Government Department of Environment and Science)	2017/810/EHP17066	SRA	Phil Ross	17/05/2020
 Key Focus Area 8 (Collaboration and capability development)				
Sugarcane for water limited environments: Characterisation of a selected sugarcane germplasm for transpiration efficiency and high biomass production for the sugarcane growing regions in Australia	2014/102	UQ	Sijesh Natarajan, Shu Fukai	15/12/2018
Statistical data mining algorithms for optimising analysis of spectroscopic data from on-line NIR mill systems: improving system calibrations for quality measures and variety discrimination	2014/109	JCU	Justin Sexton	01/02/2019
Mesostigmatid mites as predators of nematodes in sugarcane soils: occurrence, ecology, food preferences and biocontrol potential	2015/103	University of Sunshine Coast	Matthew Manwaring	01/03/2019
Plant Growth Promoting Rhizobacteria for Australian Sugarcane: Bridging the Gap from Simple Systems to Engineered Microbiomes	2015/105	UQ	Selby Berg	01/07/2019
Combining controlled release and nitrification inhibitor properties to deliver improved fertilizer nitrogen use efficiency in high risk environments	2016/101	UQ	Chelsea Stroppiana	31/03/2020
Development and modelling of novel controlled release fertilisers for improved nutrient delivery efficiency	2016/102	UQ	Ian Levett	01/09/2020
Integrated standardised competency based training for Sugar Milling operations	2017/013	QUT	David Moller	01/01/2019
Re-evaluating the biology of the sugarcane root system: new knowledge allows for assessment of production impacts and implications for yield decline	2017/101	Southern Cross University	Anders Claassens	30/06/2020
Microwave Sensors for Sugarcane Sugar Analysis	2017/102	UQ	Scott Thomason	30/06/2020

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