Sugar Research Australia™

Prioritised R&D recommendations

September 2016

Sugar Research Australia (SRA) has recently completed three major reviews of specific areas of research activity for the Australian sugarcane industry. These review topics were precision agriculture, molecular breeding, and nitrogen use efficiency. In addition, SRA has also conducted industry consultation and workshops on research areas including ratoonability and soil health.

The recommendations from these activities are set out in the tables below. The tables set out the R&D recommendation and puts this in the context of the current investment, as well as make recommendations for future steps.

This information can be used to help guide research proposals for the 2017/2018 funding call, which closes for Preliminary Research Proposals on October 9, 2016

For more information on these reviews and activities please contact the SRA Research Funding Unit via (07) 3331 3333 or funding@sugarresearch.com.au.

Review of Precision Agriculture in sugarcane in Australia

Prioritised R&D recommendations

R&D Recommendation	Current Status	Future Investment
Highest priority is to encourage adoption of proven precision technologies, e.g. demonstrations, financial analyses, showcase advanced growers, form PA community of interest	• Project 2014/015 (QDAF) is conducting and publicising case studies of growers moving to BMPs	• More work needed to promote adoption, especially basic practices such as controlled traffic, EM maps.
Remote sensing project to link precision agriculture, yield prediction and existing nutrient and variety trials	• Project 2016/062 (UNE) aims to improve yield forecasting and nitrogen management using remote and proximal sensing, including delivery mechanisms	• No additional investment required in the short term
Need more collection and collation of field data and data analysis: which factors determine productivity?	• Project 2014/045 (Agtrix) is cleaning mill productivity data and converting it to a spatial format to be more useful to researchers • Projects 2014/054 and 2016/032 (SRA) are analysing mill data to determine regional productivity drivers	• No additional investment required at this time
Investigate data infrastructure and common data platforms	• Rural R&D For Profit Round 2 project 'Accelerating precision agriculture to decision agriculture' (CRDC) will investigate data platforms across primary industries	• No additional investment required in the short term
Improve irrigation management using automation and telemetry	• Project 2014/079 (USQ) is investigating automated furrow irrigation in the Burdekin • Additional sophisticated automation to be installed and tested in Rural R&D for Profit project 'Smarter irrigation for profit' (CRDC) • Review of scheduling tools including possible use of satellite imagery being conducted by SRA (Project 2015/082) as part of 'Smarter irrigation for profit' project	• No additional investment required in the short term • Consider options when SRA review of scheduling tools is completed
Conduct a pilot study of the availability and usefulness of newer sensing technologies	• Desktop study being conducted in project 2014/080 (SRA) on sensors for improving harvesting • Project 2016/062 (UNE) will examine proximal sensing methods for crop N content	• No additional investment required in the short term • Consider options when these two projects progress further

Molecular breeding and marker discovery for sugarcane germplasm enhancement

Prioritised R&D recommendations

R&D Recommendation	Current Status	Future Investment
Fast-track the implementation of a Pachymetra resistance marker as a test case to develop pipelines and protocols for marker implementation	• Project 2015/025 (CSIRO) is generating a high throughput disease SNP chip for introgression of resistance genes from wild germplasm into sugarcane, targeting Pachymetra and nematodes	• No additional investment required in the short term • Consider options after completion of 2015/025. This project will determine if a disease resistance specific SNP chip is economically viable and will identify the best stage within the breeding program for implementation.
Develop a realistic timeline for marker implementation and validation, including for parent development and evaluation and both trait-specific marker assisted selection and whole genome selection.	• In March 2016, a joint SRA-CSIRO workshop was conducted by the CSIRO molecular marker team to discuss and brainstorm this issue • The SRA KFA1 leader is developing a marker implementation plan	• Investment is required to apply genomic selection to improve the selection of parents and parental combinations and to reduce breeding cycle times and increase the rate of genetic gain. • Prior to investment, a molecular breeding program plan should be developed ensuring that projects are not funded in an *ad-hoc* manner. The program plan should be designed for integration with the core breeding program.
Identify traits where markers can contribute to select either for traits directly or for proxy or highly correlated traits, including traits not currently strongly targeted.	• No formal activity as yet • It is realised that for traits like ratoonability, markers are needed for correlated traits so the selection process doesn't require extension to develop better ratooning varieties	• Need investment to identify molecular markers for indirect selection of not-yet-selected traits such as ratoonability, where direct phenotypic selection is difficult or time consuming

Review of profit based measures to evaluate and prioritise genetic improvement of water and nitrogen use efficiency in sugarcane

Prioritised R&D recommendations

R&D Recommendation	Current Status	Future Investment
Identify NUE traits for high yield performance under low N conditions for better characterisation at Progeny Assessment Trial stage	• Project 2016/044 (SRA/UQ) contracted to examine NUE traits	• No additional investment required in the short term • Consider options as they arise from the new project and feedback from the core breeding program
Screen current varieties in environmentally vulnerable regions for N responsiveness to provide growers with variety-specific recommendations for N rates	• Project 2016/044 (SRA/UQ) contracted	• No additional investment required in the short term • Review opportunities as outputs are delivered from new project investment and feedback from core breeding program
Investment in developing and applying rapid ways to screen genetic material and plants in the early selection stages for water productivity	• Project 2016/028 (SRA) contracted to screen for WUE traits	• No additional investment required in the short term • Review opportunities as outputs are delivered from new project investment and feedback from core breeding program
Underpinning research to evaluate correlative traits that may contribute to water productivity (WP) or WUE, with large scale assessments at early selection stages to improve the chances of detecting clones that are extreme WUE phenotypes	• New project 2016/028 (SRA) approved by Board and contracted	• No additional investment required in the short term • Review opportunities as outputs are delivered from new project investment and feedback from core breeding program

Soil health workshop (June 2016)

Prioritised R&D recommendations

R&D Recommendation	Current Status	Future Investment
Develop a Resource Hub and build regional extension capability and capacity that creates the infrastructure to facilitate practice change and a conduit to deliver new research and technologies	• No current investment	• Create a **SOIL HEALTH UNIT** in SRA to coordinate resources and develop a core of stakeholders to evaluate new practices and develop adoption programs • Develop regional research agronomy capacity to provide an interface between extension, growers and research • Review and collate material from the SYDJV and identify barriers to adoption to guide resource hub development • Develop extension materials that motivate sugarcane growers
Build on existing innovation nodes to foster adoption of the recommendations embodied in the New Farming System (Sugar Yield Decline Joint Venture)	• Case studies being developed in project 2014/015 (QDAF) to measure economic implications of transitioning to BMP using FEAT and CaneLCA tools	• Use regionally based existing commercial NFS sites as innovation nodes for Producer Advisor Learning (PAL) activity to demonstrate improved production, profitability and sustainability and address barriers to adoption • Measure economic and environmental benefits of implementing NFS, soil health impacts, profitability and land values • Establish support networks for innovation sites with harvesting contractors embedded
Spatial mapping of exploitable yield potential to target industry practice change and provide a baseline for measuring and monitoring improvement	• Project 2014/045 (Agtrix) - cleaning mill productivity data into spatial formats of use to researchers • Projects 2014/054 and 2016/032 (SRA) - mill data and regional productivity drivers • Project 2015/075 (JCU/SRA) - climate variability signals in soils in the Wet Tropics	• Use geo-referenced mill data (yield/CCS) to develop yield maps and understand yield gap potential of soil and terrain • Combine yield data with climatic zones, soil mapping and constraint information to identify climate variability signals and soil performance • Benchmark management zones for NUE and/or WUE
Managing compaction to avoid cycles of compaction and de-compaction	• No current investment • Opportunity to leverage against investment in the	• Work with the harvesting value chain to improve scheduling and facilitate the development of harvester groups, wide row spacing and control traffic

	Rural R&D for Profit project on Value Chain Efficiency (2016/901)	• Soil mapping and on-farm tests to identify management zones and areas of high compaction risk • Explore benefits of deep rooted, mixed species cover crops and reduced tillage on permanent beds to improve soil structure
Develop a soil health 'Tool Box' that can be promoted to industry to monitor important indicators of soil condition or soil constraints to assist with decision making	Current investments include: • Project 2016/047 (SRA): qPCR tests for soil borne pathogens • Project 2013/101 (CSIRO): strategies to mitigate soil pathogens • Project 2014/004 (Biological Crop Protection): soil food web capable of improving soil health • Project 2015/007 (SRA): management strategies for marginal soils • Projects 2015/002 and 2015/402 (CSIRO): examining root health	• Develop/recommend simple field-based soil health kits for soil biophysical parameters and accredited commercial providers • Research biological indicators of soil health and determine cost effectiveness. • Determine if densities of nematodes and faunal populations improve estimates of rate of nutrient mineralisation. • Develop industry disease maps- hot spots based on pathogen test results • Develop practical metrics for root health that relate to rhizosphere function and microbial ecology
Understanding why significant soil carbon sequestration has not been demonstrated in Australian sugarcane systems.	• No current investment	• Understand carbon sequestration in sugarcane farming systems to build soil labile carbon and stocks at depth that are responsive to management strategies
Develop innovative approaches to the agro-ecological management of cover crops to improve soil health	• No current investment	• Research cover and intercropping and other innovative approaches (e.g. bio-fumigants) to improve productivity and reduce pathogen loads • Demonstrate benefits of cover crop agronomy and root 'signatures' to promote improved soil structure, beneficial soil biology and reduced weed pressure
Identify if there are sub-lethal effects of pesticide use and residue accumulation on sugarcane soil function	• No current investment	• Research off target impacts of pesticide residues/metabolites on soil microbial function • Explore possible impacts on P availability and phytotoxic effects • Establish critical thresholds for residues that have negative effects on soil function

Ratoonability workshop (August 2016)

Prioritised R&D recommendations

R&D Recommendation	Current Status	Future Investment
A. Improve the ratooning performance of existing commercial varieties		
Enhance the productivity of ratoon cane by improving adoption of Best Practices for Crop Management and Harvesting **(high priority)**	• Project 2014/015 (QDAF) is conducting and publicising case studies of growers moving to BMPs • Similar recommendations for improved adoption of best practices arose from the soil health workshop	• There is a strong need to drive the adoption of readily available farming and harvest practices to improve ratoon productivity • This may require a concerted effort across multiple KFAs involving harvesting and farming management, nutrient management and pest, weed and disease management. • Site and grower-specific issues should be addressed as they arise within an overall adoption strategy, e.g. developing district-specific recommendations, working with grower clusters, researching problems as needed (why is something not working?), engaging harvest contractors, gathering evidence of productivity improvement.
Further collection and collation of field data and subsequent data analysis to identify external factors that contribute to ratoon yield decline in each region	• Variable data collection and limited analysis has been done by productivity service companies but it is too variable to draw reliable conclusions. • Effect of harvester damage, soil compaction and soil diseases like Pachymetra seem to have maximum impact.	• Prior to investing in more data collection, there is a need to collate existing field data and conduct an analysis to assess if there is enough existing data to draw meaningful conclusions

B. Breeding for better ratoonability		
Assess whether the current variety selection trial procedures are optimal for selecting varieties for real farm conditions, especially in terms of farm management and harvesting practices.	• Varieties are currently not selected for ratoonability as a direct trait • Varieties selected for ratoonability under trial conditions may not perform similarly in commercial conditions, considering that management and harvesting practices have very strong influences on ratoon performance	• There is a need to assess if varieties selected under trial conditions (management and harvesting) perform similarly under commercial conditions. This may involve comparing results from parallel trials that are managed using both methods (breeding trial and commercial). • If trial conditions aren't optimal, trial management may need amending or an alternative strategy(ies) should be identified to select for ratoonability
Modify current breeding program to include selection for ratoonability. This would involve identification of a suitable stage for selection (PAT, CAT, or FAT) and identification of suitable traits and methods for direct and/or indirect selection.	• Ratoonability has been formally defined in SRA breeding objectives but is not adequately addressed	• The breeding program needs to consider all selection case scenarios and conduct a preliminary cost-benefit analysis to assess the most effective strategy to select for ratoonability. • Direct selection for ratoonability would need to extend current selection cycles to include more ratoons and has on-going cost implications for the program. • Research investment would be required to conduct studies to convert ratoonability parameters into measureable traits within selection criteria. • Indirect selection for ratoonability would involve R&D investment to (i) identify traits linked to ratoonability, (ii) understand their heritability, (iii) determine feasibility and costs to select for identified indirect selection traits, (iv) determine broad-sense heritability for traits, (v) determine phenotypic and genetic correlations between these traits and cane yield under commercial harvesting practices and (vi) identify/validate markers linked to ratoonability to enhance selection efficiency through marker aided selection (MAS)
Introgress genes linked to ratoonability in the parental gene pool	• Project 2014/053 (SRA) aims to improve ratooning by exploiting new sources of genetic variability from wild relatives of sugarcane (ends June 2017).	• Needs major, long-term investment of a broad-based, focused introgression program that by necessity should be based onshore, have a long-term sunset clause, and be operated as a basic breeding program parallel to the core commercial program.

Sugar Research Australia Limited
ABN 16 163 670 068

Head Office
50 Meiers Road
Indooroopilly QLD 4068
Australia

Postal Address
PO Box 86
Indooroopilly QLD 4068
Australia

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