

December 2017

More data to improve variety selection

New technology is showing its potential to enhance the selection of sugarcane varieties.

This technology, using drones as a platform for advanced imaging, could allow sugarcane plant breeders to collect new and more detailed data on potential new varieties as they progress through the breeding program.

Better data leads to better decisions about the potential for a new a sugarcane variety and whether it should progress through the breeding program, or be discarded.

The work is part of a project led by SRA Researcher Dr Jaya Basnayake where he and his team are investigating ways of improving early stage selection in the breeding program.



SRA Principal Researcher, **Dr Jaya Basnayake**, is part of a project using technology such as drones and advanced imaging to help improve the selection of varieties.

Currently, there is limited ability to assess potential varieties in early stages of the breeding program such as clonal assessment trials (CATs). The process would not only be very labour intensive, it is also prone to high margins of error.

Jaya's project is using drones along with advanced cameras and sophisticated data processing and analysis software to collect measurements on new varieties throughout the season.

Using the drone means that a job that could take days can be done in less than 20 minutes, and environmental variables are almost entirely eliminated.

"Currently, SRA invests a lot of resources into CATs, and the main measures are CCS and yield at harvest. But by using a model incorporating more desirable crop traits we hope to provide an improved system for continual assessment for breeders where they can see which families and clones are growing faster in say summer, and which are growing faster in winter, and they can refine their selections for different growing conditions," Jaya said.

"In addition, we may also be able to tell breeders which clones have good water use efficiency (WUE), flowering and lodging propensity, ratoonability, and disease incidence, which would provide varieties suited to different environments."

Now in its second year, the project has already completed numerous successful drone flights and is continuing to improve how the data is collected and processed. The results indicate that these tools will provide valuable and practical outcomes for the breeding program. All of this work, once proven and adopted by the breeding program, would continue to inform the existing weighting of traits that have been determined by the industry. It could add value by providing better information about clone performance.

For example, one of the measures the researchers are collecting is canopy temperature, which is related to canopy conductance and how efficiently plants are using water.

"We know that varieties with high water use and high biomass are not very good for drought environments and would be better suited to regions like the Burdekin," he said. "On the other hand, we know there are varieties that have high biomass with low water use, which means they can keep on photosynthesising and producing biomass.

"At the moment we don't have a good process for capturing that information and using it for selection, but this research is looking to solve that."

Better sugarcane varieties for growers and millers – targeting two percent annual gain

Sugarcane growers and millers will be the beneficiaries of significant enhancements to the way Australian sugarcane varieties are created.

SRA has recently announced these new enhancements to its process for creating sugarcane varieties, which will target improved profitability for sugarcane growers and millers.

SRA has set the ambitious target of delivering 2% annual genetic gain. Progress against this goal will be measured in Final Assessment Trials with the relative economic value of new clones compared to the established varieties.

To put that goal into context, the global average gain for wheat breeding is 1 percent per annum, and the global average for sugarcane is less than 1 percent.

“We have set this 2 percent target based on feedback from the industry that new varieties must continue to offer meaningful improvements and improve profitability for our grower and miller investors,” said SRA CEO, Mr Neil Fisher.

This process will be led by Key Focus Area Leader, Dr Jason Eglinton, who is one of Australia’s leading plant breeders and was recently appointed at SRA. Dr Eglinton reviewed the current breeding program and the SRA Board has endorsed his recommendations for a series of enhancements.



Key Focus Area Leader for Optimally Adapted Varieties, Plant Breeding, and Release, Dr Jason Eglinton.

These include:

- Reducing the number of parent plants and crosses that are used to create new varieties. This will allow an increase in the size of high leverage (high value) populations of plants, but reduce the total number of populations;
- Decreasing the proportion of original seedlings with defective traits by using modern breeding tools such as molecular markers;
- Increasing variety trial precision;
- Applying earlier screening for smut and Pachymetra;
- More precisely select for sugar content by measuring sugarcane maturity;
- Piloting fast-track selection schemes including the use of tissue culture in place of traditional propagation;
- Using wild relatives of sugarcane to focus on challenging traits with the first target being ratoon crop performance;
- Improving the efficiency and effectiveness of research engagement and adoption; and
- Establishing lead indicators as the basis for performance measures and developing a dashboard appropriate for regular management and Board reporting.

This represents a significant investment of an additional \$4 million over the next seven years, which reinforces the development of new commercial varieties as the single largest investment that SRA makes on behalf of investors.

“By setting the 2 percent goal, and defining a clear strategy to target that goal, we are laying the foundation for ongoing improvement in the breeding program, ultimately leading to a more sustainable Australian sugarcane industry and more profitable growers and millers,” Mr Fisher said.

Plant breeding enhancements – summary

Generating larger quantities of seed from high value crosses

Inducing flowering has been a perennial challenge in sugarcane breeding, and synchronising the flowering time of prospective parents is even more difficult.

The experience of our staff in modifying photoperiod facility conditions and monitoring the variety responses will now be exploited to place more emphasis on specific parental combinations and generating larger quantities of seed from high value crosses.

The population structure used in Progeny Assessment Trials (PATs) can then be better balanced between testing the value of novel cross combinations and larger numbers of clones from elite crosses from which commercial varieties are more likely to be selected.

Core capacity for molecular selection

SRA has made considerable investments in genetic analysis research and molecular marker development, both through core funding and contestable funding through our annual project calls.

This technology will now be applied in commercial variety development to identify seedlings with disease susceptibility before they are planted into initial field trials. Genomic selection for traits influencing profitability will be piloted in conjunction with research led by the University of Queensland.

The establishment of core capacity for molecular selection in the SRA breeding program is also a positive driver for further investment in genetic research by CSIRO and universities because there is now a clear path to industry impact.

Further genetic characterisation of sugarcane is required to develop the precise molecular selection approaches used in other crops.

Increasing the precision of field trials

Testing potential new varieties in field trials that reflect the target production environment remains crucial.

Measures will be adopted to increase the precision of field trials, ranging from simply adjusting the balance of replication through to using soil mapping to better account for spatial variation.

Improved use of NIR

CCS is key to profitability at the mill and on farm, is a priority breeding trait, and is weighted heavily in economic value. However, significant improvements have been difficult to achieve. NIR calibrations for moisture content will be adopted to allow CCS values to be interpreted in the context of differences in maturity. Separating CCS differences due to moisture variation from the underlying genetic potential will allow more precise selection.

This new NIR tool will also characterise where potential new varieties fit into the harvest schedule by providing maturity information across trials with different planting and harvest dates.

Enhanced pathology testing

Pathology testing to develop disease resistance ratings is a carefully controlled and resource intensive process, and therefore is only possible at the late stages of the breeding program. This will now be supplemented with lower precision disease screening earlier in the breeding program to identify clones susceptible to *Pachymetra* and smut.

Additional infrastructure will be purchased to increase the capacity for *Pachymetra* screening, while early generation trials will be inoculated with smut spores (adhering to biosecurity and risk management procedures). This strategy is designed to maximise the number of clones promoted to Final Assessment Trials that meet minimum disease standards, which in turn allows greater selection pressure and genetic progress for yield and CCS.

Introgression

Using wild relatives of sugarcane as a source of novel variation has a long history in variety improvement. SRA has decided to move the practical elements of this activity from project based funding to an ongoing core commitment, which will allow long-term objectives to be pursued.

The introgression program has a specific medium term objective of improving ratoon crop performance. Field evaluation will be centred in the Herbert region but the objective is to supply novel variation to benefit all regions as well as contributing increased genetic diversity to support genetic gain for productivity.



SRA Technician, **Chris Tom**, explains some of the research occurring at Mackay.

Getting involved in variety selection



The plant breeding team at SRA Mackay recently held an open event to give people an insight into the progeny assessment trial (PAT) stage of the plant breeding program.

The PATs are an early stage in the SRA plant breeding program and is the first stage of selection clones go through.

SRA's Leader for Crossing and Selection, Dr George Piperidis, discussed the Central region's program and the PAT selection process. Participants then walked into the field and helped select clones progressing in the pipeline. The day concluded with an SRA Mackay farm block review, a critical step for the management of varieties and the chance to share ideas about the farming practices used on the station.



Above: In the field at the PAT field day.