

Varieties and plant breeding update

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Sugar Research
Australia™

Variety exchange brings in new talent

By Dr Nicole Thompson, Senior Researcher, SRA

Variety exchange is an important part of the SRA breeding program. SRA imports between 20-50 elite foreign varieties for assessment in Australia each year. The varieties are selected from the foreign programs to increase the diversity of the germplasm in Australia.



About half of all new varieties have at least one foreign variety as a parent, emphasising the importance of variety exchange.

An example of this from the most recent imports include varieties from USA which have been bred for tolerance to frost (they are from Florida), which is an important trait for some areas of Australia. Other traits include exotic pest and disease resistance, high yield, biomass, introgression lines, and others.

Foreign varieties are imported from partner countries to the SRA post-entry quarantine facility at Indooroopilly.

At Indooroopilly in Brisbane, they undergo a two-year quarantine and propagation program which includes disease testing and regular inspections to ensure that we are not importing any exotic pests and diseases with the new varieties.

Once the varieties are released from quarantine, they are propagated by tissue culture and then sent to the SRA stations for assessment.

The assessment includes disease resistance screening at Woodford and inclusion in regional plant breeding trials – this is to make sure that the varieties are on par with the SRA varieties and to give information to the plant breeders so they can be selected as parents.

The majority of imported varieties are used as parents in the plant breeding program to improve the new SRA varieties. About half of all new varieties have at least one foreign variety as a parent, so this is a very important part of the plant breeding program.

Current releases this year are varieties from: USA, Barbados, Reunion, Guatemala, Guadeloupe and Colombia. Under quarantine for release next year are varieties from: Brazil, Japan, Barbados, Vietnam and Reunion.

The variety exchange program is a collaboration between plant breeders and plant pathologists: mainly George Piperidis and Roy Parfitt (decide what country, what clones, and the distribution) and Nicole Thompson and Elizabeth Wilson (coordinate the import, quarantine, disease testing and distribution).



Foreign varieties that have been through quarantine and on their way to join and improve the breeding program.



Len Paris is looking forward to trying the new varieties SRA6 and SRA7 at his Far North Queensland property.

Wide range of choice in Far North Queensland

Fishery Falls farmer Len Paris is looking forward to planting the new Northern cane varieties SRA6 and SRA7 this year and hopes that they will play an important role for him in the future.

In fact, with these two new varieties approved for release this year, and several others that have been recently approved and on his list of varieties to try, he says his biggest problem is narrowing down the wide range of choice.

As well as SRA6 and SRA7, the varieties SRA1[Ⓢ] and SRA3[Ⓢ] have also been approved for FNQ.

"At the moment I have six varieties to play with, not including the two new ones, and I am happy with all of them – so it is a good problem to have to be scratching my head to decide what to plant," Mr Paris said.

"Saying all that, I have a lot of soil types from high range granite gravels to river flats, so there is not one variety that suits everything."

He sees the main varieties on his list to plant include Q240[Ⓢ], Q241[Ⓢ], Q242[Ⓢ], Q245[Ⓢ], Q246[Ⓢ] and Q247[Ⓢ].

"Looking at my plots, I probably prefer Q242[Ⓢ] as it is about one metre taller than the other varieties and has a lot of leaf material, which will put a lot of organic matter on the ground," he said.

"I'm also looking forward to the new SRA canes as they are showing great promise from what I have seen and heard of the trial results."

Mr Paris likes to trial varieties for himself and is an advocate of using tissue culture to access varieties quicker. He also makes a point of speaking to other growers about their thoughts on varieties and also reads published material available from SRA, such as variety guides.

He currently grows a range of varieties, but says that he still rates Q200[Ⓢ] as one of the best performing varieties, particularly for CCS. He also likes Q231[Ⓢ].

"It is an environmentally friendly cane insofar as it probably leaves about 30cm of trash on the ground and when it is standing the leaves are so interlocked that it blocks out the sunlight and no weeds can grow," he said.

"So it only requires one pre-emergent herbicide, and the organic material stops the run-off. It also has good early sugar."

Mr Paris says that all research is vital for keeping the industry moving forward, whether it be varieties, Yellow Canopy Syndrome, genetic modification, or new ways of speeding up variety development.

"We have to keep looking for ways to make the industry more sustainably, as at the end of the day we are here to make a profit, and to do it properly. If we don't have research, then we won't get to where we need to be in the future in terms of being competitive with other countries."



Perspectives on plant breeding from other crops

By Dr Bert Collard, Focus Area Leader

Plant breeding has often been described as an endless process. Varieties are the primary output of a breeding program, and new varieties are usually produced every year (or every two or three years depending on the size of the program). New varieties have improvements in at least one character compared to the current varieties. However, there will always be improvements that will be required in the future, especially regarding improved yield, quality and enhanced disease and insect resistance.

There are two universal features of breeding programs regardless of the crop species. First, breeding programs require a large logistical operations comparable to an industrial factory.

Second, all plant breeding programs require a lot of time to develop new varieties, which is related to the biology of the crop species.

There are several common elements of a plant breeding program: crossing (also called 'hybridization') and selection. The purpose of crossing is to create new genetic combinations by combining genes from both the female and male parents.

A large breeding population (usually tens or hundreds of thousands of genetically different individual plants) derived from many specific cross combinations are produced after crossing. Selection involves screening for specific traits (such as disease resistance) and evaluation for agronomic traits such as yield in multi-location trials over several years so that new clones are tested in different climates and soil types.

During selection, the poor performing plants are discarded and the 'good' ones are promoted for further testing (this is like the Rugby League finals games). This is a huge amount of work since such large numbers of plants need to be tested. This is why plant breeding is often referred to as a "numbers game". Plant breeding requires a multi-disciplinary team effort involving other disciplines such as plant pathology, statistics, and biochemistry.

There are many additional challenges for sugarcane breeders. The genetics of sugarcane is much more complicated compared to related grasses like rice or sorghum because it is a 'polyploid' species (consisting of multiple sets of chromosomes).

The mode of genetic inheritance is far more difficult to study compared to main field crops which are usually "self-pollinated" such as cereals (wheat, rice, barley), pulses (chickpea, soybean) and oilseeds (canola).

In practice, sugarcane breeding is more complicated than other crops due to its large size, longer growth duration and mode of propagation. This means that field trials are harder to access at certain growth stages, trials take longer compared to annual field crops, and more time and resources are required to propagate material for trials (i.e. compared to planting seeds directly). Another important difference concerns ratoonnability, which is unique to sugarcane and requires much longer time for evaluation in field trials.

In the future, SRA plans to implement new technologies such as molecular (or DNA-based) markers, imaging methods and sophisticated data analysis methods to improve the efficiency and precision in breeding.

A photograph of Merv Greaves, a man in a blue work shirt and cap, standing in a sugarcane field. He is holding a stalk of sugarcane. The field is filled with tall, green sugarcane stalks.

Merv Greaves says soil testing is an important part of the family's nutrient management plan.

Greaves family targeting productive and profitable farming

By Brad Pfeffer

Bundaberg farmers the Greaves family say that crop nutrition is at the core of running a profitable, productive, and sustainable sugarcane farming operation.

Farming on the eastern side of town, Merv Greaves operates the multilayered business that also includes machinery engineering and contract harvesting with his sons Peter and Paul, and grandchildren Cameron, Benjamin, Sheree and Rachael.

Mr Greaves says they have a strong focus on maximising production, but they do this in the context of keeping costs to a minimum to remain profitable.

With that in mind, they follow the SIX EASY STEPS™ nutrient management guidelines and have a very strong emphasis on soil testing.

To further ensure they don't have nitrogen losses and match the nitrogen to the crop's requirements they will often apply fertiliser in two or three issues.

The third issue, if it occurs, is determined based on the sugar price and yield potential, to ensure that they will receive a return on investment.

Their focus on maximising production saw them earlier this year awarded the district productivity award for highest tonnes of sugar per cane production area (hectares), with an average over the past three seasons of 20.22 tonnes of sugar per hectare on one of their farms.

Also looking at costs, they have moved this year from winch irrigation to flood irrigation to avoid increasing electricity costs.

Bundaberg Sugar Services Limited (BSSL) assisted with a cost comparison of the winch and flooding, which prompted the switch to using flooding once the cane was out of hand.

The flood operates on an 8.5 hour shift and work they have done with the BSSL suggests that they are not using more water with the flood.

For the last three years they had already been investing in grading their blocks, and they also felt they were losing too much water to the wind with the winches.

Mr Greaves said variety selection was also crucial. While they grow a range of varieties, he said that Q235[Ⓛ] was their standout for sugar, including at their Number 3 farm that received this year's productivity award.

He also said they were getting good results with Q240[Ⓛ] and that it was giving comparable profitability to their long-term benchmark, Q208[Ⓛ].

"We are also starting out with Q252[Ⓛ], after we looked at its parentage, and so far it is looking impressive and is a big crop that is still standing," he said. "It still has some green leaves on top, but it doesn't seem to be carrying the water that it falls over when it gets wet like it has this year.

"We still need to put our own analysis onto it, and won't know for sure for three years' time yet, but it is looking good."

They also have SRA1[Ⓛ] and SRA2[Ⓛ] in tissue culture as they move them toward commercial planting.

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